
Climate change and adaptation of the aviation community

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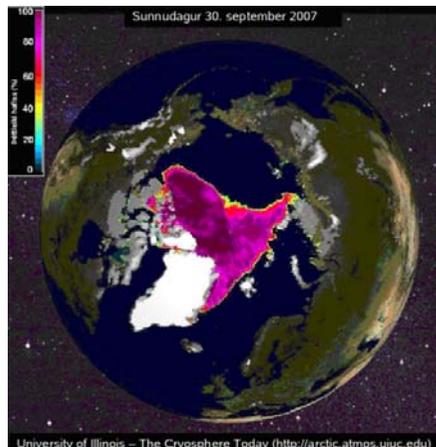
Icelandic Meteorological Office

International Air Safety & Climate Change conference –

EASA September 8th - 9th 2010

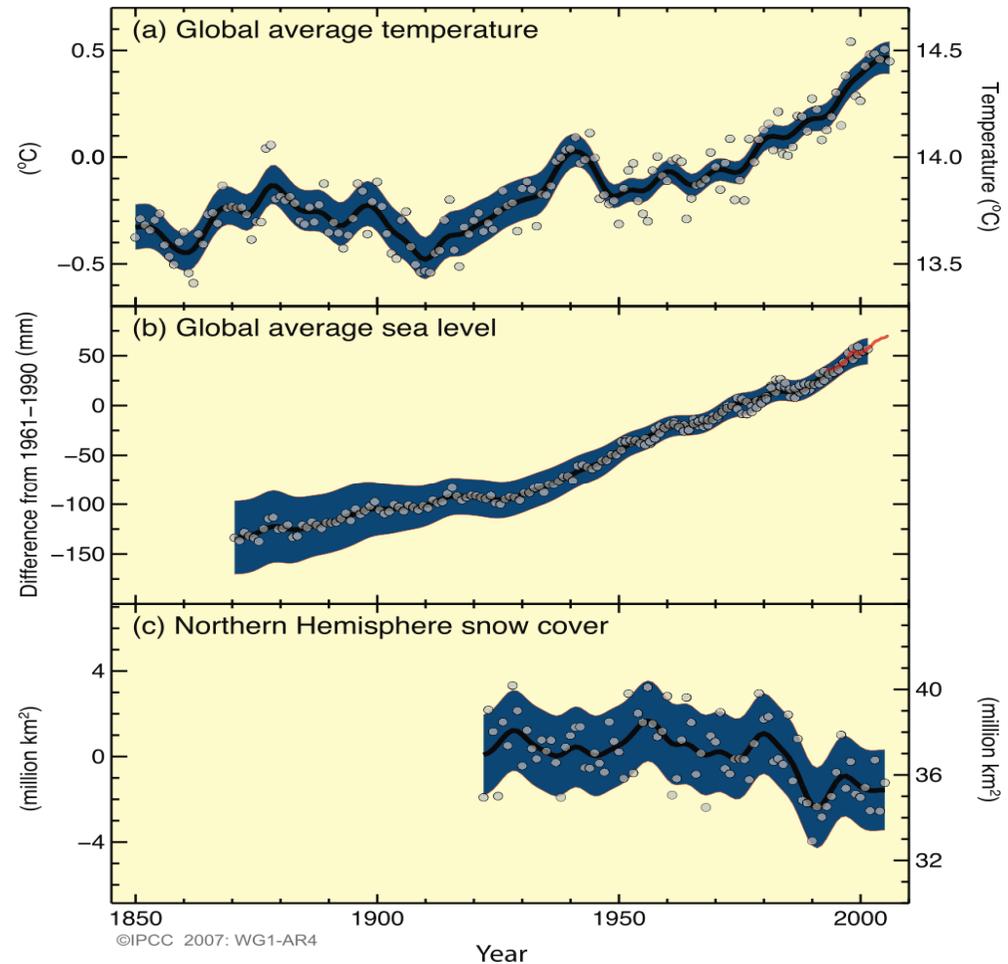
Overview

- ▶ Climate change possible effect on
 - ▲ Volcanic eruption pattern
 - ▲ Drought
- ▶ Adaptation Management
- ▶ UN – ISDR methodology
 - ▲ www.unisdr.org
- ▶ Summary



Changes since 1850

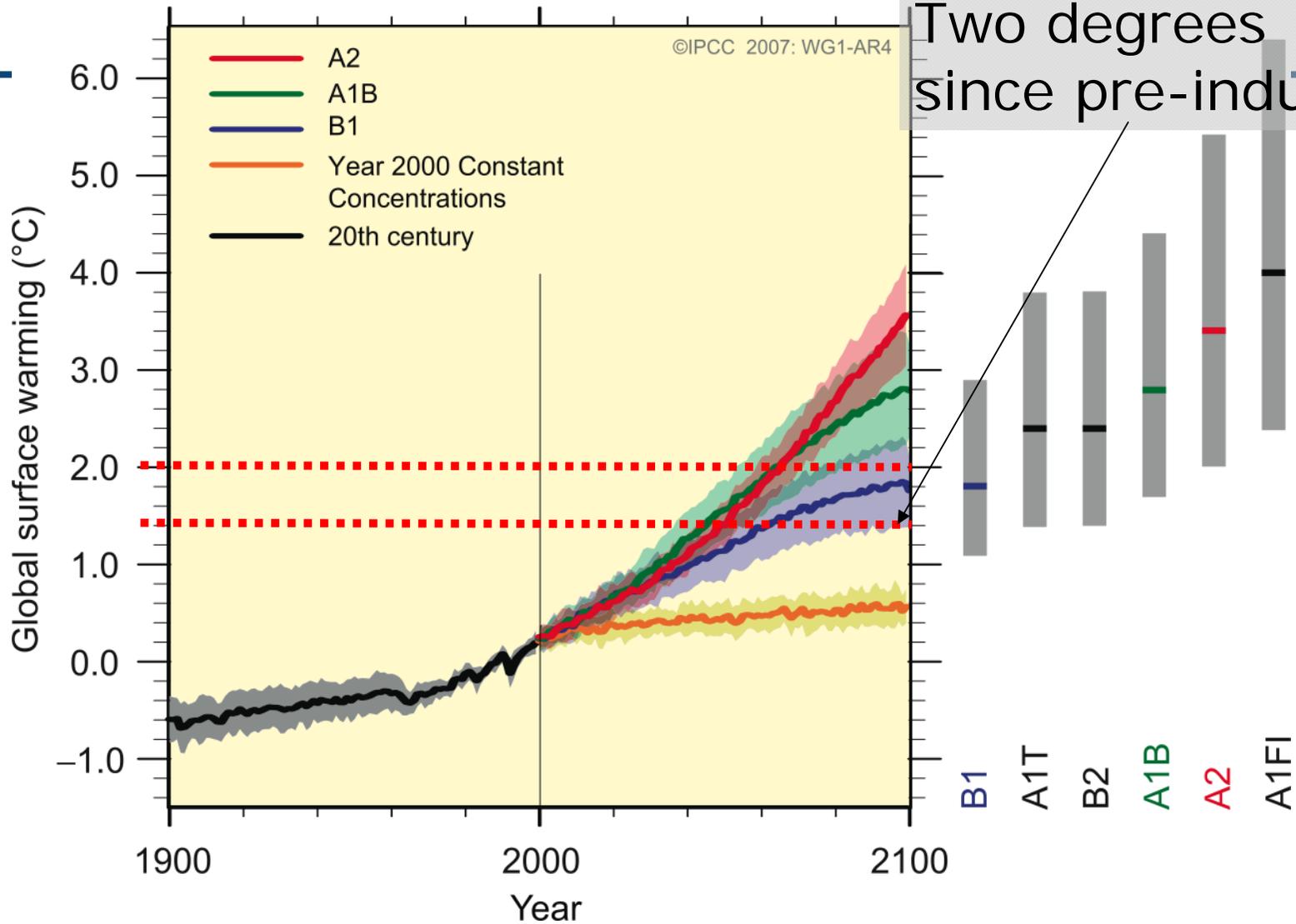
- Warming exceeds 0.7°C during last 100 years
- Sea level rise
- Decreasing snow cover in N-Hemisphere



Some observed changes

- ▶ Warming intensified towards northern high latitudes
 - ▲ Widespread glacier retreat and formation of pro-glacial lakes
 - ▲ Reduced sea ice cover, especially during summer
- ▶ Frequency of floods and droughts has increased
- ▶ Higher incidence of heat related fatalities
- ▶ Ocean acidification
- ▶ Ecosystems
 - ▲ Poleward and shift upwards in ranges of various plants and animals
 - ▲ Earlier spring events (egg laying, leaf unfolding etc.)

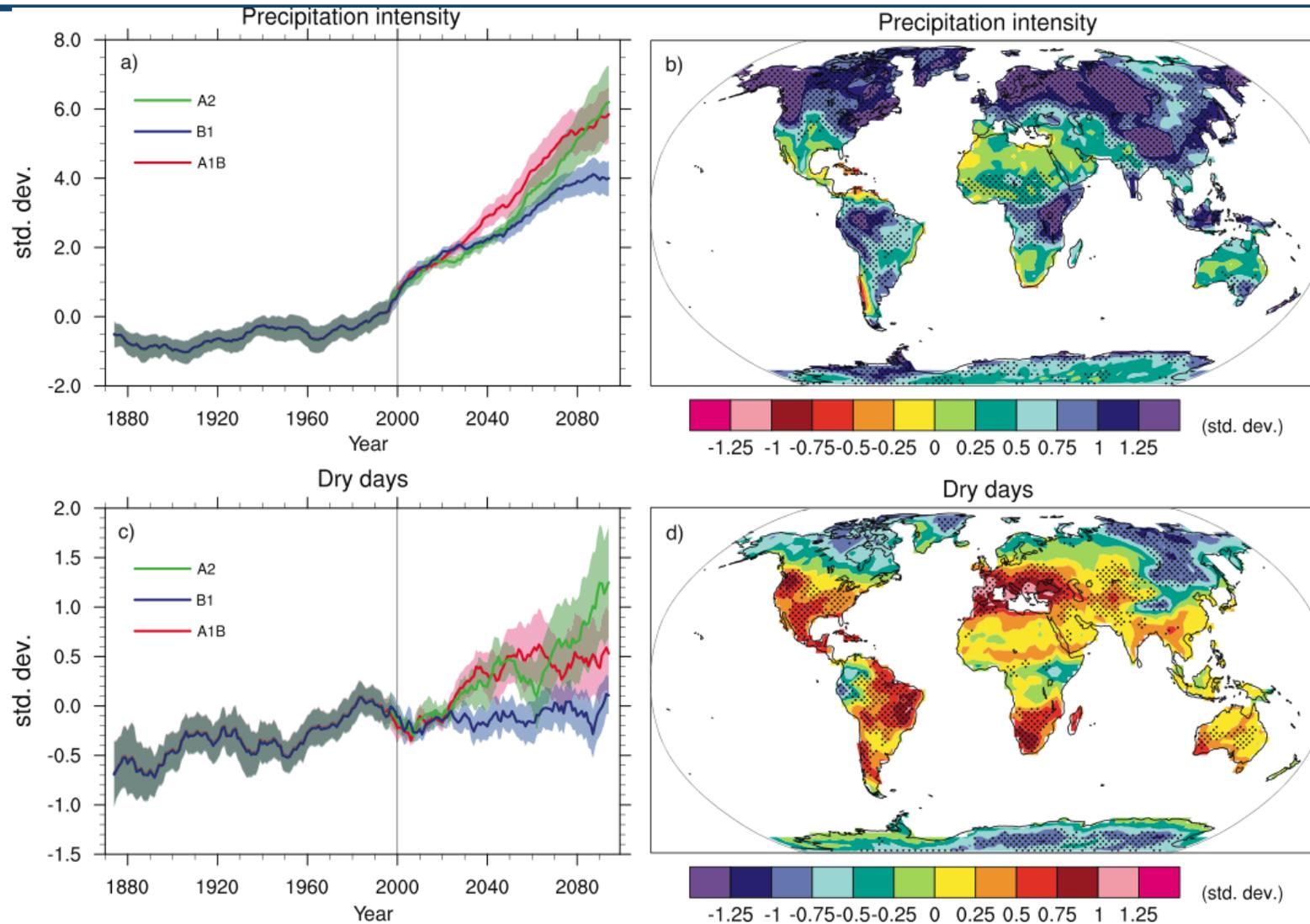
Quo vadis?



(source IPCC, 2007 WG1 report, SPM)

Precipitation intensity and dry days

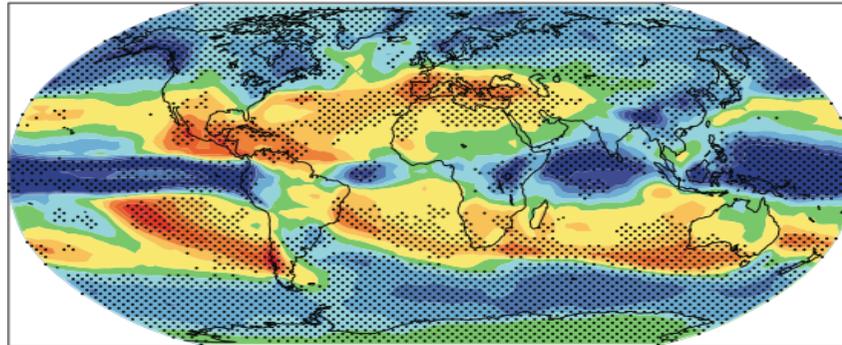
IPCC 2007, WG1 fig. 10.18



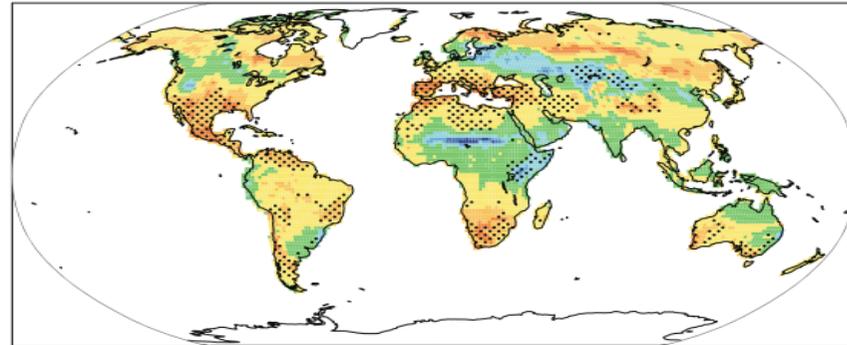
Precipitation, Soil moisture, Runoff and evaporation

IPCC 2007, WG1 Figure 10.12

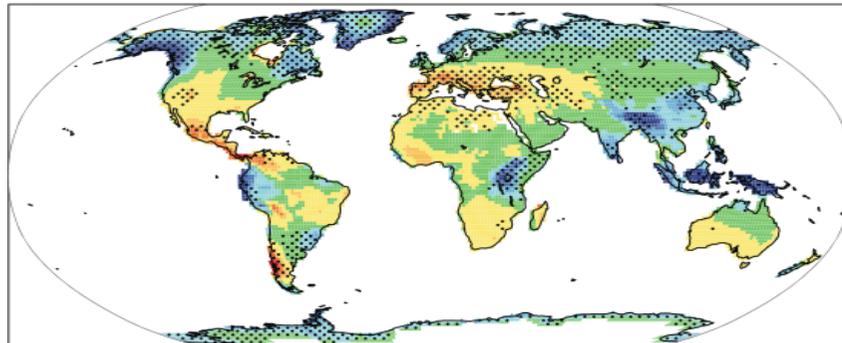
a) Precipitation



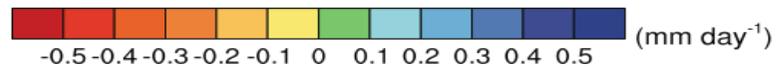
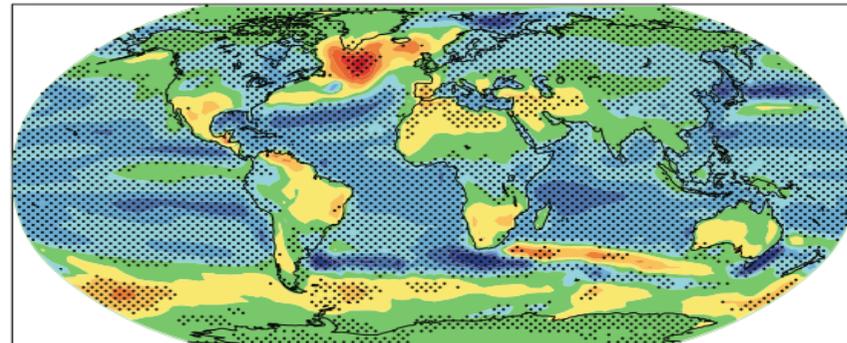
b) Soil moisture



c) Runoff



d) Evaporation



Some consequences

- ▶ **Glacial retreat**

- ▶ Isostatic rebound already taking place
- ▶ Enhanced production of magma due to pressure drop under Vatnajökull glacier
- ▶ Major changes in glacial river runoff

- ▶ **Sea level rise**

- ▶ **Increased drought**

- ▶ Ecosystem changes

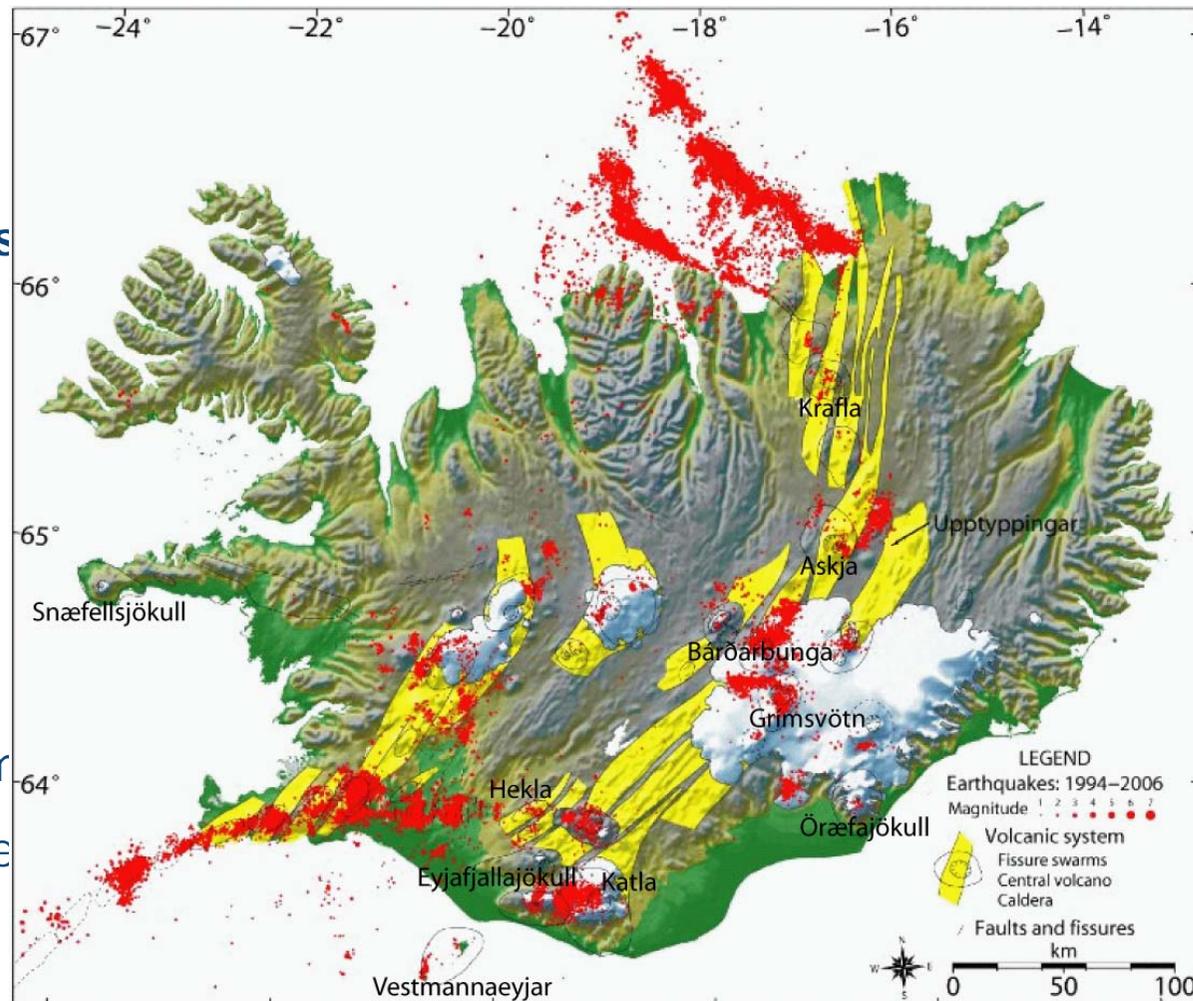
- ▶ Changes in natural hazards

- ▶ e.g. increase in severe weather events

Icelandic active zone

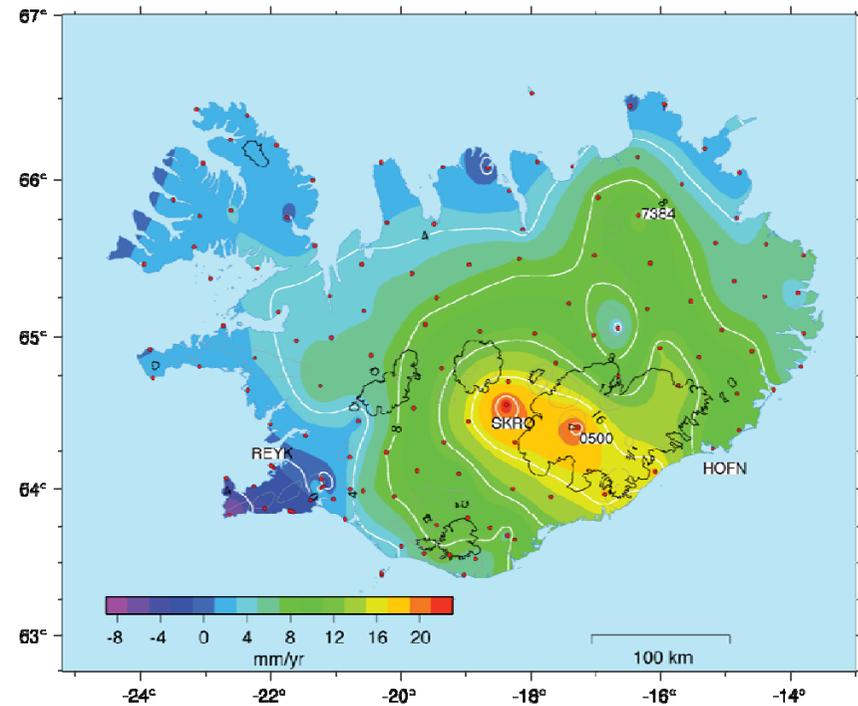
Iceland's
volcanic zones
About 12 eruptions
Since 1961:

- ▶ Askja
- ▶ Surtsey
- ▶ Hekla 4 times
- ▶ Vestmanneyjar
- ▶ Krafla several times
- ▶ Grímsvötn 2 times
- ▶ Gjalp
- ▶ Eyjafjallajökull



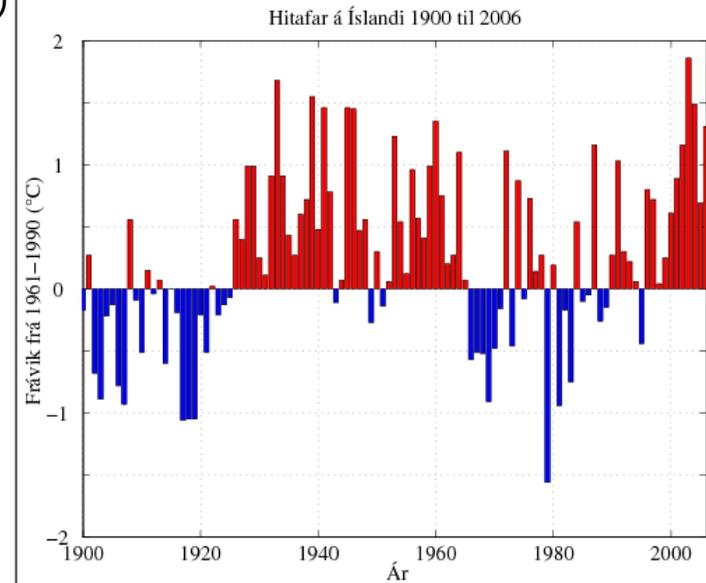
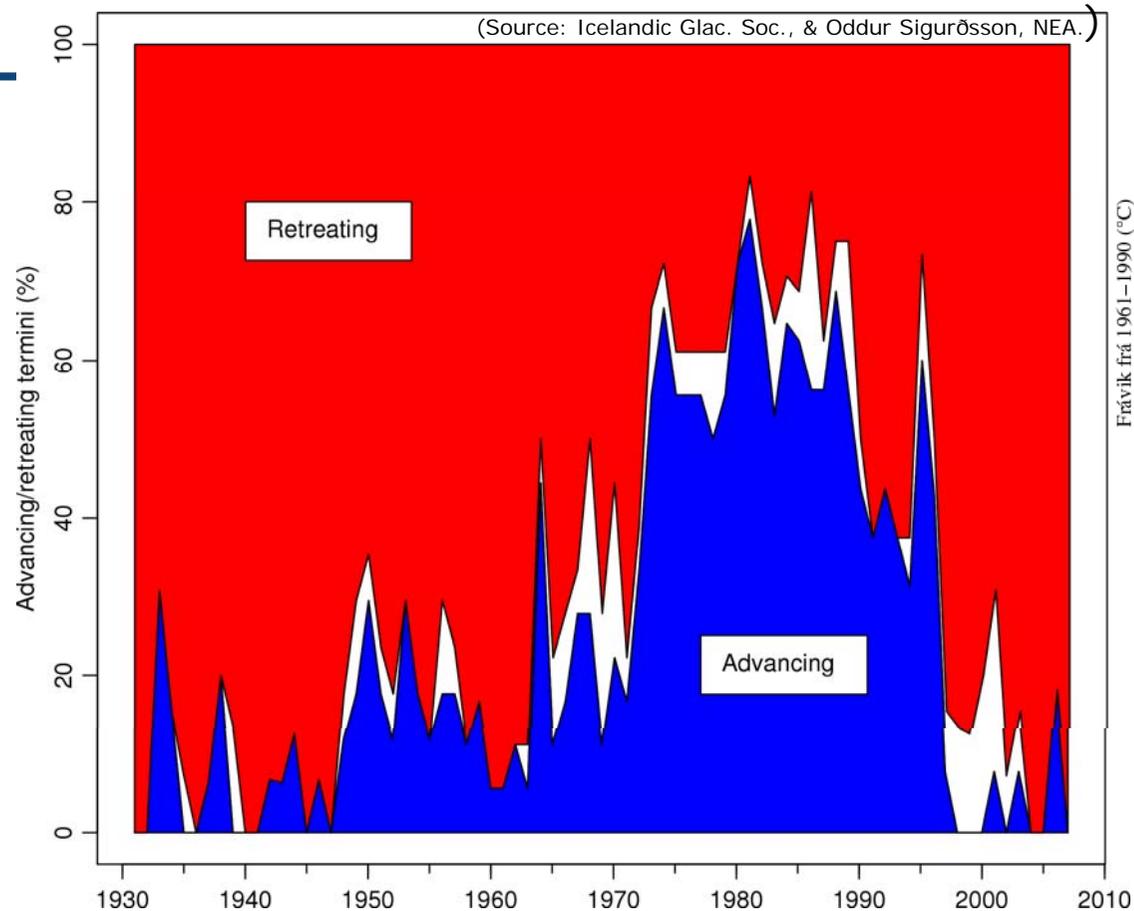
Melting glaciers and isostatic rebound

- ▶ GPS measurement show that rapid rebound is taking place (Árnadóttir et al., 2009)
- ▶ Reduced pressure on lower boiling point of magma under Vatnajökull glacier
 - ▲ Enhanced magma production (Pagli and Sigmundsson (2008))



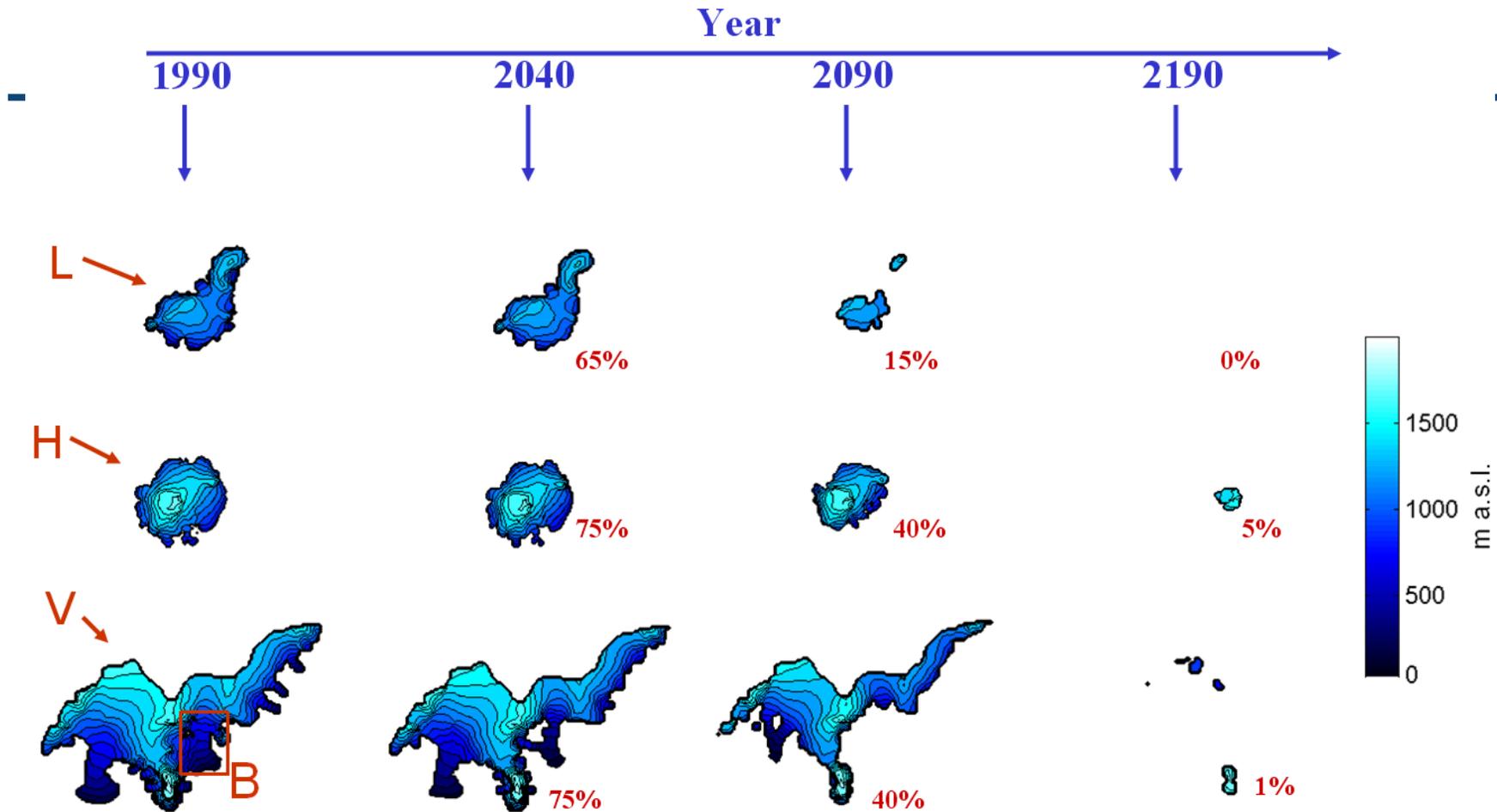
Árnadóttir et al., GJI 2009

Glaciers and recent warming

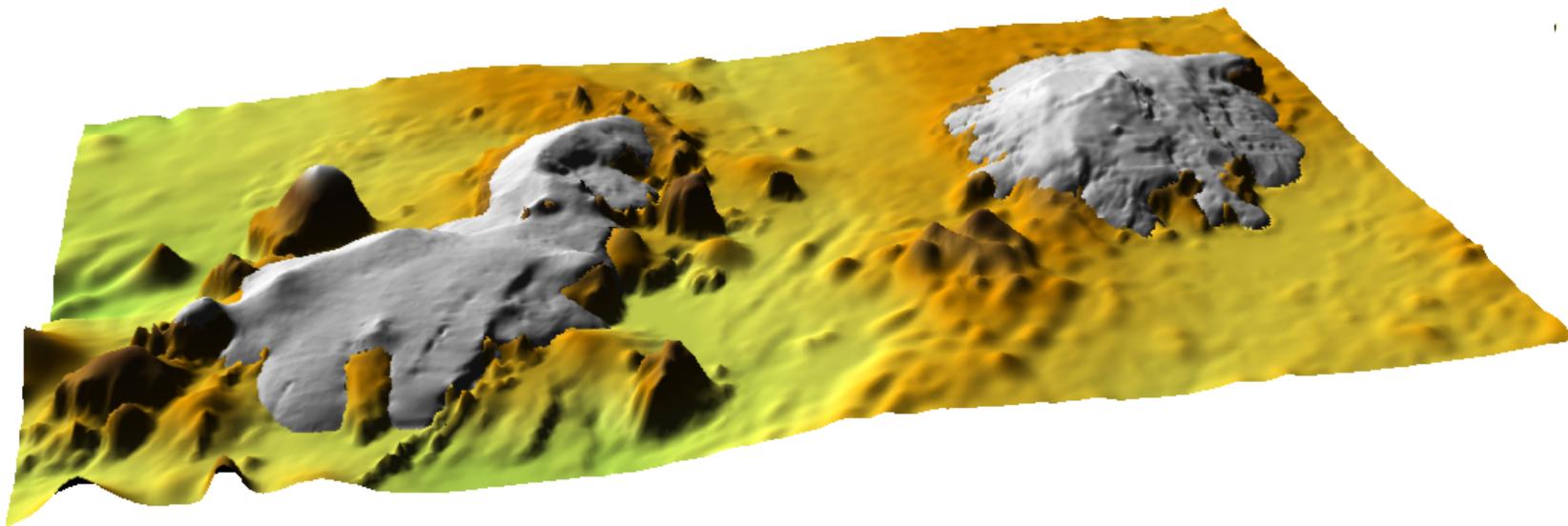


All monitored glaciers are now retreating

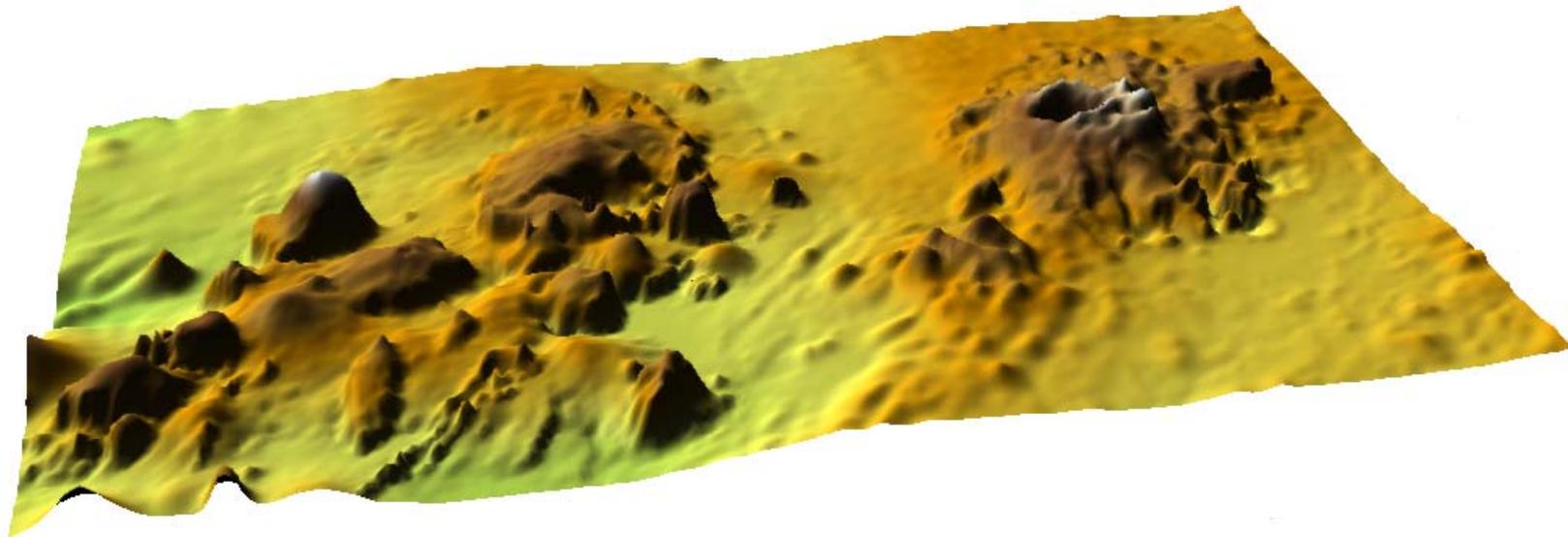
- Except surging glaciers



(Source: Inst. of Earth Sciences
Adalgeirsdottir et.al 2006, see also Jóhannesson et. al. 2007)



(Source: Inst. of Earth Sciences
Bjornsson et.al 2006; see also Jóhannesson et. al. 2007)

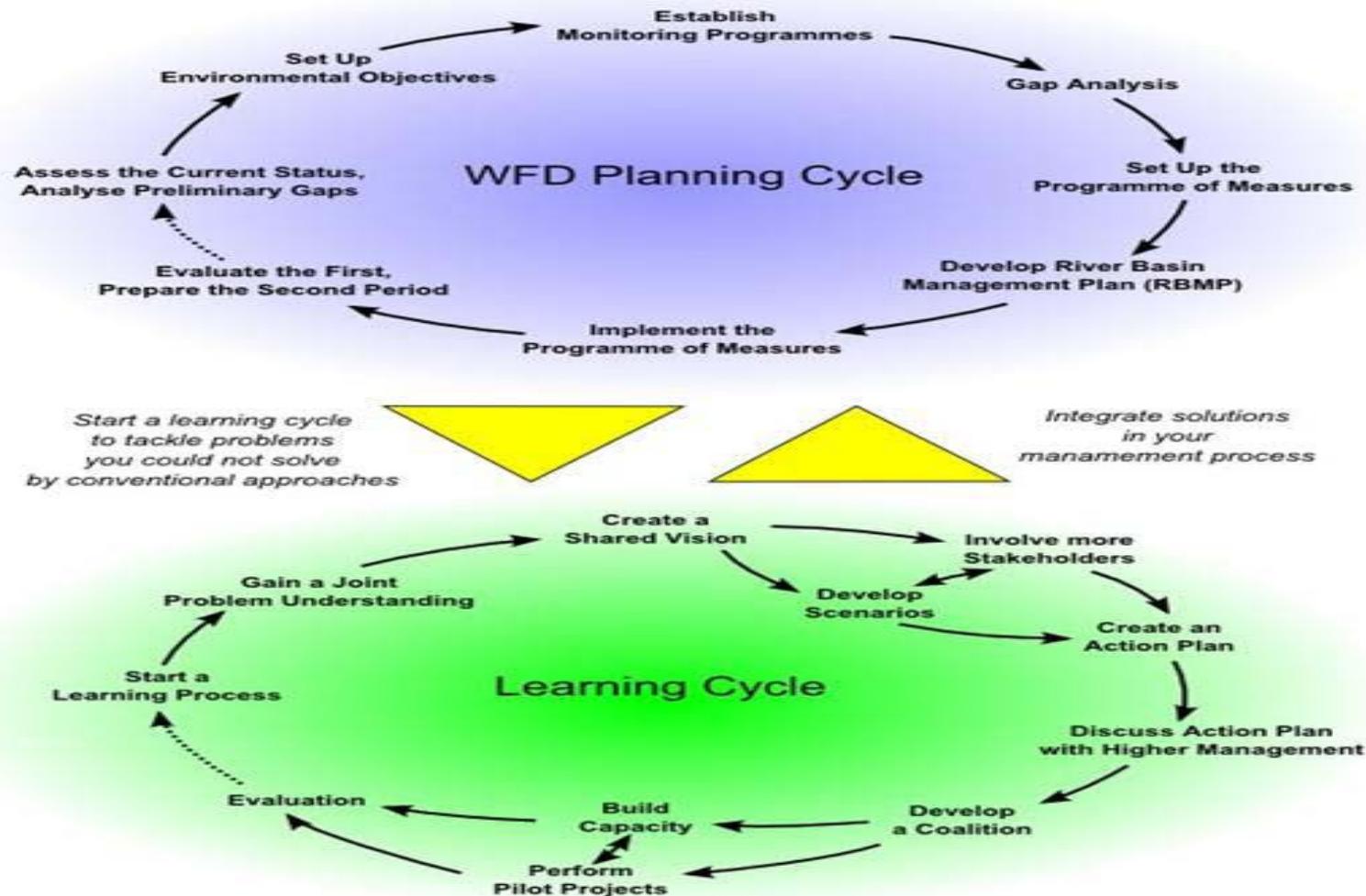


(Source: Inst. of Earth Sciences
Bjornsson et.al 2006; see also Jóhannesson et. al. 2007)

Adaptation and Adaptation management

- ▶ Adaptation
 - ▲ Process of adapting
 - ▲ Conditions of being adapted
 - ▲ Climate adaptation as defined by IPCC (2007):
 - ▲ “Adjustment in natural or human systems in response to actual or expected climate stimuli or other effects, which moderates harm or exploits beneficial opportunities.”
- ▶ Adaptive management is about making complex decisions that are robust to uncertain future outcomes (J.C.Refsgaard, 2010 - <http://en.vedur.is/nonam/material/>)

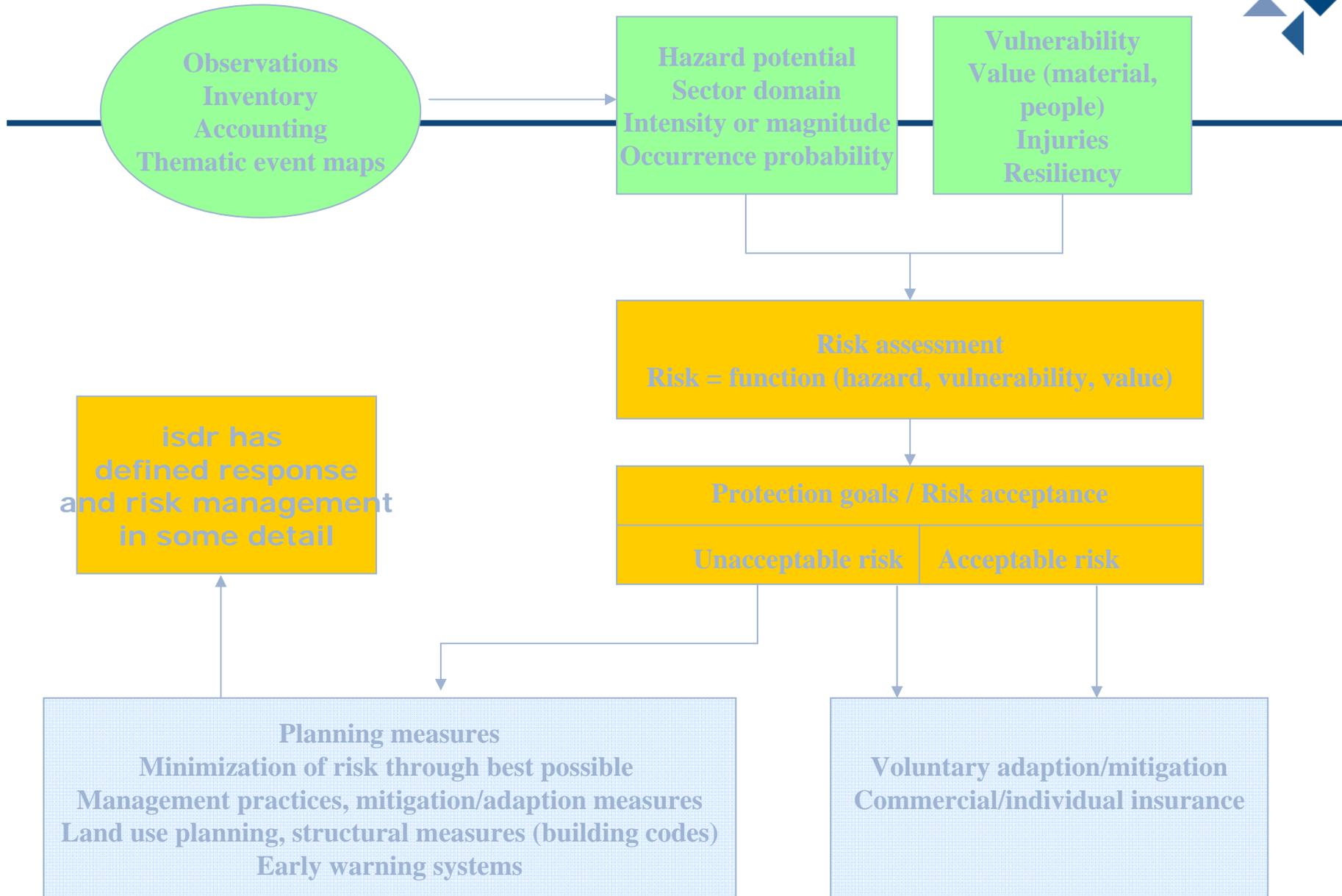
Water Framework Directive Planning- and Learning Cycle (www.newater.com)



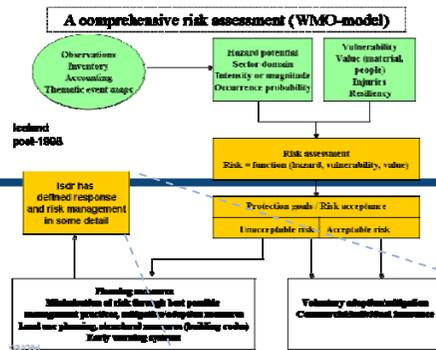
International Strategy for Disaster Reduction (www.unisdr.org)

- ▶ WMO (1999) Comprehensive Risk Assessment for Natural Hazards WMO/TD No. 955, 92 p.
- ▶ Living with Risk: A global review of disaster reduction initiatives (2004)
- ▶ Global assessment report on disaster risk reduction (2009)
- ▶ Terminology
 - ▲ www.unisdr.org/eng/terminology/terminology-2009-eng.html
- ▶ Mitchell J.K. (ed. 1996): The long road to recovery: Community responses to industrial disasters. UN University Press, 307 p.
- ▶ Mitchell J.K. (ed. 1999): Crucibles of hazards: Mega-cities and disasters in transition. UN University Press, 535 p.

A comprehensive risk assessment (WMO - model)



Comprehensive risk assessment



Risk management / adaption (isdr)



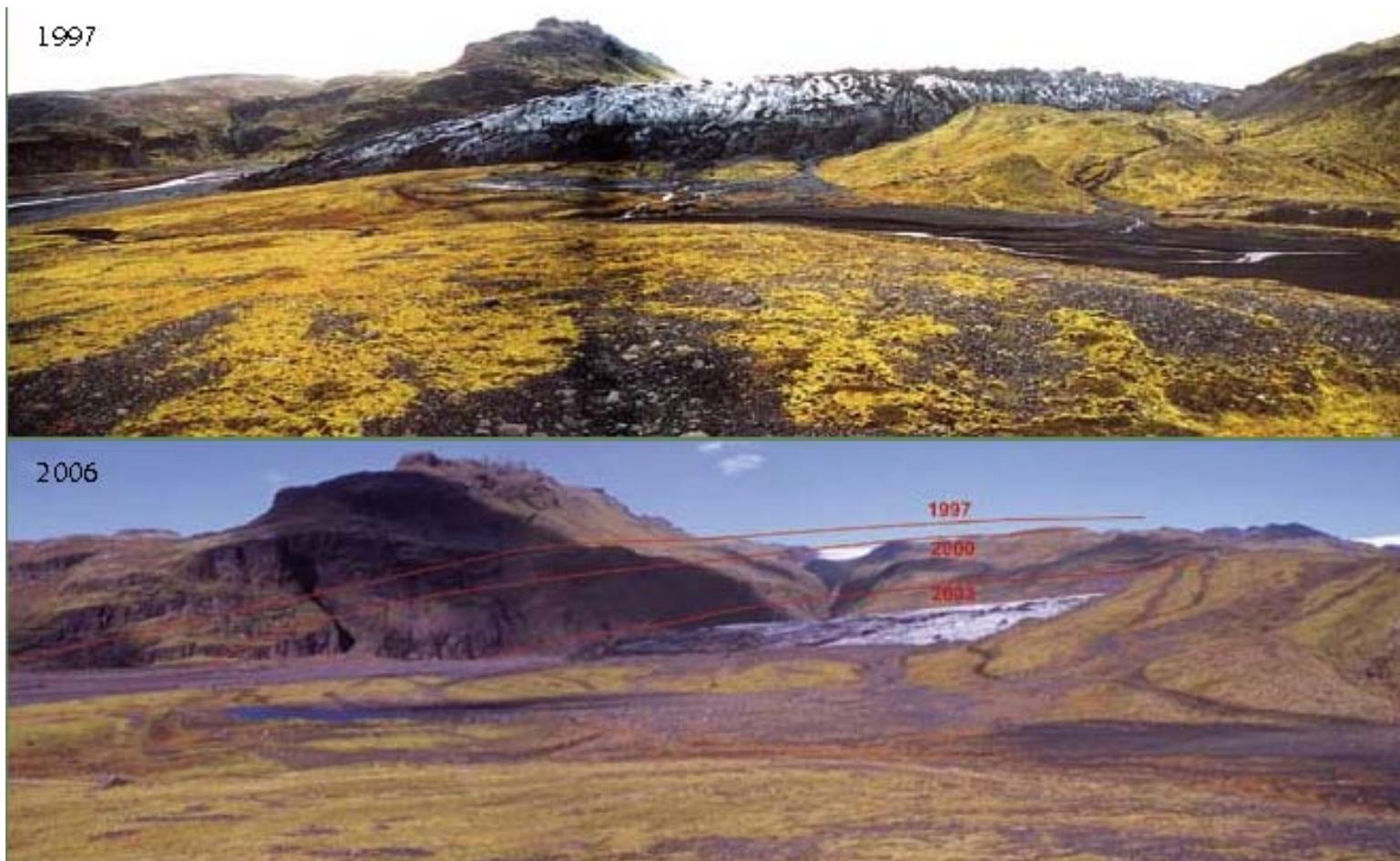
Summary

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- ▶ Climate change lead to
 - ▲ rise in sea level and ground water level
 - ▲ glacial retreat → possible increased volcanic eruptions in Iceland
 - ▲ drought → possible increase in dust storms
 - ▶ Adaptation management important and the use of the ISDR methodology can be of help.
 - ▲ Finished and ongoing research projects
 - ▲ www.newater.info
 - ▲ NONAM – <http://en.vedur.is/nonam>
 - ▶ Short term
 - ▶ Long term

Reference

- ▶ Adalgeirsdottir G., Johannesson T., Bjornsson H. (2006), Response of Hofsjokull and southern Vatnajokull, Iceland, to climate change. J. of Geophys. Res-earth surface, Vol. 111, Issue F3, Article nr. F03001.
- ▶ Arnadottir T., Lund B. Jiang W et al. (2009), Glacial rebound and plate spreading: results from the first countrywide GPS observations in Iceland. Geophys. Journal International, Vol. 177, Issue: 2, p. 691-716.
- ▶ Pagli C. and Sigmundsson F. (2008), Will present day glacier retreat increase volcanic activity? Stress induced by recent glacier retreat and its effect on magmatism at the Vatnajokull ice cap, Iceland, Geophys. Res. Letters, Vol. 35, Issue 9, Article nr. L09304.

Thank you



(Courtesy of Oddur Sigurðsson)