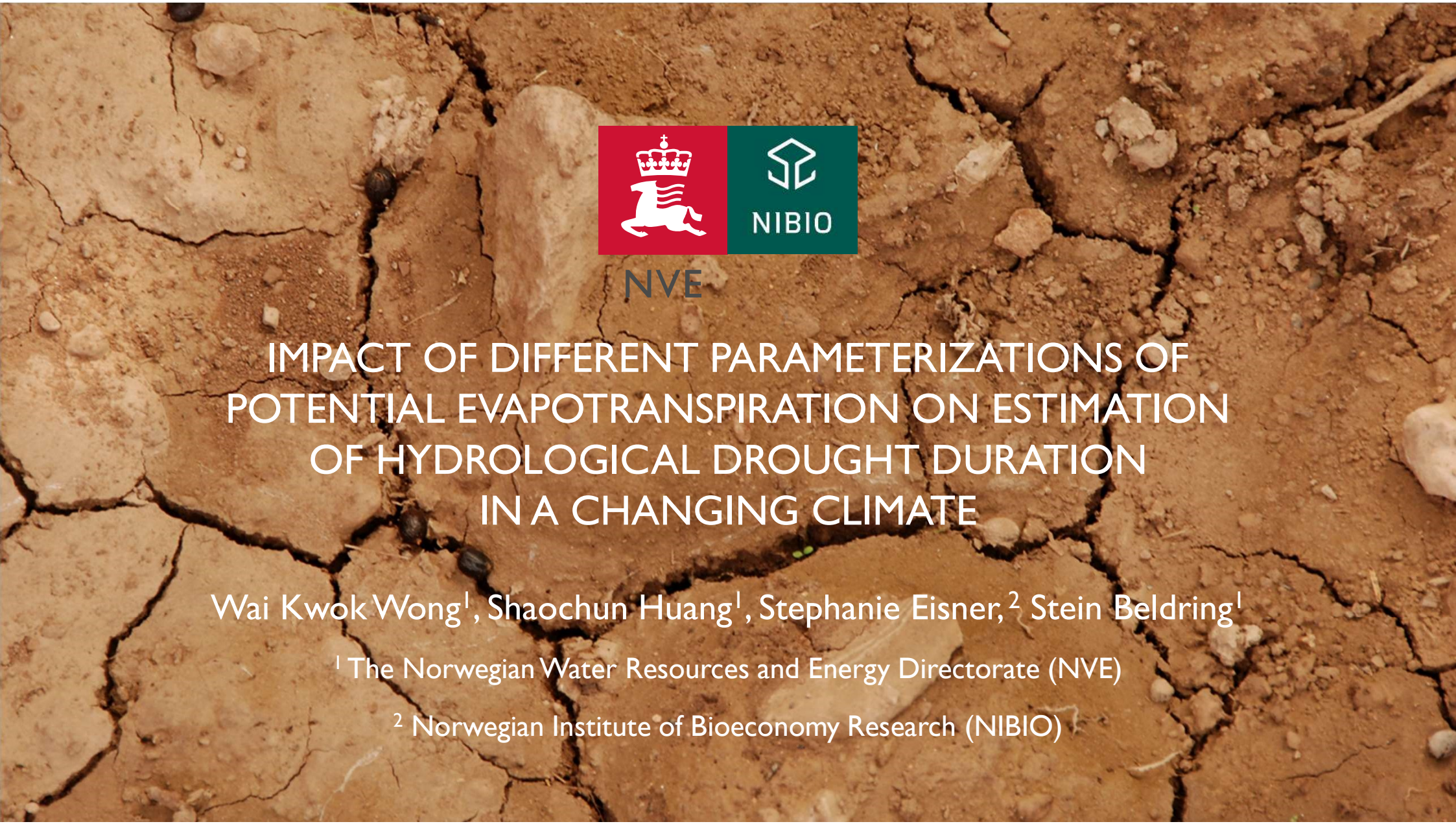

NVE

IMPACT OF DIFFERENT PARAMETERIZATIONS OF POTENTIAL EVAPOTRANSPIRATION ON ESTIMATION OF HYDROLOGICAL DROUGHT DURATION IN A CHANGING CLIMATE

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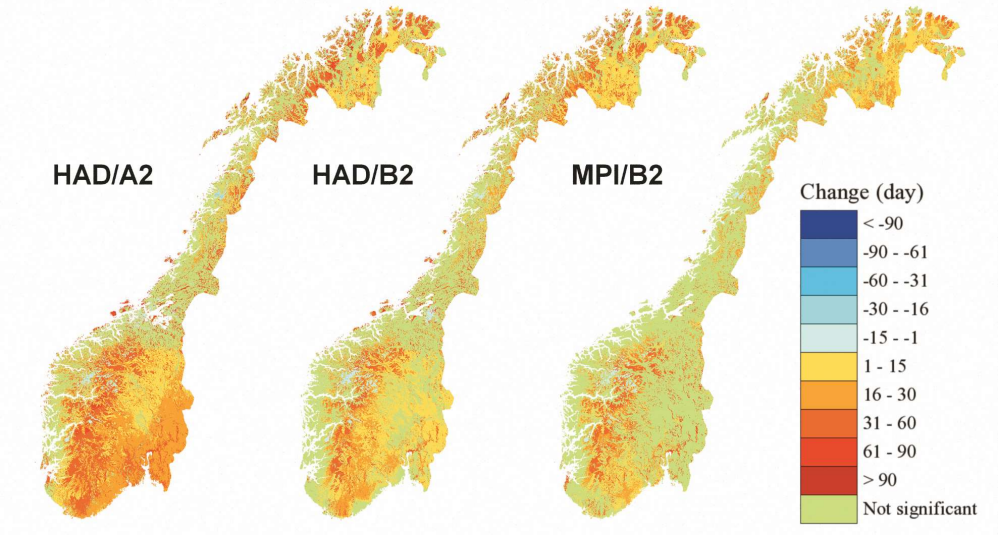
[1] The Norwegian Water Resources and Energy Directorate (NVE)

[2] Norwegian Institute of Bioeconomy Research (NIBIO)

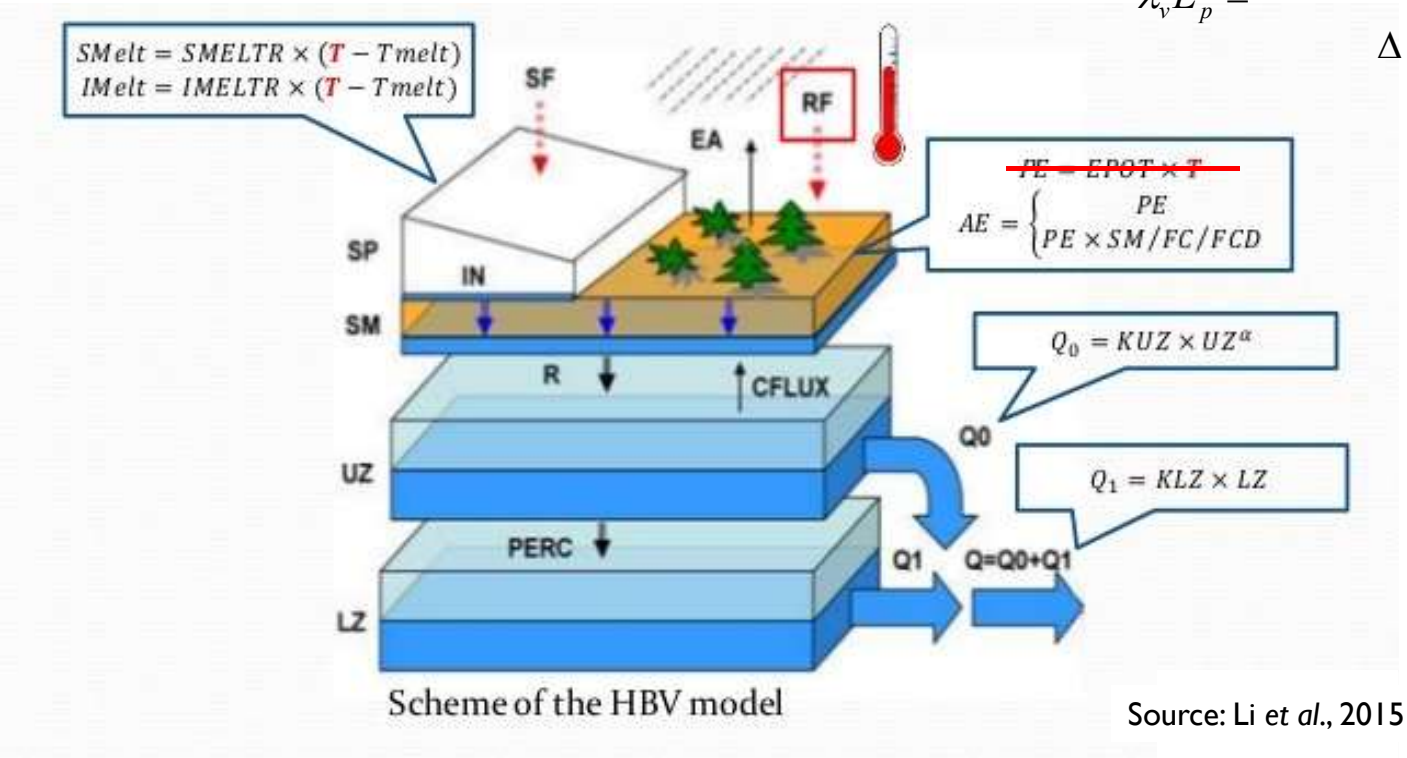
Motivation

- AR4 (A2 & B2)
- 2071-2100 vs 1961-1990
- ET => temperature index method
- Hydrological drought
- Overestimation of evapotranspiration???



Evapotranspiration

$$\lambda_v E_p = \frac{\Delta(R_n - G) + \rho_a c_p (v_s - v_a)/r_a}{\Delta + \gamma^*(1 + \frac{r_s}{r_a})}$$

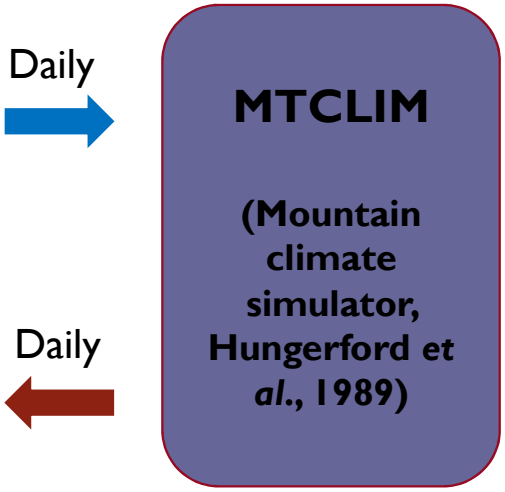


Scheme of the HBV model

Source: Li *et al.*, 2015 Huang *et al.*, 2019

Forcing data

- Historical data (SeNorge v2.1 1982-2012)
- Temperature-based approach (daily P, T_{mean})
- Penman-Monteith approach
  - T_{max} (°C)
  - T_{min} (°C)
  - Wind (m/s)
  - P (mm/day) (corrected using wind data)
  - T_{mean} (°C)
  - R_s (MJ/m^2/day)
  - Actual vapor pressure (KPa)



Input data – land surface parameters

- Albedo
- LAI
- Vegetation height (m)

National Forest Inventory and remote sensing

- Bulk resistance (s/m)
- Roughness parameter (m)

VIC vegetation library, Federer *et al.*,1996 Zhou *et al.*, 2006

- Crop parameters

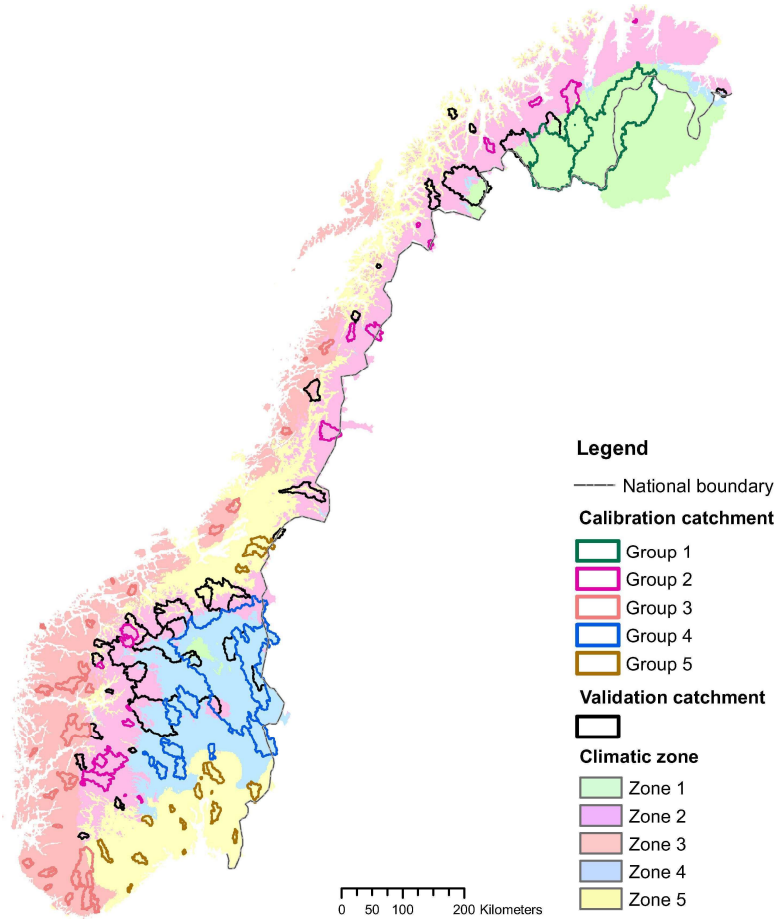
Crop database from SWAT model

- Additional biome properties

Mu *et al.*, 2011

Regionalized calibration

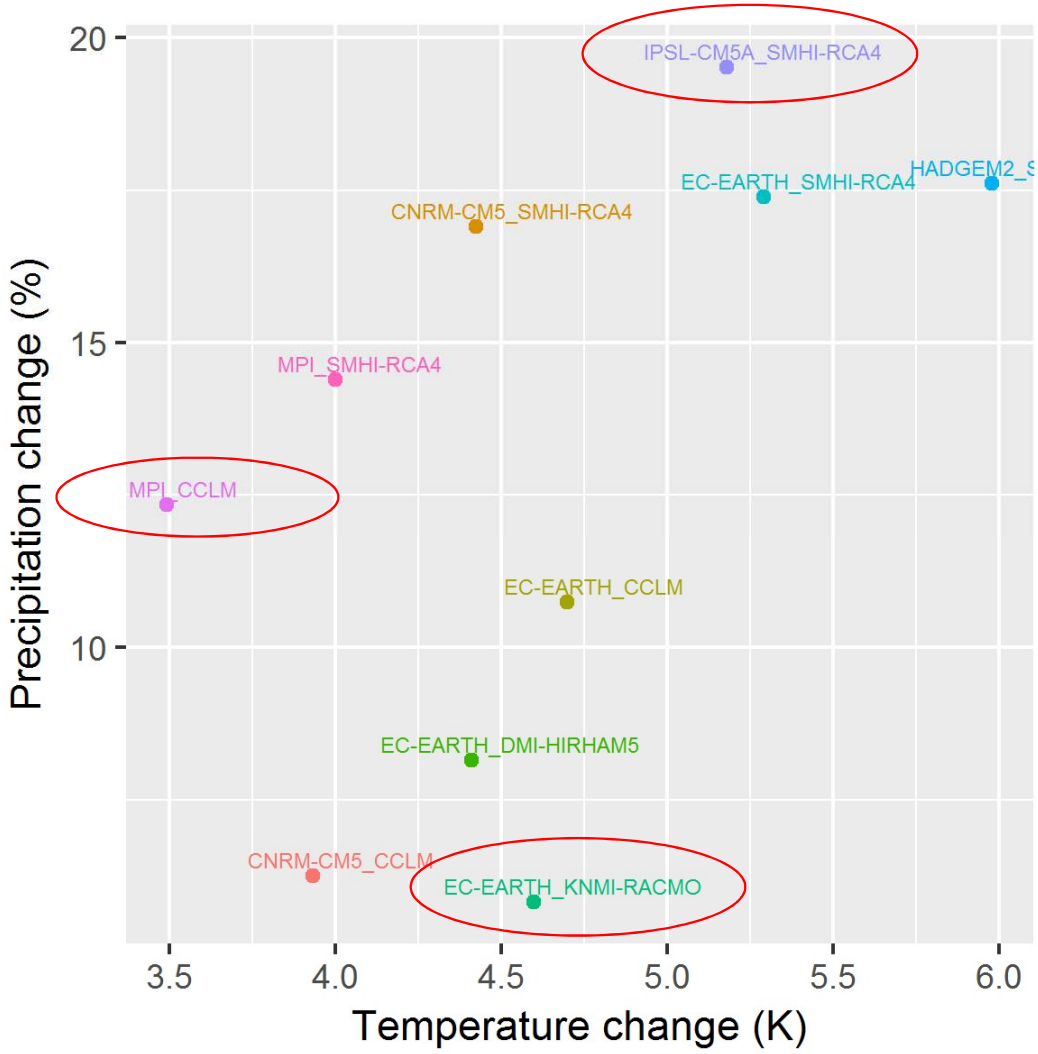
- Mean annual precipitation & temperature
- Precipitation & temperature seasonality index
- K-mean clustering
- 5 climatic zones



Huang, S., S. Eisner, J. Magnusson, C. Lussana, X. Yang, S. Beldring (2019): Improvements of the spatially distributed hydrological modelling using the HBV model at 1 km resolution for Norway. *Journal of Hydrology, 557:123585, https://doi.org/10.1016/j.jhydrol.2019.03.051*

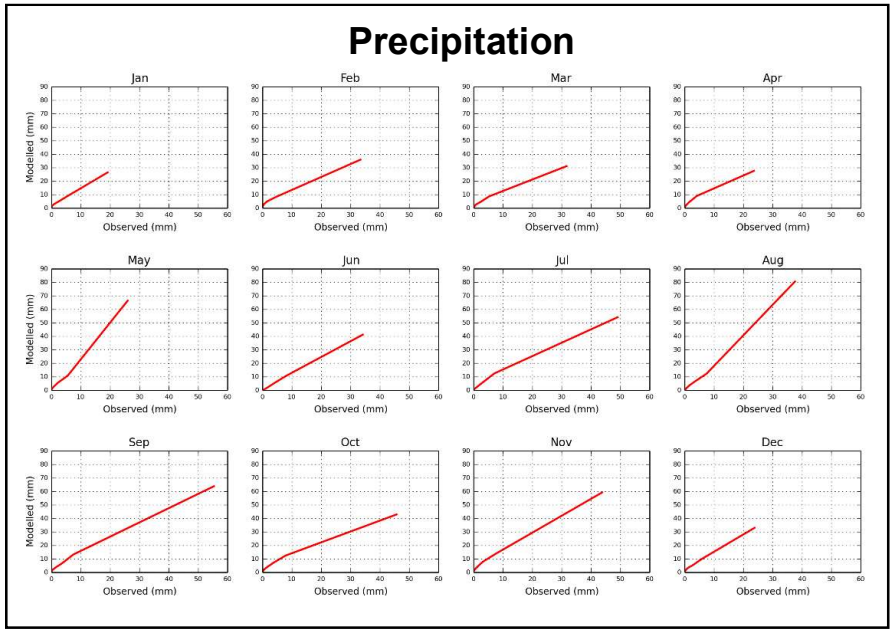
Future climate projections

- EURO-CORDEX
- RCP 4.5 & RCP 8.5
- 2071-2100 vs 1971-2000

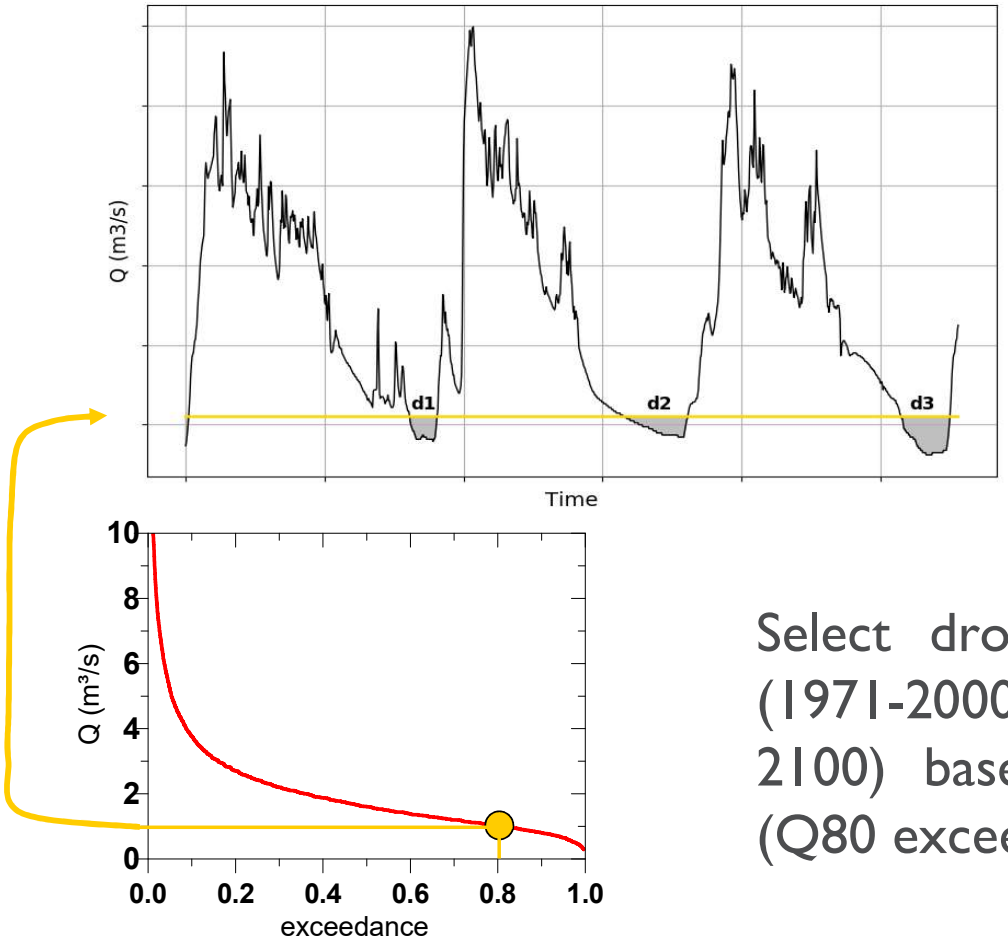


Bias-adjustment – empirical quantile mapping (EQM)

- 1 x 1 km grid cell, nearest neighbour method
- Monthly transfer function
- Stationarity
- Wet-day correction



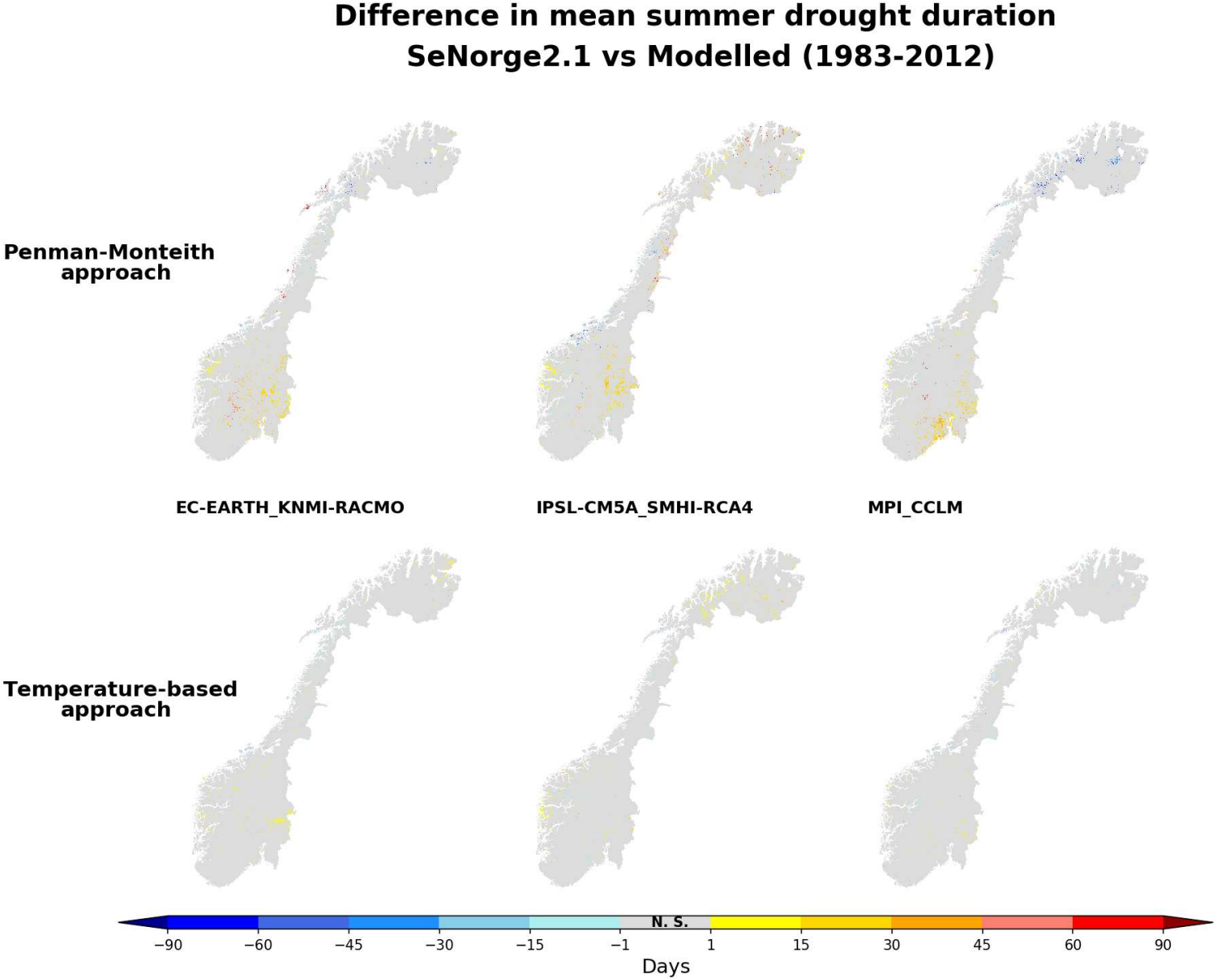
Drought definition - threshold level method

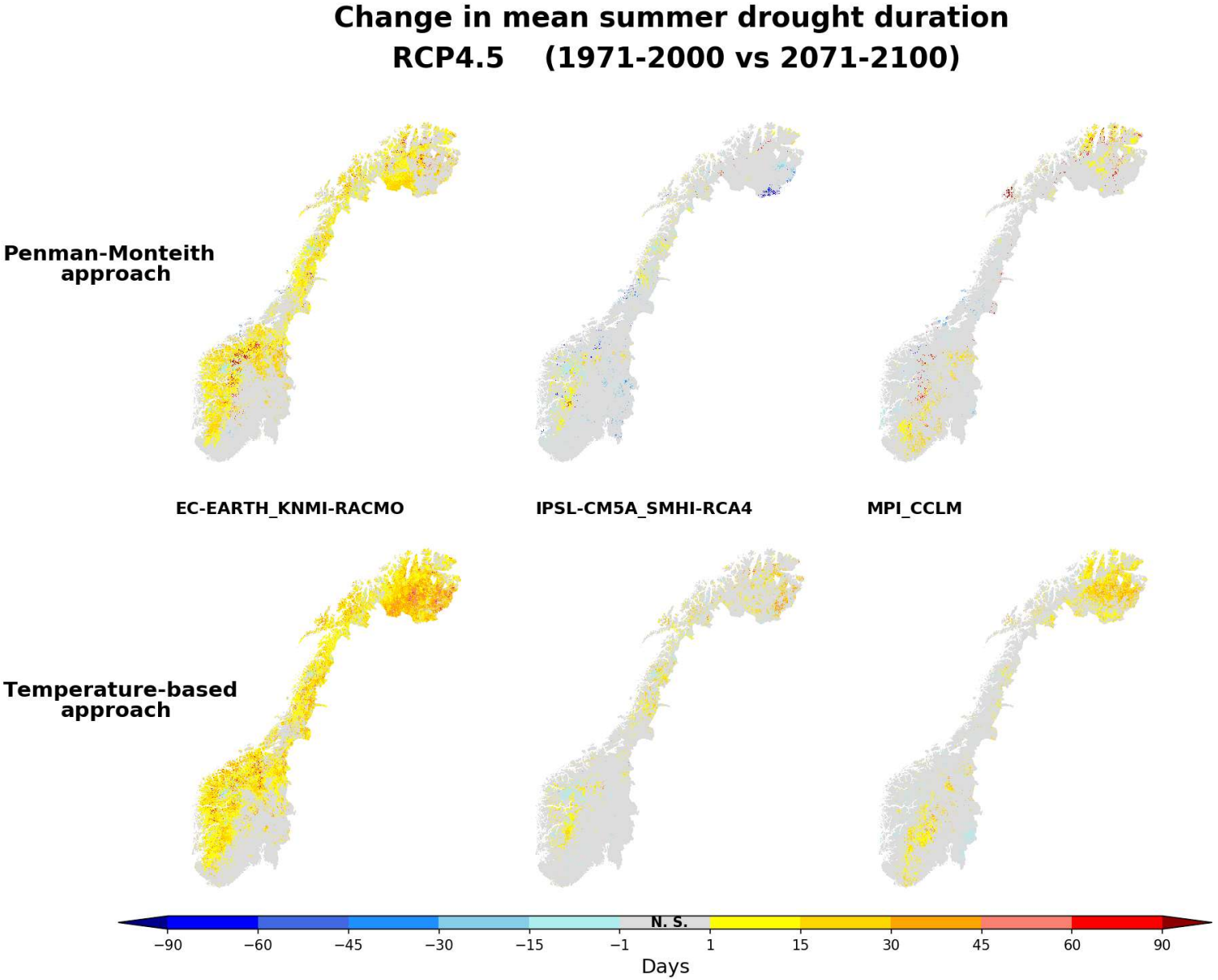


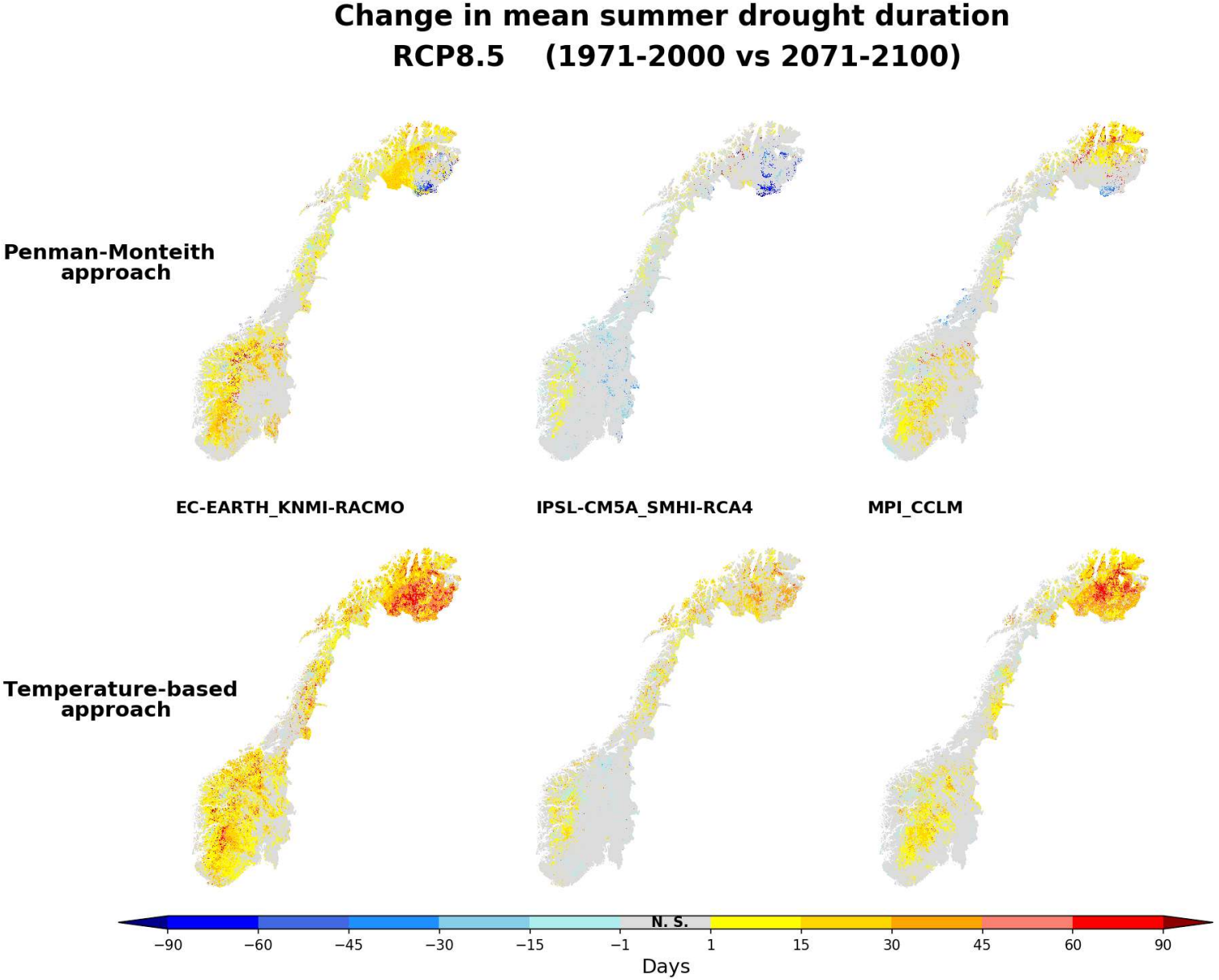
Select drought events for both present (1971-2000) and future climates (2071-2100) based on threshold level method (Q80 exceedance frequency)

Drought event

- Drought selection on grid cell basis
- MA(7) applied prior to analyses
- Focus only on summer season
- No multiyear drought


Difference in mean summer drought duration
SeNorge2.1 vs Modelled (1983-2012)
Penman-Monteith approach
Temperature-based approach
EC-EARTH_KNMI-RACMO
IPSL-CM5A_SMHI-RCA4
MPI_CCLM
N. S.
−90
−60
−45
−30
−15
−1
1
15
30
45
60
90
Days


Change in mean summer drought duration
RCP4.5 (1971-2000 vs 2071-2100)
Penman-Monteith approach
Temperature-based approach
EC-EARTH_KNMI-RACMO
IPSL-CM5A_SMHI-RCA4
MPI_CCLM
N. S.
−90
−60
−45
−30
−15
−1
1
15
30
45
60
90
Days


Change in mean summer drought duration
RCP8.5 (1971-2000 vs 2071-2100)
Penman-Monteith approach
Temperature-based approach
EC-EARTH_KNMI-RACMO
IPSL-CM5A_SMHI-RCA4
MPI_CCLM
N. S.
−90
−60
−45
−30
−15
−1
1
15
30
45
60
90
Days


Thank you for your attention!
Photo: NVE/Arne T. Hamarsland