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Machine learning vs. statistical methods for climate data analysis

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Norwegian Computing Center

Tekna

Data driven climate insight
January 19, 2021

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Machine learning or statistical methods for climate data analysis?

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Data driven climate insight
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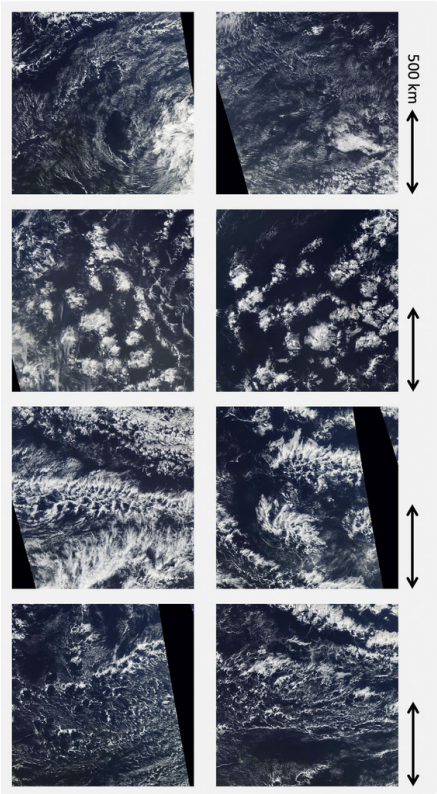
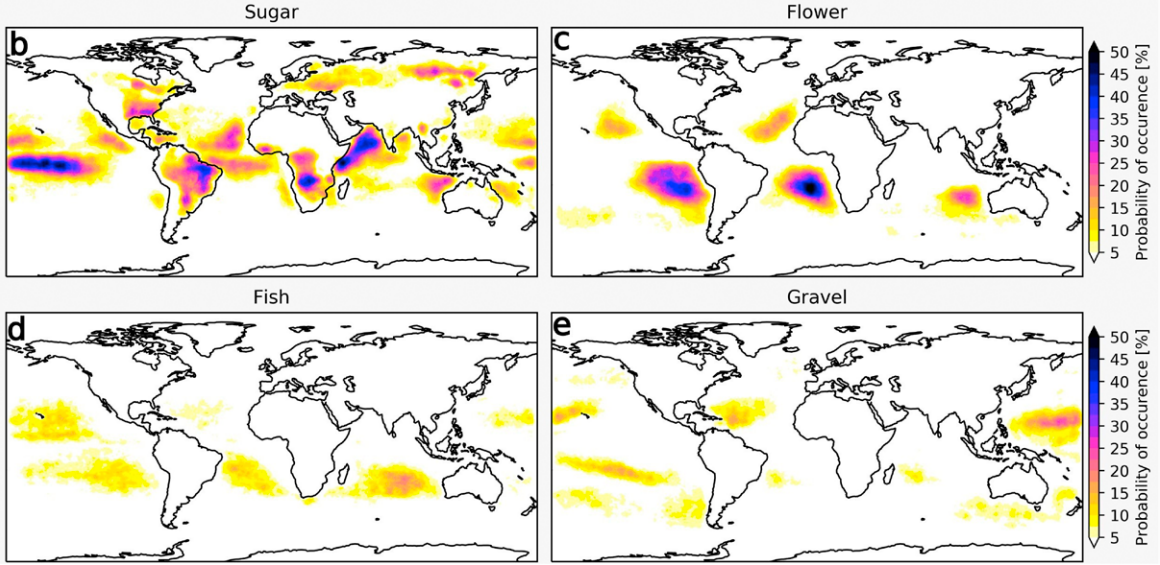
It depends…

Sugar, Flower, Fish and Gravel: Finding clouds with deep learning





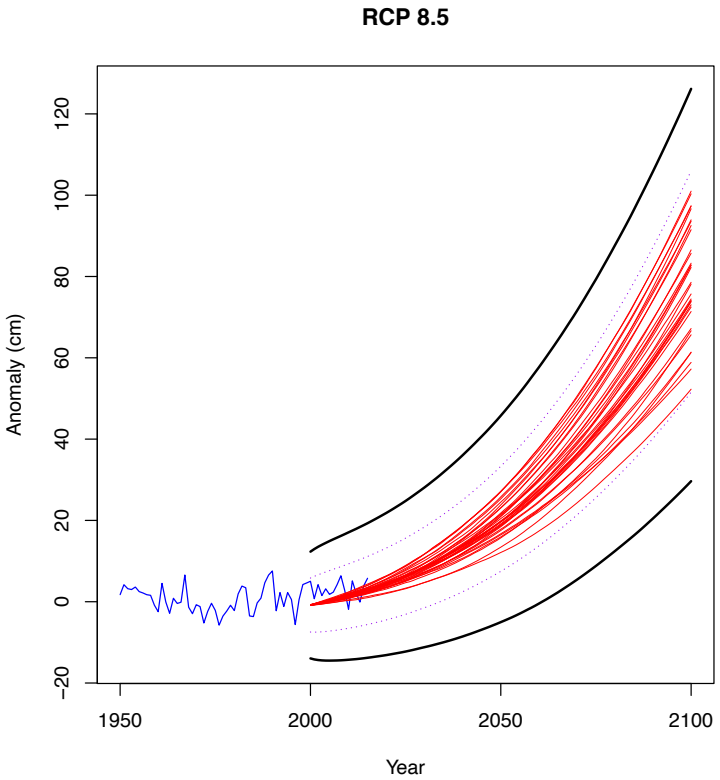
DNNs are great for **detecting features in images**.

Issue: Need large hand-labelled training data sets.

Proposed solution: Crowdsourcing.

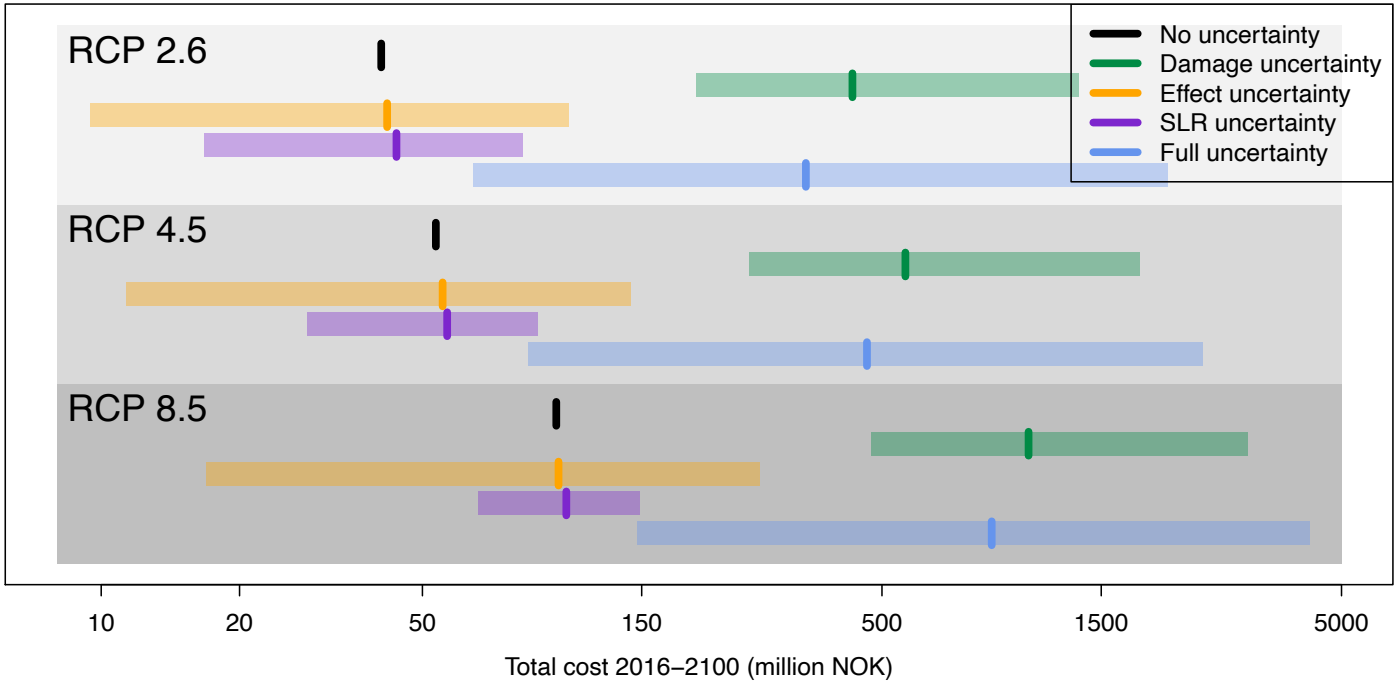
Rasp et al. (BAMS, 2020)

Decision support for decision-making on coastal adaptation



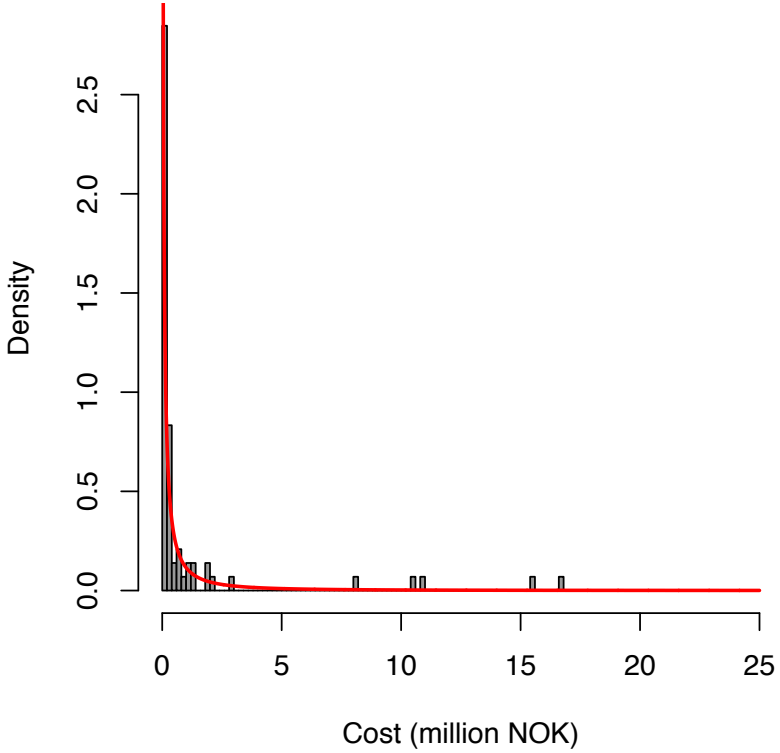
Thorarinsdottir et al. (WRR, 2017)

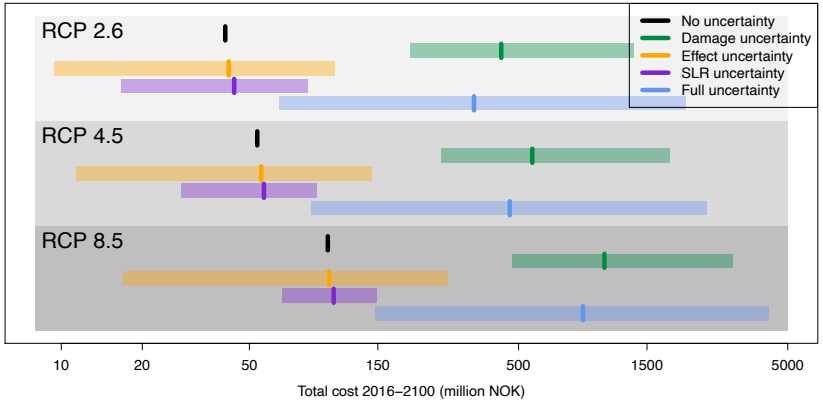
Total costs 2016-2100: damage costs + SLR + effect of SLR on damage



Thorarinsdottir et al. (WRR, 2017)

Distribution of damage cost is highly skewed



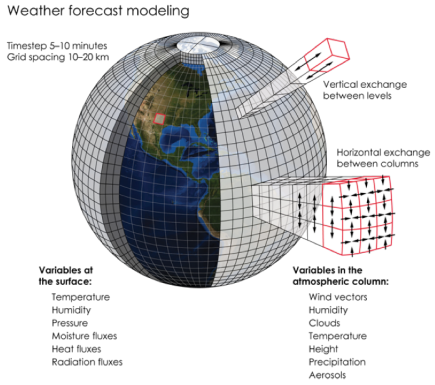


Thorarinsdottir et al. (WRR, 2017)

Decision support for decision-making on adaptation and mitigation

- We need **transparency** between scientists from different disciplines, decision makers, other practitioners, stakeholders and the general public.
- Including **uncertainty** is vital
- **Extrapolation** beyond observed data requires a model

Post-processing of weather and climate predictions



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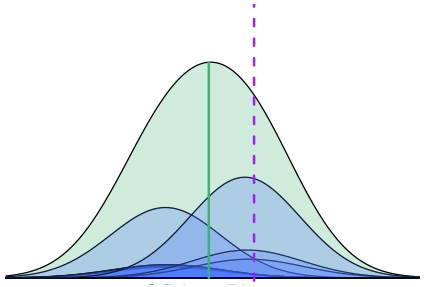
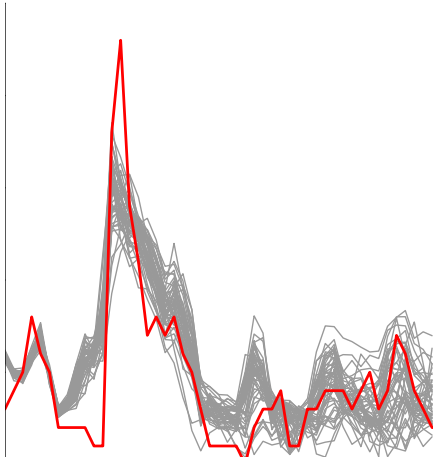
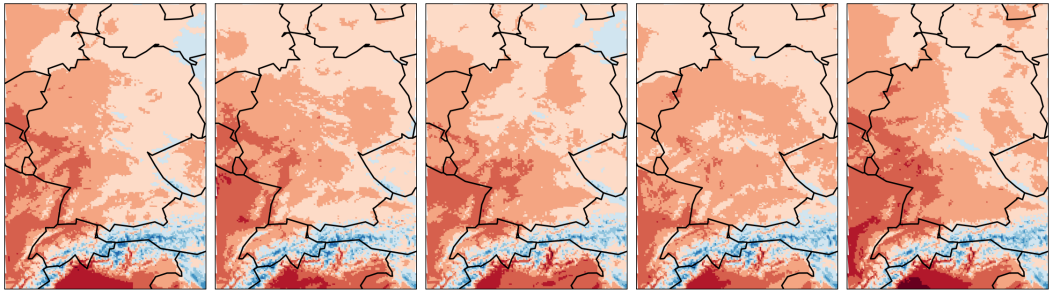
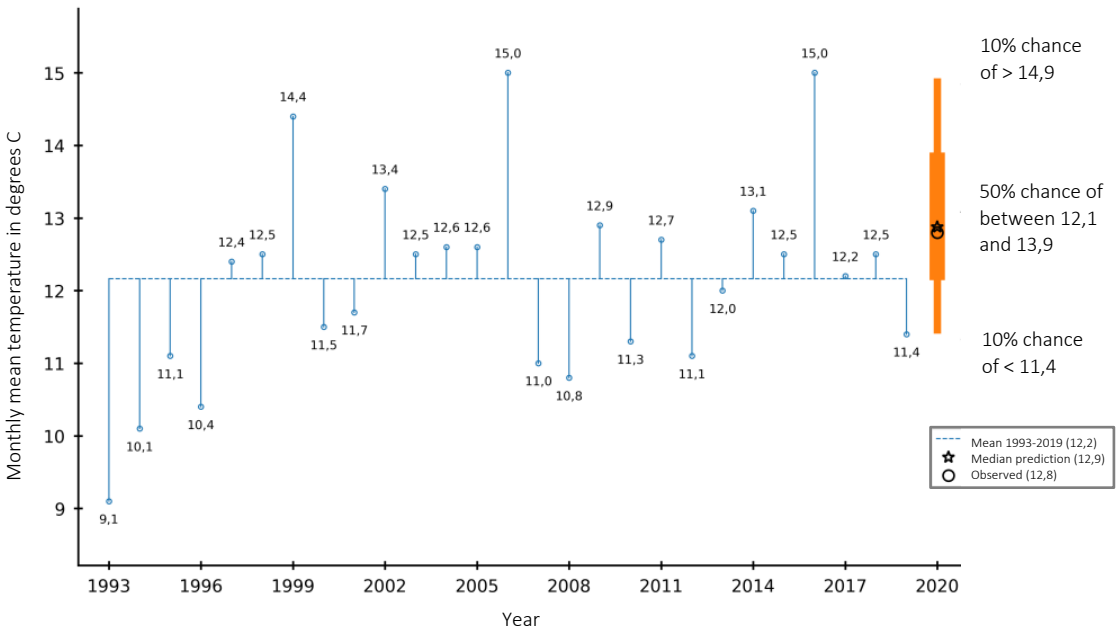






Mean monthly temperature in Oslo next month

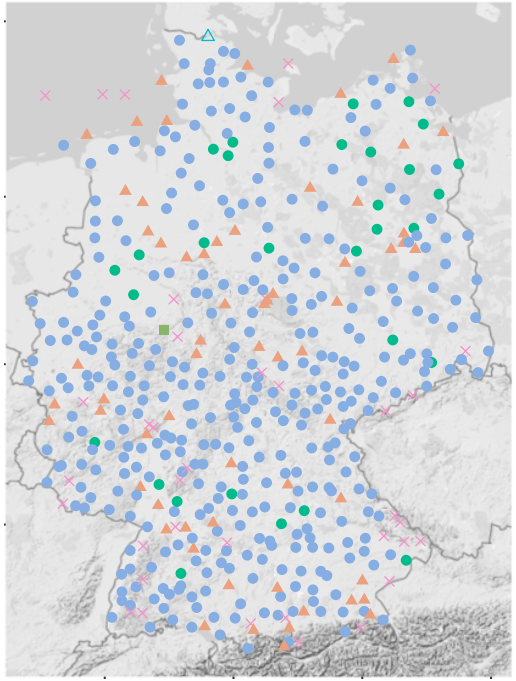
September 2020 forecast issued in August 2020



~200 ensemble members

Results by E. Kolstad and A. Lenkoski.

Daily temperature forecast for Germany



Best model

- EMOS−gl
- EMOS−loc
- EMOS−loc−bst
- QRF
- FCN−aux
- FCN−emb
- FCN−aux−emb
- NN−aux
- NN−aux−emb

Nonlinear relationships
Auxiliary predictors
Latent station features

Feature	Description
Ensemble predictions (mean and std dev)	
t2m	2-m temperature
cape	Convective available potential energy
sp	Surface pressure
tcc	Total cloud cover
sshf	Sensible heat flux
slhf	Latent heat flux
u10	10-m *U* wind
v10	10-m *V* wind
d2m	2-m dewpoint temperature
ssr	Shortwave radiation flux
str	Longwave radiation flux
sm	Soil moisture
u_pl500	*U* wind at 500 hPa
v_pl500	*V* wind at 500 hPa
u_pl850	*U* wind at 850 hPa
v_pl850	*V* wind at 850 hPa
gh_pl500	Geopotential at 500 hPa
q_pl850	Specific humidity at 850 hPa
Station-specific information	
station_alt	Altitude of station
orog	Altitude of model grid point
station_lat	Lat of station
station_lon	Lon of station

Rasp and Lerch (MWR, 2018)

Post-processing of weather and climate predictions

- The choice of methodology should depend on the **sample size**
- Post-processing can provide valuable input to weather/climate model developers if the results are **explainable**

There are many more applications for machine learning and statistical modelling in climate data analysis

- Downscaling numerical model output to higher resolutions
- Representation of subgrid-scale processes
- Combining multi-type information into a single prediction/projection

- For a list of weather and climate datasets preprocessed for AI research, see **mldata.pangeo.io**

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Thank you for your attention!