Investigating SARAL/AltiKA instrument performance with relevance to research/operational programs that are focussed on continental waters.

Charon Birkett[1], Brian Beckley[2], Xu Yang[2]

[1]ESSIC, University of Maryland, College Park, USA

[2] SGT at NASA/GSFC, USA

NASA OSTST

Program Manager: Dr. Eric Lindstrom

NASA Water Resources

Program Manager: Dr. Brad Doorn

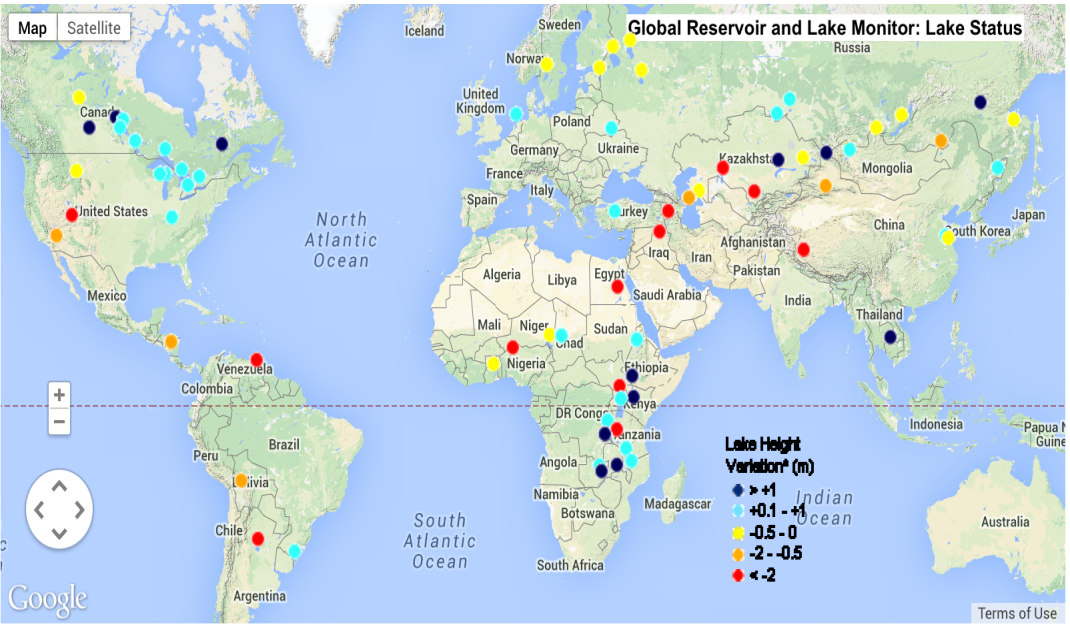
NASA Earth Science Data Records

Program Manager: Dr. Martha Maiden

The exploitation of long- and short-term altimetry data sets for

- **climate**
- **natural hazard (flood, drought)**
- **agricultural**
- **hydrological**

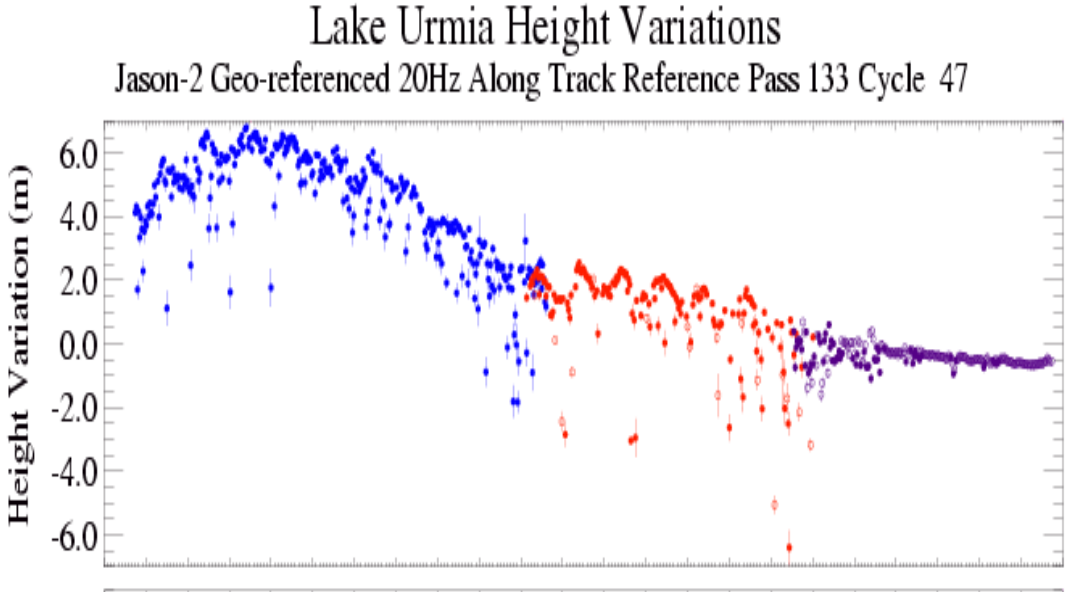
analysis and application, with emphasis on lakes, reservoirs, wetlands and river basins.



The NASA/USDA Global Reservoir and Lake Monitor.

Typically one third of the monitored lakes/ reservoirs are 0.5m or more below their long-term average.

ISRO/SARAL for
- Near real time Agricultural Monitoring
- Continuity with ERS and ENVISAT for longer-term hydrological monitoring.



Understanding the Hydrology and Hydraulics of River Basins with sparse gauge networks.

E.g., Yukon Basin, USA

Only 4 USGS gauging stations within the USA, yet the basin encompasses ***many different climate zones and is variable in its hydrological complexity.***

ISRO/SARAL for
- Supplementing the sparse gauge network.

- And taking a longer (more research based) look at the application of altimetry and imagery to the determination of river discharge.

Understanding the Hydrology and Hydraulics of Complex wetland zones.

Case Study: Usangu wetlands (north of Lake Malawi)

Application to
- Availability of freshwater in semi-arid region
- Conservation in a fragile ecosystem versus agriculture and grazing

Large growth in cattle farms and irrigation. All supported by water draining into the Usangu with no return flow to the rivers.

Wetland outflow controls inflow into the Great Ruaha River catchment basin. Influences downstream water available for consumption and hydro-electirc power. ***No integrated water resources management in the region.***

ISRO/SARAL for
Altimetric measurement of river channels, impoundments, and marsh lands.

Investigation of ISRO/SARAL AltiKa data.

- To date – qualitative quick-looks only

- GDR cycles 001 to 012/014, DIODE acquisition/median tracking mode

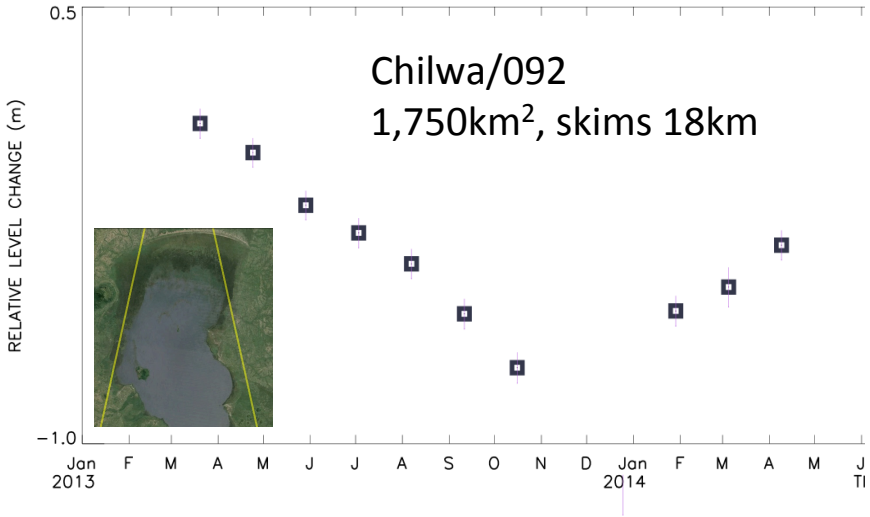
- Various Lakes and Reservoirs around the world,
- Usangu wetlands and the Yukon Basin around Eagle gauge station.

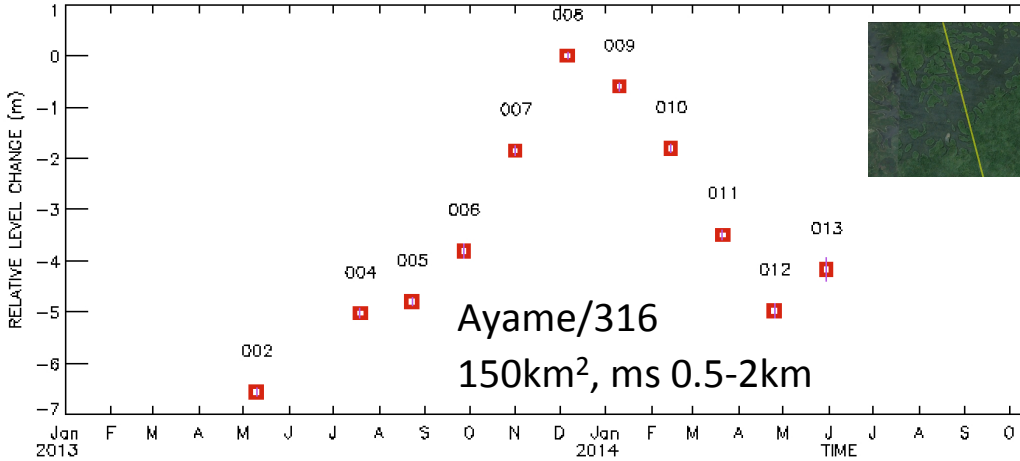
- Looking for improvements due to Ka-band use, smaller footprint, and 40Hz. (Quick acquisition and maintaining lock, stability, expected seasonal variability)

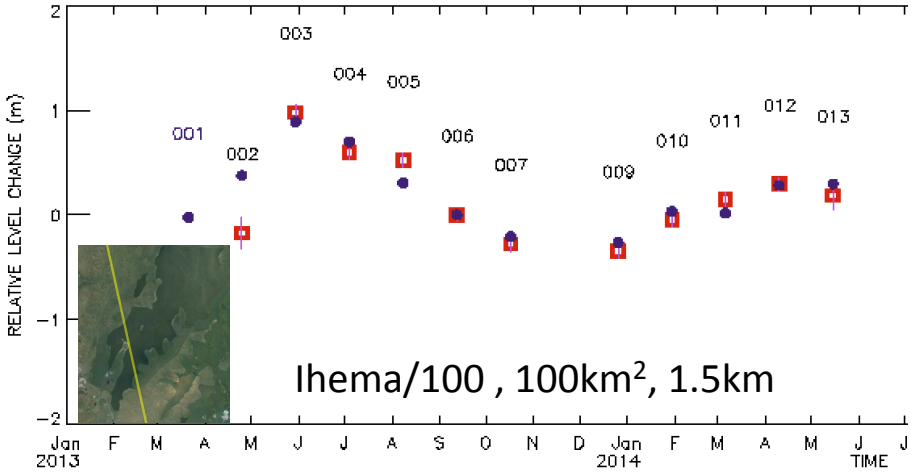
- Comparisons with Jason-2/OSTM (rather than ENVISAT)) for now.

……Many good results, some requiring further investigation

African Lakes (15S to 5N), SARAL, various passes, Ice1 retracker

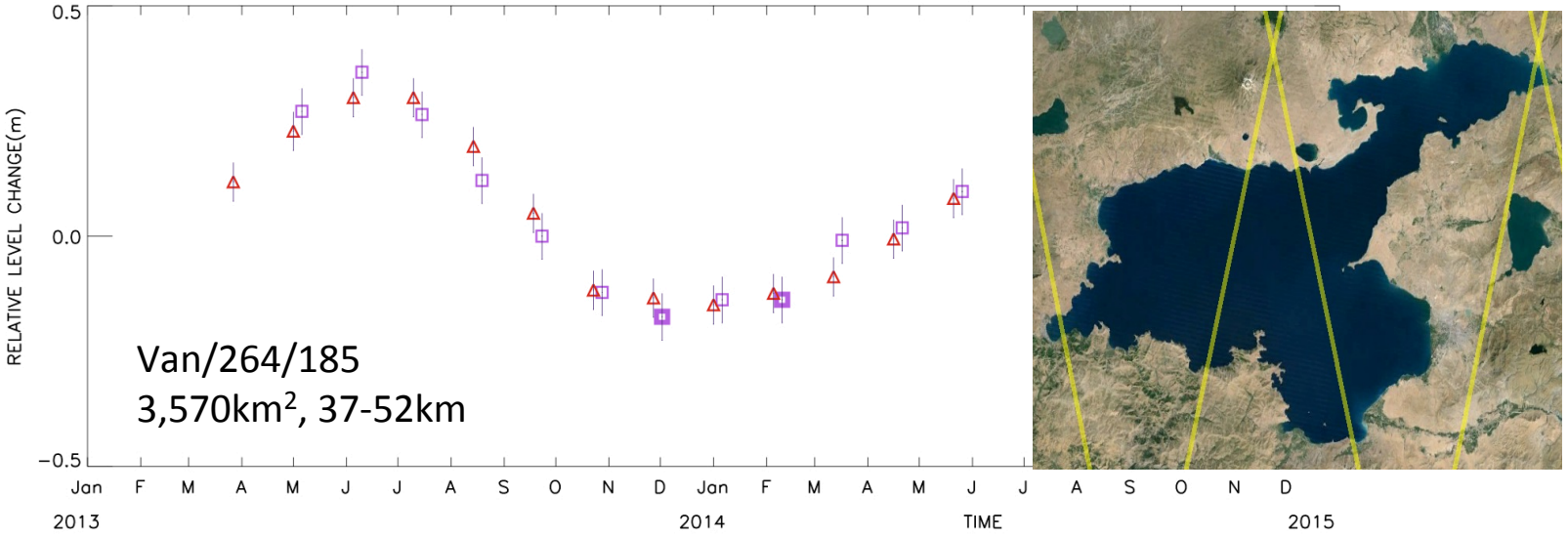




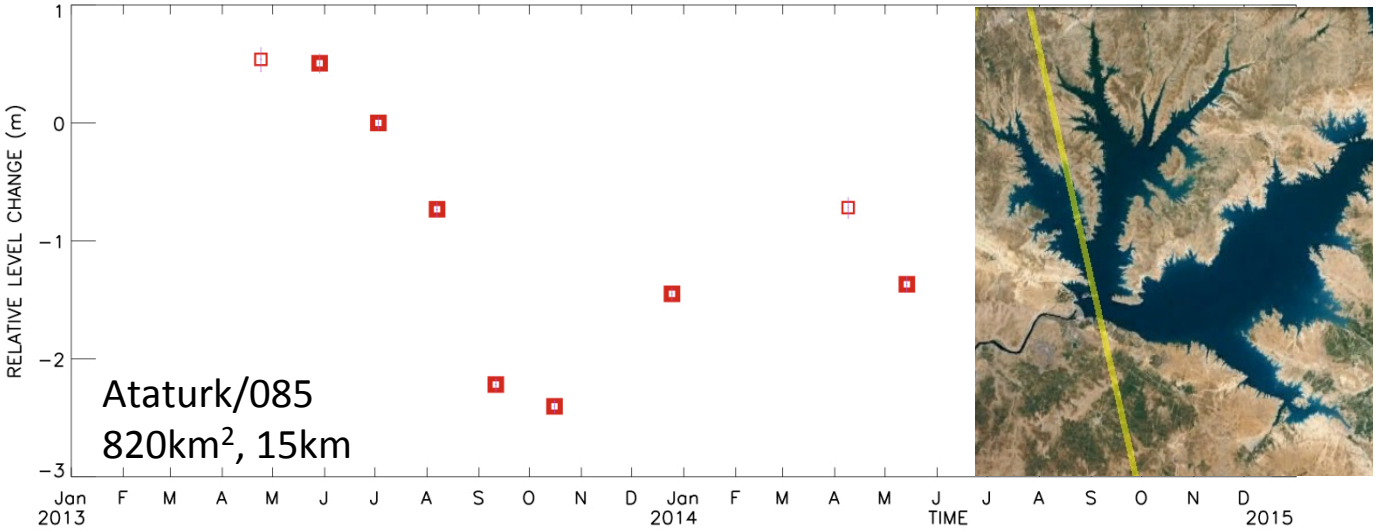


Smallest lake 100km²
Narrowest extents 0.5-2.0km
Maximum data loss 20%
Max cross-track separations 1.4-1.9km
Good overall results
Expected variability

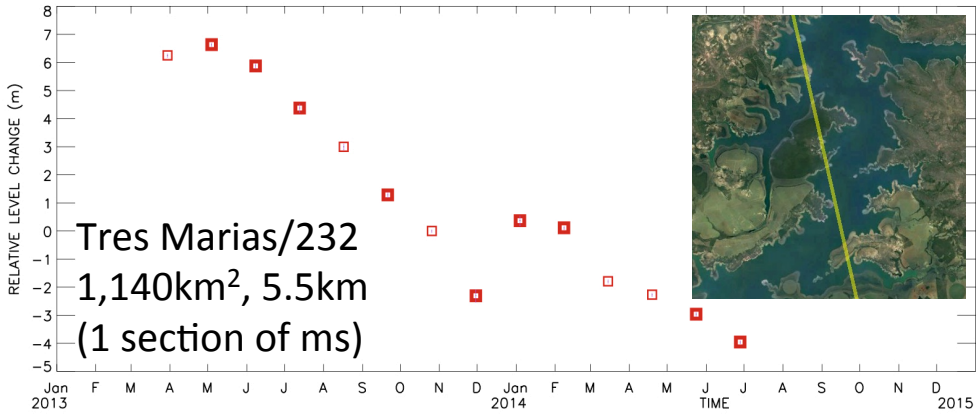
Turkish Lakes (~38N), SARAL, various passes, Ice1 retracker

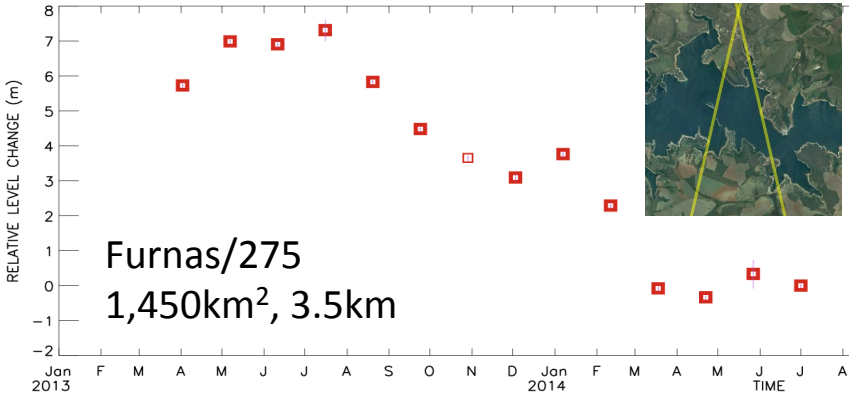


Smallest lake
820km²
Narrowest extents
0.5-2.0km
Max data loss 30%
Max cross-track separations 2.5-3.0km



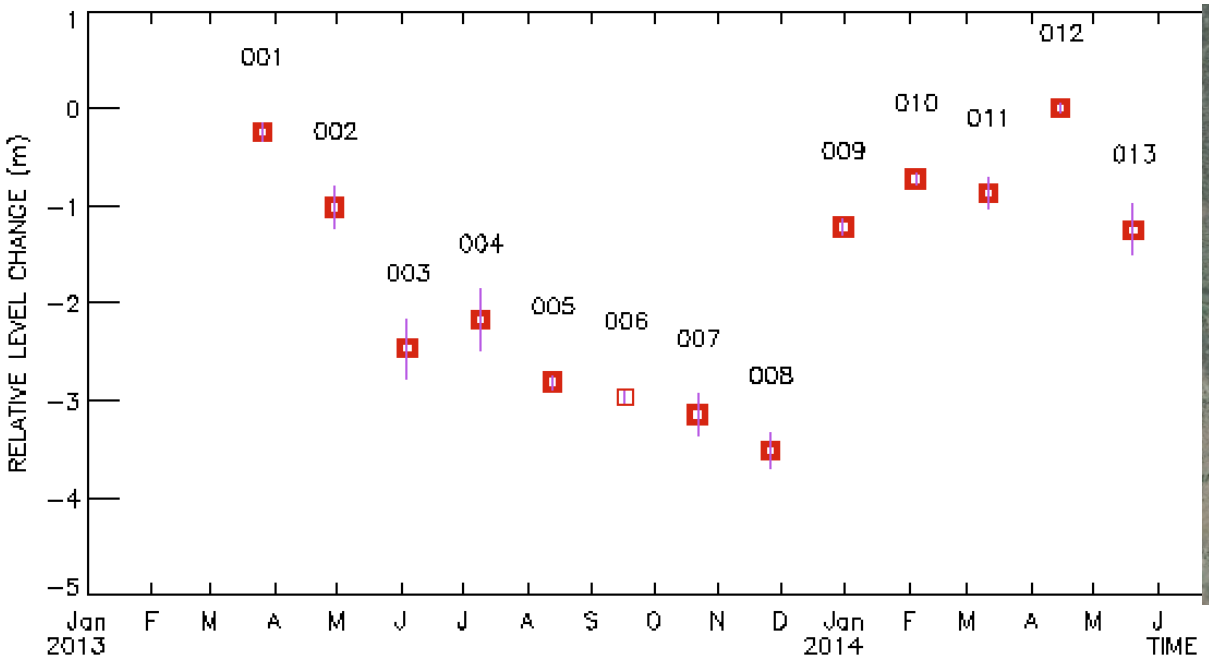
Brazilian Lakes (25S to 18S), SARAL, various passes, Ice1 retracker

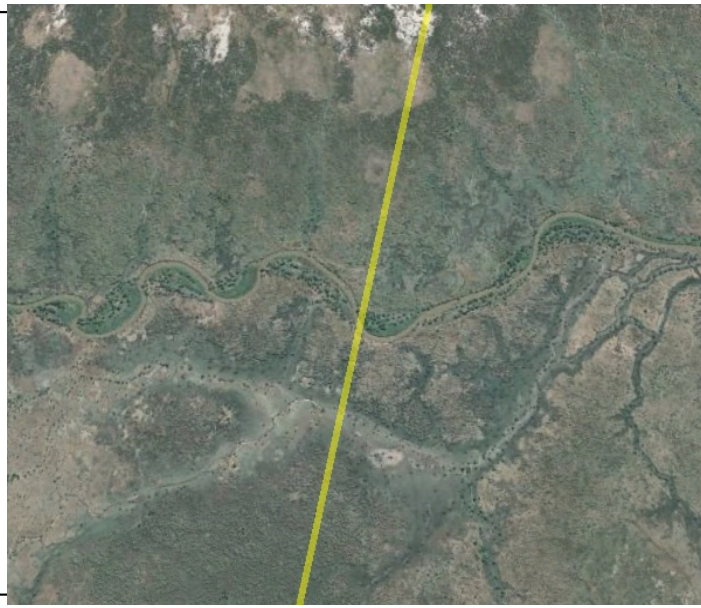




Smallest lake 1,140km²
Narrowest extent 3.5km
Maximum data loss 15%
Max cross-track separations 1.2-2.2km
Maintaining lock poorest for Itaipu

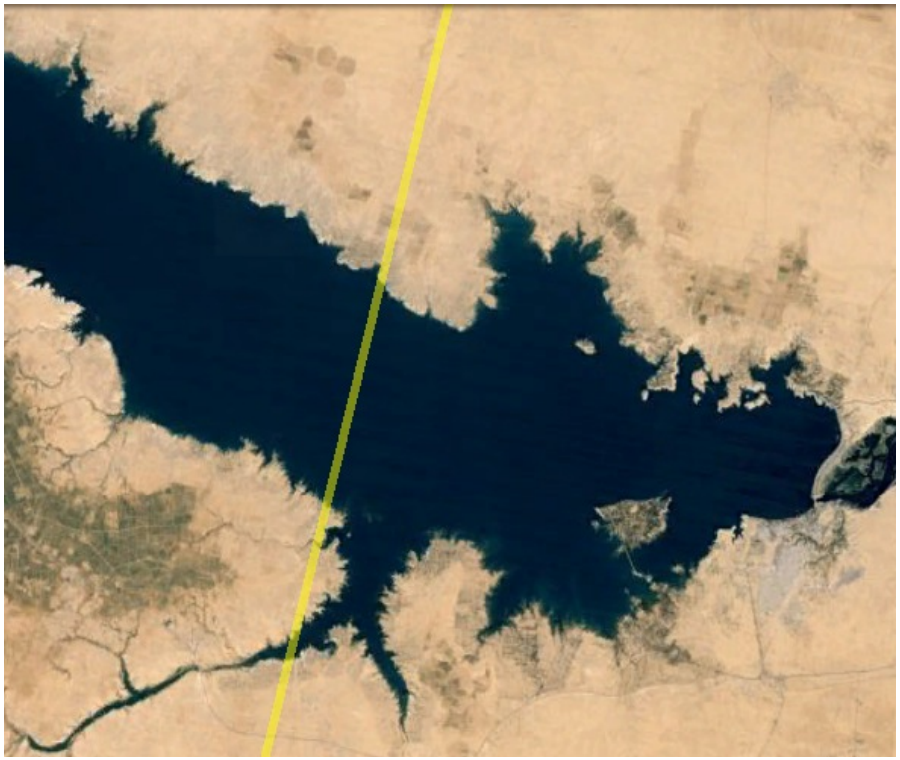
Usangu Wetland (~8S), SARAL, Pass 178, Ice1 retracker

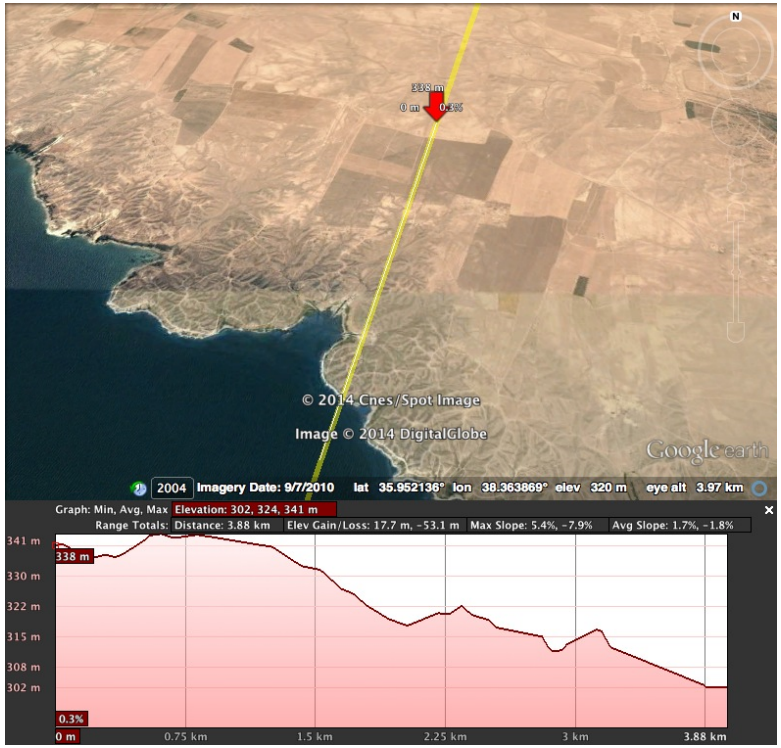


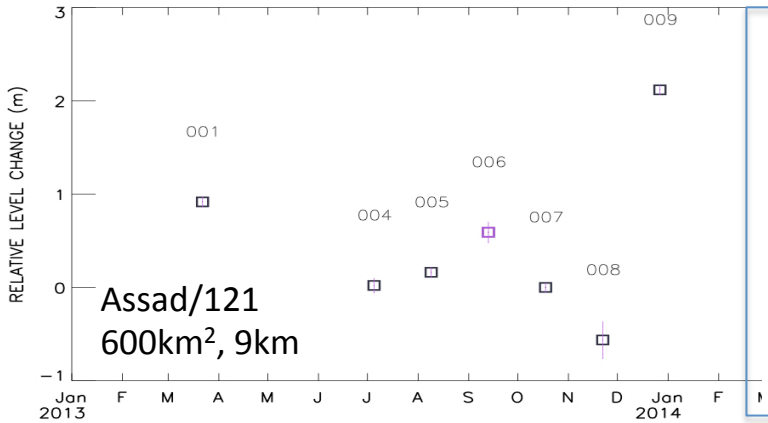


Narrowest extent 1km
Maximum data loss 0%
Max cross-track separation 1.3km
Good results (expected 3m seasonal variation) for periods of constant inundation

Assad Dam (34N, 38E), Syria, SARAL







Lake 600km^2

Narrowest extent 9km

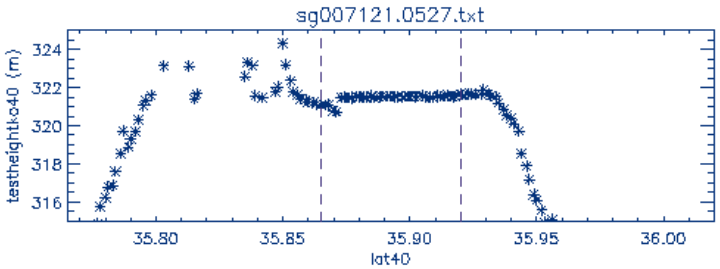
Data loss 40%

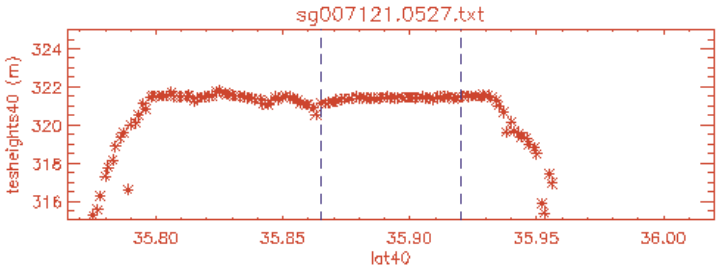
Pass121 – 40m height jumps and striping in 5 cycles

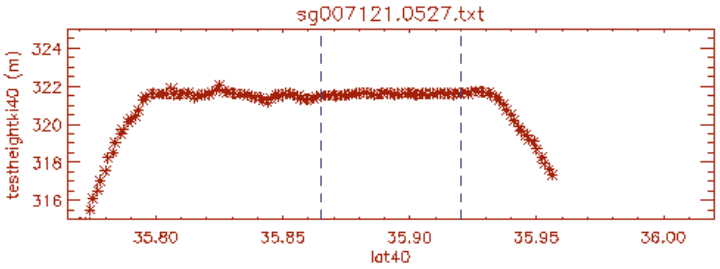
Max cross-track separations 2.8km

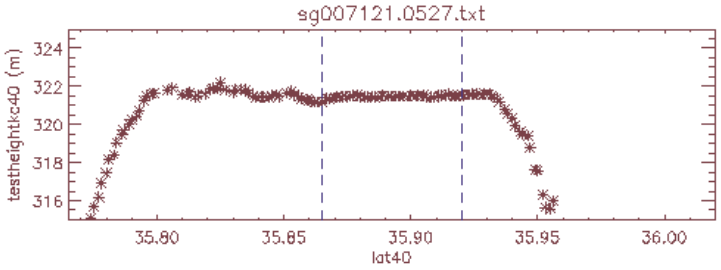
Assad Dam, Syria, SARAL

cycle007

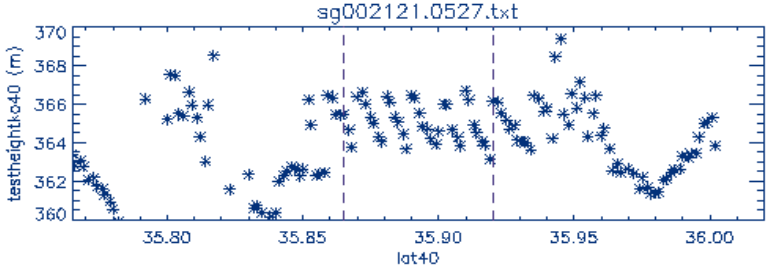


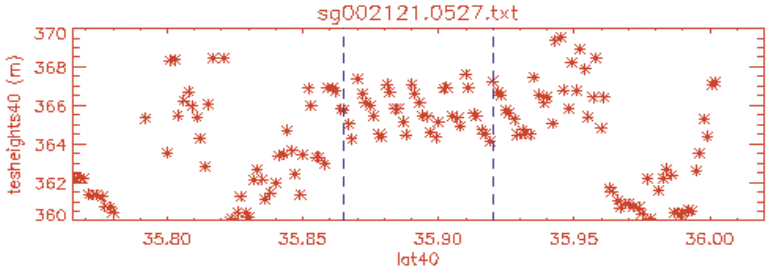


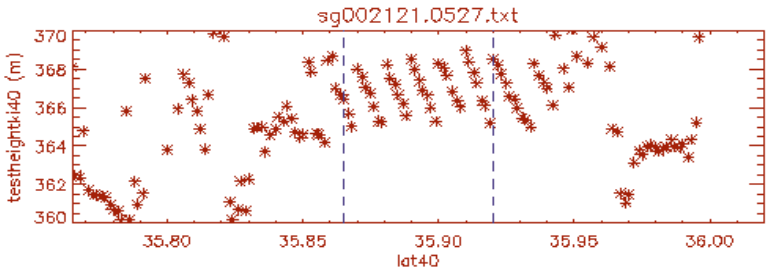


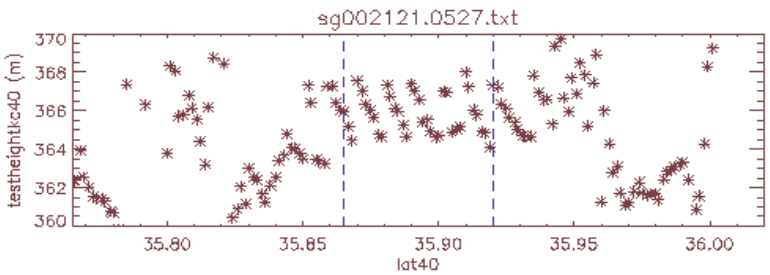


cycle002



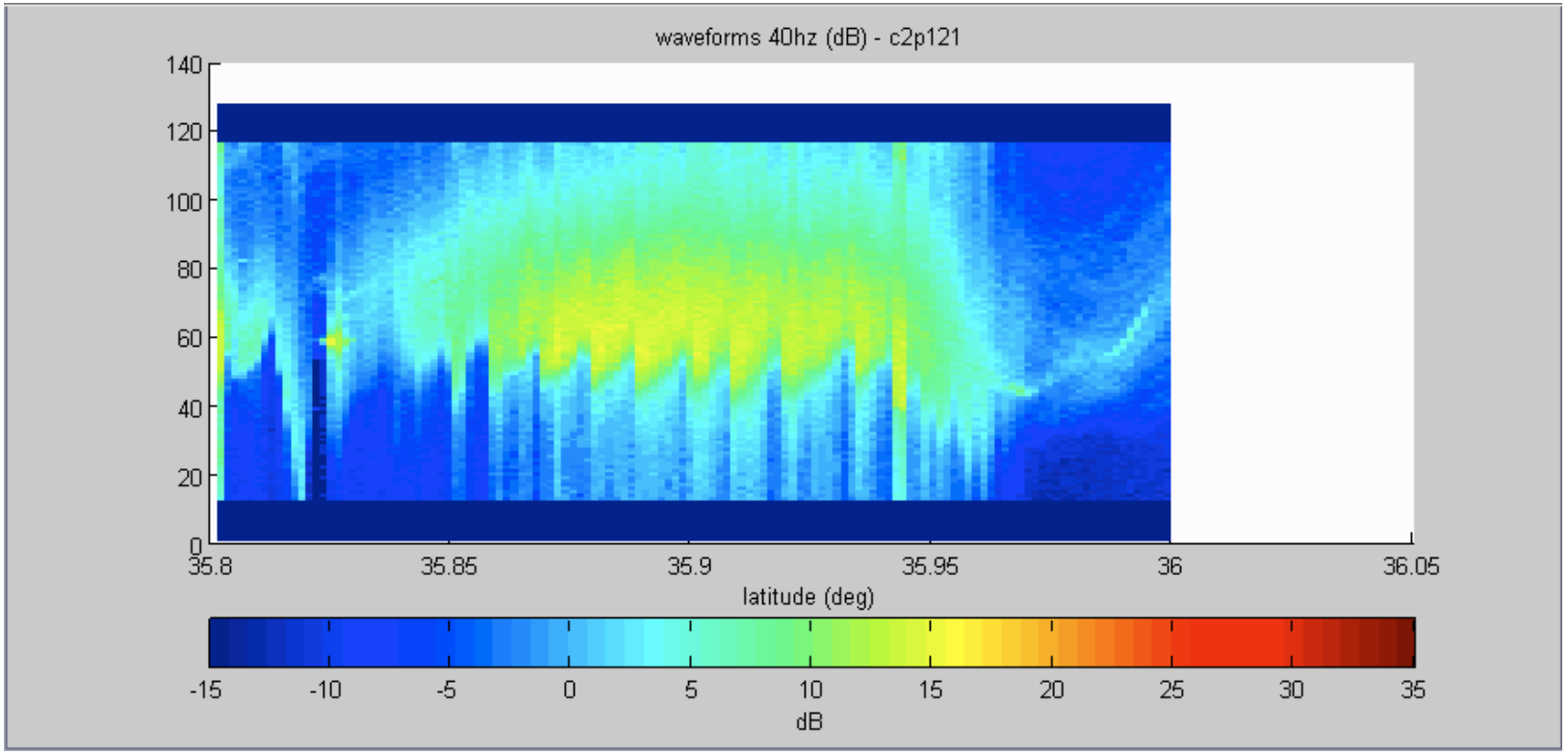




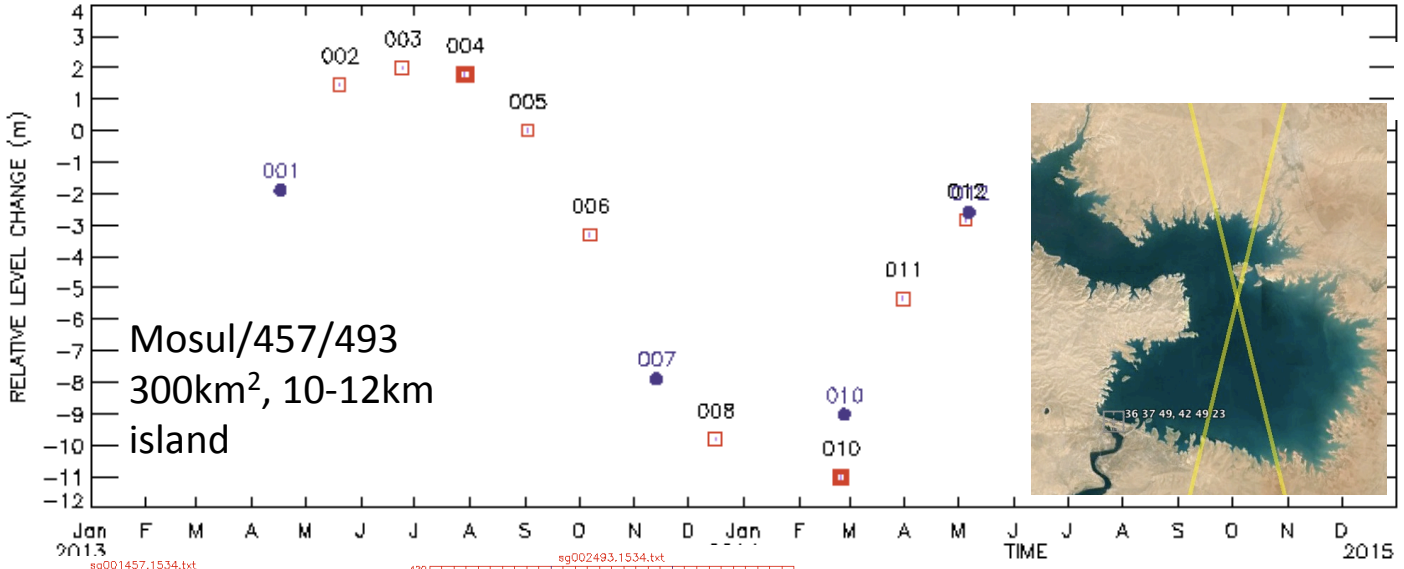


Assad Dam, Syria, SARAL

Lake Assad rev 242(121)
DIODE Acquisition/median tracking mode
SARAL waveforms for cycle 007
(Figures courtesy of Amandine Guillot

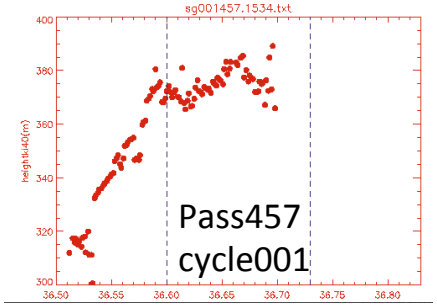


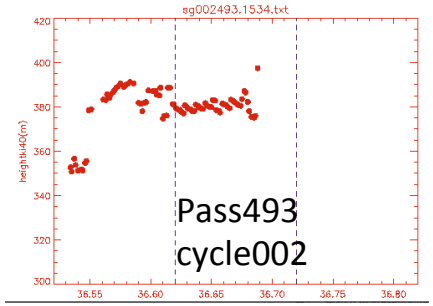
Mosul Dam (36N, 43E) Iraq, SARAL, Ice1 retracker

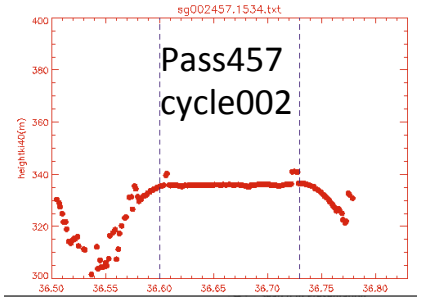


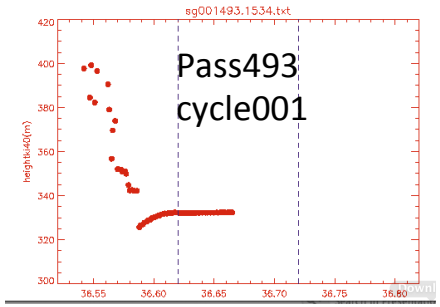
D//493

A\\457



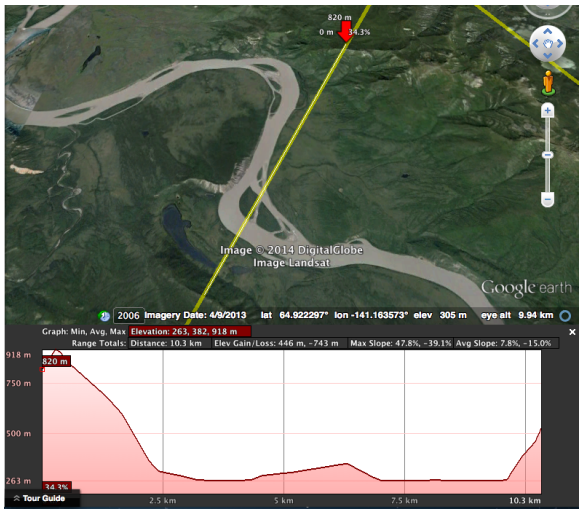




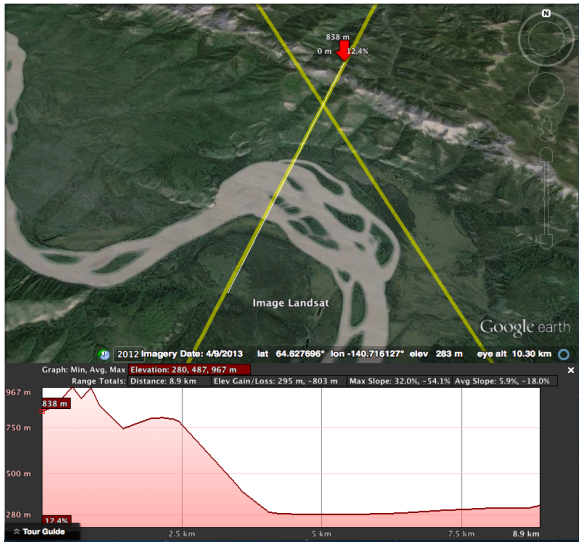


Lake 300km²
Narrowest extent 10km
Data loss 25-66%
Max cross-track separations 0.9-2.4km
Pass457 – 30m height jumps in 3 cycles
Pass493 – 25m height jumps in 6 cycles with "striping" observed in 4 (cycles 002, 004, 005, 011)
Solution - utilize both passes

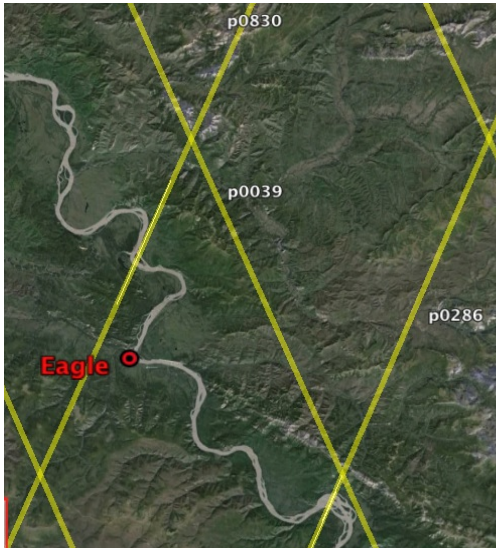
Yukon River (65N), SARAL, Passes 413(D//830) and 143(D//286)



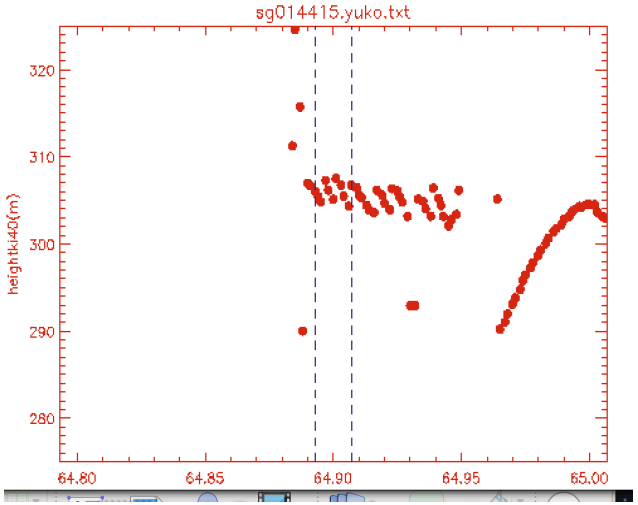
Pass D//830, 1-2km extent, **100% GDR data loss, striping in cycles 013+014**



Pass D//286, 2km extent, potential islands, **80% GDR data loss**

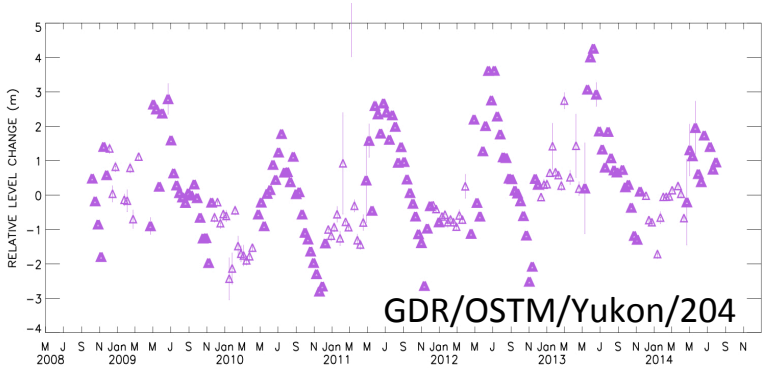


SARAL Pass830
Narrowest extent 0.9km+islands
GDR Data loss 100%
~25m height jumps and striping in 3 cycles
SARAL Pass286
Narrowest extent 2km+islands
GDR Data loss 75%



Yukon River, Eagle Station, SARAL v OSTM

OSTM Pass204
Narrowest extent
0.7km
OSTM Pass251
Narrowest extent
0.9km+island
Data losses ~10%



Investigation of ISRO/SARAL AltiKa data.

Qualitative GDR quick-looks, various lakes/reservoir/river channel/wetland regions.
Cycles 001 to 014.
Investigation still ongoing – future looks with SDR and 50-100km^2 lake size range.

Summary

- Majority of water body acquisitions ok with expected seasonal variability
- Ice retrackers better than ocean over calmer waters
- (GDR) Acquisition times/distances variable (e.g. 3-4km Lake Van, Turkey)
- Deviations from reference track can be several km.
- Target acquisition and maintaining lock appears problematic in some regions with the need for echo retracking investigations.
- Height bias and "striping" for some water bodies – requesting SWT investigation.