Adapting to climate change - from research to “operation” (R2O)

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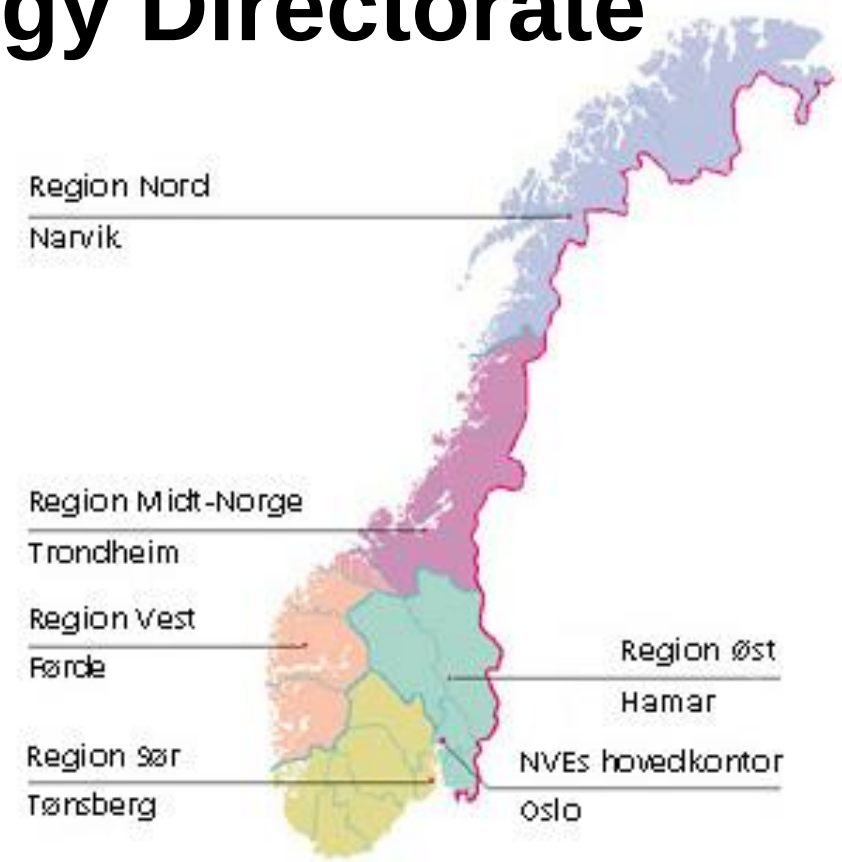
Outline

- NVE and NCCS
- Changing climate and hydrology - research
- Land use planning – “operation”
- From R2O – the role of NCCS

Trøndelag, June 2011
Photo: Geir Otto Johansen/Scanpix

NVE - The Norwegian Water Resources and Energy Directorate

- **Established in 1921**
- **Staff ~550**
- **5 Regional Offices**
- **6 Departments**
  (Administration, Licensing, Energy, Supervision and Preparedness, Landslides and Water Resources and Hydrology)
- **International Office**



The role of NVE

- **Directorate under the Ministry of Petroleum and Energy**
- **Responsible for the management of Norway's water and energy resources** (land based/stationary)
- **Central role in flood & landslide contingency planning**
- **Overall responsibility for maintaining national power supplies**
- **National centre for hydrology**

NVE cross-cutting aim on CC:

•NVE will *document climate change by* collecting hydrological data, *research* and analyses.

•NVE will *assess the implications* of CC for the management of Norway's renewable energy and water resources.

•NVE will *carry out CC adaptation* within its areas of responsibility. This includes changing requirements set related to dam safety, robust power supply, flood and land slide contingency planning and land use planning.

•NVE will contribute to increasing knowledge about CC in society….

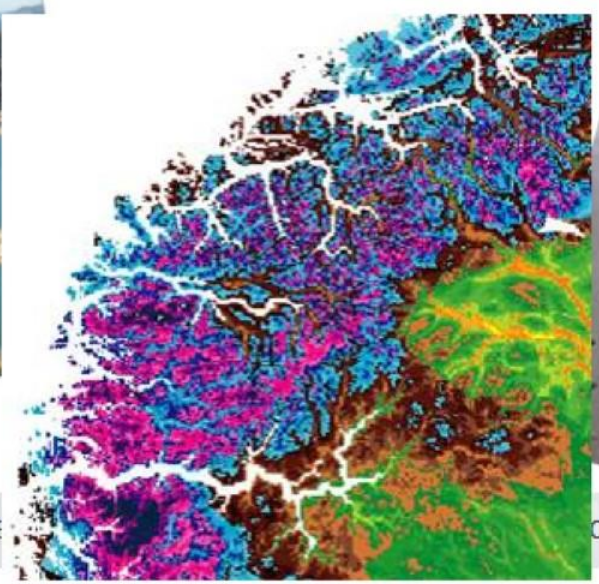
Floods and flooding – management responsibilities

- Mapping – including flood inundation maps
- Land use planning
- Flood protection
- Forecasting
- Preparedness and crisis management

Photo: Grethe Holm Midttømme, *NVE*

Hydrology

- Collecting streamflow, groundwater and soil moisture data and information about glaciers, ice and snow conditions
- Responsible for the national flood, landslide and avalanche forecast services
- Analyses and R&D-activities

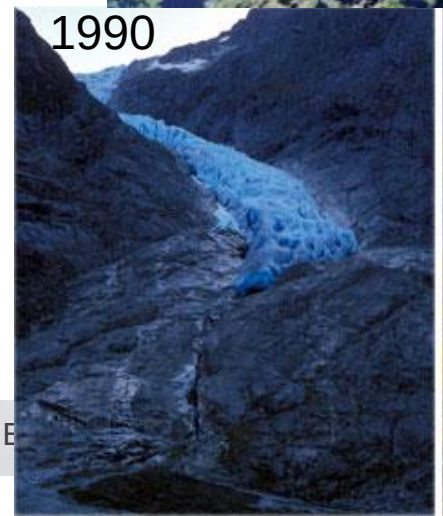


Climate research at NVE: Effects of climate change on hydrology

1. Identify changes in long time series: Has the river flow changed? Do the glaciers retreat?

2. Modelling hydrological projections: Will flood magnitudes increase? Will droughts be more severe? When will the glaciers disappear?

3. Understanding processes: Climate affects hydrology, but hydrology also affects climate. We need to understand the processes to be able to project future changes globally and locally.



The Norwegian Centre for Climate Services

NCCS

NCCS - a cooperation between:

Meteorologisk institutt

uniResearch

Norges vassdrags- og energidirektorat
NVE

Background of NCCS

- Official Norwegian Reports NOU 2010:10

http://www.regjeringen.no/pages/14545340/PDFS/NOU201020100010000DDDPDFS.pdf

- White paper on climate adaptation in Norway, 2013: «Stortingsmelding 33 (2012-2013)»

Norwegian Centre for Climate Services:

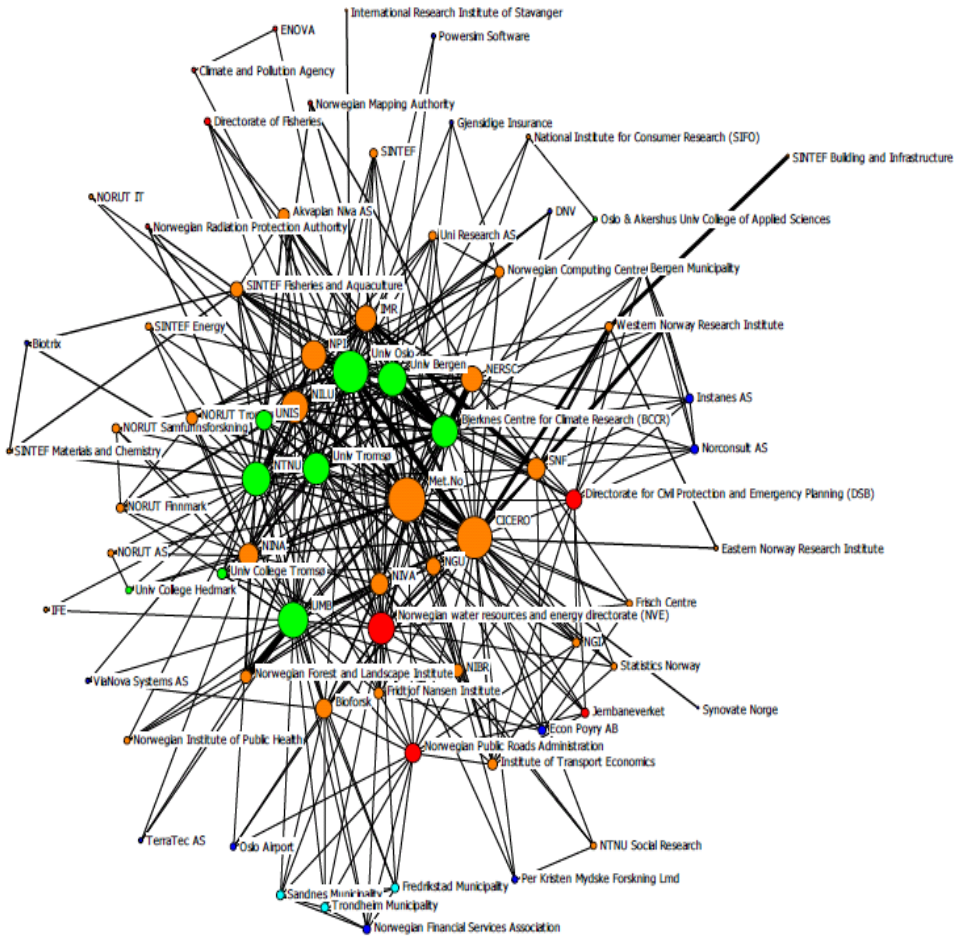
- A cooperation between MET, NVE and UNI
- The Norwegian Environment Agency is represented in the board
- Main purpose:
  Provide decision makers in Norway with information relevant for climate adaptation

Knowledge gap 1

Present products

- Climate projections for Norway: “Klima i Norge 2100”
- “Climate profiles” for counties
- User interfaces

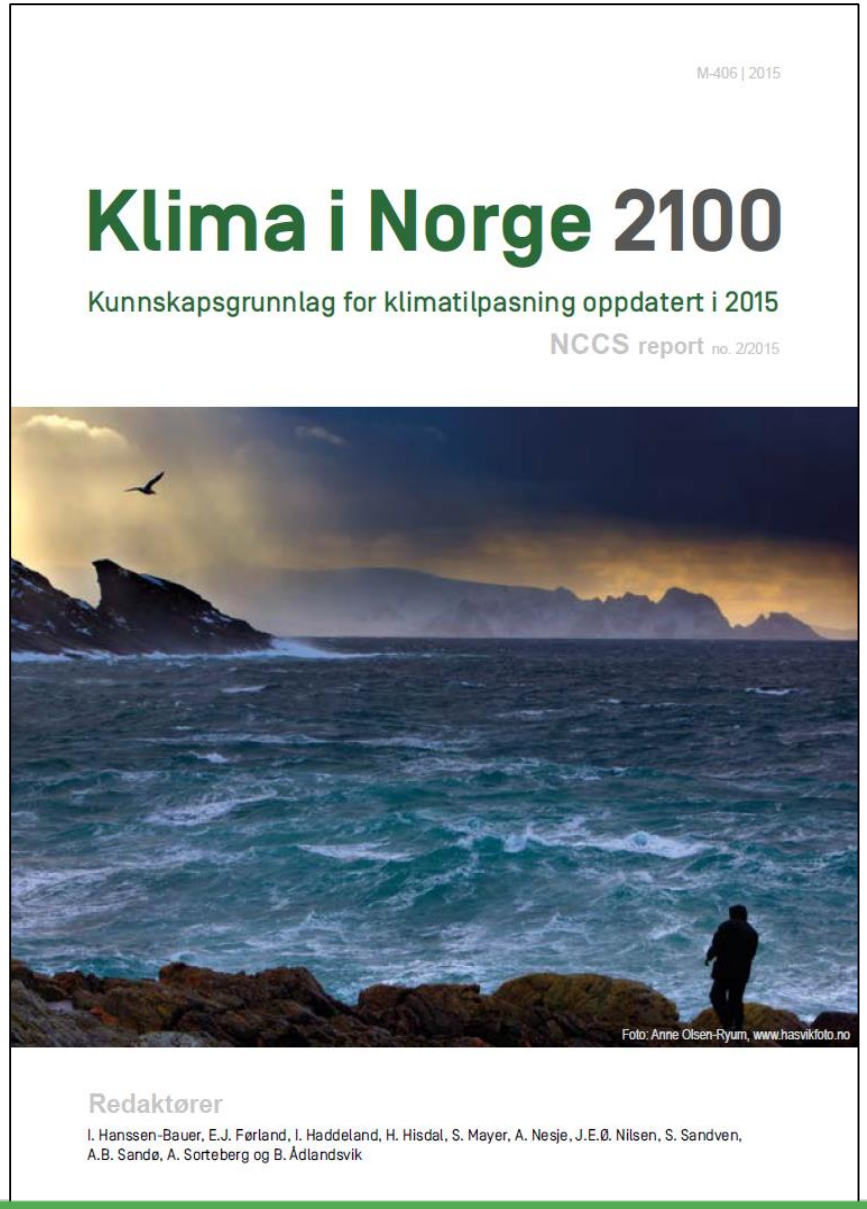
NVE and NCCS two actors in climate change adaptation



- Scientific community
- Governmental bodies
- Private sector
- Consulting Companies
- Regional authorities
- Municipalities
- Individuals

- The Norwegian Centre for Climate Services – NCCS
  - MET, NVE, Uni Research

Climate change - research



Norwegian Meteorological Institute

NVE

uni Research

UNIVERSITAS BERGENSIS

HAVFORSKNINGSINSTITUTTET
INSTITUTE OF MARINE RESEARCH

NERSC Nansensenteret

Kartverket

Bjerknes Centre for Climate Research

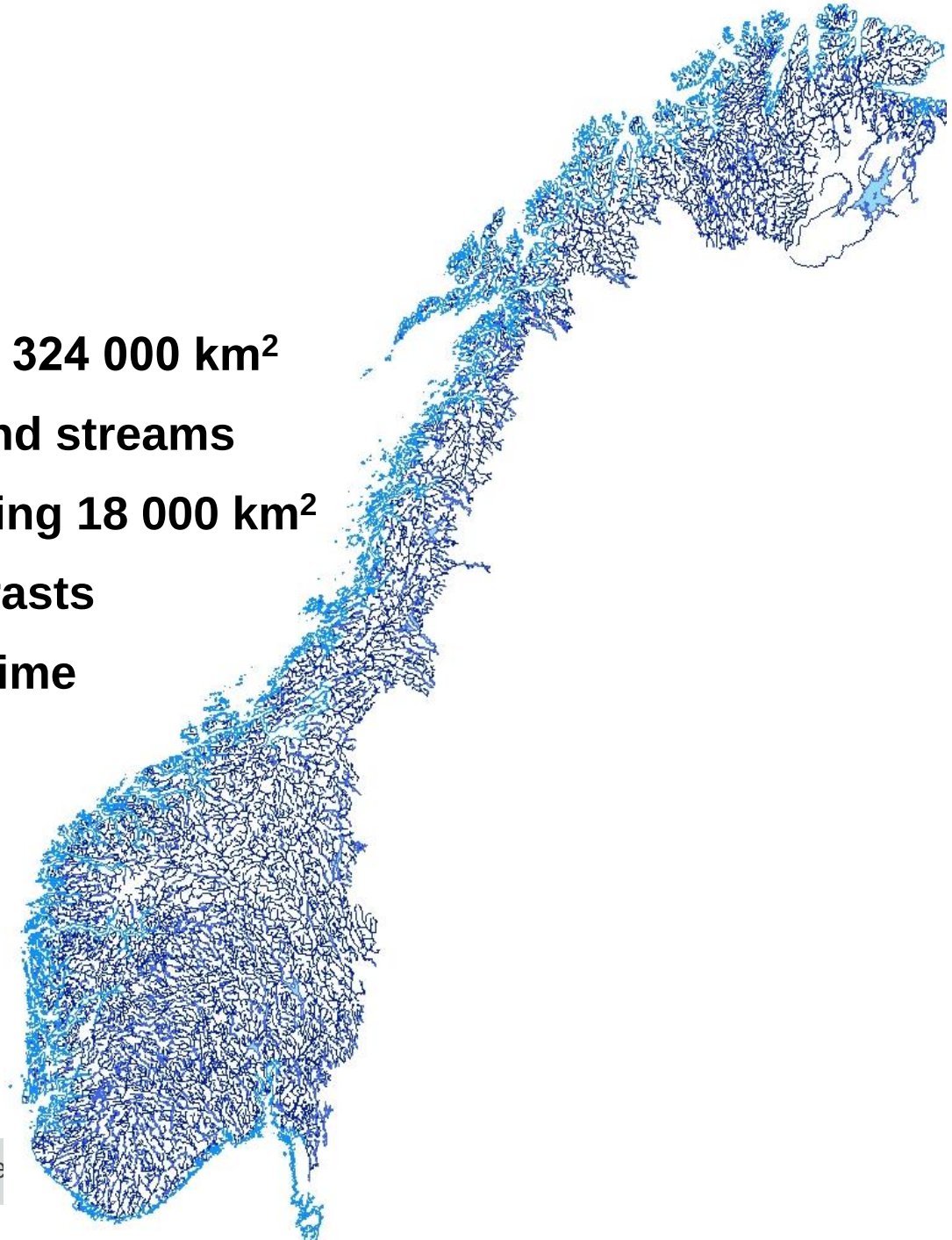
Meteorologisk institutt

uni Research

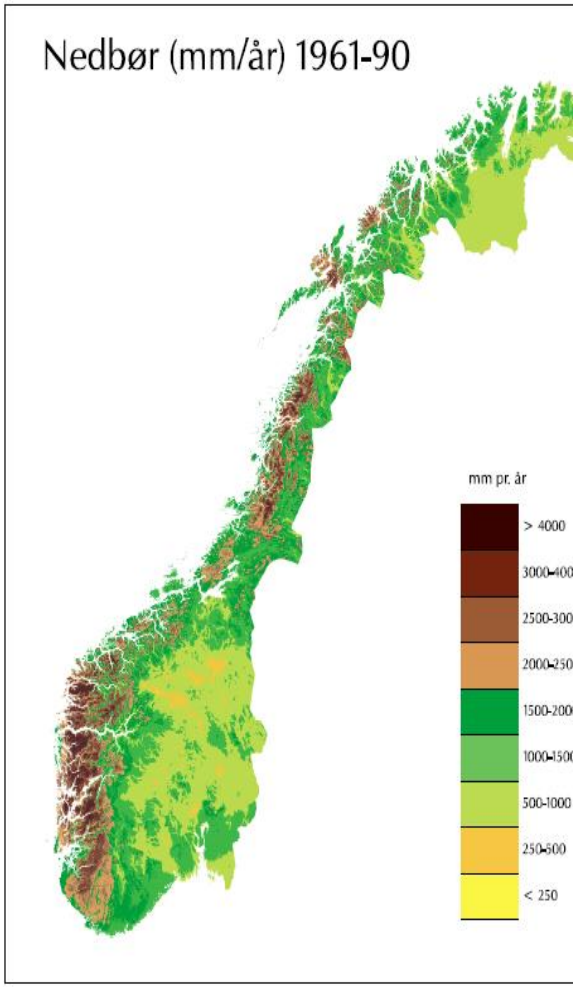
Norges vassdrags- og energidirektorat NVE

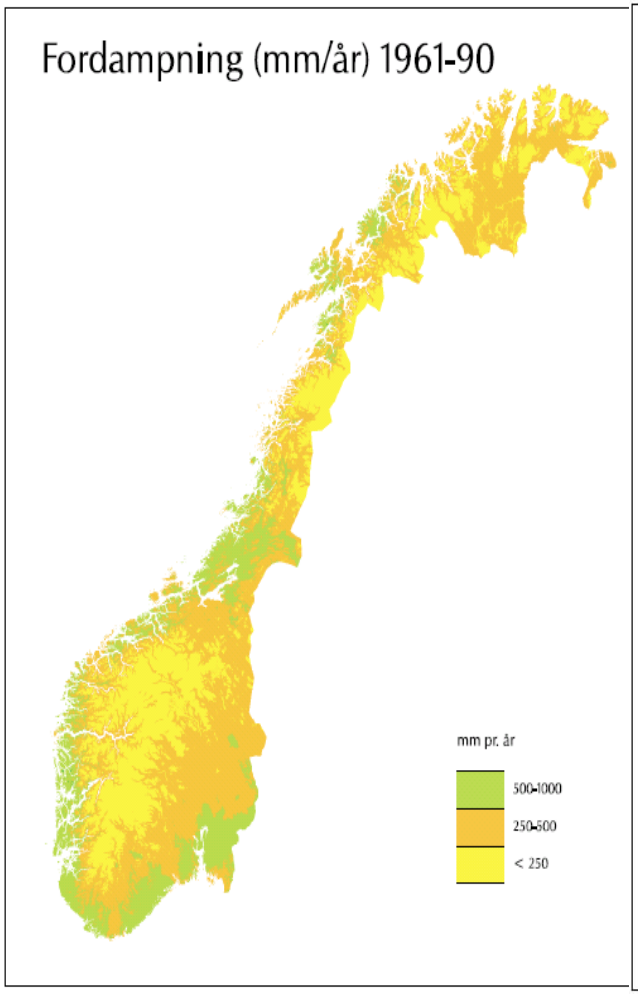
Geography

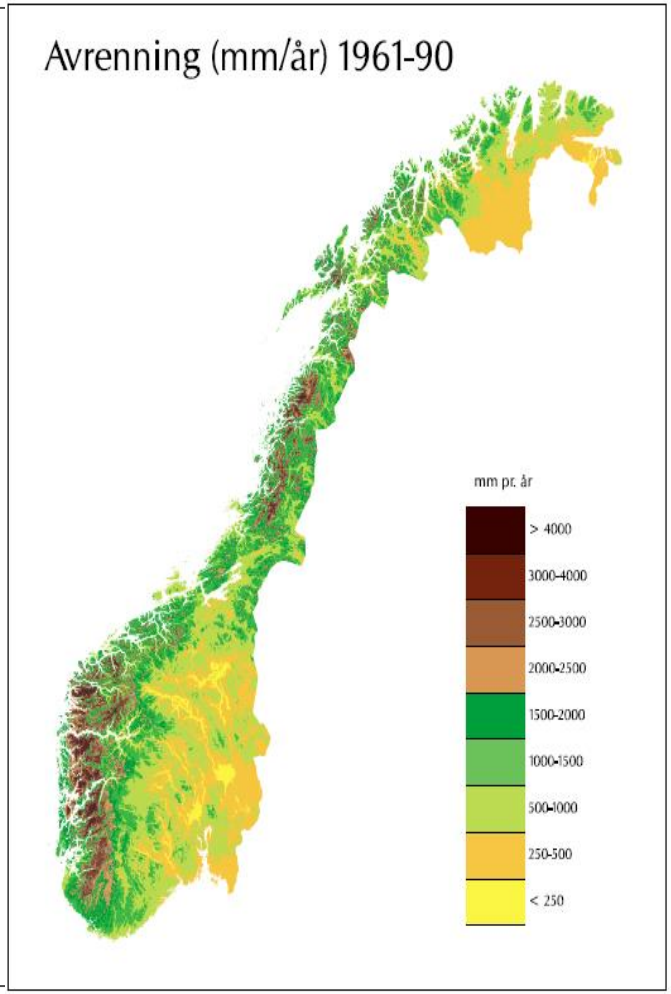
- **Norway's total area: 324 000 km^2**
- **410 000 km rivers and streams**
- **968 444 lakes covering 18 000 km^2**
- **Large climatic contrasts**
- **Flood season: any time**



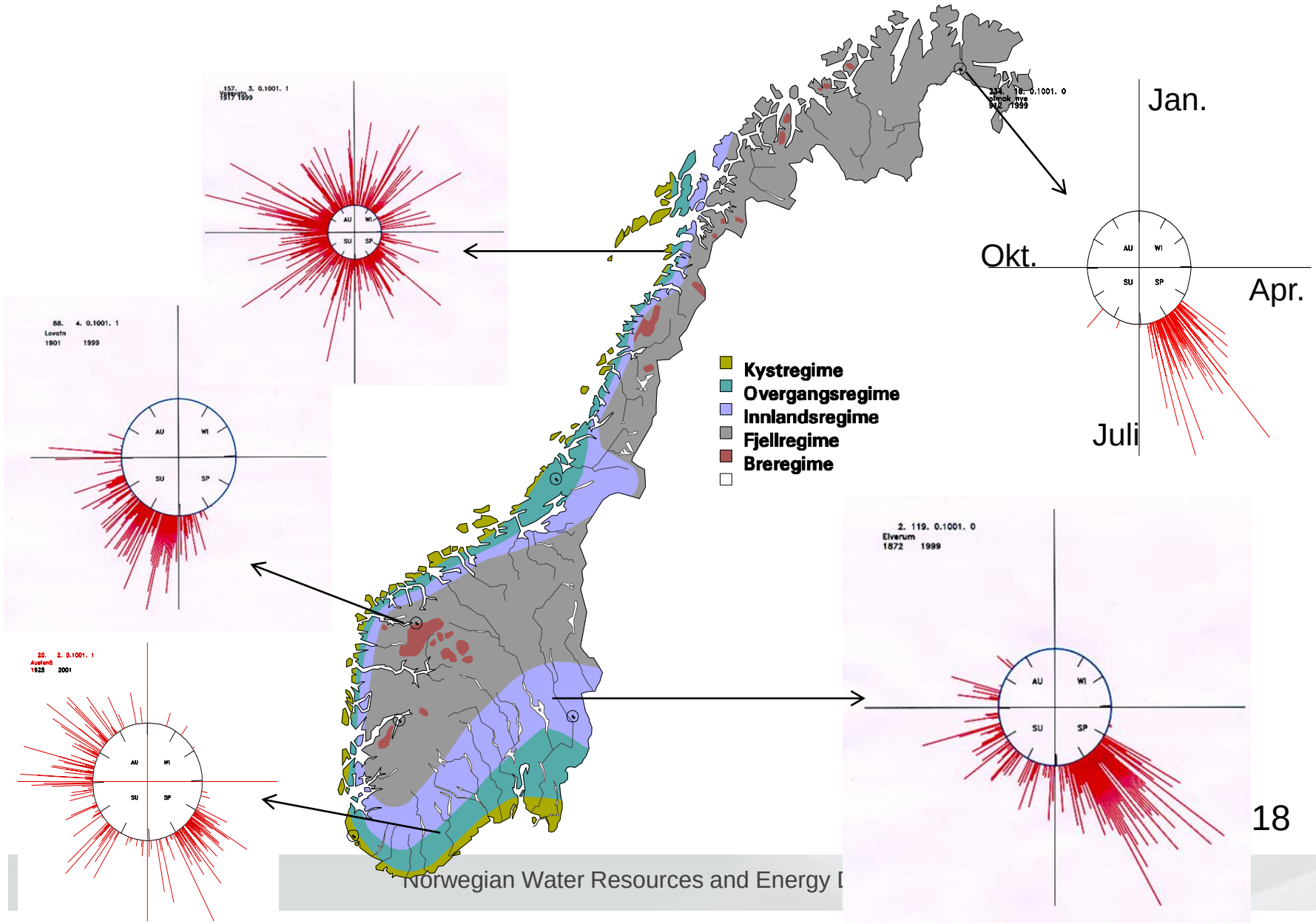
Meteorology and hydrology

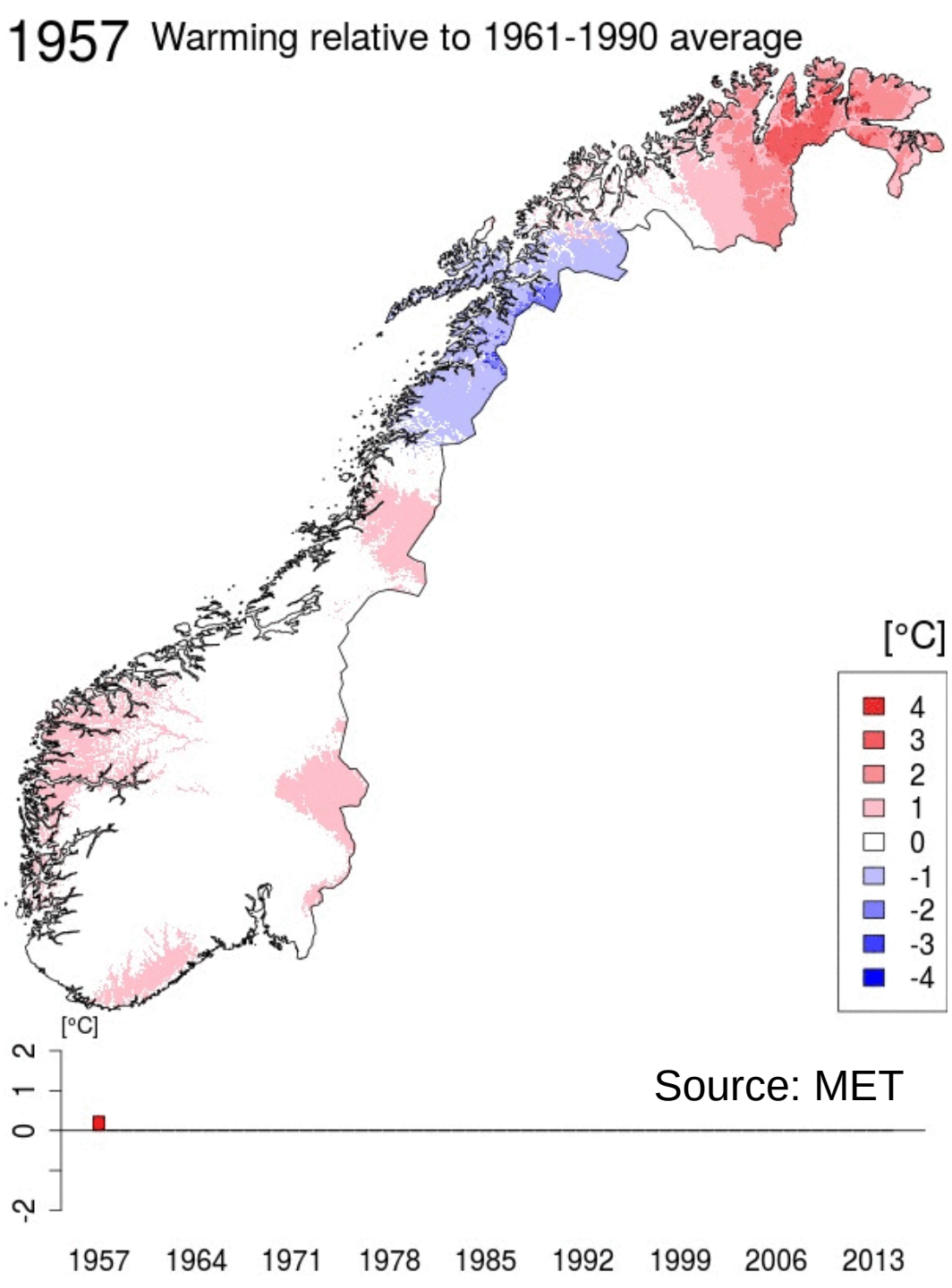




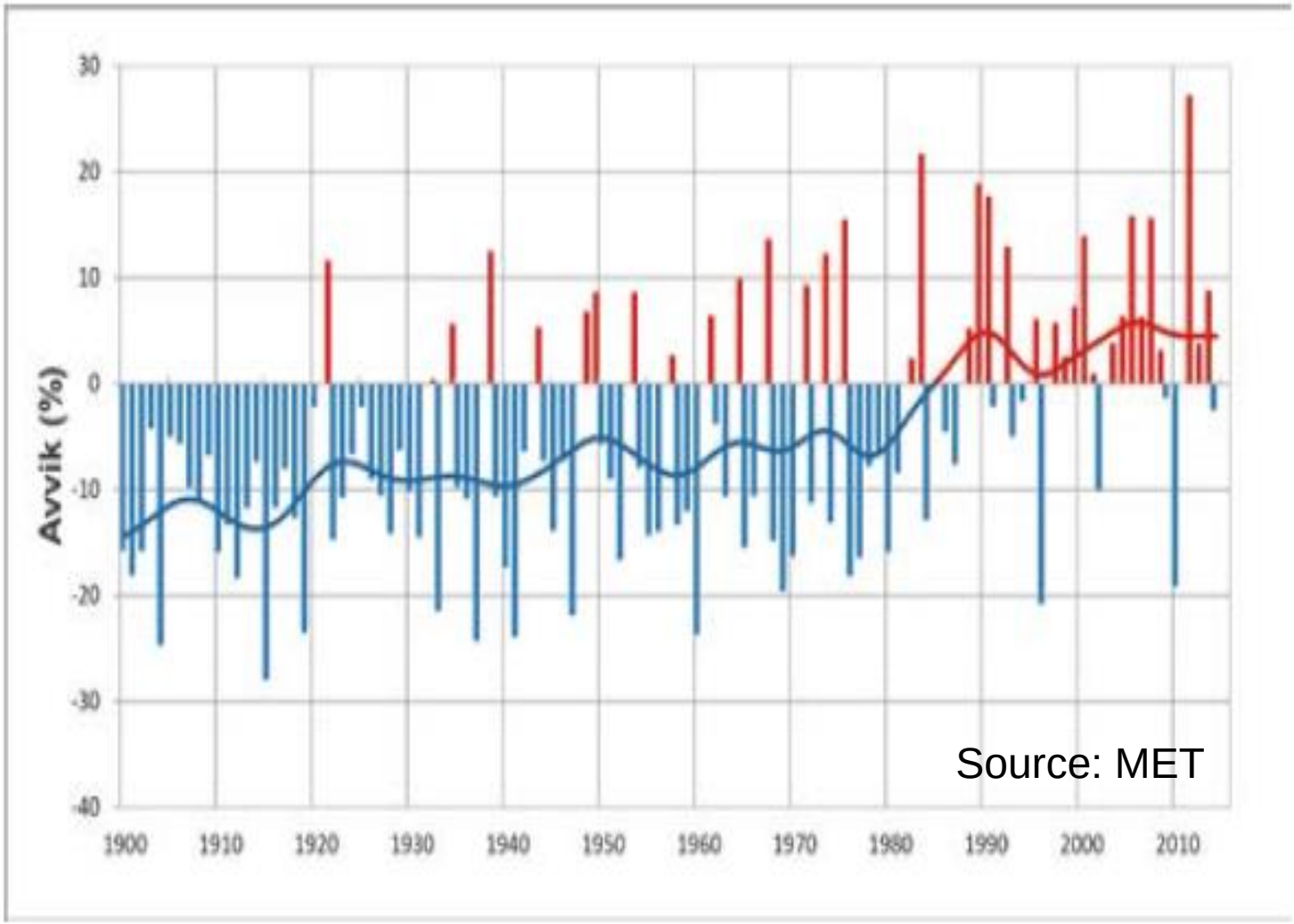


Flood season

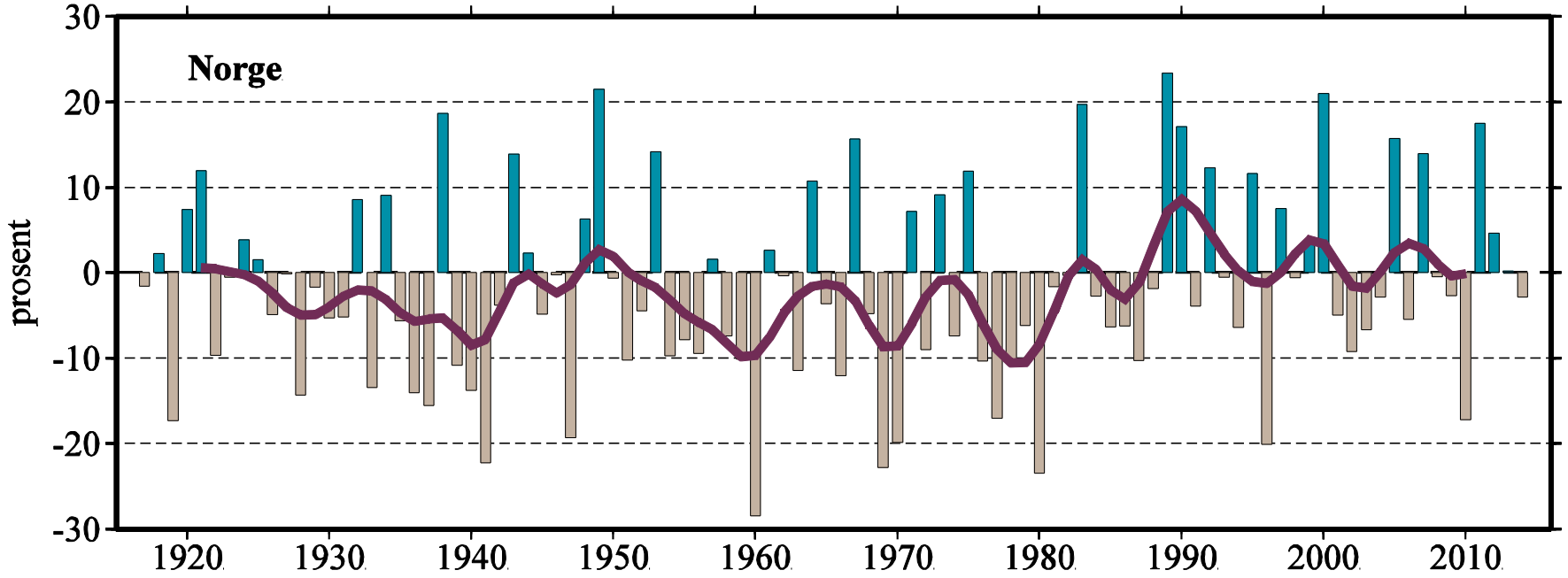



1957 Warming relative to 1961-1990 average
[°C]
4
3
2
1
0
-1
-2
-3
-4
[°C]
2
1
0
-2
1957
1964
1971
1978
1985
1992
1999
2006
2013
Source: MET

Precipitation (1900 – 2014)

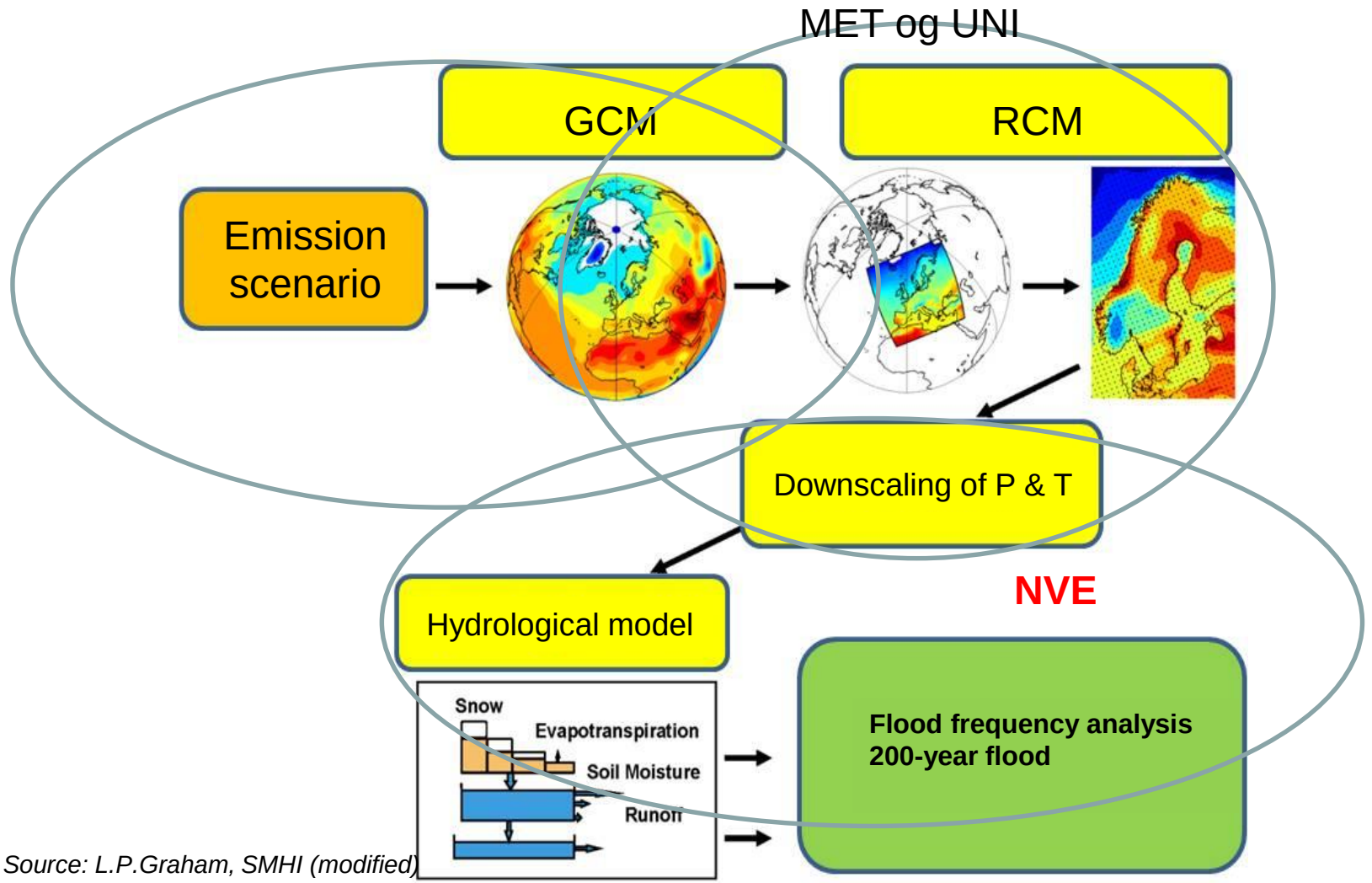


Runoff (1914 -2014)



Source: NVE

The modelling chain

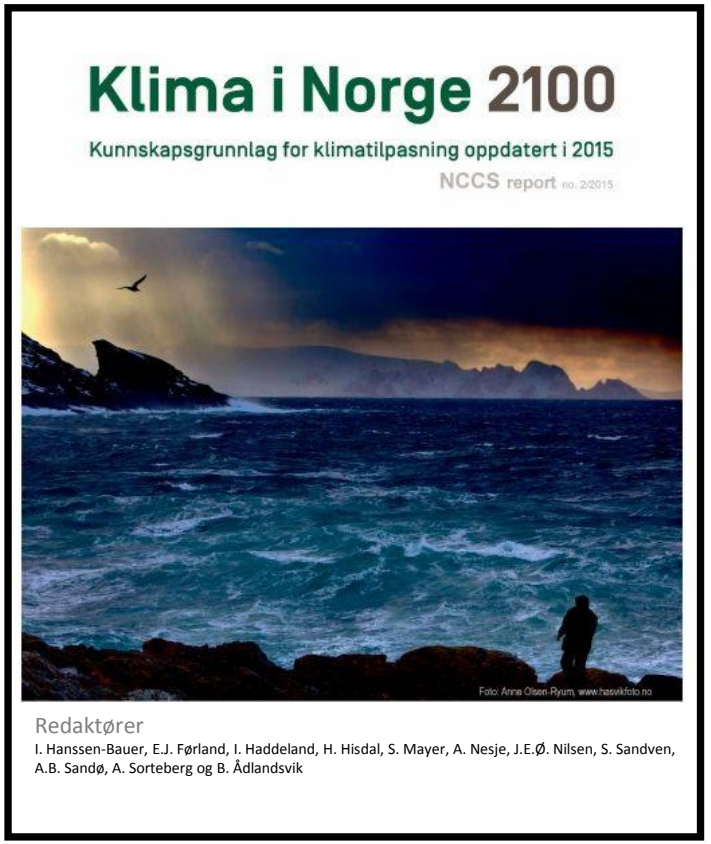


Source: L.P.Graham, SMHI (modified)

Climate in Norway 2100

Results *high* emissions:

- Warmer? YES Temp.: + 4.5 ^{0}C (3.3-6.4)
- Wetter? YES + 18 % (7-23 %)
- More intense and frequent extreme rain? YES
- Sea level rise: YES + 15–55 cm (depends on location)



Meteorologisk institutt

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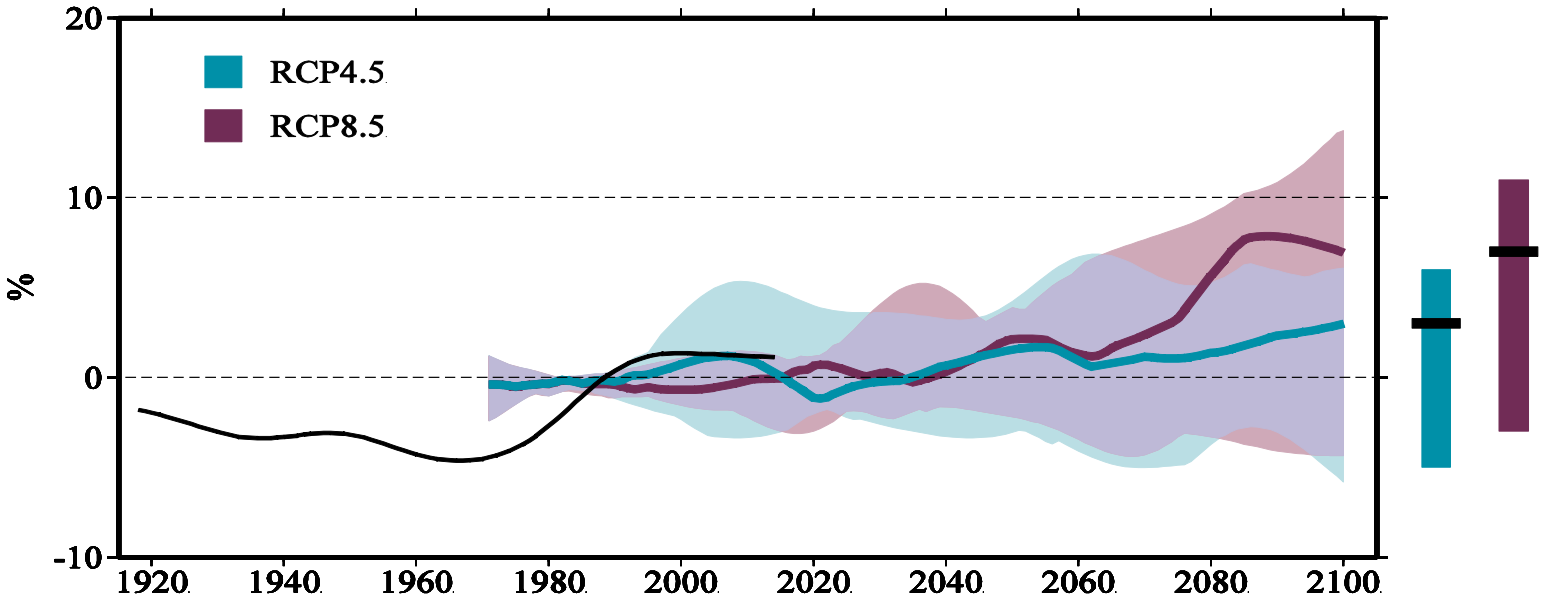
NVE

Annual runoff

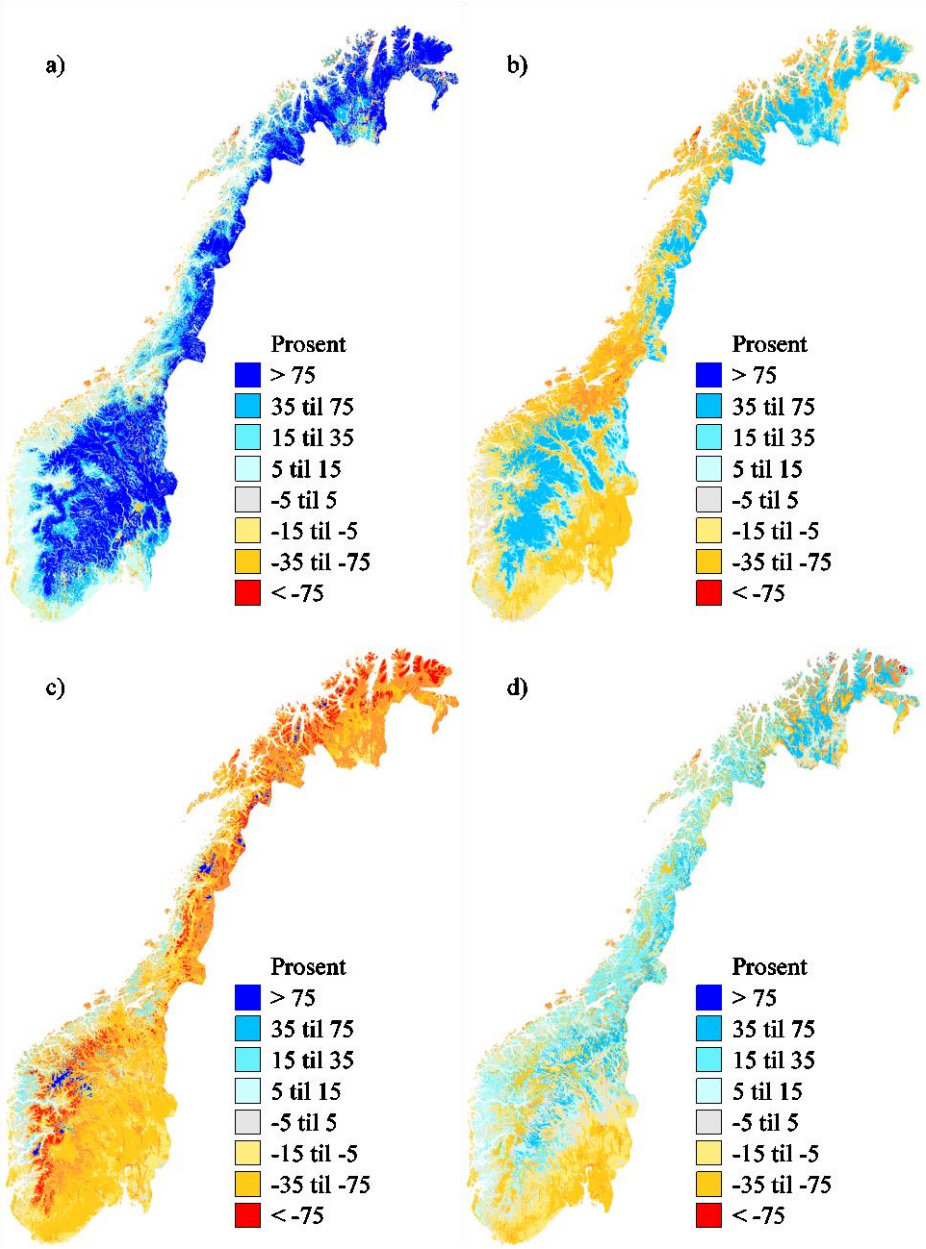
- 10-, 50- og 90-percentiles (filtered)



Runoff, seasons

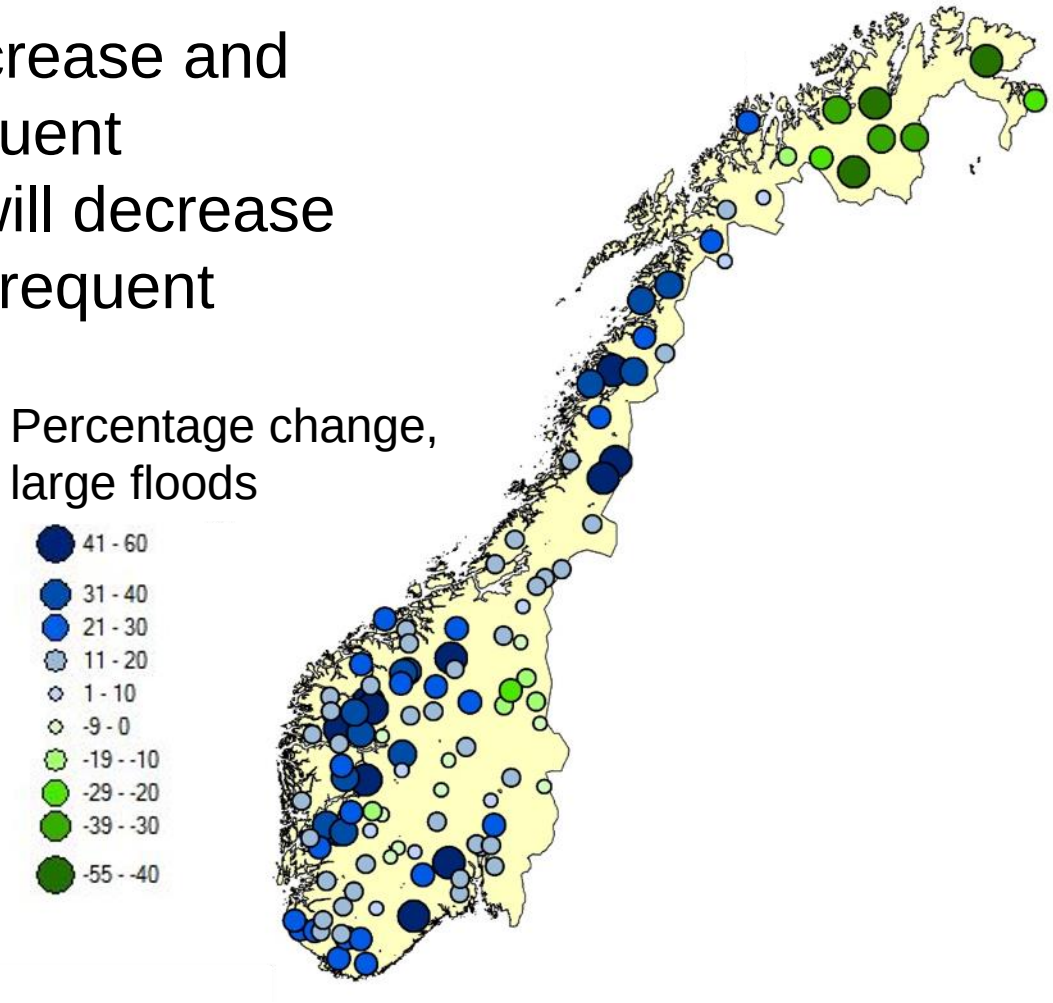
RCP8.5, percentage change 2071-2100 vs. 1971-2000

a) Winter
b) Spring
c) Summer
d) Autumn

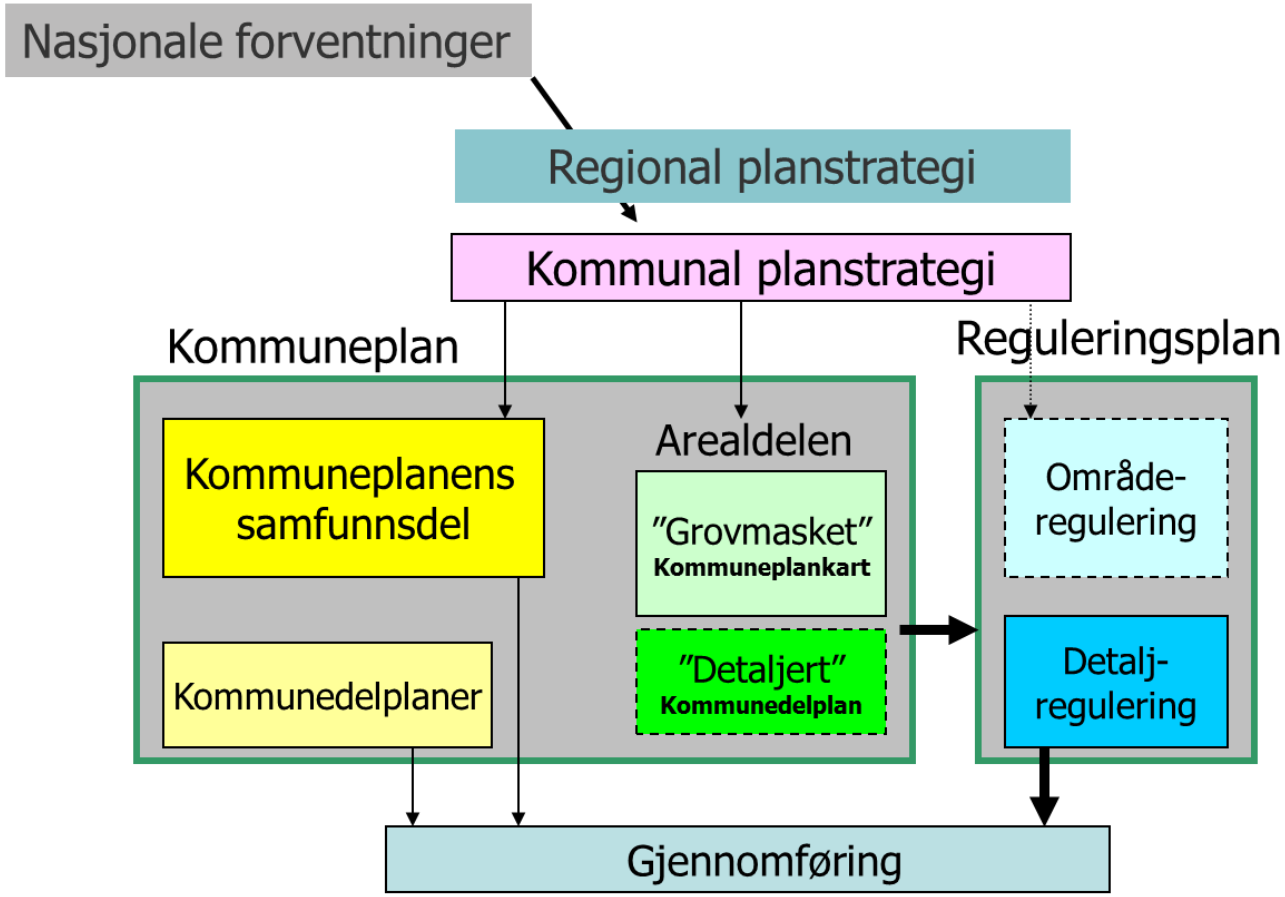


Flood increase here and decrease there

- Rain floods will increase and become more frequent
- Snowmelt floods will decrease and become less frequent

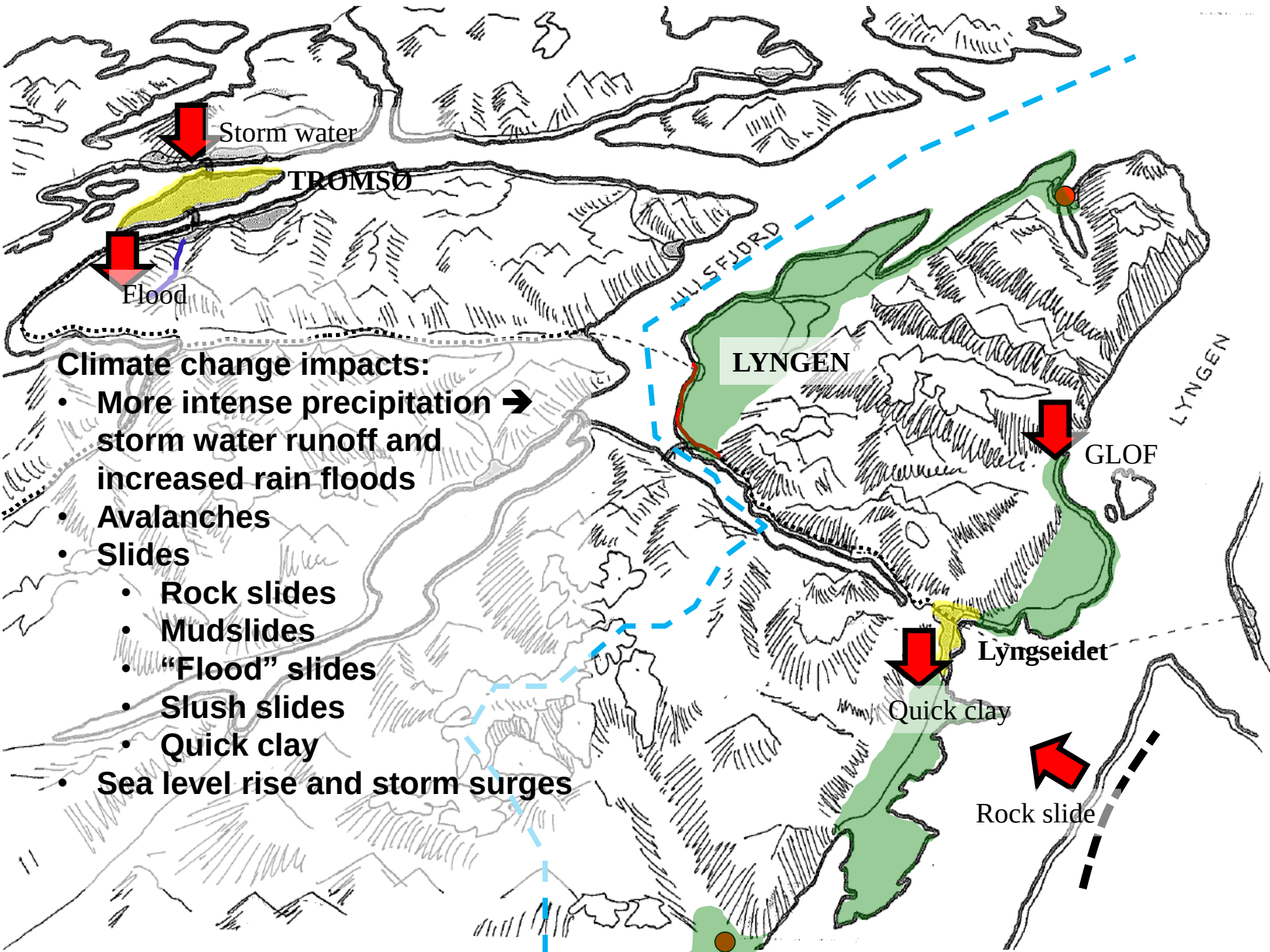


Operation - land use planning : Planning in the municipalities



Operational needs:
The message from the municipalities

- The planning process includes many aspects, we have limited time to consider natural disasters and climate change
- There is a lot of information, how do we know where to find what we need?
- Tell us where there is a risk of flooding – give us numbers



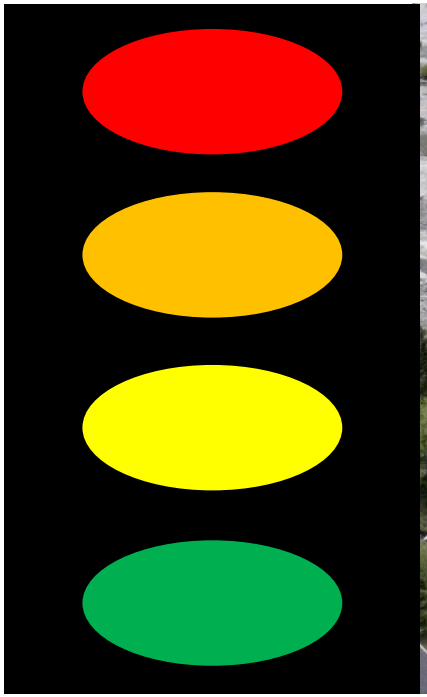
Climate change impacts:

- **More intense precipitation ➔ storm water runoff and increased rain floods**
- **Avalanches**
- **Slides**
  - **Rock slides**
  - **Mudslides**
  - **“Flood” slides**
  - **Slush slides**
  - **Quick clay**
- **Sea level rise and storm surges**

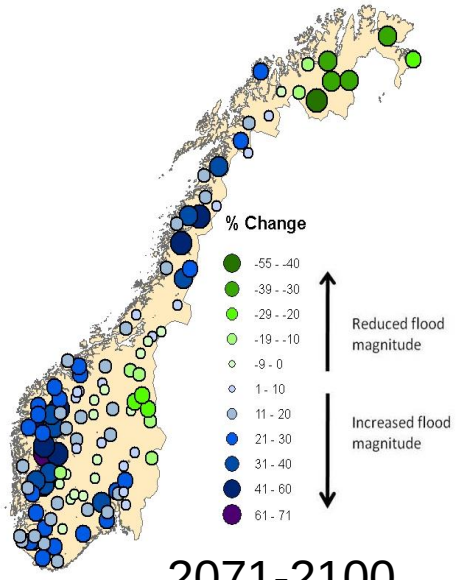
Laws and regulations

- The planning and building act: Housing properties not allowed within area of 200-year flood

➔ Where can you build, i.e. a need for “numbers” of overall heights



The role of NCCS in filling the gap



2071-2100

SCIENCE

- How can we take account of changed floods in land use planning etc.?

PRACTICE

NCCS: A key role in deciding the ensemble members and recommend how to use the results for adaptation, including informing about uncertainty

From R2O

Floods and land use planning

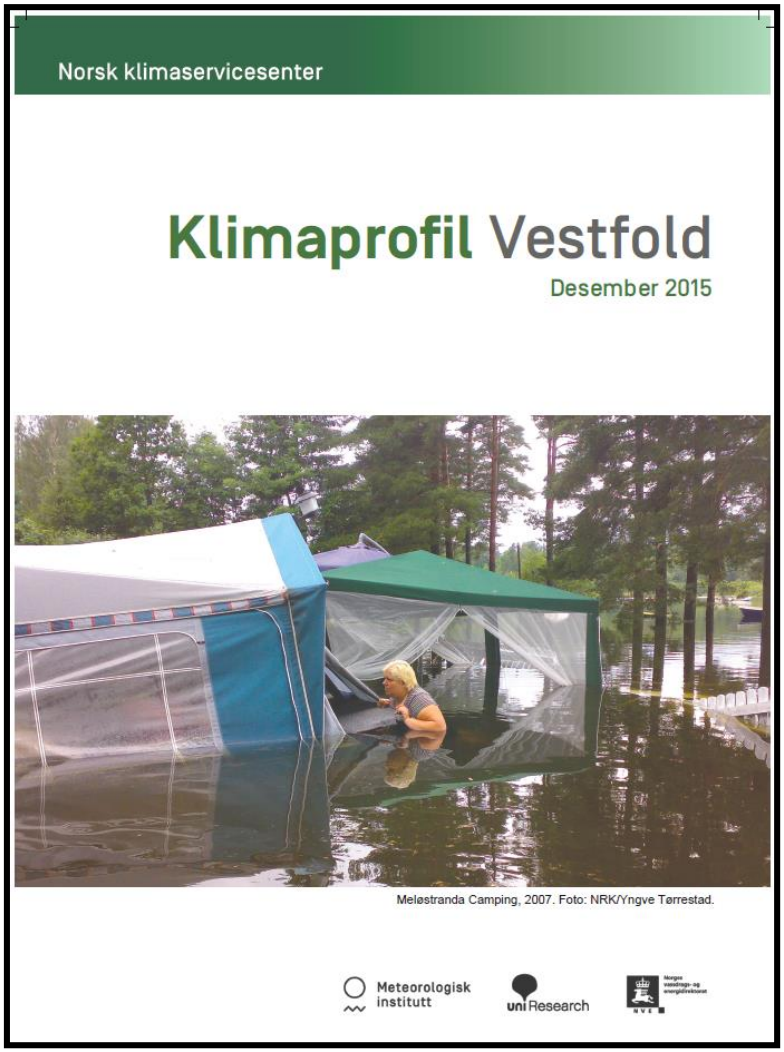
Decision made by scientists & the water managers at NVE:

- Use the median change
- If the flood projections indicate more than 20 % increase in the 200-year flood, the flood projections will be used as a basis for flood inundation maps
- If the flood projections indicate less than 20 % increase, historical data will be used as a basis for the flood inundation maps

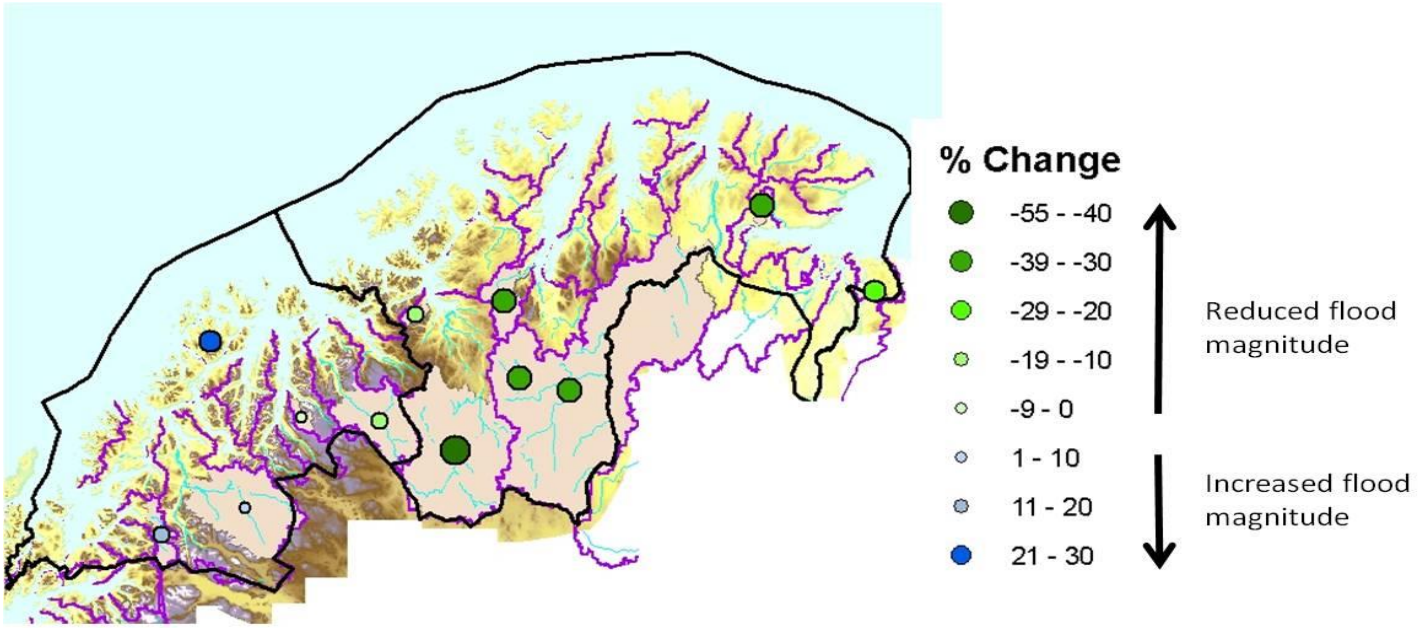
Photo: A. T. Hamarsland, NVE

For each county: «Climate profiles»

- Short summary of the main challenges for the county
- Developed in dialog with county authorities
- Concerns projected changes in temperature, precipitation, flooding, snow conditions, landslides and avalanches



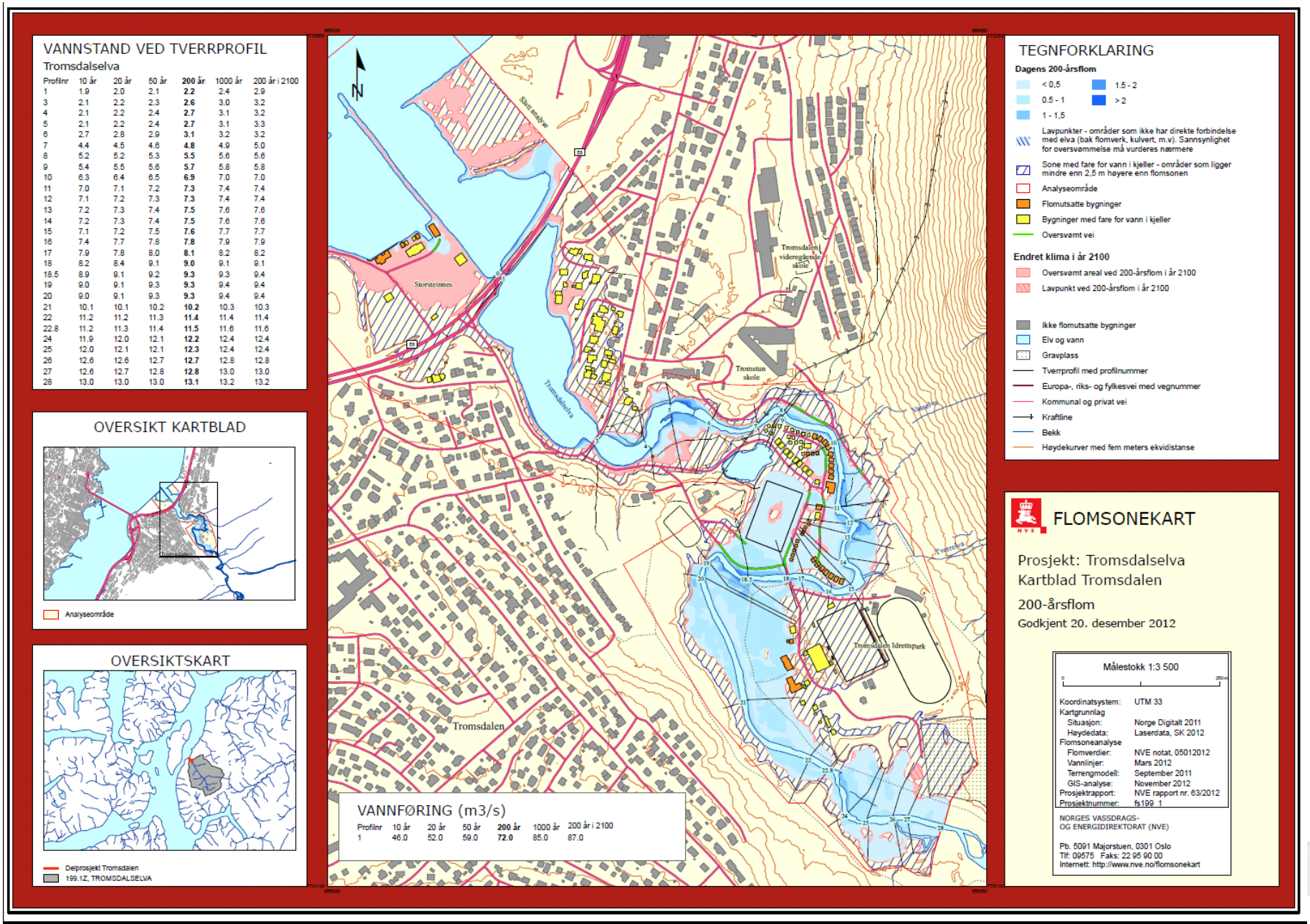
Climate profile – floods in a future climate



Expected change in Troms – consequences for design values:

- Smaller snowmelt floods in the large rivers – use historical data
- Larger rain floods near the coast – increase discharge by 20%
- In small, steep rivers and urban areas, increased frequency of local intense precipitation – 20 % increase should be used

Flood inundation map



The role of NCCS

- Knowledge about the most recent scientific results
- Knowledge about different actors and their role (distribution of responsibility)
- Knowledge about requirements in laws and guidelines
- Knowledge about requirements in different planning processes related to land use planning
- Knowledge about the different needs of different user groups

➔ Recommend which “numbers” to use in a consistent way

➔Contribute to capacity building at the national, regional and local level

Thank you!