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Dear Surface Water Working Group Colleagues,

I thank each of you for your continued interest in our NASA Surface Water Working Group (SWWG) as well as for your collegiality and collaborative efforts to advance our science and technology goals. This letter is my summary of our March 23, 2004 meeting in Irvine, California at the Beckman Center.

Introduction:

I believe this meeting was our most successful to date, and I expect that future meetings will be even more rewarding. Over 50 people attended the meeting with several from the USGS, many from NASA, and international representatives of ESA and CNES. A large number of researchers, new to our SWWG, also attended. An attendance list is posted on our web page, www.swa.com/hydrawg click on the "meetings" button. Although our Terrestrial Hydrology Program Manager, Jared Entin, could not attend, we are very grateful that he was representing our goals at an Earth Science Enterprise (ESE) retreat. The SWWG meeting followed a terrific meeting of hydrologists interested in using and better understanding the monthly gravity measurements collected by the GRACE mission. Please contact Jay Famiglietti for more information on this outstanding GRACE meeting (Jay's email: jfamigli@uci.edu) and review the meeting summary online at www.ess.uci.edu/~famiglietti/grace.

Summary of Presentations:

I started the SWWG meeting with an overview of our hydrologic science goals. This presentation is available on our web page by clicking on the "meetings" button; there you will find a PowerPoint link entitled "Alsdorf Science Goals". These goals are already outlined in our *EOS* paper. I also briefly discussed the current best guesses on our required spatial and temporal samplings of surface water hydraulics. These guesses are available on the web page (click on "meetings" and the link for the "letter to technology teams"). Finally, I quickly mentioned that Jared awarded our funding request for the Step-1 Virtual Mission (VM). The VM is essentially a synthetic hydrologic model of a continental-scale basin with an embedded floodplain and channel hydraulics model. By controlling the various hydrologic parameters (precipitation, evaporation, infiltration, energy balances, etc.), the runoff related boundary conditions of the channel and wetlands hydraulics models are known which thus allows a known relationship between samplings of various channel and wetland morphologies to water cycle science. In the very near future, I will post more information about the VM on the SWWG web page.

The bulk of the meeting focused on presentations from representatives of the following four different technology groups: Ernesto Rodriguez (NASA JPL, radar altimetry), Keith Raney (Johns Hopkins APL, radar altimetry), Peter Hildebrand (NASA GSFC, radar technologies), Paul Houser (NASA GSFC, HYDROS), Bob Schutz (CSR U. Texas, ICESat GLAS), and David Harding (NASA GSFC, GLAS and lidar altimetry). All presentations are on our SWWG web page (click on the "meetings" button and then find information for this meeting).

Ernesto presented an interferometric altimeter concept which he proposed as a two-SAR-antennae system for swath mapping of surface water heights and area. The system has a heritage based on SRTM and the technology of the wide-swath ocean altimeter. Ernesto advocates the use of waveform history modeling to improve spatial resolutions of radar altimeters over land surfaces. He also demonstrated, from a preliminary study, that the profile of an altimeter (as opposed to a wide swath) in a 16-day orbital repeat cycle will miss several of the world's significant rivers and lakes whereas the swath approach does not miss these targets.

Keith presented the delay-Doppler radar altimeter concept which he has demonstrated via a number of airborne campaigns and the concept is the basis of the CryoSat SAR modes. The method utilizes coherent processing of radar returns in a SAR-like method to allow a greatly increased along-track spatial resolution compared to conventional altimetry (e.g., Topex/POSEIDON). He indicated the potential of combining both the SWWG and the ABYSS ocean bathymetry mission requirements under the delay-Doppler technology.

Peter continued the series of outstanding presentations during the first afternoon session when he presented cautionary thoughts based on his hydrology expertise and experiences with radar technologies (note: Peter is the Chief of Goddard's Hydrospheric Sciences Laboratory, neptune.gsfc.nasa.gov). He indicated that any technology the SWWG selects will need demonstration of its capabilities and limitations early in the ESSP process (i.e., it needs a high TRL which necessarily requires funding from NASA HQ). Our sampling objectives must be clear and yield important, new hydrologic science. Compromises and partnering will almost certainly be required.

Paul briefed us on the wonderful success of HYDROS (hydros.gsfc.nasa.gov) and stressed the 30-year historical perspective that underlies remote sensing of soil moisture as well as the great benefits from their partners, including the DoD. The process to data acquisition, however, is long with a launch data of 2010. Clearly, successful ESSP missions involve a great deal of dedicated community-based effort.

Bob detailed the height measurements presently collected by GLAS, the lidar altimeter orbiting onboard ICESat (icesat.gsfc.nasa.gov). Bob showed that GLAS has demonstrated returns over the Tapajos River in the Amazon Basin with a height RMS of 2.5 cm. He also outlined the anomaly in the first laser that precipitated a shut-down of the remaining two and discussed the timeline for re-start of these two lasers.

David presented a number of GLAS waveforms showing cloud structure and underlying ice sheet topography of Antarctica. He also demonstrated the vegetation penetration in the Amazon Basin yielding both canopy heights and underlying water surface elevations. Across the lower Mississippi River near Vicksburg, the ICESat team generously provided 2.5° off-nadir returns for evaluation (2.5° equals 22 km off-track for ICESat), which Dave demonstrated as showing slope of the river surface. Off-nadir degrees greater than 6° yield little if any returned waveforms. He also outlined a concept for a SWWG mission utilizing a number of lasers to provide high-spatial resolution, small swath-like coverage of surface water bodies

Important Concerns:

A number of concerns are now strongly apparent after listening to these excellent presentations on various altimetry related technologies.

(1) Through the Virtual Mission concept, we need to identify the hydrologic and hydraulic science and cost trade-offs associated with varying spatial and temporal sampling densities. Perhaps a cut-off can be established below which no valuable gain is apparent from a spaceborne mission. My guess is that even the most basic of measurements, i.e., a regular sampling of water surface heights from a profiling altimeter with known error characteristics, will greatly benefit global hydrology. This assertion needs proof as well as a demonstration of the cost-science benefits from increasing sampling beyond a simple profile to a series of tightly-spaced profiles and even to an image of heights. Fortunately, we are well underway with identification of these trade-offs via the first step of the VM, however, future work will be required for a global identification of the trade-offs based on real hydrologic parameters and geomorphologies as well as sampling possibilities from existing missions.

(2) The instrument selected for our ESSP submission will require demonstration of its ability to penetrate clouds and vegetation, and more importantly, to provide accurate off-nadir measurements (if it is determined from the VM that off-nadir swaths are required). Therefore, we need to ensure that funding opportunities exist for such demonstrations. I am actively working with NASA HQ as well as with NASA JPL and NASA GSFC to indicate the importance of these funding needs.

(3) The costs for an eventual mission will likely require partnering with other groups, most likely international efforts, to pool our funding resources. Such an assemblage may also involve a focus on additional, non-surface water science and thus require compromises in spatial and temporal samplings.

Several of you have already shared your thoughts about the meeting and I would be pleased to hear from others. As our effort grows, we will need open lines of communication, thus I plan to increase the visibility and interactive nature of our web page in the next month or two. **The future of the NASA SWWG is bold and exciting!**

Sincerely,

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