

# Current Climate Change in Norway

Eirik J. Førland, MET Norway / NCCS; - Riga 19.05.2016

NCCS is a cooperation between:



# Topics

- **Data accessibility: Challenges, quality, climate change parameters, indicators**
- **Data analysis and methods**
- **Data interpolation & homogenisation**
- **Results – How climate is changed**

# Climate services (at MET Norway)

- Observations
  - Data quality control
  - Data bases, data management
  - Modelling
  - Product development
  - User support
  - Portals
  - APIs
- Observing
  - Describing
  - Analysing
  - Disseminating



Meteorologisk  
institutt 150 år

yr.no



**www.eklima.met.no**

Norwegian Meteorological Institute

**eKlima**  
Free access to weather- and climate data from Norwegian Meteorological Institute  
from historical data to real time observations

Home

**Log in**  
e-mail  
  
password  
  
  
Forgot your password?  
New user

**Select language**  
 Bokmål  
 Nynorsk  
 English

**Help**  
Using eKlima

eklima@met.no

**What is eKlima?**  
eKlima is a web portal which gives free access to the climate database of the Norwegian Meteorological Institute, for all. The climate database contains data from all present and past weather stations of the Norwegian Meteorological institute, as well as data from other institutions (owners) that are allowed distributed. From eKlima you can pick out simple lists or sophisticated analysis and you decide how the reports will look like.

**Examples of reports**

- Weather a special day (accident)
- Weather on a certain day each year (Christmas Day)
- Long timeseries with monthly values
- Graph with normalvalues
- Wind Rose (Select Statistics/Frequency distribution)

**FAQ - Questions and Answers.**  
How to get started.  
How to use eKlima.  
FAQ - Questions and Answers.  
How can data and products from eKlima be used and redistributed?  
- License and copyright.

**News**

- 2016.02.09 - eKlima will be unavailable few hours from Tuesday 9. February at 9(GMT)
- 2015.08.12 - Short network interruptions Wednesday 8 August 10:00 -> 11:30(GMT)
- 2015.07.08 - eKlima will be unavailable few hours from Wednesday 8. July from 08:00 (GMT).

**Other links**

- The weather where you are: yr.no
- Maps with weather, snow and climate: senorge.no
- More than just the weather: met.no
- Web service access to climate data: wsKlima

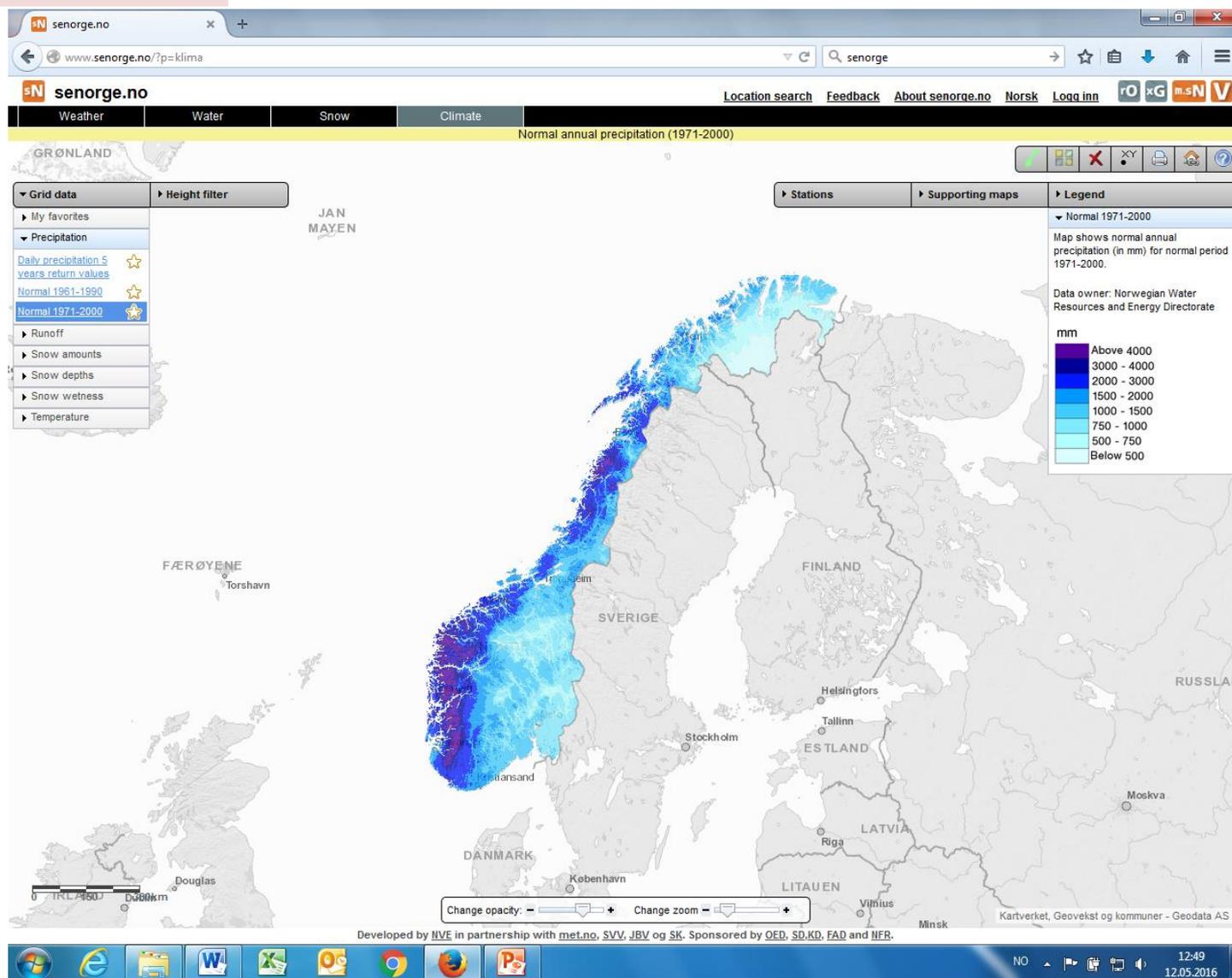
**Stations**

- Map with operational stations
- Stationmap 2007 (in norwegian)
- Last station changes

HOPEN WEATHERSTATION  
Photo: Bjarne Fosmo (1970)

NO 12:35  
12.05.2016

<http://www.senorge.no>



<http://arcticdata.met.no/>

The screenshot shows a web browser window displaying the Arctic Data Centre website. The browser's address bar shows the URL `arcticdata.met.no/metamod/search`. The website header features the Arctic Data Centre logo, which includes a map of the Arctic region, and the text "Arctic Data Centre Hosted by the Norwegian Meteorological Institute". Below the header, there is a navigation menu with links for "Browse data repository", "ISO23950/SRU Search", "Metadata search", "View basket (0)", "Help", "Subscription", and "Login". The main content area is titled "Metadata Catalogue Search" and contains a search instruction: "Search the METAMOD Catalogue. Use the links on the left hand side to access pages for setting search conditions and initiate the search. Initially, only directory level datasets are shown. For each directory level dataset containing files on a second level, there is a small [+ ] button that may be used to show metadata about the files." Below this instruction, there are several buttons: "Show xml: Show all metadata for the dataset", "Subscribe: E-mail notification when files are added/changed (needs user account)", "Visualize: Display map representation of the data", and "Add to basket: Add the file(s) to the collection basket. (More than 100 files in the basket needs user account)". At the bottom of the page, it is noted that the site is "Hosted by: Norwegian Meteorological Institute" and "Powered by: METAMOD". The Windows taskbar at the bottom of the screenshot shows various application icons and the system clock indicating the time is 12:56 on 12.05.2016.

Web-site:www.klimaservicesenter.no

The screenshot shows a web browser window with the URL <https://klimaservicesenter.no>. The page features a green header with the text "Norsk klimaservicesenter" and a hamburger menu icon. Below the header is a large image of a coastal landscape with a bird in flight. The photo credit reads "Foto: Anne Olsen-Ryum, www.hasvikfoto.no".

Below the image, there are two main content blocks:

- A green box with a large exclamation mark icon and the text: "Vann vil være en stor utfordring for Norge i framtiden." To its right is a link "Klima i Norge 2100" with a right-pointing arrow.
- A dark blue box with a large quotation mark icon and the text: "Det blir færre dager med snødekke, mer regn og større flommer, men noen". To its right is a link "Klimaframskrivninger" with a right-pointing arrow.

The Windows taskbar at the bottom shows the time as 14:40 on 05.12.2015.

Re: KSS-web - eirikjf@met... x Nedlasting av Klimadata x +

tst-h-web03.nve.no/gridown#/main/Klima senorge

### Nedlasting av klimadata

Legg til nedlasting Velg data / kartlag fra venstre-menyen

Nedlastingskurv (0)

**Profil:**  
Klima

**Utslippsmodell og Klimaprojeksjon**

**Utslippsmodell**

- RCP8.5
- RCP4.5

**Klimaprojeksjon**

- CNRM, CCLM, 1971-2100
- CNRM, RCA, 1971-2100
- EC-EARTH, CCLM, 1971-2100
- EC-EARTH, HIRHAM, 1971-2100
- EC-EARTH, RACMO, 1971-2100
- EC-EARTH, RCA, 1971-2100
- HADGEM, RCA, 1971-2100
- IPSL, RCA, 1971-2100
- MPI, CCLM, 1971-2100
- MPI, RCA, 1971-2100

2016 05 12 (1 dag)

Alle **År** Mnd Dag

Fra 2016 5 12

Til 2016 5 12

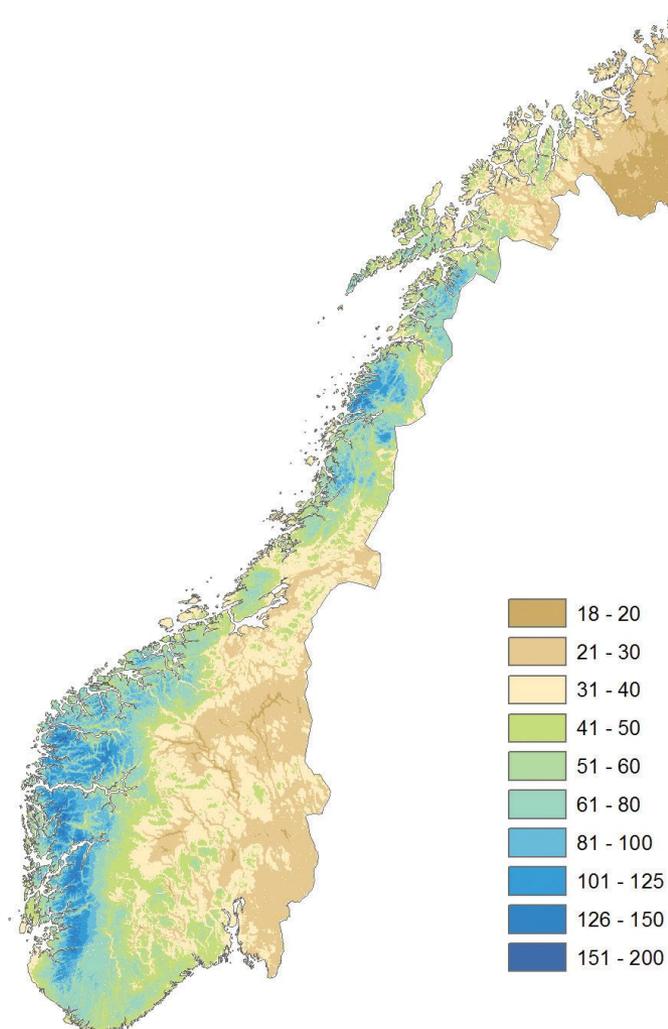
Norge map showing climate data download options. The map displays Norway and surrounding regions (Sverige, Danmark, Estland, Latvia, Litauen) with major cities marked. A vertical scale on the left indicates the time period from May to June. The interface includes a legend for county selection (Legg til fylke) and a topographic map layer (Topografisk gråtonekart).

NVE © 2015-2016

Windows taskbar: 12:52 12.05.2016

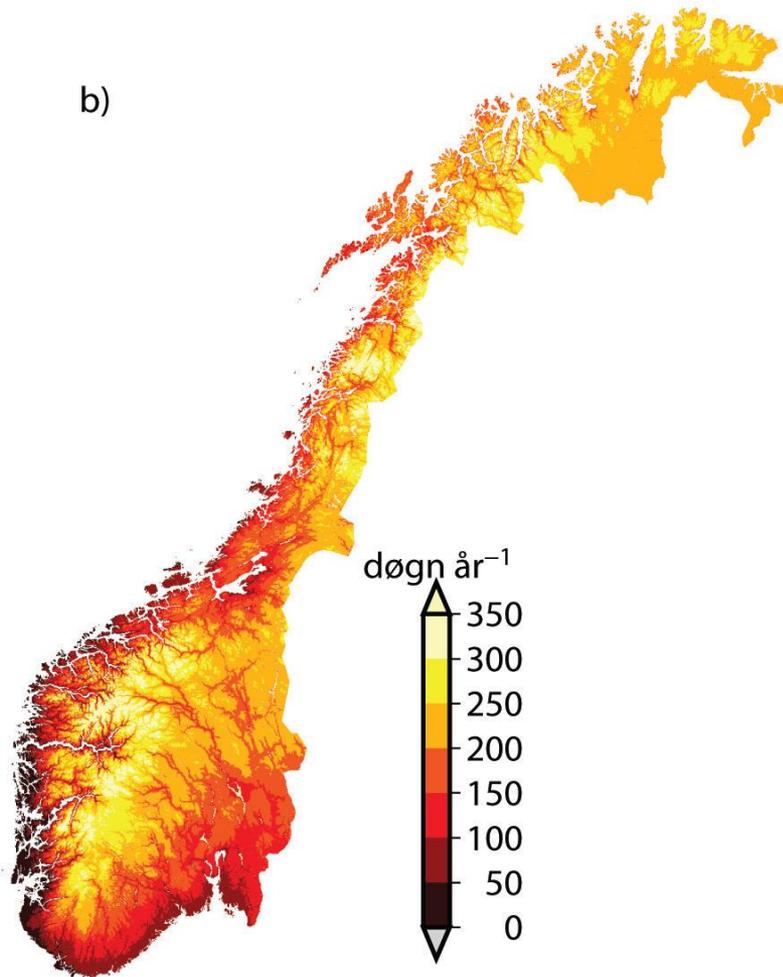
# NCCS: Main Climate indicators

- **WMO-Essential Climate Variables (ECV) and indicators developed to meet specific user needs**
- **Based on standard climate elements; alone or in combinations**
- **Atmosphere (Temperature, Precipitation, Wind, +++)**
- **Hydrology (Runoff, Snow, Glaciers, Soil moisture, +++)**
- **Permafrost, Land slides, Avalanches**
- **Ocean climate (Sea level, Storm surges, Sea ice, Acidification)**

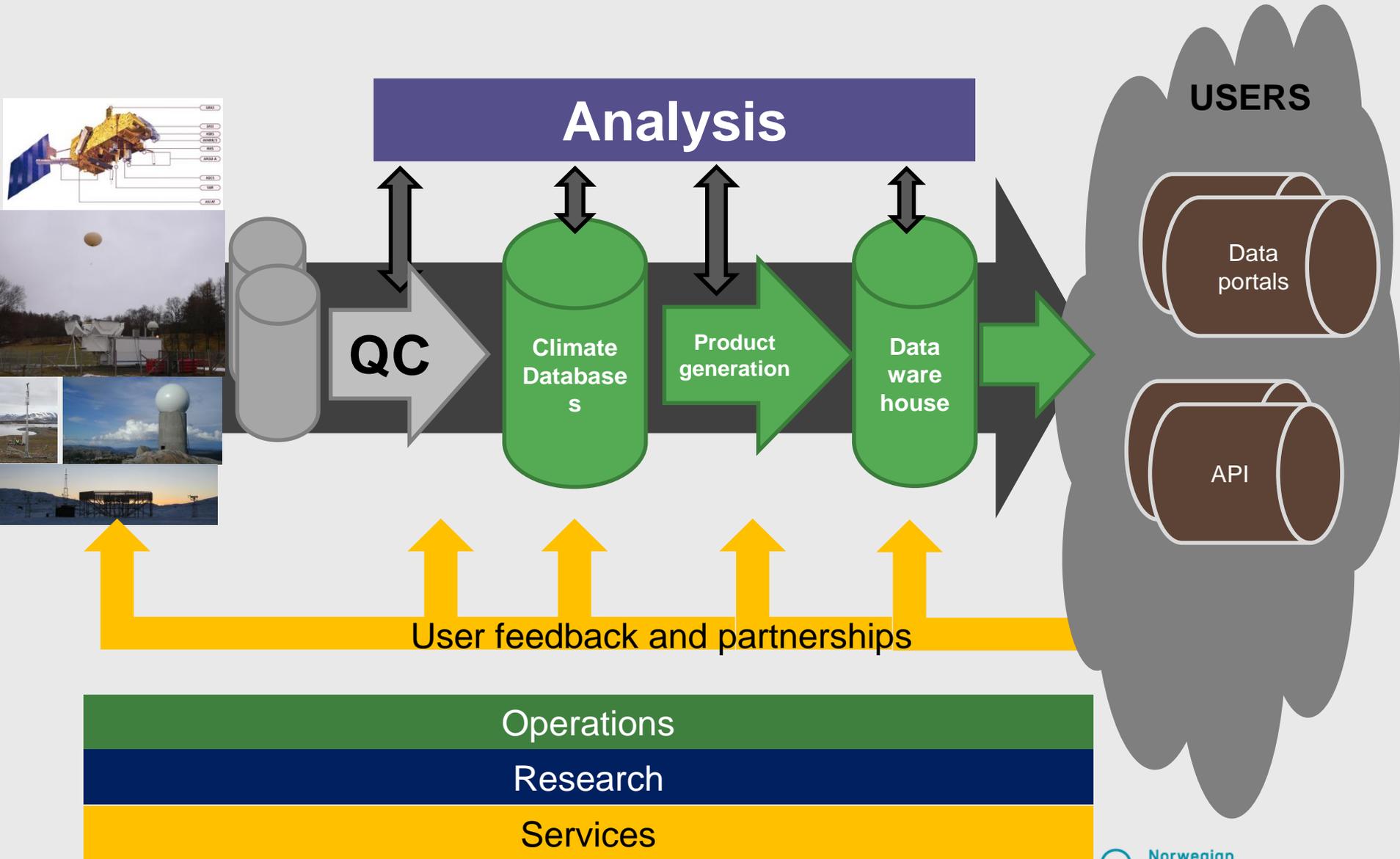


**Extreme daily rainfall:  
Rainfall (mm/day )  
exceeded in  
0,5 % of days  
during 1971–2000**

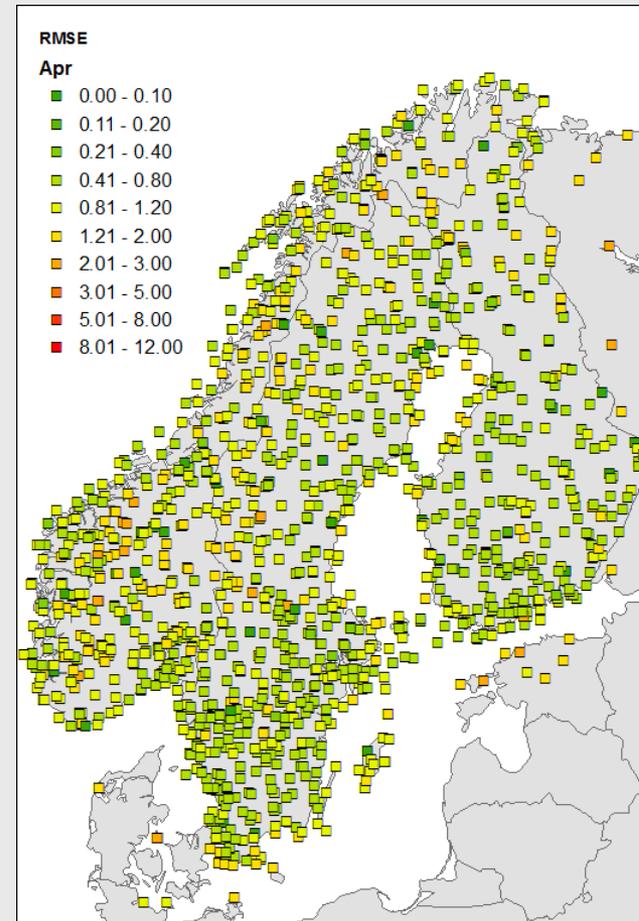
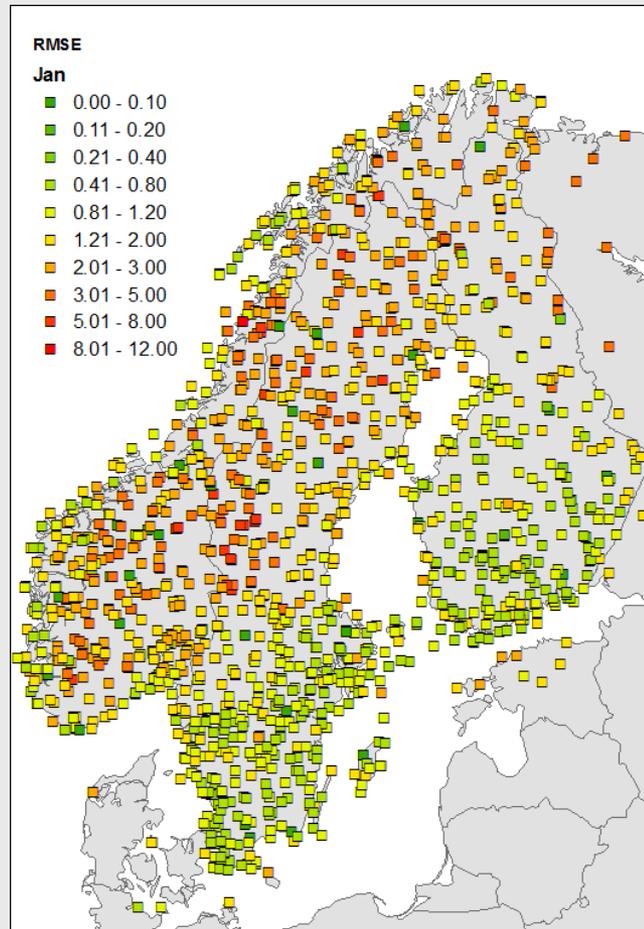
b)



**Number of days per year  
with ground covered by  
snow during 1971–2000**

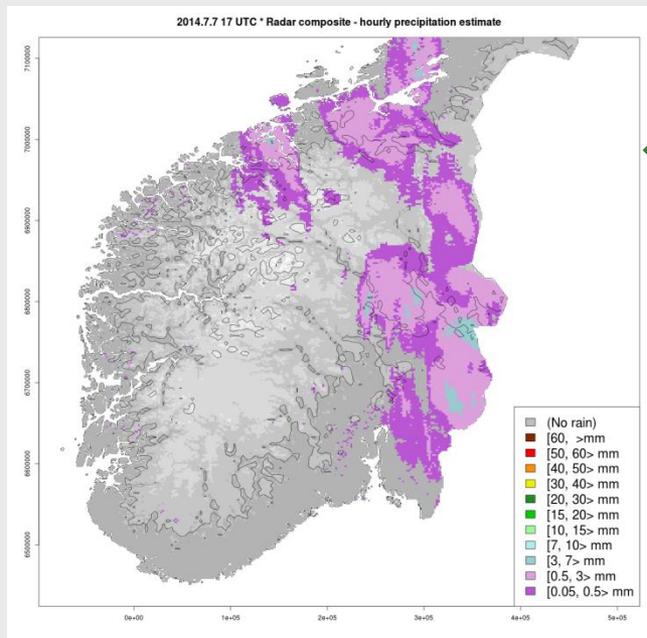


# NGCD.RK @ MET Norway – TEMP1d - Evaluation

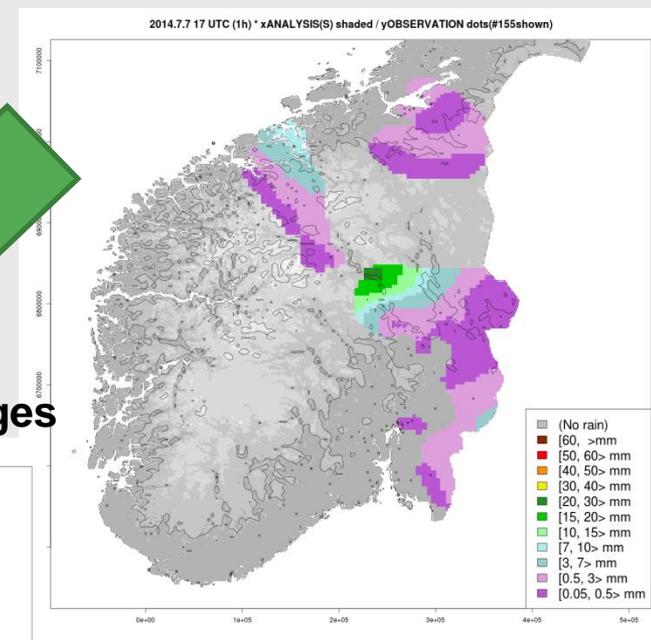


# Convective rainstorm in Norway (7.July 2014)

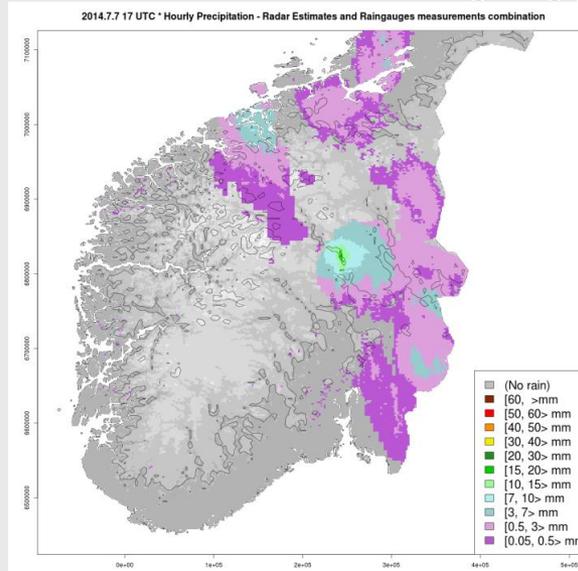
## Radar



## Automatic weather stations



## Combination radar+raingauges



## Routines for Interpolation and homogenisation: Nordic and international collaboration (incl. Estonia and Hungary)

### The main features of MISHv1.03

### Software used at CARPATCLIM project

[http://www.met.hu/en/omsz/rendezvenyek/homogenizationa  
nd\\_interpolation/software/](http://www.met.hu/en/omsz/rendezvenyek/homogenizationa<br/>nd_interpolation/software/)

### **MASHv3.03**

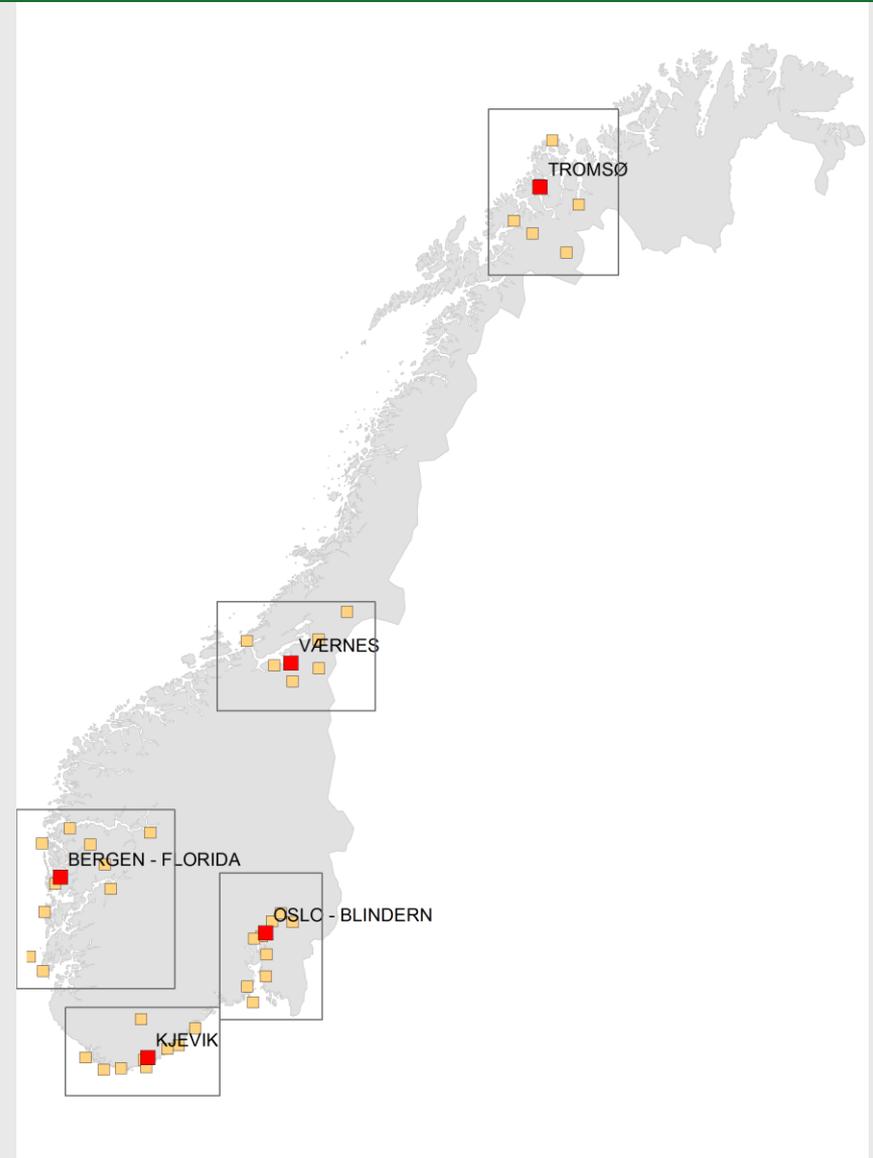
Multiple Analysis of Series for Homogenization;  
*Szentimrey, T.*

### **MISHv1.03**

Meteorological Interpolation based on Surface  
Homogenized Data Basis;  
*Szentimrey, T. and Bihari, Z.*

# Homogenization

- **Monthly temperature and precipitation for all Norway (incl. Arctic stations) 1890 – present**
- **Daily homogenization of temperatures for five areas (see map)**
- **Daily precipitation for selected stations/key catchments**



M-406 | 2015

# Klima i Norge 2100

Kunnskapsgrunnlag for klimatilpasning oppdatert i 2015

NCCS report no. 2/2015



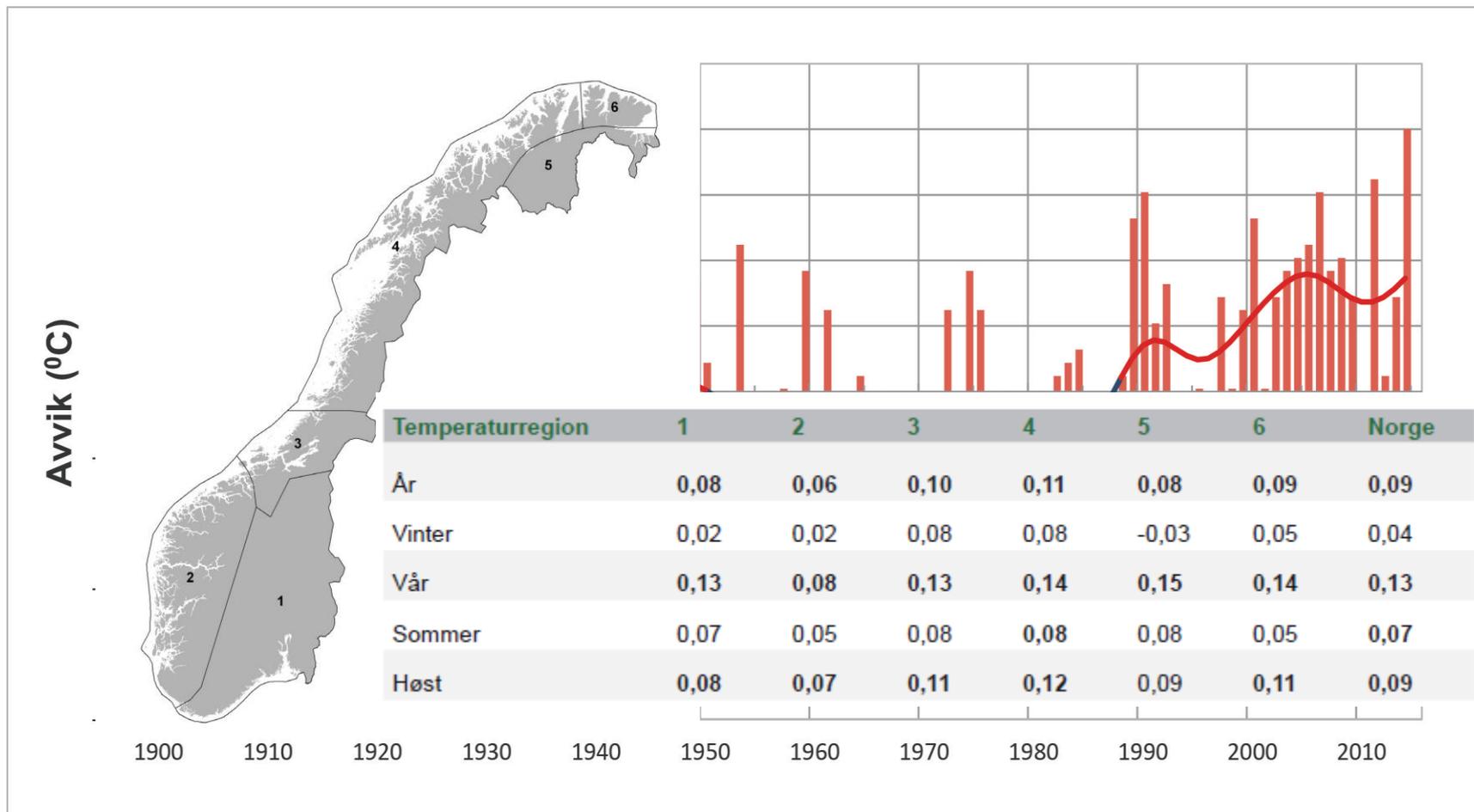
Foto: Anne Olsen-Ryum, www.hasvikfoto.no

## Redaktører

I. Hanssen-Bauer, E.J. Førland, I. Haddeland, H. Hisdal, S. Mayer, A. Nesje, J.E.Ø. Nilsen, S. Sandven, A.B. Sandø, A. Sorteberg og B. Ådlandsvik

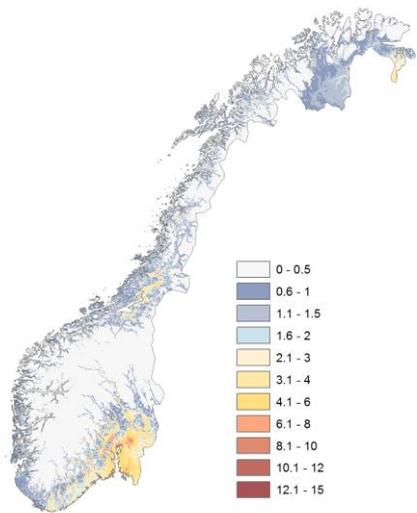


# Temperature variability in Norway 1900-2015

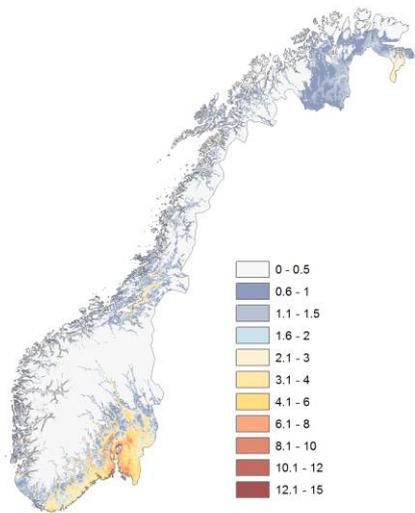


# Change in number of “Hot Days”

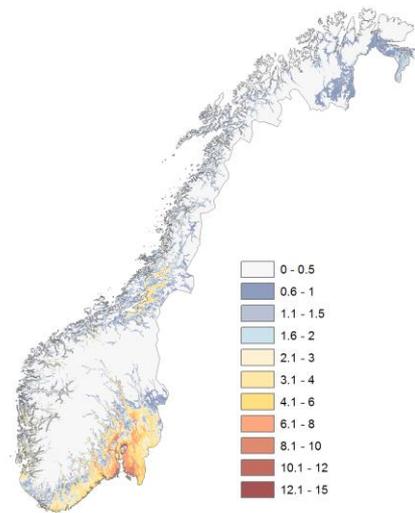
1961-1990



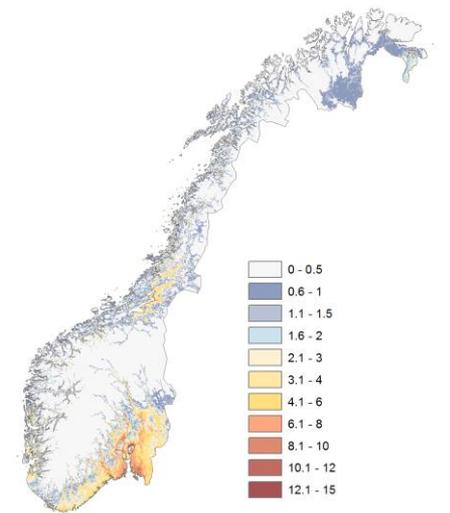
1971-2000



1981-2010

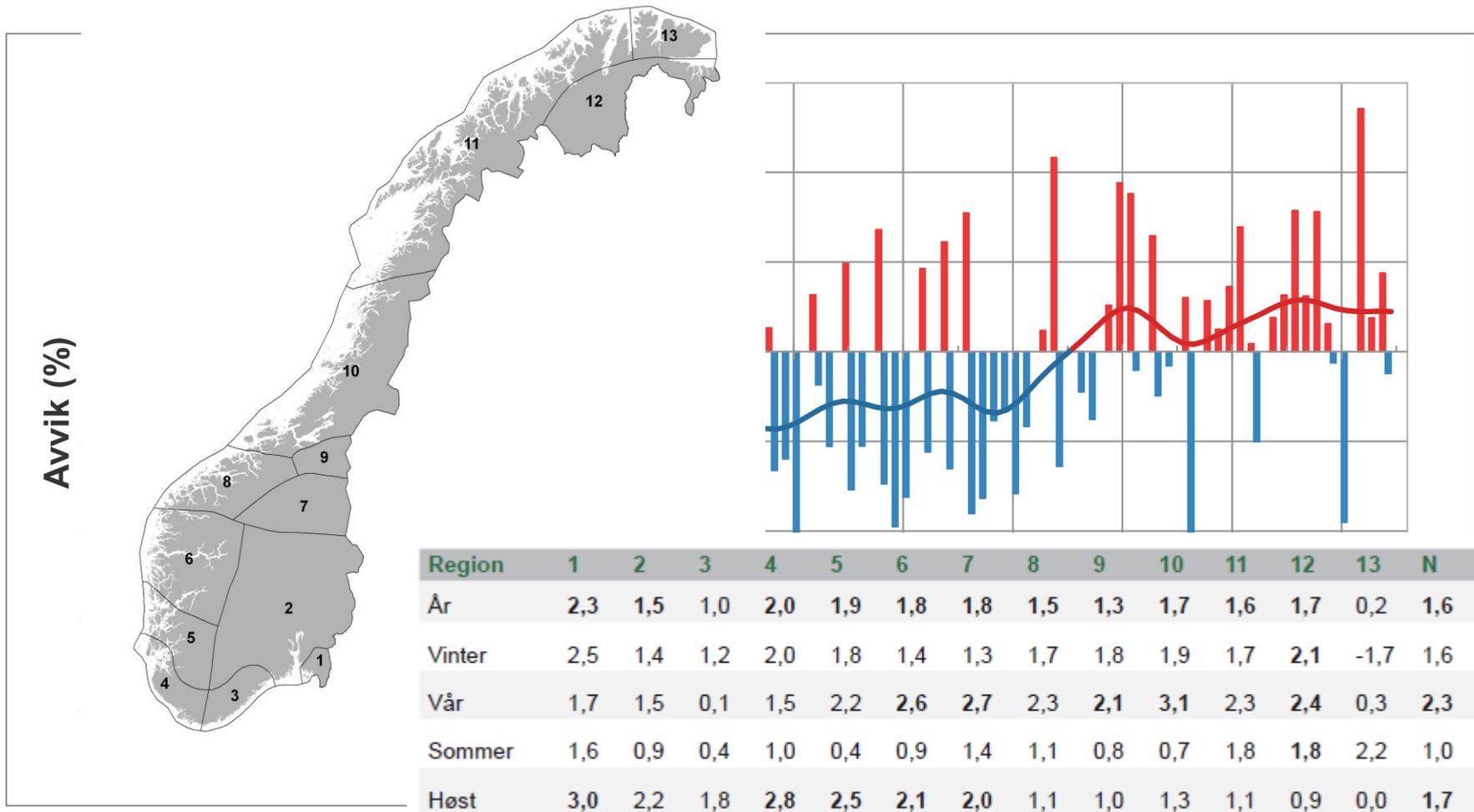


1985-2014

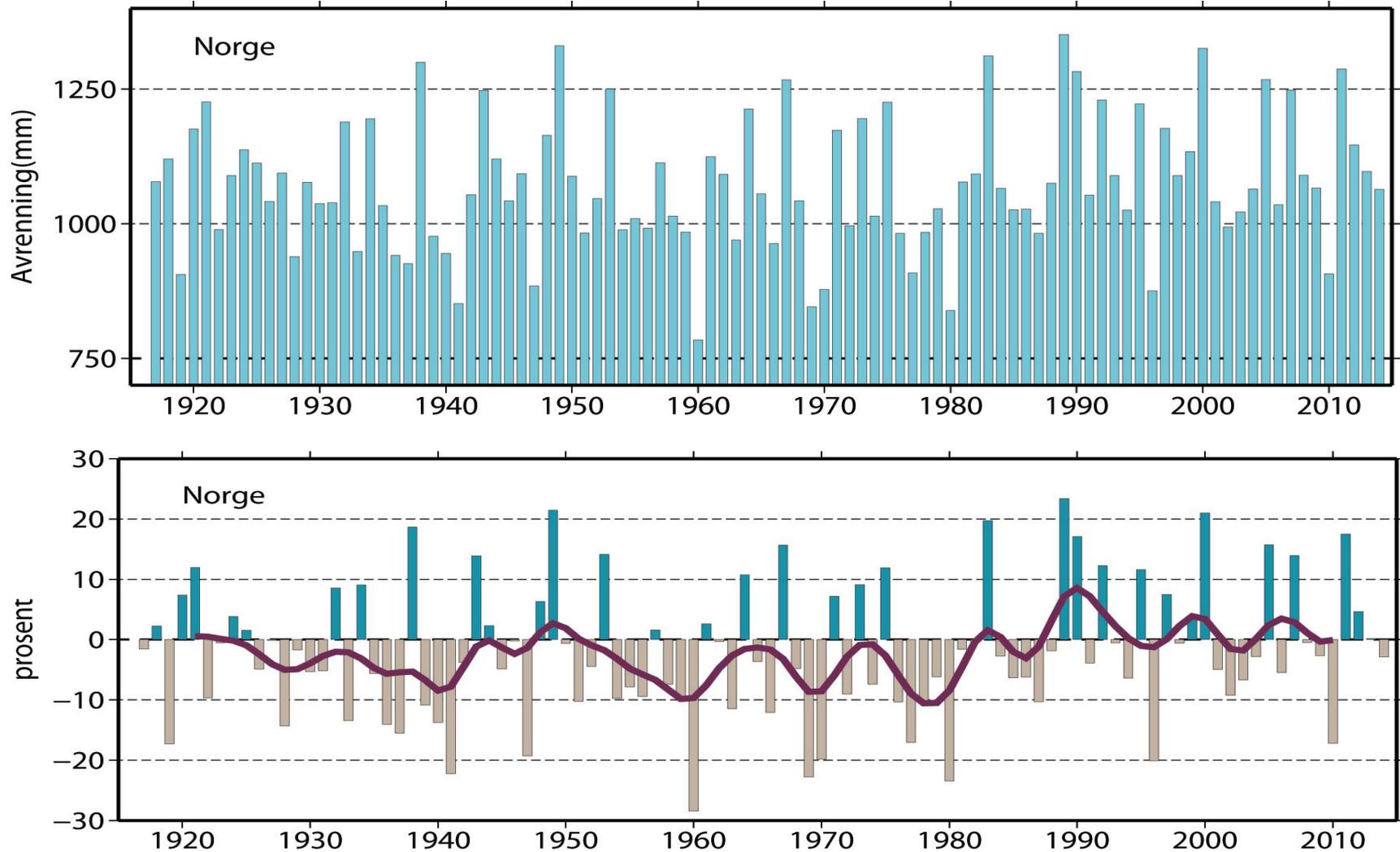


Days with mean temperature  $> 20\text{ }^{\circ}\text{C}$

# Precipitation variability in Norway 1900-2015

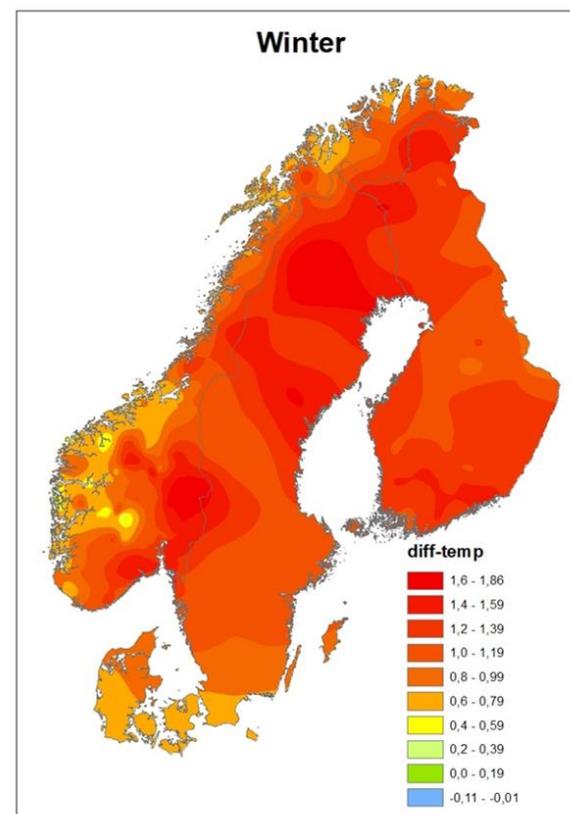
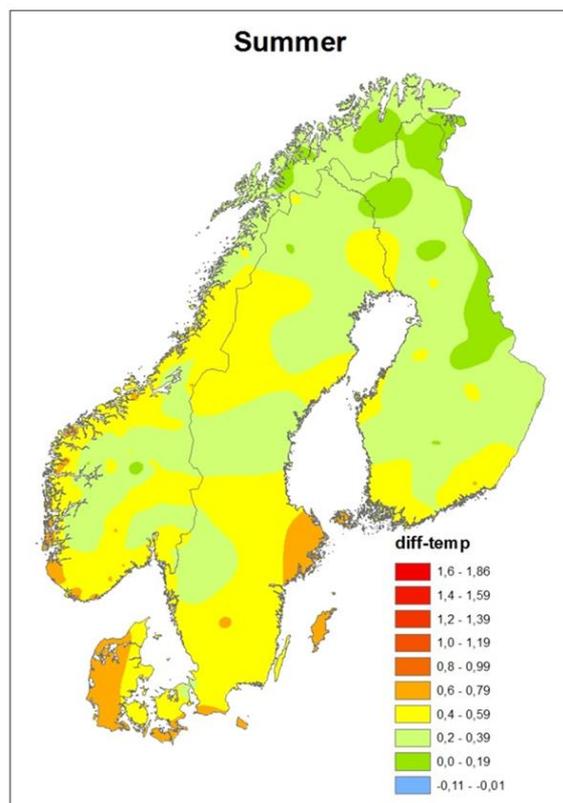


# Norway: Total runoff (Top: mm/year, bottom: Deviation (%) from 1971-2000)



# Change in mean seasonal temperature from 1961-1990 to 1981-2010

Nordic Framework for Climate Services (NFCS): <http://blog.fmi.fi/nordmet/>



# Considerations

- **The explosive increase in volume of climate data (surface, radar, satellite, models) is a challenge in management of climate data**
- **Homogeneous long series of key elements are crucial for climate change studies → “Reference Climate Stations”.**
- **For climate services, tailored climate indicators should be developed in close collaboration with users**
- **Gridded data are a good basis for climate indicators for adaptation studies**
- **Climate services (across national borders) will benefit from harmonization and standards for key indicators and products**
- **Distributed services, big data volumes, data sharing, open access....**
- **→ International collaboration!**