



The Icelandic Volcanoes Supersite: The role of interferometric analysis of synthetic aperture radar images for mitigating effects of volcanic hazards and understanding volcanic processes in Iceland

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Andy Hooper⁶, Sara Barsotti², Bergrún A. Óladóttir¹,

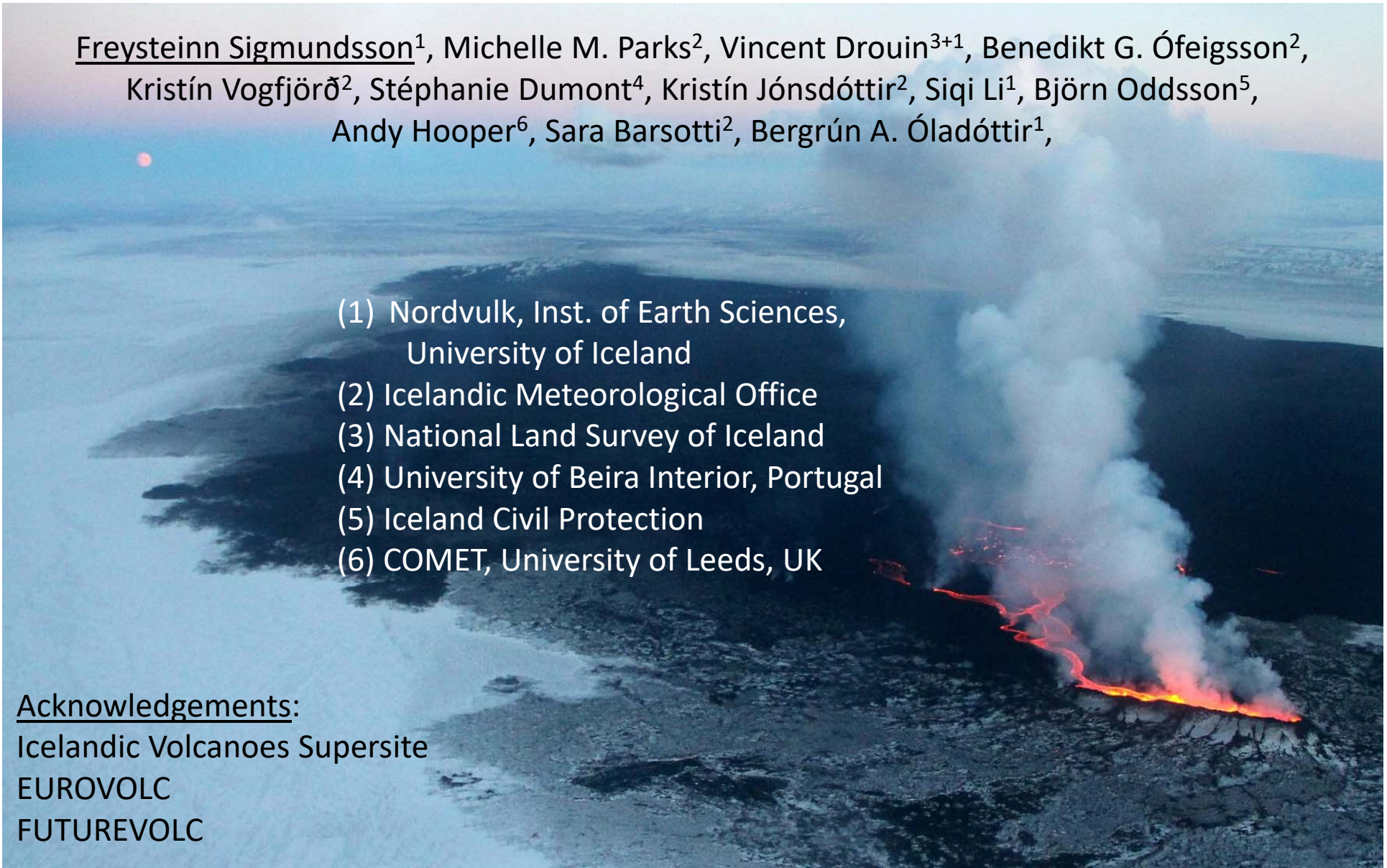
- (1) Nordvulk, Inst. of Earth Sciences,
University of Iceland
- (2) Icelandic Meteorological Office
- (3) National Land Survey of Iceland
- (4) University of Beira Interior, Portugal
- (5) Iceland Civil Protection
- (6) COMET, University of Leeds, UK

Acknowledgements:

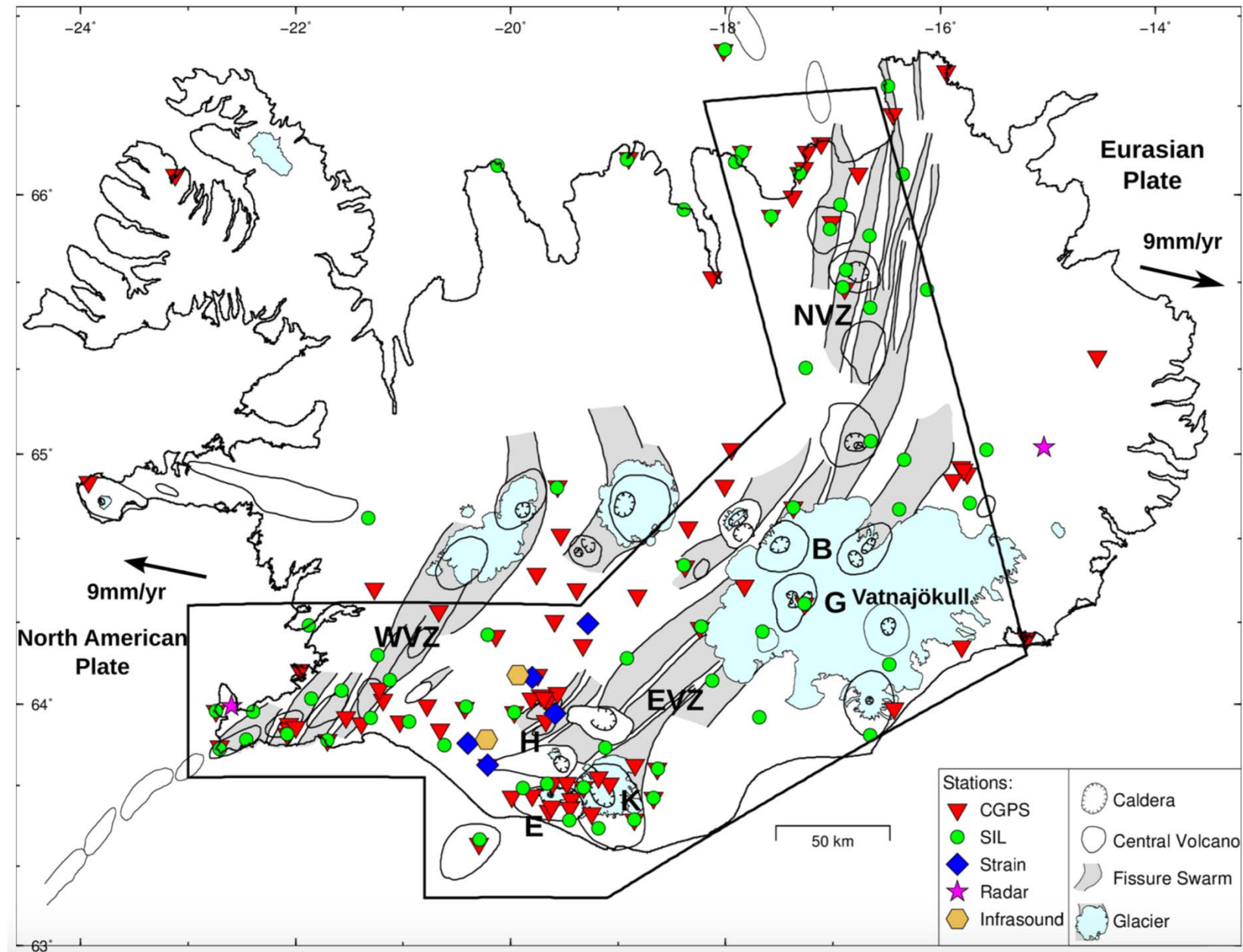
Icelandic Volcanoes Supersite

EUROVOLC

FUTUREVOLC

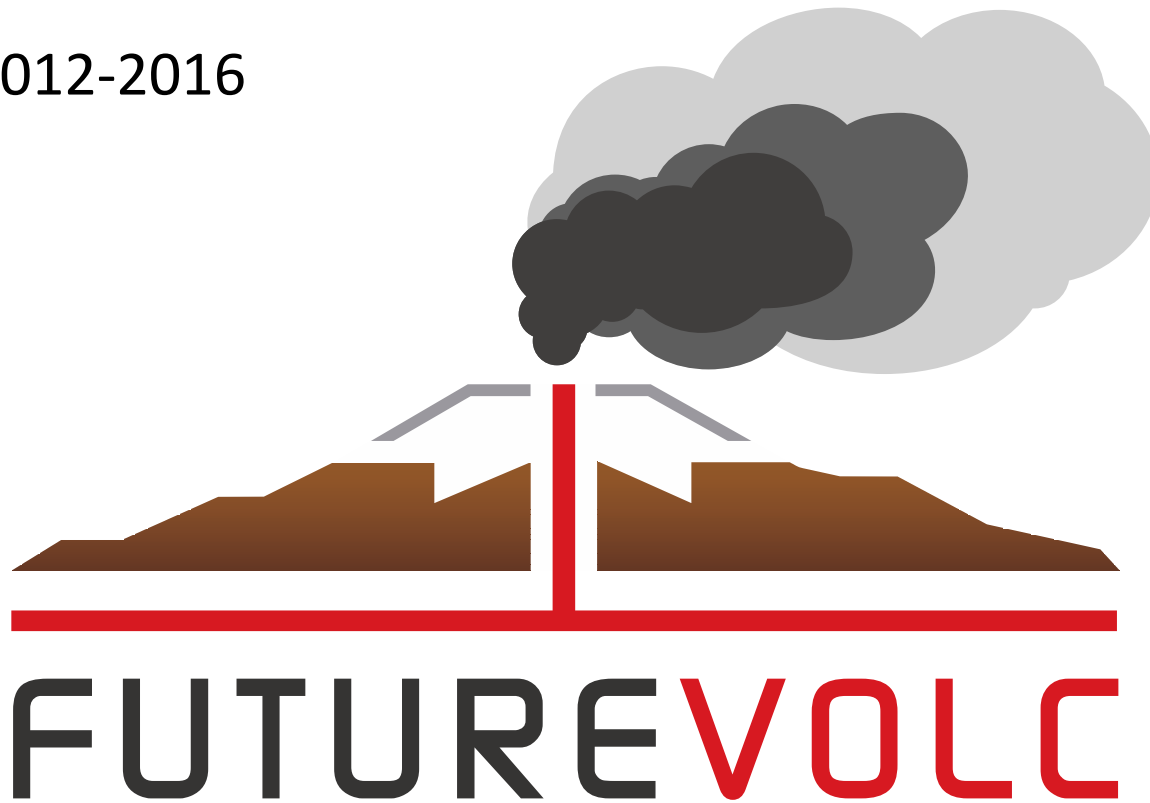


Icelandic Volcanoes Supersite: CEOS proposal accepted 2013





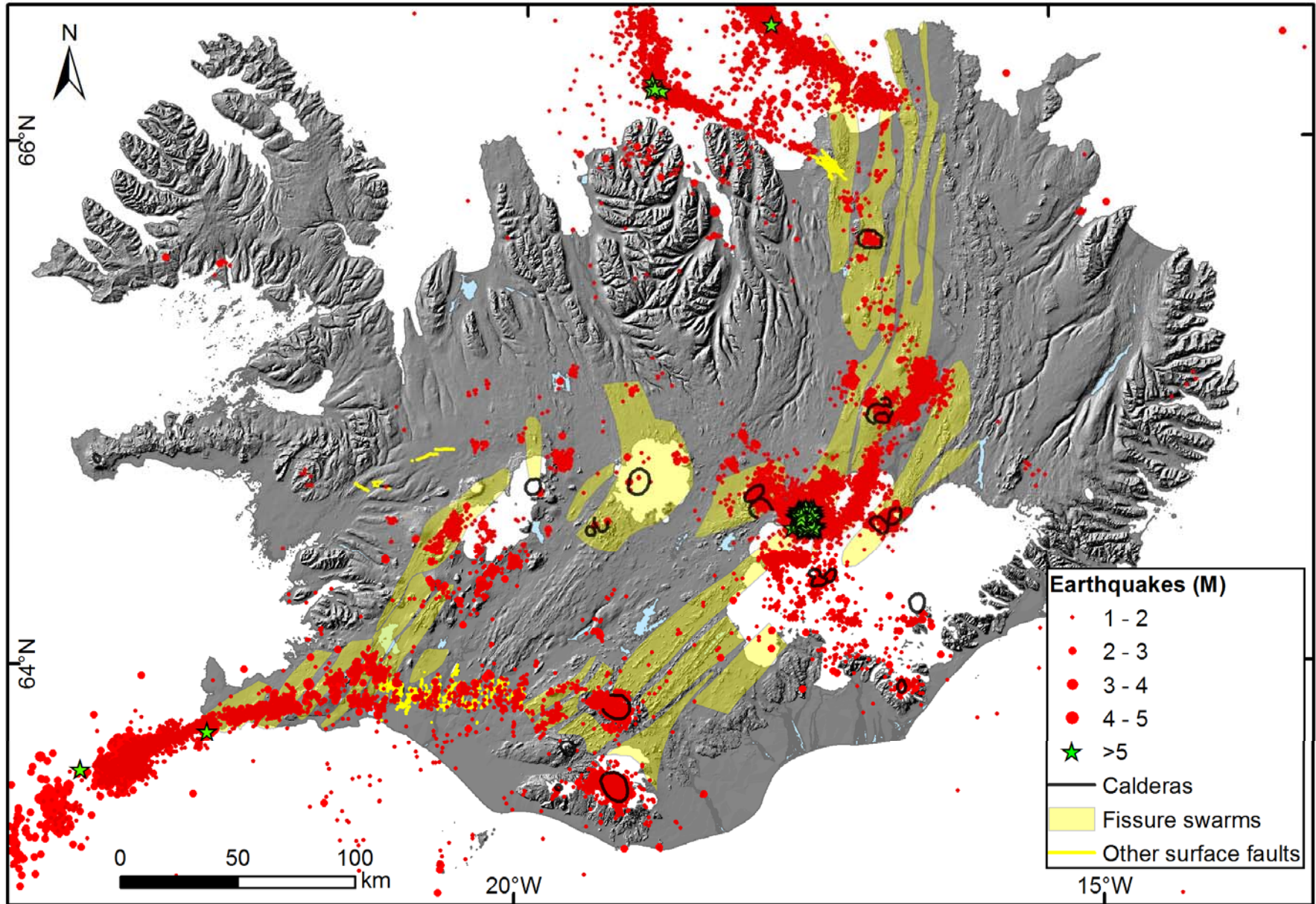
2012-2016




A EUROPEAN VOLCANOLOGICAL SUPERSITE IN ICELAND:
A MONITORING SYSTEM AND NETWORK FOR THE FUTURE

Objectives:

- Establish an innovative volcano monitoring system/strategy
- Develop new methods and instrumentation
- Advance scientific understanding of magmatic processes
- Improve delivery of information from scientists to society



Seismicity in Iceland 2012-2016 (Icelandic Meteorological Office)

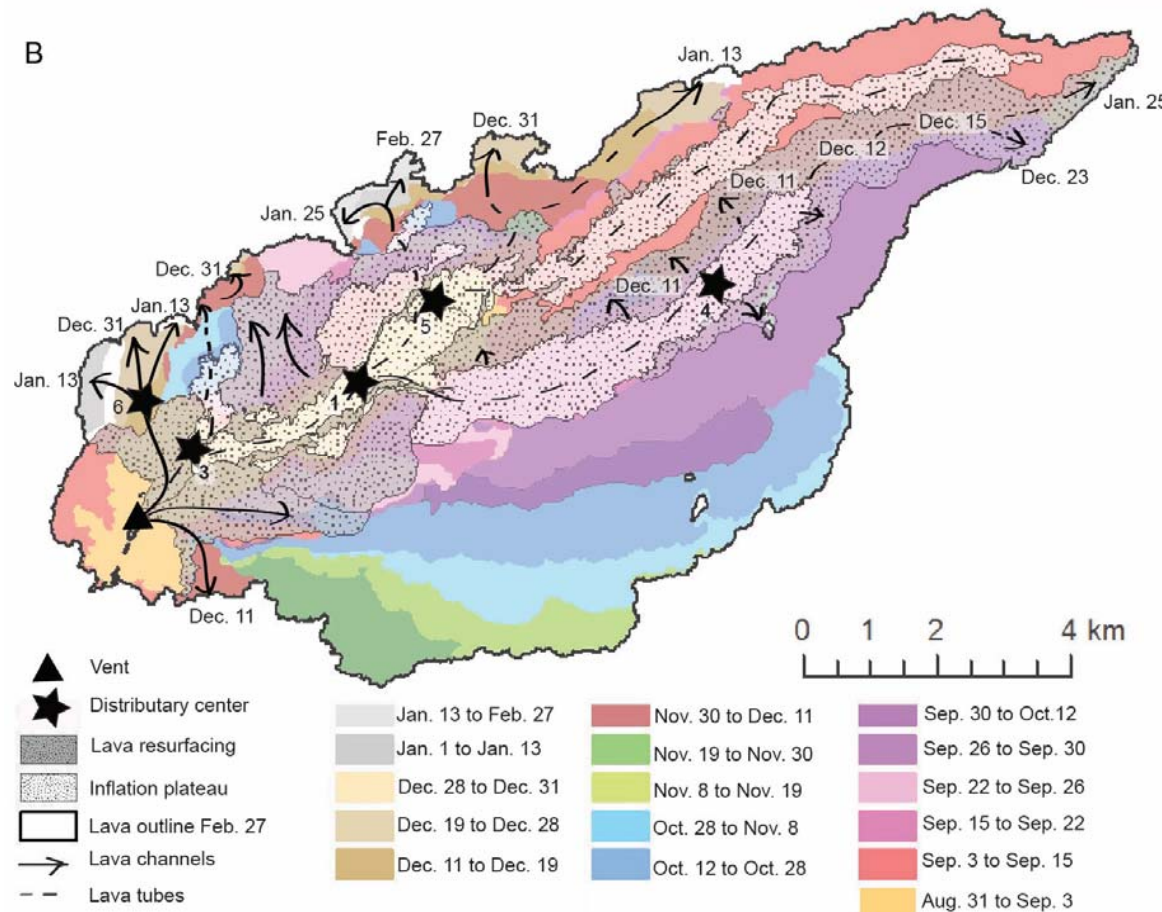


2014-2015 (6 months)
Bardarbunga volcanic system:
Holuhraun lava: $\sim 1.4 \text{ km}^3$



The Holuhraun lava field

First day of main eruption, 31 August, 2014
(photo: Gro Pedersen)

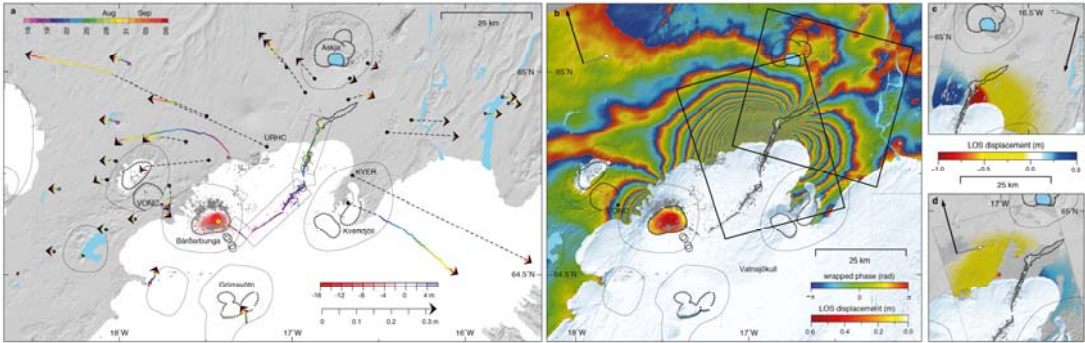


B. Map showing the evolution of the Holuhraun lava field – formed over 6 months

Gro Pedersen et al. (2017)



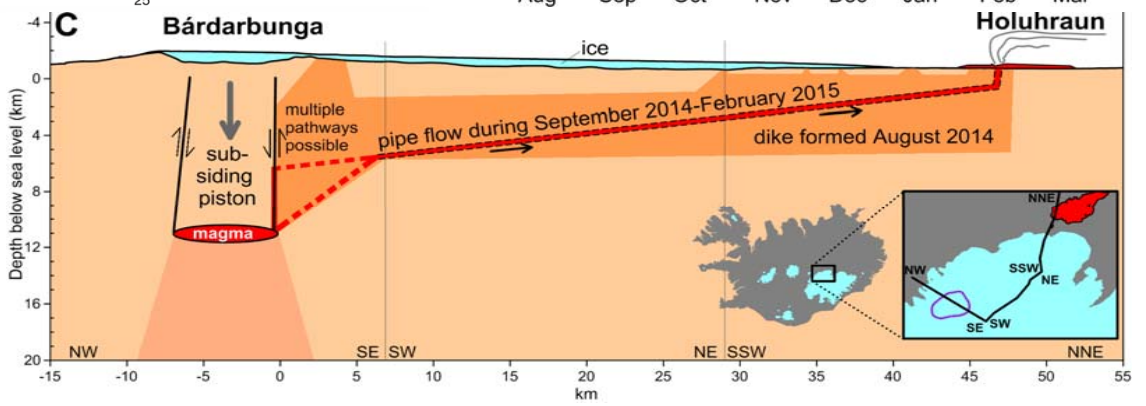
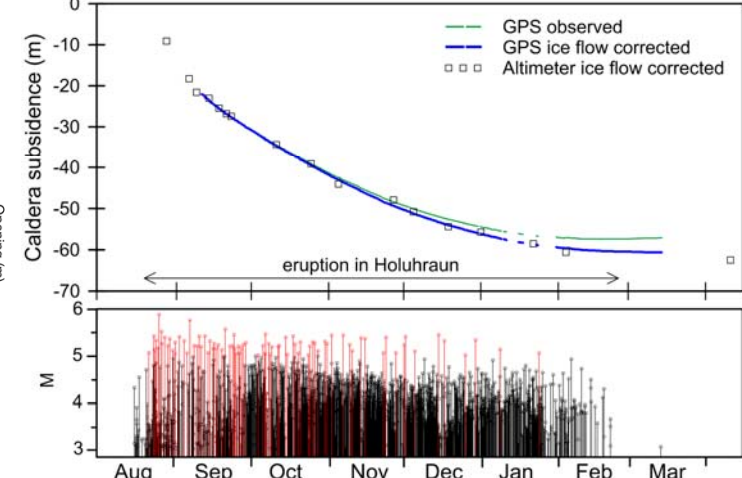
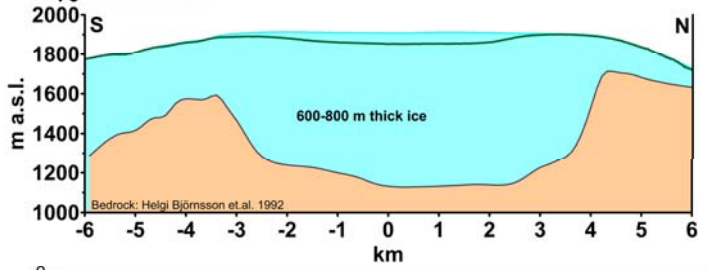
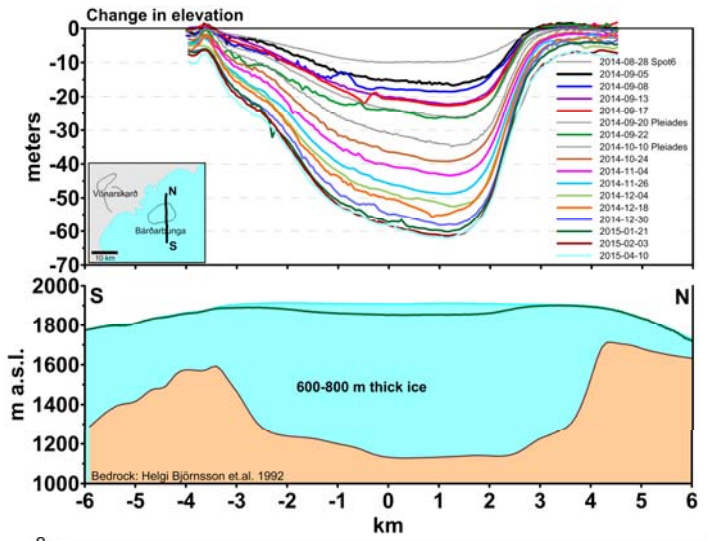
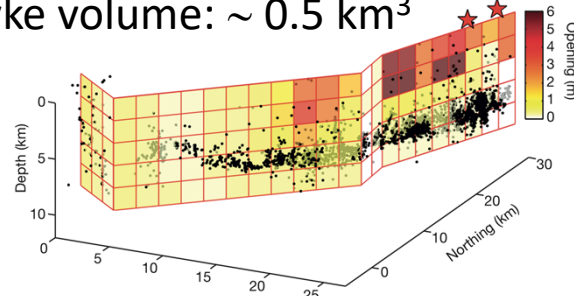
Bárðarbunga 2014-2015

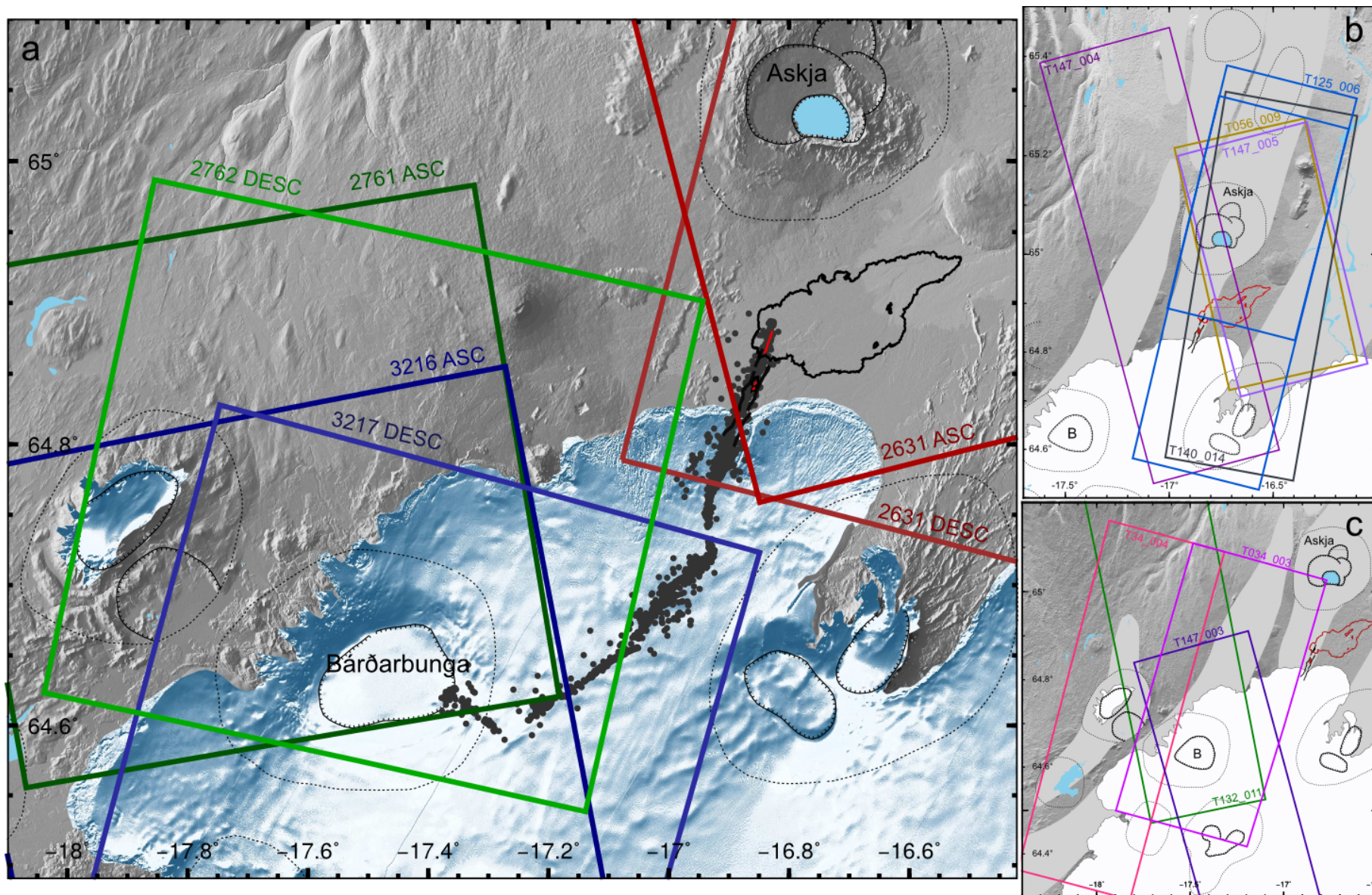


Selected Publications:

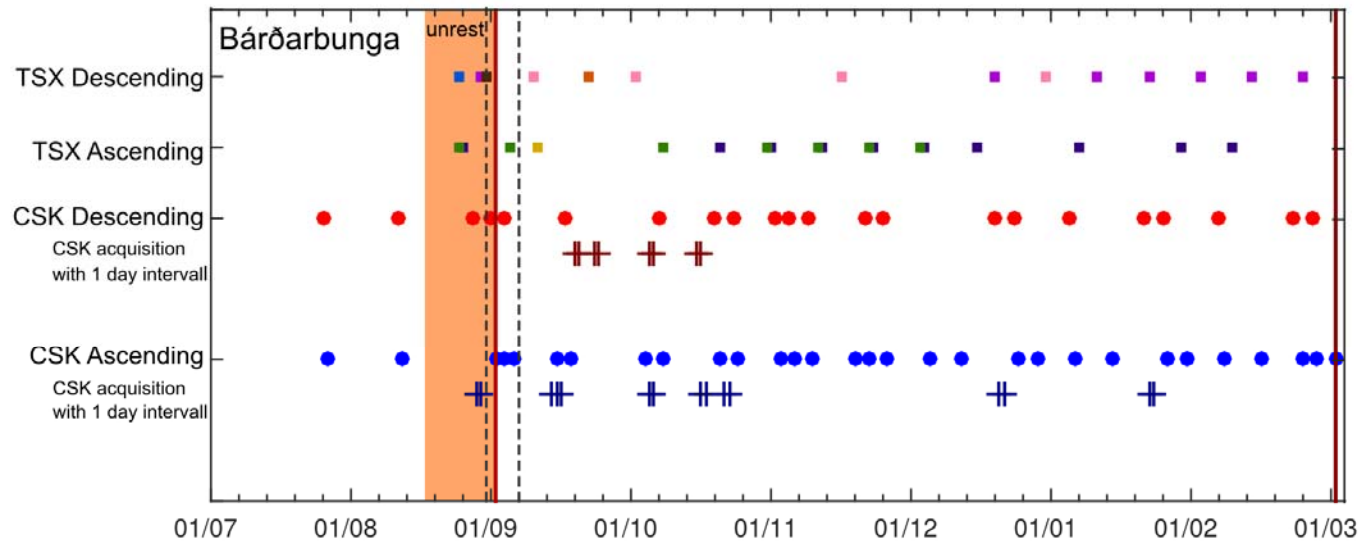
- Sigmundsson et al., 2015
- Gudmundsson et al., 2016
- Ruch et al., 2016
- Parks et al., 2017
- Dumont et al., (submitted): Integration of SAR data into monitoring of the 2014-2015 Holuhraun eruption, Iceland: Contribution of the Icelandic Volcanoes Supersite and the FutureVolc projects, Frontiers

Dyke volume: $\sim 0.5 \text{ km}^3$

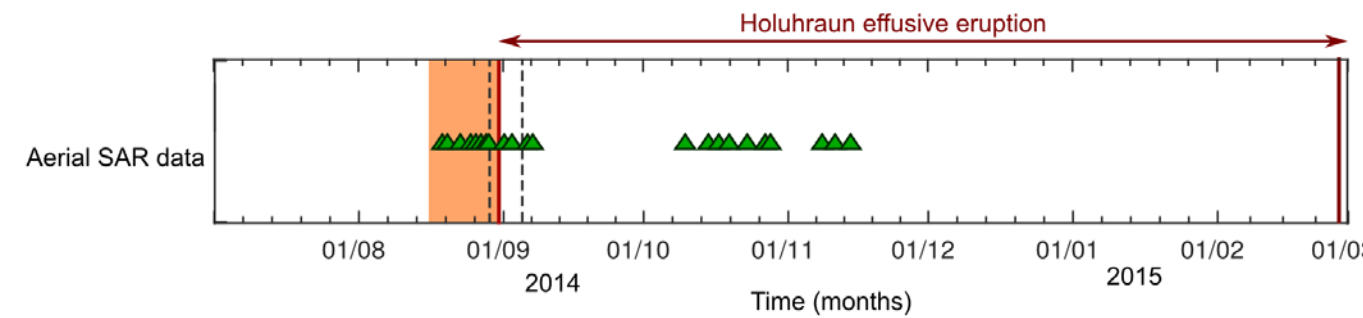
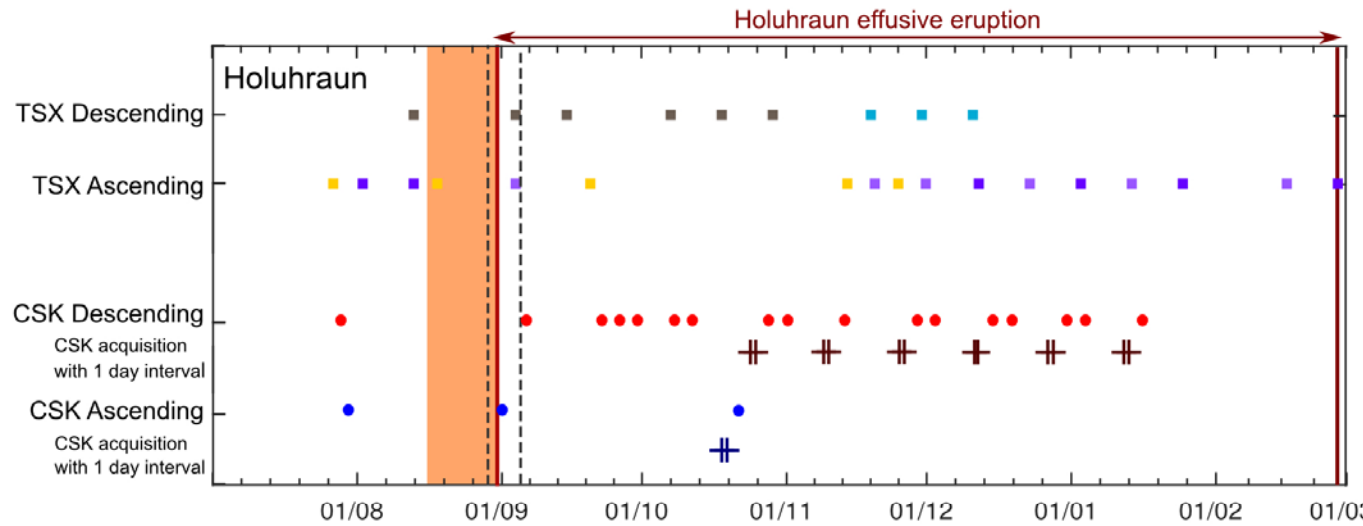




SAR satellite tracks used during unrest at Bárðarbunga and Holuhraun eruption. (a) Cosmo-SkyMed satellite images, (b) and (c) Most frequent TerraSAR-X images
 Gray dots: seismic events related to dyke propagation. Dumont et al. (submitted)

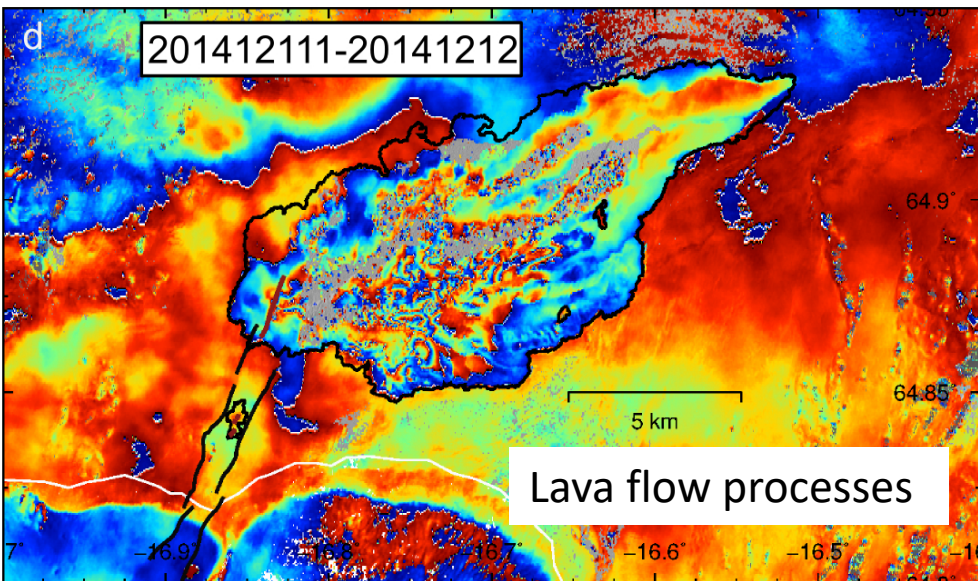
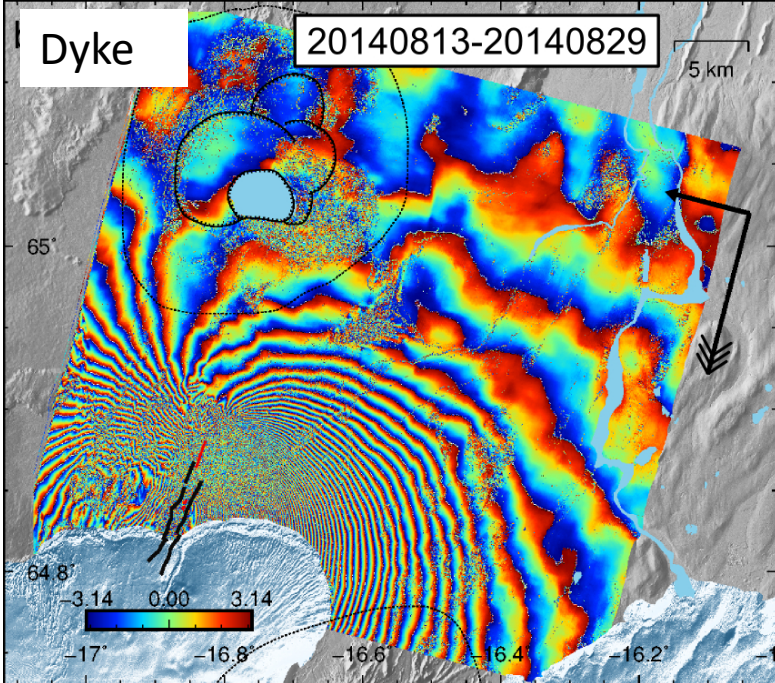
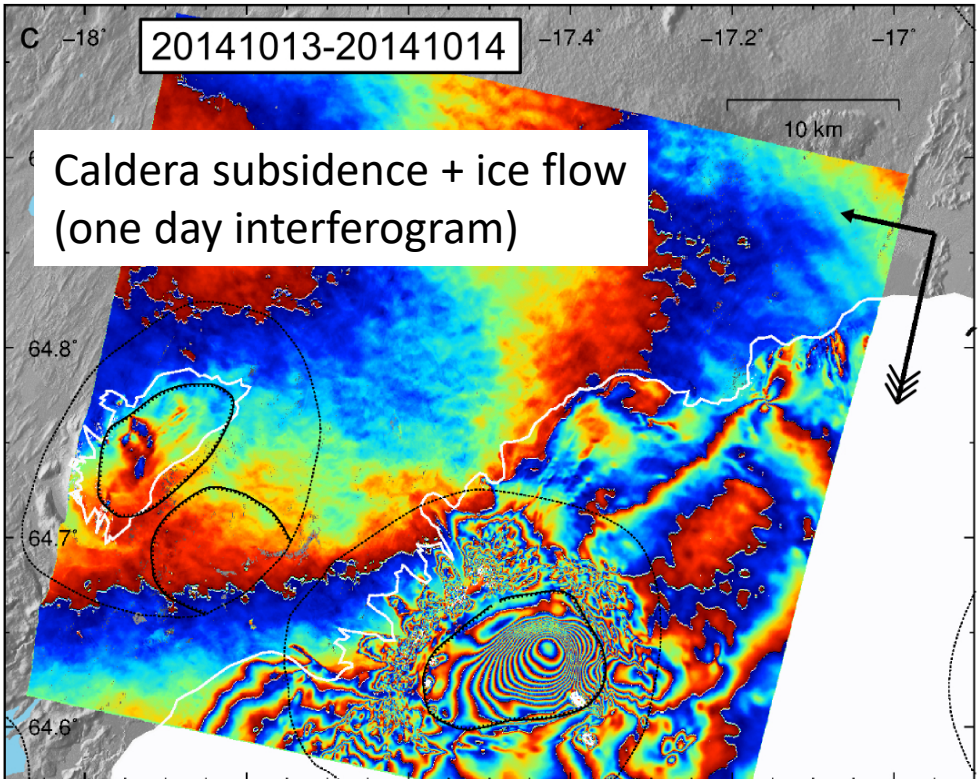
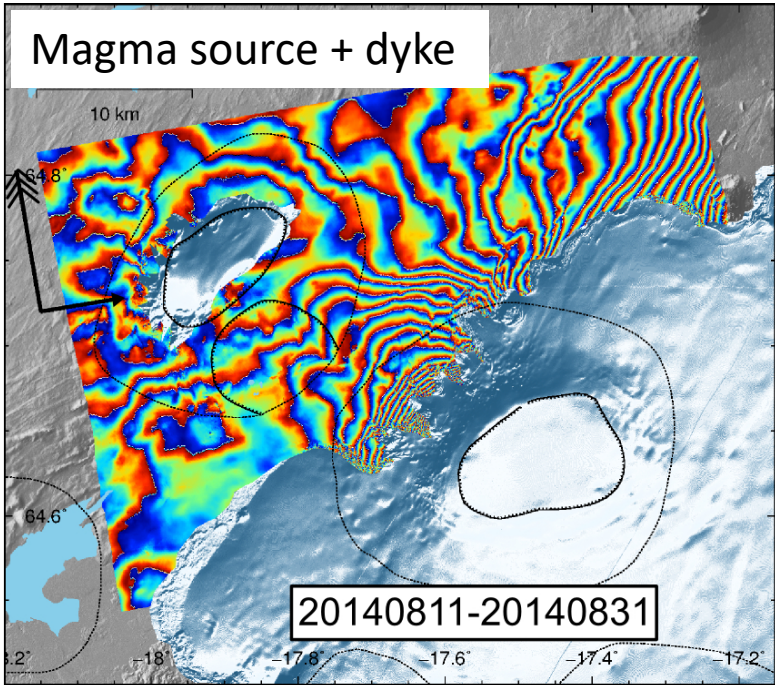


Time-line of SAR satellite acquisitions: Bárðarbunga Holuhraun

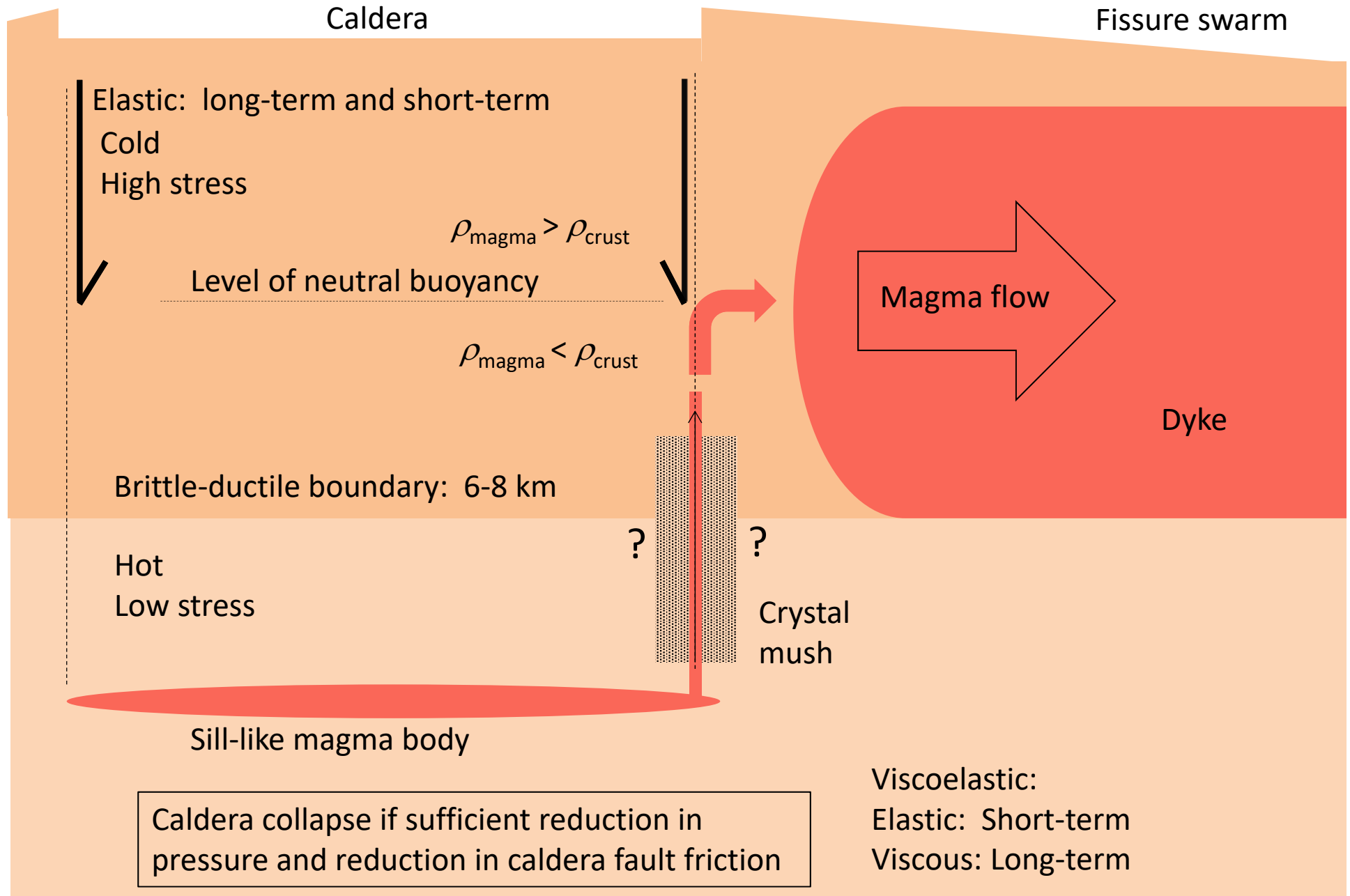


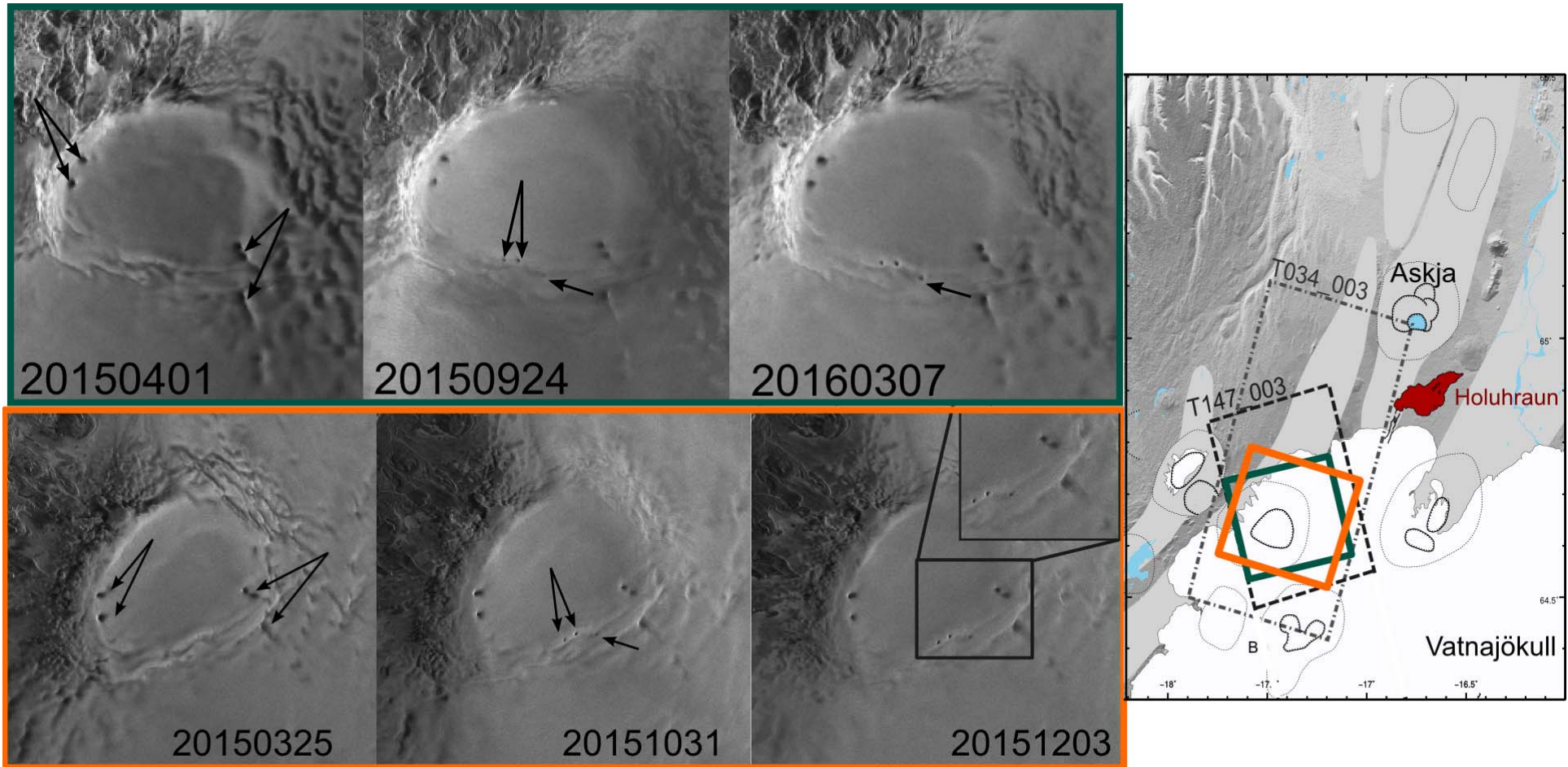
Time-line of SAR airplane Acquisitions

COSMO-SkyMed interferograms (wrapped, 1 fringe = 15.5 mm)



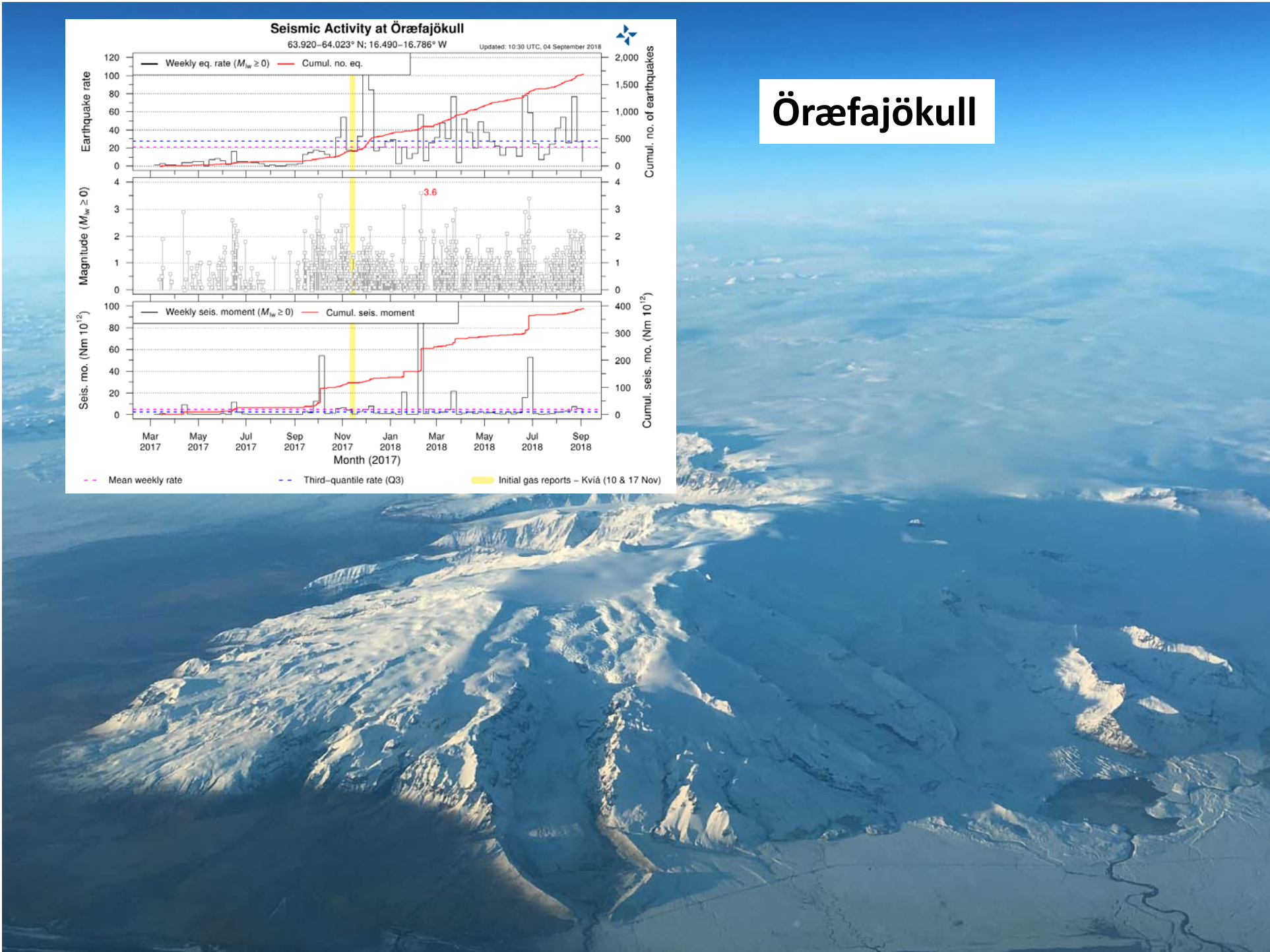
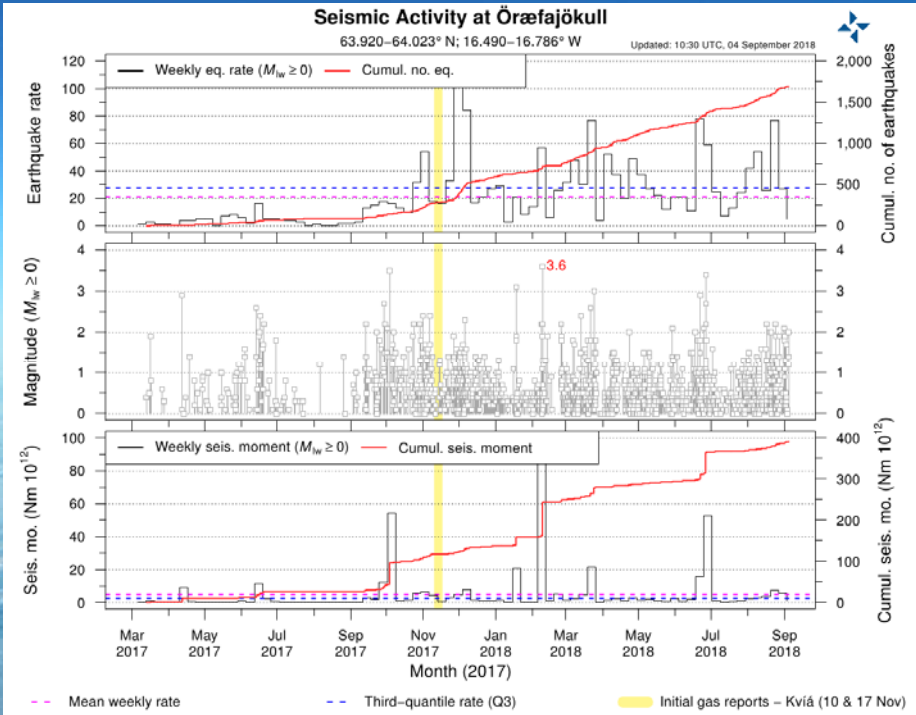
Bárðarbunga 2014-2015: Physical model for the onset of the caldera collapse





Bárðarbunga ice-capped caldera:
Tracking surface changes at the using SAR amplitude images

Öræfajökull



Öræfajökull

Situation Map

Background imagery
CSK
1-day interferogram
Imagery Acquired:
19th - 20th January 2018



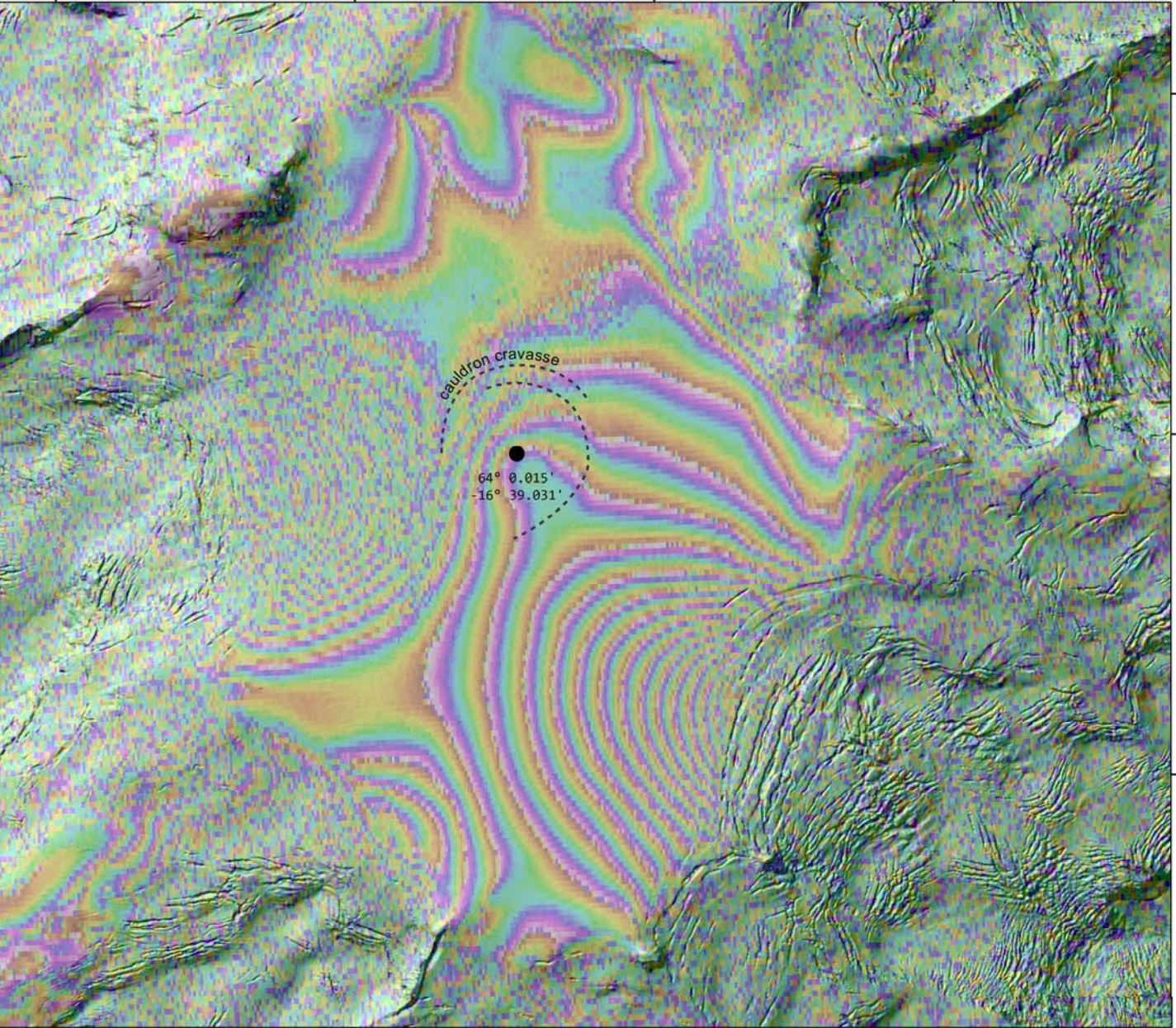
Cauldron approx. center:
64°00,015' | -16°39,031'

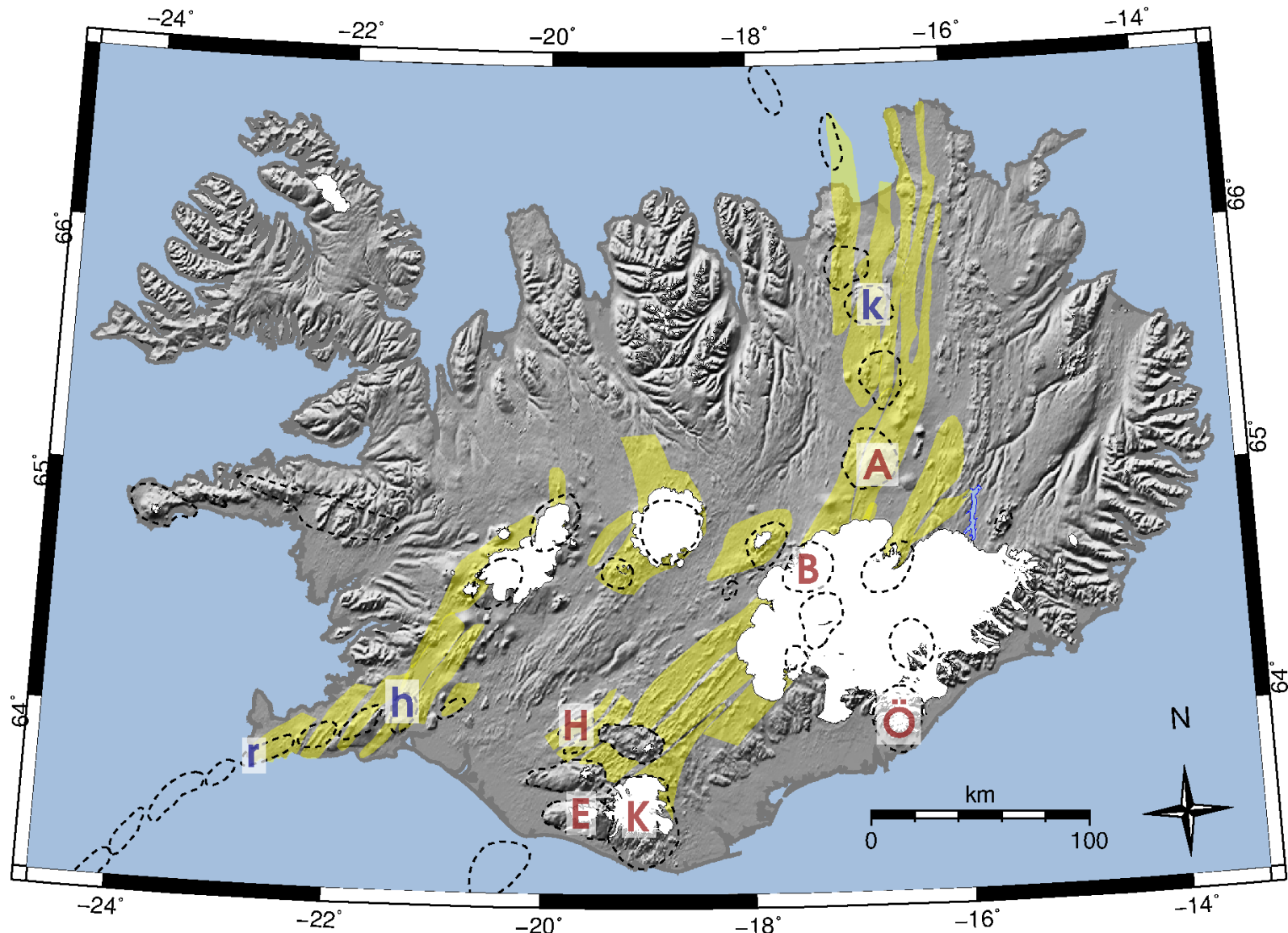


0 500 m



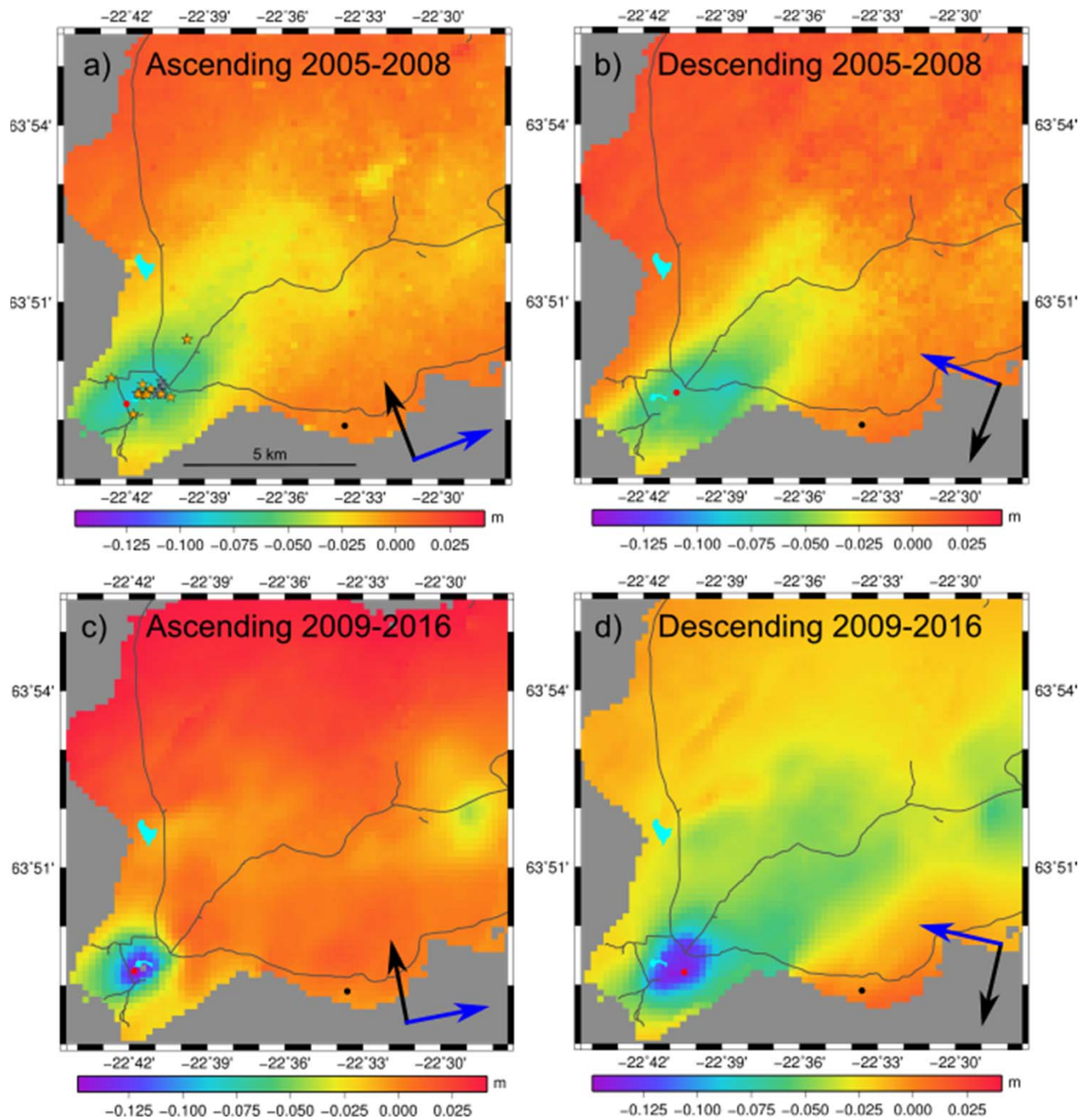
This map was published on
31-01-2018 16:05:46 UTC
by The Icelandic Meteorology Office





Areas studied: Öræfajökull (Ö), Bárðarbunga (B), Hekla (H), Eyjafjallajökull (E), Katla (K), Askja (A), Krafla (k), Reykjanes (r), and Hengill (h).

Blue letters represent areas where geothermal processes have been studied.



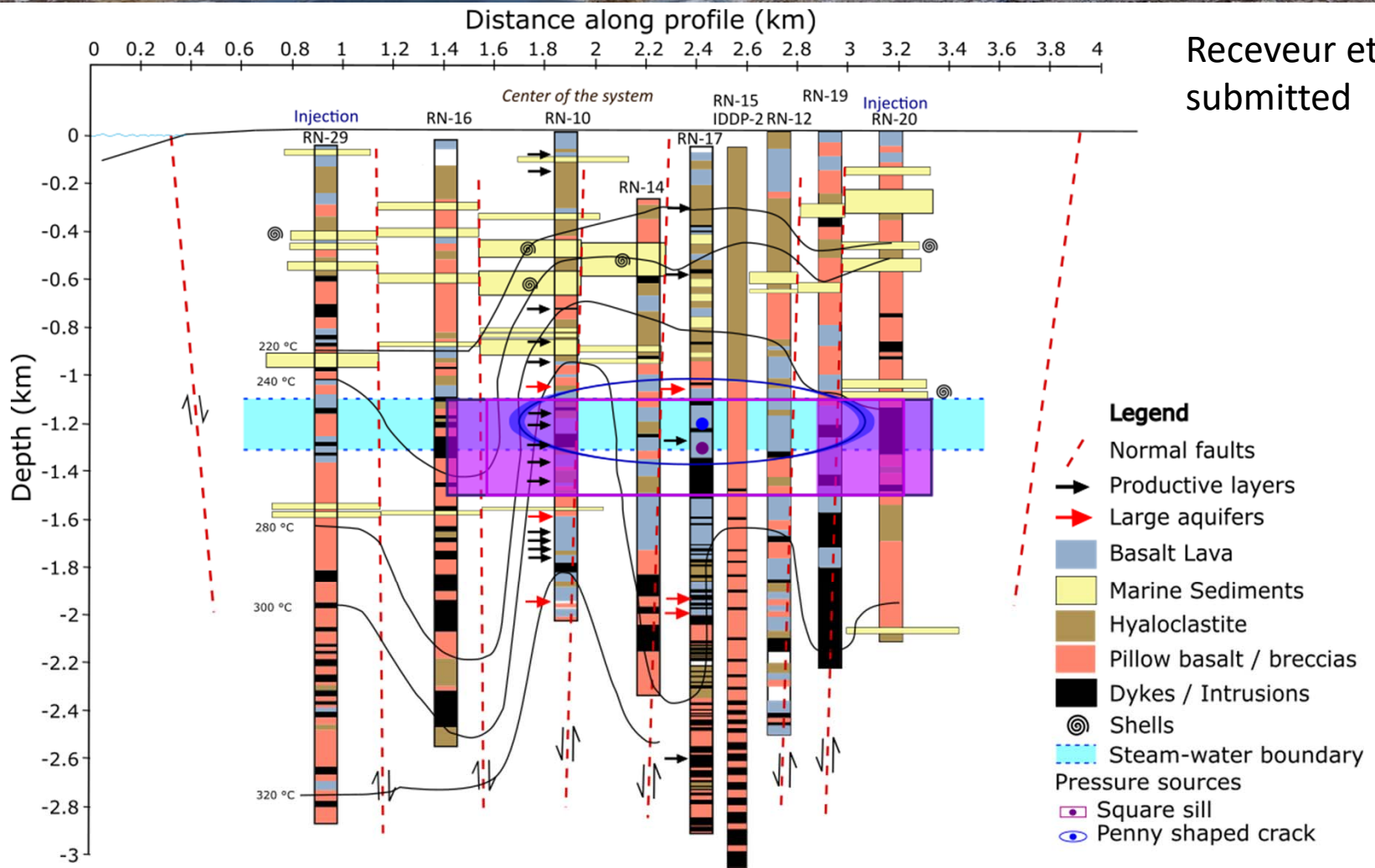
Reykjanes

Cumulative LOS displacements maps

- a. Envisat track 173
- b. Envisat track 138
- c. TSX track T26
- d. TSX track T110

Black circle displays the LOS reference point.

Parks et al., 2018



Receveur et al.,
submitted

Coming years:

- Extensive use of Sentinel-1 interferometry
- EUROVOLC project (2018-2021; Integrating and opening research infrastructures of European interest)

Year	Envisat	Cosmo-SkyMED	TerraSAR-X	Radarsat-2	Sentinel-1
2003	21				
2004	87				
2005	116				
2006	100				
2007	134				
2008	196		2		
2009	59		45		
2010	29	35	70		
2011		41	75		
2012		32	72	6	
2013		24	99	26	
2014		459	179	69	15
2015		351	173	22	358
2016		344	147	42	336
2017		235	112		801
Total:	742	1521	974	165	1510

Conclusions

- New scientific results + societal benefits
- Results communicated to Iceland Civil Protection
- Unrest evaluated: Bárðarbunga / Öræfajökull
- One day COSMO-SkyMed interferograms
- New understanding of magma movements
- Geothermal processes evaluated
- Continued new results / input to hazard evaluation

