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Artículo Académico

SOCIAL ISOLATION POLICIES AGAINST CORONAVIRUS PANDEMIC AND ITS IMPACT ON METEOROLOGICAL OBSERVING SYSTEMS

POLÍTICAS DE AISLAMIENTO SOCIAL CONTRA LA PANDEMIA DEL CORONAVIRUS Y SU IMPACTO EN LOS SISTEMAS DE OBSERVACIÓN METEOROLÓGICA

María Alejandra Ruano[1], Manuel Zambrano[2]

Palabras clave: COVID-19; observación meteorológica; aviación comercial; satélites meteorológicos; atmósfera; clima

Resumen
La pandemia por COVID-19 ha obligado a la mayoría de los países del mundo a adoptar políticas estrictas de aislamiento social. Como consecuencia, ha habido efectos indirectos positivos y negativos sobre el medio ambiente. Por ejemplo, algunos países han informado mejoras en la calidad del aire, playas más limpias y disminución del ruido ambiental. Sin embargo, también ha habido efectos indirectos negativos. Esta investigación tiene como objetivo analizar los efectos de las políticas de aislamiento social en los sistemas de observación meteorológica. Se encontró que las observaciones meteorológicas desde aeronaves, así como las observaciones desde la superficie, se han visto muy afectadas. En menor medida, las mediciones marinas y satelitales se han visto afectadas. Nuestra investigación destaca la importancia de tener un sistema de observación meteorológica automatizado y resistente, así como métodos complementarios para monitorear la atmósfera y el clima.
Códigos JEL: Q52, Q54

Keywords: COVID-19; meteorological observation; commercial aircraft; meteorological satellites; atmosphere; weather

Abstract

The COVID-19 pandemic has forced most countries in the world to adopt strict policies of social isolation. As a consequence, there have been positive and negative indirect effects on the environment. For example, some countries have reported improvements in air quality, cleaner beaches, and decreased environmental noise. However, there have also been negative indirect effects. This research aims to analyze the effects of social isolation policies on meteorological observation systems. It was found that the meteorological observations from aircraft as well as surface-based observations have been strongly affected. To a lesser extent, marine and satellite measurements have been affected. Our research highlights the importance of having a resilient and automated meteorological observation system, as well as complementary methods of monitoring the atmosphere and weather.

[1] Escuela Superior Politécnica del Litoral, Facultad de Ciencias Sociales y Humanísticas, ESPOL, Campus "Gustavo Galindo", Km. 30.5 vía Perimetral, Cuarto paradero, Guayaquil, (Ecuador).
E-mail: maruano@espol.edu.ec
[2] Universidad Espíritu Santo (UEES), (Ecuador).
E-mail: manuelzambranom@uees.edu.ec

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INTRODUCCTION

The rapid spread of the coronavirus disease, COVID-19, is causing fatalities worldwide since its first detection in December 2019 (Li et al., 2020). A coronavirus (SARS-CoV-2) with no previous history of infecting human beings started this pandemic. In early 2020, the World Health Organization (WHO) declared this coronavirus disease to be a public health emergency of international concern (He et al., 2020).

One of the indirect effects recently noted by the World Meteorological Organization (WMO) is on the quantity and quality of meteorological observations and forecasts, as well as in the atmosphere and climate monitoring activities (WMO, 2020).

Although the National Meteorological and Hydrological Services (NMHSs) continue to provide real-time information without interruption due to its automation, the cessation of economic activities as a result of the COVID-19 pandemic is putting its normal operation at risk. This risk is because the repair, maintenance, and provisioning of the equipment have been discontinued. Also, meteorological measurements taken from aircraft have dropped by an average of 75-80% in comparison to the normal number of measurements taken. Although there are very marked differences depending on the region in question: in the southern region of the planet, the decrease is practically 90% (WMO, 2020). For their part, surface-based meteorological observations have also been affected, mainly in Africa and parts of Central and South America, where many stations are not automated and constantly require manual operation.

This research aims to expose the indirect effects of COVID-19 on the different sources of meteorological information, which allow providing information on the state of the atmosphere and the surface of the ocean. Thanks to these data, analyzes, forecasts, and meteorological warnings are made, so analyzing their correct operation is of utmost importance to the world. After the literature was reviewed, there is no evidence of previous work on the subject, so this research seeks to fill this theoretical gap. The rest of the article is structured as follows: in section 2, the indirect effects of COVID-19 on each of the meteorological data sources are detailed, and section 3 concludes with the main findings.

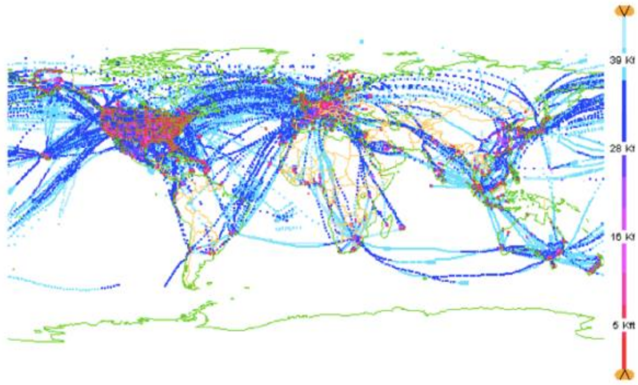
METEOROLOGICAL DATA SOURCES

Observations from aircraft

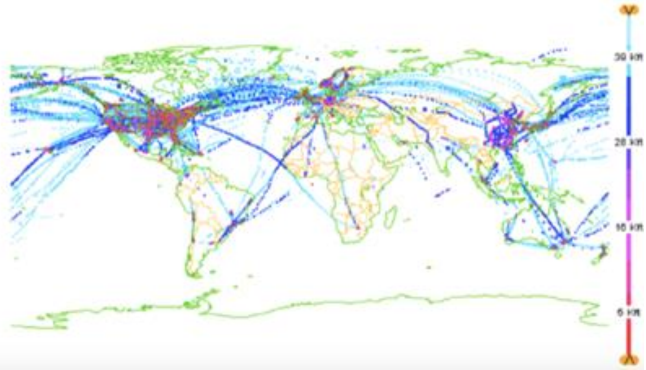
In addition to offering air transport services to people, commercial aircraft automatically collect, process and transmit meteorological observations to ground stations via satellite or radio links. This operation is possible because aircraft have sensors, computers, and communications systems that allow them to collect such information.

Figure 1. Transmission of meteorological information from commercial aircraft.

Date: January 31 2020



Date: May 4 2020



Source: WMO (2020)

With the observation system of the Aircraft Meteorological Data Relay (AMDAR), approximately 800,000 observations are generated daily on air temperature and wind speed and direction. Also, an increasing number of humidity and turbulence measurements are obtained. Currently, 43 airlines and several thousand aircraft contribute to the AMDAR Program, from which a notable expansion would be expected in the coming years as a result of the participation of the International Air Transport Association (IATA) in it (WMO, 2020).

As a result of the COVID-19 pandemic, commercial flights have decreased dramatically and with it the transmission of meteorological information. Thus, in certain parts of the world, the meteorological information provided by commercial aircraft has dropped between 75% to 80%. The drop is close to 90% in some of the most vulnerable areas where other surface-based observations are scarce, for example, in the tropics and the southern hemisphere. Figure 1 shows the decrease in the transmission of meteorological information of commercial aircraft from January 2020 (without the pandemic) to May 2020 (with the pandemic).

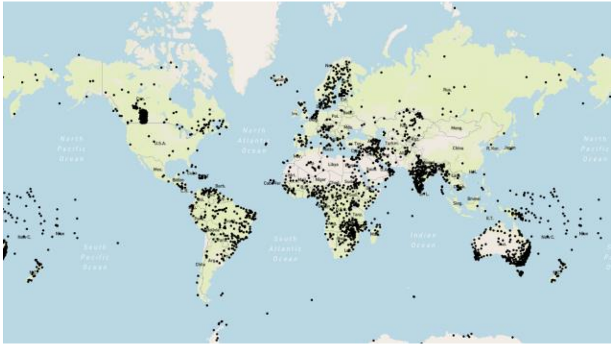
Surface-based observations

Most developed countries have automatic surface weather stations, but not developing countries. In the latter, the collection of meteorological information is usually done manually and then transmitted to international networks for use in global weather and climate models.

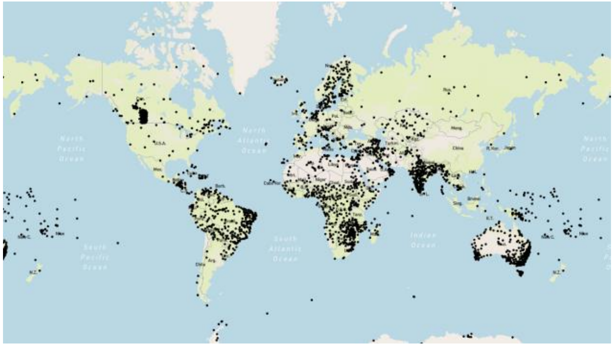
By establishing social isolation policies in most countries in the world, manual weather collection processes have been severely affected. Figure 2 shows that this has occurred mainly in African countries and some in Central and South American countries.

Figure 2. Countries that have not transmitted surface-based meteorological information.

Date: October 1 2019



Date: April 28 2020



Source: WDQMS (2020)

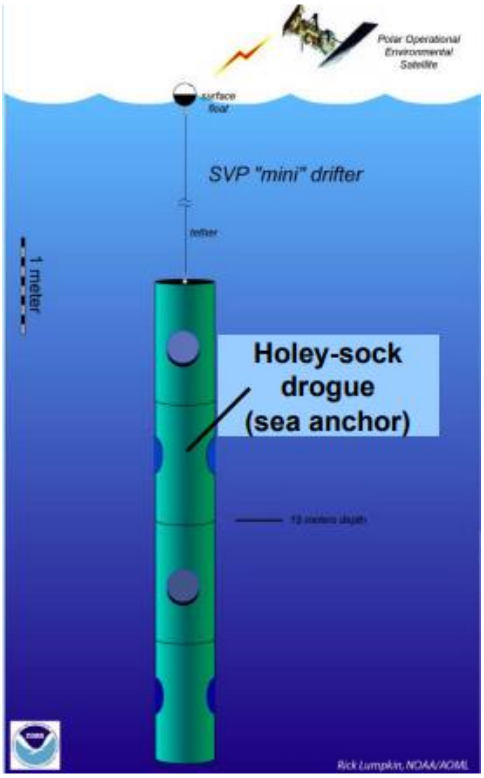
Marine observations

The oceans cover about 71% of the Earth's surface (Rahmstorf, 2002). Therefore, many meteorological observation systems are located over most of the world's oceans.

Most ocean observing systems are automated, so much of their components are expected to continue to function correctly for several months.

However, special instruments such as drifting buoys and floats will have to be deployed again . The moored buoys require constant repairs, as well as the observation systems onboard ships, which must frequently undergo maintenance, calibration, and replenishment operations. Therefore, it is expected that, over time, there will be a gradual decrease in the number of observations, and that this reduction will continue until the necessary provisioning and maintenance activities can be resumed (WMO, 2020).

Figure 3. Spherical surface float.



Source: Lumpkin (2010).

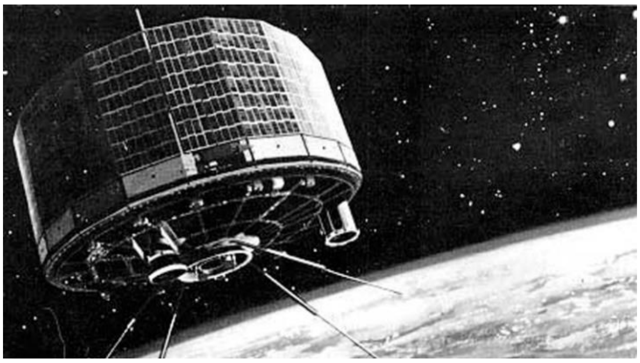
Observations by meteorological satellites

Since the launch of the first meteorological satellite in April 1960 (Figure 4), meteorological satellites have become an indispensable part of the basic and strategic resources for economic and social development in all countries of the world. As environmental pollution problems, resource scarcity, and natural disasters get worse and worse, the role of meteorological satellites in weather forecasting, environmental monitoring, and disaster mitigation and prevention has become more important than never (Guo et al. 2019; Zhou et al., 2006).

The operational stability of meteorological satellites has made much of the scientific community trust in its ability to observe the climate. Currently, 30 meteorological satellites and 200 research satellites provide continuous and highly automated observations (WMO, 2020).

These satellites are operated by members of the Coordination Group for Meteorological Satellites (CGMS) and the Committee on Earth Observation Satellites (CEOS). Although the spatial component of the observation system is expected to be unaffected and remain fully operational in the short term, international climate agencies should assess the possible long-term indirect impact of the COVID-19 pandemic on this type of artificial satellites.

Figure 4. The world's first weather satellite: TIROS-1



Source: NOAA (2016).

DISCUSSION

The new coronavirus has generated unprecedented impacts worldwide. Most countries have adopted strict measures of social isolation as a way to curb the spread of the disease. These measures have had significant indirect effects on the environment. For example, air quality has improved in many countries, environmental noise has decreased, and natural resources such as beaches are less polluted. However, there have also been negative side effects.

This research analyzes the indirect effects of COVID-19 on the different meteorological observation systems. Meteorological observation systems are important because they provide information about the state of the atmosphere and the surface of the ocean employing terrestrial, marine, and spatial instruments. Thanks to these data, analysis, forecasts, and meteorological warnings are prepared.

On the one hand, the flow of commercial aircraft travel has decreased. As a consequence, meteorological reports from this type of source have also fallen. Some countries are conducting additional radiosonde launches in order to partially mitigate the loss of aircraft data, particularly in Europe. These types of instruments are launched with the help of weather balloons. On their journey from the surface to altitudes that can reach 30 kilometers, they transmit measurements of fundamental meteorological variables (WMO, 2020).

On the other hand, meteorological information from surface-based sources has also fallen. An explanation for this lies in the fact that many of these sources are not automated, and therefore require human intervention for their proper functioning. As quarantine policies are in force in most countries, the latter has not been possible. The mainly affected regions are in Africa, Central, and South America.

Marine and satellite weather sources have been least affected by social isolation measures. This is because these sources are automated in their operation and require little human intervention (just for maintenance). However, some projects in operation, such as the Voluntary Observing Ship Program (VOS), have suffered a reduction in the amount of data available of about 20% with respect to the usual levels (WMO, 2020).

Although the global impact of the reduction in meteorological observations may not be thoroughly evaluated or fully understood until long after the pandemic has ended, the new coronavirus clearly highlights the importance of having a resilient and automated meteorological observation system, as well as complementary methods of monitoring the atmosphere and climate.

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