Monitoring California Water Resources from Space

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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. The goal of this work is to exploit these current and emerging capabilities to develop a framework for monitoring California water resources from space.

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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. 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. We are 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, we 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. 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 from the preliminary study 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.

Publications

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

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

Professional Presentations

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

Collaborative Efforts

Our UCI group collaborates with John Wahr and Sean Swenson from the University of Colorado, and with Victor Zlotnicki from the Jet Propulsion Laboratory on GRACE hydrology research. We work with Eni Njoku from JPL, and Tom Jackson and Dongryeol Ryu from the USDA ARS Hydrology Laboratory in Beltsville, MD on AMSR-E soil moisture. We will be working with Tom Painter from the National Snow and Ice Data Center in Boulder on AMSR-E snow water equivalent.

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