

## Notes from 6-7 December 2001 meeting

The third meeting of the working group was held in Arcadia, CA, December 6-7, 2001. There were 20 participants.

A discussion of the three proposals submitted to the GWEC NRA and their failure to get funding was discussed at some length. A common theme in the reviews seemed to be insufficient emphasis on science. Jasinski stated there were 144 proposals submitted under this NRA but only 54 were funded. The Working Group felt there was an important need in the development of observational strategies, defining observational requirements for proposed space-based instruments and formulating roadmaps for instrument and data assimilation development under LSHP.

The working group was encouraged by NASA (*Paul Houser* and *Michael Jasinski*) to formulate input for inclusion in the draft USGCRP Global Water Cycle Theme -Terrestrial Observations Strategy. (Available upon request.) A key issue to be looked at is the current emphasis on global precipitation and soil moisture excluding hydrology and cold seasons.

*Houser* commented that HydraSat was the least focused of the working groups. He felt WG was too focused on technology – focus on science – mission is defined on science/needs not on what technology wants. Don't let technology define mission.

*Jasinski* – in agreement with Houser's comments. Need to go down a list of items such as:

1) develop scientific justification for sampling scheme for surface water measurements – whether space or ground based need to follow strategic plan

2) work in developing roadmap/justification for HydraSat – why needed

3) think about field program – technology studies need to be done – could be done in the next couple of years. Look at 2004 planned programs support for field project

*Lettenmaier* to Jasinski or Houser – can you offer any insight into available funds to do trade studies?

*Costa* – program needs to take leadership with regards to trade studies stating it needs these and providing mechanism for doing them as a part of the strategic future mission for LHSP.

*Houser* – trade studies could fall under WG – put down in a table listing what needs to be studied

**Emmitt** – will put out from this meeting a list of what needs to be studied in trade studies

Discussions also covered the following issues:

(a) how to respond to the upcoming NRA;

(b) begin formulating a plan for a field campaign in the 2003-2004 time period, possibly piggybacking on another scheduled field effort;

(c) how to lobby for extending the TOPEX instrument's lifetime by operating in the no-tracking mode which would provide an avenue to study how the radar altimeter can work over restricted bodies of water such as rivers;

(d) having a designated session at a conference or possibly a special issue in an appropriate journal; and

(e) preparing a proposal for continued support of the working group.

**Jasinski** recommended the following agenda items if WG is to continue: (1) further definition of the role of water measurements in discharge cycle; (2) is a special field program needed? If yes, need to start working with funding agencies to set aside monies for 2004 period; and (3) define science justification for a space-based project – GWEC – what are tolerances which will be allowed – global vs US coverage

USGS (**John Costa**) has been conducting field work which continues to suggest that river surface velocities combined with width may provide very useful estimates of river discharge. USGS is planning to continue their experiments on the San Joaquin River in California in the spring of 2002 for further evaluation of non-contact stream flow gaging.

Research at the University of New Hampshire (**Dave Bjerklie**) is also showing that the combination of surface velocity and width are useful (the best?) combinations of remote observations for estimating streamflow. Need to develop an approach to develop a rating system to formulate a set of possibly six variables – surface velocity is a critical element. The optimum system would allow control of data measurement radius.

Work at UCLA (**Doug Alsdorf**) continues to show the value of interferometric SAR for deducing storage, and possibly flow of inundated flood plains of the Amazon Basin. Annual river exchange with floodplain is 25%. There is approximately a 3100 m<sup>3</sup>/s difference between gage and interferometric measurements – if interferometer is correct – there is a mass material balance which needs to be redistributed.

Representatives from JPL (**E. Rodriguez** and **D. Moller**) presented a new design for a radar altimeter with river application as its primary objective. This design would enable the measurement of surface height for rivers with widths down to 100 m (it was previously > 250 m).

NASA/MSFC personnel (**D. Bowdle, J. Rothermel** and others) have carried out experiments using a water slide to demonstrate the ability of the lidar to measure the velocity of the water surface at large (> 10 deg) nadir angles. More experiments are being done with smoother water cases.

UNH researchers (**Charles Vorosmarty et al.**) provided additional evidence of the deterioration of the global network of gaging stations. He also showed results from a study addressing the question “How many gages are needed globally to achieve the measure of certain percents of continental discharge”.

Simpson Weather Associates (**Dave Emmitt**) reported that the IPO funded 2  $\mu\text{m}$  Twin Otter lidar is now scheduled to fly over the San Joaquin River in February 2002. The USGS has offered to provide ground truth of surface speeds during the aircraft overflights.

#### **Lettenmaier –**

Point Measurements – in-situ measurements are very accurate – will need to demonstrate that HydraSat will be more accurate. Need to answer why gages are only at “choke points”.

Application Benefit – enabling prediction – potential to increase input to models to improve soil moisture, precipitation, and weather/climate prediction

#### Additional thoughts –

(1) Manipulation of water balance by man argument – no way of doing this even in U.S. Very difficult to get data. Ability to track water use could be very beneficial. Gauging at mouth of river will not provide this information – could possibly provide in small streams. None of the global models deal with irrigation, human impact, etc.

(2) Identify issues where science needs to be studied.

(3) Not a total believer that science has to drive technology – needs to be argued with NASA.

#### **Other Comments**

**Bjerklie** – perhaps approach in step method – not all at once, i.e., 1 satellite to measure width; 1 satellite to measure velocity; and 1 satellite as imager. Can design satellite to give best results - but which could give additional insights as added value.

**Rodriguez** – feels proposers have been branded – not a good idea to resubmit/recycle proposals – need to have involvement of Houser/Jasinski in redoing the proposals

**Fekete** – look at piggybacking on other projects (missions) first as proof of concept – feels premature to want a dedicated satellite

**Als Dorf** – need a complete science justification to hand to NASA – WG has now had three meetings – SCIENCE is an issue raised by NASA at each meeting – needs to be addressed. Paper

needs to be written by well respected hydrologist (Lettenmaier) and published in peer reviewed medium which gives concrete scientific evidence for HydraSat – WG should focus on this

### Notes from December 7<sup>th</sup>

**Emmitt** – Prepare compelling justification for HydraSat  
Review objectives from May '01 meeting  
Review planning priorities from May '01 meeting  
Research priorities – science – some work already ongoing (UNH)  
Research priorities – technology – ingredients for new proposal  
Extract what can be done – draft set of requirements  
Need to address cost issues

**Rodriguez** – On the science side – perhaps add/include additional groups – outside discharge  
Add others from NASA Headquarters – ecology?

### Justification issues

Noble science goals

Quantitative:  $P - E = dS/dt - Q$  – need numbers/time rate of changes (S = soil, ground, snow/ice, biomass, storage in lakes, channels, wetlands)

Can a case be made for Q being an important variable?

**Vorosmarty** – depends on use as to applying numbers

Uses – water resource management

**Bjerklie** – glacier melt perhaps should be looked at – discharge – melt water vs water balance – ICESat/PROSat doing some of this

**Emmitt** – validation of ICESat measurements?

**Rodriguez** – continental glaciers do not drain into oceans – might be able to determine from lakes

**Vorosmarty** – detect possible geothermal hot spots

- flood warnings – change to assessment
- ice/snow melt (glaciers) validation

Time scale important – wetlands - inundation – NASA Ecology connection

**Bjerklie** – need view chart(s) of equations stating values (error bars/time scales and changes) – need input for draft documents before they are on street – snow/ice/HydraSat need to be included

**Vorosmarty** – source/sink areas melting into water – how much fresh water discharging into ocean important for oceanographers; changes in level/height are also important

WMO data – more is known about land surface hydrology in 1980 than in 2000 – world community is not providing data needed to monitor climate change

U.S. is losing long term stations – global data sets are in disarray

12-yr or more data sets – number of stations reporting is decreasing – community is not doing its job in global monitoring hydrology – Fekete will review and update station data reports

Could HydraSat be cast as a component “D” to GPM?

With well established/well validated data sets can close budget

Optimize discharge monitoring stations as science requirement

NASA is monitoring atmospheric change in Arctic (Arctic Oscillation) – needs to monitor atmospheric temperature changes – a good gage of atmospheric change is project at Mauna Loa (Keeling and Whorf, 2000)

Water use by man – irrigation is largest user of water but there is little data – important to know because of human’s use or irrigation channels

Satellite system for monitoring reservoir volume changes would give information on human use impact

Land-ocean – could be initial absolute target to achieve – when flow is stabilized, nutrients are not getting to coast – could impact habitability

Science does a very poor job of monitoring hydrography

Other issues –

**Alsdorf** – do people at NASA view coordinating with others as a positive or negative – would it lower WG’s status?

**Vorosmarty** – WG needs to have consolidation of effort – if not could be fragmented. Be willing to use tools that are there and show how much value could be added with own instrument.

*Emmitt* – concern in rebutting argument for discharge at a set site – remote would be more adaptive monitoring system – would allow diagnosis of changes

*Rodriguez* – need data to key off on to excite people

*Kim* – what is place in strategic plan? Only JASON dealing with river discharge – need to show economy of sensor

Why aren't peers seeing the issue as important as WG? Is there something group is missing?

## **Roadmap**

- Justification and inclusion in NASA Science planning documents
- FY02 – Trade studies (technology neutral) – in proposal to continue WG recommend trade study funds outside of NRA – where will they be done
- Basic technology studies (water slide, airborne, etc.)
- Initial set of observation requirements based on trade studies which are technology neutral – need to meet model requirements (surface velocity, slope, width)
- FY04 – Field program (2003-04) (SNOW/ICE will have completed their field work) – will need funds from several agencies not just LHSP
- Draft of HydraSat data requirements – what cannot be gotten from JASON/GLAS – end result is to define a space mission

## **Field Experiment**

- space-based – do we want multiple points
  - GLAS/JASON could perhaps provide some funds– how could system interact with GLAS ('02)? TOPEX – get someone to assume costs to continue flying – retarget to get other data – Kim to get estimate of cost to fly TOPEX
- airborne
  - TODWL (Caltech)
  - MISTRAL (German)
  - DC-8
  - UWA (USGS)
  - JPL
- ground-based
  - bankside (new technology)
  - traditional

- models
  - HD
  - GCMs

*Alsdorf* – Happy with overall direction of group. Will try to get a collection of works from upcoming AGU session  
– Can WG do an annual publication letting people know what’s been going on?

## Issues

*Kim* – Need to look to see what other instrument groups can be added to achieve goal. Should keep remote sensing people in group.

*Alsdorf* – Got to get headquarter voice in favor of group – willing to back concept

*Emmitt* – Concentration on field experiment – if requirements cannot be established with data cannot justify remote sensing

*Rodriguez* – Synoptic view at several points more useful than in-situ. Satellite will show basin process better

*Rodriguez* – Field observations – include as many variables in data as possible for other science areas to use and put out. Try to bring on application side – human impact, resource management

*Kim* – Wait until scientist buy into concept before approaching application side

## Action Items

1. Prepare a proposal for continuing the HydraSat Working Group. Current funding is scheduled to end in September 2002 – one more meeting will be scheduled in the May-June 2002 timeframe on the east coast. It is planned to include a request for some seed monies for moving the trade studies forward some in preparation for a field experiment. In addition, funding will be requested for a special workshop to involve a broader cross-section of the earth science community. *Emmitt* to draft proposal and solicit input from WG members. Work with an end of January deadline.
2. With the successful launch of JASON, TOPEX will operate in tandem for approximately 6 months and then be shut down. *Rodriguez* suggested lobbying for an extra few weeks extension of TOPEX lifetime to operate in a “non-tracking” mode. This would enable investigation into how a radar altimeter would function over restricted water bodies such as rivers. *Yunjin Kim* estimated the nominal operating cost for TOPEX to be \$500K/month. *Rodriguez* and *Emmitt* will pursue this opportunity.

3. It was suggested that the Working Group try to organize a special issue of a journal or a session at a conference to bring attention to the role of lakes, rivers and wetlands in inventorying fresh water supplies. *Lettenmaier* and *Alsdorf* to work on this.

4. Considerable time was spent in discussing the budget equation:

$$P - E = dS/dt - Q$$

where S = soil + ground + snow/ice + biomass + lakes + rivers + wetlands

To make a case for a HydraSat mission, the WG needs to approach the water budget quantitatively, putting numbers on the terms in the above equation which would include estimates of current observational errors and expected errors with proposed new instruments. *Fekete* will attempt to provide numbers.

5. It was suggested by Jasinski that members of the WG schedule a meeting with Jack Kaye to make a case for space-based measurements under HydraSat including how this would contribute to the overall GWEC and GEWEX project. *Emmitt*, *Lettenmaier* and *Vorosmarty* to work on this.