Hydrology Mission Requirements for a GRACE Follow-On

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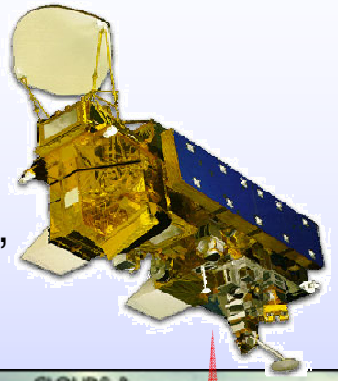
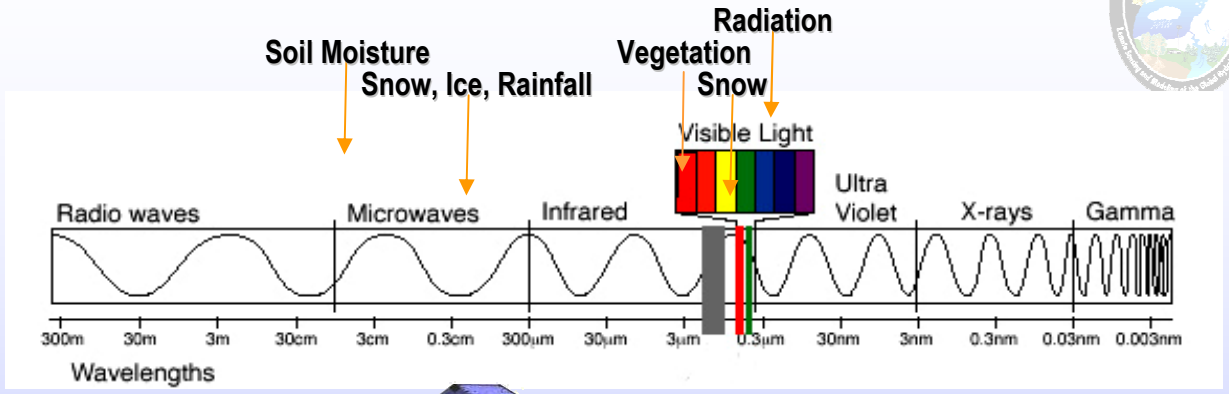
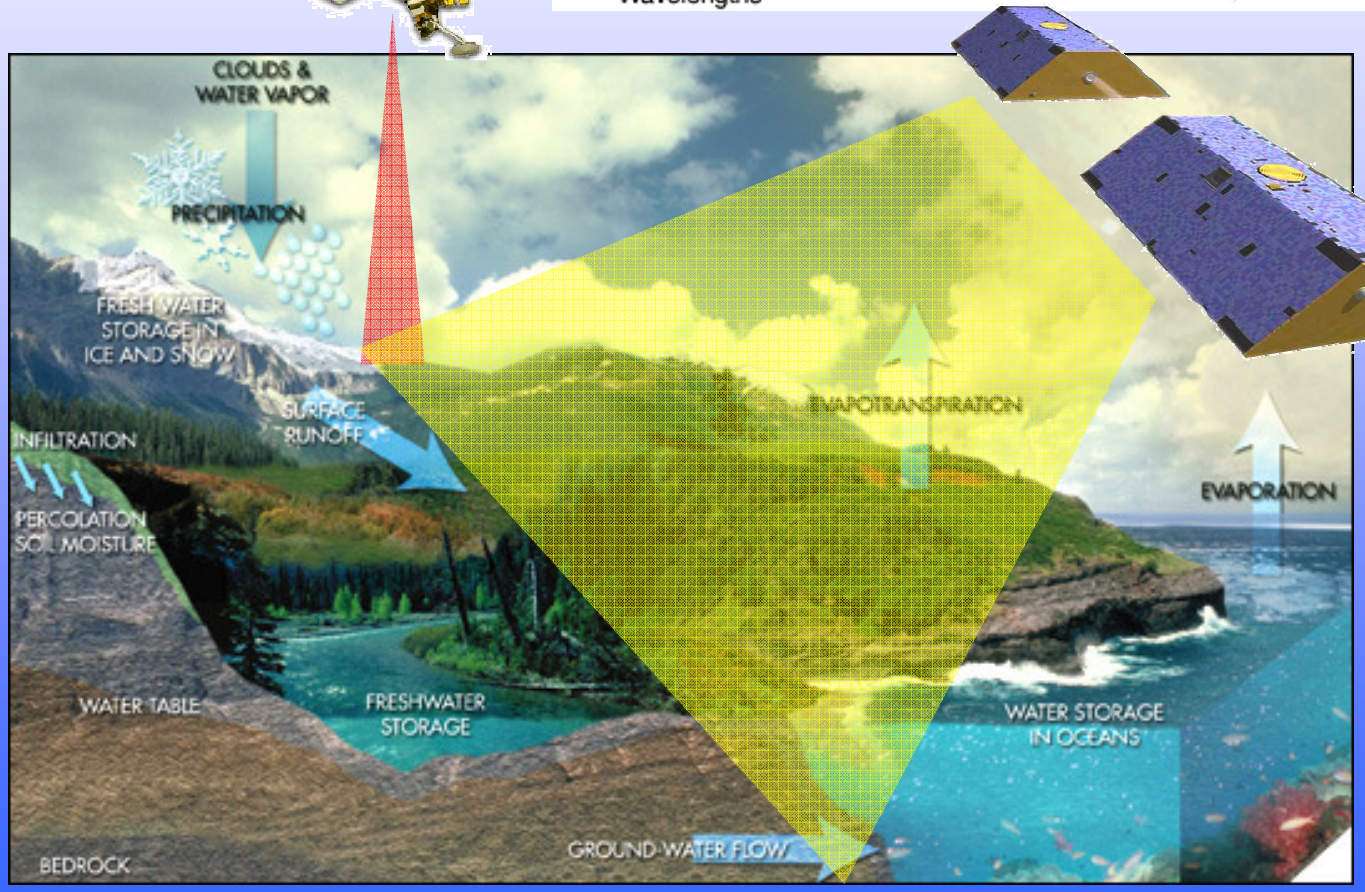
Remote Sensing of the Water Cycle

Aqua:
MODIS,
AMSR-E,
etc.







Traditional radiation-based remote sensing technologies cannot sense water below the first few centimeters of the snow-canopy-soil column

Gravimetry is unique in its ability to monitor water at all levels, down to the deepest aquifer

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Mission Requirements for Hydrology

1) Accuracy

- Typically within 5-20%; GRACE is sufficient, depending on resolution

2) Product latency

- Need real-time; GRACE delivers hydrology products 6-12 weeks after

3) Spatial resolution

- Most practical applications require observations at scales of 0.01 – 2500 km; resolution of GRACE is two orders of magnitude coarser

4) Isolating individual water storage components

- GRACE provides no clue

5) Temporal resolution

- Most hydrological processes operate on hourly to weekly timescales; GRACE is monthly, 10-day at best

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And yet GRACE has been hugely valuable for hydrology

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Mission Requirement Drivers

Because satellite gravimetry measurements are unique and valuable, other factors will more likely drive mission requirements for a follow-on:

1)Cost (and cost sharing among space agencies)

2)Technology readiness

3)Limitations on resolution/accuracy due to aliasing

4)Cutting edge – certain space agencies prefer to fund exciting new missions, with new technologies (e.g., laser ranging), rather than continue purely for the sake of monitoring

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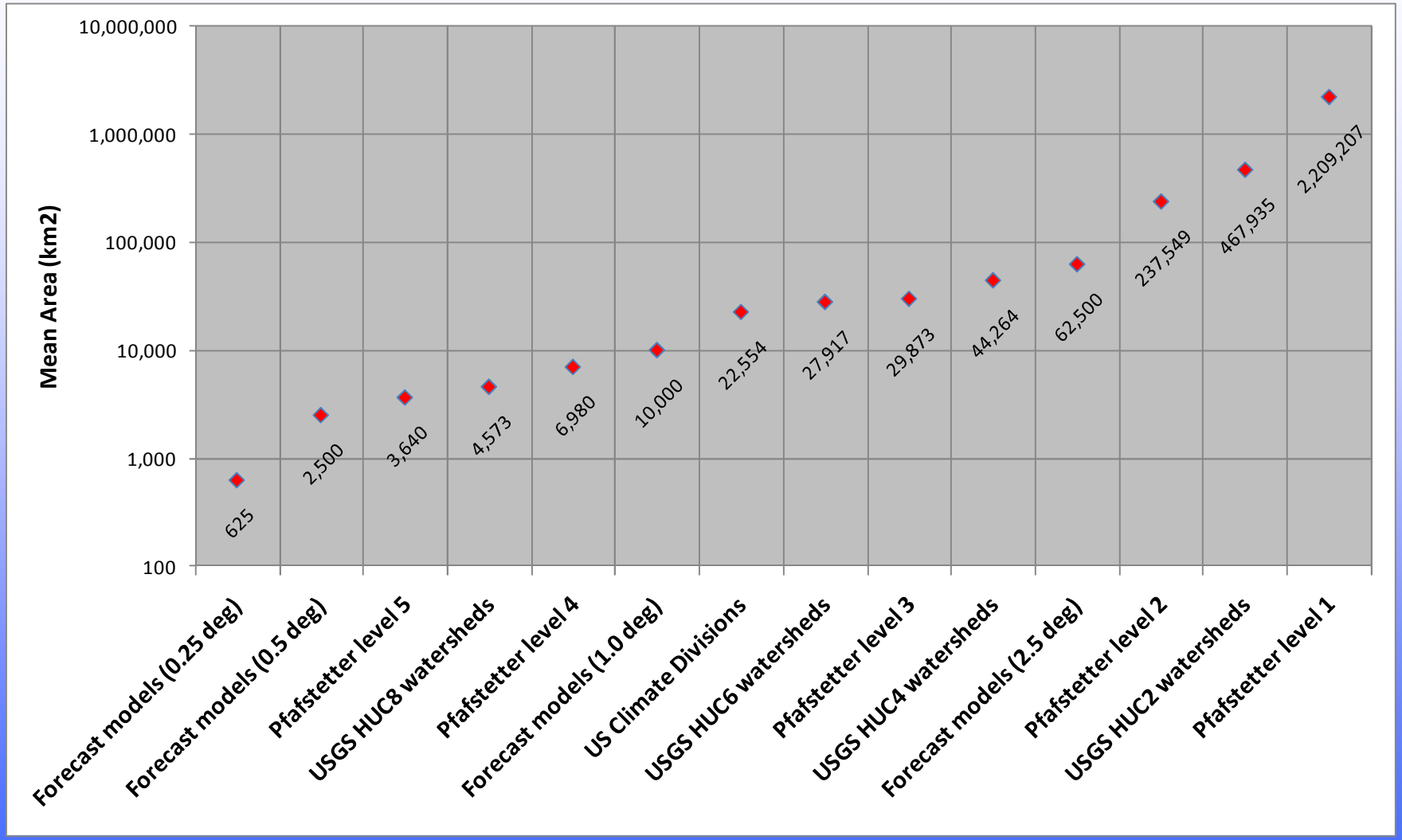
Scales of Hydrology



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Water Managers' Reactions to GRACE Products

On the issue of temporal averaging:

• "In areas with monotonically increasing snowpacks (e.g., mountains of the western U.S.), the forecasting framework is set up to a large extent around water supply outlooks, issued monthly. If a 5-10 day integration period yielded a good estimate of the conditions prior to the outlook issuance, they'd probably love it."

On the issue of spatial resolution:

• "Two hundred ***thousand*** square kilometers?"

• "The NWS, for example, forecasts for a set of contiguous basins across the country. The mean basin size is 981 km^2, 90% of the basins are less than 2000 km^2, and 95% are less than 3500 km^2 … even the comparatively huge basins of the USGS HUC-6 delineation have a mean area of 17,592 km^2, 90% are less than 40,000 km^2, and 95% are less than 50,000 km^2."

• "The only hope here would be a 'check', allowing forecasters to integrate their basin estimates over a large region to compare to GRACE."

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Water Managers' Reactions to GRACE Products

On the issue of latency:

• "Operationally speaking, the latency would generally be considered a killer. Normally, most snow observations make it into the system within 24 hours, and the really bad ones take 2-3 days."

• "Different forecasting entities (NWS River Forecast Centers, NRCS, etc.) have different requirements, but for the most part everyone needs data more quickly than 10-14 days. Even snow surveys (snow courses, airborne surveys, etc.) are generally completed and reported in a few days to a week, putting sort of an upper bound on acceptable snow data latency."

• "Given the latency, GRACE based snow estimates may be valuable for refining the climatologies that underpin the runoff prediction systems, but not for the operational predictions themselves."

• "Perhaps if you could take advantage of water storage memory to extrapolate the data forward" [using a data assimilating model].

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