



CALFED Progress Report
California Sea Grant College Program

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Project Information

ProjectNo_2C R/SF-34 StartDate_3a 10/1/2008 EndDate_3b 9/30/2010
 ProjectTitle_4 Investigating the Frequency and Magnitude of Floods in the Sacramento-San Joaquin Valleys under Changing Climate

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Additional Research Mentors and Community Mentors

Additional Research Mentors_8

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Project Objectives: Please type your responses, and answer the questions in a style appropriate for laymen.

ProjectObjectives_10

The goal of the proposed research is to investigate how warmer temperatures and possible changes in precipitation may cause changes in the frequency of occurrence and the intensity of floods in the Sacramento-San Joaquin Valleys - the areas that historically have been buffered from winter floods because precipitation usually came in the form of snow-pack instead of rainfall. In particular, water managers in the Sacramento-San Joaquin River watersheds in California have expressed great concern about such changes because this region is the hub of California's water supply and also because of the large and growing population that lives in the lowlands of these river systems.

The proposed research will address the following research questions:

- (i) To what extent do simulated flood statistics emulate historical observations?
- (ii) How and why do extreme events of simulated streamflows change under current projections of future climate?
- (iii) How does uncertainty in the GCM model results impact the extreme events statistics?
- (iv) To what extent are projected changes in flood frequencies and magnitudes being indicated in historical observations? How large would the changes need to be recognized as such?

Summary of progress in meeting each of these goals and objectives

ProgressSummary_11

The project investigation is based upon downscaled daily precipitation and temperature simulations from General Circulation Models (GCMs). We downscale data from these GCMs using a statistical downscaling method Constructed Analogues. The downscaled meteorologies are fed into a hydrologic model (Variable Infiltration Capacity). The hydrologic model is also driven by an observed gridded historical meteorology developed at the University of Washington. The Variable Infiltration Capacity (VIC) model output, from historical and from projected climate change runs, allows to evaluate possible changes in annual maximum 3-day flood magnitudes and frequencies of floods greater than selected historical thresholds. There are several layers of uncertainties related to GCM: each GCM runs with its own horizontal and vertical discretization of the atmospheric layer, different parameterization schemes, and different initial conditions. In this project, uncertainties related to GCM are encountered, to some extent, with using downscaled precipitation and temperature data from three different GCMs covering a range of temperature and precipitation sensitivity. A manuscript describing the results in the west slopes of the Sierra Nevada Mountains, the major region contributes water to the Sacramento-San Joaquin Valleys has been recently submitted to Climatic Change.

PROJECT MODIFICATIONS: Please explain any substantial modifications in research plans, including new directions pursued. Describe major problems encountered, especially problems with experimental protocols and how they were resolved. Describe any ancillary research topics developed.

Modifications_12

No major modifications are undertaken, except the project would not attempt to study flood statistics using a second hydrologic model. Instead, in the next few months before the end of the fellowship period, a set of analyses will be performed to explore the sensitivity of flood statistics as simulated by VIC to prescribed uniform changes in temperature and precipitation of the past observed historical period. These sensitivities are important, as the current climate change projections for the region are particularly uncertain, and the sensitivities can guide studies to determine how vulnerable the river basin is to changes in climate.

BENEFITS AND APPLICATIONS: Suggest the relevance of these new findings to management. Describe any accomplishment, that is significant effects your project has had on resource management or user group behavior. CALFED is looking for "management cue" (see <http://science.calwater.ca.gov/pdf/soemgmtcues.pdf>).

BenefitsApplic_13

Some hydrologic consequences of climate change are relatively straightforward (earlier snowmelt; more precipitation as rain). Our investigations to date indicate, at the most basic level, that flood-frequency impacts of current climate change projections may not be at all straightforward. Instead, so far, results suggest that even in a single drainage, future flood frequencies are likely to be complex and interwoven responses to many aspects of the climate changes, including possible changes in the magnitudes of largest storms, frequencies and sequencing of large storms, temperatures during storms as well as between storms, and seasonality of storms, with no single climate change dominating the overall flood responses. At the basin to basin level, this complex mix of climate forcings and vulnerabilities is further complicated by the fact that responses differ considerably from basin to basin depending on the topography in the various basins. This means that projections of flood changes with climate change are very likely to be basin dependent, and are likely to require full hydrologic modeling rather than simpler rules of thumb of the sort that might work with some other hydrologic responses.

PUBLICATIONS: List any publications, presentations, or posters that have resulted from this funded research. Give as many details as possible, including status of paper (e.g., in review; in press), journal name, conference location and date of presentation. Please note (as outlined in the conditions of the award) that each fellow is required to submit an abstract for an oral or poster presentation at each State of the Estuary conference and CALFED Science Conference during the duration of the fellowship.

Publications 14

Publications:

Das T., Dettinger M.D., Cayan D.R. and Hidalgo H.G. 2010. Potential increase in floods in California's Sierra Nevada under future climate projections. Climatic Change (in review).

Presentations and Posters:

Das T., Dettinger M.D., Cayan D.R. and Hidalgo H.G. 2010. Potential increase in floods in California's Sierra Nevada under future climate projections. Intended for submission to Bay-Delta Science Conference, September 2010, Sacramento.

Das T., Dettinger M.D., Cayan D.R. and Hidalgo H.G. 2010. Potential increase in floods in California's Sierra Nevada under future climate projections. CWEMF, February 2010, Asilomar, California, 2010. (Oral Presentation)

Das T., Hidalgo H.G., Dettinger M.D. and Cayan D.R. 2008. Increased flood risks in the Sacramento-San Joaquin Valleys, CA, under climate Change. VI Annual California Climate Change Conference, September 2009, Sacramento, California. (Poster Presentation)

Das T., Hidalgo H.G., Dettinger M.D. and Cayan D.R. 2008. Increased flood risks in the Sacramento-San Joaquin Valleys, CA, under climate Change. EOS Transactions, American Geophysical Union. 2008 Fall Meeting, San Francisco, California. (Poster Presentation)

Das T., Hidalgo H.G., Dettinger M.D. and Cayan D.R. 2008. Increased flood risks in the Sacramento-San Joaquin Valleys, CA, under climate Change. 2008 CALFED Science Conference, October, 2008. Sacramento, California. (Poster Presentation)

COOPERATING ORGANIZATIONS: List those agencies and/or persons who provided financial, technical or other assistance to your project since inception. Describe the nature of their collaboration.

CoopOrganiz_15
SIO/USGS: Dr. Daniel Cayan, Scripps Institution of Oceanography and U.S. Geological Survey. Dr. Michael Dettinger, U.S. Geological Survey and Scripps Institution of Oceanography. Dr. Cayan and Dr. Dettinger help in the project as research mentors. California Department of Water Resources: Dr. Michael Anderson, California Department of Water Resources. Dr. John Andrew, California Department of Water Resources. Dr. Anderson and Dr. Andrew support in the project as community mentors. California Energy Commission: California Energy Commission supports to develop some of the downscaled climate data. Santa Clara University: The fellow is collaborating with Professor Edwin Maurer to develop an improved hybrid statistical downscaling method.

AWARDS: List any special awards or honors that you, or mentor or members of the research team, have received during the duration of this project.

Awards_16
None

KEYWORDS: List keywords that will be useful in indexing your project.

Keywords_17
California, flood frequency analysis, climate change, general circulation models, hydrologic model

PATENTS: List any patents associated with your project.

Patents_18
Nil
