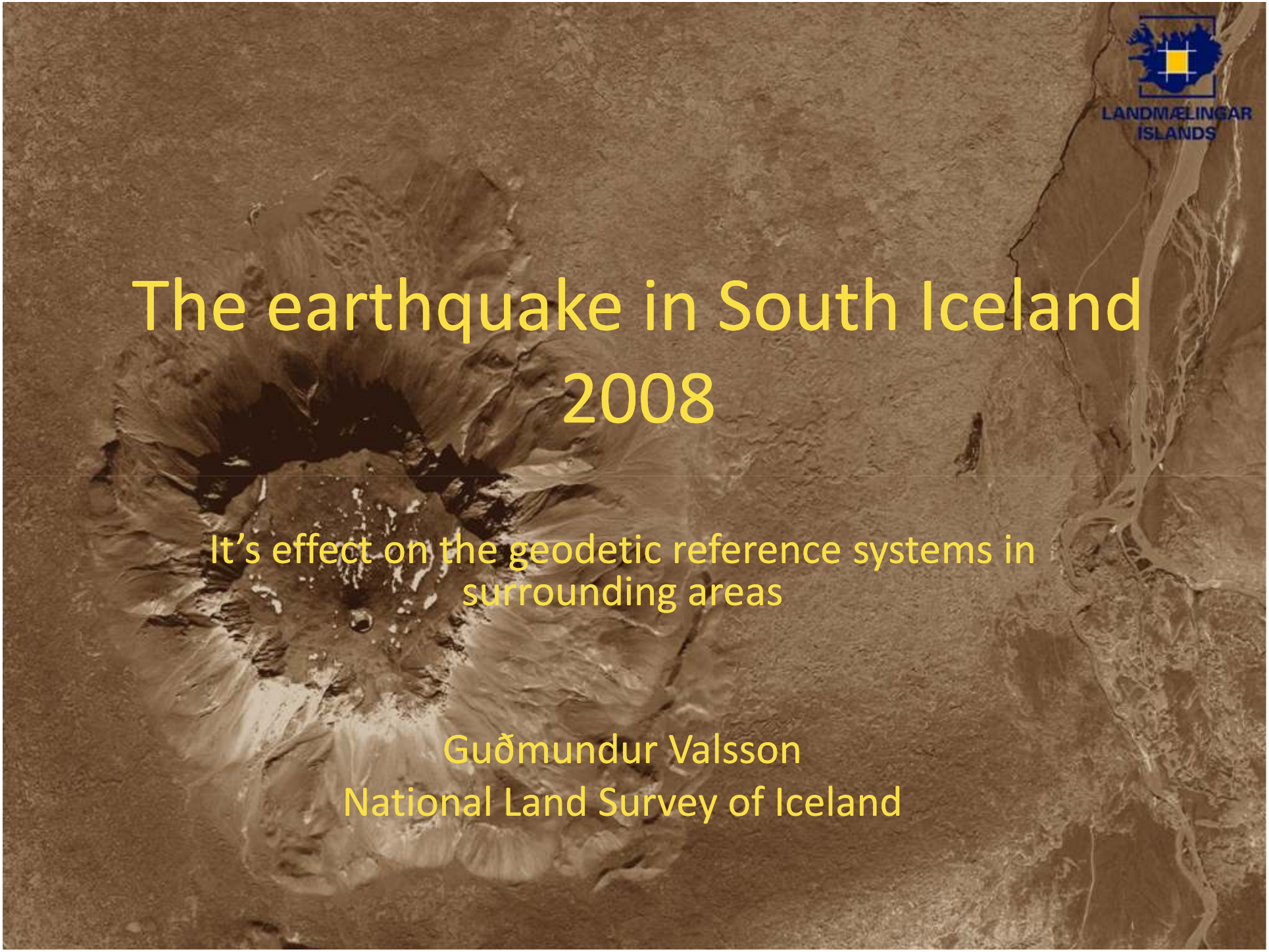


The earthquake in South Iceland 2008

It's effect on the geodetic reference systems in surrounding areas

Guðmundur Valsson
National Land Survey of Iceland

Problems in maintenance of geodetic networks in Iceland

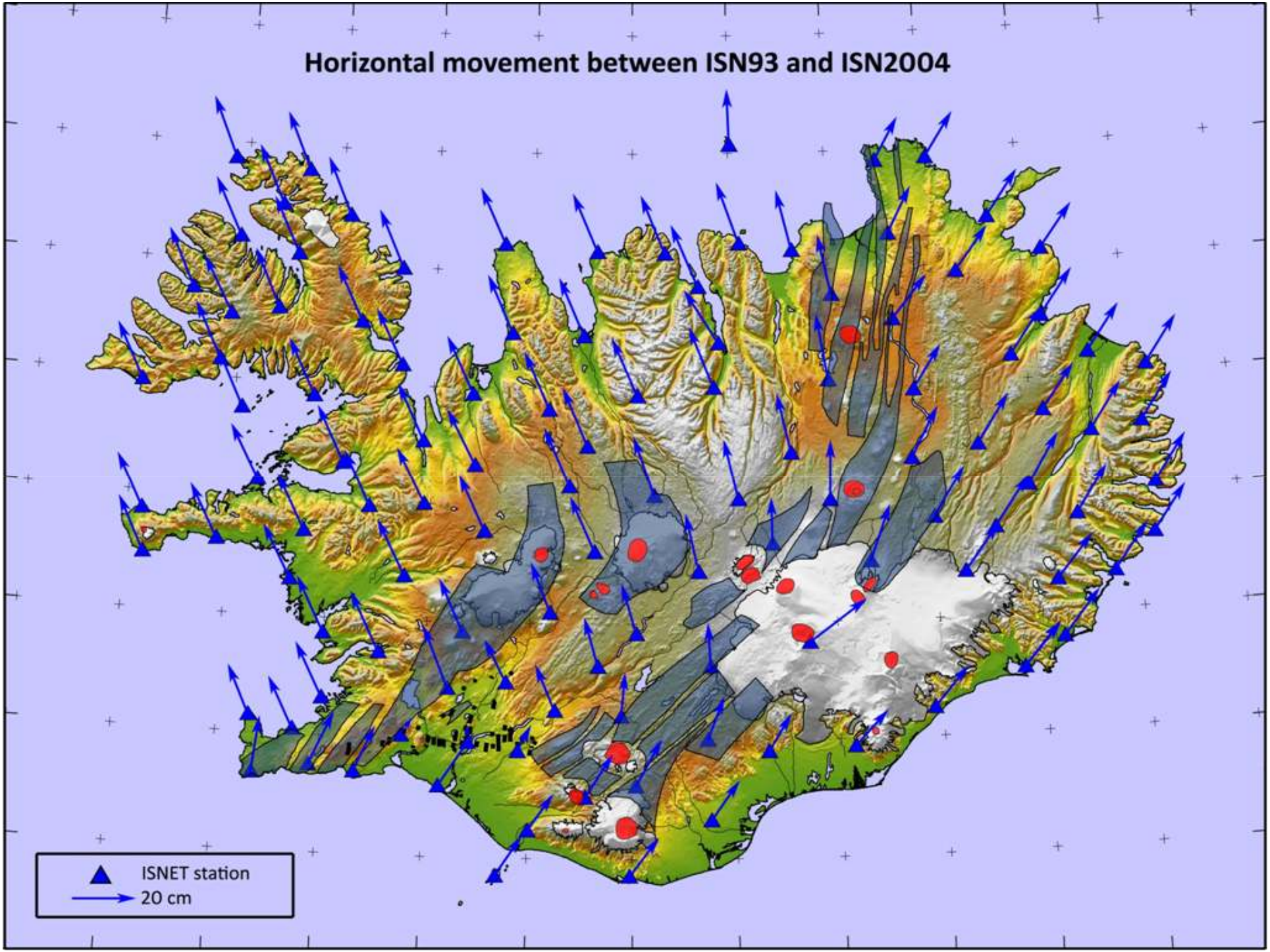
LANDMÆLINGAR ÍSLANDS

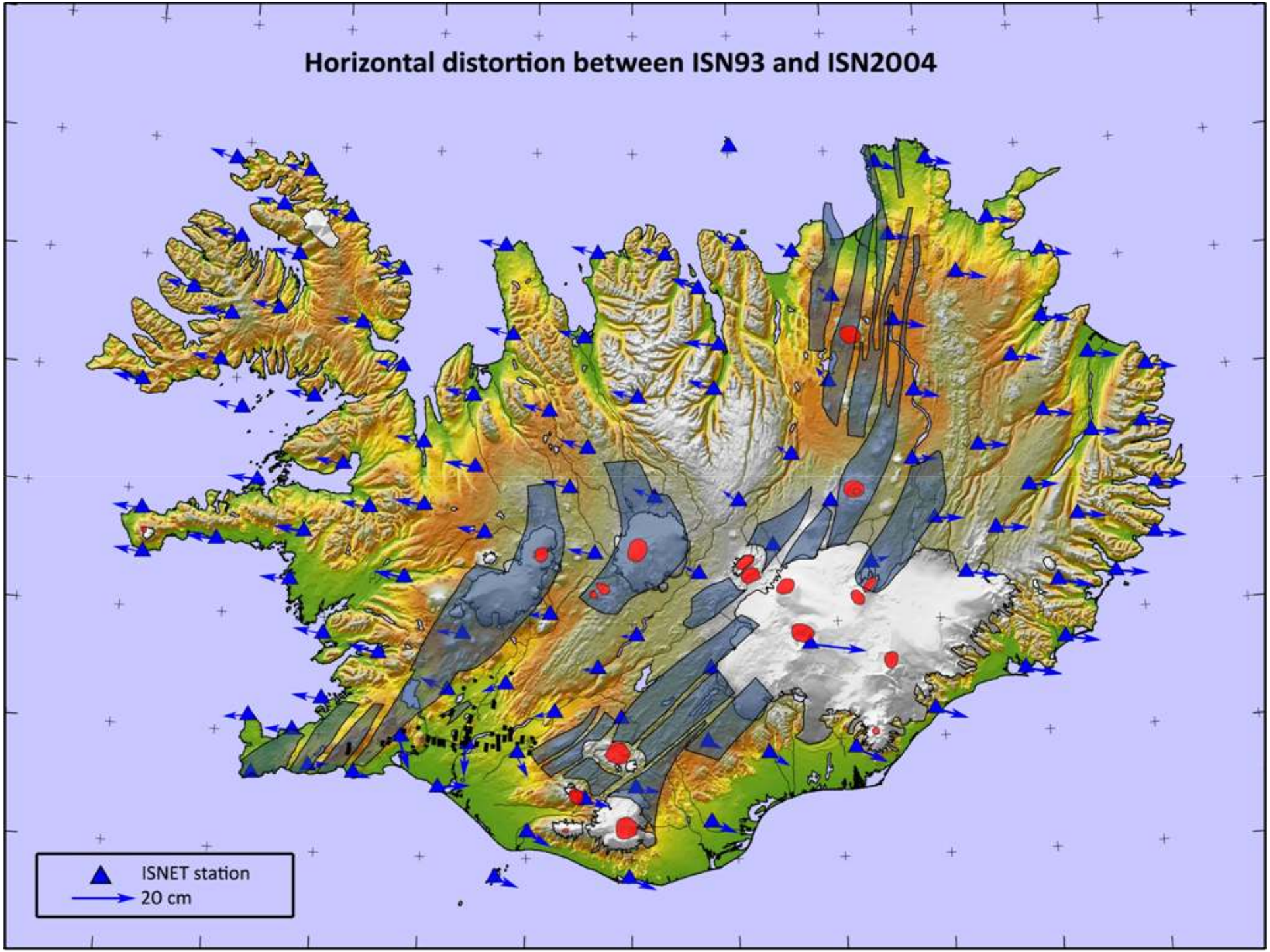
- Iceland is positioned on the plate boundaries of the Eurasian and North-American plate
- The plates are drifting apart with a rate of ca. 1 cm/y from each other
- The plate boundaries interacts with a deep-seated mantle plume currently situated under Vatnajökull
- This leads to complicated pattern of rift and transform fault zones

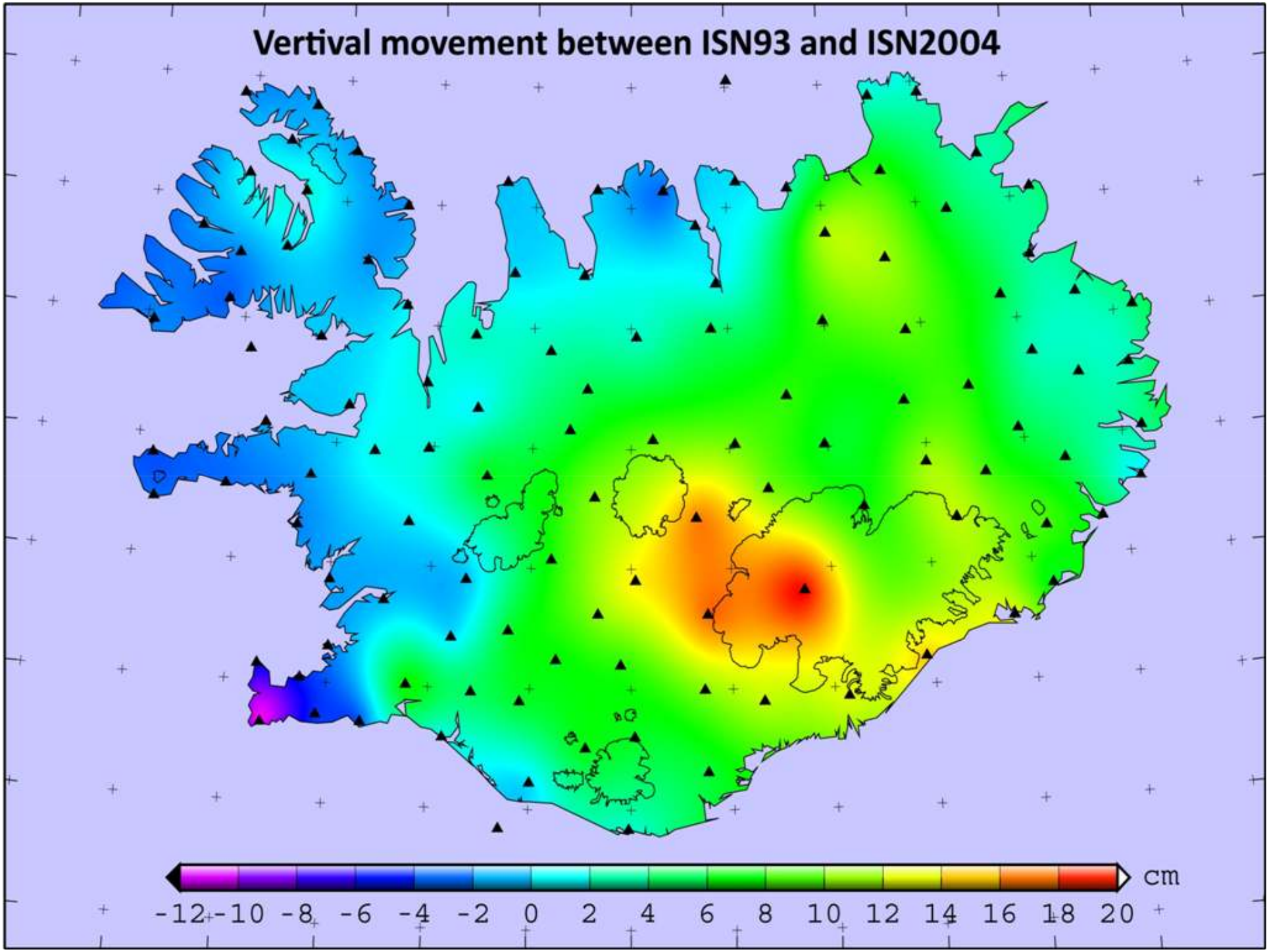
Problems in maintenance

LANDMÆLINGAR ÍSLANDS

- The network is constantly deforming due to plate tectonics
- Local deformation due to earthquakes and volcanic eruption
- The reference network was re-mesured in 2004
- Datum ISN2004
- Shows considerable deformation both in plane and height between ISN93 and ISN2004


Horizontal movement between ISN93 and ISN2004
ISNET station
20 cm


Horizontal distortion between ISN93 and ISN2004
ISNET station
20 cm


Vertival movement between ISN93 and ISN2004
cm
-12 -10 -8 -6 -4 -2 0 2 4 6 8 10 12 14 16 18 20

The vertical system

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- Precise leveling has been going on since 1992
- The ring road was finished in 2002
  - 1423 km, 7.5 cm raw misclosure
- Now working on highland trespassing and connections to tide gauges
- Around 2700 km measured
- 3700 points
- 320 points measured with GPS to monitor height changes

The earthquake in 2008

LANDMÆLINGAR ÍSLANDS

- An earthquake struck South Iceland on May 29, 2008
  - Magnitude 6.3 Richter scale
  - Epicenter southwest of Ingólfsfjall, between Selfoss and Hveragerði
- Permanent GPS stations showed considerable movements
- Indicates deformation of the reference systems

GPS campaign in October 2008

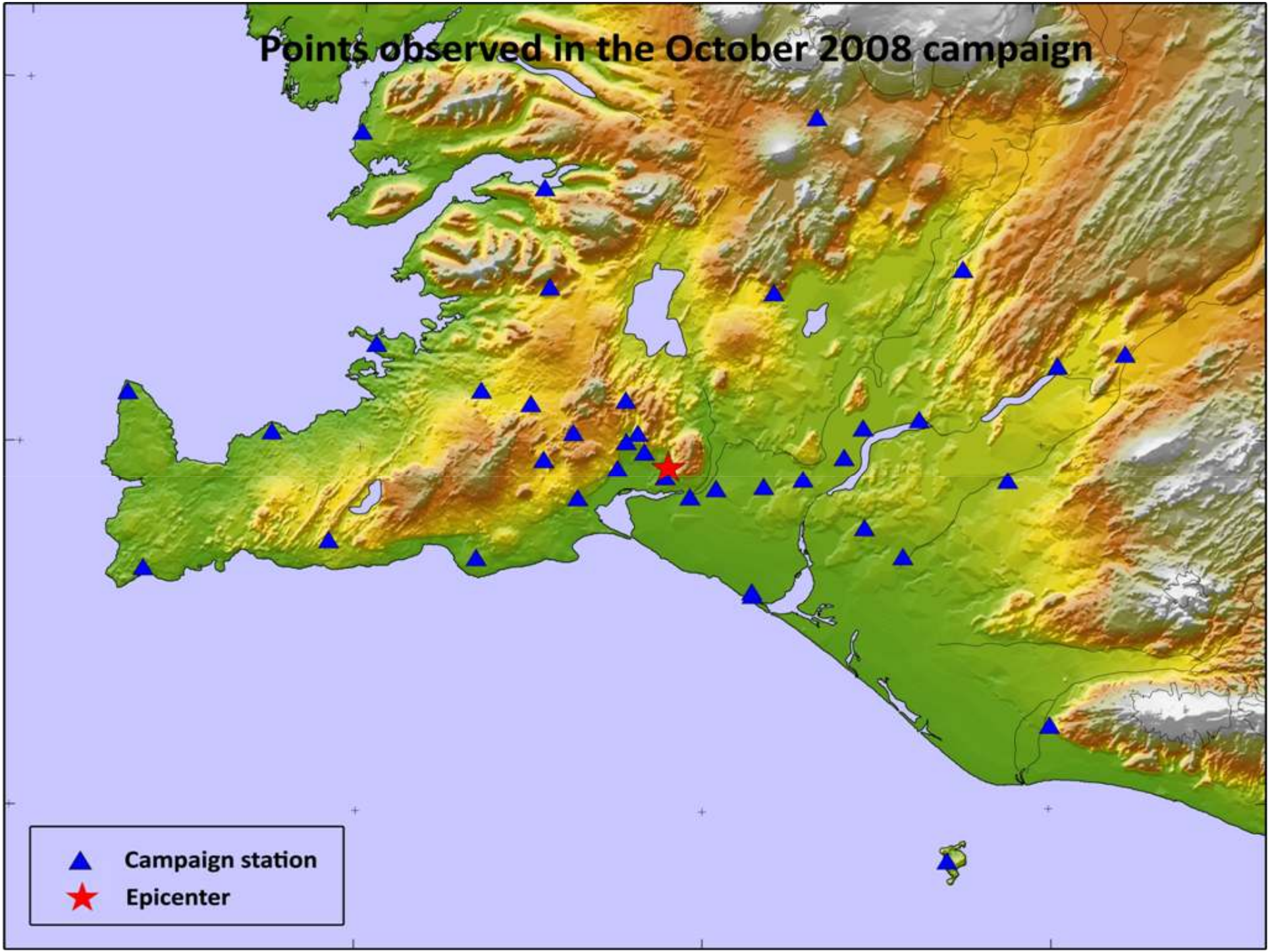
LANDMÆLINGAR ÍSLANDS

- National Land Survey of Iceland initiated GPS campaign in October 2008
- Goal to investigate deformation of reference- and height network
- Cooperation with the Road Administration, surrounding municipalities and ISMAR

GPS campaign in October 2008

LANDMÆLINGAR ÍSLANDS

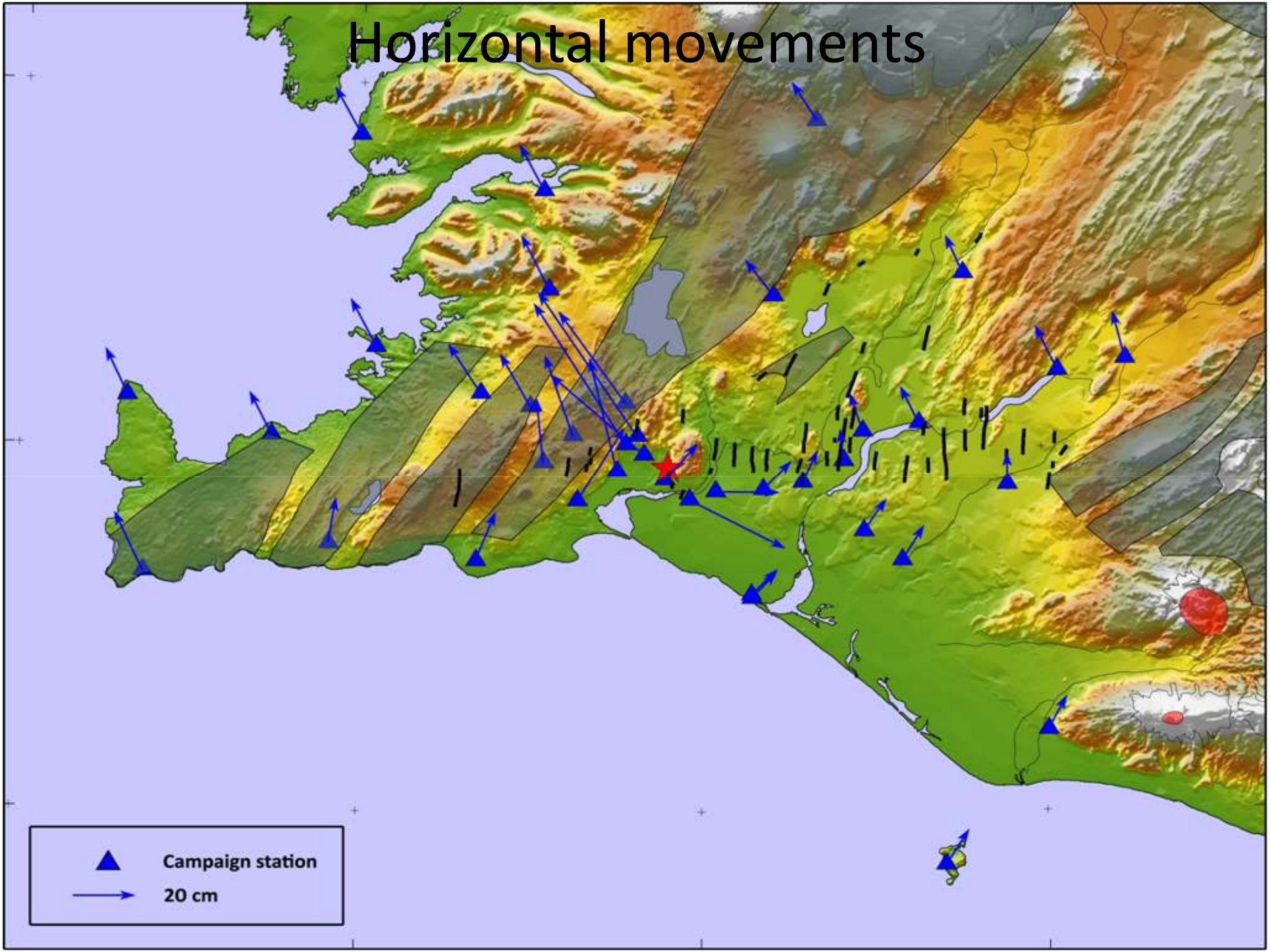
- 47 points measured
  - Permanent stations
  - Reference network
  - Height system
  - Municipality network
- Extensive survey area
  - All reference network points in Southwest Iceland
  - All height network points within 30 km radius from epicenter (measured in 2001 and 2003)
- Points occupied for up to 48 hours

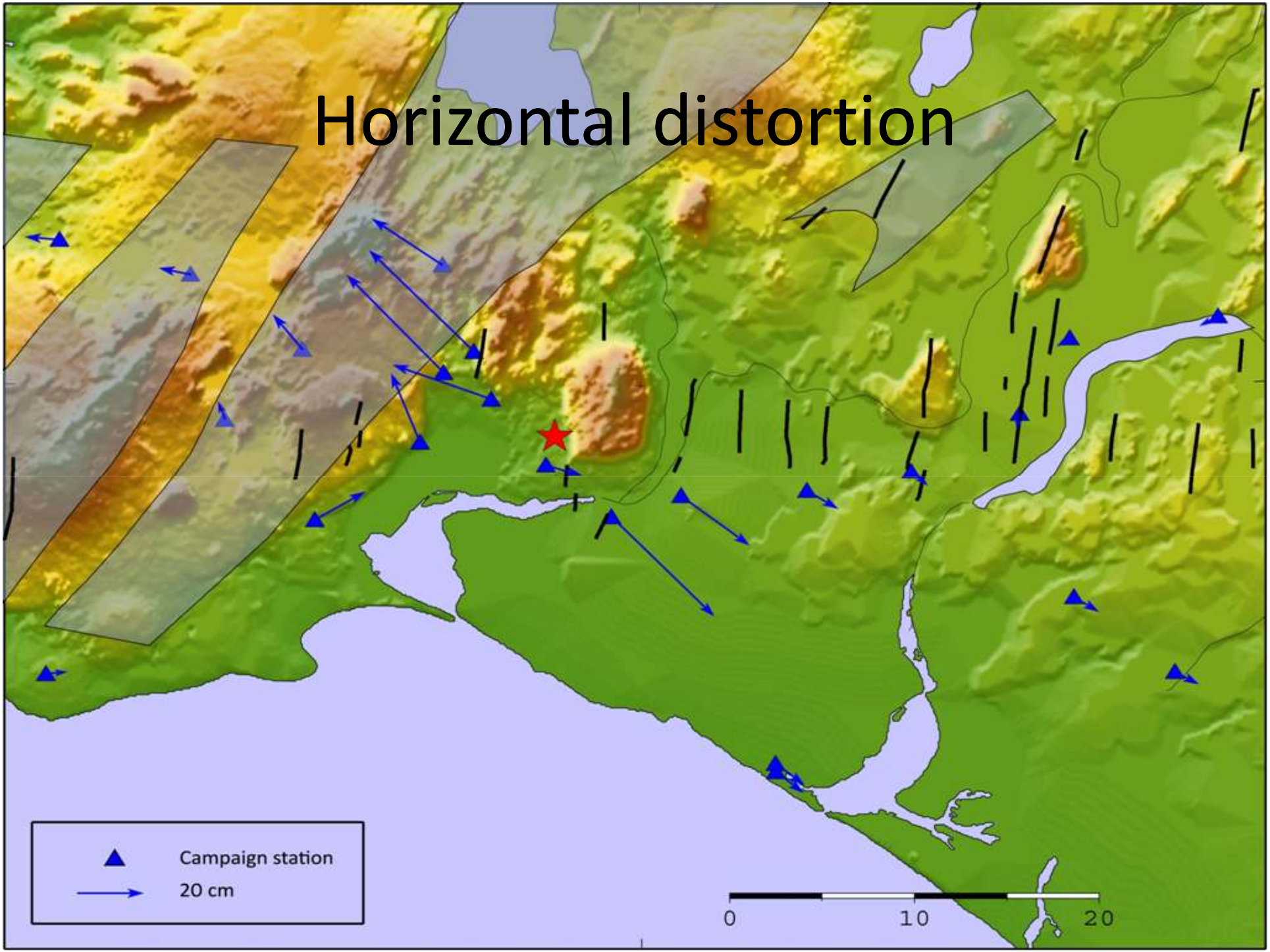

Points observed in the October 2008 campaign
Campaign station
Epicenter

Results

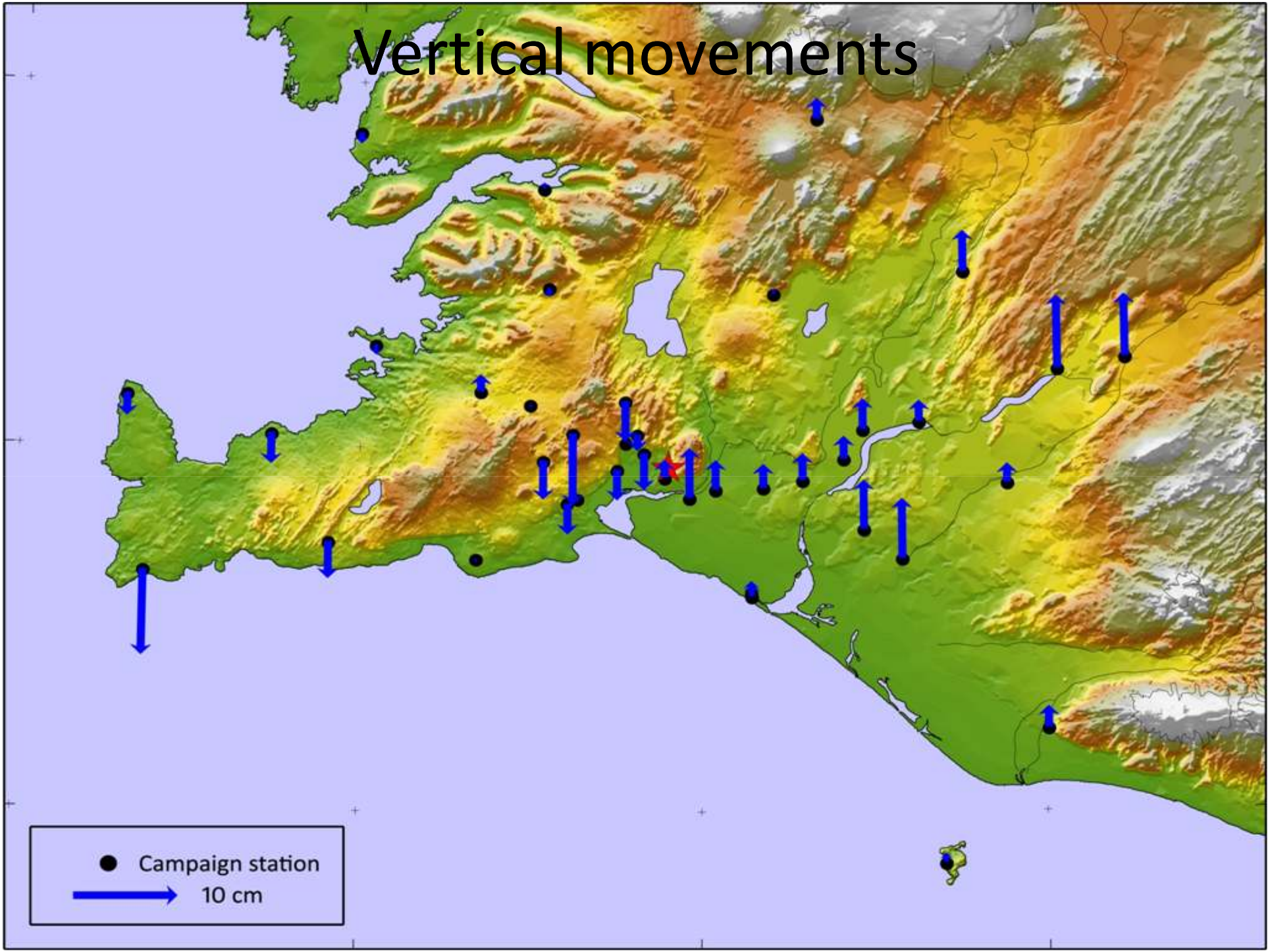
- The data was processed with Trimble Total Control
- Fairly good results with 4 mm accuracy in plane and 8 mm in height
- Shows serious deformation of the reference systems
- Up to 45 cm displacement between points
  - Hveragerði-Selfoss
- About 15-20 km deformation radius
- Plate movements very visible in other points
- Height deformation is more complicated

Horizontal movements




Horizontal distortion
Campaign station
20 cm
0
10
20

Vertical movements



Following actions

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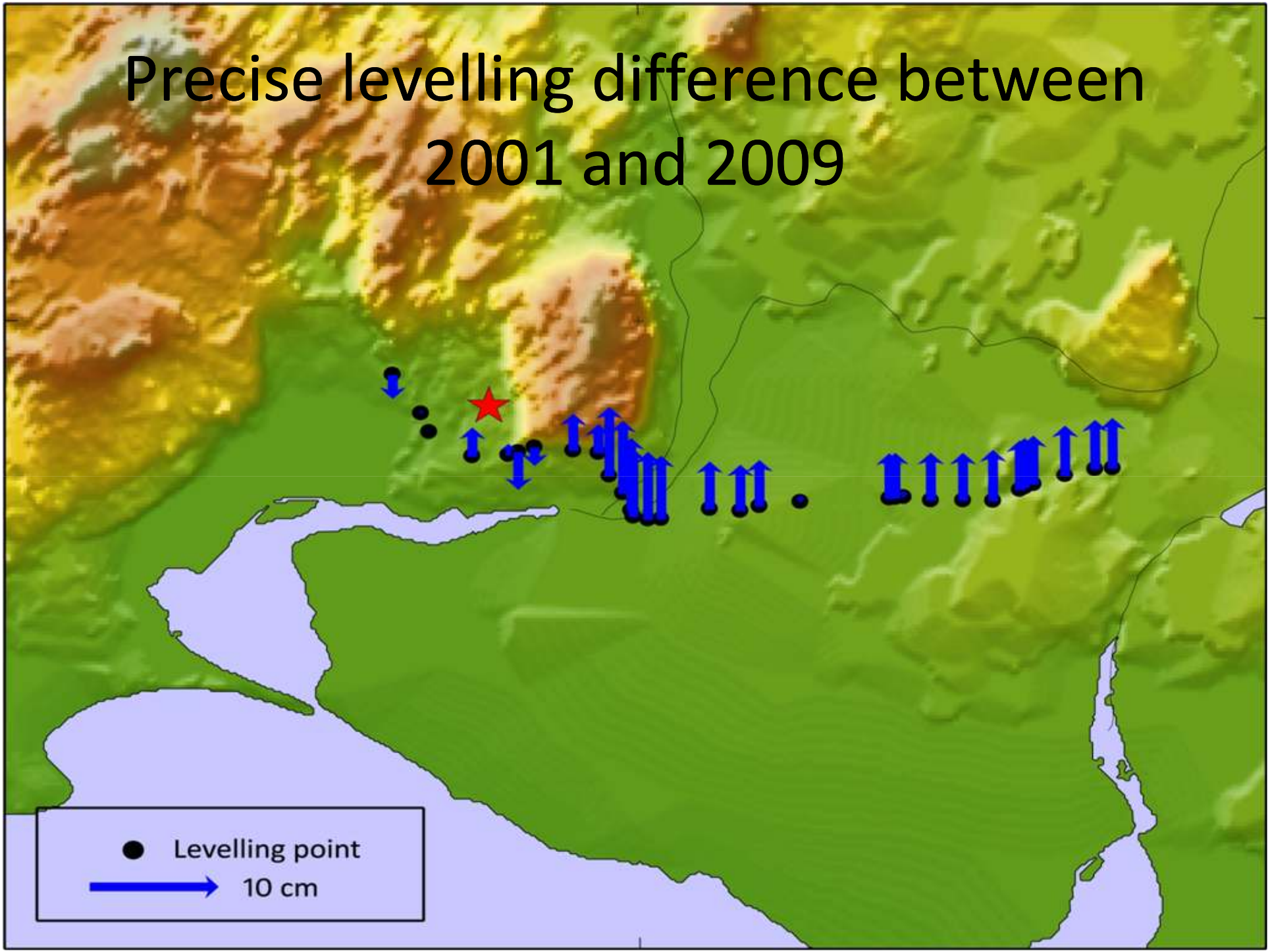
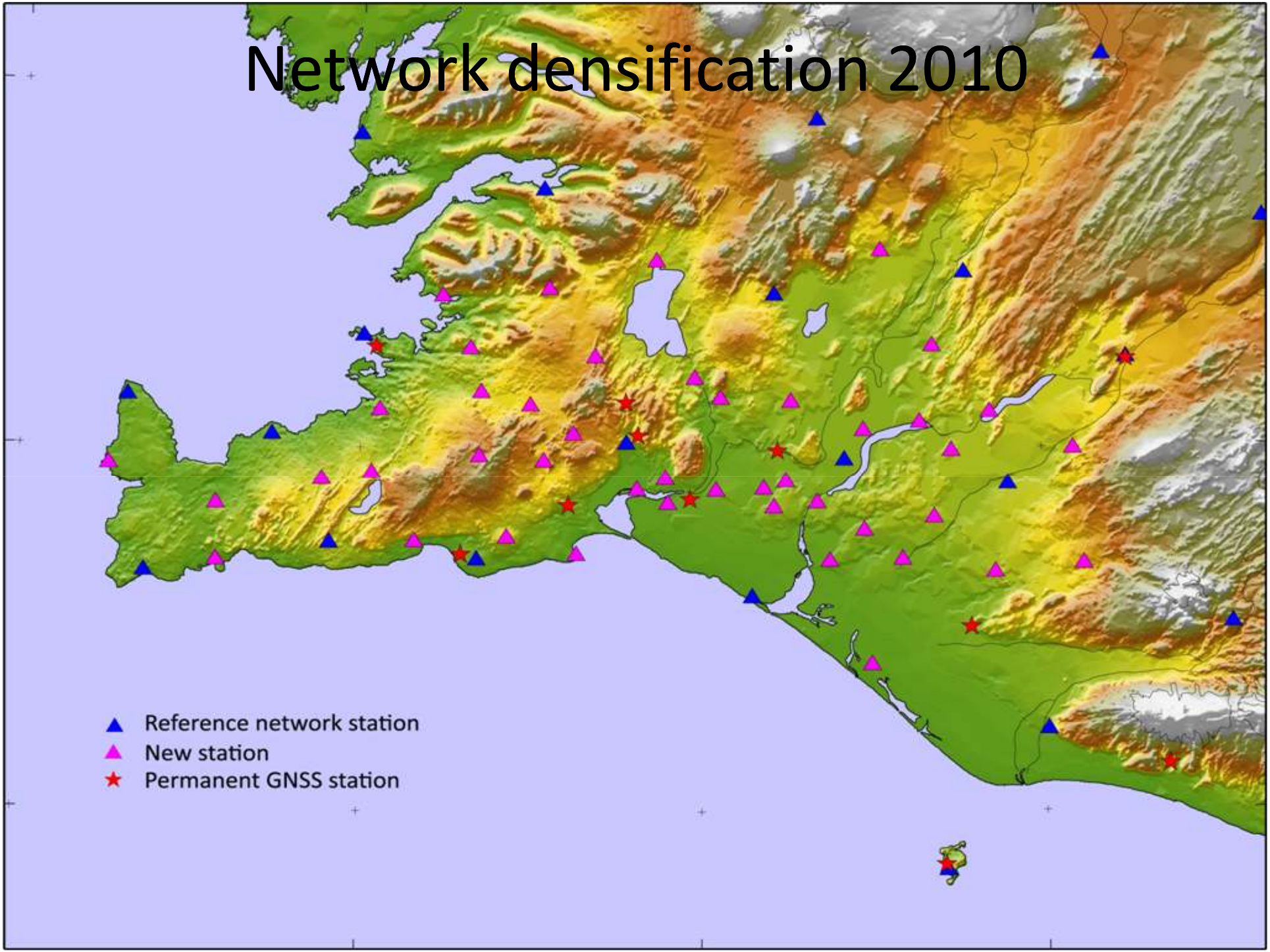
- Publish new coordinates in ISN2004
  - Residuals up to 70mm due to plate tectonics
  - Using velocity mode residuals go down to 10mm
- Publish new coordinates with characteristics of ISN93
- Level from Reykjavík to Skeið
- Level through Þrengsli
  - On-going
- Densify the network in Southwest Iceland


Precise levelling difference between 2001 and 2009
Levelling point
10 cm

Network densification 2010



Considerations

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- GPS-levelling difference fits well to the precise leveling difference
- Processing with Berense would be useful to validate the results
- Important to create precise velocity model for Southwest Iceland
- Feasible to measure a very dense grid with RTK in South Iceland ?

Conclusion

LANDMÆLINGAR ÍSLANDS

- The earthquake had serious effect on the geodetic reference systems in South Iceland
- The height deformation is very complicated not only caused by the earthquake
- Maintaining precise geodetic networks in Southwest Iceland
  - Complicated
  - Challenging
  - Interesting


LANDMÆLINGAR
ÍSLANDS
Thank you
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