# Developing the Science and Applications

Hans-Peter Plag

Nevada Bureau of Mines and Geology & Seismological Laboratory
University of Nevada, Reno, USA.

http://geodesy.unr.edu/hanspeterplag/

# Developing the Science and Applications

- Science Benefit Question (SBQ) of Gravity
- Application Benefit Areas (ABA) of Gravity
- “Science” Obstacles for Utilization (SOU) of Time-Variable Gravity Observations
- Improved Geophysical Modeling
- Improved Utilization for Applications

# Science Benefit Question (SBQ)

Solid Earth physics: glacial isostatic adjustment, co-/post-seismic deformation, slow/silent earthquakes, plate tectonics, mantle convection, volcanoes, core motion

Hydrology: snow, precipitation, ground water, dams, soil moisture, run-off, evapo-transpiration, regional and global mass balance;

Glaciology: ice mass balance, bottom topography, ice compaction, geoid for sea ice thickness;

Oceanography: mean flow, narrow currents, topographic control, coastal currents along shelf edges, interaction between mean and eddy flow, ocean fronts position, bathymetry, basin scale mass change, deep water formation, bottom currents

Sea Level: separation of steric/non-steric, GSL monitoring

Climate Change: understanding of the global water and energy cycle and its changes

# Application Benefit Areas (ABA) of Gravity

Geodesy: precise heights, inertial navigation
Regional water management:
- assessment of groundwater reservoirs;
- changes in water storage;
- forecast of water storage changes

Natural hazards:
- draughts, including forecasting;
- earthquakes displacement field;

Early warning systems:
- Sea level forecasting (5-15 years)
- tsunami

Scientific decision support (for adaptation):
- global water cycle (trends, forecast, prediction)

# “Science” Obstacles for Utilization (SOU)

(Processing algorithms)
Ocean tide aliasing
Atmospheric aliasing
Geophysical modeling
Integration of the “three pillars” of geodesy and consistency
Integration with non-geodetic observations and consistency

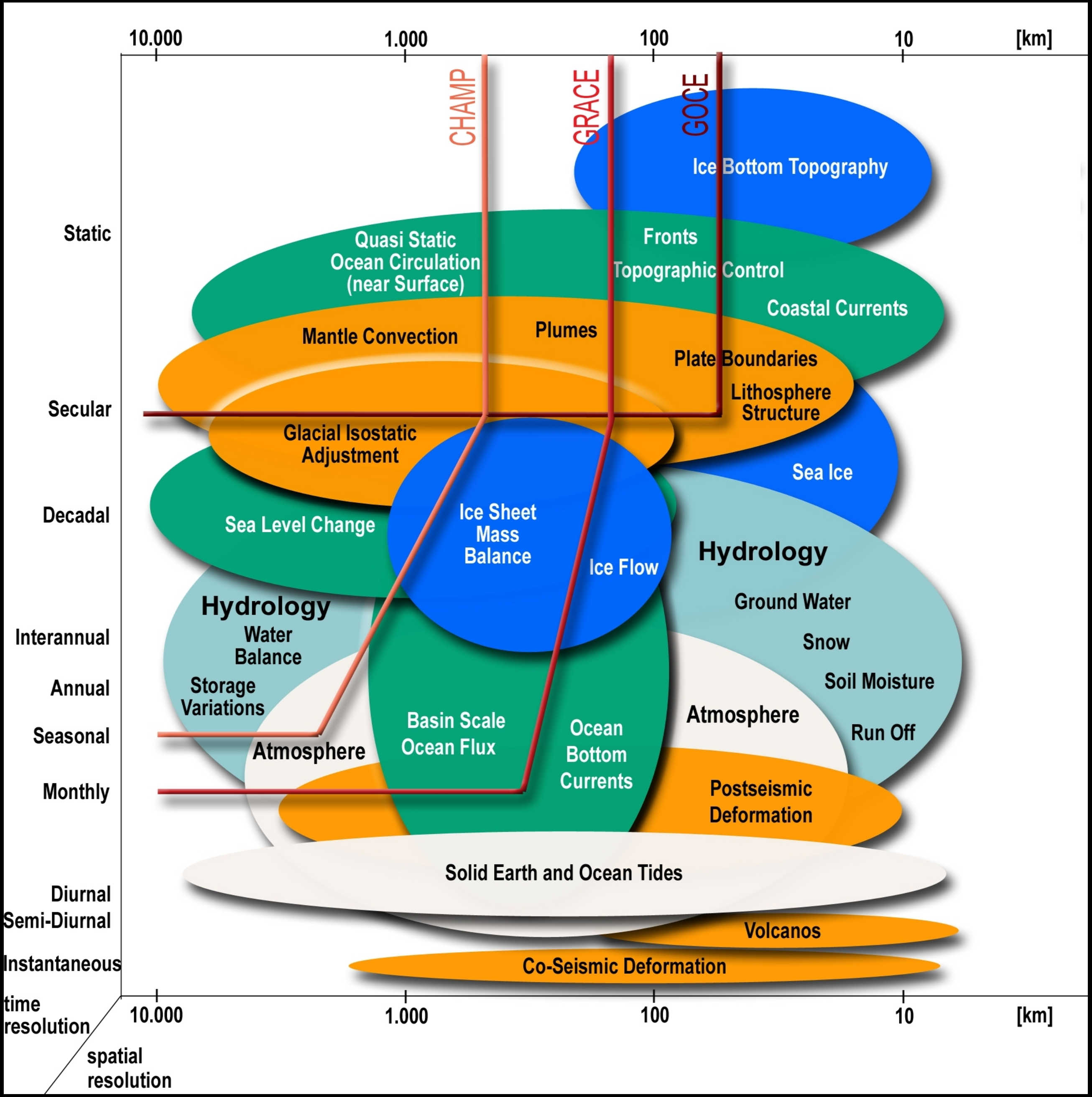
Mike Watkins:
“It is my belief that considerably more science than we know today is already embedded in the current GRACE data set, and more completely exploiting it is arguably the highest payoff activity we can engage in.”

## “Science” Obstacles for Utilization (SOU)

Some of the improvements have to come from other communities (e.g. atmospheric aliasing).

Work with these communities, inform them about our needs, and identify benefits for them.

# Improved Geophysical Modeling



# Improved Geophysical Modeling

Radboud Koop: “... the way in which agencies and policy makers like to subdivide the world into easy comprehensible sub-worlds is inappropriate for gravity missions. We have to ‘educate’ people in trying to understand this characteristic of gravity and prevent from being forced into one corner of the Earth system simply because policy makers find that easier. ... We should tell the community that we look to the essential characteristic of the whole Earth system, namely mass. We cannot and should not answer the question: 'But in which division/section you belong?'

Is our approach to geophysical modeling consistent with this insight into the nature of gravity?

## Improved Geophysical Modeling

H.-P. Plag: Dissection of the Earth system into unconnected, separate sub-models is not appropriated at the level of accuracy geodesy has reached today.

During the workshop, the need for Earth system models has been emphasized many times.

A number of "simple" models have been developed since 1995 (e.g., Juettner&Plag, Thomas, Seitz et.al., ...)

Lessons learned:

- modular models including modules for the solid Earth work;
- Need initial value solution for loading/surface forces;
- For rotating models, high temporal resolution (10 minutes);
- Common reference frame for all modules is a difficult issue.

# Improved Geophysical Modeling

Developing (relatively simple, physical) Earth system models requires multidisciplinary cooperation.

Mike Watkins: "Ultimately the international Earth system science community, especially those with global and global change focus, can become the greatest allies in using and justifying the next generation(s) of geodetic satellite missions."

# Improved Utilization for Applications

Need to work more with relevant user communities.

There is a need for a forum for the communication and connection.

Mike Watkins:
"It is very important from my perspective that we continue to build strong bridges to our user communities, and to engage them in helping us develop the products that are most useful to them."

"As such, I continue to believe a focus on these areas of connection and communication with users, improved and focused data products, and seeking synergistic observations and programs are the highest priority for our roadmap and connection with GEO"

# Panel Discussion

Questions:

What applications, products and services can we develop and how should we approach this?

What could be an appropriate framework for the connection and communication with potential users and the coordinated development of products for societal applications?

Panellists:

Matthew Rodell

Radboud Koop

Roger Haagmans

Douglas Cripe

# Publications/Output

| | |
|---|---|
| Declaration | Iteration, 15 October 2009 |
| Roadmap: | Iteration, 15 October 2009 |
| Workshop Report: | Input from Breakout Session Chairs, Speaker; Iteration with participants |

Summary reports in Episode, EOS

Special issue in Journal of Physics and Chemistry of the Earth

Recommendations on web page

Presentations on web page (please, send objections or modified presentations to Hans-Peter Plag)

# Interaction with GEO

Submit Declaration & Roadmap to GEO Secretariat, Science and Technology Committee, User Interface Committee

Contact GEO Principals of:

- Member Countries
- Participating Organizations