



# Seasonal Forecasts for Norway

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# Overview

- What is Climate Futures
- The Seasonal Forecasting Engine and October Forecast
- Case Study 1: Incorporating Seasonal Forecast into Hydrology
- Case Study 2: The Seasonal Power Market Model

# What is Climate Futures?

- A center for Research-based Innovation (SFI), funded by the Research Council
- Started 1 October 2020, duration 8 years
- About 40 partners, budget > 200 mill.

## *Research partners*

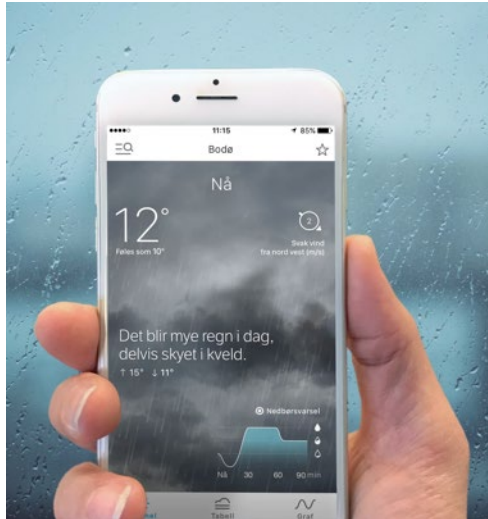


**Statistisk sentralbyrå**  
Statistics Norway



# Objective

## *Weather forecasts*



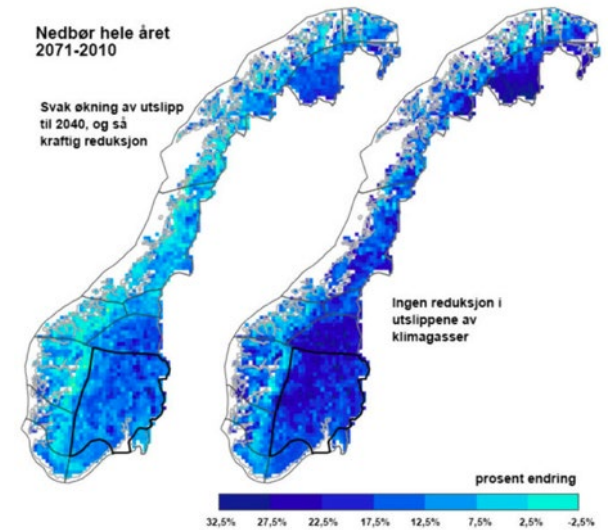
0 days

10 days

Goal: to develop new and innovative solutions for forecasting and handling climate risk from 10 days to 10 years into the future

*Forecast horizon*

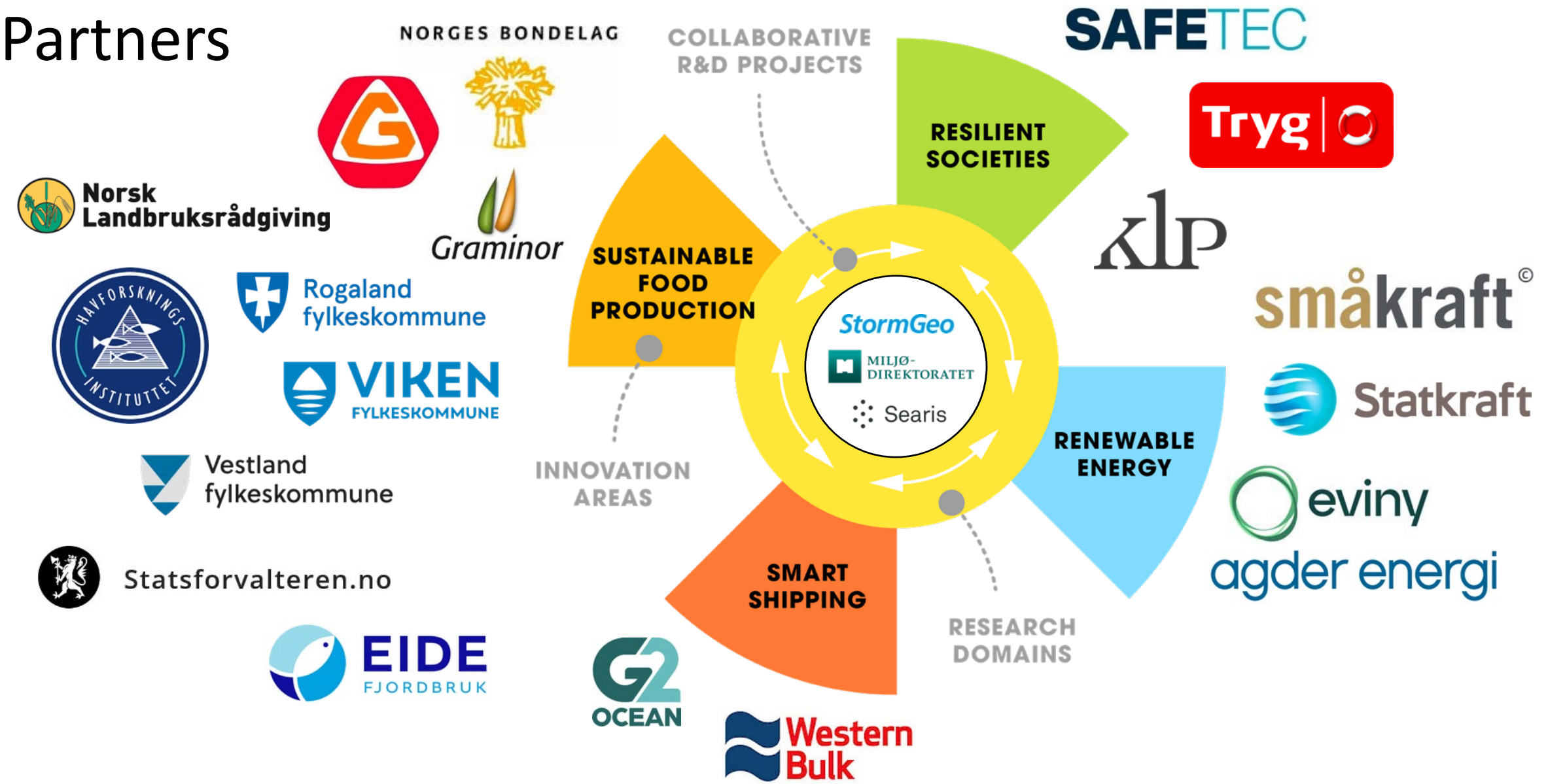
## *Climate projections*



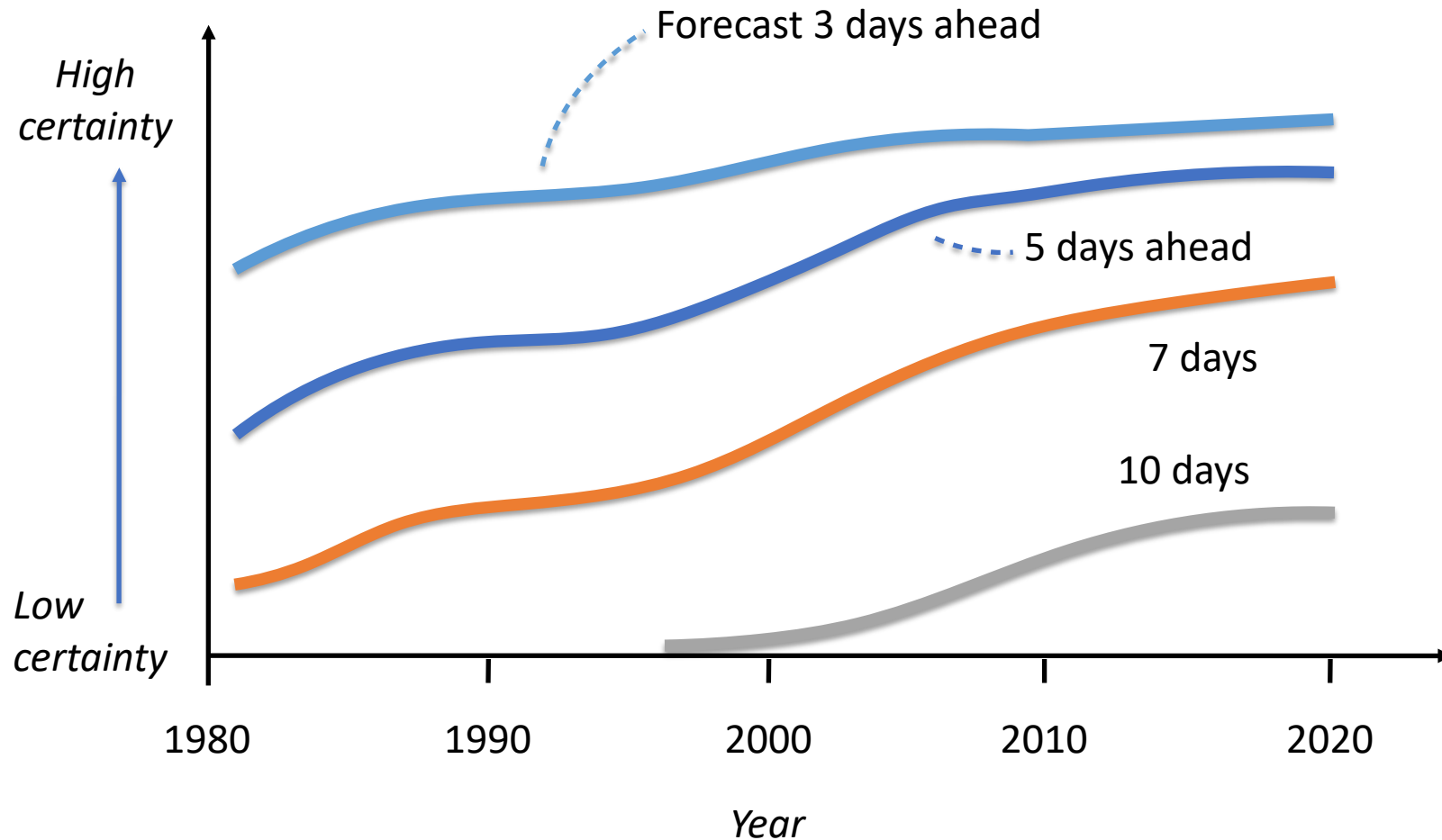
10 years

100 years

# Partners



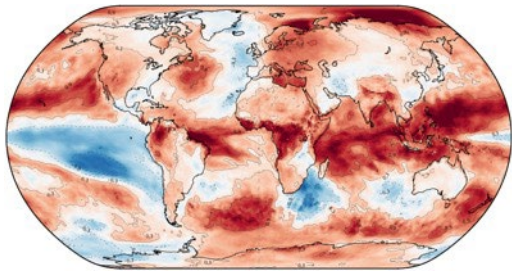
# Why Climate Futures now?



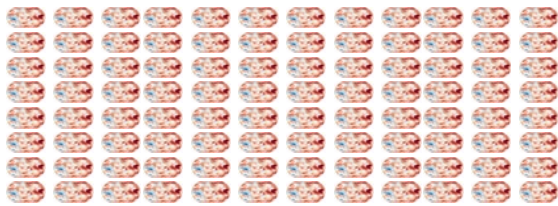
- The quality of weather forecasts up to 10 days ahead has increased during the last decades
- We use the same physical models to make forecasts for longer lead times

# Method

These are used to forecast temperature, rainfall etc.

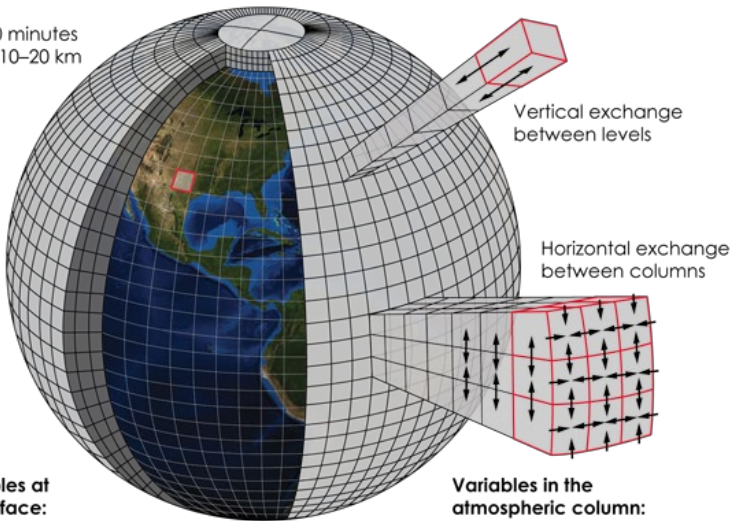


We use hundreds of forecasts



The basic building block is physical models of the climate system

Time step 5–10 minutes  
Grid spacing 10–20 km



Variables at the surface:  
Temperature  
Humidity  
Pressure  
Moisture fluxes  
Heat fluxes  
Radiation fluxes

Variables in the atmospheric column:  
Wind vectors  
Humidity  
Clouds  
Temperature  
Height  
Precipitation  
Aerosols

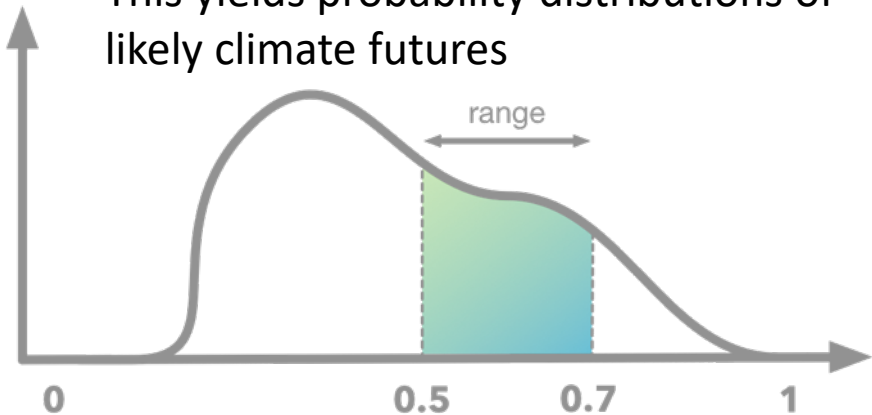
And combine these with historical observations



+

This yields probability distributions of likely climate futures

=



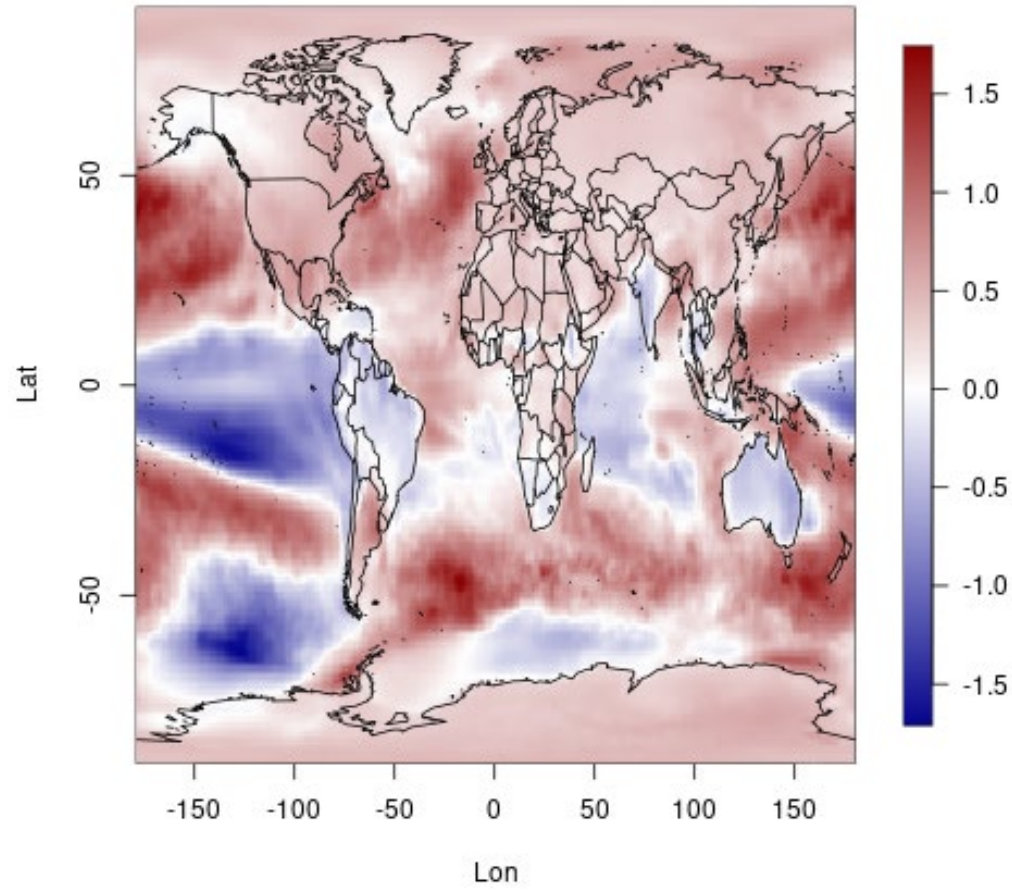


# The Seasonal Forecasting Engine (SFE)

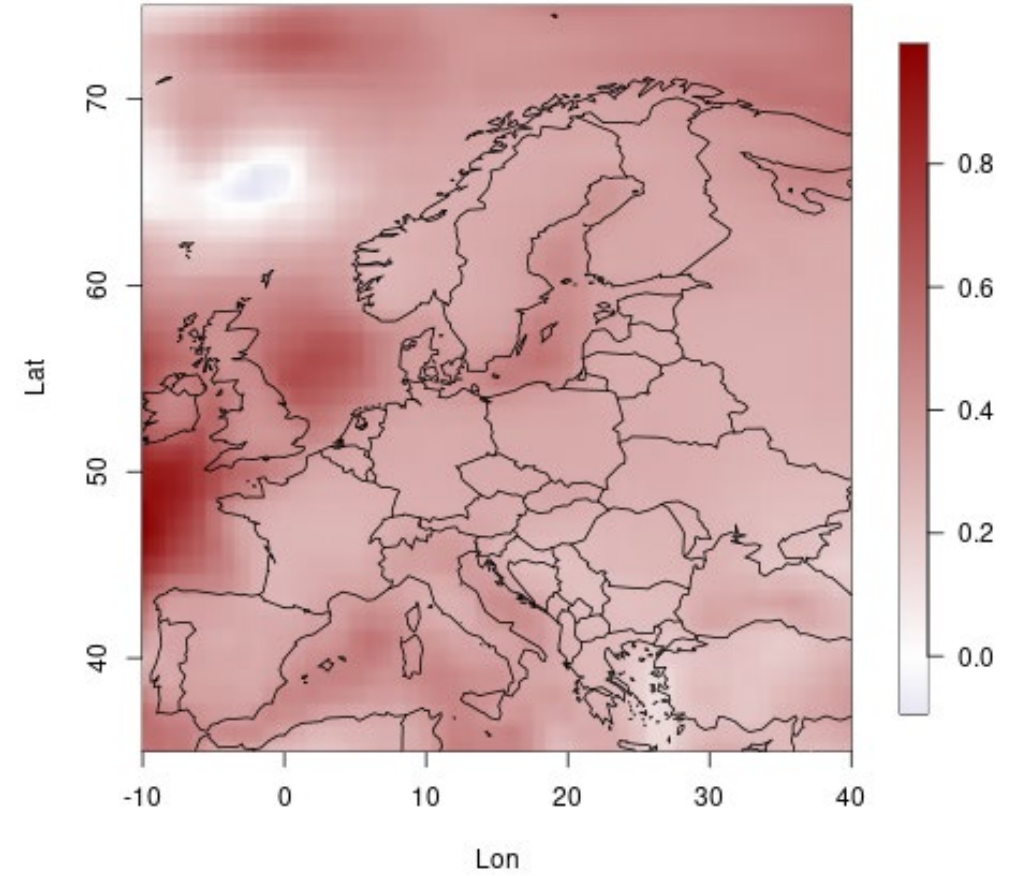
- Part of CF is to develop a core technology which combines and blends sub-seasonal, seasonal and decadal forecasts into a single ensemble forecasting system
- Goal is to update these forecasts daily based on newly issued forecasts and observations
- Global ambition, large set of target variables
- Currently at monthly issued, 400 member ensemble of seasonal forecasts going 6 months into the future



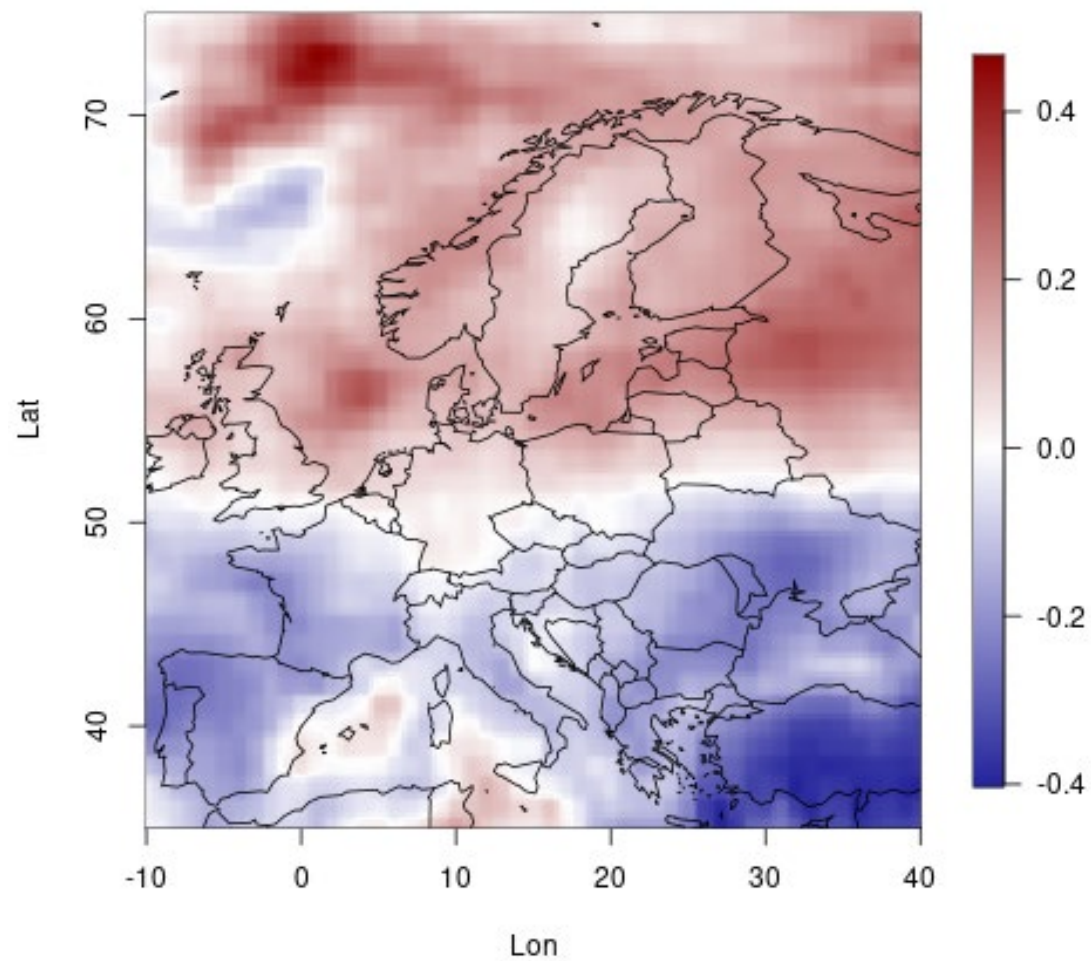
NDJ Temperature



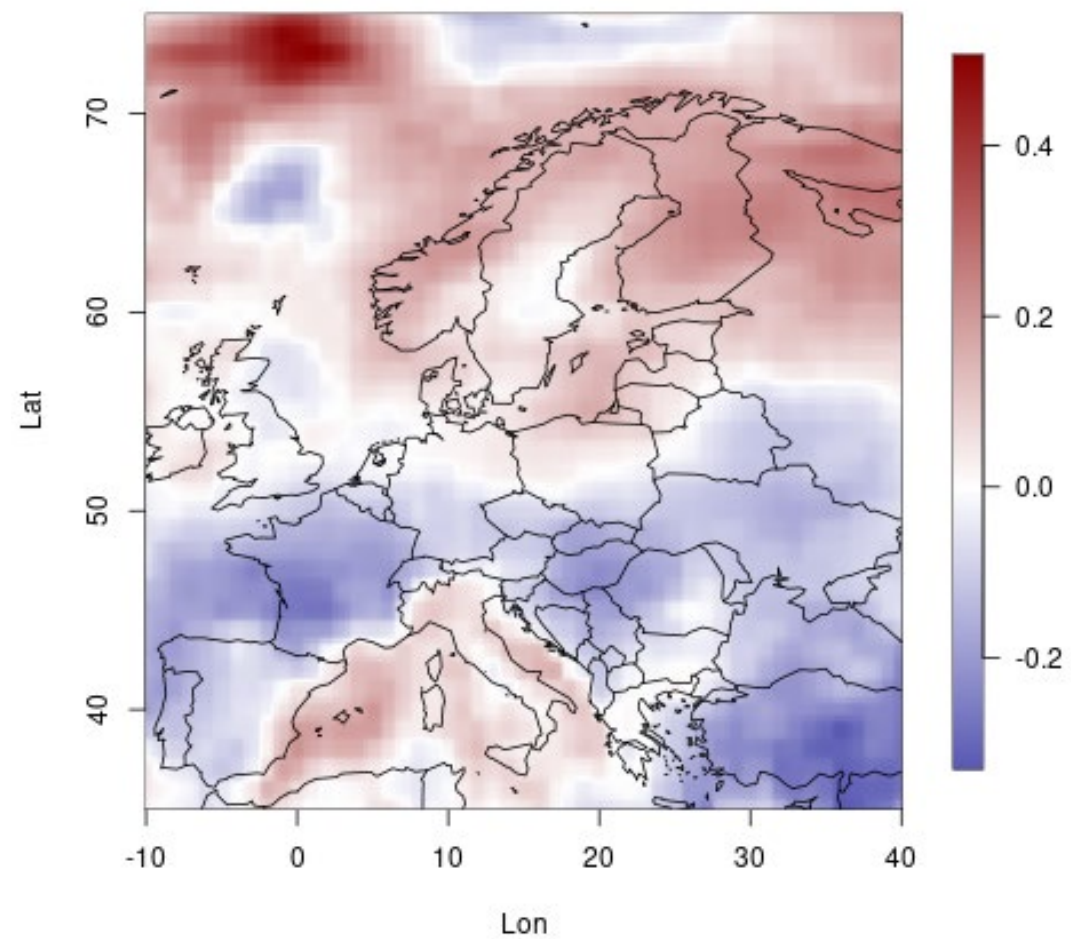
NDJ Temperature



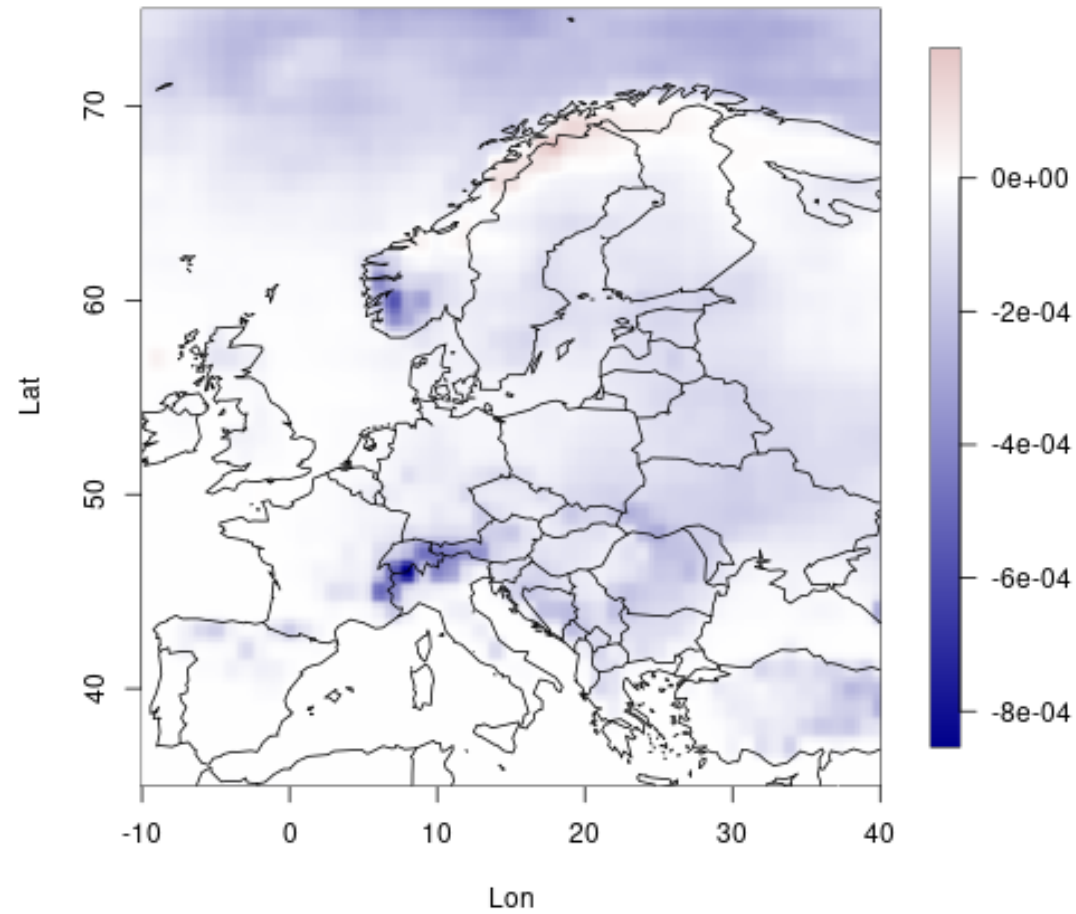
**Nov Precipitation**



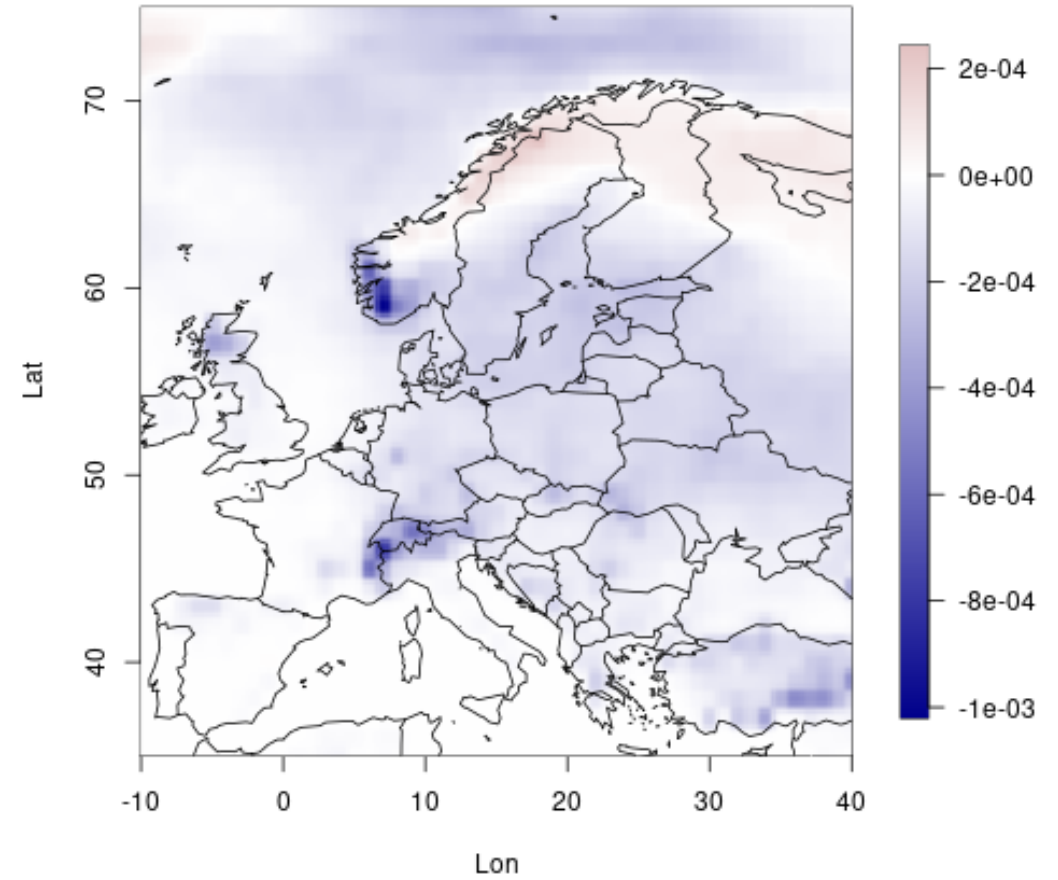
**Dec Precipitation**



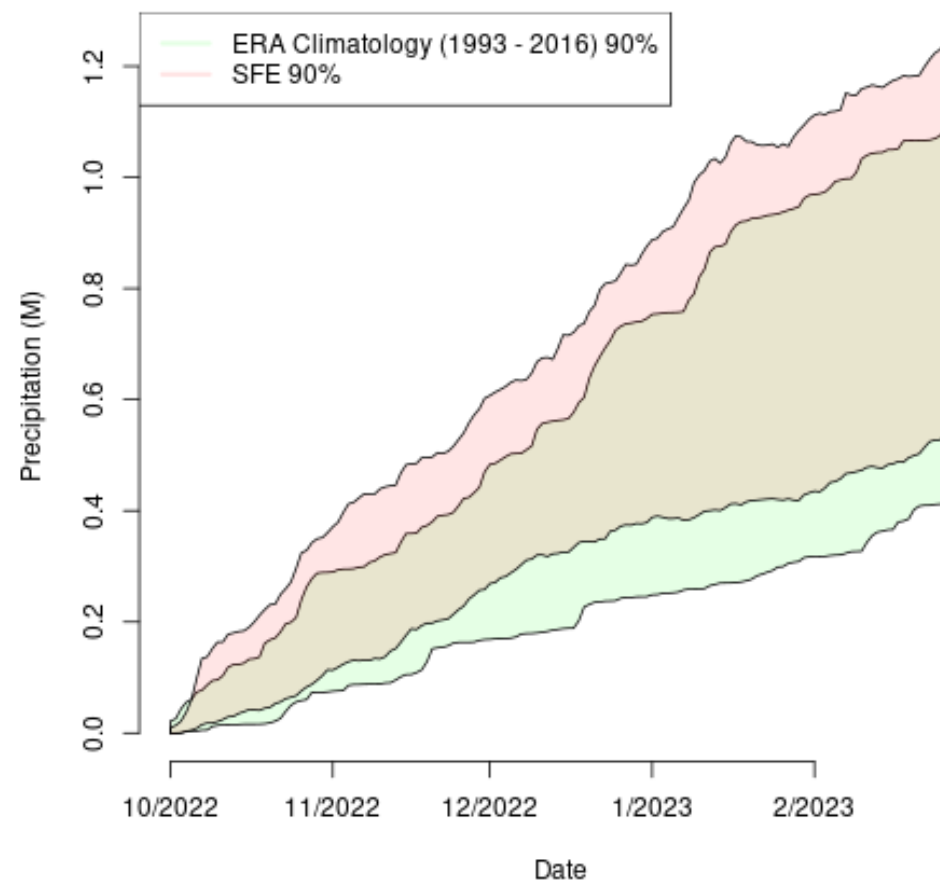
**Nov Snowfall**



**Dec Snowfall**



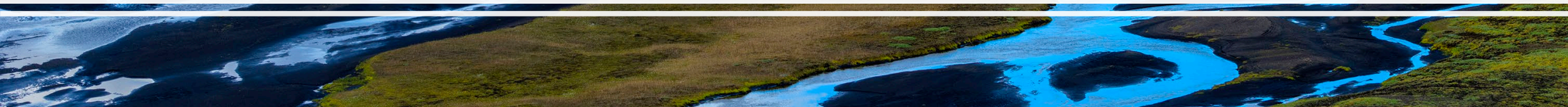
### Vossevangen Accumulated Precipitation







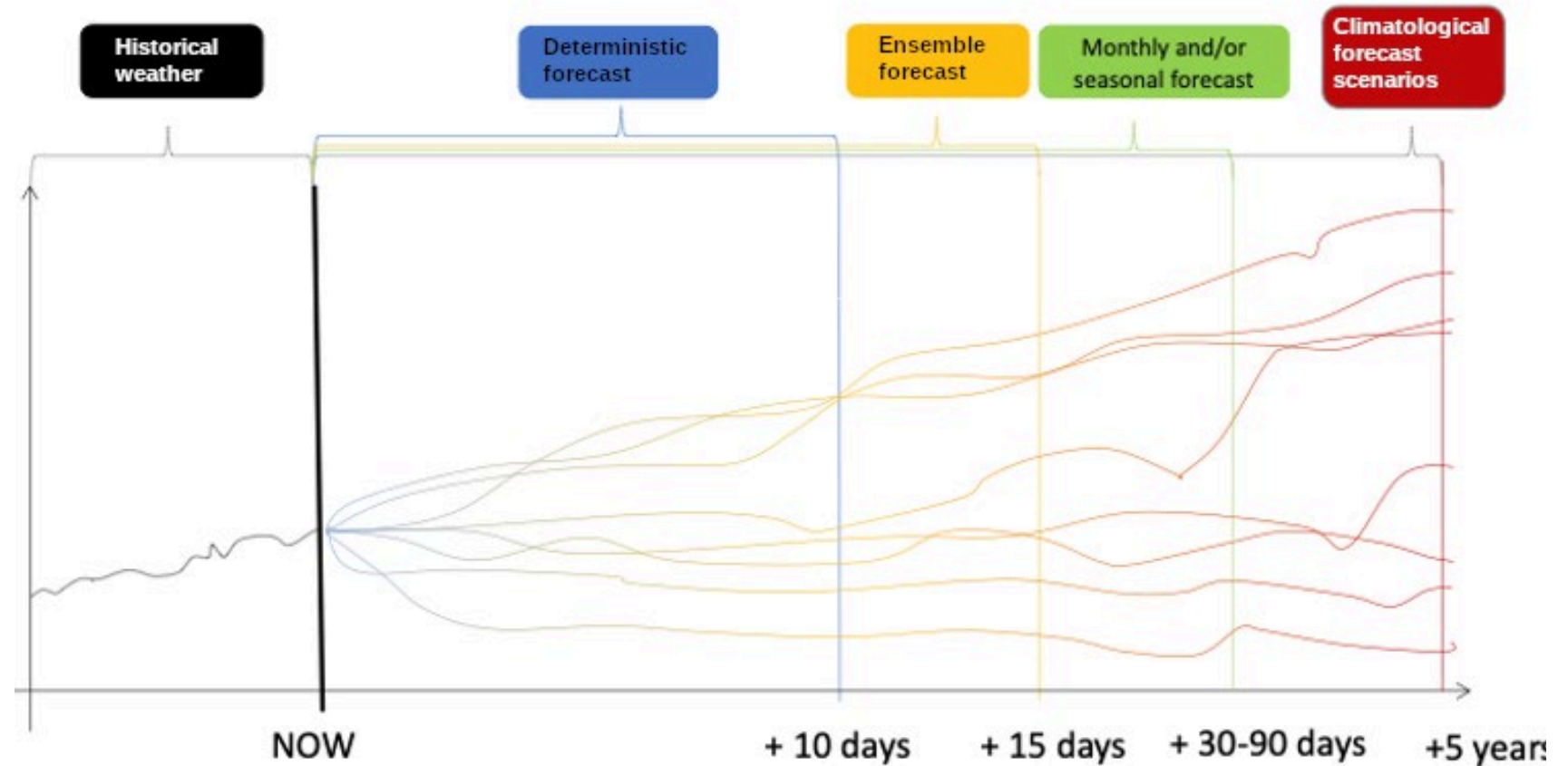
Use of (sub)seasonal weather forecasts in hydrological models



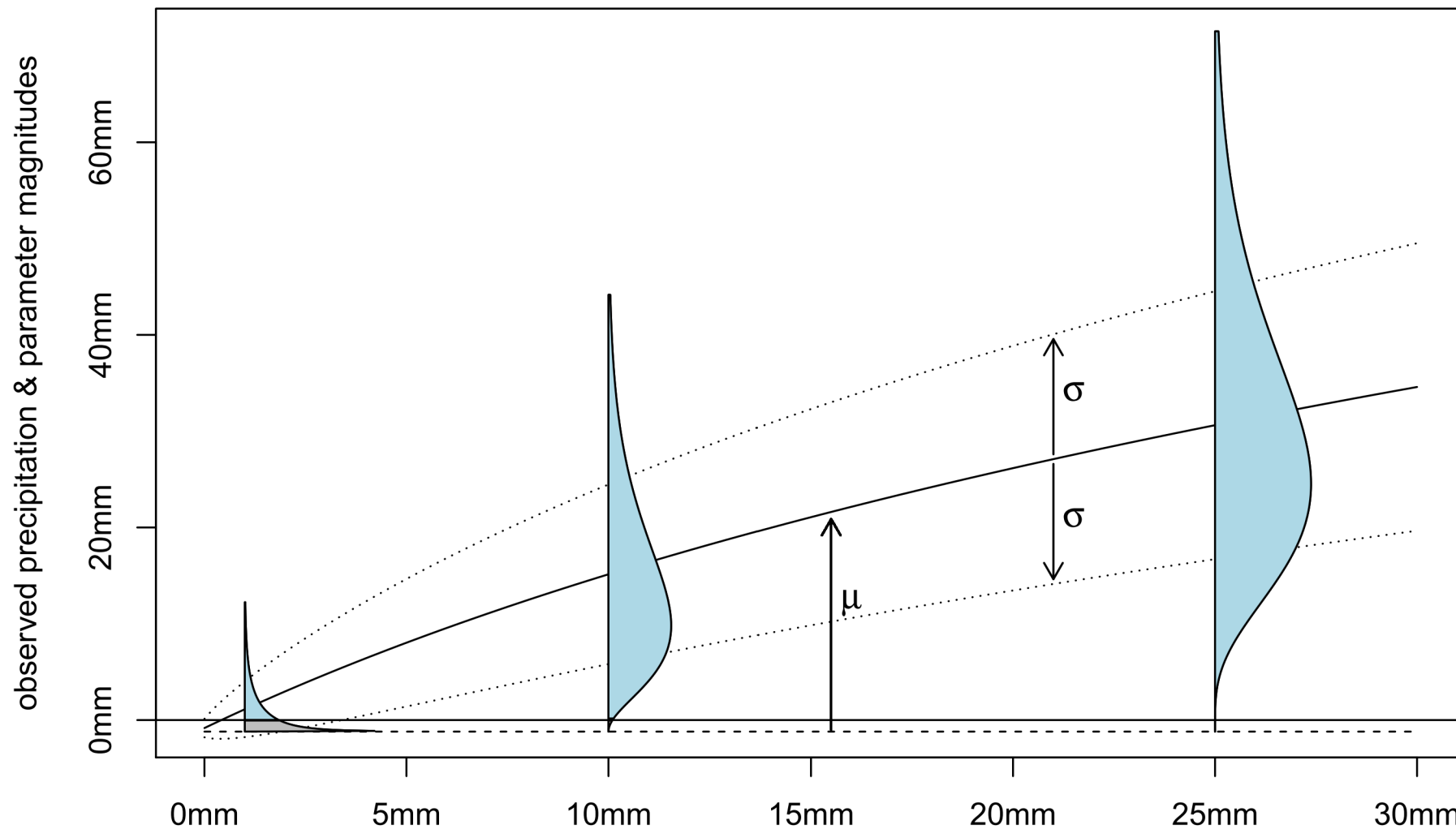


# Hydrological forecasts beyond + 15 days

If skillful weather forecasts over Norway at lead times beyond + 15 days were available, those could be used to improve hydrological predictions.

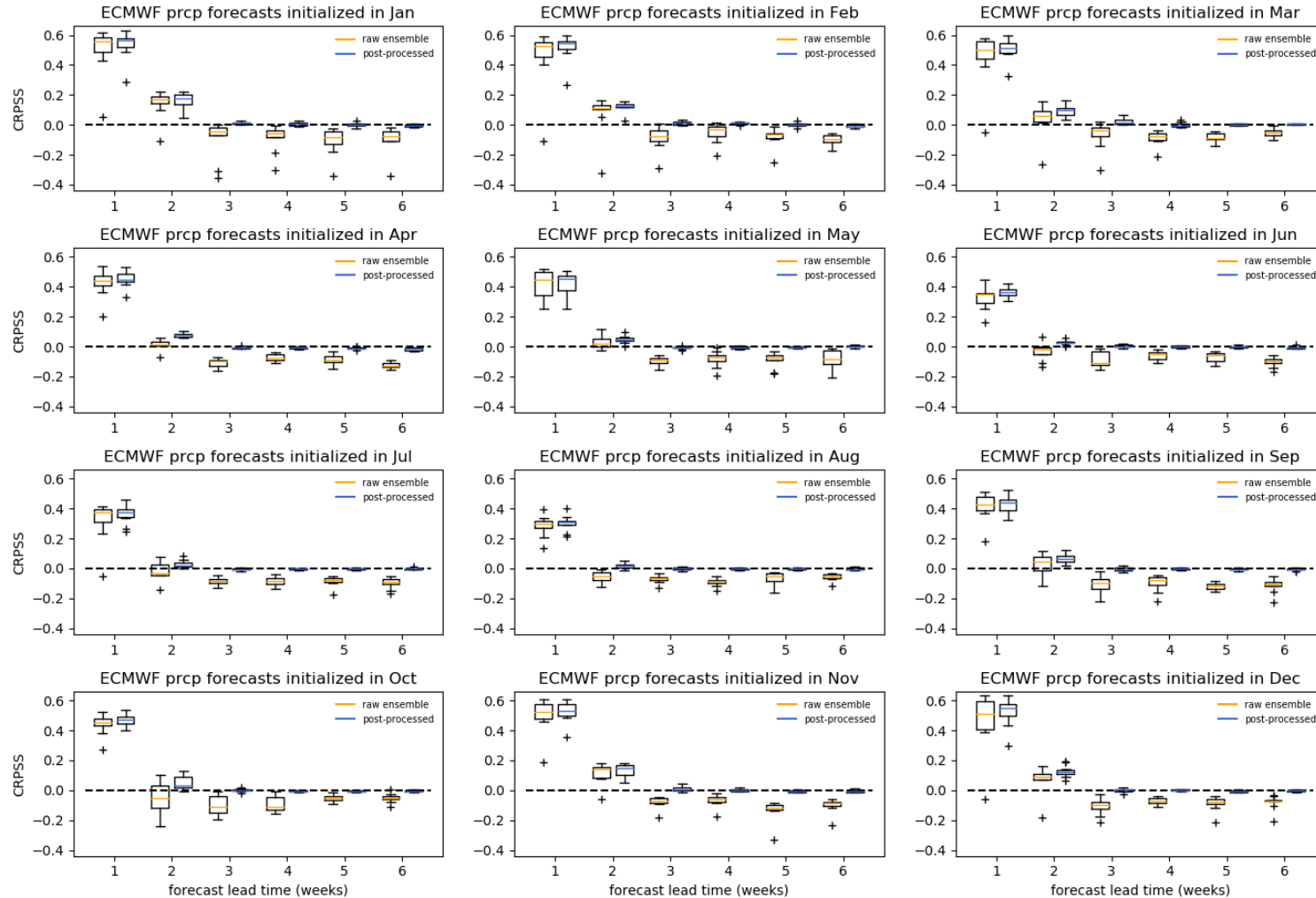


# Statistical post-processing



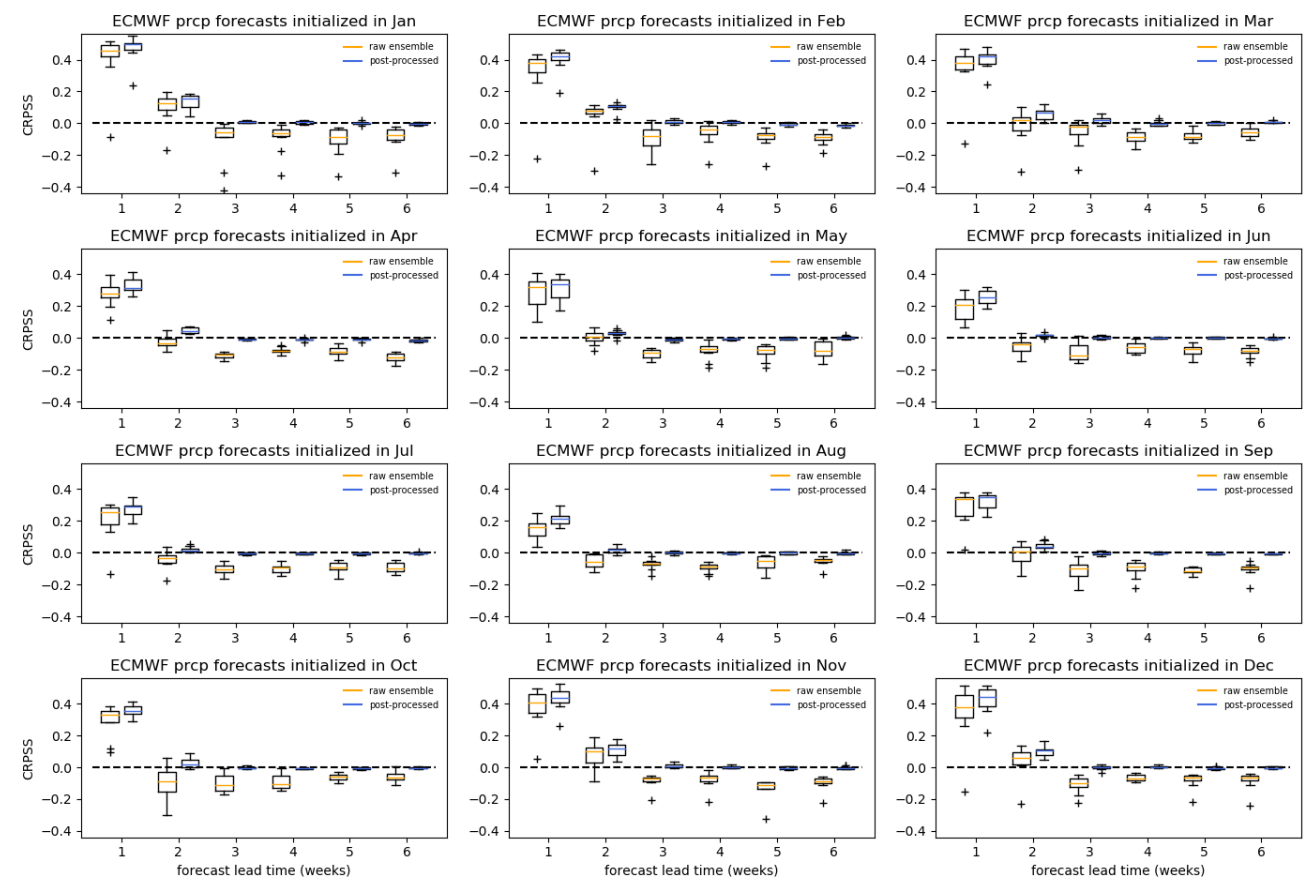
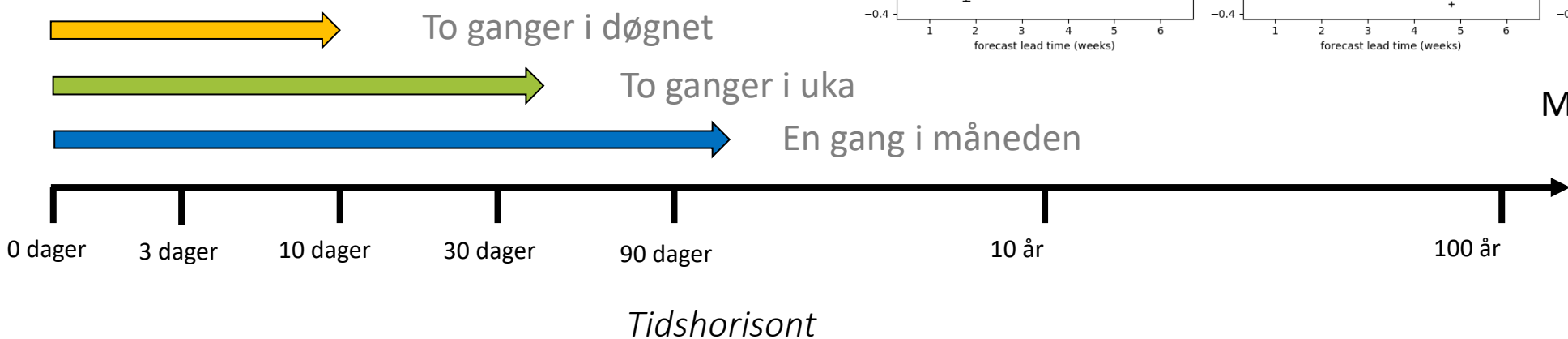


# Skill of subseasonal precipitation forecasts



- Statistical post-processing improves skill at all leads
- Raw ensemble skill is lower than that of synthetic weather scenarios after week 2
- With post-processing skill is better (week 1+2) or comparable (week 3 to 6) to synthetic weather scenarios

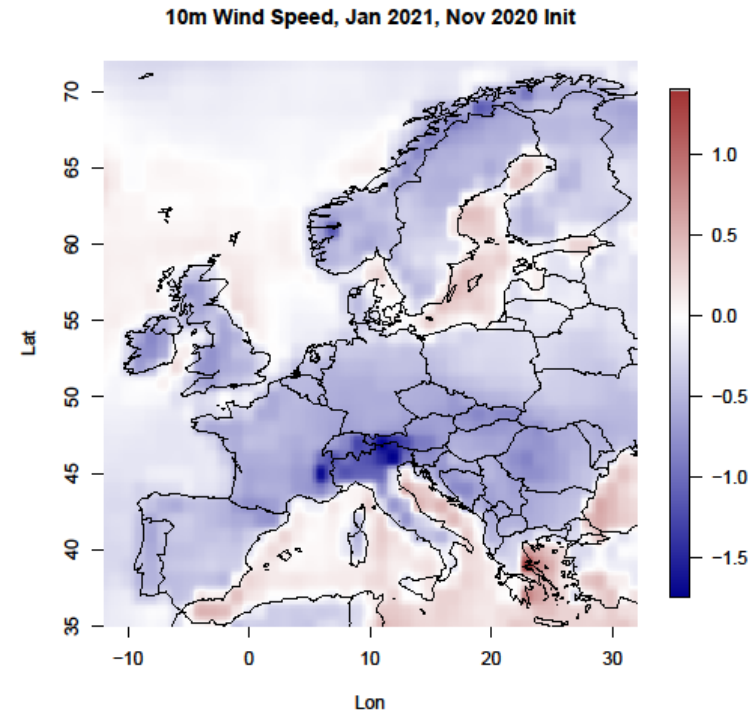
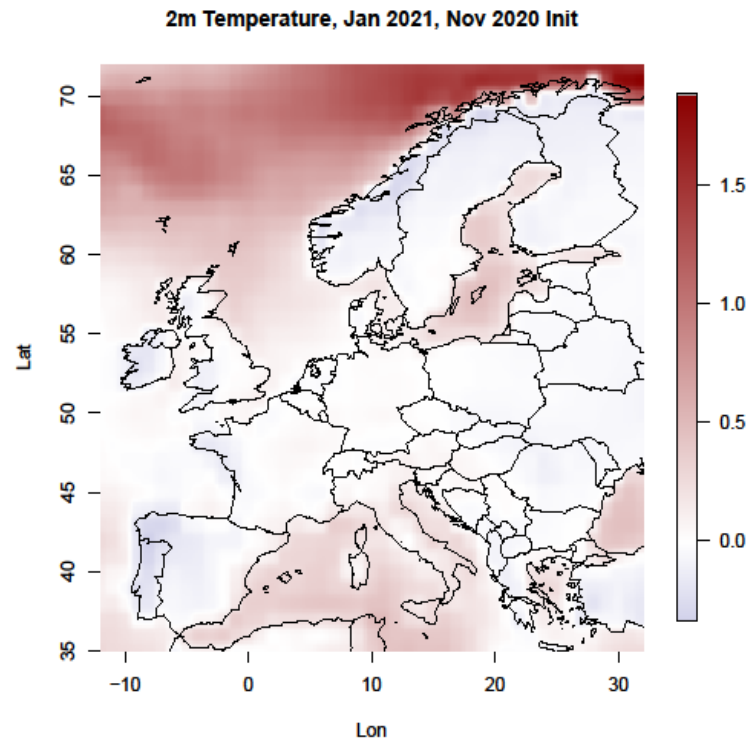
# Data fusion



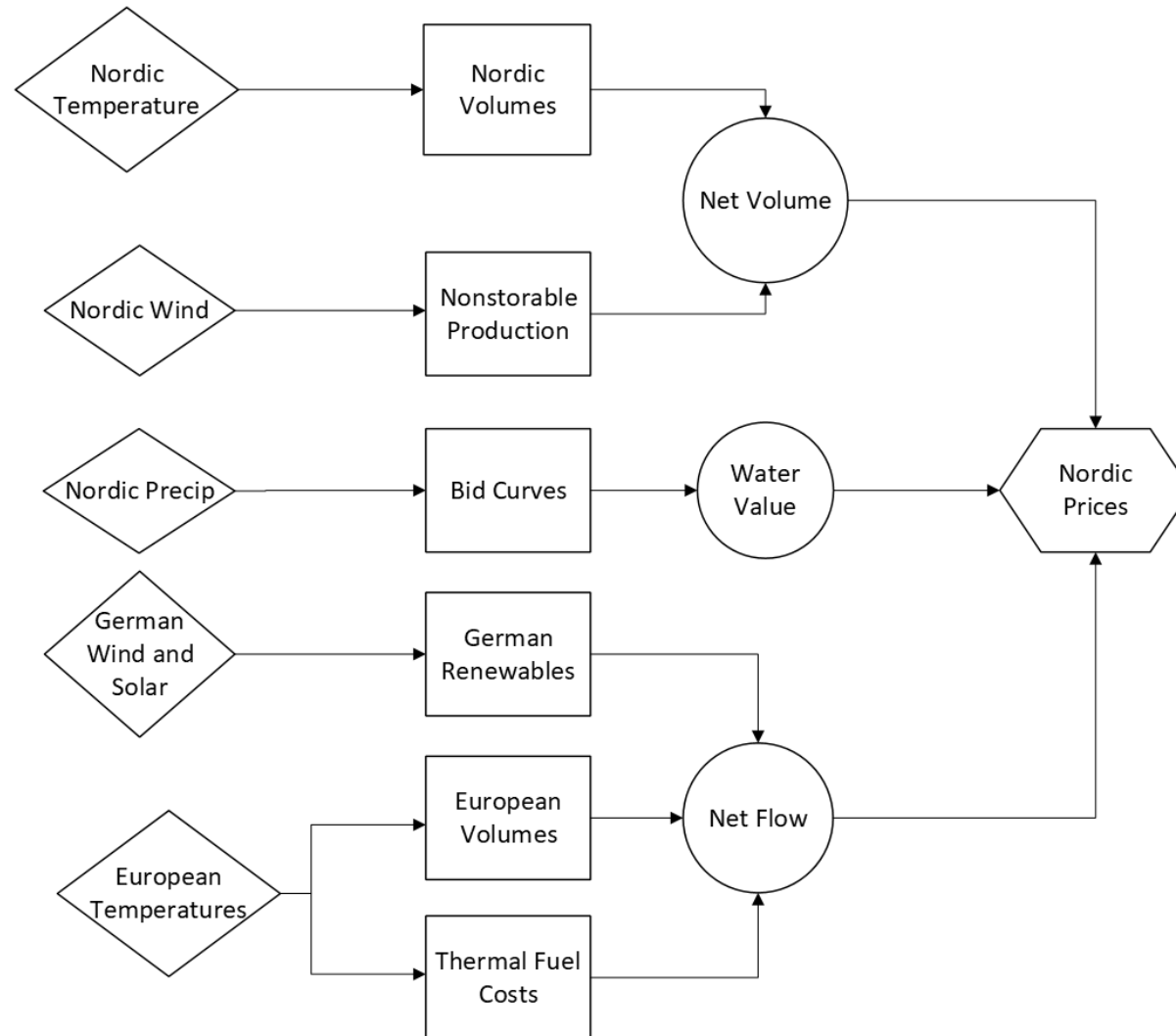
Michael Scheuerer (NR)

# Medium-Term Markets Forecasting

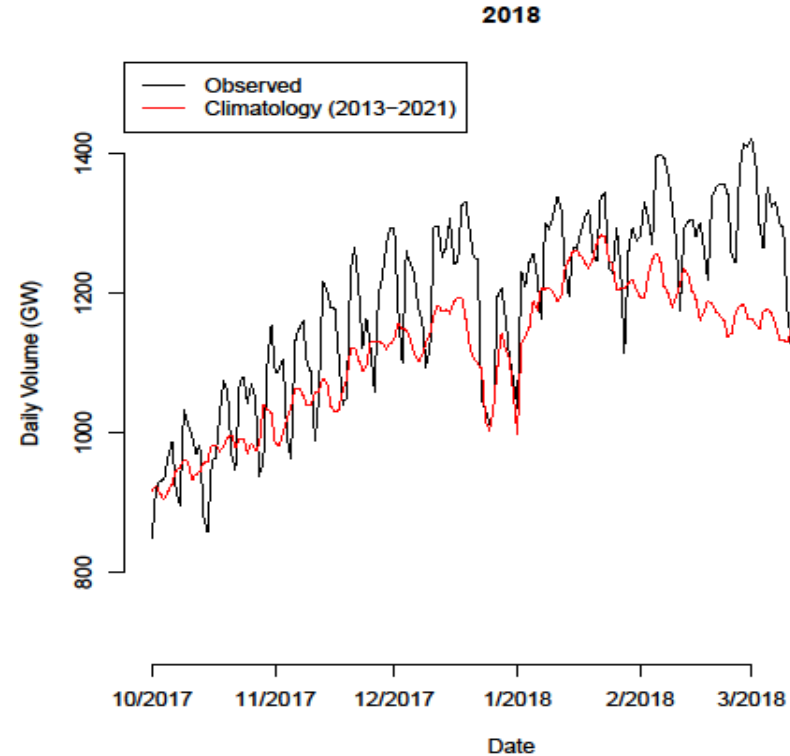
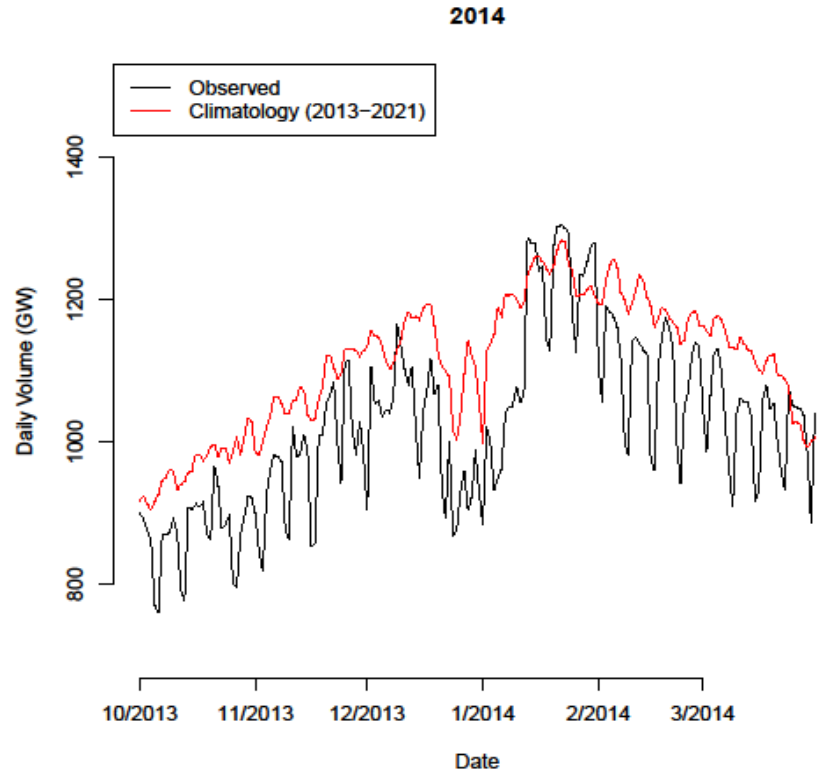
- Goal: Usefully extend the timespan of existing market forecasting.



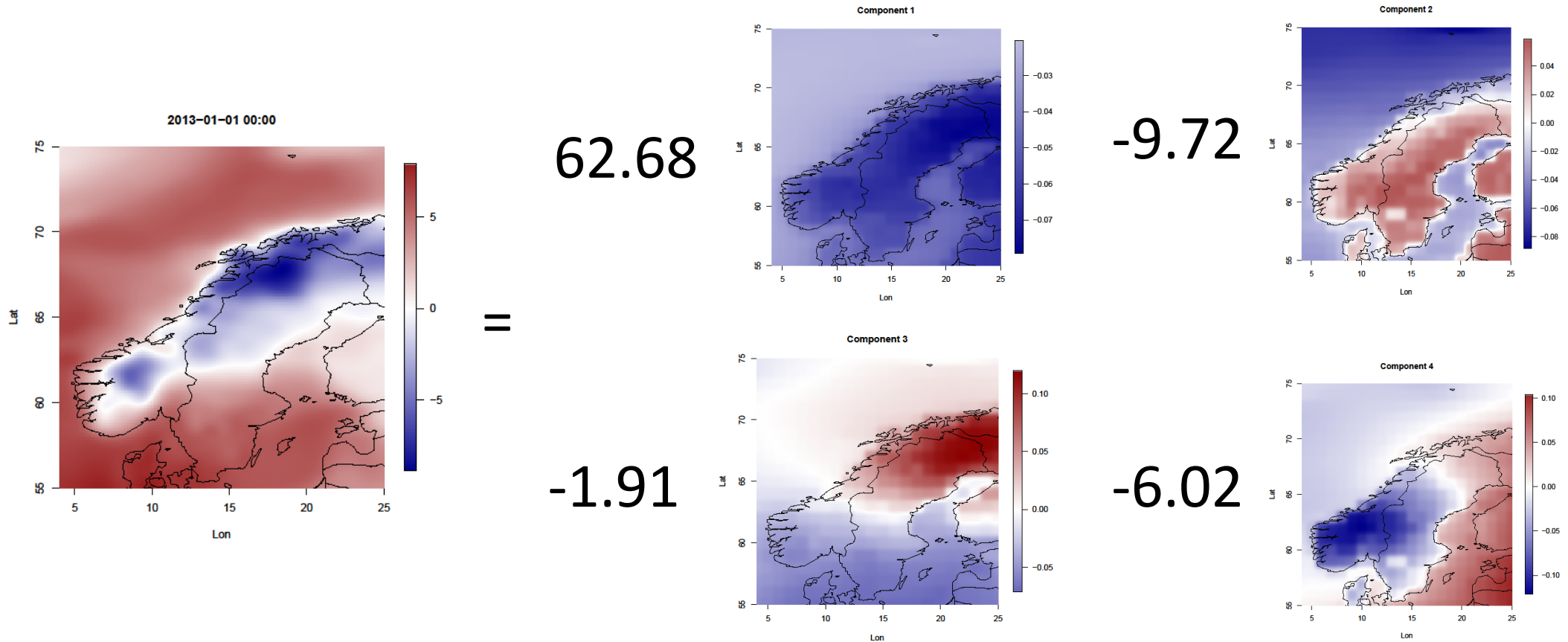
# The Seasonal Power Market Model (SPMM)



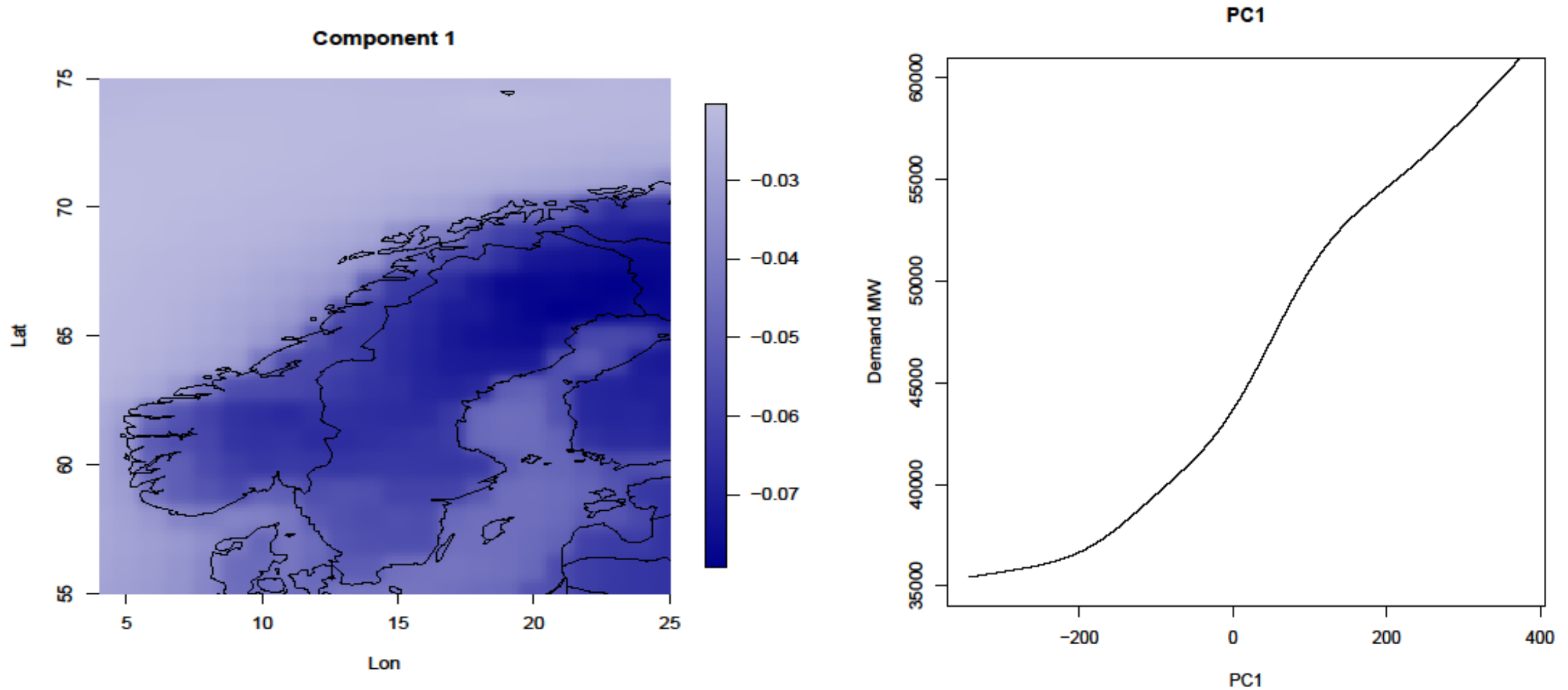
# Elspot Volume and Temperature Forecasts



# Principal Component Decomposition



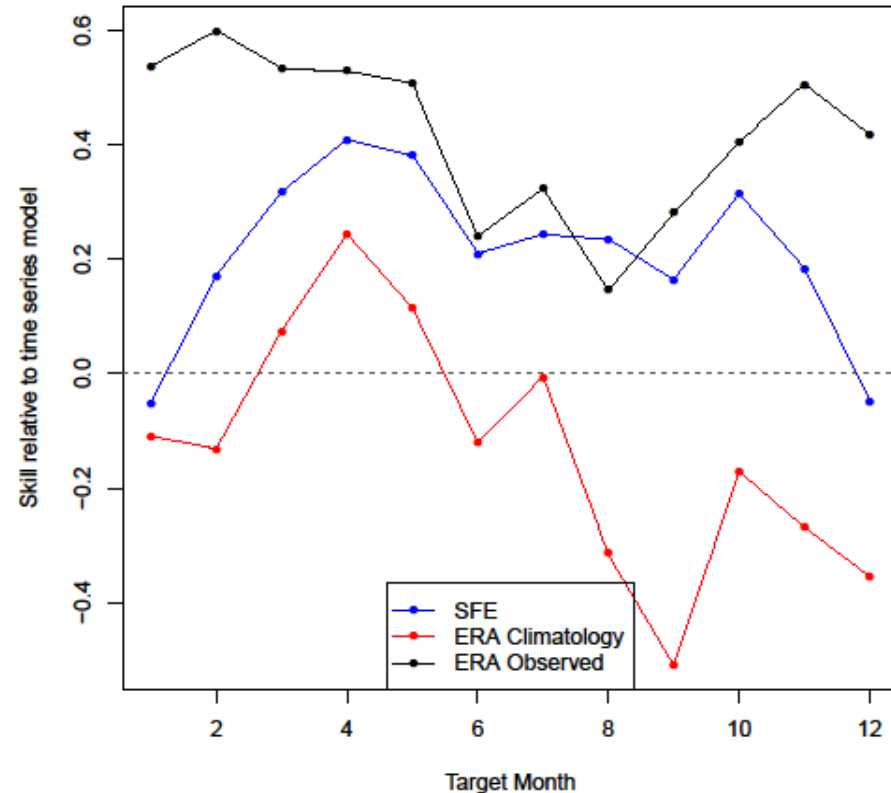
# Modeling Volume from PCA Coefficients





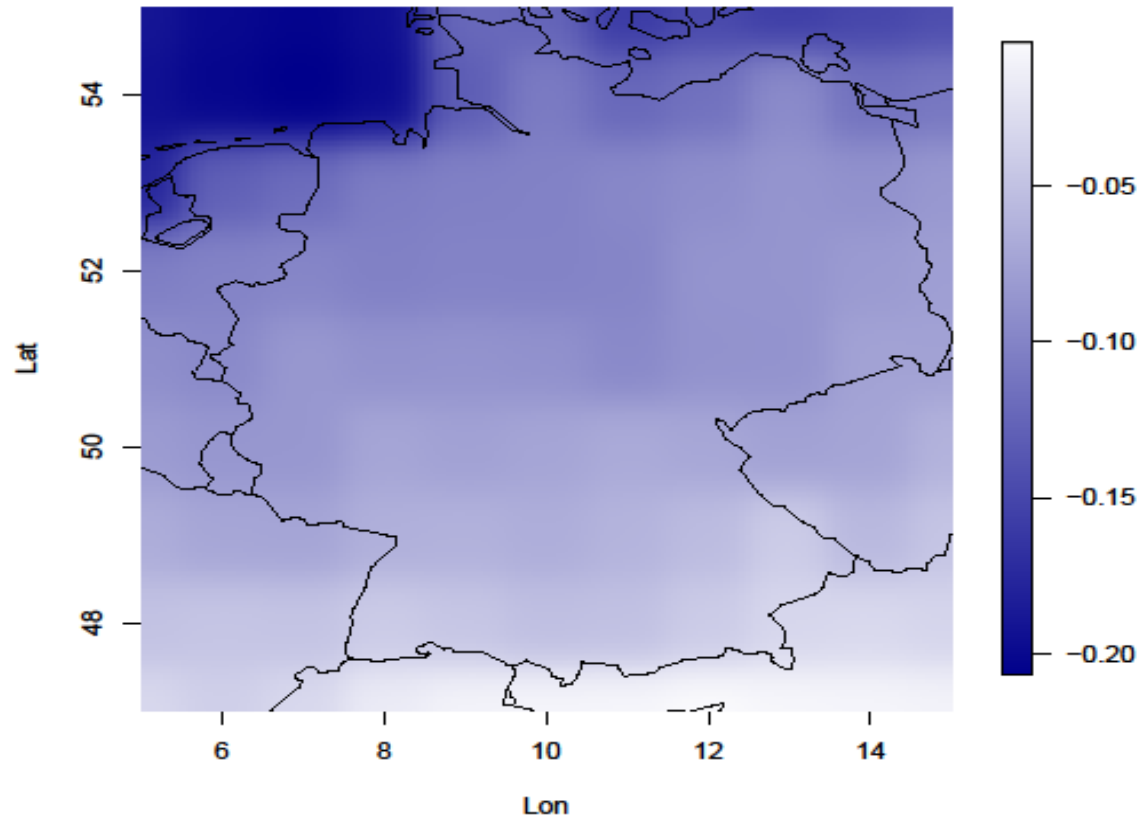
# Skill in Seasonal Forecasts

- Use seasonal forecasts to obtain forecasts of principal component coefficients
- On the 15th of each month, forecast all hours in the next month, 2013-present
- Compared to a pure time series approach we see considerable skill
- Can still be improved in the height of winter, currently researching

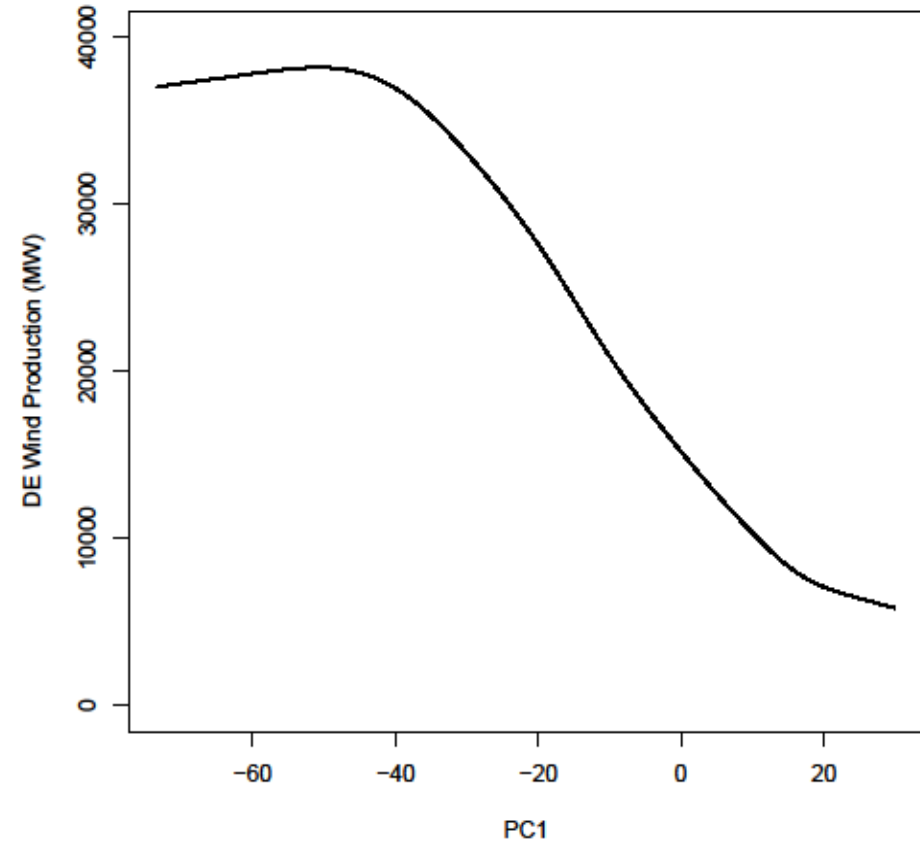


# Wind Power Generation Modeling

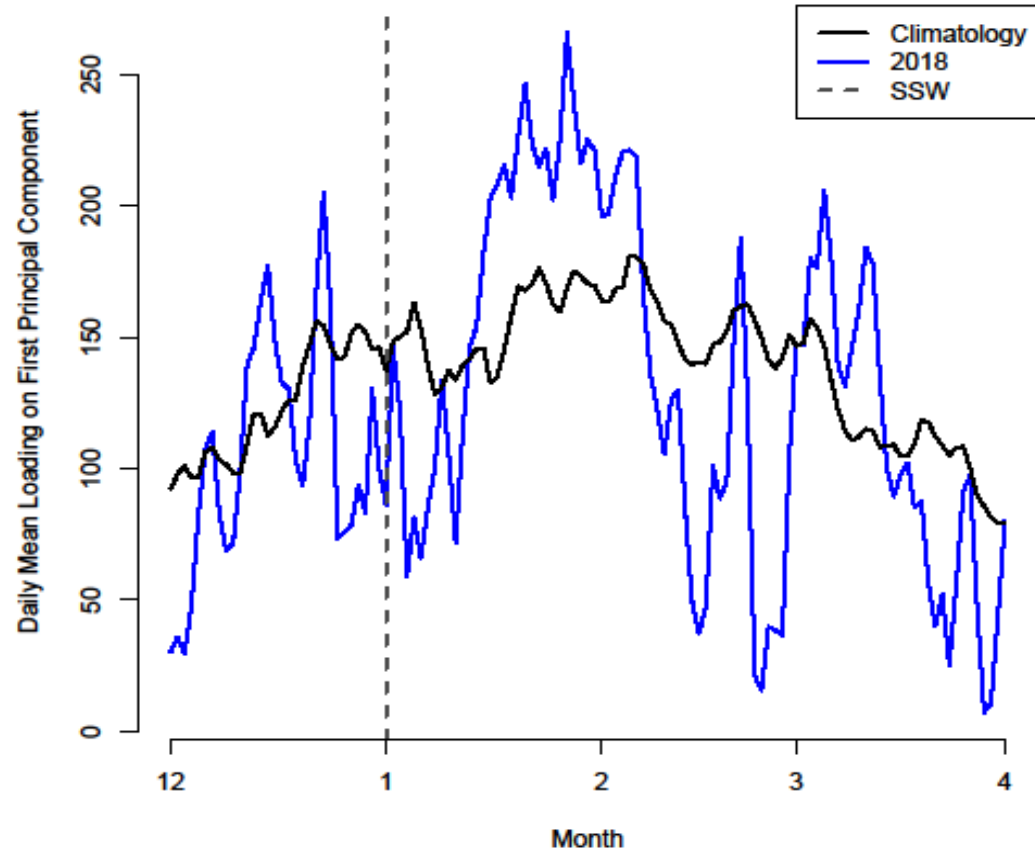
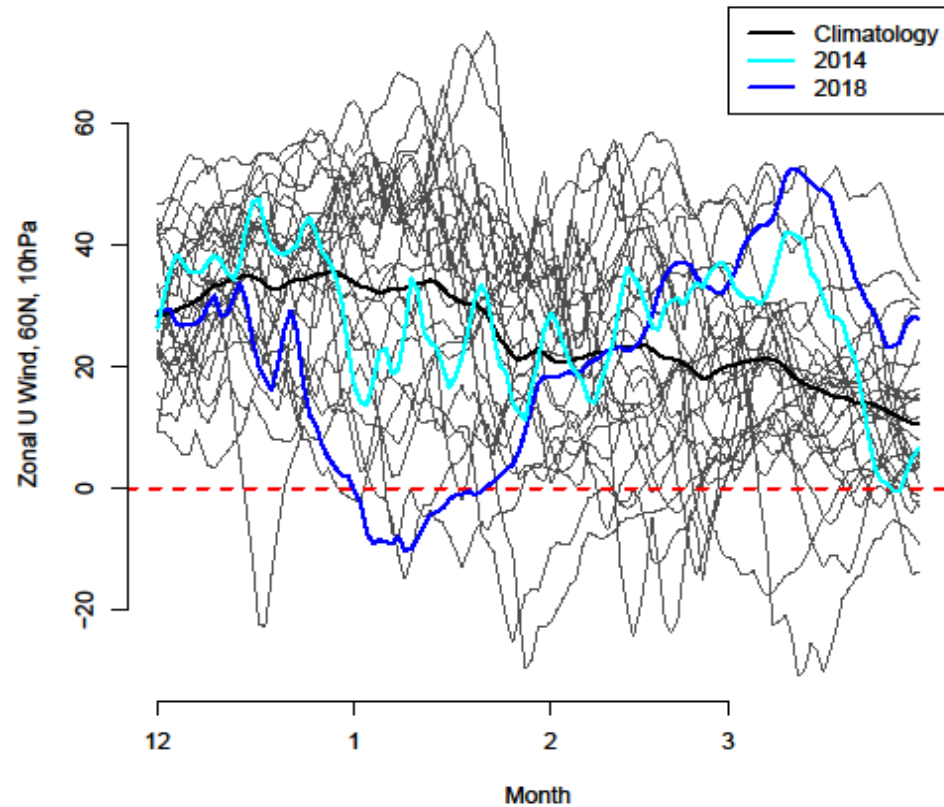
PC1



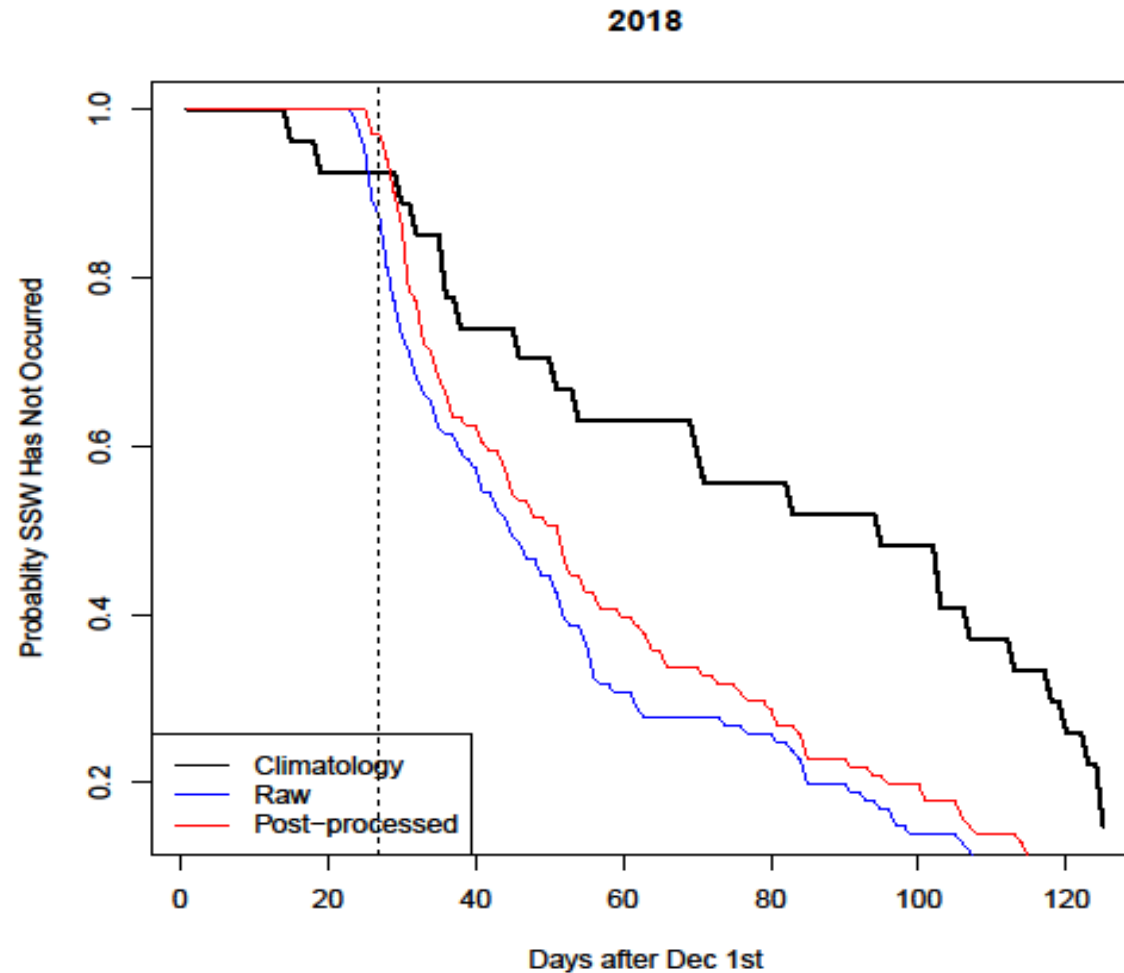
PC1



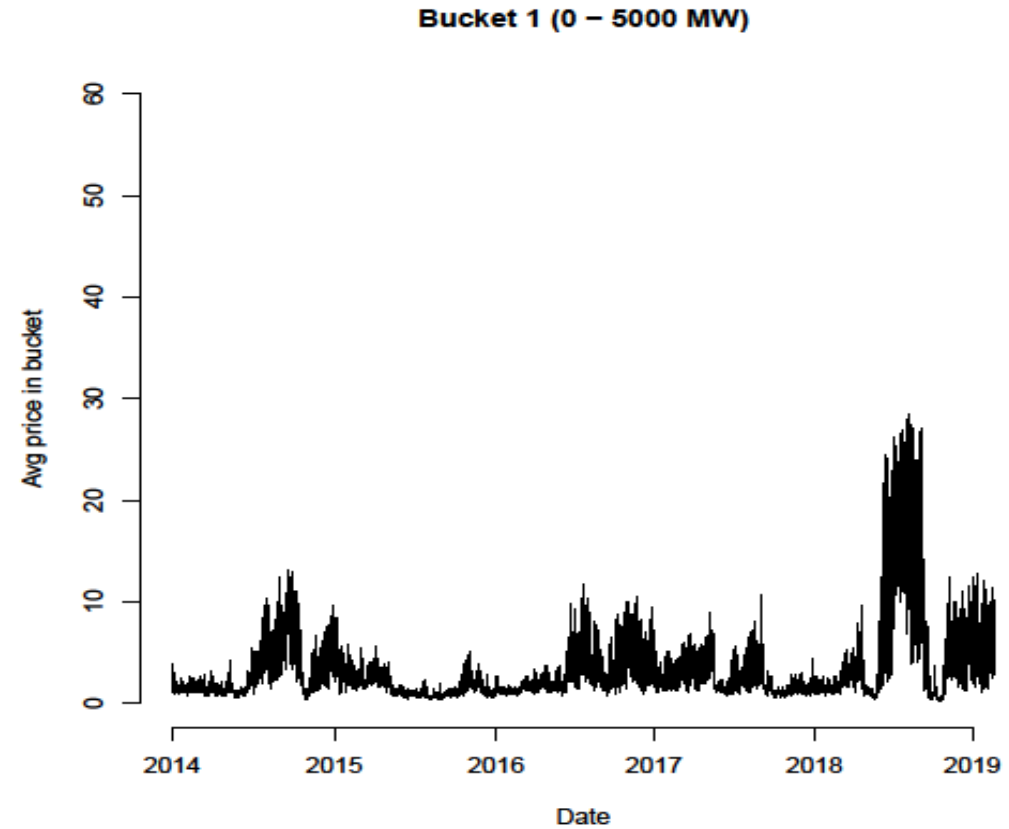
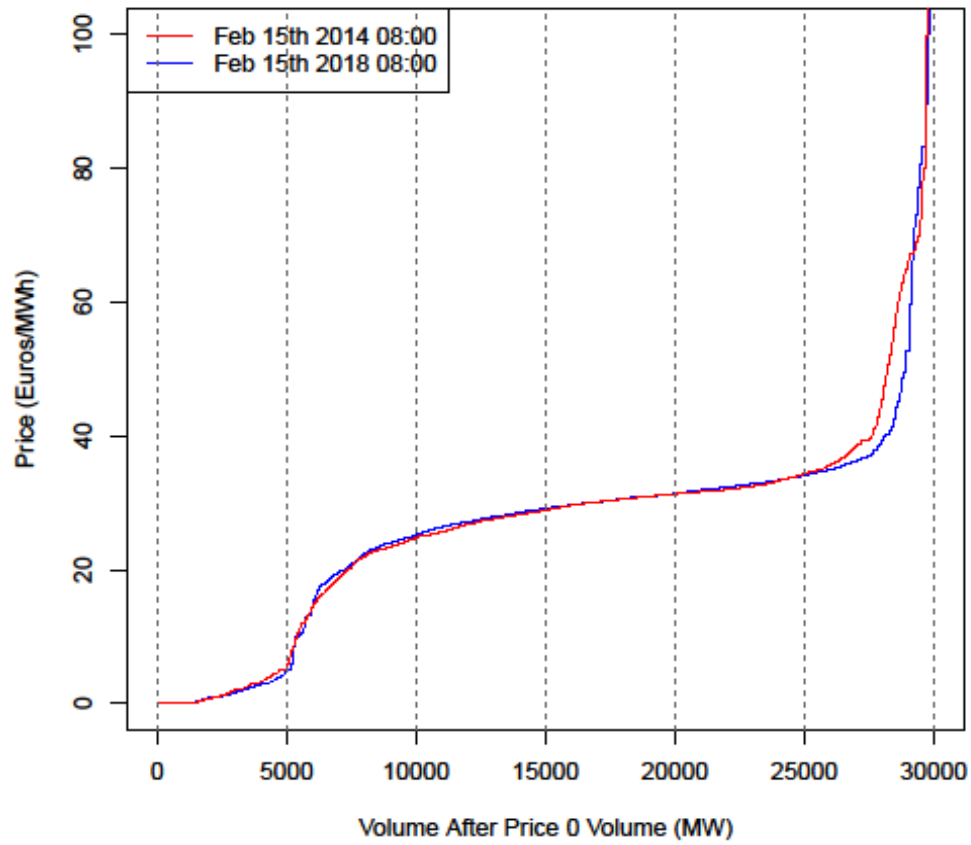
# Sudden Stratospheric Warmings



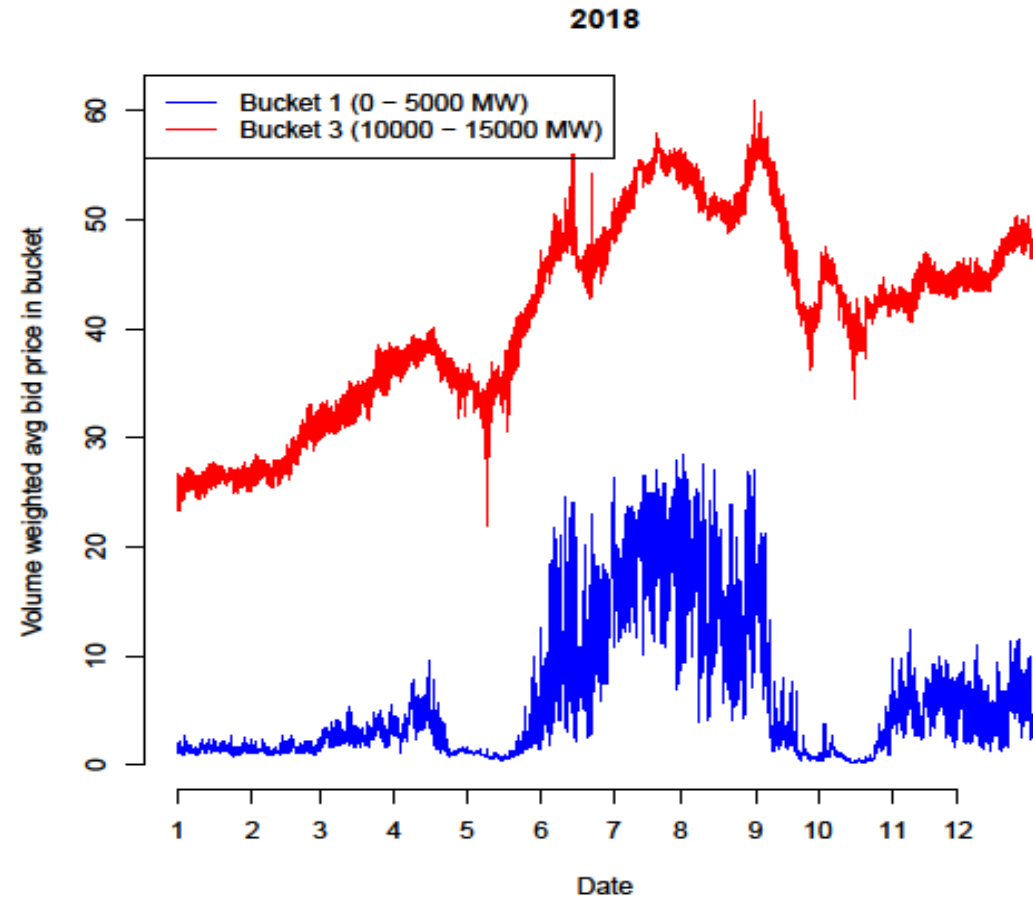
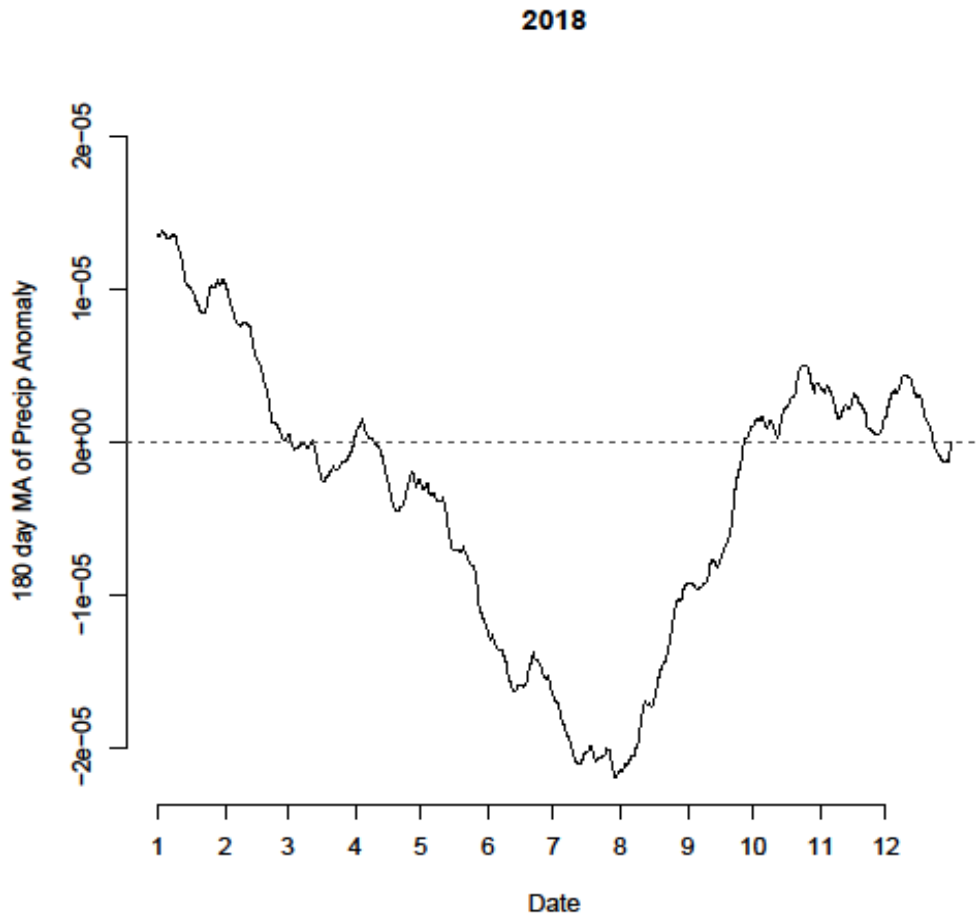
# Survival Time Methods Show Promise



# The "Water Value" and Bidding Behavior



# Predictability of Precipitation Indices



# Conclusions

- There is a wealth of new weather forecasting data coming "online", an exciting period for a statistician
- CF offers a great forum to use these data in a manner that aids partners, thereby guiding methodology
- Applications are exciting in themselves
- Core methodology: blending forecasts from multiple sources and multiple timescales offers a number of interesting problems.





[climatefutures.no](https://climatefutures.no)