Exploiting SEAS5 (re-)forecasts to support risk-based decision making

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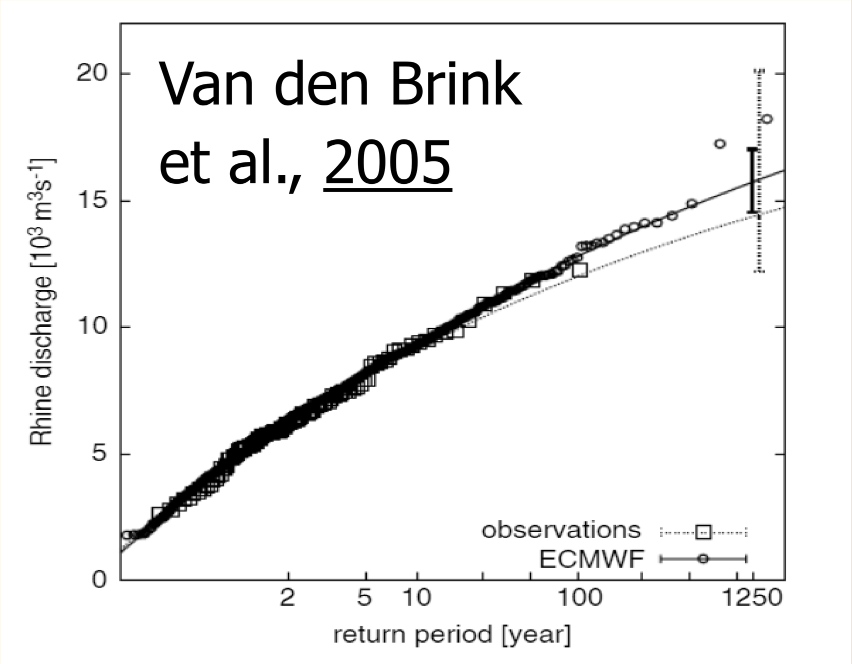
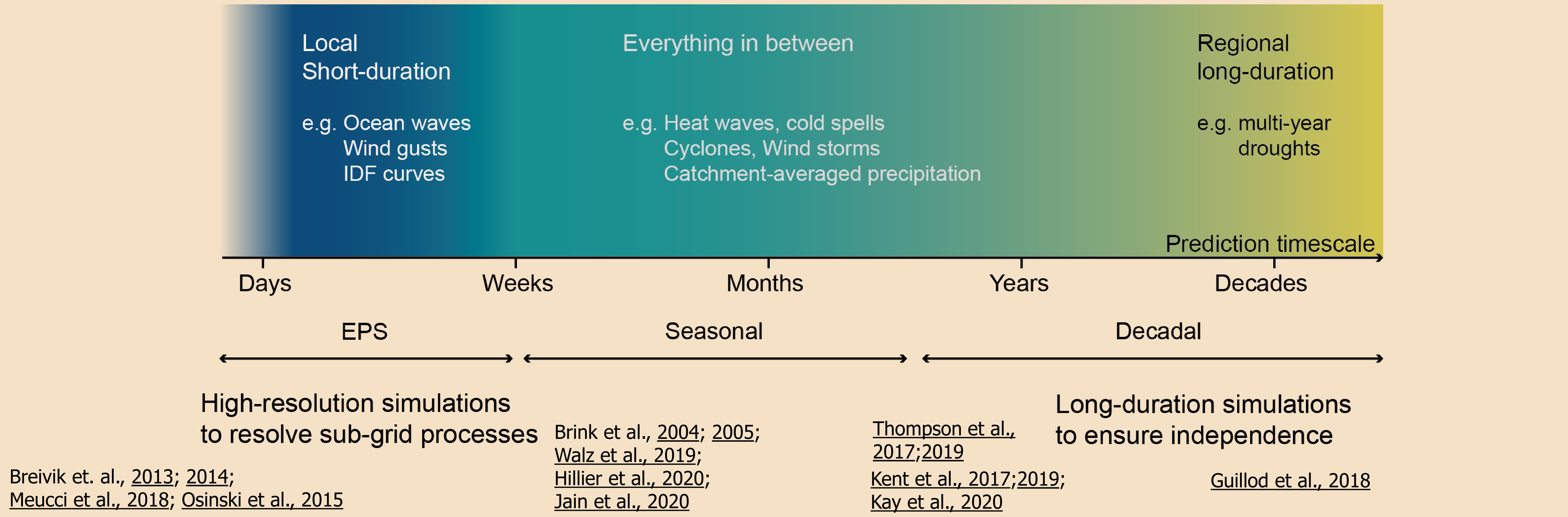
Large sample sizes required to estimate the likelihood and trends of extreme events



UNSEEN: The UNprecedented Simulated Extreme Ensemble (Thompson et al., 2017)

Weather prediction systems across prediction timescales are used to generate large samples



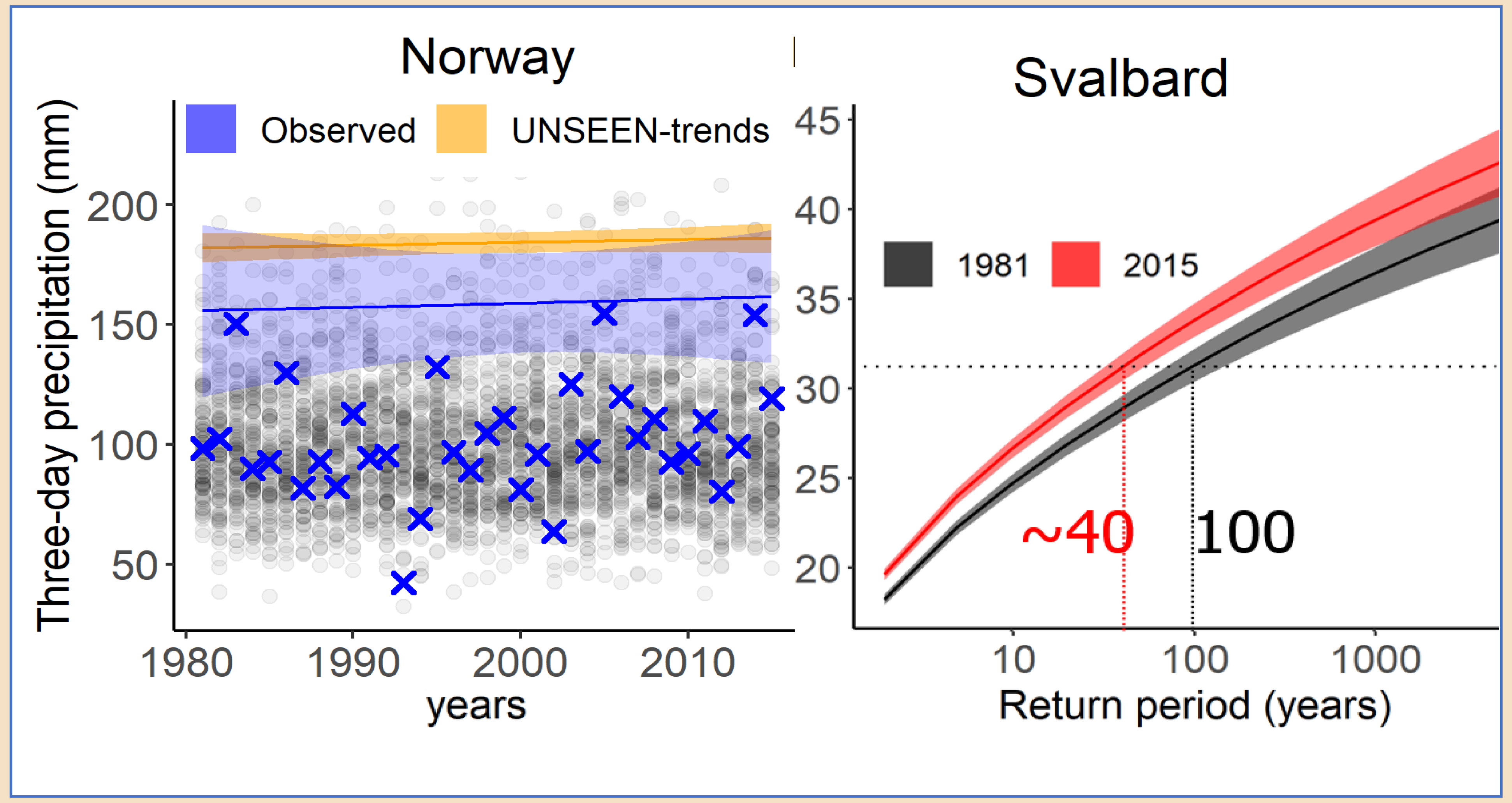
Opportunity to assess whether high-impact events have become more likely

Atmospheric-river induced floods caused severe damage in recent years

From observations it is complicated to detect trends in 100-year events

The many realizations from seasonal prediction can help!

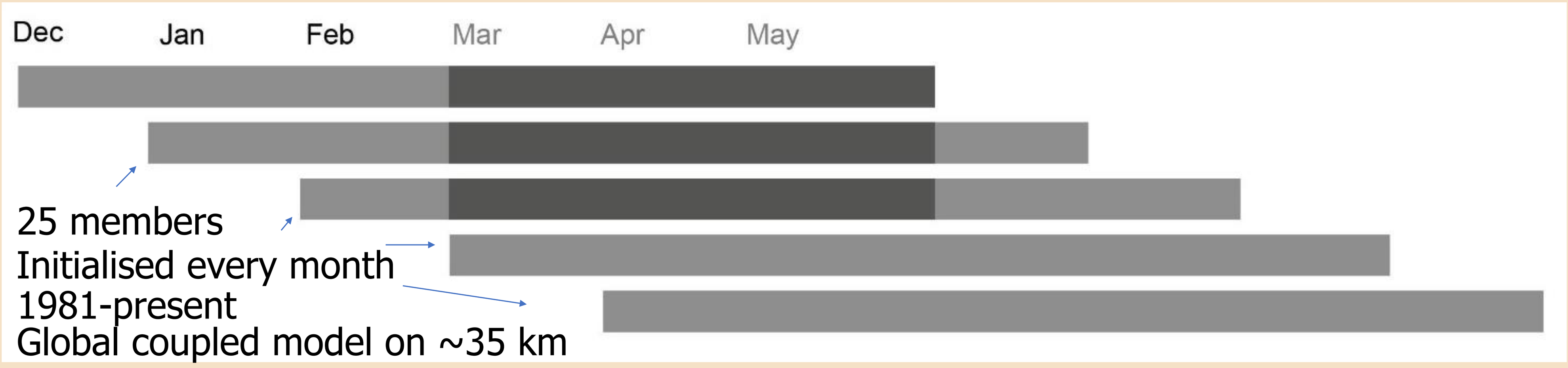
Kelder et al., 2020



Check it out: An open workflow so you can repeat the entire process using Copernicus SEAS5 data!

Methods

We pool SEAS5 ensemble members and lead times
Seasonal forecasts are initialized every month and run for 7 months
For each year, all forecasts simulating the target event are used



We use extreme value theory to detect changes in 100-year events
The GEV distribution is described by a location (μ), scale (σ), and shape (ξ) parameter:

$$F(x) = \exp\left[-\left(1+\xi\left(\frac{x-\mu}{\sigma}\right)\right)^{-\frac{1}{\xi}}\right]$$

We allow the location and log-transformed scale parameter of the GEV distribution to vary linearly with time (t):

$$\mu(t) = \mu_0 + \mu_1 t$$
$$\ln\sigma(t) = \sigma_0 + \sigma_1 t$$

Why SEAS5?

SEAS5 is less reliable than ERA5 but includes ~100 versions of the past without assimilation inhomogeneity

	SEAS5	ERA5
IFS cycle	43r1 (36 km)	41r2 (31km)
members	25 x initialization months	10 (2x coarser resolution)
Fidelity	Less constrained	More reliable
Homogeneity	Consistent over hindcast period	Assimilation inhomogeneity