## Summary of Geodetic Activities in Iceland



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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  $\phi, \lambda \approx$  1-2cm; h  $\approx$  3cm
  - 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

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## **ISN93 Benchmarks**





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## 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 Leice 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





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## **Relative Gravity Survey**





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

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## **Absolute Gravity Sites**



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



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## **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 LMÍ homepage (MSL transfer of GPS results)



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

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## **Tide Gauges**



#### Tide Gauges Operated by the Icelandic Maritime Administration



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# 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 isntitutes, 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 Meteorlogical Office")
- All in all 151 observed stations (er-occupation of 115 ISN93 sites)
- Preliminary relative accuarcy estimation:  $\phi, \lambda \approx 2$ -3mm; h  $\approx$  5mm (Estimation from baseline residuals after adjustment)









#### (Movements centered on ITRF rates)



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#### (Movements centered on ITRF rates)



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(Relative Movements)



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(Relative Movements)



## ISN2004 vs. ISN93 (Heights)





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#### (Heights centered on ITRF rates)



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# It's a very active country!



