

SST Green's functions for regional precipitation

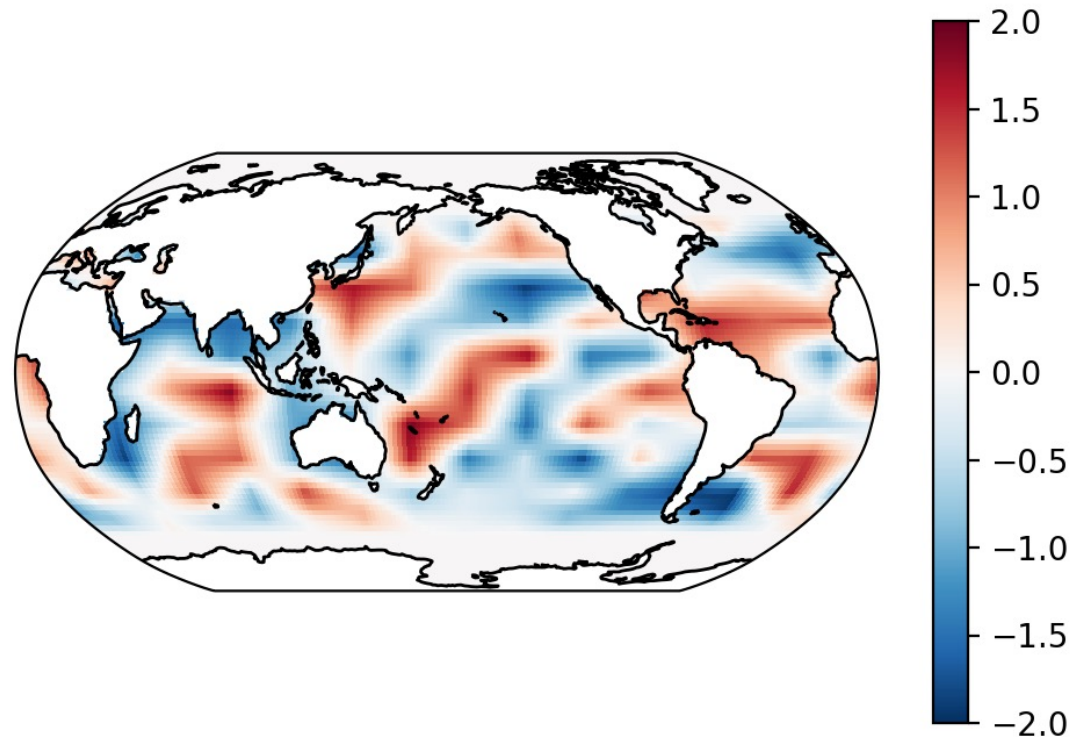
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Intro

- SST Green's function are most often considered in the context of TOA flux changes and the time-evolution of the radiative feedback parameter
- However, we know that SST patterns are important for regional climate and precipitation!
- This work is an initial attempt to gauge the “skill” of a Green's function approach in reproducing historical changes in regional precipitation

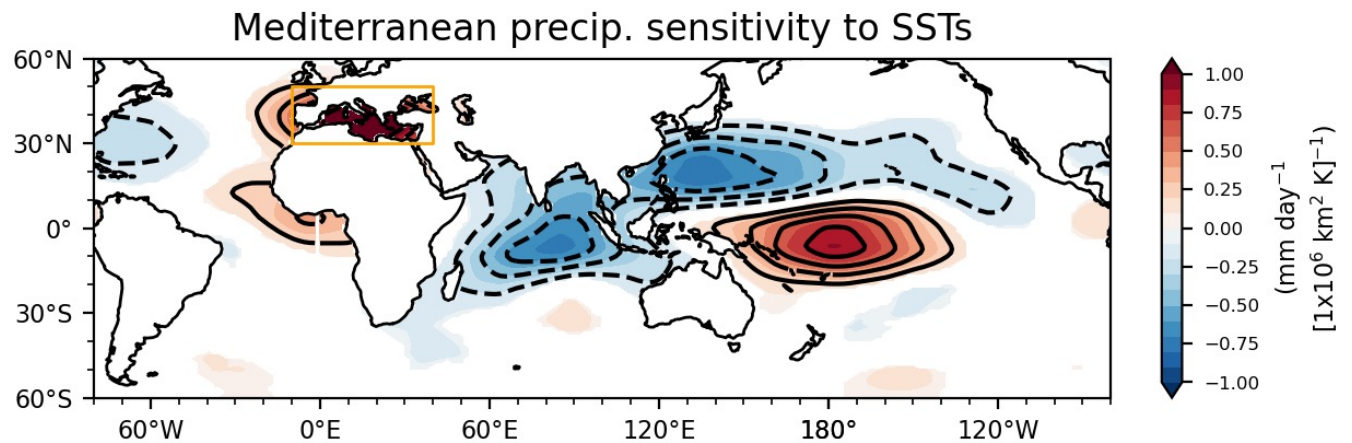
Method: a *climateprediction.net* ensemble

- Data from Baker et al., 2019
- HadGEM atmosphere-only model run 5000 times using distributed computing.
- Each of the 5000 ensemble members is forced with climatological SSTs plus a "random SST perturbation field"
 - like this ----->>>
- These ensemble members can be used to construct a Green's function analogously to that done using 'SST patches'



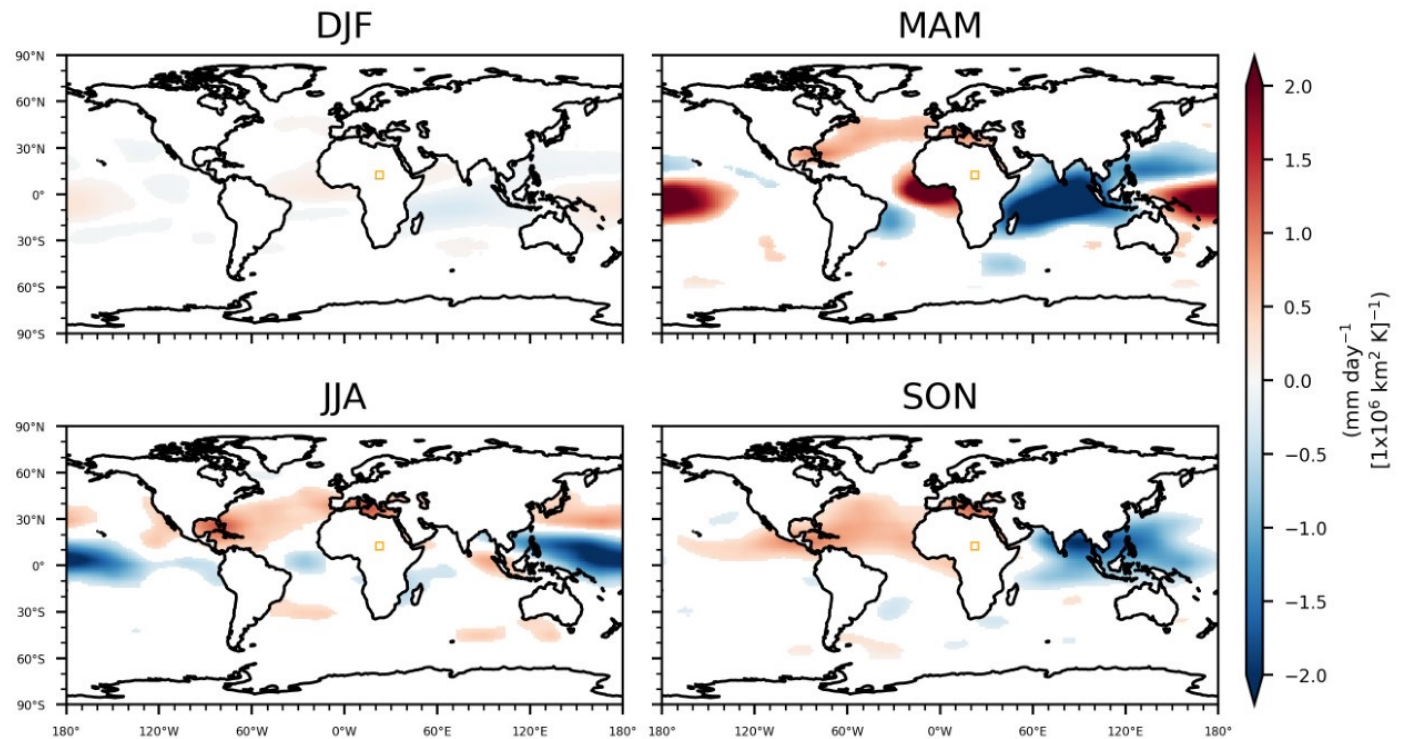
Method

- Essentially, a linear-regression at each gridpoint between the SST anomalies and the change in the 'target variable'
- For example, target variable could be 'average precipitation over the Mediterranean'



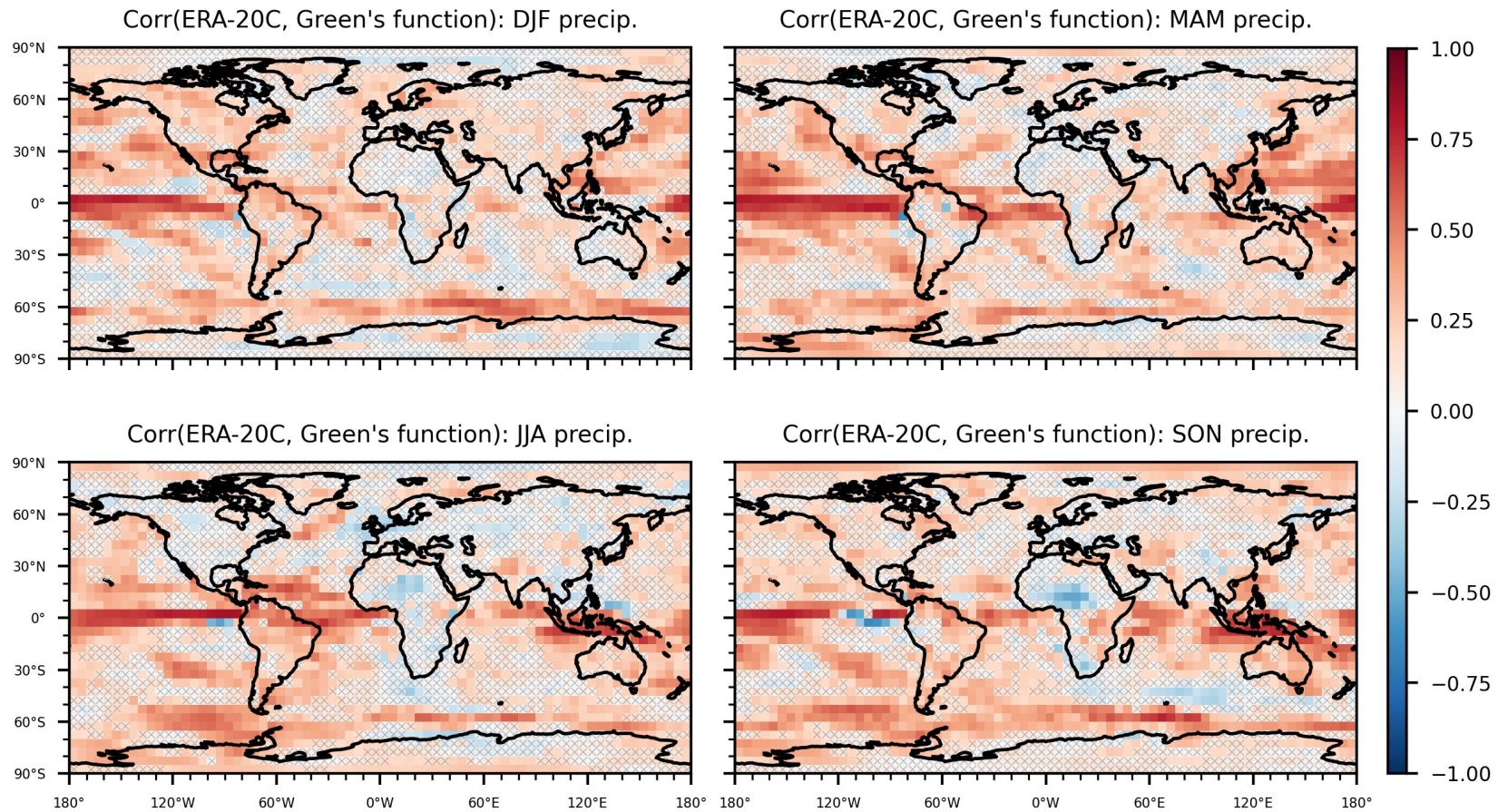
The plots are pretty, but do the reconstructions have *skill*???

- Approach: Generate an SST Green's function for the precipitation in *each 5x5deg grid-box!*
 - E.g., this box over Central Africa
- Then, reconstruct the historical precipitation in that region by multiplying by the HadISST SST data
- Does the reconstructed precip match the reanalysis precip?



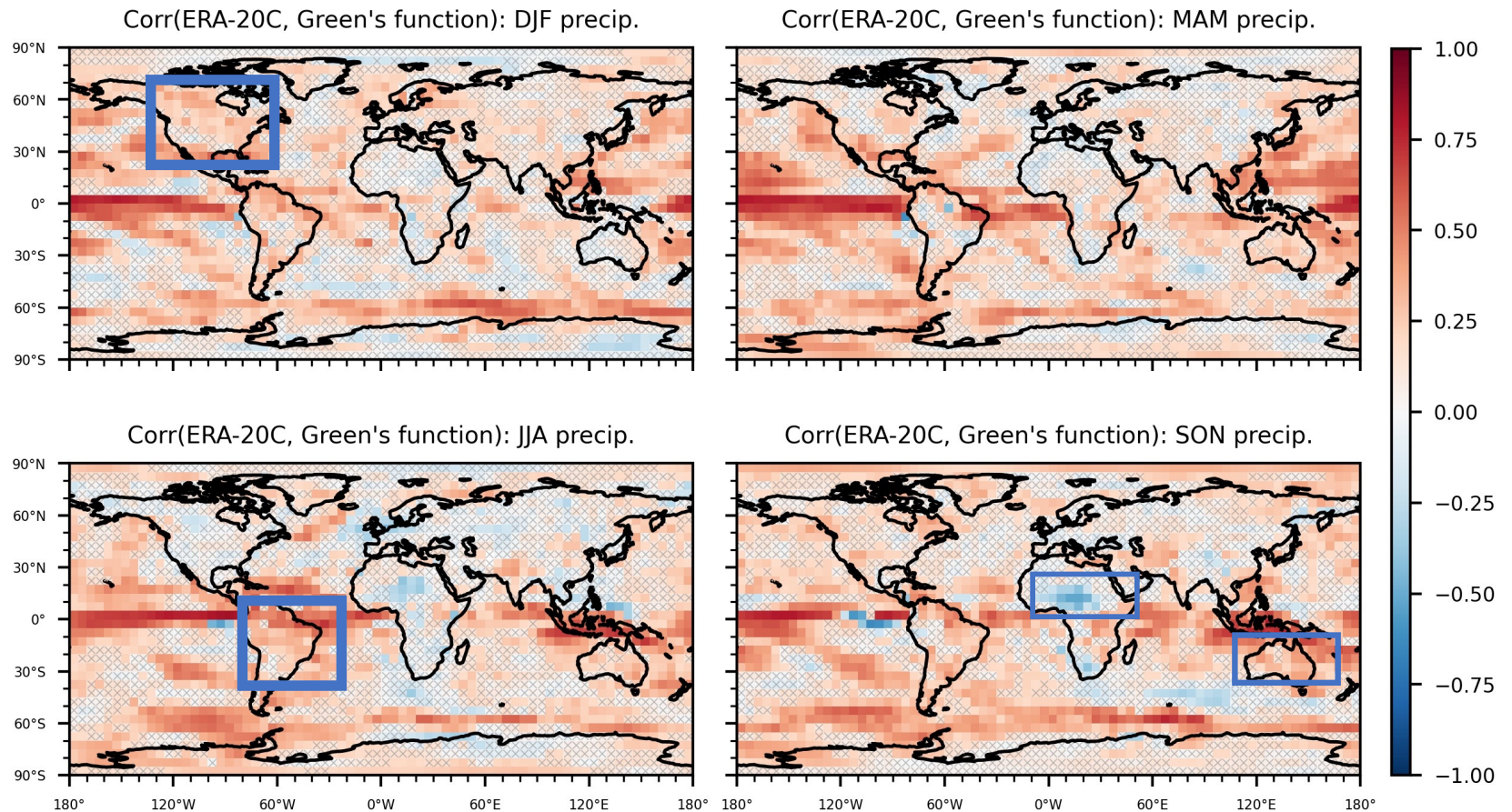
Correlation between HadISST precip reconstructions and ERA-20C

- There's a lot in these plots, but the idea is quite simple
- The color shows the correlation between the reconstructed precip and "true" precip (from ERA-20C) at each 5x5deg gridbox
- Crosses are plotted where the correlation is *insignificant*



Correlation between HadISST precip reconstructions and ERA-20C

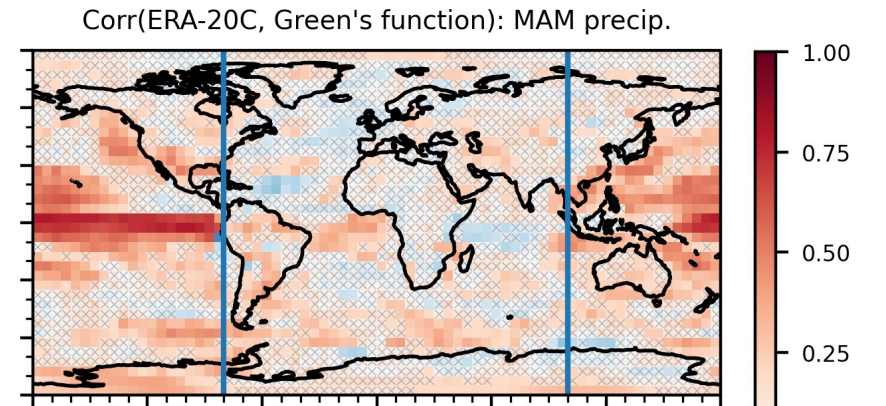
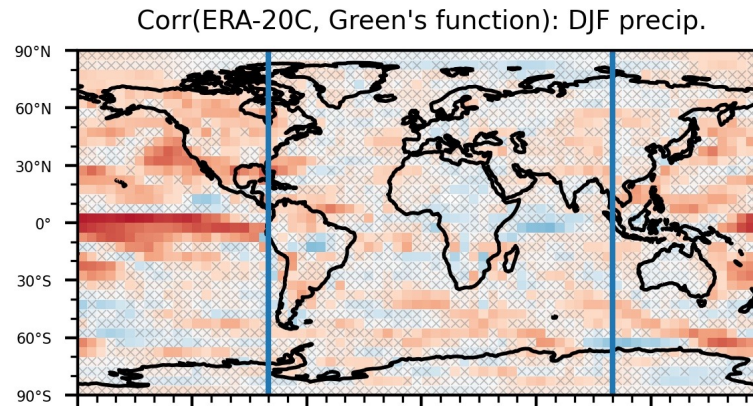
- For some regions, it actually does very well!
- E.g.
- North America during DJF
- South America during JJA
- But there's a negative correlation with Sahel precip?



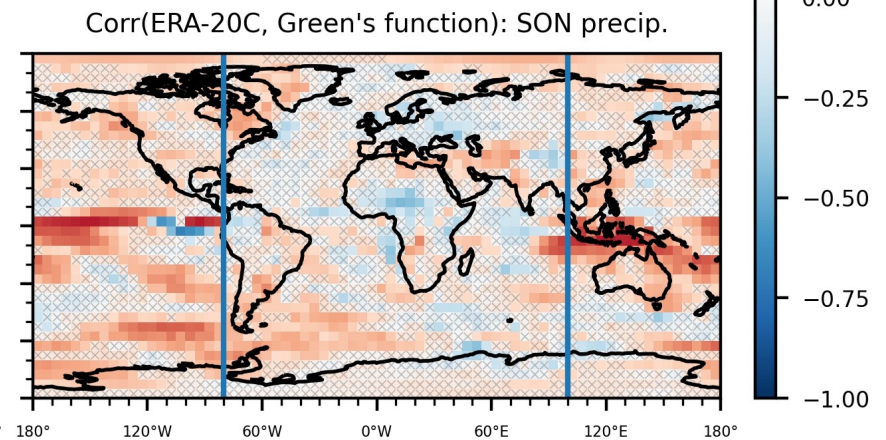
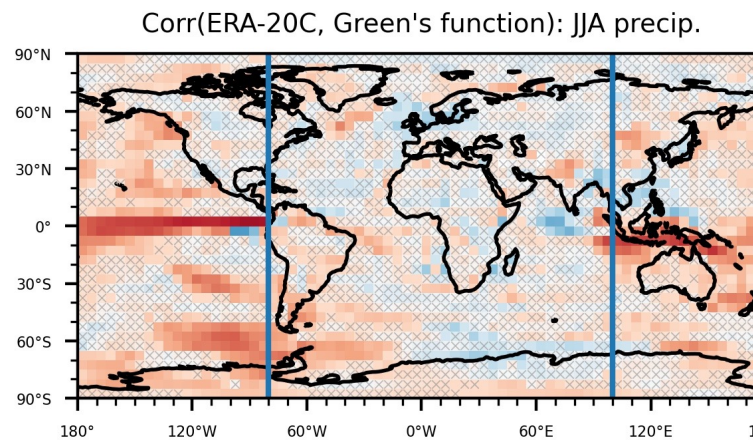
Where is the skill coming from?

Pacific sensitivities only

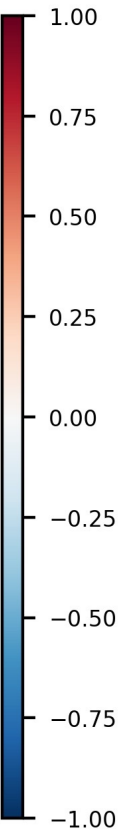
- To isolate where the skill is coming from, we can try reconstructing the precip at each gridbox using the sensitivities from each basin.



- Here is this skill coming from the Pacific basin.



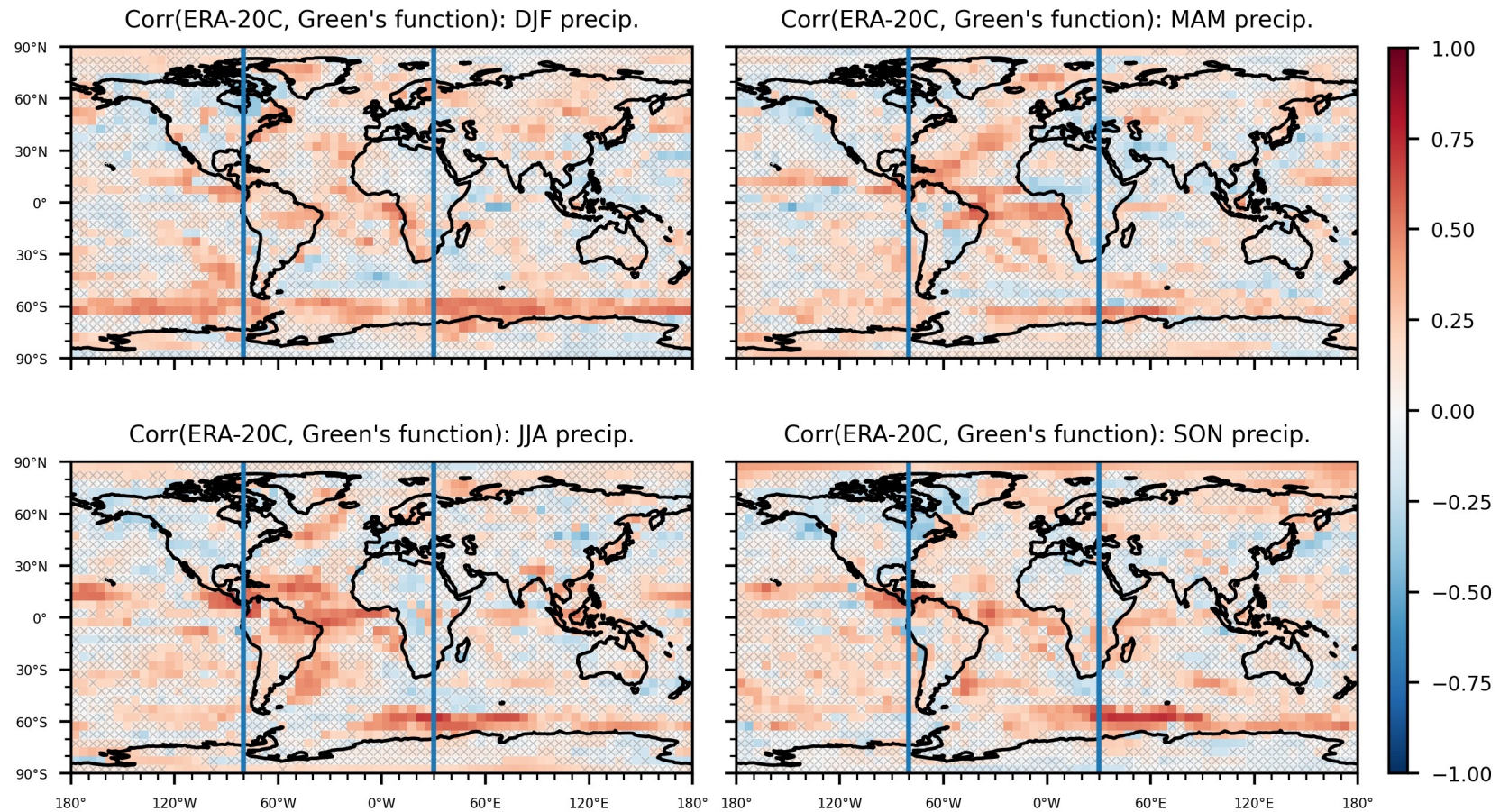
- (Practically, I've just zeroed out the Green's function everywhere outside of the Pacific)



Where is the skill coming from?

- The Atlantic basin mostly gives skill locally, particularly during JJA

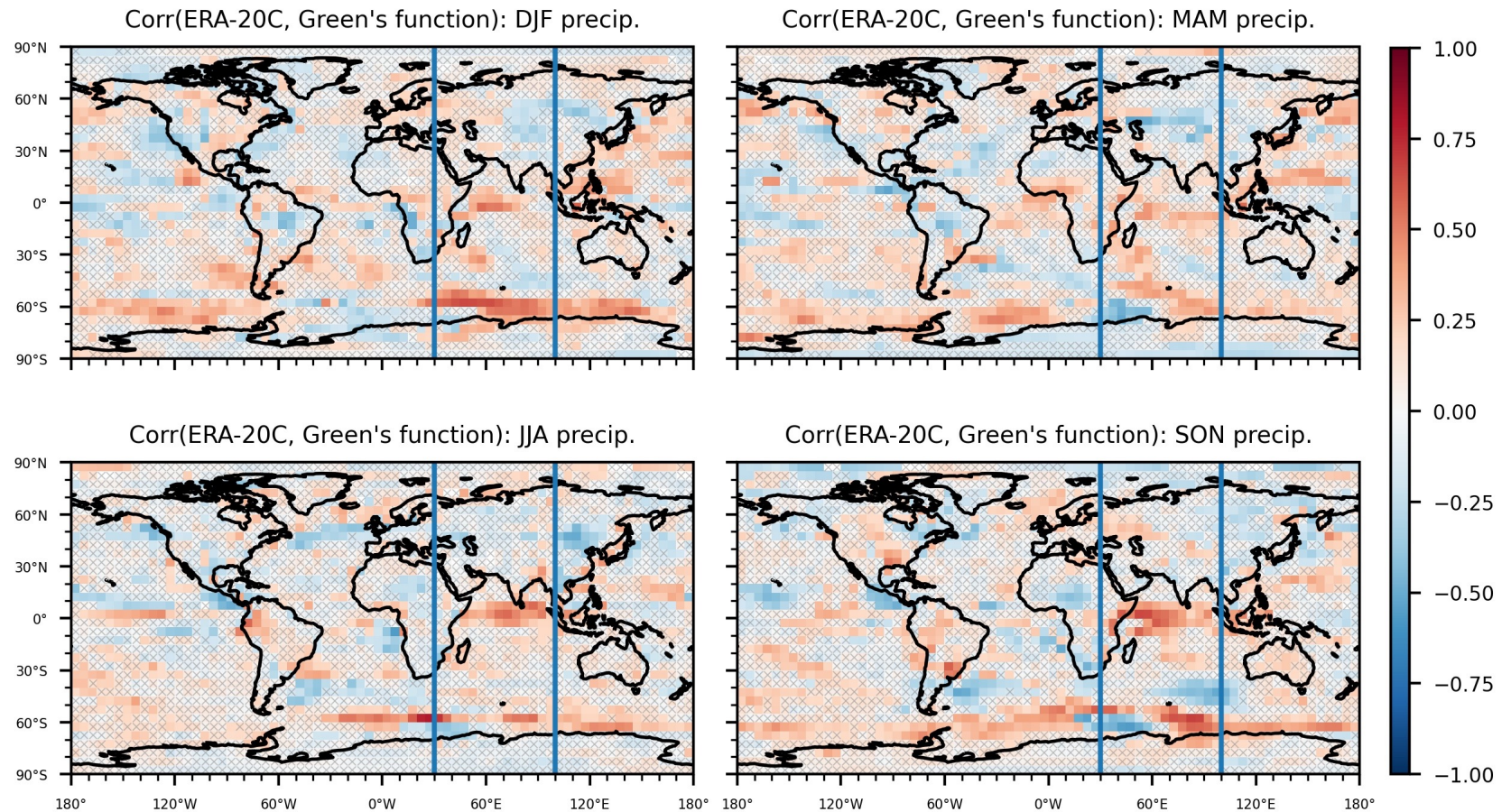
Atlantic sensitivities only



Where is the skill coming from?

- The Indian Ocean actually drives a lot of 'spurious' skill (i.e., predicts anomalously wet years, when in reality it was anomalously dry)

Indian Ocean sensitivities only



Conclusions

- It seems like this approach has a reasonable skill, particularly in the tropics and when focusing on individual seasons.
- More work is needed to establish whether the mechanisms driving this skill are physically plausible, and whether the Green's function approach also works well for climate change.
- Also, does this approach work well with the SST patch approach? Perhaps GFMIP can help out with this!

Any questions? Please do reach out! 😊

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