How Global Warming Changes the Difficulty of Synoptic Weather Forecasting

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Thanks to: Erland Källén and Rodrigo Caballero


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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

![Diagram showing high spread (stdev) with large forecast uncertainty, low (practical) predictability, and “small errors matter more”.](image1)

![Diagram showing low spread (stdev) with small forecast uncertainty, high (practical) predictability, and “small errors matter less”.](image2)
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 uncertainty in that season. This relation extrapolates to the future scenario.
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
