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Barcelona Supercomputing Center
Centro Nacional de Supercomputación

EXCELENCIA SEVERO OCHOA

Climate Prediction Group: Machine Learning

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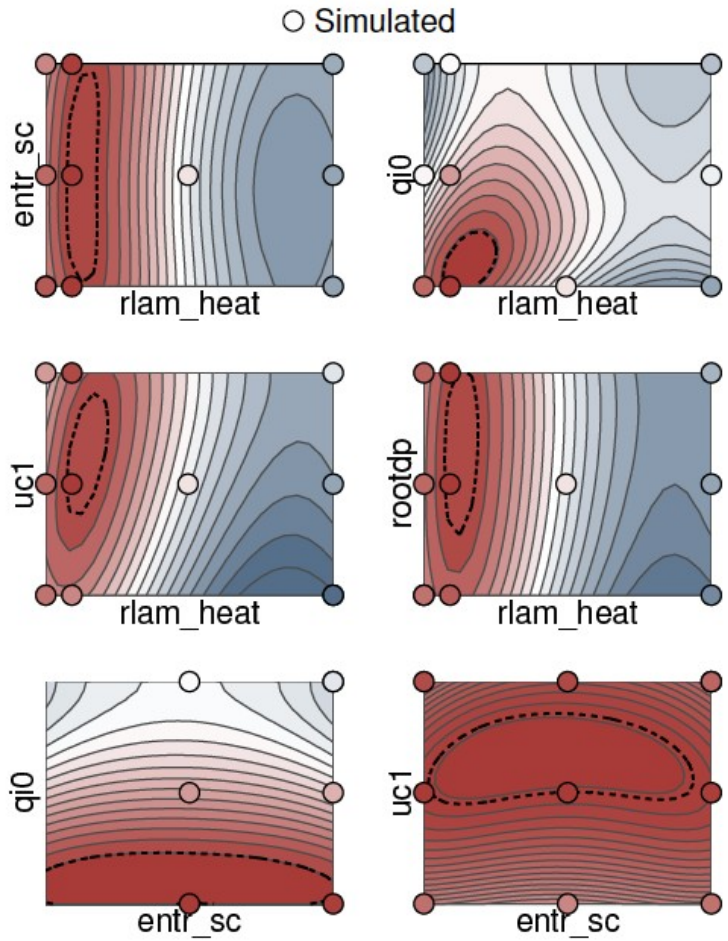
Introduction

Machine Learning: *Find patterns in high-dimensional data and predict response, optimized search (includes any kind of regression modelling)*

What we do: *Initialized seasonal-to-decadal prediction, high-resolution multi-decadal simulations, global teleconnections, empirical climate prediction, tuning ESM, data assimilation, bias-correction, verification of climate simulations, empirical downscaling.*

Tuning climate models (EC-Earth)

Curse of dimensionality: Number of simulations required to test 10 parameters with 5 intervals 5^{10} = 10 Mio. simulations

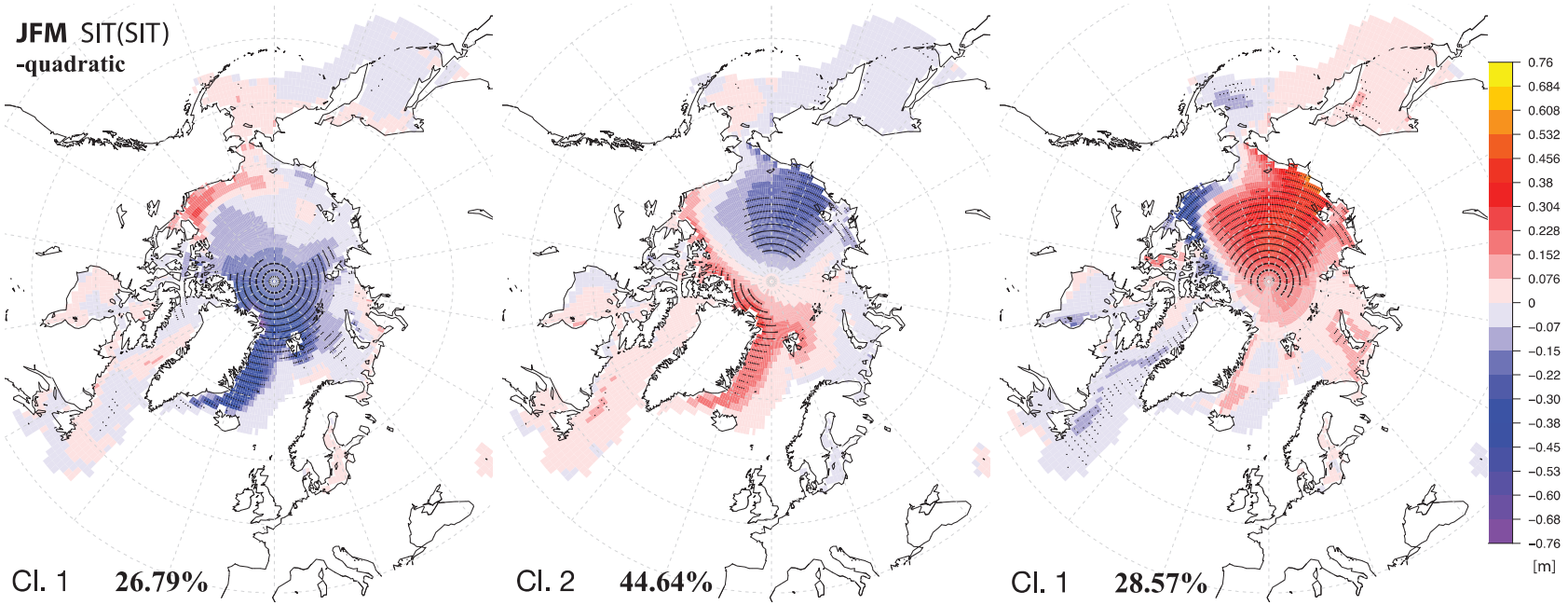


Emulators: Predict model response using a set of experimental points
-*Gaussian Processes*
-*Neural Networks*
-*Multivariate Regression*

Optimized search: Explore most efficiently parameter space
-*Genetic Algorithms*
-*MCMC*

Modes of variability

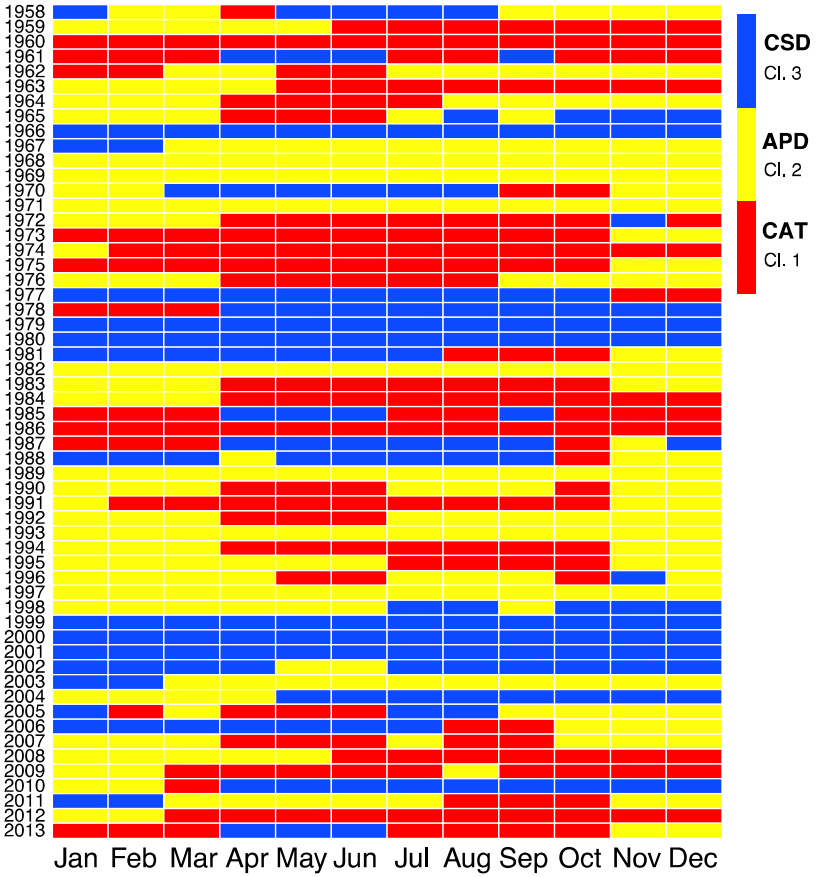
Find patterns: Modes of sea-ice thickness interannual variability determined using



Fučkar et al. (2015)

Statistical prediction

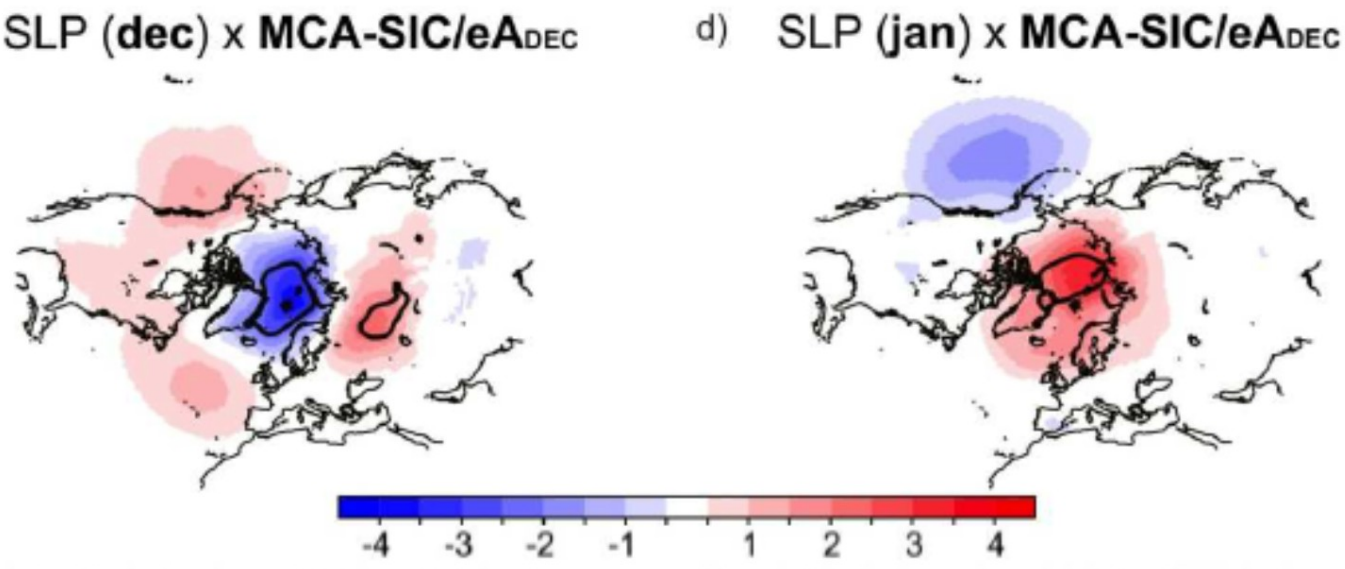
Prediction: Detect climate sequences for statistical prediction and benchmarking phyiscal models: *Marcov-Chains (MC)*



Fučkar et al. (2016)

Detect co-variability

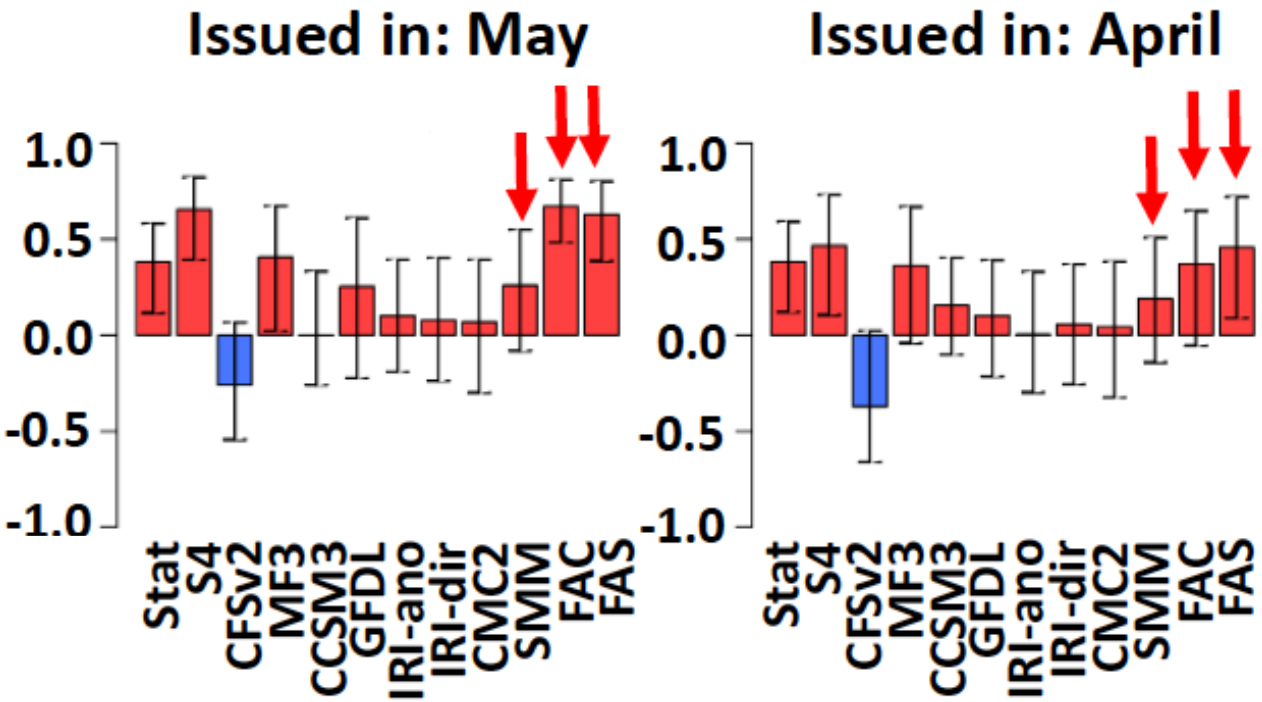
Teleconnections: Find modes of co-variability of two spatial and temporal distant modes: *Maximum Covariance Analysis*



García-Serrano et al. (2016, and more)

Combine multiple models

Combine ensembles: How to best different model simulations with different advantages and disadvantages:
- Bayesian Averaging (BA), PCA



Rodrigues et al. (2015)

Summary

Others not discussed:

Ensemble Kalman-Filters for data assimilation, kriging for statistical downscaling, others I might have overlooked...

Interesting links:

http://www.climateinformatics.org/
(tutorial) https://www.youtube.com/watch?v=Cgc3hk2yUBw

Book (at Neven‘s desk):

„Machine learning methods in the environmental science“