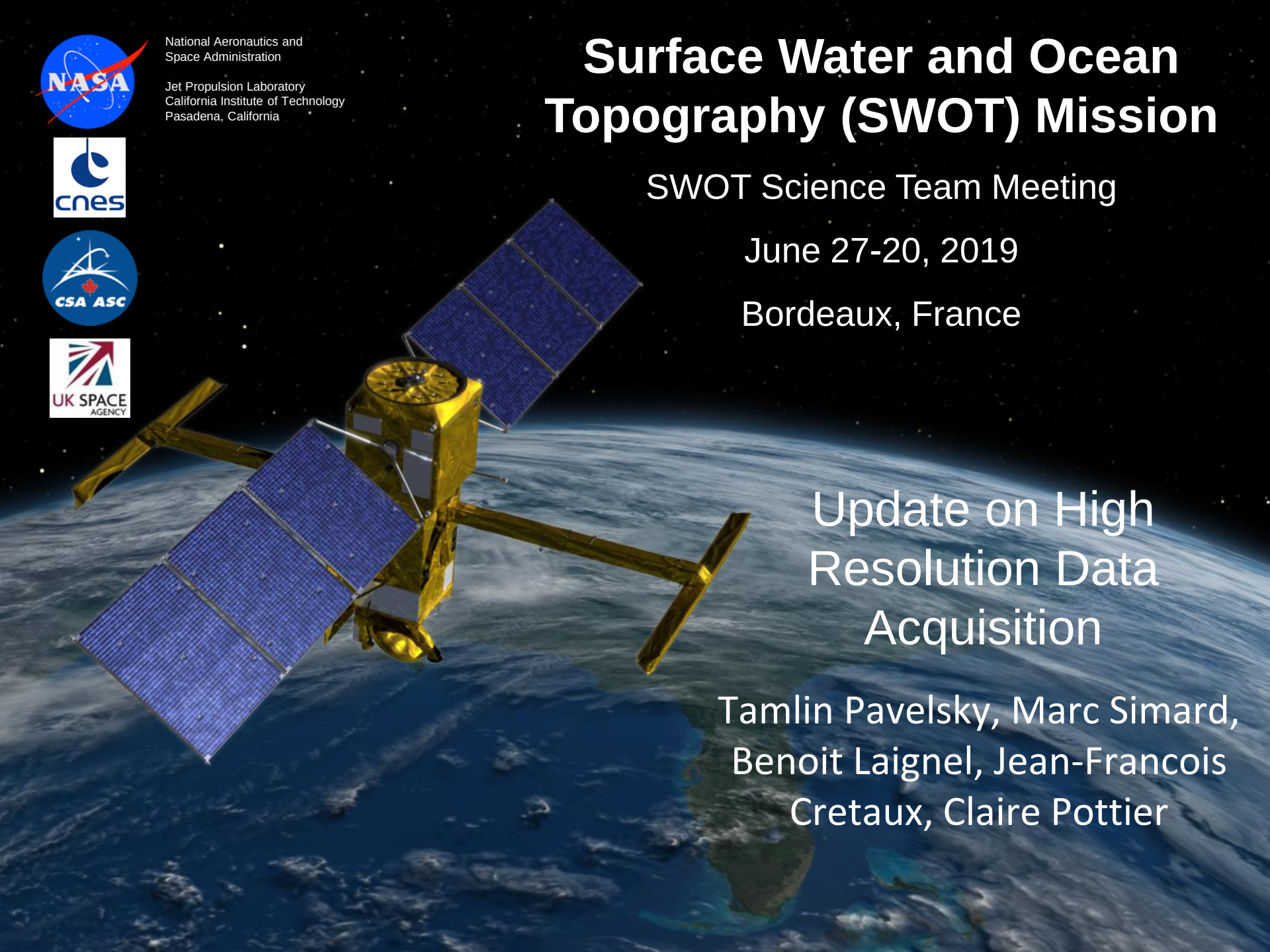


National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Surface Water and Ocean Topography (SWOT) Mission

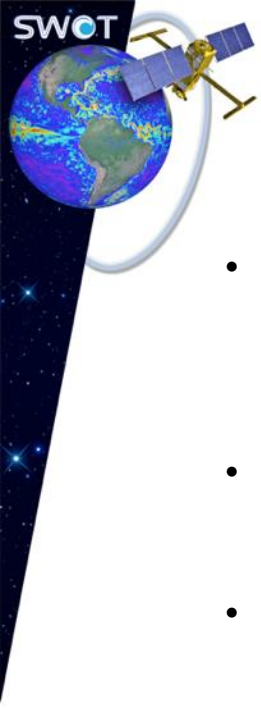
SWOT Science Team Meeting

June 27-20, 2019

Bordeaux, France

Update on High Resolution Data Acquisition

Tamlin Pavelsky, Marc Simard, Benoit Laignel, Jean-Francois Cretaux, Claire Pottier

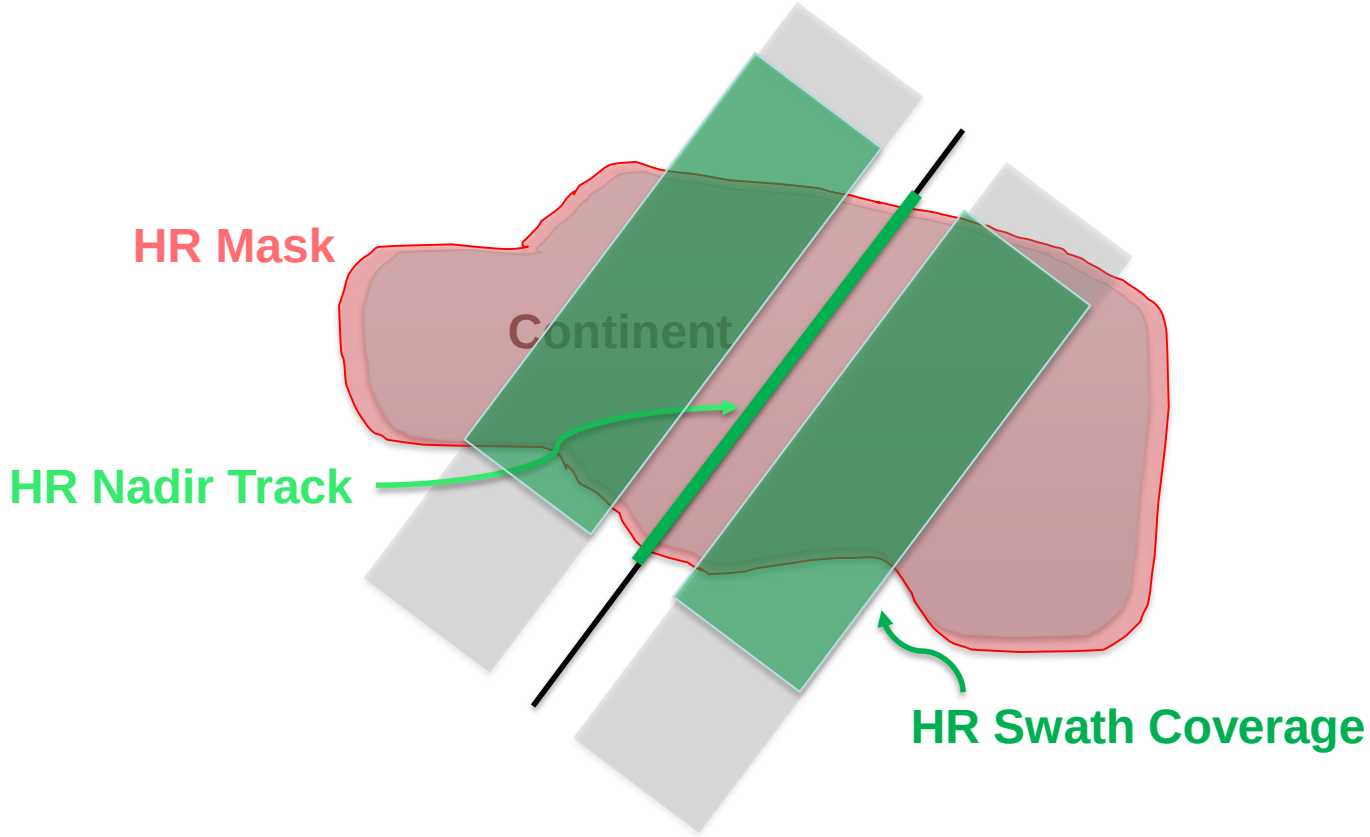


(Re)Introduction to HR Data Collection

- HR Data will only be downloaded over a portion of the globe consistent with the available data downlink capacity and onboard processing capabilities.
- Hydrologic science requires HR data in most cases, so most (but not all) HR data is collected over continents.
- HR data is presummed onboard in order to reduce data volume; as such, it is likely to be less accurate in some ways than comparable LR data.
- We have the opportunity to decide in which areas HR data will be collected.
  - Defined by data collection start/stop times, which bound HR nadir track segments.

Definitions

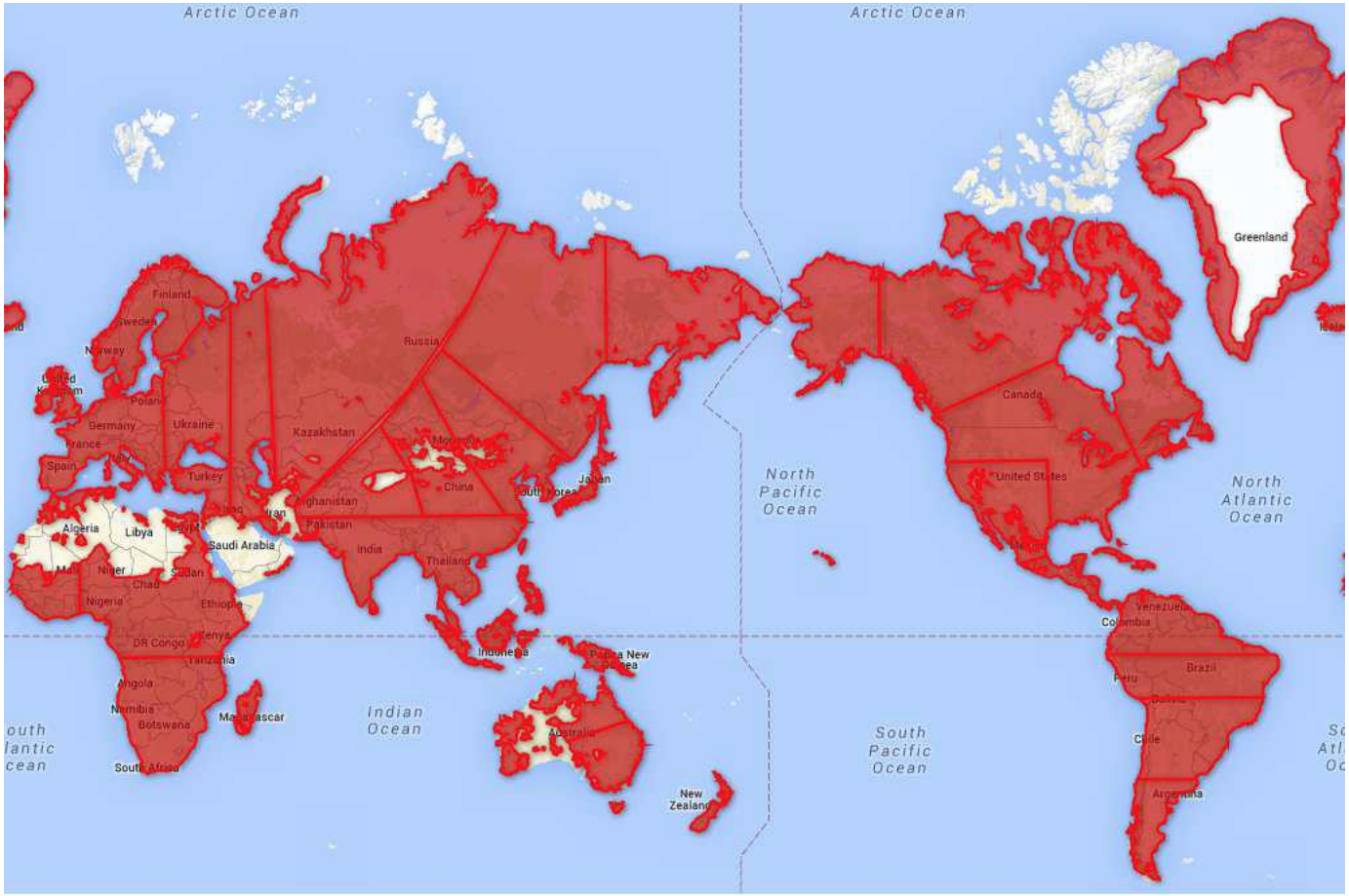
- HR Mask: region, defined by a polygon, in which we would like HR data to be collected (coastal and inland defined separately).
- HR Nadir Track: portion of SWOT ground track that defines where HR data will be retained.
- HR Swath Coverage: Area covered by actual SWOT HR data.



Origins of the c. 2015 HR Mask

- High Rate Data Coverage Working Group of the Science Definition team, chaired by Sylvain Biancamaria and Yi Chao, created the first mask.
- Polygon format, aimed to ensure coverage of major global rivers and lakes.
- Initially based on automated processing from DEM-based representations of rivers, along with locations of lakes.
- Manual editing performed in order to fix problems where necessary.
- Preliminary HR Swath Coverage based on identifying all HR nadir tracks within 3 km of the HR Mask boundaries.

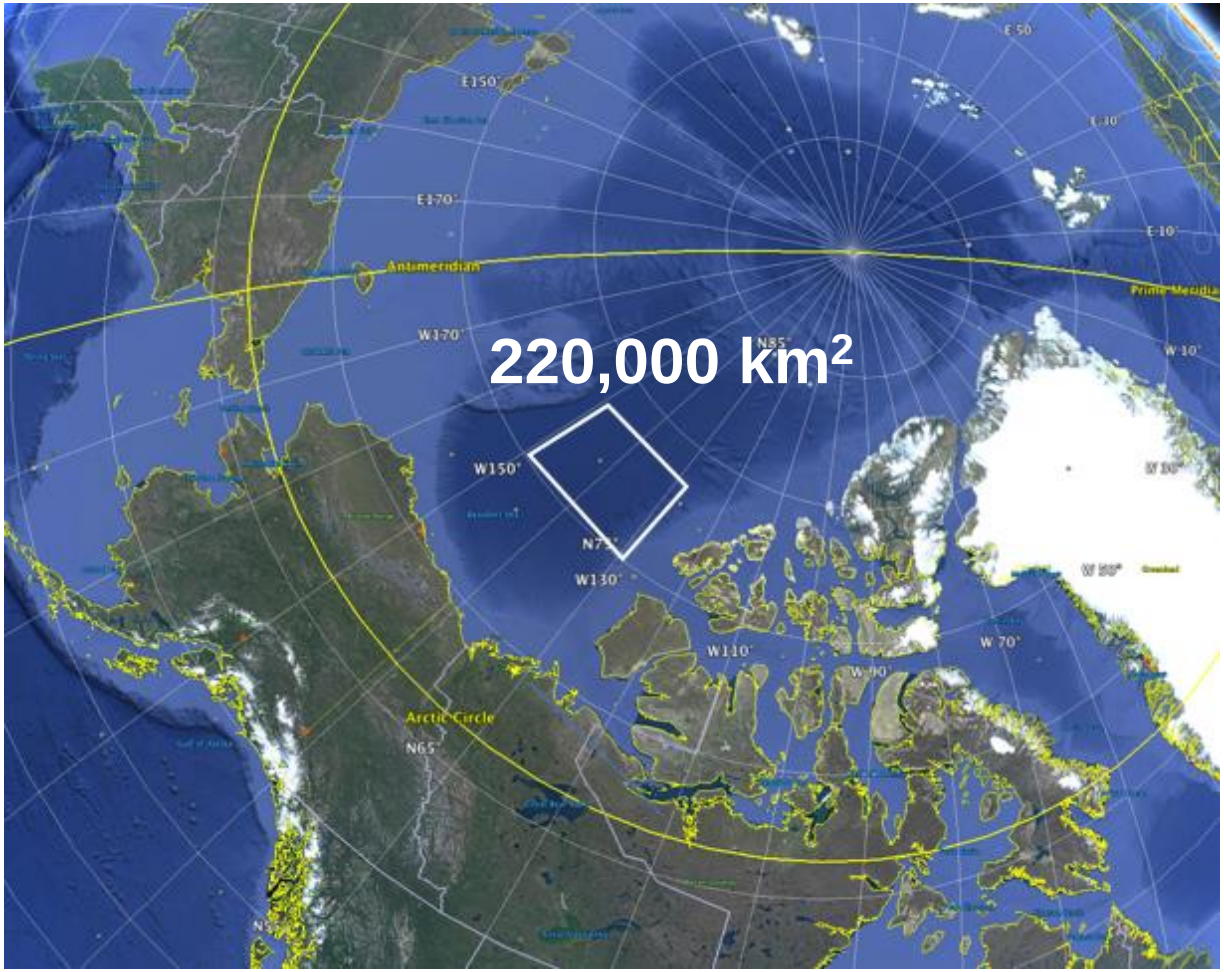
H.R. Mask circa 2015



Thanks to Sylvain Biancamaria and Yi Chao

ST 2017: Changes Related to Sea Ice

Seasonal HR coverage over a substantial area of sea ice (~220,000 km^2) will allow studies of sea ice freeboard using SWOT.



Projected area of sea ice freeboard studies.

ST 2017: Changes Related to Sea Ice

In order to facilitate download of HR data over sea ice, a portion of the terrestrial HR mask must be removed. We propose to remove a portion of the Canadian Archipelago during the months of December, January, and February. All areas north of 70º N.

Translation from HR Mask to HR Swath Coverage

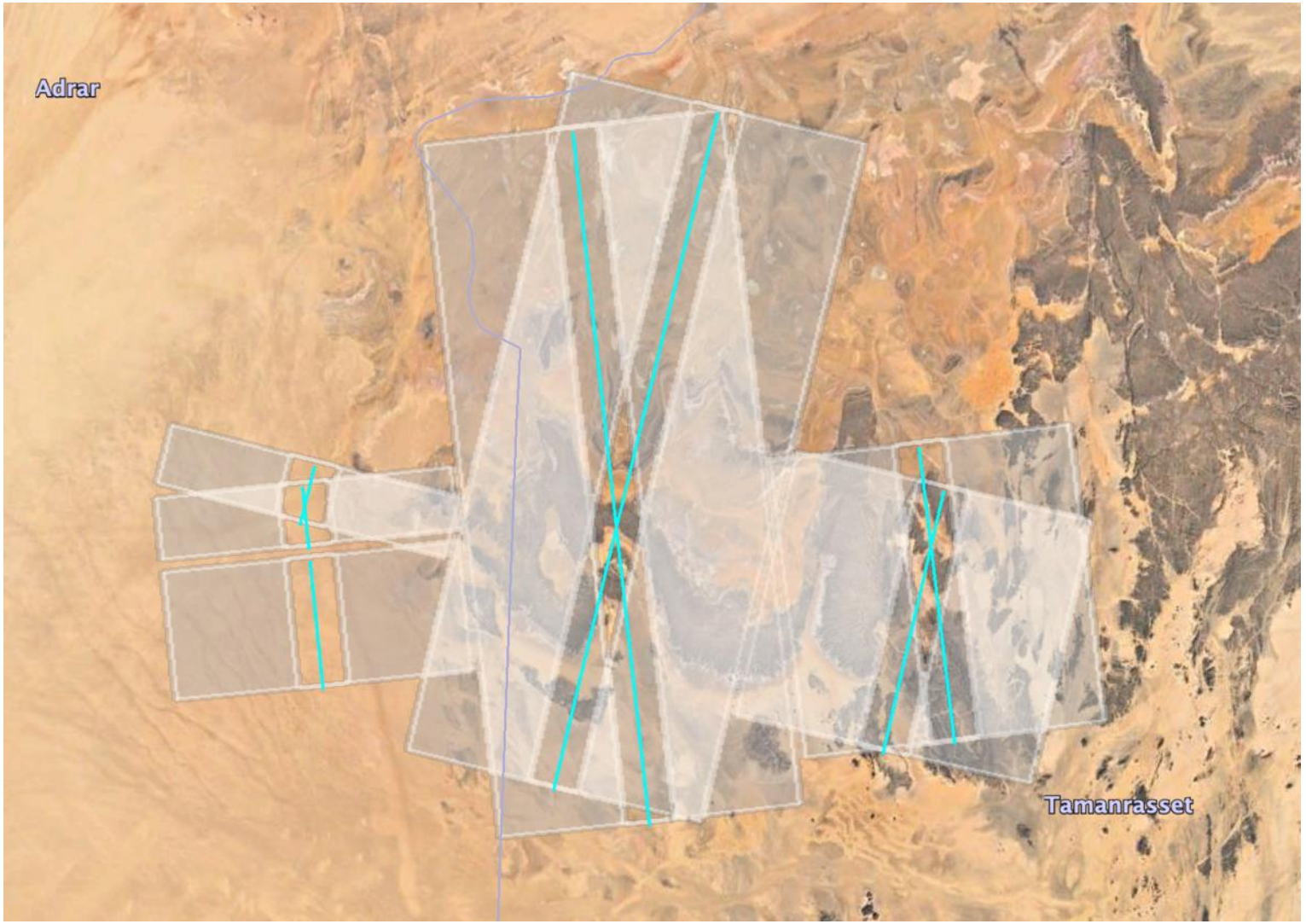
- CNES intersected the original HR Mask with SWOT ground tracks. The result is the actual map of where SWOT HR data will be downlinked (HR Swath Coverage).
- The resulting HR Swath Coverage was imperfect for several reasons:
  - The HR Swath Coverage misidentifies locations of scientific interest
    - Missing coverage
    - Coverage over uninteresting areas
  - The original method used to derive the HR Mask was based on an approximation of river location derived from DEMs, and an imperfect map of lake location.
  - The HR Nadir Track terminated 3 km from the edge of the HR mask, which results in problems in coastal areas in some cases.
- We worked through a multistep process to address these issues, while ensuring that data volume did not grow substantially.

Step 1: Identify Problems

- We (Tamlin and Jean-Francois) manually examined the HR Swaths to identify areas that were missed AND areas that were unnecessarily included.
- Areas commonly requiring changes:
  - Deserts and desert margins
  - Islands
  - Coastal Regions (left for Step 3)
- In general, problems for rivers occurred where flow accumulation did not adequately reflect actual river conditions.
- Initial HR mask also missed lakes, which are better represented in more recent datasets.
- Additional consideration: request from Canada to provide HR data over the Laurentian Great Lakes.

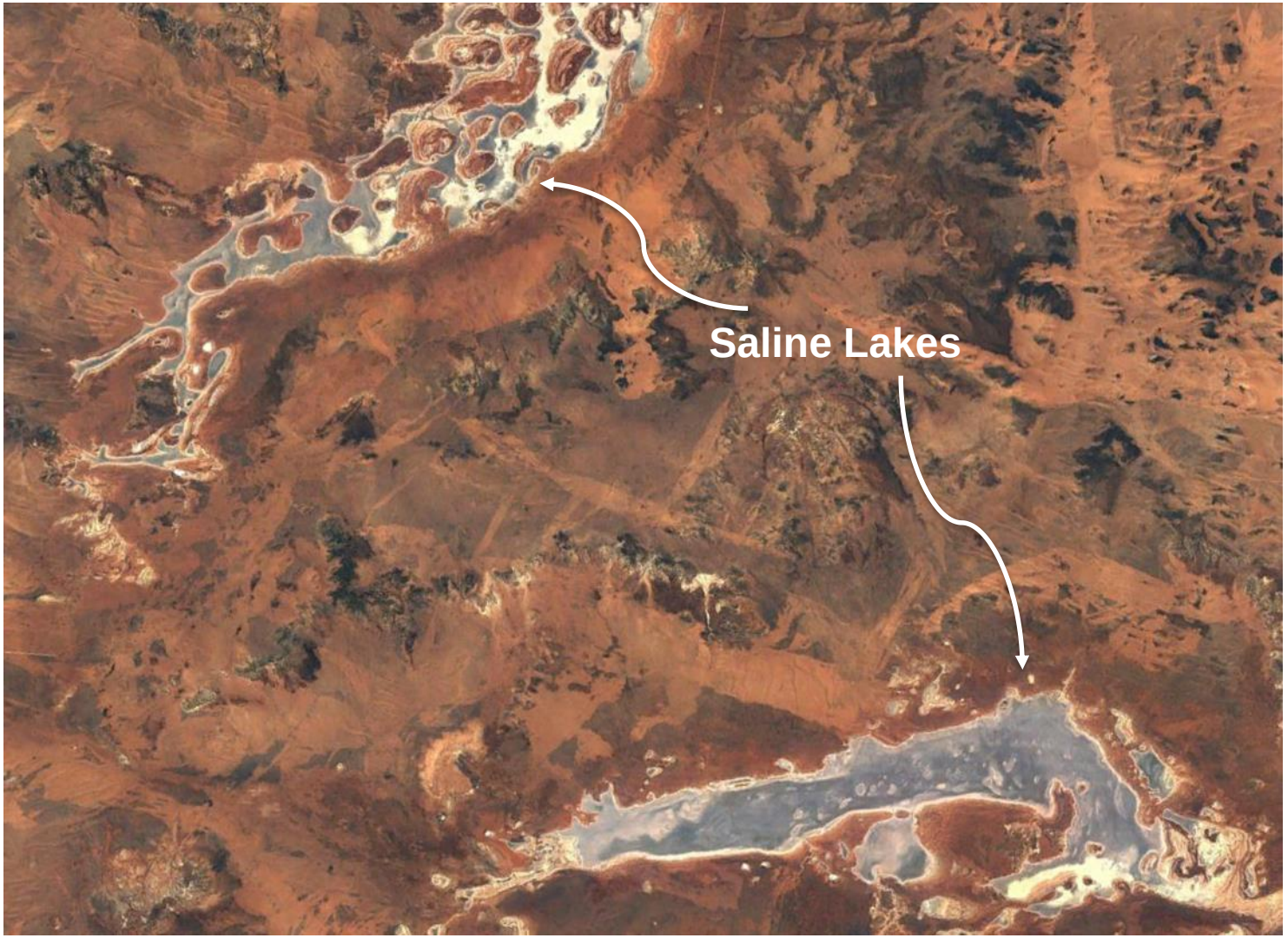
Coverage over Deserts

Too much coverage over the Sahara. . .



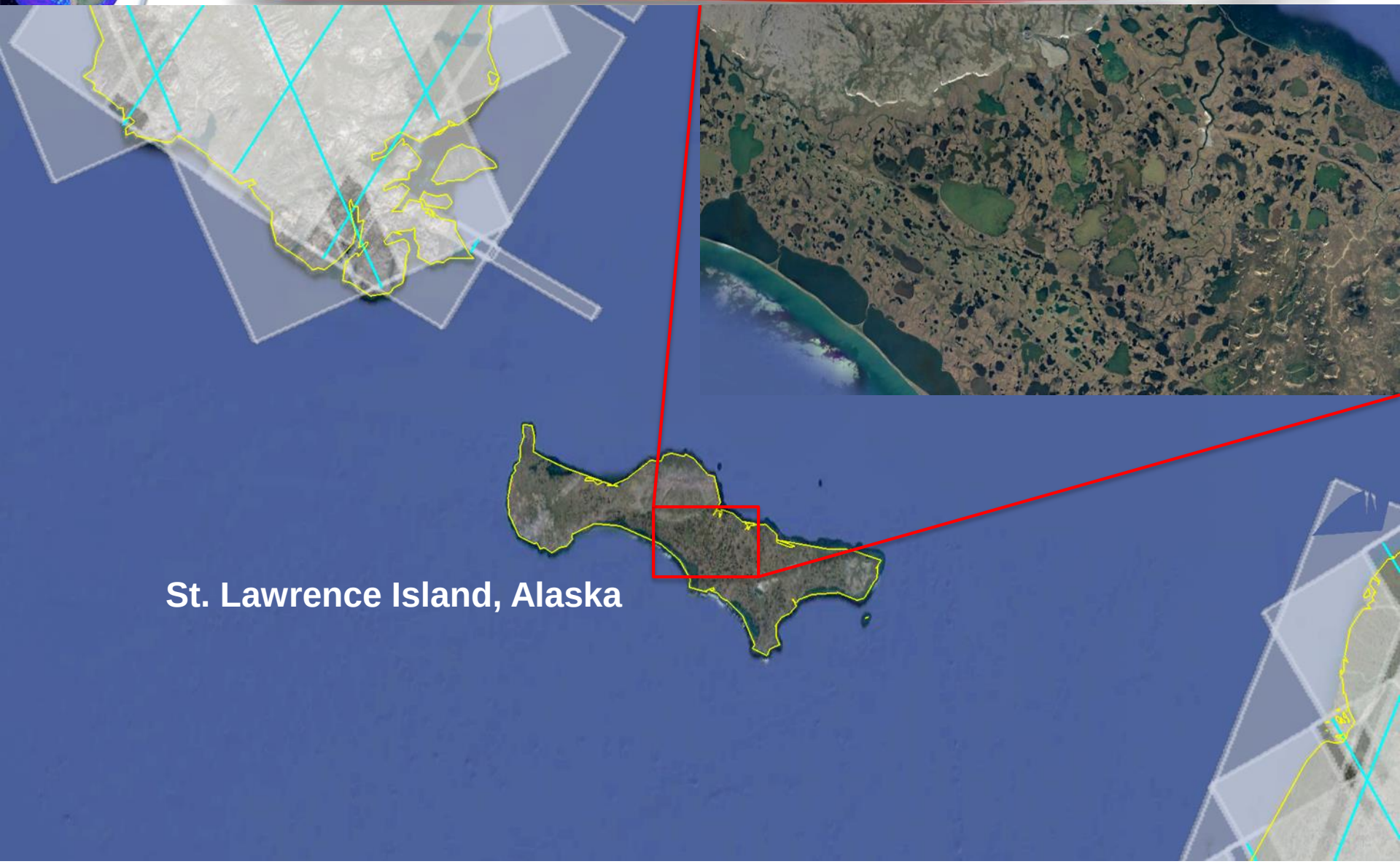
Coverage over Deserts

. . . But missed saline lakes over Australia



Missed coverage over important islands

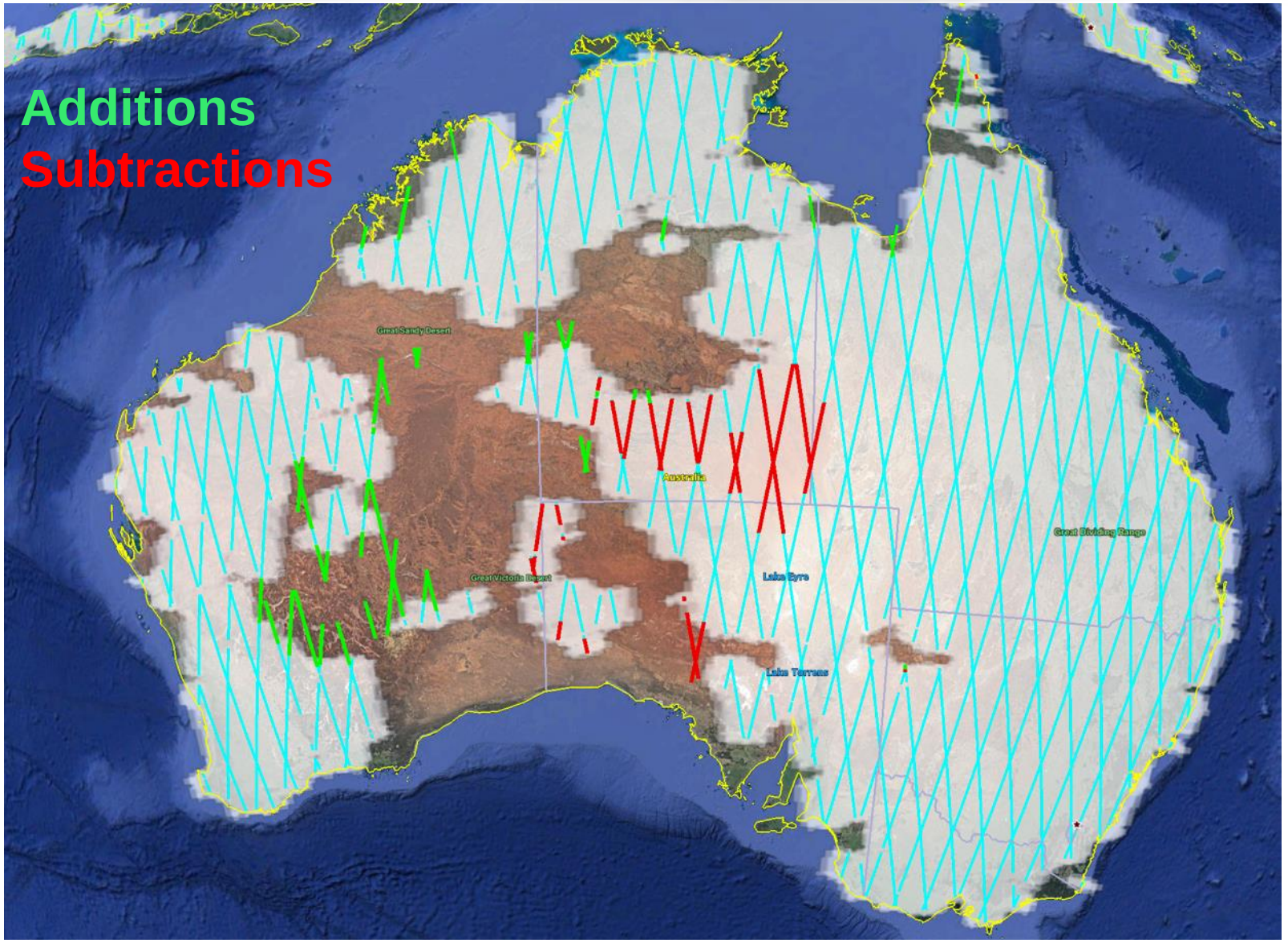
Missed Coverage over Important Islands



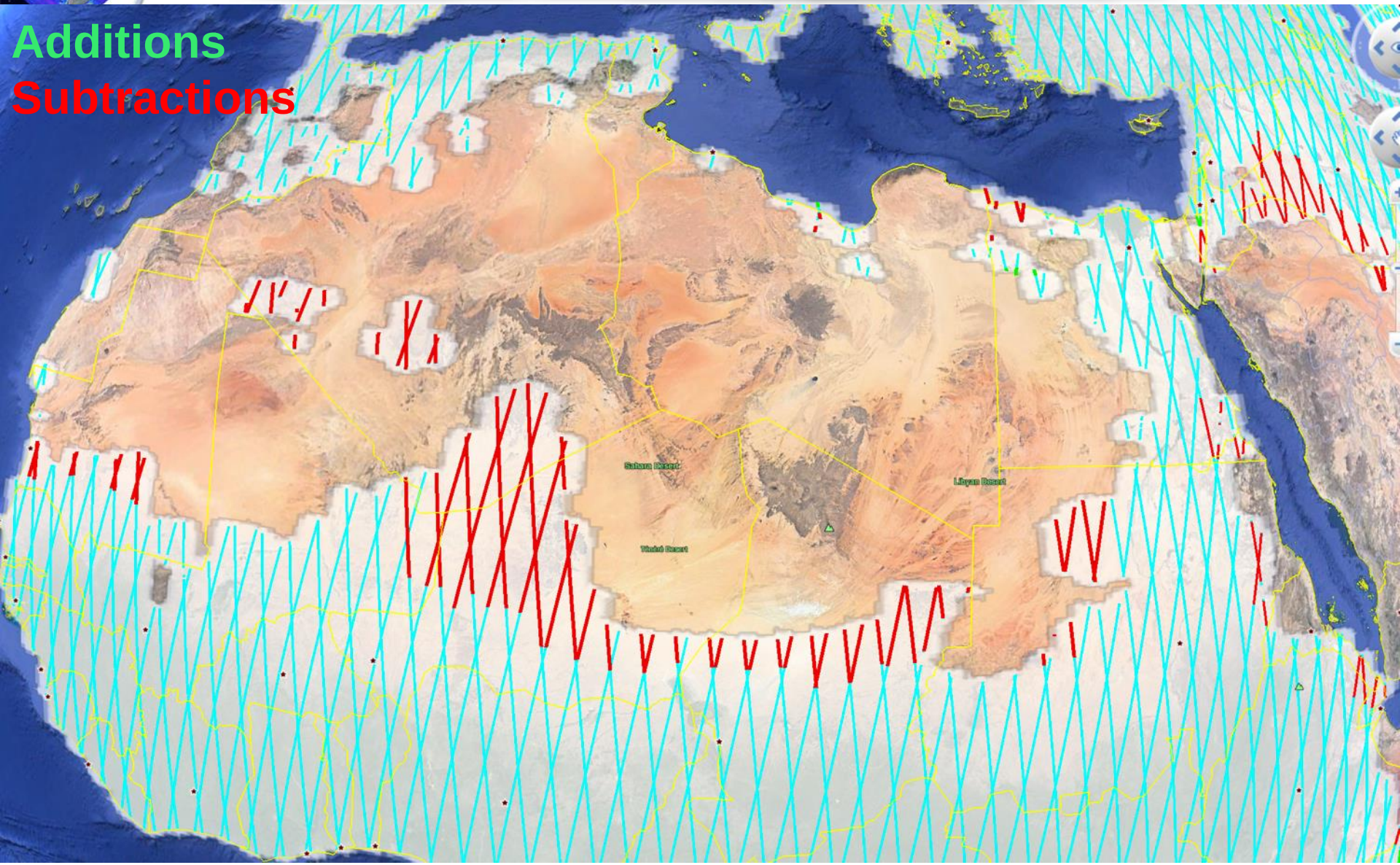
Step 2: Select Areas to Add/Remove

- Tamlin and Jean Francois decided on areas to add and remove from the HR mask based on the following concepts:
  - HR Swath Coverage of areas with no apparent rivers or lakes was removed
  - HR Swath Coverage of rivers that were clearly likely to be SWOT-observable (e.g. wider than 100 m) was added.
  - HR Swath coverage of rivers between 50 and 100 m was sometime added due to especial interest or strong seasonality.
  - Previously uncovered lakes were included in most cases.
- We examined many areas of the world, but we were not comprehensive, especially along coastal margins (more on this later).
- We aimed to remove more length of HR Nadir Track than we added in order to make space for additional delta/estuarine/coastal coverage.

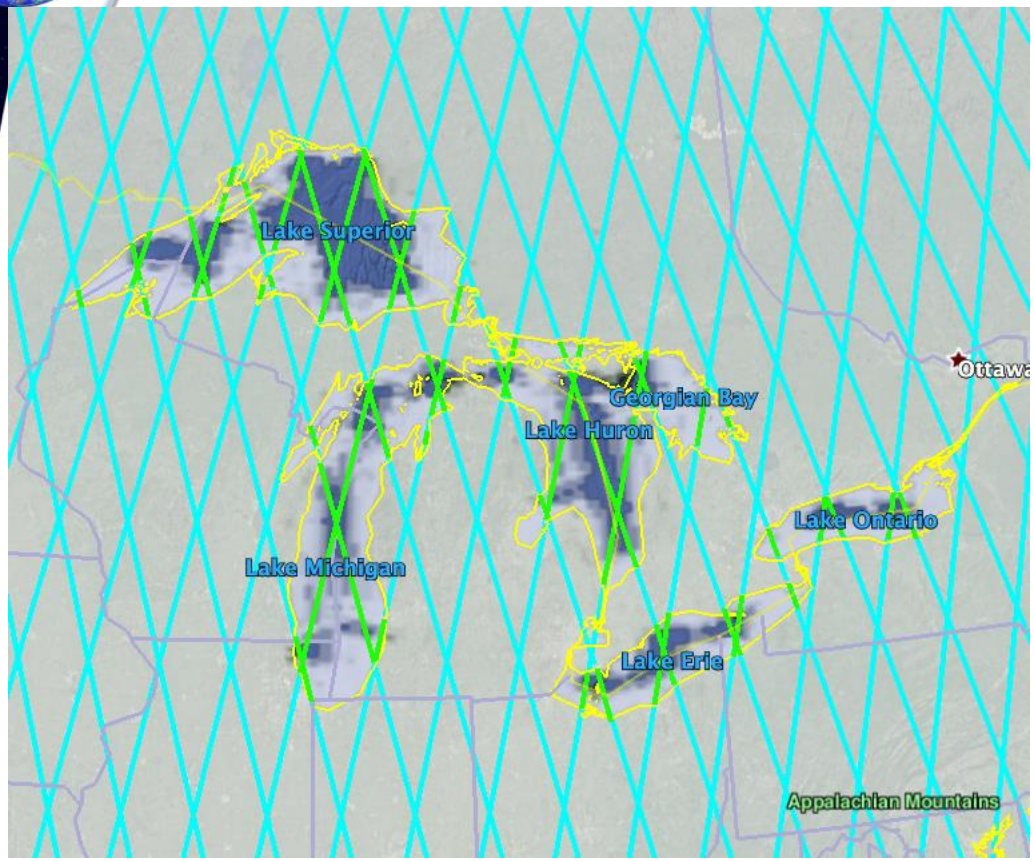
Major Regions of Change: Australia



Major Regions of Change: N. Africa/M.E.

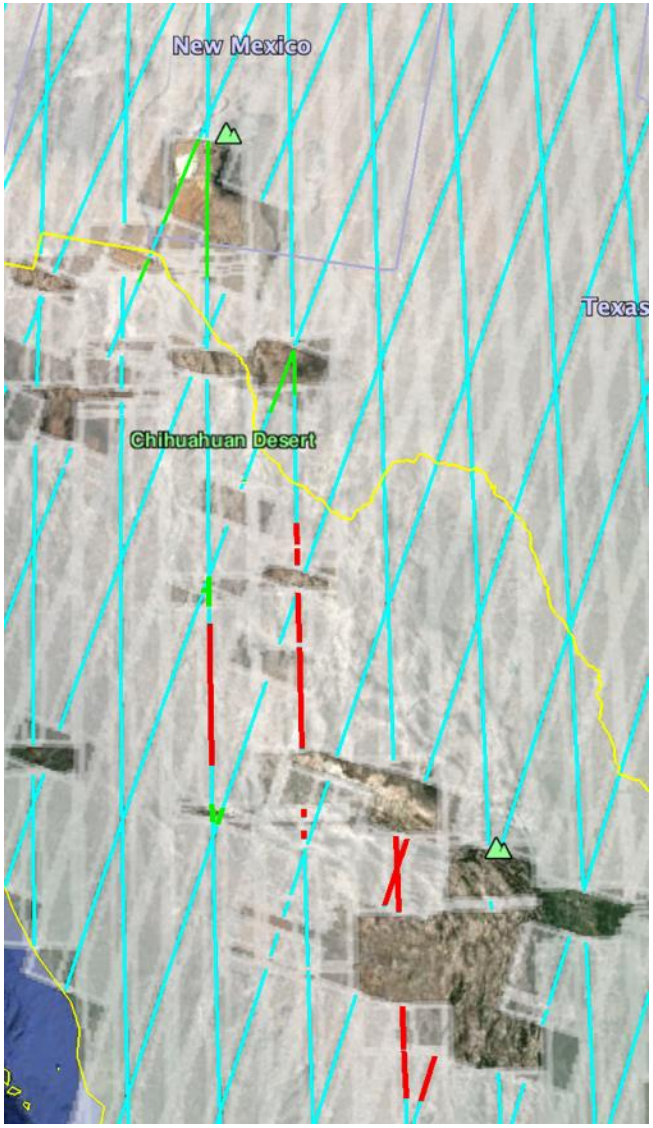


Major Regions of Change: N. America

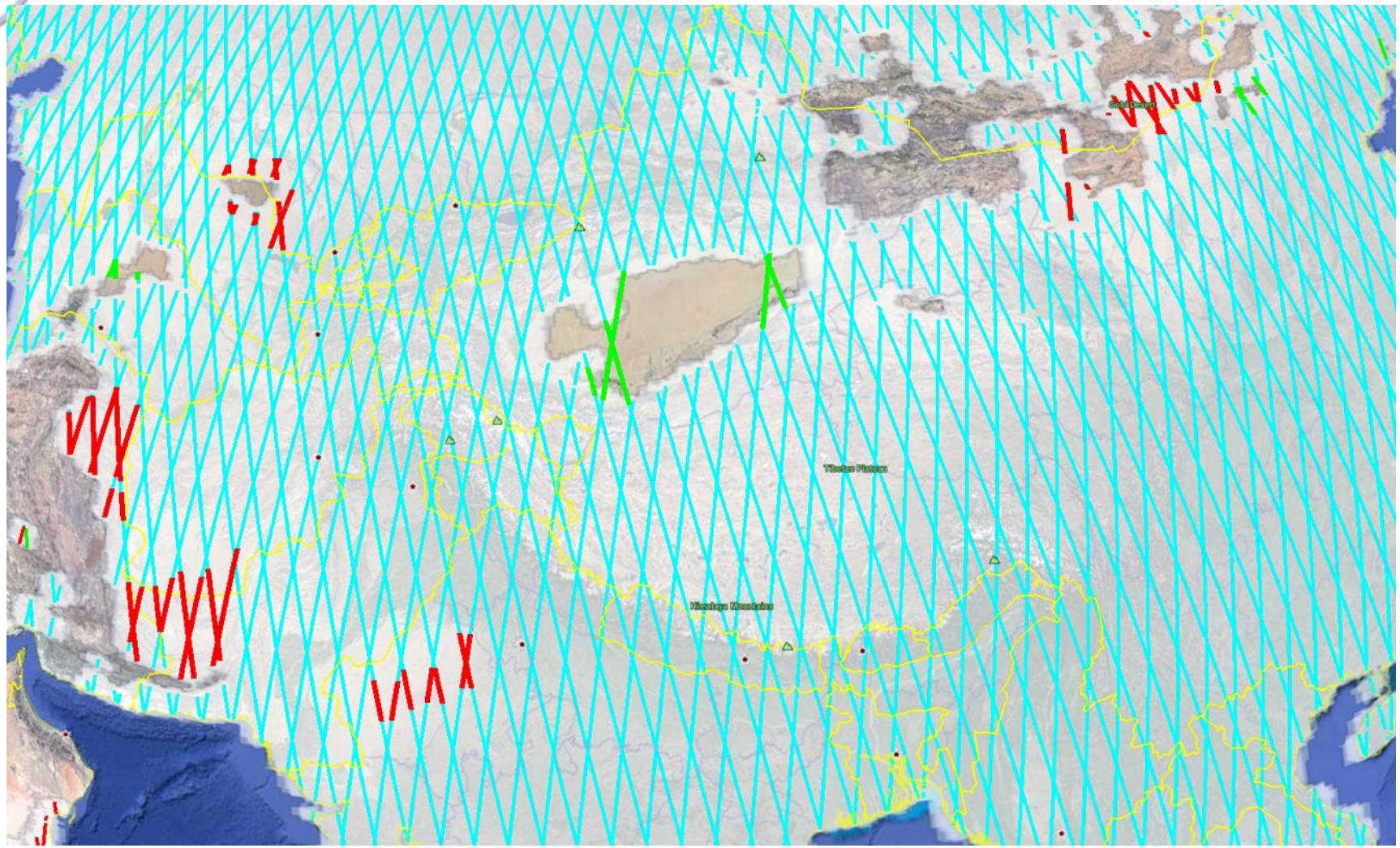


Laurentian Great Lakes Added

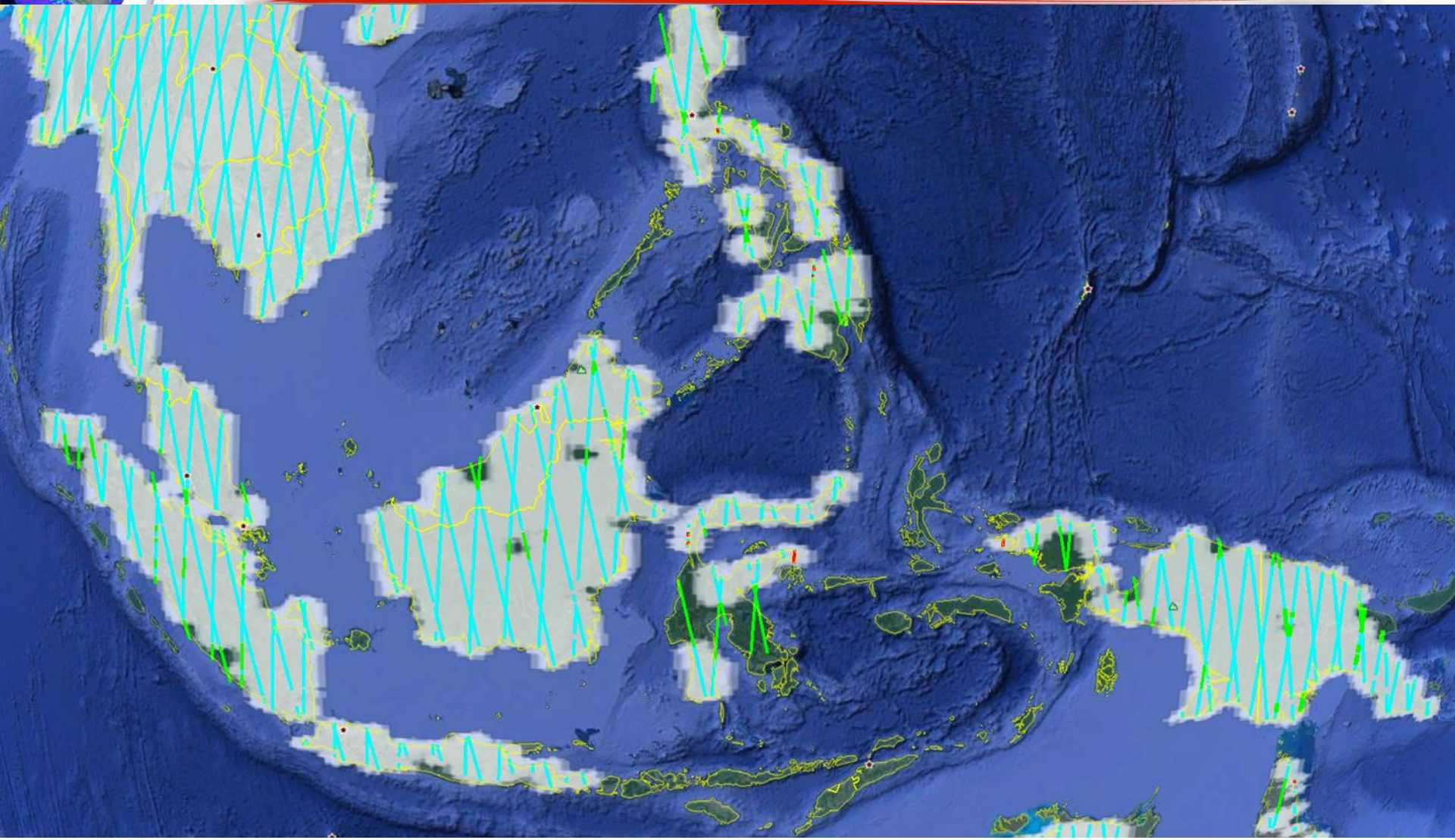
Rio Grande Added →



Major Regions of Change: Asia



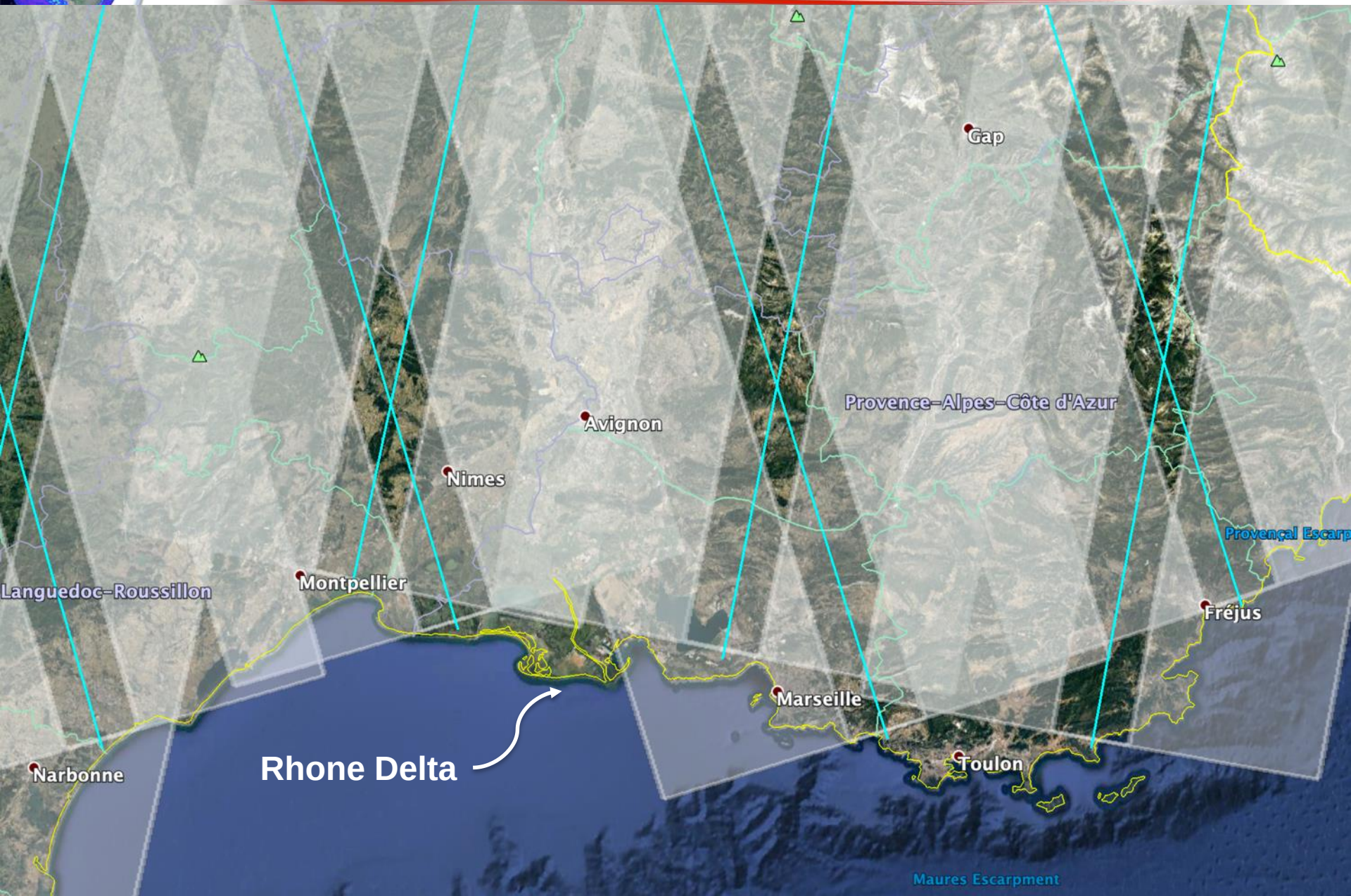
Major Regions of Change: Indonesia/Philippines



Step 3: Coastal Additions

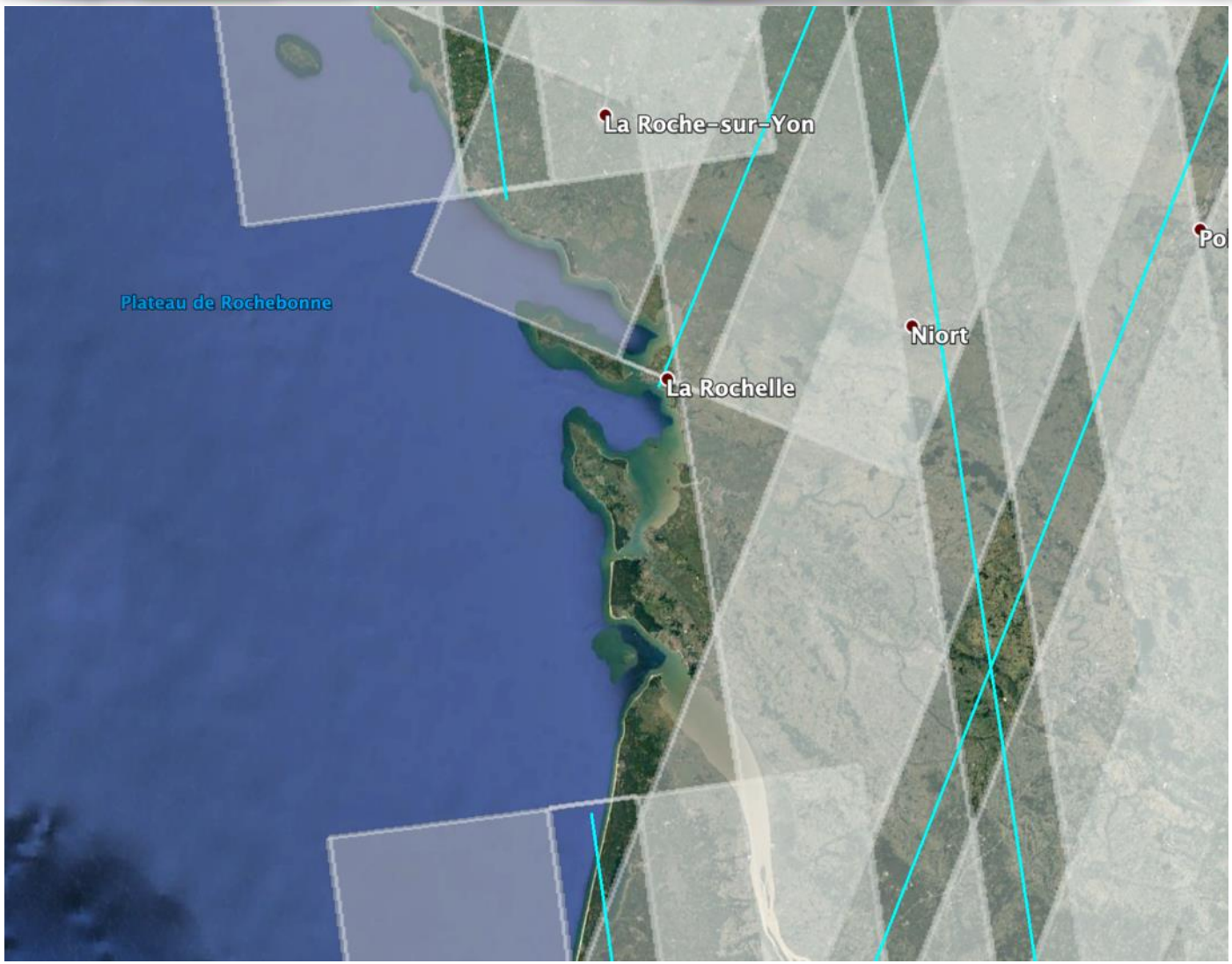
- Marc Simard, Benoit Laignel, and Claire Pottier led efforts to identify key areas where additional data collection along coasts could facilitate SWOT Science.
- Selected deltas and estuaries based on:
  - Different tidal contexts (macro, meso, microtidal)
  - Diverse Morphologies (estuary, delta, bay, with/without mangroves)
  - Different climates (temperate, Mediterranean, arctic, tropical)
  - Goal was to represent maximum diversity of environments.
- Total of ~20,000 km of HR Nadir Track added in coastal environments.

Coastal Additions: Rhone Estuary

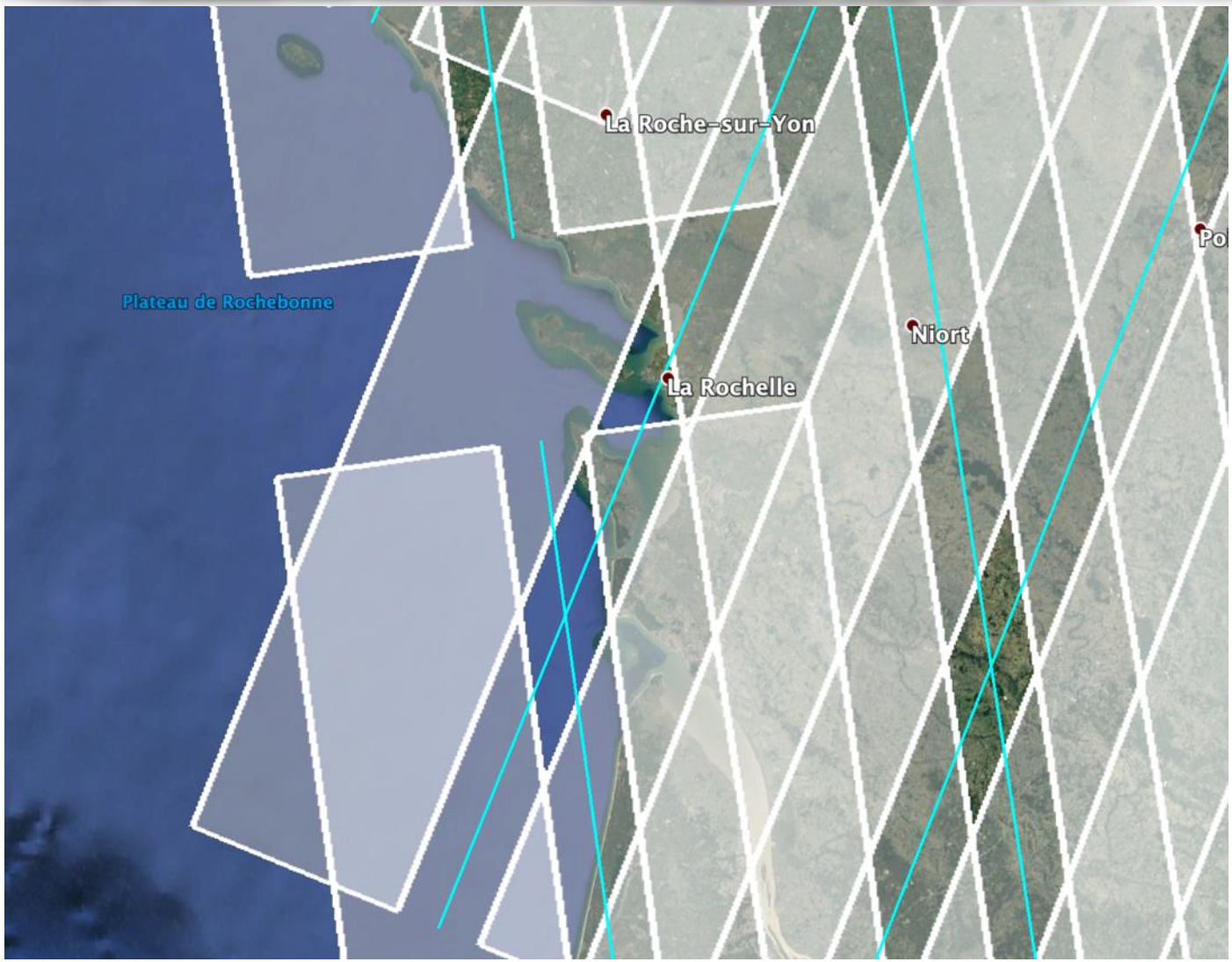


Coastal Additions: Rhone Estuary

Coastal Additions: Gironde Estuary



Coastal Additions: Gironde Estuary



New HR Swaths

- Contains all edits described here
- Available for download by the Science Team at the following links:

KML:

https://www.aviso.altimetry.fr/fileadmin/documents/missions/Swot/swot_science_hr_2.0s_4.0s_June2019-v3_perPass.kml

Shapefile (Nadir):

https://www.aviso.altimetry.fr/fileadmin/documents/missions/Swot/swot_science_hr_2.0s_4.0s_June2019-v3_nadir.zip

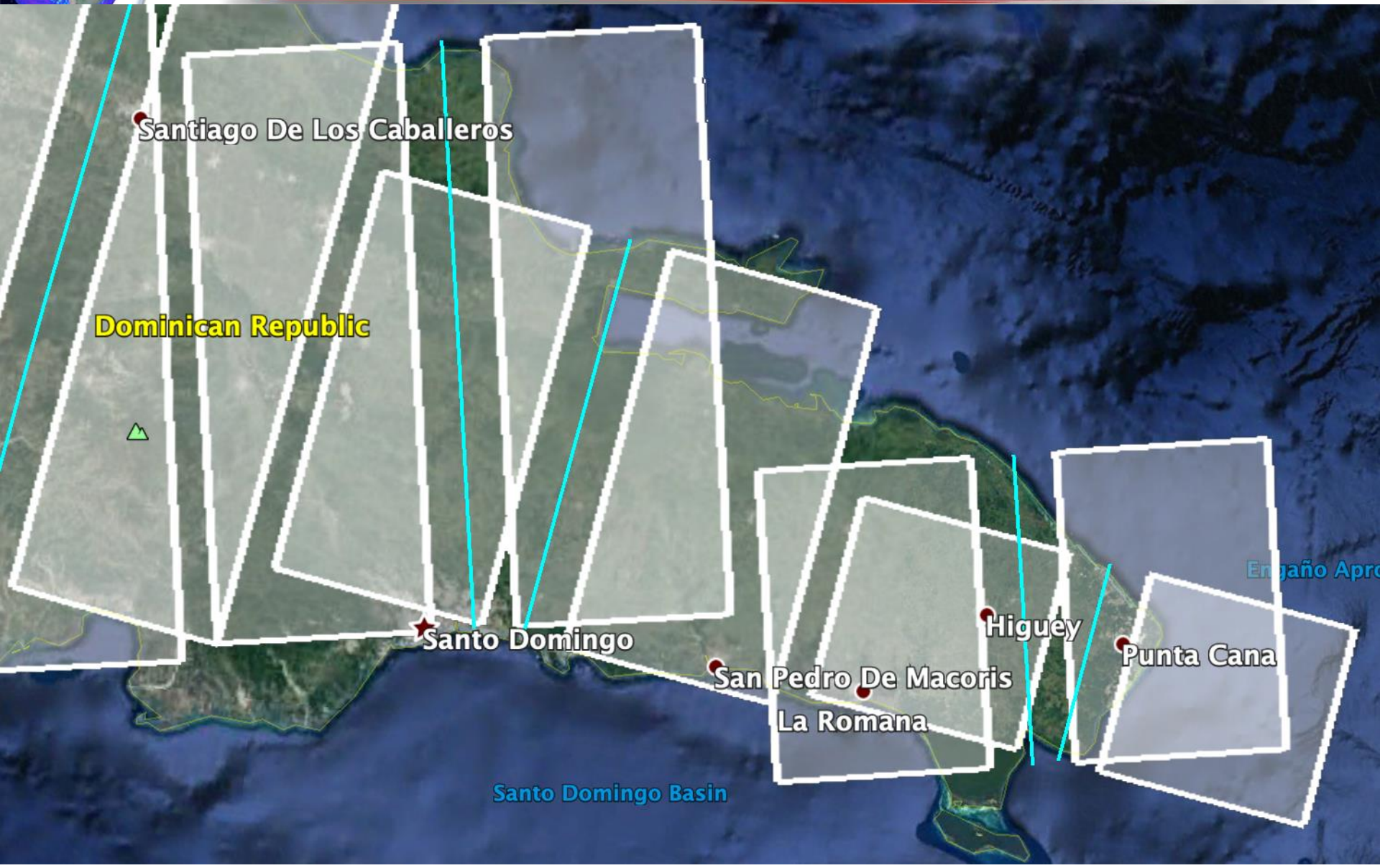
Shapefile (Swaths):

https://www.aviso.altimetry.fr/fileadmin/documents/missions/Swot/swot_science_hr_2.0s_4.0s_June2019-v3_swath.zip

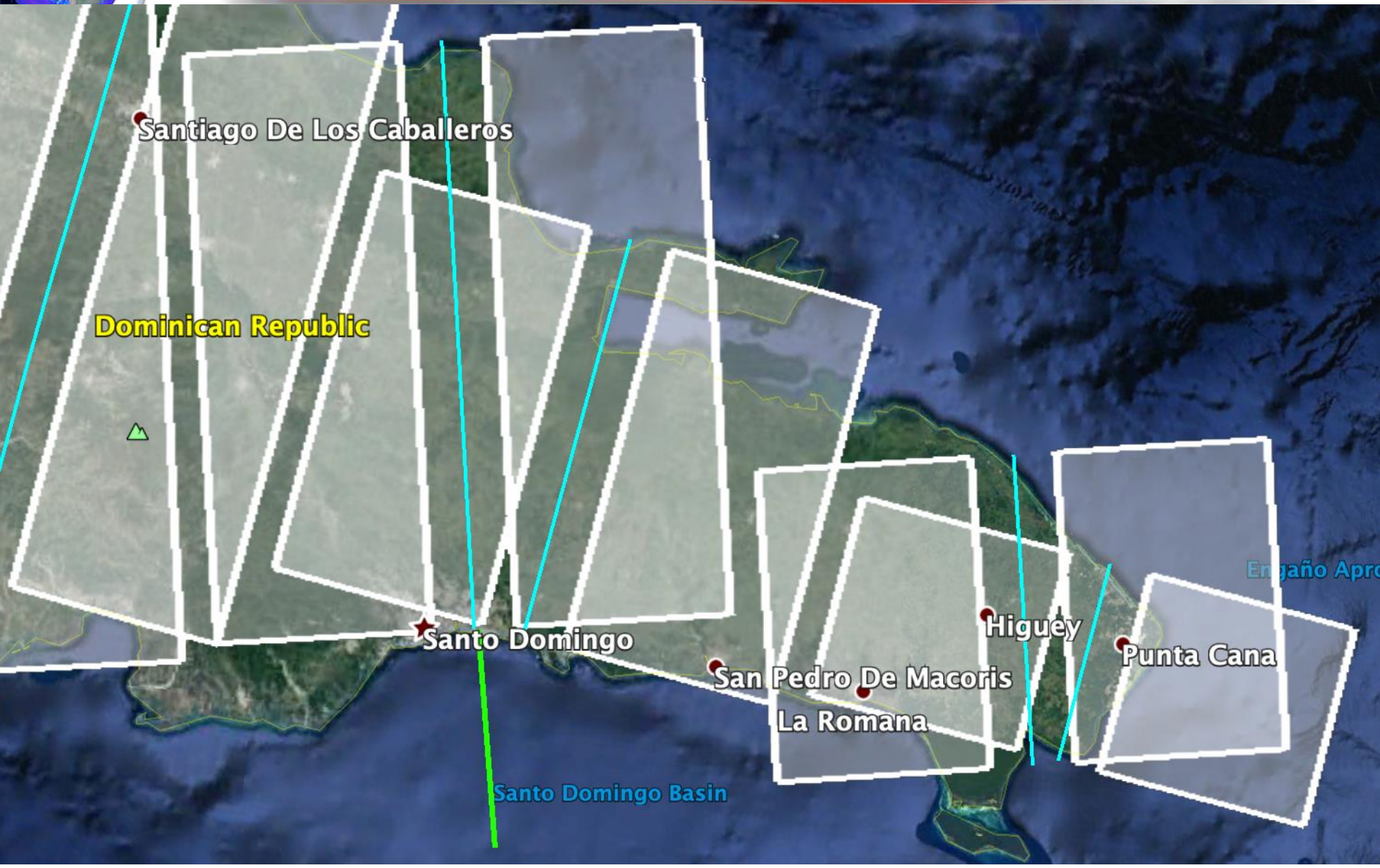
Further Edits

- We would like to incorporate further minor changes suggested by the Science Team.
  - Major additions not possible due to data downlink limits.
  - Major reductions not possible in order to meet Hydrology, Coastal, Sea Ice science goals.
- We invite ST members to suggest changes by simply creating lines in Google Earth that follow SWOT ground tracks:
  - **Red** means subtract
  - **Green** means add
- Constraints:
  - HR nadir track segments must be longer than ~13.4 km
  - Gaps between HR Nadir Track segments must be at least ~27 km
  - Based on instrument on/off timing
- For every segment that you suggest adding, please suggest an approximately equal length of subtraction.
- **Please send suggested changes as a kml to Tamlin Pavelsky (pavelsky@unc.edu), ideally by August 1st.**

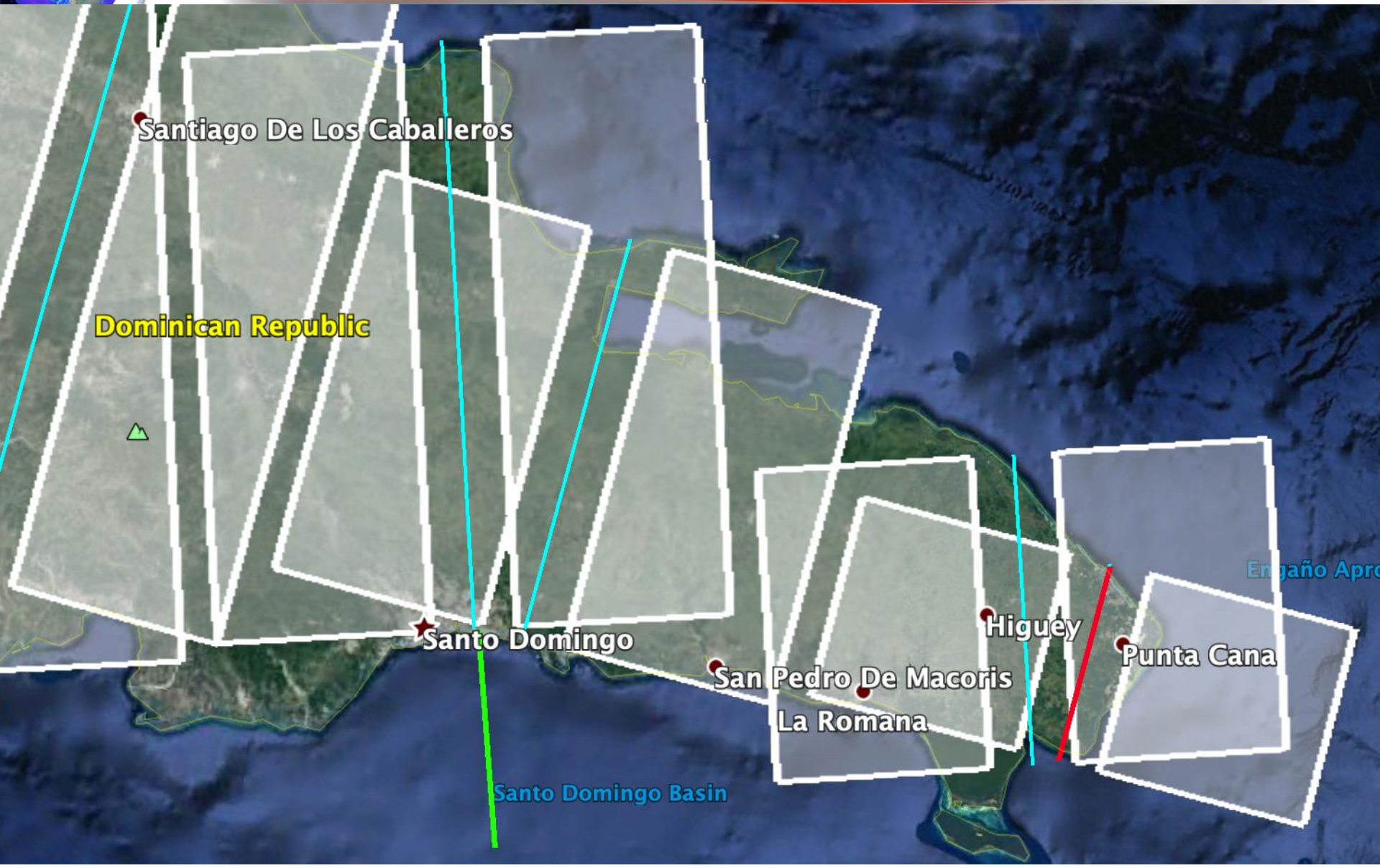
Editing Example



Editing Example



Editing Example



Next Steps

- Evaluate and incorporate suggested further changes
- Determine locations of ocean crossovers
  - per 2015 ST Meeting, there will be four crossovers during the Science Phase where HR data is collected.
  - These crossovers can be moved over time.
- Create Northern Hemisphere wintertime (DJF) mask
  - Removal of Banks and Victoria Islands in Canadian Archipelago
  - Addition of Sea Ice coverage
- Determine HR Mask for 1-day fast sampling orbit. This is a time when more data collection over oceans may be important.

Questions?