Future of International Cooperation in Observing Systems

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Background

Over the past decades, there have been great achievements in developing national, regional, and global observations systems. Although these milestone accomplishments will not be recounted here, we are truly standing on the shoulders of many giants, without whom, we would not have the progress we have seen to date. Who can imagine the world without Keeling's carbon dioxide record, the historical global surface air temperature record taken by hundreds of thousands of observation systems around the globe, or the incredible progress in real time data exchange in the field of meteorology by the members of the World Meteorological Organization (WMO)? It is a privilege to have been involved in some of these programs, including: early automated operational buoy systems; the Integrated Global Ocean Services System (IGOSS), an early joint effort by WMO and the Intergovernmental Oceanographic Commission (IOC) to develop an ocean observing system with associated services; and ocean observation data management through NOAA's National Oceanographic Data Center.

More recently, I had the honor to be involved in building the cooperative global environmental satellite program network with satellite agencies belonging to WMO members as well as participants in the Committee on Environmental Observing Satellites (CEOS). In this regard, special note is made of the contribution by the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) to that effort. Leaders of EUMETSAT — Dr. Lars Prahm today and Dr. Tillmann Mohr and John Morgan before him—paved the way for the international satellite cooperation we have today.

While there is no question the state of environmental observation systems has advanced through international cooperation, we still need more effort in this area to improve our global observation networks. Many lessons have been learned these past many years. These lessons can serve as the basis for a few recommendations for the future of international cooperation on observing

systems. Both lessons learned and recommendations are presented in this paper.

Lessons Learned

Observations and Data Management Should be Linked

Over the years, we have continued to make mistakes by considering observation systems without acknowledging the corresponding steps necessary for data management such as real time data transmission, delivery of data to real time modeling centers, data assimilation, data stewardship, and data archiving. In the author's view, good examples of data management structures associated with observation programs include the National Aeronautics and Space Administration's (NASA's) Earth Science Program and the international Argo system, which capitalizes on international cooperation for the buoys themselves, as well as buoy tracking, data distribution, and data quality control. On the other hand, while many operational satellite observation systems have grown in complexity, data volume, and, in fact, real value, the essential data management applications, such as data assimilation, data archiving, and data access, have not kept pace. Many organizations in many countries have this problem. A way must be found to guarantee the development and implementation of data management elements for every observation system, remote or *in situ*. . International discussions concerning data management should, wherever possible, include discussions of the relevant observing systems, and *vice versa*.

Fill Observation Gaps as soon as possible

In the late 1980s and early 1990s, I had the privilege of working with the distinguished scientist Dr. Francis Bretherton. Dr. Bretherton devoted part of his career to observations and their management. He made the simple, but still often overlooked statement that we must base our environmental records on observations, and each day that passes without the measurement of a needed parameter is a gap in the record, never to be filled. We can interpolate and model, but in the end, we can only guess at the values of parameters not measured during gaps. An extension of this statement is that the lack of exchange of or access to data also creates a gap in the record for those who cannot receive the data.

Promote Real Time Observations

WMO has been a leader in the exchange of near real time data, which supports the meteorological forecasting community. With each passing year, we recognize that timely access to and active distribution of real time data is essential to fields other than meteorology. For example, real time data are clearly useful if not critical during and after environmental disasters such as tsunamis. In general, data should be available for use immediately after the observation is taken, with due attention to quality issues. Whether it is tide information from the Pacific Ocean or ecosystem data from the Gulf of Mexico, each observation is potentially valuable from minute one.

The late Dr. Anthony (Tony) Hollingsworth, another great contributor to the success we have enjoyed over the years, often said that in addition to dreaming about the observations that could be taken, one has to learn to quickly use the real time observations already being taken. The satellite community could always count on his group at the European Center for Medium range Weather Forecasting(ECMWF) to use the data from new satellites first. Most often his efforts to use available observations improved model outputs. Other organizations have adopted this enthusiasm. The results of these efforts are based on the availability of real time observations.

Create Observation Inventories

While WMO maintains and improves both the satellite and *in situ* observing system inventories that support its service network, very little attention has been paid internationally to creating a broader inventory of global environmental observing systems. In the United States, NOAA began to inventory its observation systems in 2003 and found this activity useful as part of an end to end data management scheme. As a result of the inventory, all of NOAA community is now aware of NOAA's separate observing systems and how to access the data from them. This activity is one step in realizing the multiple uses of observation systems, and eventually, in designing multiple mission observation systems from the ground up. A global inventory would allow for similar discoveries on a broader scale. The Group on Earth Observations (GEO) is considering sponsoring such a global environmental observation system inventory. In the author's opinion, work on this inventory should be started soon. .

Cooperate on Transition of Research to Operations

In the United States, we are trying to improve the transition of valuable research observing systems into ongoing operational systems. Possible solutions to transition research systems may also be international in nature. For example, the research satellite altimetry systems of TOPEX/Poseidon and Jason-1, built by NASA and the French Space Agency (CNES), are now being considered for transition into an operational altimetry system sponsored by NOAA and EUMETSAT. .

Support both *in Situ* and Satellite Observing Systems

If countries could fulfill all of their requirements for global observations by building and deploying remote sensing satellite platforms, we could focus all our international cooperation on the satellite observations. However, countries of the world must rely on *in situ* systems as well. Among other organization, WMO and IOC are leaders in coordinating *in situ* observations. Joint planning for both *in situ* and remote sensing systems must continue to be done through international cooperation.

Future International Cooperation on Observations

There is no question that international cooperation on observations is necessary and will continue to be an important tool for advancing and actually planning Earth observations and corresponding data management systems. The challenge of achieving global and regional observations beyond national borders is beyond the reach of any single country. Part of the willingness of countries to participate internationally is the recognition that contributing to a global effort will only strengthen their in country programs. Also, it is increasingly recognized that data from one country may be the key to mitigating the impacts of the environment, for example disasters, in another country. Another reason for participation in international cooperation on observations is the rising costs of observing systems. Because of these rising costs, without additional funds, countries are able to fund fewer *in situ* and satellite systems. International cooperation for both *in situ* and remotely sensed observations lowers the total costs for any one participating country.

The Group on Earth Observations (GEO) was formed in 2005 to increase the recognition from countries concerning cooperation on global and regional observations, specifically the Global Earth Observation System of Systems (GEOSS). A goal of GEO is also to capture and continue to reaffirm the highest political support possible for Earth observations. This support is needed not just for new observations, but also to continue important observation systems that exist now. GEO provides the framework for Earth Observation Summits, such as the Fourth Earth Observation Summit held in South Africa this past November 2007. These summits trumpet the benefits to specific societal benefit areas from Earth observations and attempt to secure the ongoing necessary political support for the continuation and/or advancement of such observations. GEO keeps the political community informed and engaged on the topic of Earth observations. However, GEO depends on organizations such as WMO to continue to serve as intergovernmental organizations to deal with global cooperation on the specific design and implementation of observation systems. It remains to be seen if GEO can add continuing value to the promotion and execution of global observing platforms, but in the author's opinion it is off to a good start. .

One of the next big concerns in international cooperation in observation systems should be the implementation of the Global Climate Observing System (GCOS). Existing international organizations must take advantage of the opportunity that the recent emphasis on global climate change has created and the agreements that will eventually come out of discussions taking place now. We know that we must monitor the Earth's physical, chemical, and biological climate system, but we are lacking the necessary observations. While WMO and its partners have already identified GCOS priorities and have started the planning process, GEO can also contribute by advertising these priorities to GEO Members and helping to secure and then to maintain the political support necessary to ensure funding. In this time of global economic dependencies, it is important to use all measures available to maintain and even to increase the

support for these valuable Earth observing systems.

Recommendations and Conclusions

In the future, international cooperation in observing systems will be essential, just as it is now, and has been these many decades past. However, while there is no question Earth observation systems have advanced through international cooperation, we still need more effort in this area to improve our global observation networks. The following recommendations are based on the experience of the past forty years. Observations and data management should be planned together. International data policies such as the one being discussed within GEO should emphasize the real time exchange of observations. . A global observation inventory organized by platform and by data output should be created. The transition of observing systems from research to operations should be approached from an international perspective where it makes sense.

In closing, I would like to acknowledge the inspiration and leadership of Dr. Richard Hallgren, whom we are honoring in this first annual panel on the future of international cooperation on observation systems. Throughout his career, and still today, Dr. Hallgren has and continues to play a key role in international cooperation in environmental observations. Because of his leadership and that of the generation he has inspired, we can be very optimistic regarding the future of international cooperation on Earth observations continues.