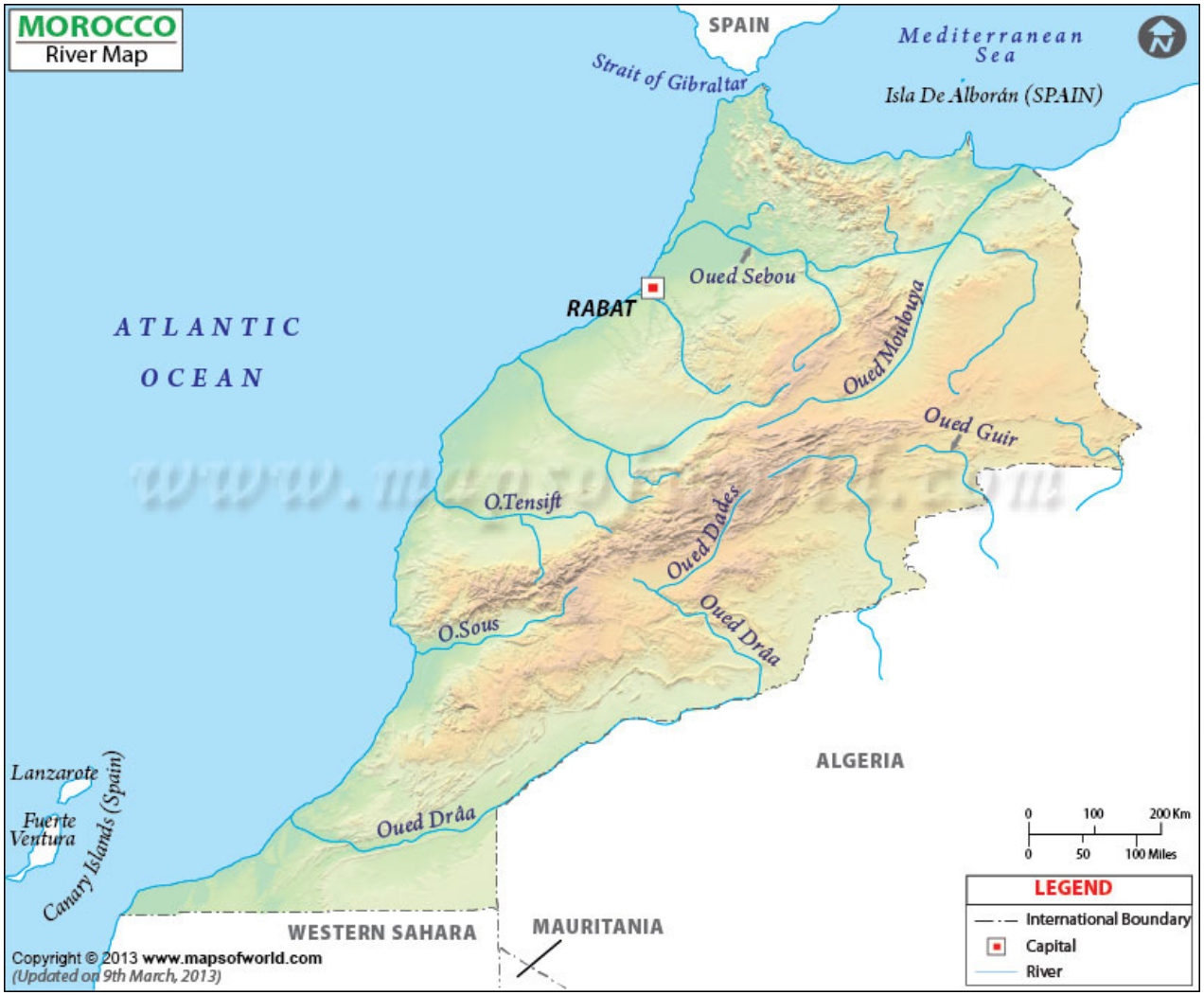

Upcoming NASA Altimetry Missions
SWOT and ICESat-2
Michael F. Jasinski
Hydrological Sciences Laboratory
NASA/GSFC
Presentation to the Moroccan Delegation
For NASA/USAID/World Bank, MENA-WISP projects
December 3, 2013


MOROCCO
River Map
SPAIN
Mediterranean Sea
Strait of Gibraltar
Isla De Alborán (SPAIN)
ATLANTIC OCEAN
RABAT
Oued Sebou
Oued Moulouya
Oued Guir
O.Tensift
Oued Dades
O.Sous
Oued Drâa
Oued Drâa
ALGERIA
Lanzarote
Fuerte Ventura
Canary Islands (Spain)
WESTERN SAHARA
MAURITANIA
0 100 200 Km
0 50 100 Miles
LEGEND
International Boundary
Capital
River
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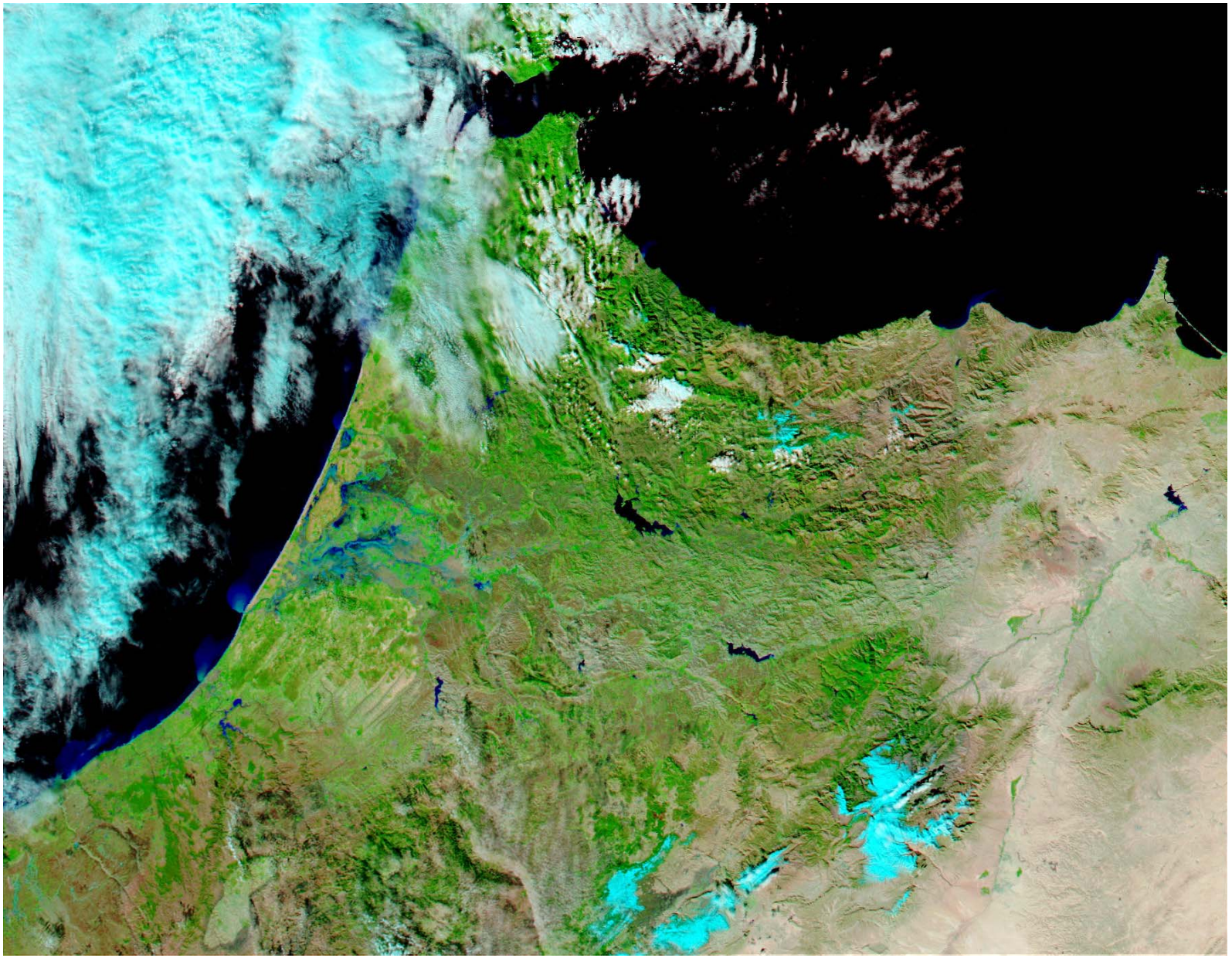
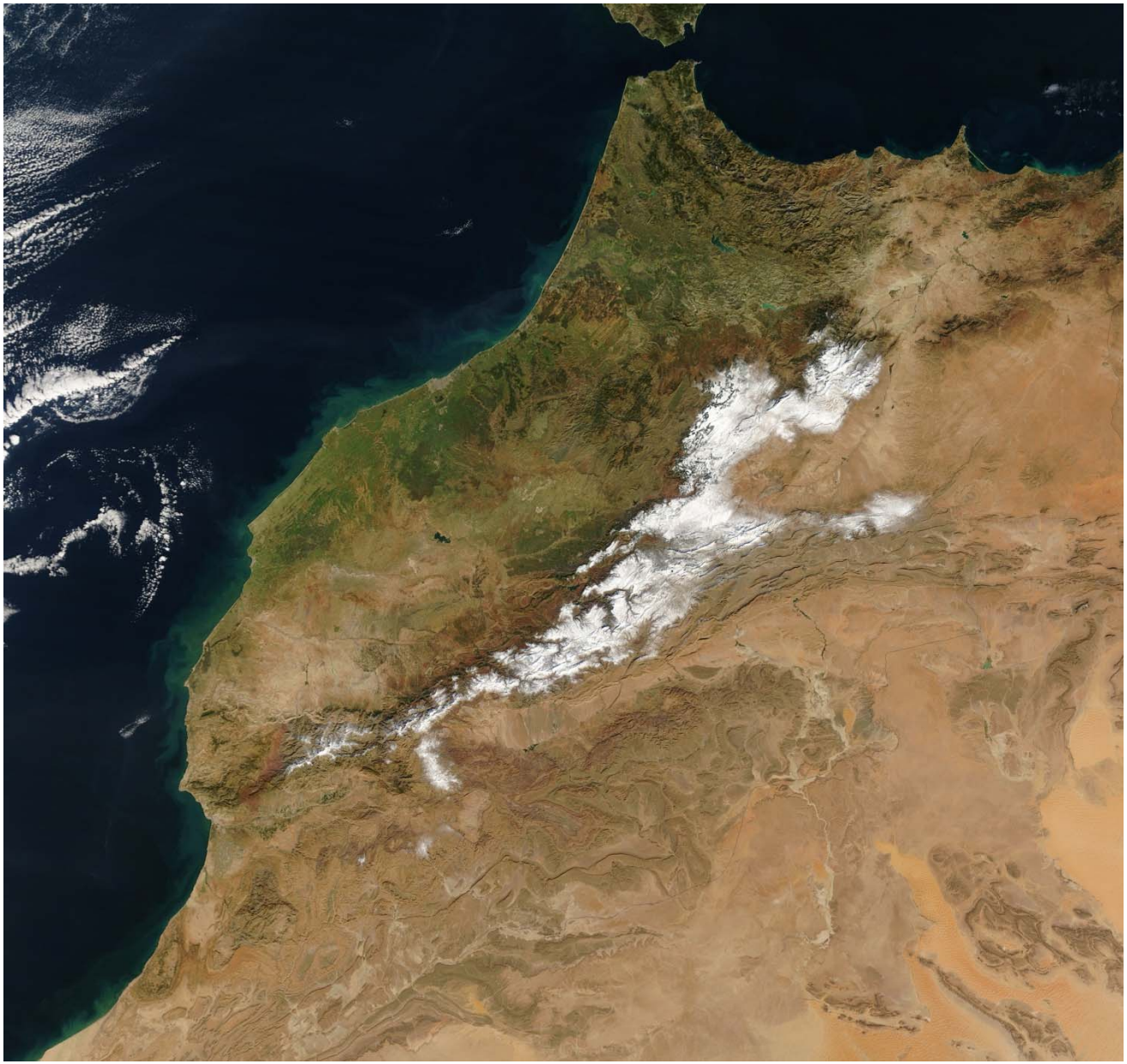
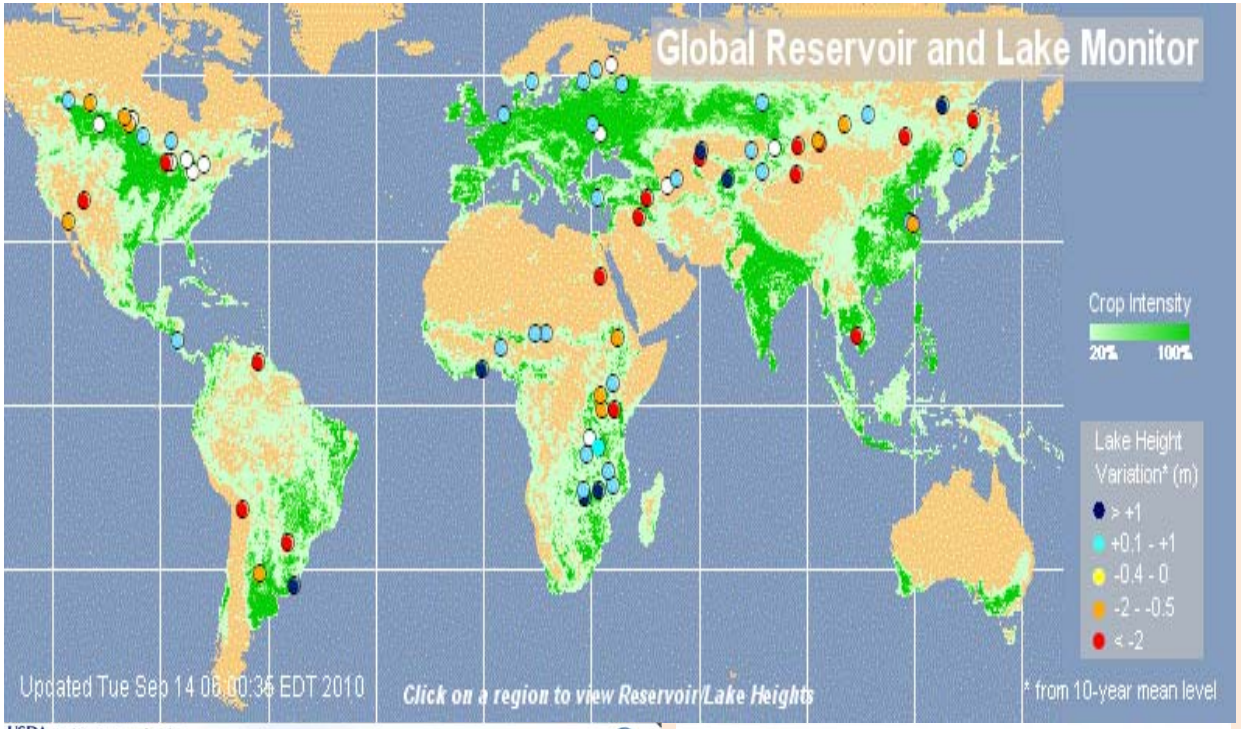
(Updated on 9th March, 2013)



Nov 2002



Jan 2005



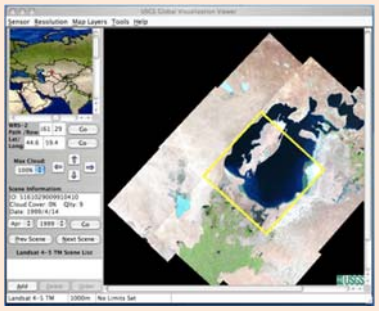
The Global Reservoir and Lake Monitor

Operational since 2003 Phase I, II

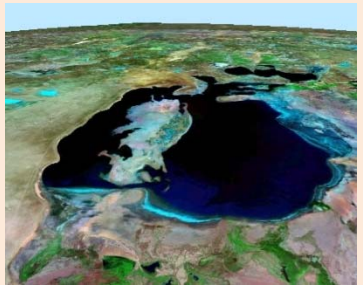
Charon Birkett PI, UMD/ESSIC

LAKENET

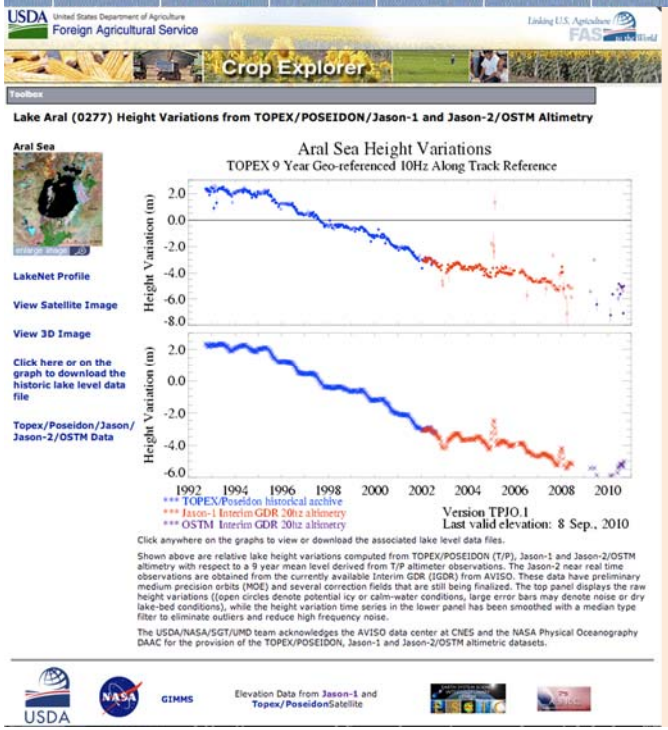
databases, Web links, etc



USGS Global Visualization Viewer



3-D Imagery



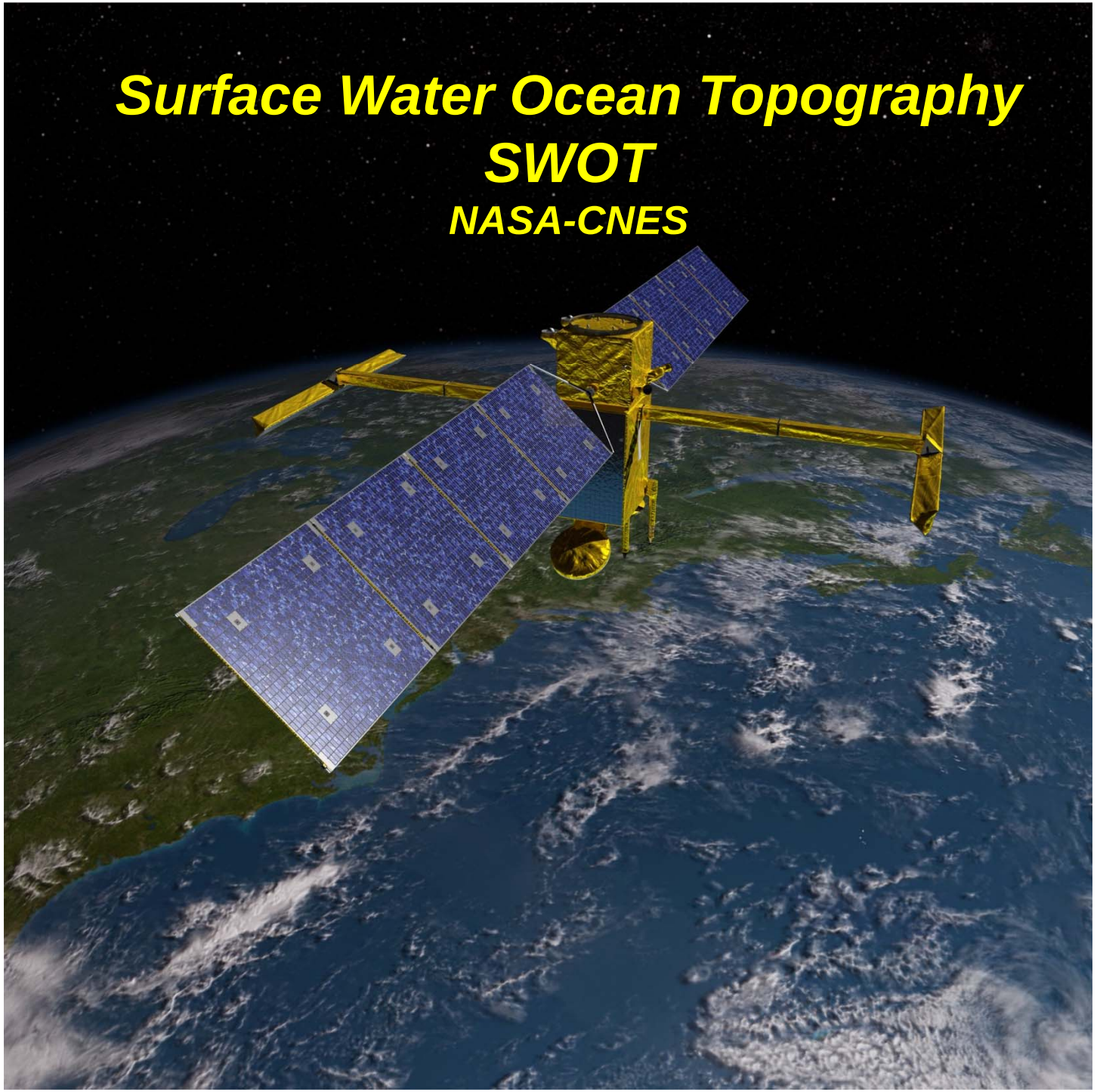
http://bigquill.gsfc.nasa.gov/images/lakes/lake0277.tp.txt

```
0277 Aral                : Lake database id number and name
 45.00  60.00            : Latitude and longitude (degrees East) of
 45.01  59.22            : Start latitude and longitude (degrees Ea
 43.96  60.14            : End latitude and longitude (degrees East
 44.10  44.65            : Latitude range of pass traversing lake a
   142   71              : Satellite pass and revolution number des

Column 1: satellite mission name
Column 2: satellite repeat cycle
Column 3: year,month,day of along track observations traversing lak
Column 4: hour of day at mid point of along track pass traversing l
Column 5: minutes of hour at mid point of along track pass traversi
Column 6: lake height variation with respect to TOPEX/POSEIDON 10 y
Column 7: estimated error of lake height variation with respect to
Column 8: mean along track K-band backscatter coefficient (decibels
Column 9: wet troposheric correction applied to range observation (

TOPEX    1 19920928  15 57    2.41   0.043   12.41 TMR
TOPEX    2 19921008  13 55    2.39   0.043   11.71 TMR
TOPEX    3 19921018  11 54 999.99 99.999 999.99 FMO
TOPEX    4 19921028   9 52    2.38   0.044   15.77 TMR
TOPEX    5 19921107   7 51    2.31   0.044   12.85 TMR
TOPEX    6 19921117   5 49    2.37   0.043   11.03 TMR
TOPEX    7 19921127   3 48    2.13   0.044    8.62 TMR
TOPEX    8 19921207   1 46    2.28   0.043   12.29 TMR
TOPEX    9 19921216  23 45    2.42   0.044   23.68 TMR
TOPEX   10 19921226  21 43    2.41   0.044   13.99 TMR
TOPEX   11 19930105  19 42    2.64   0.046   29.41 TMR
TOPEX   12 19930115  17 40    2.45   0.072   28.06 TMR
TOPEX   13 19930125  15 39    2.42   0.049   12.57 TMR
TOPEX   14 19930204  13 37   -0.20   0.384   18.04 TMR
TOPEX   15 19930214  11 36    2.30   0.044   11.90 TMR
TOPEX   16 19930224   9 35    2.92   0.046   40.93 TMR
TOPEX   17 19930306   7 33    2.74   0.046   35.53 TMR
TOPEX   18 19930316   5 32    1.09   0.133   30.54 TMR
TOPEX   19 19930326   3 30    2.39   0.044   11.83 TMR
POSDN   20 19930405   1 29 999.99 99.999 999.99 FMO
```

Surface Water Ocean Topography
SWOT
NASA-CNES



SWOT Instrument

Payload:

- KaRIN: Ka band wide band radar interferometer

- non sun sync

-Two SAR antennaes

-120km swath

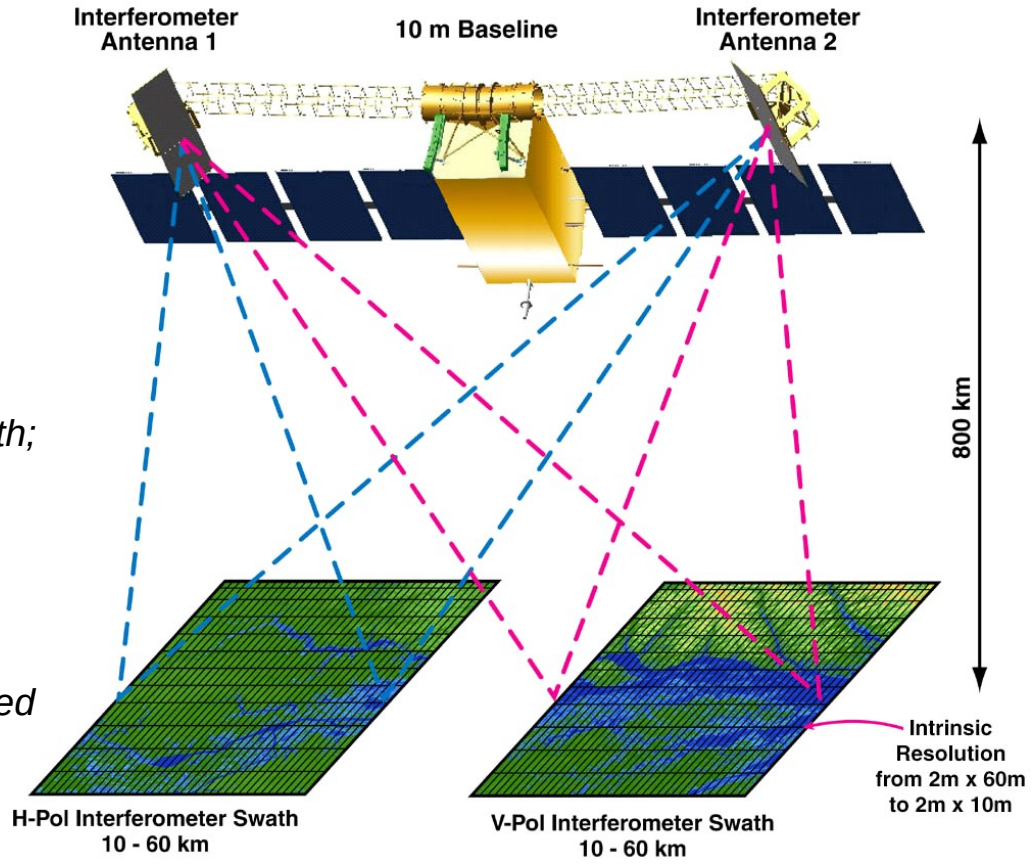
-Horizontal resolution: 10-70m along -swath; 5m processed along track

-Vertical resolution: ~0.50m vertical resolution/10m pixels, or ~1 cm/km

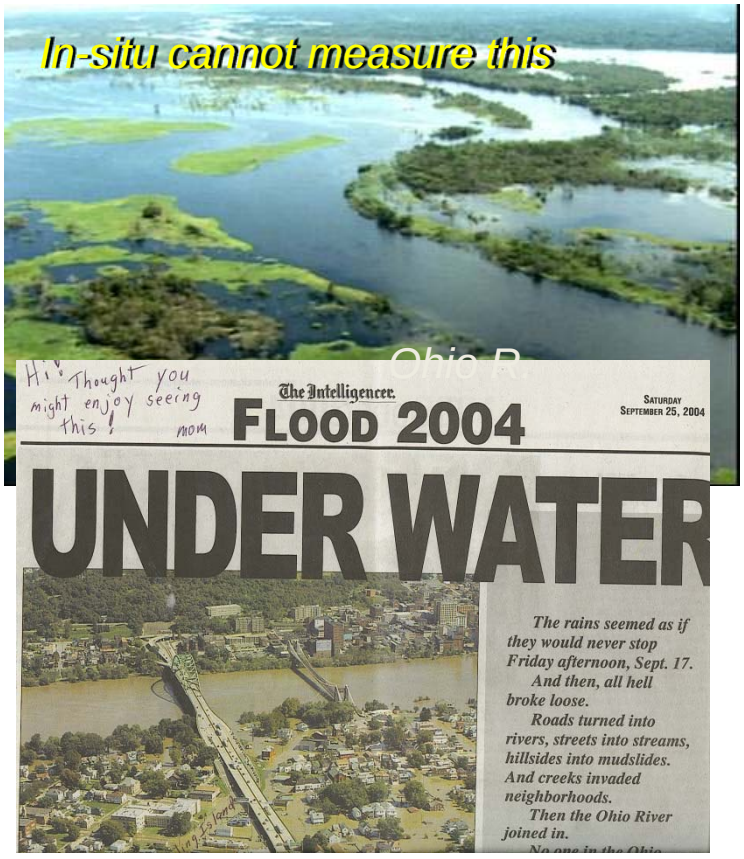
-Repeat Frequency: ~10-20 days (combined ascending/descending)

-Status: Phase A

-Launch: 2020



1. The Problem over Land



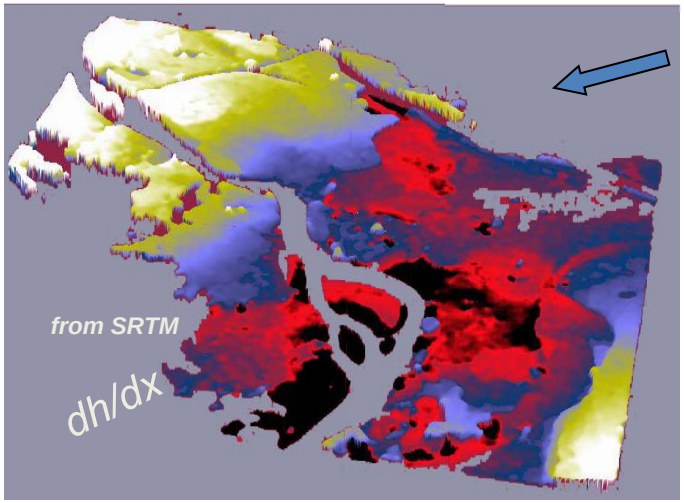
2. The Question

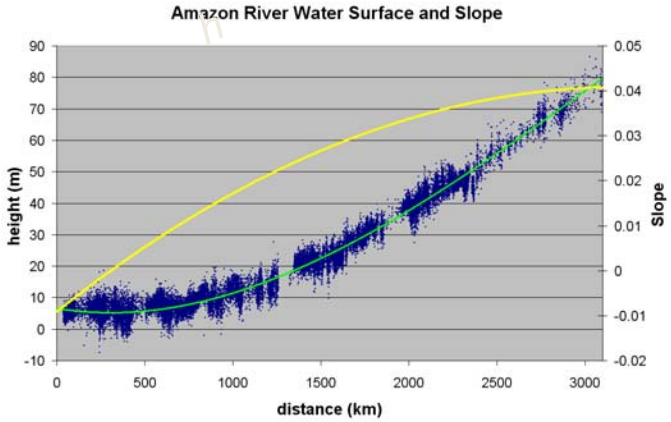
What is the spatial and temporal variability of freshwater stored in the world's terrestrial water bodies?

3. Measurements Required

maps of h, which give maps of dh/dt and dh/dx

Perspective view of dh/dt





SWOT Hydrology Goals

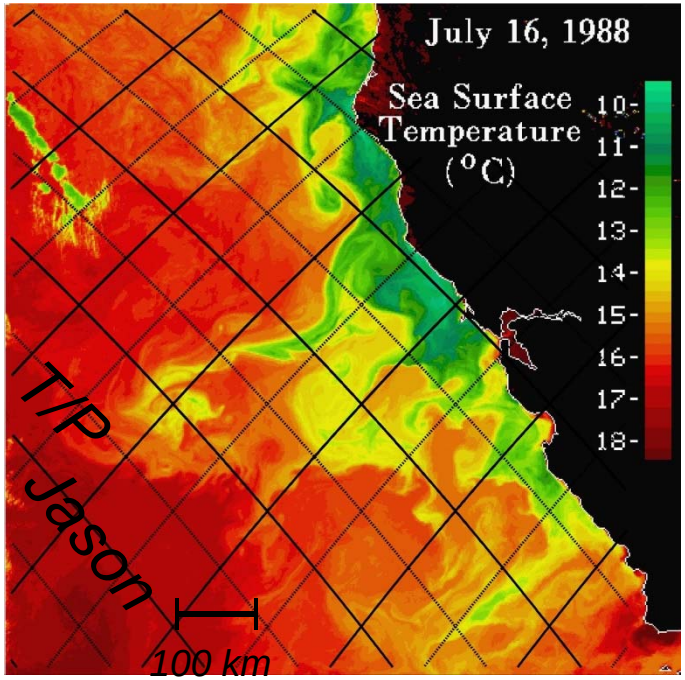
1. Provide global inventory of all terrestrial surface water bodies whose surface area exceeds 250m (lakes, reservoirs, wetlands) and rivers whose width exceeds 100m (requirement) (50m goal).

2. Measure the global storage change in terrestrial surface water bodies at sub-monthly, seasonal, and annual time scales.

3. Estimate the global change in river discharge at sub-monthly, seasonal, and annual time scales.

1. The Problem for Oceans

Altimeters miss considerable ocean and land areas.

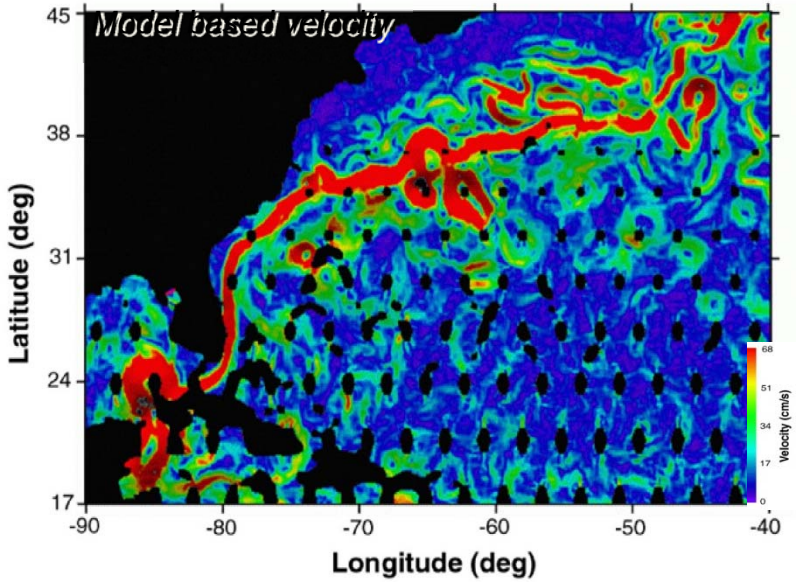


2. The Question

What are the energy dissipation, ocean circulation, and climate implications from oceanic eddies which contain 90% of the kinetic energy, but are ~10 km scale in cross-stream direction, e.g. Gulf Stream, Kuroshio.

3. Measurements Required

Maps of h, which give maps of dh/dt and dh/dx allowing derivation of velocity, vorticity, and stress tensor.



Improved Floodplain Inundation Model Calibration Using 2D InSAR Altimetry

Hahn Chul Jung and Michael F. Jasinski, Hydrological Sciences Laboratory, NASA GSFC

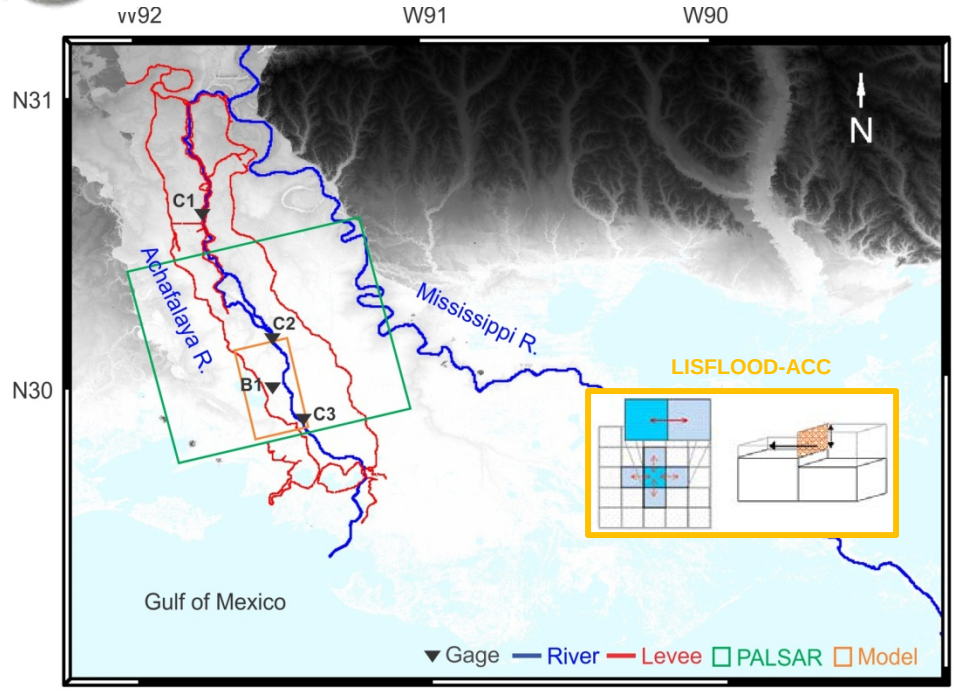


Figure 1 LiDAR map over the study area.

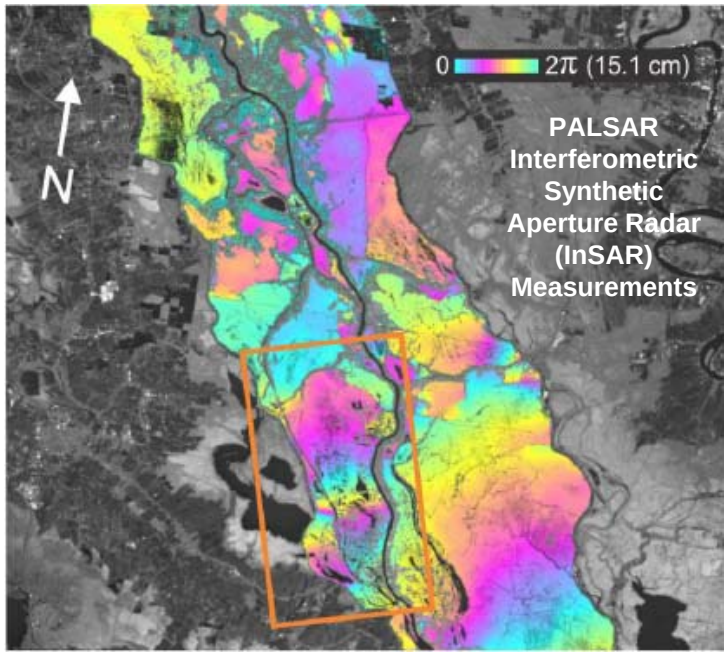


Figure 2: Differential wrapped interferogram of L-band PALSAR superimposed on the image reflectivity map.

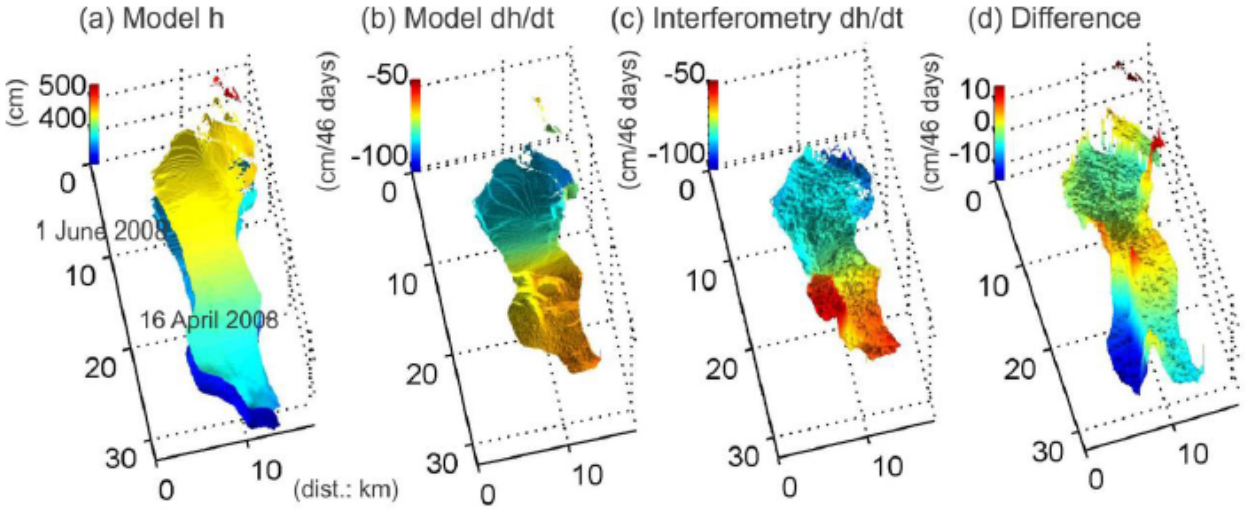


Figure 3: (a) Water elevation maps on 16 April 2008 (upper) and 1 June 2008 (lower). (b) Water elevation change map calculated from the calibrated LISFLOOD-ACC model. (c) Water elevation change map from SAR interferometry. (d) Difference between LISFLOOD-ACC and SAR interferometry water elevation change maps.

Jung, H. C., et. al., *Water Resources Research*, 48, W07511, doi:10.1029/2012WR011951, 2012.

Ice, Cloud,and Land Elevation Satellite
ICESat-2

Level 1 Baseline Science Requirements

1. Elevation changes of Greenland and Antarctica

-ice-sheet elevation change rates to an accuracy of less than or equal to to 0.4 cm/yr on an annual basis.

-annual surface elevation change rates on outlet glaciers to an accuracy of less than or equal to 0.25 m/yr over areas of 100 km^2 for year-to-year averages.

-surface elevation change rates for dynamic ice features that are intersected by its set of repeated ground-tracks to an accuracy of less than or equal to 0.4 m/yr along 1km track segments.

-resolution of winter (accumulation) and summer (ablation) ice-sheet elevation change to 10 cm at 25 sq km scale.

2. Thickness of the polar ocean sea ice

- monthly surface elevation products of sea-ice freeboard to an uncertainty of less than or equal to 3 cm along 25 km segments for the Arctic and Southern Oceans; the track spacing should be less than or equal to 35 km at 70 degrees latitude on a monthly basis.

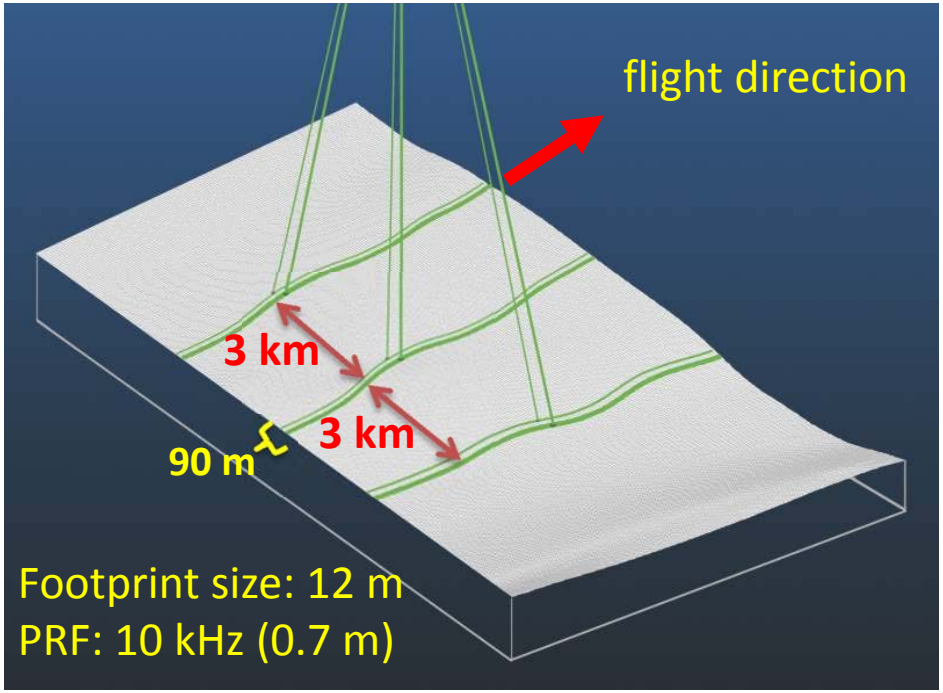
3. Global vegetation height, inland and ocean elevation

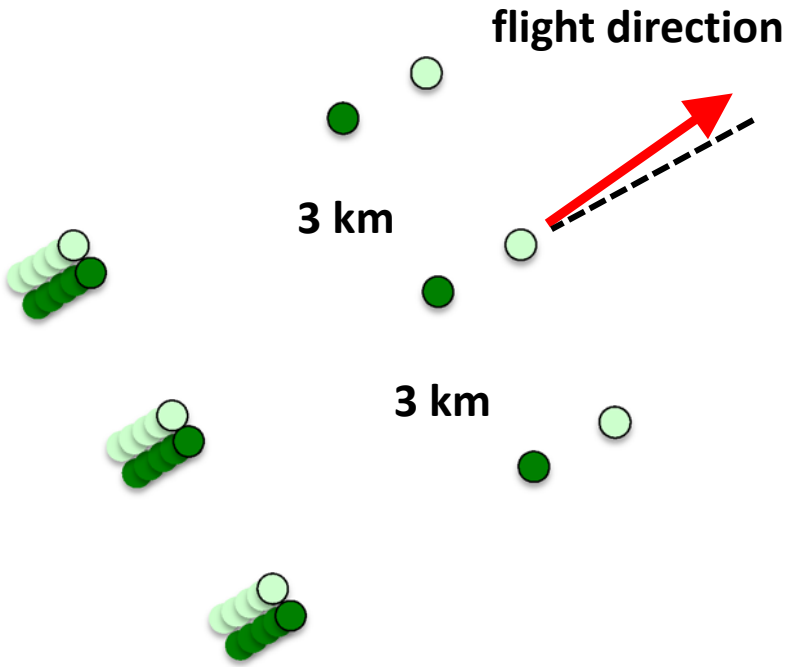
-elevation measurements, that enable determination of global vegetation height, with a ground track spacing of less than 2 km over a 2-year period.

4. Elevation measurements for a minimum three-year duration.

Advanced Topographic Laser Altimeter System (ATLAS)

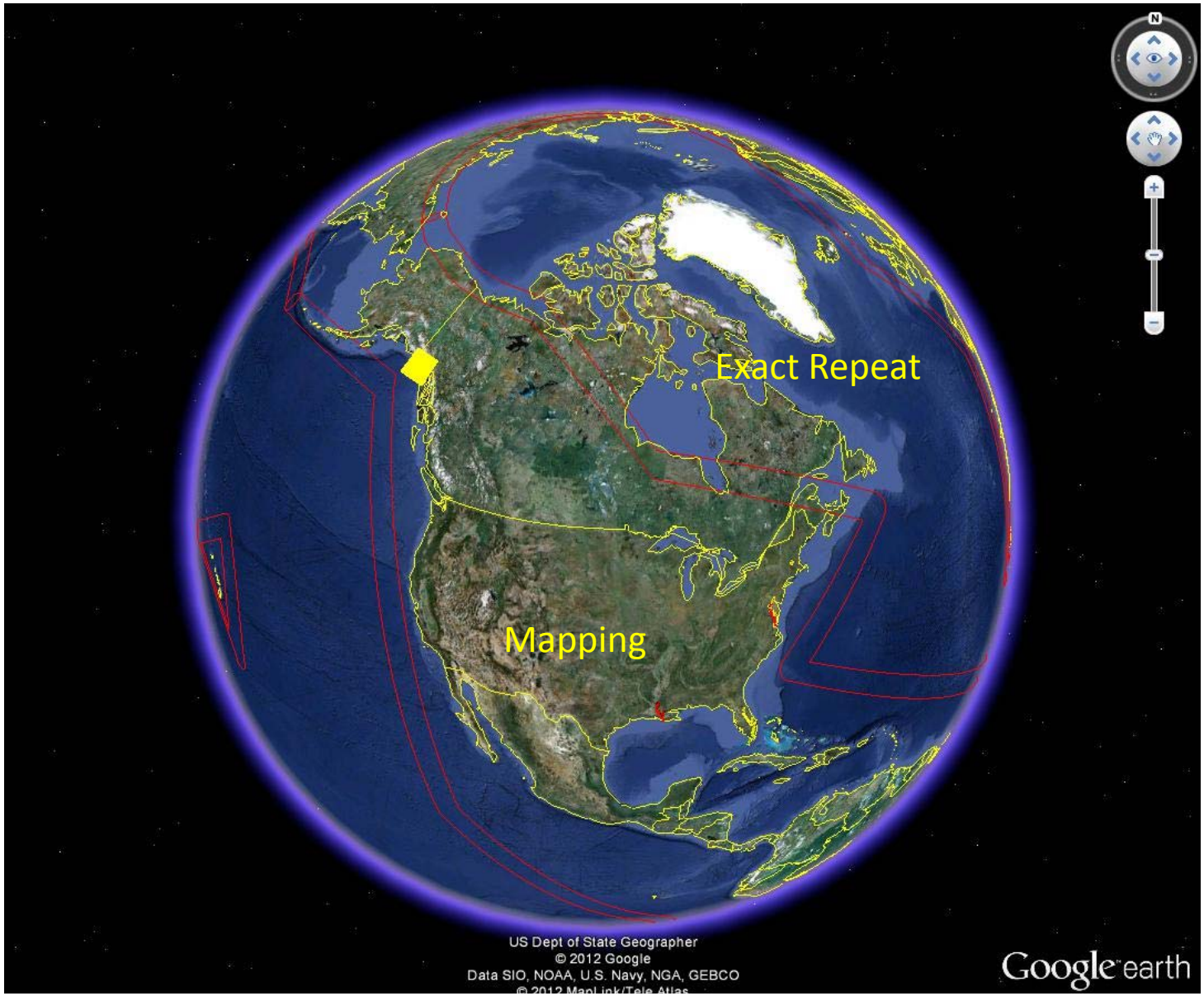
- Single micro-pulse, multi-beam hi-res, photon counting laser .
- Current launch date: mid-2016





- 3 km spacing between pairs provides spatial coverage
- 90 m pair spacing for slope determination.
- High/low-energy beams (~100/25 μJ) for better performance over low/high-reflectance targets.
- Pointing: center of footprint known to ~6.5m

"Mapping" and "Repeat" Coverage Observation Zones



Additional details:

http://swot.jpl.nasa.gov/

http://icesat.gsfc.nasa.gov/icesat2/