Planning and evaluating climate observing systems of the future

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Observations are needed to respond to critical needs of climate science. Five high priority areas have been identified for climate research by the World Climate Research Program: clouds, circulation and climate sensitivity; regional sea level change and coastal impacts; melting ice; climate extremes; and water availability. Each of these challenges involves many important scientific questions that can be focused around three themes of long-term changes, mechanisms and projections. For some of these questions, a primary challenge to scientific progress is the lack of appropriate observations.

Within the US there is an effort to identify observationally limited scientific questions around the framework of these grand challenges. The first part of the challenge is to develop appropriate hypotheses and identify the observations that are needed to address these hypotheses. The second part of the challenge is to critically evaluate proposed observing systems to determine their appropriateness for addressing the scientific question.

At a minimum, proposed observing systems will need to have the accuracy, spatial coverage/resolution, temporal resolution and completeness to address the scientific hypotheses. The evaluation of these criteria is best carried out as an independent effort to assure that the investments are appropriate and the science needs are adequately addressed.

This presentation will summarize the efforts to coordinate these ideas within the US and offer examples of approaches for evaluation of planned observing systems. Current techniques build from successful weather Observing System Simulation Experiments (OSSEs) but with critical adaptation to climate questions. Techniques have been successfully applied to carbon fluxes, total column ozone trends and water vapor measurements.

By placing climate science questions as the starting point, there future observing systems are more likely to serve the needs of the science community in addressing the most important areas of research. The identification of critical observations also opens the door for unexpected breakthroughs in observing capabilities, such as has occurred with Global Positioning System occultation and dispersed pressure sensors.