CISSM
Center for International and Security Studies at Maryland
School of Public Policy, University of Maryland

Policy Brief **September 2013**

International Cooperation in Climate Monitoring via Satellite: Incentives and Barriers to Data Sharing

By Mariel Borowitz

Executive Summary

Understanding and addressing climate change requires the collection of a significant amount of environmental data. Satellites offer the best method for collecting much of this data, but given the high costs of satellite systems, it is not practical for one nation to collect all relevant climate data on its own. Further, much of the data currently collected by civilian government systems is not shared freely. Barriers to access for this data reduce both scientific research and operational use, decreasing the overall social benefit from the data. To help understand why data is shared in some cases and not others, and how policy-making in this area might be improved, this brief examines the development of data sharing policies and identifies the barriers and incentives to international sharing of climate data collected by satellites.

Introduction

Quantitative analysis of satellite data-sharing policies for Earth observation data, as well as case studies of domestic agencies in the U.S., Europe, and Japan, show that limits in data sharing are due to 1) a belief that data can efficiently be treated as a commodity, a viewpoint that conflicts with experience for nearly all climate data; 2) the lack of recognition of the normative justification for sharing climate data, though this norm exists for weather data; and 3) insufficient agreement that international cooperation and data sharing are required to adequately monitor climate change. These limits exist due to uncertainties about the nature of the market for climate data, an inadequate understanding of climate impacts and the ability to mitigate them, and an inadequate understanding of the requirements of climate science and operational activities.

To address this situation, countries should adopt free and open policies for government-collected climate data, recognizing that social benefit is maximized when data is treated as a public good

and freely shared, and that cost recovery and commercialization of scientific satellite data are not viable. Countries should also share climate data internationally, because it has the potential to save lives and property, creating a moral requirement for sharing. Finally, countries should agree on a minimal set of climate data that must be shared to adequately monitor climate. This agreement should be institutionalized by a World Meteorological Organization (WMO) resolution framework, similar to WMO Resolution 40, which addressed weather data sharing.

Importance of satellite data sharing for climate

Satellites are particularly useful for climate change research because of their global coverage and unique vantage point—they are able to collect data over the oceans, arctic areas, and other sparsely populated zones where data can't be collected as comprehensively using any other method. They also provide monitoring that uses a consistent method over both space and time, which allows for a high level of consistency.

The Global Climate Observation System (GCOS) organization developed a list of approximately 50 "Essential Climate Variables" (ECVs) that are required to support the work of the Intergovernmental Panel on Climate Change (IPCC). About half of these variables were designated as largely dependent on satellites. Given the high cost of satellite Earth observation technology, it is impractical for any one country to collect data on all of these variables on its own. International cooperation will be required to determine which country or countries collect different types of data, and to ensure that the data that is collected is shared. This brief focuses on the latter.

Satellite data-sharing policies are generally written by the agencies responsible for operating a space-faring nation's satellites, and agencies often make distinctions on data-sharing procedures that vary depending on the specific satellite and instrument. There were 186 unclassified government satellites carrying 483 instruments that operated at some time between 2000 and 2012. Data from only about 40 percent of these instruments is currently available for free without any restrictions. Another 25 percent is available for free with some restrictions, usually limiting access to and redistribution of the data. Even this low level of restriction can pose a challenge, particularly for climate modeling projects, which require inputs from many different sources. For example, if a modeler has to submit applications for access to each dataset or if sharing of the model or model results is limited by redistribution restrictions, this can significantly slow progress. Data from the remaining 35 percent of instruments is significantly more difficult to access.

The evolution of data-sharing policies

The research on which this brief is based examines why 60 percent of satellite instruments collecting climate-relevant data are subject to some costs and restrictions, and what arguments or information drive agencies to choose these policies. To do so, it uses case studies of seven agencies across three countries, including the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), the United States Geological Survey (USGS), the European Space Agency (ESA), the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), the Japan Aerospace Exploration Agency (JAXA), and the Japan Meteorological Agency (JMA). More than 30 countries are involved in satellite Earth observations, but these three countries/regions—the United States, Europe, and Japan—represent three of the largest climate-relevant Earth observation satellite programs in the world. Together, they account for approximately 50 percent of the space-based instruments that collected data on ECVs from 2000 to 2012.

The case studies show similar patterns in satellite data sharing policy development and changes over time, although there is still significant variation. Every agency began with a period of informal data sharing. This was in part because the satellite systems were new and the technology for sharing data was limited. It was also a period during which agencies were trying to understand the value of the data. As they gained experience with these systems, nations found that the data collected by Earth observation satellites was very useful, and they began to try to capture the commercial value of this data. In some cases, this was done through government data sales or full commercialization of the system. In other cases, countries tried to distinguish between research and commercial users, charging fees for commercial users only.

Following this period of data sales, many of the agencies transitioned back to free and open data-sharing policies. NASA was the first to do so, arguing that sharing data freely maximized the number of researchers using its data, which was essential to achieving NASA's mission of promoting research and providing an improved understanding of the Earth. NOAA and USGS also transitioned to free and open data sharing, but only after attempts to sell data collected by their satellites failed—resulting in low revenues and significant reductions in data use. Similarly, in recent years, ESA and EUMETSAT have acknowledged that revenues from sales of Earth observation satellite data have been limited, and that free and open data sharing seems to provide greater benefits for member countries through increased research and value-added sector activity. JAXA and JMA continue to operate under more restrictive data-sharing policies that allow for data sales.

Explaining data-sharing policies

Interviews and analysis of documents carried out for these case studies showed that three substantive areas were key to the transitions in data-sharing policies across the seven agencies. Economic arguments, normative arguments, and arguments about international cooperation were the major areas of debate and concern in developing satellite data sharing policies. The agencies' positions on these three issues were central to determining their policies, with differences in positions due to differing opinions among stakeholder groups driven by a few key uncertainties in each area.

In terms of economic arguments, agency officials tend to argue for free and open data sharing. They argue that data use provides increasing returns—the more the data is used, the greater the overall benefit. Making the data freely available maximizes the number of people that will use it, creating benefits in terms of new scientific knowledge and value-added products, such as a better understanding of trends in global precipitation or information services aimed at improving agricultural efficiency. Many agencies argue that these policies allow them to best achieve their mission.

Officials that are more concerned with their budget as a whole, such as members of Congress or officials from the Office of Management and Budget (OMB), are often interested in the ability of data sales to reduce budget pressures. They argue that government data sales have the potential to provide revenue to offset costs, and that the transition of Earth-observing satellite activities to the commercial sector can remove the program from the government budget altogether.

There are three key uncertainties with regard to economic arguments. First, is there a viable commercial market for satellite data (i.e. will people actually pay for the data and can you make significant revenues from data sales)? Second, what is the elasticity of demand (i.e. if you raise the price a small amount, will most people continue using the data, or will many people stop using it)? Finally, if you aren't selling the data, how do you quantify the non-monetary benefits (i.e. what is the overall social benefit of the research being done or value-added products being developed)?

Over time, a number of these key uncertainties have largely been answered by experience. There does not seem to be a viable commercial market for most satellite-collected climate data—revenues from data sales are generally very low. The elasticity of demand, however, is very high—when the price was raised even a small amount, significantly fewer people used the data. Further, studies have shown that the benefits of using data for science and value-added products are quite high. Based on the information available now, agencies in the United States and the European Union have decided that free and open data-sharing policies are usually the best option

for maximizing economic efficiency, and sales of scientific data are not commercially viable in most cases. The Japanese agencies have not yet reached this conclusion.

Interestingly, despite evidence that free and open data-sharing policies seem to maximize economic efficiency, the desire to sell data remains high, particularly among government officials concerned with the budget as a whole. In general, countries seem to follow the rule of thumb that "if you can sell it, you will sell it." High-resolution satellite imagery, for example, is still sold throughout the world, and not available for free. In Europe, this data is collected and sold by public-private partnerships, and in the United States, private companies sell high-resolution imagery, depending on the government as an anchor client.

Normative arguments are the second key determinant in data-sharing policies. Unlike economic arguments, the key difference in position here is not between agency and legislative officials, but instead between the weather and climate communities. In the weather community, it is widely agreed that certain types of data must be shared for ethical reasons. For example, it would be technically possible for the government to sell hurricane warnings, and people would be willing to pay a significant amount of money to access those warnings. However, the government doesn't even consider doing this because of the obvious moral implications.

Climate data, in contrast, also has the capability to contribute to forecasting and advanced information that could help to save lives and protect property, but the moral responsibility to share this data is not nearly as widely agreed upon. This is driven in part by a lack of understanding among many people, including policy-makers, of the links between climate data and protection of life and property. It is clear to most people how severe weather, such as a hurricane, causes loss of life and property and also clear how accurate weather forecasts can help reduce these losses. These links exist for climate data, too, though they are not often acknowledged. Since satellite data is important for improving climate forecasts that can protect lives and property, such as those for long-term floods or droughts, one could also argue that there is a moral obligation to share this data. Yet, this argument has not yet gained traction, likely because of the relatively new and politically heated nature of climate science or the more long-term nature of climate change, compared to the long history and widely recognized importance of weather research as well as the immediacy of severe weather events.

The third key determinant in data-sharing policies has to do with the need for international cooperation. Again, the largest difference observed here is between the weather and climate agencies. In the weather community, it is well accepted that international cooperation is required to adequately monitor and forecast the weather. International cooperation on weather monitoring has occurred in the World Meteorological Organization (WMO) and its predecessor, the International Meteorological Organization (IMO), since the mid-1800s—just after the telegraph was invented. As discussed above, there is also good reason to believe that international

cooperation is also required to adequately monitor global climate change. It's a global issue requiring more data than any one country can reasonably collect on its own. Both the WMO and the Group on Earth Observing Systems (GEO) recognize this need for international cooperation and seek to facilitate international satellite data sharing for climate and other environmental issues.

The key uncertainties driving differences in opinion on this topic revolve around exactly how much data is needed, which data is most important, and how the data can be shared. These are challenging questions for which international consensus has not yet been reached. GEO has the potential to play an important role in addressing this issue by continuing its efforts to encourage more open sharing by providing visibility and prestige to countries that do freely share their data and calling out nations that do not. However important they are, GEO's data-sharing principles are voluntary, and progress is incremental. Another way to address this issue would be to develop an agreement within the WMO. WMO members include agencies like the ones included in the case studies, and its resolutions are generally treated as binding. This organization has already successfully developed a resolution that addressed similar issues for weather data sharing, and a climate data-sharing agreement could follow the same template.

Policy recommendations

1. Nations should put in place free and open international data-sharing policies, and encourage other nations to do the same, to maximize economic efficiency and to meet moral obligations to protect life and property. This policy would be consistent with the best available evidence at this time.

2. Nations should develop a resolution within the WMO to identify essential climate data that must be shared freely to adequately monitor climate change. This resolution can be modeled after a similar resolution that was developed for weather data sharing (WMO Resolution 40). Concurrently, nations should continue to advocate for increased data sharing within GEO, building on its existing data sharing principles and activities.

3. Nations should support more informed satellite data-sharing policy-making by analyzing the effect of existing and past satellite data-sharing policies, and providing information that further reduces the key uncertainties discussed here, including economic efficiency of data-sharing policies, climate impacts and the value of climate forecasting, and operational climate requirements.

Summaries of determinants of data-sharing policy, key uncertainties, and policy implications

This table summarizes the determinants of data-sharing policies across agencies, the key uncertainties that affect each area, and the policy implication in each area.

	Economic	Normative	Institutional
Differing Perspectives	Agency officials feel free data maximizes use and therefore benefit (though this is hard to quantify) and is the best way to achieve their mission. Legislative/ budget officials believe cost recovery or commercial systems could reduce costs and/or create revenue (quantifiable benefit), and may not have substantial effect on data use.	Data sharing saves lives and property (argument strong with respect to weather data, weaker for climate data).	International cooperation is required to address the issue (argument strong with respect to weather data, weaker for climate data).
Key Uncertainties	Is there a commercial market for satellite data? What is the elasticity of demand? What are the benefits of data use?	Link between climate impacts and loss of life/ property. Link between climate data and adaptation/ mitigation of impacts (e.g. lives saved).	How much data is required? Which data must be shared? How can/ should it be shared and used (no history)?
Conclusions / Findings	Evidence and experience suggests that for almost all climate data, there is no commercial market, and elasticity is very high. There are a multitude of valuable data uses.	Advances in climate science are making the link between climate change and its impacts more clear; operational uses of climate data need to be further developed.	Int'l organizations have shown that it is impossible for one country to collect all climate data on its own, international cooperation is required.
Policy Implications	It is most efficient for governments to treat data as a public good and make it freely available.	Climate data should be shared because of its ability to contribute to saving lives and property.	WMO should develop a resolution on climate data sharing. GEO should continue efforts to increase data sharing.

About the Author

Mariel Borowitz is an Assistant Professor in the Sam Nunn School of International Affairs at Georgia Tech. Dr. Borowitz earned a PhD in Public Policy at the University of Maryland, a Masters degree in International Science and Technology Policy from the George Washington University, and a Bachelor of Science degree in Aerospace Engineering from the Massachusetts Institute of Technology. She has also worked as a research analyst at the Space Foundation in Washington, D.C. This policy brief is drawn from the author's dissertation, "International Cooperation in Climate Monitoring via Satellite: Incentives and Barriers to Data Sharing" (University of Maryland, May 2013).