The mediatization of the air.

Wireless telegraphy and the origins of a transnational space of communication, 1900-1910s

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Abstract

Airspace today is densely penetrated by Wi-Fi networks, GPS services, broadcasting and mobile phone signals. This process, what we call the "mediatization of the air", is not so new, as it began in the first two decades of the 20th century with the advent of wireless telegraphy. Based on archival research, this paper shows that wireless telegraphy mediatized the air and made it an international matter of common interest for formerly disconnected realms. The mediatized air transformed meteorology, timekeeping, mobility, and transportation and challenged governance over aerial borders. Overall, this study on historical mediatization research contributes to telling a different story about mediatization by including an invisible and understudied phenomenon that today represents a basic and taken-for-granted infrastructure for global communication.

Keywords: historical mediatization; air; wireless telegraphy; new media; meteorology; timekeeping; mobility; aviation

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The air has always attracted human attention. Transparent and immaterial, it has always been a space where mysterious phenomena and progressive scientific inventions occurred. From ancient times, humans read the air as a space full of predictions, of directions for navigation, and of romantic signs. The air was also used as a channel of communication: encoded messages, such as smoke signals and fireworks, have been transmitted through the air for centuries. Recently, John Durham Peters elaborated on this relation between the air and communication, claiming that clouds, storms, and lightning might even be considered media because they are simultaneously seen, heard and interpreted by groups of people, ultimately resulting in forms of entertainment on a large scale (Peters, 2015). Today, the air is a normal precondition and support for everyday communication: for ubiquitous Wi-Fi networks, radio signals, broadcasting, and mobile communication using smartphones, to mention a few. Many of our communication practices are currently "cable-free," and it is the air that connects us and over which we receive and exchange text, images, and sounds.

This paper focuses on what we define as the "mediatization of the air," and it primarily aims to contribute to mediatization research by providing a historical perspective applied to an underestimated subject: the air. By focusing on the beginning of the 20th century and following the debates among international organizations, at that time based mainly in Europe, this paper analyzes a historical period and a space in which the air became heavily mediatized due to the new and emerging communication technology of wireless telegraphy, also called radiotelegraphy (hereafter "wireless").

Focusing on the mediatization of the air from a historical perspective provides valuable insights for media and communication research. On the one hand, a taken-for-granted and underestimated space of communication in mediatization research (and in communication research generally) is examined as the main object of study. As argued above, the air is not only an invisible and understudied communication channel, but it is also fully mediatized and saturated with signals that are transmitted, exchanged and received by different communication technologies. This paper studies the origins of the process of increasing saturation of the air with communication and transmitting technologies, what we call "the mediatization of the air."

On the other hand, this paper contributes to historicizing mediatization research. Instead of focusing on contemporary and digital mediatization processes, the historical analysis presented in this paper carves out the decisive transformations of perceptions of the air as a channel of communication and their social and political implications. Based on the analysis of newly discovered primary sources, we show that a significant wave of the "mediatization of the air" occurred in the first two decades of the twentieth century.

The paper begins with a brief discussion of the benefits and the necessity of historicizing mediatization research. Subsequently, the historical role of wireless telegraphy is introduced, and the sources and archival documents used for analysis are presented. Next, the empirical section presents the results of a historical study on "mediatized air" by examining different realms: political regulations and discussions about aerial borders; temporal synchronization facilitated by time signals and weather forecasting; transportation, most prominently the areas of water navigation and aviation; and finally, the correlations between these seemingly unrelated fields. In the conclusion, theoretical and historical findings are combined and discussed in terms of their implications for mediatization research.

The necessity of historicizing mediatization research

In recent years, the mediatization paradigm has been discussed and theoretically refined by many researchers and is now widely used in communication research (see, e.g., Couldry & Hepp, 2017; Hjarvard, 2013; Livingstone, 2009; Livingstone & Lunt, 2014; Lundby, 2014). Mediatization aims at understanding the transformations of socio-cultural phenomena by examining how they are linked to media transformations. In this regard, media are broadly understood as a technological and social structure and, at the same time, as a situated space of experiences for symbolic content. With its proliferation, mediatization has developed in various theoretical directions (see the overviews in Couldry & Hepp, 2013; Hepp, Hjarvard, & Lundby, 2015), which requires a clear description of the theoretical approach utilized. The present study follows the social constructivist tradition of mediatization research and considers mediatization as a complex, long-term process (Krotz, 2014a) that as such requires an examination of historical change (Bolin, 2016). Mediatization, according to this view, did not begin with modernity, the advent of mass media or the rise of digital media but must be understood as a historical meta-process (similar to the meta-processes of globalization and individualization) that has accompanied humankind (Krotz, 2014a). It is often argued that time and space are highly mediatized in *contemporary* societies, and actually they are. However, it must not be forgotten that the mediatization of basically all spheres of human life, including space and time, is a long-term process that began centuries ago. Consequently, researching mediatization from a social constructivist perspective requires a historical analysis for at least two reasons.

First, interrelations between media change and social and cultural change cannot be determined indistinctly. The concept of mediatization is thus a starting point and at the same time a demand for further empirical research examining *both historical and present phenomena*. The

idea is that the results of these analyses are then integrated into an overall reflection and theory of mediatization (Hepp, 2014). In other words, mediatization research needs empirical research to add flesh to its theoretical skeleton. As argued by, for example, Averbeck-Lietz (2015), Ekström, Fornäs, Jansson, and Jerslev (2016), Hepp (2012), and Livingstone and Lunt (2014), one of the main current challenges of mediatization research is thus strengthening its historical focus in terms of "historical mediatization research" to adequately study the complexity of media change and of mediatization itself. So far, however, most empirical analyses in mediatization focus on recent changes in current media practices, technologies, and environments (see, e.g., the respective criticism in Deacon & Stanyer, 2014, 2015). Thus, a more complex and historically situated understanding of change is needed. In particular, because the history of mediatization itself is more complicated than generally assumed, it should include alternative, marginal and unknown stories of media and their transformations.

Second, a stronger integration of historical research into the current theoretical debate on mediatization is needed to grasp the long-term nature of media change and to realistically evaluate continuities of and changes in mediatization processes. This is especially important as the majority of studies in the field of mediatization research focus on digital media, which in our view are too often considered the *decisive* starting point of (deep) mediatization processes, without situating them historically. As Krotz underscores, the knowledge gathered from historical mediatization research provides "a better understanding of the actual developments" (Krotz, 2014b, p. 158). We argue that the integration of historical analysis into mediatization research is particularly helpful for contesting the newness of seemingly "new" phenomena by putting them into a larger context. For example, the seeming "newness" of digital media (Hepp & Krotz, 2014, p. 11) vanishes when examined from a historical perspective (see e.g.

Steinmaurer, 2014). In fact, analyses of the history of digital media have shown that a clear differentiation of old and new, analogue and digital media becomes obsolete (Balbi, 2015; Balbi & Magaudda, 2018; Natale, 2016b; Peters, 2009; Sterne, 2009).

There are several ways of performing historical mediatization research. One possibility is to compare social and cultural phenomena at different points in time. In this regard, the historical analysis of a particular period of time allows one to reach qualified conclusions about "the 'before' and 'after' inherent in the mediatization thesis" (Hepp et al., 2015, p. 319). Another approach is to base mediatization research on a historical analysis that spans a certain period (Hepp, Berg, & Roitsch, 2017); for example, going back from the present to a certain point in time. Finally, other approaches to historical mediatization research investigate times of intense transformations, such as "mediatization waves" (Couldry & Hepp, 2017), "turning points" (Stanyer & Mihelj, 2016) or historical events (Sewell, 1996) that warrant close examination due to their historical relevance.

The present paper mainly follows the latter approach and contributes to historicizing mediatization research by providing an in-depth historical analysis of the advent of wireless at the beginning of the 20th century in Europe. This is not the absolute first "wave" of the mediatization of the air in history (e.g., the abovementioned smoke signals, fireworks, and clouds can be considered examples of previous times of intense transformations), but this time period represents a remarkable era because the mediatization of the air caused many implications and negotiations, changed practices and regulations in different social realms, and impacted everyday life experiences.

Wireless as a "new" international medium

After a few decades of experiments and patent battles among various inventors, wireless or radiotelegraphy became a well-known means of communication at the beginning of the 20th century. Like wired and electric telegraphy, wireless was a point-to-point technology, allowing two actors to exchange messages interactively, secretly, and in Morse code.

Wireless introduced two fundamental innovations to the media environment of the time. Instead of using electric telegraph wires, wireless transmitted its messages through the air or, better yet, through an electromagnetic spectrum referred to as the "ether." Then, because airwaves could not be restricted to national borders, wireless was, from the beginning, a form of international communication. The "cable-free" innovation significantly decreased the cost of real-time point-to-point communication, which in turn facilitated information exchange between European colonial powers and colonized countries, serving as a cheaper alternative to submarine cables (Headrick, 1988; Winseck & Pike, 2007). Wireless has also enabled communication in mobility, for instance, by improving maritime logistics, where it provided the first communication network for ships in motion (Hancock, 1950). Moreover, it also entered the popular imagination, as it was associated with mysterious and invisible phenomena of communicating at a distance and, thus, with spiritism, occultism, and telepathy (Natale, 2016a; Peters, 1999).

Wireless telegraphy (before radar, satellites, or mobile phones) was one of the first communication networks intended to be global. Wireless was global not only because of its technical ability to cross national borders, but also regarding its business dimensions. Various companies operated on an international level, e.g., Marconi Company, Telefunken, Siemens Brothers, the Anglo-French Wireless Company, and Debeg. They aimed to connect far-away

places and used the resources and inventions of multiple countries. For instance, the Marconi Company had different offices in London, Rome, Oslo, Paris, New York, Montreal, Budapest, and other cities. Considering these aspects, wireless required governance at an international level. Hence, the first conferences on wireless were organized in Berlin in 1903 and 1906. There, common rules at the international level were established, and they limited disagreements between large European corporations.

Archives and Sources

The aim of the historical analysis is to identify the key international arenas of regulatory agreements for the future development of wireless as well as the network of the national and international actors and organizations that participated in negotiations. These actors, arenas, and agreements were the starting point for the examination of further relationships and entanglements with other fields (see Fickers, 2011, for the definition of "arenas"). This examination necessitates the analysis of different sets of sources that are presented in greater detail below. Moreover, in the analysis we focused on key problems and challenges related to wireless that occurred in various context and examined which fields were involved in the discussions (e.g., meteorology, transportation). We were particularly interested in ongoing issues and topics that were continuously put on different agendas and discussed in different arenas.

The analysis is based on a large and heterogeneous corpus of national and transnational primary sources in several languages, including unpublished archival documents and historical publications of limited circulation, of the period from 1901 to 1919. A first set of transnational sources consists of documents preserved at the Library and Archives of the International Telecommunication Union, including the minutes of three international conferences and

respective conventions, 223 monthly issues of *Journal Télégraphique*, and correspondence with various state representatives, companies, and individuals either conserved in the original form or documented in a correspondence register (from 1911 when it was first introduced to 1919, in total 20,824 items). The analysis of these sources enabled us to understand how the most important technicians and politicians of the time discussed and reflected on the impact of wireless in the European context. Moreover, our analysis included technical journals and magazines, such as *Rivista di Fisica, Matematica e Scienze Naturali*, *Radiofonia*, *Illustrated London News*, and *The Wireless World*, preserved at the Marconi Archives in Oxford, the British Library in London, Dokumentationsarchiv Funk in Vienna, and the National Central Library in Florence. Technical journals help us understand how technicians and users reflected on media change and how taken-for-granted ideas of communication were discussed. Finally, we also consider non-wireless-centric publications and other transnational sources, such as documents and protocols of international conferences and negotiations about timekeeping, meteorology, and aviation. These documents are preserved at the Institut de Droit International, the US Congress, and the Bureau des Longitudes; some reports were published in international journals such as *Revue Générale de Droit International Public*, *The American Journal of International Law*, *Annales de Géographie*, *La Géographie*, and *Bulletin de la Société de Géographie*. The importance of this last set of sources was discovered during the analysis of the previous two sets that presented the starting points for broadening the analytical scope. These sources were crucial for understanding how other not primarily media-related realms were affected by the development of wireless and, specifically, how they responded to the mediatized air.

Quite typically for historical research, various difficulties have been overcome regarding the accessibility and analysis of some sources. One example is the fact that wireless itself had

different semantics and terminology in sources from various disciplines in various languages. Indeed, wireless was called alternatively *radiophonie*, *il telegrafo senza fili*, *Hertizian waves*, etc., which made it challenging to identify the subject of our study. Regarding the accessibility of some sources and information, some letters of the ITU correspondence were unfortunately destroyed and thus could not be examined directly. Fortunately, the ITU correspondence register introduced in 1911 (see above) was identified as a helpful source for reconstructing and examining the network of actors and key issues in the early correspondence on the wireless. These difficulties, in other words, have also stimulated flexibility and a search for alternative sources.

Findings

The need for transnational regulation of the mediatized air

The analysis of the sources clearly shows that with the spread of wireless, perhaps for the first time in history, the "property" of the air became an international problem. In fact, as radio waves could not be restricted to national boundaries, they frequently invaded (and still invade) the airspace of other nations. Thus, immediately after the invention of wireless, the governments of different countries as well as international institutions began to debate how to apply the concepts of sovereignty and of national borders to an immaterial object such as the air.

The analysis has also shown that when being mediatized, the air lost its "natural" and "given" neutral status and became technically and politically contested, in a way was "invented" as a new space (Hay, 2012). Technically, it was difficult, if not impossible, to "defend" national territories from an unwilling radio transmission and reception. Different suggestions for solving this problem were made, some of which were rather peculiar. To prevent "waves of foreign

origin" from entering national territory, it was proposed to protect borders with a "high metal wall" or, similarly, with a "high net of iron wire" (Giannini, 1920, p. 41, authors' translation from Italian). This suggestion raised some legal concerns. A major problem was that if a state prevented the waves from entering its territory, the wireless waves—and thus the transported message—would not be able to pass any further or to take another route, and would thus remain kind of a captive. Another problem was that the country would be completely cut off from international wireless services and would thus remain without any external news. Politicians acknowledged that if the problem with wireless and national security remained, not only could these ridiculous projects, such as the creation of an informational iron curtain, occur, but there was even the possibility of "a blind fight between nation and nation, which would end with the victory of the state that could obtain the most powerful radiotelegraph stations" (Meuker, 1910, p. 56, authors' translation from Italian). Delegates of various countries had to put common efforts into reaching an international agreement about the regulation and restriction of wireless communication in the air. The most symbolic transnational arena where wireless and the air were discussed together was the 1903 conference, the first international meeting discussing wireless. The scope of the meeting was to create competitive environment for the development of wireless, and the overall mood "was not favorable to a Marconi monopoly" (Raboy, 2016, p. 228). It sought to establish international collaboration since "wireless telegraphy … projects its waves beyond the frontiers separating nations, so the protection necessary for its free development can only be secured with the concurrence of all the maritime nations by means of an international understanding" (ITU Archives, 1903b, p. 6). Debates arose around the limits of national regulations and the attribution of messages to national or international space. The delegations acknowledged "a broad distinction between shore stations, which are entirely within national

jurisdiction, and ship stations on the high seas, beyond the plenary exercise of such control" (ITU Archives, 1903b, p. 12). Even though some delegates insisted on taking communication between ships under control, others noted the difficulties in executing regulations, calling the regulation proposals "premature" (Ibid.). The 1903 agreement was thus to regulate wireless stations according to territory, and where the borders were not clear—as in the sea—to judge the stations by "whose flag the ship flies" (ITU Archives, 1903a).

Then, in 1906, a group of national delegates met in Ghent at the Institute of International Law to further develop this discussion and to focus on the still-open question of the "property of the air." Regulation oscillated between two extreme perspectives: complete freedom of the air or strict sovereignty over national territory. The first perspective suggested treating the air as an international space, similarly to how the sea was divided (MacKenzie, 2010, p. 14). This proposal originated from the treatise of the French lawyer Paul Fauchille published in 1901 and was inspired by the 1609 doctrine of *Mare Liberum* (Fauchille, 1901; Khan, 2012). The opposing viewpoint of strict national sovereignty asserted that the airspace above the national territory should be in entire possession of the state and, consequently, national governments should have the right to exclude or prevent any passage of wireless waves through this space. Both positions would potentially create problems: the first idea risked creating substantial chaos in the air with the consequent problem of overlapping waves, while the second proposal jeopardized wireless as a point-to-point technology with the unique potential to communicate over long distances, transiting through many different nations. As a compromise, politicians attempted to draw a line between air as an international territory and air as a national (or even private) property. One suggestion was very peculiar: it consisted in defining air as state property, but only to a height of 330 meters—the exact height of the Eiffel Tower with its wireless antenna, which was the most

powerful wireless station at the time (Thurn, 1912, p. 1223). This proposal implied that the most significant and iconic building in the world of wireless communication was considered the "natural border" limiting the property of the air. Everything above the antenna would, therefore, be considered international airspace. The debate resulted in a resolution that began with the declaration that "The air is free," but that also acknowledged the right of national governments to exclude or prevent any passage through the space above their territory. There was only one exception: in the case of wireless, the state was obliged to immediately inform other governments about such a refusal (Institut de Droit International, 1906). This means that the controversy was not fully resolved, and in later discussions and regulations, the topic of wireless kept bringing up exceptions and limits to the sovereignty in the air.

In more general terms, these negotiations and difficulties show that wireless decisively changed the ways in which the air was perceived at the political and regulatory levels. The "mediatized" air brought new issues to the international agenda regarding, e.g., the governance over neutral areas, vertical divisions and regulations of a non-physical space, such as a spectrum (Savage, 1989). In fact, the struggle over regulating the borders in the air became long-lasting. Meetings and conferences (such as the international conferences about wireless in 1906 and 1912) raised the same topics, and even today, there is no international agreement on the vertical extent of sovereign airspace, as various competing visions and different standards still prevail. Today, channels, frequencies, and parts of a spectrum can be understood as "coded records of past political struggles" (Streeter, 1996, p. 220). Previously understood as an unexplored and vacant space, the mediatized air began to be seen as an arena in need of international control, regulations, and order. In addition, this also had an impact on and transformative implications for other fields, as we discuss in the following sections.

Timekeeping and meteorology

Wireless internationalized and transformed time signals and weather forecasts. Time signals and weather forecasting were predominately managed by the International Time Conference and by the Congress of Geography, respectively. However, these organizations had to be aligned with regulations of the air and wireless, adopted by the International Telegraph Union at the 1912 conference in London. Among these rules were decisions on the use of certain frequency bands for time and weather transmission, the restriction of time signals to only 10 minutes per day at a certain hour to avoid disturbances, and a particular order for the transmission of weather forecasts (ITU Archives, 1913a). Therefore, both timekeeping and meteorological institutions and their regulatory practices had to follow the directives for wireless communication, which underscores the institutional interdependencies and the complex entanglements of "mediatized air," time and weather forecasts.

Technologically, wireless consolidated previously isolated national infrastructures of timekeeping and meteorology. For experts, the "mediatized air" served as a truly international channel that enabled them to synchronize information exchange. For timekeeping services, wireless brought up the radically innovative understanding of time as an international public good. For centuries time had relied on national and even local infrastructures, and there was no proper way to determine the "right" time (Kern, 2003; Krajewski, 2014). The world became more synchronized when different users and communities began receiving wireless time signals not only from national sources but also from transnational flows. For example, the regular and intense time signals sent from the Eiffel Tower reached various European counties with higher precision than those provided by the official national services. As a consequence, the concept of

international time became a dire necessity to avoid confusion and was officially implemented following negations in October 1912 at the first International Time Conference in Paris. The main outcome was the establishment of a transnational network of wireless stations sending a series of beats at a particular hour according to a universally adopted scheme. Among those stations were the Eiffel Tower in France, Norddeich in Germany, San Fernando in Brazil, San Francisco in the USA and five other wireless stations (Lockyer, 1913). This agreement ended the chaos in timekeeping by creating a universal scheme that gradually became transparent and widespread ("The growing commercial importance of wireless...," 1913). In contrast to previous means of communication, wireless allowed listeners from different countries to adjust their clocks to precisely the same minute. In addition, professional services began relying on wireless signals. In Switzerland, clockmakers rebelled against the dismantlement and the restriction of wireless stations' operation during World War I because they could not access international time signals. The Swiss government had to provide this service over the federal telegraph and telephone lines until May 1916, but in accuracy, apparently, it could not compete with wireless ("Telephonic time service in Switzerland," 1918). Therefore, with the "mediatized air" and its regulation, time signals became an internationally successful project.

Despite the long history of weather forecasts, wireless and meteorology went hand in hand from the beginning of the 20th century: in Russia, for instance, the first wireless device by Alexander Popov was presented specifically to the meteorologists as a type of lightning detector, a "thunderstorm marker" (Sokolcov, 1912, authors' translation from Russian). Wireless made weather forecasts and meteorology a truly international matter (Edwards, 2010). During the conference organized by the International Meteorological Organization in 1905 in Innsbruck, a worldwide weather station network was introduced to combine the efforts of different nations in

collecting, calculating, and distributing data among meteorological stations ("Généralités: La conférence météorologique d'Innsbruck," 1906). Wireless played an important role: it was very soon acknowledged as a useful service for disseminating information about the weather, in contrast to the USA, which for a long time relied on cable communications ("Le service météorologique aux Etats-Unis," 1904). The regular Eiffel Tower transmissions of weather forecasts were approved at the 9th International Congress of Geography in Geneva in 1908 ("Chronique de la Société de Géographie. Le IXe Congrès International de Géographie," 1908). Reports including barometric pressure, intensity, and wind direction were sent from Reykjavik (Iceland), Valentia (Ireland) and other crucial places for ships. Meteorologists and seismologists broadcasted forecasts, exchanged information among meteorological stations, calibrated devices to international time, communicated with the International Telegraph Union and made discoveries – all through wireless (ITU Archives, 1913b, 1913c).

Moreover, the "mediatized air" also transformed the social value of time signals and weather forecasting. Wirelessly transmitted time signals and weather information slowly entered many aristocratic and enthusiasts' houses in the unexpected form of family entertainment. A drawing in the *Illustrated London News*, published in 1913, shows an Edwardian family. The well-dressed group has just arrived home after attending the theater, and now, they set their watches and clocks to the Morse code transmission from the Eiffel station (see Figure 1). This ability to catch the time signal in one's own home directly from the radio station enhanced synchronization in society considerably. The process of synchronization was accelerated itself: from the broadcasting station directly to your home, bypassing the churches, railway stations, and watchmakers that for long time were exclusive holders of the "right" time. Moreover, this international time was no longer a privilege of exclusive groups. Although the drawing captures

a quite wealthy family, the time signals were also accessible to unprivileged classes, as a radio device could be assembled from cheap materials already at hand, from “odds and ends” (“Wireless station for 30s,” 1913). Numerous articles and books on meteorological services taught enthusiasts to set their devices and to decode messages according to specific tables and maps (Lockyer, 1913).

In the 1910s, time signals and weather forecasts became actual “programs” and thus early examples of global entertainment or “infotainment” (Thussu, 2007). These practices can be considered forerunners of radio broadcasting, and the first listeners setting their clocks to information transmitted wirelessly or listening to seismographic reports can be seen as an incipient audience. Not by chance, time signals remained a very appreciated form of entertainment in the 1920s, when broadcasting was officially launched in several countries. For example, a survey launched among readers of an Italian radio weekly in 1924 identified time signals as *the favorite* radio program of the time (“Come desiderate i programmi della Unione Radiofonica Italiana?,” 1924).

Due to wireless, therefore, the role of the air changed dramatically compared to the past. Wireless mediatized time signals and weather forecasting at the international level and enabled the popularization and synchronization of time and weather information, providing synchronous access to more and more ordinary people in different places on the earth. Additionally, with wireless, the air started to be seen as a content provider and a space where relevant and popular pieces of information, such as time signals and weather forecasts, were floating around. Overall, this means that the mediatized air introduced new social and cultural practices. This can also be interpreted as an example for the mediatization of everyday life (see also Couldry & Hepp, 2013; Hepp & Krotz, 2014; Kortti, 2017).

Moreover, this caused another relevant change: the mediatization of the air by wireless also contributed to changes in wireless telegraphy itself. In fact, this technology, previously seen mainly as a point-to-point device of communication, began to turn into a broadcast medium, one through which people could entertain themselves at home. This transformation of the medium, often considered a rather sudden phenomenon that occurred in the 1920s, actually originated in the early 20th century with the possibility of listening to contents floating in the air.

New ways of traveling

The new mediatized airspace also changed how transportation was seen—especially by the old navy and the new aviation. The airspace became a channel through which information could be exchanged between moving entities, which was extremely helpful for improving security in motion. Prior to wireless, boats were hardly communicating during their trips, and aviation endured many air crashes because they lacked a technical infrastructure for information exchange. In other words, both transportation infrastructures lacked a form of info-structure (Gras, 1997; Joerges, 1988).

It is no coincidence that the first international conferences on wireless intensively discussed improvements to vessels and later to planes, in particular equipping them with wireless technology. At the 1903 Berlin conference, politicians acknowledged that wireless represented a radical change for security in transportation, in particular as ships, previously "powerless to demand assistance", were now able to call for aid (ITU Archives, 1903b). Already in 1906, the SOS-signal was adopted as an international distress call, and gradually, 'SOS' even entered the culture to become an everyday word. The most symbolic event for this field was the sinking of the Titanic in 1912 (Heyer, 2012). Although the wireless distress signal was picked up by several

ships, wireless could have saved even more lives if all the ships around the Titanic had been "on air." The deliberate negligence of the airspace and the prioritization of ship-to-shore communication played a tragic role in the 1912 Titanic disaster (United States Senate, 1912). Delegates to the 1912 ITU conference shared the opinion that wireless communication *between ships* must also be taken under control:

> "The disaster of the Titanic has once again highlighted the enormous benefits of wireless telegraphy in rescuing. This terrible tragedy has also made us feel how desirable it is that more complete and rigorous provisions should be concerted to ensure communication between ships and also between ships and land, in order to provide for cases of distress. (ITU Archives, 1913, authors' translation from French).

This is the main reason why the 1912 international conference on wireless held in London required that henceforth, large vessels had to be equipped with wireless apparatus in order to use this invisible safety network literally built in the air.

Aviation is a slightly different case: while national borders, time signals, weather forecasting, and water transport existed long before wireless (although all were reshaped by it), aviation and wireless grew up together at the beginning of the 20th century. More precisely, wireless communications favored the spread of aviation. First, similarly to boats, before wireless sets were placed on board aircraft, the latter had no information while flying and thus had to land to receive all reports and to change course, which therefore lengthened the flight ("La télégraphie sans fils et l'aérostation," 1909). Wireless allowed direct communication with other planes and dispatchers to and from airports, thus facilitating navigation in the sky. Moreover, thanks to wireless transmission, planes could pick up international time and weather reports. As a consequence, air travel became a safe and reliable form of transportation, making aviation a

typical Large Technical System (see Gras, 1993, on radar and plane traffic). In short, the mobility of information provided by wireless technologies supported the mobility of transportation, clearly demonstrating that aviation was indeed a "mediated technology of the distance" (Morley, 2011). Even though dots-and-dashes transmission seems quite a difficult way to communicate with the ground, it was still the only way to avoid crashes, navigate the sky, synchronize plane movements, and forecast weather conditions. In this regard, wireless also had a tangible and material effect on the construction of the first planes in terms of space and balance, as these planes were also especially constructed to include wireless devices and even a special seat for a wireless operator, next to the pilot ("An interesting lecture," 1914, "Military aviation," 1914, "Worries of Wartime," 1915).

The international discussion on regulating wireless and aviation began simultaneously with the first inventions of gliders and airplanes in the 1890s-1900s and reached the international arena in only a few years. Jurists agreed that aerial navigation and wireless telegraphy were related topics and had to be treated together legally with respect to international law (Viola, 1912). There were several attempts to regulate wireless in the area of aviation: at the 1906 and 1912 conferences about radiotelegraphy in Berlin and London respectively, and at the Institute of International Law with a specific project on wireless and aviation (The Institute of International Law, 1913). However, these initiatives were unable to solve the bigger contradiction of the national sovereignty in the air, mentioned above. Only after World War I, when the ideal of complete "freedom in the air" dissipated, did governments formulate the Paris Convention on aerial regulation in 1919 (MacKenzie, 2010, p. 15). Having discarded the viewpoint of strict sovereignty, international politics chose to follow the "territorial airspace model" for aviation, that is, limited freedom of the air with the right of the subjacent states to take certain measures to

ensure national security (Stadlmeier, 1998). However, even after this big step forward, aerial regulation was still affected by ITU agreements: modification of the use of wavelengths by aircraft stations by the Radiotelegraph Convention on the ITU conference in Washington in 1927 resulted in the amendment of the aerial Paris Convention of 1919.

Overall, aviation contributed to reshaping the perception of the air and the socio-cultural role of this space of communication at the beginning of the 20th century, when aviation conquered the air and the sky on a worldwide scale. The "mediatized air" played a crucial role and was, at the same time, a necessary precondition for this development. First, with its mediatization, the air gradually became a safe and regulated sphere and channel of transportation; second, aviation passed from the arena of national control to an international level or, more generally, the "mediatized air" became a supranational and symbolic space where planes from different countries transported people from country to country. In the field of transportation, therefore, wireless changed the ways sailors, pilots, and passengers used the air. Thus, the "mediatized air" became a symbolic place for keeping in contact, spending time, or even being saved. With its important implications, the new "mediatized air" transformed the world of transportation, making it more transnational, connected, safe and controlled.

The convergent power of the "mediatized air"

So far, we have treated the different fields that were transformed during the mediatization of the air separately. It must, however, be emphasized that another implication was the connection and increasing interrelation of these previously distinct areas.

Time signals and meteorology partly relied on the same network of wireless stations for transmitting their signals. Often, weather reports were immediately followed by the transmission

of time signals. Additionally, meteorologists, aside from transmitting and receiving news about weather changes and weather data, relied heavily on the transmission of exact time signals required for the calibration of seismographs. Originally, the transmission of weather reports was scheduled at midnight specifically to avoid interferences with other transmissions. ("Avertissements météorologiques," 1908). However, technical solutions do not exist in a social vacuum, as seen from the following anecdote: as meteorological and seismological station staff were not willing to work night shifts (and following the request of weather offices), signal timetables were soon changed to 11 a.m. starting in 1912. This facilitated the reception by meteorological stations and acknowledged the desire for more extensive daytime listening ("Il telegrafo senza fili e la meteorologia," 1911).

Navigation in the sea and in the sky was intertwined with time signals and weather reports transmitted via wireless. Vessels depended on wireless weather transmissions for an awareness of possible storms, and time signals served as the basis of on-board chronometers. Moreover, the regularity of transmissions itself allowed one to calculate the longitude, earth shape, and wind direction by comparing signals from different wireless stations and to calculate the possible interferences and disturbances in the signal (Lockyer, 1913, p. 3), in other words, to do manually what a GPS receiver does automatically today. It is not by chance that wireless companies saw ships and airplane companies as their main clients; thus, wireless news was decisively shaped by the needs of the transportation field.

As we have seen, international organizations of wireless, time, geography and aviation followed each other's recommendations, creating a reciprocal influence. Different international meetings discussed similar questions, such as bordering and restricting the airspace, or assigning frequencies to the wireless content. An understanding of wireless as a useful technology only

emerged gradually, having been initially obscured by the fear of wireless as an invader of national space.

There were also human actors that individually played an important role at the intersection of these fields. For instance, Edmond Rothé, a professor of physics at the University of Nancy, left his mark on aviation as a founder of a university institute of aerodynamics and as technical secretary of the Society of Friends of Aviation (SAA) (Rollet & Nabonnand, 2014, p. 351). His biography reveals that many of his achievements were due to successful experiments with wireless technology. Already in 1910, he had established regular wireless communication between the Paris Observatory and the Nancy Faculty of Sciences to receive time signals (Saint-Martin, 2008, pp. 278–283). With his colleague Maurice Gueritot, Edmond Rothé published several papers on wireless and its application to aviation and meteorology. He followed the news of the International Telegraph Union and even wrote specific requests for providing information about wireless communication. During World War I, Rothé joined the radiographic service of the military hospital in Nancy and adapted wireless to military planes. Therefore, he shared with both his university colleagues and his army comrades a new vision of the air as a mediatized space useful for different technologies.

All these interrelations show that previously discrete fields began to intersect and depend on one another in terms of infrastructure, technology, regulations and actors. The “mediatized air” promoted a consolidation of these different realms based on a particular media platform: wireless. The content flowed across different fields, enabling cooperation between various actors and experts. The audience followed and applied the innovations in various forms. Overall, this can be considered a form of technological convergence (Jenkins, 2006), long before the advent of digital culture.

Conclusion

By examining the advent of wireless telegraphy, this historical study has presented empirical findings on the mediatization of the air at the start of the 20th century. This process impacted political negotiations and had social implications on aerial borders, time signals, weather forecasting, sea navigation, aviation, and on the correlations in these fields. This study also contributes to historical mediatization research, particularly shedding light on phenomena that are taken for granted and thus tend to remain invisible, e.g., what we called the "mediatized air." Today, the mediatized air is a key feature of contemporary communication—from the national and international scales of wireless networks, mobile phones, and broadcasting signals to the personal level of wireless earphones and devices "designed for a wireless future" (per an iPhone X advertisement). However, this basic infrastructure has not yet been discussed by mediatization theorists or, more generally, in communication research. The study thus adds a thus far understudied topic and empirical findings to the broad theoretical approach of the social constructivist tradition of mediatization theory that seeks to comprehend and examine the mutual long-term processes of media and socio-cultural change.

Our research highlights the decisive impact of the mediatized air on various spheres at the beginning of the 20th century. Because of the mediatized air, politicians, engineers, meteorologists, watchmakers, pilots, and sailors had to follow new regulations, use new technical infrastructures, and adapt their everyday routines and practices. In terms of communication policy, the mediatized air was a problematic issue, as wireless was created for global communication and thus necessarily transcended national borders with different regulatory rules and law. For this reason, since its invention, wireless was prominently but controversially discussed in European society. To benefit from this technological innovation, immediate

transnational regulations were required. Moreover, wireless also impacted other fields, such as timekeeping and meteorology. The mediatized air also facilitated the synchronization and even the entertainment of people at national and international levels, thus affecting the everyday lives of listeners. Corresponding to the mutual relationships between media and socio-cultural change foreseen by mediatization research, these transforming practices were at the same time transforming wireless telegraphy itself. Hence, the previously point-to-point technology for private communication gradually developed into a mass medium later called broadcasting. Then, the mediatized air enabled mobile communication, which was essential for transportation between moving entities—such as ships and planes—and fixed ones. Our historical study also elucidates that mediatization impacted separate and supposedly unrelated fields, creating new and strong links between them.

To understand and fully grasp these links, we have analyzed both sources on wireless telegraphy and sources produced in non-media-related fields, such as international law, timekeeping, meteorology, aviation, and navigation. The inclusion of seemingly non-media-related realms in empirical mediatization research (see, e.g., Krotz, 2014a) is essential to avoid an "overly media-centered explanation" (Stanyer & Mihelj, 2016, p. 274) when examining media change. Sources from non-media-related fields helped to reexamine the mediatized air through new lenses and see it as a social construction that is created in negotiations of different media- and non-media-related social groups. We thus argue that new historical sources can bring new meanings to old realms and taken-for-granted ideas.

This study also contributes to contesting the "newness" of digital media, showing that mediatization processes are not only made of breaks and changes but also of continuities. For example, scholars often consider negotiations about cross-border communication something that

emerged in recent decades with the spread of satellite communication, GPS signals, the internet, and mobile phones. However, at the beginning of the 20th century, the mediatized air raised many regulatory problems related to national sovereignty, the internationalization and homogenization of time, and supranational networks of transportation. In other words, this study highlights that recent mediatization processes often have relevant historical roots.

Finally, historical mediatization research can stimulate further (historical or non-historical) studies on mediatization. The mediatization of time can include reflections on how the transmission of time signals changed the meaning of synchronicity. Studies on the mediatization of entertainment should also discuss the role of wireless as a content provider. Studies on the mediatization of collaborative work might be inspired by how watchmakers and seismologists exchanged information through wireless networks. Human geography could further investigate the role of media in transforming geographical space, mobility, and the perception of national borders. We also hope that studies focusing on a long-term perspective of mediatization may benefit from our waves-based approach to the mediatization of the air. This could also stimulate a continuous and *longue durée* view of mediatization, literally from smoke signals to digital wireless connections.

Every new historical study on mediatization can shed light on alternative stories and unknown perspectives on mediatization, thus challenging established narratives. Our case shows that wireless telegraphy not only used air as a channel, but also transformed it. Still invisible, intangible, and unperceivable, the air that holds our communication practices in place today, is not “natural,” but it was socially constructed and mediatized over time.

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Figure 1. Begg, S. (1913). Greenwich Time from Paris. *Illustrated London News*, August (3876), 166.