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Physics-based ensemble subselection

PDO and hot US maize growing seasons

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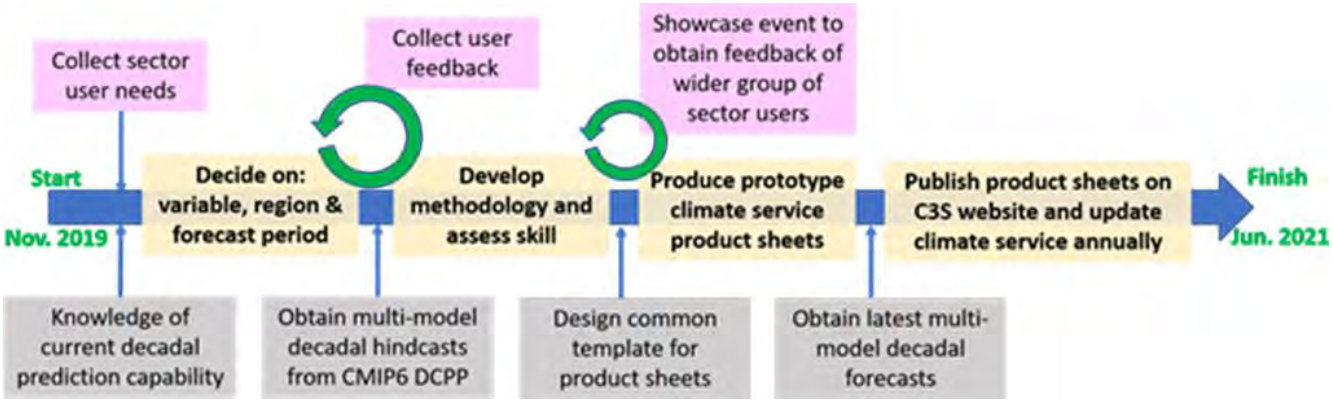
Near-term predictions of climate hazards often show low skill

Seasonal climate **predictions could provide useful information** to stakeholders (e.g. Osman et al., 2023)

There is a potential **disconnect** between prediction **system capabilities** (mean climate) and **stakeholder expectations** (event prediction)

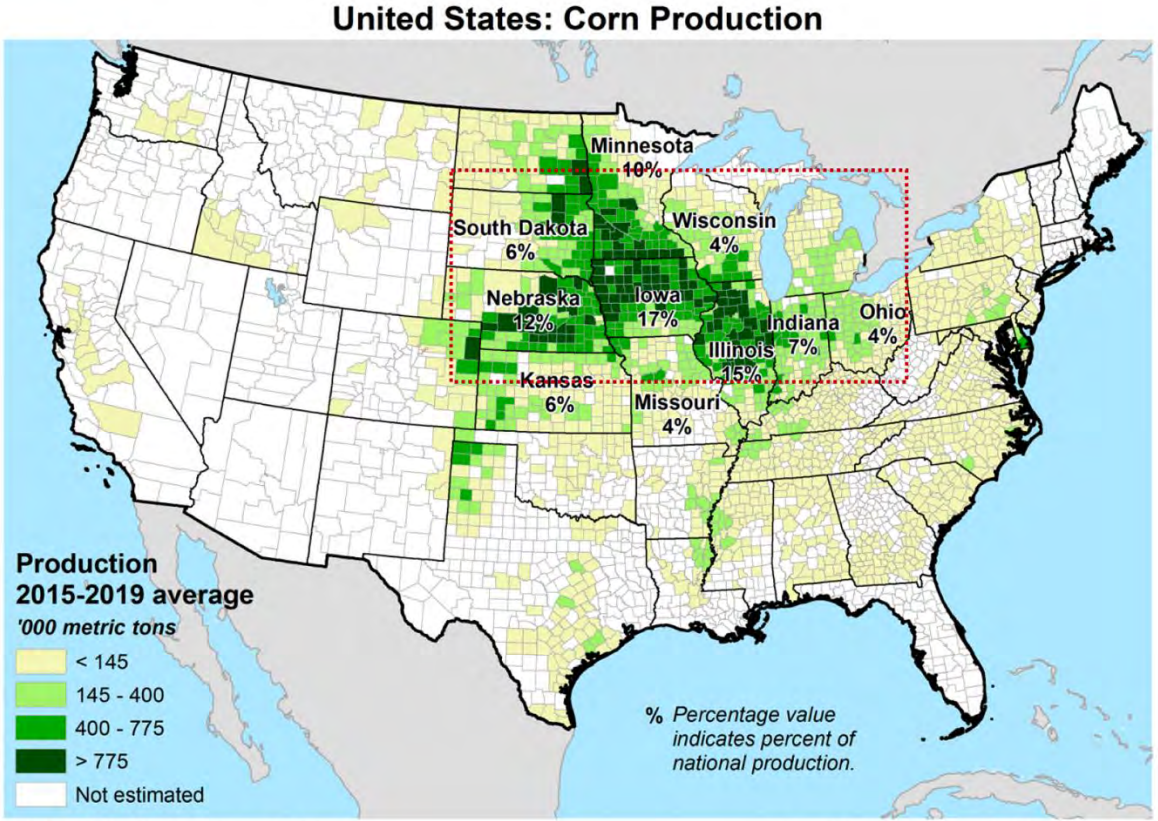
This challenge is **exacerbated by the signal-to-noise problem** in climate models (e.g. Scaife & Smith, 2020)

Here: case study of **seasonal prediction for the maize agriculture sector in central USA** to generate **useful seasonal climate prediction**



Dunstone et al., 2022: https://doi.org/10.1175/BAMS-D-21-0190.1

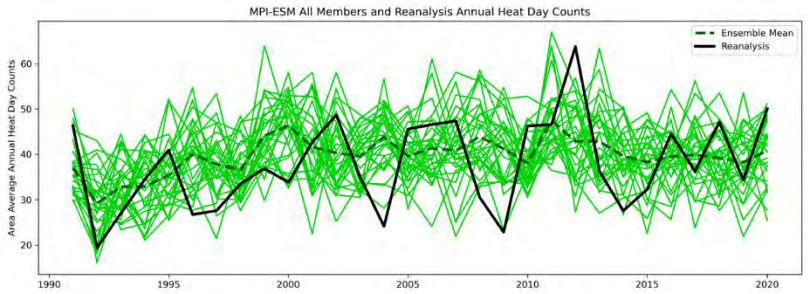
Maize production in the central USA requires heat info in November

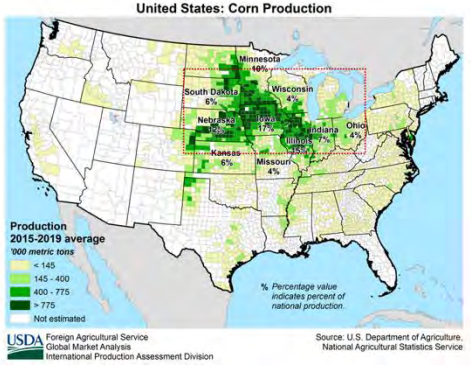


USDA Commodity Explorer, 2024

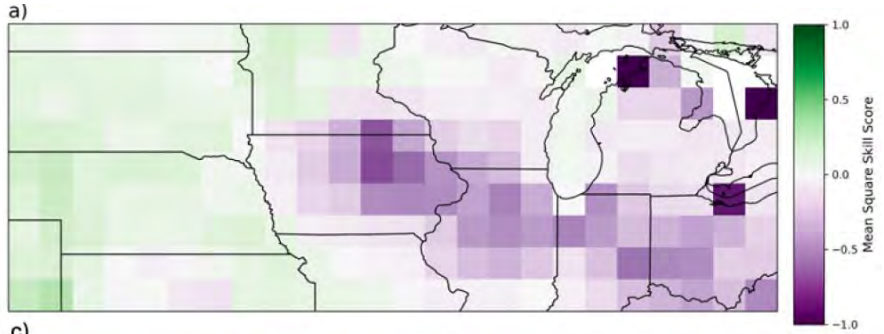
Face-value predictions for hot day counts show no significant skill…

GCFS2.1 seasonal hindcasts, 1991-2020
November → April..August (growing season: GS)
days where Tmax > 29°C

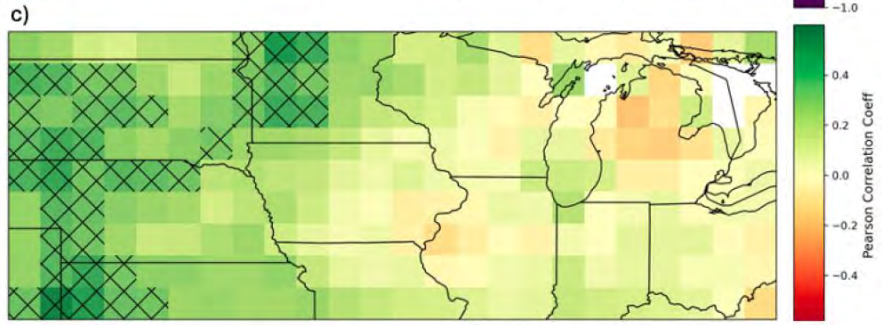




Mean Square Skill Score (MSSS)



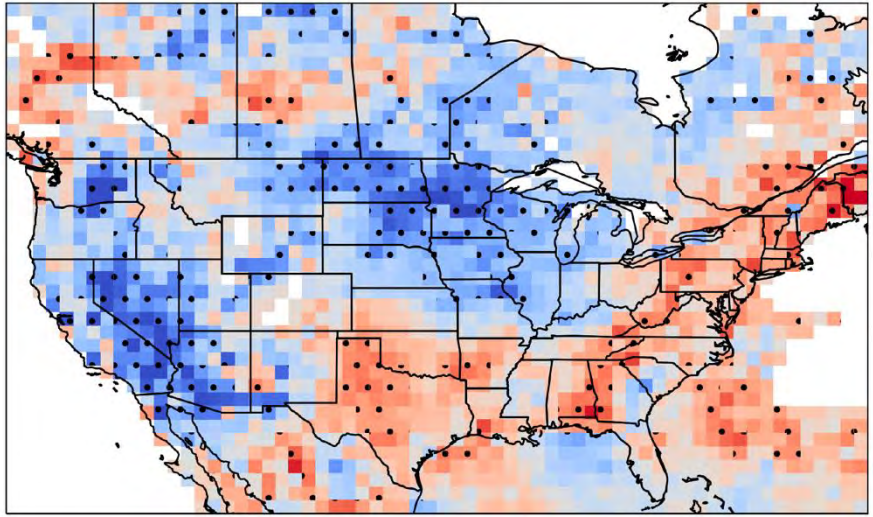
Pearson correlation coefficient (Corr)



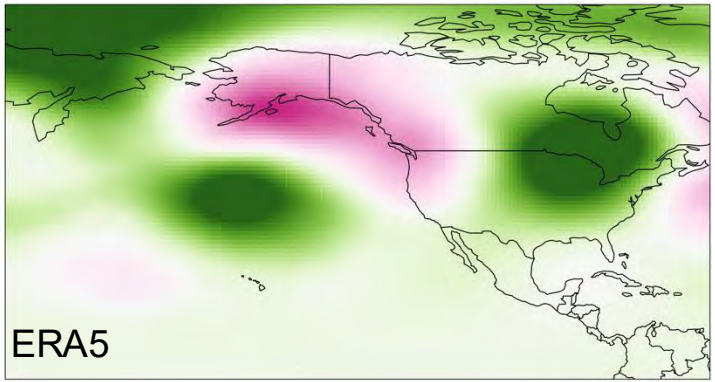
Ensemble Mean \ Reanalysis	Heat Year	Cool year
Heat Year	7	8
Cool year	6	9

…and also get the physics wrong

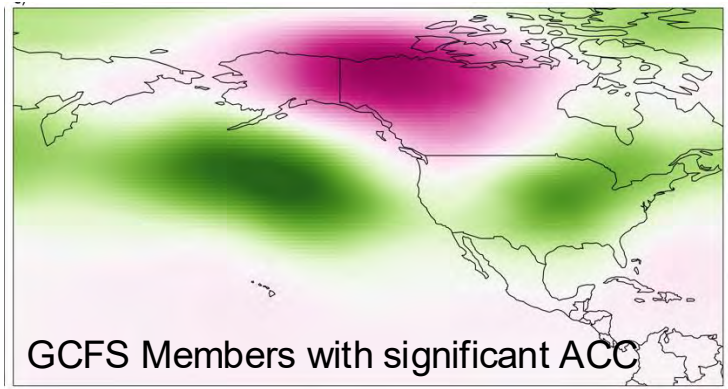
related to soil moisture

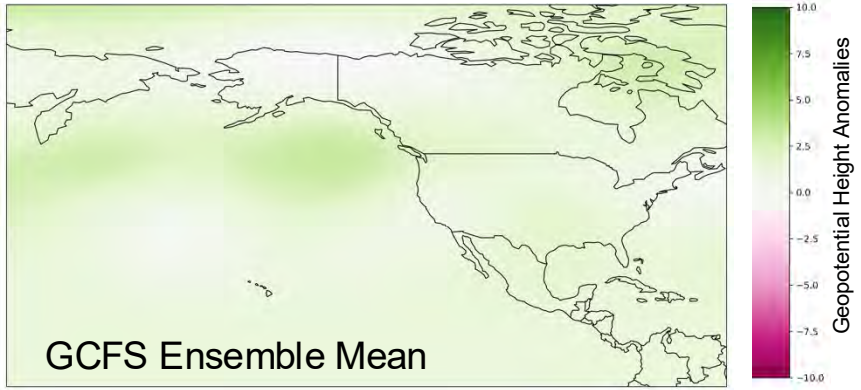


Z500 related to hot GS



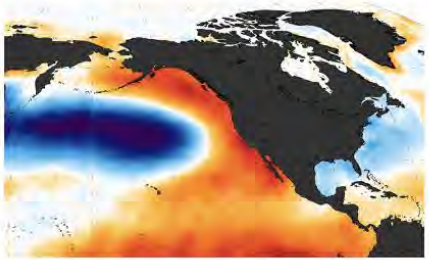
related to Z500





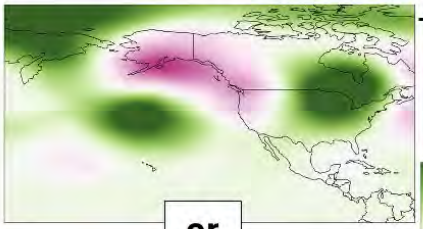
A sub-sampling of ensemble members based on PDO in fall

1. November PDO Index

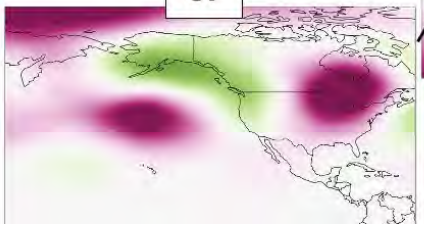


Observed Value

2. 500 hPa Wave pattern

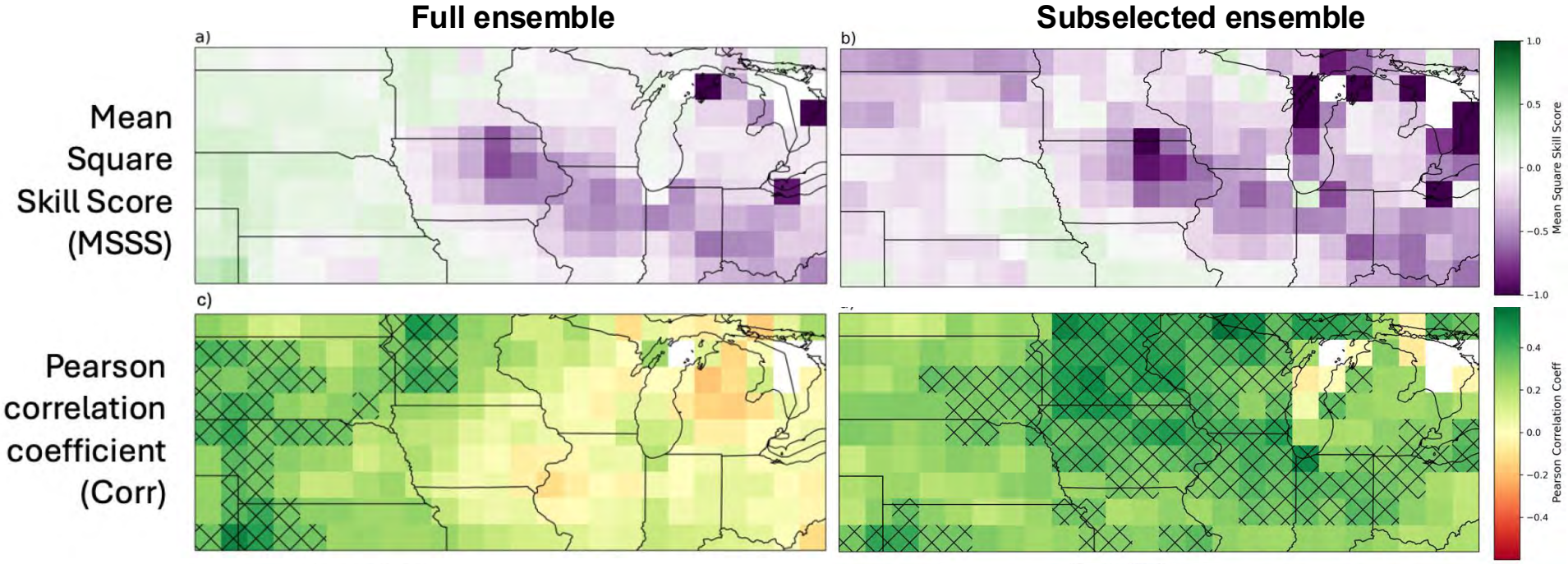


or



Choose pattern corresponding to PDO Index

The subselected ensemble predicts central US hot days skilfully



Reanalysis

Ensemble Mean	Heat Year	Cool year
Heat Year	7	8
Cool year	6	9

Reanalysis

Ensemble Mean	Heat Year	Cool Year
Heat Year	11	5
Cool Year	2	12

Take Home Messages

Providing **usable seasonal hazard predictions** to stakeholders is **tricky**

For hot days in the **central US maize producing regions during growing season**, skill is low

Subsampling based on a physical PDO-Z500 pathway **improves correlation skill**

Physics-based subsampling may alleviate issues with the usefulness of seasonal forecasts

Thanks! Leonard.Borchert@uni-hamburg.de