Longer-term weather and environmental forecasts will provide enormous benefit

March 29 2016

Weather and environmental forecasts made several weeks to months in advance can someday be as widely used and essential as current predictions of tomorrow's weather are, but first more research and sustained investment are needed, says a new report from the National Academies of Sciences, Engineering, and Medicine. The committee that conducted the study and wrote the report developed a research agenda, outlining strategies to address the scientific and capability gaps that currently limit the accuracy and usefulness of long-term weather and ocean predictions.

Extending short-term forecasts to predict Earth system conditions—conditions in the atmosphere, ocean, or land surface—two weeks to 12 months into the future will help decision makers, such as local officials, farmers, military officers, or water resource managers, plan ahead and save lives, protect property, and increase economic vitality. For example, naval and commercial shipping routes could be better planned to avoid hazards or take advantage of favorable conditions predicted for the weeks ahead.

"We have a bold vision that subseasonal to seasonal forecasts, which look two weeks to up to a year in advance, will be as widely used a decade from now as daily and weekly weather forecasts are today," said committee chair Raymond J. Ban, Ban and Associates, LLC. "Even if such information never matches the level of confidence associated with tomorrow's weather forecast, it could still be used by individuals, businesses, and governments to make a large array of important

decisions. The path to realizing this vision and its inherent value will require focused effort on Earth system processes and predictions by both physical and social scientists. It's time to step up investment in building next-generation Earth system prediction capabilities."

The report outlines a 10-year agenda with four research strategies to make seasonal and subseasonal forecasts more accurate and relevant.

The first strategy is to better engage the community that uses forecast products, which includes resource managers, military planners, first responders, and other potential users across many sectors, the report says. Social and behavioral science research can help elucidate how current forecasts are being used and identify barriers that exist. The subseasonal to seasonal research and operational prediction community should be engaged in an ongoing dialogue with user communities in order to match what is scientifically feasible with what users find actionable, as both technical forecasting capabilities and user needs continually evolve.

The second strategy is to focus on increasing the skill and accuracy of subseasonal to seasonal forecasts, the report says. This will require improvements in all parts of the forecast systems, including expanding observations, improving data assimilation methods, reducing model errors, and improving methods for quantifying uncertainties and verifying forecasts outcomes.

The committee's third research strategy is to focus on improving the forecasts of extreme and disruptive events, such as winter storms, excessive rainfall events, and intense heat waves, and the consequences of unanticipated events caused by outside forces such as volcanoes, meteor impacts, and oil spills. Improved prediction of extreme and disruptive events and of the consequences of unanticipated forcing events would give communities more time to plan ahead and mitigate.

The development of advanced Earth system model components beyond the lower atmosphere, which has been the traditional focus of numerical weather prediction, also requires more attention, the committee noted. The final research strategy calls for developing more sophisticated models of the ocean, land surface, and cryosphere and other Earth system components and expanding predictions to include more variables relevant to subseasonal and seasonal decision making, such as air quality and sea-ice characteristics, in forecast models.

The report notes these research strategies will all require advances in the U.S. computational infrastructure to support subseasonal to seasonal forecasting and a national plan and investment strategy for the future. The sheer volume of observational data, data assimilation steps, and model output involved in this forecasting challenges the limits of current cyber-infrastructure. This growing subseasonal to seasonal field also needs a workforce able to cross traditional disciplinary boundaries within the Earth sciences, between computing and physical science fields, and to bridge the divide between researchers and decision makers.

Provided by National Academy of Sciences