Mission Orbit and Phases

Lee-Lueng Fu
Jet Propulsion Laboratory

Tamlin Pavelsky
University of North Carolina

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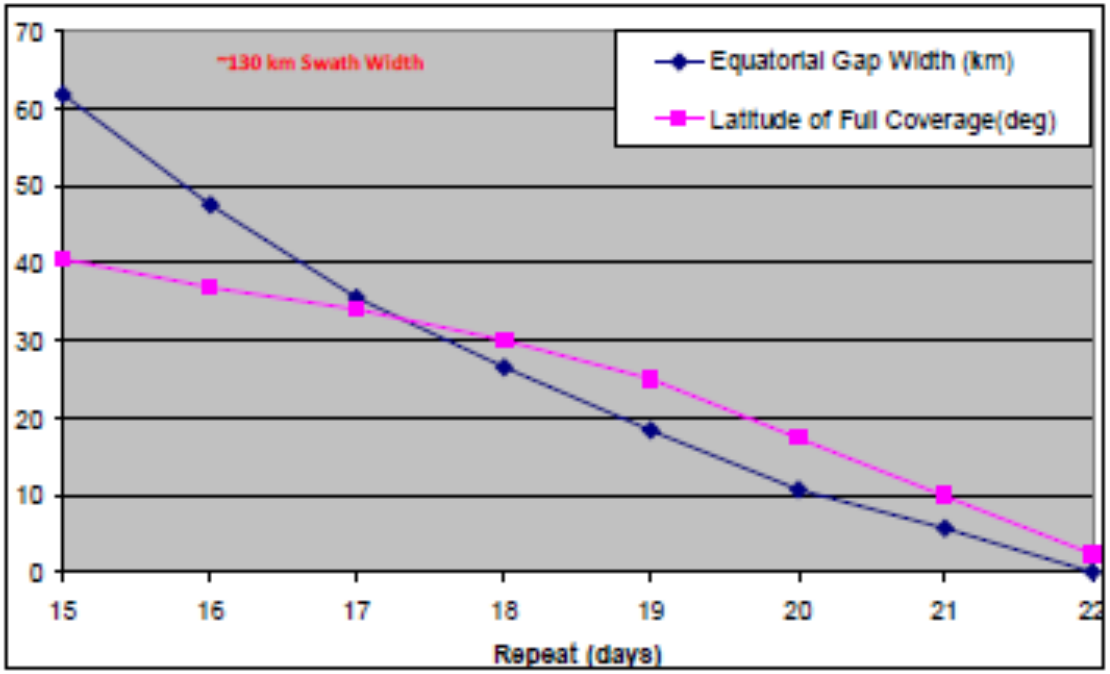
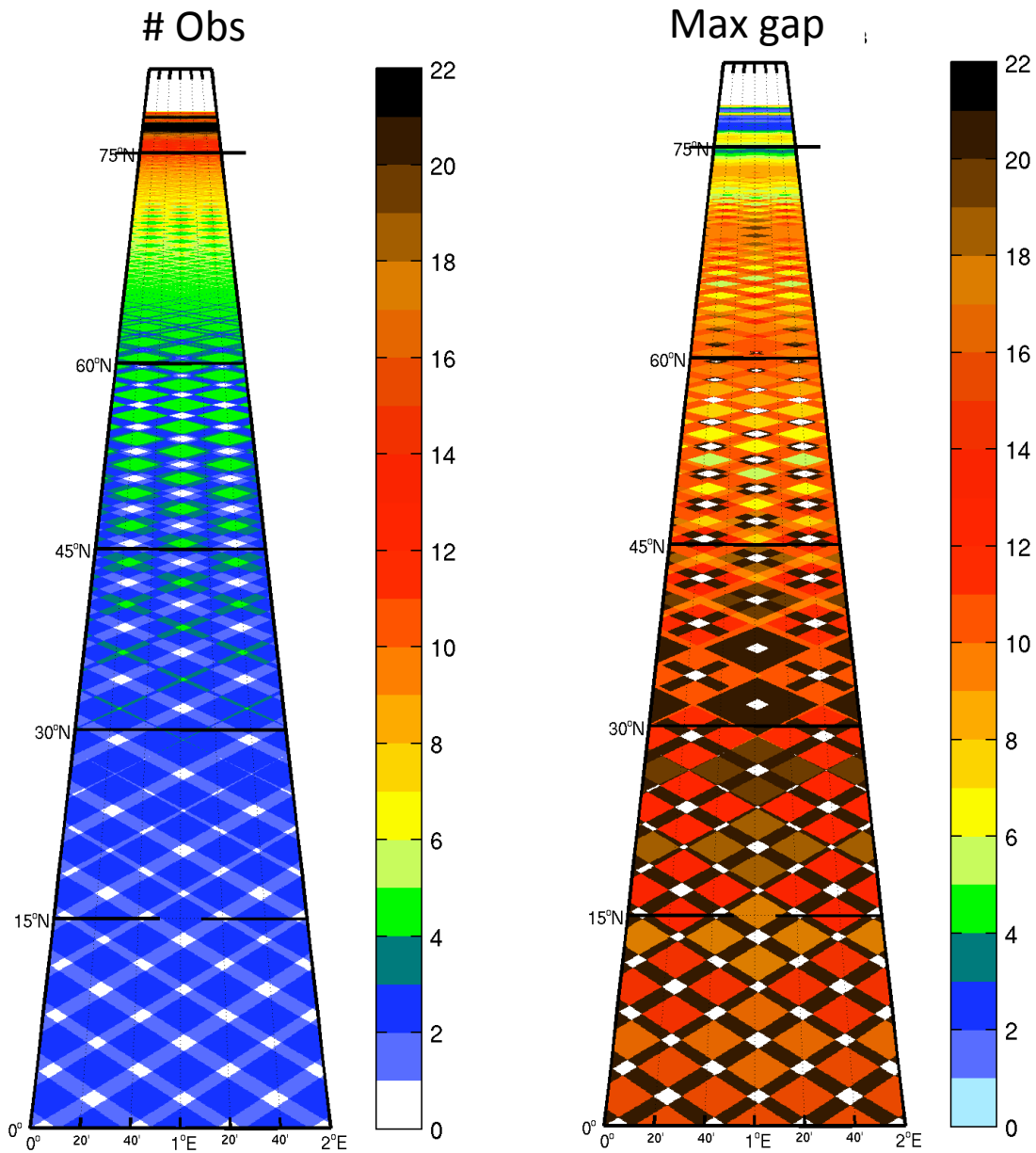
Mission orbit considerations

• Global coverage and more frequent sampling dictates a compromise in orbit repeat period of 21 days
• Inclination between 74 and 80 degrees to achieve non sun-synchronous orbit to minimize tidal aliasing and to ensure coverage of major water bodies on land.
• 1 day repeat period during the initial cal/val phase for fast sampling to achieve the cal/val objectives and study rapidly changing phenomena.



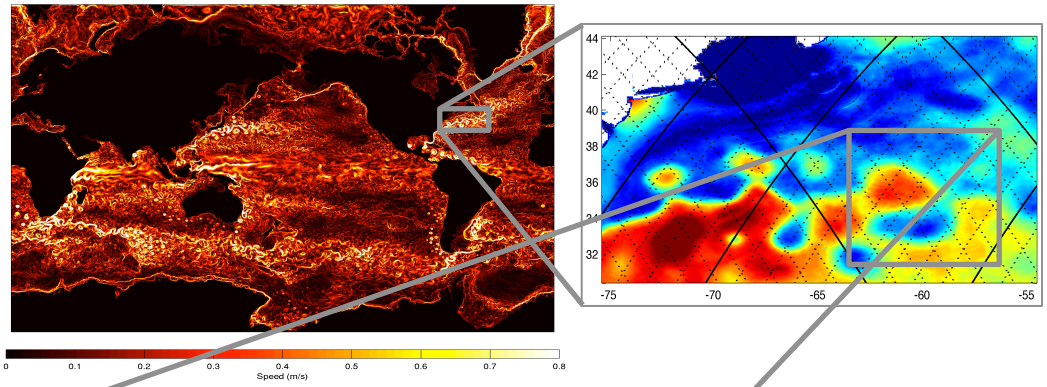
• orbit: 891 km, 77.6º Incl., 21 day repeat

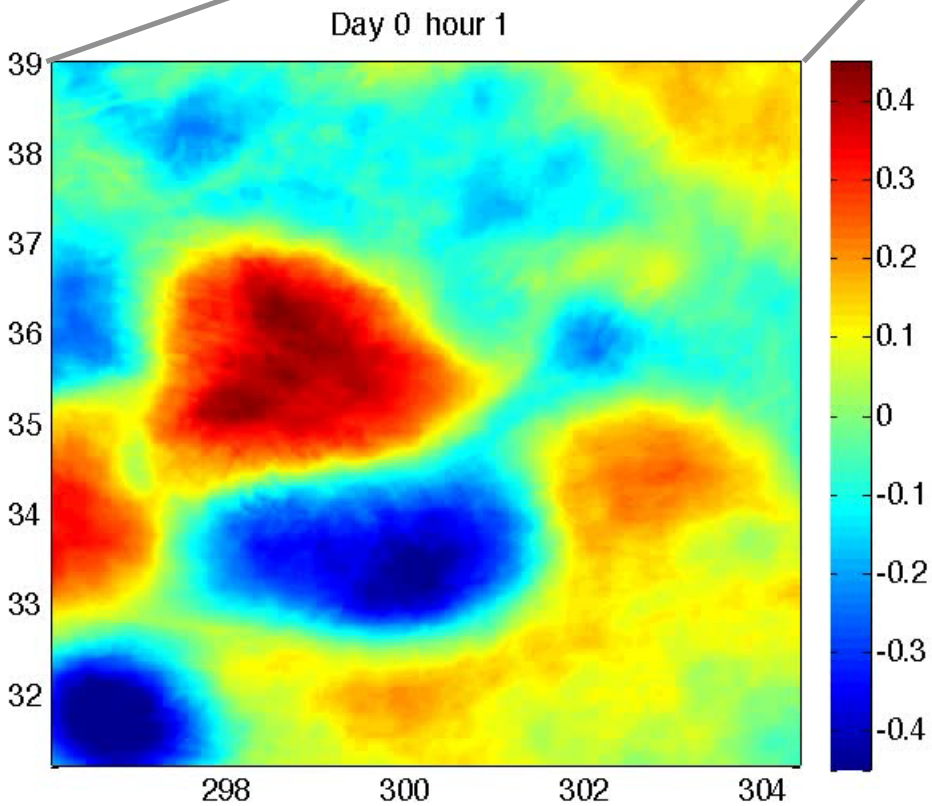
Sampling pattern of the 21-day orbit for the Science Phase



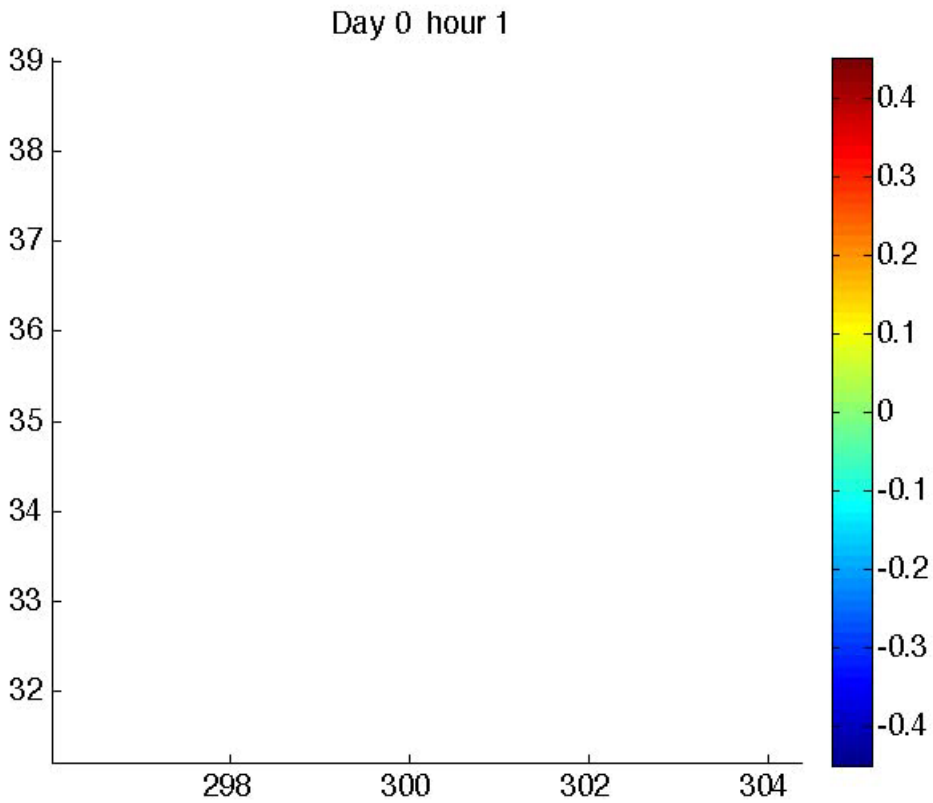
(Ubelmann)

Challenges: Reconstruction of ocean state from irregular sampling



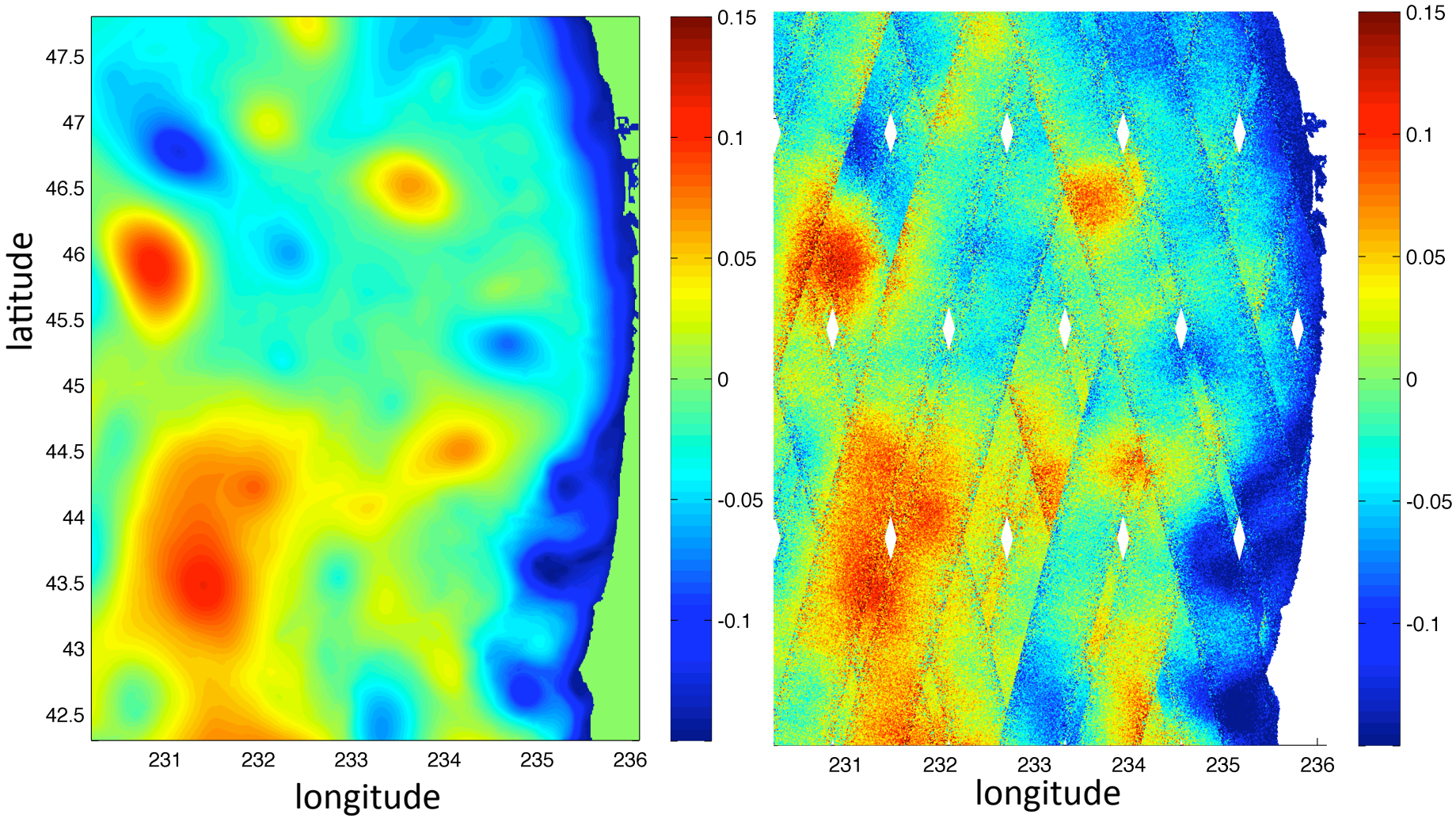


Full SSH (barot. Tides filtered)



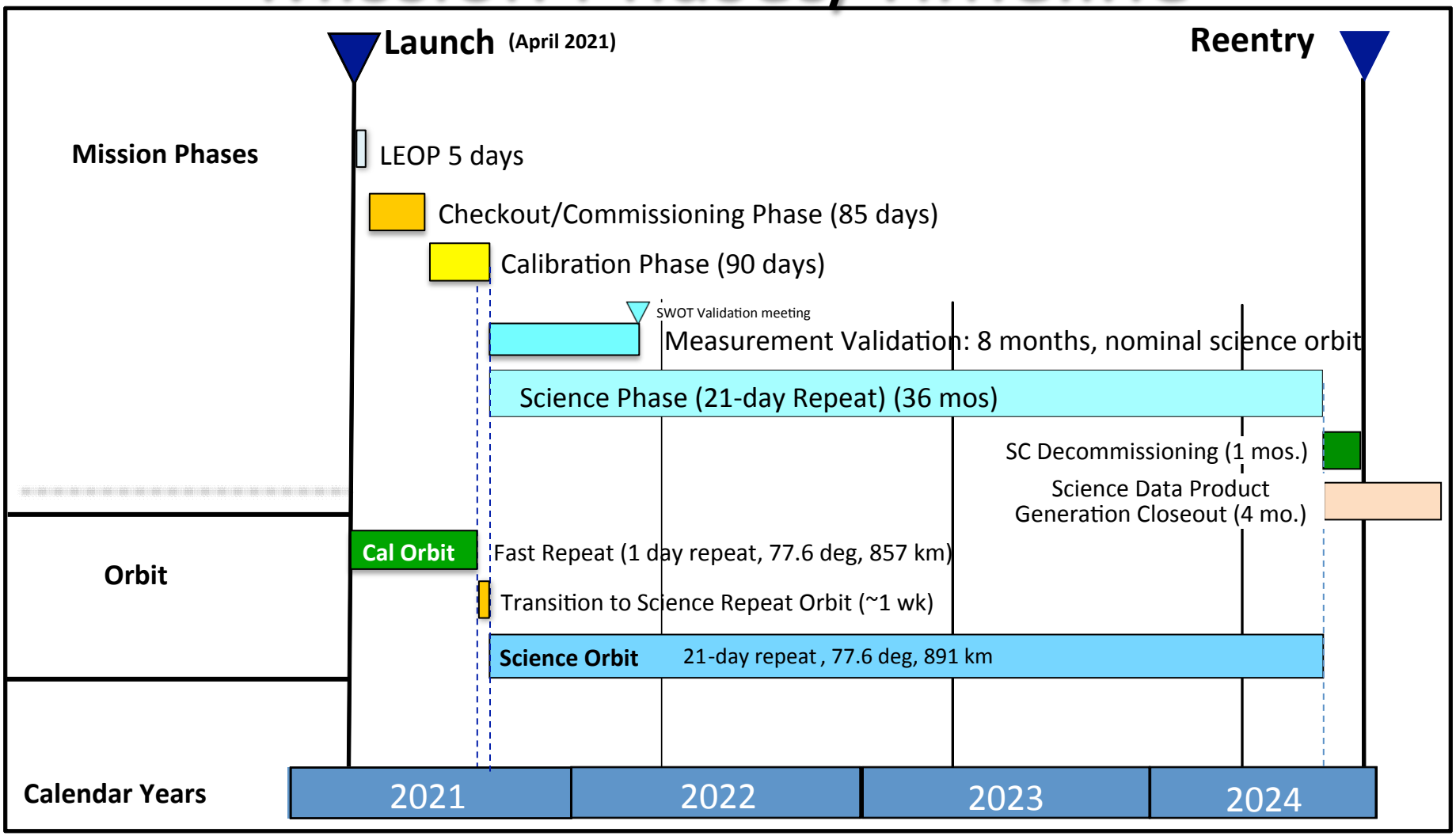
SWOT simulator

Challenges: Reconstruction of ocean state from irregular sampling and measurement errors

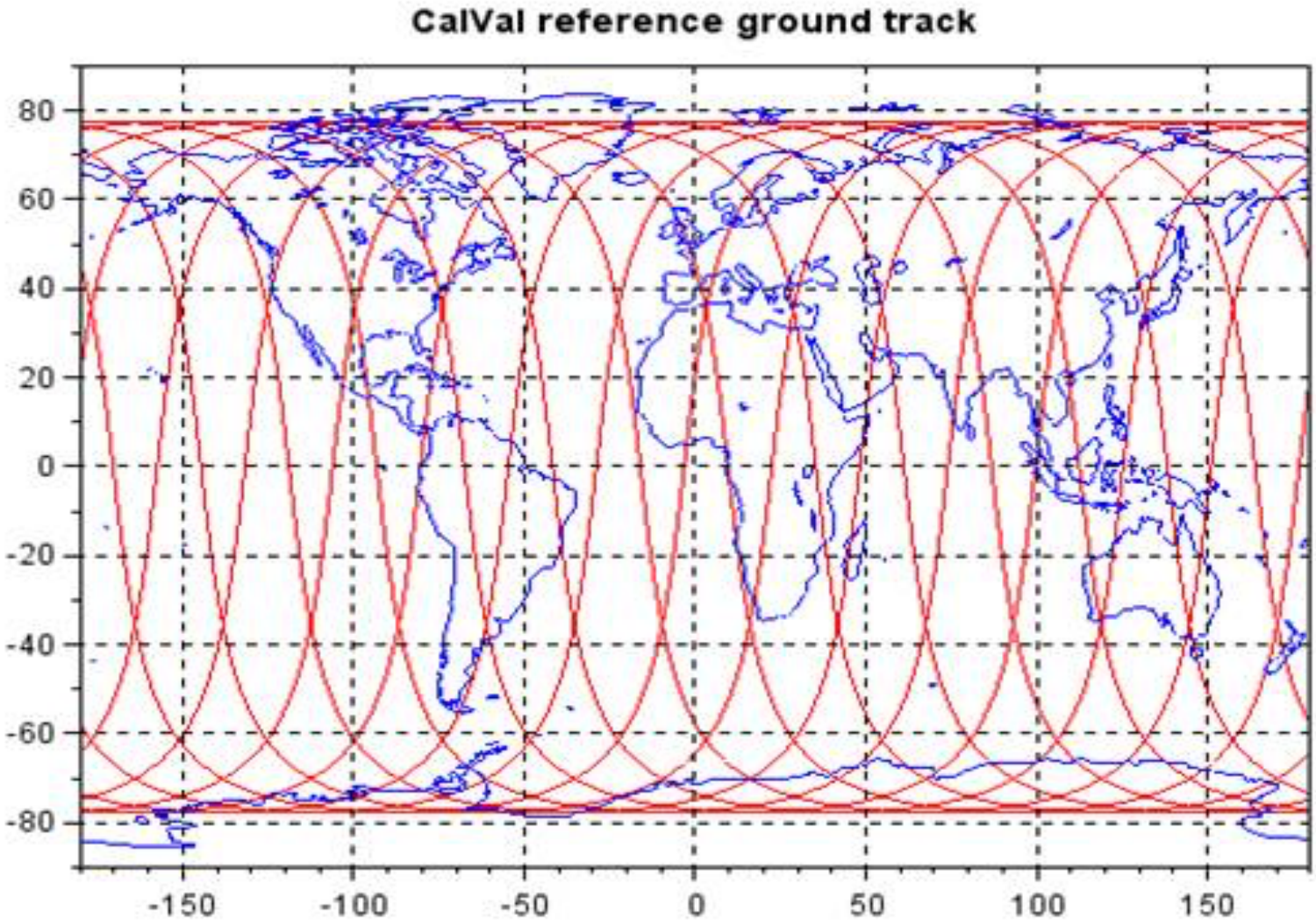


(Gaultier et al, 2016)

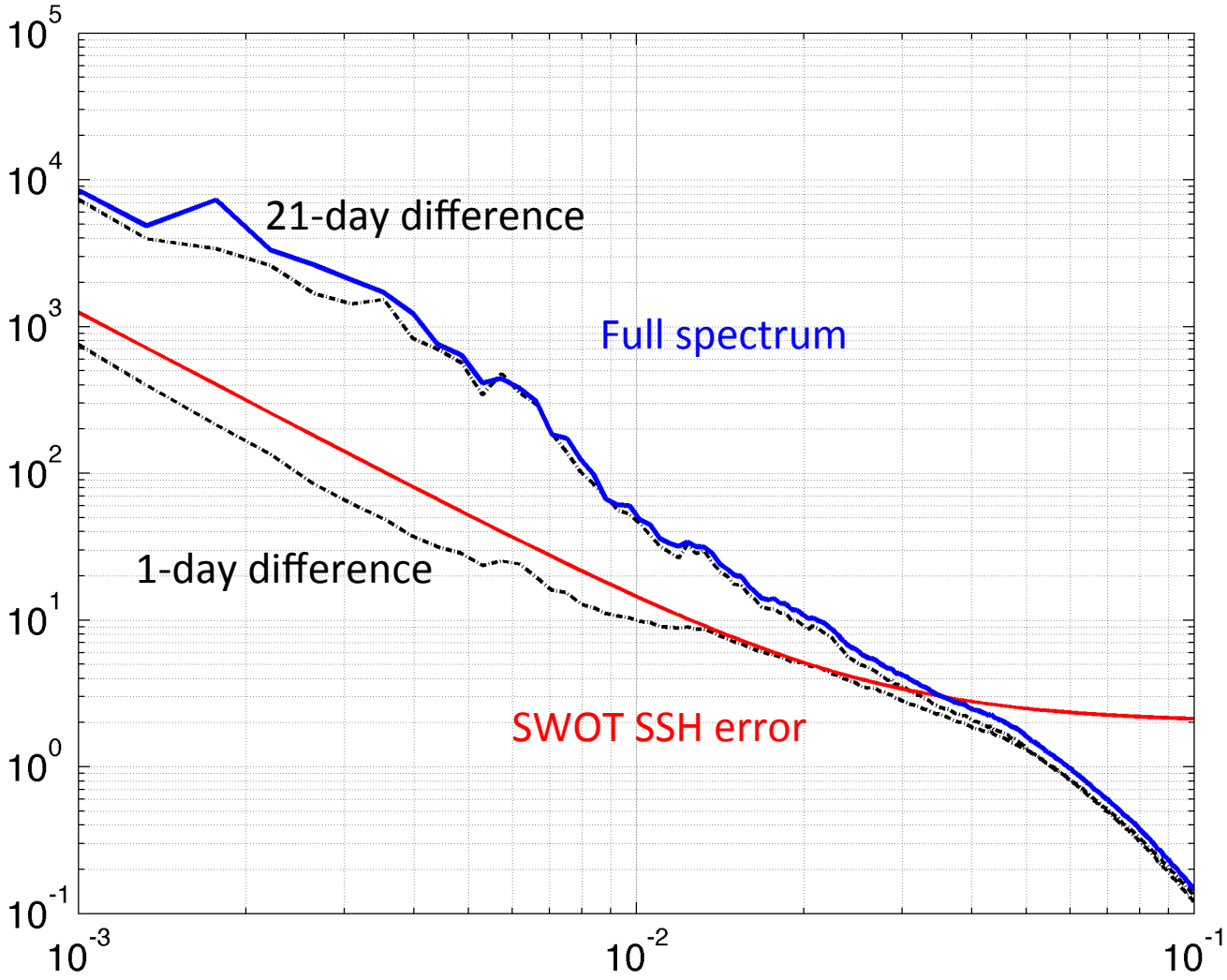
Mission Phases/Timeline



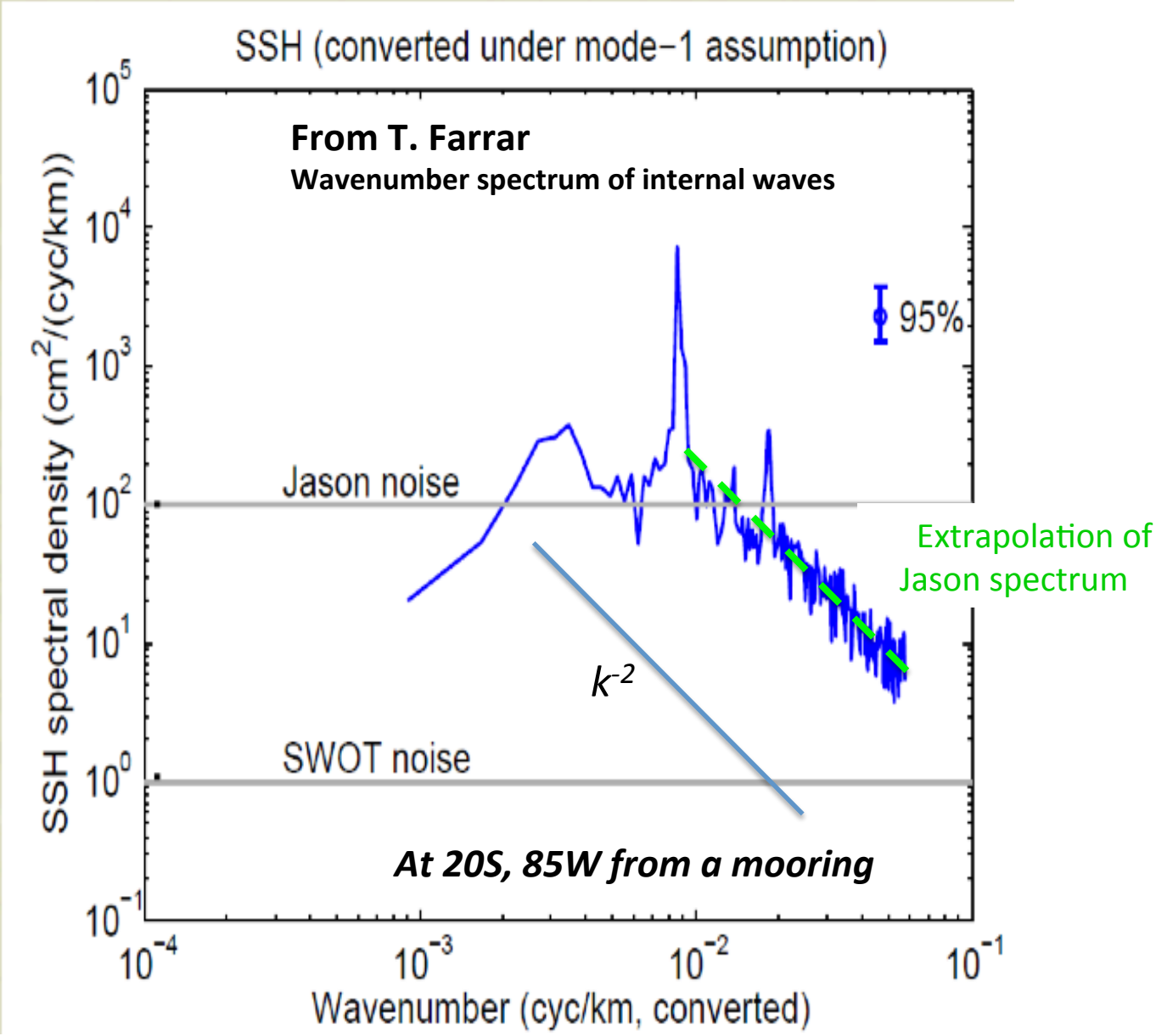
1-day fast sampling orbit



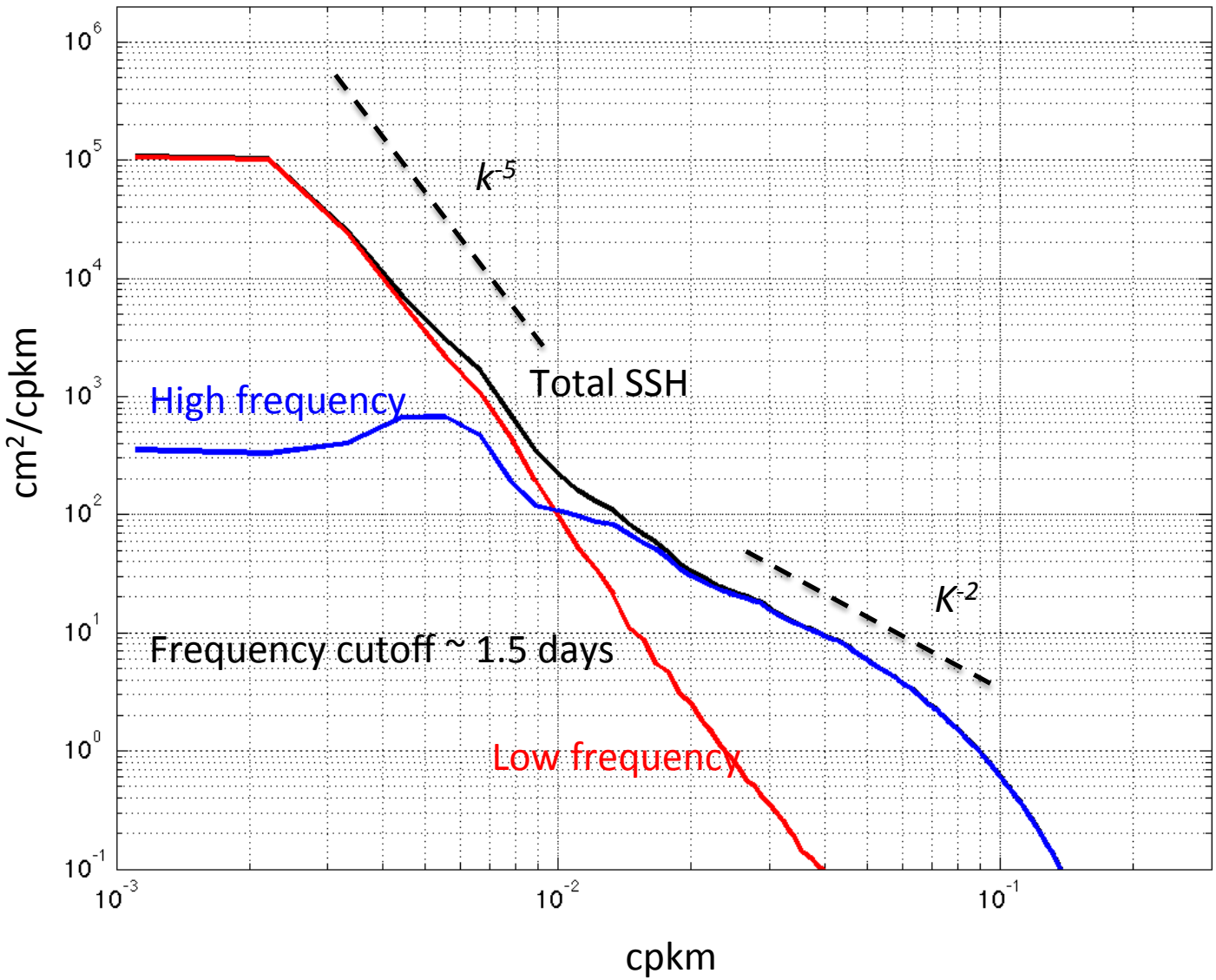
Potential for first-order validation of the measurement error



Challenges: Dealing with Internal tides and internal waves

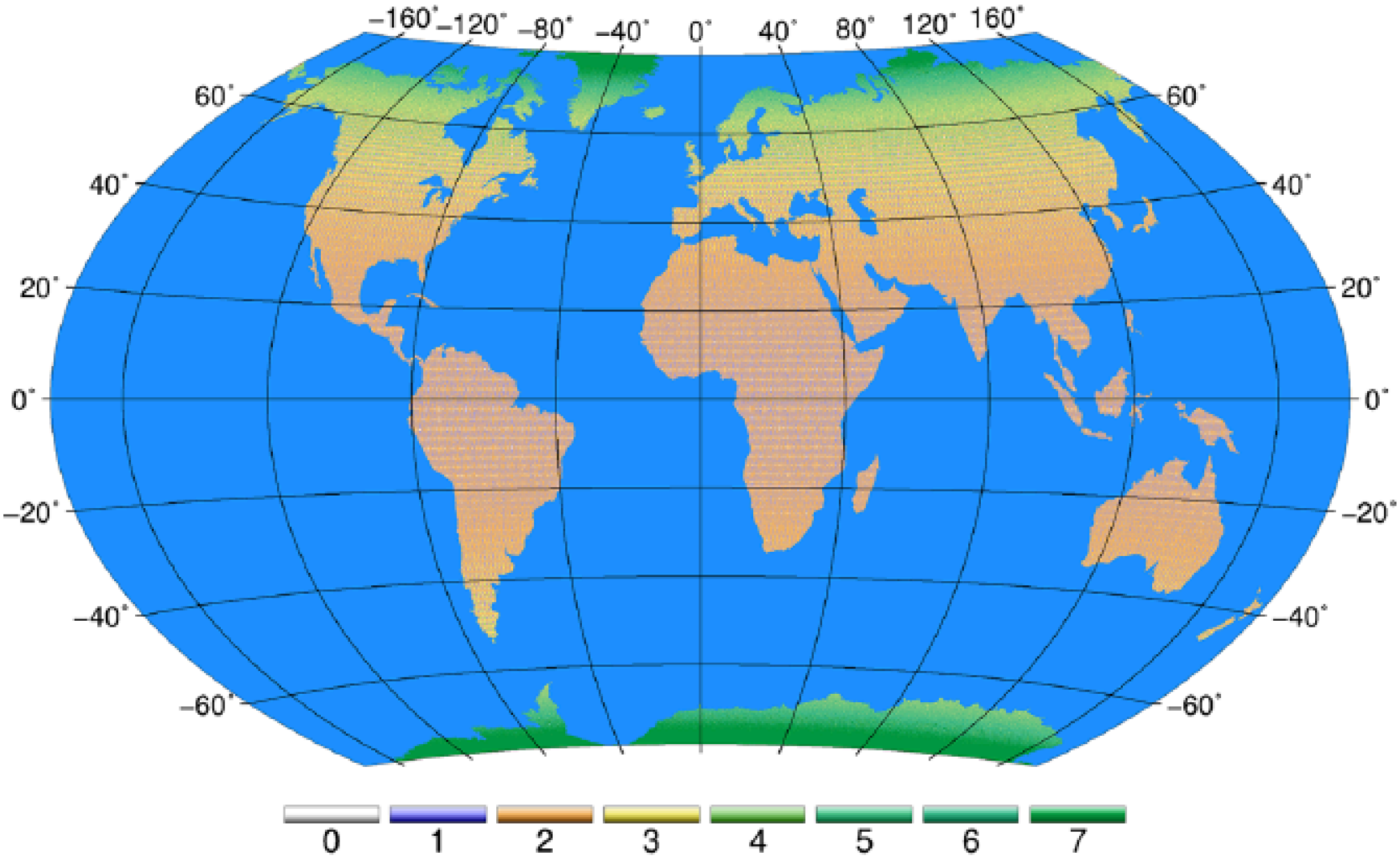


Wavenumber spectra of SSH from ECCO 1/48 deg



C. Ubelmann

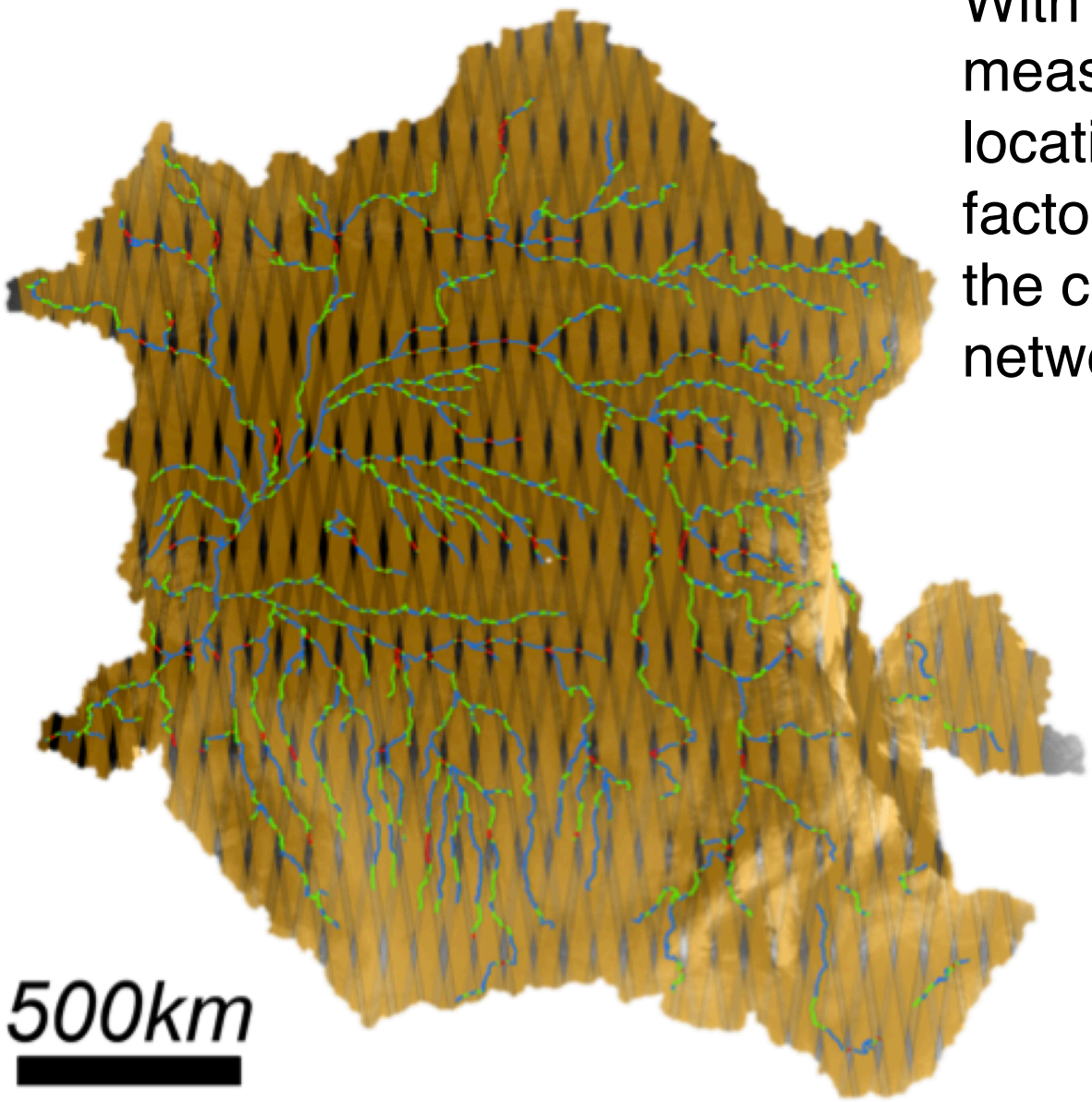
SWOT Revisits per 21-day Cycle



The 120 km wide SWOT swath will result in overlapping measurements over most of the globe. The result: an average revisit time of 11 days.

Biancamaria et al., SoG, 2015

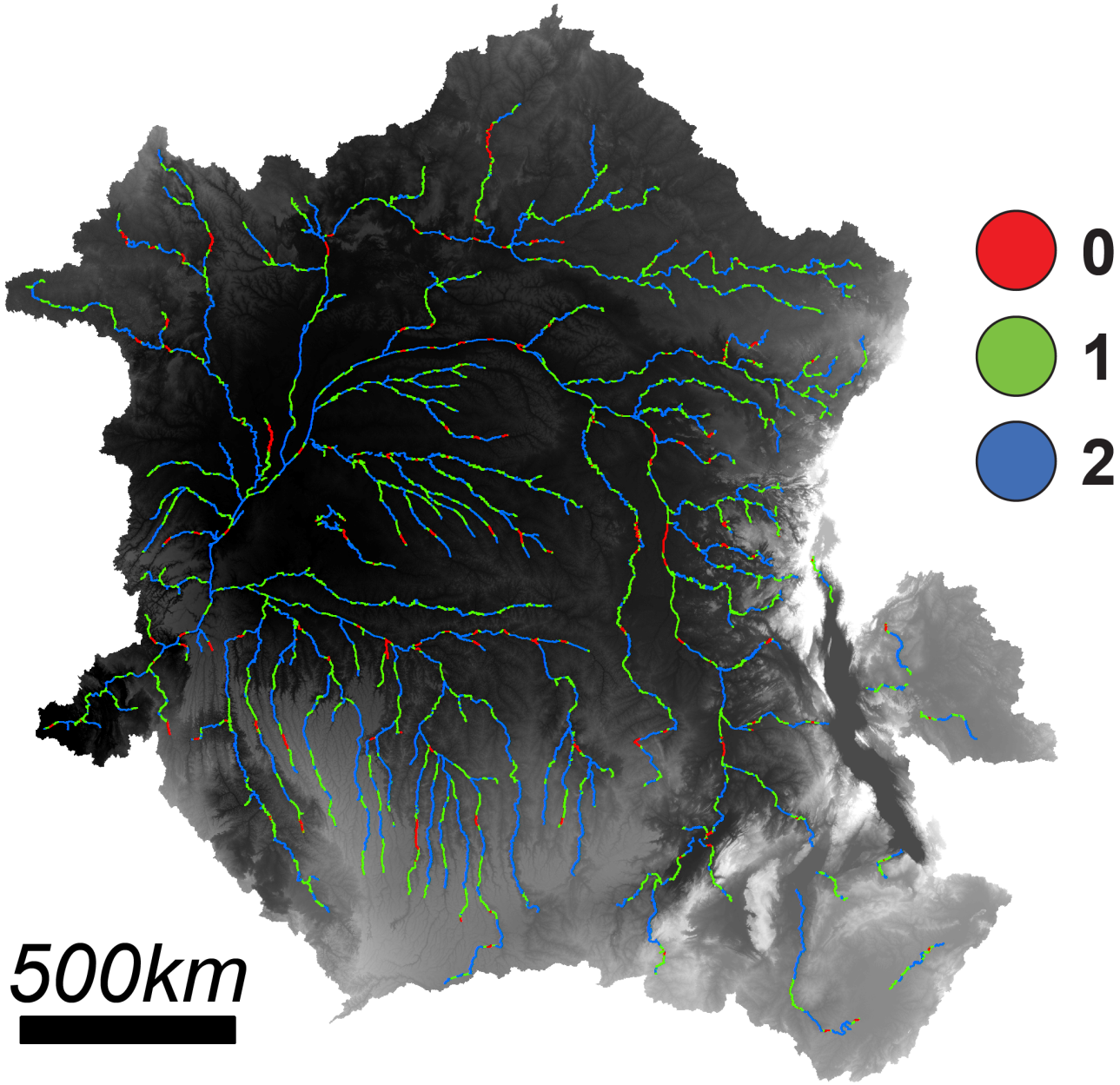
SWOT coverage for a 21-day cycle, Congo Basin



With reliable measurements of river location, width, and other factors, we can estimate the coverage of key river networks by SWOT.

Figure by C. Lion, UNC

SWOT Observations per 21-day cycle for rivers 100 m in width, Congo Basin



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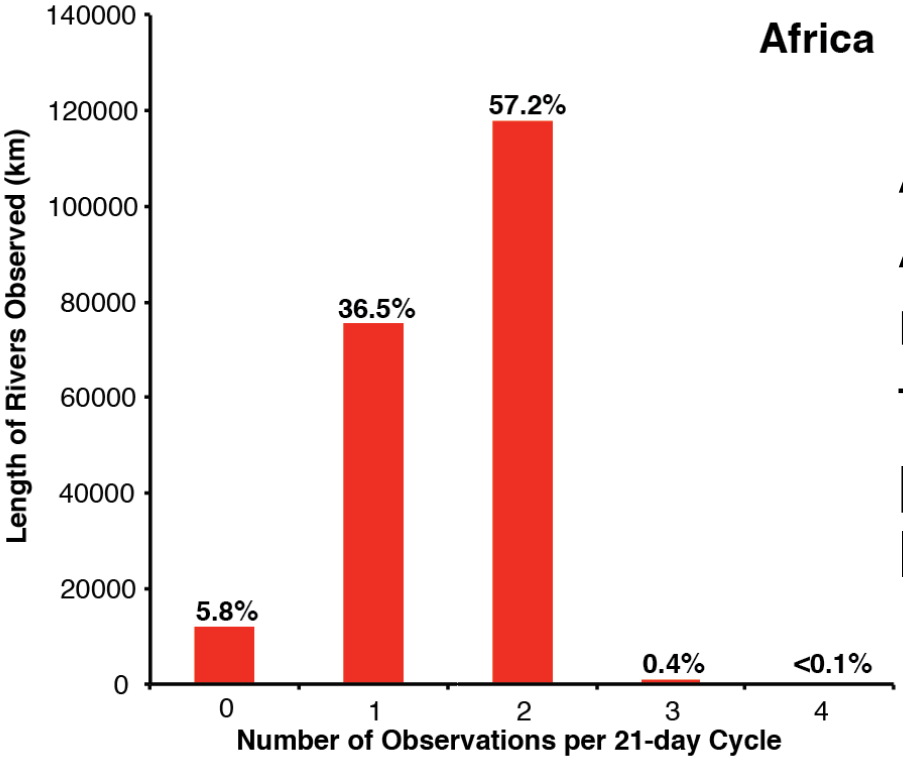
2

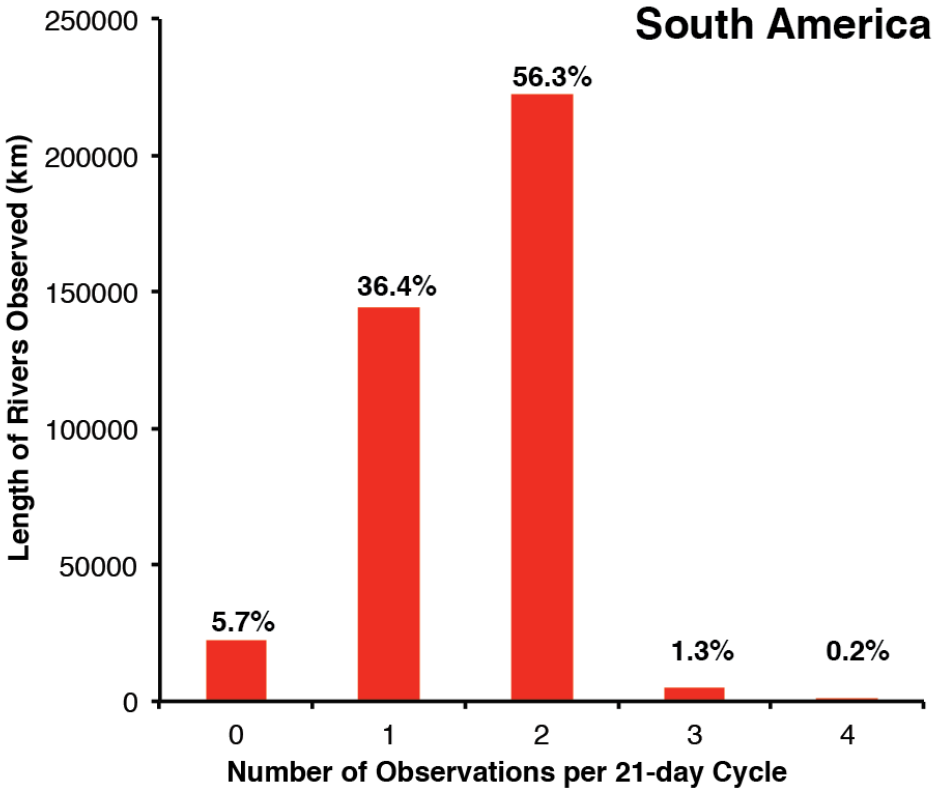
Certain portions of tropical river networks like the Congo will not be observed by SWOT at all. However, these are embedded in the overall river network, which will mostly be observed once or twice per 21-day repeat.

Figure by C. Lion, UNC

Continental-scale River Observations from SWOT

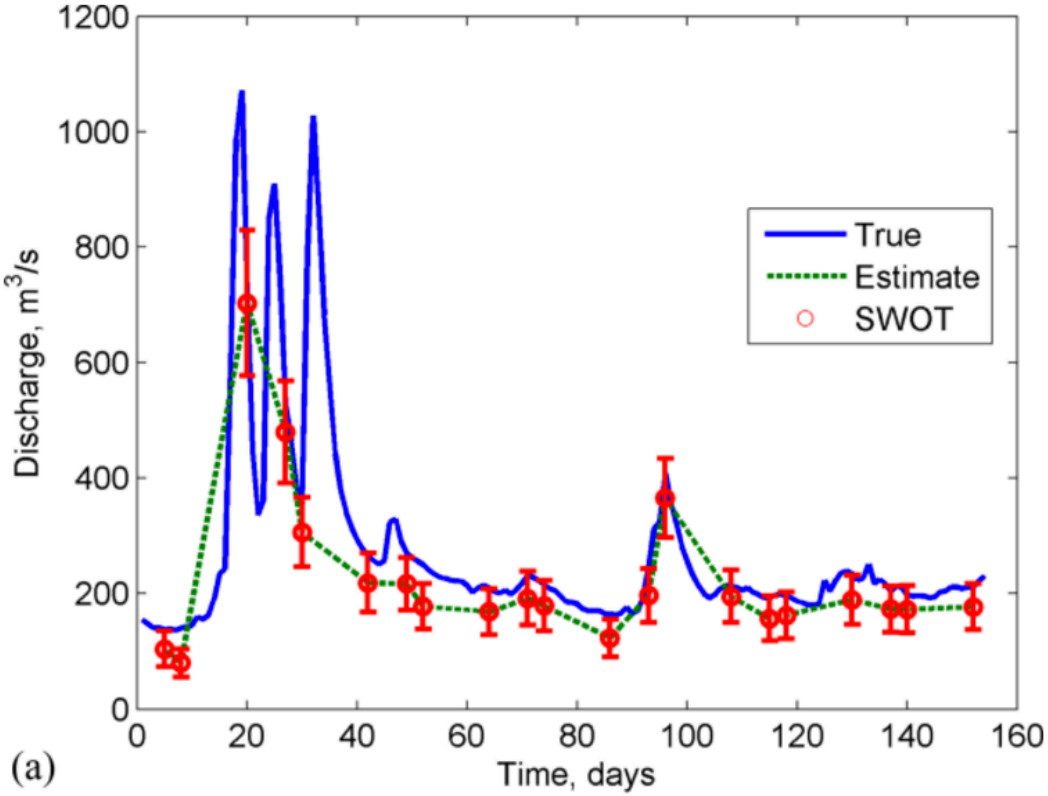
At continental scales, rivers in Africa and South America will mostly be observed once or twice per cycle. Unobserved portions of the river network limited to <6%.





The estimated network of SWOT-observable rivers derived from Landsat/SRTM and coded by SWOT overpass will be available to the science team by the end of 2016.

Simulated SWOT Discharge: Sacramento River



SWOT observations will provide intermittent coverage of rivers globally, depending on latitude and orbit characteristics.

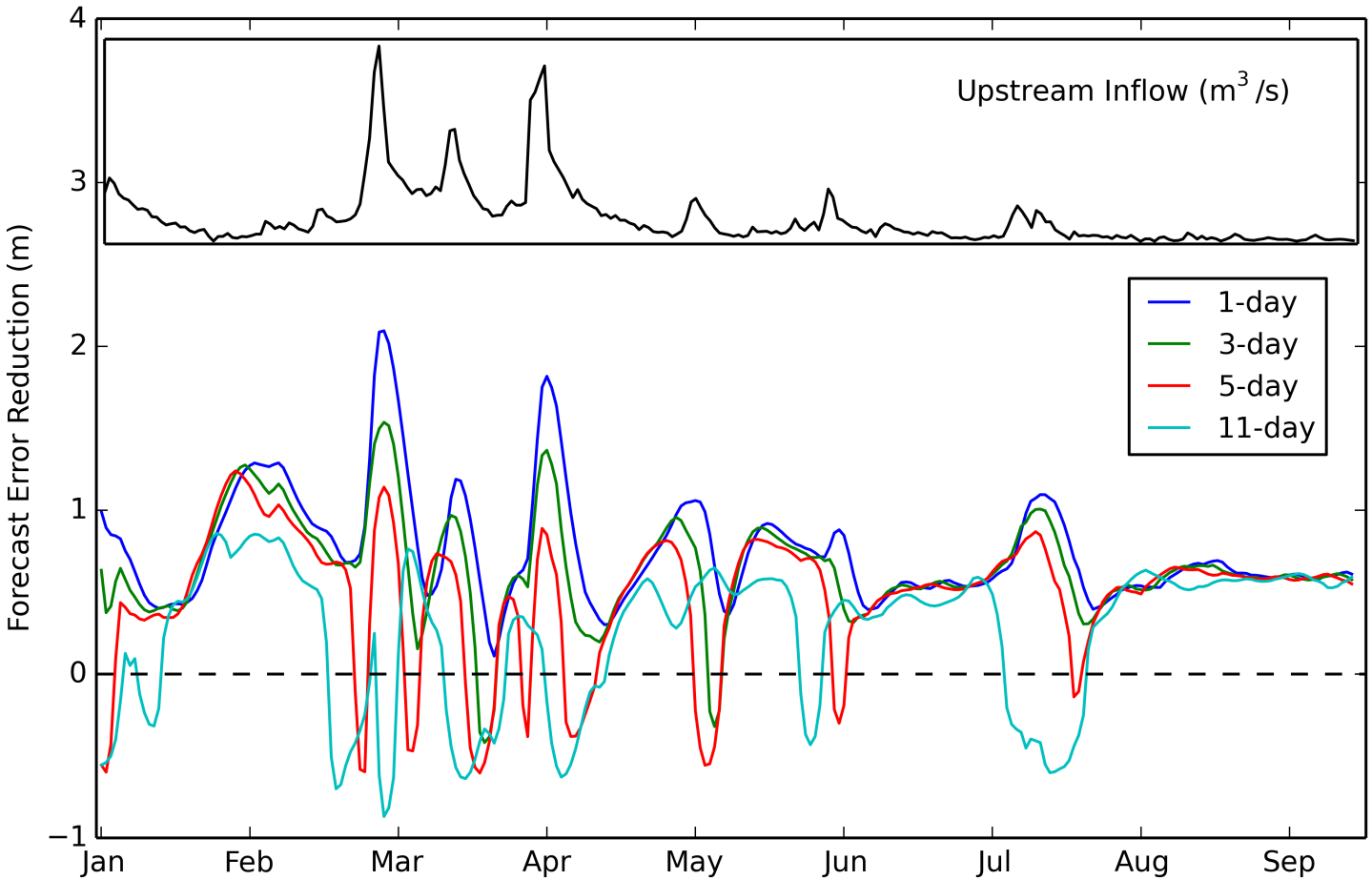
As such, robust estimation of runoff from SWOT will require assimilation into hydrologic models.

True runoff for Sacramento River: 8.5 km^3/yr
Estimated runoff: 8.1 km^3/yr (error = -5.6%)

Yoon et al., 2016, *WRR*

Interfacing SWOT and Hydrology Models: how frequent do observations need to be?

Error reduction from assimilation of SWOT-like data into a hydrodynamic model in the Ohio River Basin, based on the time since acquisition of a SWOT observation.



Even with an 11 day (~0.5 cycle) lag, assimilation of SWOT observations into a hydrodynamic model decreases error under most circumstances.

Andreadis and Schumann, 2014, *AWR*

Summary

- The 21- day science orbit presents challenges from temporally irregular sampling.
- The number of overflights in one 21- day cycle varies from one to two closely separate samples at low latitudes to a 10-day subcycle at the mid latitudes, to more than 3 at high latitudes.
- The 90-day cal/val phase will have a 1-day fast sampling orbit.

Oceanography

- A first-order test of the measurement error at regions of low ocean variability.
- Early test of tide models.
- Characterize the SSH signatures of internal waves and other rapid variabilities.

Hydrology

- Sampling of river networks will be robust even at low latitudes, where some individual river reaches will never be observed.
- The SWOT science orbit will allow characterization of discharge variations at weekly to monthly scales.
- Finer scale will require assimilation into models to fill in gaps.