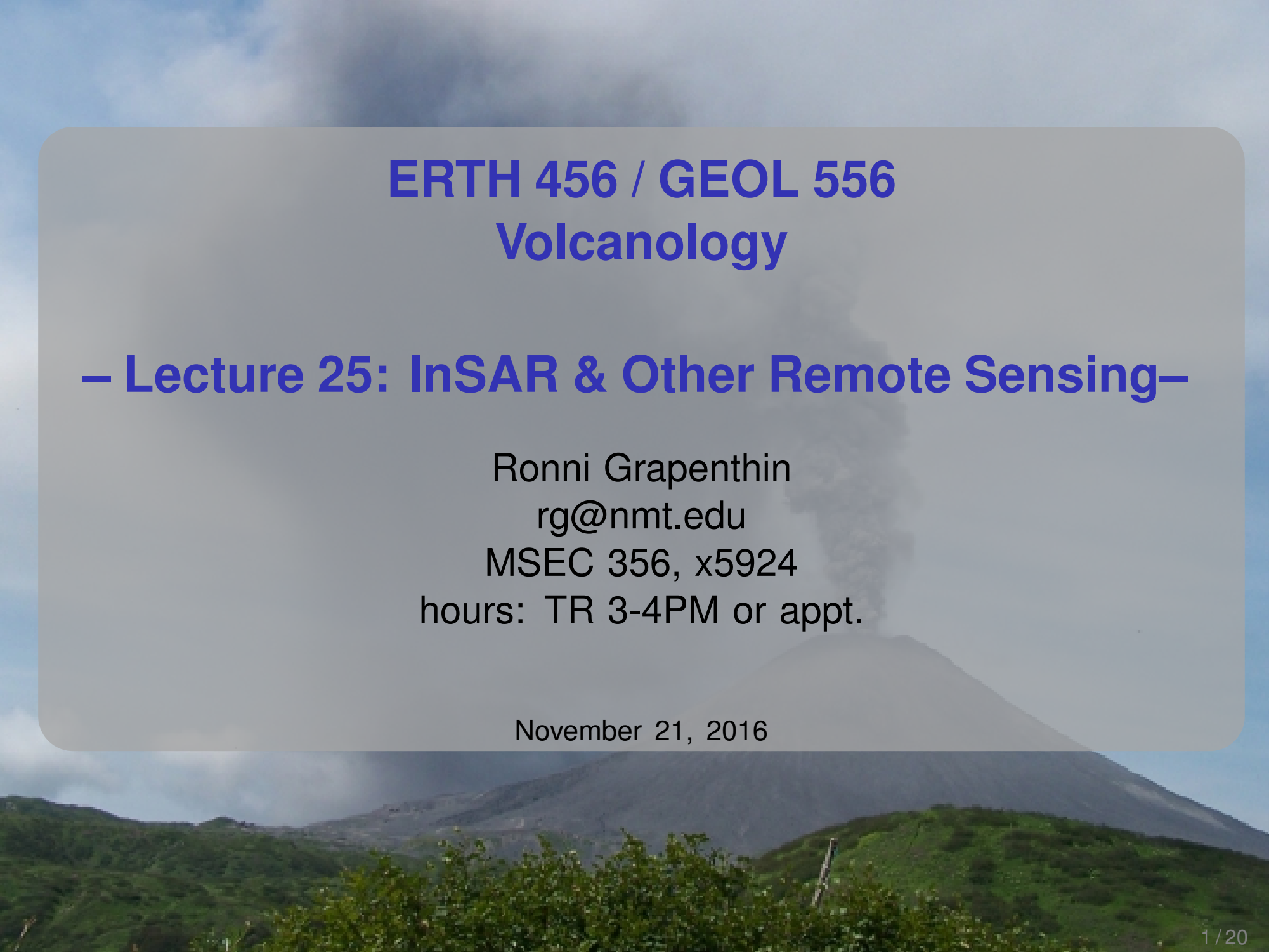

ERTH 456 / GEOL 556
Volcanology

– Lecture 25: InSAR & Other Remote Sensing–

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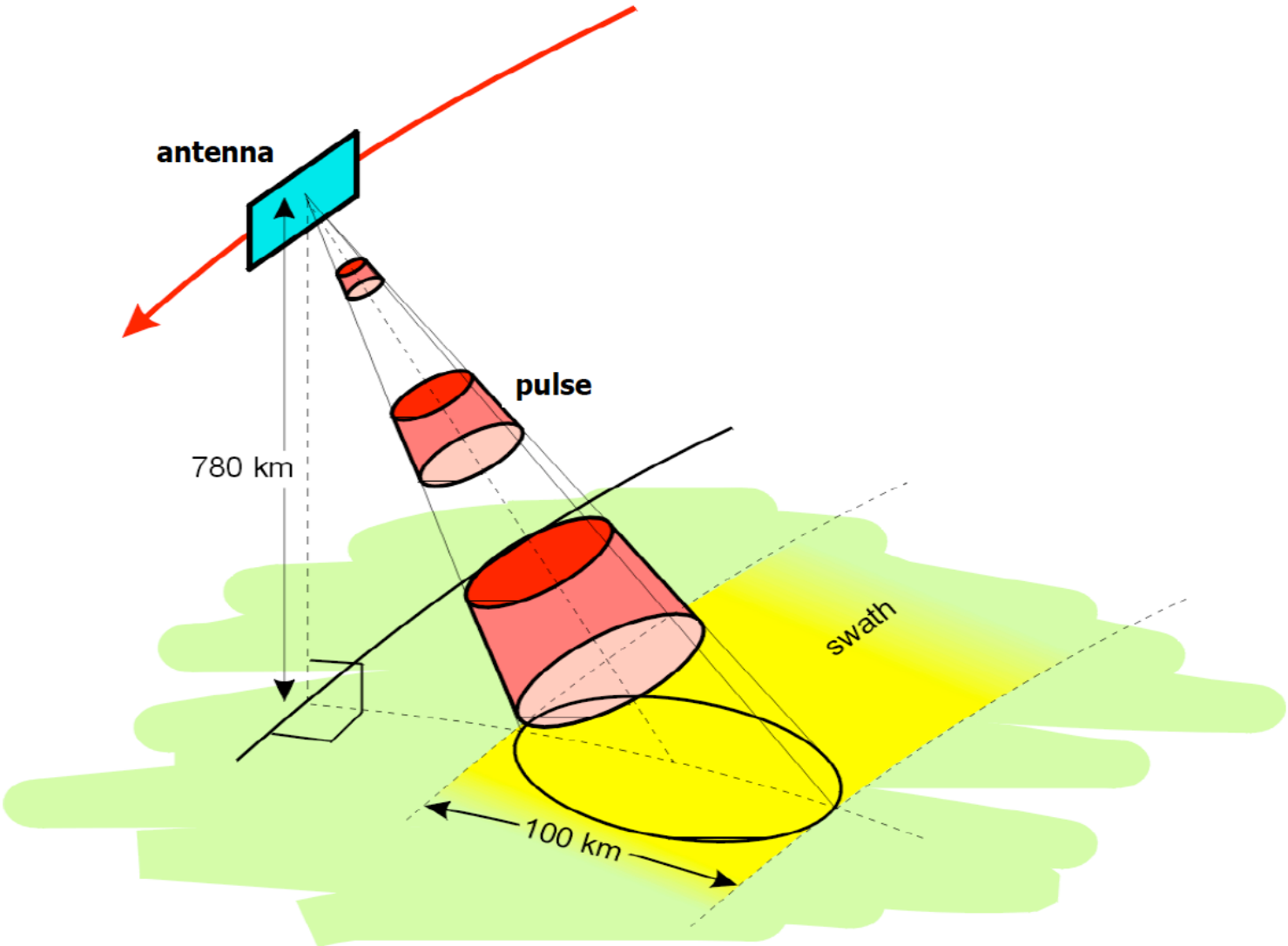
MSEC 356, x5924
hours: TR 3-4PM or appt.

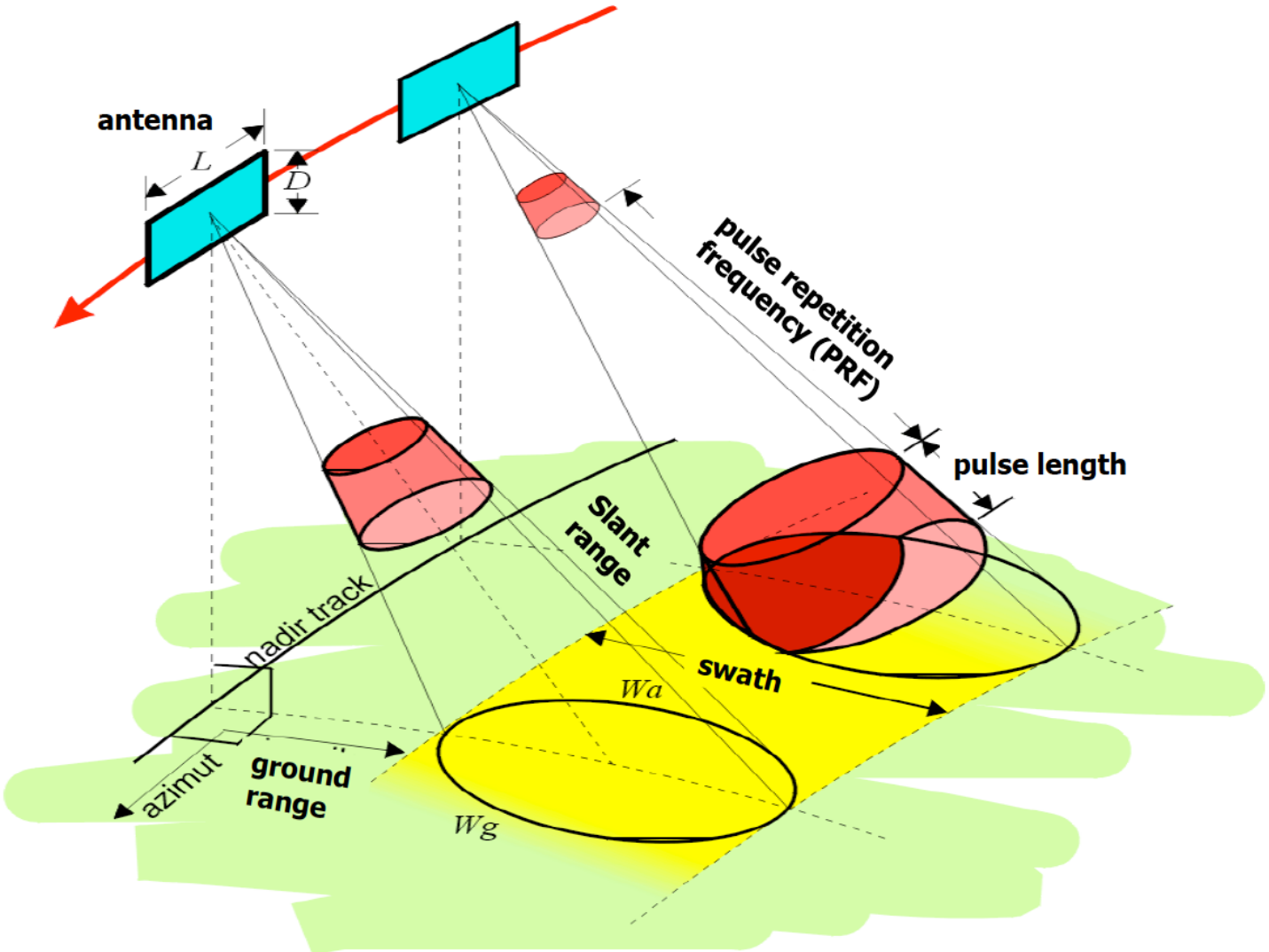
November 21, 2016

InSAR - General Concept



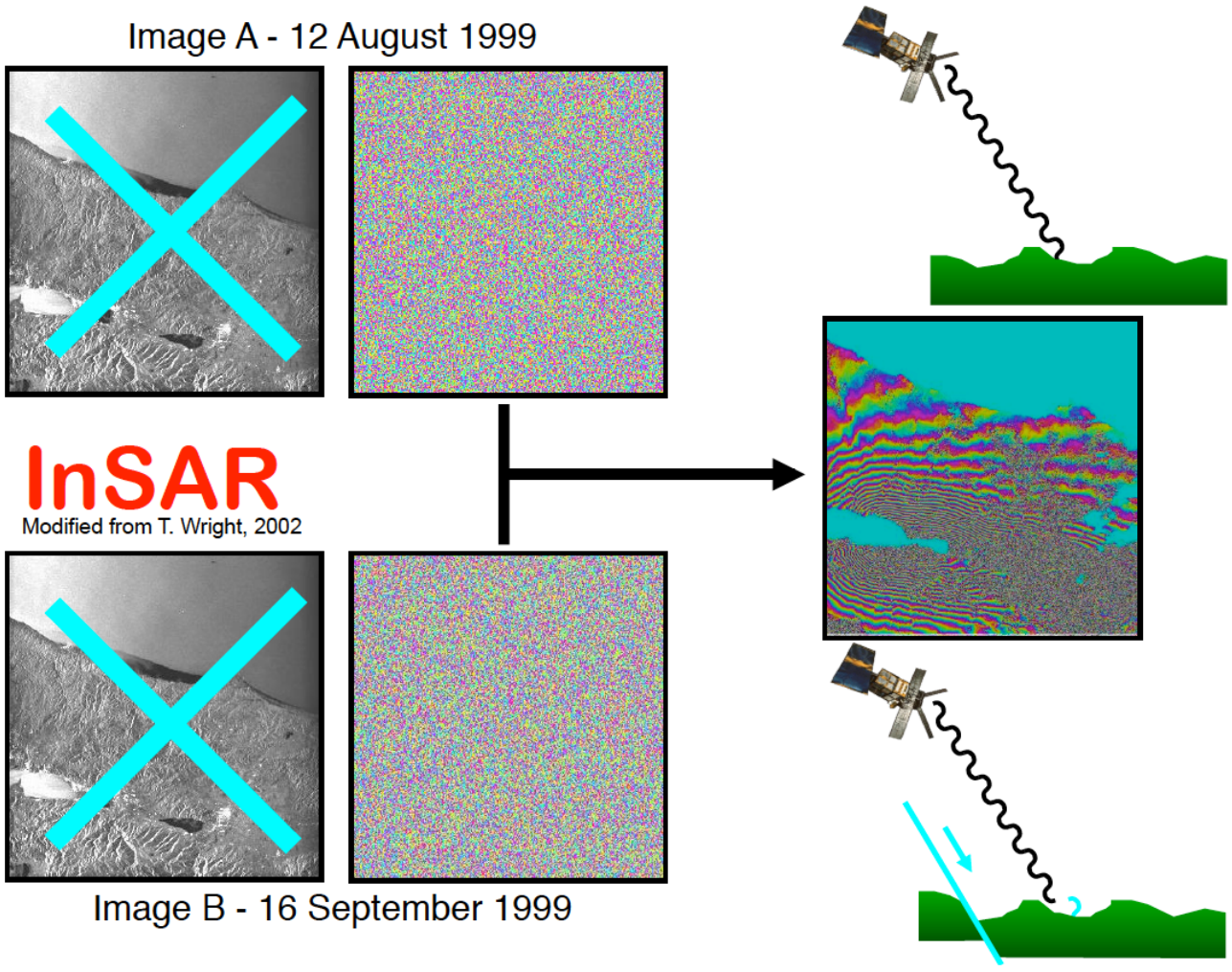
loaned from *J. Freymueller*

InSAR - General Concept



loaned from *J. Freymueller*

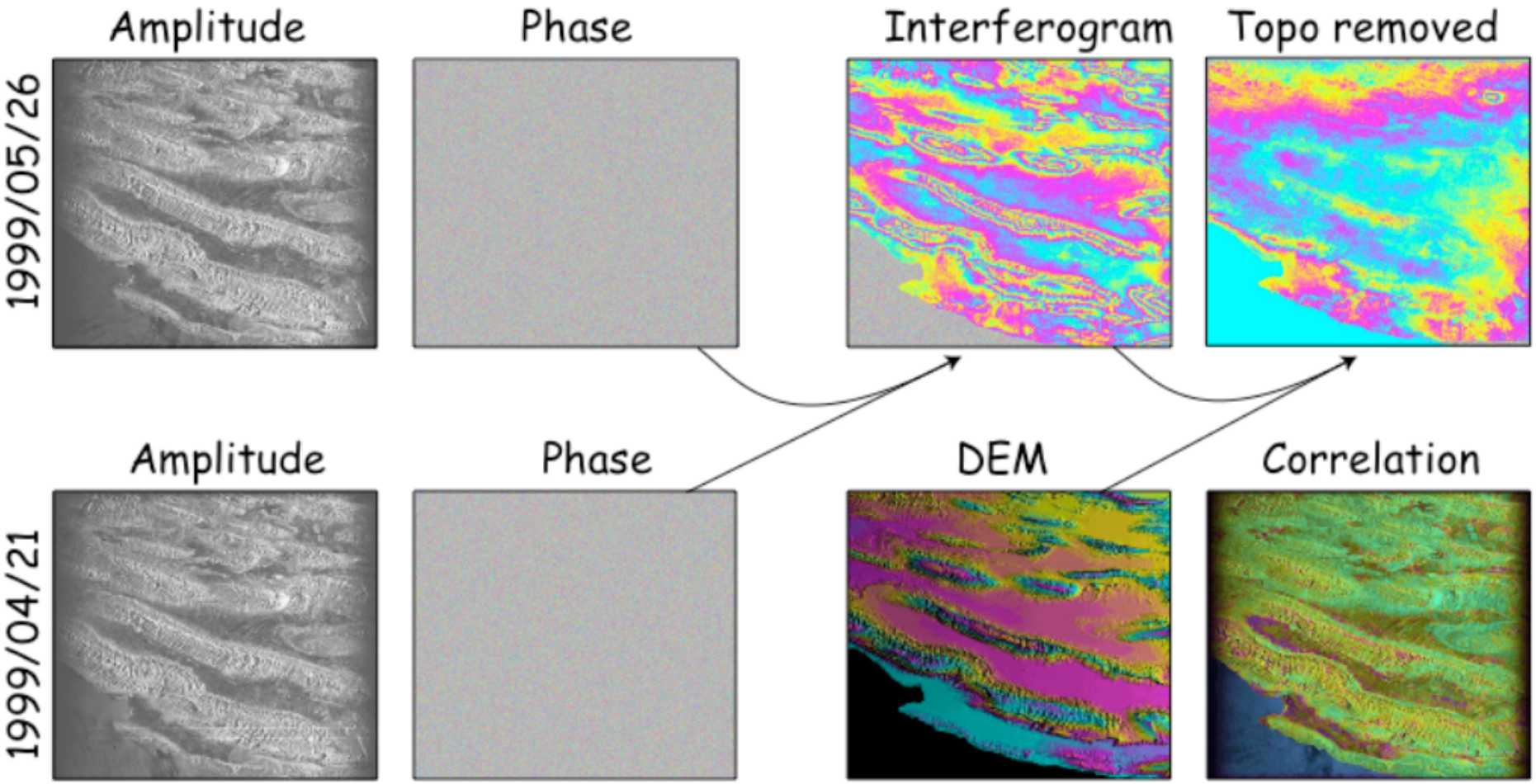
InSAR - General Concept



loaned from *R. Bürgmann*

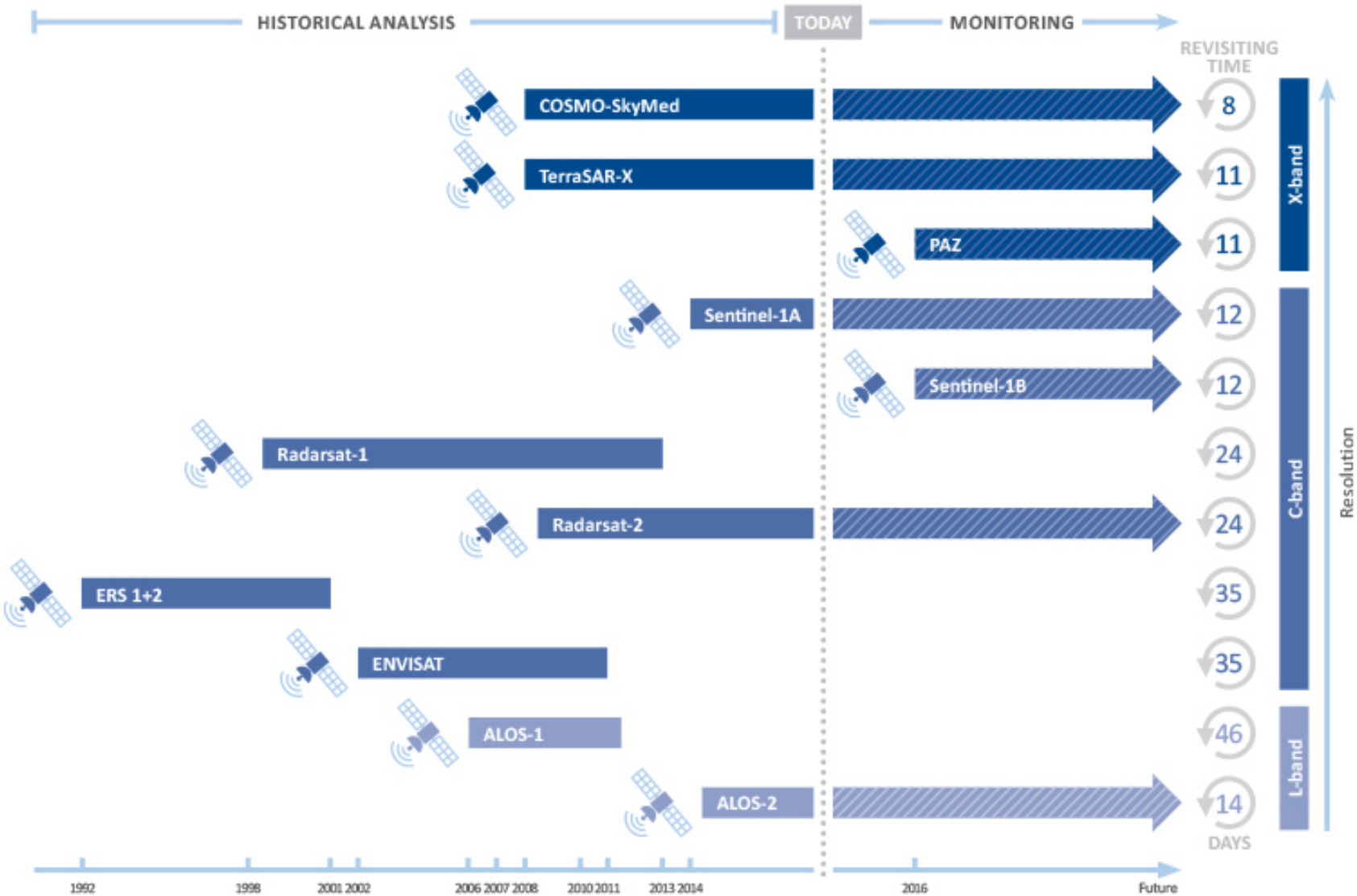
complex values radar signal contains information on amplitude $a = \sqrt{Im^2 + Re^2}$, and phase $\phi = arctan\frac{Im}{Re}$

InSAR - General Concept



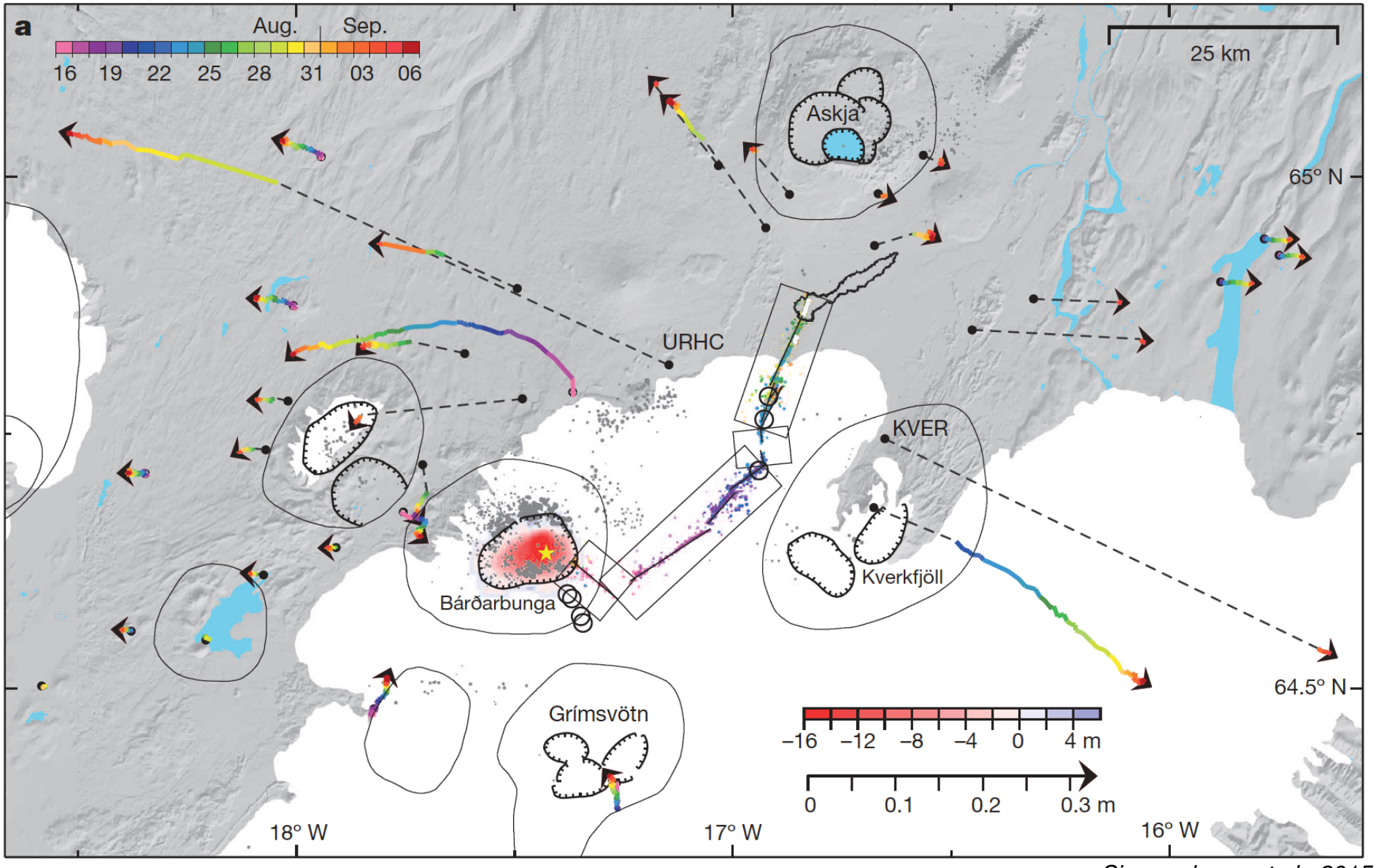
loaned from *J. Freymueller*

InSAR - Mission Overview



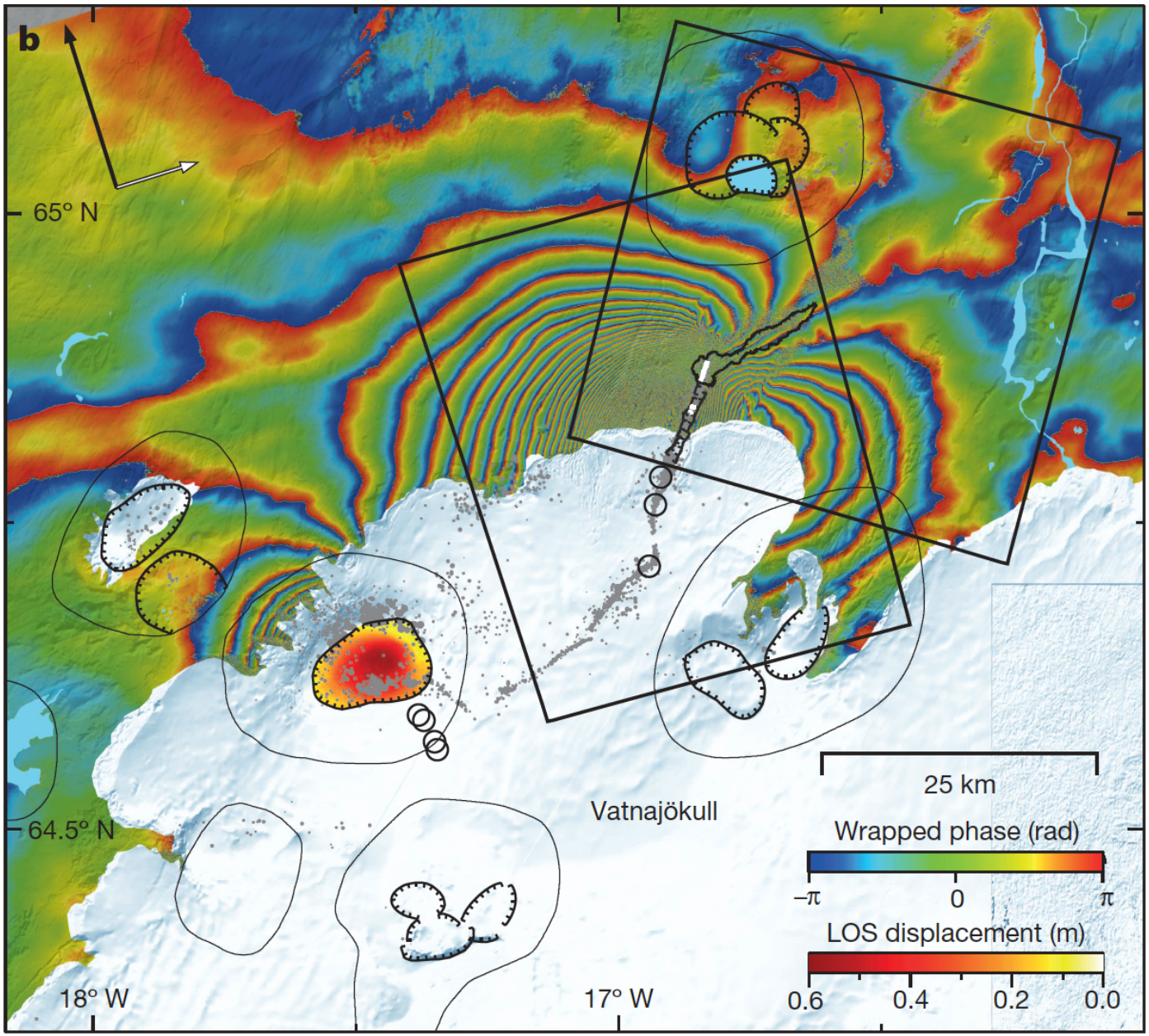
from *http://treuropa.com/newsletter/15-years-expertise-advanced-insar-technology/*

Holuhraun 2014/2015



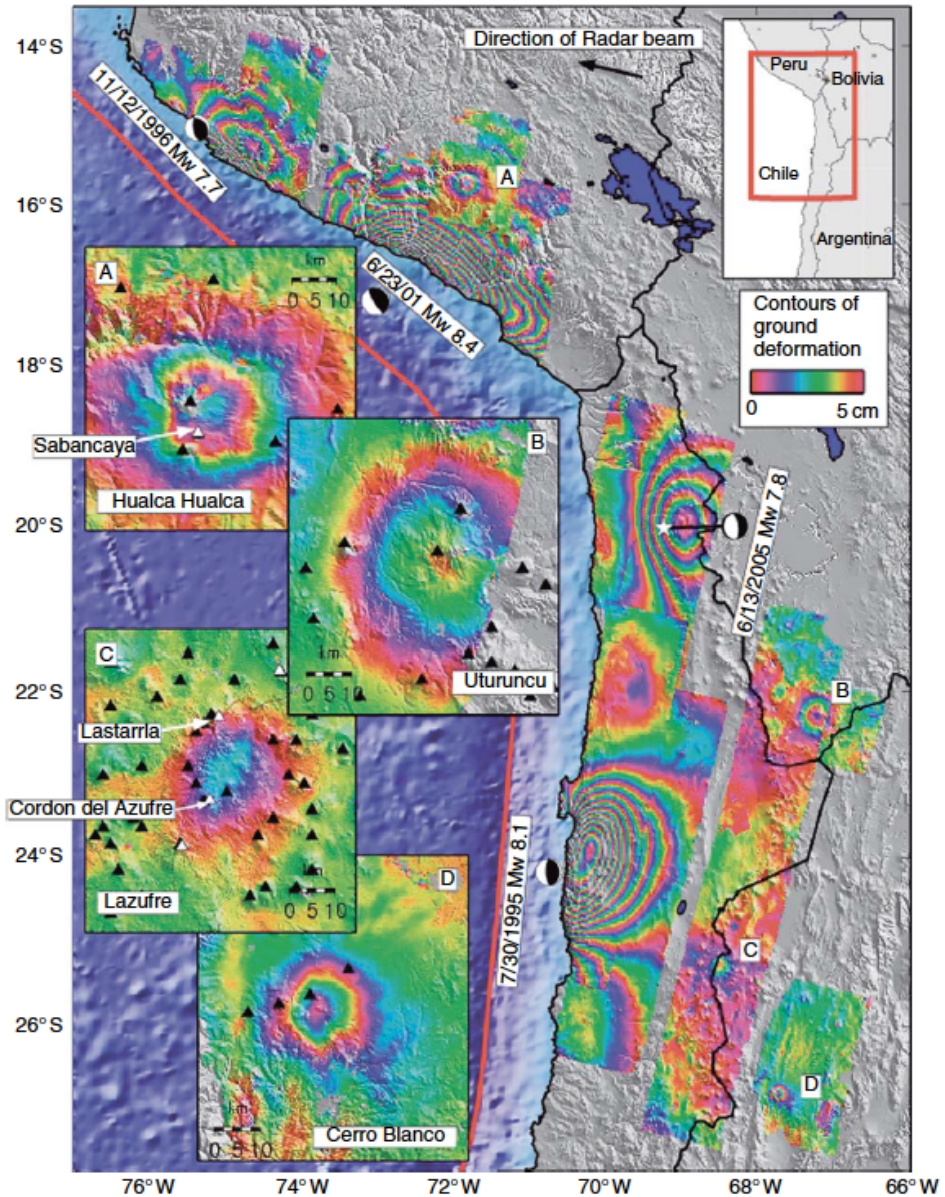
Sigmundsson et al., 2015

Holuhraun 2014/2015



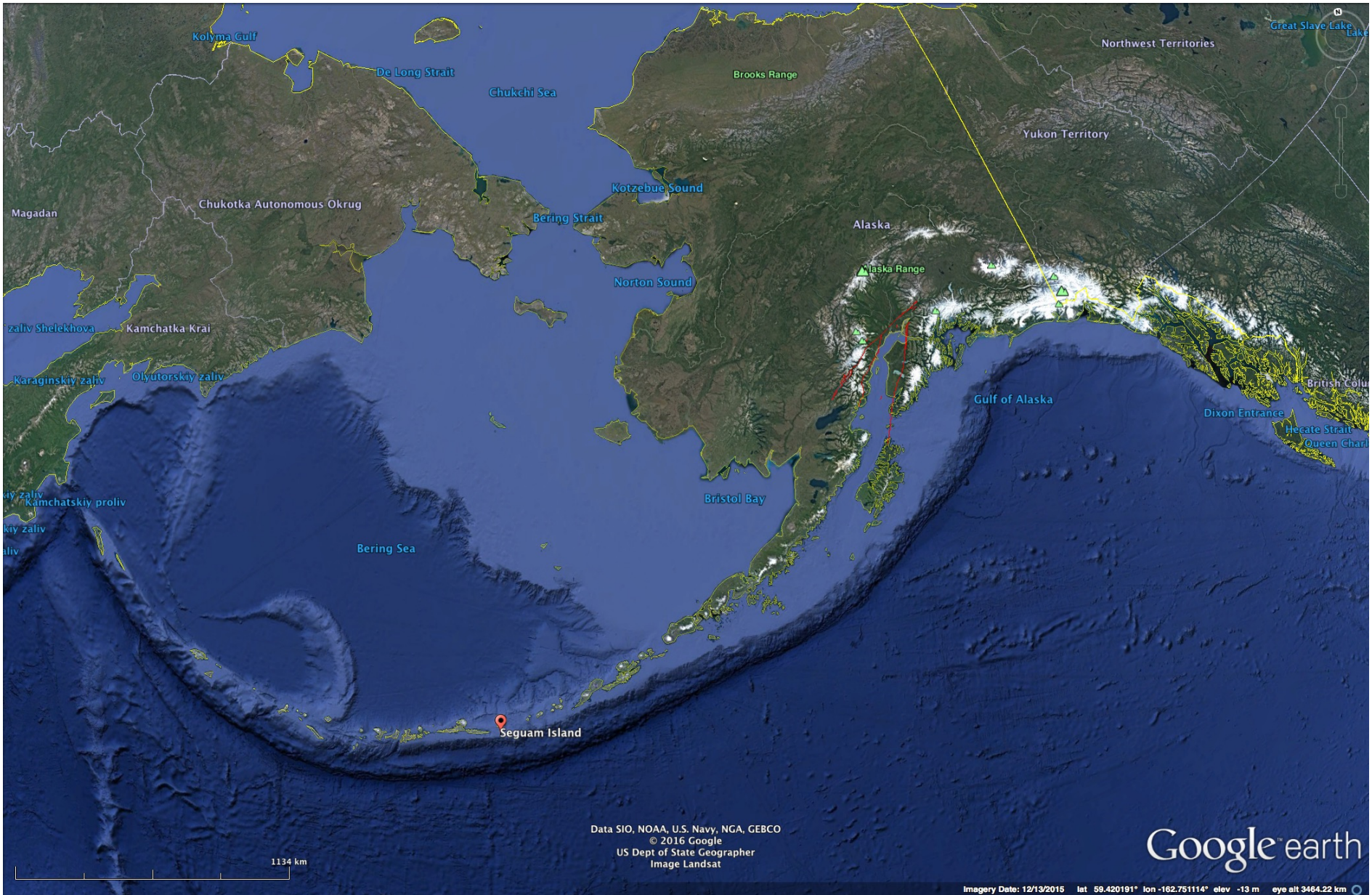
Sigmundsson et al., 2015

South America



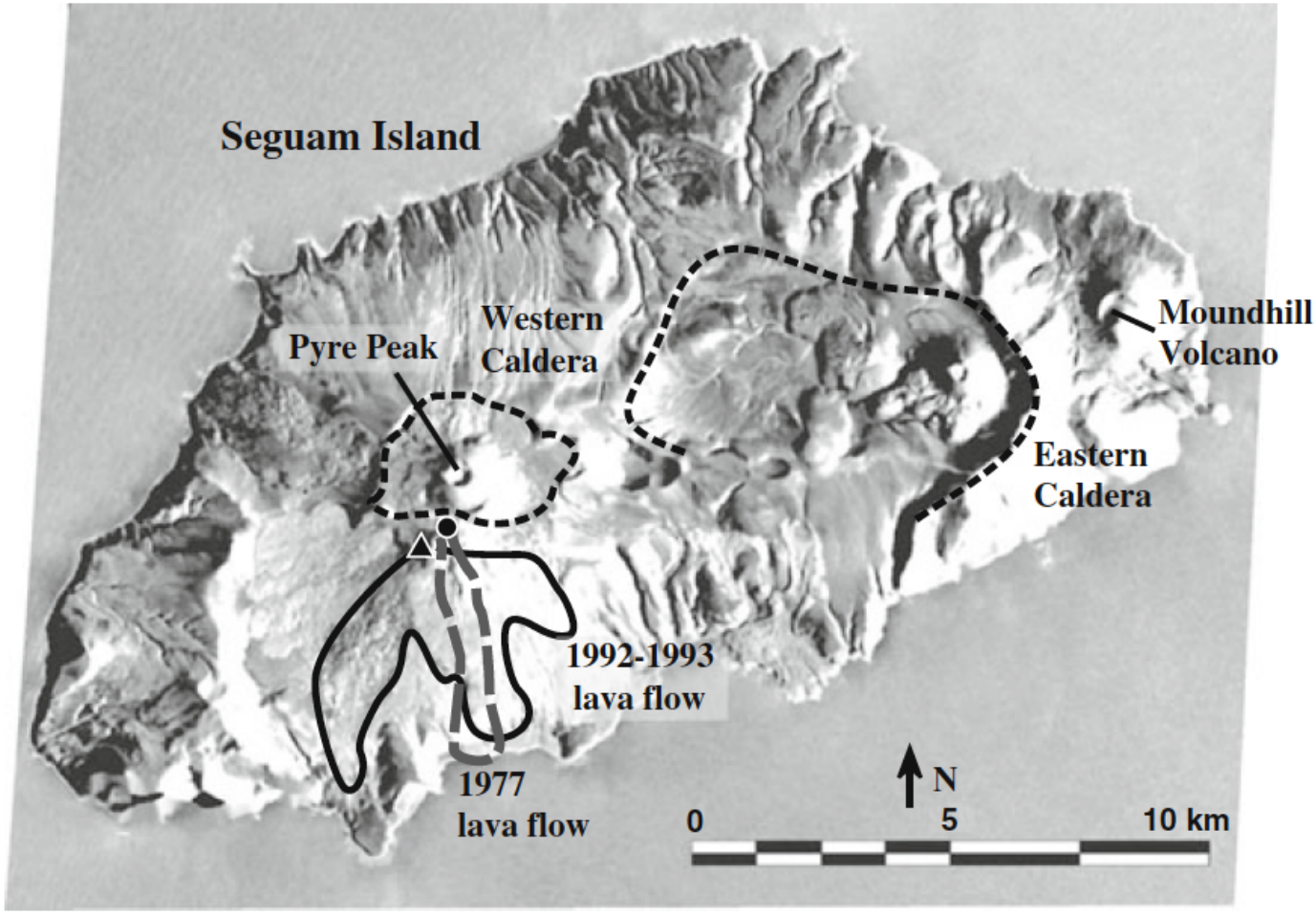
Simons and Rosen, 2007

Seguam, Aleutians



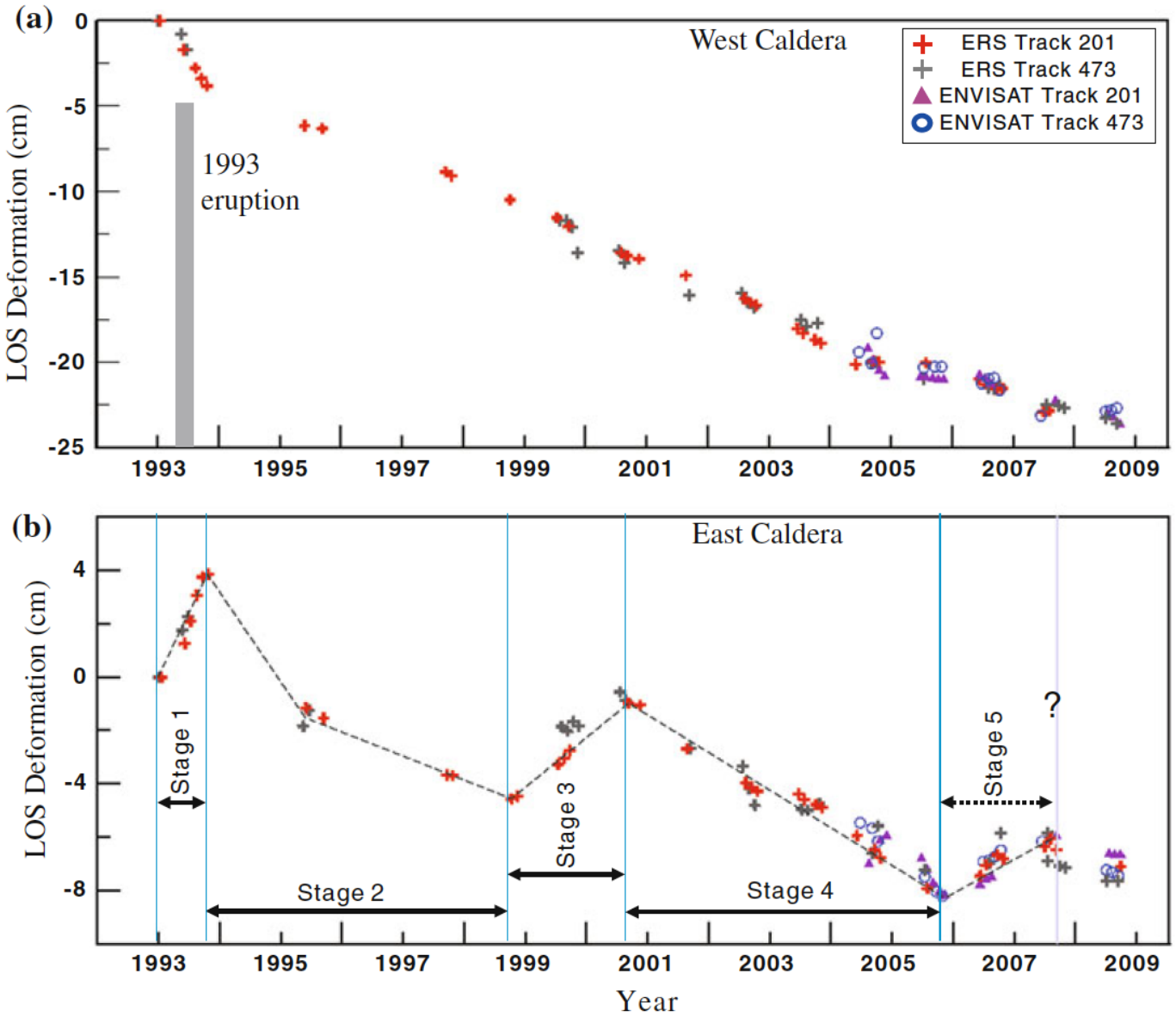
Google Earth

Seguam, Aleutians



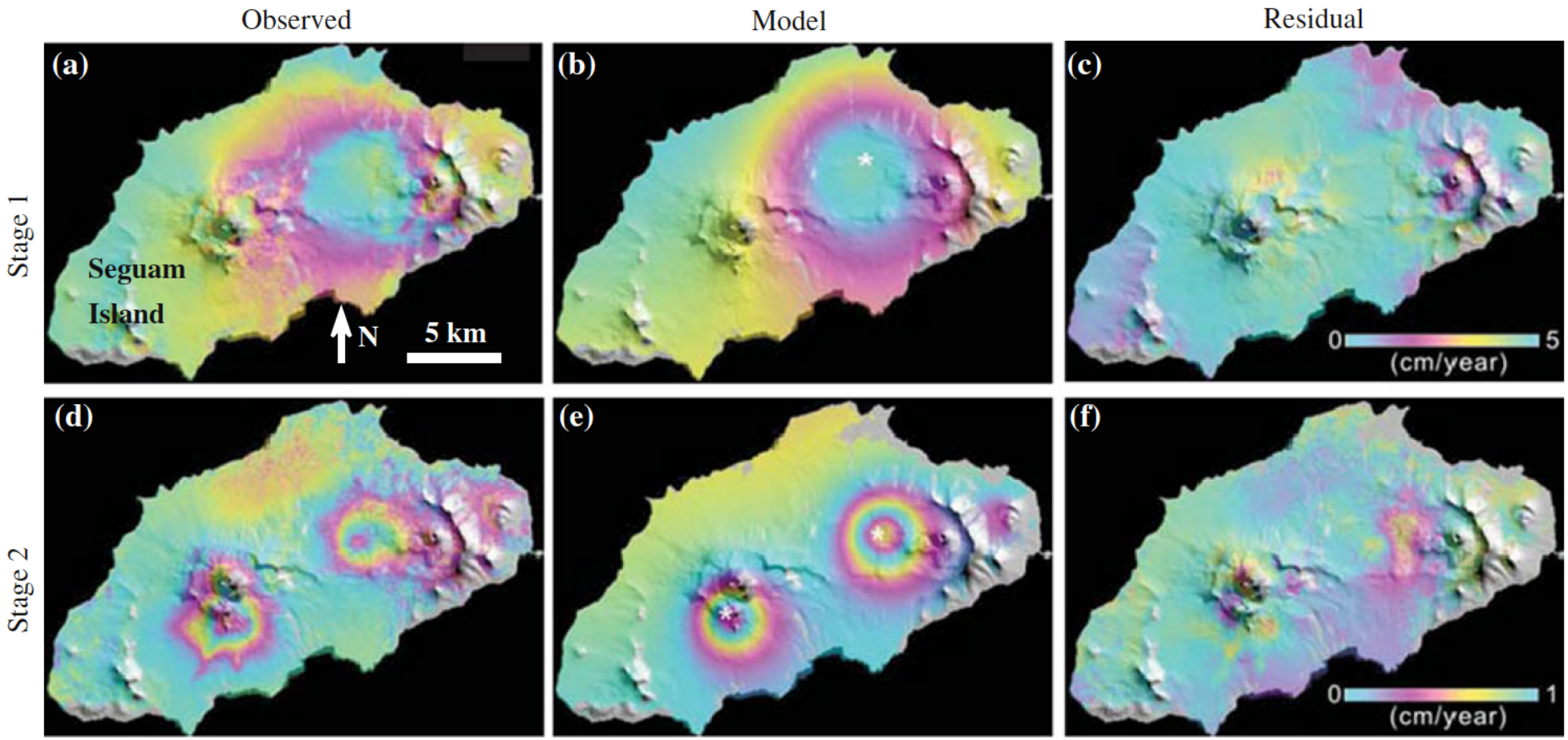
Lu & Dzurisin, 2014

Seguam, Aleutians



Lu & Dzurisin, 2014

Seguam, Aleutians: Source Modeling



Lu & Dzurisin, 2014

Western source (subsidence): 2 km bsl, dV = - 1 $\times$ 10^4 km^3/yr;
Eastern Source (subsidence): 2 km bsl, dV = - 1-2 $\times$ 10^4 km^3/yr;

Eastern Source (uplift): 5.5 km bsl, dV = - 1-3 $\times$ 10^3 km^3/yr;

InSAR & Volanoes: Length- / Timescales

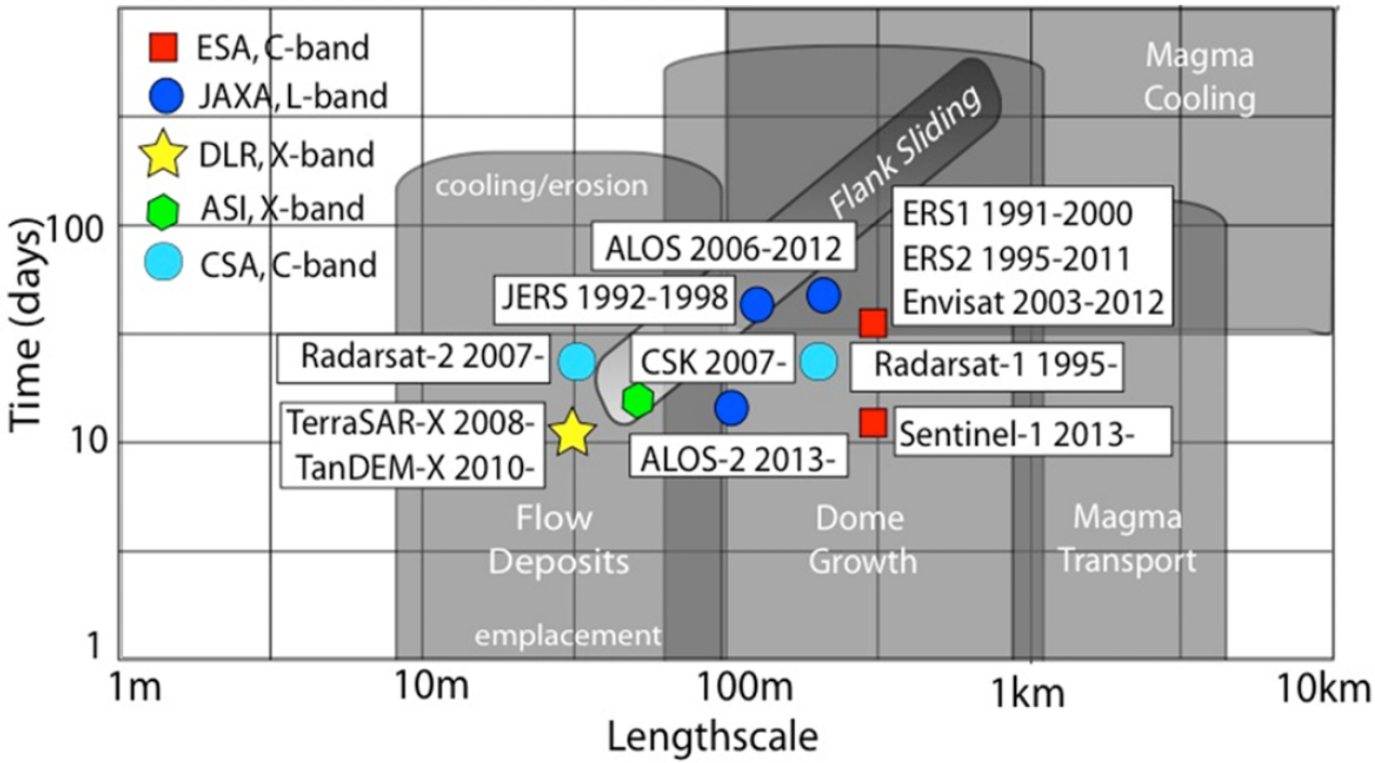


Fig. 2. A schematic illustrating the typical length- and timescales of processes that cause deformation at volcanoes, and the detection limits of past, current and planned satellites. The majority of InSAR studies concern magma transport but flow emplacement, dome growth, flank sliding and magma cooling are also expected to cause deformation. Individual

Pyle et al., 2013

Remote Sensing of Volcanoes

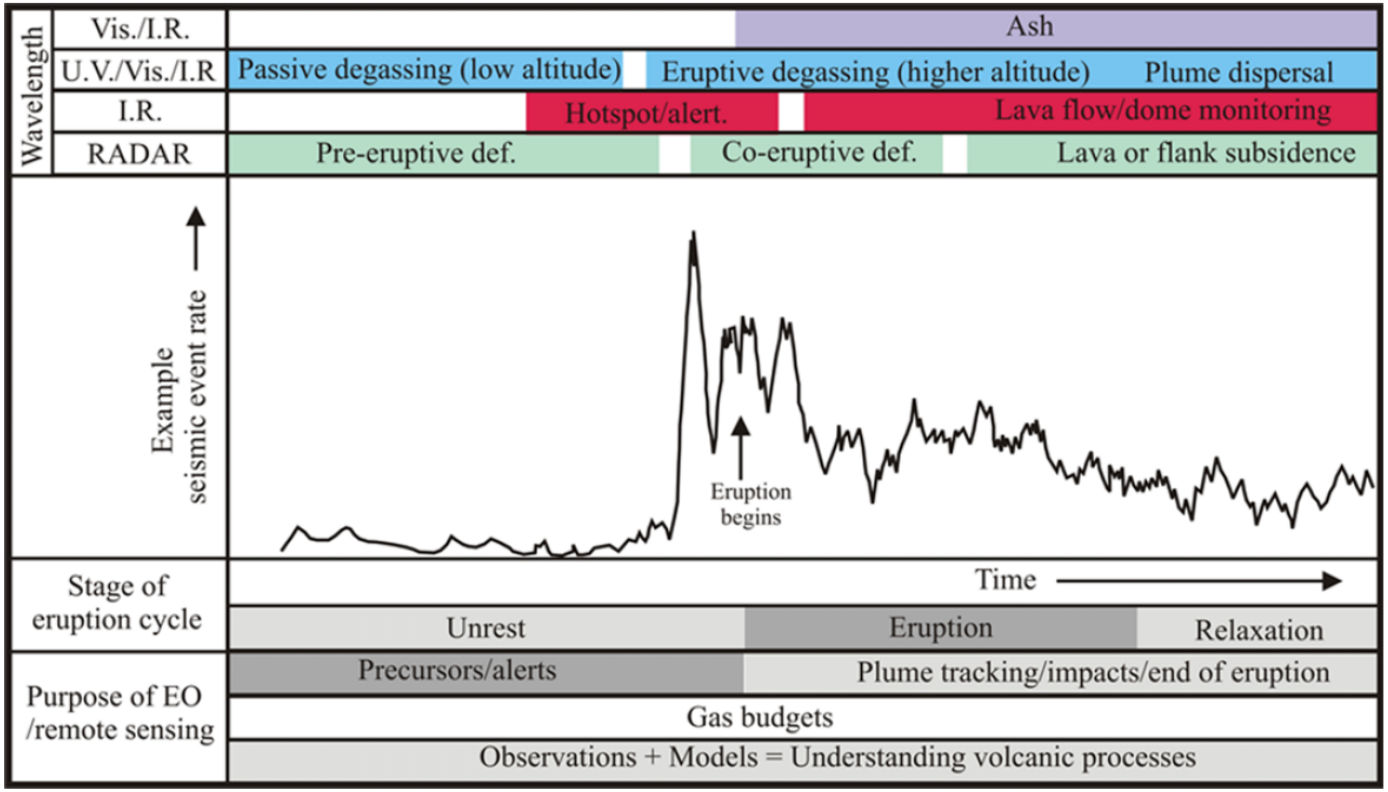
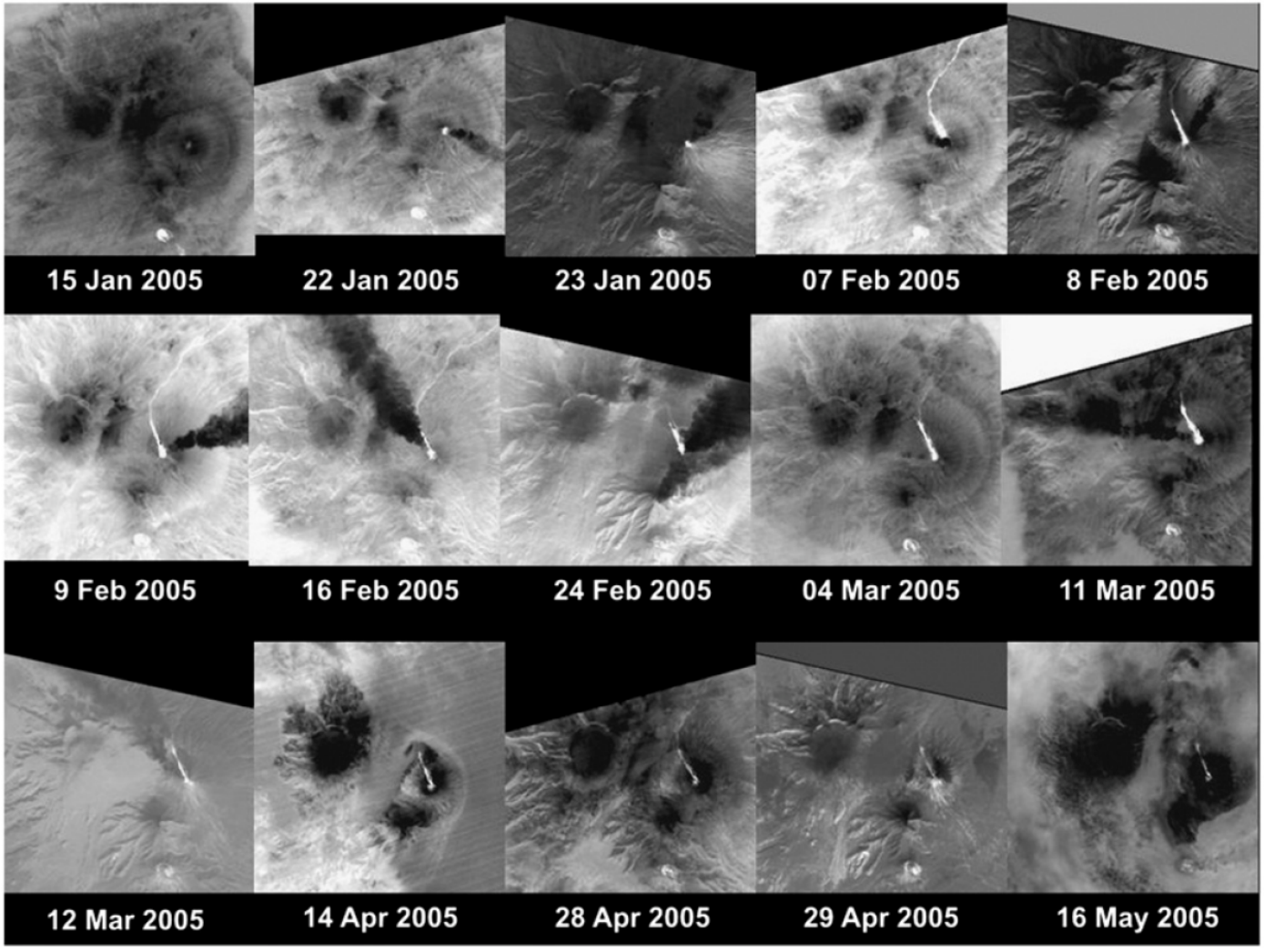


Fig. 1. An illustration of some of the applications of remote-sensing techniques to a volcano during a hypothetical eruption cycle. The example seismic trace is intended to be schematic and is based on the number of seismic events per hour with magnitudes >3.2, 20 March–28 May 1980 at Mt St. Helens. (Robert Tilling) from GVN monthly reports Mount St Helens 05/1980 (SEAN 05:05) http://www.volcano.si.edu/world/volcano.cfm?vnum=1201-05-&volpage=var

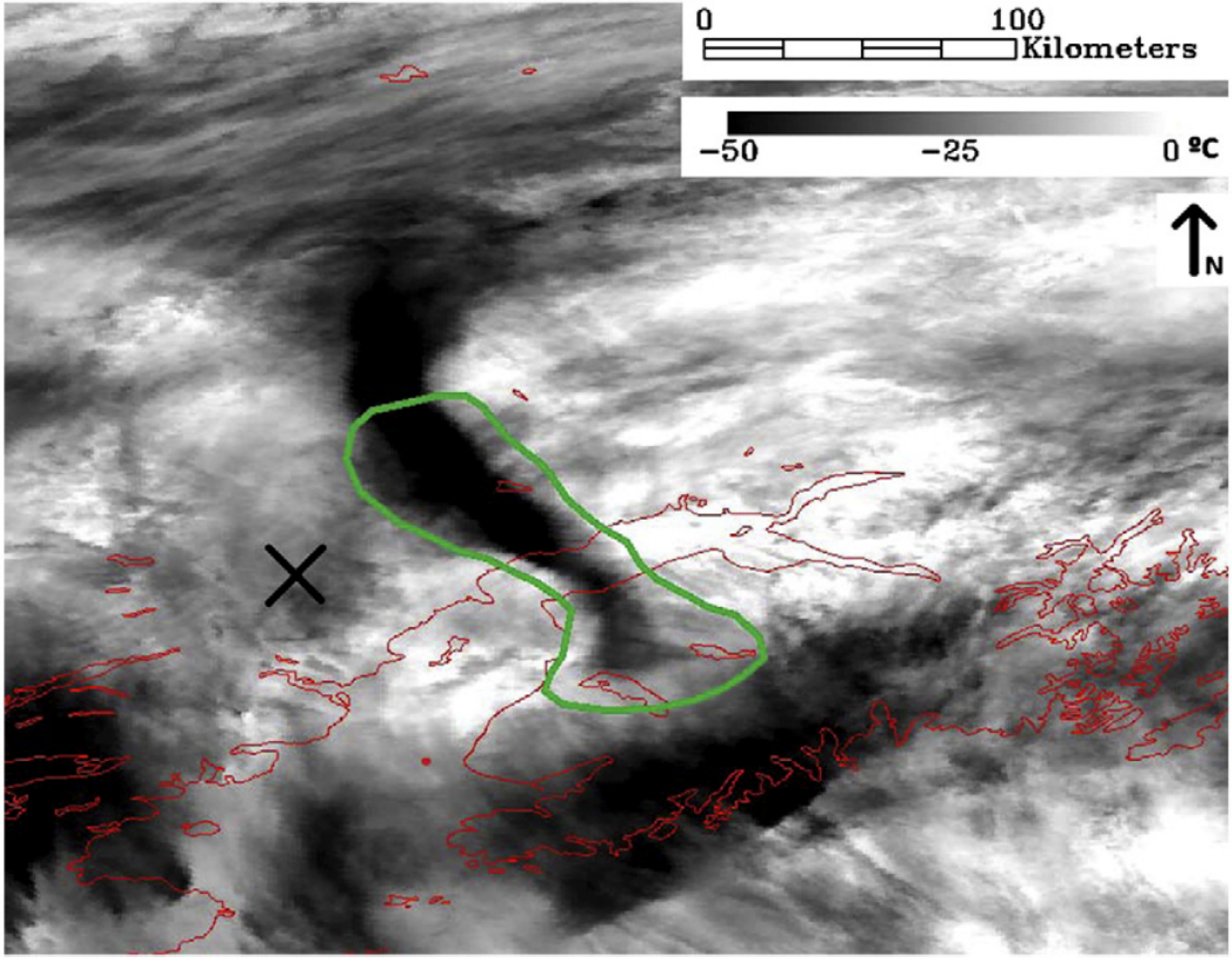
Pyle et al., 2013

Satellite IR: Kliuchevskoy lava (ASTER IR)



Ramsey & Harris, 2013

Satellite IR: Redoubt plumes (AVHRR)

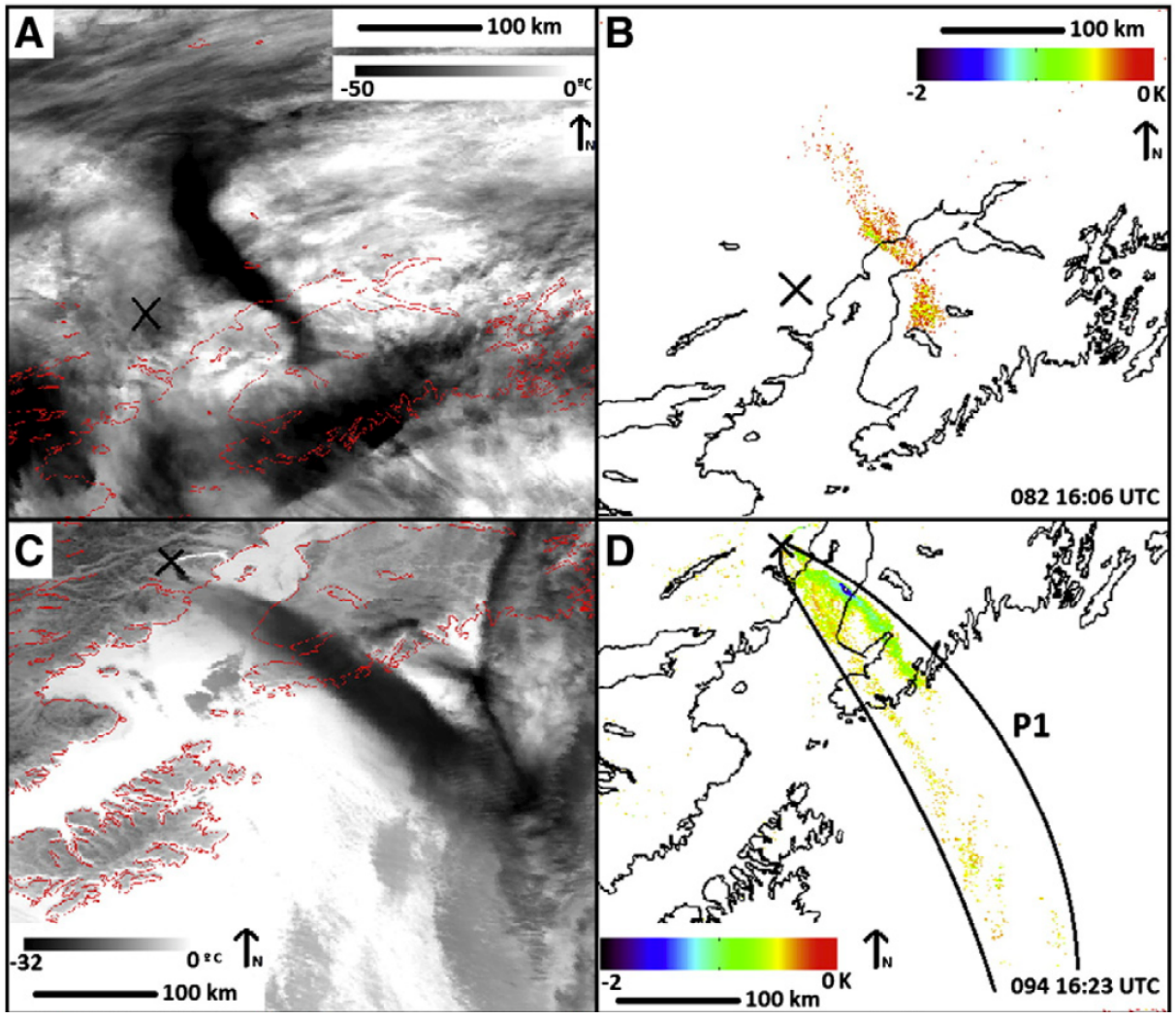


Steensen et al., 2013

Advanced Very High Resolution Radiometer thermal infrared channel 4 image

Repeat Cycle: daily, Resolution: 1 km, Swath Width: 2900 km

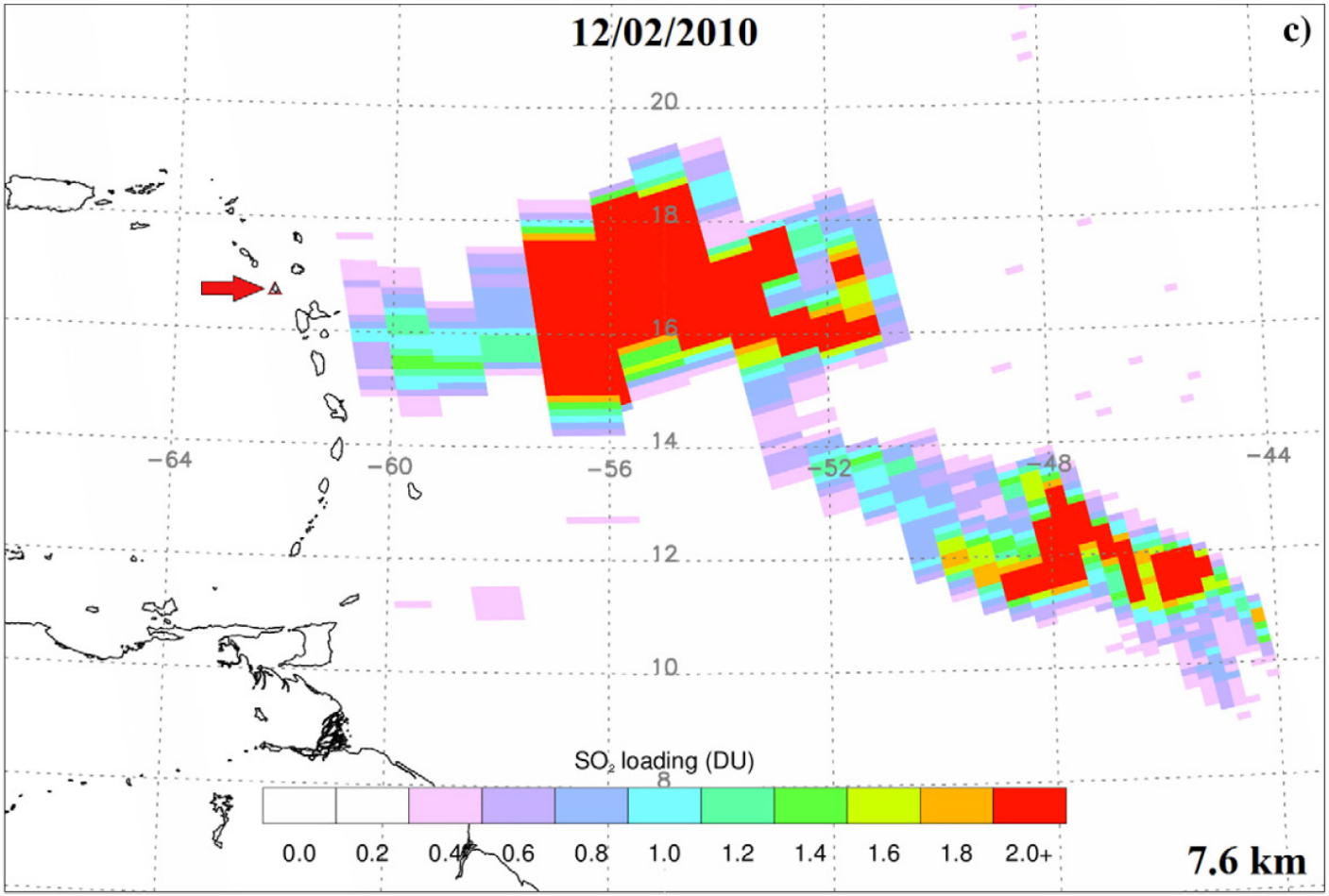
Satellite IR: Redoubt plumes (AVHRR)



Steensen et al., 2013

Comparison to plume dispersion model (PUFF)

Ozone Monitoring Instrument (OMI): Soufriére Hills



Hayer et al., 2016

SVH: 138,381 tons of SO_2

OMI on AURA satellite, 16 day repeat time, measures OMI measures pollutants O_3, NO_3, SO_3, and aerosols. ground resolution: 13 km x 25 km

Satellite Resolution & Repeat Times

Sensor	Temporal Resolution	Spatial Resolution
AVHRR	daily	1×1 km
MODIS	$2 \times$ daily	1×1 km
OMI	16 days	13×24 km
ASTER	16 days	TIR: 90 m
GOES	geostat. US (several minutes)	TIR: 4-8 km, visible: 1 km
GOES-R	geostat. US 30 sec intervals	TIR: 1-2 km, visible: 0.5 km

NASA, NOAA