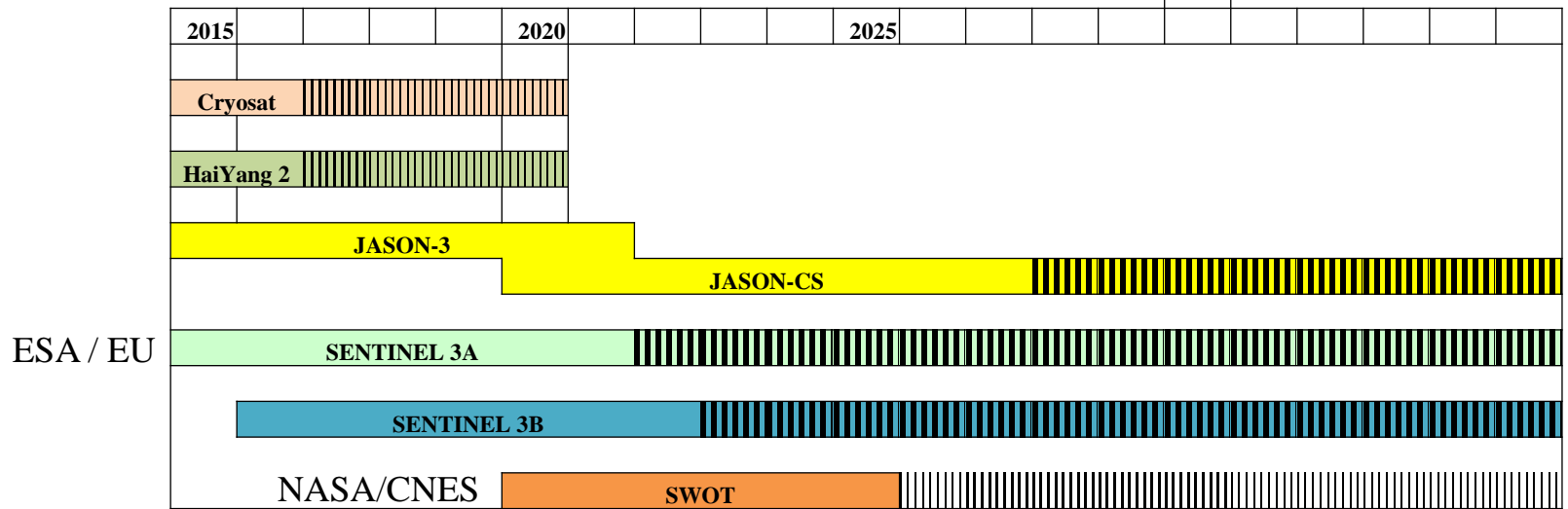
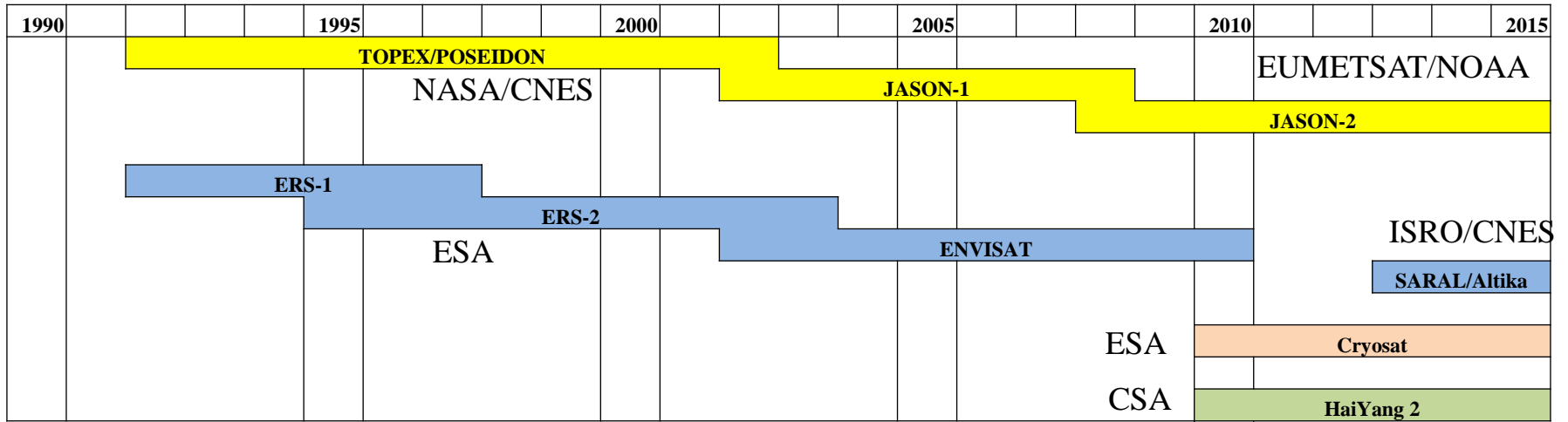
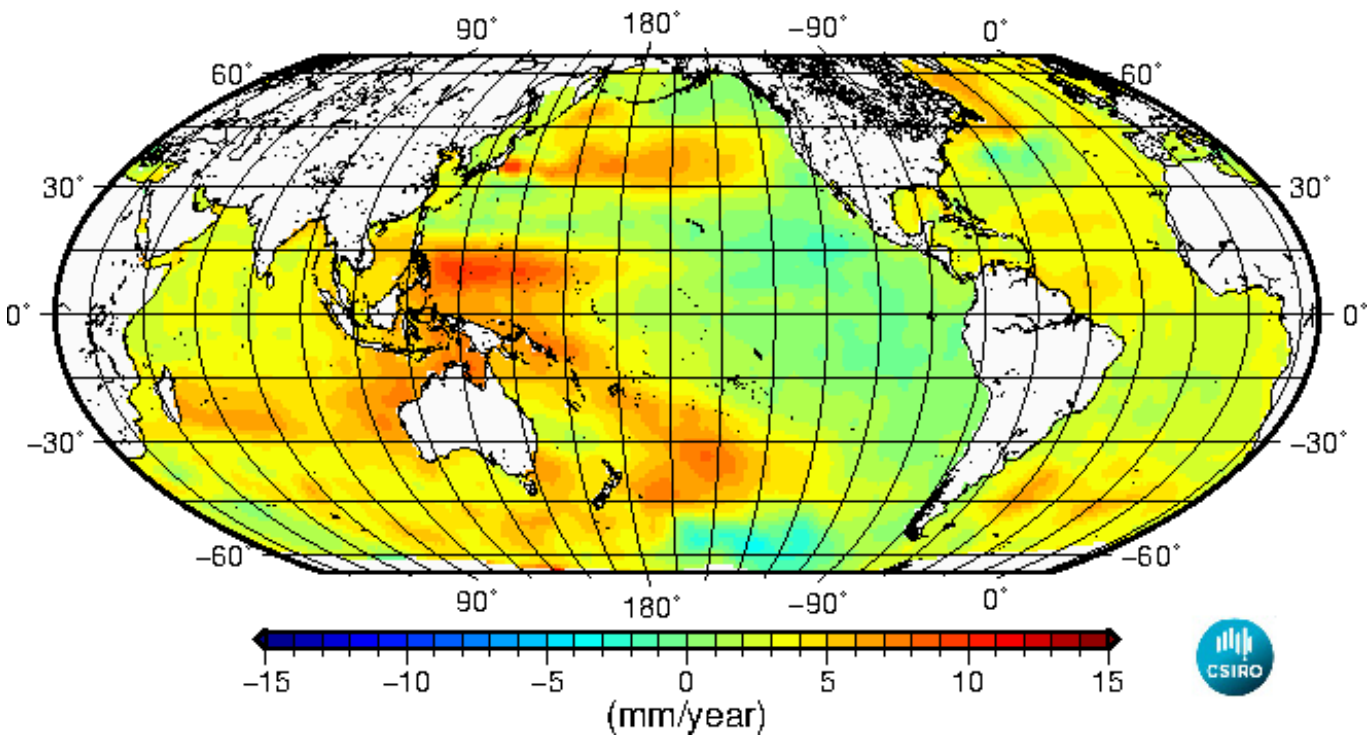


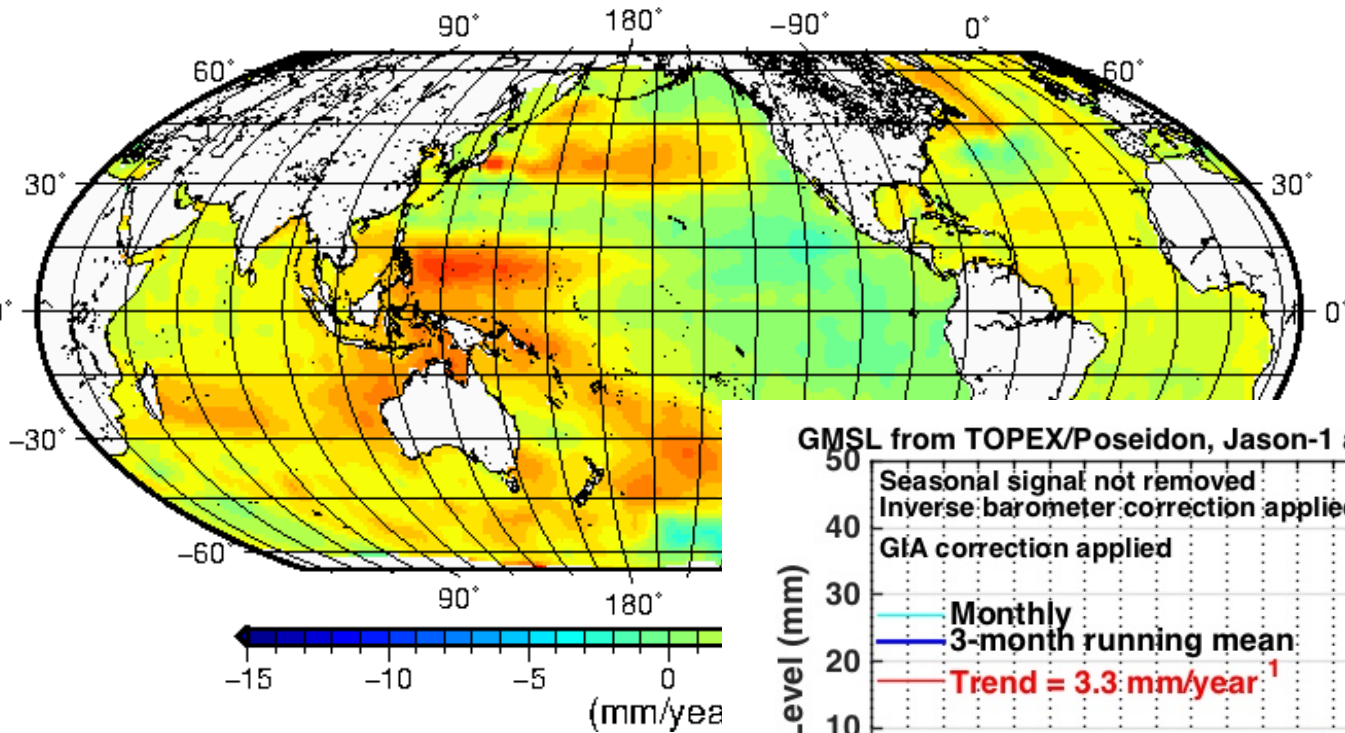
# Future Satellite Altimetry



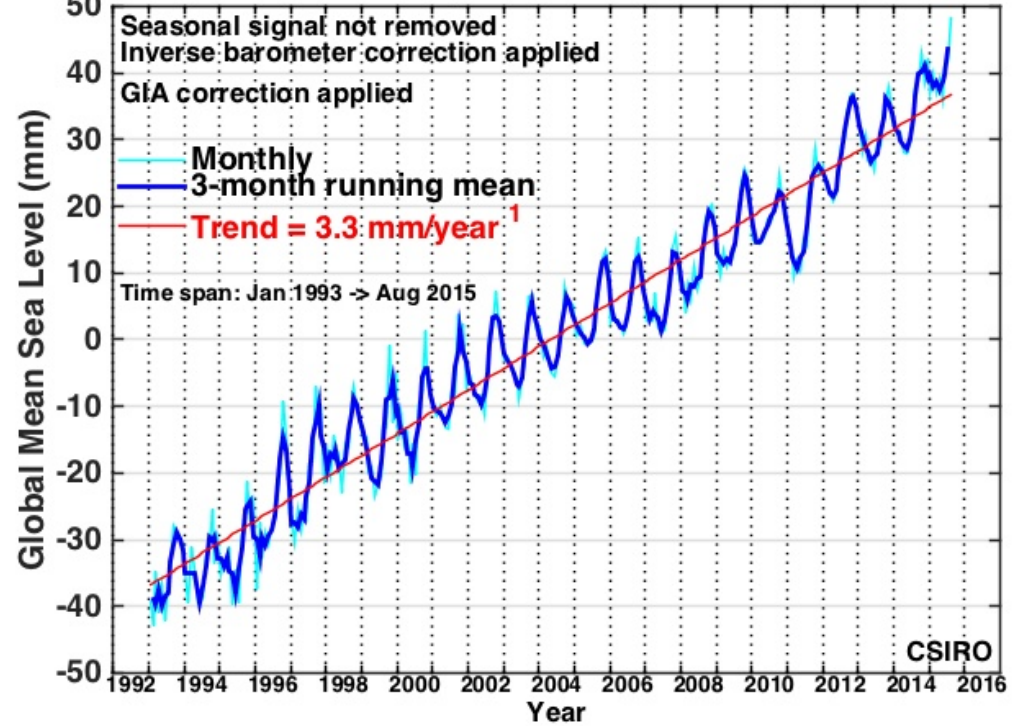
Sea level trend 1993 to 2014



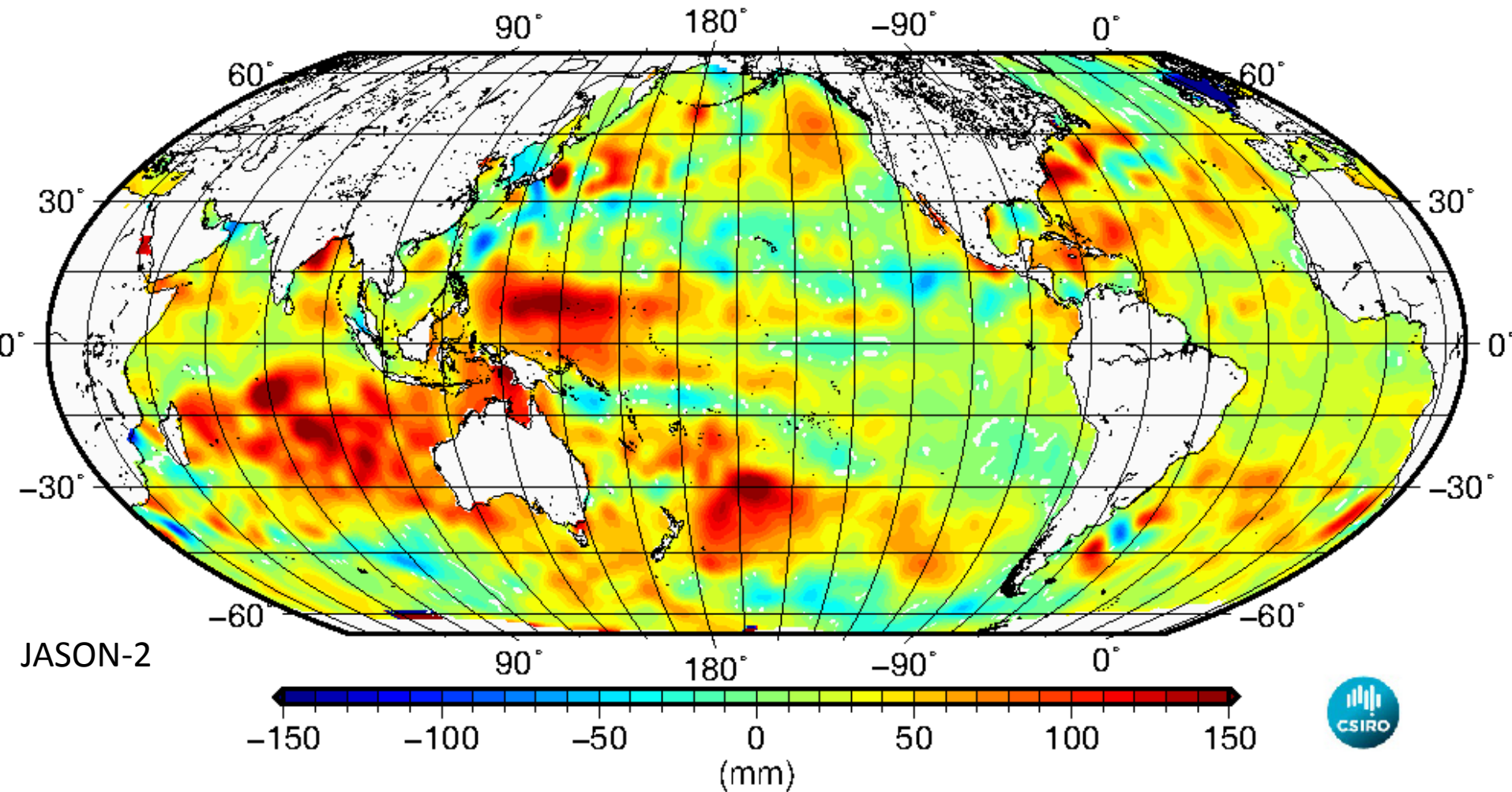
# Sea level trend 1993 to 2014



### GMSL from TOPEX/Poseidon, Jason-1 and Jason-2 satellite altimeter data

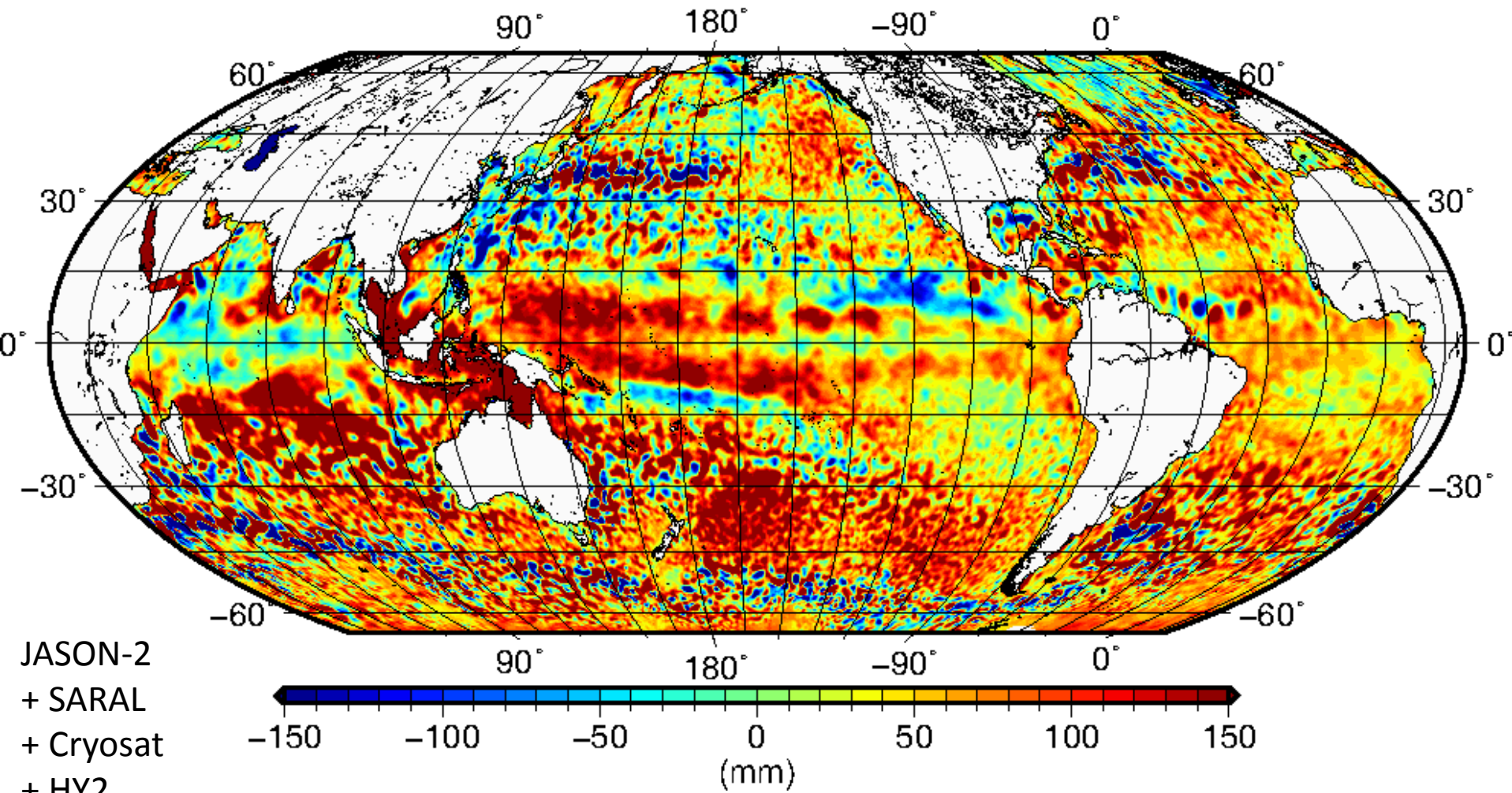


<http://www.cmar.csiro.au/sealevel>

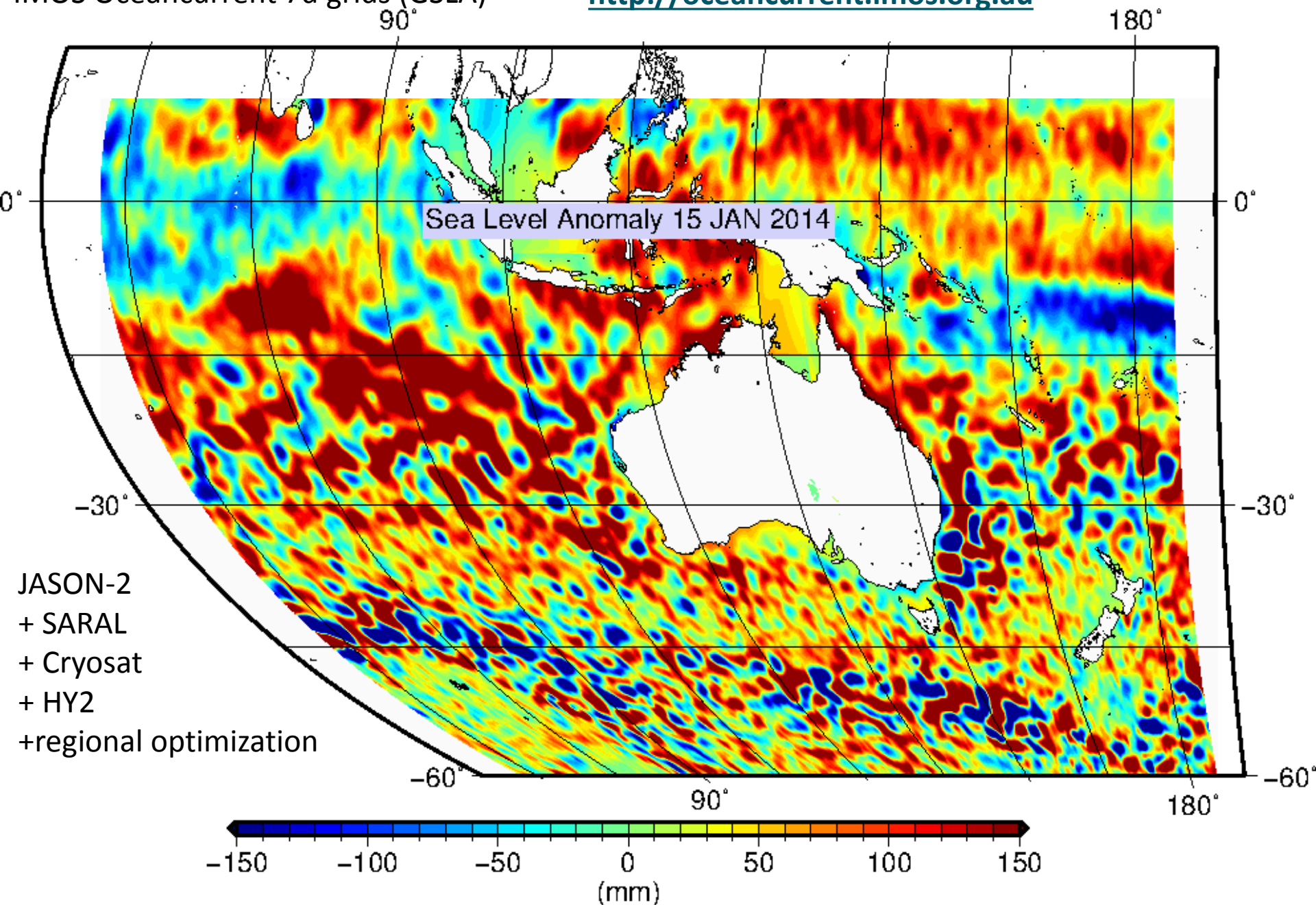


[http://www.cmar.csiro.au/sealevel/sl\\_data.html](http://www.cmar.csiro.au/sealevel/sl_data.html)



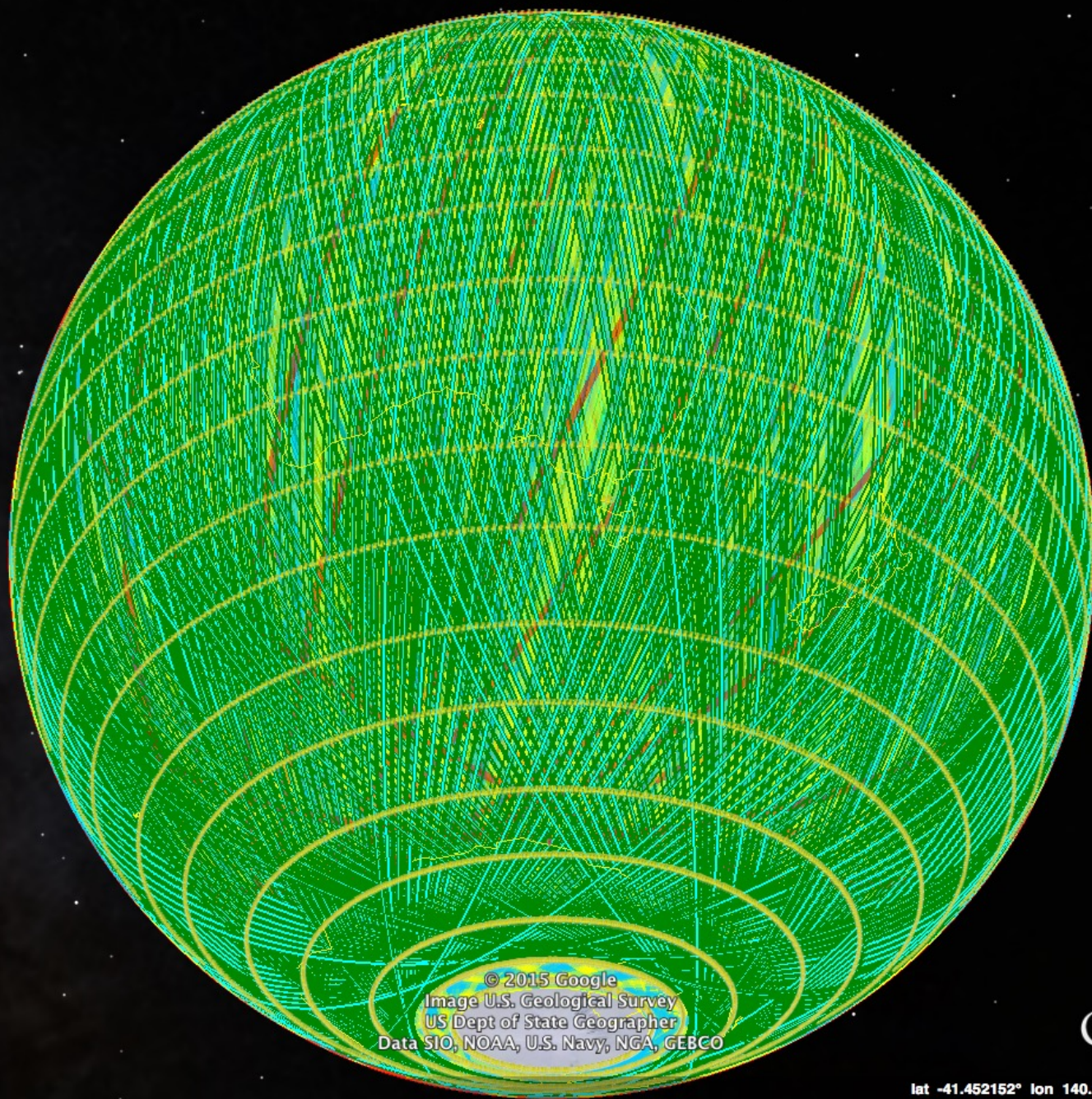


<http://www.aviso.altimetry.fr>









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Image U.S. Geological Survey  
US Dept of State Geographer  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google earth

lat -41.452152° lon 140.295322° eye alt 11034.43 km





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Image Landsat

US Dept of State Geographer  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google earth



JASON

SARAL-Altika

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Image Landsat  
US Dept of State Geographer  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google earth

Imagery Date: 4/10/2013 lat -26.935340° lon 134.945970° elev 167 m eye alt 4794.97 km



JASON

SARAL-Altika

100km

Melbourne  
Port Phillip Bay  
Geelong  
Frankston

Bass Strait

Flinders Canyon

Bass Strait Satellite Altimetry cal/val site

© 2015 Google  
Image Landsat  
Data LDEO-Columbia, NSF, NOAA  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google earth

Imagery Date: 4/10/2013 lat -39.462316° lon 146.183336° elev -74 m eye alt 488.98 km



JASON

SARAL-Altika

100km

Melbourne  
Port Phillip Bay  
Geelong  
Frankston

Bass Strait

Flinders Canyon

Bass Strait Satellite Altimetry cal/val site

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Image Landsat  
Data LDEO-Columbia, NSF, NOAA  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google earth

Imagery Date: 4/10/2013 lat -39.462316° lon 146.183336° elev -74 m eye alt 488.98 km



SENTINEL-3A

JASON

SARAL-Altika

100km

Melbourne  
Port Phillip Bay  
Geelong  
Frankston

Bass Strait

Flinders Canyon

Sentinel-3A temporary mooring  
Bass Strait Satellite Altimetry cal/val site  
Sentinel-3A cal/val site

© 2015 Google  
Image Landsat  
Data LDEO-Columbia, NSF, NOAA  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google earth

Imagery Date: 4/10/2013 lat -39.462316° lon 146.183336° elev -74 m eye alt 488.98 km



Xmas 2015

SENTINEL-3A

JASON-3

~ 2 km to the coast

~ 20km to the coast

100km

Melbourne  
Port Phillip Bay  
Geelong  
Frankston

Bass Strait

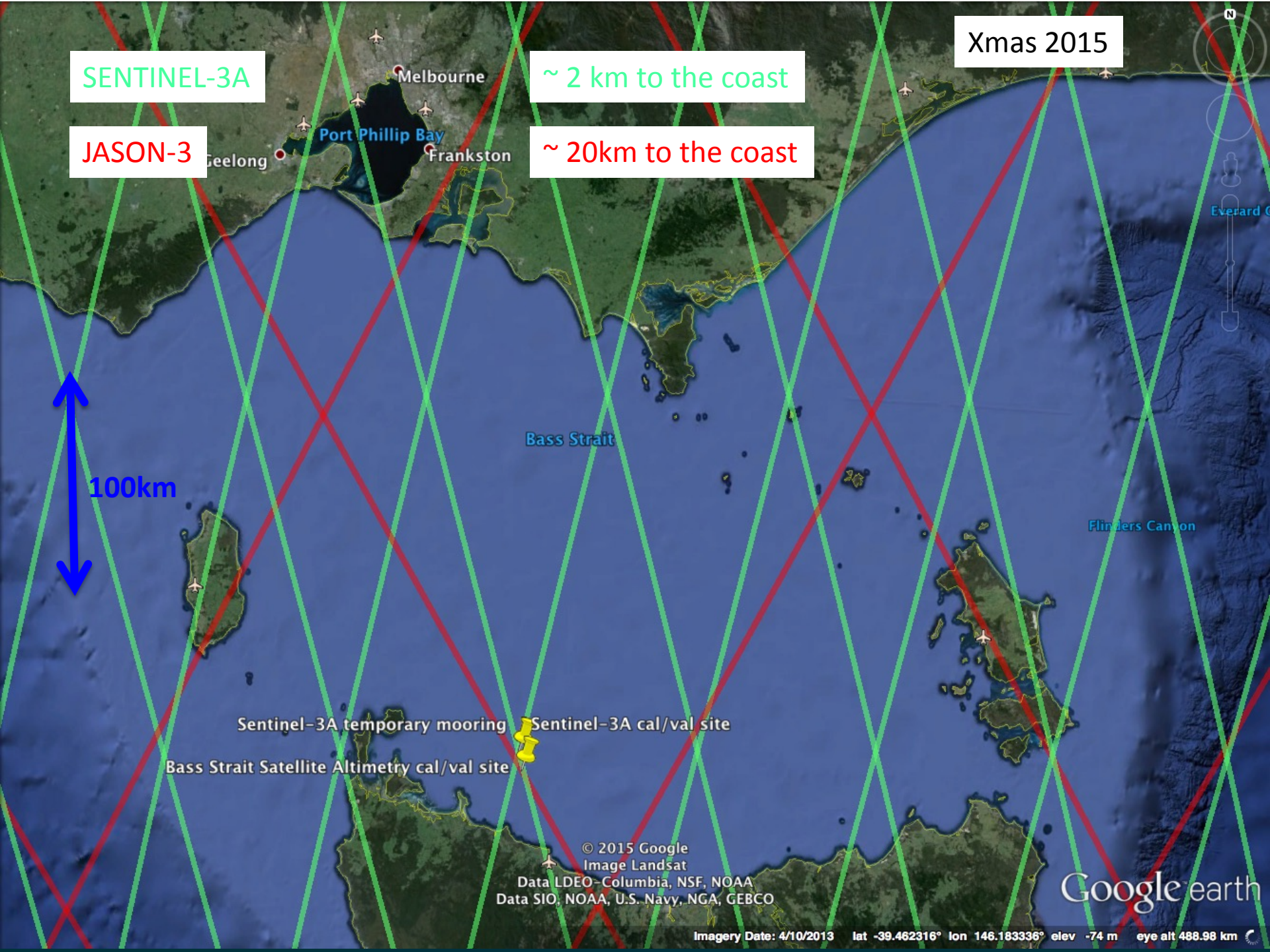
Flinders Canyon

Sentinel-3A temporary mooring  
Sentinel-3A cal/val site  
Bass Strait Satellite Altimetry cal/val site

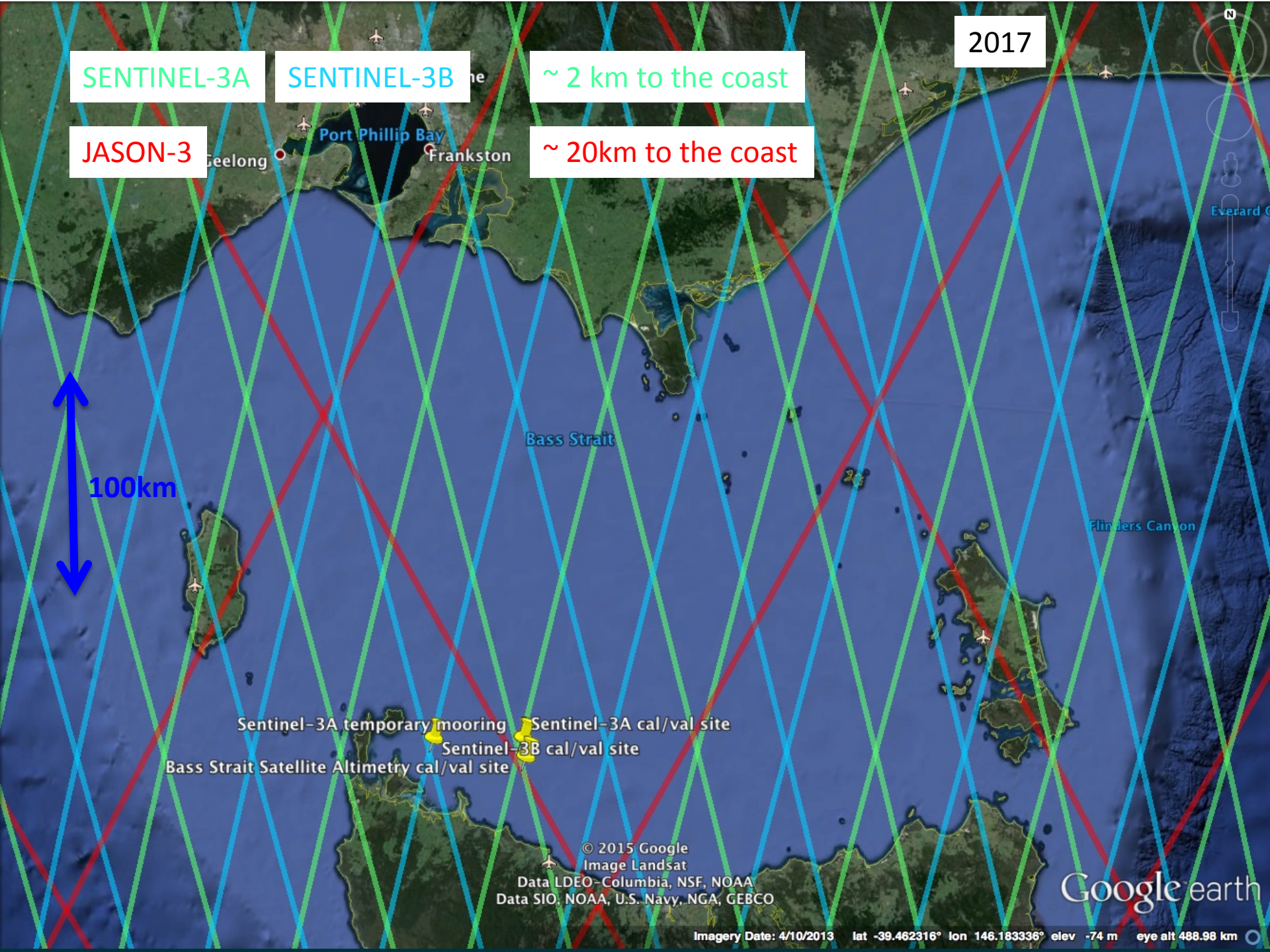
© 2015 Google  
Image Landsat  
Data LDEO-Columbia, NSF, NOAA  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google earth

Imagery Date: 4/10/2013 lat -39.462316° lon 146.183336° elev -74 m eye alt 488.98 km







2017

SENTINEL-3A

SENTINEL-3B

~ 2 km to the coast

JASON-3

~ 20km to the coast

100km

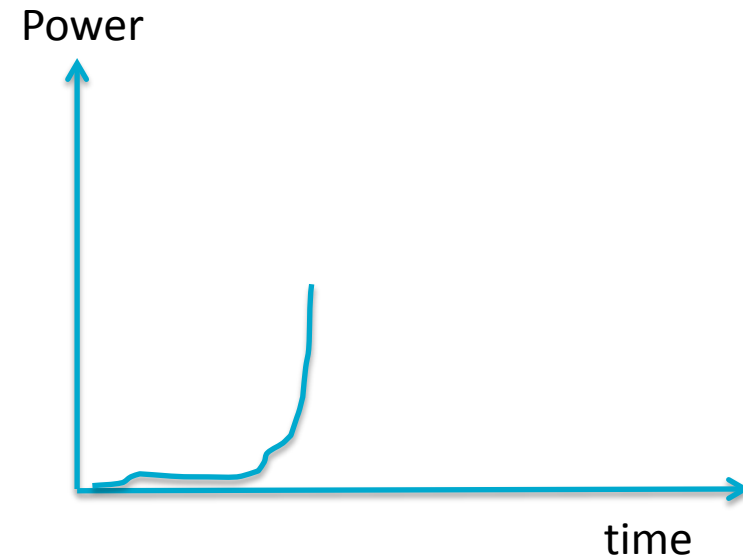
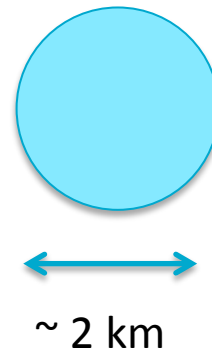
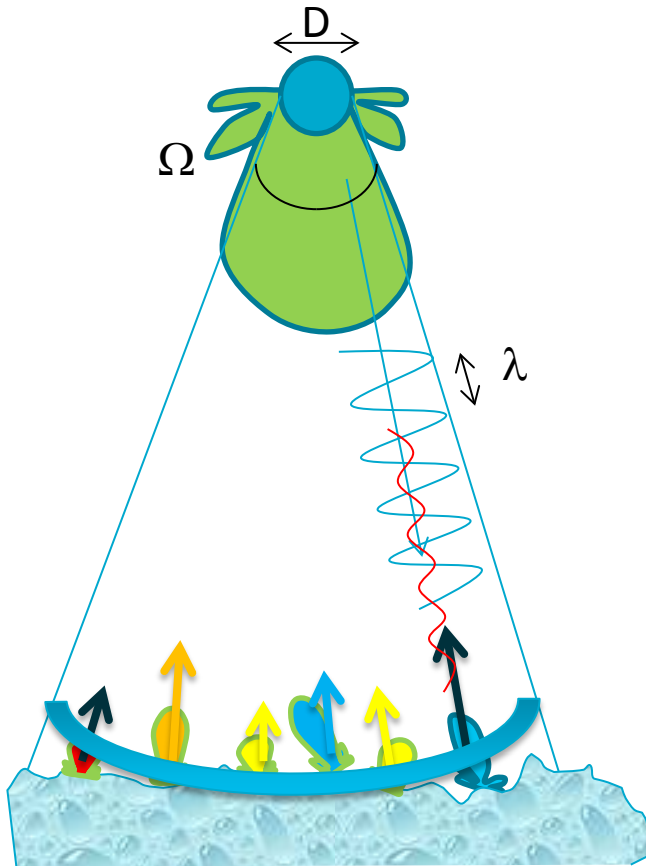
Sentinel-3A temporary mooring  
Sentinel-3A cal/val site  
Sentinel-3B cal/val site  
Bass Strait Satellite Altimetry cal/val site

© 2015 Google  
Image Landsat  
Data LDEO-Columbia, NSF, NOAA  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

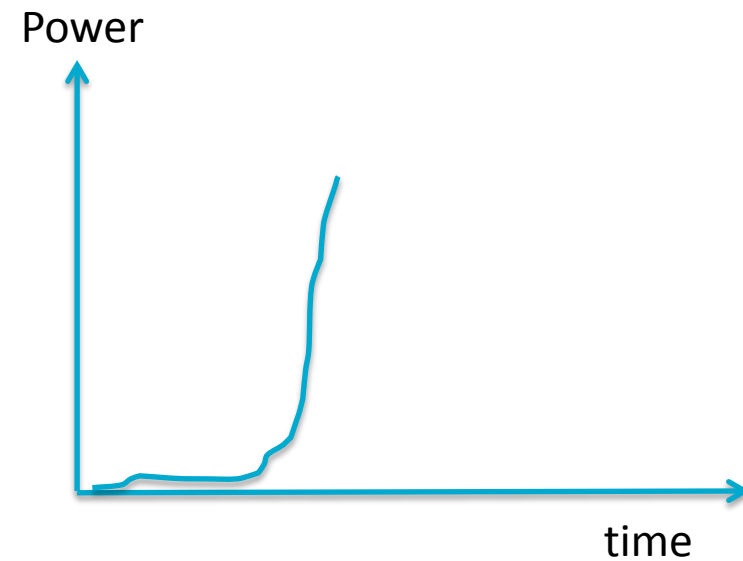
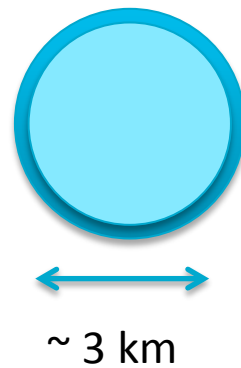
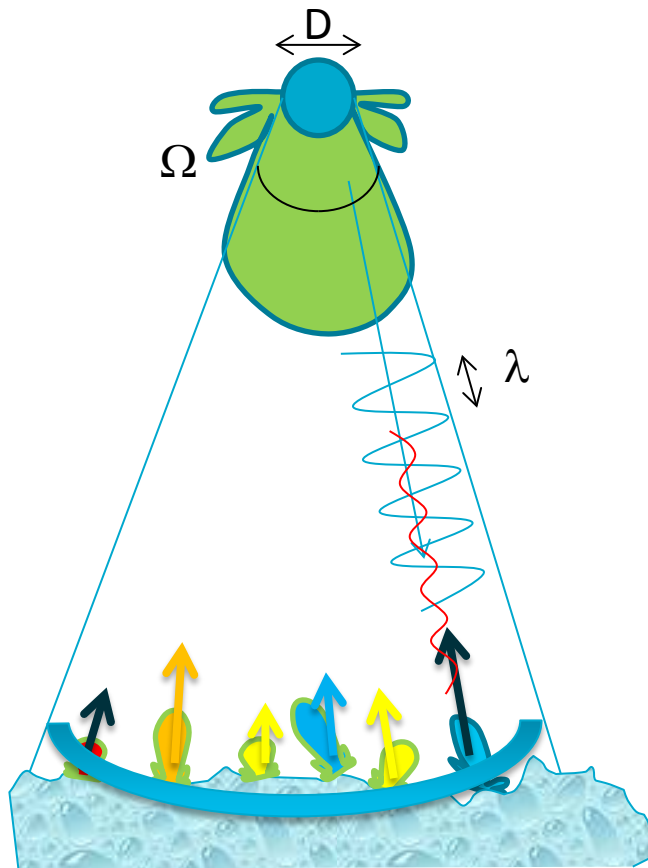
Google earth

Imagery Date: 4/10/2013 lat -39.462316° lon 146.183336° elev -74 m eye alt 488.98 km

# Classic Satellite Radar Altimetry (now called Low Resolution Mode) LRM

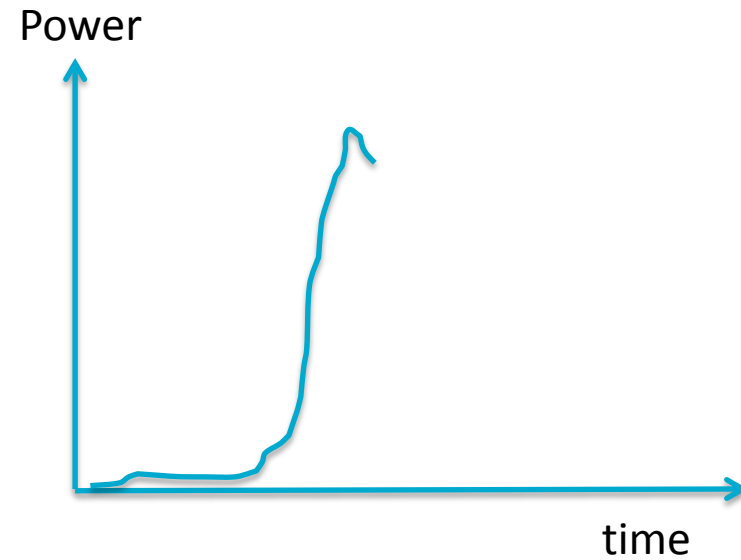
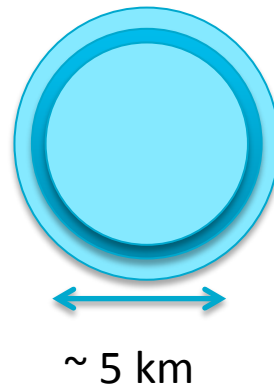
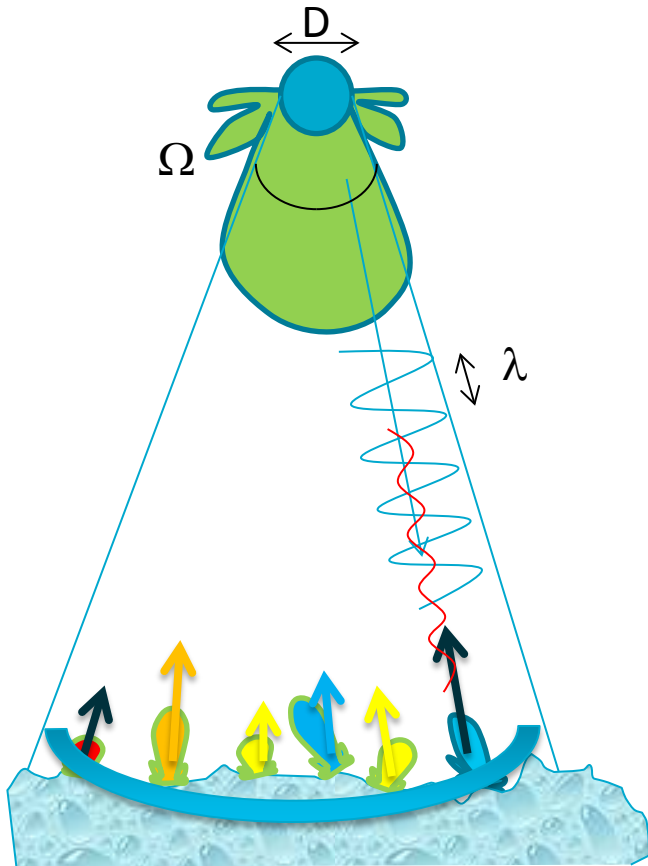


# Classic Satellite Radar Altimetry (now called Low Resolution Mode) LRM

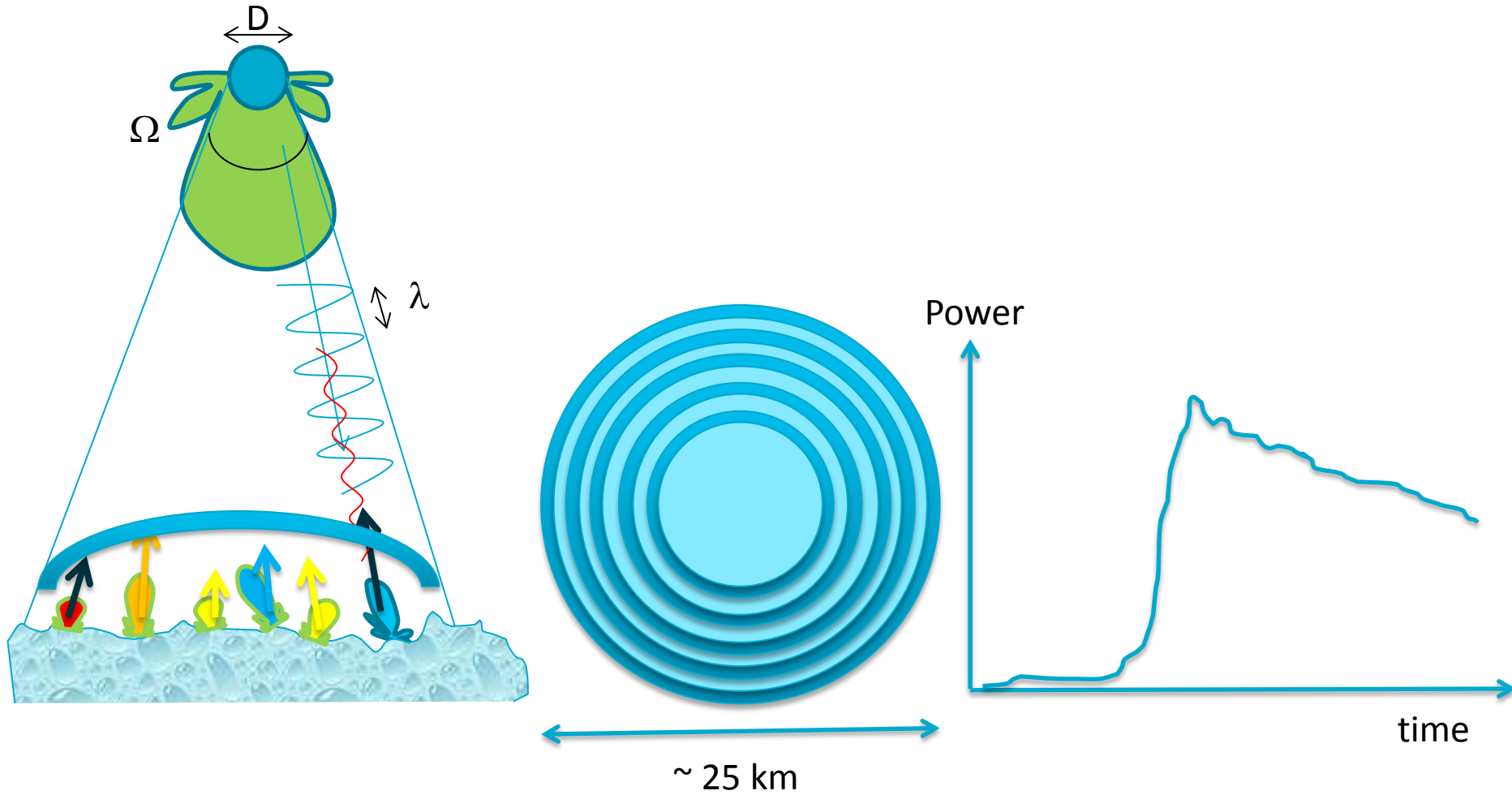




# Classic Satellite Radar Altimetry (now called Low Resolution Mode) LRM



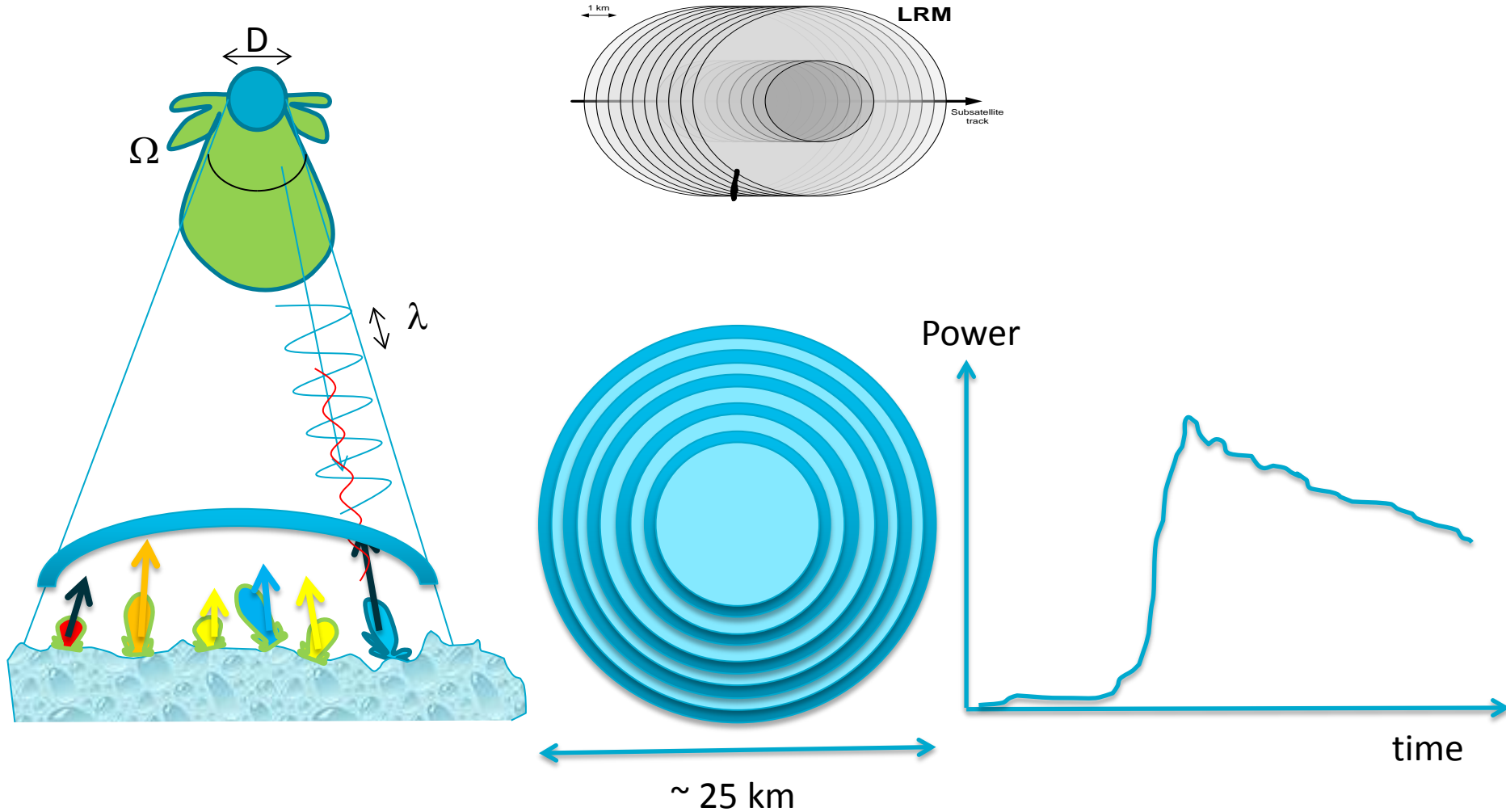
# Classic Satellite Radar Altimetry (now called Low Resolution Mode) LRM



# Classic Satellite Radar Altimetry (now called Low Resolution Mode)

## LRM

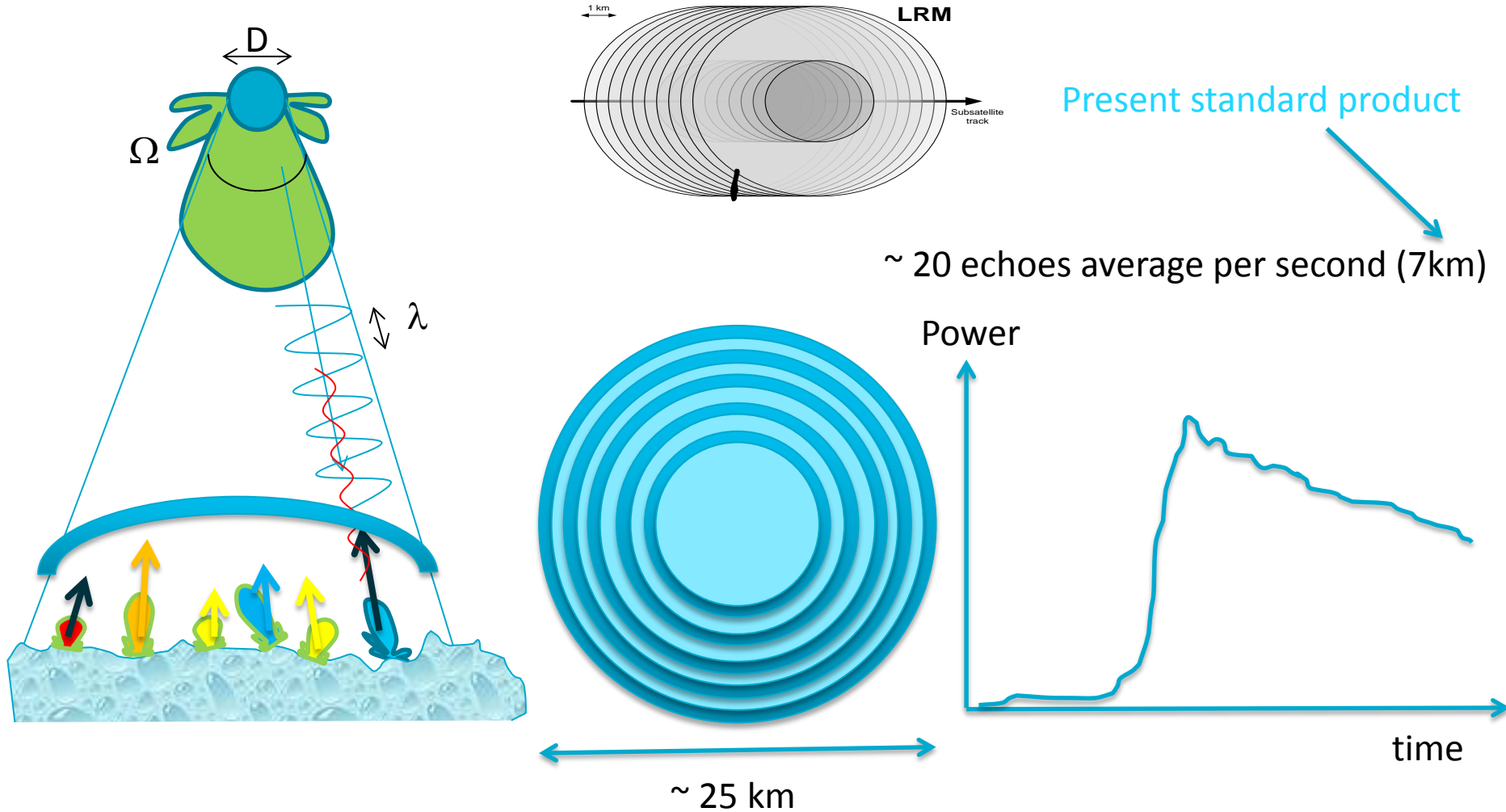
~ 100 individual echoes averaged per recorded echo



# Classic Satellite Radar Altimetry (now called Low Resolution Mode)

## LRM

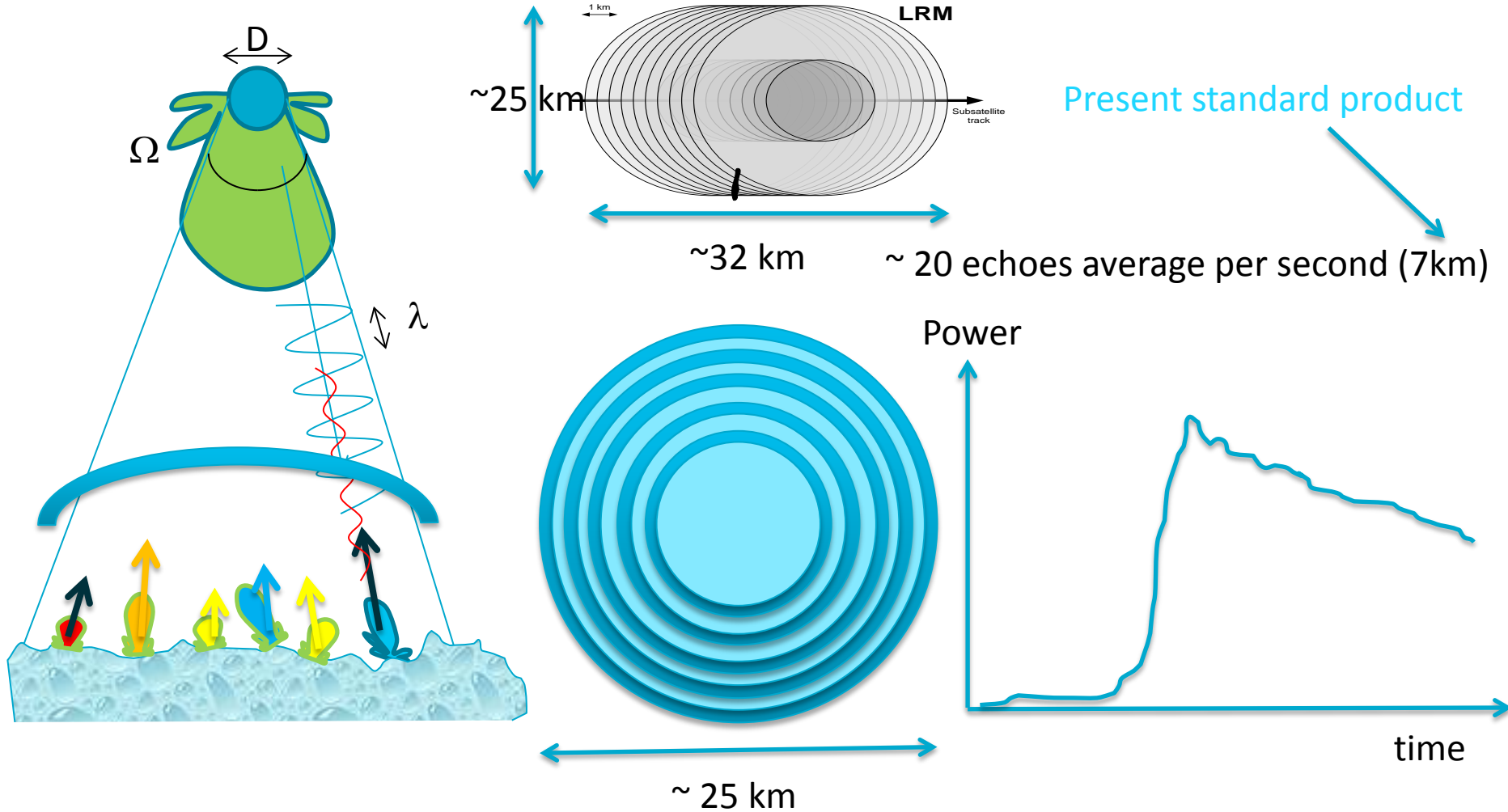
~ 100 individual echoes averaged per recorded echo



# Classic Satellite Radar Altimetry (now called Low Resolution Mode)

LRM

~ 100 individual echoes averaged per recorded echo

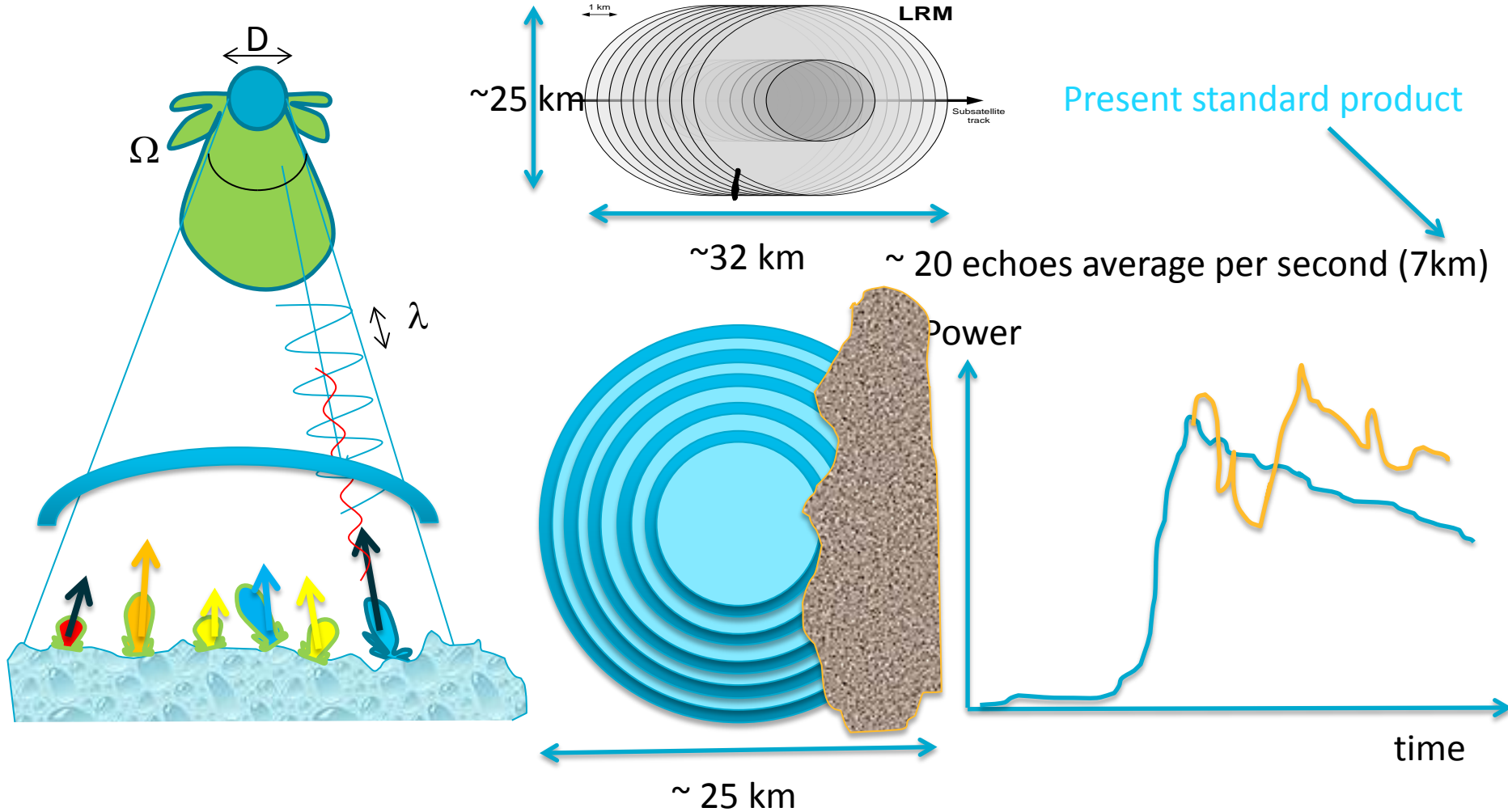




# Classic Satellite Radar Altimetry (now called Low Resolution Mode)

LRM

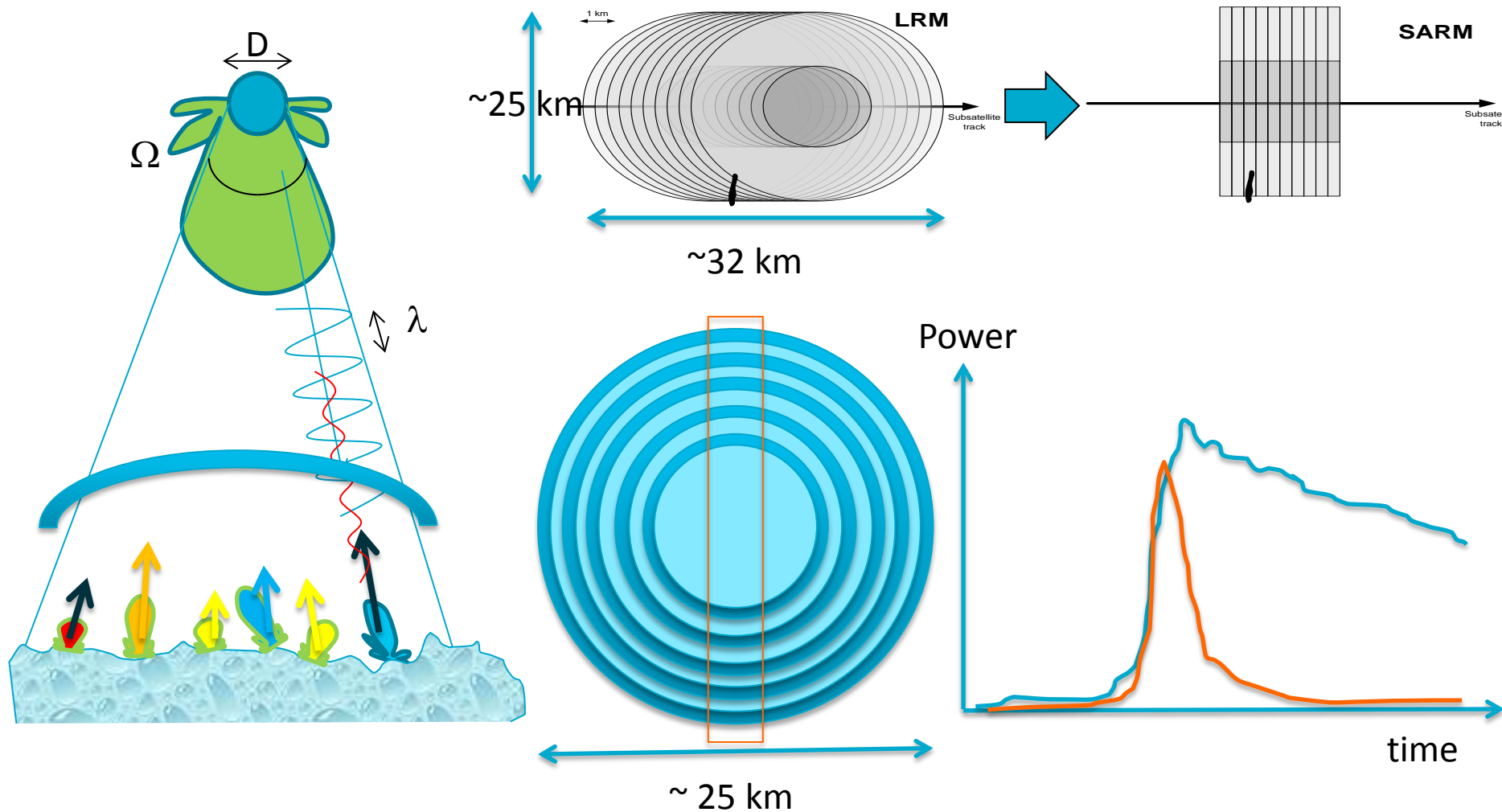
~ 100 individual echoes averaged per recorded echo



# Synthetic Aperture Satellite Radar Altimetry

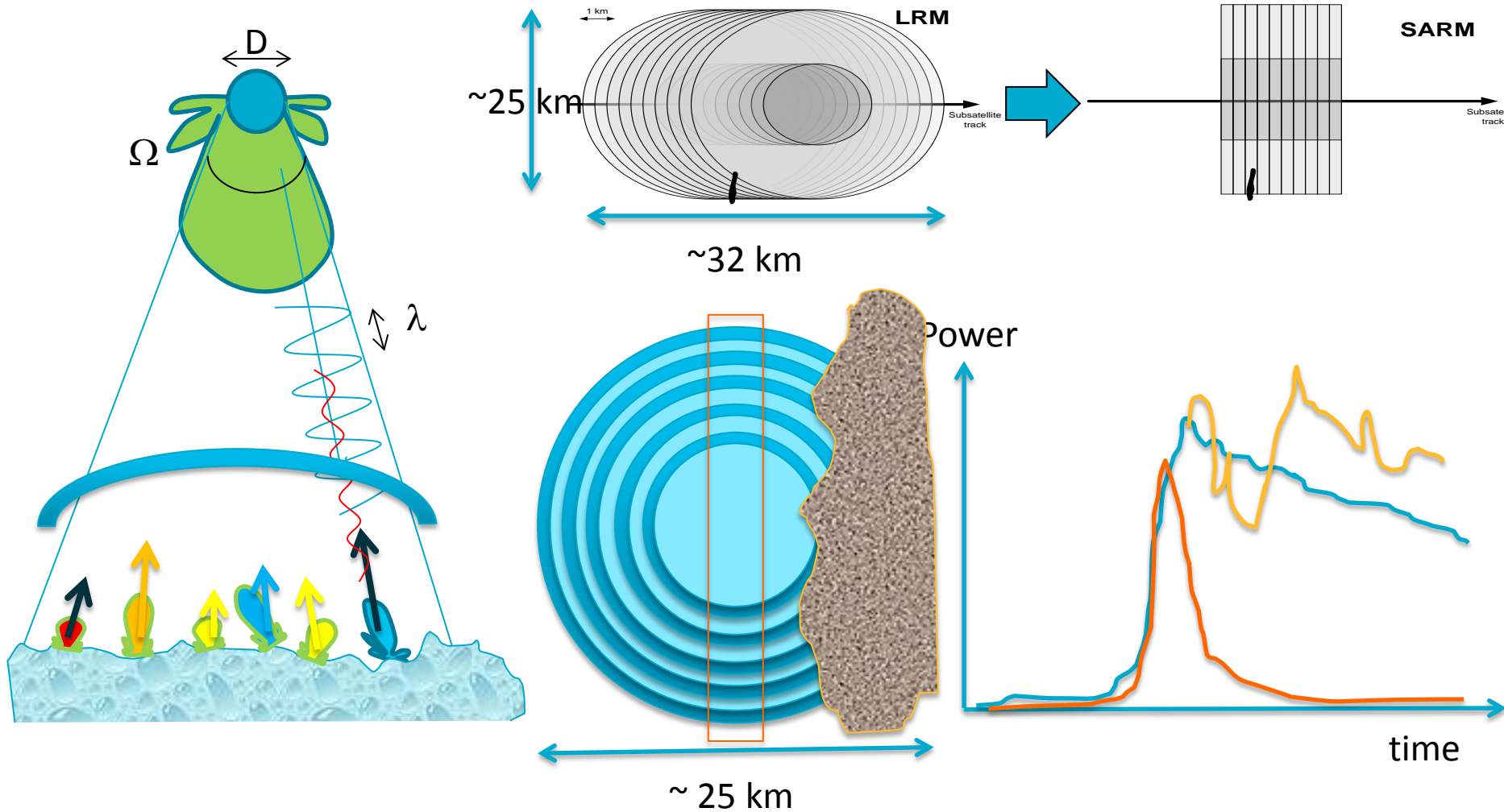
## SARM

(= processing the individual 1000s of echoes to Synthetically reconstruct a 2-3 km long antenna)

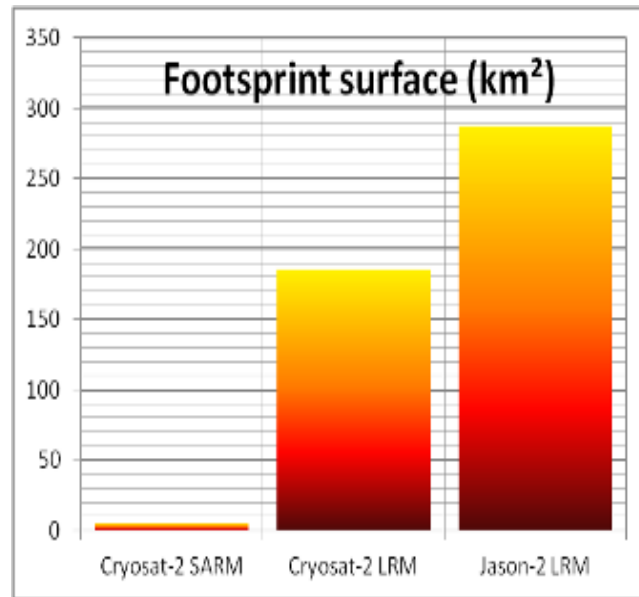
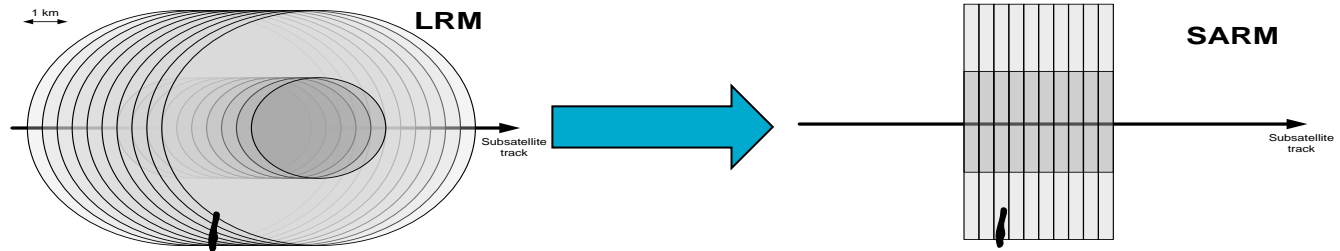


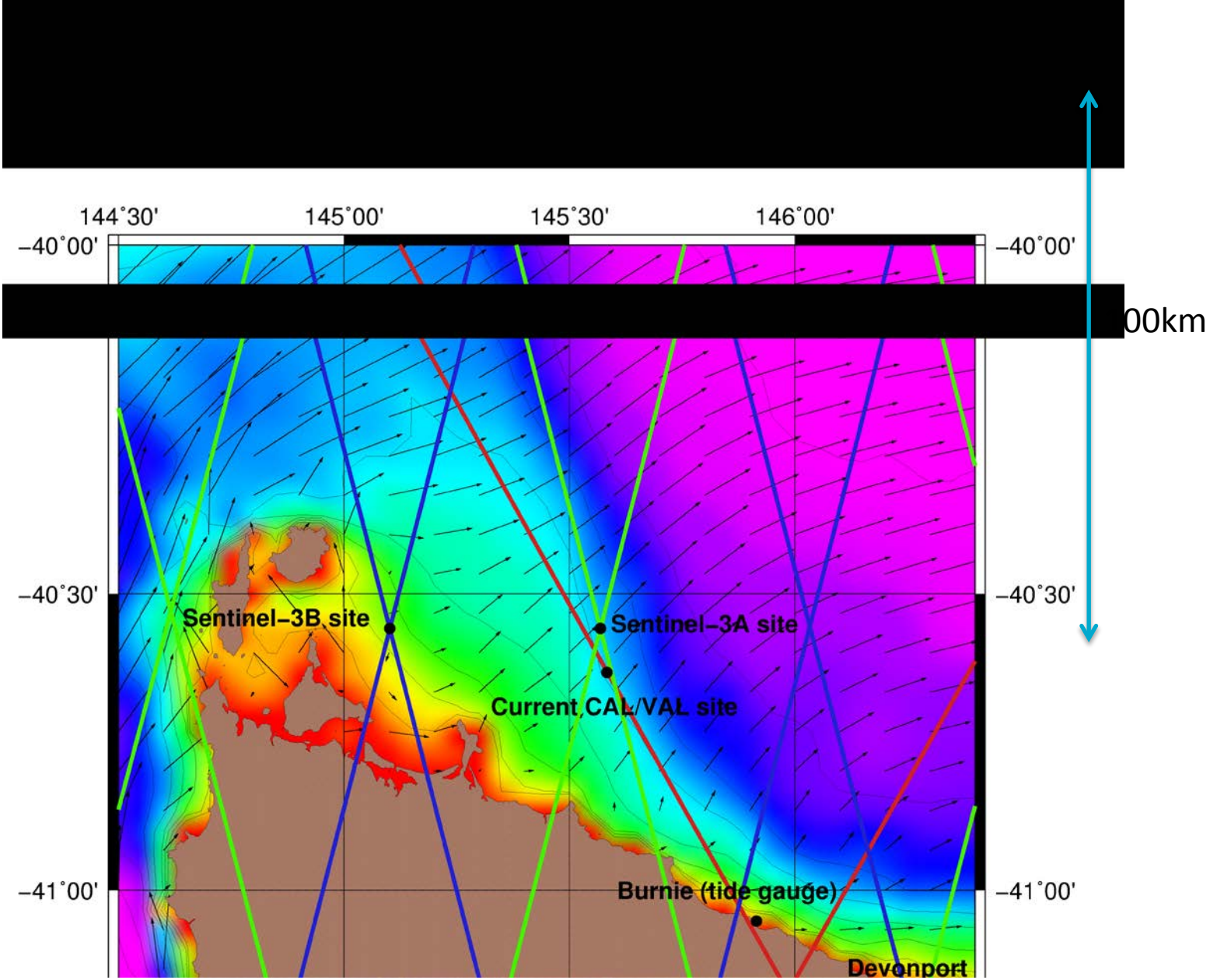
# Synthetic Aperture Satellite Radar Altimetry SARM

(= processing the individual 1000s of echoes to Synthetically reconstruct a 2-3 km long antenna)



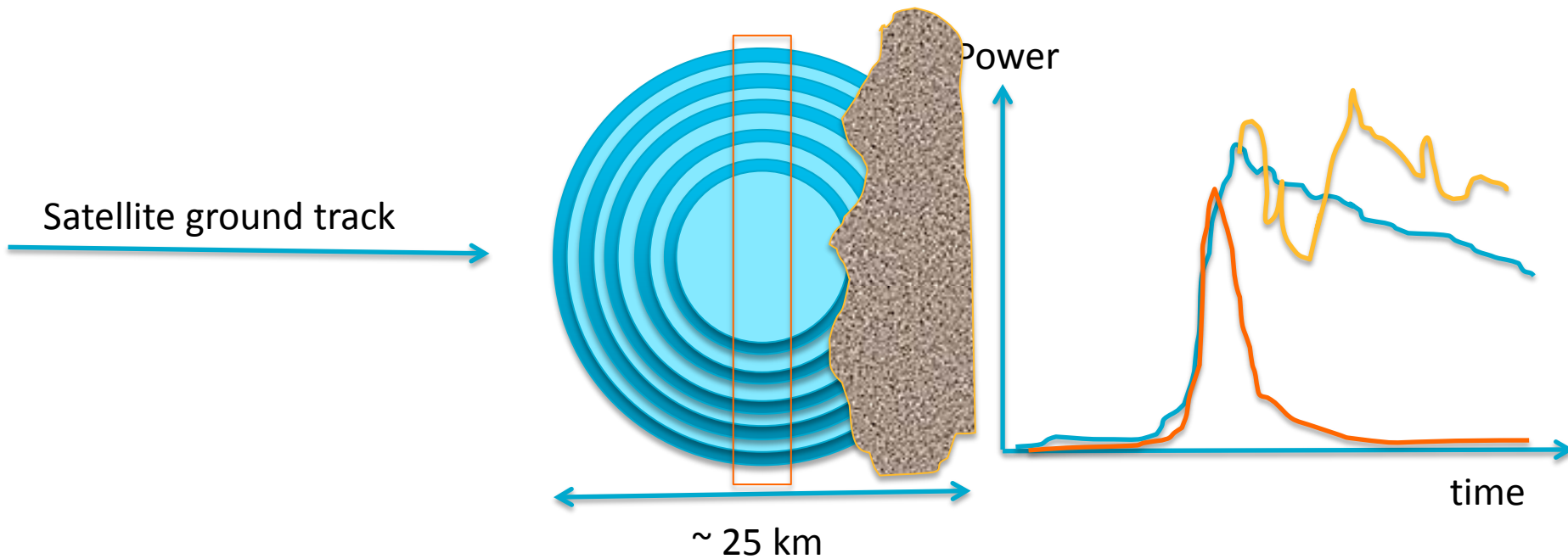
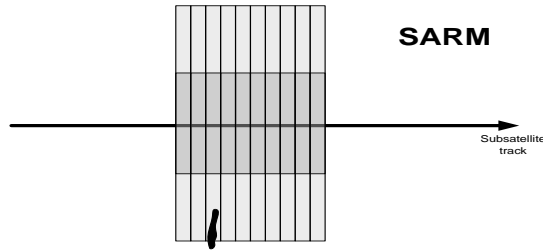
# LRM / SARM footprint



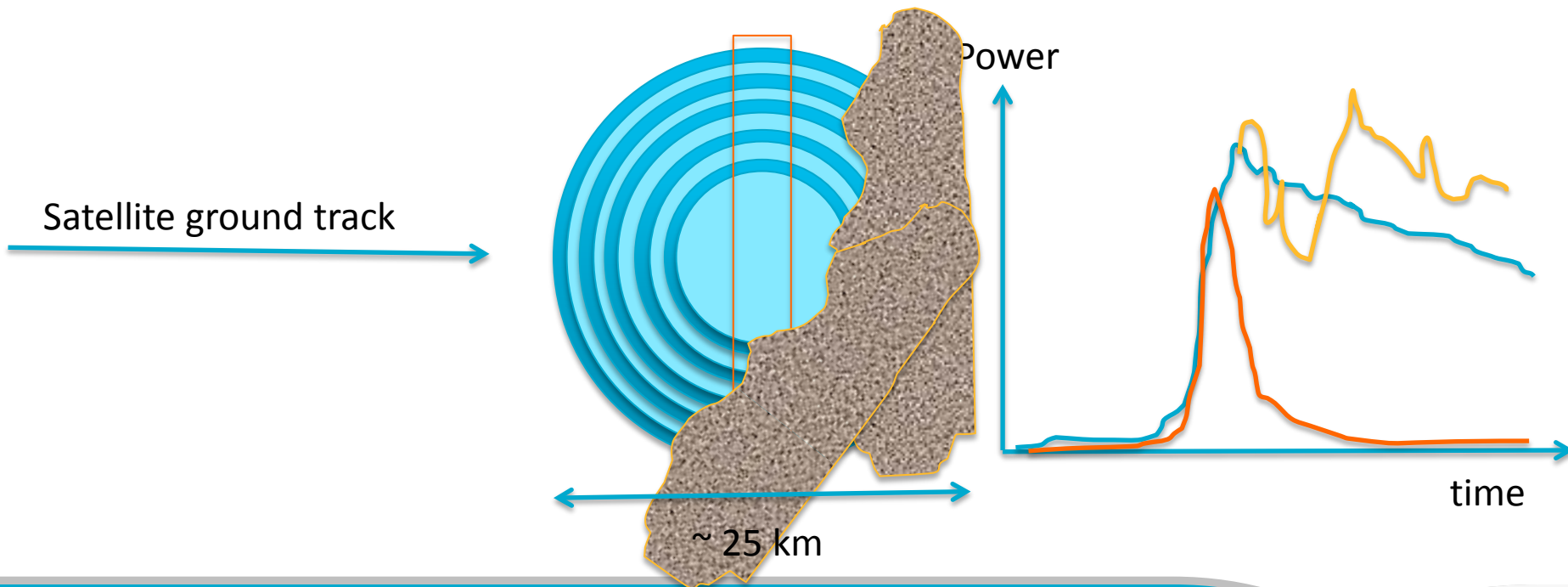
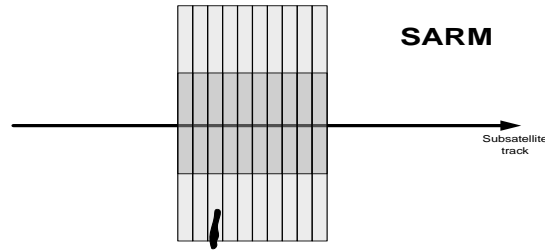




# Synthetic Aperture Satellite Radar Altimetry SARM

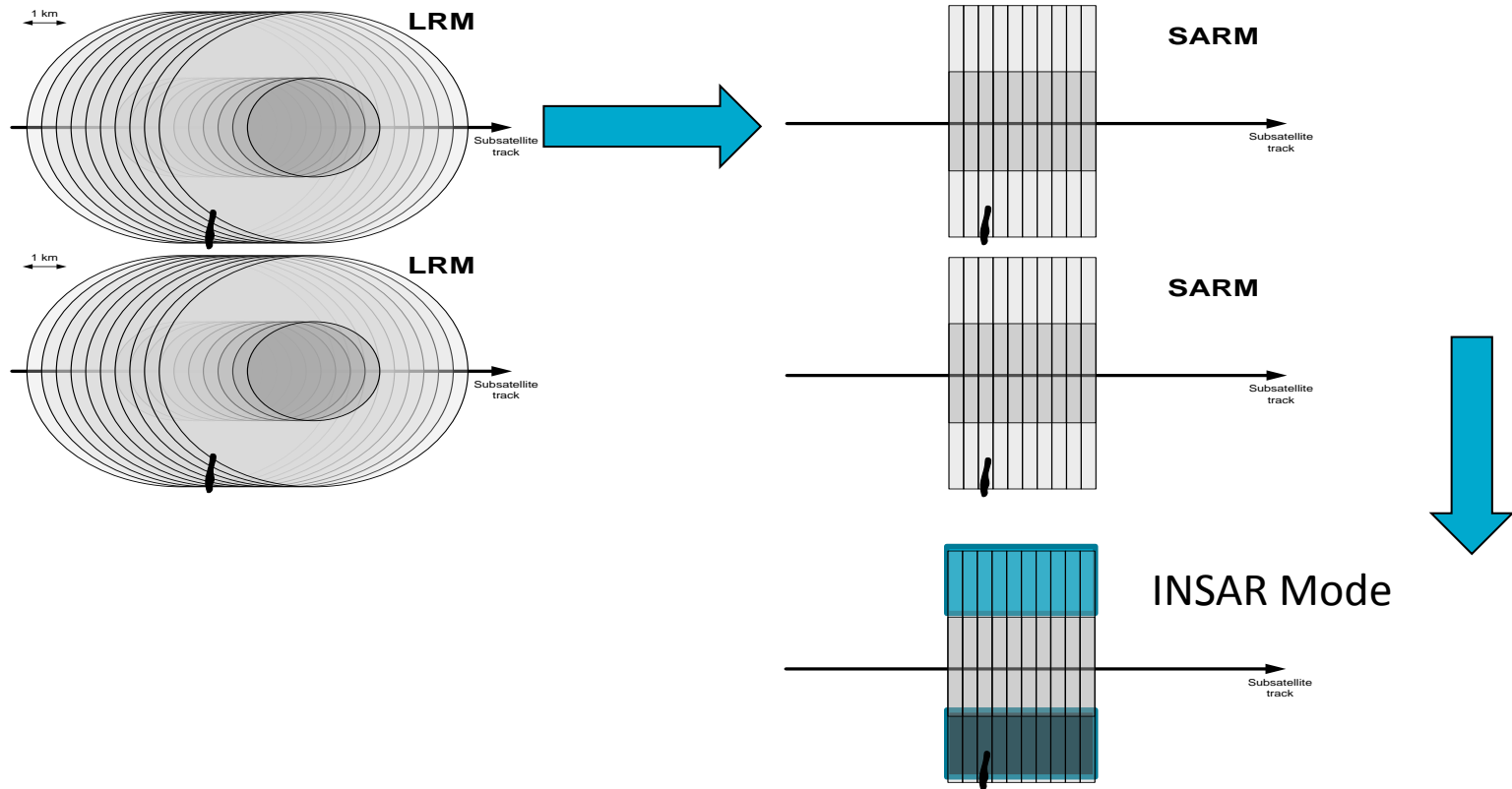


# Synthetic Aperture Satellite Radar Altimetry SARM



# Interferometric Synthetic Aperture Satellite Radar Altimetry SARM

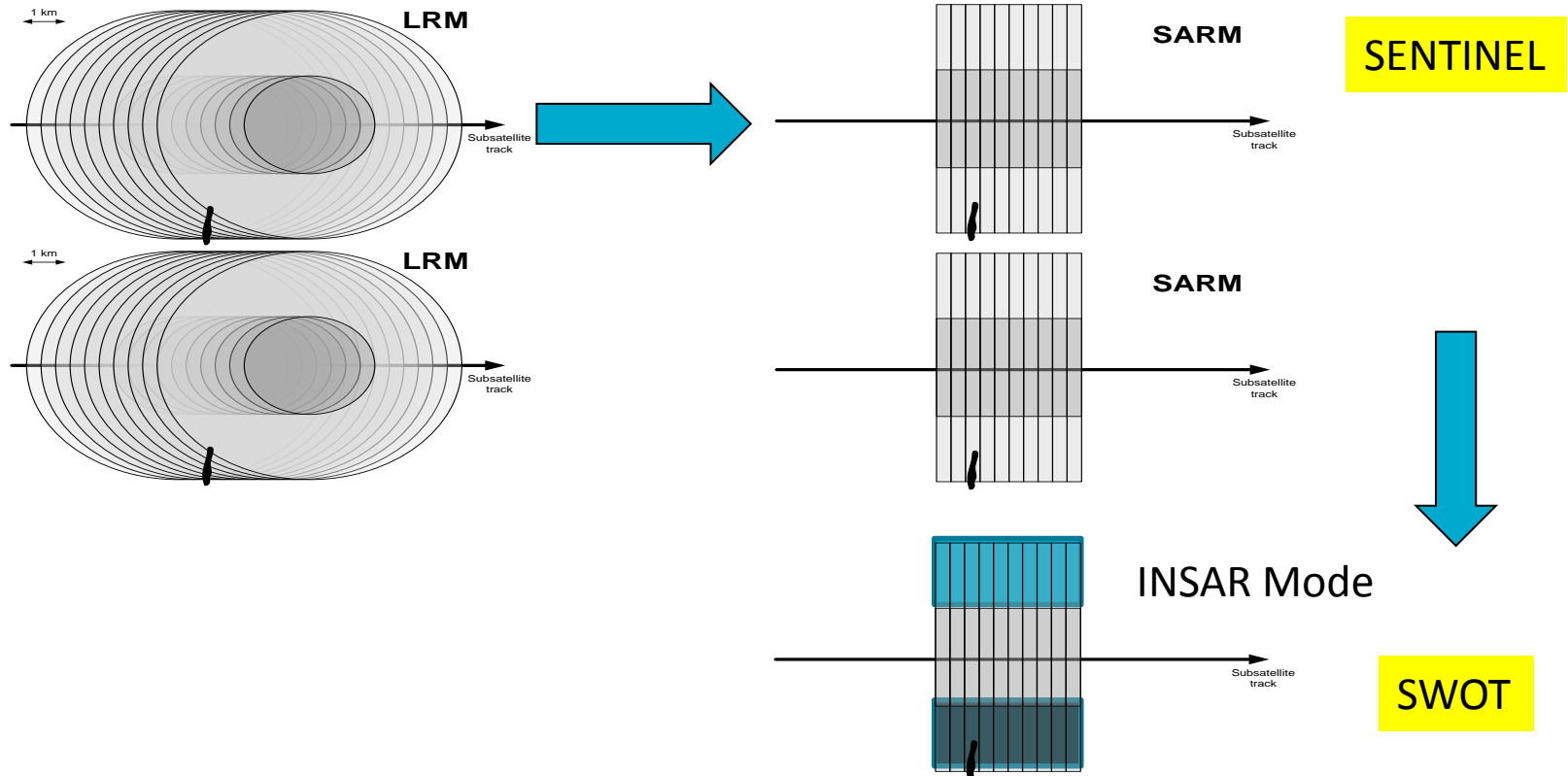
## LRM / SARM footprint



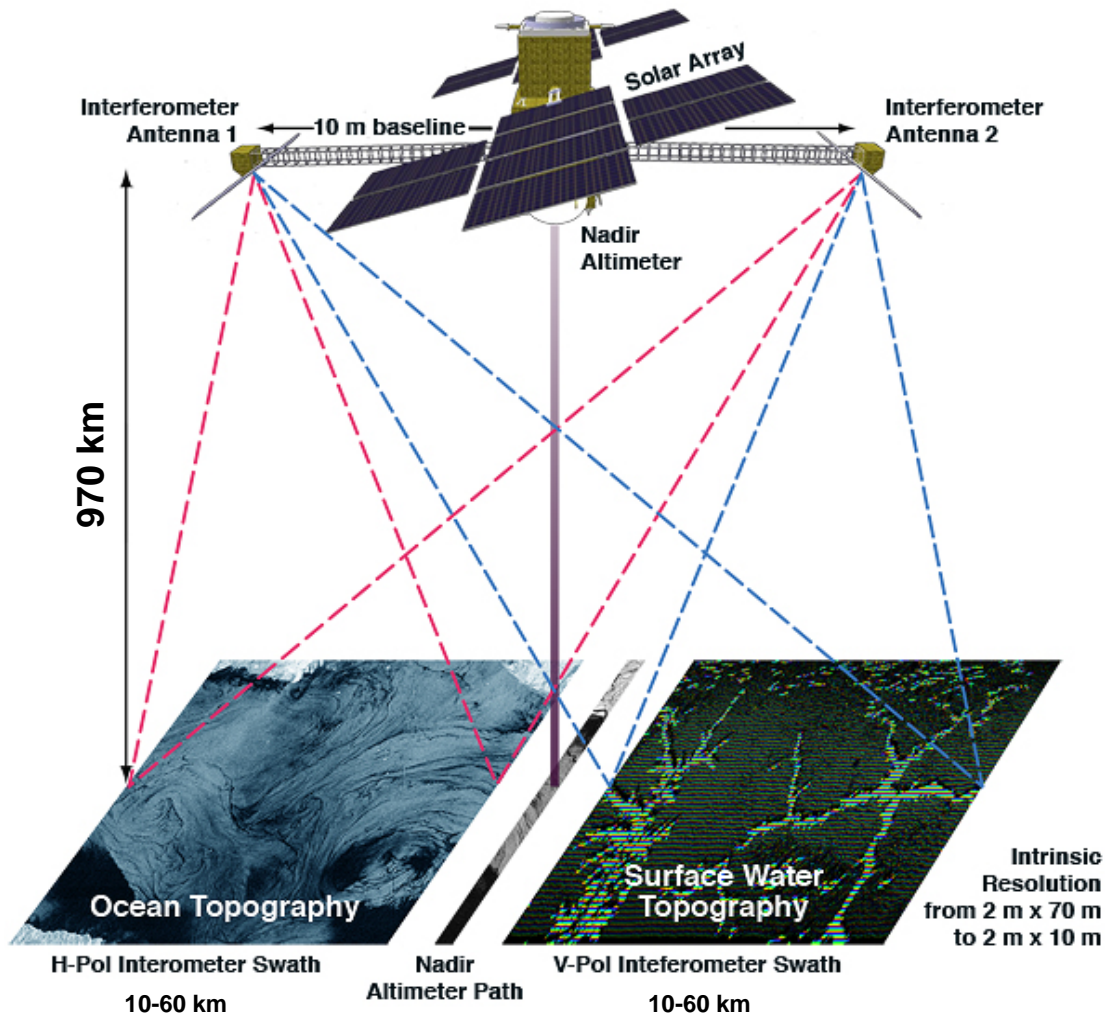
# Interferometric Synthetic Aperture Satellite Radar Altimetry SARM

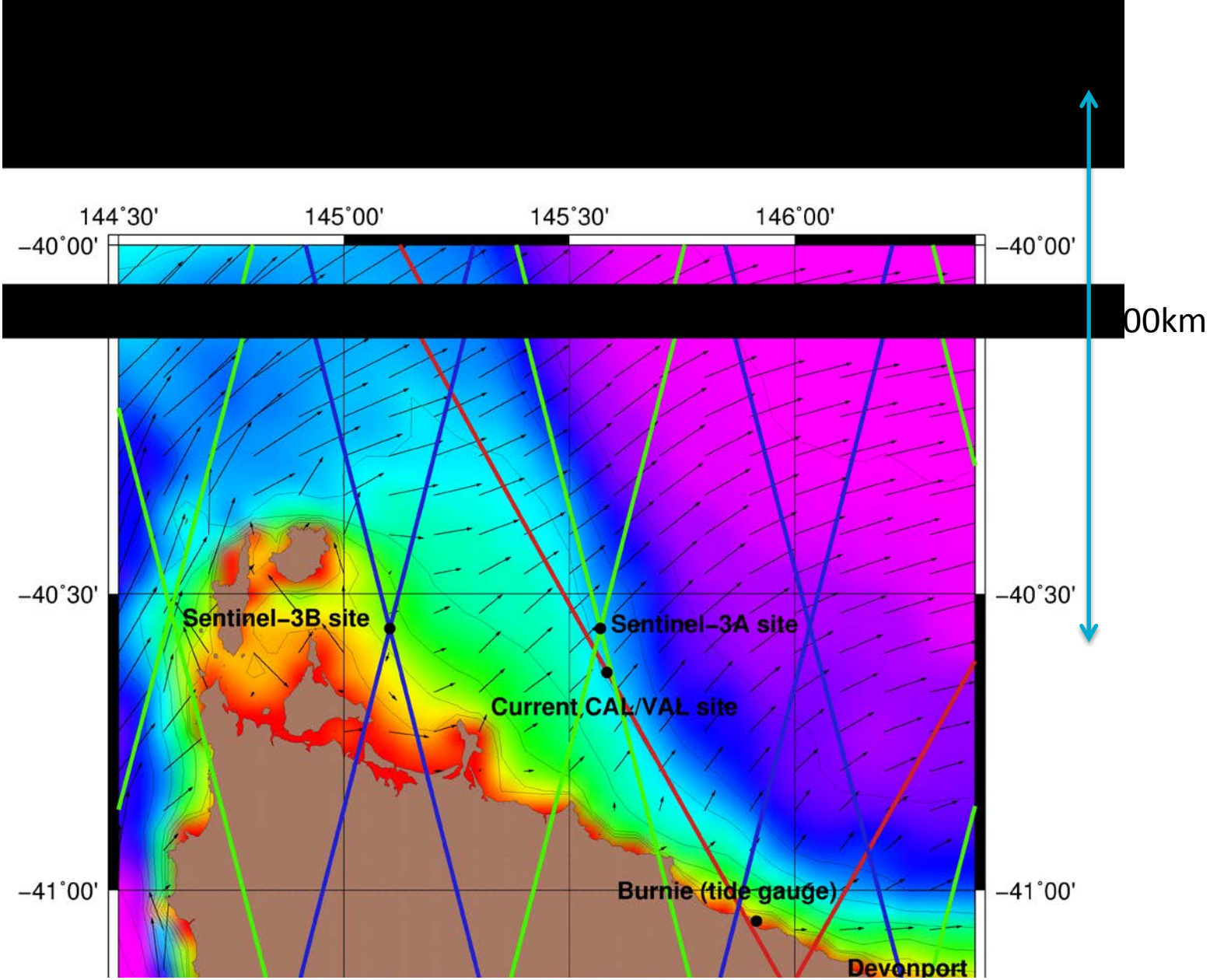
JASON etc...

## LRM / SARM footprint

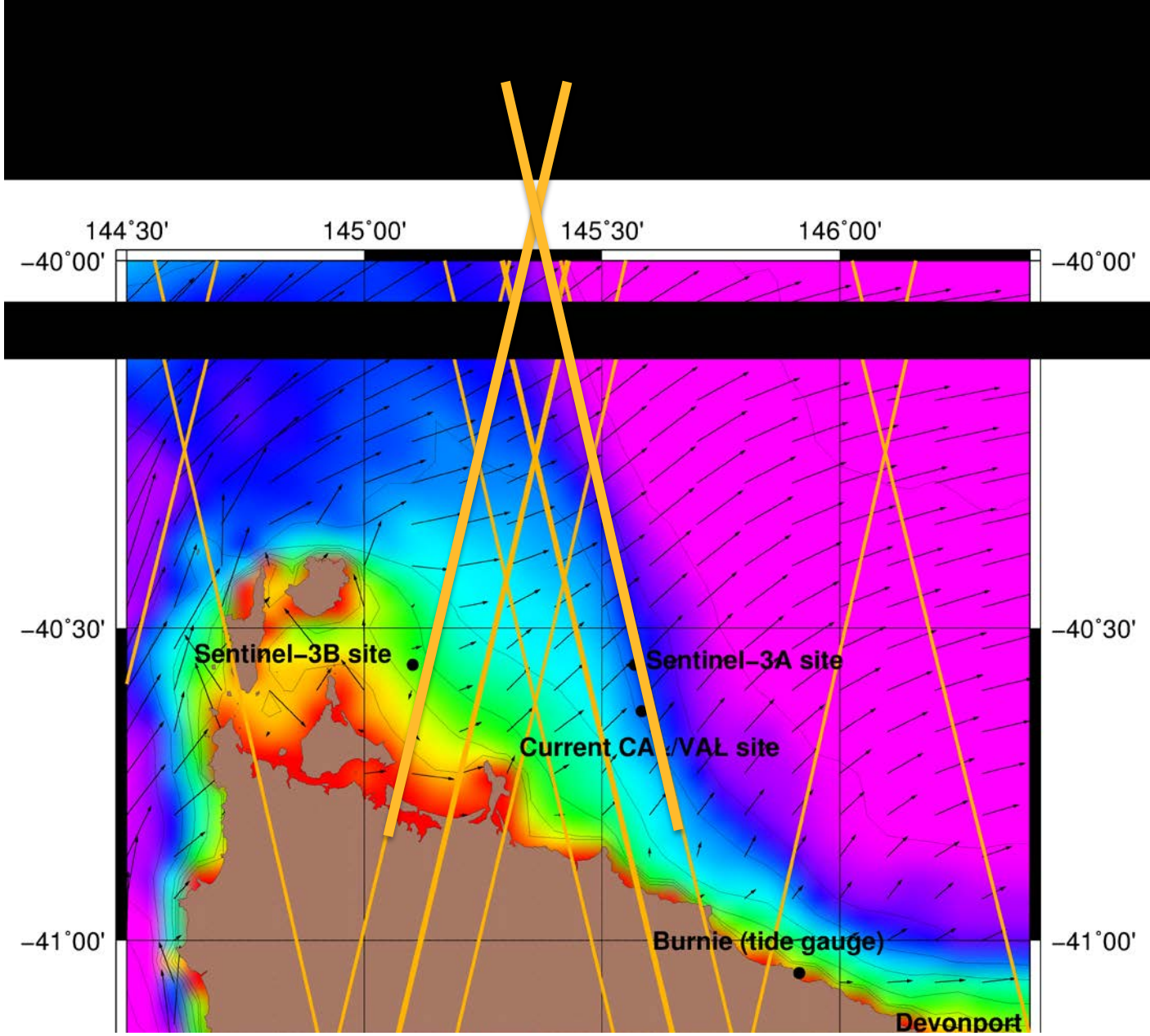


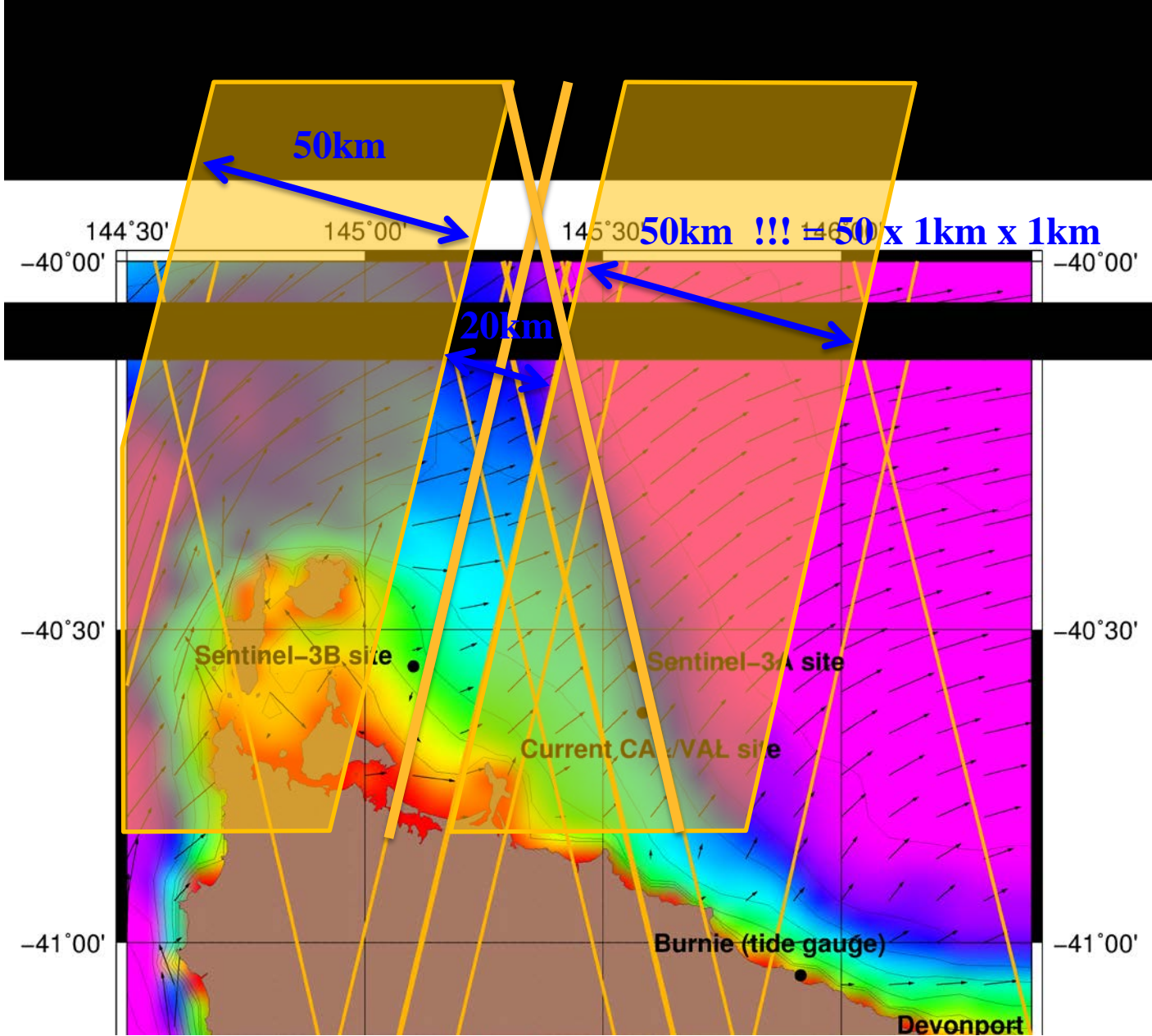
# SWOT Surface Waters and Ocean Topography

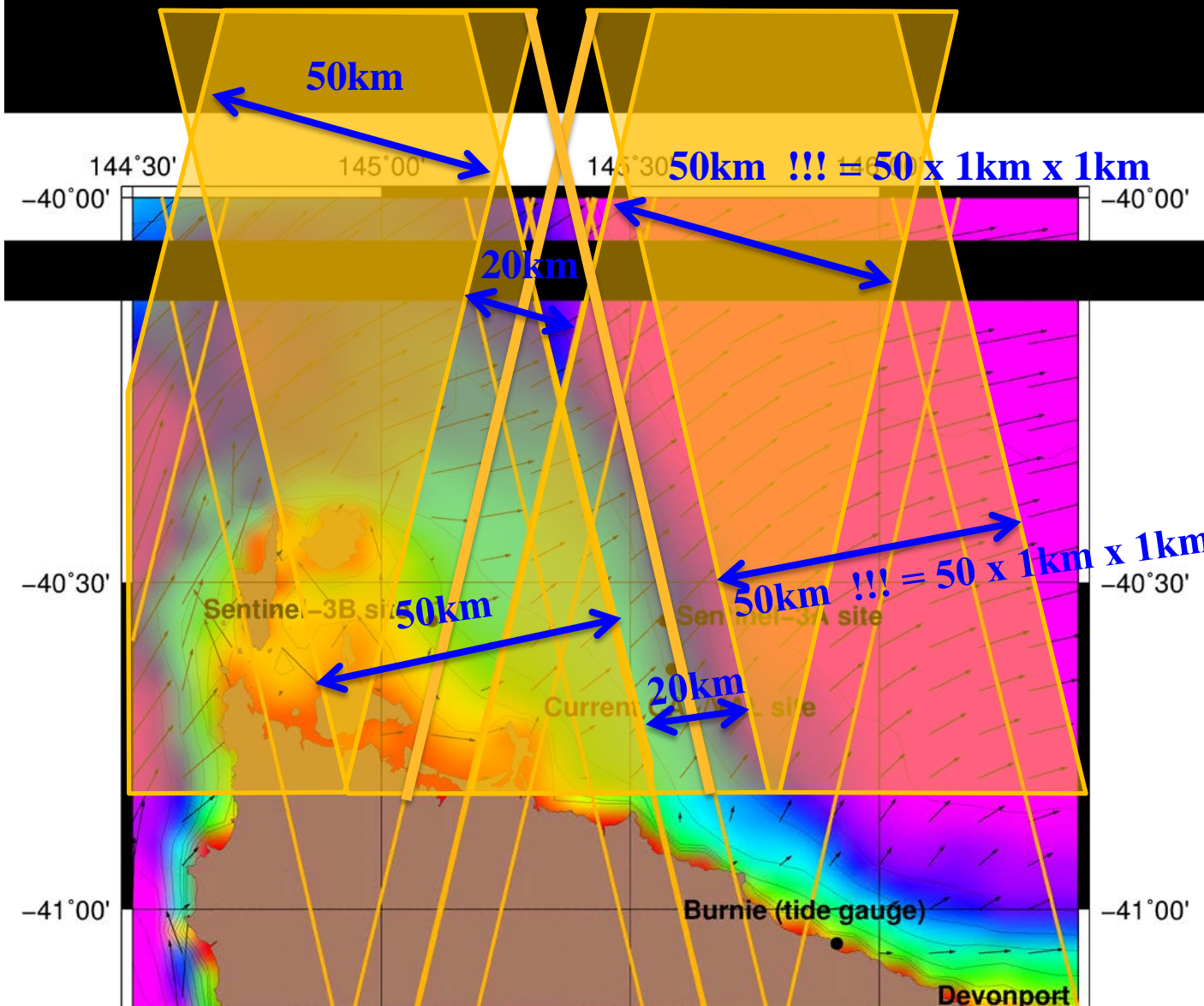












## Summary

Today LRM mode is the standard.

The SAR Altimetry era is starting next month with the Launch of Sentinel-3

Jason-CS will upgrade the Jason series to SAR mode in 2020

SWOT brings interferometry and 1km resolution over 120 km swath in 2020.

- ◆ SAR altimetry will bring the altimetry to the coast.
- ◆ The future altimetry constellation will not only allow to resolve the mesoscale but opens the opportunity to observe sub-mesoscale, i.e. mixing, transfers, exchanges.
- ◆ If you haven't already started, it's the best time to start multi sensors approaches for process studies.
- ◆ Ocean-coast exchanges, ocean-land exchanges. (SWOT = Surface Waters / Ocean Topography)
- ◆ Higher resolution brings lot more signals to light... and lot more issues (e.g. swell,...)