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# Iceberg and floating sea ice characterisation in the Yung Sund fjord, Greenland, by means of optical and radar data observation

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## MOTIVATIONS

This study concerns the observation, detection, ranging and tracking of icebergs and floating sea ice. Indeed, they represent a risk for maritime transport and need to be monitored. We focus our study on the Yung Sund fjord, Greenland where lot of icebergs and sea ice are generated during the break off. In beginning of July, sea ice is breaking first followed by iceberg created by the different glaciers having their base on the ocean, that are drifting very fast.

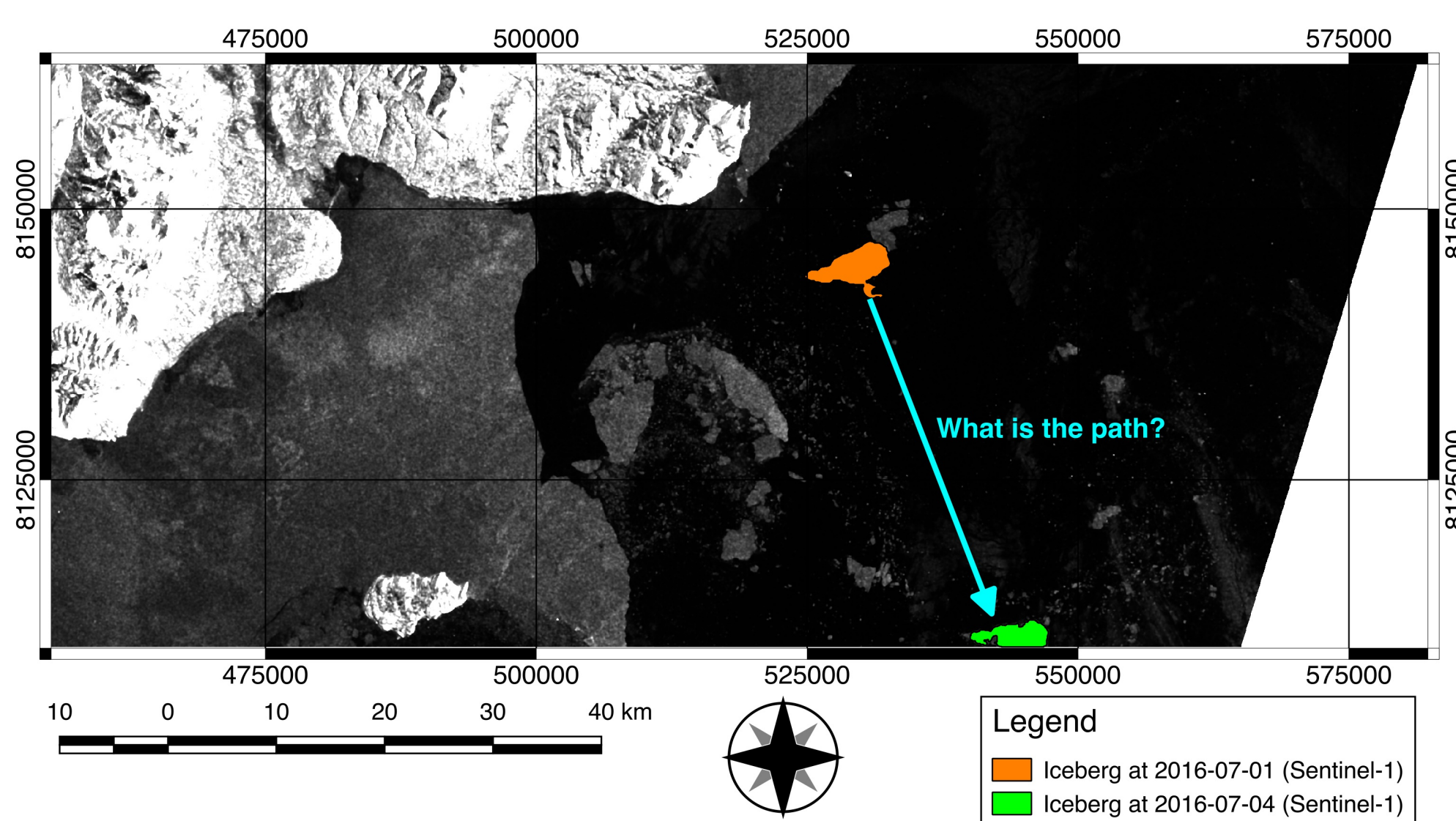


Figure 1: Displacement between 4 days.

To achieve our goal, we combine optical and radar remote sensed data in a common framework which consists in segmenting input data using a watershed transformation.

## (PRE)PROCESSING

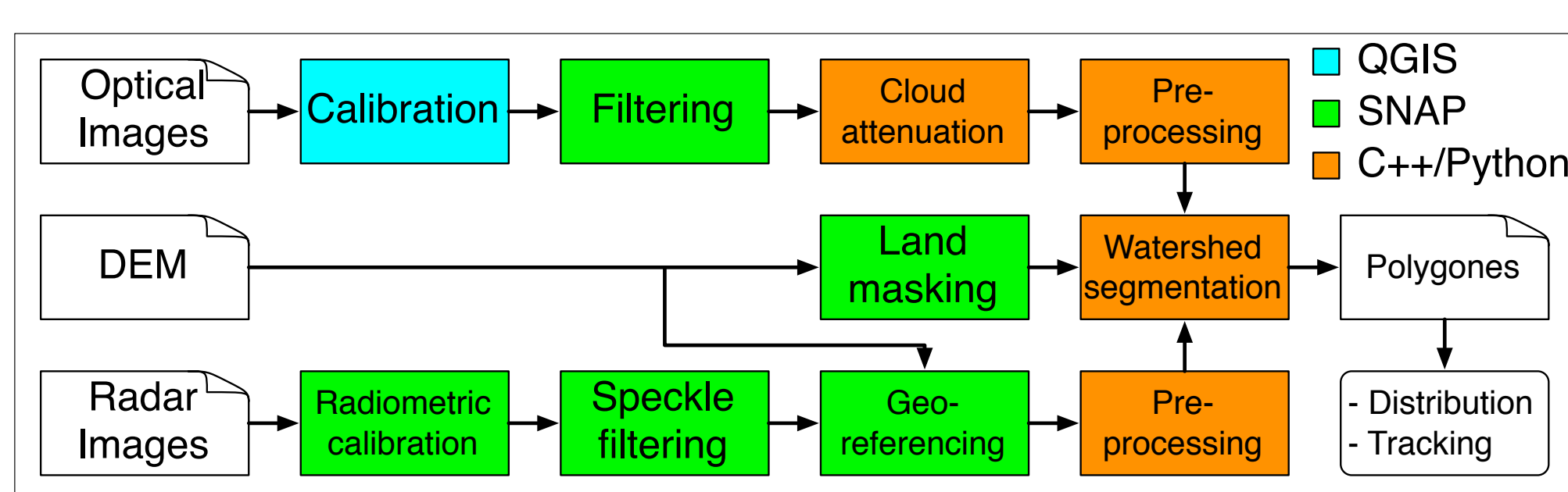


Figure 2: Processing chain.

### Optical images:

- **Calibration:** Get the reflectance
- **Filtering:** Remove image noise
- **Cloud attenuation:** Increase ice radiometry level

### Radar images:

- **Calibration:** Apply radiometric calibration
- **Filtering:** Remove speckle effect
- **Geocoding:** Resample image in a geographic coordinate system

## TEST SITE

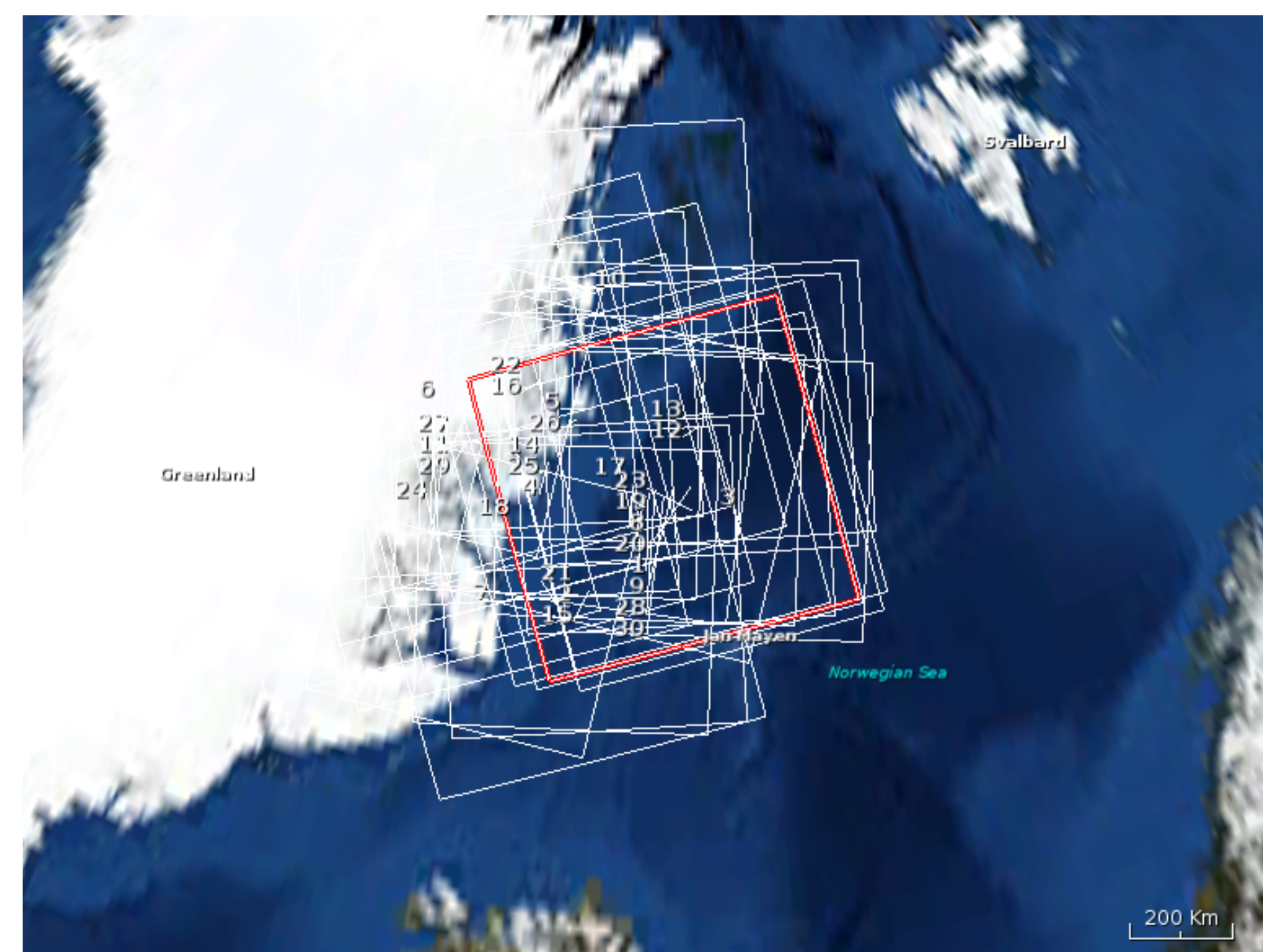


Figure 3: Zackenberg Test Site

The Yung Sund fjord (74°18N, 10°15W) is located in a natural park of the North-East of the Greenland. This fjord is covered by ice between 9 to 10 mth/yr and we can observe open water from 15th July until 15th September. Biological and physical knowledges for this site offer an unique opportunity to study climate change impact on Actic ecosystems.

For the proposed study, we used a combination of 10 Sentinel-1, 4 Sentinel-2 and 2 Landsat-8 images, acquired between 30th June 2016 and 19th July 2016.

## WATERSHED PROCESSING

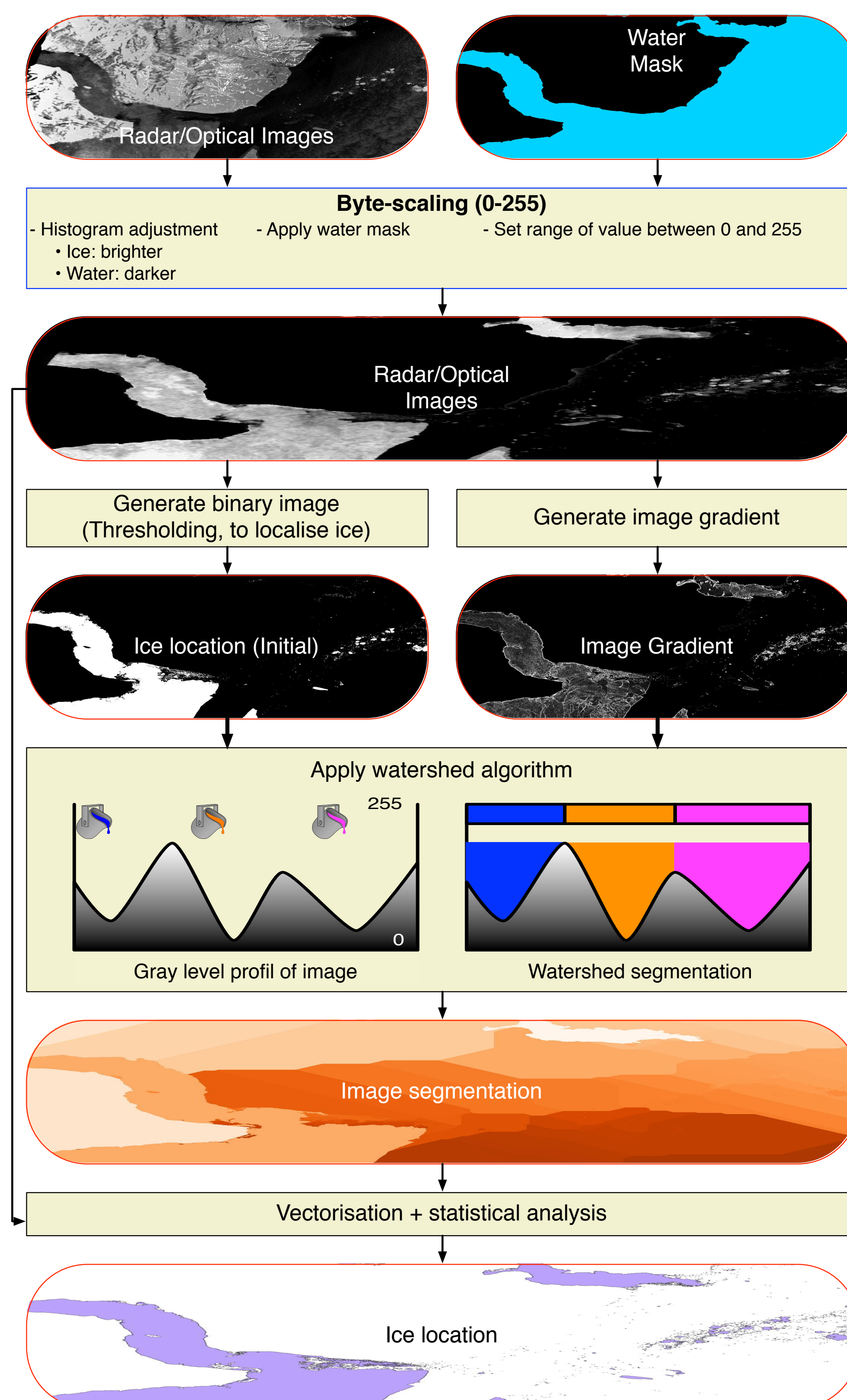


Figure 5: Watershed approach

## PRELIMINARY RESULTS

### Detection

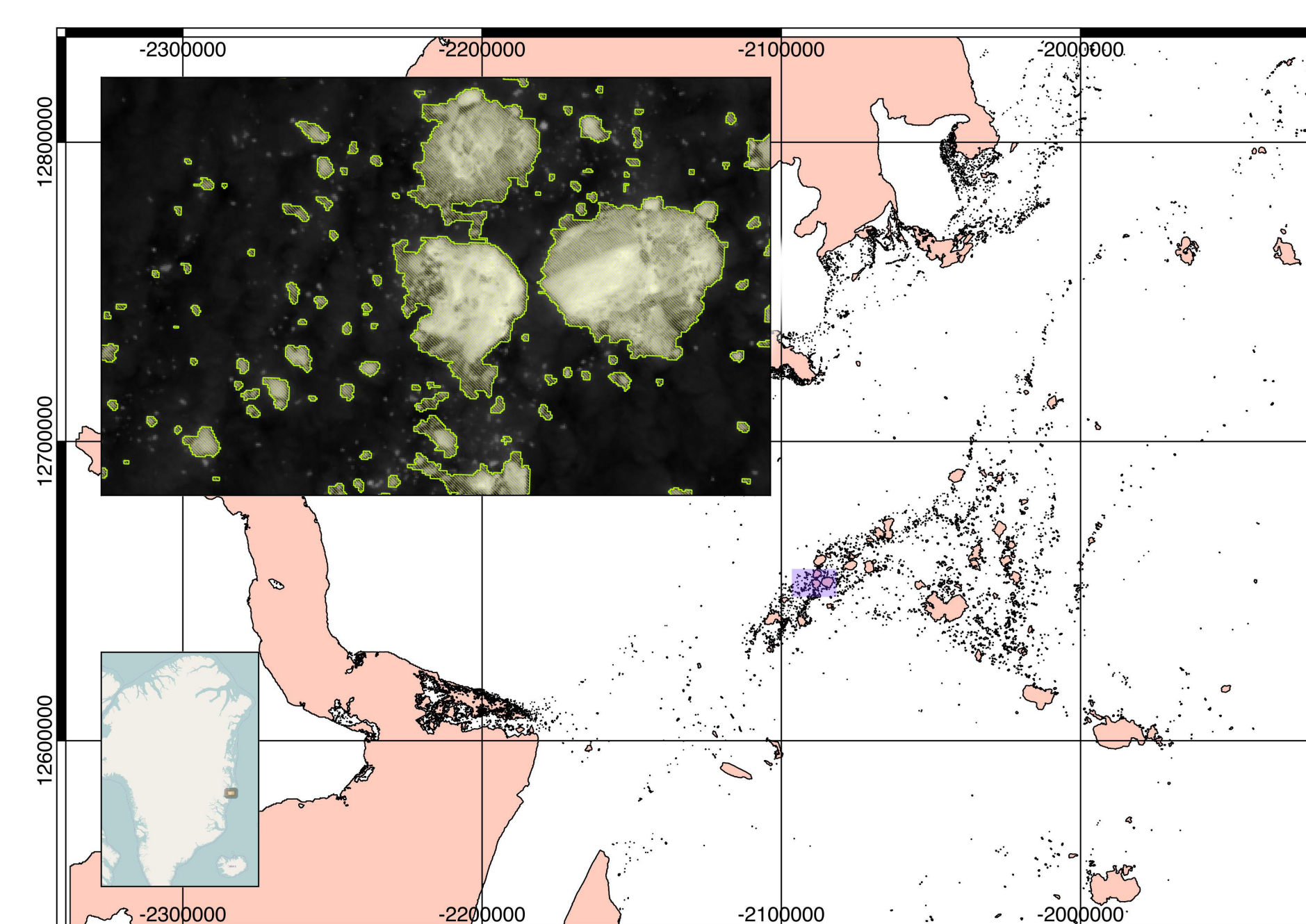


Figure 6: Iceberg/Floating ice detection

### Tracking

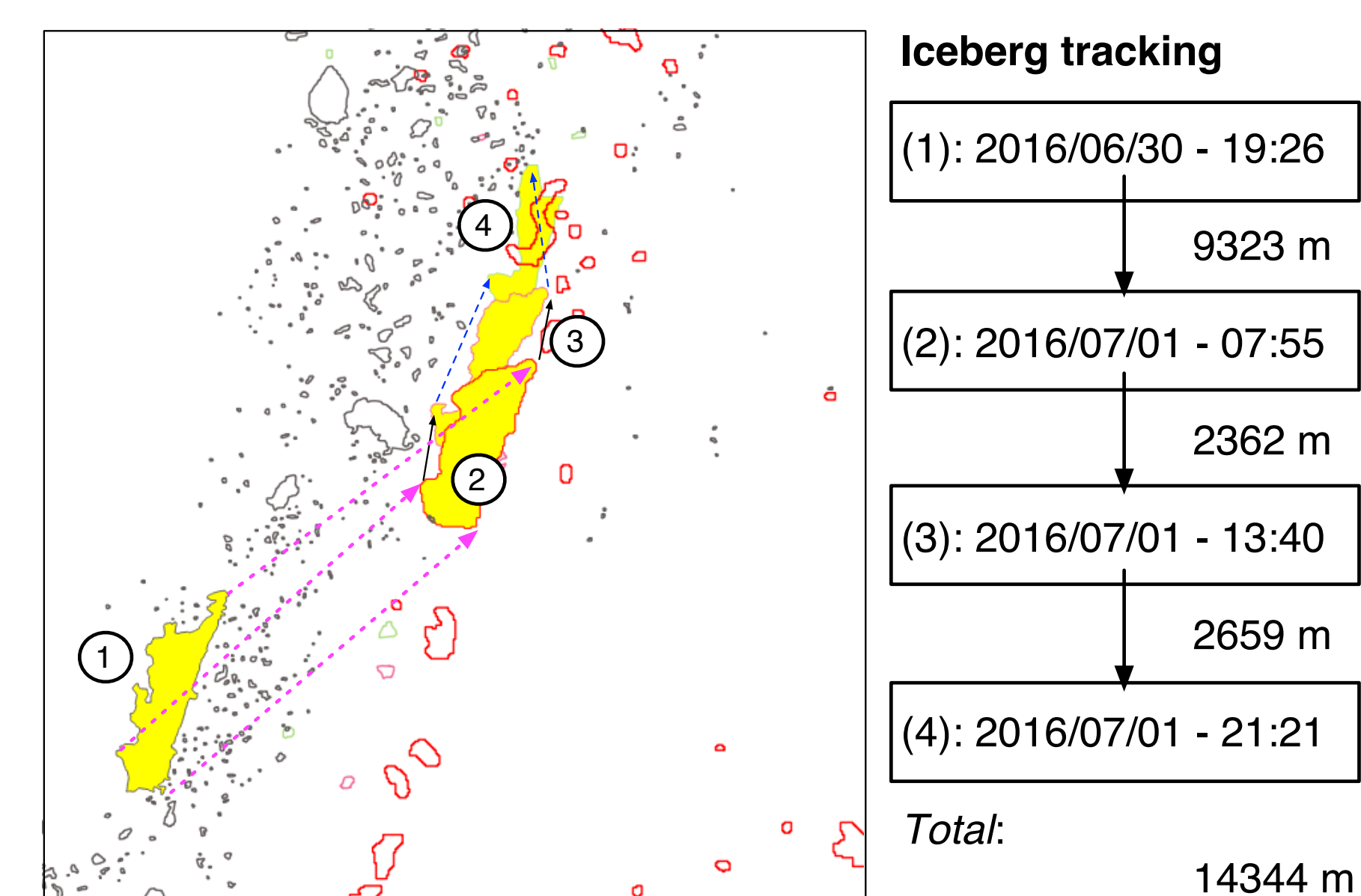


Figure 7: Manual iceberg tracking

## CLOUD ATTENUATION

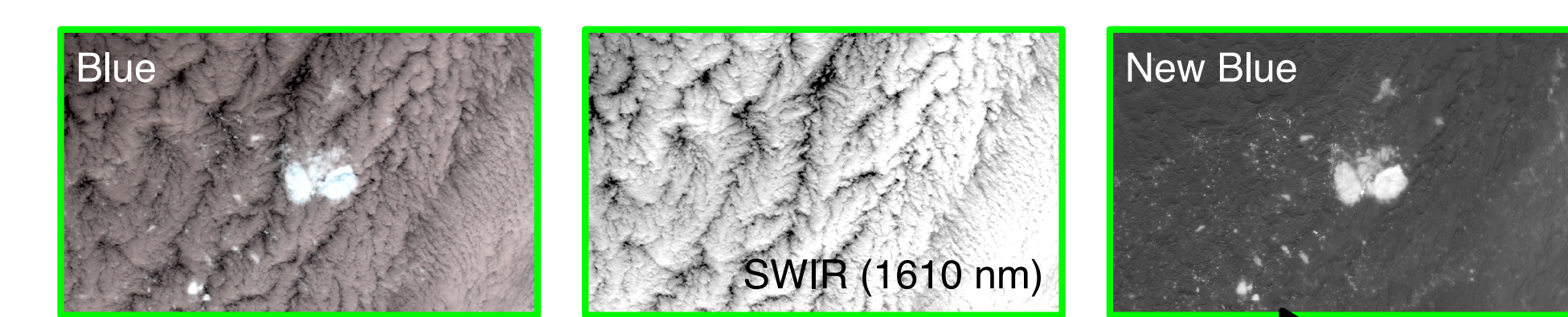


Figure 4: Cloud attenuation

- Band SWIR is insensible to ice reflection
- Is used to estimate the cloud part in visible band (here blue)
- The following formula is applied (at first approximation):

$$\hat{RT}_{vis} = \frac{RT_{vis} - RT_{swir}}{1 - RT_{swir}}$$

## CONCLUSION / Future work

- Iceberg and floating ice detection and tracking using optical and radar imagery;
- Watershed segmentation;
- Cloud influence reduction on optical imagery;
- Independent of the image resolution;
- *Improve the input labeling (watershed)*
- *Automatize the iceberg/floating ice tracking*

## REFERENCES

- A.K. Mazur, A.K. Wahlina and A. Krezel. (2017). An object-based SAR image iceberg detection algorithm applied to the Amundsen Sea. *Remote Sensing of Environment*. 189:67–83
- L. Vincent and P. Soille. (1991). Watersheds in digital spaces: an efficient algorithm based on immersion simulations. *IEEE Trans. Patt. Anal. Mach. Intell.* 13(6):583–598

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