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GLOBAL ANALYSIS OF SIMULATED 21st CENTURY CHANGES IN DAILY TEMPERATURE VARIABILITY

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DAILY TIME SCALE?

Estimating the changes in the variability is very important for the users of the climate data. For high-frequency variability, daily resolution data is needed. However, the data analysis process might be very time consuming if compared to the monthly data. Is doing this technical work worth the effort? Does the used ensemble contain enough useful information? Could we not just use monthly data?

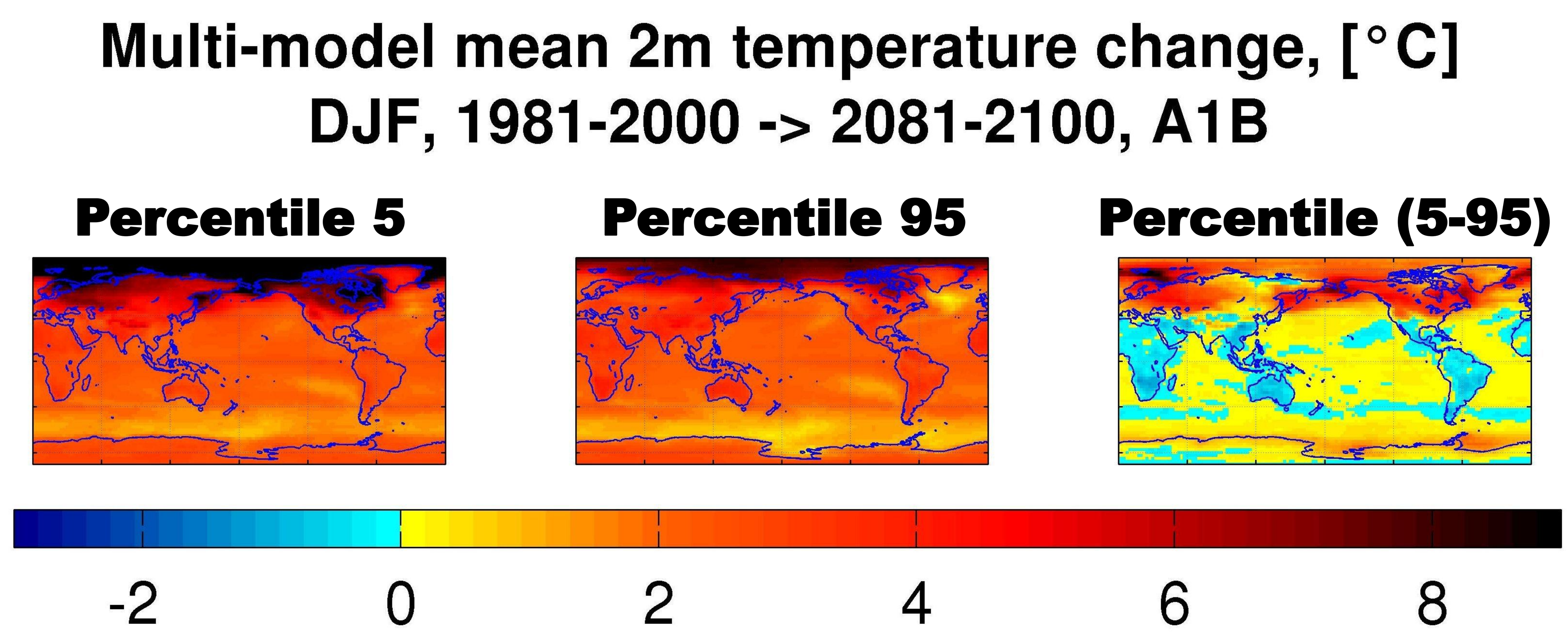
HIGH LATITUDES – HIGH VARIABILITY

The 21st century temperature changes in the Northern high latitudes are expected to be very strong compared to many other areas over the world, especially in the winter (top figure) when the daily temperature variability is the largest. After homogenizing the data into common 2.5° x 2.5° grid and removing the annual cycle of the temperature, CMIP3 models simulate temperatures at the lower end of the daily mean temperature distribution to increase more than at the higher end. This is illustrated as the difference in the change between the percentiles 5 and 95 (top figure, right panel).

REDUCED VARIABILITY?

For zonally averaged multi-model mean values, temperature is projected to increase in every part of the distribution and for all seasons. Middle figure illustrates the projected changes in variability. On high latitudes we note:

- Variability decreases on annual time scale: Winters are warming more than summers.
- Variability decreases on daily time scale: The coldest (warmest) temperatures increase more (less) than the mean values. Locally on summer over mid-latitudes, this is vice versa (e.g. Australia and South Africa in top figure).
- The larger mean temperature increase during the local winter and autumn corresponds with the larger reduction in the variability. Cryospheric feedbacks seem to be dominant features.



Global maps of simulated multi-model mean winter daily mean temperature change during the 21st century. The figure is drawn using data from 15 CMIP3 models.

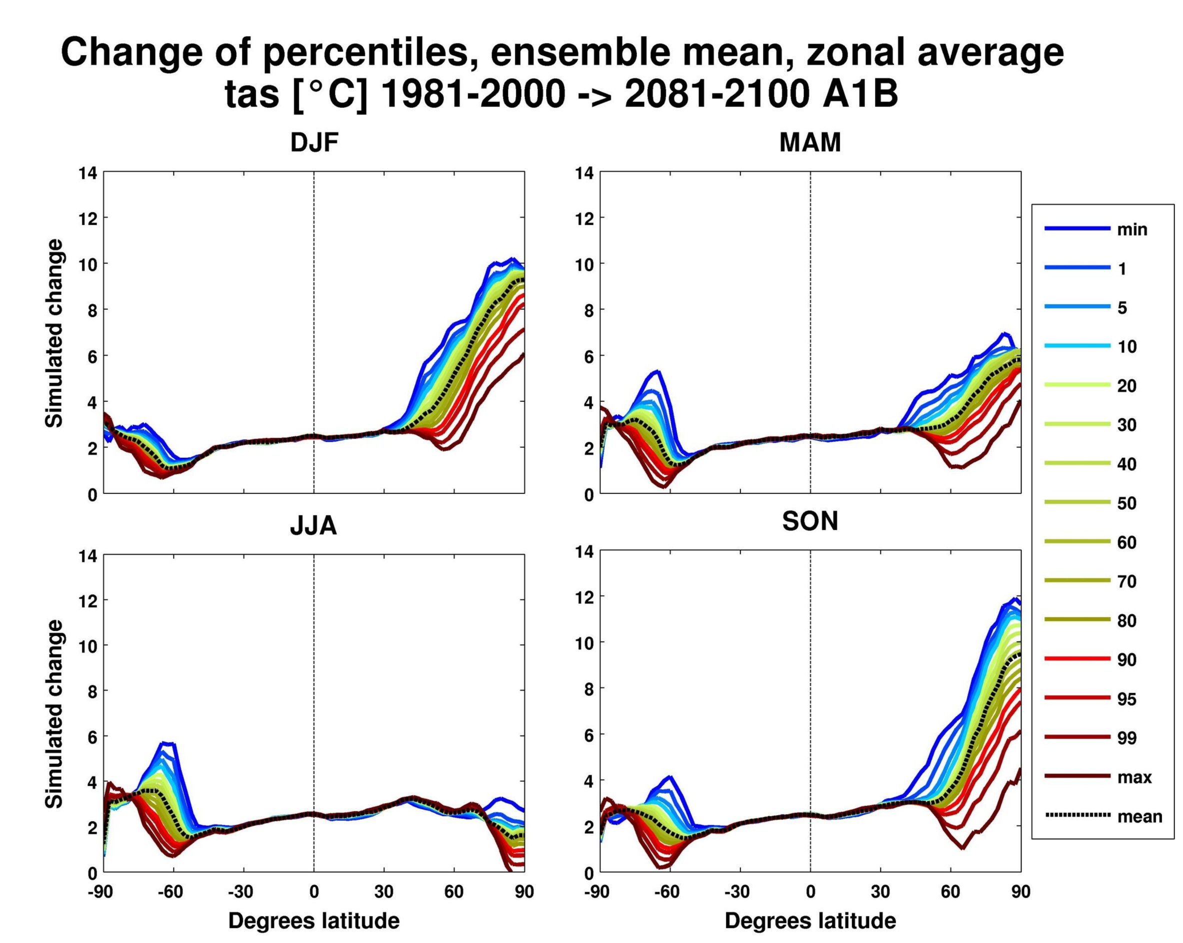
For zonally averaged values at lower latitudes, temperatures are expected to increase very uniformly throughout the temperature distribution. This indicates negligible benefit in using the daily resolution data and the user could choose to facilitate his/her analysis by using monthly data.

ROBUSTNESS?

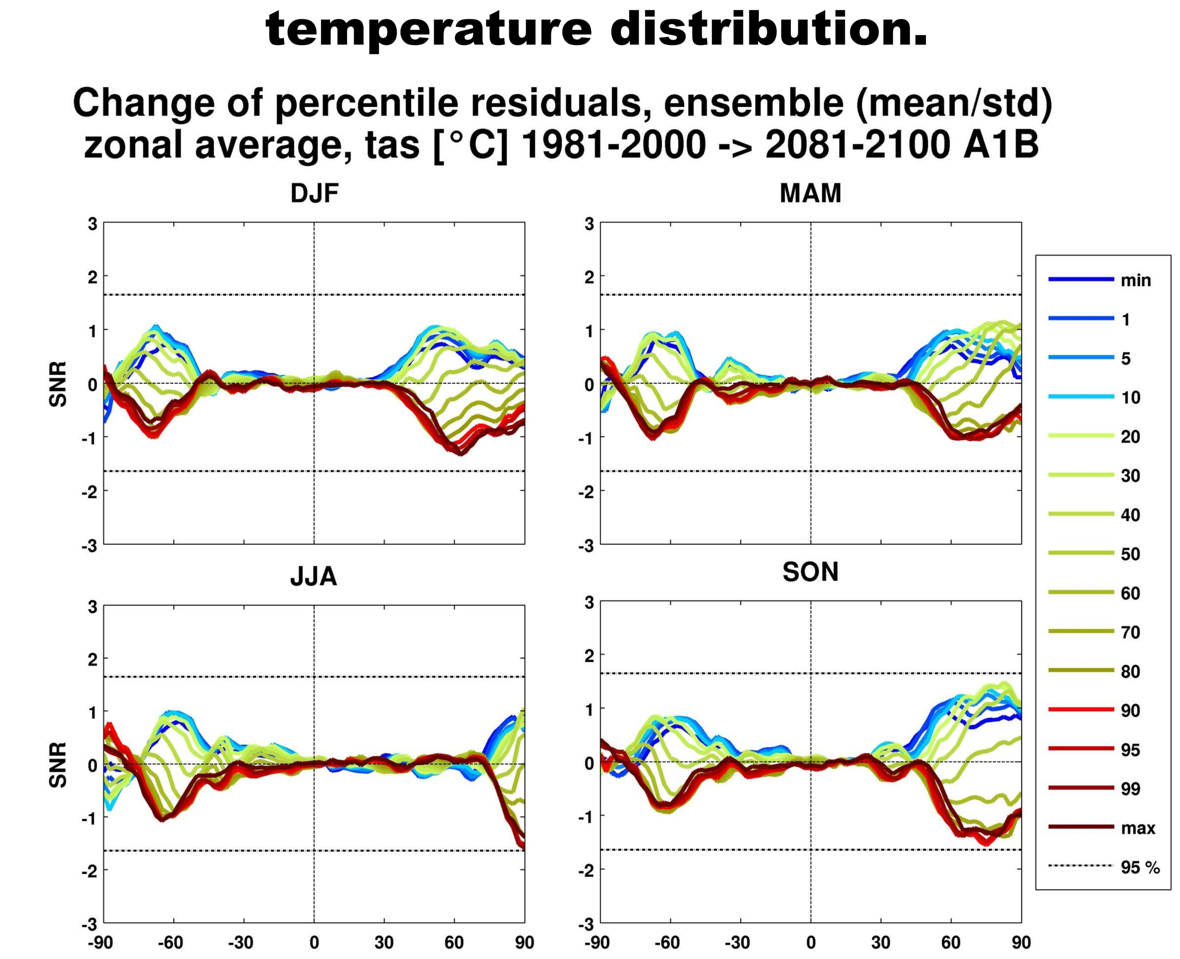
From multi-model mean values in middle figure we do not know how robustly the different CMIP3 models in simulate these results. For this, lower figure presents the signal-to-noise ratio, SNR, (multi-model mean divided by inter-model standard deviation) of the percentiles:

First, percentile residuals in a certain season were obtained by subtracting the mean temperature change from the simulated change of a certain percentile. For these values, gridded signal-to-noise ratios were calculated. Zonal averaging was done last. The lower figure contains also the sign of the residual change compared to the mean change. For percentiles increasing more (less) than the mean value, SNR values are above (below) zero.

- The most robust signal in the ensemble is seen over the high latitudes, where the daily variability decreases. On Northern Hemisphere the high values of SNR extend to higher latitudes.
- On Northern Hemisphere SNR has more annual variability than on Southern Hemisphere. Absolute values are the largest in local autumn and winter, the smallest in summer.
- 95% confidence interval (assuming independent, normally distributed simulations) is not exceeded anywhere.



Zonal averages of the simulated 21st century changes in daily mean temperature distribution.



Temperature distribution changes. Zonal averages of the signal-to-noise ratio (multi-model mean / inter-model standard deviation)