



Integration of meteo-hydro-cryosphere observation networks: key challenges and triumphs

Jórunn Harðardóttir, WMO RA VI Hydrology Forum, April 2-4, 2019

2009
2019



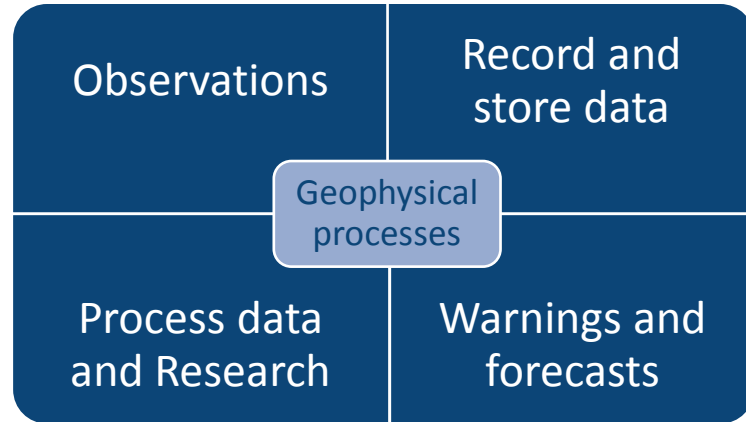
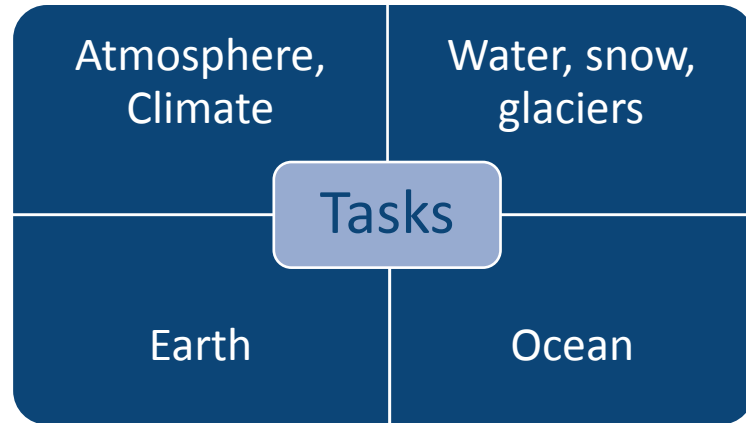
+  HYDROLOGICAL
SERVICE

The new Met Office

Integrated institute

Expanded scope

- ▶ Natural hazards
- ▶ Climate change
- ▶ Hydrological research



Main processes and tasks for the new Icelandic Met Office from January 1, 2009

Integration was the strategy for the new combined institute

Increasing
efficiency through
economy of scale

Expansion of
science

Independent
divisions that span
all scientific
disciplines

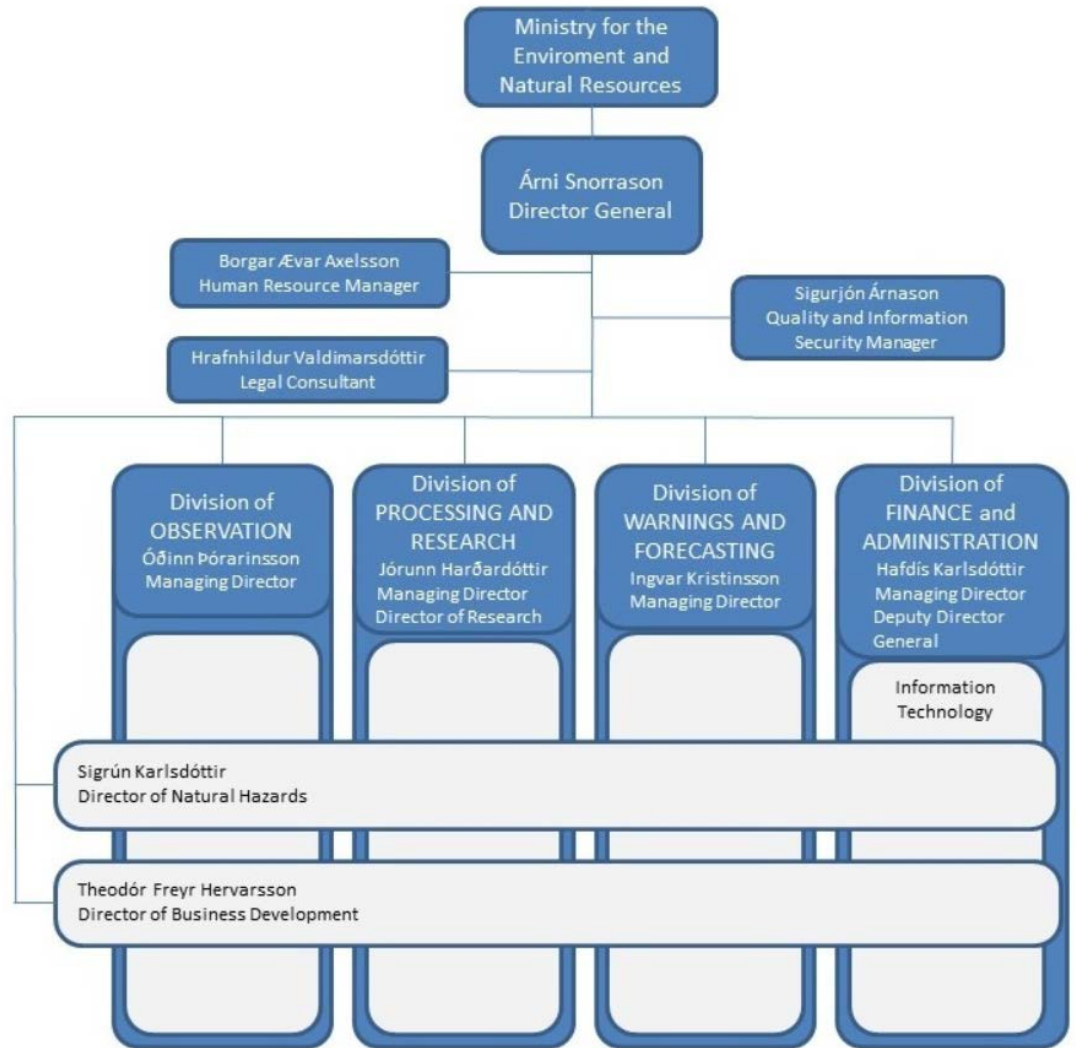


Organization of IMO

The key is integration!

Independent divisions that span all scientific disciplines

- ▶ Observations
- ▶ Processing & Research
- ▶ Warning & Forecasting
- ▶ Finance & Administration
- ▶ Information Technology

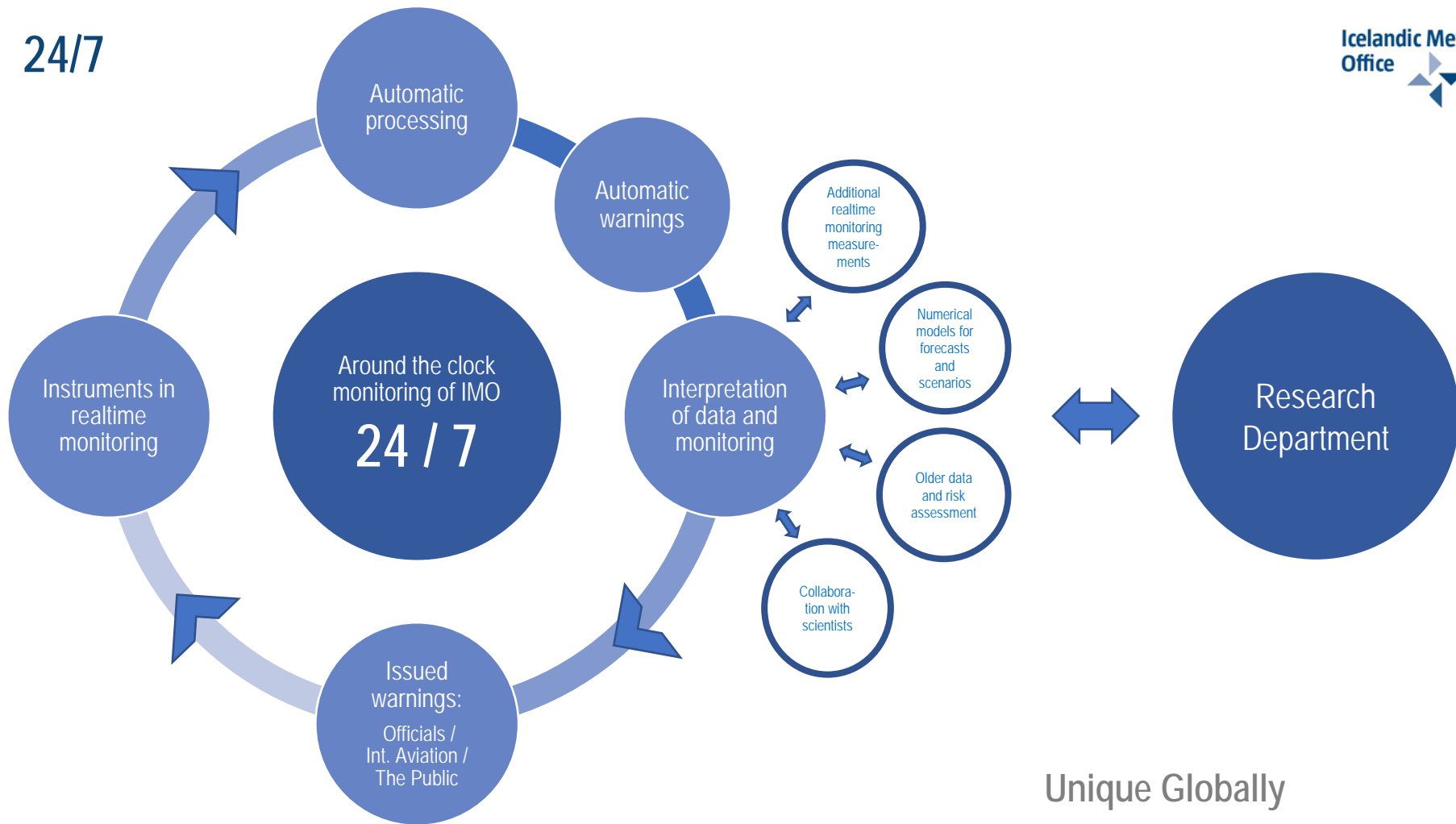




Icelandic Met
Office



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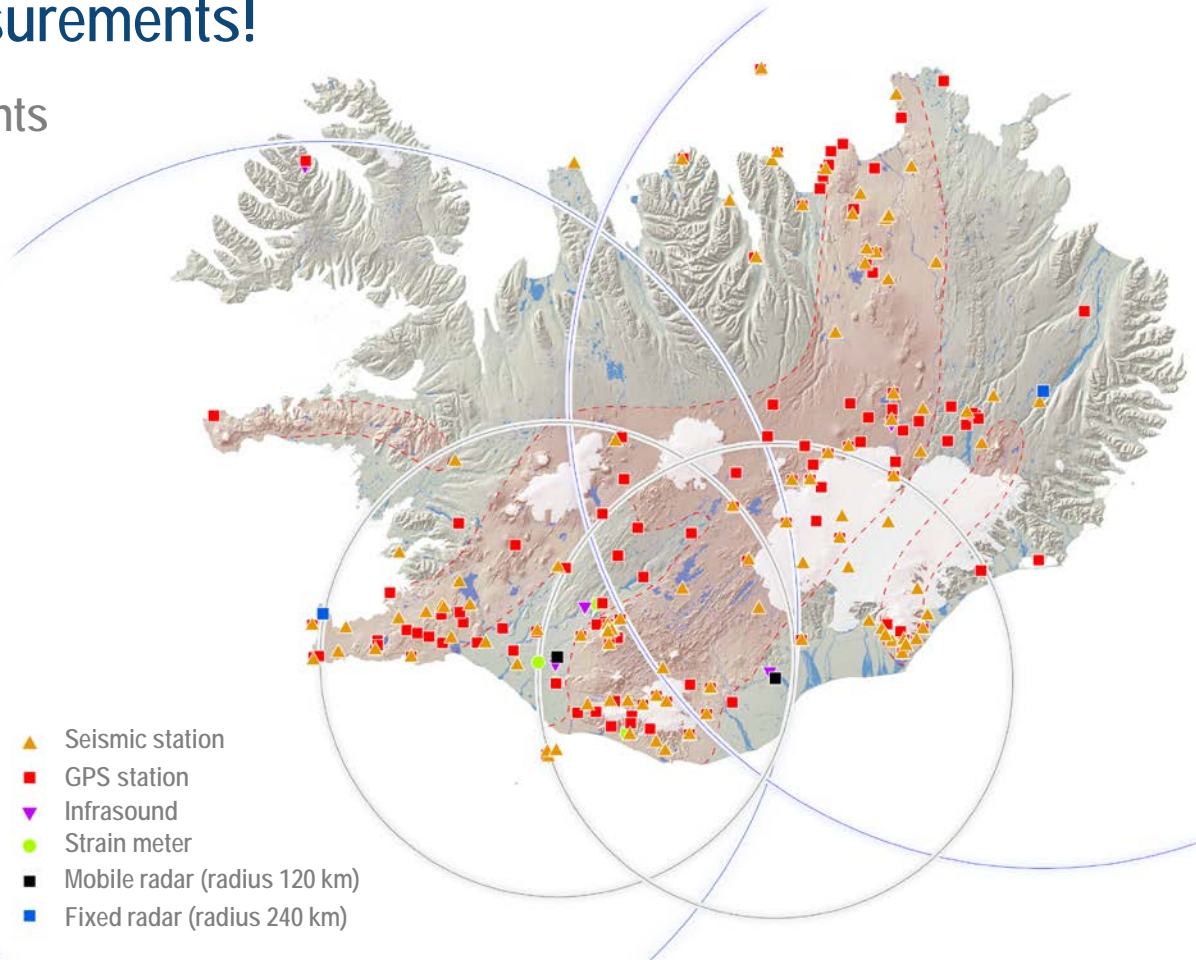
Unique Globally

Monitoring needs measurements!

Over 500 real-time measurements

Earthquakes and volcanoes

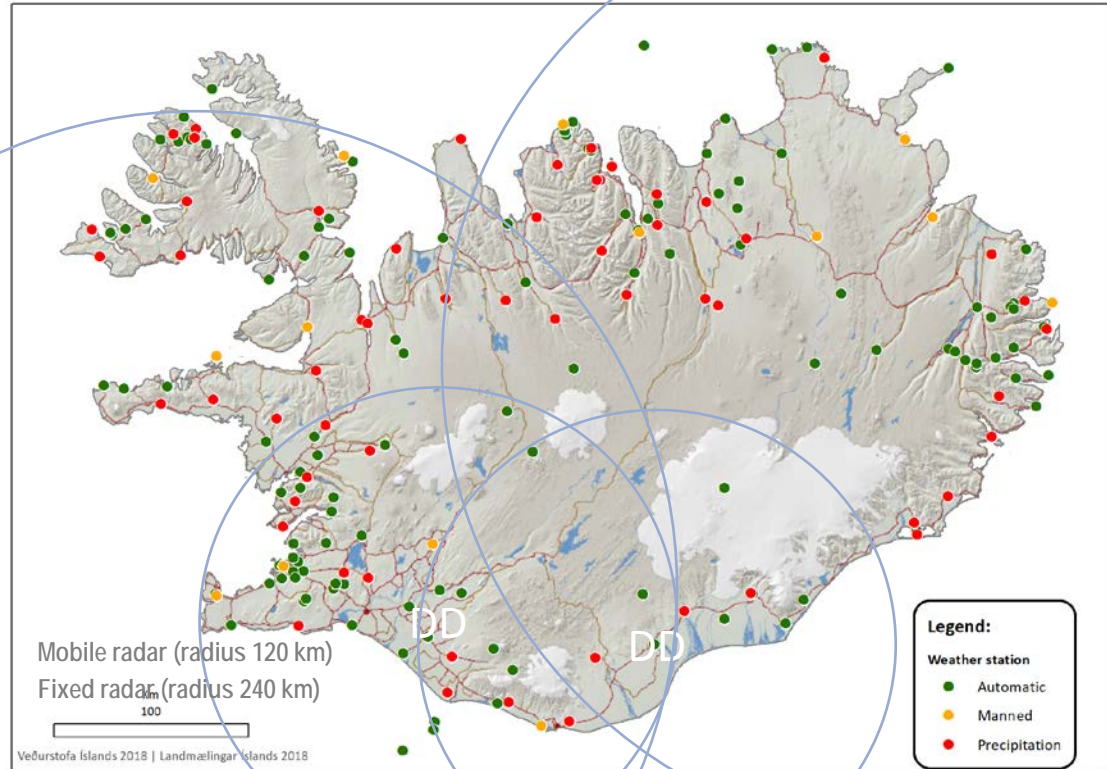
- ▶ Seismic stations
- ▶ GPS monitoring system
- ▶ Strain meters
- ▶ Tilt meter
- ▶ Infrasound
- ▶ InSAR measurements
- ▶ Gas measurements



Meteorological monitoring

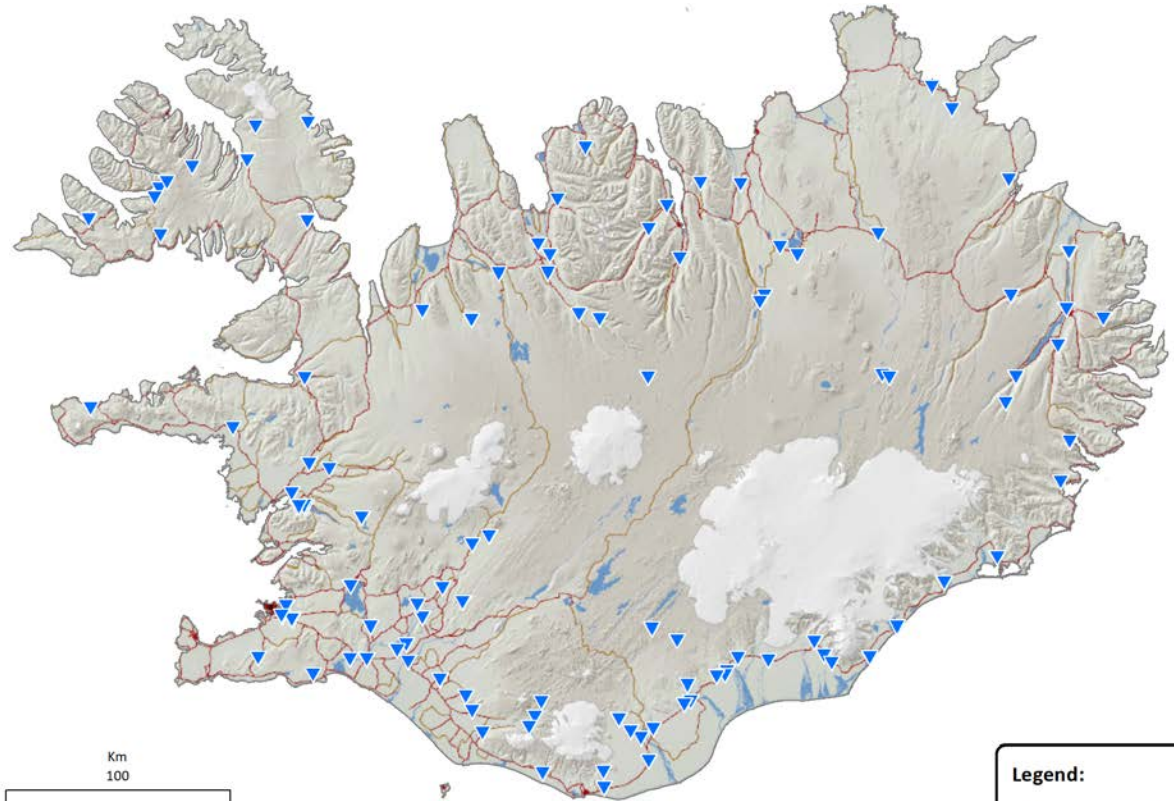
Atmosphere

- ▶ Weather stations
- ▶ Radars (fixed and mobile)
- ▶ Wind and particle lidars
- ▶ Remote sensing via satellites



Hydrological monitoring

- ▶ 120 water gauges of which 78 have discharge measurements and rating curve
- ▶ 42 water temperature
- ▶ 23 conductivity
- ▶ 2 turbidity
- ▶ 1 pH
- ▶ 14 air temperature
- ▶ 3 web cams
- ▶ Sediment transport
- ▶ Glacier mass balance
- ▶ Snow thickness



The Hydrometric Observation Network

New network analysis

The new Icelandic Met Office has broader scope than the older HydroService

- ▶ Water-related risks, hydrological, environmental and climate research more pronounced

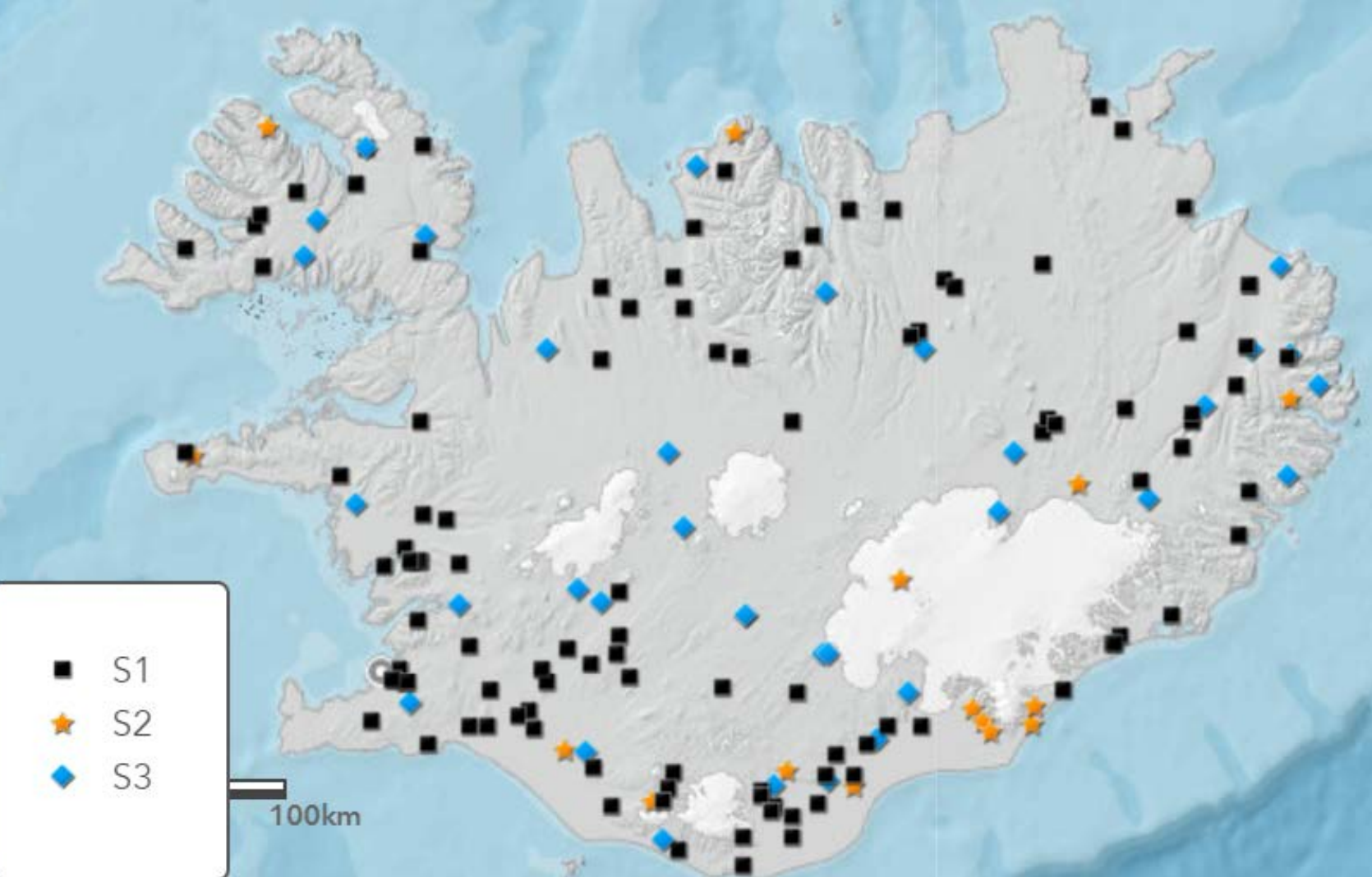
Major changes in Icelandic society, travelling, tourism

Changes in the Icelandic frame of law

Over 35% downsizing of governmental funding in 10 years

Long term strategy for network extension has been sent to the ministry – three timescales





Equipment isn't all!

What more is needed?

Human resources

- ▶ 25 trained personnel with diverse background
- ▶ Engineers, geophysicists, geologist, geographers, meteorologists, technicians...

Specialized vehicles, snowmobiles, all-terrain vehicles, boats, helicopters...

Power generation in the field

Tele-communication network – data streaming

Databases



Observation division (AOT)

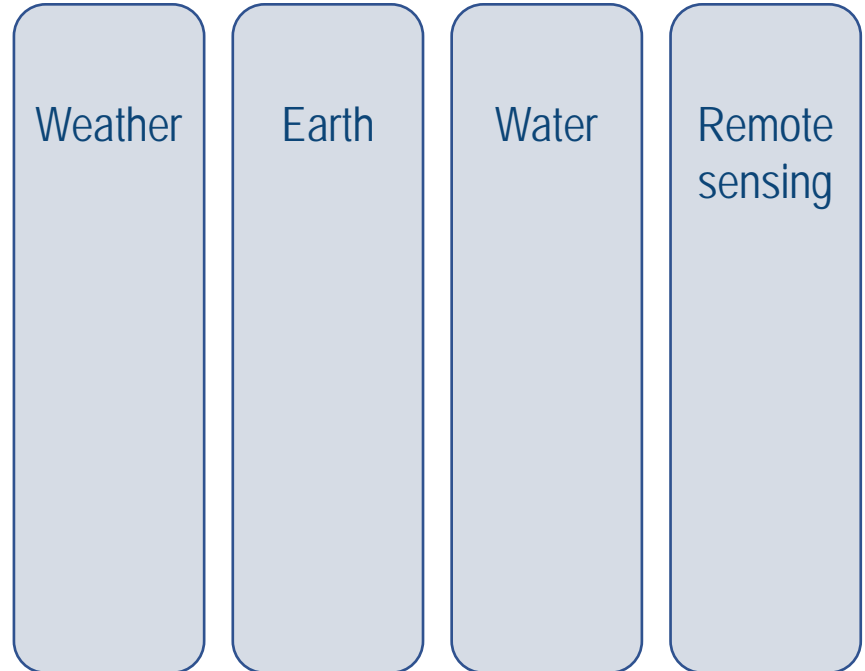
Status of integration

Four divisions by subject

- ▶ Still certain specialization
- ▶ Short weekly meetings with all staff of AOT
- ▶ Coordination of field work
- ▶ More integration with weather and water than with seismometers and GPS equipment

QC differs by subject

- ▶ Only primary QC for Earth, Weather and RS
- ▶ Time series of quality controlled data (annual basis) produced for water
- ▶ QC for other data performed at Processing and Research Division



Observation division

Status of integration

Coordinator of data streams & raw data quality

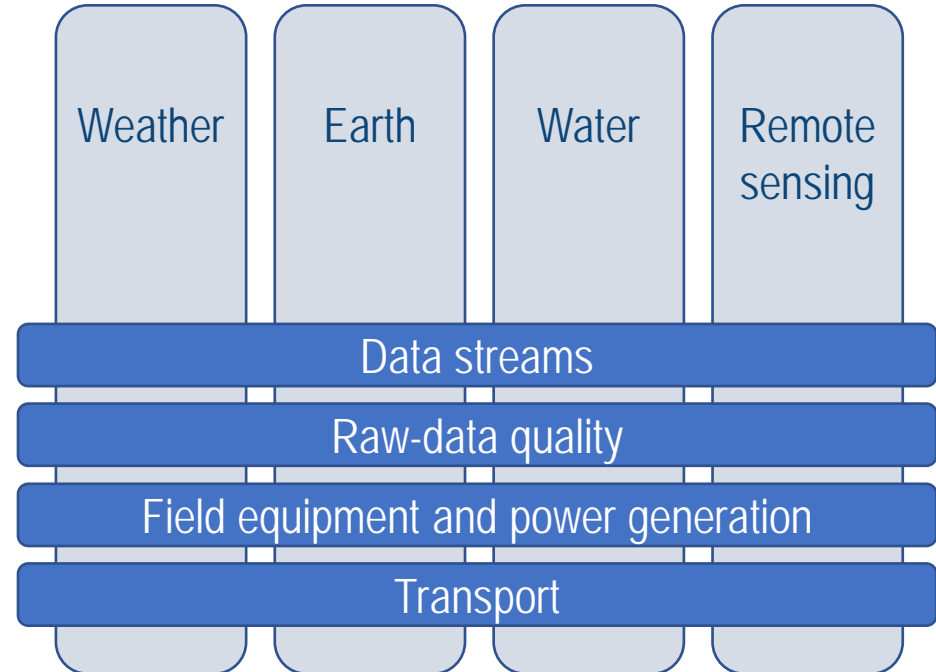
- ▶ Integration of data stream options
- ▶ Development of solutions for QC of raw data

Independent data bases

- ▶ WISKI for hydrology but homemade for other
- ▶ New upgrade of **Vista Data Vision** will help displaying different data from different fields

Innovation at home

- ▶ Development of homemade solutions for power generation, telecommunication, transport issues etc. – for all observation fields



Integration of observation systems quite good

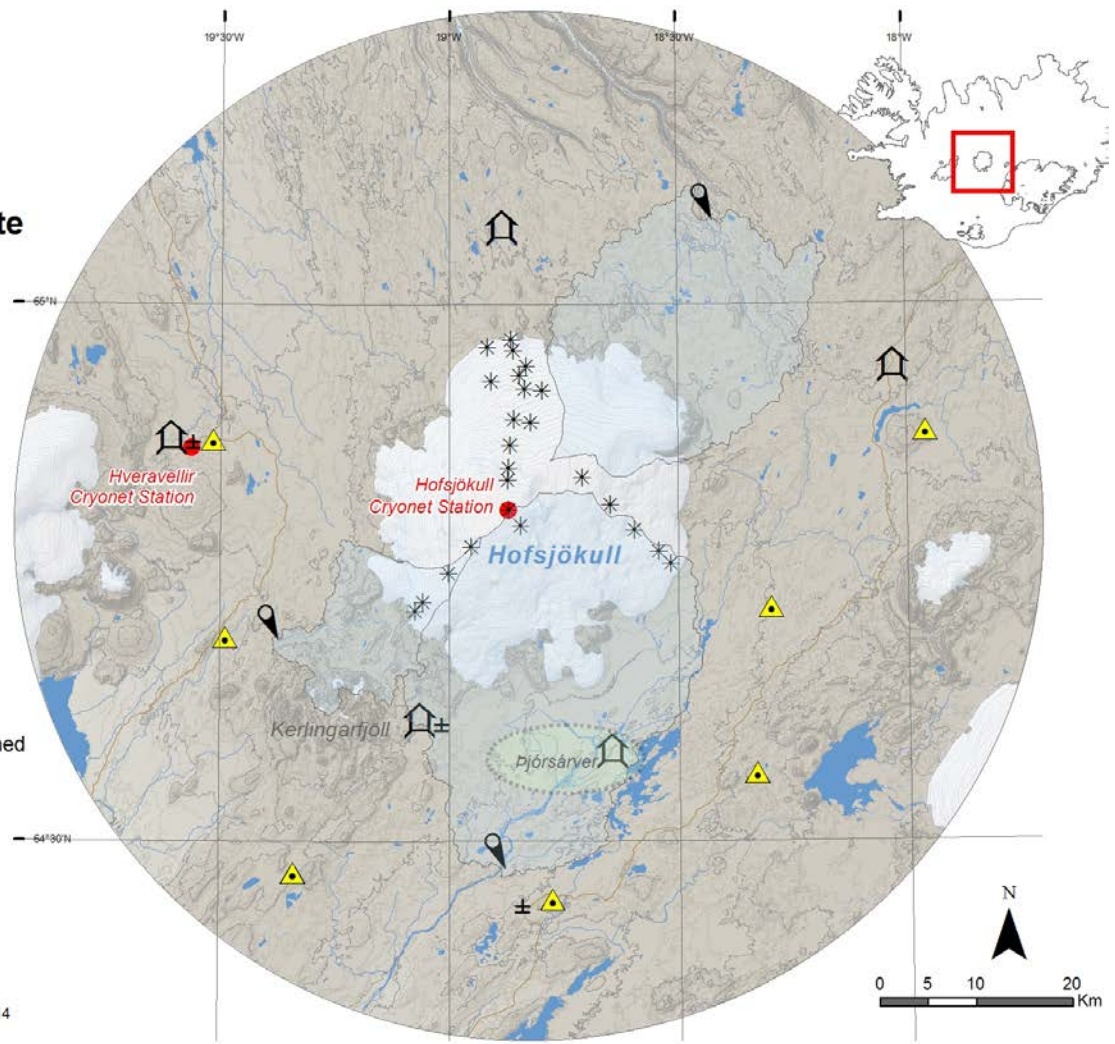
Hofsjökull example



Hofsjökull Cryonet Site

Legend

- Cryonet Station
- ✱ Glacier mass balance
- ± Snow depth station
- 🏠 Weather station
- 📍 Gauging station
- ▲ GPS station
- Gauging Station Watershed
- Permafrost study site



Hofsjökull

- ▶ WMO Global Cryosphere Watch
- ▶ Integrated CryoNet Cluster station
- ▶ <http://globalcryosphe.rewatch.org/cryonet/sitepage.php?surveyid=52>

Observation systems

More integration achieved in
logistics/hardware/software
of the networks than in staff
mobility



Other integration of hydrology

Processing and Research Division

Much increased knowledge transfer between hydrologists, meteorologists, geophysicists etc.

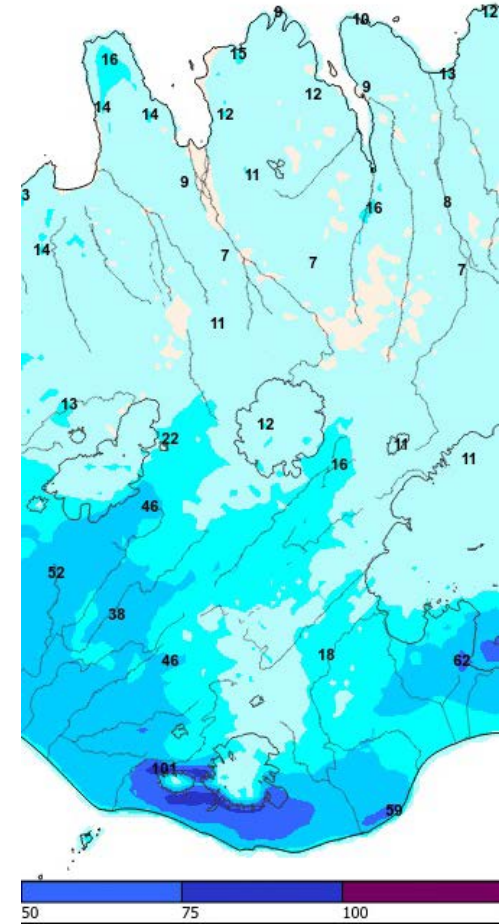
Mobilization of scientist between subjects

Numerical Weather Prediction data used in hydrological products

Major advances in data analysis, modelling and product development with integrated approach

Climate change research shows how greatly these systems are interconnected in Iceland

Accumulated discharge from the HARMONIE NWP model



Climate change

Affects the whole natural system

- ▶ Increased temperatures and precipitation
- ▶ Melting glaciers
- ▶ Change in total and seasonal discharge patterns
- ▶ More floods and droughts
- ▶ Increased rockfalls/debris flows due to melting of glaciers and permafrost
- ▶ Isostatic uplift due to decreased glacier volumes
- ▶ Eustatic sea-level rise
- ▶ Possibly more geothermal and magma production due to less glacier volume – more frequent/larger eruptions and glacier outburst floods (jökulhlaups)

Interlinked system!



Holistic approach needed
Big data – remote sensing
Complies with WMO strategy



Overall triumph with very
few cons!!





*IMO's Centennial
1920 - 2020*