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Thesis Material: Exogeography: Astropolitics and Space Economy

ECUADOR AT THE GEOPOLITICAL CROSSROADS OF SPACE: LEVERAGING EQUATORIAL GEOGRAPHY AMID GLOBAL ASTROPOLITICAL RIVALRIES

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CONTENT

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

Outer space has ceased to be a peripheral realm of scientific–technological exploration to become a strategic domain in which power hierarchies, technological dependencies, and critical infrastructures are redefined (Castro Torres, 2021). In this shift, geography reemerges with vigor: from the control of maritime and land routes characteristic of classical geopolitics, the focus transitions to the control of orbits, inclination planes, and launch windows, particularly within the equatorial strip, which concentrates technical advantages and political opportunities (Colbert, 2018). For Ecuador, situated on the equatorial line and with explicit references to the geostationary orbit in its Constitution, this scenario represents a crossroads that directly challenges its development, security, and foreign policy strategies (Ortiz Guerra, 2021).

The introductory chapter situates Ecuador within this new geography of orbital power and serves five functions: it explicates the teleological justification of the study, formulates the hypothetical proposition and the missional objectives, presents the central inquiry, delimits the methodological approach, and describes the structural architecture of the dissertation (Carassale, 2023). The purpose is to articulate an analytical framework that allows for the interpretation of the country's equatorial position as a geostrategic asset—and not merely as a cartographic fact—endowing it with institutional, normative, and verifiable material content (Castro Torres, 2021).

1.1. PREAMBLE AND TELEOLOGICAL JUSTIFICATION: ECUADOR'S GEOSTRATEGIC ASSET OVER THE EQUATOR

In its origins, space law and international narratives regarding the cosmos emphasized scientific cooperation and peaceful uses "for the benefit of all mankind," as reflected in the initial treaties promoted within the United Nations framework (González Ferreiro, La regulación de las actividades espaciales como estrategia de seguridad y crecimiento nacional, 2021). Nevertheless, since the Cold War, the strategic dimension has always been present: launch vehicles were derived from intercontinental ballistic missiles, and reconnaissance and communications satellites formed part of the military architecture of the superpowers (Mahmud, 2022). In this context, space functioned as a symbolic arena for systemic competition and as a technical platform for the command and control of armed forces (Hossain, 2022).

With the end of bipolarity, the expansion of commercial applications and the institutionalization of multilateral mechanisms gave the impression of a “relative orbital peace,” yet failed to eliminate the underlying security dilemmas (Castro Torres, 2021). In

recent decades, the proliferation of anti-satellite tests, the characterization of space as a "new operational domain," and the rise of the New Space Economy have openly reinstated the logic of rivalry, now intersected by private actors and the expansion of mega-constellations in low orbits (Colom Piella, 2025). The result is an increasingly congested, strategic, and politically sensitive orbital environment (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021).

Astropolitics, in the wake of Everett C. Dolman, interprets this process as the configuration of outer space as the "ultimate high ground," from which global strategy is reorganized (Hossain, 2022). In critical continuity with classical geopolitics, which associated power with the control of maritime routes or the continental Heartland, astropolitics underscores that securing advantageous positions in orbital infrastructure—key satellites, access and denial capabilities, command and control systems—grants enduring structural advantages (Mahmud, 2022). The notion of orbital cartography expands upon that intuition, demonstrating how distinct orbits, object densities, and spectrum regimes constitute a new "militarized geography" surrounding the Earth (Colom Piella, 2025).

In this map, the equatorial strip acquires a singular significance. From a technical standpoint, the greater momentum from the Earth's rotation at latitudes near 0° offers a quantifiable advantage for launches, reducing fuel consumption and increasing payload capacity toward low orbits and, most notably, toward the geostationary orbit (Mahardhika, 2025). The example of the Kourou Space Centre and other projects in equatorial countries evidences that this exogeographic configuration can become a relevant economic and strategic resource when managed deliberately (Castro Torres, 2021).

For Ecuador, the equatorial condition overlaps with a complex territorial organization between the Highlands, the Coast, and the Amazon, with an Andean–Amazonian and Pacific integration that has historically shaped its development and infrastructure (Dalmasso y Fillon, 1972). The projection of this territory onto the geostationary belt led the country, along with other equatorial States, to participate in the 1976 Bogotá Declaration, which claimed sovereignty over the segments of the synchronous orbit situated above its territory (Vučković, 2020). Although such an interpretation was not accepted within the current space regime, the 2008 Constitution includes a reference to the "corresponding segments of the geostationary synchronous orbit," signaling a persistent sensitivity regarding this issue (Ortiz Guerra, 2021).

On the legal front, Ecuador has been a party to the Outer Space Treaty since the late 1960s and has signed the principal multilateral instruments regulating the exploration and use of outer space for the benefit of all States, irrespective of their degree of development (González Ferreiro, La regulación de las actividades espaciales como estrategia de seguridad y crecimiento nacional, 2021). Furthermore, it participates in specific conventions such as the Convention on Registration of Objects Launched into Outer Space and has signed bilateral space cooperation agreements, for instance, with Argentina, which explicitly refer to the principles of non-appropriation, peaceful use, and shared benefit of outer space (González Ferreiro, La regulación de las actividades espaciales como estrategia de seguridad y crecimiento nacional, 2021). This regulatory framework situates Ecuador within the current international space regime; however, the absence of a national space law and a specialized civilian agency hinders the translation of these commitments into concrete policies for the supervision of space activities, the promotion of the industry, and the defense of its interests as an equatorial country.

Despite this regulatory framework, specialized literature notes that Ecuador lags behind in the construction of a comprehensive aerospace policy compared to Latin American countries that have developed consolidated agencies, satellite programs, and security and defense doctrines with a strong space component (Ortiz Guerra, 2021). In these cases, space has become infrastructure for environmental monitoring, disaster management, border surveillance, and the modernization of armed forces, whereas the Ecuadorian trajectory has been more fragmentary and dependent on isolated initiatives (Castro Torres, 2021). In order to empirically support this diagnosis of lagging behind, the following paragraphs present an empirical overview of the Ecuadorian space sector between 2007 and 2019.

1.1.1. Empirical Overview of the Ecuadorian Space Sector (2007–2019).

Since the early 2000s, the Ecuadorian Civilian Space Agency (EXA) promoted the Civilian Space Program and the orbiting of the NEE-01 Pegaso and NEE-02 Krysaor nanosatellites, which granted the country international visibility, although without translating into a sustained State policy (Ortiz Guerra, 2021). During this same period, EXA combined scientific outreach activities, international cooperation, and the operation of its own ground station; however, it lacked a stable framework for public financing and a legal-institutional setting comparable to that of a state space agency, which limited the long-term consolidation of capabilities (Ortiz Guerra, 2021). At the governmental level, the creation of the Ecuadorian Space Institute (IEE) in 2012, attached to the Ministry of

Defense, sought to provide the sector with a public institutional framework responsible for generating geoinformation, articulating scientific capabilities, and supporting territorial and security planning (Moreno Arvelo et al., 2021; Ortiz Guerra, 2021).

Available management and analysis reports show that the IEE administered investment projects in space technology and services worth several million dollars during the 2012–2018 period, including the development of ground station infrastructure, the production of satellite imagery for risk and land management, and participation in national satellite initiatives (Ortiz Guerra, 2021). These budgetary allocations were oriented, among other purposes, toward the operation of the Cotopaxi Ground Station, the strengthening of geospatial information systems used by civilian and defense institutions, and technical support for Earth observation programs for agriculture, disaster management, and border security, which evidences that Ecuadorian space policy possessed a concrete materiality beyond programmatic discourse (Moreno Arvelo et al., 2021; Ortiz Guerra, 2021). Nevertheless, the suppression of the IEE by executive decree in 2019 interrupted this process and left a void in inter-institutional coordination: the functions of Earth observation and geospatial information management were redistributed among entities such as the Military Geographic Institute, the Navy Oceanographic Institute, and EXA itself, without a clear governing authority on space matters emerging (Ortiz Guerra, 2021). This closure marked the end of an investment cycle concentrated in less than a decade and raised questions about the preservation of technical capabilities, specialized personnel, and the infrastructure built during those years.

This institutional trajectory reflects what Ortiz Guerra (2021) characterizes as an "under-representation" of security and defense interests in the space domain: policy documents mention the geostationary orbit and satellite services as strategic resources, yet budgetary allocations, organizational stability, and specialized technical profiles fail to consolidate a long-term space policy. Consequently, the Ecuadorian space ecosystem combines relevant symbolic milestones—such as the launch of nanosatellites and the constitutional inclusion of the synchronous orbit—with a limited institutional capacity to sustain complex projects, evaluate results, and project future scenarios (Moreno Arvelo et al., 2021; Ortiz Guerra, 2021).

From Latin American and critical astropolitical perspectives, this lag expresses not only technical limitations but also asymmetries in the capacity to imagine and contest the possible futures of space, within a context of ecological crisis and civilizational reconfiguration (Andrade, 2025). The expansion into the cosmos risks reproducing

extractivist patterns and inequalities of the international system, unless countries of the Global South—and particularly equatorial ones—incorporate their own concerns, values, and priorities into governance regimes and technological projects (Carassale, 2023).

On this basis, Ecuador's equatorial condition is defined here as a dual geostationary asset. In its physical–technical dimension, it offers advantages for the development of its own or cooperative space capabilities—launches, ground stations, satellite services; in its political–legal dimension, it constitutes a negotiation resource in debates regarding the administration of the geostationary orbit, spectrum allocation, and the design of liability and benefit regimes (Vučković, 2020). Transforming this asset from a latent potential into a deliberate vector of national strategy is the purpose guiding this research (Colbert, 2018).

1.2. HYPOTHETICAL PROPOSITION AND MISSIONAL OBJECTIVES

The central hypothetical proposition of this study maintains that, to the extent that Ecuador develops a comprehensive space policy that recognizes its equatorial position as a geostrategic asset and articulates it with international legal frameworks, astropolitical rivalry dynamics, and Latin American regional initiatives, it will increase its capacity to capitalize on said asset in terms of development, security, and technological sovereignty; if it fails to do so, the orbital belt associated with its territory will continue to be functionalized primarily by external actors (Ortiz Guerra, 2021).

The dependent variable is, therefore, the degree of capitalization of the Ecuadorian equatorial position within the global space architecture, observable in the development of satellite capabilities, the existence of specific regulatory frameworks, and active participation in orbital governance forums (Castro Torres, 2021). Among the independent variables, the most prominent are the hegemonic rivalry in space—manifested in the competition for constellations, navigation, and infrastructure defense—international legal frameworks that regulate the use of space, and national institutional capacities to design and sustain space policies (Seyedi Asl, 2024).

The outer space treaties, the International Telecommunication Union regulations, and the interpretations of the non-appropriation principle delimit the States' margin of action, but also open opportunities for equatorial countries to update their claims in terms of equity and shared benefit (Vučković, 2020). To this is added the necessity of having specialized institutions, epistemic communities, and intersectoral coordination mechanisms that allow for the translation of the equatorial condition into concrete projects and policies,

which constitutes one of the identified weaknesses in the Ecuadorian case (Ortiz Guerra, 2021).

The general objective of the research is thus formulated as a comprehensive analysis of the extent to which, and under what legal, geopolitical, and institutional constraints, Ecuador can capitalize on its equatorial position as a geostrategic asset within the context of global astropolitical rivalries, and what strategic guidelines could be proposed to do so in a sovereign, cooperative, and sustainable manner. This objective unfolds into specific goals that structure the remainder of the work: (i) systematizing the theoretical foundations of astropolitics and those of exogeography; (ii) examining the legal and governance framework of space; (iii) evaluating Ecuadorian institutions and capabilities based on available empirical data; (iv) comparing with other equatorial countries; and (v) formulating scenarios and public policy guidelines. The missional nature of these objectives projects beyond academia. At the level of public policy, it seeks to provide input so that the space dimension is explicitly incorporated into development planning, integral security, and international engagement, preventing it from remaining a marginal or purely technological component (Moreno Arvelo et al., 2021). At the diplomatic level, the aim is to strengthen Ecuador's capacity to position itself in negotiations on demilitarization, space debris, the allocation of orbital resources, and the distribution of benefits from the space economy (González Ferreiro, La regulación de las actividades espaciales como estrategia de seguridad y crecimiento nacional, 2021).

1.3. CENTRAL RESEARCH QUESTION

The central question guiding this research can be summarized in the following primary inquiry: to what extent and through which legal, institutional, and strategic mechanisms can Ecuador capitalize on its position within the equatorial belt and its potential link to the geostationary orbit, in a context of growing astropolitical rivalries and accelerated commercialization of outer space, while simultaneously avoiding the reproduction of technological dependencies and security vulnerabilities? (Seyedi Asl, 2024). This question articulates the country's equatorial condition with the international dynamics of space as a strategic domain and with its capacity to design comprehensive responses (Colom Piella, 2025).

Several analytical dimensions derive from this formulation. The first refers to how astropolitical literature conceptualizes space as a strategic domain and what continuities it establishes with classical geopolitics, particularly regarding the control of the high ground and critical routes (Hossain, 2022). A second dimension investigates Ecuador's

objective and potential place in world orbital cartography, considering its situation in the administration of the geostationary orbit, its constitutional and legal references, and its effectively deployed satellite capabilities (Ortiz Guerra, 2021).

A third dimension examines the legal, institutional, and geopolitical constraints that frame Ecuadorian action. In the legal sphere, international treaties and technical regulations stand out, which limit the appropriation of space while also allowing for the articulation of demands for equity and shared benefit by equatorial countries (Vučković, 2020). In the institutional sphere, the organization of the space sector, the coordination between ministries, armed forces, academia, and the private sector, and the existence or absence of a State policy are decisive factors for any sustained strategy (Ortiz Guerra, 2021).

Finally, the questioning incorporates a prospective dimension: what action scenarios open or close for Ecuador based on the decisions it adopts in the next decade, and to what extent is it feasible to build trajectories that combine South-South cooperation, resilience against transnational threats, and active participation in the definition of norms on peaceful uses, demilitarization, and space debris management (González Ferreiro, La regulación de las actividades espaciales como estrategia de seguridad y crecimiento nacional, 2021). These questions are linked to broader debates about the technological and civilizational futures that Latin America seeks to promote within a context of planetary crisis (Andrade, 2025).

1.4. METHODOLOGICAL DELIMITATION AND PRIMARY SOURCES

Given that the object of study combines geopolitical processes, legal frameworks, institutional capacities, and strategic scenarios, a qualitative, theoretical–analytical, and exploratory–descriptive approach is adopted, aimed at understanding power configurations and policy options rather than producing quantitative prediction models (Ortiz Guerra, 2021). The core strategy is the case study, in which Ecuador is analyzed as an example of a middle-income equatorial country facing an accelerated reconfiguration of the astropolitical environment (Seyedi Asl, 2024).

This design incorporates elements of comparative analysis, by contrasting the Ecuadorian trajectory with that of other equatorial countries that have managed to capitalize on their position through spaceports, their own constellations, or launch service agreements, in order to identify patterns, divergences, and relevant lessons (Mahardhika, 2025). The analysis is supported by a systematic literature review of astropolitics, space geopolitics, exogeography, and classical geopolitics, which allows for the articulation of scales and conceptual categories (Colbert, 2018).

In parallel, the key instruments of international space law and the technical regulation of the orbital environment—treaties, principles, resolutions, and ITU regulations—are examined, as well as the debates on the interpretation of the non-appropriation principle and the rights of equatorial countries (Vučković, 2020). At the internal level, the Constitution, sectoral regulations, development and security plans, and policy documents that reference outer space and the geostationary orbit are analyzed, paying attention to the allocation of competencies and the integration (or absence) of the space dimension in state planning (Ortiz Guerra, 2021).

Official discourses, parliamentary interventions, documents from technical agencies, and projects promoted by the Ecuadorian Civil Space Agency and other relevant actors are also considered units of analysis, allowing for the reconstruction of formal policies as well as imaginaries, risk perceptions, and opportunities (Carassale, 2023). In spatial terms, the focus falls on the Ecuadorian territory and its projection toward the synchronous orbit segments constitutionally recognized as being of national interest, embedded within a regional Andean-Amazonian and Pacific cartography (Dalmasso y Fillon, 1972).

The temporal delimitation spans from the 1976 Bogotá Declaration—a milestone in the claims of equatorial countries—to the present, with special emphasis on the cycle opened by the 2008 Constitution and the 2009–2021 security and development policies (Ortiz Guerra, 2021). Primary sources include regulatory texts, plans, resolutions, and national and international technical documents, while secondary sources encompass academic studies and analyses from think tanks on astropolitics, space security, and Latin American space policy (Castro Torres, 2021).

1.5. STRUCTURAL ARCHITECTURE OF THE DISSERTATION

The dissertation is organized following a logic that moves from conceptual foundations to the proposal of strategic scenarios, advancing through levels of abstraction and empirical concretization (Carassale, 2023). Each chapter contributes to answering the research question and testing the central hypothesis, articulating theory, law, geopolitics, and the analysis of national capabilities (Castro Torres, 2021).

Chapter 2 is dedicated to classical astropolitical, exogeographic, and geopolitical foundations: it reconstructs the main traditions of thought regarding the control of strategic spaces—sea, land, air, and orbit—and presents the contributions of contemporary astropolitics, including critical debates on transhumanism and expansion into the cosmos (Andrade, 2025). Chapter 3 analyzes Ecuador's position in terrestrial and

orbital cartography, considering its internal geography, its projection toward the geostationary orbit, and the implications of the Bogotá Declaration and the 2008 Constitution (Dalmasso y Fillon, 1972).

Chapter 4 focuses on hegemonic rivalries and the dispute over equatorial space, examining the militarization of space, the deployment of megaconstellations, and the competition for the protection of orbital infrastructures among powers and large corporations (Colom Piella, 2025). Chapter 5 addresses regional astropolitics and Ecuador's margins of maneuver within the Latin American context, evaluating the space programs of neighboring countries, attempts at common space agendas, and scenarios for South-South cooperation or active non-alignment (Castro Torres, 2021).

Finally, Chapter 6 formulates strategic paths and public policy scenarios for Ecuador in the space sector, proposing guidelines regarding institutions, financing, international cooperation, regulation, and the construction of social imaginaries about space as a strategic asset (González Ferreiro, La regulación de las actividades espaciales como estrategia de seguridad y crecimiento nacional, 2021). In this way, the text shows how Ecuador's equatorial position can move from being an underutilized resource to becoming a deliberate axis of its international insertion, development, and security within the new geopolitics of space (Ortiz Guerra, 2021).

2. ASTROPOLITICAL AND EXOGEOGRAPHIC FOUNDATIONS

This chapter consolidates the theoretical-analytical framework that sustains the research and defines the categories through which Ecuador's equatorial position will be interpreted, in subsequent chapters, in the face of contemporary astropolitical rivalries. The objective is not to mechanically transfer terrestrial geopolitics to space, but to construct an operational language that allows for the understanding of how access, permanence, and functional control of orbital infrastructures produce advantages, generate dependencies, and open security and development dilemmas for non-hegemonic States (Castro Torres, 2021).

The centrality of the space domain is explained by its status as critical infrastructure. Communications, navigation and timing, Earth observation, meteorology, disaster management, environmental monitoring, and maritime surveillance depend on satellite services and terrestrial networks for data control, processing, and distribution. To the extent that these services enable economic functioning and state decision-making, their interruption—due to failures, interference, or attacks—can produce cascading effects on national security, the economy, and governance (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021).

At present, space power is expressed less as a "feat of arrival" and more as the governance of sociotechnical ecosystems: constellations, ground stations, industrial chains, software, spectrum, data, and interoperability standards. Consequently, competition shifts toward network resilience, the control of rules, and the ability to impose or condition access. This transformation is significant when space infrastructure is integrated in a dual-use manner into defense doctrines and critical supply chains, raising the strategic sensitivity of seemingly technical decisions (Bowen, 2022).

In coherence with that diagnosis, the chapter is organized into four sections. The first establishes a notional framework of astropolitics and applied exogeography; the second articulates Everett C. Dolman's theory of space power with Brandon E. Bowen's space geopolitics; the third specifies a minimal lexicology—space power, orbital sovereignty, and strategic neutrality in space—to avoid analytical ambiguities; and the fourth examines the legal hiatus between the Outer Space Treaty (OST) regime and contemporary practices, with an emphasis on the geostationary orbit (González Ferreiro, La regulación de las actividades espaciales como estrategia estrategia de seguridad y crecimiento nacional, 2021).

2.1. NOTIONAL FRAMEWORK: ASTROPOLITICS AND APPLIED EXOGEOGRAPHY

Astropolitics can be defined as the study of power relations, competition, and cooperation that emerge from the access, use, and control of outer space, including the technical systems that make it operational: launching, orbital platforms, command and control networks, ground segmentation, and the data economy. Unlike approaches focused exclusively on scientific exploration, astropolitics assumes that space constitutes a strategic domain in which material and symbolic power is accumulated, and where rules and standards determine who accesses it, at what costs, and under what levels of risk (Castro Torres, 2021).

A key assumption of this perspective is that space technologies are not neutral. By organizing information flows, enabling persistent surveillance, and facilitating logistical coordination and command and control, satellite systems can translate into power advantages. However, this same dependency creates systemic vulnerabilities: electronic interference, cyber operations, anti-satellite actions, technical failures, or the degradation of the orbital environment due to congestion and debris can simultaneously affect civilian and military services. In this sense, astropolitics is concerned as much with capabilities as it is with risks and the protection mechanisms for space activity (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021).

In its genealogy, astropolitics dialogues with classical geopolitics insofar as it recovers the intuition that certain positions concentrate value for material and technological reasons. However, the shift toward space requires adjusting the framework: it is not about stable borders or territorial control, but rather functional advantages associated with orbits, planes, nodes, and space lines of communication. The analytical axis shifts from sovereignty over territory to the capacity for access, permanence, coverage, and resilience—categories more consistent with a domain governed by orbital physics and international technical coordination (Colbert, 2018).

From this perspective, "position" in space is relational: an orbit acquires strategic value based on how it integrates with terrestrial infrastructure (stations, transmission networks, control centers), its exposure to threats, and the capacity to sustain operations under congestion and collision risks. In practical terms, advantage translates into coverage, latency, persistence, resilience, and replenishment capacity. Applied exogeography helps map these conditions, replacing the political-territorial map with a map of corridors, planes, nodes, and constraints (Bowen, 2022).

Applied exogeography describes space as an operational geography: orbital regions, inclinations, transfer corridors, equilibrium points, and bottlenecks that condition costs, risks, and performance. Its contribution is to turn the space environment into an object of strategic mapping, allowing for the identification of where value is concentrated (for example, GEO for coverage persistence) and where vulnerability accumulates (for example, LEO due to congestion). Consequently, the analysis shifts from generic narratives of a "space race" toward concrete questions about scarcity, coordination, and technical governance (Castro Torres, 2021).

For this work, a minimal exogeographic classification is adopted, distinguishing five regions of high interest: LEO, MEO, GEO, polar and sun-synchronous orbits (SSO), and the cislunar environment (including Lagrange points). Each region presents distinct profiles of utility, predictability, congestion, and protection; therefore, its strategic value depends on missions, doctrines, industrial capabilities, and regulatory arrangements. This distinction will be used as a conceptual "map" to evaluate the opportunities and constraints of States seeking to integrate into the space economy without hegemonic capability (Bowen, 2022).

Table 1. Exogeographic regions and strategic value (synthesis)

Exogeographic region	Typical services/functions	Strategic value	Risks and dilemmas	Relevance for Ecuador
LEO (Low Earth Orbit)	Earth observation; low-latency communications; IoT; mega-constellations	Informational advantage and connectivity; support for risk management and the digital economy	Congestion; debris; interference; dependence on providers and standards	Access to EO data and connectivity; agreements for continuity; data usage capabilities and cyber resilience
MEO (Medium Earth Orbit)	Navigation and timing (GNSS); certain communications services	Critical infrastructure for transport, logistics, banking, and energy	Systemic vulnerability due to high dependency; limited national alternatives	GNSS source diversification; contingency plans; technical training and inter-institutional coordination
GEO (Geostationary)	Telecommunications and broadcasting; meteorology; fixed links	Persistent coverage; high economic value; scarce resource	Competition for positions and frequencies; administrative barriers;	Strengthen regulatory capabilities (slot application/coordination); technical diplomacy; alliances for GEO services

		(slots and spectrum)	risk of exclusion	
Polar orbits / SSO	Persistent observation; environmental and maritime monitoring; intelligence	Global and repetitive coverage; value for territorial control and border surveillance	High sensitivity to third-party observation capabilities; dual civil-military use	Observation programs for security and the environment; data protocols; regional cooperation
Cislunar and Lagrange points	Communications and logistics for lunar missions; science.	Emerging frontier of governance and standards; medium-term potential	Technological asymmetries; rules in formation; risk of being excluded from coalitions	Early diplomatic engagement; academic integration and cooperation; regulatory monitoring

Note. Source: Own elaboration based on Bowen (2022).

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In the case of Ecuador, thinking of the territory as a projection platform implies integrating internal spatial organization and logistical capabilities. Studies on Ecuador's spatial organization show that Andean centrality and the unequal articulation between regions have historically conditioned the location of strategic nodes and the efficiency of corridors. Translated to a space agenda, this forces the question of which territories, infrastructures, and local arrangements could support launch operations, tracking, or ground segment services, and how they are articulated with security, energy, and connectivity (Dalmasso y Fillon, 1972).

Finally, contemporary astropolitics incorporates critical debates regarding the imaginaries of technological expansion into the cosmos, including narratives of colonization, resource extraction, and transhumanism. These narratives influence investment priorities, legitimize models of economic appropriation, and shape

governance frameworks. For peripheral countries, incorporating this critical dimension shifts the discussion from "which technology to acquire" toward "which risk and benefit regime to accept," "who defines the standards," and "how to avoid new dependencies under discourses of progress." (Andrade, 2025).

2.2. CONCEPTUAL INSTRUMENTAL: DOLMAN AND BOWEN IN THE READING OF SPACE POWER

Everett C. Dolman, in Astropolitik, proposes a realist reading that reinterprets classical geopolitics for outer space. His central thesis maintains that space operates as the ultimate "high ground": whoever controls critical orbital positions and space lines of communication will obtain structural advantages over terrestrial competitors. In his formulation, orbital infrastructure is a power multiplier, and competition for control of the space domain can shape lasting hierarchies in the international system (Dolman, 2002).

One of Dolman's conceptual contributions consists of shifting the analysis from "having satellites" toward "controlling the conditions of possibility" for the use of space. This includes launch access, space situational awareness, command and control, protection, replenishment capacity, and, controversially, the ability to deny access to third parties. This formulation helps explain why, as satellite dependence grows, incentives to develop interference, degradation, or denial capabilities also grow, even when this increases the risk of escalation (Dolman, 2002).

Dolman adopts a prescriptive stance by suggesting that a great power should secure unilateral space dominance, even if this strains the cooperative spirit of space law. For this research, the value of the argument is analytical: it allows for the identification of incentives faced by dominant actors when space becomes critical infrastructure. In a domain where functional control grants the ability to condition access and where the attribution of aggression is difficult, "protection" can lead to militarization and the practical weakening of general norms (Mahmud, 2022).

Subsequent critical readings point out that, although Dolman clarifies the geopolitical dimension of space, his proposal underestimates the value of transparency, trust, and risk-control regimes. Space is a fragile environment: short-term actions can generate systemic damage (for example, persistent debris) that reduces the utility of the domain even for the dominant actor. This observation is crucial for non-hegemonic States, as it suggests that the stability of the orbital environment and the validity of norms are decisive for their

security and development, given their dependence on services that they cannot quickly replenish (Hossain, 2022).

Brandon E. Bowen provides a complementary approach by articulating power, technology, and warfare. His perspective emphasizes that space infrastructure is integrated into modern military conduct and the political economy of data; therefore, space power is expressed as the capacity to build, sustain, and defend technological ecosystems, rather than as a stable state of dominance. Competition unfolds both in orbit and within industrial chains, software, standards, and regulatory regimes that organize interoperability and, consequently, access (Bowen, 2022).

Bowen's distinctive contribution is the conceptualization of an orbital cartography where each region (LEO, MEO, GEO) presents different profiles of vulnerability, congestion, latency, and protection. In LEO, megaconstellations may increase resilience through redundancy, but they elevate the risks of collision and saturation; in GEO, operational predictability and scarcity make assets especially sensitive and politicized. This interpretation links orbital geography with dilemmas of governance and security, showing that the dispute over standards and rules can be as relevant as the competition for platforms (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021).

The Dolman-Bowen comparison offers a useful synthesis for middle and peripheral powers. Dolman assists in identifying the logic of functional control and coercion, while Bowen helps in understanding how that logic is operationalized within technological and commercial networks. Consequently, space power is not measured solely by launches or satellites, but by the regulatory, industrial, and diplomatic capacity to integrate into global chains, negotiate access, and mitigate dependencies. This synthesis guides an Ecuadorian perspective centered on resilience, governance, and relative autonomy, rather than aspirations of supremacy (González Ferreiro, La regulación de las actividades espaciales como estrategia estrategia de seguridad y crecimiento nacional, 2021).

Table 2. Dolman and Bowen: convergences and divergences (analytical reading)

Dimension	Dolman (Astropolitik)	Bowen (Space Geopolitics)	Reading for Ecuador
Central object	Control of the 'high ground' and space lines of communication.	Space infrastructure as part of power, technology, and warfare.	Focus on ensuring access and continuity of critical services.
Idea of control	Domain/denial of access; critical orbital positions.	Distributed functional control (constellations,	Prioritize resilience and access governance (data, agreements, standards).

		industrial chains, data)	
Center of gravity.	Strategic positions and veto capacity in orbit.	Technological ecosystems and vulnerabilities (congestion, replenishment, interoperability).	Investing in data usage capabilities, regulation, and risk management
Priority risk.	Militarization and escalation due to the pursuit of supremacy.	Technological dependence and dual infrastructure vulnerability	Avoiding single dependencies; evaluating technological alignment risks.
Levers for non-hegemonic actors.	Difficult to compete in dominance; margin in alliances and niches.	Niches in services, standards, data, governance.	Building institutional capacities and technical diplomacy, rather than a 'space race'
Relationship with law.	Tension with cooperative spirit; realist reading of the regime	Law and standards as arenas of competition	Using the Outer Space Treaty (OST) as a framework; acting in ITU/forums to protect interests.
Implicit recommendation.	Understanding incentives for coercion and denial	Mapping chains, risks, and de facto rules	Designing an active neutrality strategy: diversifying partners and strengthening regulation.

Note. Source: Own elaboration based on Dolman (2002) and Bowen (2022).

The context of rivalry between great powers reinforces the relevance of the conceptual framework. Influence is projected through technological agreements, financing, space cooperation, and normative frameworks that can generate alignment pressures. Seemingly technical decisions—such as providers, interoperability standards, or data exchange agreements—can translate into long-term strategic dependencies, especially when competition takes on features of technological and geopolitical polarization (Seyedi Asl, 2024).

Applied to Ecuador, this conceptual framework enables operational questions: which satellite services are critical for the State and the economy; which vulnerabilities are systemic (interference, cyber, congestion); what minimum resilience thresholds are required (redundancy, diversification, agreements); and which niches for integration are realistic without pursuing an illusion of supremacy. Through this lens, the "equatorial advantage" is understood as a potential lever for a strategy of access, services, governance, and space diplomacy, rather than as geographical determinism (Ortiz Guerra, 2021).

In summary, Dolman and Bowen offer a complementary framework for assessing Ecuador's position: understanding the logic of power without reproducing it as a prescription. The practical consequence is to prioritize a space policy aimed at ensuring reliable access, managing risks, and building relative autonomy in an environment of increasing rivalry, where space infrastructure is already a geopolitical asset of the first magnitude (Hossain, 2022).

2.3. FUNDAMENTAL LEXICOLOGY: SPACE POWER, ORBITAL SOVEREIGNTY, AND STRATEGIC NEUTRALITY

The concept of space power is employed here as the capacity to utilize the space domain to achieve national objectives while simultaneously influencing the ability of other actors to do the same. It encompasses material dimensions (assets and technology), organizational dimensions (institutions, doctrine, and coordination), and impact dimensions (informational advantage, deterrence, prestige, and guaranteed access). Defining it precisely prevents reducing it to mere "exploration" or "symbolic presence" and allows for the observation that space functions as an enabling infrastructure for terrestrial capabilities (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021).

From an applied perspective, it is useful to distinguish between space power as an inherent capability (autonomous development and operation) and space power as guaranteed access (continuity of critical services). Many States lack launchers or a robust space industry but are heavily dependent on navigation, communications, or observation; in such cases, the strategic priority is typically to ensure continuity through supplier diversification, redundancies, agreements, and data governance. This distinction is central for Ecuador because it allows for the formulation of realistic goals: sovereign decision-making and functional resilience, rather than "dominance" of the domain (Castro Torres, 2021)

The expression orbital sovereignty is used as an analytical category to describe forms of functional—not territorial—control over scarce resources and operating conditions of the space environment: orbital positions, frequency bands, command and control capability, and access to strategic data. Although the OST prohibits national appropriation of space, technical and regulatory mechanisms exist that generate operational exclusivities and distribute power unevenly. Therefore, “orbital sovereignty” functions here as a measure of the margin of decision-making and effective access to orbital resources, without being equivalent to territorial sovereignty (González Ferreiro, La regulación de las actividades espaciales como estrategia estrategia de seguridad y crecimiento nacional, 2021).

The Bogotá Declaration (1976) is a key precedent for understanding this tension. Equatorial States maintained that the geostationary orbit, due to its geometric relationship with the equator, should be considered a natural resource linked to the underlying territory. Although the claim was rejected due to its incompatibility with the principle of non-appropriation, its relevance lies in exposing a persistent perception of inequity regarding access to GEO slots and the associated spectrum. For this research, Bogotá serves as a historical starting point to discuss how Ecuadorian interests are asserted without contradicting the current legal regime (Ortiz Guerra, 2021).

In Ecuador, the discussion is reconfigured by the constitutional recognition of the geostationary synchronous orbit as part of the sphere of national interest. Analysis from the perspective of space law maintains that this formulation does not create an exclusive right nor does it enable appropriation; however, it does establish a political mandate: to develop legal, administrative, and diplomatic capabilities to defend national interests within the framework of international technical coordination, registration, liability, and public policy. In other words, the challenge is to build the institutional framework necessary to transform a constitutional statement into a strategy compatible with the Outer Space Treaty (OST) (Moreno Arvelo et al., 2021).

Strategic neutrality in space is understood as an active foreign policy stance aimed at maximizing relative autonomy by avoiding rigid alignments in a domain of dual-use infrastructure. This neutrality is not equivalent to abstention: it implies criteria for partner selection, technological transparency, diversification, risk assessment, and participation in multilateral forums. In a context of rivalry, strategic neutrality becomes a design for resilience: it reduces critical dependencies and preserves bargaining power, without renouncing technical and scientific cooperation when it is consistent with the national interest (González Ferreiro, La regulación de las actividades espaciales como estrategia estrategia de seguridad y crecimiento nacional, 2021).

Table 3. Fundamental Lexicology (Working Definitions)

Term	Operational definition	Indicators/manifestations	Implication for Ecuador
Space Power	Capacity to utilize the space domain for national purposes and to influence the access or use by third parties	Access to critical services; data control/management; resilience; participation in governance	Realistic goal: ensuring reliable access and decision-making capacity, rather than supremacy

Orbital sovereignty	Functional control (non-territorial) over scarce resources: positions, spectrum, links, and strategic data.	Coordinated slots and frequencies; licensing; ground control capabilities; data agreements	Strengthening regulatory capabilities and technical diplomacy; defending equitable access without incompatible claims
Strategic neutrality in space	Active foreign policy stance: selective cooperation and diversification to maximize relative autonomy	Partner portfolio; transparency clauses; interoperability; risk assessment.	Avoiding dependency on a single bloc; aligning cooperation with national interest and space law.
Space resilience	Capacity to maintain services despite failures, interference, or crises (redundancy and replenishment)	Supplier redundancy; contingency plans; cybersecurity; operational continuity.	Designing satellite service continuity policies for emergencies and the economy.
Technical governance (slots/spectrum/STM)	Set of technical rules and procedures (e.g., coordination and registration) that enable or obstruct access.	Coordination procedures; compliance with deadlines; debris mitigation standards	Creating administrative and technical critical mass to participate and avoid missing opportunities due to institutional weakness.

Note. Own elaboration based on Castro Torres (2021) and González Ferreiro (2021).

A practical implication of this lexicology is that the "sovereignty" relevant to a dependent State is expressed as the capacity for informed decision-making and the continuity of critical services, rather than territorial control. In this sense, a country can increase its space power through institution-building (inter-ministerial coordination, regulatory authority), human talent, access agreements, and data policies, even without possessing its own launchers. This interpretation is pertinent for Ecuador because it enables an incremental agenda: strengthening governance and negotiation capabilities to reduce vulnerabilities without pursuing technologically unattainable objectives in the short term (Castro Torres, 2021).

In crisis scenarios, dependence on a single provider or technological bloc can translate into strategic vulnerability. For this reason, strategic neutrality functions as a design

criterion: diversifying cooperation, maintaining legal compatibility with space law, and avoiding commitments that close off future access or substitution options. This logic also opens up a regional dimension: building Latin American coalitions can improve bargaining power in spectrum governance, orbital sustainability, and data access, without the need to replicate the model of powers with space military capabilities (Ortiz Guerra, 2021).

2.4. THE LEGAL HIATUS AND THE PRIMACY OF THE OUTER SPACE TREATY (OST)

The 1967 Outer Space Treaty (OST) constitutes the pillar of space law: it enshrines the freedom of exploration and use, prohibits national appropriation by claim of sovereignty, use, or occupation, and establishes international responsibility of States for space activities, including those carried out by private actors under their jurisdiction. This framework helped stabilize expectations during the Cold War, but it faces tensions in the face of the massification of space access, the privatization of services, and the growing civil-military integration of orbital infrastructure (Vučković, 2020).

The legal hiatus is explained by the change in scale and actors. The OST was born in a scenario with few state programs; the present includes megaconstellations, global data markets, dual-use systems, and interference and maneuver capabilities. In the absence of robust universal reforms, national norms, partial agreements, and technical standards proliferate, operating as de facto rules and shaping conduct without full universal consensus. This shift favors those who control infrastructure and standards and can reduce the capacity of peripheral States to influence governance without sustained diplomatic strategies (González Ferreiro, La regulación de las actividades espaciales como estrategia estrategia de seguridad y crecimiento nacional, 2021).

An area where the hiatus is visible is the sustainability of the orbital environment. Congestion in LEO, the accumulation of debris, and the risk of collisions demand space traffic management (STM) and mitigation mechanisms that do not yet have a universal binding regime. The gap is strategic: a degraded orbital environment disproportionately affects those who depend on satellite services without the capacity for replacement, reinforcing asymmetries between great powers (with redundancy and rapid replacement) and dependent users (Bowen, 2022).

The security dimension aggravates the problem. Doctrinal reorganization and the creation of space military structures show that space is being integrated into defense planning, while technological ambiguity complicates attribution: electronic interference, cyber

operations, and proximity maneuvers can degrade capabilities without crossing clear thresholds. This increases distrust and raises the risk of escalation, weakening the effectiveness of a regime based primarily on general principles. (Vučković, 2020).

The emergence of minilateral arrangements, such as the Artemis Accords, shows how technologically advanced coalitions can define operational principles for cislunar activities and resources, influencing standards without replacing the OST. For non-hegemonic States, the dilemma is participating early in rule-making without sacrificing normative autonomy or becoming trapped in bloc logics; therefore, space diplomacy becomes a critical component of foreign policy and economic security (González Ferreiro, La regulación de las actividades espaciales como estrategia estrategia de seguridad y crecimiento nacional, 2021).

The geostationary orbit requires specific attention due to its high value and relative operational scarcity. GEO combines high-impact services (communications and meteorology) with an intense dependence on spectrum and international technical coordination. Although legally framed under non-appropriation, actual access depends on administrative capacities to request, coordinate, and sustain positions and frequencies, which can produce de facto inequalities. For Ecuador, this implies that the "equatorial advantage" must be translated into regulatory capacity and technical representation, rather than a territorial claim incompatible with the OST (Moreno Arvelo et al., 2021).

The Bogotá precedent should be read as a claim for equity and as a reminder that technical governance is political. A strategy compatible with the OST can be oriented towards strengthening internal regulatory capabilities, participating in multilateral forums, and building regional coalitions to promote more inclusive mechanisms in spectrum management, orbital sustainability, and access to strategic data. For Ecuador, the challenge is not to "possess" the GEO, but to avoid marginality and underrepresentation in decisions that determine long-term access and costs (Ortiz Guerra, 2021).

n summary, the legal hiatus does not imply the obsolescence of the OST, but rather the need to complement it with national policies capable of navigating a hybrid regime: universal principles, technical rules, minilateral agreements, and private standards. For Ecuador, legitimately capitalizing on its equatorial position requires translating geography into strategy under international law, avoiding both passive resignation (dependency without policy) and maximalist claims (incompatible with the current regime) and prioritizing, instead, governance, resilience, and selective cooperation

(González Ferreiro, La regulación de las actividades espaciales como estrategia estrategia de seguridad y crecimiento nacional, 2021).

Table 4. Manifestations of the legal hiatus in the space domain

Axis of the hiatus	Principle of the base regime	Contemporary manifestation	Strategic risk	Guidance for Ecuador
Non-appropriation vs. functional resources (GEO/spectrum)	Prohibition of national appropriation (OST)	Operational exclusivities through slot and frequency coordination; competition for positions.	Exclusion or marginality due to administrative weakness; dependency on external operators.	Strengthening technical authority, coordination, and diplomacy; alliances for the legitimate use of GEO.
State responsibility vs. private actors	States are responsible for national activities (OST)	Mega-constellations and private transnational services with de facto rules and standards.	Legal and security risk due to insufficient oversight; regulatory capture.	Updating internal framework; licensing and oversight; regulatory cooperation.
Peaceful use vs. militarization/protection	Use for peaceful purposes; no weapons of mass destruction in orbit (OST)	Space defense doctrines, ASAT capabilities, interference, and cyber	Escalation and collateral damage to civilian infrastructure; uncertainty and difficult attribution.	Active neutrality policy; participation in forums for confidence-building measures and risk reduction.
Orbital sustainability vs. absence of binding STM (Space Traffic Management)	General principles; non-binding guidelines	Congestion and debris; lack of a universal space traffic management regime	Degradation of the orbital environment; disruption of critical services; increasing costs	Adopting mitigation standards; requiring sustainability in contracts; regional technical cooperation
Extra-atmospheric resources vs. minilateral frameworks	Freedom of use; debates on global commons	National laws and agreements (e.g., Artemis) that establish operational practices	Asymmetries in rule-making; normative and technological dependency	Evaluating accessions based on national interest; early participation in debates; specialized legal capacity
Transparency/attribution vs. technical ambiguity	Cooperation and good faith (general regime)	Proximity operations, electronic interference, cyberattacks;	Conflict due to misinterpretation; coercion under ambiguity	Strengthening Space Domain Awareness (SDA) capabilities through

	complex attribution	cooperation and data access

Note: Prepared by the author based on Vučković (2020) and González Ferreiro (2021).

The theoretical and conceptual framework developed in this chapter establishes the vocabulary for analyzing the Ecuadorian crossroads. First, exogeography allows for the identification that equatorial latitude has the potential for projection toward GEO, but requires institutional and logistical conditions to become a capability. Second, the Dolman-Bowen synthesis shows that space power is contested as functional control of technological ecosystems and rules, rather than mere presence. Third, the proposed lexicology delimits categories (space power, orbital sovereignty, and strategic neutrality) that allow for the design of realistic objectives for a dependent State. Fourth, the examination of the legal hiatus demonstrates that the primacy of the OST coexists with de facto standards and minilateral arrangements, meaning that the defense of Ecuadorian interests requires space diplomacy, regulatory capacity, and selective cooperation. Based on these foundations, Chapter III delves into the historical and political articulation of the Ecuadorian claim over the GEO, and the strategic implications of the 2008 Constitution within the framework of contemporary space law (Moreno Arvelo et al., 2021).

3. ECUADOR IN ORBITAL CARTOGRAPHY

After having outlined the theoretical frameworks of astropolitics and their growing relevance in the international system in the preceding chapters, this chapter moves from the conceptual level to concrete analysis. The focus is centered on the Republic of Ecuador, a State whose particular geography grants it a position of singular interest in the new geopolitical map of outer space. This analysis seeks to "map" the Ecuadorian position, not only in geographical terms but also in its legal, strategic, and institutional dimensions, to evaluate the correspondence between its inherent potential and its manifested capacity.

The chapter structure is designed to address this evaluation systematically. First, Ecuador's unique geographical positioning will be determined with respect to the orbits of greatest strategic value: the Geostationary Orbit (GSO) and the equatorial Low Earth Orbit (LEO). Next, the legal status of the sovereign claims the country has formulated over these orbital bands will be examined, contrasting them with the current international legal regime. Subsequently, the relevance of its location will be evaluated against the dynamics of NewSpace, such as the deployment of megaconstellations and the growing need for space traffic management and surveillance. Finally, Ecuador's theoretical suitability as a space actor will be contrasted with its actual national capabilities, analyzing the institutional and political deficiencies that limit its projection.

The central thesis articulating this chapter maintains that Ecuador possesses a geographic advantage of considerable strategic value in the contemporary space age, a natural asset that could translate into geopolitical influence and technological development. However, this potential remains largely latent and untapped, weighed down by inconsistencies in its international legal stance and, more critically, by a marked institutional weakness and a notable absence of public policy in the space domain. This gap between potential and reality constitutes the critical knot that this chapter aims to unravel, beginning with the analysis of its primary asset: its position on the globe.

3.1. Determination of Ecuadorian Geographical Positioning in GSO and Equatorial LEO

In the space age, one might assume that terrestrial geography has lost its strategic centrality. Nevertheless, a State's physical location on the planet's surface remains a determining factor for its power projection and its capacity to access outer space. Astropolitics, as a discipline, recognizes that positional advantages on Earth translate directly into operational and economic advantages in orbit. For Ecuador, it’s very name

reveals its primary geostrategic asset: its location on the equatorial line, which grants it privileged access to the two most critical orbital bands for contemporary space activity.

It is fundamental to differentiate these two key orbits to understand the scope of the Ecuadorian advantage:

- **The Geostationary Orbit (GSO):** Situated at an altitude of approximately 36,000 kilometers above the Earth's equator, its main characteristic is that a satellite located within it orbits at the same rotational speed as the Earth. This causes it to appear fixed at a point in the sky, an indispensable quality for its primary strategic use: telecommunications, satellite tracking, and search and rescue missions. Access to and exploitation of this orbit have historically been of great value for global connectivity.
- **Low Earth Orbit (LEO):** It encompasses altitudes ranging from 160 to 2,000 kilometers. It is the domain of the International Space Station, most Earth observation satellites, and, increasingly, the new satellite megaconstellations designed to provide high-speed internet globally. Its proximity to Earth makes it the most congested and contested orbital region.

Ecuador's equatorial location offers direct physical and economic benefits for access to both orbits, but its advantage is particularly pronounced for equatorial inclination Low Earth Orbit. Launching rockets from the equator allows for maximum utilization of the Earth's rotational speed, which translates into significant fuel savings and the ability to place heavier payloads into orbit. In an era defined by the deployment of megaconstellations requiring thousands of launches, this efficiency is a primary economic and strategic factor. This privileged access to LEO resonates with the astropolitical maxim formulated by Everett C. Dolman, which postulates a hierarchy of control extending from orbit to the surface: "who controls low Earth orbit controls near-Earth space. Who controls near-Earth space dominates the Earth. Who dominates the Earth determines the destiny of mankind" (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021, pág. 201). From this perspective, Ecuadorian geography is not merely a curiosity, but rather an enclave of superlative potential strategic value in the competition for dominance of near-Earth space.

Table 5. Strategic Comparison of Key Orbits for Ecuador

Characteristic	**Geostationary Orbit (GSO)**	**Equatorial Low Earth Orbit (LEO)**
Altitude	Approx. 36,000 km above the equator	Between 160 and 2.000 km

Main Strategic Advantage	Fixed position for continuous communications, broadcasting, and meteorology.	Fast, low-latency access for observation, megaconstelations, and intelligence.
Relevance to Ecuador	Object of constitutional sovereignty claim; high value for national communications.	Physically and economically efficient access; potential for launch services and megaconstellation management.

Note: Author's own elaboration.

While this geographical advantage is clear and immutable, its effective utilization depends not only on physics but also on a solid legal framework that allows for its capitalization. It is precisely in the legal realm where Ecuador's potential encounters its first and most significant obstacle.

3.2. Legal Status and Potential Claims over Orbital Bands

A state's aspiration to exercise control over the space above its territory clashes head-on with the foundational principles of international law governing outer space. This regime, consolidated during the Cold War to prevent the escalation of conflicts beyond the atmosphere, is based on the postulate of space as *res communis omnium*, or the common heritage of mankind, not subject to national appropriation. This fundamental tension is the core of Ecuador's legal dilemma, as it has attempted to reconcile its sovereign ambitions with its international obligations.

The Ecuadorian position is explicitly enshrined in its fundamental law. The 2008 Constitution of the Republic, in its Article 4, affirms the State's right over "the corresponding segments of the geostationary synchronous orbit" (Ortiz Guerra, 2021). This declaration is not an isolated act, but the continuation of a regional diplomatic effort dating back to the 1976 Bogota Declaration. In this historic document, a group of "equatorial states" jointly proclaimed their sovereignty over the portion of the geostationary orbit that overlaps their territories, arguing that it constituted a natural resource and an extension of their airspace (Moreno Arvelo et al., 2021).

However, this sovereign claim is in direct contradiction with the corpus iuris spatialis, the body of international space law to which Ecuador itself is a party. The pillar of this regime is the 1967 Outer Space Treaty, ratified by Ecuador. Its Article II expressly proscribes any claim of sovereignty over outer space, the Moon, and other celestial bodies, whether by use, occupation, or any other means (Moreno Arvelo et al., 2021). Under the fundamental principle of international law pacta sunt servanda, ratified treaties prevail over domestic legislation in the event of conflict, which substantially weakens the legal

basis of the Ecuadorian constitutional claim. Given that the geostationary orbit is located at an altitude of 36,000 km, it is unequivocally comprised within the concept of outer space, governed by the principle of non-appropriation (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021).

The role of the International Telecommunication Union (ITU) is often confused with an adjudication of sovereignty, but its function is purely technical and administrative. The ITU does not assign portions of the orbit as territory, but rather manages the allocation of orbital positions and radio frequencies as "rights of use" (Moreno et al., 2021). Its objective is to ensure that satellite telecommunications systems can operate without causing harmful interference with one another, functioning as a global coordinator for the orderly use of a limited resource, not as a notary of sovereign property titles.

Table 6. Contrast between National Claim and International Legal Regime

Sovereignty Position (Ecuador)	**Principle of Non-Appropriation (International Law)**
Basis: 2008 Constitution and Bogotá Declaration (1976).	**Basis:** Article II of the Outer Space Treaty (1967) and ITU practice.
Central Argument: The geostationary orbit over the national territory is a natural resource and an extension of the State's sovereignty.	**Central Argument:** Outer space is the common heritage of mankind and cannot be subject to national appropriation by any means.
Nature of the Right: Claim of a territorial property right over an orbital segment.	**Nature of the Right:** Coordinated use rights for orbital positions and frequencies are granted (not ownership) for peaceful purposes

Note: Author's own elaboration.

In synthesis, Ecuador's claim of sovereignty, while constituting an important political declaration and a historical aspiration, lacks support under the current international legal regime. This inconsistency forces the country to seek the realization of its strategic relevance through means other than territorial sovereignty, focusing on the practical and operational advantages that its geography confers in the new and congested space environment.

3.3. Strategic Relevance for Space Surveillance, Injection Corridors, and Megaconstellations

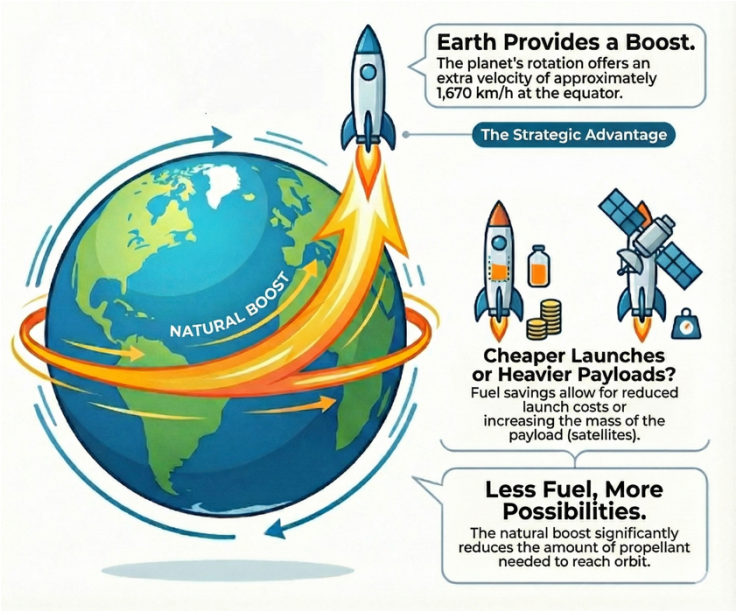
The transformations driven by the NewSpace phenomenon—characterized by the growing participation of the private sector, the miniaturization of satellites, and the drastic reduction in launch costs—are reconfiguring orbital geopolitics. The proliferation of

satellites, especially in LEO, and the resulting congestion of near-Earth space, revalue geographical locations that offer advantages for access, observation, and management of this environment. This new paradigm creates unprecedented strategic opportunities for nations with privileged positioning, such as Ecuador.

One of the most dangerous consequences of the intensification of space activity is the accumulation of orbital debris. Space junk, composed of inoperative satellites, rocket stages, and collision fragments, has become a veritable space minefield that threatens operational assets (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021, pág. 195). This has made Space Situational Awareness (SSA) a critical function for global security. Ecuador's equatorial position is ideal for hosting terrestrial infrastructure, such as radars and optical telescopes, dedicated to tracking and cataloguing objects in equatorial orbits. Contributing to SSA would not only be a contribution to global orbital security but would also position the country as a relevant and cooperative actor in the space community.

Likewise, the value of equatorial injection corridors has been magnified with the advent of megaconstellations. Projects such as SpaceX's Starlink, which plan to deploy tens of thousands of satellites in LEO to provide global internet connectivity, depend on an extremely high launch rate (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021). The physical efficiency of equatorial launches translates into a decisive economic advantage for the viability of these business models. Ecuador is geographically positioned to become a key logistical hub, whether by hosting a spaceport or providing tracking and control services for these vast satellite networks.

Figure 1. Conceptual Description of the Equatorial Launch Advantage



Note. This conceptual figure illustrates the physical principle underpinning Ecuador's strategic advantage. It represents the rotating globe, highlighting how the tangential velocity is at its maximum at the equatorial line (approximately 1,670 km/h). A rocket launched from this latitude receives a natural "boost" in the direction of the Earth's rotation. This initial momentum translates directly into a smaller amount of propellant required to reach the necessary orbital velocity, especially for insertion into an equatorial orbit. The fuel savings allow for two strategic options: (1) reducing the total cost of the launch or (2) increasing the mass of the payload (the satellite) for the same rocket capacity. This factor is critical for the economics of megaconstellations, where the cost per kilogram in orbit is the fundamental variable. Image generated from author's instructions through "notebook.lm".

These opportunities, derived directly from the interaction between geography and new space technologies, are theoretically immense. However, an unavoidable question arises: is the Ecuadorian State prepared, in institutional and capacity terms, to capitalize on these strategic advantages? The analysis of its national reality offers a stark contrast to its theoretical potential.

3.4. National Suitability and Gaps for Space Traffic Management and Data Relay Infrastructure

There is a deep gap between Ecuador's astropolitical potential, derived from its privileged geography, and the practical reality of its space sector. While its location positions it as an ideal candidate to play key roles in the new space economy, the current state of its institutional, political, and technological framework reveals critical gaps that prevent the materialization of such potential. This dichotomy between suitability and capacity is the main obstacle to the country's strategic projection.

The growing orbital congestion has made the need for a Space Traffic Management (STM) system imperative. Unlike air traffic, which relies on a robust global system (ATM), space lacks a centralized authority or a comprehensive regulatory framework to coordinate the movement of thousands of satellites and prevent collisions (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021). The location of Ecuador, which allows for constant visibility of the most heavily trafficked equatorial orbits, makes it a natural candidate for hosting control, communications, and data relay infrastructure for a future global or regional STM system. However, this is a theoretical opportunity that requires a national capacity that currently does not exist.

The country's dependence on foreign data and observation infrastructure is a clear symptom of this gap. An emblematic case is that of the National Institute of Meteorology and Hydrology (INAMHI), which depends for its forecasts on limited-quality data from the US satellite GOES-16, obtained via the internet (Ortiz Guerra, 2021). The availability of a proprietary Earth observation satellite, or even priority access to high-resolution data, would have a transformative impact. It would allow for a drastic improvement in early warning systems for floods, the calibration of hydrological models, the monitoring of volcanic activity, the management of risks and natural disasters, and the support of agricultural planning, among multiple direct benefits for national security and development (Ortiz Guerra, 2021).

The root of this inability to capitalize on space opportunities lies in a profound institutional weakness. The most representative milestone of this deliberate strategic regression was the dissolution of the Ecuadorian Space Institute (IEE). Its functions were absorbed by the Military Geographic Institute (IGM), an entity whose organic structure lacks a specific department dedicated to aerospace matters (Ortiz Guerra, 2021). This decision constituted a true institutional decapitation, eliminating the only state entity that could have promoted a coherent space policy. This abdication of the State in its articulating role contrasts sharply with initiatives emerging from civil society and academia, such as the PEGASO and KRYSAOR nanosatellite projects of the Ecuadorian Civil Space Agency (EXA). The existence of these capabilities demonstrates that talent and initiative exist in the country, but they operate in a disjointed manner and without the backing of a State policy to integrate and strengthen them.

Table 7. Matrix of Potentialities vs. Real Capabilities of Ecuador in the Space Sector

Strategic Area	Potential Derived from Geography	National Real Capacity
Space Traffic Management (STM)	Ideal Locations for Equatorial Orbit Tracking and Control Stations	Absence of Dedicated Infrastructure and Policy Frameworks for Participation in Space Traffic Management (STM).
Earth Observation	Feasibility of Continuous Territorial Monitoring for Risk Management, Natural Resources, and National Security	High Dependency on Foreign Satellite Data of Limited Quality: The INAMHI Case and Fragmented Capabilities.
Institutional Framework	Potential as a Regional Hub for Space Services: Catalyzing Investment and Technological Advancement	Institutional Vacuum Following the Dissolution of the IEE: The Absence of Public Policy and a Coordinating Space Agency

Note: Author's own elaboration.

This divergence between what Ecuador could be in the space domain and what it currently is necessitates a reflection on the underlying causes of this strategic paralysis.

The analysis developed throughout this chapter allows for the assertion that Ecuador's equatorial position grants it an intrinsic geopolitical and strategic value of great significance in the space context of the 21st century. In an era marked by the increasing congestion of Low Earth Orbit, the boom of megaconstellations, and the imperative need for sustainable management of the orbital environment, Ecuadorian geography stands as a first-rate asset. Efficient access to equatorial orbits and its suitability for hosting tracking and control infrastructure represent a tangible potential for national development and the projection of influence in the international arena. No matter the potential, the findings of this chapter reveal a reality of contrasts. On one hand, the profound contradiction between Ecuador's claims of sovereignty over the geostationary orbit, embodied in its Constitution, and its binding obligations under the 1967 Outer Space Treaty, which explicitly prohibits such appropriation, has been evidenced. On the other hand, and even more decisively, the existence of a deep gap between the country's geographical potential and its current vacuum in terms of public policy, investment, and space institutionality has been confirmed. The dissolution of the Ecuadorian Space Institute (IEE) without an effective functional replacement is the clearest symptom of this involution, which leaves the country in a position of strategic passivity while the space environment evolves at an accelerated pace.

Having established the geostrategic centrality of equatorial space for any space projection—and, by extension, the unique position of Ecuador—it is now appropriate to situate this advantage on the actual board where power is contested: the global hegemonic competition for access, infrastructure, and control of critical orbits. Consequently, the following chapter examines how different powers have consolidated astropolitical presences in equatorial latitudes (through launch platforms, hosting agreements, and logistical networks), and what models of orbital control and infrastructural implementation sustain that expansion. Based on these cases, the dilemma between sovereignty and foreign presence is analyzed, with its security dilemmas and legal-institutional tensions, to finally evaluate Ecuador's margin of maneuver: not only as a potential territory of strategic value, but as an actor capable of leveraging its position in multilateral forums of space governance.

4. GLOBAL HEGEMONIC RIVALRIES AND THE ASTROPOLITICAL CROSSROADS OF EQUATORIAL SPACE

Having established the theoretical foundations and the institutional framework in the preceding chapters, this chapter delves into the dynamics of contemporary geopolitical competition in outer space. The cosmos, far from being a mere field of scientific exploration, has been reconfigured as a first-rate operational domain, characterized by growing militarization and an intensification of strategic competition. This scenario is driven both by the hegemonic rivalry between established powers, primarily the United States and China, and by the emergence of new private actors, a phenomenon known as NewSpace, which has transformed the philosophy and costs of space access. This reconfiguration generates a new board of pressures and opportunities for States that, like equatorial nations, possess inherent geographic advantages. The purpose of this chapter is, therefore, to analyze these global dynamics to understand the strategic "crossroads" in which Ecuador finds itself, a country with historical claims of sovereignty over the geostationary orbit but with still incipient national capacities.

4.1 Consolidated Astropolitical Presence: Models of Influence in the Equatorial Belt

The strategic importance of the equatorial belt lies in its fundamental physical advantage for space access: it is the optimal location for positioning satellites in geostationary orbit, located 35,719 km above the equator, with the resulting fuel savings. (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021). However, the control of or access to this space transcends the merely technical. As defined by Everett Dolman (2002), it is a manifestation of astropolitical power, where the ability to project influence from terrestrial points toward the cosmos determines military and political dominance. Therefore, the presence of global powers in this belt is not accidental, but a calculated extension of their geopolitical might into the space dimension.

The following presents a comparative analysis of the astropolitical influence models that global powers have deployed, with special attention to their manifestation in the equatorial region.

The European Shared Infrastructure Model

The European model, embodied by the European Space Agency (ESA), represents a strategy of multinational cooperation to ensure autonomous and competitive access to space. By operating its main launch base from French Guiana, an equatorial territory, ESA leverages geographic advantage to consolidate the collective influence of its member states (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021). This approach

allows Europe to maintain a robust space program in all fields of the sector—from science and exploration to satellite navigation (Galileo) and Earth observation (Copernicus)—acting as a central and less confrontational actor in geopolitical space disputes (Ortiz Guerra, 2021; Ventura-Traveset, 2021).

The Chinese Model of Technological and Strategic Partnership

China's approach is inextricably linked to its "space dream" as part of the "great rejuvenation of the nation," defining space as the pinnacle of "international strategic competition" (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021, pág. 40). In its challenge to U.S. hegemony, China has rapidly modernized its capabilities, developing its own global positioning system and an ambitious lunar exploration program (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021). Its model of influence is characterized by establishing strategic and technological partnerships, as evidenced by the launch of satellites for other nations. Notable examples include the launch of the Venezuelan remote sensing satellite VRSS-2 from the Jiuquan center (Conde et al., 2022) and the launch of the first Ecuadorian satellite, NEE-01 PEGASO, from the same cosmodrome (Ortiz Guerra, 2021).

The United States Model of Global Dominance and Alliances

The United States seeks to maintain space supremacy through a model centered on technological and military dominance, backed by a network of alliances. The creation of the Space Force in 2018 formalized the purpose of "organizing, training, and equipping space forces to protect U.S. and allied interests in space."(Aznar Fernández-Montesinos y Sánchez Mayorga, 2021). Its influence is projected through the provision of capabilities to partners and the control of global critical infrastructures, such as the GPS positioning system, which has become an asset of vital importance for the world economy (Potti, 2021).

The Emerging Regional Power Model

The case of Brazil exemplifies the model of a regional power actively seeking strategic autonomy in the space domain. Through its Brazilian Space Agency (AEB), it has developed significant proprietary capabilities. A paradigmatic example is its Geostationary Defense and Strategic Communications Satellite (SGDC), whose dual-use design allows it to secure government communications while simultaneously providing an X-band for the exclusive use of the Armed Forces, strengthening border and airspace control (Ortiz Guerra, 2021). This strategy demonstrates an effort to reduce dependence

on extra-regional powers and respond to security and development needs with its own resources.

Table 8. Comparative Analysis of Astropolitical Presence Models in the Equatorial Belt.

Power Model	Strategic Objectives	Instruments and Agreements	Infrastructure and Results
Europe (ESA/France)	Leadership in science, exploration, and space applications. Strengthen the European project and industrial competitiveness. Logic: Consolidate European strategic autonomy, using scientific and technological excellence (Copernicus, Galileo) to ensure non-dependence on other powers and reinforce its global industrial competitiveness.	International cooperation agreements (e.g., with NASA on the Gateway station). ESA creation treaties.	Launch base in French Guiana. Key programs: Copernicus (Earth observation) and Galileo (global navigation system). Participation in the International Space Station (ISS).
China	To become the leading space power by 2050. To project a new geopolitical status through the "space dream." To ensure military and technological capabilities. Logic: To employ space cooperation (e.g., Miranda satellite) as a tool for diplomatic and technological penetration to build an alternative sphere of influence to the Western order.	Bilateral agreements for the development of infrastructure and capabilities (e.g., with Venezuela for the Miranda satellite). Use of cooperation as a diplomatic tool.	wn global positioning system (Beidou). Chang'e lunar exploration program (includes landing on the far side). The Chang'e program is used to project an image of technological superiority and audacity, reinforcing the 'space dream' as a pillar of the 'great rejuvenation of the Chinese nation,' a key concept of its global strategy. Own launch capability (Jiuquan

			Cosmodrome, from which the Ecuadorian satellite PEGASO was launched)
United States of America	Maintain space primacy against revisionist powers. Establish norms and principles for the exploration and utilization of space. Ensure military dominance. Logic: Use cooperation (Artemis Accords) as a soft power instrument to establish international norms favorable to its interests and those of its allies.	Artemis Accords to guide cooperation in lunar exploration. Bilateral agreements and strategic alliances.	Creation of the Space Force as the sixth branch of the Armed Forces. Advanced military and civil infrastructure (NASA). Programs for the return to the Moon and the exploration of Mars.
Regional Power (Brazil)	Consolidate regional leadership in space affairs. Develop an autonomous national industry based on the peaceful use of space. **Logic:** Position itself as the hegemonic space power in South America, diversifying alliances to maximize technology transfer and reduce dependence on a single global partner, thereby ensuring regional autonomy.	Multiple cooperation agreements with global powers (China, USA, Russia, ESA) and regional partners (Argentina). Partner in the International Space Station (ISS).	Hell's Barrier (Barreira do Inferno) launch base. Launch of more than 20 satellites. Development of the first domestically designed and operated observation satellite (Amazonia-1).

Note: Author's own elaboration.

Lessons for Ecuadorian Strategy

The analysis of these models offers valuable lessons for Ecuador. The European model highlights the benefits of multilateral cooperation to overcome budgetary and technological limitations. The Chinese model presents technological partnership as a way to access launch capabilities and satellite development, although with potential strategic conditions. The United States model, while dominant, illustrates the importance of alliances for security, but also the risks of dependency. Finally, the case of Brazil demonstrates that the gradual development of autonomous capabilities, focused on specific security and defense needs, is an achievable goal for a regional power. These paths—cooperation, partnership, alliance, and autonomy—are not mutually exclusive and present a range of options and challenges that must be carefully weighed in the formulation of an Ecuadorian space policy.

The realization of any of these models of geopolitical presence depends, fundamentally, on the ability to deploy and protect the technical infrastructure that sustains it, which leads us to the analysis of orbital control models.

4.2 Orbital Control Models and Infrastructural Architecture Deployment

Astropolitical influence is not sustained solely by a physical presence in strategic territories but, fundamentally, by the ability to exert control over orbits and deploy a robust and resilient infrastructural architecture. The concept of "space control" is defined as the sum of three interdependent capabilities: surveillance to detect and track objects, the protection of one's own assets, and the denial of space use to an adversary (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021). The construction of this capability is a strategic imperative for any actor with space aspirations.

Key Components of the Control Architecture

The space control architecture is composed of several interconnected segments, each with critical functions and specific vulnerabilities.

- Ground Segment: It is the foundation of all space operations. It includes launch centers, tracking and control stations that operate satellites, and the complex logistical chains for the transport of fuels and components. An example of this infrastructure is Spain's Space Surveillance Operations Center (COVE), which, through a network of radars and telescopes, is dedicated to tracking objects in low Earth orbits (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021). The security of this segment, especially against cyberattacks, is paramount.

- Space Segment: It is composed of satellite constellations that provide essential services for modern life and military operations: telecommunications, Earth observation, navigation (such as the U.S. GPS and Europe's Galileo systems), and intelligence. The increasing proliferation of satellites, especially commercial mega-constellations in Low Earth Orbit (LEO), has generated unprecedented congestion, increasing the risk of collisions and masking the potential deployment of weapon platforms. (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021).
- Security and Resilience: The vulnerability of this infrastructure has driven the development of countermeasures. Great powers are working on anti-satellite (ASAT) weapons, capable of destroying or disabling enemy satellites, with tests already conducted by the U.S., China, and India (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021). Cybersecurity has become a crucial battlefield, as a successful cyberattack can neutralize critical infrastructures with high cost-effectiveness and difficult attribution (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021). To this is added the challenge of dual-use, where the same technology can have peaceful civilian and aggressive military applications, making the distinction and arms control difficult.

Classification of Operational Models

The deployment of this complex architecture has been organized around three primary operational models, which reflect different governance philosophies and strategic priorities.

- State-Military Model: This is the traditional model, where the development and control of space infrastructure respond directly to national security imperatives. It is dominated by state actors and focused on the protection of sovereign interests. Clear examples include the creation of the United States Space Force; the Russian Aerospace Forces (VKS), which integrate the Russian space command; the Space Systems department in the Chinese Armed Forces; and the Space Command of France, all designed to integrate space capabilities into military doctrine (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021).
- State-Commercial Model: In this model, government agencies develop and operate space infrastructures to provide public and commercial services to society. The European Union's Copernicus program is an emblematic case: managed by the European Commission and the ESA, it offers Earth observation data in an open and free manner for applications in climate change, agriculture, emergency management, and security (Ventura-Traveset, 2021).

• Hybrid Model (NewSpace): Characterized by the "outpouring of private companies" and close public-private collaboration, this model is revolutionizing the sector (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021). Actors such as SpaceX are drastically reducing launch costs and developing mega-constellations (Starlink) that are changing the paradigm of global communications (Potti, 2021). Governments act as clients, regulators, and partners, leveraging the innovation and agility of the private sector to achieve their strategic objectives.

Table 9. Space Architecture Deployment Models

Operating Model	Key Actors	Advantages	Risks and Requirements
State-Military	States, Armed Forces, Ministries of Defense.	Direct control over strategic assets for national security. Development of dual-use technologies (civil-military). Deterrence capability.	High costs assumed by the State. Potential for escalation of space arms races. Increased "security dilemma" due to the difficulty in differentiating between offensive and defensive systems (e.g., ASAT weapons). This dilemma is exacerbated by the lack of transparency, as demonstrated by the maneuvers of Russian satellites Kosmos 2542 and 2576 in close proximity to U.S. intelligence assets.
State-Commercial	Government space agencies, state-owned enterprises, public-private partnerships.	Boost to national industry and the technological fabric. Potential for financial return for the State through the commercialization of services. Sovereignty over infrastructure.	Risk of aligning national strategic interests with the private interests of specific corporations. Bureaucratic processes may hinder innovation.
Hybrid (NewSpace)	Innovative private companies (e.g., SpaceX, Virgin Galactic) in collaboration with	Drastic reduction in launch costs. Acceleration of the pace of innovation and technological development. Opening of new markets (e.g.,	Regulatory and normative gaps. Non-state actors acquire power and strategic capabilities. Increased risk of orbital congestion and space debris.

	government agencies.	space tourism, asteroid mining).

Note: Author's own elaboration.

The interaction with these different models and the necessity of integrating technologies and services from foreign actors introduces a fundamental dilemma for States regarding how to balance national sovereignty with the requirements of international cooperation.

4.3 The Dilemma Between Sovereignty and Foreign Presence: Security and Legal Framework Dilemmas

For nations with limited space capabilities, such as Ecuador, the development of a national program often requires collaboration with foreign powers. This necessity creates an inevitable tension between the benefits derived from cooperation and the inherent risks of technological dependency and the presence of foreign infrastructure on the territory or in orbits of sovereign interest. This dilemma places these States at a strategic crossroads, where every agreement and every partnership must be evaluated through the prism of security and national sovereignty.

Risk and Benefit Assessment

The decision of a State to permit the presence of or depend on foreign space infrastructure involves a complex matrix of risks and benefits that must be carefully weighed.

- Security and Dependency Risks: The primary risk is technological dependency, which can limit autonomy in decision-making. A clear example is the use by Ecuador's National Institute of Meteorology and Hydrology (INAMHI) of data from the U.S. GOES-16 satellite, which, while useful, does not possess optimal quality and places the country in a position of a passive recipient of critical information (Ortiz Guerra, 2021). Other risks include power asymmetries in agreement negotiations, the possibility of espionage or intelligence gathering by the providing power, and the political conditioning that may be imposed as part of the cooperation, affecting the foreign policy of the recipient State.
- Strategic and Development Benefits: Despite the risks, the benefits can be substantial. Cooperation can facilitate technology transfer and the development of specialized human capital, laying the foundations for future autonomy. Foreign investment associated with the installation of ground infrastructure can stimulate the local economy. Perhaps most importantly is the access to essential services that would otherwise be unattainable. Ecuador, for example, is a beneficiary of the COSPAS-

SARSAT international satellite search and rescue system, which provides crucial emergency alerts without requiring its own national infrastructure (Ortiz Guerra, 2021).

Analysis of the International Legal Framework

This dilemma is exacerbated by the weakness and ambiguity of the international legal framework governing space, known as the *Corpus Iuris Spatialis*. The Outer Space Treaty of 1967, the cornerstone of this corpus, is a product of the Cold War that establishes general principles such as peaceful use and non-appropriation, but lacks robust enforcement mechanisms and clear definitions (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021). The main deficiencies are:

1. Lack of Delimitation: There is an "absence of an agreed definition" regarding the exact boundary between sovereign airspace and outer space, which concerns all of humanity, thereby creating legal uncertainty (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021).
2. Insufficient Regulation: Current regulations are inadequate for managing the growing activity of private actors (NewSpace), orbital congestion, and space debris mitigation (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021).
3. Unilateral Trends: In the face of the regulatory vacuum, powers such as the United States have enacted national laws, such as the 2015 SPACE Act, which grant their companies rights over resources obtained in space, an action that challenges the principle of non-appropriation and further fragments the international regime (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021).

This weakness in international law favors the most powerful States and leaves nations such as Ecuador in a vulnerable position, forcing them to negotiate bilateral agreements without a solid multilateral framework to protect their interests.

Table 10. Sovereignty vs. Benefit Matrix in Space Agreements

Critical Variable	**Sovereignty Risk Level** (High/Medium/Low)	**Benefit Potential** (High/Medium/Low)
Data Control	**High** (Risk of strategic subordination)	**High** (Benefit of national resilience)
Jurisdiction over Infrastructure	**High** (Risk of cession of territorial/functional sovereignty)	**Medium** (Conditioned economic benefit)
Cybersecurity	**High** (Risk of shared systemic vulnerability)	**Medium** (Benefit of collaborative defense)
Dual-Use of Technology	**High** (Risk of involvement in external conflicts)	**High** (Benefit of critical capacity building)

Financial Dependency	**High** (Risk of loss of political autonomy)	**High** (Project viability benefit)
Technology Transfer	**Medium** (Risk of persistent technological dependence)	**High** (Benefit of sovereign capacity building)

Note: Author's own elaboration

In the face of this complex landscape of risks, benefits, and legal gaps, it is imperative that Ecuador designs a proactive and multidimensional international integration strategy, which leads to the analysis of the potential strategic scenarios at its disposal.

4.4 Ecuador's Diplomatic Leverage and Strategic Integration Scenarios

Ecuador is in a unique position: it possesses a geostrategic advantage due to its equatorial location and has maintained historical claims of sovereignty over the geostationary orbit, as articulated in the 1976 Bogotá Declaration (Ortiz Guerra, 2021). However, this advantageous position is offset by limited national capabilities and fragmented state policy, evidenced by the abolition of the Ecuadorian Space Institute (IEE) in 2019 and the existence of valuable but isolated civil initiatives, such as those of the Ecuadorian Civil Space Agency (EXA) (Conde et al., 2022; Ortiz Guerra, 2021). Despite these weaknesses, the confluence of its geographical position and diplomatic background grants it leverages that, if utilized intelligently, can forge a strategic integration into the competitive global space arena.

Analysis of Strategic Scenarios

Four possible scenarios for Ecuador's strategic integration are proposed and analyzed below, grounded in the identified dynamics and capabilities.

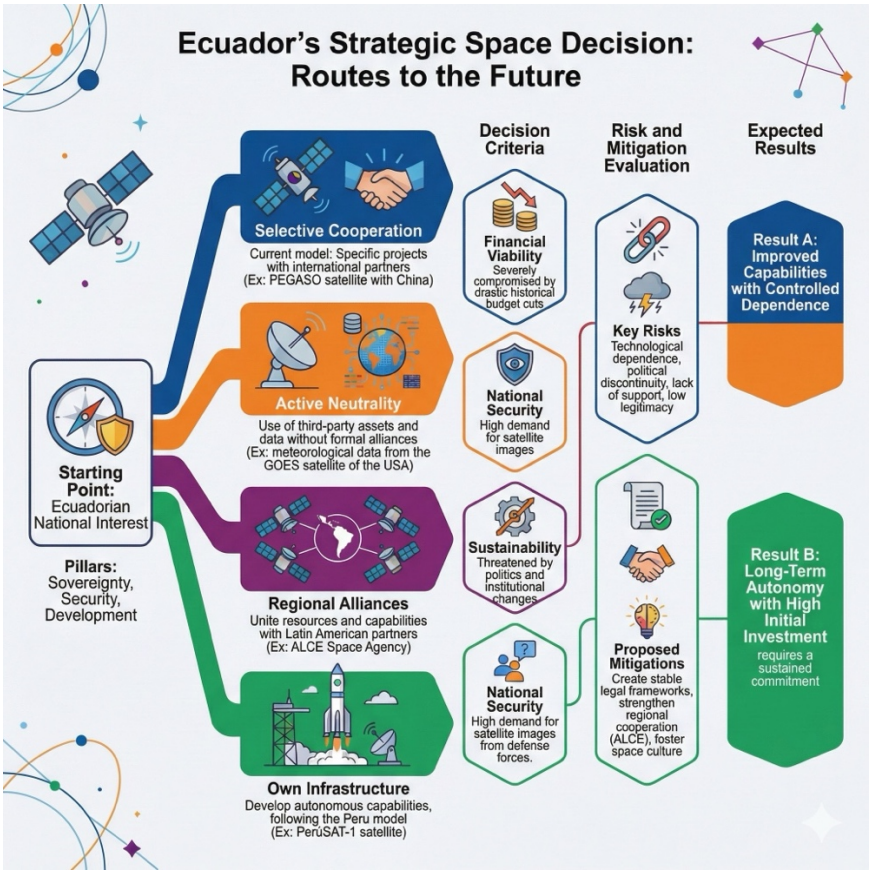
1. Scenario of Selective Cooperation with Powers: This strategy is based on a pragmatic approach of "à la carte alliances," avoiding exclusive dependence on a single actor. Ecuador could collaborate with different powers according to the specific area of interest. For example, it could deepen cooperation with the European Union to access data from the Copernicus program for Earth observation and disaster management, and simultaneously, maintain ties with China to leverage its low-cost launch services, as EXA already did with the NEE-01 PEGASO satellite (Ventura-Traveset, 2021; Ortiz Guerra, 2021). This approach entails interacting pragmatically with the various influence models, such as the European Shared Infrastructure Model to obtain observation data and the Chinese Technological Partnership Model to secure launch services, thereby diversifying strategic dependencies.

2. Scenario of Active Neutrality and Multilateral Leadership: In this scenario, Ecuador would utilize its diplomatic leverage to position itself as a leader among developing countries advocating for more equitable and regulated space governance. It could employ forums such as the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) and, more prominently, the newly formed Latin American and Caribbean Space Agency (ALCE)—of which Ecuador is a member—to promote an international regime that protects the interests of non-space-faring nations, limits militarization, and guarantees fair access to orbital resources (González Ferreiro, La regulación de las actividades espaciales como estrategia estrategia de seguridad y crecimiento nacional, 2021).

3. Scenario of Multiple Regional Alliances: Recognizing that its South American neighbors face similar dilemmas, Ecuador could opt to strengthen regional cooperation to build shared capabilities and increase the bloc's negotiating power. Countries such as Brazil, Argentina, Peru, and Colombia already possess space programs with complementary capabilities in observation satellites, communications, and nanosatellite development (Ortiz Guerra, 2021). This avenue represents an effort to emulate, on a regional scale, the Emerging Regional Power Model exhibited by Brazil, seeking the construction of collective autonomy that could lead to the development of joint projects and the creation of regional infrastructure that reduces dependence on extra-regional powers.

4. Scenario of Gradual Development of Domestic Infrastructure: This is a long-term scenario that prioritizes the construction of technological sovereignty. It would require, first and foremost, resolving internal institutional disputes over space competencies, particularly the conflict between the Military Geographic Institute (IGM) and the Ecuadorian Air Force (FAE) following the abolition of the IEE (Ortiz Guerra, 2021). Once this obstacle is overcome, a sustainable national program could be built that capitalizes on the pioneering experiences of the civil agency EXA and the nanosatellite projects of universities such as the UTE (Universidad Técnica Equinoccial) to gradually develop satellites and services that address the specific needs of the country (Ortiz Guerra, 2021). This scenario constitutes the long-term aspiration towards full autonomy, a fundamental objective that, in various ways, underlies all the models of the powers analyzed.

Figure 2. Flowchart for Ecuador's Strategic Space Decision



Note: Image generated from the author's instructions using "notebook.lm".

Synthesis and Projection

Global hegemonic rivalries and the emergence of NewSpace profoundly reconfigure the astropolitical "crossroads" in which Ecuador finds itself. The choice is not between isolation and total dependence, but rather between different models of strategic integration. Any future national space policy must be guided by principles of strategic pragmatism, seeking a balance between international cooperation and the progressive development of sovereignty. It must adopt a multidimensional approach that integrates security and defense needs with economic and social development objectives, recognizing that, in the 21st century, power on Earth is increasingly linked to the capacity to operate in and from space.

The analysis of these scenarios and their implications lays the groundwork for the formulation of specific public policy recommendations, a task that will be addressed in the final chapter of this research.

This chapter has demonstrated that outer space has consolidated as a domain of intense geopolitical rivalry. This new landscape is defined by growing militarization, evidenced

by the creation of dedicated space forces; an accelerated technological competition between the United States and China; and the emergence of the private sector (NewSpace), which democratizes access to space while challenging existing regulatory frameworks. It was established that the *Corpus Iuris Spatialis* is an insufficient and ambiguous legal framework, incapable of effectively managing orbital congestion, the proliferation of anti-satellite weapons, and unilateral aspirations regarding space resources.

This global landscape directly impacts Ecuador, presenting it with a critical dilemma. On the one hand, cooperation with space powers offers tangible benefits in the form of access to technology, essential services, and capacity building. On the other, this very cooperation introduces significant risks to its sovereignty, ranging from technological dependence to political conditioning and security vulnerabilities. It has been evidenced that the absence of a coherent State policy, aggravated by institutional fragmentation, severely limits the country's capacity to navigate this complex crossroads and capitalize on its equatorial geostrategic advantage.

Having diagnosed the nature of global competition and explored the strategic scenarios available to Ecuador—ranging from selective cooperation to autonomous development—the analysis has laid the foundations for the proposal phase of this research. The following chapter will aim to situate Ecuador's astropolitical debate within its immediate environment, examining how regional dynamics condition—and simultaneously enable—its margins of strategic action. To this end, a cartography of South American space capabilities and ambitions will be mapped out, the perceptions of neighboring countries regarding Ecuador's strategic space design will be analyzed, and the main axes of Latin American cooperation (ALCE, AEB, and bilateral initiatives) will be identified. Finally, emerging diplomatic challenges and potential regional security scenarios that could derive from a greater space projection in the equatorial space will be discussed.

5. REGIONAL ASTROPOLITICS AND ITS REPERCUSSIONS IN LATIN AMERICA

This chapter transitions from the analysis of space policy at the national level, addressed in previous sections, toward an evaluation of the South American regional environment. It is argued that Ecuador's strategic options in the outer space domain cannot be understood in isolation; rather, they are deeply conditioned by the capabilities, ambitions, and perceptions of its neighboring States. The development of a national space policy, however modest, generates repercussions for the delicate regional balance of power, necessitating an astropolitical analysis that transcends national borders and is situated within the security and cooperation dynamics of South America.

To this end, this chapter is structured into four analytical sections. First, a mapping of space capabilities and ambitions in South America is presented, identifying the asymmetric distribution of power in this domain. Second, the potential perceptions of neighboring nations, primarily Colombia and Peru, regarding a prospective Ecuadorian strategic space design are examined, applying the concept of the "security dilemma." Third, existing and potential axes of cooperation in the region are explored, evaluating their opportunities and risks. Finally, the diplomatic challenges and security scenarios shaping the astropolitical environment for Ecuador are analyzed within a context of growing competition between extra-regional powers.

5.1 Mapping of South American Space Capabilities and Ambitions

The assessment of the regional strategic environment requires, as a starting point, an accurate mapping of existing space capabilities in South America. Understanding the asymmetric distribution of power in the outer space domain is fundamental to analyzing the balance of power, identifying technological gaps, and contextualizing Ecuador’s relative position. This overview not only reveals the strengths and weaknesses of each actor but also outlines the contours of competition and cooperation within the region.

The space activity in South America is led by a small number of countries that have managed to consolidate state programs, develop industrial capabilities, and operate assets in orbit, although none have achieved full autonomy in space access (Ortiz Guerra, 2021). The most significant actors are:

- **Brazil:** It possesses the oldest and most ambitious program, managed by the Brazilian Space Agency (AEB). It operates communication satellites for governmental and military use and pursues strategic autonomy through the development of its own

launch vehicles, although it has faced persistent technical difficulties in this field (Ortiz Guerra, 2021).

- **Argentina:** Through the National Commission on Space Activities (CONAE), it has developed a notable specialization in Earth observation satellites. The SAC (Scientific Application Satellites) series and, more recently, SAOCOM (Argentine Microwave Observation Satellite) constitute its most prominent programs. In contrast to other regional actors, its strategic focus has been predominantly oriented towards socioeconomic and scientific applications, such as emergency management and environmental monitoring, while maintaining pivotal cooperation with Italy for the Italo-Argentine Satellite System for Emergency Management (SIASGE) (Ortiz Guerra, 2021).
- **Perú:** The Peruvian program, led by the National Commission for Aerospace Research and Development (CONIDA), centers on the high-resolution optical satellite PeruSAT-1, procured from France. This asset evidences a space doctrine clearly focused on national security and defense, employed in the fight against drug trafficking, illegal mining, and disaster management (Ortiz Guerra, 2021). This approach contrasts markedly with the Argentine orientation, illustrating the divergent strategic priorities within the region.
- **Colombia:** Space development has been driven primarily by the Colombian Air Force (FAC). It has operated the FACSAT-1 nanosatellite since 2018 and is currently developing its successor, FACSAT-2, seeking to bolster its observation capabilities and expertise in the field of nanosatellites (Ortiz Guerra, 2021).
- **Venezuela:** The Bolivarian Agency for Space Activities (ABAE) has placed into orbit, with direct technological support from China, communication satellites (Venesat-1, currently out of service) and Earth observation satellites (VRSS-1 and VRSS-2). Its program stands as a clear example of external technological dependence for the consolidation of sovereign capabilities (Ortiz Guerra, 2021).
- **Chile:** It is recognized as an actor within the regional space domain, although the sources consulted for this analysis do not detail its specific operational satellite capabilities (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021; Ortiz Guerra, 2021).

In contrast, Ecuador exhibits an incipient and fragmented landscape. Following the dissolution of the Ecuadorian Space Institute (IEE) in 2019, the country lacks a state entity

to articulate a coherent space policy (Ortiz Guerra, 2021). The most conspicuous initiatives emanate from the private sector, notably the Ecuadorian Civilian Space Agency (EXA) and its nanosatellites NEE-01 PEGASO and NEE-02 KRYSAOR, and from the academic sphere, featuring projects by the Universidad Técnica Equinoccial (UTE). This absence of a consolidated state program places Ecuador in a position of vulnerability and dependence, notwithstanding its historical sovereign claim over a segment of the geostationary orbit (Ortiz Guerra, 2021).

Table 11. Comparative Map of South American Space Capabilities

Country	Main Agency	Notable Satellites	Industry / Development	Key External Alliances	Declared Doctrine / Strategy
Brazil	AEB	Communication and observation satellites	Development of launchers and satellites	China, Rusia, Ukraine	Regional leadership, strategic autonomy
Argentina	CONAE	Series SAC y SAOCOM (observation)	Advanced in observation satellites	Italy (SIASGE), EE. UU. (NASA)	Scientific and socioeconomic applications
Peru	CONIDA	PerúSAT-1 (optic)	Observation satellite operator	France (Acquisition of PerúSAT-1)	Security, defense and disaster management
Colombia	Fuerza Aérea Colombiana	FACSAT-1, FACSAT-2 (on development)	Nanosatellite development	India (launching)	Strengthening of defense capabilities
Venezuela	ABAE	Communication and observation satellites	Dependent on external technology	China	Sovereignty in communications and observation
Chile	No detallado en fuentes	Not detailed in sources	Not detailed in sources	Not detailed in sources	Not detailed in sources
Ecuador	(IEE disuelto, EXA privada)	NEE-01 PEGASO, NEE-02 KRYSAOR (nanosatellites)	Private and academic initiatives	China, Rusia (launching)	Claim to geostationary orbit; no active State policy

Source: Own elaboration based on Ortiz Guerra (2020) and Aznar Fernández-Montesinos & Sánchez Mayorga (2021).

Declared Ambitions and Technological Gaps

A more in-depth analysis reveals a significant gap between the declared ambitions and the actual capabilities of South American countries. Autonomy in the access to and utilization of space remains a distant objective, as the majority of States rely on extra-regional powers (principally the United States, China, Russia, and Europe) for launch services and the procurement of critical technological components (Aznar Fernández-Montesinos & Sánchez Mayorga, 2021). This dependence conditions strategic autonomy and circumscribes the scope of their space programs.

Table 12. Declared ambitions and technological gaps in South America

Country	Declared Ambition	Actual Capacity (Synthesis)	Main Gap / External Dependency
Brazil	Autonomy in access to space (own launchers).	Advanced satellite capabilities; launcher program with difficulties.	Dependence on critical technology and on achieving successful launches.
Argentina	Leadership in Earth observation applications.	Strong in space segment and data processing.	Dependence on foreign launchers.
Peru / Colombia	Sovereignty in intelligence and observation data.	Capacity to operate own satellites but acquired abroad.	Technological dependence in the manufacturing of advanced satellites.
Ecuador	Sovereign exploitation of the geostationary orbit	Nanosatellite capabilities, but without infrastructure or state policy.	Absence of institutionality, financing, and a State policy.

Source: Own elaboration based on Ortiz Guerra (2020) and Aznar Fernández-Montesinos & Sánchez Mayorga (2021).

This landscape of asymmetric capabilities and structural dependencies shapes a complex scenario. On the one hand, it generates an imperative for regional cooperation to pool resources, share costs, and develop joint capabilities that no single country can attain on its own. On the other, it creates a latent risk of competition and mistrust, particularly for emerging actors such as Ecuador, whose maneuvers could be misinterpreted by neighbors possessing superior capabilities. This duality between cooperation and conflict is central to understanding security perceptions within the region.

5.2 Perceptions of Neighboring Nations Regarding Ecuador's Strategic Space Design

In international relations, perception is often as significant as material reality. This principle is particularly acute within the space domain, owing to the intrinsically dual-use nature of its technology. It proves extremely difficult to distinguish between space capabilities intended for peaceful purposes and those possessing military potential (Colom Piella, 2025). An Earth observation satellite for environmental monitoring can be utilized with equal facility for intelligence, surveillance, and reconnaissance (ISR) tasks. This ambiguity fuels the security dilemma, in which a State's actions to increase its own security (for example, by developing a surveillance satellite) are perceived as a threat by its neighbors, who respond with countermeasures, generating a spiral of mistrust and militarization (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021).

Any space advancement by Ecuador, however modest or peaceful its intent, would inevitably be scrutinized by Colombia and Peru through this prism. Given that Ecuador's principal security imperatives center on border surveillance, combating drug trafficking, and countering illegal mining (Ortiz Guerra, 2021), the development of Earth Observation (EO) capabilities for these purposes would constitute the most logical step. However, a satellite designed to monitor illicit activities along the border could be perceived by a neighboring country as an instrument of espionage targeting its military assets or critical infrastructure, thereby exacerbating regional mistrust.

The equatorial advantage—its equatorial geographic position and the constitutional claim over the geostationary orbit—constitutes a double-edged sword. On the one hand, it is a diplomatic asset that could be utilized to attract investment and foster cooperation. On the other, were Ecuador to decide to exploit this resource in alliance with an extra-regional power (such as the United States or China), it could be perceived by its neighbors as an attempt to obtain a unilateral strategic advantage or, worse still, as the cession of sovereignty to a global actor, turning Ecuador into a pawn in great power competition and generating a point of geopolitical friction in the heart of South America (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021).

To mitigate these risks, it is imperative that Ecuador adopt a policy of maximum transparency and actively pursue the implementation of Confidence-Building Measures (CBMs).

Table 13. Matrix of adjacent perceptions and confidence-building measures

Strategic Variable (Ecuador's Action)	Possible Negative Perception (Colombia/Peru)	Strategic Risk for Ecuador	Proposed Confidence-Building Measure (CBM)
Development of an observation satellite (ISR)	Attempt to spy on or monitor border areas and military assets.	Escalation of mistrust; small-scale regional arms race.	Propose a satellite data exchange framework for common border security (fight against transnational crime).
Use of the geostationary orbit with extra-regional partners	Cession of sovereignty to a foreign power (e.g., China, USA) near their borders.	Ecuador seen as a pawn in great power competition; regional isolation.	Promote regional communication satellite projects using the orbit, prioritizing Latin American partners.
Investment in ground segment infrastructure	Development of interference capabilities (jamming) or cyberattacks against their own satellites.	Increase in tension and adoption of countermeasures by neighbors.	Invitations to observers from neighboring countries to control centers; transparency regarding technical capabilities.
"Space sovereignty" discourse	Nationalist rhetoric seeking hegemony or an unfair advantage.	Difficulty in establishing alliances and regional cooperation.	Adopt a "cooperative sovereignty" discourse, emphasizing space as a regional asset for development and shared security.

Source: Own elaboration based on Ortiz Guerra (2020), Aznar Fernández-Montesinos & Sánchez Mayorga (2021), and Colom Piella (2025).

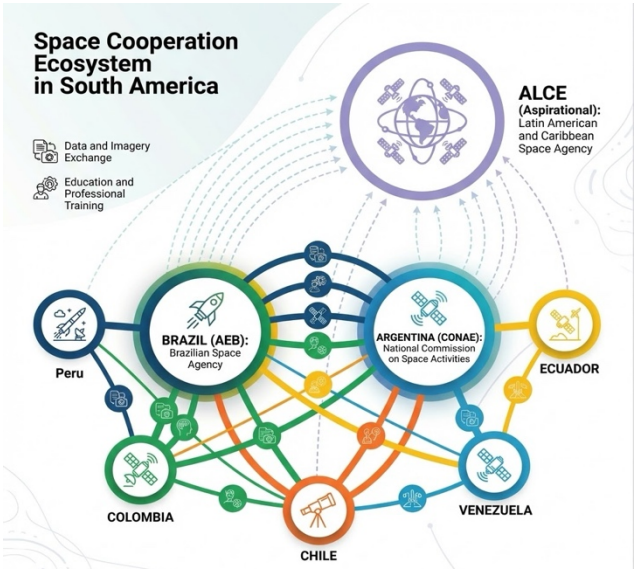
The proactive implementation of CBMs is crucial. Instead of developing capabilities in isolation, Ecuador could propose from the outset the creation of a regional mechanism for satellite data exchange, focused on shared threats such as natural disaster management, environmental monitoring of the Amazon, or the fight against transnational organized crime (Ortiz Guerra, 2021). This approach would transform a potential source of conflict into an opportunity to deepen regional integration and security. In this manner, active cooperation presents itself not as a mere diplomatic option, but as a strategic

necessity for Ecuador to develop its space program without generating instability in its environment.

5.3 Axes of Latin American Space Cooperation: ALCE, AEB, and Bilateral Initiatives

Faced with a scenario of limited capabilities and high development costs, regional cooperation presents itself as the most logical and efficient pathway for countries like Ecuador to access the benefits of space. The fragmented model that has prevailed in South America, characterized by national programs with limited coordination, contrasts with the success of the European integrative model, embodied in the European Space Agency (ESA). The ESA demonstrates how the pooling of financial, technological, and human resources can enable a group of nations to achieve the status of a top-tier space power, an achievement unattainable for each of its members individually (Ventura-Traveset, 2021). In the region, space cooperation has manifested primarily through bilateral or multilateral initiatives of limited scope. The Brazilian Space Agency (AEB) and Argentina's CONAE act as the most advanced poles of development, around which potential collaborations orbit. The aspiration for an integrating entity, such as the Latin American and Caribbean Space Agency (ALCE), has been discussed but has not yet consolidated as a robust operational framework. Therefore, the predominant model remains that of specific alliances, such as the Italo-Argentine cooperation in the SIASGE system (Ortiz Guerra, 2021).

Figure 3. Description of the Regional Space Cooperation Network



Note: Image generated from the author's instructions using "notebook.lm".

Cooperation modalities can encompass a wide spectrum of activities, ranging from the most basic to the most complex: data exchange, human capital formation, sharing of ground infrastructure, development of joint missions, and regional governance. For Ecuador, insertion into these axes of cooperation presents both significant opportunities and risks that must be managed with prudence.

- **Opportunities:** The principal advantage is access to capabilities that the country cannot develop on its own. This includes high-resolution satellite data from Argentina or Peru, technical expertise from Brazil, and the possibility of participating in projects that strengthen its scientific and technological base. Ecuador, in turn, can contribute a strategic asset of great value: its claim over the geostationary orbit, which can serve as a powerful negotiating tool to secure its participation in regional telecommunications projects.
- **Risks:** The principal danger lies in asymmetric cooperation. The risk of technological dependence is palpable, given that Argentina's advanced specialization in Earth observation satellites (SAOCOM), detailed previously, places emerging actors such as Ecuador in an inherently weaker negotiating position. The cooperation agenda could be captured by the interests of the most powerful actors, and the lack of political continuity—an endemic problem in the region—could curtail long-term projects, leaving the country in a position of vulnerability.

In conclusion, despite the inherent risks, regional cooperation is not merely an option, but a strategic imperative for Ecuador. However, for this cooperation to be beneficial and sustainable, the country must possess skilled space diplomacy capable of negotiating balanced agreements, and a robust internal institutional framework that guarantees the continuity of commitments and defends national interests. Managing these diplomatic challenges is fundamental to navigating the complex regional security landscape.

5.4 Diplomatic Challenges and Regional Security Scenarios

The South American regional environment is not a strategic vacuum; it is a stage where the pressures of global geopolitical competition, the challenges of rapid technological evolution, and persistent security dilemmas converge. Ecuadorian space diplomacy, therefore, cannot be merely reactive. It must be proactive and sophisticated, capable of navigating this complexity to position the country advantageously and mitigate the risks inherent to an increasingly contested and militarized domain.

The principal diplomatic and security challenges that Ecuador and the region must face are multiple and interconnected:

- **Competition from Extra-Regional Powers:** The growing rivalry between the United States and China is projected directly into space and, by extension, into Latin America. Initiatives such as the U.S.-led Artemis Accords and China's "Space Silk Road" create alignment dilemmas for countries in the region. Adhering to a bloc may bring technological and financial benefits, but at the cost of strategic autonomy and the risk of importing global conflicts into the neighborhood (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021).
- **Militarization and the Ambiguity of Dual Use:** As has been mentioned, the dual-use nature of space technology fosters mistrust and the risk of an arms race. The development of anti-satellite (ASAT) capabilities, advanced ISR, or cyberattacks against space assets by any actor could rapidly destabilize the region (Colom Piella, 2025).
- **Security of Critical Infrastructure:** Space assets and their ground segment are vulnerable to a variety of threats, ranging from signal interference (jamming) to sophisticated cyberattacks that could disable communication or navigation satellites, with devastating economic and social consequences (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021).
- **Governance and Space Debris:** The problem of space debris threatens the long-term sustainability of orbital operations (the so-called "Kessler syndrome"). The weakness of the international legal regime (*Corpus Juris Spatialis*) and the absence of an effective space traffic management system turn the most congested orbits into a virtual "minefield," representing an operational and security challenge for all actors (Ventura-Traveset, 2021; Aznar Fernández-Montesinos y Sánchez Mayorga, 2021).

Regional Security Scenarios for the Next Decade

To navigate this complexity, it is useful to consider three possible future scenarios for the South American astropolitical environment:

- **Scenario 1: Expanded Cooperation ("Latin American ESA"):** In this optimistic scenario, regional leaders recognize that common threats (climate change, competition from external powers, transnational crime) and the high costs of space development make cooperation the only viable path. The success of a flagship joint project acts as a catalyst, leading to the consolidation of a robust institutional

framework. For Ecuador, this scenario represents the opportunity to access advanced capabilities and influence regional governance.

- **Scenario 2: Fragmentation and Nationalist Competition:** This scenario is characterized by the primacy of national agendas, mutual distrust, and economic crises that disincentivize investment in cooperation. The failure of multilateral initiatives or the resurgence of border disputes extending into the space domain are possible triggers. For Ecuador, this scenario would imply strategic isolation, the need for greater defense investments, and increased vulnerability.
- **Scenario 3: Alignments with Extra-Regional Powers:** This scenario is directly grounded in the structural dependencies analyzed in the capability mapping, where the need for foreign technology and launch services creates vulnerabilities that extra-regional powers can exploit. The global U.S.-China rivalry intensifies to such a point that countries in the region are forced to choose a side. For Ecuador, this would mean immense diplomatic pressure, the loss of strategic autonomy, and the direct importation of global geopolitical tensions into the region.

Table 14. Regional Security Scenarios and their Implications for Ecuador

Scenario	Key Assumptions	Strategic Impacts for Ecuador	Early Warning Indicators
Expanded Cooperation	Political will, common threats	Access to technology, diplomatic influence	Signing of binding multilateral agreements; creation of common funds.
Fragmentation and Competition	Nationalism, mistrust	Isolation, increase in defense spending	Sovereigntist rhetoric in official speeches; cancellation of joint projects.
External Alignments	Intensification of global rivalry	Loss of autonomy, importation of conflicts	Adhesion of neighboring countries to exclusive superpower initiatives.

Source: Own elaboration based on Aznar Fernández-Montesinos & Sánchez Mayorga (2021) and Ortiz Guerra (2020).

Faced with these scenarios, Ecuadorian diplomacy must be guided by clear principles. A space foreign policy based on active multilateralism is recommended to promote regional forums and transparency mechanisms; strategic autonomy, to avoid exclusive dependencies and diversify partners; and niche diplomacy, focusing on areas where

Ecuador can contribute value (disaster management, environmental monitoring) to build political capital. Ecuador's space future, therefore, will not be decided solely by its capacity to develop technology, but, decisively, by the sagacity of its diplomatic strategy to shape a regional environment favorable to its interests.

The analysis developed in this chapter has demonstrated that the design and implementation of a space strategy for Ecuador is inextricably linked to the dynamics of its regional environment. The central argument is that the South American context—characterized by marked asymmetries in space power, a latent distrust rooted in the security dilemma, and the growing projection of global geopolitical rivalries—acts as the primary conditioning factor for any emerging actor. The findings reveal that Ecuador's path in space cannot be a solitary effort, but must be navigated with a deep awareness of its regional repercussions.

Throughout the chapter, fundamental tensions were identified that will define the region's astropolitical future. The first is the tension between cooperation and competition; while logic dictates joining efforts to bridge technological gaps, nationalism and suspicion drive isolated programs. The second is the dilemma between national sovereignty and regional integration, where the desire to control strategic assets clashes with the benefits of shared governance. Finally, the tension between autonomy and alignment forces States into a delicate balance between seeking strategic independence and accepting the advantages of partnering with extra-regional powers, at the risk of importing their conflicts.

Having outlined the regional framework and the tensions traversing space projection in Latin America, the next chapter will focus on the strategic paths that Ecuador can adopt to translate its equatorial position into state action capacity. To this end, projective diplomatic scenarios—alignment, non-alignment, and a possible South-South doctrine—will be examined, as well as an institutional roadmap laying the groundwork for the creation of a space agency and a national regulatory framework. In parallel, the instrumentalization of soft power through the promotion of new norms (norm entrepreneurship) in multilateral spaces will be analyzed. Finally, a risk analysis focused on technological dependence, potential loss of sovereignty, and the danger of drifting towards militarization will be incorporated, with the aim of identifying viable options and concrete safeguards for a sovereign and sustainable space strategy.

6. STRATEGIC PATHWAYS FOR ECUADOR

Following the diagnostic analysis and the scenario forecasting developed in the preceding chapters, this chapter is eminently proactive in nature. Its objective is to articulate a comprehensive strategic proposal for the Ecuadorian State, transforming research findings into a pragmatic and realistic roadmap. This proposal seeks to coherently integrate diplomacy, institutional frameworks, soft power, and risk management as fundamental pillars for Ecuador's sovereign, sustainable, and beneficial inclusion in the global space arena. The pathway outlined herein aims to provide the country with the conceptual and practical tools necessary to overcome past inertia and gaps, transforming the nation's geographical potential and diplomatic vocation into a vector of sovereign power within the emerging space economy and geopolitics.

6.1 Projective Diplomatic Scenarios: Alignment, Non-Alignment, and South-South Doctrine

The choice of a diplomatic stance constitutes a critical and foundational decision for any national space policy. Such a position will determine not only the degree of access to advanced technologies and knowledge but also the level of strategic autonomy and the state's exposure to the burgeoning geopolitical rivalries that characterize the space domain. In a global context marked by competition among powers such as the United States, China, and Russia, along with a lack of transparency in their respective space programs (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021), the integration of an emerging actor such as Ecuador must be the result of a deliberate strategic calculation. The following section analyzes three projective diplomatic scenarios that the country could adopt.

Strategic Alignment

This option implies formal adherence to a technological-political bloc led by a consolidated space power. This model materializes through the signing of binding cooperation treaties, participation in joint exploration programs, and the acquisition of technology under government-to-government agreements. Regional examples of this approach include Colombia's signing of the Artemis Accords with the United States' National Aeronautics and Space Administration (NASA), or Chile's early cooperation agreements with the same agency (Conde et al., 2022).

The key instruments of this scenario are varied. They include adherence to regulatory frameworks such as the Artemis Accords, which establish principles for lunar exploration and the utilization of space resources under U.S. leadership (Aznar Fernández-

Montesinos & Sánchez Mayorga, 2021). They also encompass the procurement of complete satellite systems, such as the PeruSAT-1 acquired by Peru from the French firm Airbus Defense and Space, and participation in large-scale international programs like the International Space Station (ISS) (Conde et al., 2022).

The advantages of strategic alignment are evident: it allows for accelerated access to cutting-edge technology, facilitates interoperability with the systems of the allied power, and offers opportunities for training and capacity building. However, the costs and risks are significant. The primary danger is technological dependency, which can lead to a lock-in effect with a single provider and subject the country to political conditioning, as seen in the Chinese Space Silk Road strategy, which seeks to generate dependency through cooperation (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021). Additionally, the inherently dual nature of space technology (civilian and military) drags minor allies into the security dilemma, where acquired capabilities may be perceived as a threat by rival powers, thereby increasing the country's vulnerability (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021).

Non-Alignment and Active Neutrality

This stance is defined by a conscious pursuit of strategic autonomy, avoiding permanent alliances and opting for flexible and multi-vector cooperation. Instead of adhering to a bloc, the State interacts with various international actors based on its specific interests and without long-term political commitments. This option is grounded in the theoretical perspective of Nayef Al-Rodhan, who posits that small countries can effectively manage the influence of major powers through the formation of temporary alliances and the use of diplomacy in multilateral forums to gain prestige and power (Ortiz Guerra, 2020).

The primary instrument of this scenario is proactive participation in multilateral forums, with a particular emphasis on the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS). Within this sphere, a non-aligned state can actively promote norms for the peaceful use of space, transparency in space activities, and the non-militarization of the domain. Colombia's historical stance in COPUOS, which has consistently advocated for these principles and expressed concern regarding the arms race and space debris, serves as a regional benchmark for this approach (Conde et al., 2022).

The main advantage of this doctrine is maximum strategic autonomy, which preserves sovereignty in decision-making and offers significant diplomatic flexibility. However, its costs lie in potential isolation, reduced access to large-scale projects that require the

capacity of a major power, and the imperative need to develop greater indigenous technological capabilities to compensate for the lack of a primary partner.

South-South Doctrine

This projective scenario prioritizes the establishment of strategic alliances with other developing nations, particularly within the Latin American and Caribbean region. The objective is to build collective capabilities based on shared interests and challenges, creating a regional pole of power with its own voice in the global space arena. The most representative and promising instrument of this doctrine is the recently established Latin American and Caribbean Space Agency (ALCE).

Driven by Mexico, ALCE seeks to articulate the efforts of regional countries to achieve common goals. According to projections by the Mexican Space Agency (AEM), these objectives include improving satellite communication systems, developing early warning systems for natural disasters (floods, fires, hurricanes), agricultural planning, and the monitoring of borders and natural resources (Conde et al., 2022). South-South cooperation would allow Ecuador to collaborate with regional partners possessing significant space capabilities, such as Argentina, a regional pioneer with its SAC satellite series; Brazil, the leading equatorial power with geostationary development; and Peru, with its experience in the acquisition and operation of Earth observation satellites (Ortiz Guerra, 2021; Conde et al., 2022).

The advantages of this doctrine are considerable. It is based on shared interests (disaster management, resource monitoring), carries lower political costs as it does not imply alignment with major powers, and offers greater potential for genuine technology transfer. Fundamentally, it acknowledges the impossibility of achieving technological independence in the short term for developing countries (Conde et al., 2022), Therefore, this doctrine represents the most pragmatic path toward interdependence and collective self-sufficiency. The risks, however, center on the fact that the region's aggregate technological capabilities may be lower than those of established powers, as well as on Latin America's historical political fragmentation, which could hinder the consolidation of long-term projects.

Comparative Synthesis and Decision Matrix

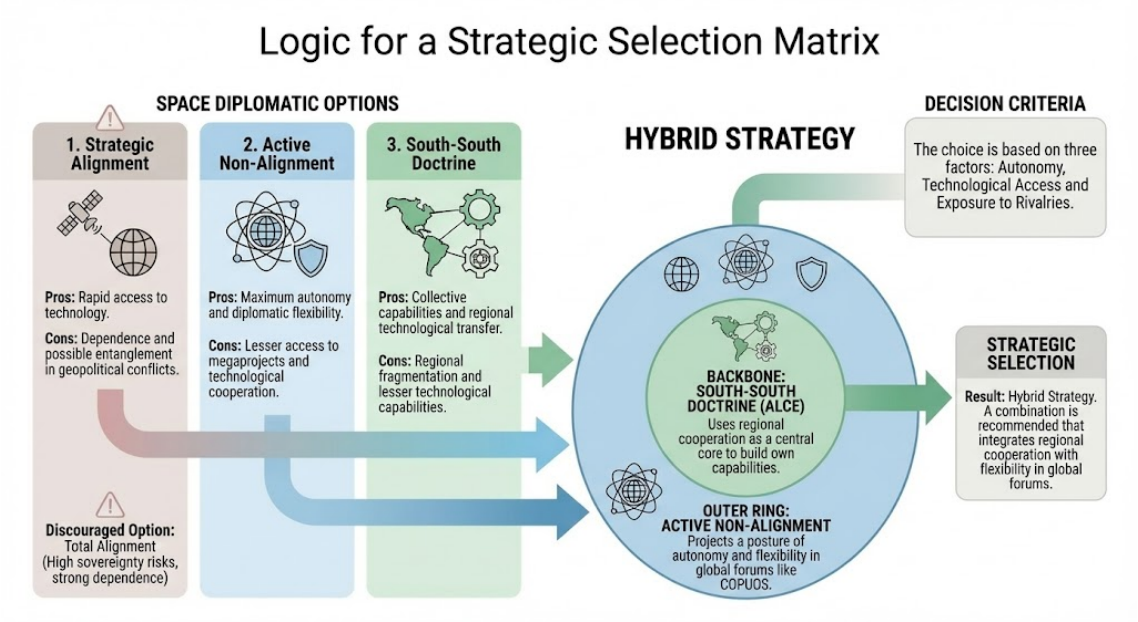
To visualize the implications of each scenario, the following list summarizes the comparative analysis.

Table 15. Comparative Analysis of Diplomatic Scenarios for Ecuadorian Space Policy

Strategic Criterion	Alignment	Active Non-Alignment	South-South Doctrine
Main Objective	Rapid access to technology and advanced capabilities through a primary partner.	Maximize strategic autonomy and diplomatic flexibility.	Building collective capabilities with regional partners based on common interests.
Key Instruments	Signing of treaties (e.g., Artemis Accords), purchase of technology (e.g., PeruSAT-1), participation in programs of major powers (e.g., ISS).	Proactive participation in multilateral forums (COPUOS), promotion of norms for peaceful use, specific and non-binding scientific cooperation.	Creation and strengthening of regional agencies (ALCE), joint satellite development projects, data exchange.
Main Advantages	Access to cutting-edge technology, interoperability, human capital training.	Full sovereignty in decision-making, ability to interact with all actors, avoidance of geopolitical rivalries.	Shared interests, lower political costs, potential for real technology transfer, strengthening of the regional voice.
Costs and Risks	Technological dependency, political conditioning, being drawn into the "security dilemma," vulnerability to conflicts.	Potential isolation, less access to large-scale projects, greater need to develop own capabilities.	Technological capabilities potentially inferior to those of major powers, risk of regional political fragmentation.
Impact on Autonomy	Significant decrease. Foreign policy remains subject to the interests of the bloc.	Maximum. The State retains full control over its policy and alliances.	Moderate to High. Sovereignty is exercised collectively in regional projects, but autonomy from major powers is maintained

Note: Author's own elaboration.

Figure 4. Logic for a Strategic Selection Matrix



Note: Image generated from the author's instructions using "notebook.lm".

The selection of a diplomatic pathway for Ecuador should not be conceived as a mutually exclusive choice among the options presented. On the contrary, the most pragmatic and beneficial route for the country lies in a strategic combination that leverages the strengths of each scenario while mitigating their weaknesses. The core proposal is to adopt a South-South Doctrine as the backbone of Ecuadorian space policy. This approach, channeled primarily through ALCE, should serve as the engine for the development of indigenous technological capabilities, the execution of Earth observation projects relevant to the region, and the consolidation of a national industry. This regional foundation must be complemented by a policy of Active Non-Alignment in global forums such as COPUOS. In these spaces, Ecuador can position itself as a defender of international space law, peaceful use, and sustainability, engaging in specific cooperation with various powers on non-binding scientific projects. Total Strategic Alignment with a major power would be discouraged as State policy due to the high risks of dependency and the potential for being drawn into geopolitical conflicts that would compromise national sovereignty.

The successful execution of this hybrid diplomatic strategy depends, inevitably, on the construction of a robust internal institutional and regulatory framework, capable of articulating and sustaining this vision over the long term.

6.2 Institutional Roadmap: Prolegomena for the Creation of a Space Agency and National Regulatory Framework

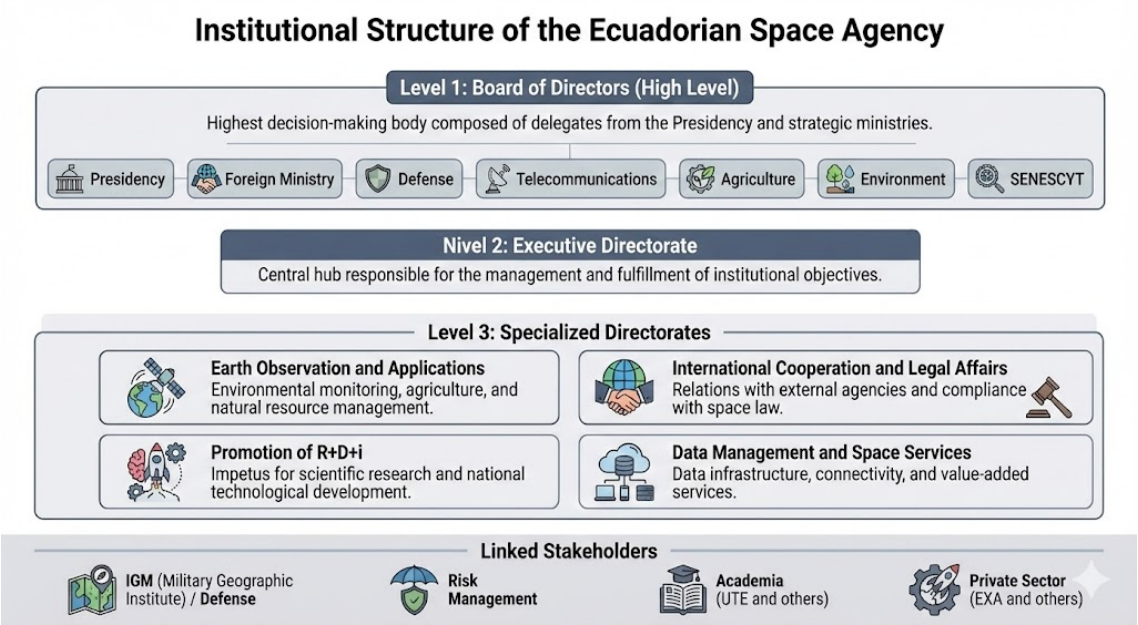
The abolition of the Ecuadorian Space Institute (IEE) in 2019, within the framework of a public sector optimization process, left a profound institutional vacuum in the country (Ortiz Guerra, 2021). The suppression of the Ecuadorian Space Institute (IEE) in 2019, within the framework of a public sector optimization process, left a profound institutional vacuum in the country. This decision exposed a critical structural weakness: without a stable governing entity, with a long-term vision and a sustained budget, any space policy dissolves into "isolated" and disconnected efforts (Müller, 2025). Experience demonstrates that, without a solid institutional anchor, even the most elaborate diplomatic strategy is destined for failure, as it lacks the necessary state apparatus for its implementation, coordination, and continuity. Therefore, the first step toward materializing a sovereign space policy is the reconstruction of its institutional architecture and the creation of a modern regulatory framework.

Proposal for an Institutional Model

To avoid the errors of the past, marked by instability and the suppression of entities by decree, it is fundamental to design an institutional model that is resilient and suited to the country's capabilities. An analysis of regional models offers valuable lessons:

- **Intersectoral Commission Model (Initial Phase):** As a pragmatic and rapid first step, Ecuador could establish a National Space Commission via Executive Decree, following the model of the Colombian Space Commission (CCE). The CCE is an intersectoral body for consultation, coordination, and planning, chaired by a high-ranking State authority (the Vice Presidency of the Republic in the Colombian case), which ensures the effective coordination of various ministries and public and private entities involved (Conde et al., 2022). This model would allow the foundations of national policy to be laid without initially requiring a large bureaucratic structure.
- **Decentralized Agency Model (Maturity Phase):** In the medium term, this commission should evolve into an Ecuadorian Space Agency created by law. This model, inspired by the Mexican Space Agency (AEM), would have the character of a decentralized public body, with legal personality, its own assets, and technical and management autonomy (Conde et al., 2022). The creation by law would grant it the necessary stability to transcend political cycles and ensure multi-year funding.

Figure 5. Description of the Minimum Organizational Chart for Ecuadorian Space Institutionality



Note: Image generated from the author's instructions using "notebook.lm".

The key functions of this new institutional structure must be:

1. **Coordinate** national space policy and its execution.
2. **Articulate** the actors of the space ecosystem: the Defense sector (through the Military Geographic Institute - IGM), Telecommunications, Risk Management, the Foreign Ministry, academia (such as the Universidad Técnica Equinoccial - UTE), and the private sector (such as the Ecuadorian Civilian Space Agency - EXA).
3. **Promote** research, development, and innovation (R+D+i) in space science and technology.
4. **Manage** international cooperation and represent the State in forums such as COPUOS and ALCE.
5. **Oversee** compliance with the national regulatory framework, including the registration of space objects.

The organic structure of the future agency should be efficient and functional. A minimum organizational chart could consist of:

- A high-level **Board of Directors**, chaired by a delegate of the Presidency of the Republic and with representation from the Ministries of Foreign Affairs, Defense, Telecommunications, Agriculture, Environment, and the Secretariat of Higher

Education, Science, Technology, and Innovation. This board would define the strategic policy.

- An **Executive Directorate**, responsible for the management and execution of the policy and programs.
- **Key Functional Areas**:
    - **Earth Observation and Applications:** Responsible for managing projects for disaster management, precision agriculture, environmental monitoring, and security.
    - **International Cooperation and Legal Affairs:** Responsible for space diplomacy, the negotiation of agreements, and the oversight of compliance with space law.
    - **Promotion of Research, Development, and Innovation (R+D+i):** Responsible for articulating collaboration between the agency, universities, and industry to generate national capabilities.
    - **Space Data and Services Management**: Responsible for the infrastructure for the reception, processing, and distribution of satellite data to government users and civil society.

Roadmap for Institutionality and Regulations

The establishment of this scaffolding requires a sequence of realistic milestones, distributed over defined time horizons.

Table 16. Roadmap for Ecuador's Space Institutionality and Regulations

Time Horizon	Key Milestones	Actors Involved
Short term (1–2 years)	Creation of a National Space Commission (CCE Colombia model) by Executive Decree.	President of the Republic; key ministries (Foreign Affairs, Defense, Telecom.).
Short term (1–2 years)	Drafting of the National Space Activities Law.	National Space Commission; National Assembly; legal and technical experts.
Short term (1–2 years)	Start of the internal regulatory alignment process for the Registration Convention.	Ministry of Foreign Affairs; National Space Commission.
Medium Term (3–5 years)	Approval of the National Law on Space Activities.	National Assembly; Presidency of the Republic.
Medium Term (3–5 years)	Transition from the Commission to an Ecuadorian Space Agency (AEM	National Government; Ministry of Finance.

	Mexico model) with an assigned budget.	
Medium Term (3–5 years)	Establishment of the national registry of space objects.	Ecuadorian Space Agency.
Long term (5+ years)	Implementation of national Earth observation programs.	Ecuadorian Space Agency; sector ministries; IGM.
Long term (5+ years)	Capacity building in cooperation with regional partners (ALCE).	Ecuadorian Space Agency; Ministry of Foreign Affairs; ALCE.
Long term (5+ years)	Consolidation of the national space ecosystem (academia–industry–State).	All space ecosystem actors.

Note: Author's own elaboration.

Essential Components of the National Regulatory Framework

The future National Law on Space Activities is the cornerstone of the sector's governance. Its purpose is not only to comply with international obligations but also to regulate and promote the participation of private actors within the framework of the **NewSpace** paradigm, attracting investment and capitalizing on the agility of the emerging industry (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021). Drawing from international best practices, such as the laws of Portugal, the United Kingdom, and Russia (González Ferreiro, 2021), This regulation must include, at a minimum, the following components:

- **General Principles:** An explicit declaration affirming Ecuador's commitment to the exclusively peaceful use of outer space, in line with the vocation declared by the country before UNOOSA (Muñoz Mera, 2024).
- **Licensing and Authorization Regime:** The establishment of a clear and transparent system to authorize and supervise the space activities of non-governmental entities (private companies, universities). This is an essential requirement to comply with the obligations of Article VI of the 1967 Outer Space Treaty, which holds the State responsible for all national activities in space (González Ferreiro, La regulación de las actividades espaciales como estrategia estrategia de seguridad y crecimiento nacional, 2021).
- **Liability and Insurance:** The definition of a liability regime for damages caused by space objects and the mandatory requirement for private operators to obtain insurance, in order to protect the State from potential international claims.

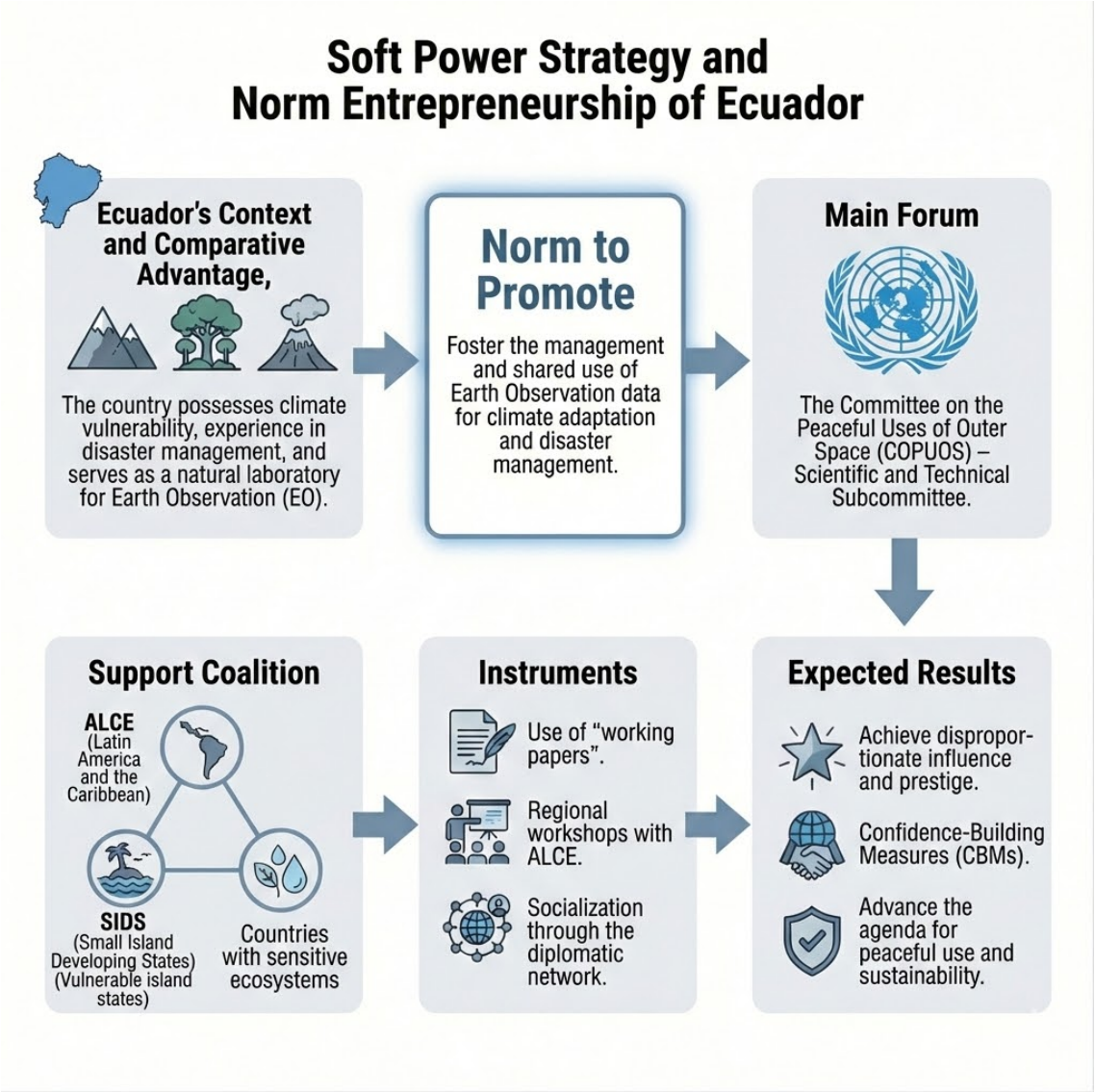
- **National Registry:** The implementation of a national registry of all objects launched into space under Ecuadorian jurisdiction, in compliance with the Registration Convention, ratified by Ecuador and in effect since March 2025 (Muñoz Mera, 2024).
- **Data Governance:** The development of standards for the ownership, management, access, and distribution of data obtained by satellites, seeking a balance between national security, the promotion of science, and the encouragement of commercial applications.
- **Security and Dual Use:** The creation of control mechanisms for the export and import of dual-use technologies, as well as measures for the protection of space infrastructures considered critical for national security and development.

A robust institutional framework and a modern legal structure are not ends in themselves, but rather the indispensable platform from which Ecuador can project its influence and defend its interests on the global stage—even without possessing large-scale material capabilities—through the strategic instrumentalization of soft power.

6.3 Strategic Instrumentalization of Soft Power and the Promotion of New Norms (Norm Entrepreneurship)

For a state with limited material resources such as Ecuador, soft power and "norm entrepreneurship" emerge as highly efficient strategic tools. As Nayef Al-Rodhan argues, a state's diplomatic influence does not derive exclusively from its military or economic strength; small countries can gain prestige, visibility, and power through their diplomatic activity in international organizations and the promotion of global norms (Ortiz Guerra, 2021). In the space domain, where norms of behavior are still being formed, Ecuador has a unique opportunity to position itself as a constructive and influential actor.

Figure 6. Soft Power Strategy and Norm Entrepreneurship Map



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Projecting influence in the absence of hard power capabilities

Ecuador may undertake a series of concrete actions to cultivate its soft power and leverage its standing within the space domain without the necessity of committing to massive investments in hard infrastructure:

- **Scientific Diplomacy:** Strengthening and broadening cooperation between Ecuadorian universities and international research centers. The collaborative framework established between the Universidad Técnica Equinoccial (UTE) and Southwest State University in Russia, which has culminated in the deployment of nanosatellites, exemplifies the potential of this avenue for generating specialized

knowledge and international prestige (Ortiz Guerra, 2021). The prospective space agency must serve as a catalyst for these strategic alliances.

- **Leadership in Multilateral Fora:** Maintaining an active, visible, and proactive engagement within COPUOS and its subcommittees. Building upon the foundation laid by its 2025 declaration upon ratifying the Registration Convention, Ecuador can consolidate its reputation as a steadfast advocate for the peaceful, responsible, and sustainable use of outer space, while promoting transparency and confidence-building measures (Muñoz Mera, 2024).
- **Focused Regional Cooperation:** Assuming a leadership role within ALCE in specific niches aligned with Ecuador's geographical strengths and national interests. The country can propose and spearhead regional projects for the monitoring of the Amazon basin, Andean ecosystems, Pacific marine resources, and the management of volcanic and seismic risks.
- **Provision of Data and Services:** Positioning the country as a "natural laboratory" for Earth observation (Müller, 2025). Ecuador can evolve into a regional center of excellence for monitoring deforestation, managing water resources, and adapting to climate risks, offering data and value-added analysis to neighboring countries that face similar challenges.
- **Strategic Narrative:** Constructing and projecting a coherent and unified international discourse based on Ecuador's "vocation for peace." (Muñoz Mera, 2024). This narrative must emphasize the country's commitment to sustainable development, international space law, and the utilization of space technology as a tool for the welfare of humanity, in contrast to the confrontational narratives of major powers.

Normative Entrepreneurship Strategy

Beyond merely participating in existing debates, Ecuador can position itself as a "normative entrepreneur," that is, a state that actively proposes, socializes, and advocates for the adoption of new international norms.

- **Norm to Promote:** It is proposed that Ecuador spearheads the advancement of an international norm or a set of guidelines regarding the "Management and Shared Use of Earth Observation Data for Climate Change Adaptation and Disaster Management." This initiative aligns seamlessly with the country's geographical vulnerabilities and strengths, addresses a critical need of developing nations, and promotes outer space as a global public good.

- **Fora and Coalitions:** The primary forum for this initiative would be the Scientific and Technical Subcommittee of COPUOS. The natural coalition to support this proposal would be comprised of other Latin American nations (coordinated through ALCE), Small Island Developing States (SIDS) vulnerable to rising sea levels, and other countries with vast ecosystems sensitive to climate change.
- **Instruments:** The strategy would be implemented through the submission of working papers in Vienna, the organization of regional workshops and seminars within the framework of ALCE to build consensus, and the active utilization of its diplomatic network to socialize the proposal and garner support.

The success of a strategy centered on soft power and normative entrepreneurship can generate an influence disproportionate to the country's material capabilities. Nevertheless, this projection of opportunities must not obscure the existence of tangible and growing risks within the space domain, which must be actively analyzed and managed to ensure the viability of the entire national policy.

6.4 Risk Analysis: Technological Dependency, Erosion of Sovereignty, and the Danger of Militarization

Outer space, far from being an exclusively scientific and peaceful domain, constitutes an arena of intense strategic competition and increasing militarization. For an emerging actor such as Ecuador, venturing into this field not only presents opportunities but also exposes the nation to significant risks that could compromise its sovereignty and security. The dual-use nature of most space technologies creates a permanent "security dilemma," wherein capabilities developed for peaceful purposes may be perceived as a threat by other actors, thereby generating tensions and escalatory dynamics (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021). A proactive analysis of these risks is, therefore, an essential component of a prudent space policy.

Strategic Risk Matrix

The following matrix identifies the primary strategic risks for Ecuador, evaluates their potential impact and probability, and proposes mitigation measures based on the strategies outlined in this chapter.

Table 17. Strategic Risk Matrix and Mitigation Measures

Identified Risk	Risk Description	Impact / Probability	Proposed Mitigation Measures
Technological Dependency	Critical dependency on a single foreign	High / High	Diversify partners through a diplomacy of Active

	provider for satellites, launches, and software, with a risk of "lock-in" and political conditioning (e.g., China's Space Silk Road).		Non-Alignment. Prioritize South-South cooperation (ALCE) that includes technology transfer. Foster national industry and academia.
Institutional Instability	Suppression or defunding of the space governing entity due to changes in government, diluting state policy and losing capabilities (as in the case of the suppression of the IEE).	High / Medium	Establish the space agency by law rather than by decree to provide stability. Ensure a multi-year budget. Foster a national space culture that legitimizes investment.
Militarization and Involvement in Conflicts	Being perceived as a threat or becoming involved in the space arms race due to alliances with major powers. Vulnerability of assets to anti-satellite (ASAT) weapons.	Critical / Medium	Adopt a foreign policy for the exclusively peaceful use of space. Actively promote transparency and confidence-building measures (TCBMs) in multilateral forums (COPUOS). Avoid alignment with powers that maintain aggressive military stances in space.
Space Debris (Kessler Syndrome)	Risk of collision of Ecuadorian satellites (as occurred with PEGASO) with the growing population of space debris, making low orbits unusable.	High / Increasing	Adhere to and promote international debris mitigation guidelines (IADC, COPUOS). Include end-of-life deorbiting requirements in all national licenses.

Note: Author's own elaboration.

Connection between Risks and Diplomatic Scenarios

There is a direct correlation between the diplomatic scenarios analyzed in section 6.1 and the exposure to identified risks. A scenario of Strategic Alignment with a major power, while offering rapid access to technology, exponentially increases the risks of technological dependency and being drawn into conflicts. By joining a bloc, Ecuador could import the rivalries of its primary partner, transforming its space assets into potential targets in a conflict. In contrast, the proposed hybrid strategy, which combines a South-South Doctrine with Active Non-Alignment, serves as the primary mitigation measure against these geopolitical risks. The diversification of partners and the

prioritization of regional alliances reduce dependency on a single actor, while a stance of active neutrality and the promotion of peaceful use minimize the perception of the country as a threat and bolster its sovereignty.

Conscious and proactive management of these risks is not a mere secondary addition to space policy, but rather the final pillar that ensures its coherence, viability, and long-term sustainability.

This chapter has articulated a comprehensive strategic course for Ecuador to navigate the complex space domain in a sovereign and sustainable manner. The proposals presented within each section are intertwined to form a coherent roadmap, addressing everything from the country's international posture to the management of its intrinsic vulnerabilities.

- **Diplomatic Recommendation:** It has been argued that the most prudent and beneficial diplomatic strategy for Ecuador is a hybrid model. This model must center on South-South cooperation, channeled through ALCE, to build technological capabilities and collectively address common challenges. This core must be complemented by a policy of Active Non-Alignment in the global arena, allowing the country to maintain its autonomy, cooperate flexibly with multiple actors, and actively promote norms of peace, transparency, and sustainability within fora such as COPUOS.
- **Synthesis of the Roadmap:** The reconstruction of the institutional and regulatory framework is the inescapable step toward overcoming the precariousness and discontinuity of the past. The proposed roadmap, which commences with an intersectoral commission and evolves into a space agency established by law and endowed with a stable budget, is fundamental to transforming aspirations into executable and enduring state policies.
- **Integration of Soft Power:** It has been emphasized that the instrumentalization of soft power and normative entrepreneurship is the most efficient pathway for a country such as Ecuador to gain influence and defend its interests within the space arena. Through scientific diplomacy, leadership in specific thematic niches, and the promotion of a discourse centered on peace and cooperation, the nation can cultivate significant diplomatic capital.
- **Risk Management as a Viability Condition:** Finally, it is concluded that the proactive mitigation of risks—ranging from technological dependency to the threat of militarization and space debris—is not a secondary component, but rather a core

condition for the long-term sustainability and success of Ecuadorian space policy. A strategy that ignores these threats would, ultimately, be unfeasible.

In conclusion, this comprehensive proposal offers a realistic path for Ecuador to transform its undeniable geographical and diplomatic potential into a strategic reality within the space domain, ensuring that its venture into this final frontier effectively contributes to its national development and global security.

7. FINAL CONSIDERATIONS AND POLICY RECOMMENDATIONS

This final chapter represents the argumentative culmination of this thesis, transitioning from the diagnostic phase—*the pars destruens* that has deconstructed Ecuador's strategic vulnerabilities and opportunities in the space domain—toward a proactive and constructive phase: *the pars construens*. Its function is threefold and synergistic. First, it will focus on an epistemic synthesis of the core findings, integrating scattered evidence into a coherent contribution to the fields of astropolitics and strategic studies. Second, it will translate said knowledge into a body of public policy recommendations, conceived not as a wish list, but as the interconnected components of a grand strategy for the Ecuadorian State. Finally, it will outline a post-doctoral research agenda, opening new avenues of inquiry emerging from this study. Here, the accumulated evidence is transmuted into actionable knowledge, reaffirming the thesis that a proactive space policy is not a niche interest, but a fundamental requirement for Ecuador's functional sovereignty, economic development, and national security in the 21st century.

7.1 Epistemic Synthesis of Core Findings

The purpose of this section is not to offer a mere summary of the preceding chapters, but rather to construct an epistemic synthesis. This exercise consists of the coherent integration of the arguments and evidence presented throughout the research to validate the central hypothesis: that Ecuador’s historically claimed geostrategic advantage has been systematically underutilized due to a paralyzing combination of internal institutional fragmentation and extra-regional technological dependence. This synthesis articulates the original contribution of the study, demonstrating how Ecuador stands at a crossroads that demands decisive state action to transform its geographic potential into tangible astropolitical power. List 7.1 condenses the fundamental findings that underpin this conclusion.

Table 18. Map of Core Findings, Evidence, and Strategic Implications

Central Finding	Key Evidence (Sources)	Strategic Implication for Ecuador
Internal space governance fragmentation nullifies geostrategic advantage. The absence of a unified governing entity, following the abolition of the Ecuadorian Space Institute (IEE), has dispersed	Abolition of the IEE and division of competencies between the Military Geographic Institute (IGM) and the Ecuadorian Air Force (FAE), preventing a long-term State vision	Without a national champion to centralize policy and budget, Ecuador cannot formulate a coherent strategy, capitalize on its orbital position, nor negotiate effectively in

competencies and generated strategic paralysis.	(Ortiz Guerra, 2021; Conde et al., 2022).	international forums or with potential partners.
Data and technology dependence on extra-regional powers creates critical vulnerabilities for functional sovereignty. The country operates as a passive recipient of strategic information, limiting its decisional autonomy in key areas for security and development.	Dependency of the National Institute of Meteorology and Hydrology (INAMHI) on non-optimal quality data from the U.S. satellite GOES-16 for critical functions. (Ortiz Guerra, 2021).	The lack of control over the complete data cycle (reception, processing, analysis) exposes the State to political conditioning, cybersecurity risks, and decision-making based on second-hand intelligence.
The *Corpus Iuris Spatialis* is an insufficient framework that favors established powers. Designed during the Cold War, international space law lacks mechanisms to regulate new dynamics (NewSpace, militarization, space debris) and protect the interests of developing countries.	The 1967 Outer Space Treaty presents normative gaps in the delimitation of space and the management of private activity, allowing unilateral interpretations by major powers (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021).	Ecuador cannot depend solely on international law to protect its access to orbital resources. It must exercise proactive diplomacy and normative entrepreneurship to build coalitions that defend its interests.
Regional multilateralism is the most viable platform for building collective autonomy. The Latin American and Caribbean Space Agency (ALCE) emerges as a force multiplier to overcome individual budgetary and technological limitations.	Creation of ALCE as a mechanism to share costs and develop infrastructure projects that would be unfeasible unilaterally, emulating the cooperative success of the European Space Agency (Conde et al., 2022; González Ferreiro, La regulación de las actividades espaciales como estrategia estrategia de seguridad y crecimiento nacional, 2021).	Active participation and leadership in ALCE allow Ecuador to access shared capabilities, increase its global bargaining power, and promote a governance model aligned with the interests of the Global South.

Note: Author's own elaboration.

This synthesis of the structural problems and global dynamics facing Ecuador demonstrates the urgency of coordinated state action. The clear identification of these gaps and opportunities constitutes the logical foundation for formulating concrete solutions, which are presented in the following section.

7.2 Strategic and Public Policy Recommendations

The value of research in strategic studies does not reside solely in the precision of its diagnosis, but in its capacity to inform decision-making and guide state action. The

following recommendations, therefore, do not constitute a menu of isolated options, but rather an integrated and prioritized roadmap. They are articulated across three interconnected spheres—legal, diplomatic, and infrastructural—which, together, seek to provide the Ecuadorian State with a coherent grand strategy to navigate the complex astropolitical crossroads of the 21st century and transform its potential into a sovereign reality.

7.2.1 Legal Sphere: Sovereign Claims and Teleological Interpretation of Treaties

The principal barrier to Ecuadorian space sovereignty on the legal plane is the fundamental asymmetry between its historical claims, anchored in the 1976 Bogota Declaration, and a Corpus Iuris Spatialis designed during the Cold War that privileges established powers (Aznar Fernández-Montesinos y Sánchez Mayorga, 2021). This normative weakness must not be a cause of paralysis, but rather a catalyst for the development of a proactive national legal framework and a sovereign legal interpretation that protects the interests of the country.

It is recommended to adopt the following measures:

- **Design a General Law on Space Activities:** It is imperative to create a framework law that overcomes the current institutional fragmentation. This law must establish an Ecuadorian Space Agency as the unified governing body and national champion of space policy. Furthermore, it should create a national registry of space objects—following the models of Argentina and Brazil (Conde et al., 2022)— and develop a clear regime of licenses and authorizations to regulate the activities of private actors, such as the Ecuadorian Civil Space Agency (EXA), thereby filling the gaps that currently generate legal uncertainty and limit investment.
- **Adopt a Functional Data Sovereignty Policy:** A national policy must be formulated that defines space data infrastructure and flows as a critical asset for national security. This policy should directly address vulnerabilities such as INAMHI's dependence on data from the GOES-16 satellite (Ortiz Guerra, 2021), establishing protocols for the collection, storage, processing, and dissemination of strategic information, with the objective of reducing dependence on intelligence controlled by external actors.
- **Formulate a National Interpretation of Space Treaties:** It is recommended that the Ministry of Foreign Affairs draft and disseminate an official position paper that interprets the space treaties ratified by Ecuador in a teleological manner. This

entails reading the norms in light of their object and ultimate purpose—the benefit of all mankind—to counter unilateral interpretations by other powers seeking to legitimize the appropriation of orbital resources, and to legally strengthen the claim for equitable access to such resources.

7.2.2 Diplomatic Sphere: Articulation of Coalitions and Promotion of Multilateral Dialogue

Ecuador's diplomatic crossroads is complex: it must balance the necessity of cooperating with major powers to access technology and knowledge with the imperative of maintaining its strategic autonomy and avoiding subordination (Ortiz Guerra, 2021). A passive or unidimensional diplomacy is unsustainable. The only way to navigate this complexity is through a multidimensional, pragmatic, and proactive strategy. The following diplomatic roadmap is proposed:

- **Consolidate Leadership in ALCE:** Ecuador must position itself as a central and proactive actor within the Latin American and Caribbean Space Agency (ALCE). This involves leading proposals for joint regional infrastructure projects, such as a shared Earth observation system that emulates the successful shared infrastructure model of the ESA (Conde et al., 2022). Furthermore, it must promote a unified position for the bloc in global forums such as UNCOPUOS to amplify the region's bargaining power.
- **Implement a Selective Cooperation Strategy:** It is fundamental to formalize the pragmatic "a la carte alliances" approach (Ortiz Guerra, 2021). This strategy responds directly to the need to mitigate the risks inherent to each model of influence: it allows for access to high-quality data from the **European shared infrastructure model** (Copernicus) without incurring the technological dependence that could derive from an exclusive association with the **Chinese technological partnership model**, while leveraging security cooperation from the **United States model** without subordinating national foreign policy. Thus, specific and delimited agreements are established: with Europe for observation data (Ventura-Traveset, 2021), with China for low-cost launches, and with the USA in areas of security and space traffic management.
- **Exercise Norm Entrepreneurship:** Instead of being a passive recipient of norms, Ecuador, alongside its regional partners, must assume the role of a "norm entrepreneur." It must utilize multilateral forums such as UNCOPUOS and the International Telecommunication Union (ITU) to actively propose new rules

regarding the long-term sustainability of space activities, the governance of mega-constellations, and a clear definition of the boundary of outer space, building coalitions with Global South countries with similar interests.

7.2.3 Infrastructural Sphere: Ground Stations, Payload Hosting, and Data Centers

The infrastructural deficit in Ecuador is one of the most critical strategic vulnerabilities, as it directly feeds technological and data dependence (Ortiz Guerra, 2021). While the development of autonomous launch capabilities is a very long-term goal, the sovereign and gradual construction of infrastructure in other segments is a fundamental and unavoidable pillar to guarantee data sovereignty, operational autonomy, and value generation in the new **NewSpace** economy (Potti, 2021).

A gradual and prioritized infrastructural development package is proposed:

- **Phase 1 (Short Term) -** Strengthening the Ground Segment: The immediate priority must be the modernization and expansion of the national capacity for ground stations for satellite tracking, telemetry, and control (TT&C) and direct data reception. This reduces reliance on third-party stations for receiving information and constitutes a tangible first step toward data sovereignty, positioning the country as a potential provider of ground segment services for international operators.
- **Phase 2 (Medium Term) -** Payload Hosting and Nanosatellite Development: Ecuador must capitalize on the valuable experience of the civil agency EXA and academic projects to create a national nanosatellite development program. This program should focus on high-impact niches tailored to the country's needs (environmental monitoring, precision agriculture, border security, disaster management). Additionally, payload hosting services can be offered on these platforms to other countries or companies, generating revenue and fostering collaboration.
- **Phase 3 (Long Term) -** Analytical Sovereignty: The final step to close the cycle of data sovereignty is the creation of a National Center for Space Data Processing and Analytics. This infrastructure, equipped with supercomputing capabilities and linked to a robust cybersecurity strategy, will allow for the transformation of raw data (received by national ground stations) into actionable intelligence and sovereign information products. This directly resolves the key vulnerability identified in the diagnosis, such as the dependence on non-optimal data from the

GOES-16 satellite, ensuring that the State controls the process from data reception to final intelligence.

Table 19. Matrix of Prioritized Strategic Recommendations

Strategic Action	Time Horizon	Suggested Responsible Actors	Principal Risk	Success Metric	Link to Findings
Legal: Enact a General Law on Space Activities to establish the Ecuadorian Space Agency as the governing body.	Short Term (1-2 years)	Presidency of the Republic, National Assembly, Ministry of Defense, Ministry of Foreign Affairs.	Bureaucratic resistance and jurisdictional disputes between the IGM and the FAE.	Law approved and published; Agency established and operational with an assigned budget.	Finding 1: Governance fragmentation.
Diplomatic: Formalize the "a la carte alliances" strategy, establishing at least one key agreement with Europe (data), China (launch), and the USA (security).	Medium Term (2-4 years)	Ministry of Foreign Affairs, Ecuadorian Space Agency (proposed), Ministry of Defense.	Political or technological conditioning by major powers; lack of negotiating capacity.	Specific cooperation agreements signed and in execution, diversifying technology and data sources.	Finding 2 and 4: Technological dependency and the potential of multilateralism
Infrastructural: Modernize and expand the network of ground stations for direct data reception, reducing dependence on external providers.	Short Term (2-3 years)	Ecuadorian Space Agency (proposed), IGM, Universities, Private Sector.	High initial costs and dependency on equipment procurement; lack of trained personnel.	Reduction of at least 50% in dependence on raw data processed abroad for a critical sector (e.g., meteorology).	Finding 2: Data dependency.

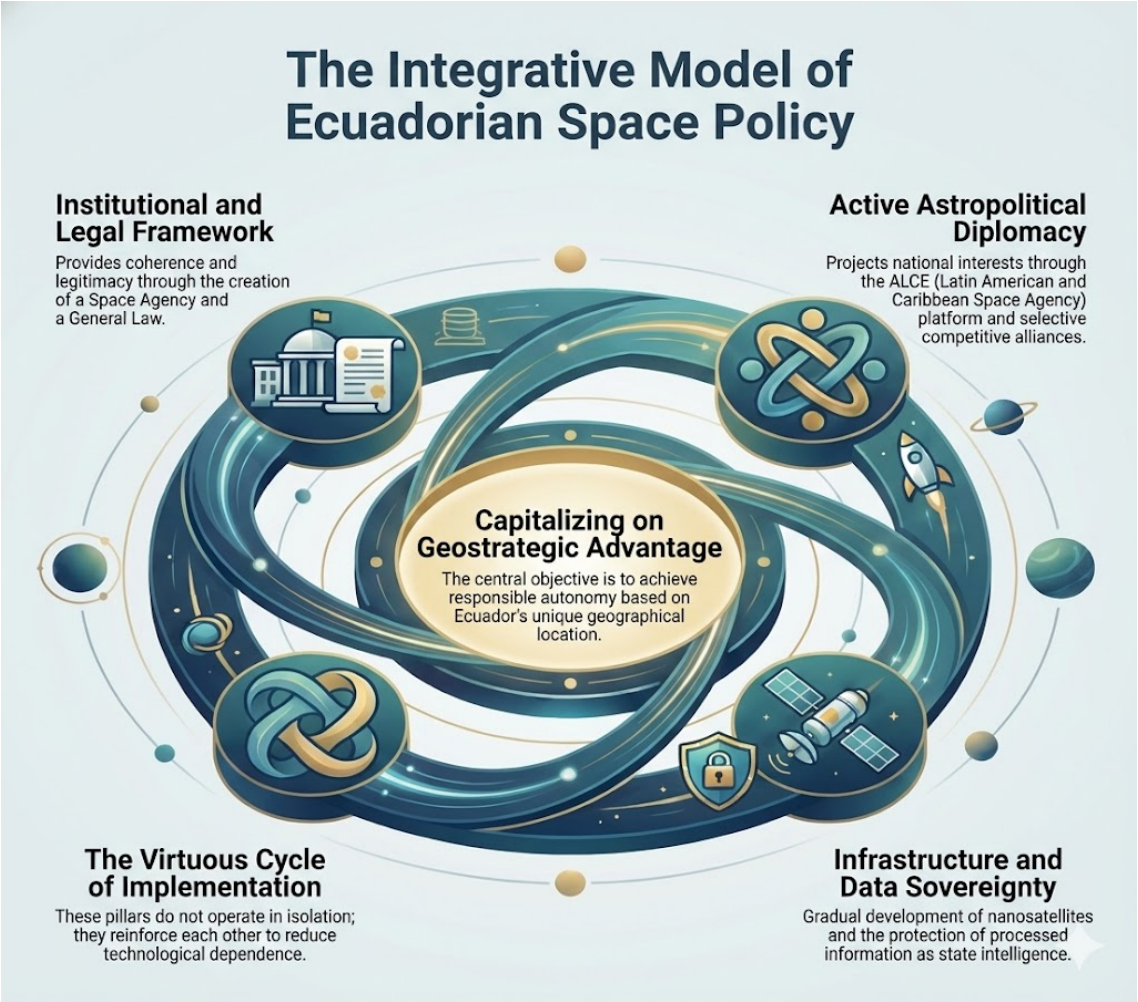
Note: Author's own elaboration.

Table 20. Inter-institutional Synergy Matrix (Legal-Diplomatic-Infrastructural)

Strategic Objective	Legal/Policy Instrument	Diplomatic/Technical Actor	Expected Outcome
Overcoming Institutional Fragmentation and Creating a National Champion	General Law on Space Activities, establishing and granting competencies to the Ecuadorian Space Agency.	Ecuadorian Space Agency, acting as the technical and political focal point for all interactions.	A unified State policy with a long-term vision and the capacity to execute complex projects that transcend government cycles.
Reducing Technological Dependency through Intelligent Cooperation	"A la Carte Alliances" strategy, formalized as foreign policy within the space domain.	Diplomatic missions in Europe, China, the USA, and to ALCE, coordinated by the Ministry of Foreign Affairs and the Space Agency.	Strategic partner diversification, minimizing risks of dependency on a single power while maximizing technology and knowledge transfer.
Materializing Data Sovereignty	Functional Data Sovereignty Policy (part of the General Law) and Gradual Infrastructural Development Plan.	Space Agency (management), National Data Analytics Center (operations), Ministry of Foreign Affairs (defense in international forums).	National control over the complete strategic geoinformation cycle (reception, processing, analysis, and dissemination), reducing critical vulnerabilities.

Note: Author's own elaboration.

Figure 7. Integrative Model of Ecuadorian Space Policy



Note: Image generated from the author's instructions using "notebook.lm".

To visualize the interconnection of these recommendations, a conceptual model is proposed that articulates Ecuadorian space policy as an integrated and dynamic system. This model is sustained by four interdependent pillars that reinforce one another. The first, the **Institutional and Legal Framework**, constitutes the fundamental base, providing coherence, direction, and legitimacy through the new Space Agency and a robust General Law. The second, **Active Astropolitical Diplomacy**, projects national interests abroad, utilizing ALCE as a platform for regional power and selective alliances to maximize influence and cooperation in a competitive environment. The third, **Gradual Sovereign Infrastructure**, builds technical capabilities—starting with the ground segment and advancing toward nanosatellite development—that materialize operational autonomy and reduce dependency. Finally, the fourth pillar, **Data Sovereignty and Cybersecurity**, ensures that the most valuable asset generated—information—is

protected, processed sovereignly, and transformed into intelligence for the State. These four pillars do not operate in isolation but rather in a virtuous cycle, with the central objective of achieving the **Capitalization of Geostrategic Advantage with Responsible Autonomy**.

The implementation of this roadmap not only addresses the questions raised in this research but also opens new and important avenues of academic inquiry that deserve to be explored.

7.3 Future research directions: The Latin American Orbital Commons and the Construction of an Equatorial Identity

Every master's research, upon closing a line of argument, inevitably opens new frontiers of knowledge. The findings and recommendations presented here are not an end point, but rather a starting point for a deeper and more specialized post-doctoral research agenda. This section outlines the strategic questions and problems emerging from the present thesis, with the aim of guiding future academic efforts that contribute to the consolidation of a Latin American school of astropolitical thought.

The following future research lines are proposed:

- Line 1: The "Latin American Orbital Commons" as a Strategic Doctrine**.**
    - **Research Question:** Under what legal, economic, and political principles could ALCE develop and manage access to orbits and frequencies as a "regional common good," avoiding models of national appropriation or privatization?
    - **Relevance:** It offers a theoretical and practical Global South alternative to hegemonic models of space governance.
    - **Suggested Method:** Comparative analysis of common-pool resource regimes (e.g., Antarctica, seabed) and critical international relations theory.
- Line 2: Norm Entrepreneurship from the South: Space Diplomacy of Middle Powers.
    - **Research Question:** How can States like Ecuador and other ALCE members effectively use norm entrepreneurship in forums such as UNCOPUOS to influence the creation of new international rules on space sustainability and arms control?
    - **Relevance:** It explores the sources of soft power and the agency of non-hegemonic States in the construction of the international order.

    - **Suggested Method:** Multiple case study (Brazil, Argentina, Ecuador) utilizing the "norm entrepreneurship" framework."
- Line 3: Political Economy of the Equatorial Space Industry.
    - **Research Question:** What public-private partnership model is most suitable for fostering a national space industry in Ecuador, capitalizing on private sector capabilities (e.g., EXA) without compromising State security and sovereignty objectives?
    - **Relevance:** It addresses the central challenge of financial sustainability and innovation in the space programs of developing countries.
    - **Suggested Method:** Analysis of public policies and business models within the NewSpace sector of emerging powers.
- Line 4: Data Sovereignty and Cloud Geopolitics in South America.
    - **Research Question:** How can the construction of regional data centers for satellite information processing reduce dependence on cloud infrastructures controlled by extra-regional actors and strengthen collective security?
    - **Relevance:** It connects astropolitics with digital geopolitics, a nexus that is becoming increasingly critical.
    - **Suggested Method:** Analysis of critical infrastructure networks and study of regional internet architecture.
- Line 5: National Identity and Astropolitical Narrative.
    - **Research Question:** How can the Ecuadorian State build a national narrative that links the country's identity ("center of the world") with a vision of the future in space, generating public support and political cohesion for a long-term space policy?
    - **Relevance:** It investigates the role of symbolic power and strategic culture in the viability of State policies.
    - **Suggested Method:** Political discourse analysis and cultural studies
- Line 6: Regional Security Dilemmas in the Space Domain.
    - **Research Question:** What Trust-Building Measures (CBMs) mechanisms can be implemented in South America to prevent a regional space arms race and manage the dual use of space technologies?
    - **Relevance:** It anticipates and proposes solutions to potential future conflict scenarios in the region.

- **Suggested Method:** Security regime theory and strategic scenario analysis.

This research has demonstrated that Ecuador finds itself at a historical crossroads. The geostrategic advantage conferred by its equatorial position—a potentially transformative asset—remains largely latent, constrained by persistent institutional fragmentation and a deep technological dependence that limit its autonomy and capacity for action. The global astropolitical scenario, characterized by hegemonic rivalry, the disruptive emergence of **NewSpace**, and an obsolete international legal framework, only heightens the urgency for a strategic, coherent, and sovereign response.

The central argument of this thesis is that overcoming this strategic paralysis is both possible and imperative. It requires, first, the political will to unify the sector's governance under a governing body with a long-term State vision. Second, it demands the adoption of a proactive and multidimensional diplomacy that leverages regional multilateralism through ALCE and selective alliances to diversify dependencies and maximize benefits. Finally, it requires a gradual but sustained investment in indigenous infrastructure—beginning with the ground segment—as an indispensable pillar of data sovereignty and operational autonomy.

The choice for Ecuador is not between autarky and subordination, but between strategic passivity and the construction of responsible autonomy. The formulation and implementation of the grand strategy outlined here must not be seen as a luxury or a distant aspiration, but as a categorical imperative for the State. In the 21st century, space has ceased to be the final frontier, establishing itself instead as the *ultimum refugium* of state power—an inescapable dimension where sovereignty, security, and development on Earth are decided.

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