Prediction as a Mechanism for Coping with Climate Variability and Change

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Introduction

There is much current discussion of climate variability and change, and the likely impacts upon our environment and society. Regardless of the degree to which climate variability and change result from anthropogenic influences, coping with both will be easier if we can predict what is coming, over a broad spectrum of time scales ranging from tomorrow's weather through the next season to as far in advance as science will permit.

The Earth's fluid envelope…oceans, atmosphere, lakes, streams…together with their interaction with land constitutes a coupled system. Examples abound:

- the important role of the oceans in long term atmospheric (climate) variability;
- the role of precipitation input to rivers and streams, ultimately affecting the health of the coastal ocean;
- the critical role of the oceans in supplying energy and moisture to cyclonic storms, both tropical and extratropical;
- the interaction of the land, atmosphere, and coastal ocean to generate sea-breeze circulations which affect energy use and air quality in coastal areas.

Policies that affect monitoring, prediction, and/or modifying the components of this coupled system should recognize that it is coupled.

Useful prediction of the Earth's fluid envelope involves three components: observations, modeling, and provision of services. Education and institutional arrangements are necessary to ensure that services are effective, dependable, and subject to continuous improvement.

Observations

The AMS is supportive of an integrated global observing system for monitoring the state of the coupled ocean-atmosphere-land system on a continuing basis. Such a system should be built by extending the existing system of *in situ* and remotely sensed observations of the oceans, atmosphere, rivers, streams, and lakes, ice-covered areas, and land surfaces, to be more comprehensive than at present. This integrated global observing system should be designed and operated with full recognition that the information that it will produce will have multiple uses.

In particular, the time is right for a major initiative in ocean observations, so that the state of the ocean through its depth at any time is known to the modeling centers of the world. The AMS urges that the Commission recommend and the Congress and the Administration support such an initiative as part of an international effort to implement an integrated global earth observing system.

Modeling

Comprehensive numerical models of the coupled system must also be coupled. Increasingly complex model representations of the climate system are now known to be essential for estimating the impact of increasing concentrations of greenhouse gases on climate variability and change. These representations certainly include modeling of the complete ocean circulation. Seasonal predictions of the El Nino-Southern Oscillation phenomenon require predictions of the sea surface temperature. In a much shorter-range example, accurate prediction of the evolution of tropical cyclone intensity requires a coupled ocean-atmosphere model that can faithfully depict the exchange of heat, momentum, and moisture across the air-sea interface. The AMS is strongly supportive of research to better understand the behavior of the coupled system, and to improve the models used to predict its evolution.

Services

From public investments in observing, analyzing, and predicting the Earth's physical environment, the public reasonably expects a benefit; namely in prediction and other environmental information services that help to protect life and property, enhance the nation's economy, and provide for national security. Such services, when provided as a "public good" return on the public investment, should also be organized according to the notion that the system is coupled. Thus, a recreational user of the coastal ocean should not have to seek ocean surface temperature from one source and wind information just above the surface from another.

All publicly financed information about the coupled Earth system should be available for the marginal cost of making it available. The AMS endorses unrestricted availability of publicly financed environmental information, unrestricted exchange of such information with other nations, and "public good" services based on the investment of public funds.

Education

Our continuing future ability to advance all these efforts – the observations, the modeling, the services – is predicated on a healthy educational system. In particular, we need strong educational programs in Earth system science that also stress the coupled, integrated nature of the system. These should underpin not only the training of professionals, but also K-12 education of the general populace. Only if the general populace and decisions makers in government and industry understand how use weather and climate predictions will such predictions be helpful in coping with climate variability and change.

Institutional Arrangements

Organizing the national effort to routinely observe the coupled Earth system, managing the information flow, modeling the coupled system, and providing services suggests that care should be taken to reflect the coupled characteristics of the system. Such arrangements should avoid separating oceans from atmosphere, weather from climate, or similar unhelpful distinctions. The AMS favors institutional arrangements which promote an integrated view of the coupled ocean-atmosphere-land system in monitoring, science, service, and policy. The AMS urges the Commission to recommend and the Administration and the Congress to support such arrangements internationally.

Nature manages to run a seamless Earth system; governments should try to do likewise.

Founded in 1919, the American Meteorological Society exists to advance the atmospheric and related oceanic and hydrologic sciences and their applications to services. AMS membership consists of over 11,000 scientists, practitioners, teachers, students, and weather enthusiasts worldwide. The AMS publishes nine peer-reviewed journals and the Bulletin of the AMS, conducts several scientific and technical conferences each year, operates a K-13 education program, a scholar/fellowship program, two professional certification programs, and an Atmospheric Policy Program.