High in the Sky: Turkish-Argentine South-South Space Cooperation

Ariel González Levaggi
agonzalez@uca.edu.ar
Associate Professor, Department of Political Science and International Relations
Faculty of Social Sciences
Pontifical Catholic University of Argentina
https://orcid.org/0000-0002-7326-3659

Associate Professor at the Political Science and International Relations Department at the Pontifical Catholic University of Argentina (UCA) and a Consulting Member at the Argentine Council for International Relations (CARI). His academic research focuses on regional security orders and the role of extra-regional actors—particularly Turkey and Russia—in the international politics of Latin America. Among his latest works are: Confrontational and Cooperative regional orders: managing regional security in world politics (2020), 'Crossing roads: Middle East's security engagement in the Horn of Africa' (Global Change, Peace and Security Journal, vol. 33, 2021) and 'Turkey's changing engagement with the global South' (International Affairs, Vol. 97, Vol. 3, 2021).

Daniel Blinder
dblinder@unpaz.edu.ar
Researcher, National Scientific and Technical Research Council (CONICET)
https://orcid.org/0000-0002-9318-7040

Researcher at the National Scientific and Technical Research Council (CONICET), and professor at the National University of José Clemente Paz, Argentina, specializing in International Relations and Geopolitics of technology, Space Policy, and National Defense. Among his latest works are: *Falklands/Malvinas' Air Warfare and Its Consequences: A Critical Geopolitical Approach (The Falklands/Malvinas War in the South Atlantic, Palgrave);* Covid-19 and Semi-Periphery: Argentina and the Global Vaccines Research and Development (*Journal of World-Systems Research*, Vol. *27 Nº*2); and (in Spanish) Foreign space bases: the construction of an imaginary about China and Europe in the Argentine press and politics (Revista Iberoamericana de Ciencia, Tecnología y Sociedad, Vol. 12 Nº36); Geopolitics of strategic and non-strategic technologies (Revista Estudos Internacionais, Vol. 7 Nº2); and World Order and technology. Institutional analysis from the geopolitical perspective in the semi-periphery: space and missile technology in Argentina and Brazil (Revista Geopolíticas(s), Vol. 8 Nº2).

Abstract

In September 2019, the partly state-owned Turkish Aerospace Industries (TAI) and Argentine provincial state-owned INVAP officially agreed to co-develop a geostationary satellite. Despite both being developing countries, they have extensive satellite space programs with different stimuli. In the last two decades, Ankara has pushed for the development of a strategic industry in line with its military needs, while Argentina developed the satellite sector as part of broader initiatives to boost innovation and profits. This article examines the intersection of Argentina and Turkey's space programs by focusing on the goals, scope and dimensions of the geostationary joint project. The central argument is that despite their dissimilar motivations and policy paradigms, bilateral space cooperation in the Global South could be an alternative route to technological growth bypassing the dependence on traditional geopolitical partners and technological providers.

Keywords: Argentina, Turkey, space cooperation, South-South cooperation, geopolitics, technological autonomy

Introduction

During the Cold War, space technology was very much a great-power asset, the realm of high-tech nations with strong military industrial complexes. In recent years, a wider range of nations has joined in the technologic ladder of this industry. There are rapid changes in space technology that expand its applications, from imaging to telecommunications. Likewise, many more public and private users are joining the space market by purchasing services or acquiring technologies. This expanding space market becomes an incentive for new and non-traditional space-tech providers. According to the Space Participation Metric (SPM), more than twenty countries evidence some level of space hardware or launch facilities capabilities, which can be catalogued as emerging space powers as middle power states (Harvey, Henk and Pirard 2010; Jordaan 2003). Among them: Argentina and Turkey (Wood and Weigel 2012a). Both nations have developed strong space projects since 1990s, while their backgrounds and ulterior aims differ. Argentina developed a military-based project during the Cold War and later on moved towards a civilian, economic-oriented program, while autonomous development and pursuit of profit became central to space planning. On Turkey's side, even if initially the project had civilian motivations, lately it has been profit and national security oriented. As an unexpected partnership, Buenos Aires and Ankara decided to develop space cooperation by supporting the signature of an agreement between the partly state-owned Turkish Aerospace Industries (TAI) and Argentine provincial state-owned INVAP to develop together a geostationary satellite in late 2019.

Despite being space middle powers and pursuing different motivations, cooperation between Turkish and Argentinian space programs has a common ground: which is to create autonomous and indigenous capabilities to solve national problems and avoiding reliance on foreign providers. For a long time, both countries have developed special programs focusing on low earth orbit (LEO) and geostationary (GEO) satellites development. The need to reach new technological frontiers and foster marketable space products in a niche market however, has led to a strategic crossroads. This article aims to introduce Argentina and Turkey's space developments and analyze the reasons it triggered cooperation between them in order to

reach their diverse goals. This work assumes that both have an emerging scientific-technological and industrial base that allows them to scale up the development of space launchers and satellites.

The literature on the space dimension of the Global South cooperation is still very limited to a few descriptive pieces, extremely focused on the role of China (Klinger 2018; Klinger 2020; Frenkel and Blinder 2020). The study seeks to provide a set of theoretical insights to approach space cooperation, while broadening their scope taking as case study the cooperation between two emerging space powers with similar degrees of technological development. Framed within the South-South cooperation literature, the Wood and Weigel's (2012b) Space Technology Ladder and Latin America's approaches based on the evolutionary neo-Schumpeterian theory (Suarez and Yoguel 2020), examine the space technology development policy of each country, its motivations, limitations and the reasons that have promoted cooperation, while the case study shows evidence of a complex interplay among geopolitical, technological autonomy and innovation elements during the space policy development.

By analyzing the link between Argentina's and Turkey's space programs, this article investigates how dissimilar motivations and different policy paradigms can trigger space cooperation in the Global South and provide an alternative route to technological growth, bypassing the dependence on traditional providers. The article takes a qualitative empirical-analytical approach by reviewing relevant literature, using public documents and information in the public domain, in addition to two interviews with Argentinean officials within the venture project. The interviews were conducted by email and assessed with qualitative data analysis. The interviewees were interviewed per email instead of in person because the interviewees were active officials and had limited time at their disposal. The authors approached Turkish counterparts for interviews, but they declined without offering an explanation. Therefore, although documents and public information from both sides have been analysed as part of this research, the authors acknowledge that the Argentine dimension of the project is more developed due to the lack of testimonies from Turkish officials. Given that the focus is a strategic cutting-edge technology project, and that much information is protected by laws and commercial arrangements between companies, it is difficult to access open sources providing information for academic research. Most information and details remain confidential, and those who have not responded may have done so for business reasons or strategic state secrets. In any case, our methodological selection allows us to analyze the data provided by primary and secondary sources, tracing and reconstructing the trajectory of the joint venture between Turkey and Argentina.

In the first section, we introduce some conceptual ideas to frame the bilateral cooperation within the South-South cooperation agenda. In space technology terms, beyond both countries' alternative motivations, climbing the space technology ladder seems to be a common goal. The second and third sections introduce the Argentine and Turkish space programs respectively. A fourth section explores the main elements of the joint project by focusing on its goals, scope and dimensions and, finally, we present some concluding remarks and lessons learnt from the joint space project.

South-South Cooperation in the Space: Developing joint GEO satellites

Access to space is highly contested because of its geopolitical nature. The military and diplomats clash over strategic needs and opportunities for economic and technological development (Doboš 2019). A key indicator of space's access competition is the satellite technological development. The cause for conflict is satellites' dual use for military or civilian purposes. On the one hand, satellites and other telecommunications networks have redefined the world, altering patterns and even many of modern society's goals. Satellites globalized and interconnected our world, closing distance among nations with worldwide access to rapid telecommunications networks (Pelton 2004). On the other hand, states – especially developed ones – implement strict export controls over space-systems through licensing authorizations.

Licenses are granted depending on the nature of the space item and according to the technical sensitivity, international oversight, the end-user and the technological end-use. Nowadays, the paradigm of space technology control is nation-centric since the "states seek to maximize their legal discretion in exercising space technology trade and proliferation controls in the interests of 'national security'" (Mineiro 2012, p. xiv-xv). Despite their state-centric nature, there is room for bilateral and multilateral cooperation on projects such as the International Space Station; committees such as the United Nations Committee on the Peaceful Uses of Outer Space (Froehlich, Seffinga and Qiu 2020); treaties such as the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (1967), the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (1979); or United Nations Resolutions such as Preventing Arms Race in Outer Space (Moltz 2014). Due to the high-tech nature of space activity, the principal players are great powers, while the technology transfer cooperation hardly ever goes into the North-South direction for developing countries (Harding 2013; Serna 2018).

There are different approaches to Space Policy in developing countries. While the developed nations' space programs are focused on their military or economic clout in which players have larger degrees of agency, the approaches of middle powers are generally cooperation and technological development centered, being largely constrained both by technology capabilities and scarce human and economic resources. When the developer is perceived defiant of the international technological order, the country is considered a challenger or even a security threat (Sheldon 2006; Hertzfeld and Li 2013).

The literature on space programs portrays how a state develops capabilities in order to accomplish goals of power and technological improvement. Dolman centers his analysis on the *astropolitik* (2018), a realist formulation for space-based geopolitics in which great powers can achieve the domain of the final frontier, and it is likely to have the United States as the most important player. The United States space policy is generally portrayed as the result of the Space Race against the Soviet Union (Bulkeley 1991; Mowthorpe 2002; Chertok 2009), while the literature focuses on foreign partnership (Newton and Griffin 2011), or policymaking about technical decisions (Sadeh 2009; Logsdon 1986; Logsdon 2015). Literature on Russia, a major space player, usually deals with current space projects, industry, and the interplay of space and national identity (Makarov and Payson 2009; Eriksson and Privalov 2021). On the EU, the literature deals with technological autonomy for civilian and military purposes, industrial and institutional framework on space, the EU foreign policy with third parties, or the provision of public goods such as environmental or

human security (Al-Ekabi and Mastorakis 2015; Hörber and Stephenson 2016). Finally, the arrival of China – a recent full-fledged space player – has been perceived as new route to achieve their national goals ambitions (Aliberti 2015), or as a threat to international security (Johnson-Freese and Erickson 2006; Wu 2015; Zhang 2011).

Finally, neo-schumpeterian analysis focuses on climbing the technology ladder trough innovation, catching-up with industrialized States (Lee and Lim 2001; Mu and Lee 2005; López, Pascuini and Ramos 2018). Barriers are not just of economic nature (Lee 2005), they are of political nature too. Such analysis disregards geopolitical variables such as the involvement of the state in the development of strategic industries and global competition of market niches for economic advantages, and the search for autonomy of developing countries (Almeida 2019; Blinder 2017a; Blinder 2017b). Recent literature suggests that the systemic constraints over some emerging space powers are pushing the need to develop autonomous programs. These new space players find economic limitations and international pressures from developed nations and private companies (Blinder, 2015a, 2015b). However, as Wood and Weigel point out, governments take decisions subject to "many non-technical factors when they consider space policy decisions, including factors such as geopolitical relationships, regional status, military postures and national pride" (Wood and Weigel 2011).

Technological development also matters. Developing space players are rule takers, rather than rule makers, while they are often compelled to adapt their technology policies to the international norms and rules, in line with major powers' normative such as the International Traffic in Arms Regulations (ITAR) US-led regulatory regime. In this case, the treaty aims to restrict and control the export of defense and military related technologies to safeguard national security. However, developing nations can opt to circumvent global and national obstacles by developing bilateral and multilateral cooperation to achieve their space policy goals. International cooperation could be an alternative route to reach technological development bypassing the dependence on traditional providers.

In the last two decades, a resurgence of South–South cooperation[1] has moved once more to the center stage of global affairs (Gosovic 2016; Gray and Gills 2016). Increasing international space cooperation among Global South countries is a critical indicator of the new wave of cooperation among non-western, developing nations. Developing nations have been building asymmetric associations with rising space powers. Africa's space policy highlights cooperation, technology transfer, and the need of aid to face unsolved social and environmental problems (Froehlich and Siebrits 2019). Latin American space programs are diverse, involving asymmetrical cooperative interaction to develop domestic capabilities (Froehlich, Alonso, and Soria 2020). In December 2019, Beijing launched the joint China–Brazil CBERS-4A observation satellite, the fourth achievement of a long-term partnership project between the National Space Research Institute (INPE) and the Chinese Academy of Space Technology. Years early (2014), Indian Prime Minister Narendra Modi brought up the idea of launching a geostationary communications and meteorology satellite for the South Asian Association for Regional Cooperation (SAARC), which would

1 Despite different conceptualization and approaches, the article understands the South–South cooperation as the processes, institutions and arrangements designed to promote political, economic and technical cooperation within the Global South (Can Gürcan 2019:4).

be launched successfully in May 2017. These cases present live examples of space cooperation within the Global South.

Space cooperation among Global South nations has grown in light of the rise of the post-Western world. It started in the middle of the Cold War but reached its peak in its last years. Space cooperation can be framed within the broader South–South cooperation in science, technology and innovation involving both bilateral and multilateral cooperation targeted at increasing capacity-building for development, transferring technology for mutual benefit and overcoming dependence from developed powers. The access to space has been widened for new developing actors, according to their growing needs. The developing countries' limited resources and technological development required new forms of international cooperation beyond the traditional partners, thus avoiding any patronization over space improvements. At the same time, the South–South cooperation approach emphasizes the respect to sovereignty and to the principle of "noninterference" in domestic affairs while avoiding economic and institutional conditionalities (Bergamaschi and Tickner 2017).

Satellite cooperation in the Global South is not only a way to diversify access to space and reach technological crossover, but an alternative route to overcoming economic and technical structural limitations. An interesting approach involves assessing the situation, needs and potential strategies of developing countries by locating their position in the space technology ladder (Wood and Weigel 2014). The ladder offers two main features: it tracks the evolution of satellite programs and identifies the next rungs of the satellite plans. The higher position in the ladder, the higher technological and economic needs. The space technology ladder has four steps from the bottom up: the creation of a National Space Agency, location of satellites in Low Earth Orbit (LEO) and Geostationary Orbit (GEO) and launch capability. Regarding the GEO satellite development, the authors introduce four GEO satellite sub-categories: locally built, built through Mutual International Collaboration, and built locally with outside assistance and Procurement (Wood and Weigel 2012b).

There is no straightforward explanation why space powers climb the ladder, but there are common elements, which can be drawn from the cited literature. On the one hand, there is a clear influence of regional and global geopolitical dynamics that can push for a military or civilian-oriented program or provide incentives to look for new international partners. At the same time, economic development requires higher levels of innovation, which can be instrumented through national capabilities development or international cooperation, while the search for technological autonomy strengthens the political instruments *vis-à-vis* peer countries, in addition to providing potential economic gains.

In September 2019, the partially state owned companies from Argentina and Turkey announced an deal to develop a joint project: a communication GEO satellite. Argentina and Turkey are examples of emerging space powers, which are partially dependent on global value chains from developed nations both in terms of materials and technology. In that sense, space policies in developing nations should adapt to global players' technology designs and to their regulations.

Argentina's Space Project: a route to economic development

Argentina has deep-rooted civil space policy despite the recurrent financial crisis that paved the way to de-industrialization and the erosion of productive capabilities. The country ranked high in research and development for decades, which helped develop civilian technological projects based on previous military space activities. Moreover, Argentina has advanced nuclear and space technological institutions. The fundamentals of space-based technology in Argentina are centered in INVAP, a regional state-owned company, an acronym for *Investigaciones Aplicadas Sociedad del Estado* (Applied Research State Company). INVAP designs and builds complex technological systems both for domestic market and export, developing state-of-the-art technology in different industrial, scientific and applied research fields such as nuclear and space. It is a provincial state-owned company established in 1976, in the Province of Rio Negro, the company is a byproduct of the national nuclear agency, the National Commission of Nuclear Energy (CNEA) (Thomas, Versino and Lalouf 2008).

INVAP is the centerpiece of Argentina's technological ecosystem. Its main client is the government, which requires nuclear reactors for power generation and for research purposes (Hurtado 2010). Among their main products are PALLAS reactor (Netherlands), OPAL reactor (Australia), ETRR-2 reactor (Egypt), NUR reactor (Algeria), RP-0 reactor (Peru), RP-10 reactor (Peru), RA-6 reactor (Argentina) and RA-8 reactor (Argentina). At the same time, the company provides services for researching reactors, nuclear fuel manufacture facilities, radioisotope production plants, instrumentation and control, products and services for NPP, other products and services, and siting evaluation. Regarding the space sector, it produced the SAC-A, SAC-A, SAOCOM satellites, SAC-B, SAC-C, SAC-D/Aquarius, and ARSAT[2], and the radars *Radar Secundario Monopulso Argentino*, Argentine Primary Radar 3D (RPA), meteorological radars, computational simulators and maintenance. Other projects include renewable and clean energy such as wind turbines, robots and special machines, industrial developments and services, process simulation, chemical processes. For instance, in the last two decades it developed the Chihuidos Sur Eolic system, a hydrokinetic turbine, a steam injection plant, and the OPAL reactor reflector vessel (INVAP 2020).

Historically, Argentina has developed further space capabilities since the 1960s. President Frondizi (1958-1962) created the National Commission for Space Research (CNIE), functionally under military control. Several extraordinary goals were achieved, such as the Rockets Alfa, Beta, and Gamma Centauro, the

2 INVAP, the main contractor for space development in Argentina, has established partnerships to manufacture the satellites with other companies such as VENG or CEATSA. This information illustrates the complexity of the space development ecosystem in Argentina. This information is introduced just as an example and does not constitute this paper´s main objective. It does show, however, the sector´s growth in the last few decades. The capabilities developed in nuclear projects are related to satellite production. Scientists and technologists, who initially virtuously developed a robust nuclear sector in a country of the global south, had a learning process that shaped a technological ecosystem. It was a company in which qualified nuclear workers learned to make space technology, radars, and more recently Unmanned Aerial Vehicles, among other developments. The company also has experience, with government support, in nuclear cooperation. Due to that synergy there was also learning of internationalization of relationships, which allowed cooperation with other global players. Unlike Argentina, Turkey does not have a decades-long tradition of developing and managing nuclear technology. For more information see M. Versino, Trayectorias de empresas productoras de 'bienes complejos' en el ámbito latinoamericano: los casos de INVAP S.E. y EMBRAER S.A., Anuario Centro De Estudios Económicos De La Empresa Y El Desarrollo (2017) nº6. http://ojs.econ.uba.ar/index.php/CEEED/article/view/1063 D. Hurtado, Semi-periphery and capital-intensive advanced technologies: The construction of Argentina as a nuclear proliferation country, Journal of Science Communication (2015), vol. 14, núm. 2,. http://jcom.sissa.it/archive/14/02/JCOM_1402_2015_A05.

rockets Orion, Castor, Rigel, Tauro, and especially the Canopus II Rocket, with which a monkey was sent to space and brought back alive. Nevertheless, no clear policy about space field institutionalization continued, and often there was a fuzzy line between civil and military activities (Blinder 2015b).

The flagship project of Argentinean space development was the Condor II, a medium-range missile developed under the Air Force auspices to improve firepower especially after the Malvinas-Falklands War (1982). Its development began near the end of the 1970s and the beginning of 1980. It became a strategic project for the military aviation after Argentina was defeated in the Falklands War (1982) and the Air Force lost deterrent capability along with its aircraft and fighter pilots. Though Condor II received contributions from both European companies and other countries such as Egypt and Iraq, its development was classified. Due to its secretive nature and the reputation of certain countries supporting its construction, the United States put pressure on Argentina to deactivate the project for the sake of limiting missile proliferation and stabilizing international security.

The foreign policy of President Carlos S. Menem (1989-1999) radically changed the perspective of Argentine international relations, vis a vis the changes the world was undergoing with the dissolution of the Soviet Union fading the tensions of the Cold War. President Menem's administration proposed to change foreign perception of the country: opening up to free trade and generating "special" and close ties with the major world power. The government of Menem intentionally dismantled national industrial capabilities allowing foreign corporations to compete with domestic ones. However, at the same time, special relations with the United States led Argentina to higher status in terms of international trust and access to technologies (Azpiazu, Basualdo, and Nochteff 1998); which had been denied before due to what American foreign policy officials considered an erratic space policy (Escudé 1998).

The arrival of a US-oriented government led by Carlos Menem linked the space policy development to a US-oriented foreign policy. After pressures from the US security establishment, Argentina canceled the dual-use Condor II and started a civilian space policy by creating the National Commission of Space Activities (CONAE) and avoiding any military-related uses. Until then, the national space institution was under the Air Force umbrella based on national security reasons. Consequently, Menem administration reached strategic agreements with the American National Aeronautics and Space Administration (NASA). Space cooperation between the United States and Argentina materialized the launching of μSAT-1, the experimental satellite Victor in 1996, the SAC-B in 1996 to study the sun, the SAC-A in 1998 with experimental objectives, and the SAC-C in 2000 for earth observation[3]. The United States launched these satellites sending a clear signal that Argentina would not develop its own dual-use missile capabilities. Nevertheless, due to solid space institutionalization under the non-military CONAE, Argentina advanced its national space capacities and achieved international recognition.

The technological results, the crisis non-withstanding, proved fruitful and results were obtained by 2006 under Kirchner's administration. The Kirchner administration started a strategic-industrial policy in 2003 releasing a series of demands from the productive sector and civil society. The demand of satellite images

3 While initially disconnected from the space policy since the beginning of the 1990s, the Menem administration decided to promote "the business" of satellite communications. After some initial steps, in 1995, the Ministry of Communications supported the creation of the first national satellite communications company, NahuelSat.

for productivity to the CONAE and the request of sophisticated communications led to the creation of a state-owned firm, Argentina Soluciones Satelitales (ARSAT) to plan, design and manage geostationary satellites for telecommunications. The State-run INVAP was involved in the design and construction of the satellites. Despite its initial purpose being telecommunications, ARSAT could be considered another institution indirectly tied to space policy (due to the production of satellites and management of space orbits). Created in 2006, its objectives are the domestic design and development of geostationary satellites, and their orbital positions in the space assigned to Argentina by the International Telecommunications Union. The company along with INVAP constructed and operated its two satellites. The first was launched in 2014 and the second in 2015, from French Guyana[4].

ARSAT's main assets are its orbital positions: 71.8 º W Arsat 1, and 81° W of Arsat 2 covering South and North America. A technology ecosystem was created for ARSAT, increasing the value chain of the satellite market in Argentina. In 2013 the company CEATSA (High Technology Test Center) started up in Bariloche, a partnership between the two-state owned high-tech companies INVAP and ARSAT, the companies were looking for sites to carry out satellite tests. As a result of the satellite program, INVAP has been hired to develop national radars to cover the whole national territory. In 2015, ARSAT expanded the company to the Data Center business and the Open Digital Television (TDA).

While CONAE carried out the civilian effort, GRADICOM did its part for the military side. The Argentine Ministry of Defense developed a missile project with a solid-fuel rocket both as deterrent weaponry, and as a further civilian satellite launcher. The Gradicom rocket raised concerns on external and internal levels, including diplomatic officials and CONAE members, who wanted to be explicitly separated from any activity qualified as military. This development stirred some debates within political and business circles linked to Argentine space policy around the proliferation issue because the government already had been researching and testing the Tronador 2 liquid-fueled rocket, opening the discussion about how a solid-fueled would affect civil space project. Certainly, the continuation of Tronador depended heavily on external perceptions, especially on the United States position, and the Argentina continuing a strict non-proliferation policy.

In terms of international satellite cooperation, the US has been the traditional partner and technological provider, but Argentina also receives support from Italy, France, Denmark and Brazil. Among the main achievements there are the LEO satellite SAC-C (terrestrial observation), the SAC-D (meteorological), SAOCOM series 1A and 1B (Argentine Microwaves Observation Satellites) and the GEO satellites ARSAT 1 and 2 (communications) which partially relied on instrumental from Thales Alenia Space, Astrium and Honeywell. Regionally, the Kirchner's administration supported the creation of the South American Council of Defense (CDS) in the Union of South American Nations (UNASUR). In 2011 they pushed forwards the idea of creating a multinational and regional space agency of South American states. However, the initiative did not succeed. Beyond cooperation with regional and western nations, in the last years

4 The National Commission for Space Activities (CONAE in Spanish) is the Argentine State owned space agency. The Plan Espacial Nacional has never included telecommunications satellite projects. Although is a has a different institutional frame and scope, Arsat S.A. is a Public Limited Company whose capital is in the hands of the National State, it operates ARSAT 1 and 2. INVAP is the main contractor for satellite projects in Argentina.

Argentina has been looking for non-western, alternative, partners and engaged in a series of diplomatic ties with non-traditional allies' space powers such as China and Russia. The aim was to widen cooperation, resulting only in information transfer with China related to the establishment of a deep space ground station in the Neuquén province, which delivers support for lunar and interplanetary missions with similar technical characteristics as the European Space Agency deep space ground station in the neighbor province of Mendoza (Blinder, 2017b). This turn to new sources generated some concerns in the US Defense Department due to the perception that Beijing could improve intelligence-gathering capabilities in the region (Lodoño 2018). At the end, the changing goals in the Argentina space plan from the military to a civilian approach has been related to the country's democratization trajectory and the geopolitical constraints.

Turkish Space Project: a route to strategic advantage

Turkey is rising not only as a regional power, but also as a global player in various fields, including the space and defense industry. Some three decades ago, Turkey was a marginal player in the space industry. The country's plans started later than her more developed counterparts (Yilmaz 2016). However, a mix of mid-term planning and military and economic needs have launched Turkey to the regional forefront in the Eurasia region as an emerging space country. Nowadays, the country can be compared with a middle space-power like Argentina, Australia, Brazil, Chile, India, Indonesia, Malaysia, Mexico, Nigeria, Pakistan, South Africa, Taiwan and Thailand (Wood and Weigel 2012a).

Turkey's space related activities were meager between 1993 and 2004, but there has been an increase since 2005 until now, matching rising military needs and requirements. The Syrian Civil War and the stress on Ankara's southern borders since 2011 pushed for greater autonomy on intelligence, surveillance, and reconnaissance (ISR) purposes. The development of space projects has become a critical instrument for Turkey's security and defense goals, particularly the development, production and operation of satellites. According to Ercan and Kale "satellites provide a major contribution to the security and defense sector with their advantages of flexible, cheaper, resilient and global coverage service capability" (Ercan and Kale 2017)

In terms of space policy, after decades of being outcast, the Supreme Council for Science and Technology (SCST) encouraged the Turkish space plan when, on February 1993, it approved the document 'Science and Technology Policy of Turkey: 1993-2003'. The main document for Turkey's technological development identified space as one of five priority areas, which affect the economy overall, next to informatics, nuclear technology, advanced technology materials, and biotechnology. Almost a decade later, despite the approval of a series of official initiatives and documents it has not been able to reach the goal of establishing a centralized agency to coordinate all space activities. In 1999, TÜBITAK drafted a study to prepare a national policy under the title 'General framework for Turkey's national space policy' which did not become official. A couple of years later, the National Security Council approved the decision to establish a 'Turkish Space Agency' but the internal political changes with the arrival of the Justice and Development Party (JDP) hindered its implementation.

A year later, TÜBITAK would prepare the document 'Vision 2023 Project, Security, Aeronautics and Space Industry Panel Report': it called for the establishment of a National Space Program and a National Space Agency, in addition to boosting international cooperation (Halim and Medeni 2012; Özalp 2009). Step by step, all those goals were accomplished.

Firstly, Turkey signed agreements with the European Space Agency (2004) and Roscosmos (2009), became a founder member of the Beijing-based Asia-Pacific Space Cooperation Organization (APSCO) in 2008, and later with countries interested in Turkish space activities such as Ukraine and Hungary (Özalp 2009; Bicer 2019). Secondly, on March 2005, a 10-year National Space Research Program was approved by the Prime Minister with the main goal of establishing space R&D infrastructure and creating the necessary national mechanisms to maintain it under the coordination of TÜBITAK. Additional aims encompass mobilizing and strengthening Turkish space industry by improving their capacity and capability, encouraging and supporting research and technological development, developing new technologies and an integrated system, and generalizing the use of space technologies and space-based services in society in order to create opportunities for industry, trade and services. From the establishment of the National Space Research Program until the creation of the Turkey's Space Agency, there was a process of dual diversification of actors and projects.

On the one hand, the space environment had been traditionally state-centered. Traditional space players include TÜBİTAK Üzay, Türksat, Directorate General of Aeronautics and Space Technologies, and the Directorate General of Civil Aviation under the Ministry of Transport Maritime Affairs and Communication and the Under-secretariat for Defense Industries (SSM) of the Ministry of Defense. However, lately local companies and research centers within the research and development space activities had grown in relevance. As an example, Turkish Aerospace Industries; Roketsan and a major Turkish rocket producer had become central for the development of a national space industrial ecosystem (Bakırcı-Taylor 2019).

On the other hand, the focus of the space development program has been on satellites. Until 2010, Ankara's principal space assets were communication and remote sensing satellites, later on high-resolution earth observation became a crucial point. After a couple of decades, Ankara has been able to develop, produce and operate earth observation and communication satellites, in addition to CubeSats or miniaturized satellites (Kara and Kilic 2015). At the same time, around 75% of the National Space Research Program's budget had been oriented towards space systems' infrastructure (Özalp 2009). The main products of the space industry includes GEO communication satellites (Türksat developed with jointly with Thales – 3A – and Mitsubishi – 4A & 4B –), LEO earth observation satellites such as the reconnaissance satellites for military use (Göktürk-1 in cooperation with Telespazio and Göktürk-2 developed only by Turkish institutions) and remote sensing satellites (BILSAT-1 and RASAT), in addition to three CubeSat developed by the Istanbul Technical University with experimental purposes.

Finally, the Turkish Presidency approved the creation of Turkey's Space Agency (TSA) on December 2018, a long aspiration from the entire space ecosystem. The Ministry of Industry and Technology Mustafa Varank summarized the achievement by saying "our dream of 20 years has come true" (Daily Sabah 2018). According to Presidential Decree number 23, the agency would be under the Ministry of Industry and

Technology and it seeks to formulate the National Space Program and other strategic plans with medium and long-term goals, developing competitive space industry, deciding on the use of rights under the national sovereignty and space coordination systems and the national sovereignty of spacecraft and space systems, and develop multilateral and bilateral cooperation (Turkish Presidency 2018). In sum, the Turkish Presidency aims to become a global player in space technologies with its vision of indigenous technology and strong industry.

As an institutional turning point, Turkey has gone through the first eight steps of the space technology ladder while procuring to climb the next three steps: domestically-built GEO satellite, launching autonomy and bi-nationally built GEO satellite (Wood and Weigel 2012b). First, Türksat and Turkish Aerospace Industries (TAI) built Türksat 5A at the Satellite Assembly Integration and Test Facility with the assistance of Airbus Defense and Space and launched on a Falcon 9 rocket in January 2021. Ankara has invested broadly on the development of defense research activities, particularly in "space infrastructure in the areas of space-based remote sensing systems such as electro-optical and Synthetic Aperture Radar (SAR) systems, ground systems, and related subsystems for carrying out intelligence, reconnaissance and surveillance", trying to establish a "non-dependent space capacity by boosting its defense industry and research institutions" (Özalp 2009, 231). The new institutional centralization highlights the relevance both of the space development itself and the boost for the local defense industry. The military sector supported the creation of the TSA despite it not being under the Ministry of Defense. In terms of space military capabilities, Turkey has become "one of the 30 countries who have and operate their own LEO and GEO satellite/s in orbit/s, one of the seven NATO nations who have their own military X Band SATCOM payloads, the only other country, after France, that has developed national STANAG 4606 compatible X Band frequency hopping SATCOM modems, one of the two NATO countries who have successfully initiated and completed processed EHF R & D project, and one of the several countries who have their own class 100,000 Assembly, Integration and Test (AIT) center" (Ercan and Kale 2017, 3).

Additionally, Ankara has tried to push for a domestic launch capability project. Rokestan and the Turkish Presidency of Defense Industries (SSB) agreed in 2018 to develop a Satellite Launch System (MSLS) to LEO that will allow gaining independent access to space (Rokestan 2020). Up until now, Turkey has relied on developed nations to launch her satellites including the United States, Russia and the European Union. Finally, Turkey is developing a geostationary satellite in cooperation with the argentine state-owned INVAP. President Recep Tayyip Erdogan announced these goals in February 2021, as part of an ambitious Turkish Space Agency National Space Program, which aims to make the first contact with the Moon in 2023 (Anadolu Agency 2021). Turkey has incorporated the special sector as an emerging dimension of new strategy to gain technological military advantage as the regional context becomes increasingly confrontational.

The bi-national geostationary satellite: goals, scope, and dimensions

The case of Turkish-Argentine satellite cooperation is located in the second sub-category of the GEO technology ladder since both countries had developed GEO with foreign assistance, but a further steps required international cooperation. Even if both pursue technological development, the motivations are

alike. The Buenos Aires's space plans changed from a military-based project until the late 1980s towards one driven by developmental goals, including the need to obtain external revenues. In the case of Ankara, the increasing strategic and military engagement in the Middle East and the Central Eurasia required communication and intelligence capabilities where the satellite industry is critical.

Despite having different paths and development trajectories, Argentina and Turkey crossed paths in early 2019 when they reached an agreement based on their technological and economic needs and after identifying a market niche that had not been explored for cooperation between two space powers. This partnership was surprising since political relations between Turkey and Argentina had gone through turbulent waters since mid-2000s due to a series of diplomatic incidents related to the Armenian question (Gonzalez Levaggi and Donelli 2021). However, there was a clear niche market that had not been covered and in which they could be very competitive should they develop an electric small-size geostationary satellite. Argentina is experienced exporting national production of high-tech nuclear reactors to a variety of countries, while she also has expertise on geostationary satellite development. Turkey is proficient exporting space-related products and had been developing geostationary satellites too. In the context of a growing telecommunications worldwide market, a joint project was an opportunity to climb the technological space ladder without relying on traditionally developed powers.

As GSATCOM's chief executive Luis Genovese states:

> "We believe it is strategic for our countries (…) this is one of the most important reasons. It is not only a commercial operation, doing business, but developing capabilities that will allow us to really support our countries for more autonomous development" (Henry 2019).

The joint project began as an Argentine exploration; a search for partners domestically and overseas. In 2015 INVAP carried out a market study finding an empty niche from which it began developing the concept of a small geosatellite: a small electric geosatellite. The state-own company undertook the calculations for budgeting and the design. A senior official source at INVAP specified,

> "In 2016 we strategically decided to develop it, as INVAP did not have the money to face this investment, we went out to look for financing or partners in Argentina. In 2017, when we failed to find financing locally, we went out to look for a foreigner partner and client. We saw that there was a lot of interest from customers on that type of satellite. But finding partners was not easy. We were negotiating with various stakeholders to partner up in development during 2017. Finally, we did not reach an agreement with anyone. In March 2018 we met with senior TAI executives at an international congress on satellites, and we told them about INVAP's capabilities, we invited them to meet us. Shortly after, they hired us to do a consultancy, and then we began to talk about setting up a new company. Fortunately, they had plans to develop a similar product. TAI is a company very similar to ours in its history and in its corporate composition, and immediately we both saw the potential of partnering to carry this out. INVAP is more experienced in designing, testing, constructing and putting satellites into orbit. But the TAI had the money and the ambition to learn" (Interview INVAP 2019).

Later on, in August 2018 the formal negotiations started and finally in March 2019, both companies agreed to create GSATCOM, a bi-national company to design, manufacture and market a new kind of fully electric small size geostationary satellite. GSATCOM become a joint venture between INVAP and the Turkish Aerospace Industry aiming the development and commercialization of a new generation electric-powered communications satellite. It also aims to develop a flexible type of communications system. Officially, GSATCOM offers a range of telecommunications solutions from the new satellite family. The satellite's payload capabilities are based on digital control solutions providing flexibility with custom designs, adaptive frequency reconfiguration, coverage, and power allocation.

On the Turkish side, the TAI 'Vision 2023 Document' pushes the company to participate actively in the satellite world market. The Space Systems Deputy General Office was responsible for implementing such an approach (Donanım 2020). The CEO of TAI Temel Kotil introduces the small satellite concept and the bilateral cooperation as unique solution for the geographic telecommunications market (Ertaş 2019), while the Deputy General Manager Selman Nas underlines that the small size GEO possess an optimal relation between quality and price, while opening a new stage for TAI from 'making our own satellites with domestic sources' to 'developing competitive satellite systems locally and selling them abroad' (Yeni Şafak 2019). In every public intervention, the Turkish officials repeat as a mantra the commercial advantages of the joint venture project and the potential in the global satellite market.

According to the INVAP senior official "this kind of satellites constitutes the state of the art in communication satellites and puts Argentina and Turkey at the forefront of technology" (Interview INVAP 2019). The platform has full electric propulsion, both for the satellite to be lifted into orbit and for maintenance during its 15-year design life. In technical terms, it will have 2,000 kilograms, which integrate payloads consuming up to 7Kw and a capacity of up to 50 Gbps (GSATCOM 2020). The GSATCOM modular and scalable concepts provide a more straightforward payload - platform integration due to market needs on supporting a wide range of payload types (GSATCOM 2020). The satellite will be produced in equal parts, providing each of the countries with half of components. Then, after setting the final engineering, the satellite should be delivered in 24 months, around 2021 (Latam Satelital 2019).

However, the financial constraints in Argentina due to the economic crisis since 2018 – further deepened by the COVID19 crisis – adds on serious weaknesses. In 2019 the government of Argentina had a debt to INVAP of 700 million pesos and some of its workers had received wages in portions and generally late. Regarding the absence of payments, INVAP went to look for cash for capitalization between projects. Among the company's clients there are the CONAE, ARSAT, the Air Force, the Secretary of Hydrology, National Agency of Commercial Flights, the nuclear agency CNEA (Interview INVAP 2019). This led INVAP to a very difficult situation, triggering some options for a company that considers its projects to be strategic.

Despite being a strategic project supported by both states, the governments did not intervene, the agreement is based purely on the commercial interest of both companies to capture the international market and become leaders in that small GEO satellite niche (Wood and Weigel 2012b). However, both sides have benefited from broader state support. Regarding the Argentine State, INVAP led a collective effort involving the Ministry of Foreign Affairs, the Argentine Embassy in Turkey, the Ministry of Science and

Technology, CONAE, and ARSAT that also have experience producing this sort of satellites. According to the vice-president of INVAP Vicente Campenni this kind of national projects is crucial because it "allows us to develop capabilities that are later capitalized and gives us the ability to negotiate internationally" (Alonso 2019). Regarding Turkey, the Ministry of Foreign Affairs and the Turkish Embassy in Argentina played a key role, in addition to the space-related institutions has been supporting the TAI's international efforts.

Even if there had been a set of different factors at play, the case study shows a preeminence of geopolitical and technology autonomy concerns behind Turkish space policy due to attempts to become independent from the traditional western providers, while innovation plus autonomy has been influencing the Buenos Aires' decision-makers. This means that the south-south cooperation in space arena can be presented as a broader narrative, which can contain heterogeneous approaches and motivations to develop space policies. Finally, Turkish-Argentine satellite cooperation provides a new route to achieve national space goals by overcoming the constraints of the geopolitical context and of the lack of available resources, both economic and technological.

Final Remarks

What do we learn from this case study about the role of economic, geopolitical or innovation-based motivations for middle power in space? We found out that they may decide to climb space technology ladder, driven by geopolitical or economic innovation. However, both are amalgamated: creative destruction occurs in a geopolitical context; geopolitics provides the context for political or economic agents to concur in space economy. Great space players will compete with the newcomers, either in the technological offer or in the rules of the game. Thus, countries of the Global South will have incentives to seek market niches and a robust diplomacy to be able to achieve the objectives of technology developments.

Research and development of developing players in the space arena are not triggered for competing in a global market, or achieving the state of the art of technology, but mostly for geopolitical concerns, the development of autonomous technology and the quest for innovation. The cooperation between Argentina and Turkey began exploring technological frontiers regarding geostationary satellites for a marketable niche in which traditional players have several advantages, such as a robust national innovation scheme, and productive capabilities developed within a national security environment.

(Insert Table 1)

While both countries have been climbing Wood and Weigel's technological scale (2012b) (see Table 1), their pathways to development have been significantly different. Turkey has developed her satellites with heavy foreign involvement and had managed to produce her own by the beginning of the XXI century with the Low Earth Orbit and Geostationary Orbit linked to a flourish military industrial complex. Argentina has embarked on a winding path of technological climbing. The South American country set up her first space

agency and in the 1960s, in the field of launchers, among those, the successful launches of the experimental load of two live animals stands out. The Condor II interrupted further development, along with international cooperation. On the one hand, international pressures for reasons of missile non-proliferation led to the creation of a new space agency strictly oriented to the satellite industry. On the other hand, a public telecommunications company that placed two geostationary satellites in orbit. Argentina continues researching and developing new launch vehicles, based on the knowledge accumulated in past decades strongly tied to the INVAP's institutional experience related to the nuclear industry.

Two elements are critical to assess the Argentine-Turkish joint satellite project. First, the purpose of cooperation between Argentina and Turkey seeks to gain a commercial place in a strategic industry. On one hand, from INVAP's point of view the agreement opens new marketable horizons, thus helping to internationalize the local technological achievements and circumscribe financial constraints. For Turkey on the other hand, this cooperation creates an opportunity to compete in the global markets while improving its industry, strengthening know-how and enriching the geopolitical and technological autonomy of a NATO member that depends upon Western technology. Domestic development is part of the broader Ankara's diversification strategy in several areas, particularly national security related issues. Second, while the immediate motivation for partnership is defined by widening customer pool for profits, there is a divergence in the ulterior goals since Argentine's space projects is basically civilian-oriented while Turkey has a particular interest in improving its strategic - military means for its national security.

What lessons can other countries obtain from this experience? This case provides interesting clues to look at the sources and goals of cooperation between two non-traditional space players. Moreover, in developing countries with certain industrial and technical capabilities, specialized organizations and public companies can endeavor projects not driven by the central government. Despite both having space developments while undertaking technological autonomy in common, their motivations are different. In this regard, alternative motivations do not mean that cooperation is unachievable. On the contrary, the case for cooperation between Argentina and Turkey offers an example where both countries aim for climbing up the technological ladder. Finally, the consequences of the project are not only technological improvement and empowerment of national innovation systems, but foreign policy in a rising multipolar world.

As a middle space power with geopolitical relevance regarding its location for strategic and military reasons for policymakers, the Turkish space program demonstrates how important autonomous capabilities are. Space technology contributes to the defense system as well and the science & technology ecosystem in Argentina. Nonetheless, the driver presents a Schumpeterian view of the economy, in which space spin-off drives other concomitant enterprises. Since Argentina dismantled its military industry through its process of state reform of the 1990s, the Turkish example could pave the way for leading a virtuous cycle of high-tech re-industrialization for national security. Finally, Argentina shows how an entrepreneurial state can boost a niche that could impact positively in the creation of new technologies, from the commodity chain to the international market.

Bibliography

Al-Ekabi, C. and Mastorakis, P. (2015) 'The Evolution of Europe's Launcher and Flagship Space Initiatives' in: Al-Ekabi, C. (ed.) *European Autonomy in Space*. London: Springer, p1-45.

Aliberti, M. (2015) *When China goes to the Moon…* London: Springer.

Almeida, A. (2019) *Autonomia como ação: cooperação entre Argentina e Brasil no setor aeroespacial entre 2003-2010*, MA Dissertation, Sao Paulo: UNESP - UNICAMP – PUC-SP). 2019

Alonso, M. (2019) 'INVAP mira de nuevo al cielo', *Agencia TSS – UNSAM* [online]. Available at: http://www.unsam.edu.ar/tss/invap-mira-de-nuevo-al-cielo/ (acceded 11 May 2020).

Anadolu Agency (2021) 'Turkey unveils national space program', *AA* [online]. Available at: https://www.aa.com.tr/en/science-technology/turkey-unveils-national-space-program/2139378 (accessed 7 April 2021).

Azpiazu, D. Basualdo, E. and Nochteff, H. (1998) 'Menem's Great Swindle: Convertibility, Inequality and the Neoliberal Shock', *NACLA Report on the Americas*, 31, p16-19.

Bakırcı -Taylor, Ç. (2019) 'Turkey creates its first space agency', *Nature*, 566 (7742), p20-22).

Bergamaschi, I. and Tickner, A. (2017) 'Introduction: South–South Cooperation Beyond the Myths—A Critical Analysis' in Bergamaschi, I., Moore, P. and Tickner, A. (eds.) *South–South Cooperation Beyond the Myths: Rising Donors, New Aid Practices?*, New York: Palgrave Macmillan.

Bicer, A. (2019) 'Turkey to announce space program in 2020', *Anadolu Agency* [online]. Available at: https://www.aa.com.tr/en/science-technology/turkey-to-announce-space-program-in-2020/1655905 (Accessed 10 August 2020).

Blinder, D. (2015a). 'Hacia una política espacial argentina', *CTS: Revista Iberoamericana de Ciencia, Tecnología y Sociedad*, 10(29), p65-89.

Blinder, D. (2015b) 'Argentina space: ready for launch', *Space and Defense Journal* 8(1), p34-46

Blinder, D. (2017a) 'Orden Mundial y tecnología. Análisis institucional desde la perspectiva geopolítica en la semiperiferia: la tecnología espacial y de misiles en Argentina y Brasil', *Geopolítica(s). Revista de estudios sobre espacio y poder*, 8(2), p177-202.

Blinder, D. (2017b). 'Bases espaciales extranjeras: la construcción de un imaginario sobre China y Europa en la prensa y la política argentinas', *Revista Iberoamericana de Ciencia, Tecnología y Sociedad*, *36*(2), p61-84

Bulkeley, R. (1991) *The Sputniks Crisis and Early United States Space Policy: A Critique of the Historiography of Space*. Bloomington: Indiana University Press,.

Chertok, B. (2009) *Rockets and People: Hot days of the cold war, Volume III*. Washington, DC: National Aeronautics and Space Administration.

Daily Sabah (2018) 'Turkey formally establishes its national Space Agency' [online]. Available at: https://www.dailysabah.com/defense/2018/12/13/turkey-formally-establishes-its-national-space-agency (accessed 10 August 2020).

Doboš, B. (2019) *Geopolitics of the Outer Space. A European Perspective*, New York: Springer.

Dolman, E. (2002) *Astropolitik. Classical Geopolitics in the Space Age*, Portland: Frank Cass.

Donanım, Özveri ve Disiplin Uzay Sistemleri Genel Müdür Yardımcılığımız (2020), *Türk Havacılık ve Uzay Sanayii MAG*, 110, p42-45.

Lodoño, E. (2018) 'From a Space Station in Argentina, China expands its reach in Latin America', *New York Times* [online]. Available at: https://www.nytimes.com/2018/07/28/world/americas/china-latin-america.html (accessed 10 August 2020).

Ercan, C. and Kale, I. (2017) 'Historical space steps of Turkey: it is high time to establish the Turkish space agency', *Acta Astronautica*, 130 (2017), p67-74.

Ercan, C. and Kale, I. (2017) 'The role of space in the security and defence policy of Turkey. A change in outlook: Security in space versus security from space', *Space Policy*, 42 (2017), p17-25.

Eriksson, J. and Privalov R. (2021) 'Russian space policy and identity: visionary or reactionary?', *Journal of International Relations and Development*, 24(2), p381–407.

Ertaş, G. (2019) 'Türkiye'den uzaya dev adım', Akşam [online]. Available at: https://www.aksam.com.tr/teknoloji/turkiyeden-uzaya-dev-adim/haber-968336 (acceded 25 May 2020).

Escudé, C. (2018) 'An Introduction to Peripheral Realism and its Implications for the Interstate System: Argentina and the Condor II Missile Project' in S. Neuman (Ed.), *International Relations Theory and the Third World*. New York: St. Martin's Press, p55-76.

Frenkel, A. y Blinder, D. (2020) 'Geopolítica y cooperación espacial: China y América del Sur', *Desafíos*, 32(1), p1-30.

Froehlich, A. Alonso, D. Soria, A. and De Marchi, E. (2020) *Space Supporting Latin America: Latin America's Emerging Space Middle Powers*, New York: Springer.

Froehlich, A. and Siebrits, A. (2019) *Space Supporting Africa, Volume 1: A Primary Needs Approach and Africa's Emerging Space Middle Powers*. New York: Springer, New York.

Froehlich, A. Seffinga, V. and Qiu, R. (2020) 'Introduction' in Froehlich, A. and Seffinga, V. (eds) *The United Nations and Space Security Conflicting Mandates Between UNCOPUOS and the CD*, New York: Springer, p1-6.

Gonzalez Levaggi, A. y Donelli, F. (2021) 'Turkey's changing engagement with the global South' *International Affairs*, 97(3), p1105–1124.

Gosovic, B. (2016) 'The resurgence of South–South cooperation', *Third World Quarterly*, 37(4), p733-743.

Gray, K. and Gills, B. (2016) 'South–South cooperation and the rise of the Global South', *Third World Quarterly*, 37(4), p557-574.

GSATCOM (2020) 'Full Electric HTS Satellite' [online]. Available at: https://www.gsatcom.com/ (acceded 10 April 2020).

Halim, D. and Medeni, T. (2012) 'A comparative strategic analysis of space technologies: developing a roadmap for Turkey', International Journal of eBusiness and eGovernment Studies, 4, p1-10.

Harding, R. (2013) *Space Policy in Developing Countries. The search for security and development on the final frontier*, New York: Routledge.

Harvey, B., Henk, S. and Pirard T. (2010) *Emerging Space Powers. The New Space Programs of Asia, the Middle East and South America*. Chichester: Springer–Praxis Publishing.

Henry, C. (2019) 'Argentina, Turkey wade into tough GEO manufacturing market with joint venture', *Space News* [online]. Available at: https://spacenews.com/argentina-turkey-wade-into-tough-geo-manufacturing-market-with-joint-venture/ (acceded 11 July 2020).

Hertzfeld, H. and Li, S. (2013) 'Registration of the 12 December 2012 satellite launch by North Korea: Should UNOOSA have accepted it?', *Space Policy*, 29(2), p93-94.

Hörber, T. and Stephenson, P. (2016) *European Space Policy European integration and the final frontier*. New York: Routledge

Hurtado, D. (2010) *La ciencia argentina. Un proyecto inconcluso 1930-2000*. Buenos Aires: Edhasa.

Interview with INVAP Official. Bariloche, 14 April 2019.

INVAP (2020) Sistema eólico Chihuidos Sur [online]. Available at: http://www.invap.com.ar/es/2014-05-12-14-44-54/proyectos/sistema-eolico-chihuidos-sur.html (accessed 10 August 2020).

Johnson-Freese, J. and Erickson, A. (2006) 'The emerging China–EU space partnership: A geotechnological balancer', *Space Policy*, 22(1), p12-22.

Jordaan, E. (2003) 'The concept of a middle power in international relations: distinguishing between emerging and traditional middle powers'. *Politikon*, 30(1), p165–181.

Kara, O. and Kilic, C. (2015) *Emerging Small Satellite Operations in Turkey: Interplanetary Mission Infrastructure and Benefits in the Space Sector*, Jerusalem: 66th International Astronautical Congress.

Klinger, J. (2018) 'A Brief History of Outer Space Cooperation Between Latin America and China', *Journal of Latin American Geography*, 17(2), p46-83.

Klinger, J. (2020) *China, Africa, and the Rest: Recent Trends in Space Science, Technology, and Satellite Development*. Washington, DC: Johns Hopkins University.

Latam Satelital (2019) 'GSATCOM, asociación entre INVAP y TAI' [online]. Available at: https://latamsatelital.com/gsatcom-asociacion-invap-tai/(acceded 11 April 2020).

Latam Satelital (2020) 'Informe de INVAP sobre contratos con el Estado Nacional' [online]. Available at: http://latamsatelital.com/informe-invap-contratos-estado-nacional/ (acceded 11 May 2020).

Lee, K. (2005) ‘Making a Technological Catch-up: Barriers and opportunities’, *Asian Journal of Technology Innovation*, 13(2), p97–131.

Lee, K. Lim, C. (2001) ‘Technological regimes, catching-up and leapfrogging: findings from the Korean industries’, *Research policy*, 30(3), p459–483.

Logsdon, J. (1986) ‘The Space Shuttle Program: A Policy Failure?’, *Science*, 232, p1099-1105.

Logsdon, J. (2015) ‘Why did the United States retreat from the moon?’, *Space Policy*, p1-5, http://dx.doi.org/10.1016/ j.spacepol.2014.12.001.

López, A., Pascuini, P. and Ramos, A. (2018) ‘Climbing the Space Technology Ladder in the South: the case of Argentina’, *Space Policy*, 46, p53-63.

Makarov, Y. and Payson, D. (2009) ‘Russian space programmes and industry: Defining the new institutions for new conditions’, *Space Policy*, 25(2), p90–98.

Mineiro, M. (20212) Space Technology Export Controls and International Cooperation in Outer Space. New York: Springer.

Moltz, J. (2014) Crowded Orbits. Conflict and Cooperation in Space. New York: Columbia University Press.

Mowthorpe, M. (2002) ‘US Military space policy 1945–92’, *Space Policy* 18, p25-36.

Mu, Q. Lee, K. (2005) ‘Knowledge diffusion, market segmentation and technological catch-up: The case of the telecommunication industry in China’, *Research policy*, 34(6), p759–783.

Newton E. and Griffin, M. (2011) ‘United States space policy and international partnership’, *Space Policy*, 27(1), p7-9.

Özalp, T. (2009) ‘Space as a strategic vision for Turkey and its people’, *Space Policy* 25(4), p224-235.

Pelton, J. (2004) ‘Satellites as Worldwide Change Agents’, in Pelton, J. Oslund, R. Marshall, P. (eds) *Communication Satellites. Global Change Agents*. London: LEA Publishers, p3-32.

Rokestan (2020) ‘Space Projects’ [online]. Available at: https://www.roketsan.com.tr/en/product/micro-satellite-launching-system/ (accessed 10 August 2020).

Sadeh, E. (2009) ‘Space policy challenges facing the Barack Obama administration’, *Space Policy*, 25(2), p109-116.

Serna, A. (2018) The U.S.-Latin America space cooperation equation. MA Dissertation. Monterrey: Naval Postgraduate School.

Sheldon, J. (2006) ‘A Really Hard Case: Iranian Space Ambitions and the Prospects for U.S. Engagement’, *Astropolitics*, 4(2), p229-225.

Suarez, D. and Yoguel, G. (2020) ‘Latin American development and the role of technology: an introduction’, *Economics of Innovation and New Technology*, 29(7), p661-669.

Thomas, H., Versino, M. and Lalouf, A. (2008) 'La producción de tecnología nuclear en Argentina: El caso de la empresa INVAP', *Desarrollo Económico*, 47, p543-575.

Turkish Presidency (2018) 'Türkiye Uzay Ajansi hakkinda Cumhurbaşkanliği Kararnamesi' [online]. Available at: https://www.mevzuat.gov.tr/MevzuatMetin/19.5.23.pdf (accessed 10 August 2020).

Wood, D. and Weigel, A. (2011) 'Building technological capability within satellite programs in developing countries', Acta Astronautica, 69 (11-12), p1110–1122.

Wood, D. and Weigel, A. (2012a) 'A framework for evaluating national space activity', *Acta Astronautica*, 73, p221-236.

Wood, D. and Weigel, A. (2012b) 'Charting the evolution of satellite programs in developing countries–the Space Technology Ladder', *Space Policy* 28(1), p15–24.

Wood, D. and Weigel, A. (2014) 'Architectures of small satellite programs in developing countries', *Acta Astronautica*, 97, p109-121.

Wu, X. (2015) 'China and space security: How to bridge the gap between its stated and perceived intentions', Space Policy, 33, p20-28.

Yeni Şafak (2019) 'Görücüye çıktı ilgi odağı oldu' [online]. Available at: https://www.yenisafak.com/ekonomi/gorucuye-cikti-ilgi-odagi-oldu-3529601 (acceded 9 July 2020).

Yilmaz, S. (2016) 'Space and Turkey', *Open Journal of Political Science*, 6, p323-337.

Zhang, B. (2011) 'The Security Dilemma in the U.S.-China Military Space Relationship: The Prospects for Arms Control', *Asian Survey*, 1, p311–332.