

# **Report as of FY2006 for 2006CA169B: "Monitoring California Water Resources from Space"**

## **Publications**

Project 2006CA169B has resulted in no reported publications as of FY2006.

## **Report Follows**

## Introduction

A comprehensive monitoring system for California water resources would be greatly enhanced by the large-scale view afforded by satellite remote sensing. Several current and near-future satellite missions have now demonstrated the capability for monitoring soil moisture, snow water equivalent, heights of inland water bodies (e.g. rivers, lakes, reservoirs) and changes in total water storage (i.e. the aggregate of all of the snow, surface waters, soil moisture and groundwater). The goal of this work is to exploit these current and emerging capabilities to develop a framework for monitoring California water resources from space. The focus of our work is on statewide remote sensing of soil moisture, inland water bodies, changes in the mass of the snowpack, and changes in groundwater and total water storage. Specific objectives are to 1) prepare statewide maps of surface soil moisture using the AMSR-E satellite; 2) Estimate monthly changes in the mass of the Sierra snowpack using data from the GRACE satellite; 3) Estimate monthly changes in total water storage for state's the major watersheds using GRACE; 4) Explore the performance of the current generation of ocean (e.g. TOPEX/Jason) and ice (e.g. ICESat) altimeters to monitor the heights of the state's major rivers, lakes and reservoirs; and 5) Estimate changes in groundwater storage by combining GRACE water storage change estimates with AMSR-E soil moisture estimates and state-of-the-art land surface models.

## Year 1 Progress

Our first year of research has seen important progress towards goals 1, 3, and 5. Our first surface soil moisture maps prepared from the AMSR-E data have pointed to problems with the inversion algorithm used to derive soil moisture from observed brightness temperature. We have been in contact with the JPL, USDA-ARS and Princeton groups who are working on better soil moisture retrievals. We will repeat this process when the new data become available later this year and complete the mapping and analysis of surface soil moisture variations across the state.

Research on the use of GRACE data for estimating changes in total water storage is progressing well. A key step towards application of the GRACE data towards water resources problems at the relatively small spatial scale of California (by GRACE standards) has been the development of new techniques for utilizing GRACE data at these higher resolutions [Swenson et al. 2006]. This work will now allow, for the first time, monitoring of water storage changes within the major drainage basins and mountain ranges of the state. Undergraduate student Shaunna Head is currently working on delineating these GRACE-compatible regions for the state so that we can map the GRACE data to the Sierras, the Central Valley, the coastal regions, etc.

We have also made important progress towards remote sensing of groundwater using GRACE, AMSR and in situ data. In a preliminary study using the hydrologically data rich area of Illinois, Yeh et al. [2006] used GRACE and observed soil water to successfully estimate groundwater storage variations. This work opens the door for groundwater remote sensing in the Central Valley aquifer and the Coastal Plain aquifers, which we are now ready to attempt.

## Year 2 Plans

Goals for year 2 will be to complete the major objectives of this work. In fact, given the preliminary work described here, most goals should be achievable in a one-year time frame. Our plan is to map the total water storage, snow water equivalent and soil moisture to the major drainage basins of the state, to explore the potential of satellite altimetry to monitor surface water variations, and to attempt to monitor groundwater storage variations using the methods of Yeh et al. [2006] in the Central Valley. An

implicit goal is to demonstrate the utility of these data at spatial-temporal scales that are relevant to statewide water resources management.

#### Referenced Publications

Swenson, S. C., P. J.-F. Yeh, J. Wahr and J. S. Famiglietti, 2006, A comparison of terrestrial water storage variations from GRACE with in situ measurements from Illinois, *Geophys. Res. Lett.*, 33, L16401, doi:10.1029/2006GL026962.

Yeh, P. J.-F., S. C. Swenson, J. S. Famiglietti and M. Rodell, 2006, Remote sensing of groundwater storage changes in Illinois using GRACE, accepted with minor revisions, *Wat. Resour. Res.*

#### Presentations

Ryu, D., J. Famiglietti, T. H. Syed and S. C. Swenson, 2005, Basin-scale hydrological cycles from AMSR-E and GRACE, AGU Fall Meeting, San Francisco, CA, Dec. 5-9.

