

Monitoring deformation in Iceland with Sentinel-1 data

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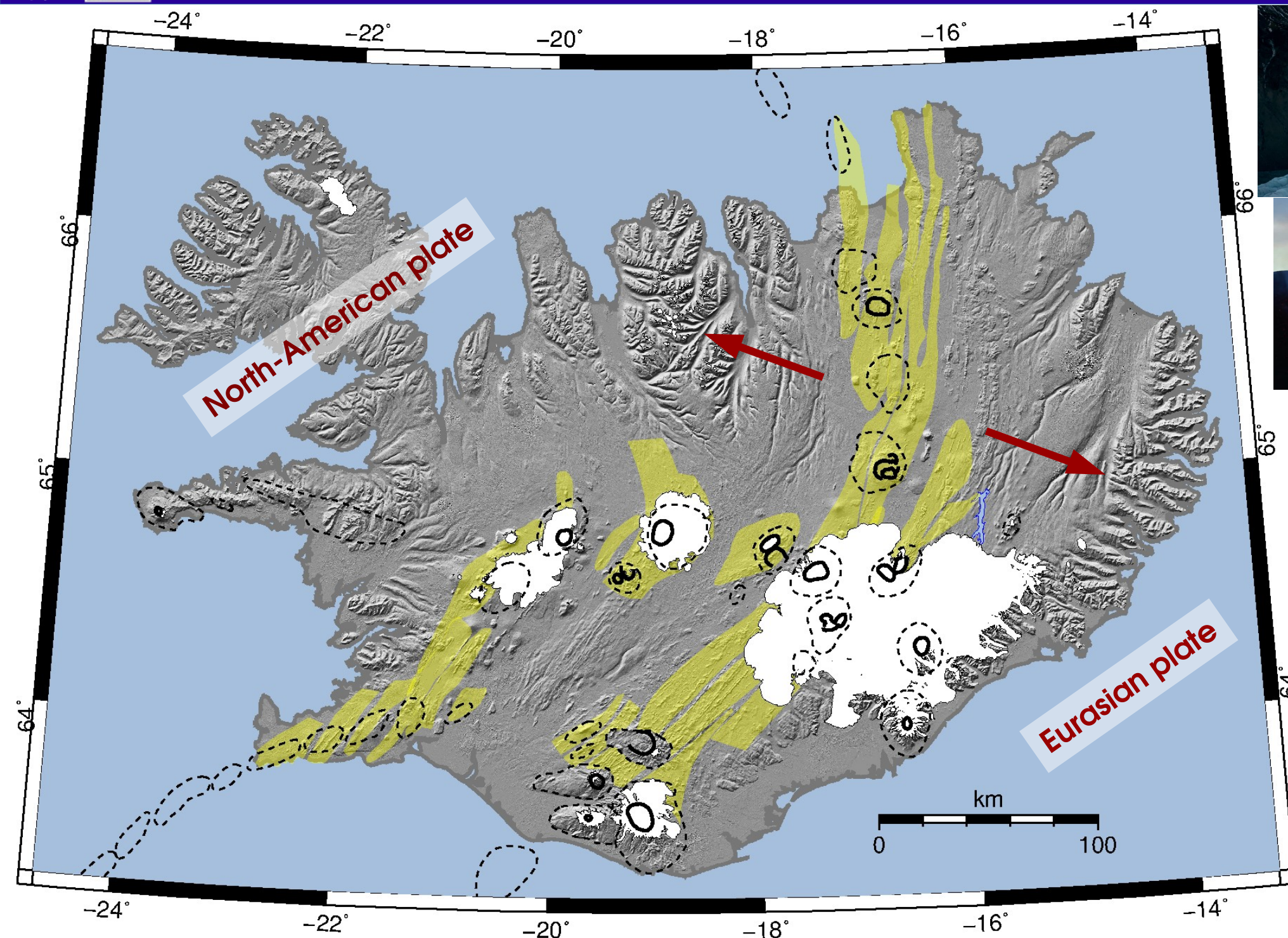
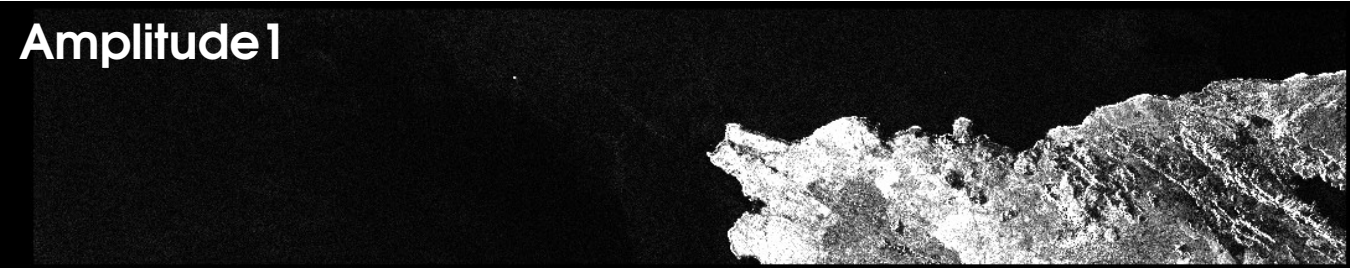


Image 1 (2015-07-21)

Amplitude1



Phase1

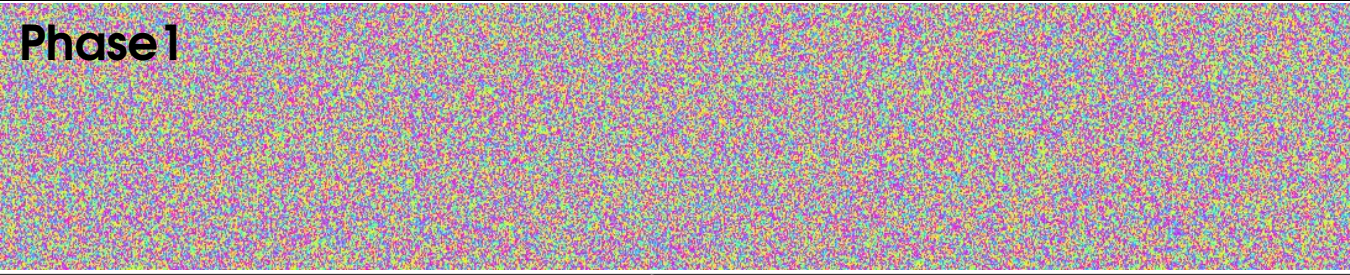
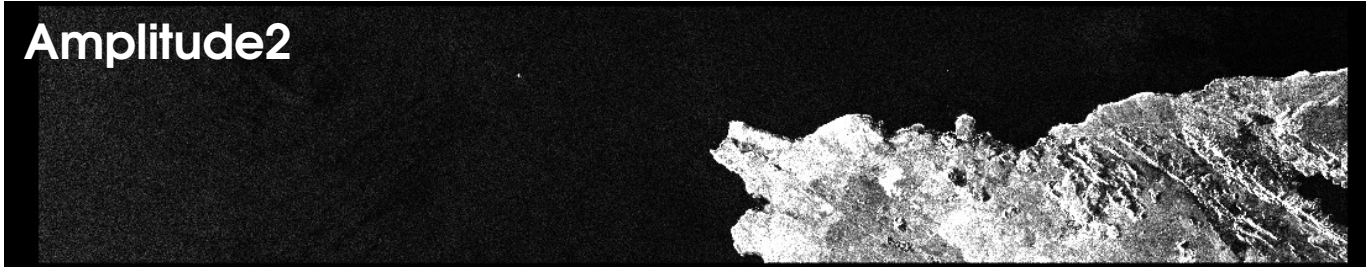
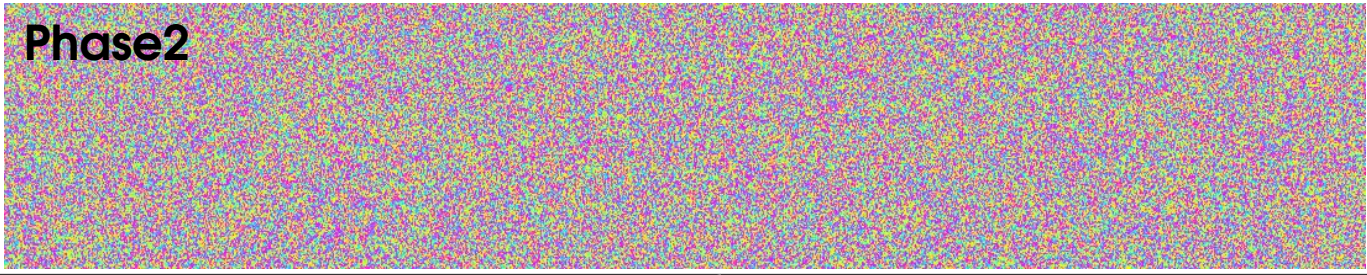


Image 2 (2017-08-21)

Amplitude2



Phase2

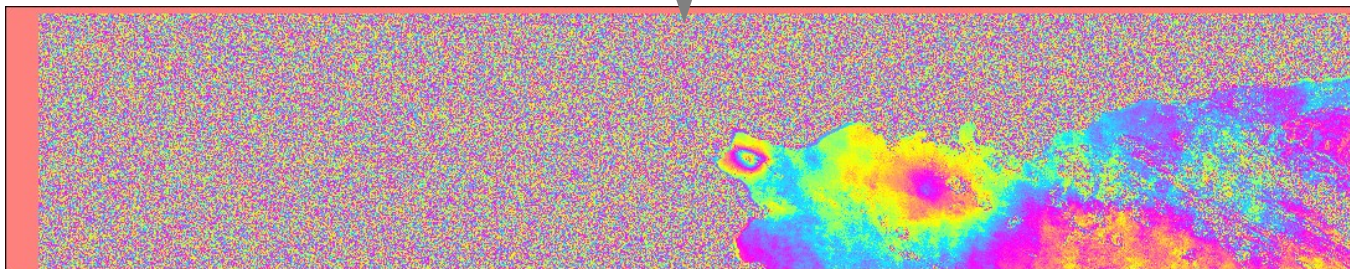


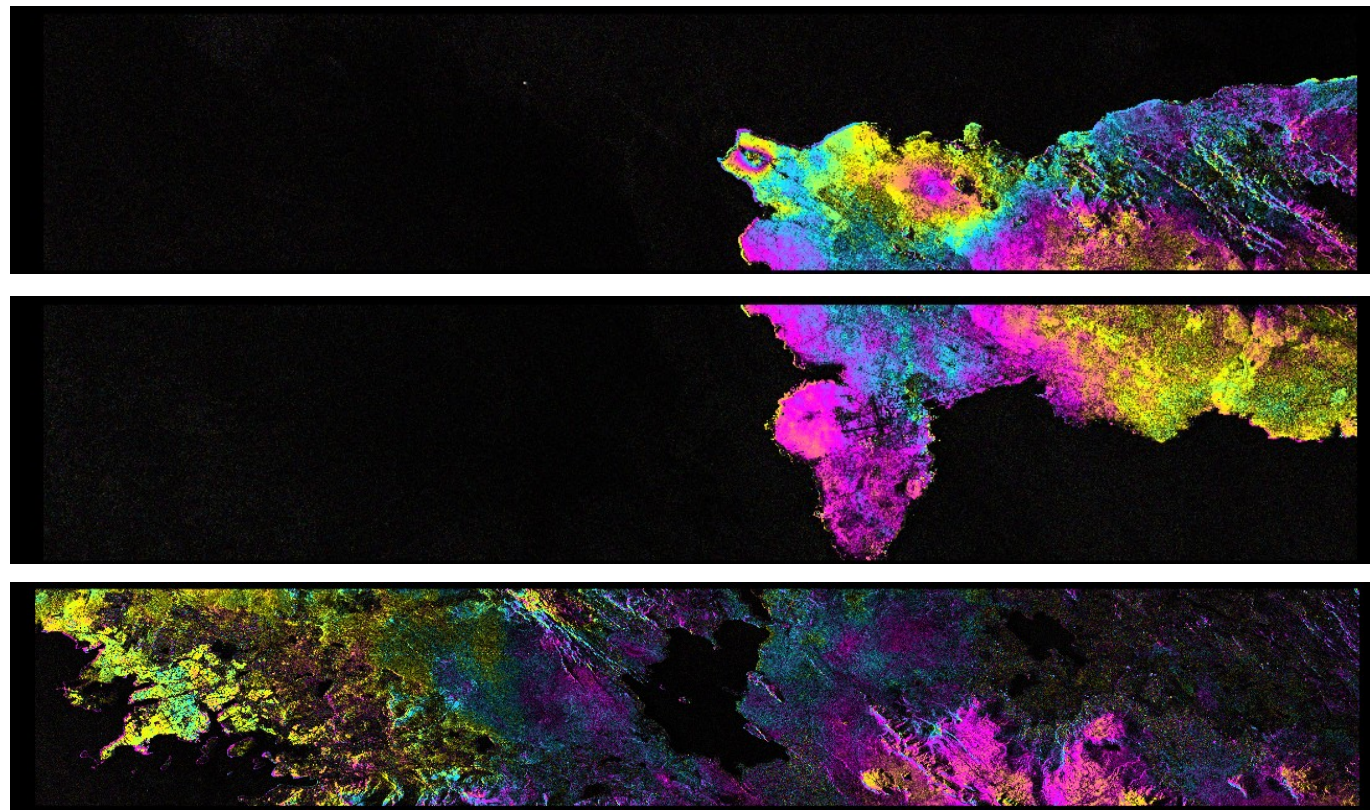
Amplitude images coregistration

Phase difference

Orbital correction

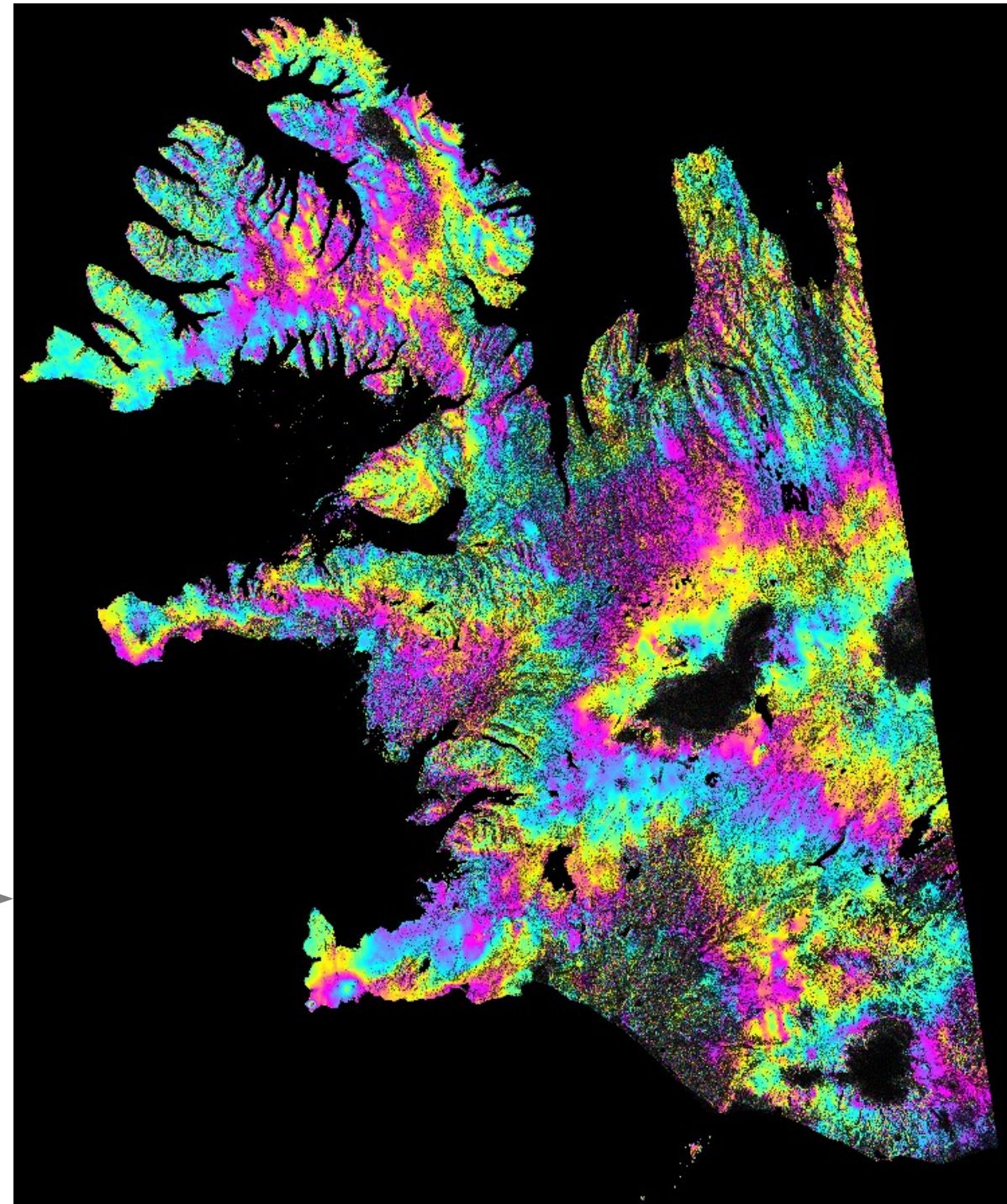
Topography correction





■ ■ ■

Geocoding



Fringes (2π) ~ deformation contour lines
 1 fringe = $\lambda/2 \approx 2.8$ cm

T16



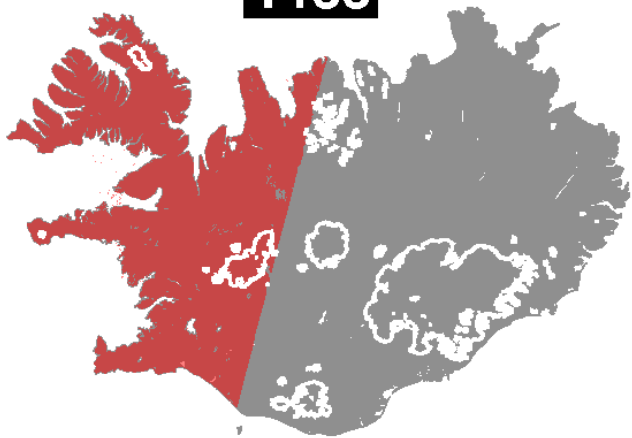
T118



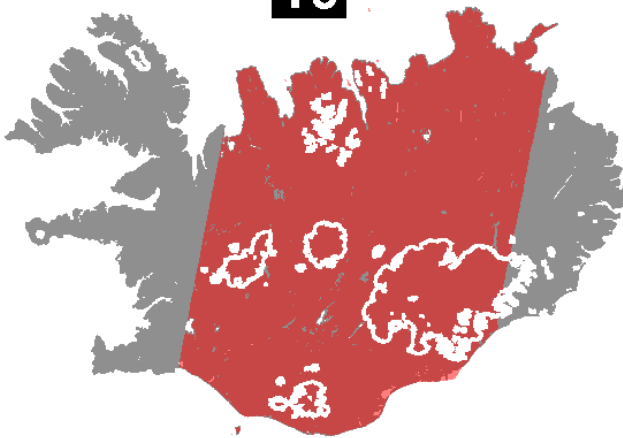
T147



T155



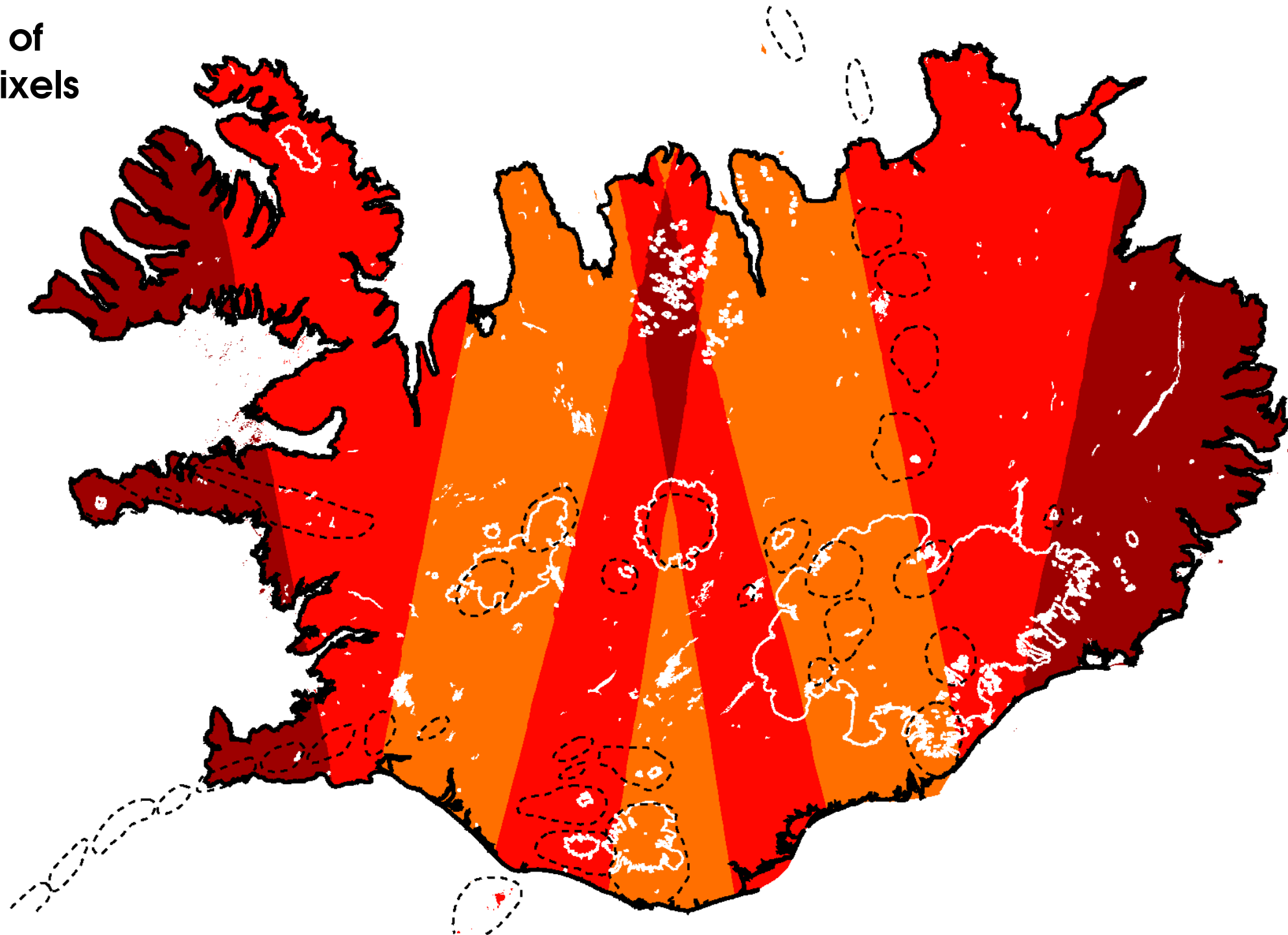
T9



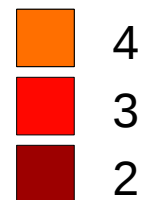
T111



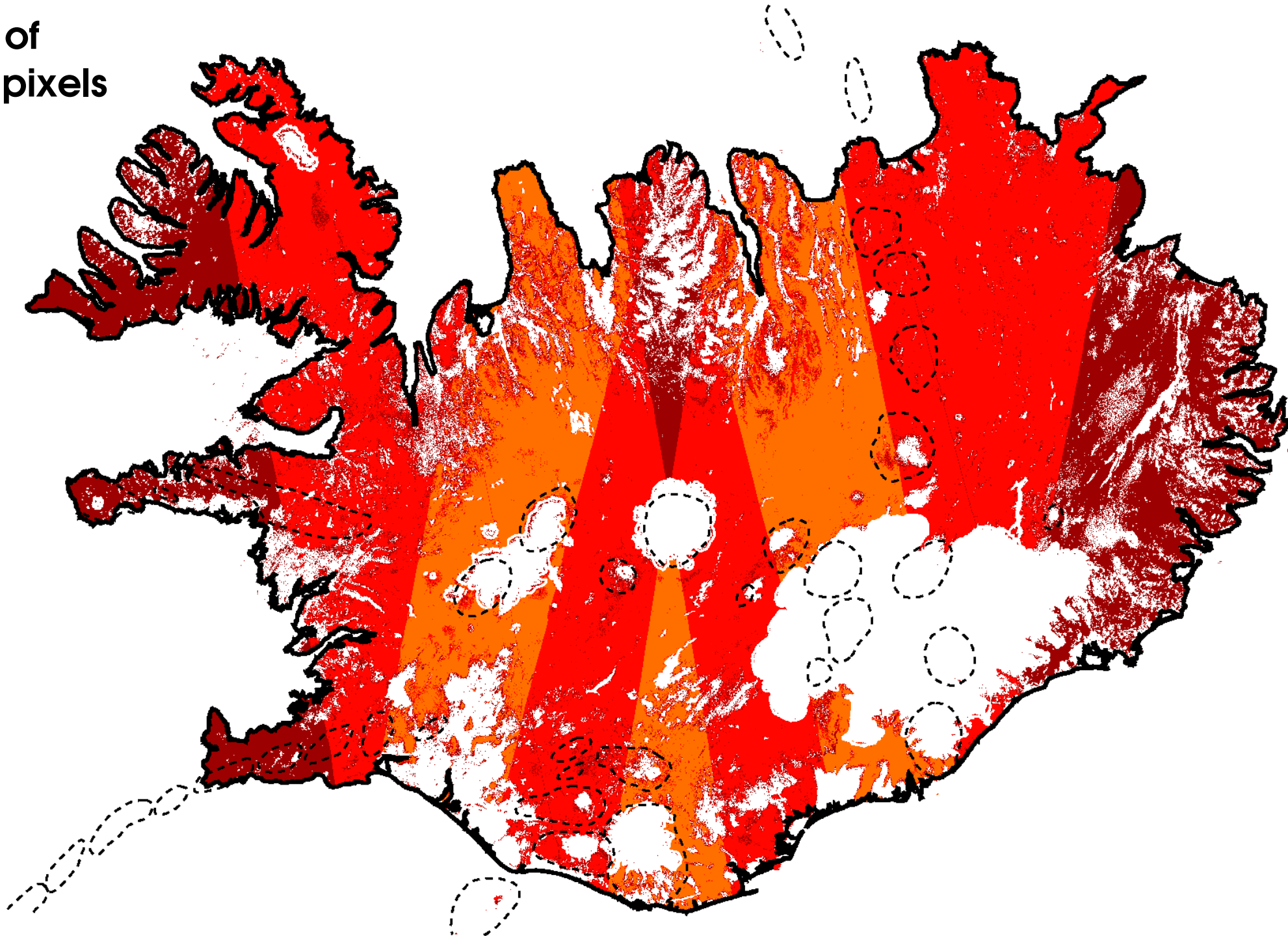
~ 41 millions of
50 m 50 m pixels



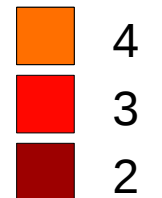
Nb of tracks



~ 31 millions of
50 m x 50 m pixels

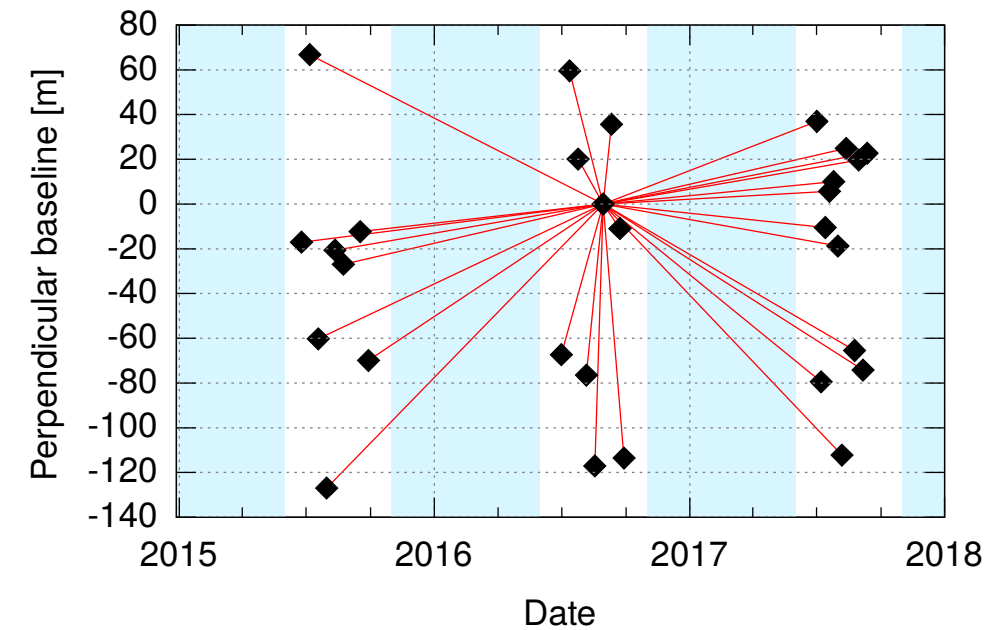


Nb of tracks



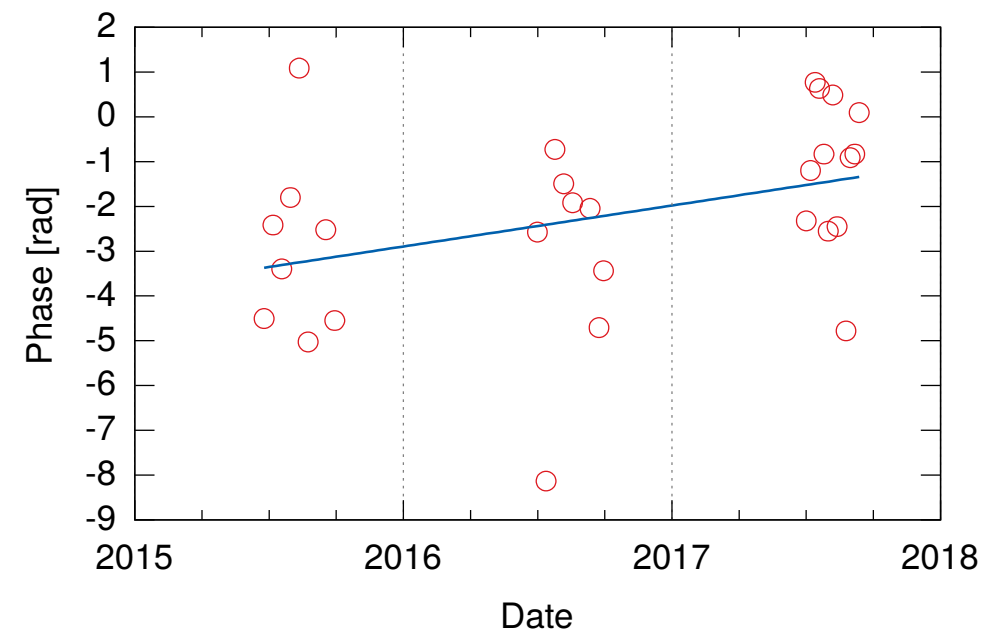
1) Forming the interferograms

- Data: Images from summer 2015, summer 2016, and summer 2017
- Software: InSAR Scientific Computing Environment (ISCE) version 2.1.0
- Method: single-master interferometry
- DEM: Preliminary TanDEM-X DEM with gaps filled with ASTER DEM

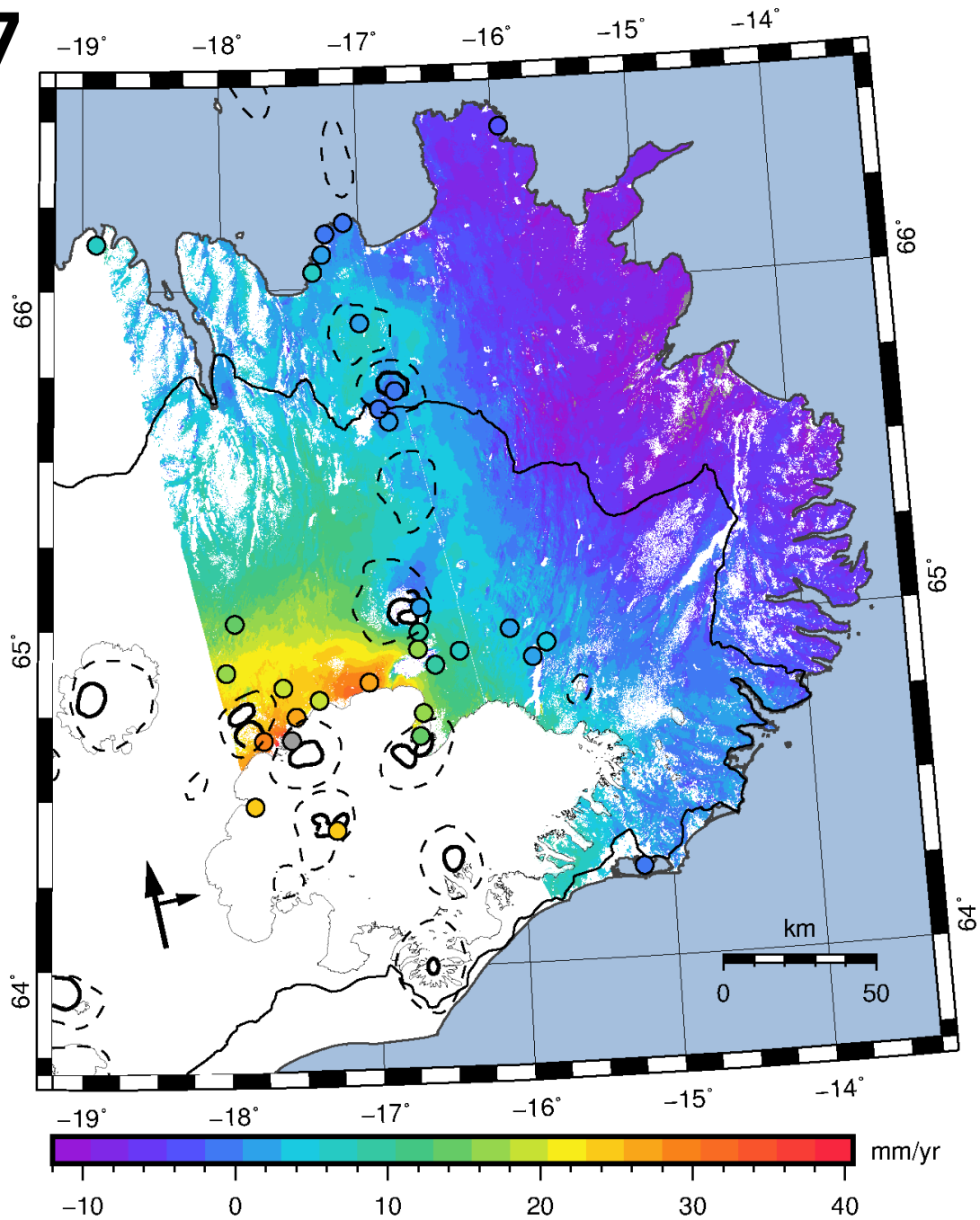


2) Estimating the 2015-2017 velocities

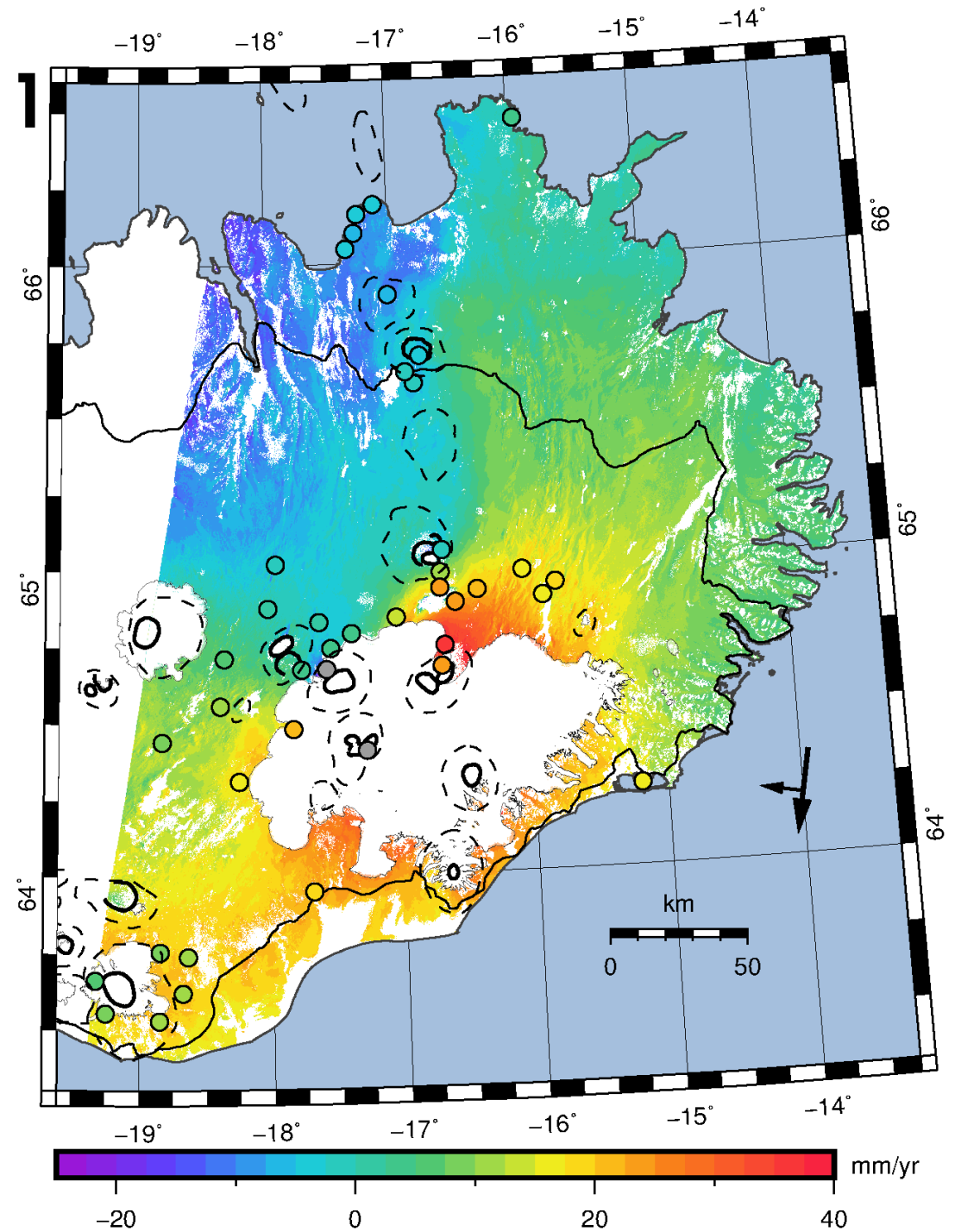
1. Reference all interferograms to the same area to have a stack.
2. Remove the bad interferograms
3. For each pixel, extract the displacement value from each image of the stack to generate a time-series. Then use this time-series to estimate the velocity of the pixel.



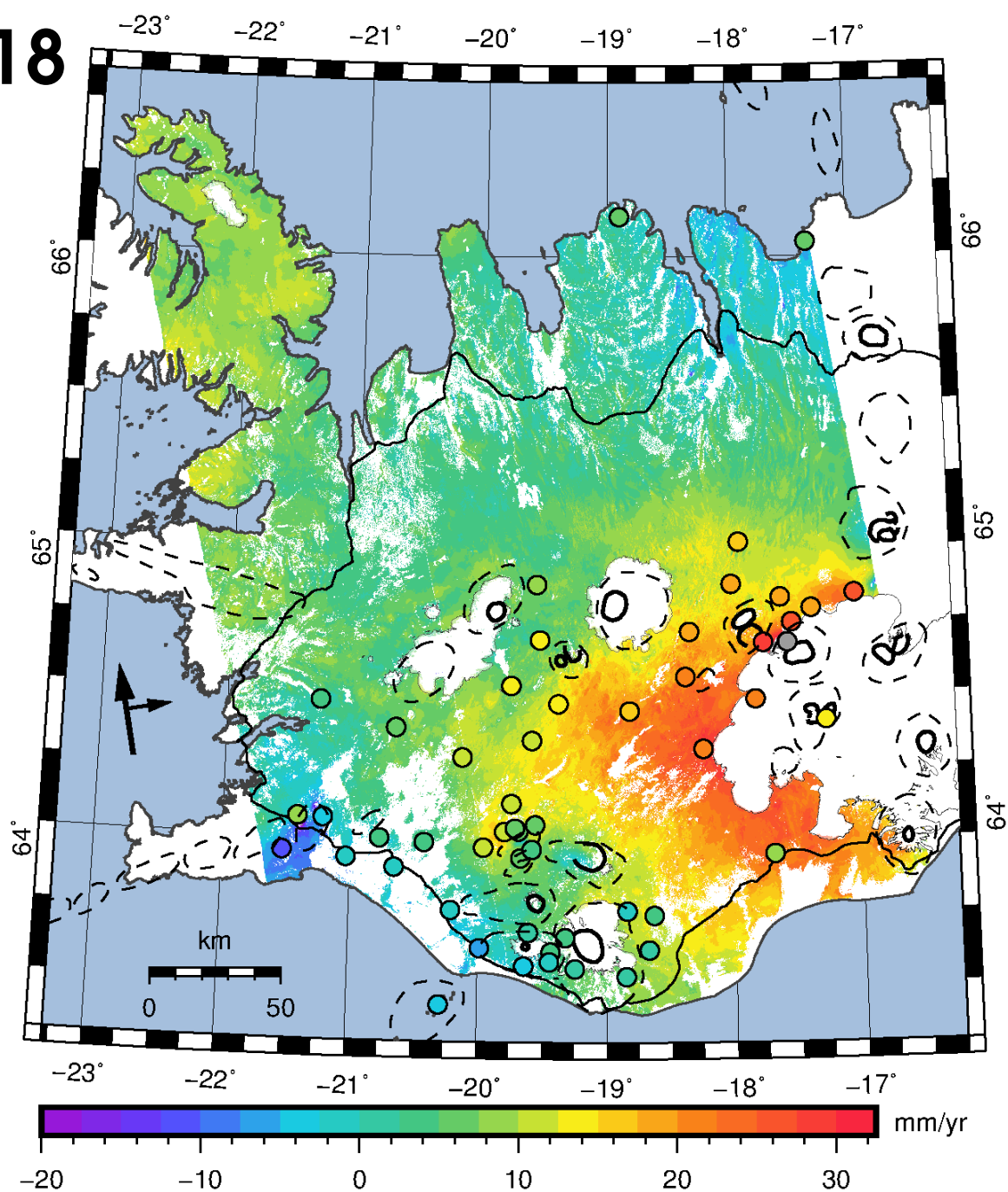
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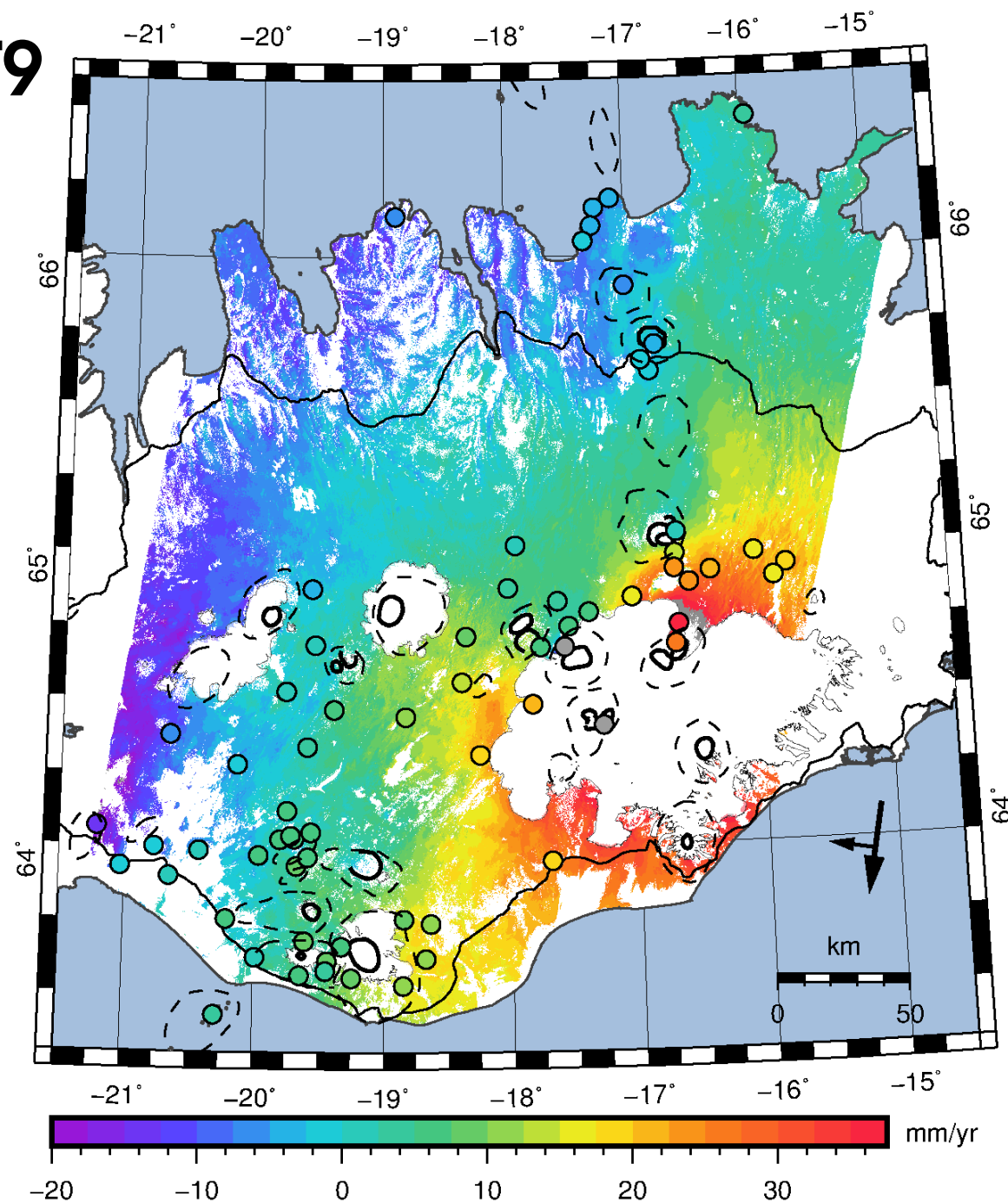
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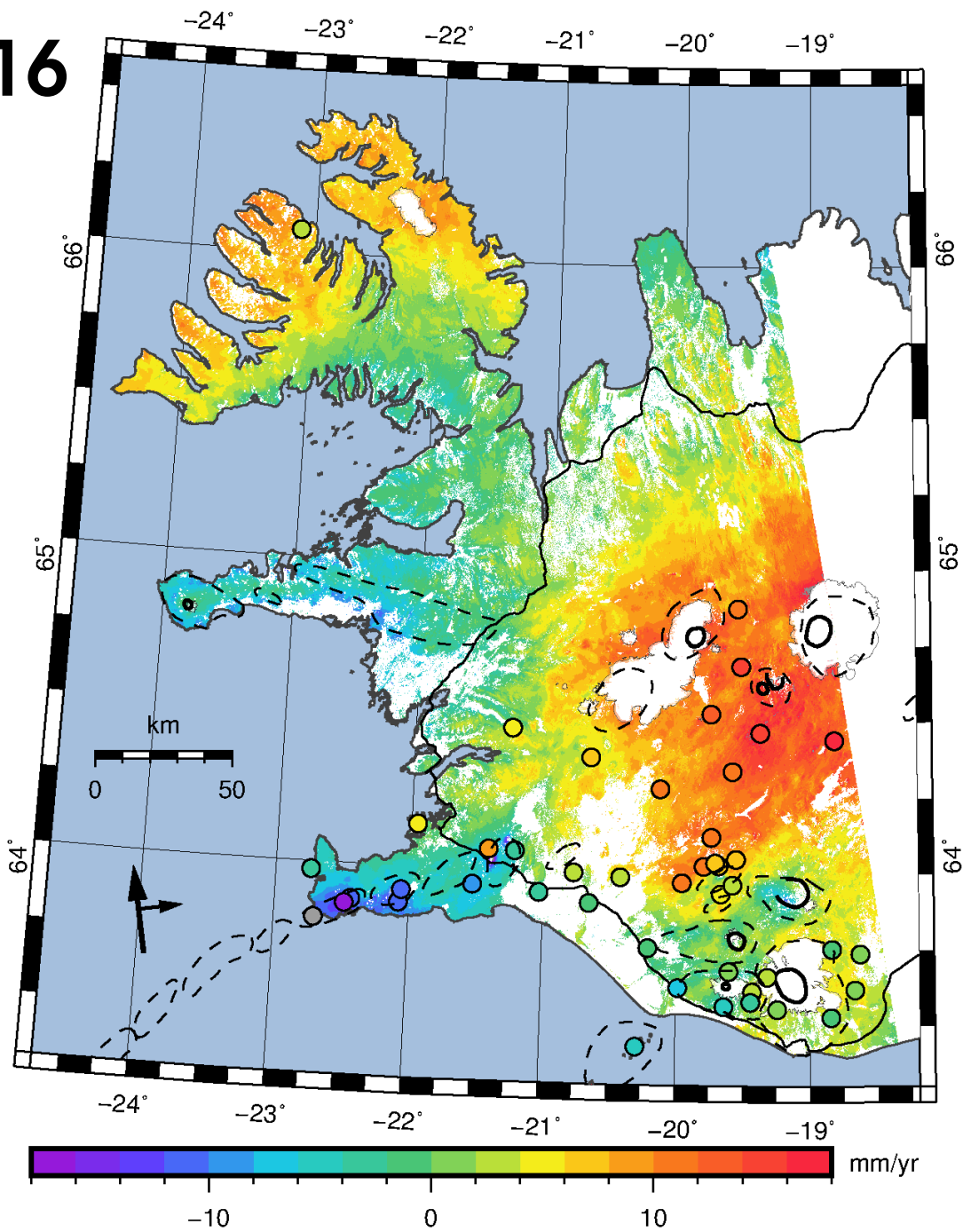
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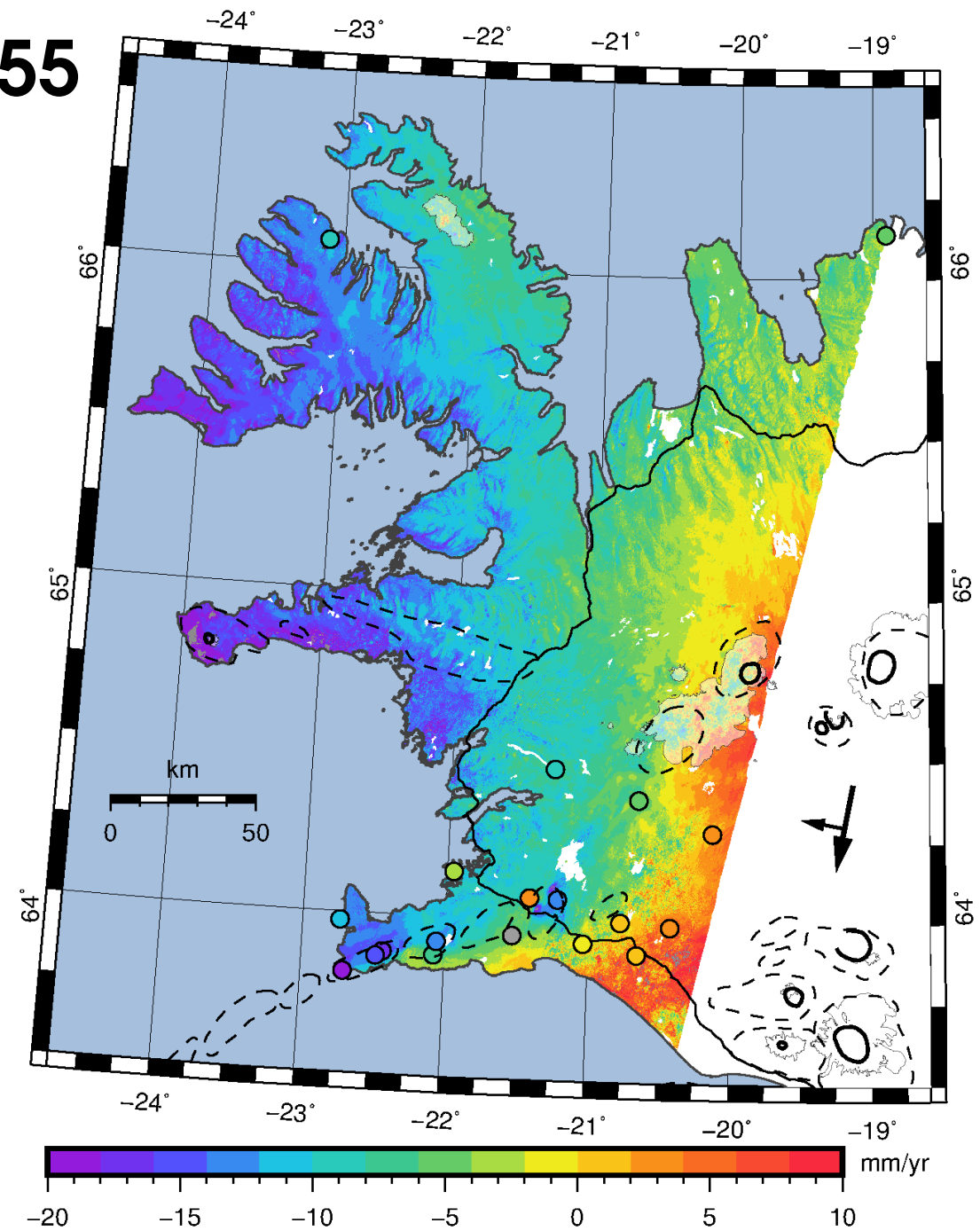
T9

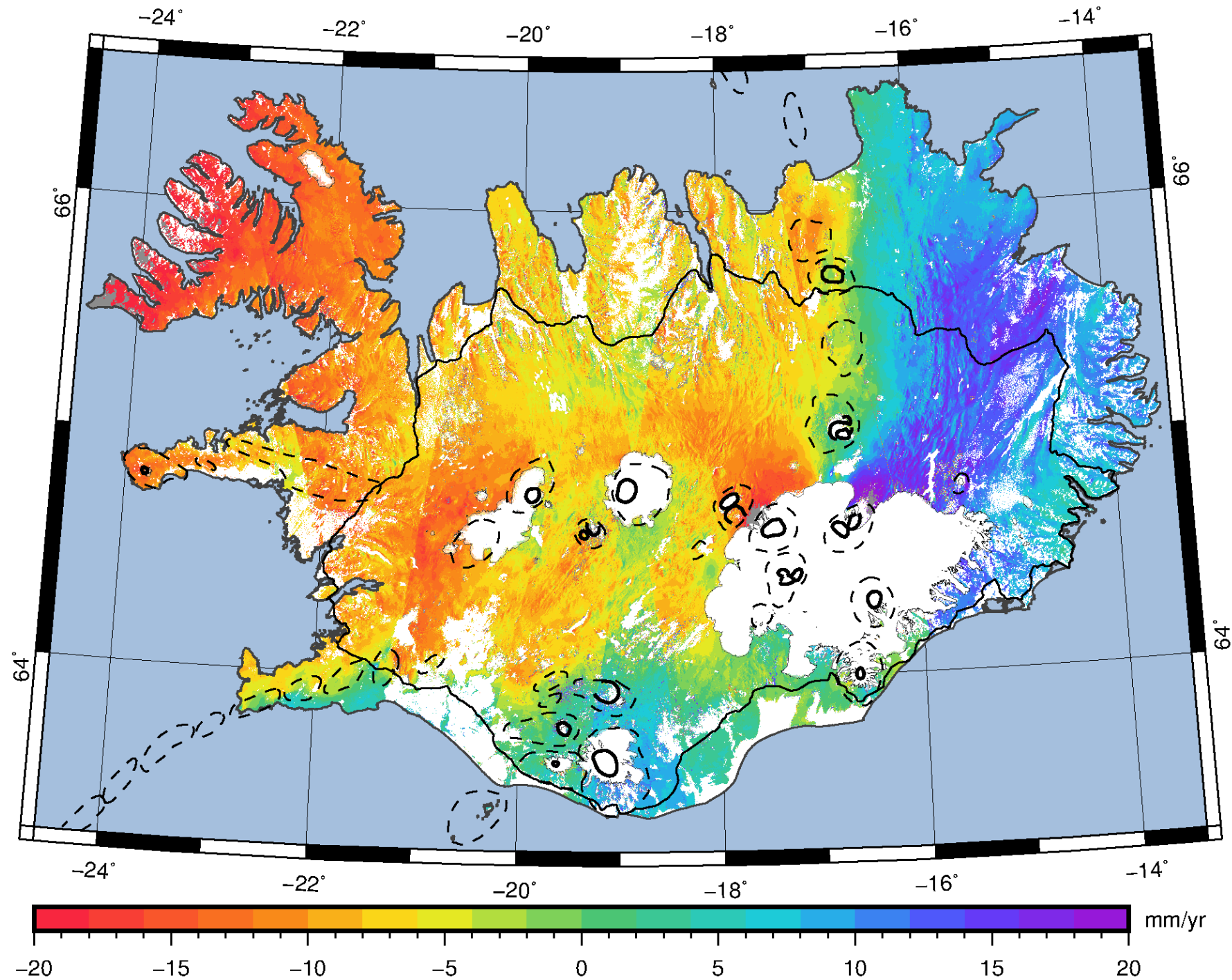


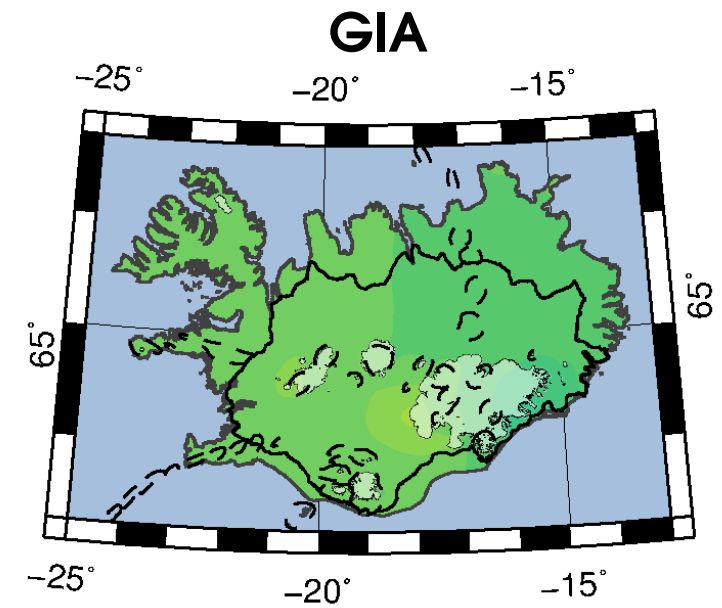
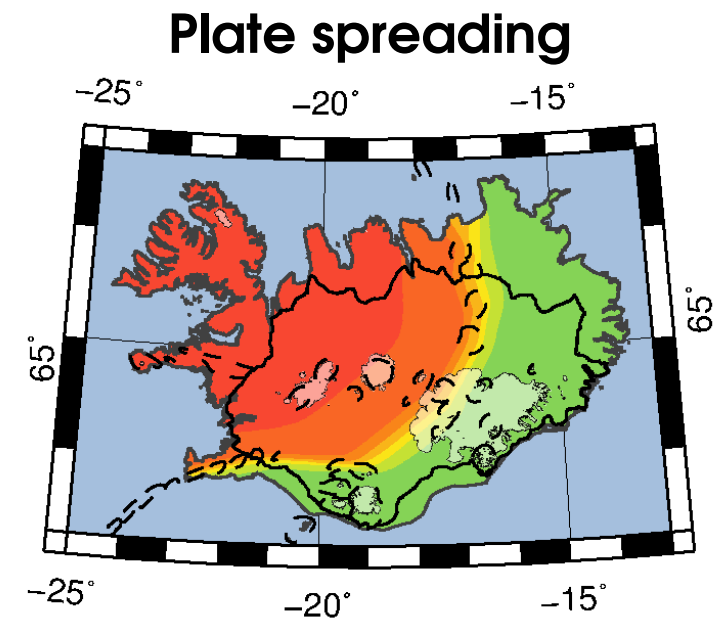
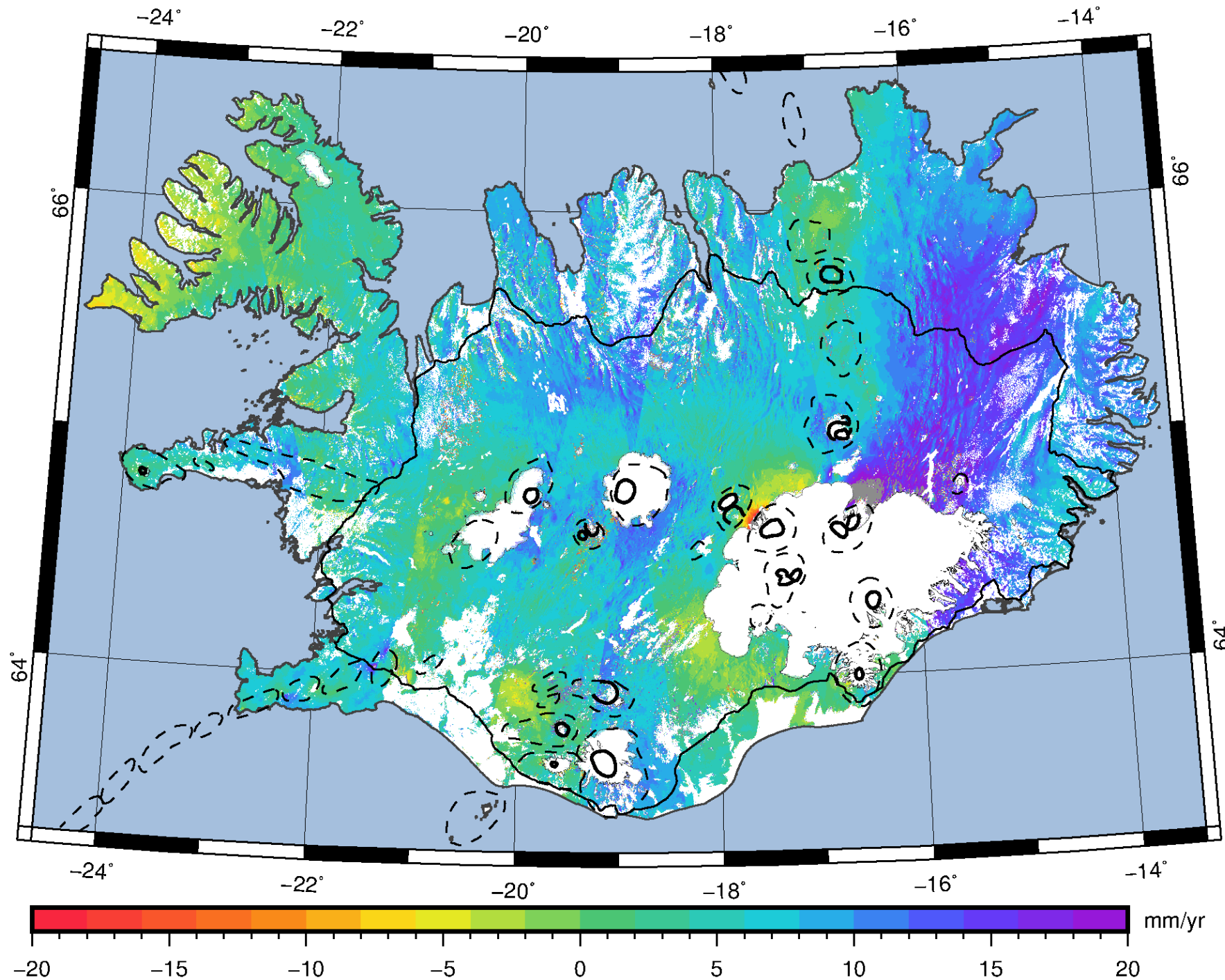
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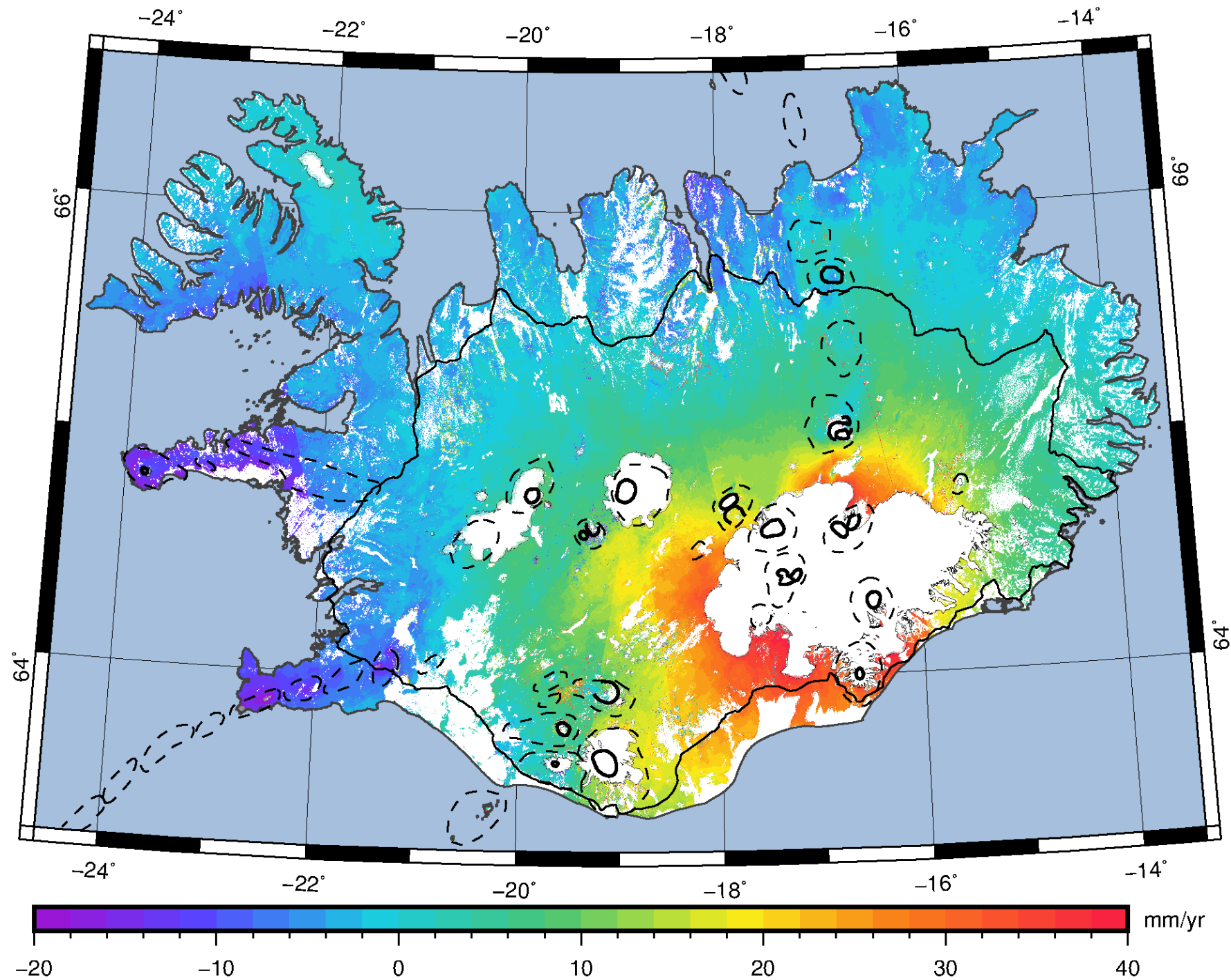


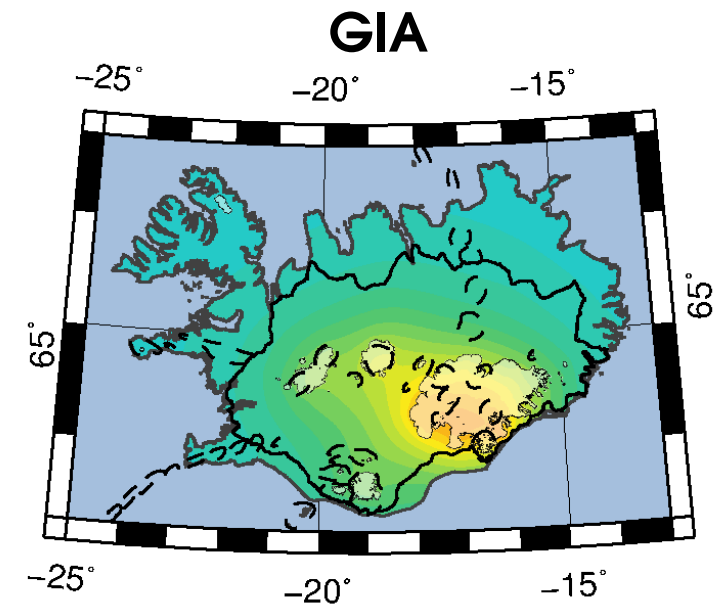
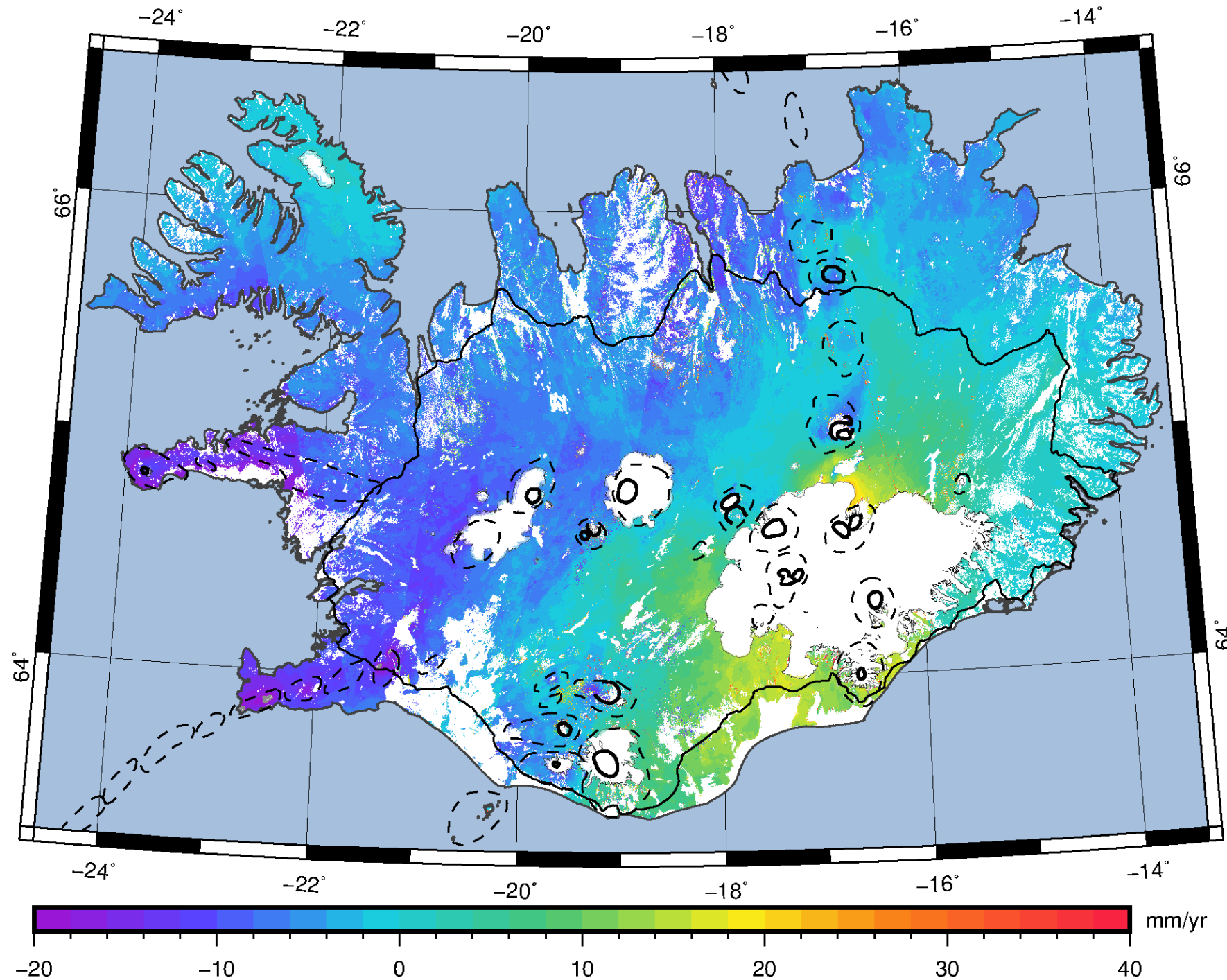
T155

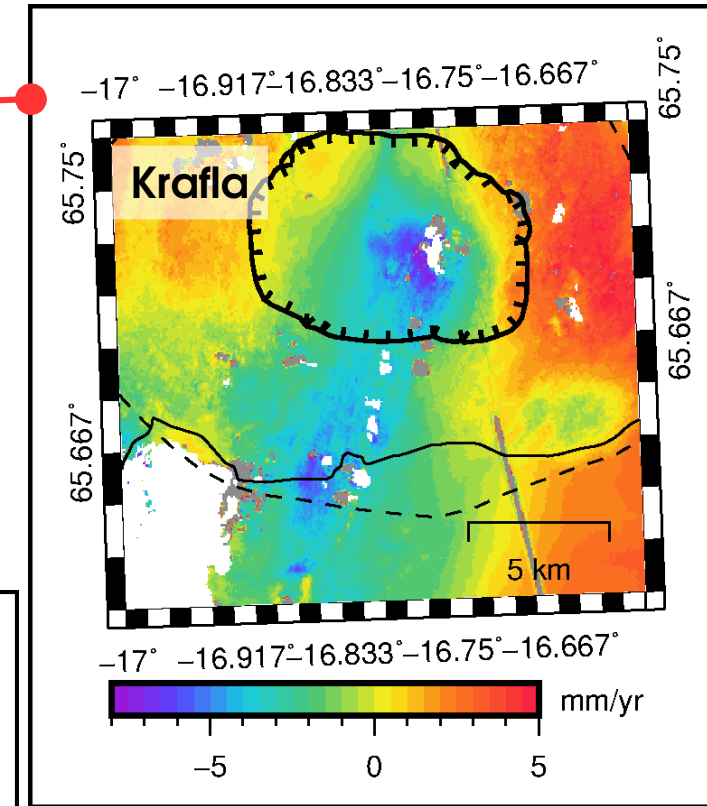
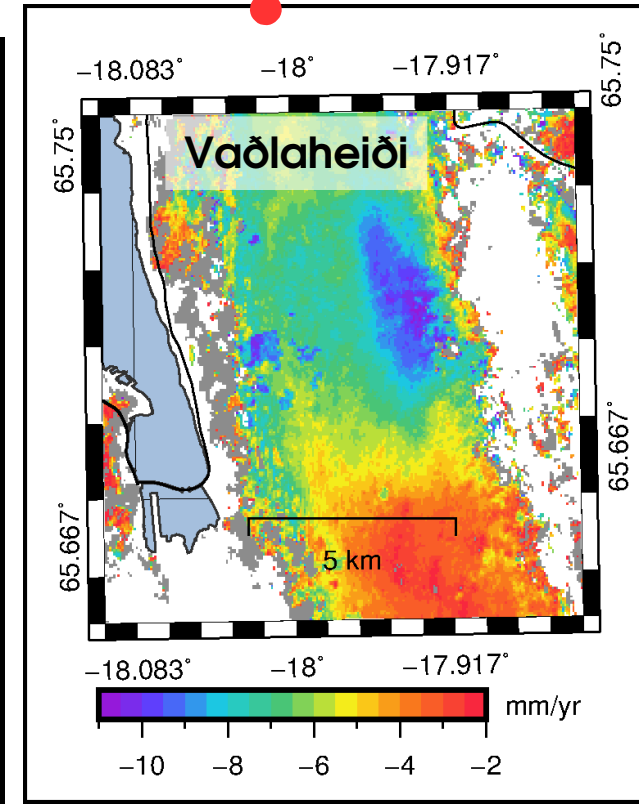
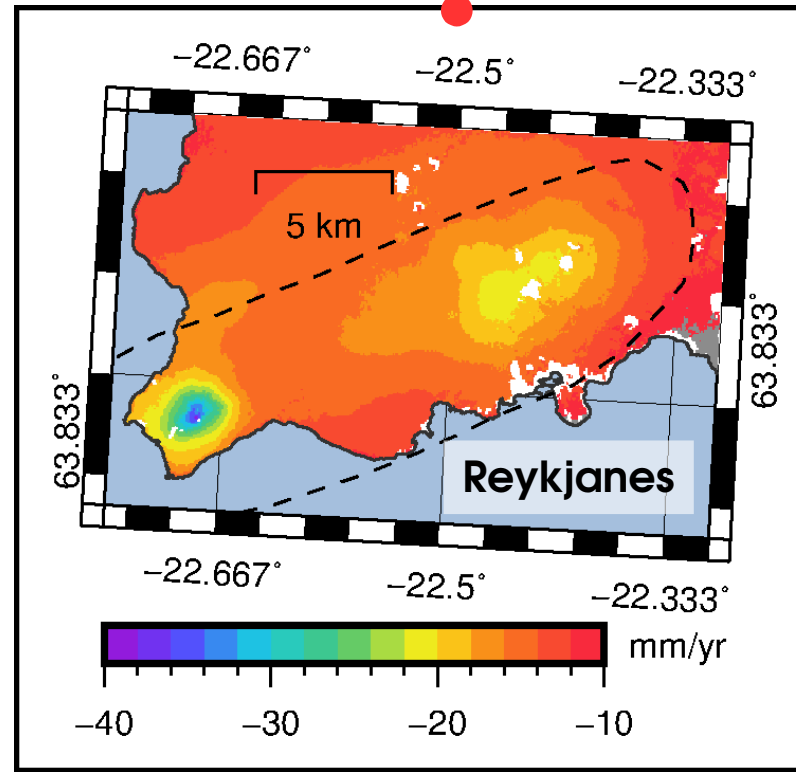
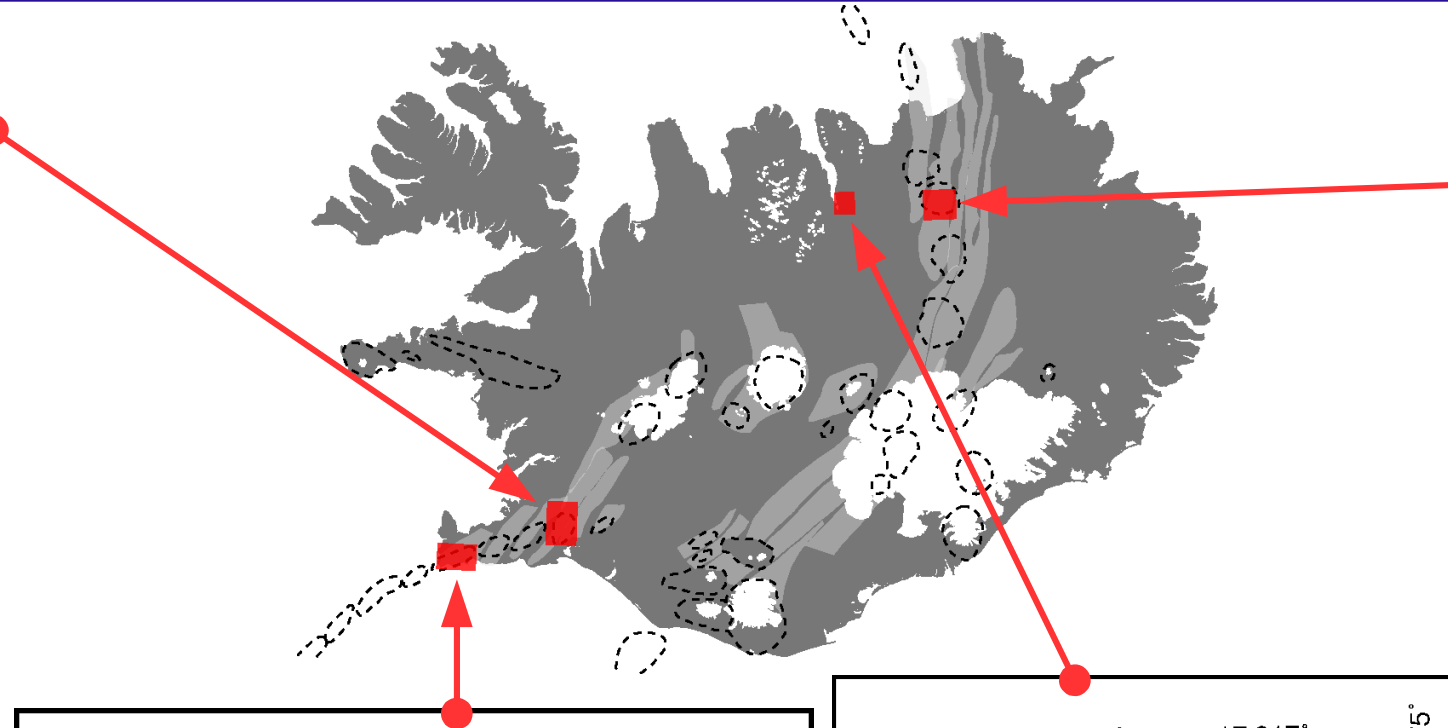
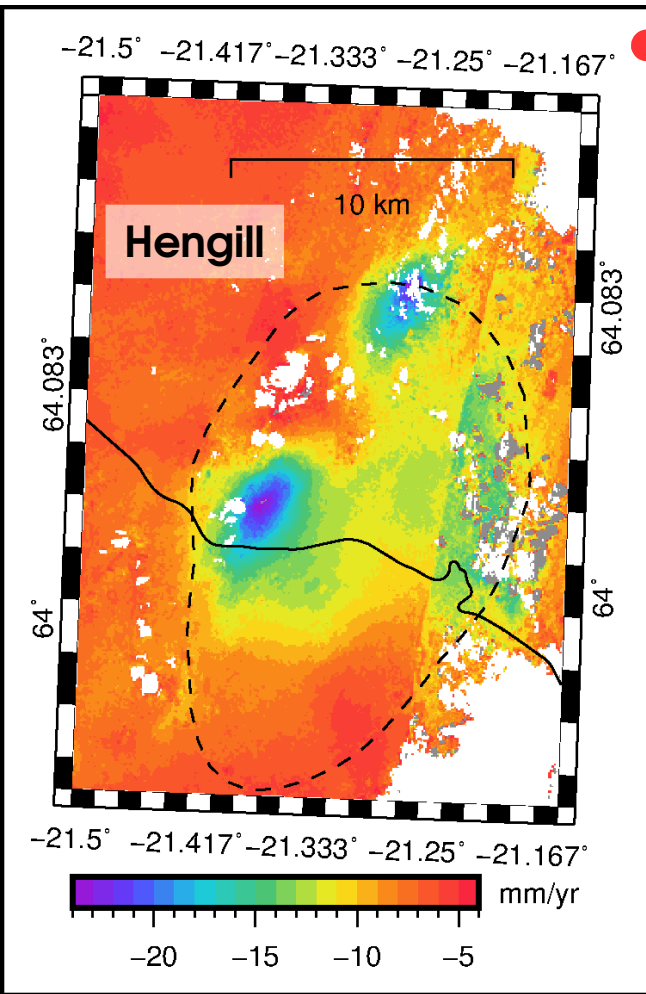


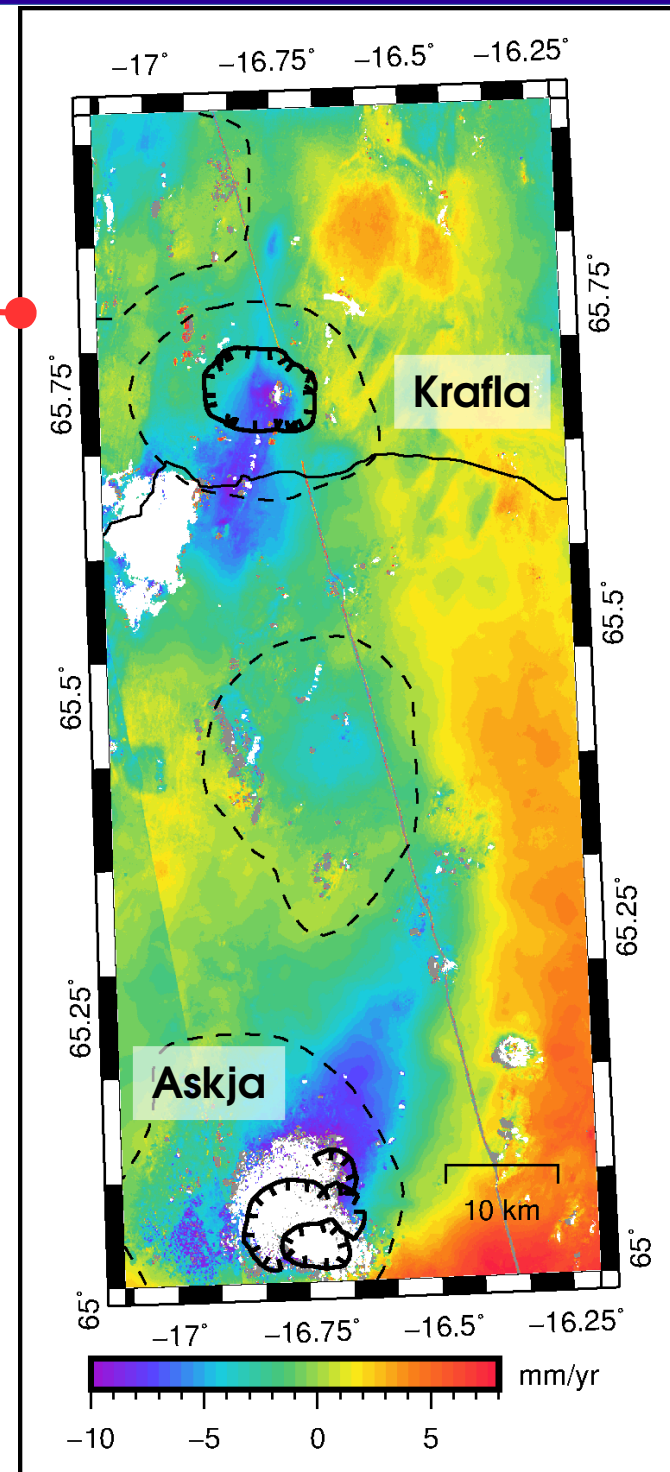
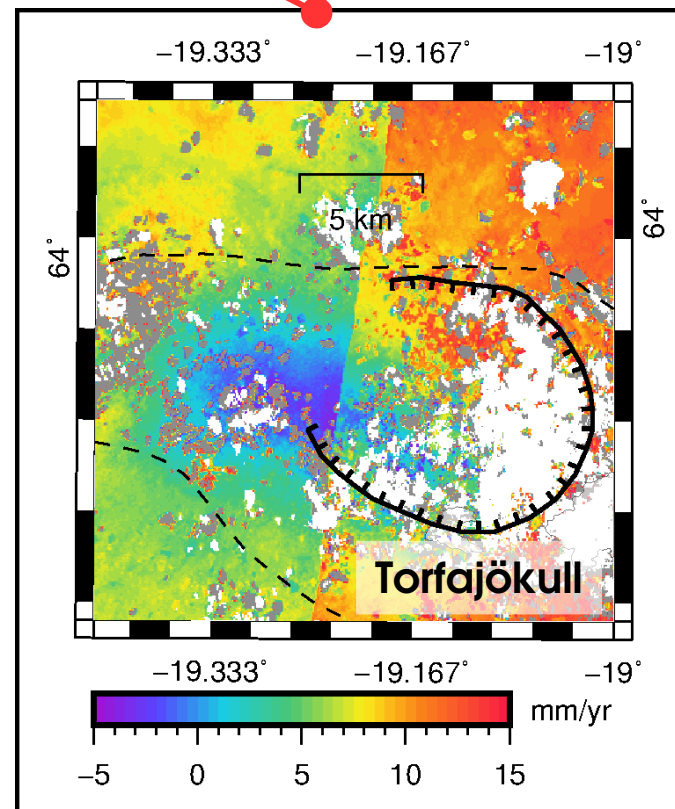
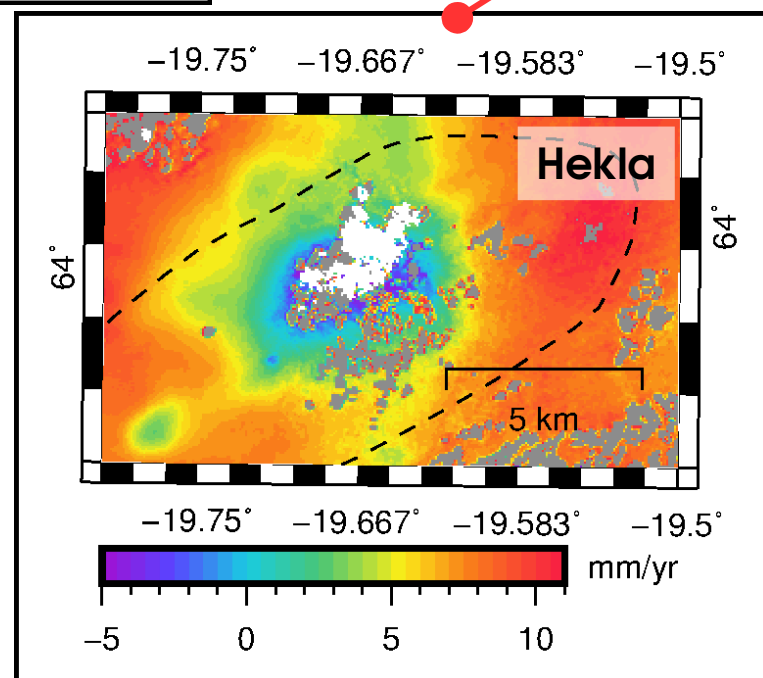
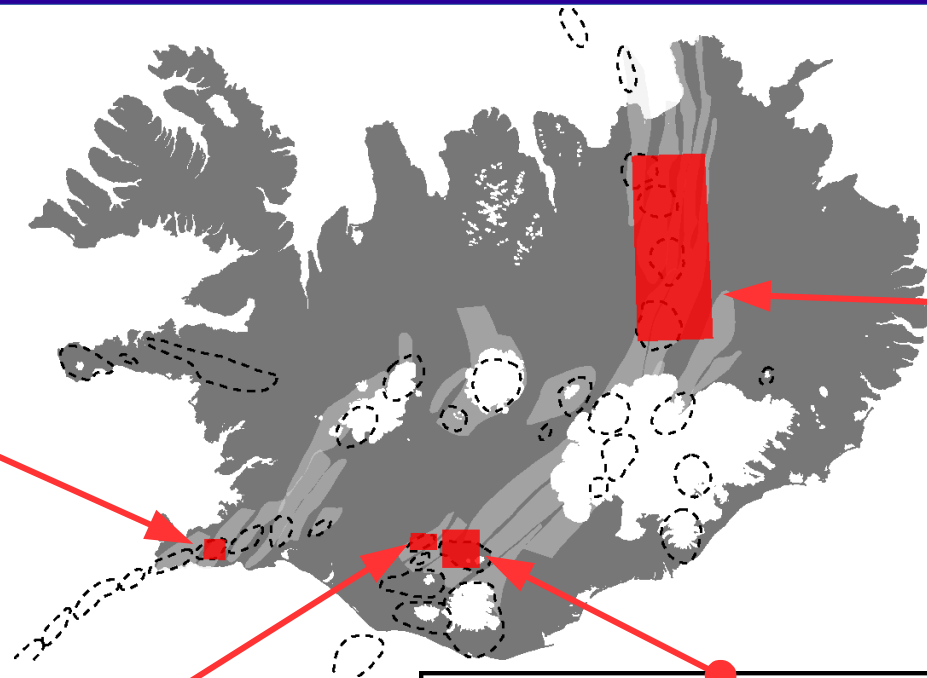
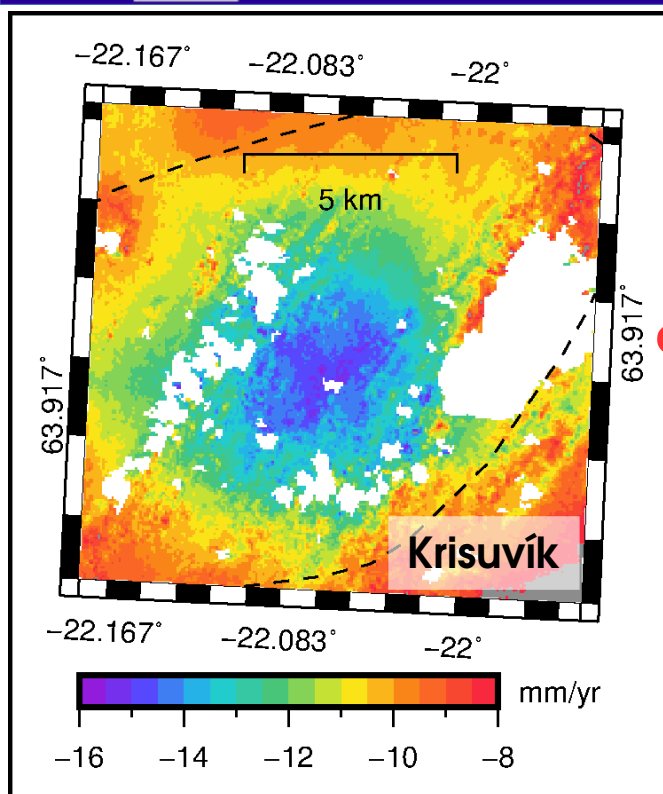


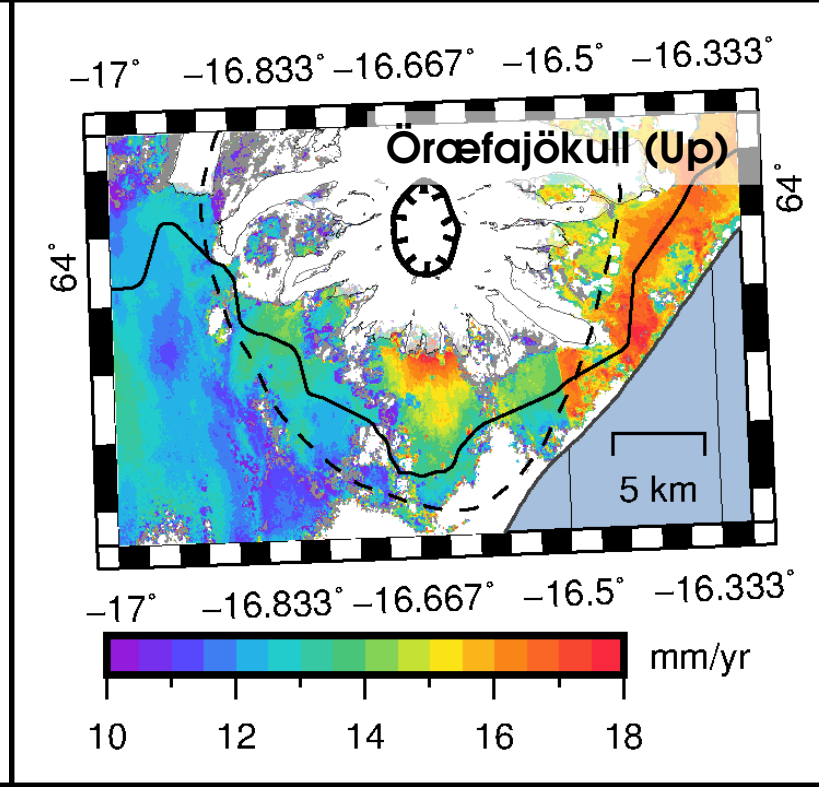
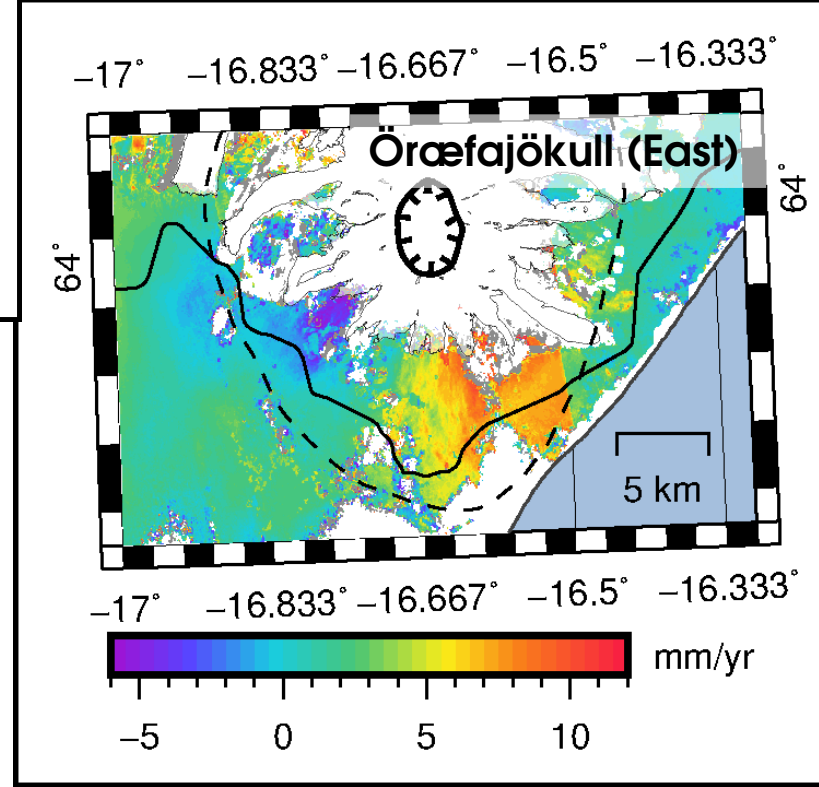
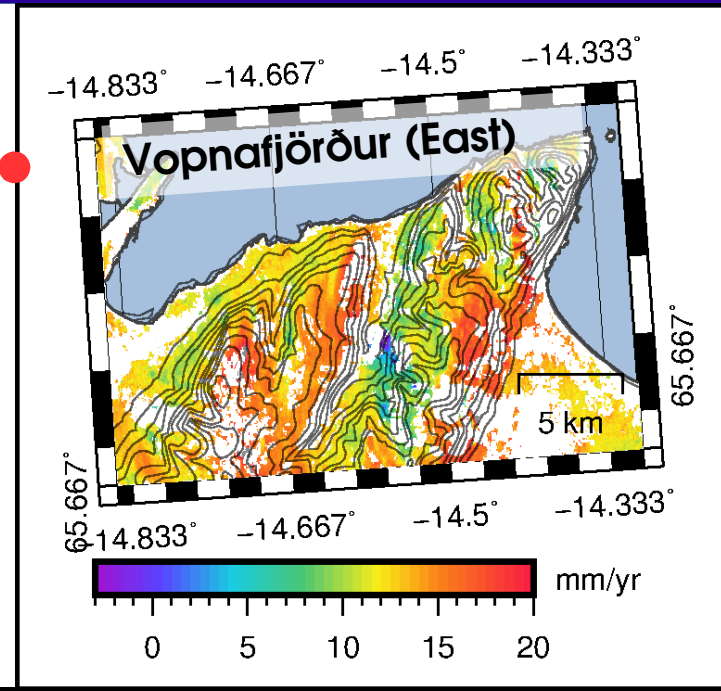
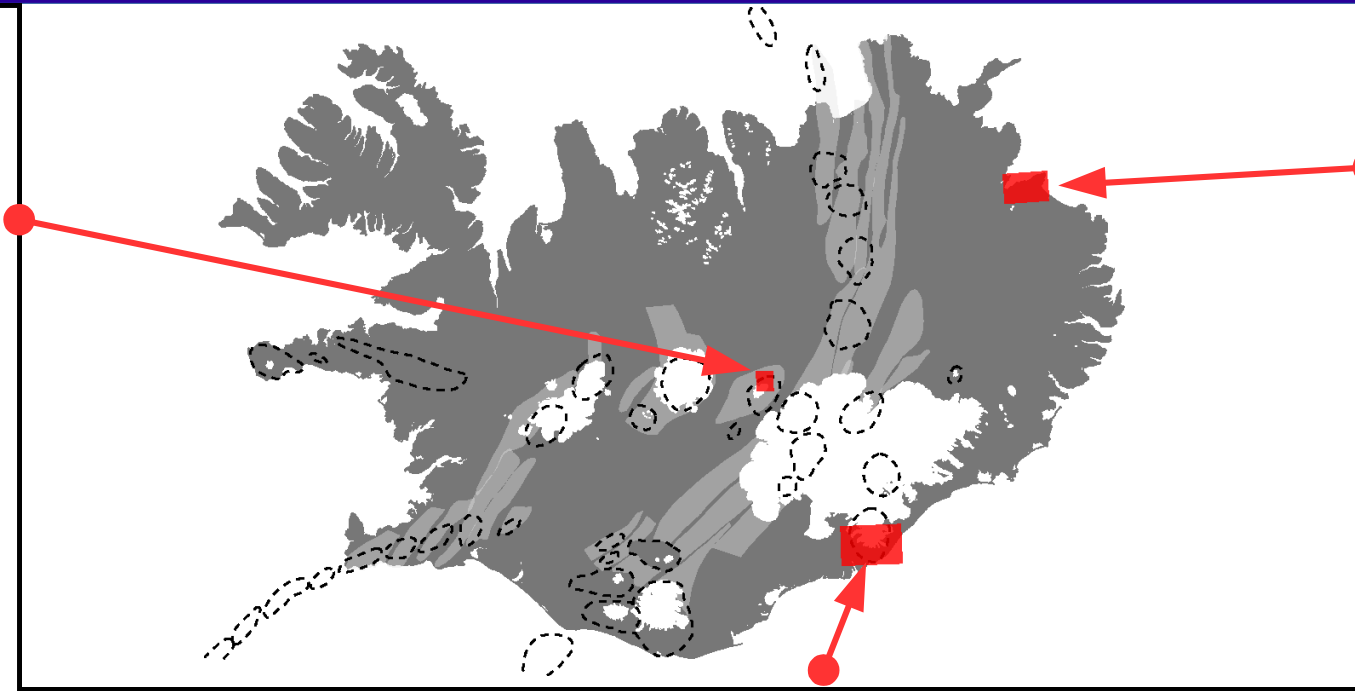
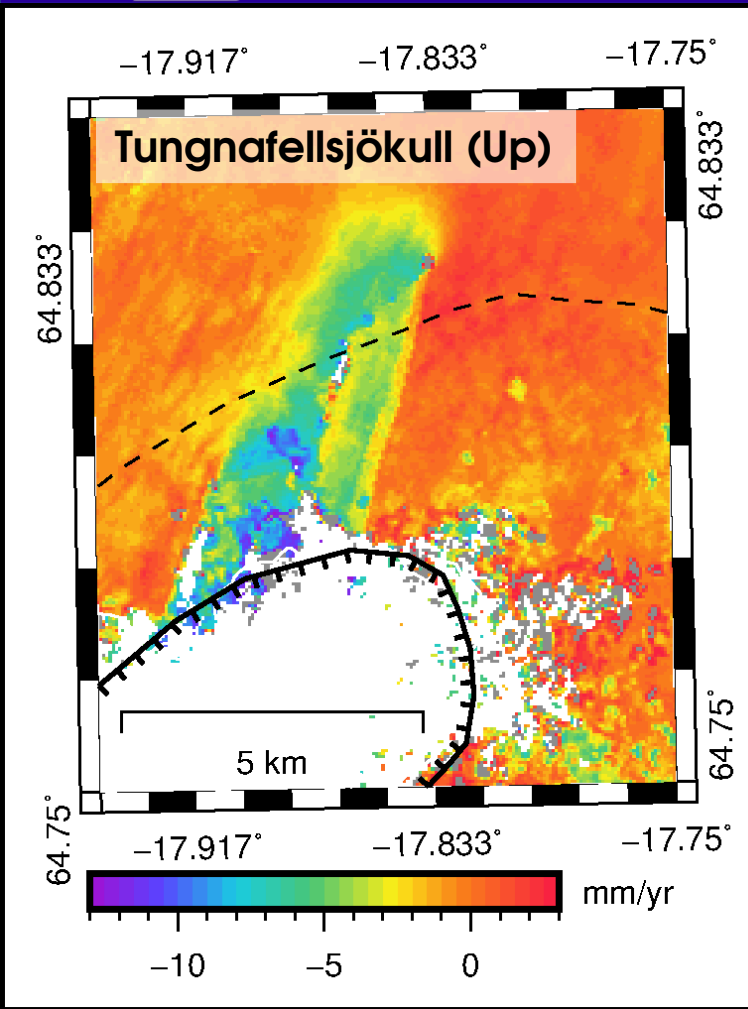


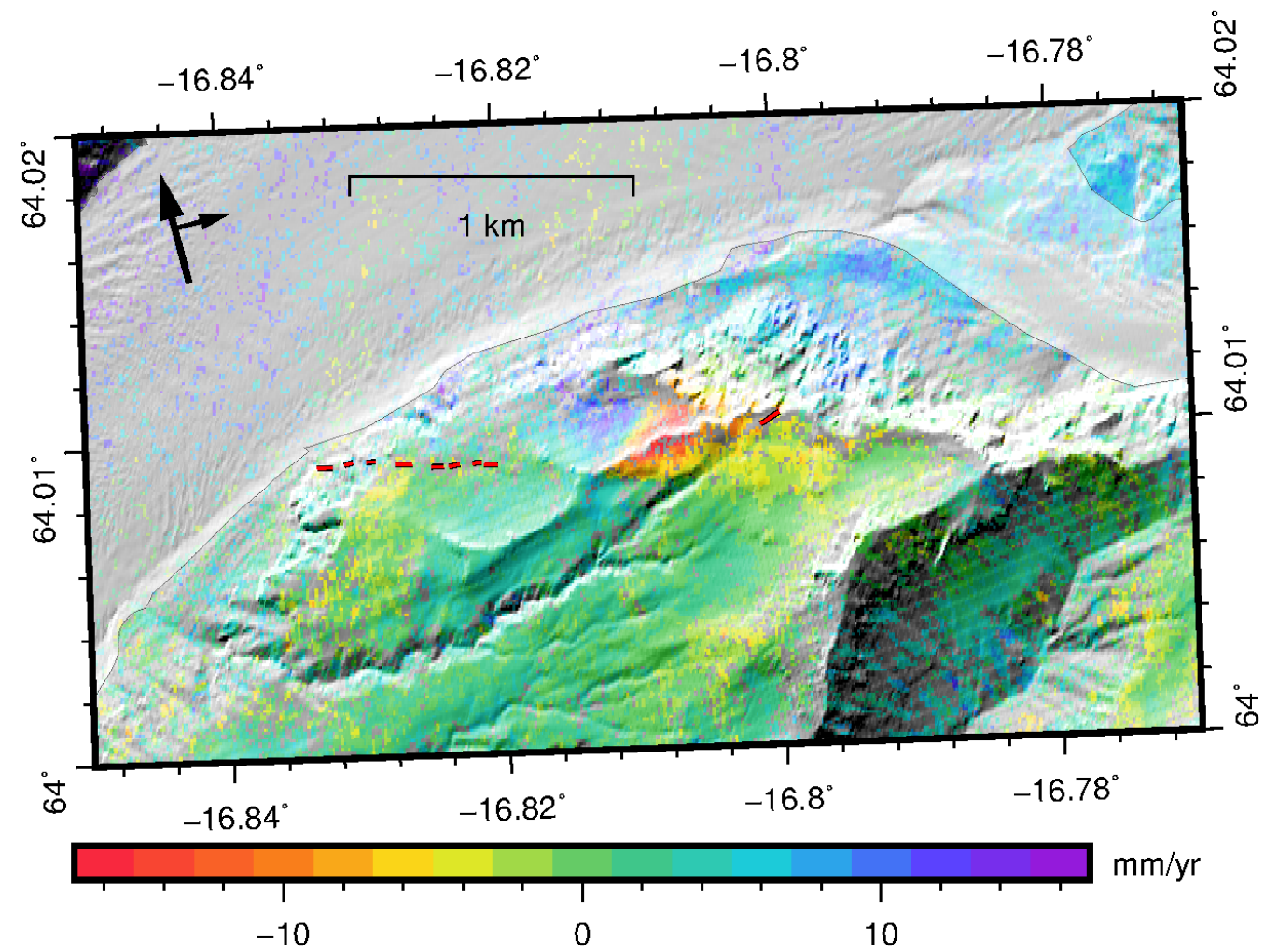
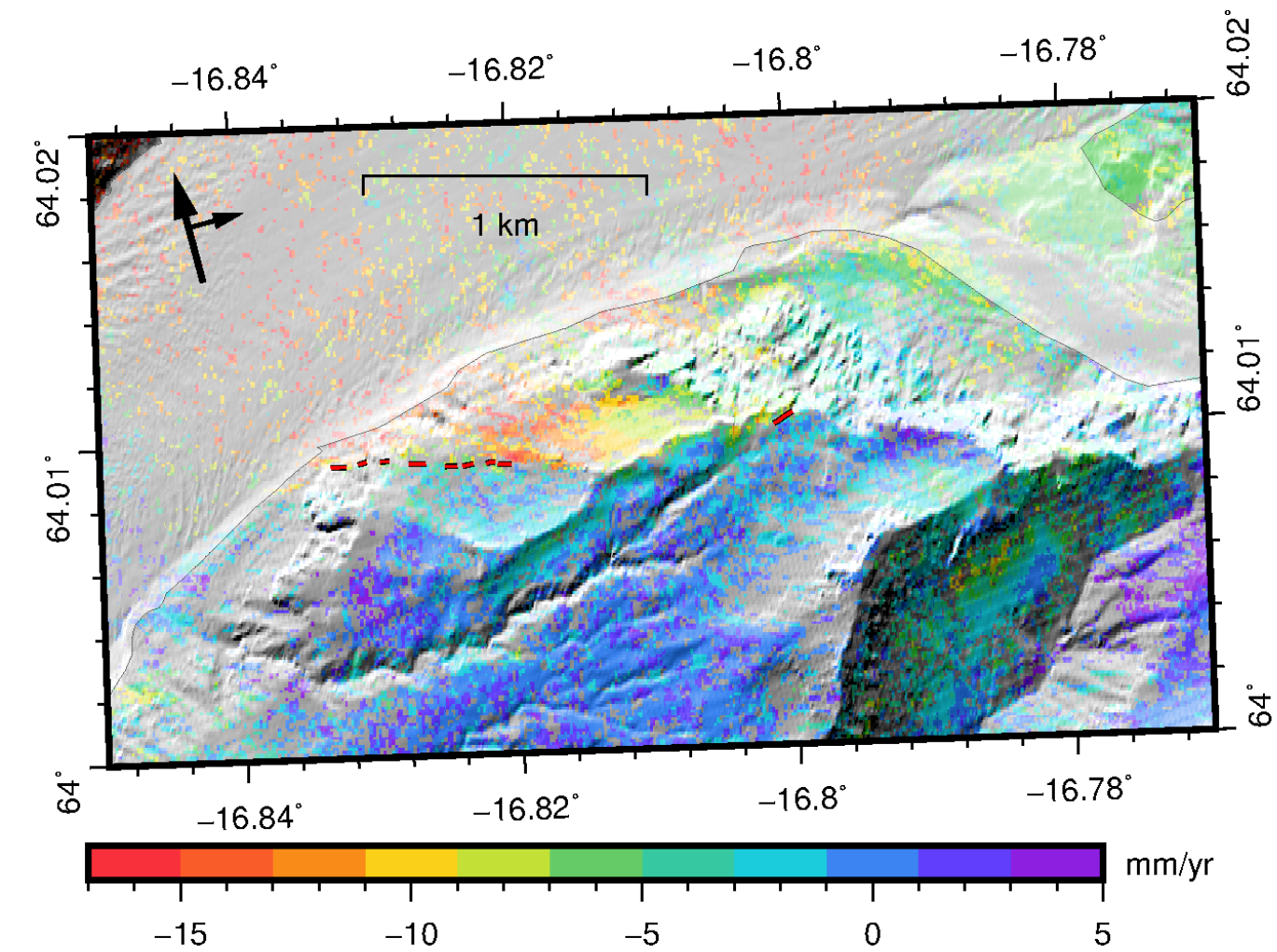












Conclusions

- Successfully observed deformation across Iceland over only 2 years.
 - Some areas may require additional work to recover a better signal: farmland, high mountains, ...
- The main previously known deformation signals are observed: GIA, plate spreading, Bárðarbunga, Askja, Torfajökull, geothermal fluid extraction, ...
- But new signal are also observed: Fremrinámar, Vaðlaheiði, slope instabilities.
 - More to be found.
- Results compare well to the deformation observed by continuous GPS network.

Future work

- Use the observed deformation as an input for the dynamic reference frame?
- Use the velocity fields to improve deformation models (ie., glacial isostatic adjustment model, plate spreading model) as they have much better spatial resolution than the GPS networks used in previous studies.
- Use the GPS time-series to constrain the InSAR time-series and extract better average velocity fields.
- Add 2018 summer data



Summer in Iceland
(ideal for InSAR purposes only)