

CGPS monitoring of crustal deformation in Iceland

A background image showing a GPS receiver on a tripod in a snowy, rocky landscape. The receiver is a white dome-shaped antenna mounted on a metal tripod. The ground is covered in snow and rocks. In the background, there are more rocks and a hazy sky.

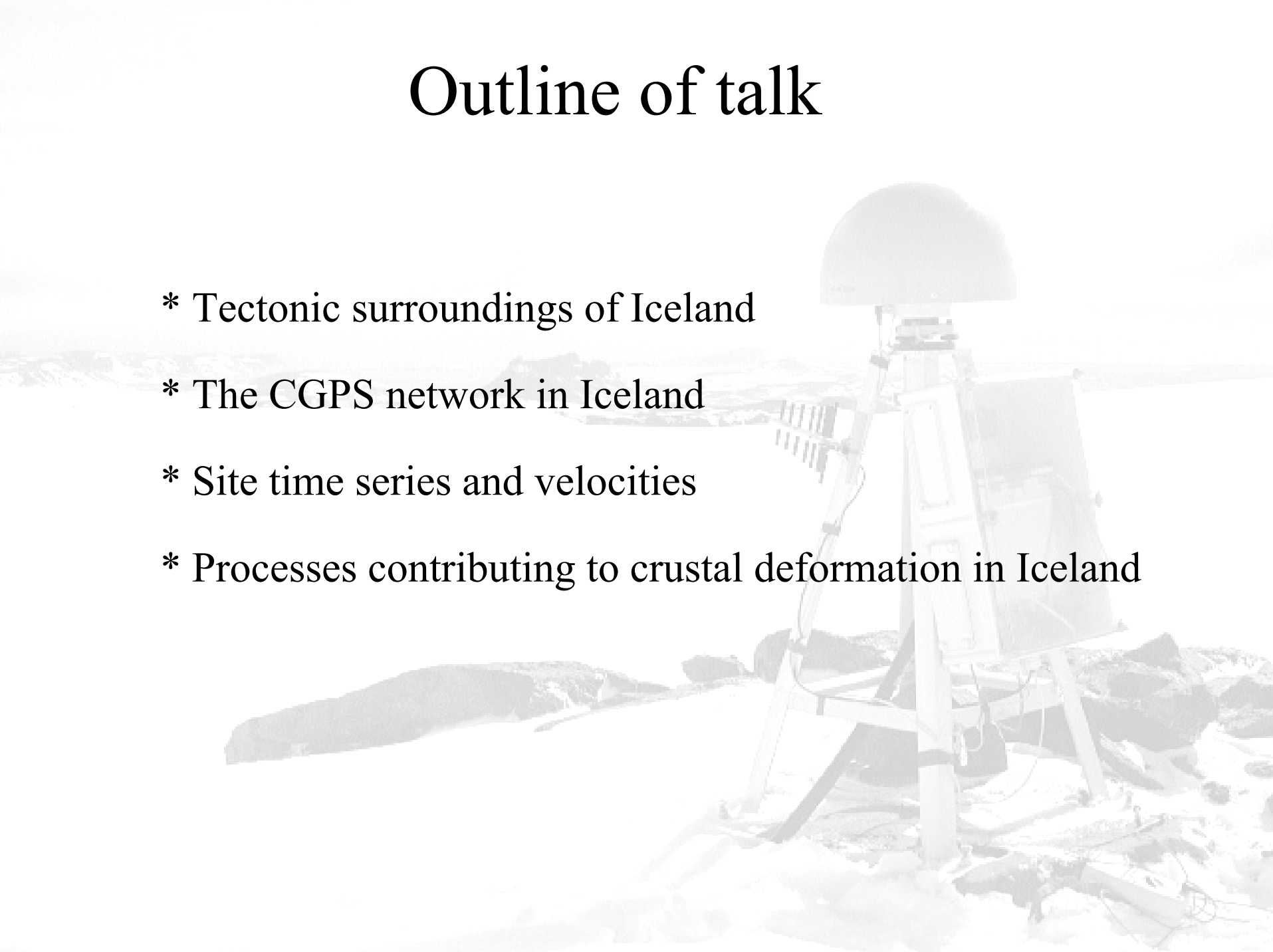
Halldór Geirsson (1), Erik Sturkell (2), Þóra Árnadóttir (2)
with contribution from many other...

1: Icelandic Meteorological Office

2: Nordic Volcanological Center, Univ. Iceland

Outline of talk

- * Tectonic surroundings of Iceland
- * The CGPS network in Iceland
- * Site time series and velocities
- * Processes contributing to crustal deformation in Iceland



Tectonic settings I: the plate boundary

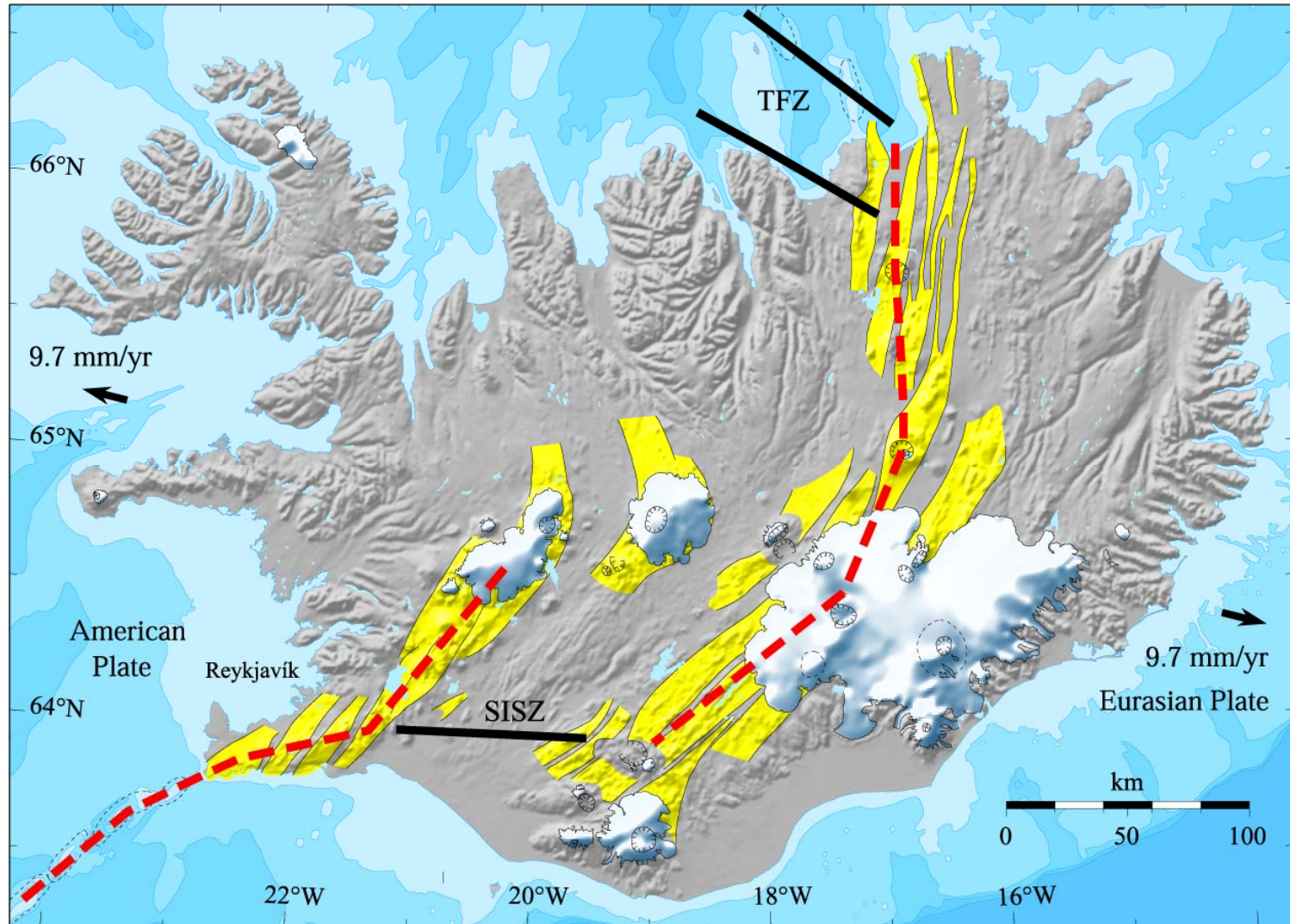
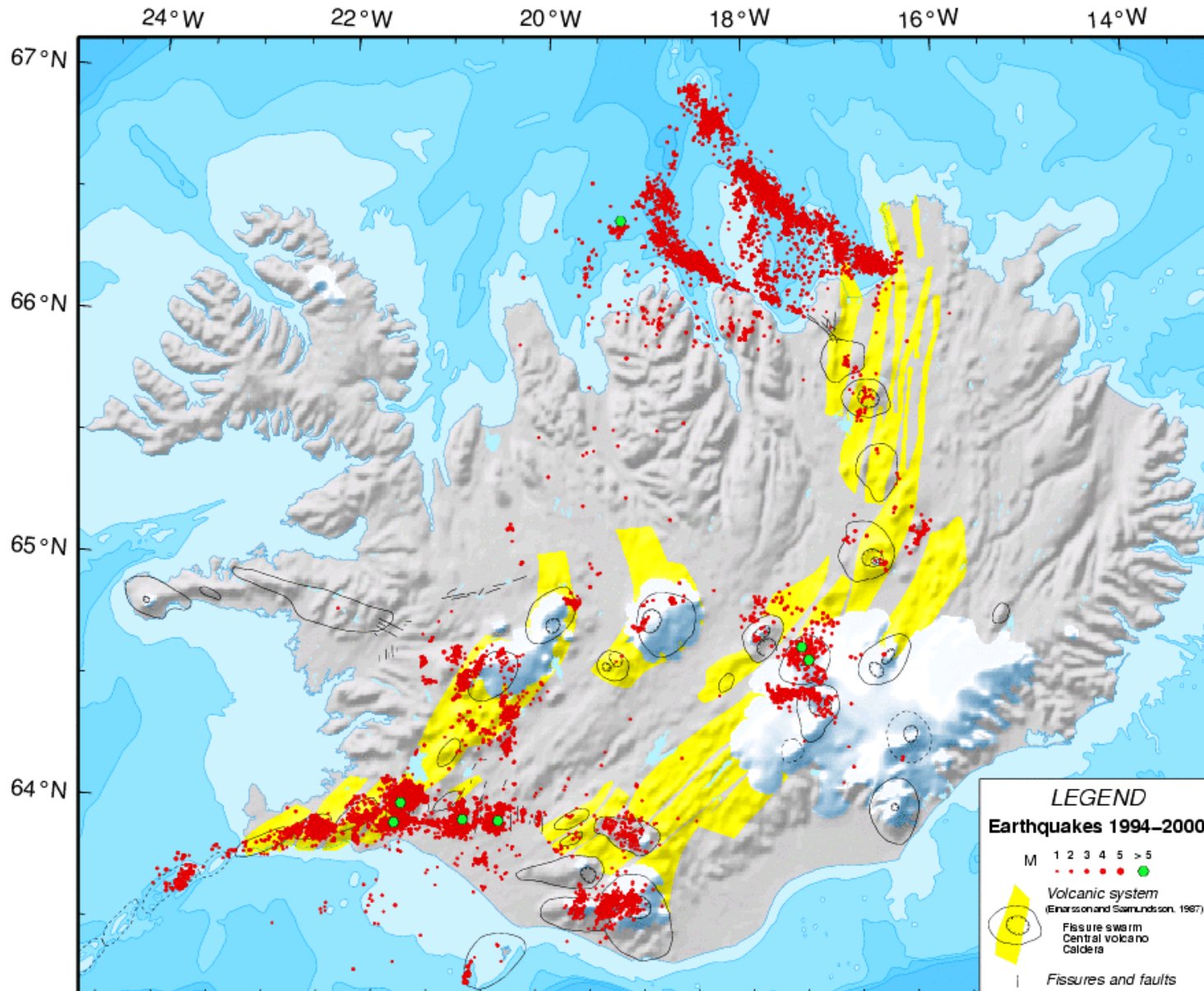


Figure: Erik Sturkell

Tectonic settings II, earthquake activity 1994 - 2000



Tectonic settings III, volcanic deformation 1990 - 2005

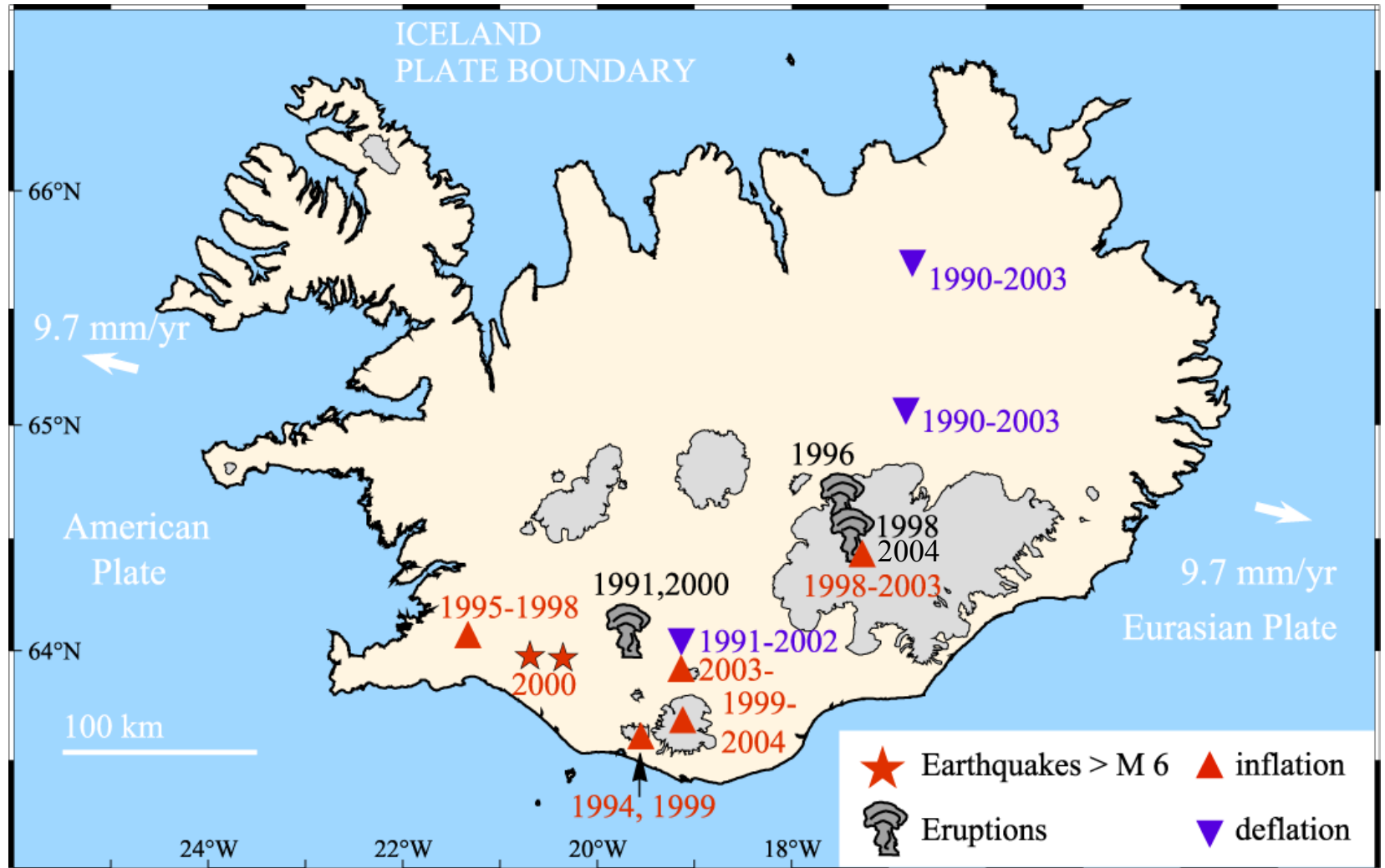
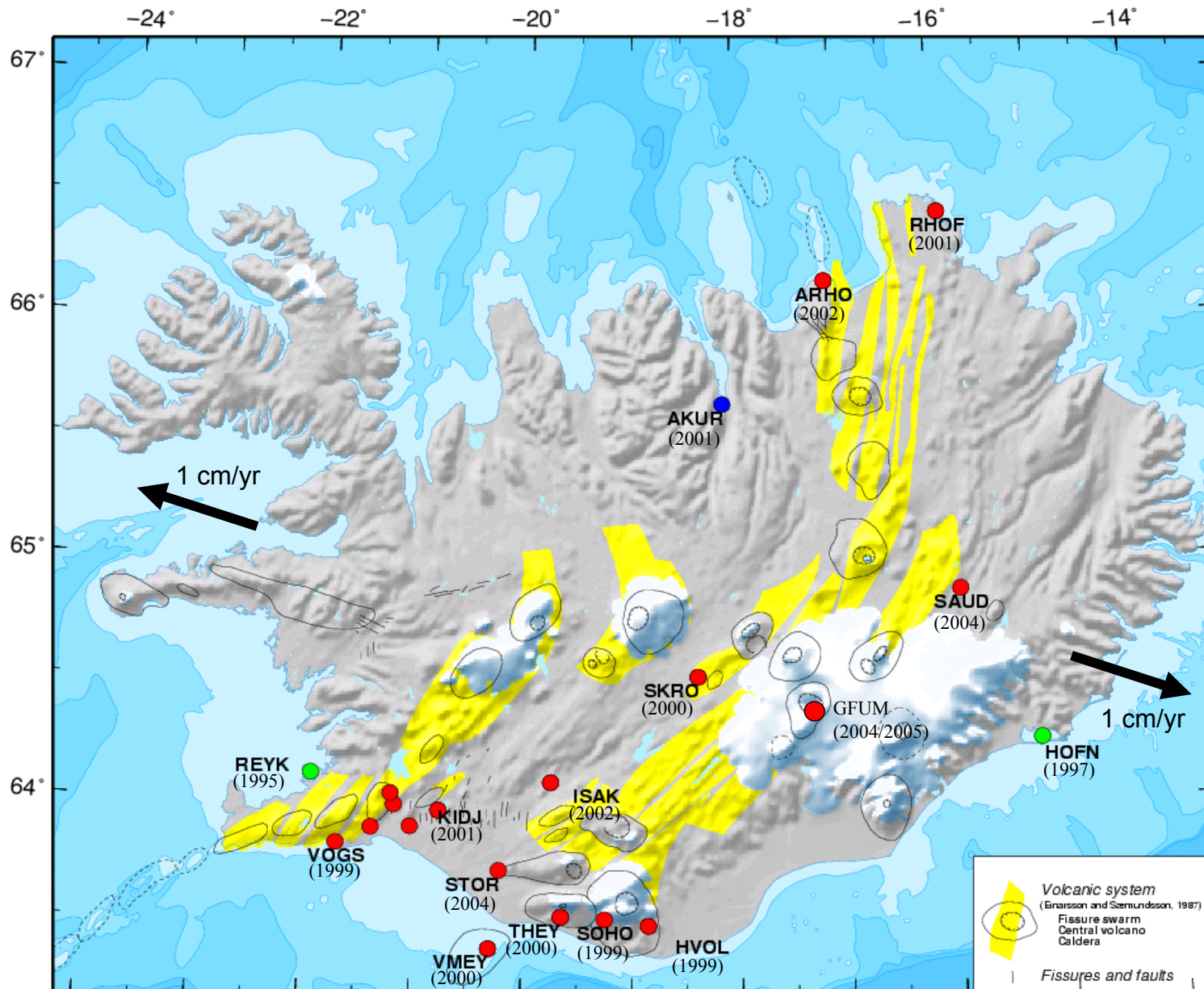
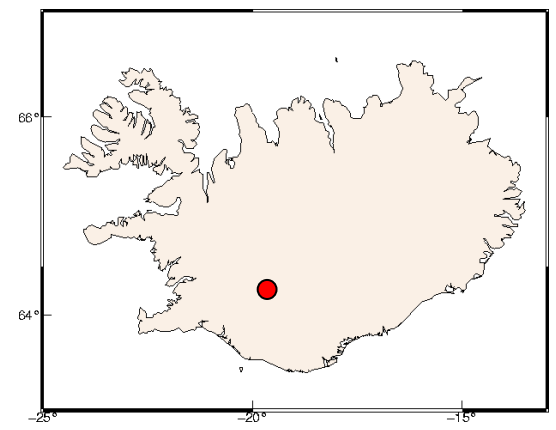


Figure: Erik Sturkell

The CGPS network in Iceland



Station ISAK



Station SOHO

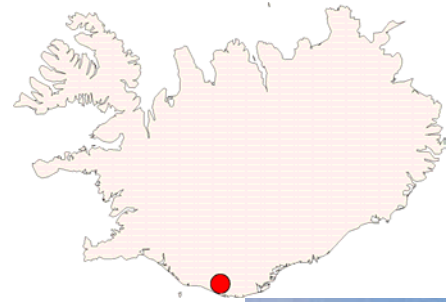
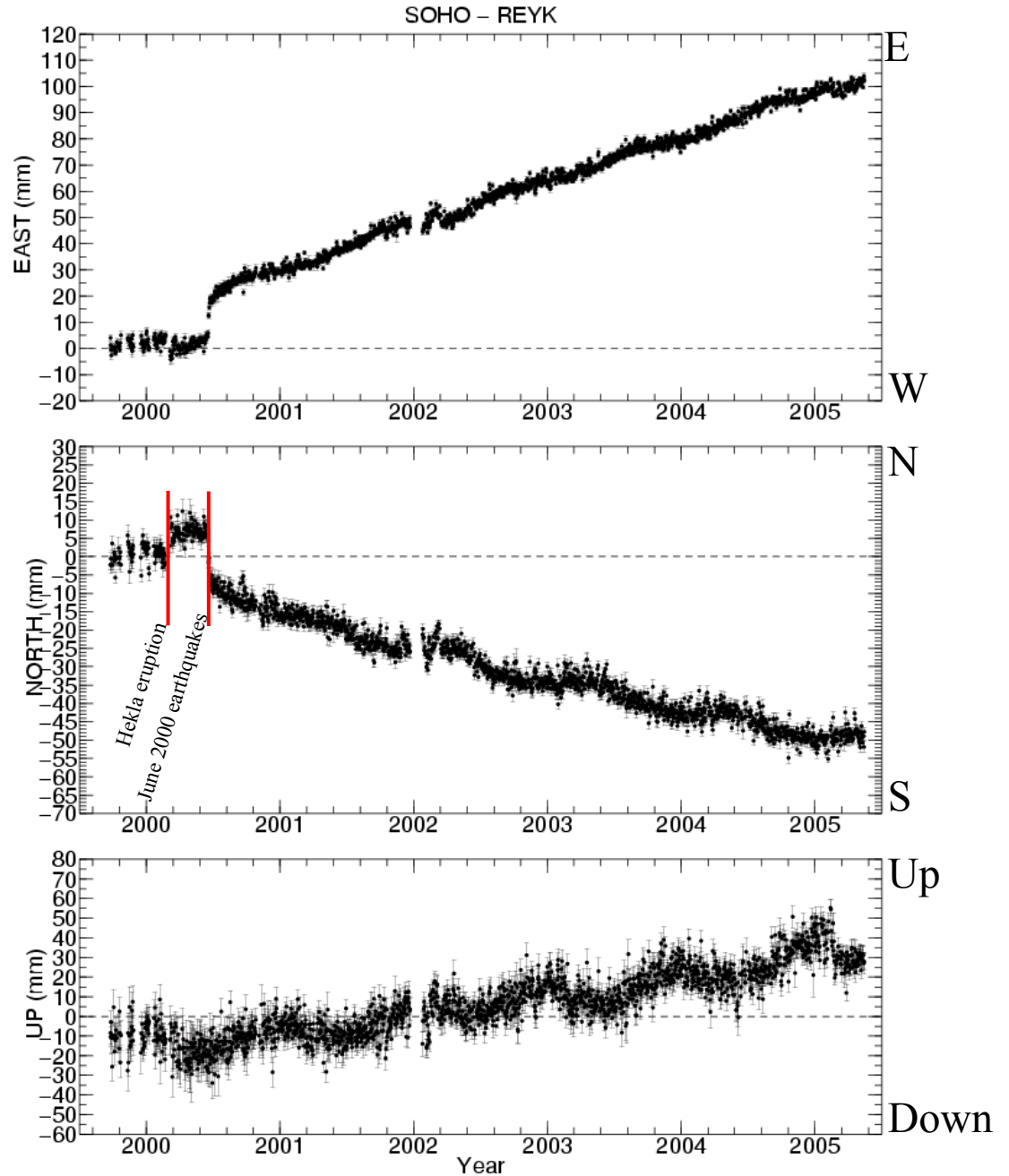
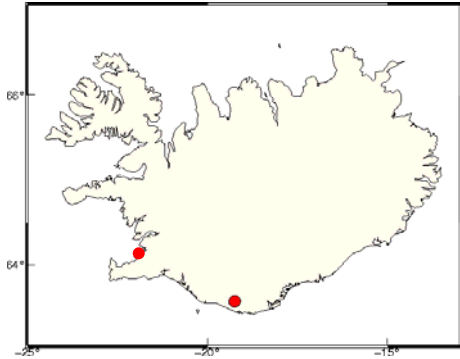
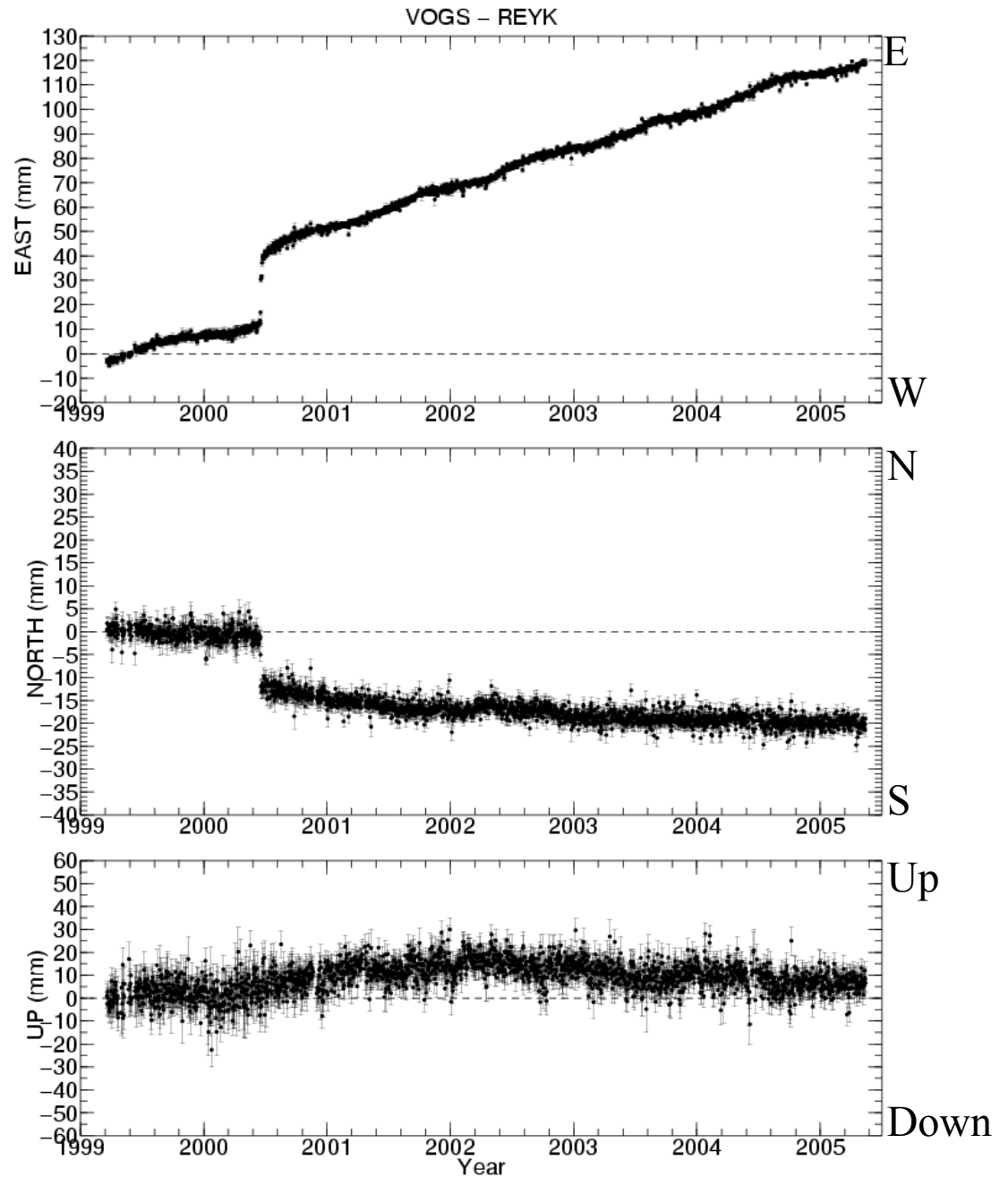
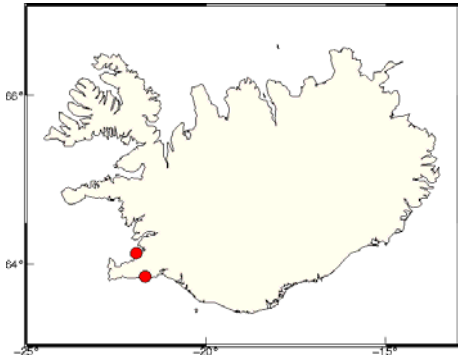


Photo: BHB

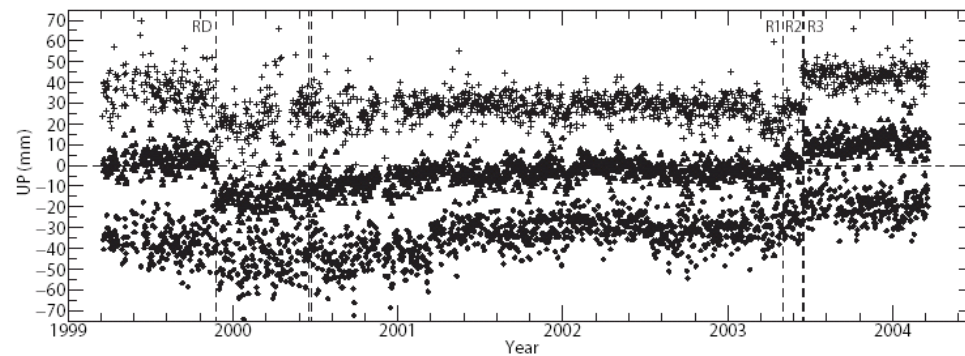
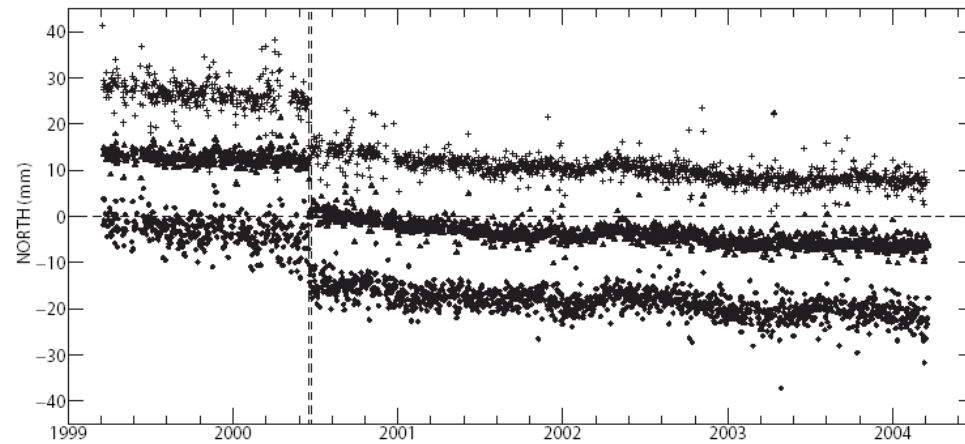
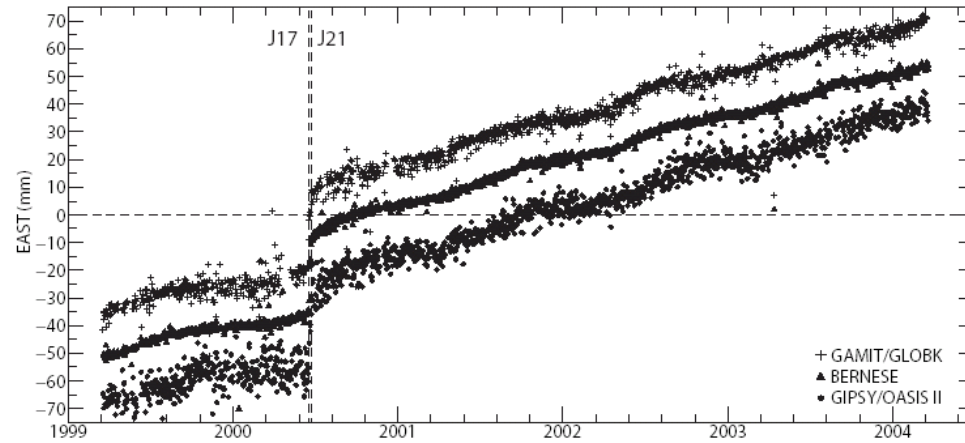
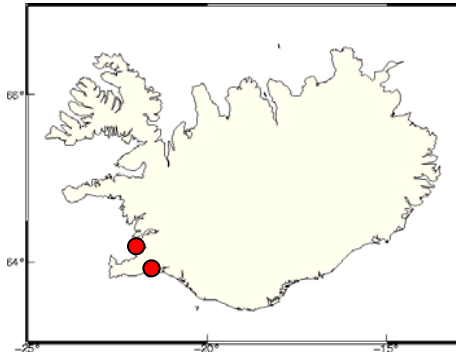
Time series of SOHO relative to REYK



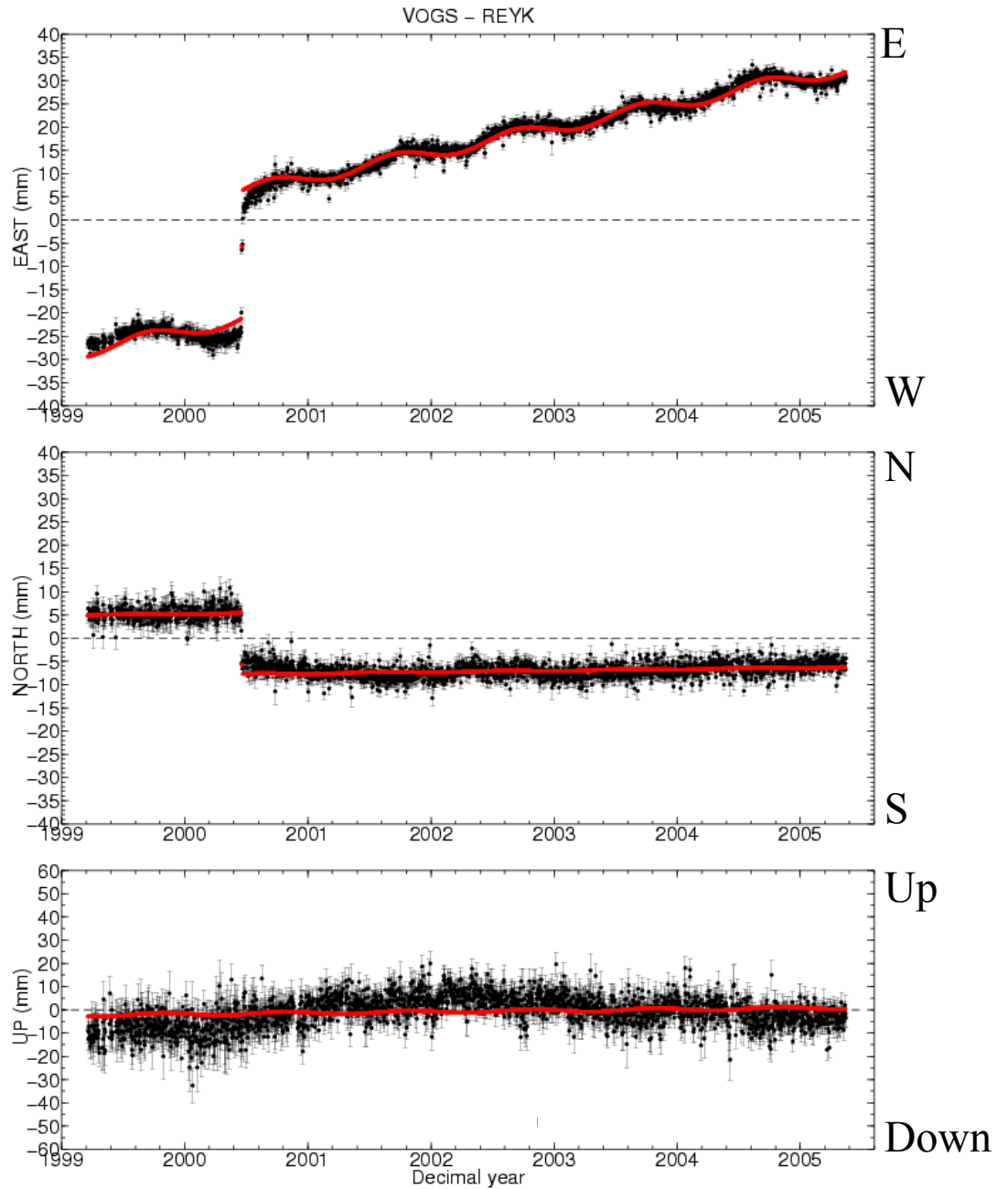
Time series of VOGS relative to REYK



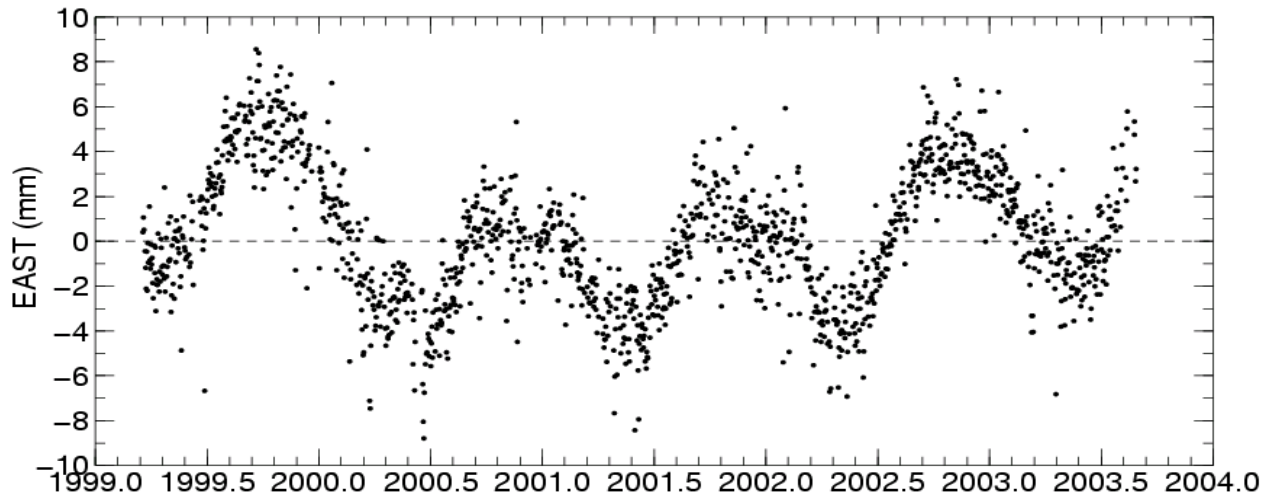
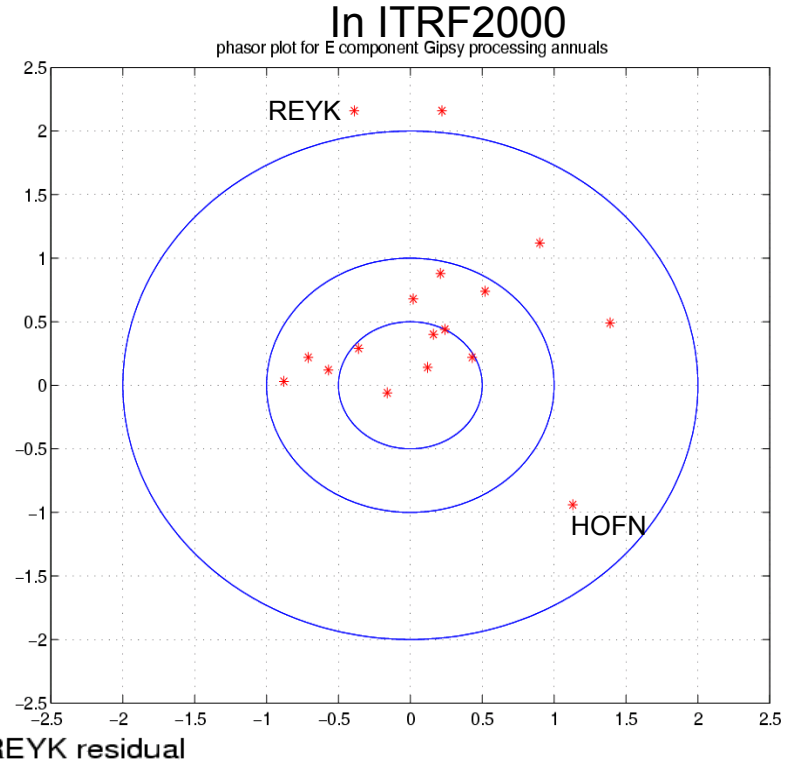
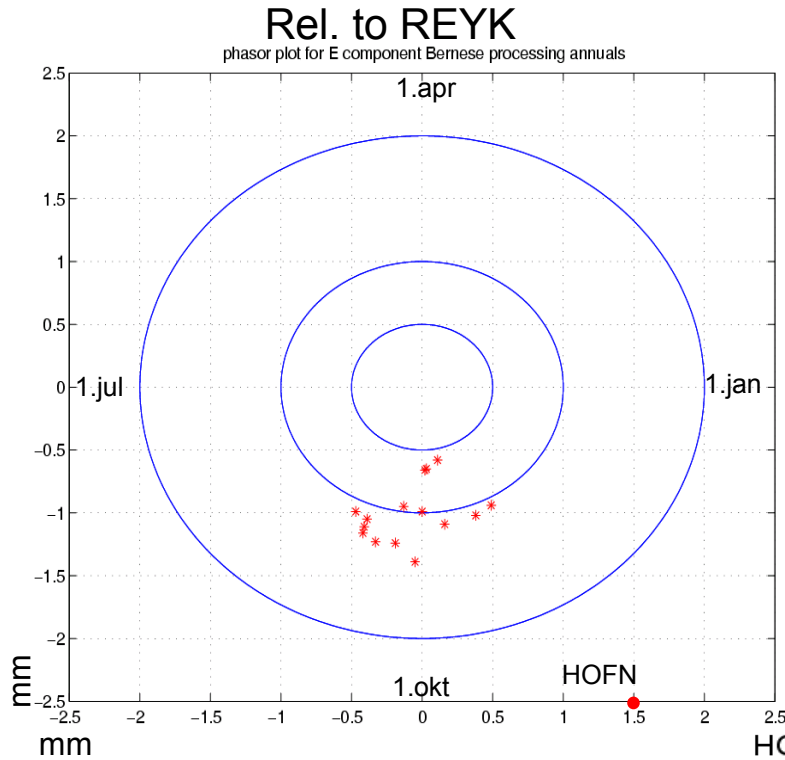
VOGS-REYK, comparing different processing softwares



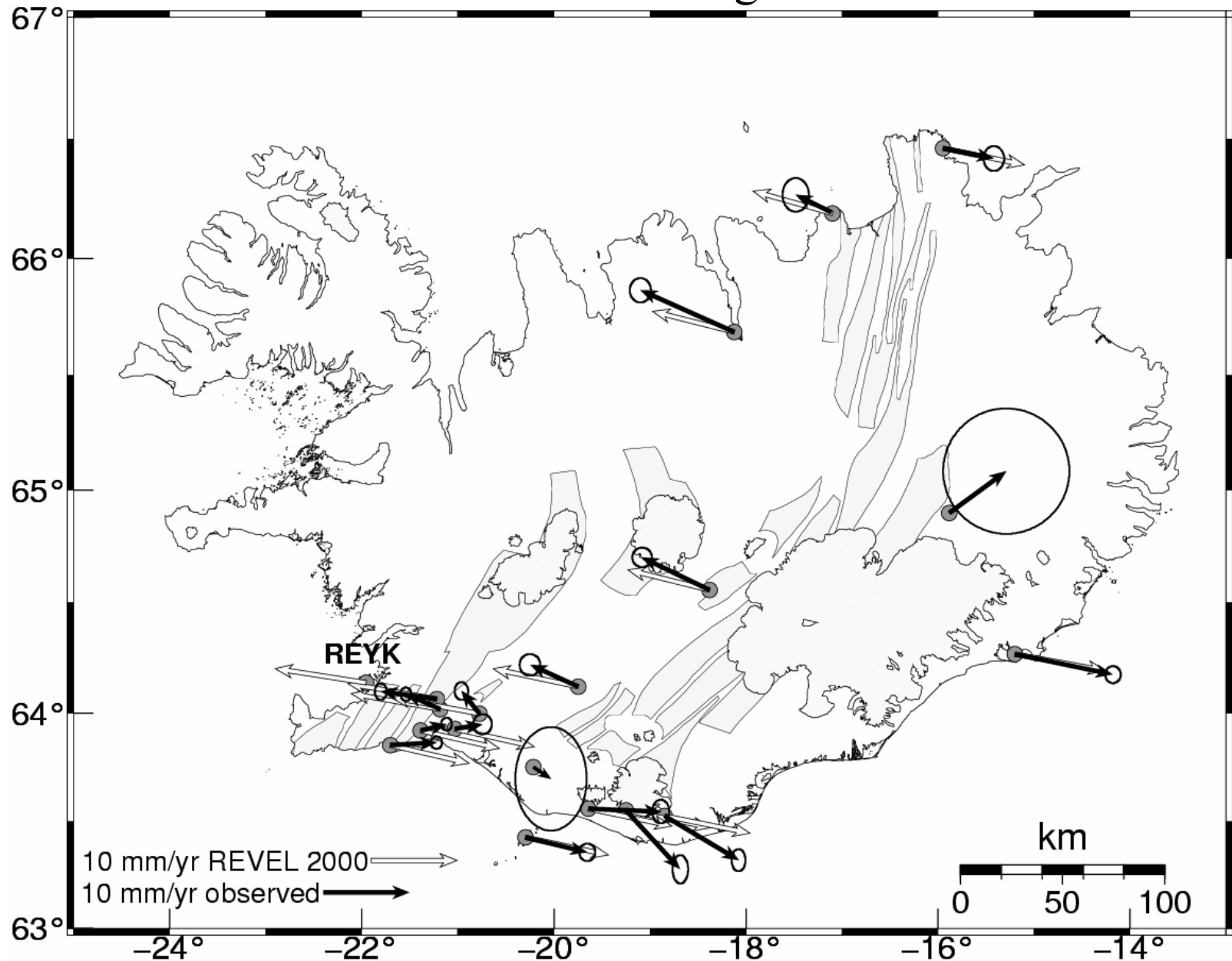
Time series of VOGS relative to REYK, data fit



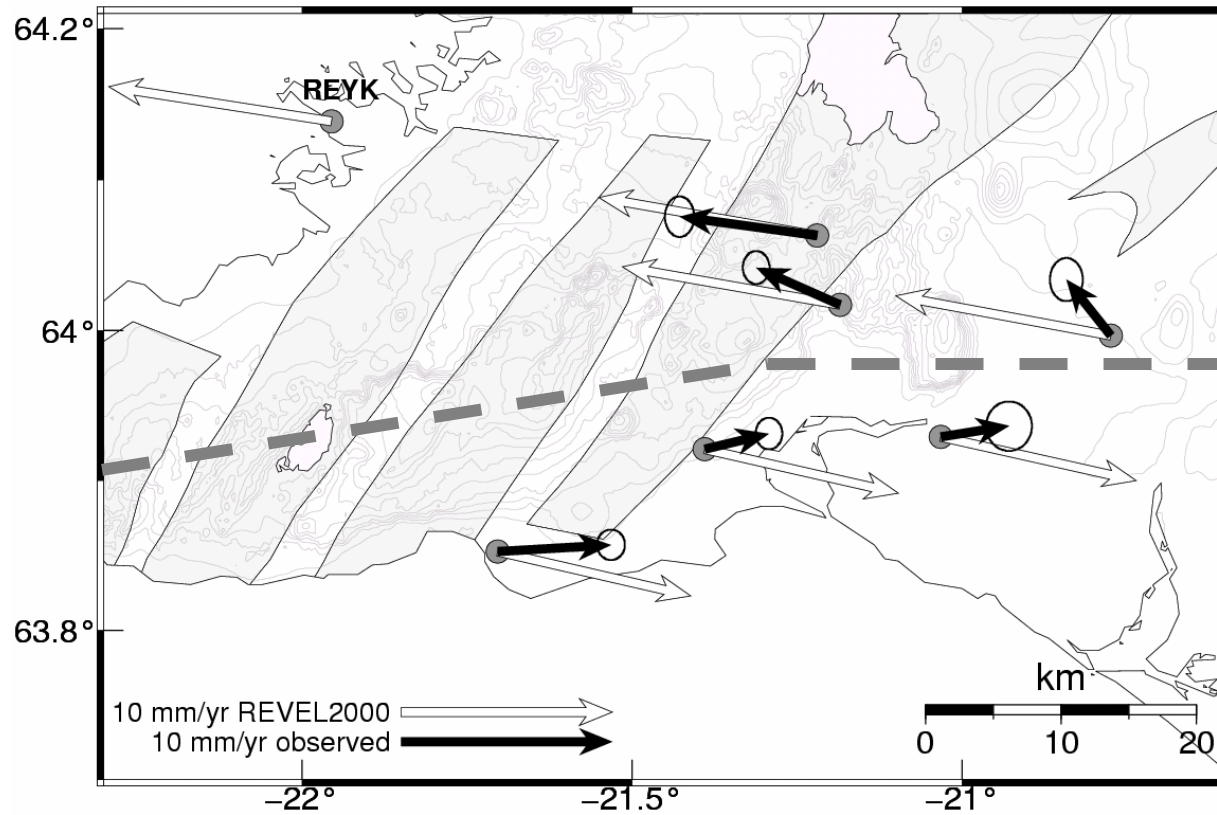
Seasonal signal in E-W component and effects of the reference station, REYK



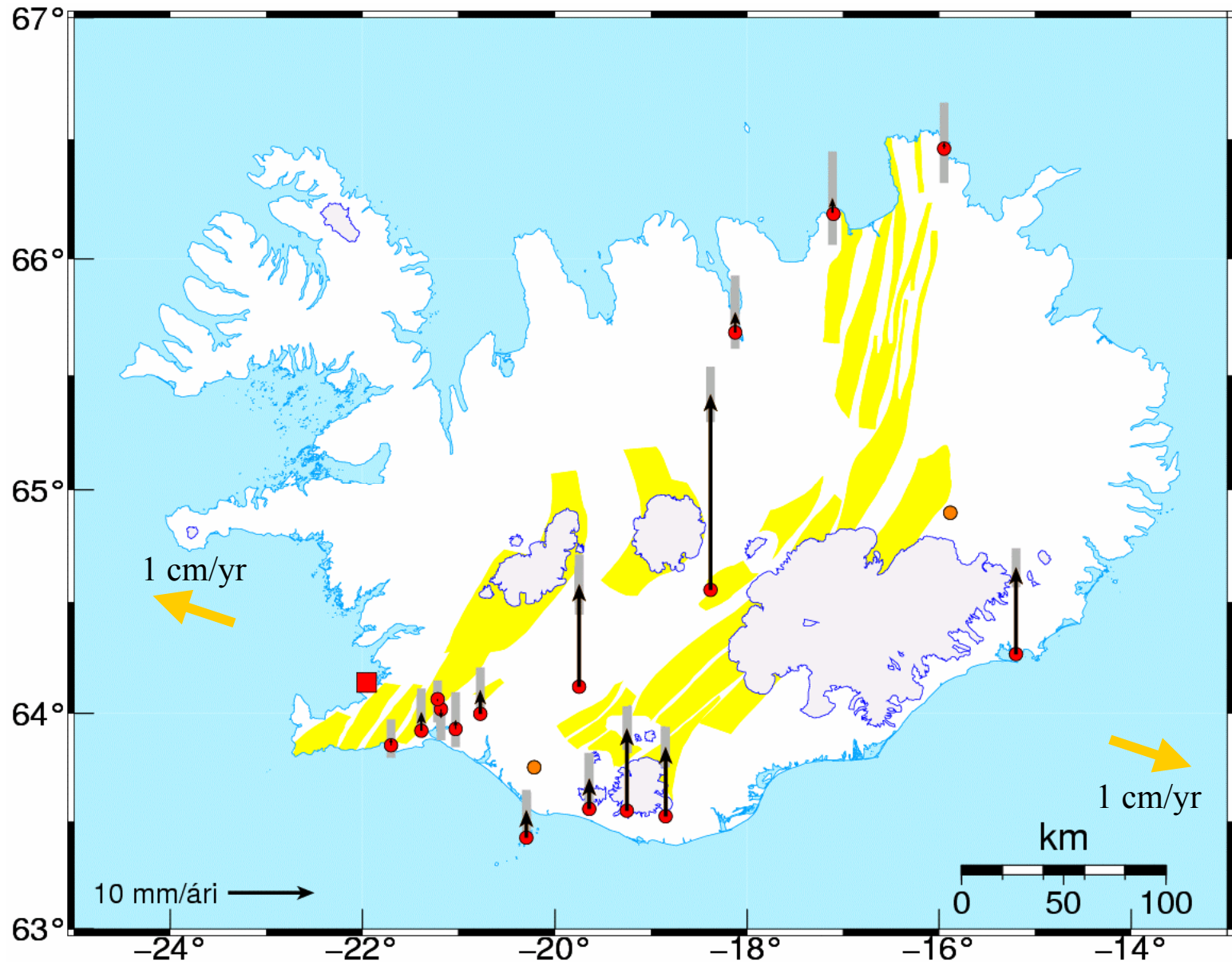
Horizontal velocities 1999 – 2005 relative to REYK moving at a fixed rate



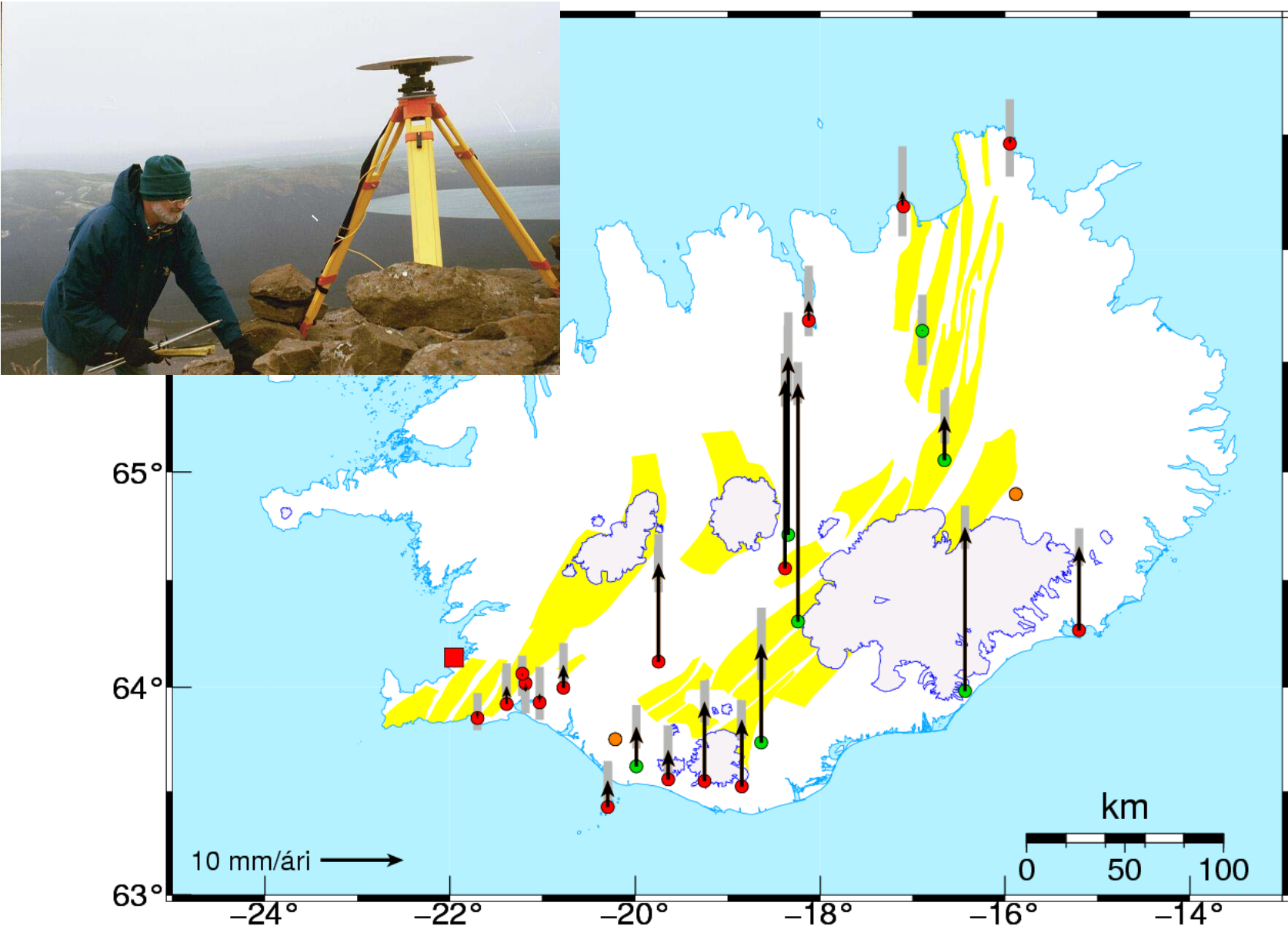
Horizontal velocities in SW Iceland 1999 – 2005 relative to REYK moving at a fixed rate



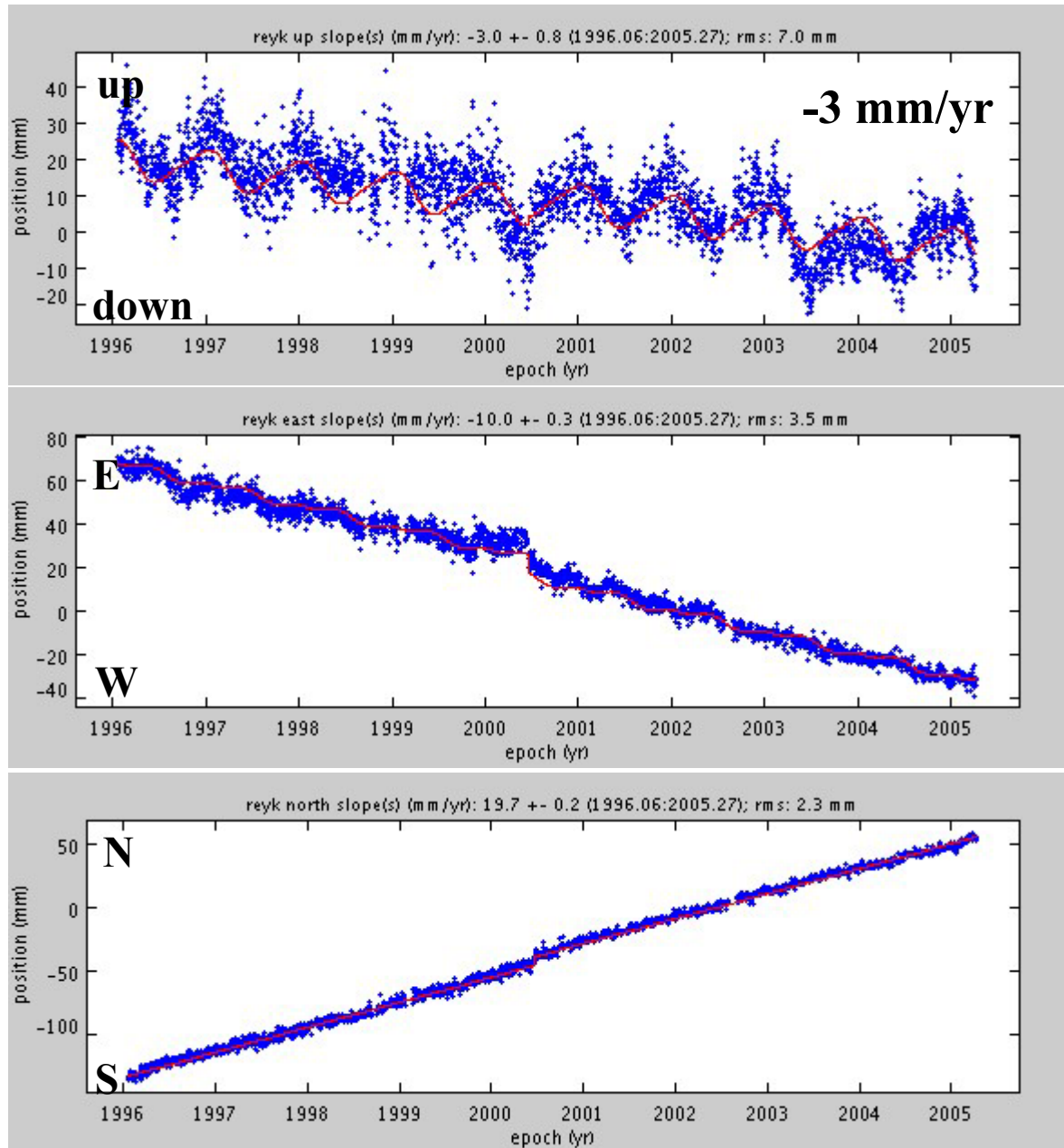
Vertical velocities (CGPS) 1999-2005 relative to REYK



Vertical velocities (CGPS and selected campaign reference stations) 1999-2005, relative to REYK

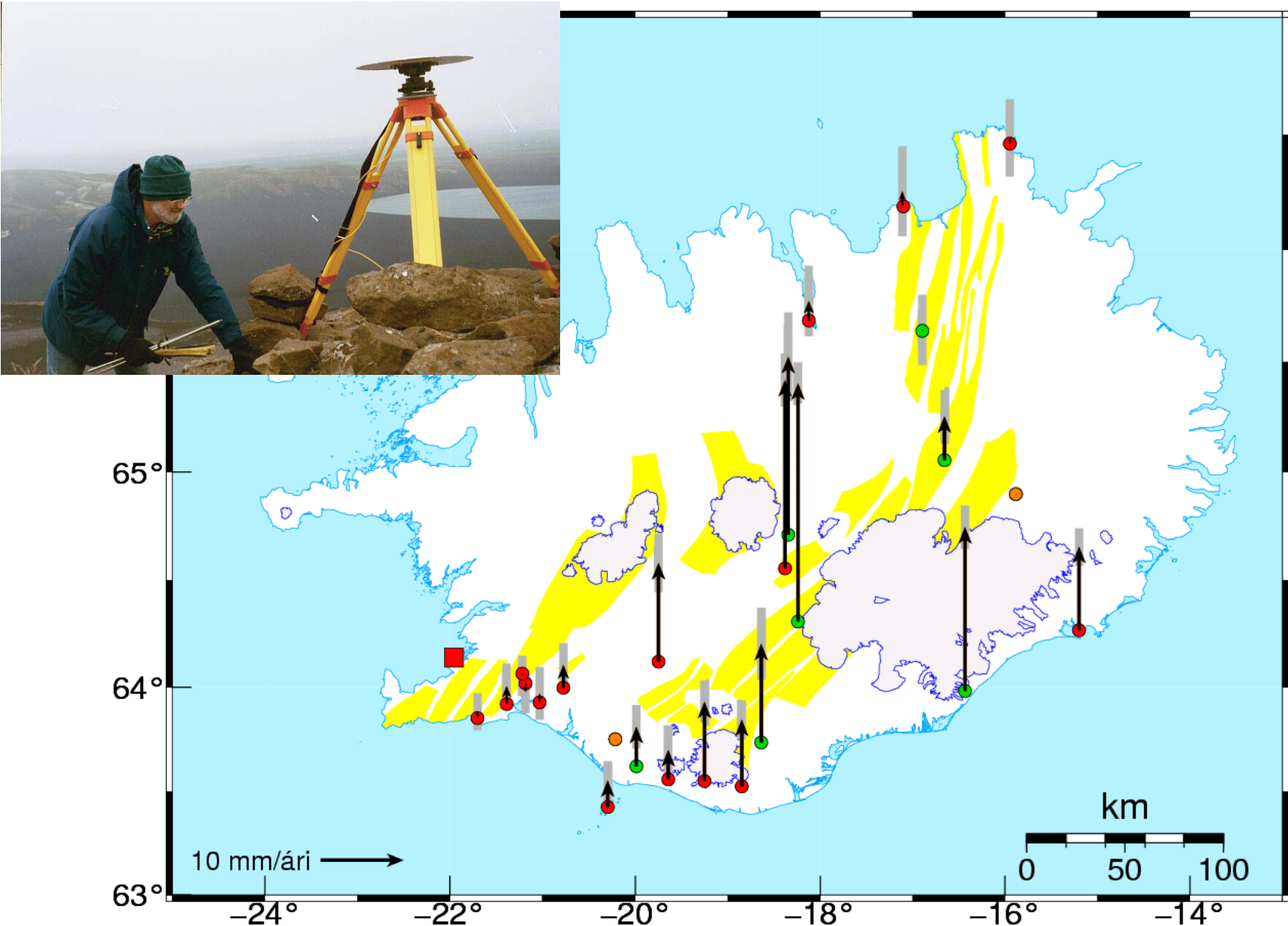


Timeseries of REYK 1996-2005

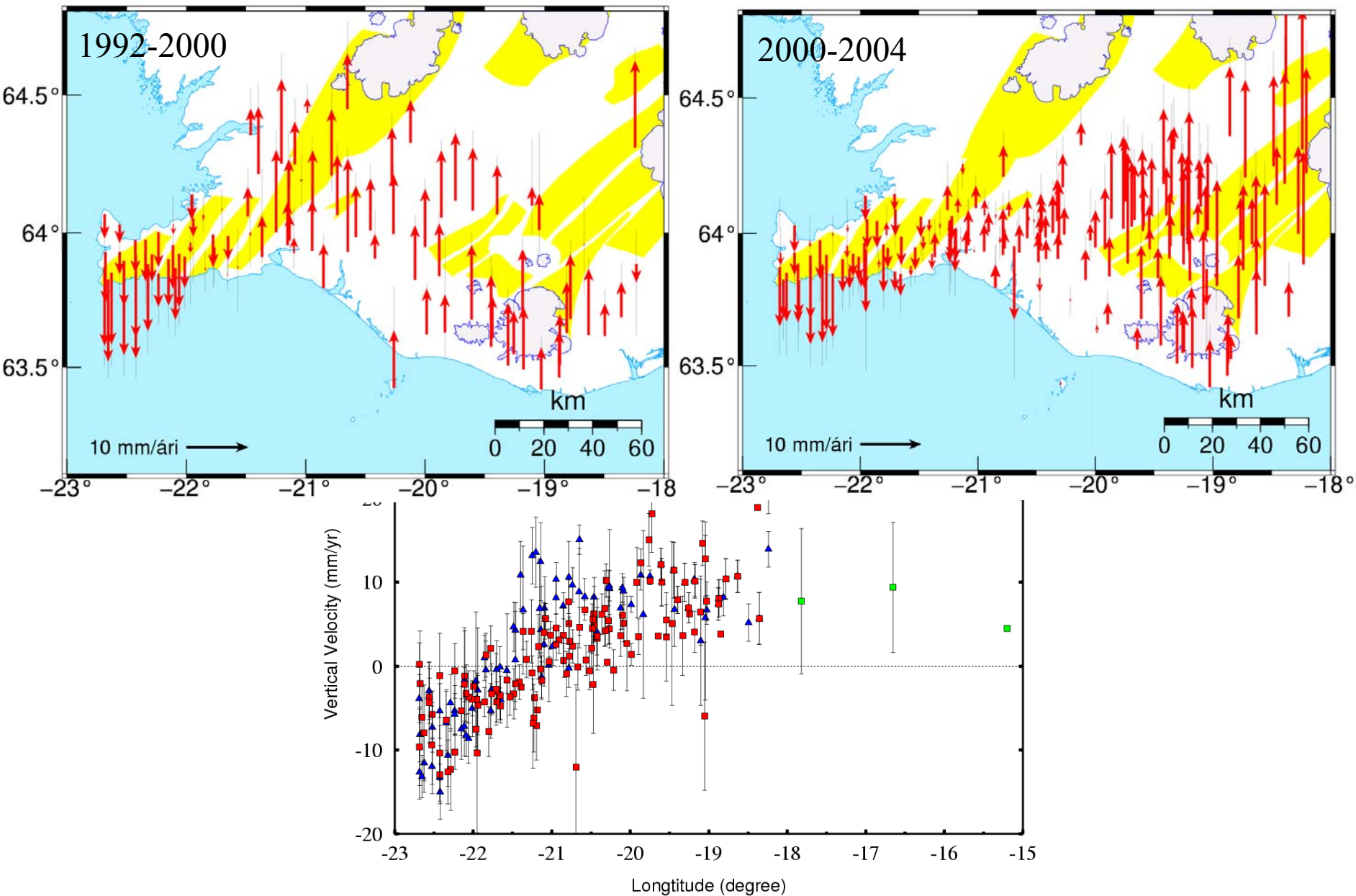


From SOPAC (Scripps Orbit and Permanent Array Center) <http://sopac.ucsd.edu/>

Vertical velocities (CGPS and selected campaign reference stations) 1999-2005, relative to REYK



Vertical velocities in SW Iceland from GPS campaigns during 1992-2004 (from Arnadóttir et al. 2005)



Processes contributing to crustal deformation in Iceland:

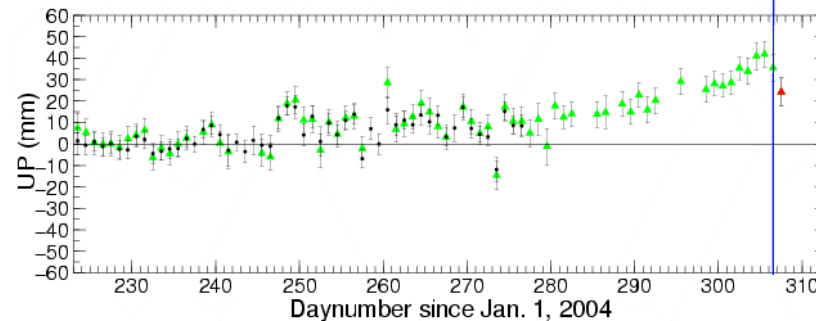
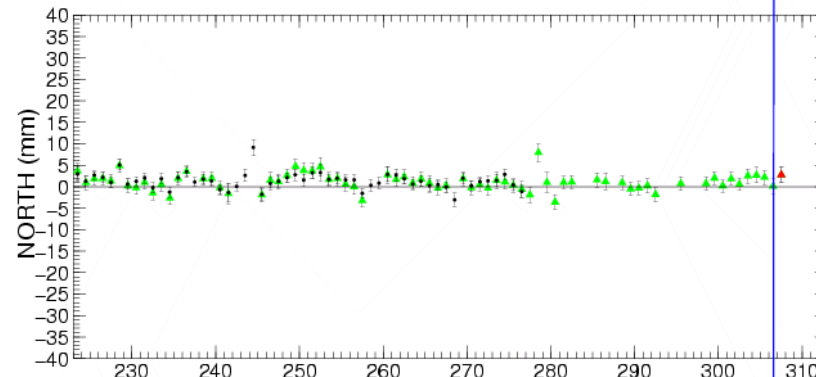
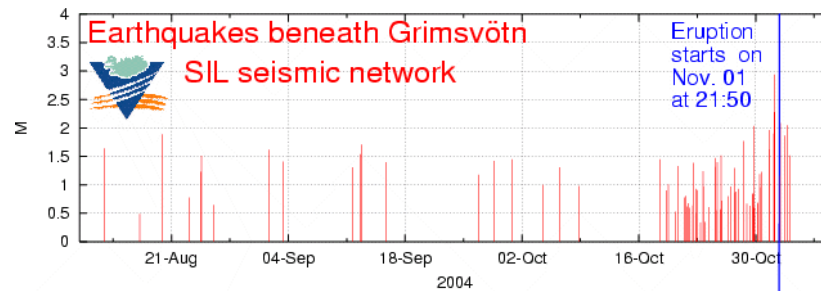
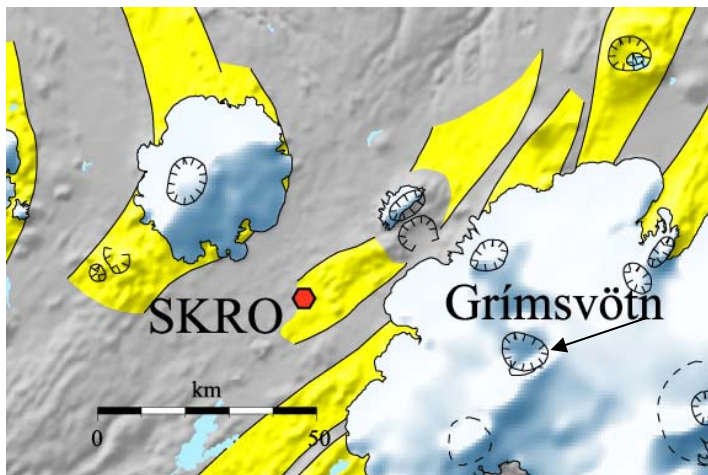
- * Plate movements
- * Earthquakes
- * Volcanic activities
- * Geothermal exploitation
- * Loading



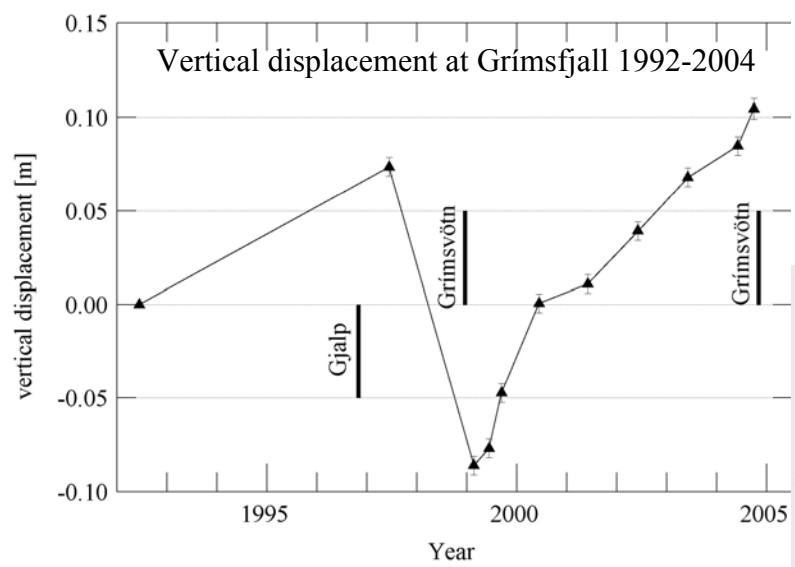
Contribution to monitoring of natural hazards:

November 2004 subglacial eruption in Grímsvötn.

Anomalous signal observed in E-W component approx. 1 week before the eruption



Repeated recharge of a magma chamber beneath Grímsvötn has been observed



Conclusions

A regional network of 20⁺ sites is operating in Iceland

Horizontal plate velocities generally agree with the prevailing plate motion models. The rifting is mostly accommodated by the Eastern Volcanic Zone.

Deviations from the plate motion models are observed at the plate boundary and near active volcanoes.

Vertical velocities show uplift at the order of 1 to 2 cm/yr close to the icecaps, probably caused by a retreat and thinning of glaciers during the last decades.

Katla volcano is inflating. A shallow magma chamber is suggested under the caldera.

Seasonal movements in the east component, with amplitudes ranging from 2 to 6 mm, are mostly explained by movement of the reference station, REYK.

Seasonal variations in the vertical component range from 0 to 20 mm. The variations are most pronounced near ice caps and cannot be explained by movement of the reference station, REYK.

