

Summary of Geodetic Activities in Iceland



Markus Rennan

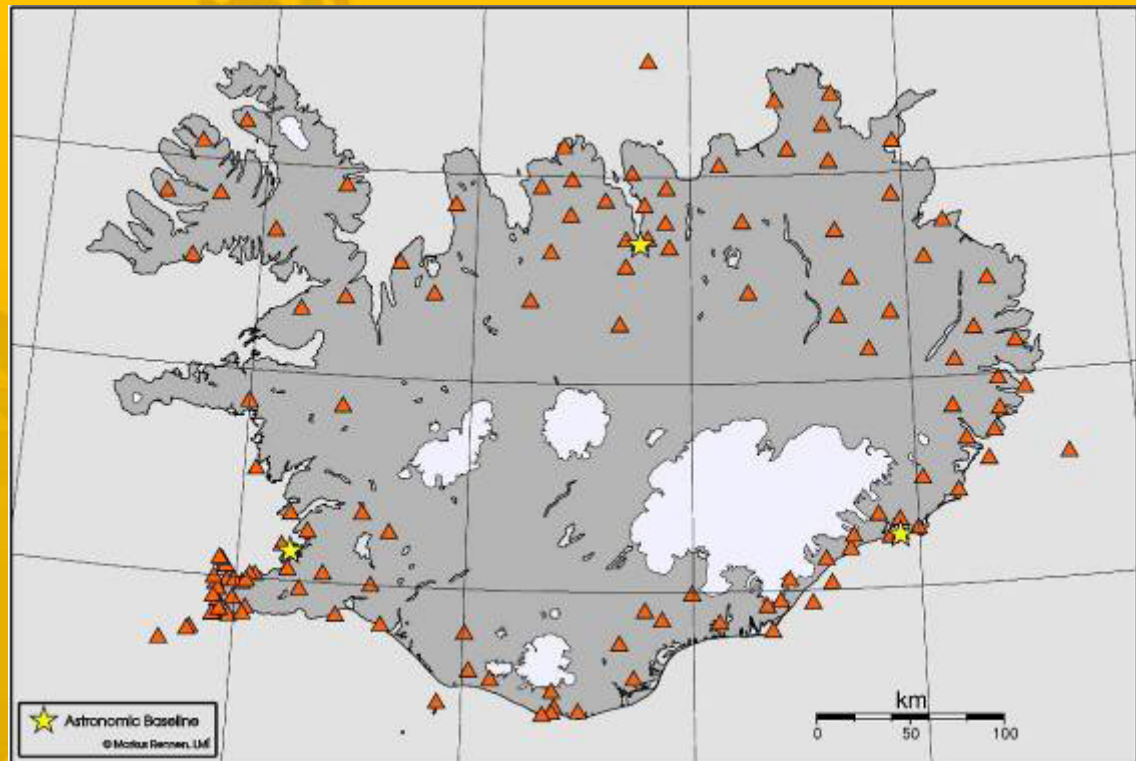
Landmælingar
Íslands

(National Land
Survey of Iceland)



Reykjavík 1900

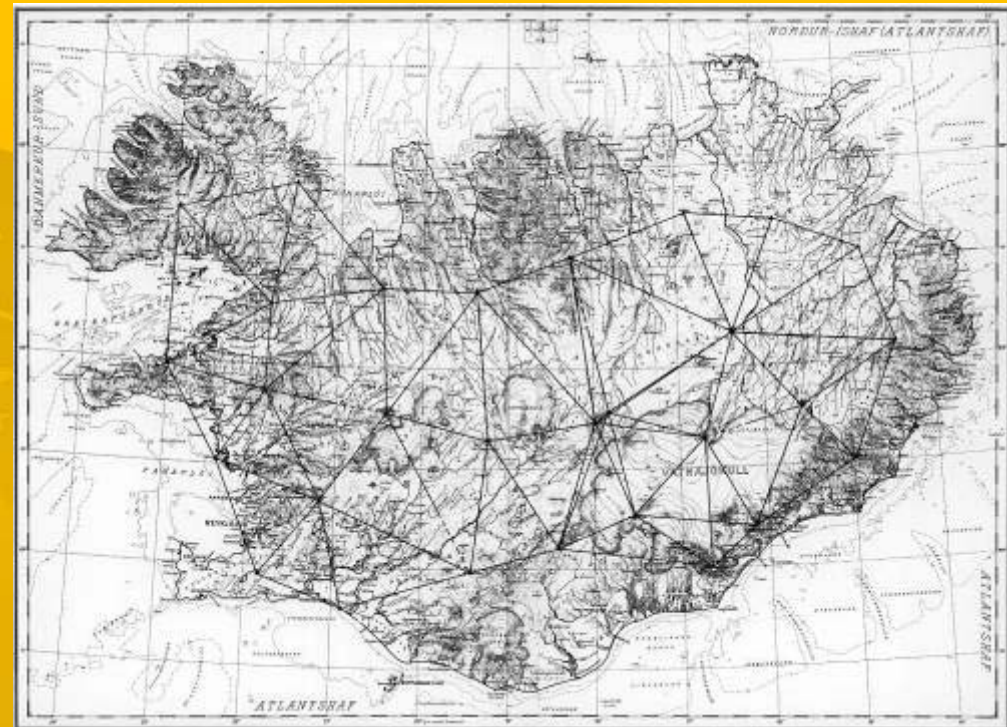
- First Icelandic nationwide reference network
- Triangulation by Danish “*Generalstabens Kartografiske Institution*”
- Orientation and global datum via astronomic baselines
- Temporary Tide Gauges in Reykjavík, Akureyri and Höfn í Hornafjörður (20 Tidal Cycles)
- Connection to triangulation network via spirit levelling
- Calculation of average MSL
- Local MSL height systems
- Growing number of rural centers with individual local height systems





Hjörsey55

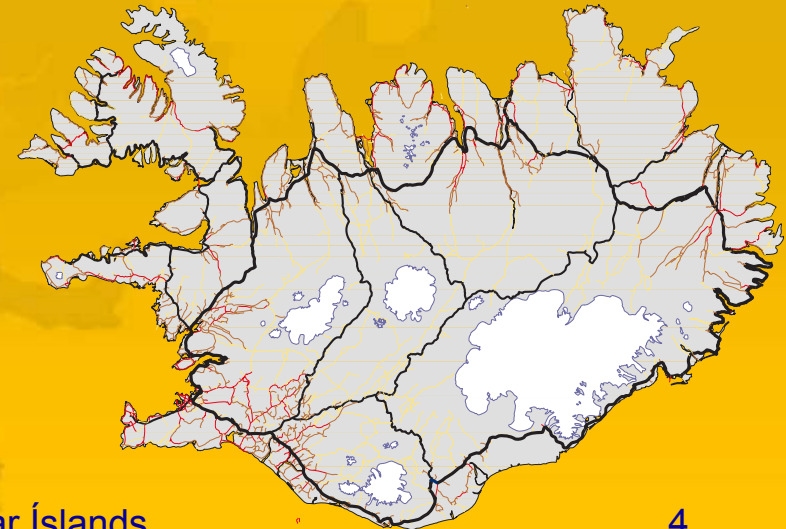
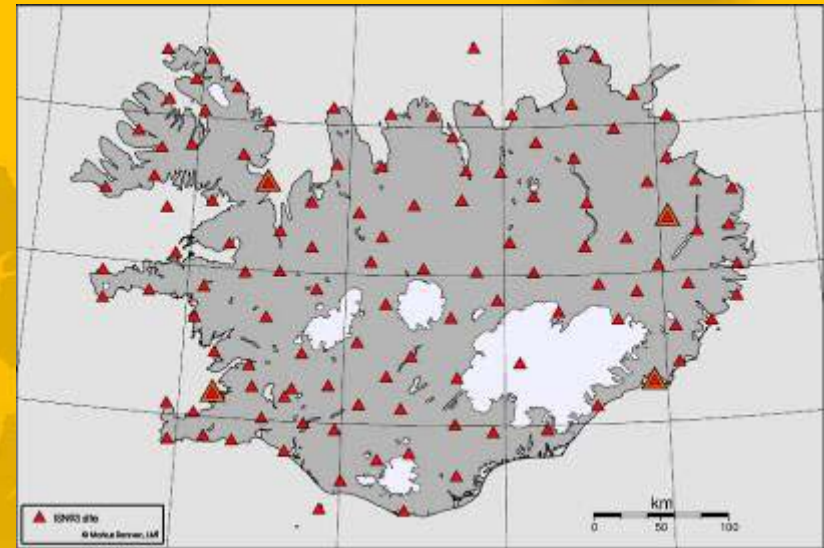
- 1953: NATO decides global topographic map coverage
- North America – Europe link via HIRAN 1953 – 1956
- Danish triangulation survey in Iceland 1955
- New network
- (i.e. no re-measurement)
- Datum Hjörsey55 (name according to astronomic baseline location)
- Focus on topographic purpose
⇒ no contribution to development of height network



ISN93 and Levelling Network



- 1992:
Ministry of Environment Commission decides:
 - Establishment of modern 3D geodetic reference “Íslenskt Grunnstöðvarnet”
 - Concept for levelling network
- 1993 GPS-survey of ISN93
 - 119 sites
benchmarks on bedrock
63 pillars with forced centering
 - GPS Occupation in 10 blocks a 8h
(Redundancy only in block boundaries)
 - Accuracy $\varphi, \lambda \approx 1\text{-}2\text{cm}$; $h \approx 3\text{cm}$
 - Global datum via 4 semi-permanent stations
- 1994 connection of 63 sites via spirit levelling to 7 temporary tide gauges (14 days of sea level observation)
⇒ **Local height systems deviate on decimeter level**





ISN93 Benchmarks



Field Work for the New Icelandic Vertical Reference



- 1997: Start of spirit levelling by the National Power Company
1999 joined by the Public Roads Administration and the National Land Survey

- Double Run precise levelling ($\sigma = 3.2\text{mm}/\sqrt{\text{km}}$)
- Invar Rods calibrated each season at Finnish Geodetic Institute
- Digital Levels ZEISS DINI12 and Leica NA3000)

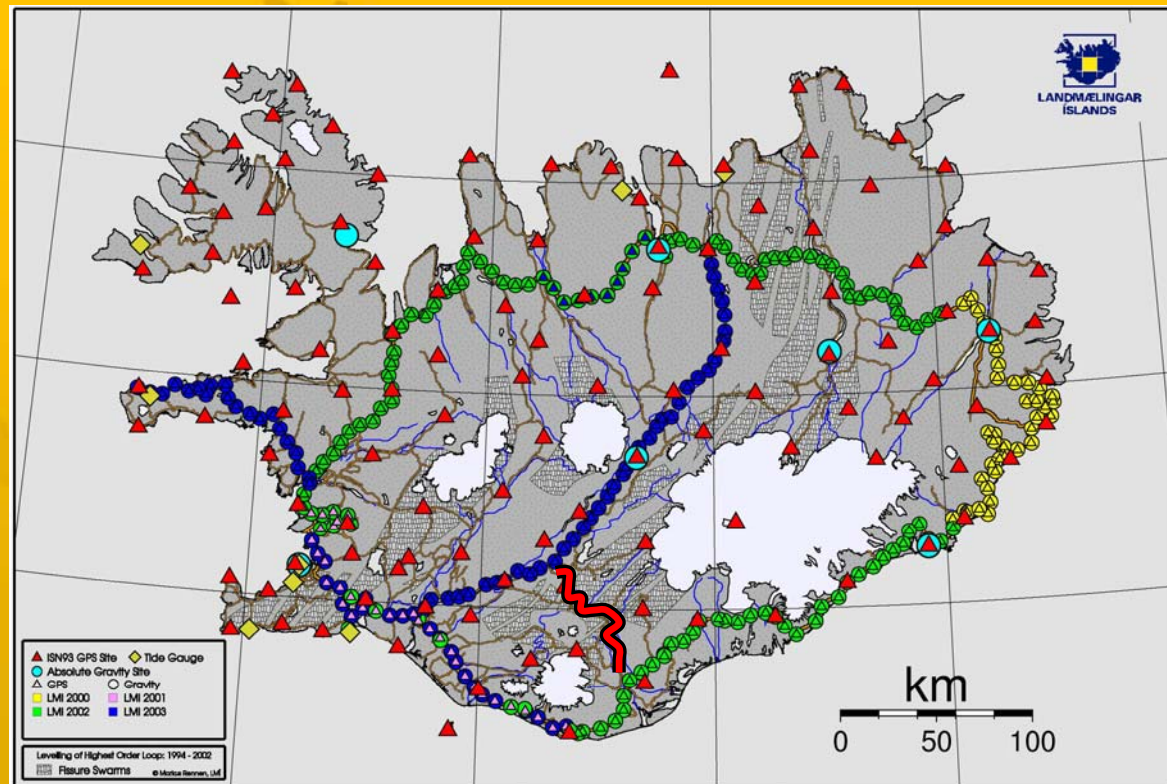
- Levelling of First Order Loop ca. 1426km (1997-2002)

- **Preliminary Loop Closure 0.075m**

- Levelling benchmark approx. every 1km

- GPS and Gravity points approx. every 8km (Surveys 2000-2003)

- All GPS points tied to ISN93



New Icelandic Vertical Reference



Levelling 1994-1998
ca. 280km

Levelling 2002
ca. 360km

Levelling 1997-2001
ca. 134km
2003
ca. 120km
2004
ca. 55km

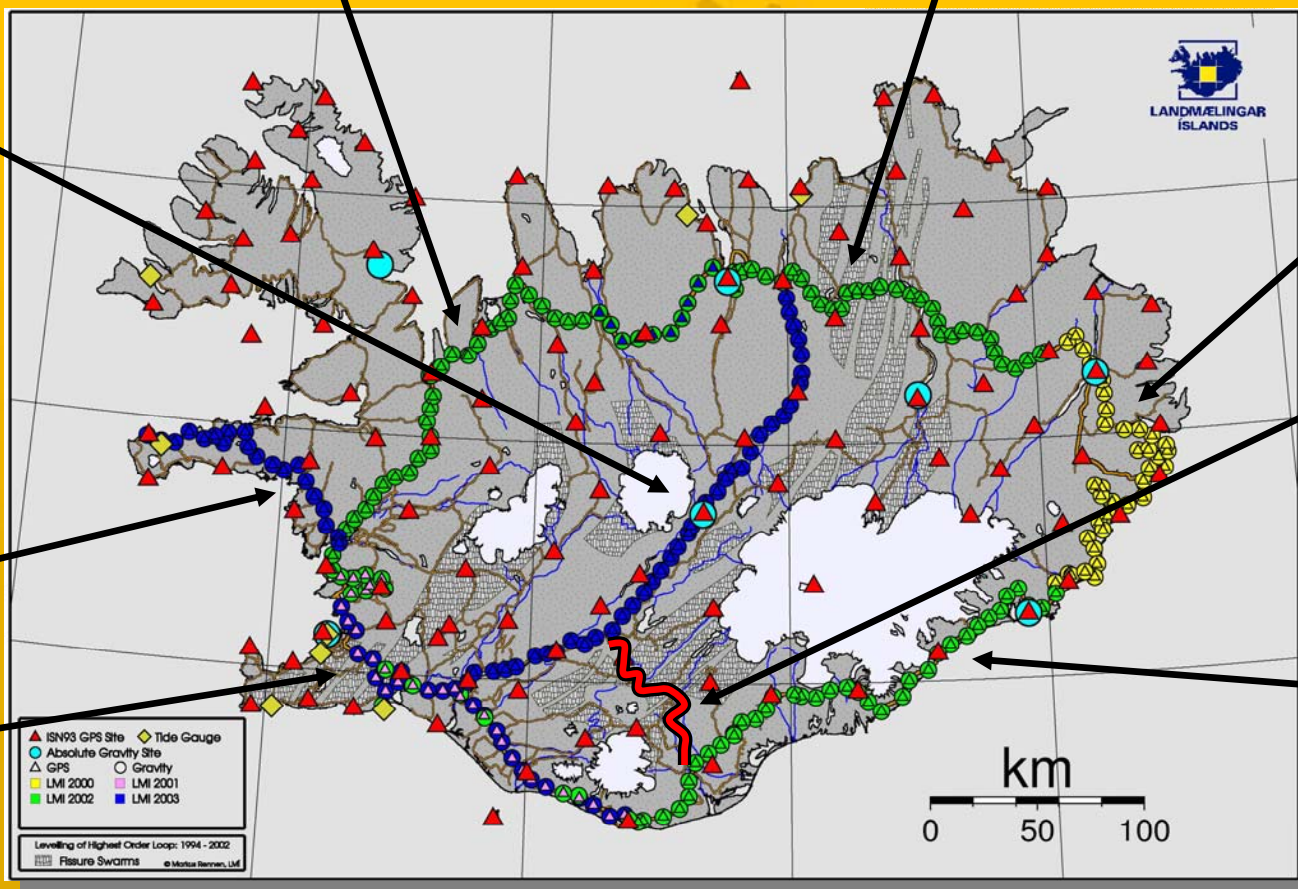
Levelling 2000
ca. 310km

Levelling 2004
ca. 100km

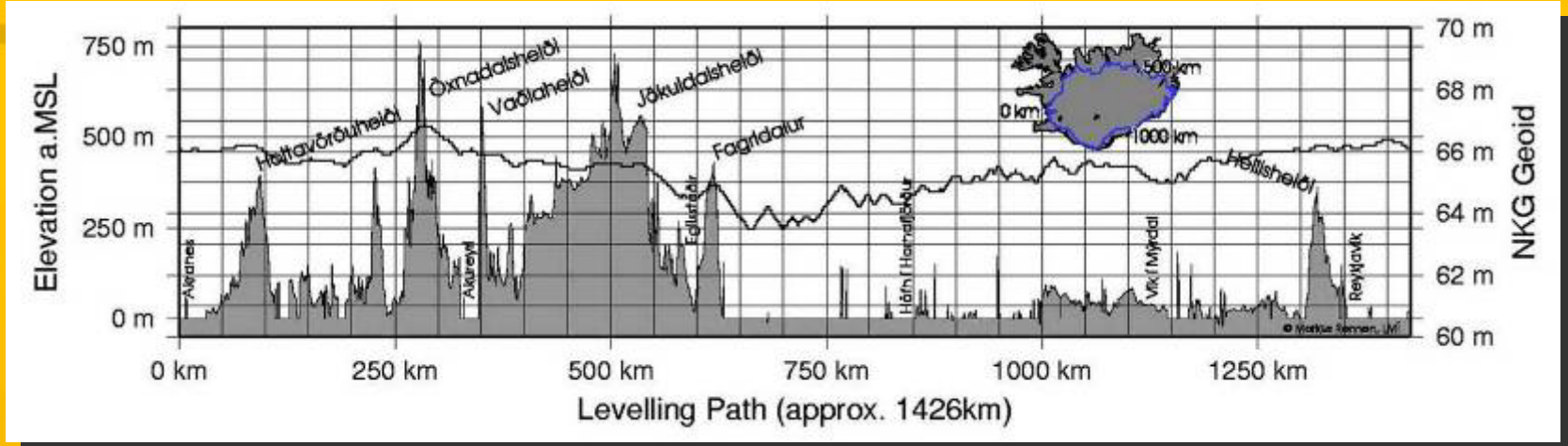
Levelling 2003
ca. 130km

Levelling 1999
ca. 250km

Levelling 2001
ca. 230km



Relative Gravity Survey



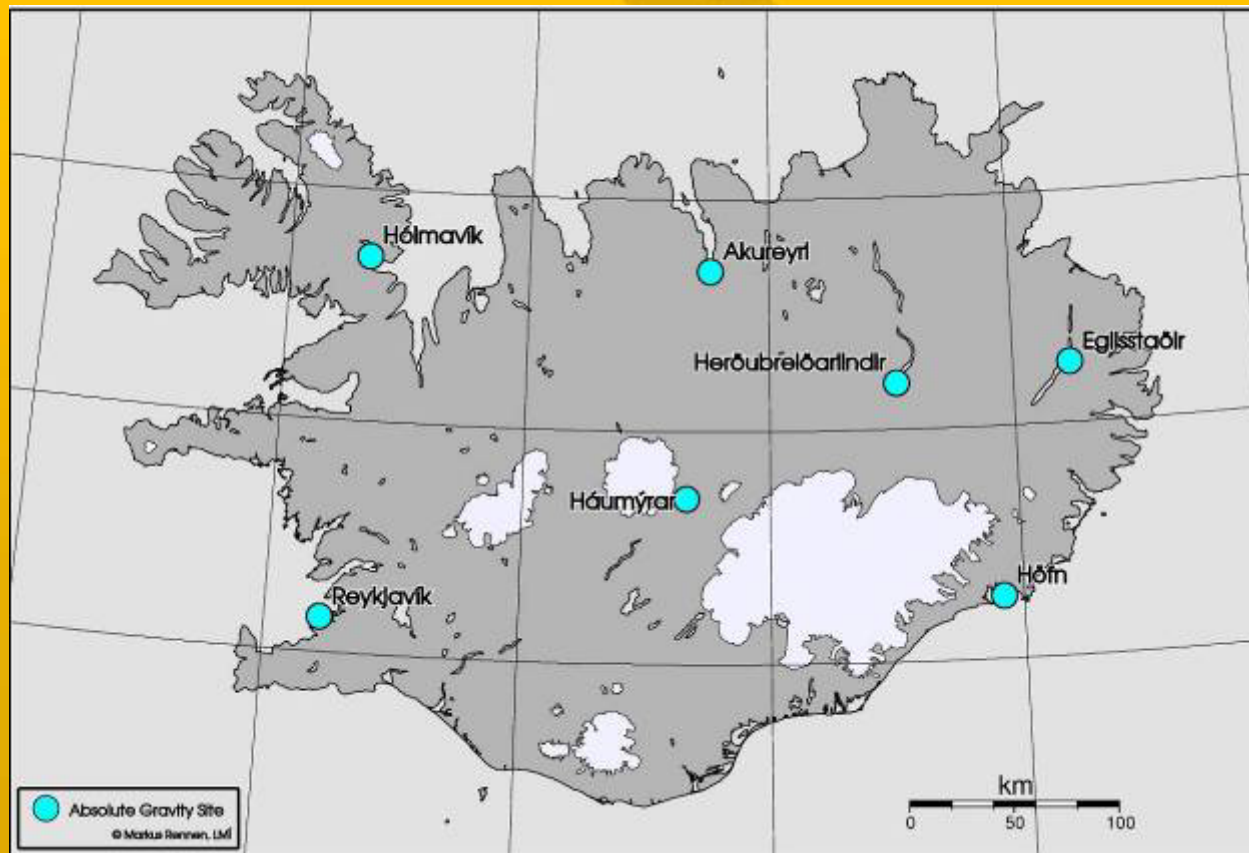
- Scintrex CG-3/3m relative Gravimeter
- Simultaneous with GPS Survey
- Points approx. every 8km
- Connection to Absolute Gravity Sites
- Adjustment will be commissioned



Absolute Gravity Sites



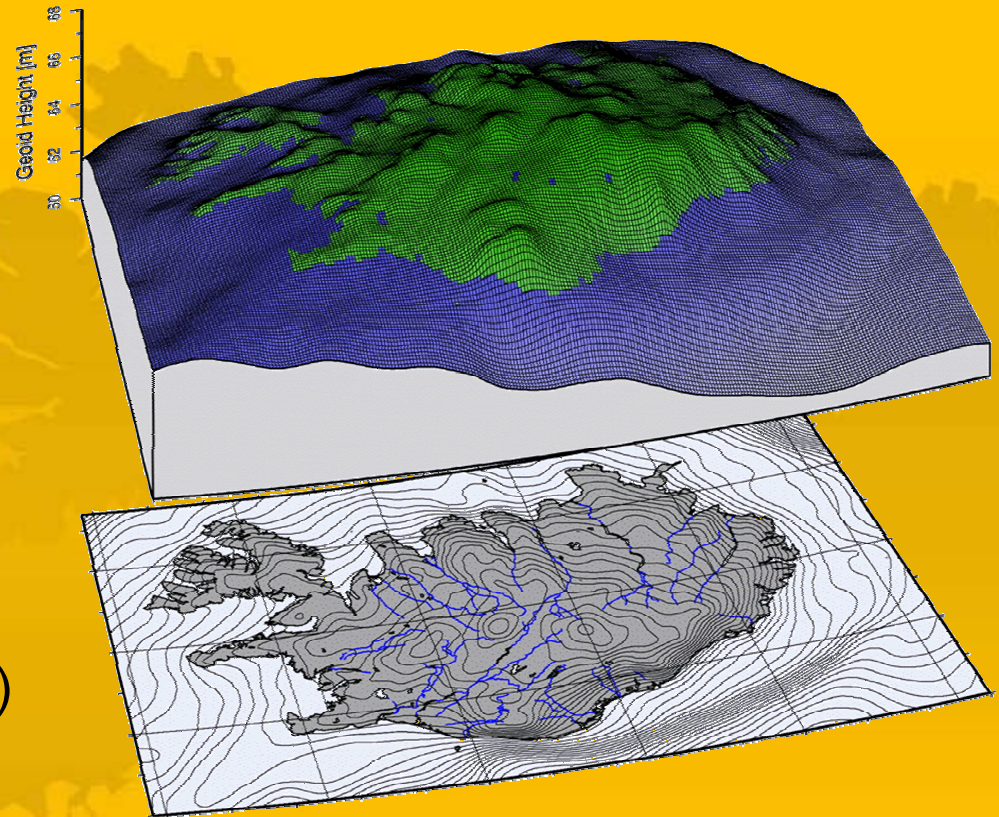
Occupation by FIG (JILAG-5) and BKG (FG5-101) in 1995

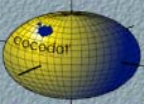


Currently used Geoid



- In use: NKG96
- Offset determined with respect to Icelandic MSL referenced benchmarks (-1.2733m)
- Gravity data gathered by “*National Energy Authority*” since early 1950s
- User access via online tool on LMI homepage (MSL transfer of GPS results)





Output Sheet



FROM:				TO:			
Latitude	Longitude	h	H above MSL	E	N	h	H above MSL
<input type="radio"/> 64 05 23.157	-22 57 11.221	134.23	<input type="text" value="68.659"/>	<input type="text" value="307305.812"/>	<input type="text" value="404553.094"/>	<input type="text" value="134.230"/>	<input type="text" value="68.659"/>
<input type="radio"/>	<input type="text" value="Browse..."/>	<input type="radio"/> h	<input type="radio"/> H a. MSL	<input type="text" value="Open..."/>	<input type="radio"/> h	<input type="radio"/> H a. MSL	

West of Greenwich
 West of Copenhagen Observatory

Datum Definition:

Ellipsoid: a: 1/f:

Transformation parameters:

Dx	Dy	Dz	Rx	Ry	Rz	Ds
<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>

Input of Transformation Parameters File:

Projection/Format:

Central Meridian	Latitude of Grid Origin
<input type="text"/>	<input type="text"/>
False Easting	False Northing
<input type="text"/>	<input type="text"/>
Standard Parallel 1	Standard Parallel 2
<input type="text"/>	<input type="text"/>
Zone	Scale Factor
<input type="text"/>	<input type="text"/>
Meridian Convergence	
<input type="text"/>	

NEW TRANSFORMATION

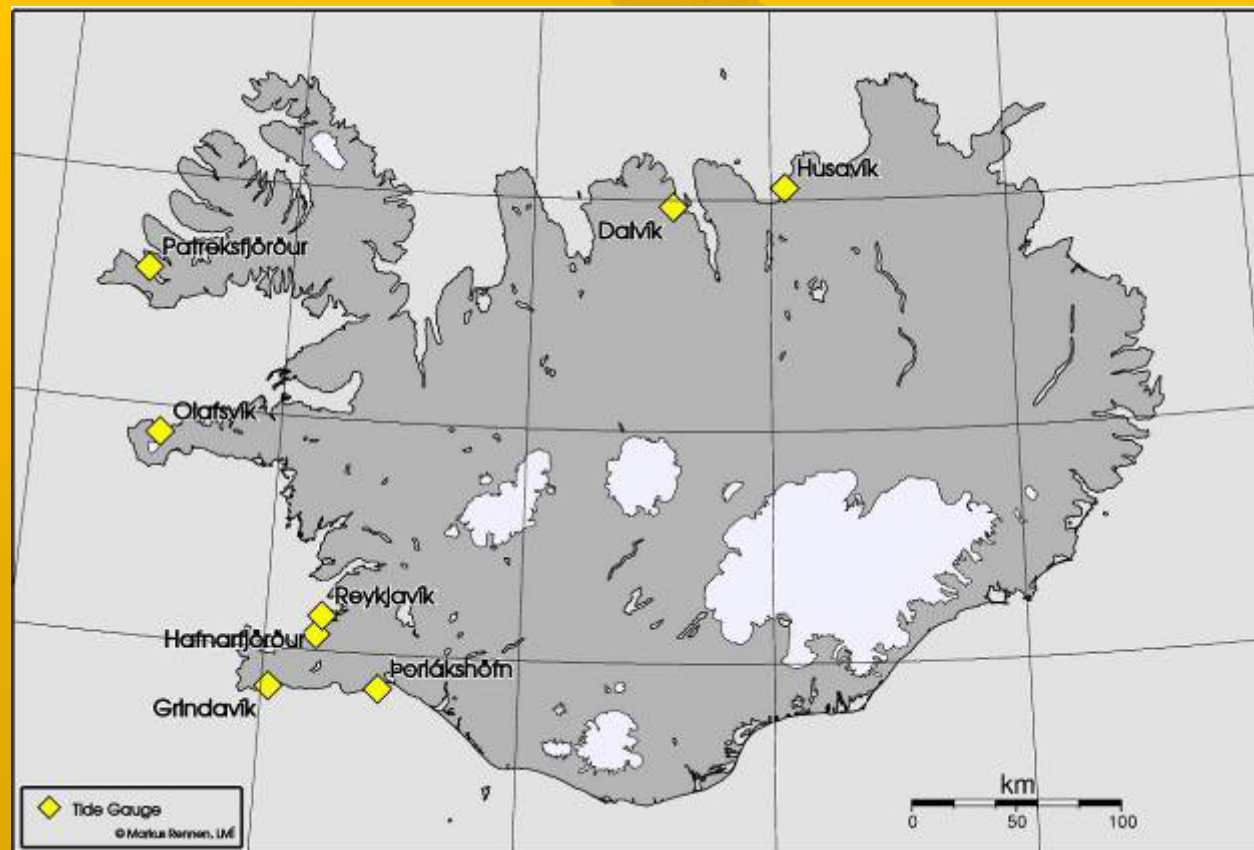
visitors

<http://lmi-apps03.lmi.is/cocodati/cocodat-i.jsp>

Tide Gauges



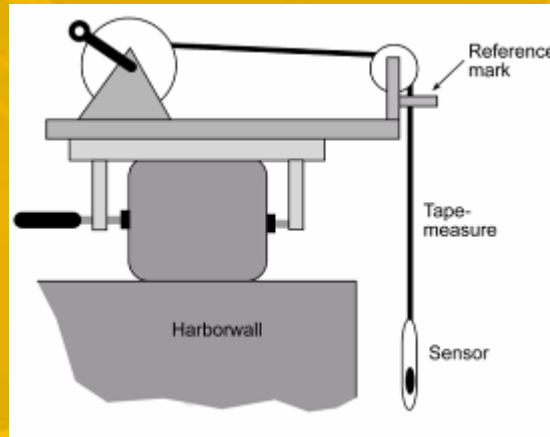
Tide Gauges Operated by the Icelandic Maritime Administration



Tide Gauge Connection to ISN93



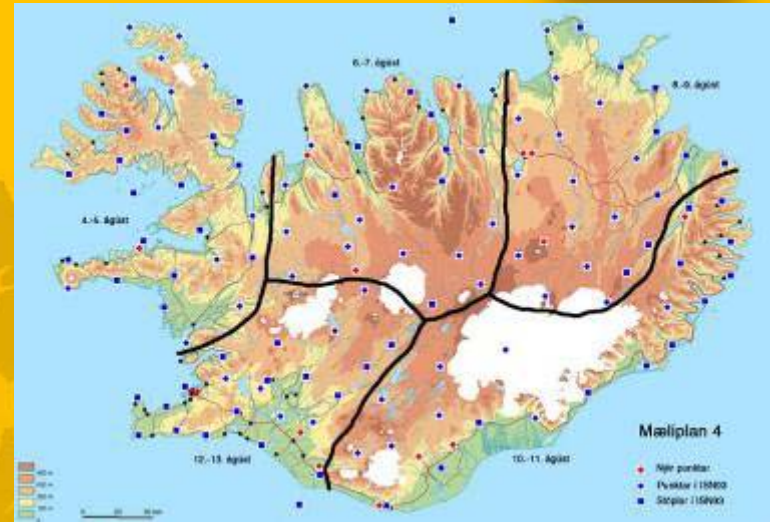
- Tide Gauges connected to ISN93 in 2000 by LMÍ
- Establishment or use of stable harbour benchmark
- Levelling towards temporary tide gauge
- Connection to ISN93 via GPS





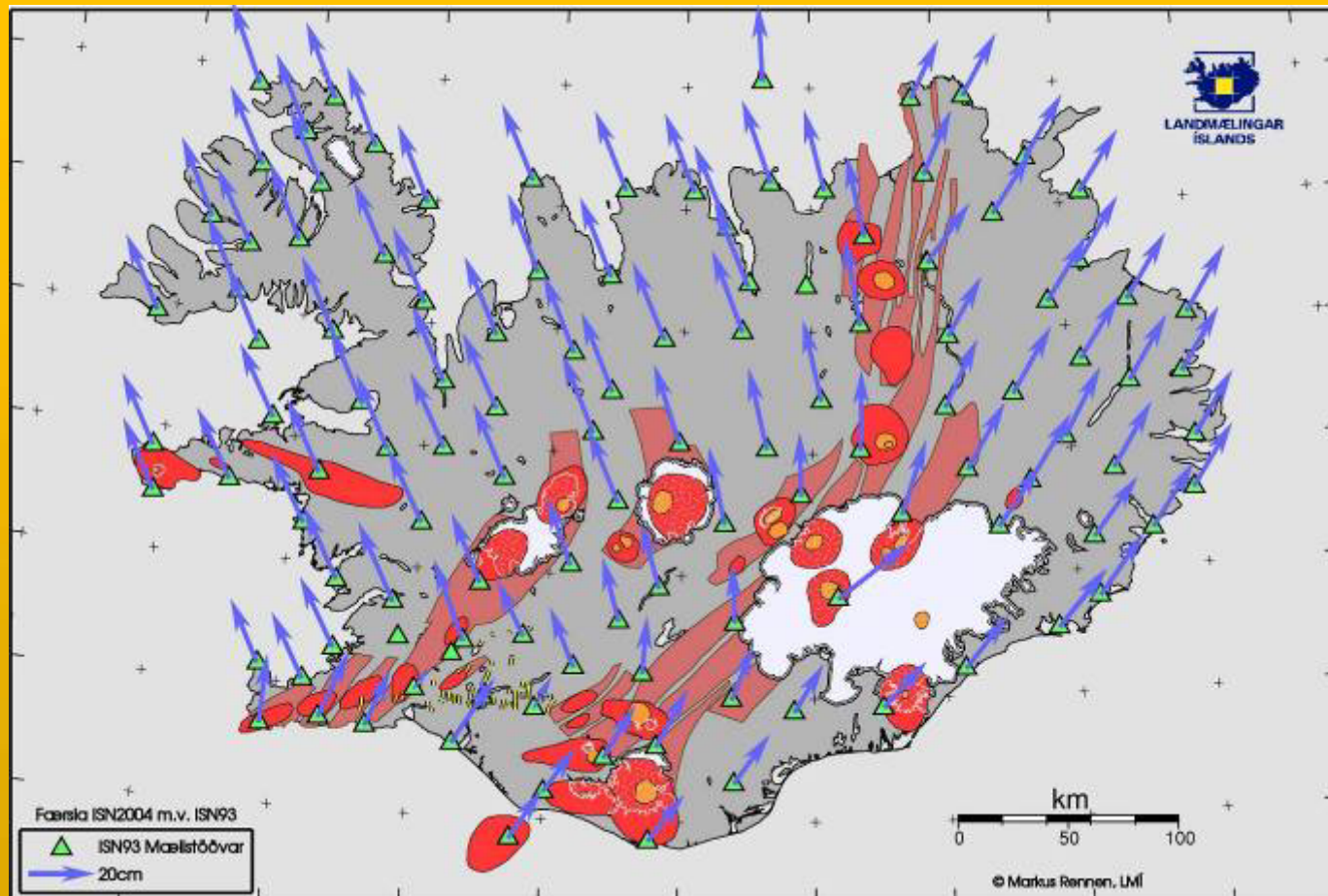
ISN2004

- GPS Survey in August 4th-14th, 2004
- Cooperation of various institutes, agencies, municipalities and companies
- 35 mobile GPS units
- 5 blocks
- Minimum 2 site occupations, sessions length 16h – 24h
- 17 Permanent GPS sites (14 operated by “*Icelandic Meteorological Office*”)
- All in all 151 observed stations (re-occupation of 115 ISN93 sites)
- Preliminary relative accuracy estimation: $\varphi, \lambda \approx 2\text{-}3\text{mm}$; $h \approx 5\text{mm}$ (Estimation from baseline residuals after adjustment)



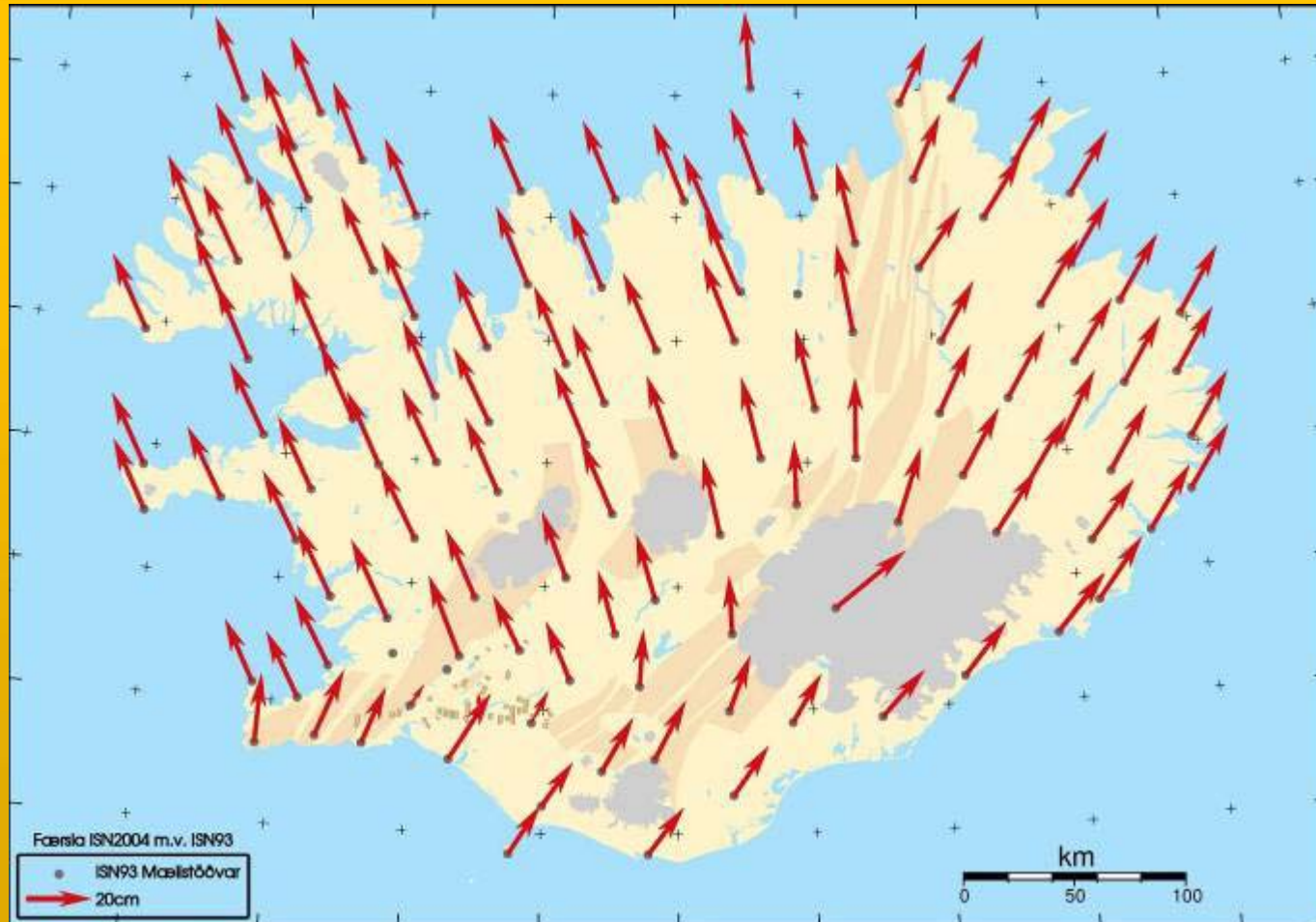
ISN2004 vs. ISN93

(Movements centered on ITRF rates)



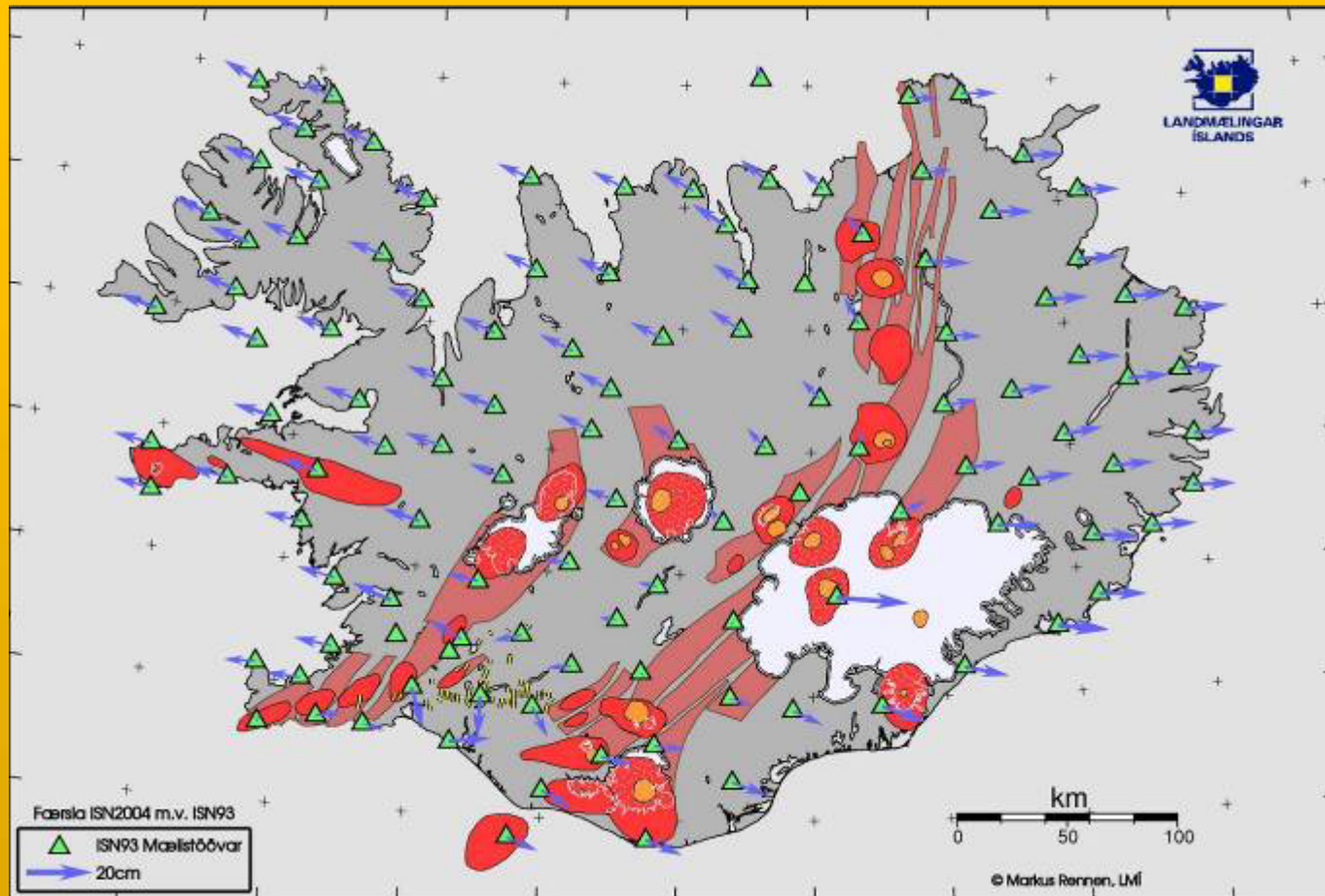
ISN2004 vs. ISN93

(Movements centered on ITRF rates)



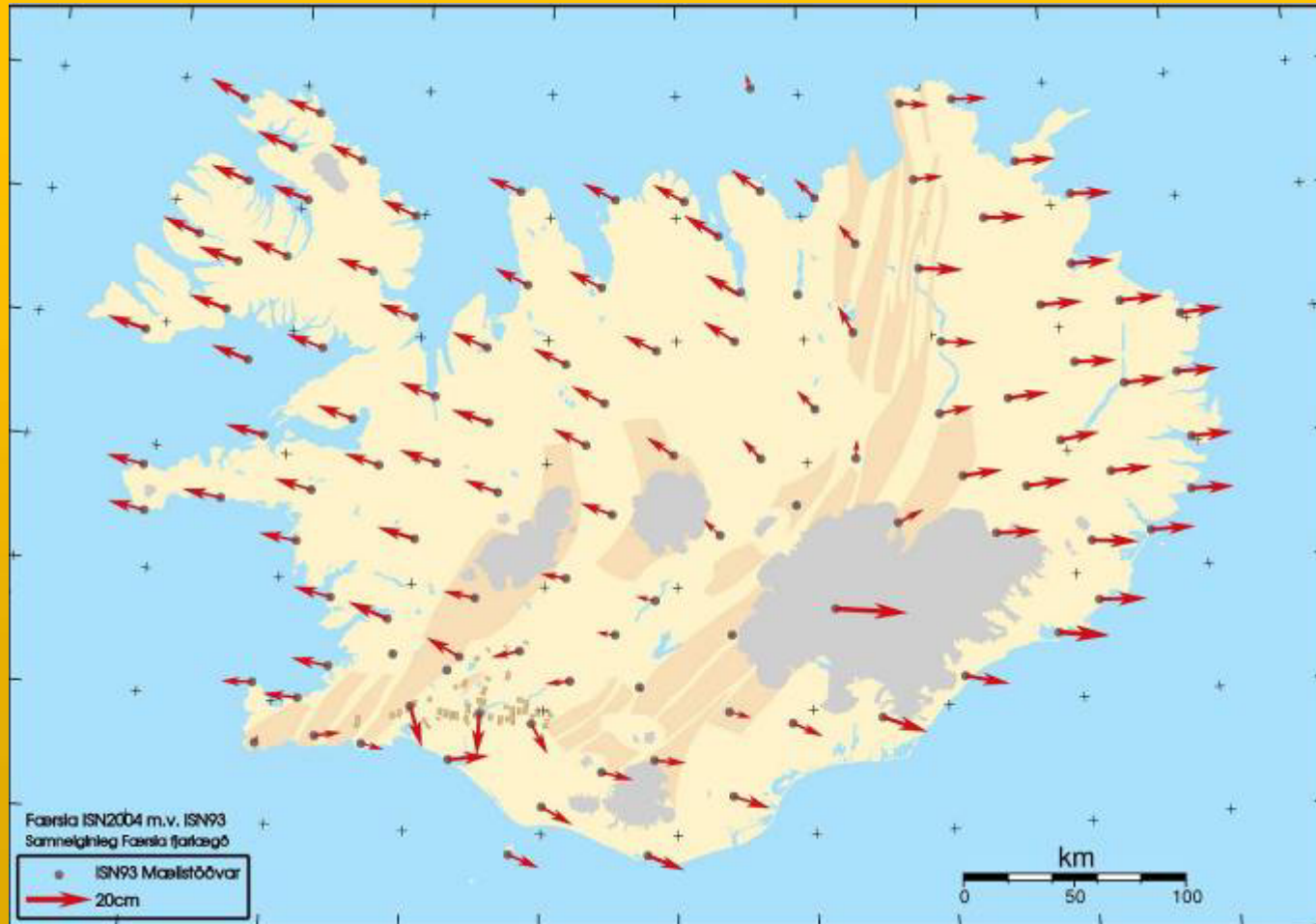
ISN2004 vs. ISN93

(Relative Movements)



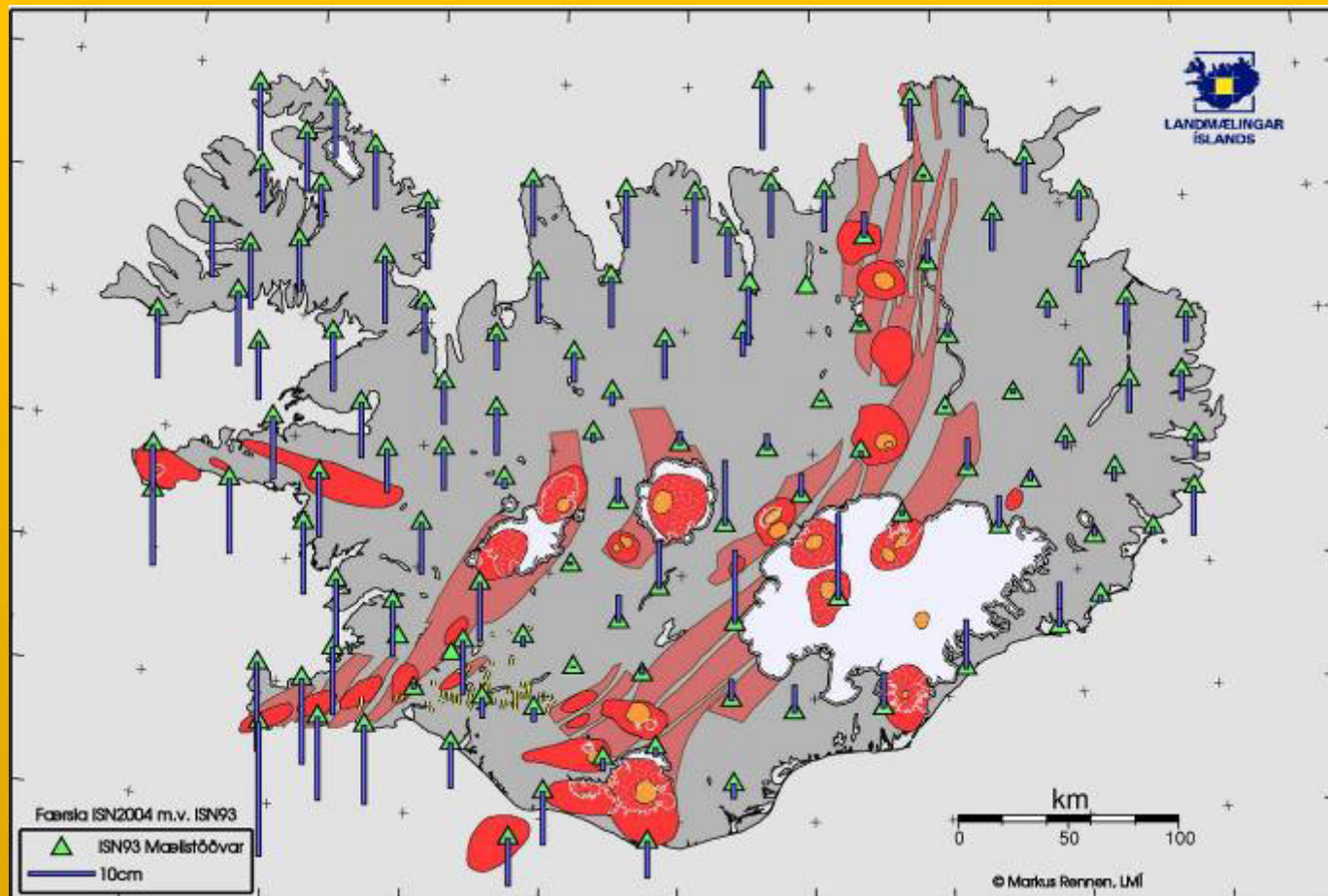
ISN2004 vs. ISN93

(Relative Movements)



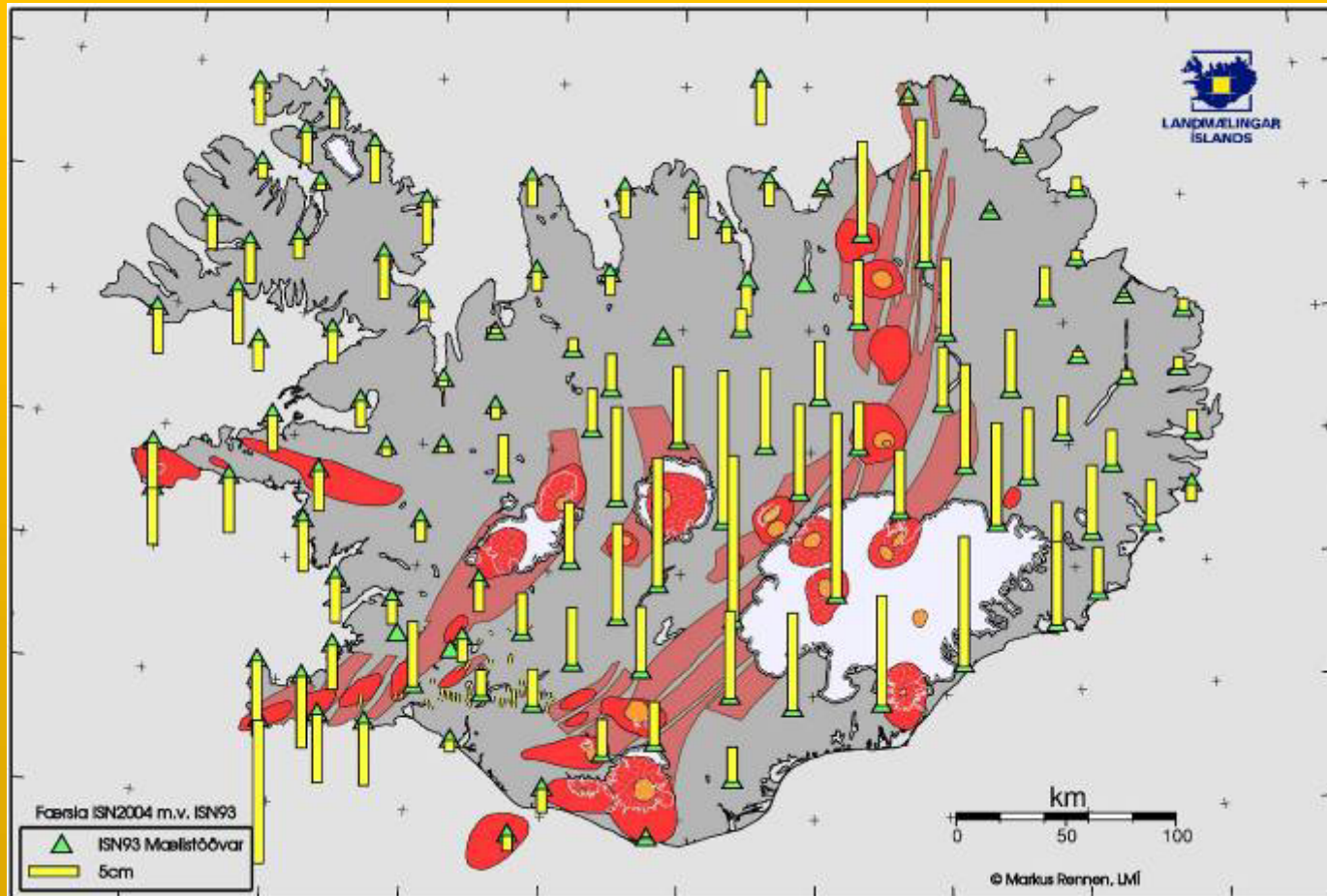
ISN2004 vs. ISN93

(Heights)



ISN2004 vs. ISN93

(Heights centered on ITRF rates)



It's a very active country!

