climate change initiative

→ CLIMATE MODELLING USER GROUP

CMUG Integration Meeting
Overview of MPI-M contributions to phase 1

24-25 October 2022, Frascati, Italy

cmug cci

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Importance of uncertainties in models and ECV CDRs

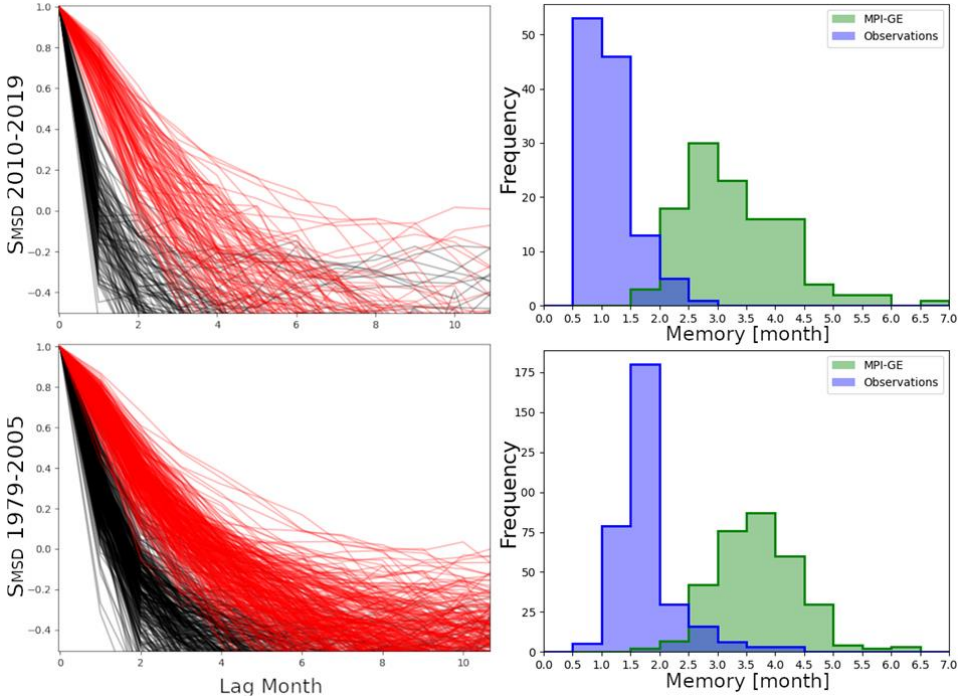
- Study the relative contributions to observation and model uncertainties

- Characterise the uncertainties

- Investigate the impact of different levels of abstraction of observational products

4.1 Evaluation of modelled system memory
4.2 Evaluation of model results considering observational uncertainty
4.3 Evaluation of model results considering the abstraction level of observational products
4.4 Optimal spatial and temporal scales for model evaluation
4.5 Evaluation of model results considering internal variability
4.6 Evaluation of model results considering a combination of sources of uncertainties

Modelled system memory

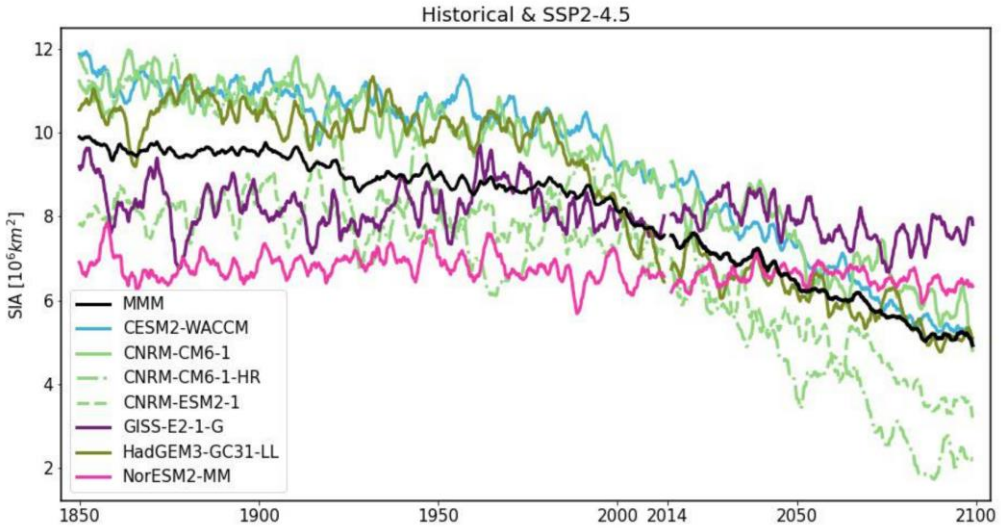


Models retain information longer than observations

Evaluation of model results considering observational uncertainty

- spatial covariance structures can have significant non-circular components
- correlation length scales are rarely below 100 km and frequently reach several hundred km
- there are weak indications for increased covariance pattern in the CCI+ products near land

Antarctic sea-ice mass budget in CMIP6 models (*abstraction level of observational products*)



- Work carried out by Quentin Rauschenbach
- Recent SIA model spread smaller than past and predicted spread
- Abstraction level makes little difference to uncertainties
- Using ice freeboard instead of ice thickness does reduce uncertainties

Optimal spatial and temporal scales for model evaluation

- estimate the ideal spatial and temporal time horizon at which a model evaluation should be carried out to minimize the impact of observational uncertainty
- most of the benefits from spatial averaging are realized below 1500 km
- substantially larger averaging intervals are needed around the yearly sea ice minimum than around the sea ice maximum (September worse than February)
- temporal autocorrelation of observational uncertainties is expected to be around one fifth of the length scale of the SIA variability

Internal model variability – impact on model evaluation

- Produced estimates of internal climate variability and its change over time for a multi-model ensemble such as CMIP5

- We find a highly variable model-specific internal variability of sea-ice volume and sea-ice area.

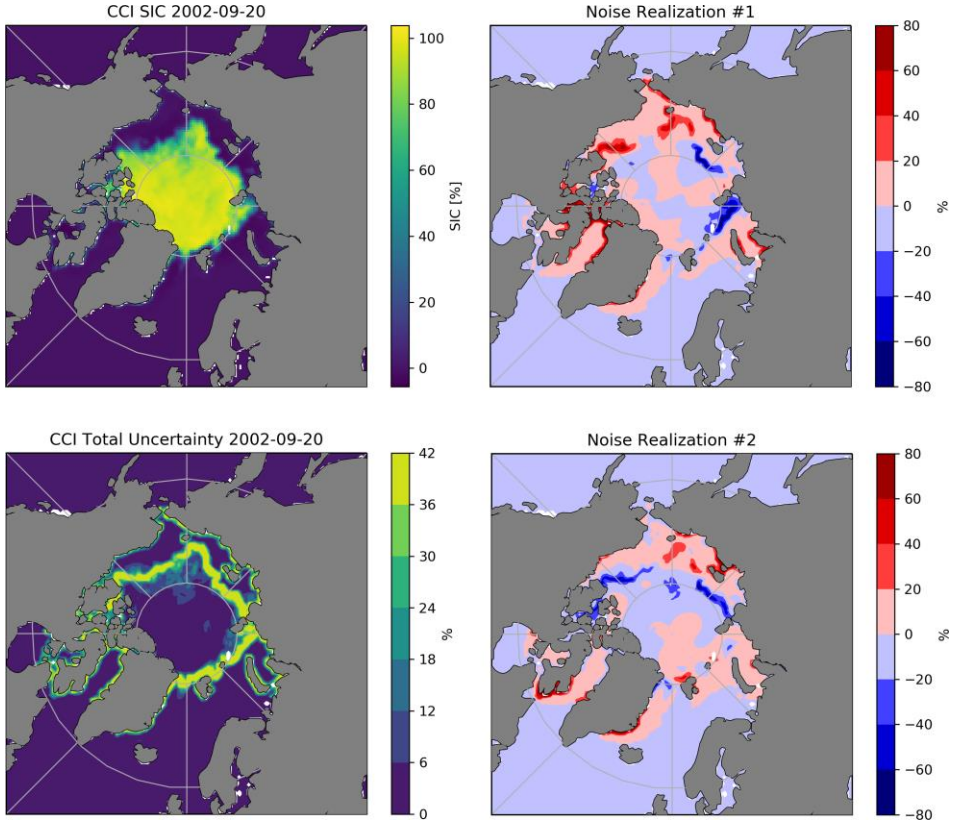
- The method allows for the evaluation of climate-model simulations by uniformly taking model-specific internal variability for all models into account.

Combined sources of uncertainty: Arctic SIA and SIE Uncertainties

Sea Ice concentration is useful for evaluating regional climate models if reliable uncertainty estimates are available

These must include accurate characterisation of the temporal and spatial error correlations

Arctic SIA and SIE Uncertainties



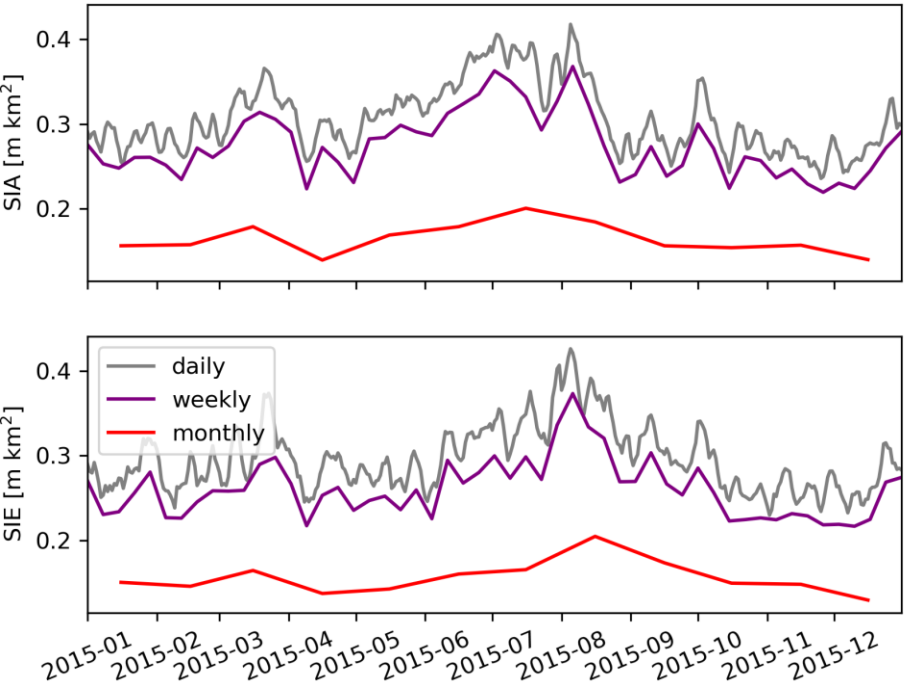
Analysed spatial and temporal correlation length scale

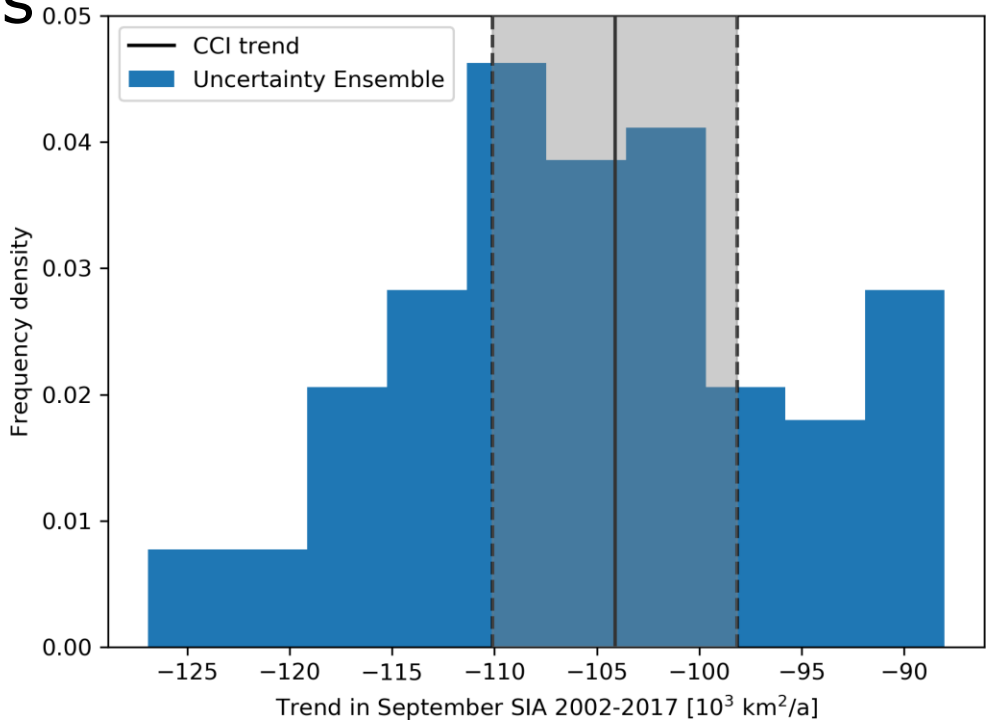
Creating homogeneous correlated noise with convolution filtering

Gives ensemble of observations which represent typical errors

Arctic SIA and SIE Uncertainties

Ensemble standard deviations





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Results discussed in CMUG D4.1:
https://climate.esa.int/en/projects/cmug/

Paper in preparation: Wernecke et al. to be submitted to *The Cryosphere*