IGCP 565 Workshop 3 Questions

How can we bridge the gap in spatial scales between regional/global and point/catchment measurements?

-Promote the development of the International Terrestrial Reference Frame. Densify, consistent processing of 1000s of station. Use to georeference InSAR etc. (VLBI, SLR, GPS, DORIS)

-Also need consistent modeling framework for assimilating gravity, surface displacement, over range of scales. Problem variation of density of observations and temporal resolutions and spatial wavelengths. Community modeling framework for geodesy (e.g. Surface processes framework).

-Requires consistent processing of the various data going into the modeling framework

-Geodesy is at intersection of many fields (tectonics, hydrology). New to tie to range of physics problems.

-Require other disciplines to support ($$) the efforts = promote interdisciplinary work

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How can we bridge the gap in spatial scales between regional/global and point/catchment measurements? Continued...

-Observation framework (way to get observations easily and in same frame)

-Note Long Range Geodesy Plan (see UNAVCO)

-Need techniques for separating hydro and geodesy.

-Need to better understand the physics of processes and techniques to improve smoothing and fill gaps

How can we bridge the gap in spatial scales between regional/global and point/catchment measurements? Continued...

-How to do combined modeling using GIA? But may still need to be more work on GIA to separate GIA from more recent processes. Have better idea of physics but perhaps not the driving forces. Need modern as well as historical observations.

-Physics helps tie across the scales of observing systems. This will help us see the whole picture. Need to improve techniques, but also span scales. Earth system approach needed.

-Define specific products required (e.g., kinematic model, hydro model at all scales)

-Foster greater collaboration to improve installation of new instrumentation in Africa and other areas. Need observations on the ground as well as space. Encourage collocation of techniques (for science and logistics and to help foster long term measurements.

-Need to define what we need to do to support hydrology with geodesy. We need to be able to understand each other's jargon. Need to increase interactions and mutual understanding of our science.

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How can we bridge the gap in spatial scales between regional/global and point/catchment measurements? Continued...

-Need a way to provide uncertainty from models to be able to do data fusion and inversion. (not easy to do). Pin down errors from GLDAS and others.

-Float the concept of a geodesy center? Data portal? E.g. GRACE, IGS and other data, no one stop shopping. Need to consider other than GLDAS but others as well WGHM, LaD (different input data, different conceptualization of model,

-Contact Hydrology Focus Group (Famiglietti), US Example

-Need water well, river flow, moisture data, lake, river and reservoir level. Currently hard to find. Need collocated tide gauge / GNSS stations. Borehole pore-pressure Data. Extensometer Data. Look at global water data center. National centers, states, etc. HIS desktop from CUASHI

How can we isolate long-term hydrological changes from secular effects due to tectonics, GIA, etc

-Use hydrologic models to estimate secular effects. Need improved resolution and to be able to separate different hydrologic effects

-GRACE can provide secular in places like Africa where GIA is not a problem

-Where there are three processes involved, additional difficulties to separate effects.

- -Multiple techniques are required to separate processes

-Better define the role of geodesy in improving hydrological models AND vice versa.

-Establish validation points. E.g absolute gravity in Fennoscandia. Perhaps tie down one point precisely? Would this be useful for GRACE? (see previous question)

- -Required in any region with secular signals (GIA, tectonics)
- -Validation also through long-term and annual hydrological data on spatial scale comparable with GRACE

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How can we isolate long-term hydrological changes from secular effects due to tectonics, GIA, etc Continued...

-Look at ratio between vertical and gravity changes to resolve mass changes and their physical origin.

- Recognize that GRACE provides the hydrological storage term: this may be new in hydrological research.

-International Ground Water Assessment Center in Utrecht produces hind-casting models for long term secular changes in groundwater.

- Hydrological models only work for certain types of processe: we should better define the limits of what they correctly predict.

-Use and compare geological data (e.g. fault cumulative slip rates) for validation of geodetic results (e.g. strain budget)

IGCP 565 Workshop 3 Questions

How can we isolate long-term hydrological changes from secular effects due to tectonics, GIA, etc Continued...

- We can compare coherence of tectonic vs. hydrological models at times to help separate sources of deformation. We can use the separation of components of deformation (e.g. horizontal vs. vertical) to test competing hypotheses for the origin of strain and strain-rate anomalies.

- We need to promote acquisition of long-term time series. This can be a problem with space systems like GRACE, ICESat, DESDynI, etc.and we need follow on systems. A similar problem can exist for terrestrial observations and we need to explicitly state this. Need to encourage long-term funding with high level document.
    - Also ensure using / reprocessing older data?

- Need to encourage more local involvement in “on the ground” measurements. Promote meaning and usefulness of new data for local country, e.g. especially in Africa. AFREF working to get two open stations/country. Also AfricaArray, AMMA, GHYRAF.

IGCP 565 Workshop 3 Questions

How can we isolate long-term hydrological changes from secular effects due to tectonics, GIA, etc Continued...

-Also need to encourage international sharing of data. Key topic for GEO. GEO portal a source of data. Governments realizing this is a problem. Gap in real-time GPS/Seismic as an example. ISO standard accepted in GEO registry. Use it and give feedback.

-Capacity building, training and collaboration are critical for sustainability.

-Provide local structure for maintenance and operation

-Promote permanent instrumentation (rather than campaign)

-Need multiple complementary observations for comparisons (GPS and GRACEfor Greenlandis an excellent exampl).. LiDAR is also . The more the better. Each has strengths. Different parameters such as gravity and deformation.

IGCP 565 Workshop 3 Questions

How can we improve measurement accuracy and robustness to seasonal and other artifacts?

-Use combination of techniques, understand multiple processes such at Atmospheric pressure loading. Bring the cryosphere into hydrological modeling. Need improved models for Antarctica as well as Greenland.

- -Also, ocean monitoring is essential for global mass balance models
- -Emphasizes the need for consistency in data analysis and modeling. Same processing when comparing different data sets (e.g. GRACE vs. GPS tidal loading correction).

-Catalogue artifacts in geodetic data (somehow..). Interoperability of observing systems. Metadata standards. Need to publish metadata about datasets.

-Not all seasonal effects are somewhat sinusoidal. Things vary from year to year. Need to have models that allow for this type of variability.

IGCP 565 Workshop 3 Questions

How can we improve infrastructure to build reliable services?

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Encourage and provide support to planned new systems (e.g. DESDynI, GRACE follow-on, ICESatII, Sentinel, SWOT). Promote ‘recent’ systems (e.g., CryosatII, GOCE, TerraSAR X, etc.).

Also applies to ground-based systems (strainmeters, tiltmeters, ...).

Capacity building: workshop, summer schools, service, to help data usage by community

Encourage sharing and making data free access (great example is ESA and Sentinel). Individually and through for example WInSAR. The Charter for InSAR might be built upon. Example Supersites. Could extend to hydrology.

How can we improve infrastructure to build reliable services? Continued...

Be able to do seasonal predictions for sustainability. E.g. Drought index, early warning for hydrological applications. Disease. Increase societal relevance. Speak to sponsors with applications of interest to them.

This can be used to leverage access to data.

Landslide detection, seismic hazard, coastal degradation, flooding, tsunami, volcanic eruption, other geo-hazards. Use InSAR and other deformation measurements for monitoring carbon sequestration projects, filling / emptying of large dam reservoirs.

Geodetic infrastructure can help with resilience to disasters (response, management and planning).

Workforce development. Integrate geodesy into hydrological programs. Requires provision of near real-time data / products to users.

Multiple use of techniques. For example GPS multipath detection of snow, moisture, and plant growth. Also GPS meteorology.