How Global Warming Changes the Difficulty of Synoptic Weather Forecasting

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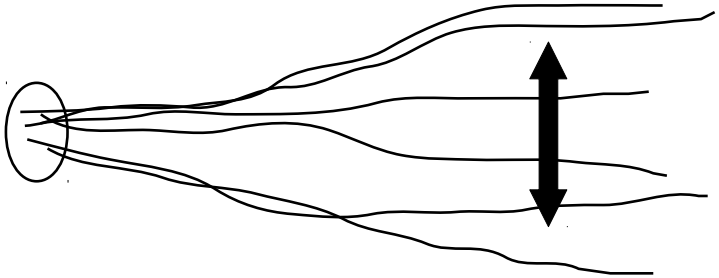

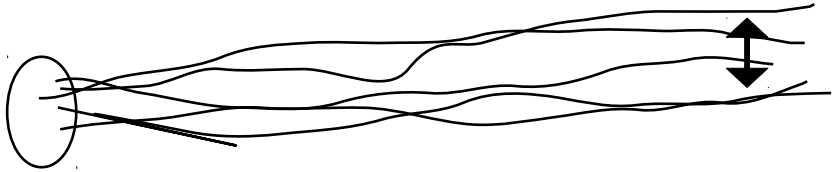

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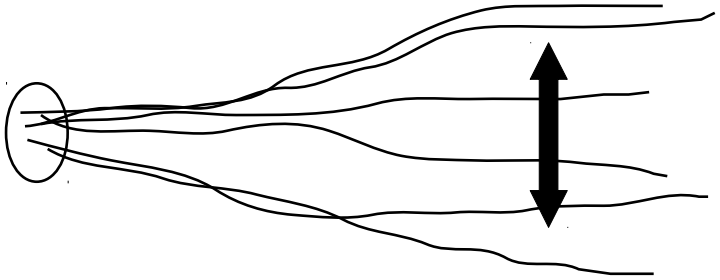
Overview

- Weather forecasts are inherently uncertain
- Is this inherent uncertainty different in a warmer future climate?
- We “measure” the intrinsic uncertainty via the spread of an ensemble forecast

high spread (stdev)
large forecast uncertainty
low (practical) predictability
“small errors matter more”



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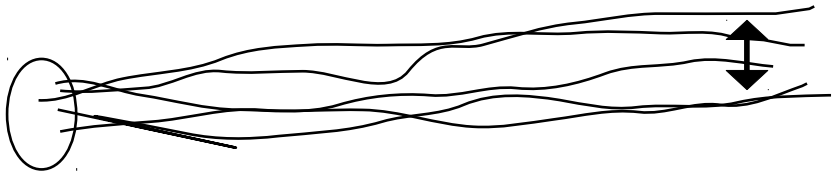
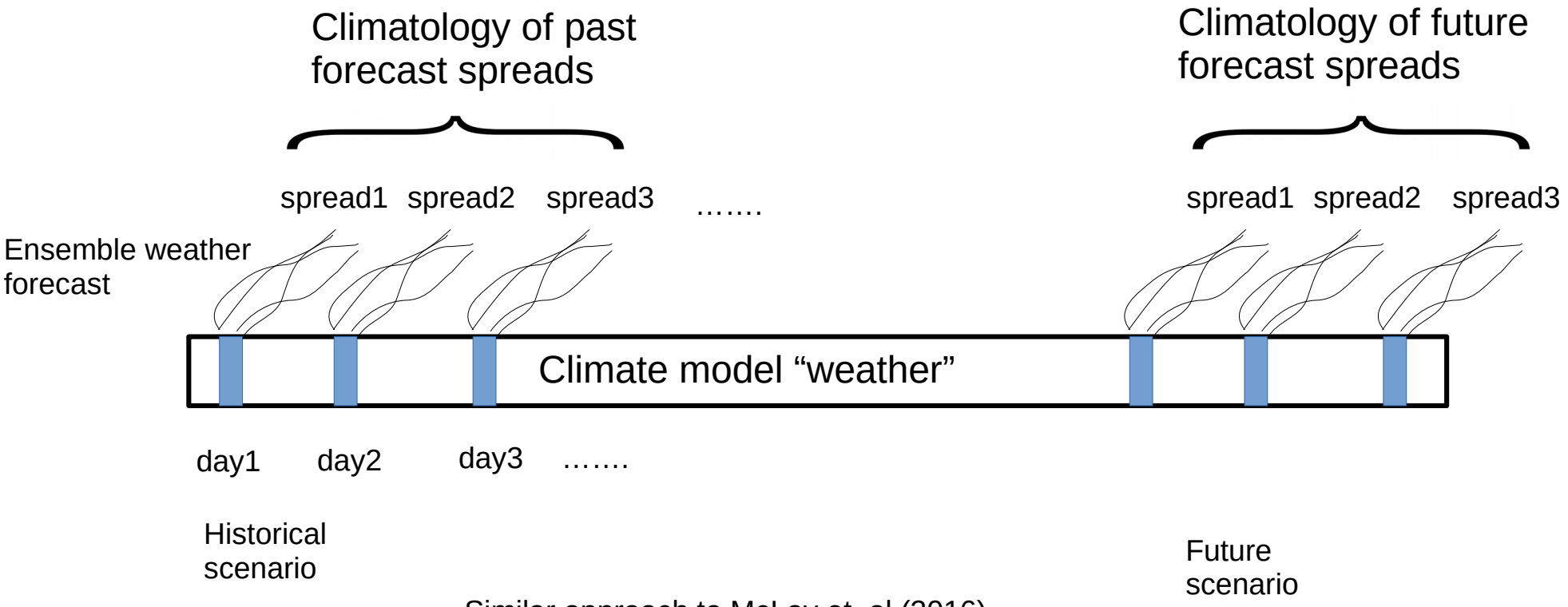


Method

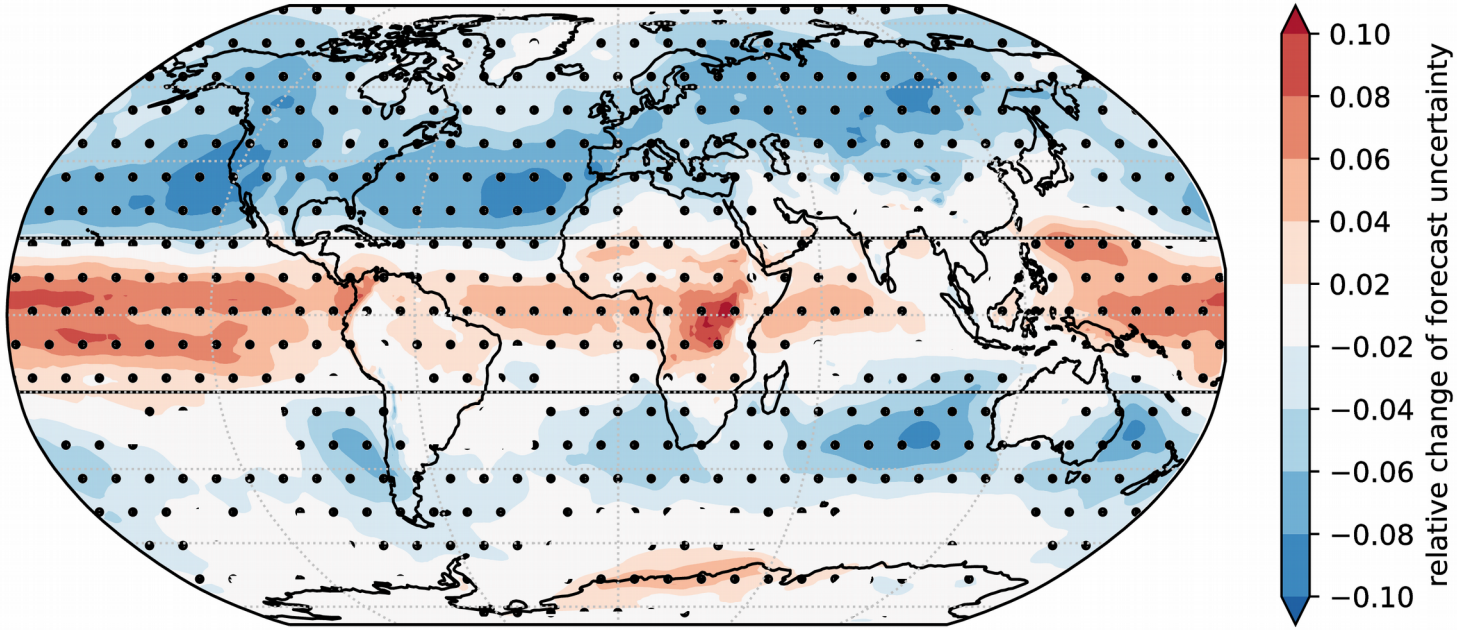
- Combine a climate model with an ensemble weather prediction model
- For every day in the climate model, make a 10 day 10 member ensemble forecast
- Compute the spread of every forecast as proxy for the intrinsic uncertainty



Similar approach to McLay et. al (2016)

Results

Change in spread of mean sea level pressure (future – historic) for 6 day forecast



→ Decrease in uncertainty in the extratropics, especially in the NH, increase in the tropics.

Per season

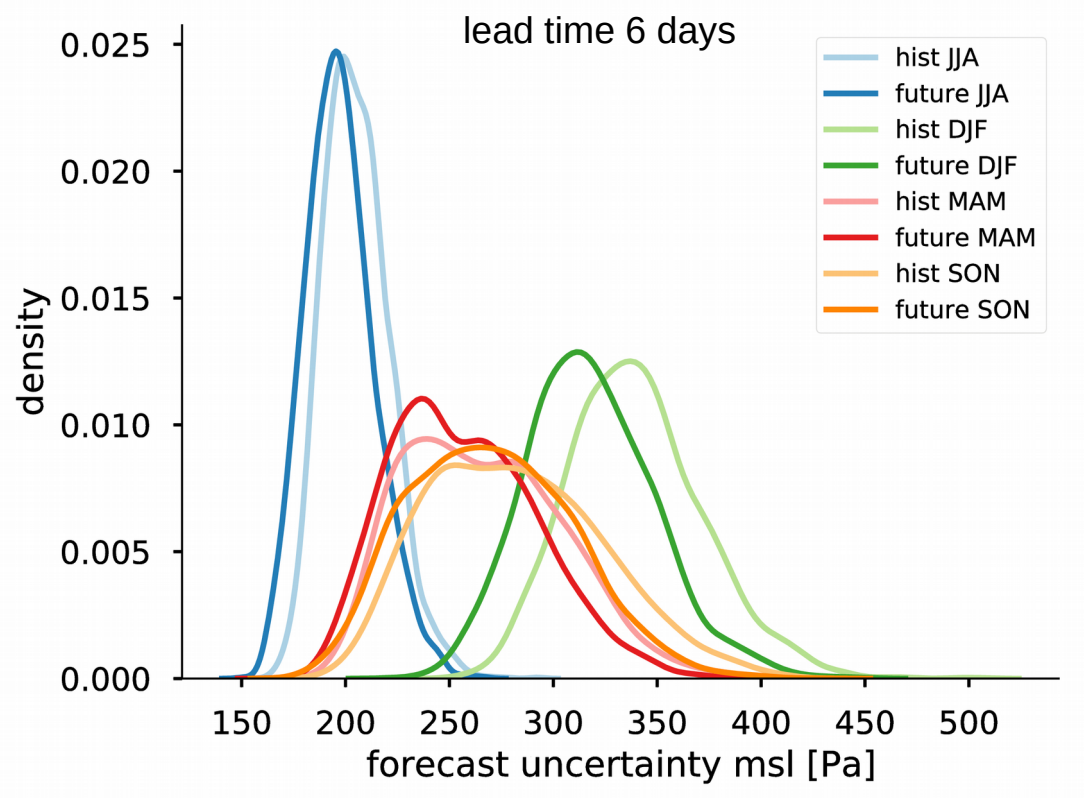
Pdf of daily forecast uncertainties for the NH extratropics, split up by season, and separately for the future and the historic scenario

→ Decrease in all seasons

→ “shift” of the distribution, only position does change, but not the shape.

→ results similar for other lead-times

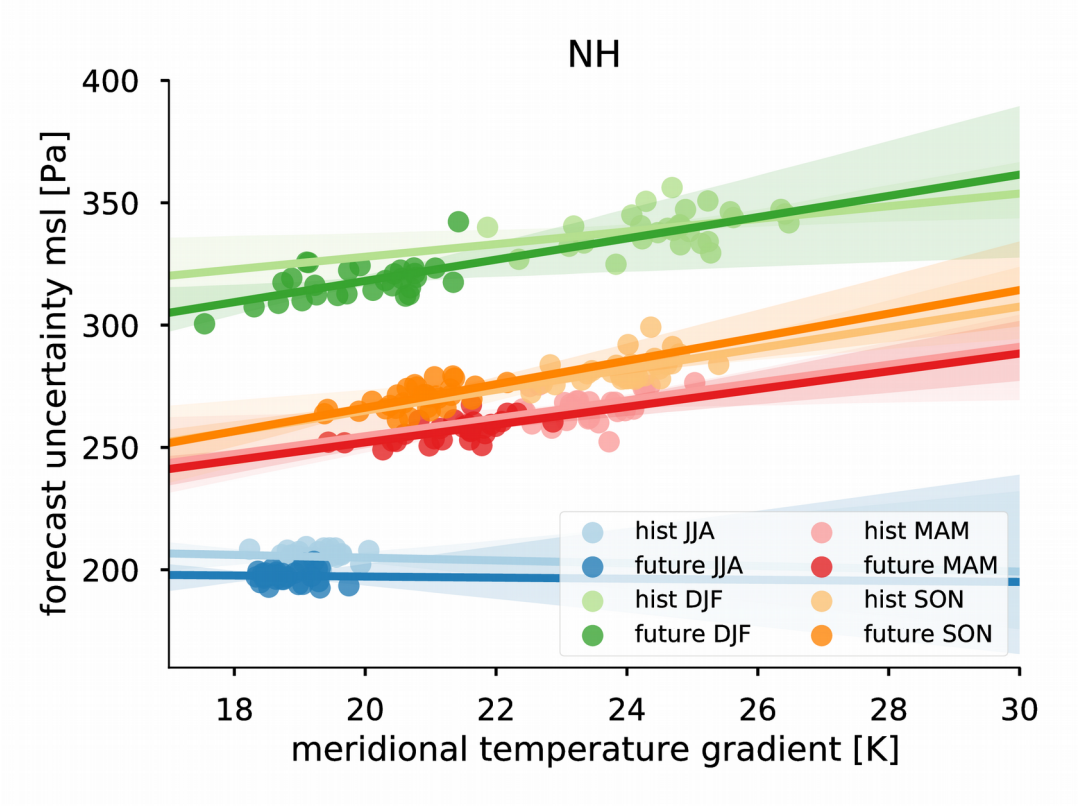
→ the typical spread of a 6-day forecast in the present climate will in the future be only reached at ~ 6+1/3 day



Explanation

- The decrease in forecast uncertainty in the NH can be attributed to the meridional temperature gradient, which is projected to decrease in the NH

Within the historic scenario, there is a correlation between the mean temperature gradient in a season and the average forecast uncertaitny in that season. This relation extrapolates to the future scenario.



Summary

- Q: (How) does global warming affect the intrinsic uncertainty in weather forecasts?
- Result: decrease of intrinsic uncertainty in extratropics, especially NH
- Explanation: decrease in meridional temperature gradient

References

- Scher, S., & Messori, G. (2019). How global warming changes the difficulty of synoptic weather forecasting. Geophysical Research Letters, 46, 2931– 2939. https://doi.org/10.1029/2018GL081856
- McLay, J. G., Reynolds, C. A., Satterfield, E., & Hodyss, D. (2016). Changes to intrinsic weather forecast uncertainty in one scenario of extreme future climate. Quarterly Journal of the Royal Meteorological Society, 142(698), 2102–2118. https://doi.org/10.1002/qj.2806