

# Analysis of convection-permitting COSMO-CLM simulations for Germany

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## Background

- National Project „Network of Experts – **Adapting transport and infrastructure to climate change and extreme weather events**“

→ focus Germany, transport sector

- Key **parameters**: temperature, precipitation, wind
- plus **extremes** on **small scales**:  
heavy precipitation, wind gusts

→ high-resolution climate information needed

- Large climate model ensemble available on 0.11° (CORDEX)
- Study exemplarily downscaling of one realization for the **added value on convection-permitting scales**



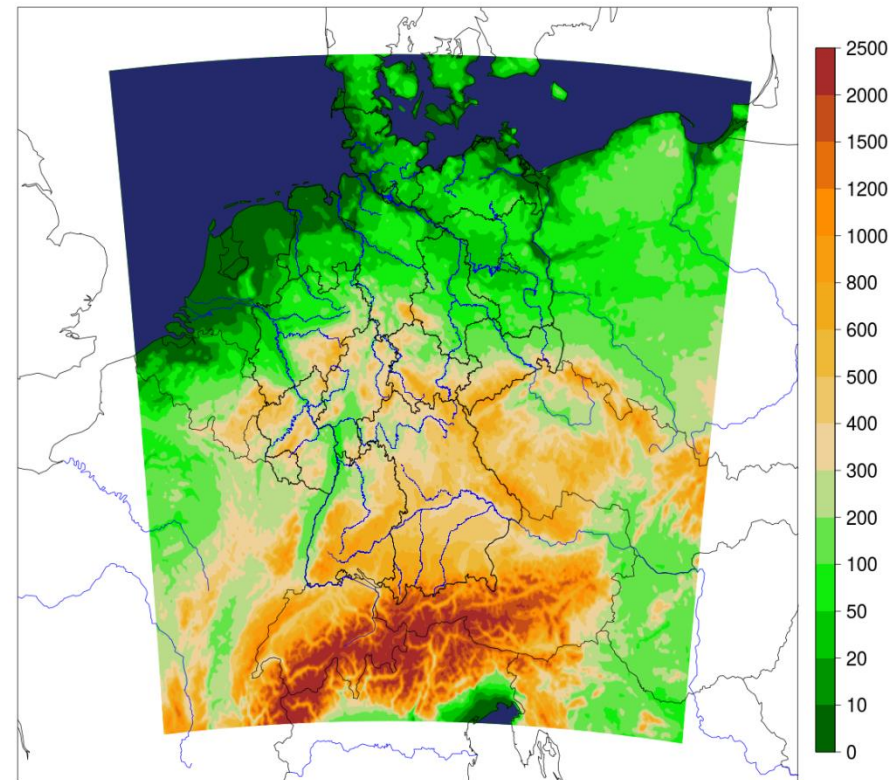
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## COSMO-CLM simulation characteristics

- **Version:** COSMO4.8\_clm18, INT2LM1.19
- **Grid:** 0.025° (~2.8km; 461x481 points)  
50 levels
- **Domain:** Germany with parts of surrounding river catchments
- **Time step:** 15s
- **Physics:** only shallow convection, no SSO, tur\_len=150, q\_crit=1.6, hinc\_rad=0.25
- **Nested** in 0.11° COSMO-CLM
- **Time period:** 1971-2100
- **Scenario:** RCP8.5



## List of simulations

- **Nesting data:** COSMO-CLM simulations at 0.11° from CORDEX / ReKliEs-De
- **Hourly output** of temperature, humidity, wind, precipitation

Acronym	Time Period	Type	Grid spacing	Forcing Data
EVAL	1971 – 2000	Evaluation	0.025°	ERA40 / ERA-Interim
EVAL12	1971 – 2000	Evaluation	0.11°	ERA40 / ERA-Interim
HIST	1971 – 2000	Historical	0.025°	MIROC5
SCENnf	2031 – 2060	RCP 8.5	0.025°	MIROC5
SCENff	2071 – 2100	RCP 8.5	0.025°	MIROC5

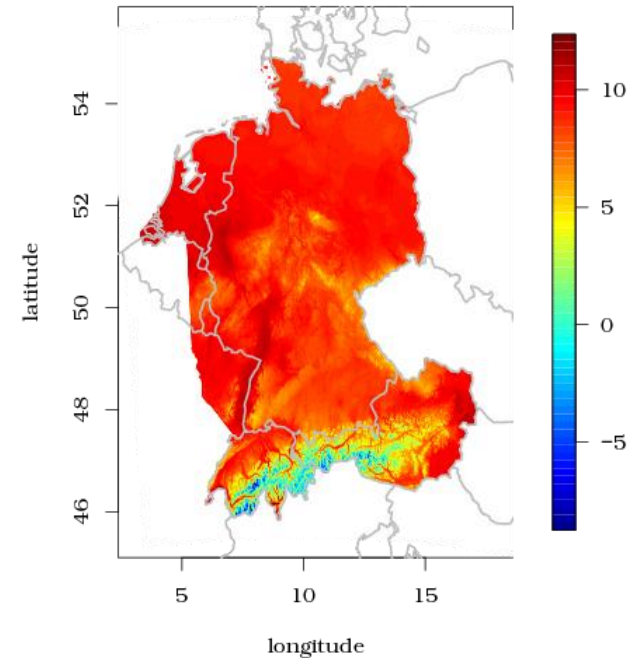
## Observational data

### HYRAS:

- Interpolated station observations
- Time period: 1951 – 2015, daily
- Domain: Germany (+), 1x1 (5x5) km grid
- Variables: tas (v3.0), pr (v2.1)

### RADKLIM:

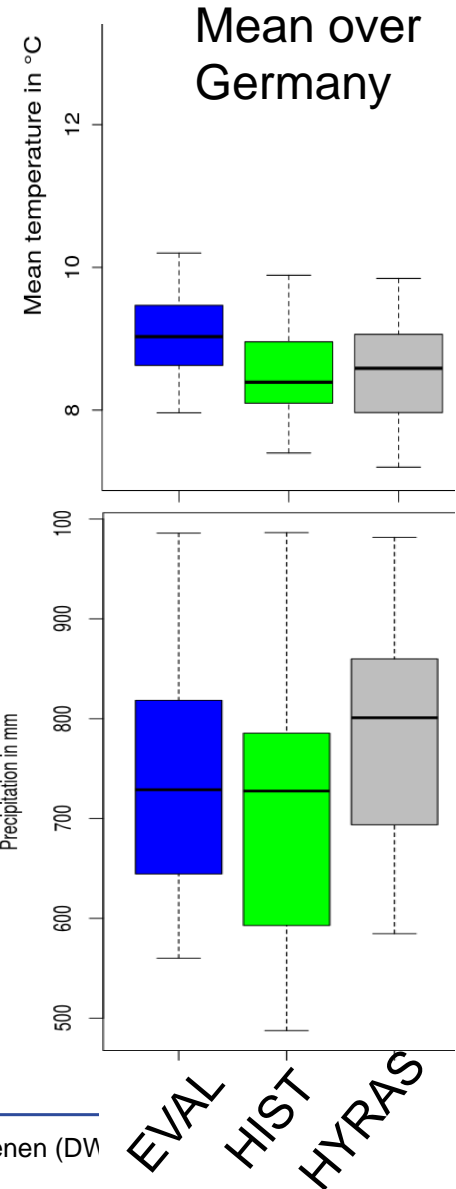
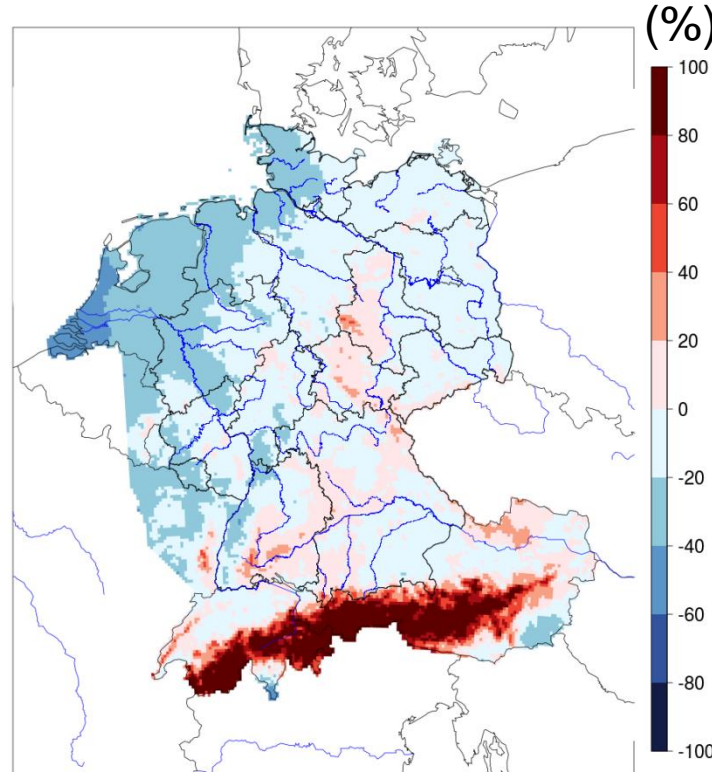
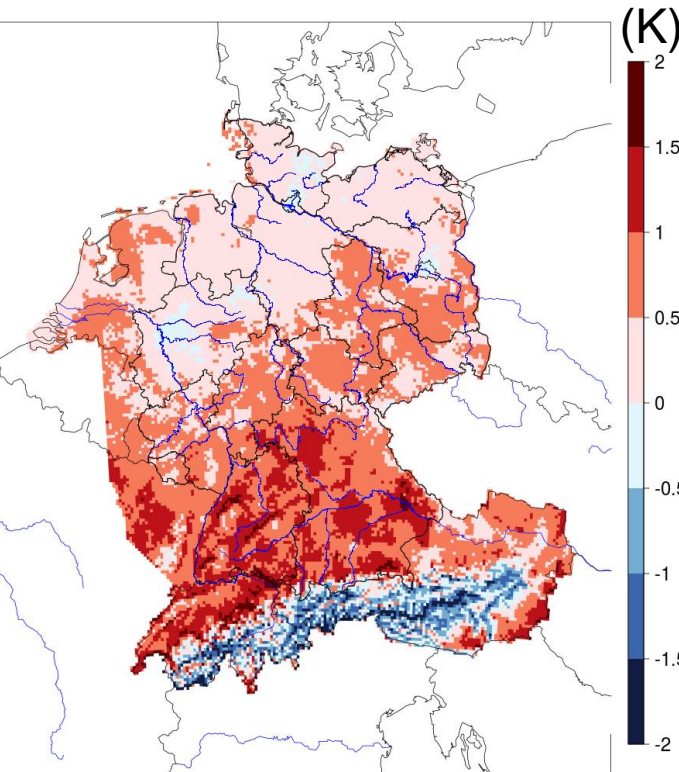
- Radar observations corrected with station observations
- Time period: 2001 – 2017, 1 hour / 5 min
- Domain: Germany, 1x1 km
- Variables: precipitation (v2017.002)



# Evaluation: EVAL – HYRAS, annual mean

Mean annual temperature

Mean annual precipitation

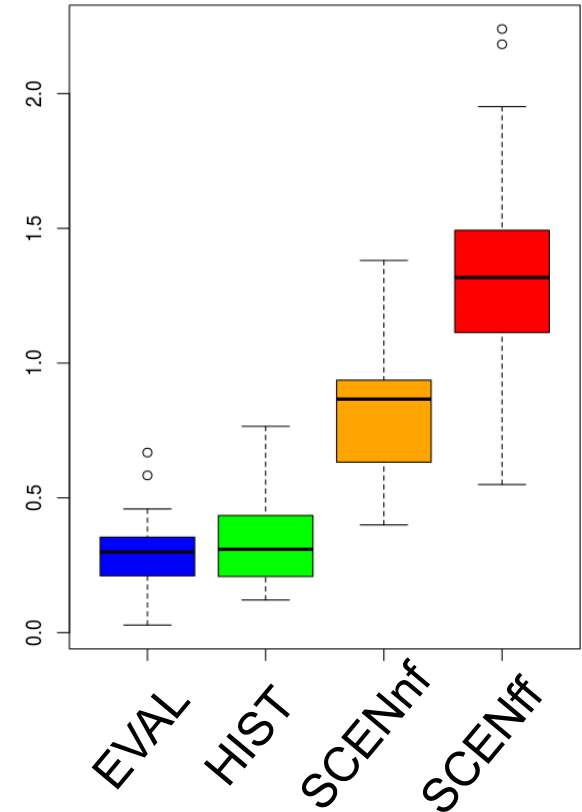
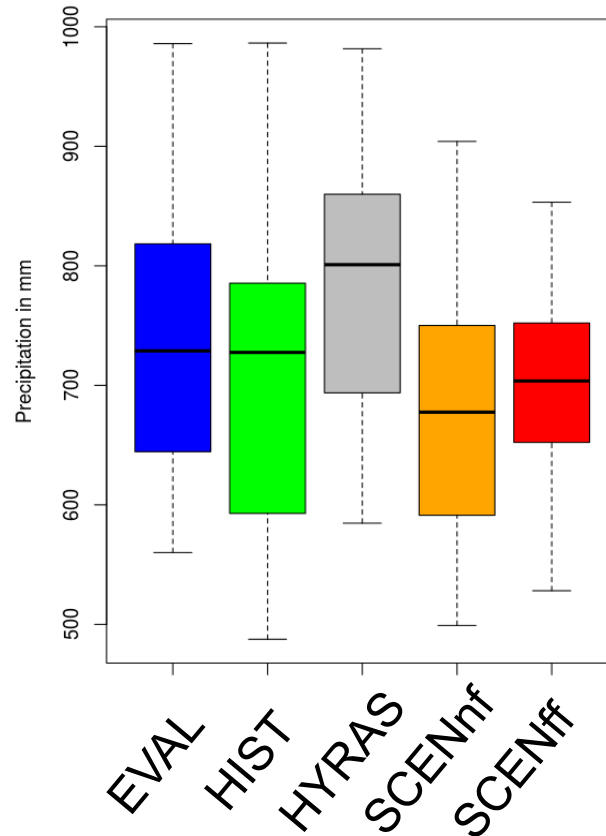
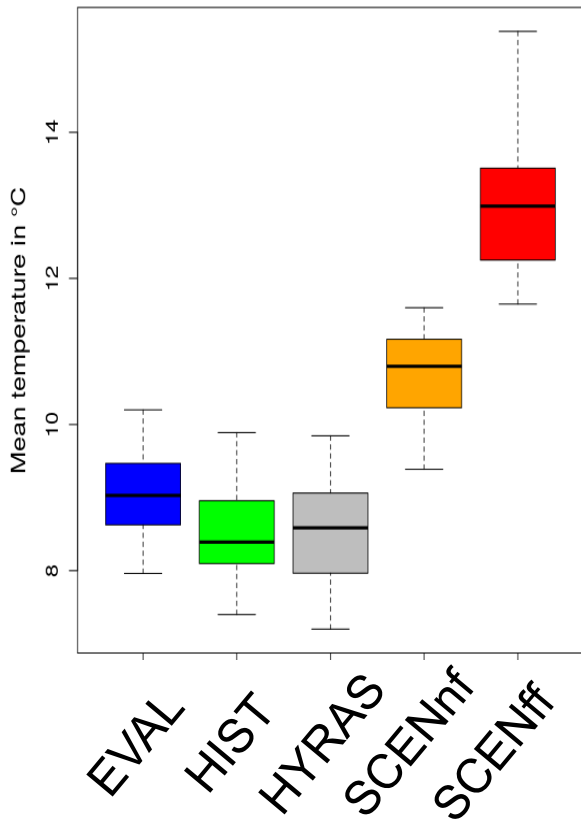


# Climate change: indices for Germany

Mean annual temperature :

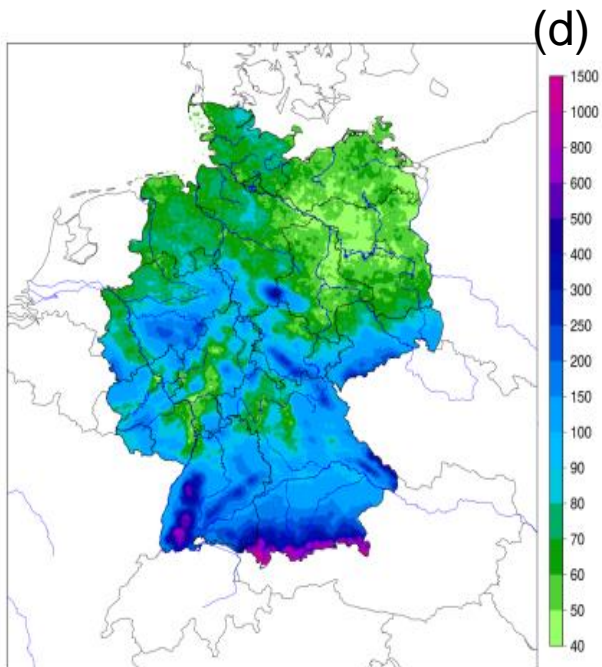
Mean annual precipitation

Number of heat days

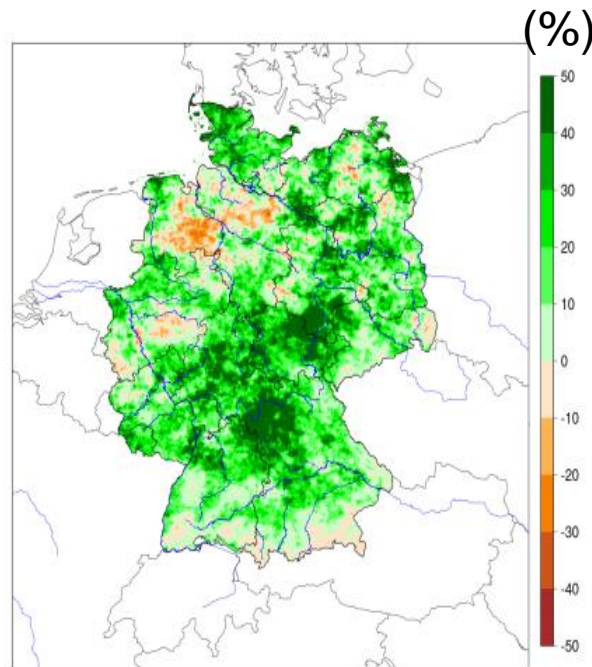


# Extreme precipitation: $pr > 20\text{mm}$

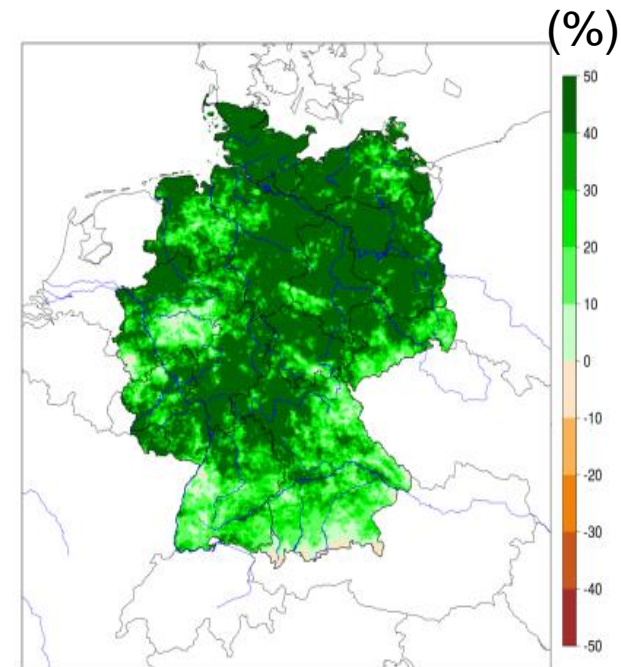
HIST



SCENnf - HIST

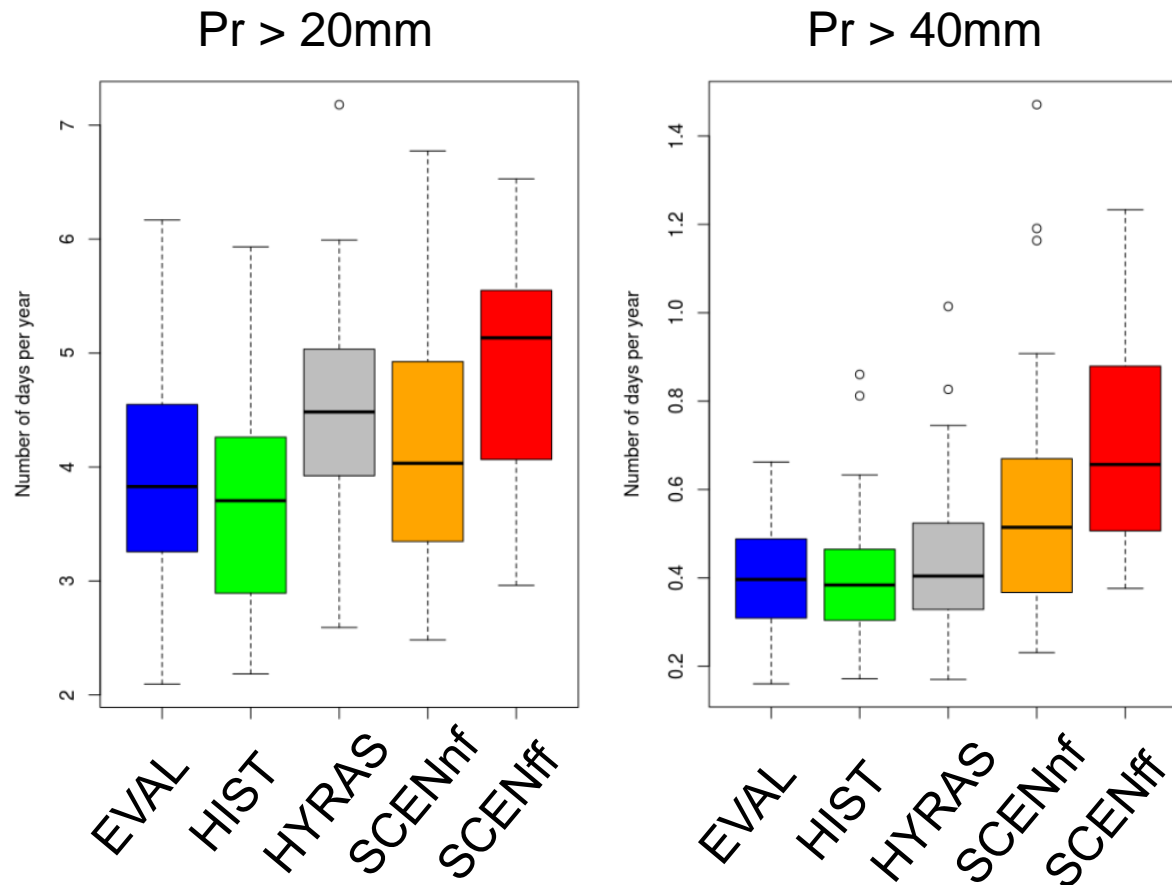


SCENff - HIST

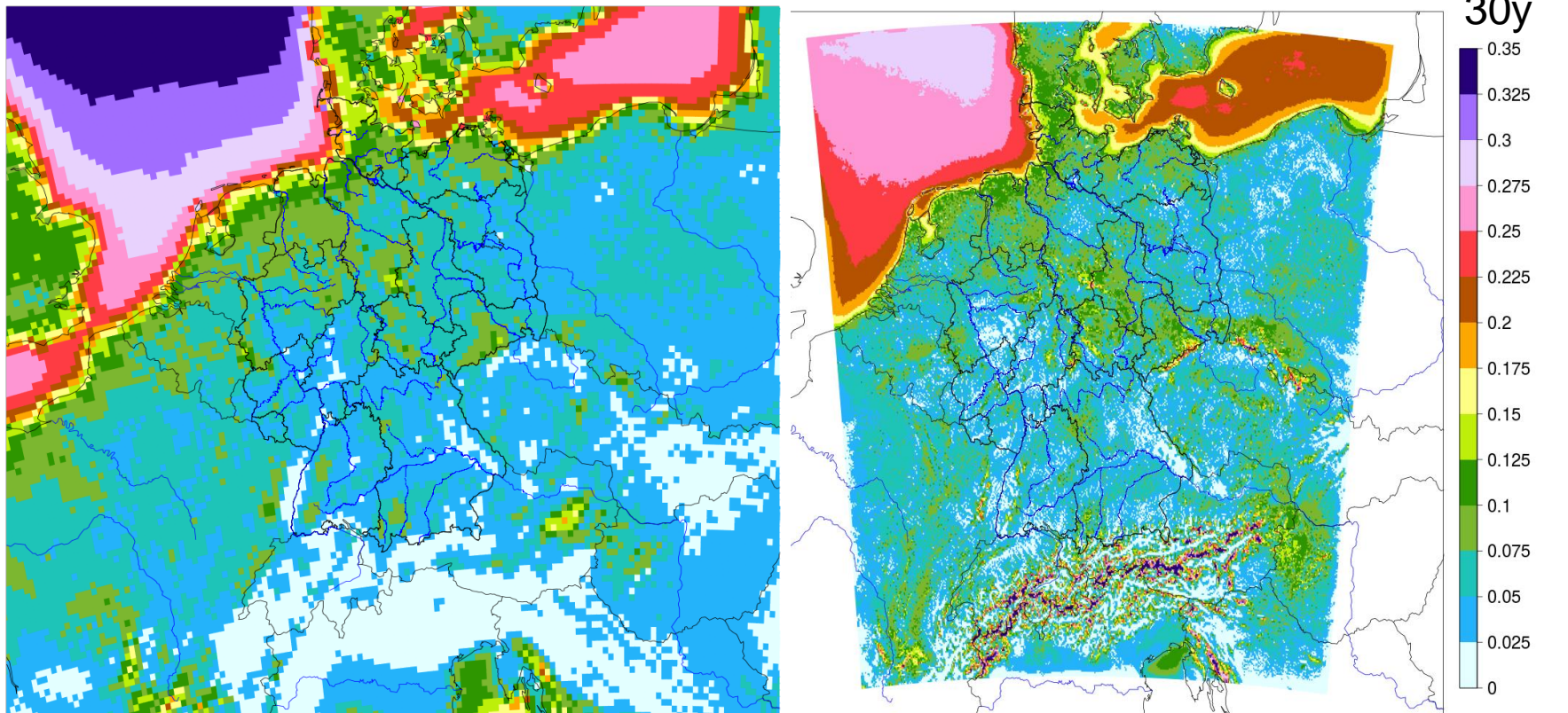




# Extreme precipitation change (Average Germany)

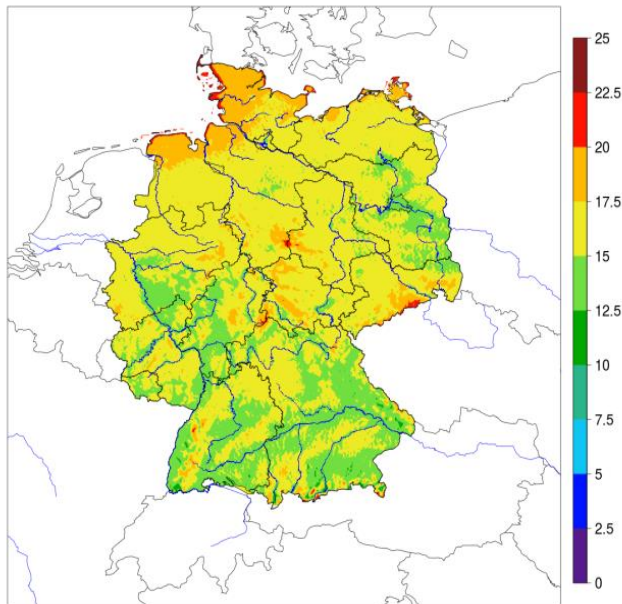


# Comparison 12 to 2.8 km (evaluation runs) Mean exceedance frequency for wind speed > 8Bft

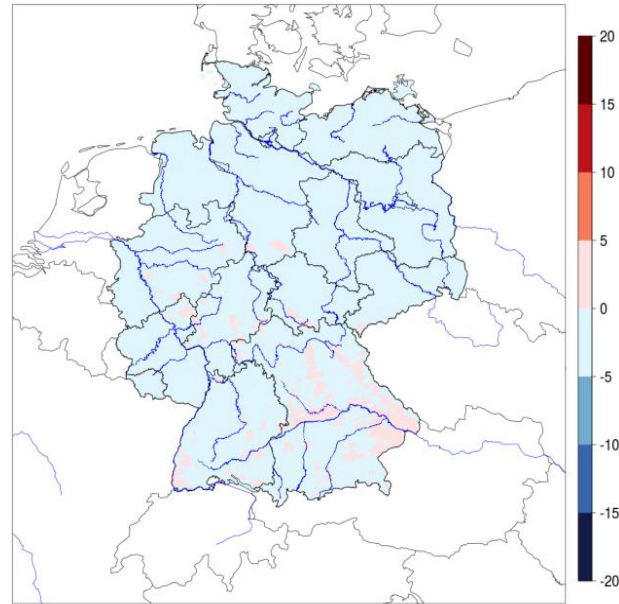


# Climate change: wind gusts (98th percentile)

HIST

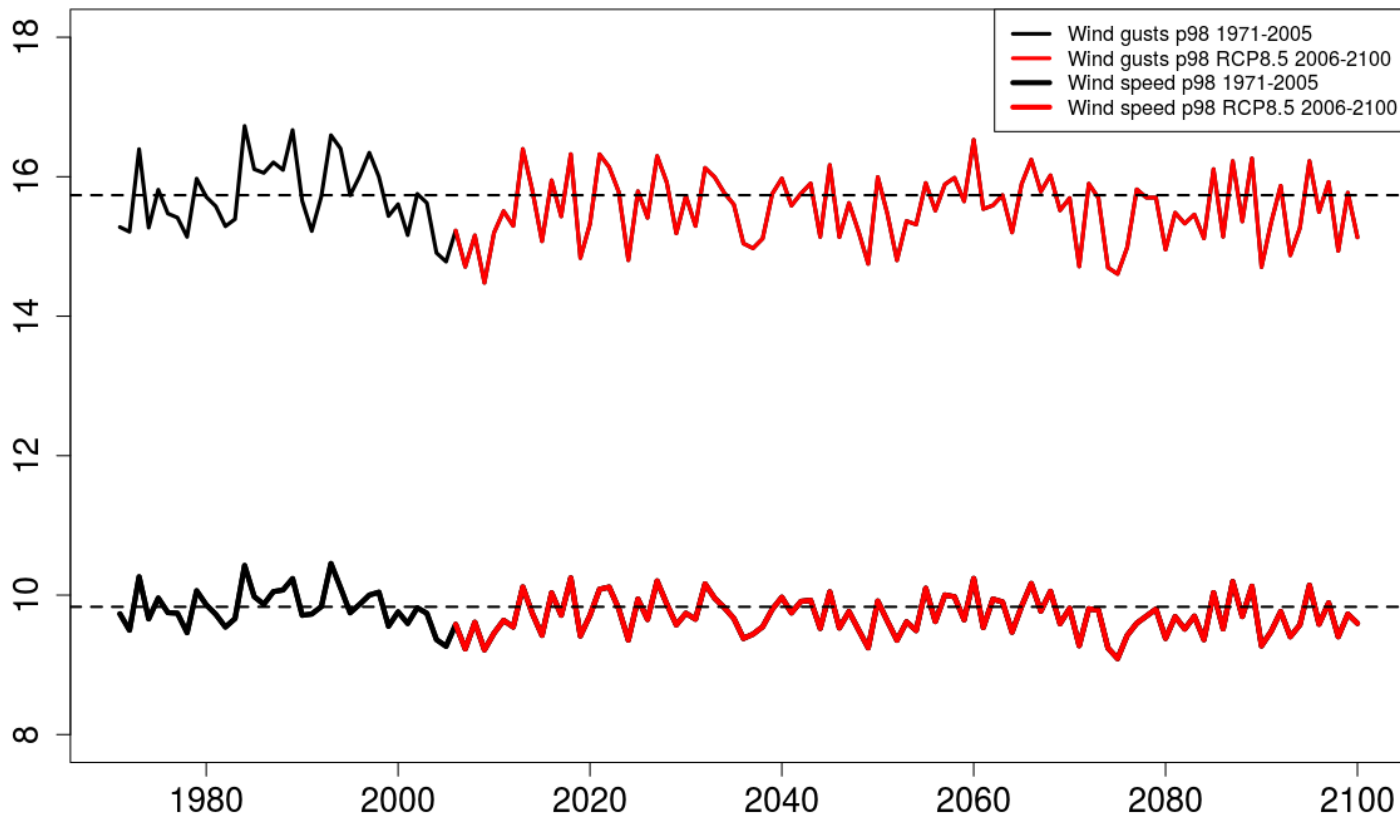
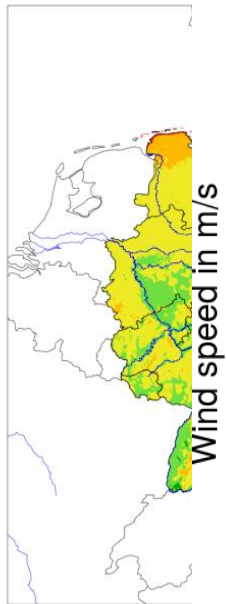


SCENnf - HIST



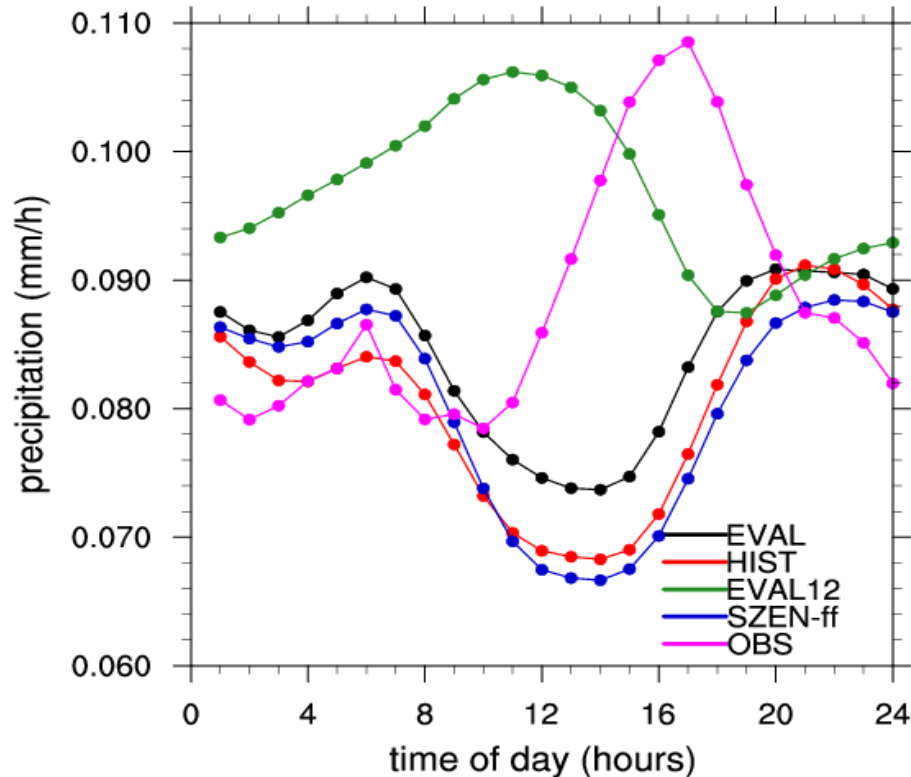
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ST

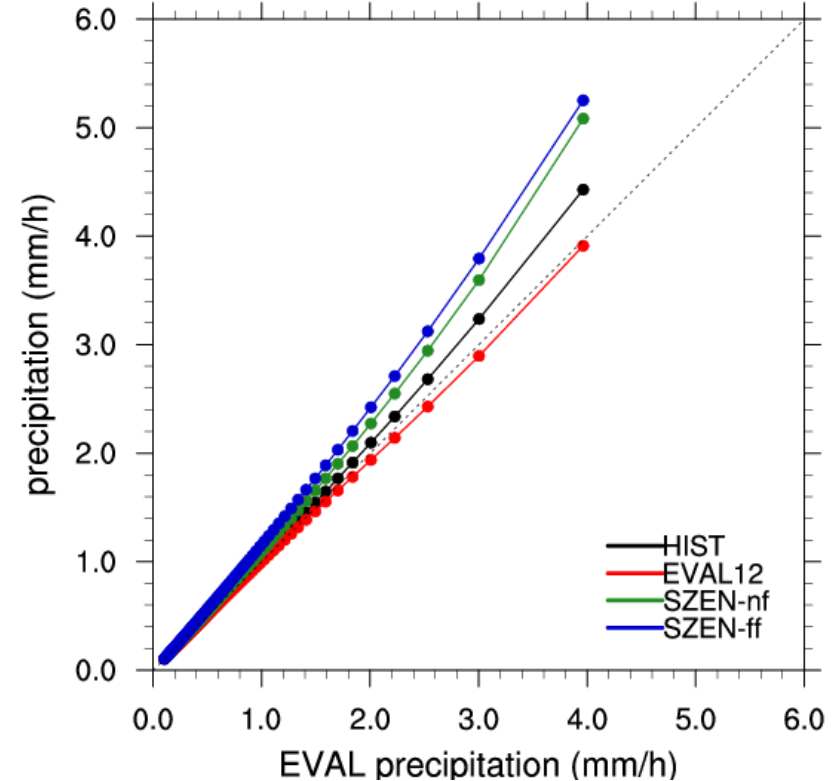


# First impression of hourly statistics

Diurnal cycle  
OBS: RADKLIM 2001



Quantile-quantile plot  
Reference: EVAL (2.8km)



## Outlook

- Look more into the hourly statistics of precipitation and wind
- New simulation for RADKLIM period with ERA-Interim forcing
- Investigate 5-minute precipitation statistics
- Use extreme value statistics
- Look more into wind gust parameterization and postprocessing of wind gusts