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Sea level changes: guidelines and adaptation plan for ports and other coastal infrastructure

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Do we need an adoption plan?



1. of September – full moon harbour by Reykjavik



The government of Iceland has recently released a proposal for an adaptation plan;

- A national framework for mitigation and adaptation
- And conducting a infrastructure climate change impact assessment



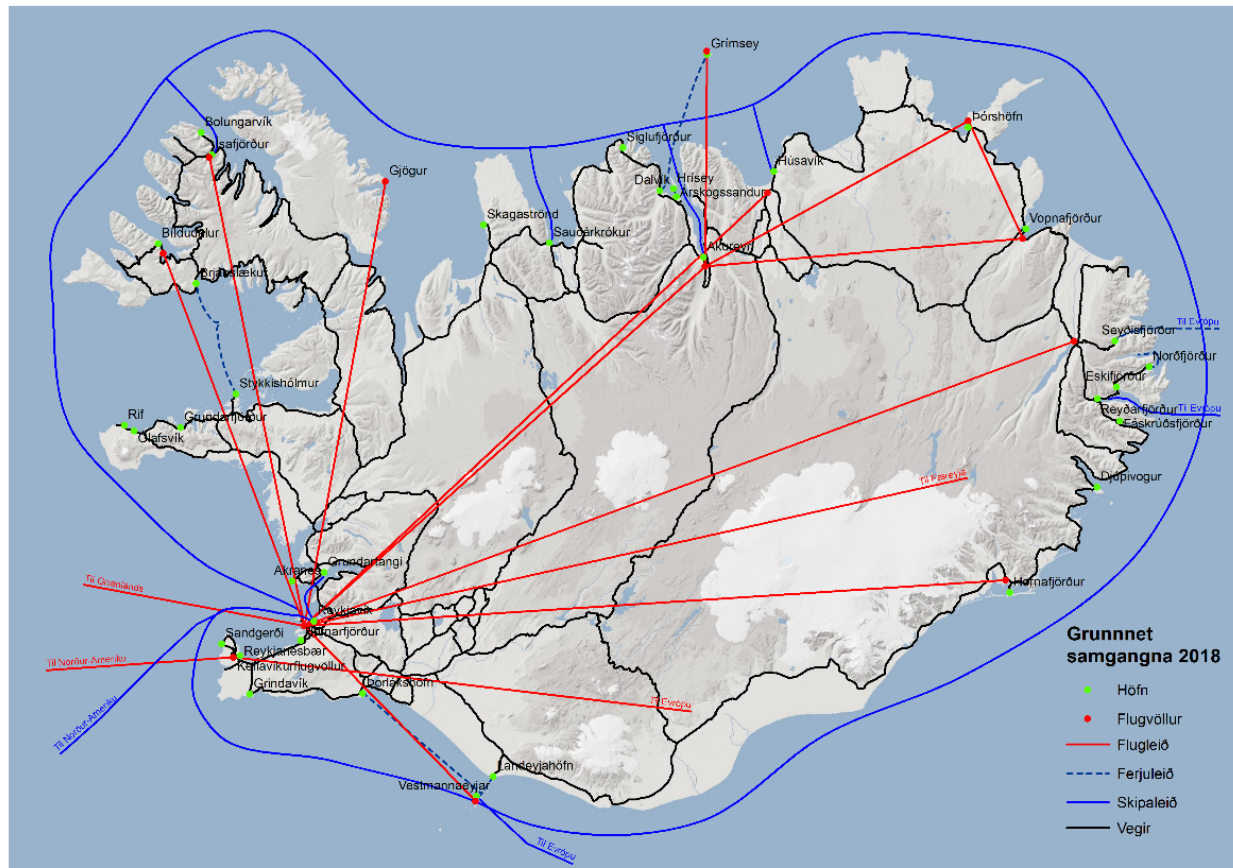
Iceland's Transport system

Population concentrated on the coast

More low-lying areas are being developed

- Natural + constructing on landfills. This requires the establishment
- Rising sea level relative to land causes coastal erosion. Up to recently this erosion was more likely to be caused by isostatic changes and crustal movements rather than climate change.

The exception of the rapid uplift in the South east – affecting the tidal prims of the inlet and the navigational depth over the ebb shoal into harbour.



The concerns for coastal structures



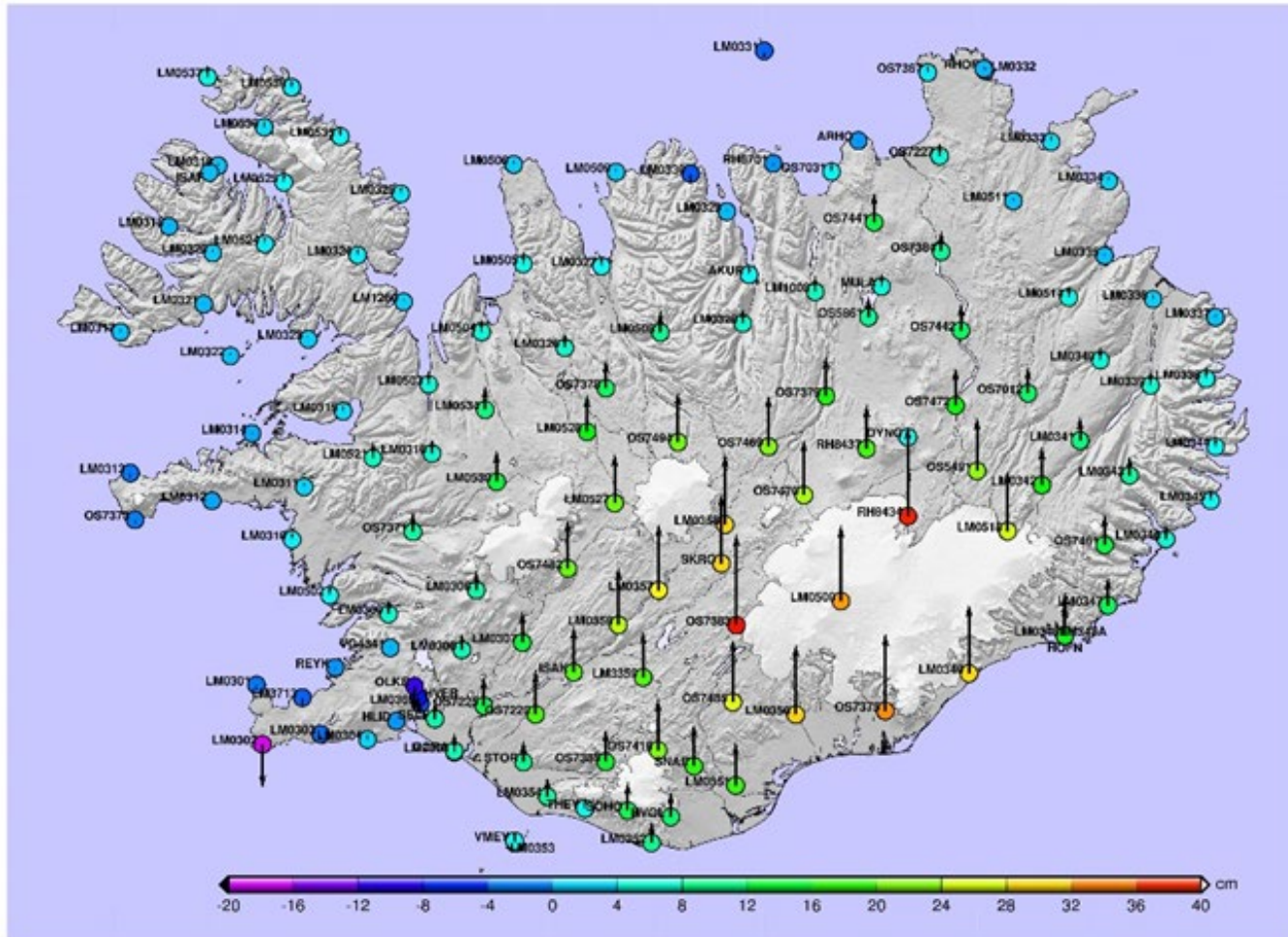
Living on an island :

Relative changes in sea to land level and its implications to adaptation of transport infrastructure to climate change.

1. The global sea level rise due to climate change – Melting glaciers
2. The isostatic movements,
the rise due to loss of icemass
or subduction of the crust as it cools (moves away from volcanism)
3. The Greenland's Gravitational pull as it rises due to its melting glaciers

The impacts depend much on whether Greenland melts first or Antarctica or evenly

The unique situation



- *Changes in vertical height due to*
 - *Melting glaciers*
 - *Cooling crust (moving away from volcanism)*
 - *Human activity*
- *from 2004 and 2016 measured at the ISNET campaign GPS stations.*
- *Positive numbers indicate uplift and negative are subsidence. Preliminary results from the National Land Survey of Iceland.*



The guideline for construction in low-lying areas

- An official guideline sets the marker for acceptable land level; harbours, roads, airports etc.
- Harbours
 - Quays and harbour areas must be raised timely to avoid flooding,
 - Breakwater and revetment exposed to depth limited waves have to be strengthened

A new official guideline for construction in low laying coastal areas, April 2018

- thereby raising the base by 30 cm (not to be burdensome)

The 100 yr flood becomes biannual !

Note: The private sector is raising the baseline by 70 cm for an estimated lifetime of 50yrs.

- The guideline is to be revised

The adaption plan for transport

To enable preparedness and resilience

By

- Mapping areas most likely to be affected
- Monitoring and surveillance
- Research and modelling

Feeding into the Coastal construction guideline
as to design and build for the future

Creating awareness of planners and politicians



Proposals for a for the adaptation plan

1. A monitoring system of tidal gauges “for preparedness



- Average mean sea level
- Tides
- Air Pressure
- Wind direction
- Landscape



Mynd 1 Sjávarborðsmælar sem eru í rekstri í apríl 2019

2. Probability of extreme nearshore sea conditions using a multivariate extreme value modeling

Predicting floods and stormsurges

Destructive flood in Reykjavík the morning of 24th of December 2003.

High tide – low pressure - SW winds





The variables

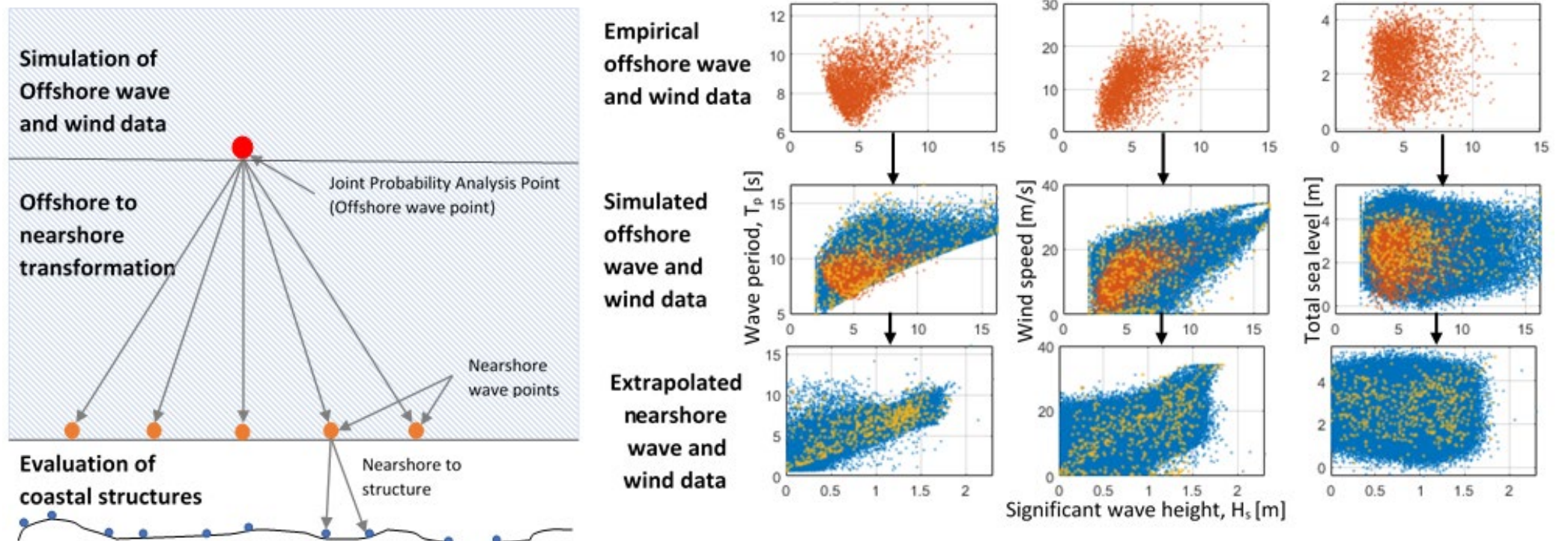
The 24th of December 2003 flood was not a rare event for each variable

The estimated return period for joint probability is estimated 50 - 100 years.

Variable	Measured	Return period
Significant wave height	9 m	< 1 year
Mean wave period	10.38 s	< 1 year
Maxium Sea level	+4,6 m	twice a year
Wind speed	20 m/s	>2% of the year
Atmospheric pressure	980 Mpa	>2% of the year

Multivariate extreme value modelling

A large sample of extreme offshore events are simulated and transferred to a nearshore location of interest





The Pros and cons of Climate change

