Summary: Aerosol effects on clouds operate at spatial scales of short-lived cloud updrafts (typically 100 m-100 km), yet exert a global effect on climate over multiple decades. The multiscale nature of these indirect effects on the planetary energy balance presents particular challenges to climate modeling, which has led to large uncertainties in estimates of indirect effects. The most difficult types of aerosol indirect effects to quantify are those for which the aerosol sources are controlled by complex interactions of ecosystems with climate, such as the aerosol emissions from ocean phytoplankton and from wildfires in forests. The decadal feedbacks of climate onto biological productivity contribute to this uncertainty because of the difficulties in making accurate multidecadal predictions and in collecting detailed observations on comparable time scales.

Intellectual Merit. This proposed project addresses these challenges through a combination of advanced parameterizations, explicit modeling, and observations with a multi-institutional, multidisciplinary team of experts. Advanced parameterizations of aerosol effects on stratocumulus, shallow cumulus and deep cumulus clouds that have been or are being developed under separate funding will be brought together into a common framework for multidecadal simulations with and without coupling with the ocean. These simulations will be compared with available observations and with simulations for selected periods by a multiscale modeling framework (a cloud-resolving model operating as a superparameterization within each grid cell of a global model) that has recently been extended to treat cloud-aerosol interactions. Offline single column simulations with the parameterized and superparameterized cloud-aerosol interactions will be compared with observations for selected field experiments characterizing warm clouds, mixedphase clouds, and cirrus. The coupled and uncoupled simulations with and without interactive aerosols will be examined to determine the influence of aerosol indirect effects on decadal climate variability. This evaluation will be accomplished by relating climate-scale changes in oceanic and atmospheric conditions over the Pacific, including tropical teleconnections and midlatitude downstream effects, to the sensitivities of regional ocean-atmosphere interactions to aerosols along the west coast of North America and consequent atmospheric flows and hydrological conditions over the entire U.S. The evaluation will consider the decadal and interannual variability of clouds, temperature, precipitation, and hydrologic conditions, and the processes affected by aerosols.

Broader Impacts. The broader educational impacts of the proposed research will be realized through: (1) Promotion of teaching, training and learning through development, piloting, and evaluation of an informal science education program targeting an underserved audience; (2) Broadened participation of underrepresented groups – in this case, retired and elderly people – in research as well as in outreach; (3) Enhancement of infrastructure for teaching through partnerships with an established educational organization; (4) Broad dissemination of results through presentations, peer-reviewed publications and via the web; and (5) Societal benefits in terms of improved understanding of climate science and the related ethical issues. In addition to outreach activities, there will be at least three graduate students trained in coupled Earth system modeling as part of this project. In addition, the methodology and results incorporated in this
study will be incorporated in courses taught annually by Russell as part of the Scripps climate sciences curriculum.

**[10-382] An Informed Guide to Climate Data Sets with Relevance to Earth System Model Evaluation**

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<tr>
<th>PI</th>
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<th>Collaborating Institutions</th>
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<tr>
<td>Clara Deser*</td>
<td>Aiguo Dai, James W. Hurrell, Dennis J. Shea, Kevin E. Trenberth</td>
<td>NCAR*</td>
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*Overall Project Lead

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**Summary:** We propose to establish and maintain a web-based informed guide to selected climate data sets of relevance to the evaluation of Earth System Models (ESMs). The proposed work has two main objectives related to ESM evaluation and these are identified as high priority needs of the World Climate Research Programme (WCRP): 1) to evaluate and assess selected climate datasets, and 2) to provide “expert-user” guidance and advice on the utility and limitations of selected climate datasets. The proposed work will advance the evaluation of ESMs from a system perspective, including those models participating in the upcoming IPCC AR5 and CMIP5 activities, and as such directly addresses the goal of the proposal solicitation “to improve upon and expand on current modeling capabilities in order to substantively contribute to the advancement of reliable regional and decadal climate predictions”, and that of Type 1 proposals in particular as an “incubator and capacity/community building activity[y]”. Increasingly, there are multiple versions of datasets on a single variable, all legitimate but generated with a different algorithm, quality control, error adjustments, and data processing and analysis, as well as multiple comprehensive gridded “reanalyses”. The proliferation of datasets makes it difficult for individual scientists to know which are most appropriate for specific applications, including evaluation and analysis of increasingly complex and comprehensive ESMs. A unique feature of this “Informed Guide” will be expert-user commentary on the strengths and limitations of individual data sets from the researchers who construct and evaluate the data. As such, it will serve to facilitate and enhance access to relevant climate data archives for diagnostic analyses and model evaluation. A method such as a web-based “forum” will be devised to enable informed commentary by researchers and also to accommodate variables and datasets not within our own expertise. Each component of the earth system will be addressed, including the atmosphere, ocean, land, cryosphere, and biosphere. The project will leverage the expertise already within NCAR and the Climate Analysis Section in particular. Consideration will also be given to hosting workshops to help achieve these objectives, in close collaboration with the WCRP and U.S climate services needs. University collaboration is an important aspect of the proposed work, as demonstrated by the letters of collaboration from the University of Washington (Professor John Michael Wallace), the University of Alaska-Fairbanks (Professor John E. Walsh), and the University of Maryland (Professor Sumant Nigam).

**Intellectual Merit** There is a critical need for assessment of observational data sets and guidance on their appropriate usage for the purpose of evaluating and improving ESMs. These activities are vital to the integrity of observational, modeling and prediction studies of climate variability and change. The Climate Analysis Section team at NCAR is a world-class leader in the evaluation and assessment of data sets, and the project described here is not done anywhere else.

**Broader Impacts** With many reprocessing and reanalysis projects producing new datasets that have yet to be vetted, and a proliferation of datasets on the same variable, the project and service proposed here has been called for with very high priority both nationally and
internationally. The WCRP Working Group on Coupled Modeling (WGCM) working group has led to new demands for observational assessments and dataset availability for evaluating the forthcoming CMIP5 model runs. There is also very strong support for this activity within universities, as evidenced by accompanying letters of support from several leaders in this area. The results of this work will greatly assist students and all scientists working with climate data. The results will be available to everyone and it is planned to have an interactive web presence to enable commentary and questions. Participation by students and others is welcomed.