

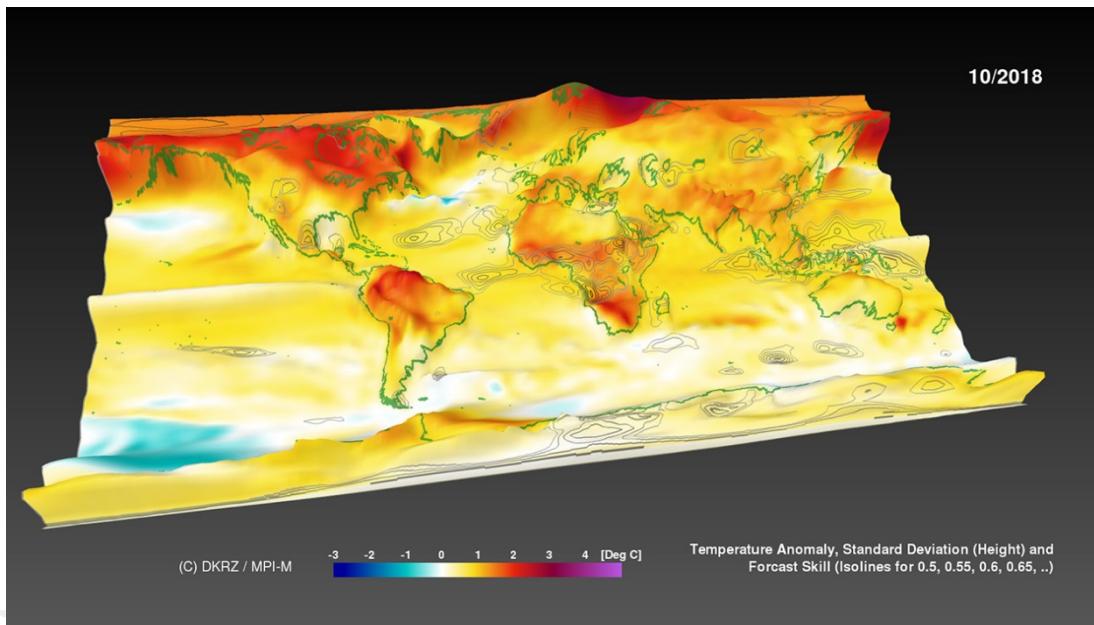
Visual Analysis of time-dependent 2D Uncertainties in Decadal Climate Predictions

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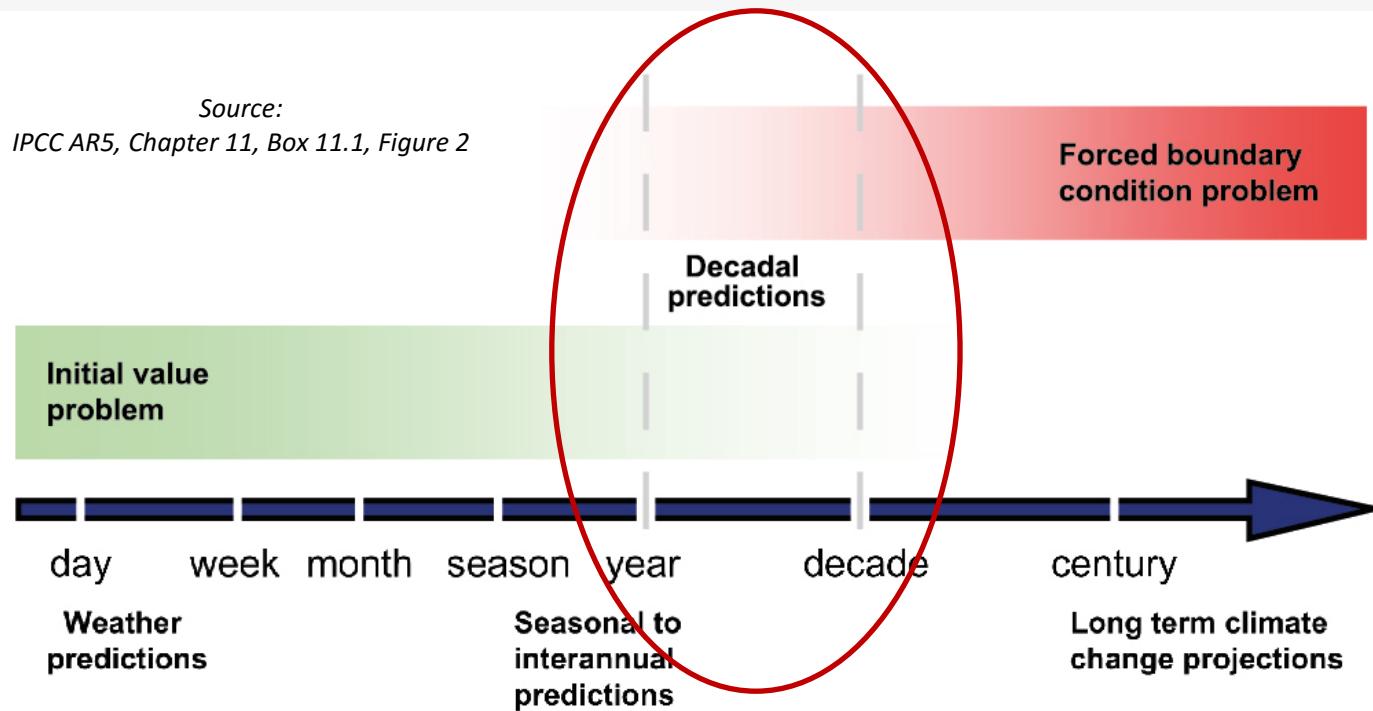
Deutsches Klimarechenzentrum (DKRZ)

Holger Pohlmann

Max Planck Institute for Meteorology



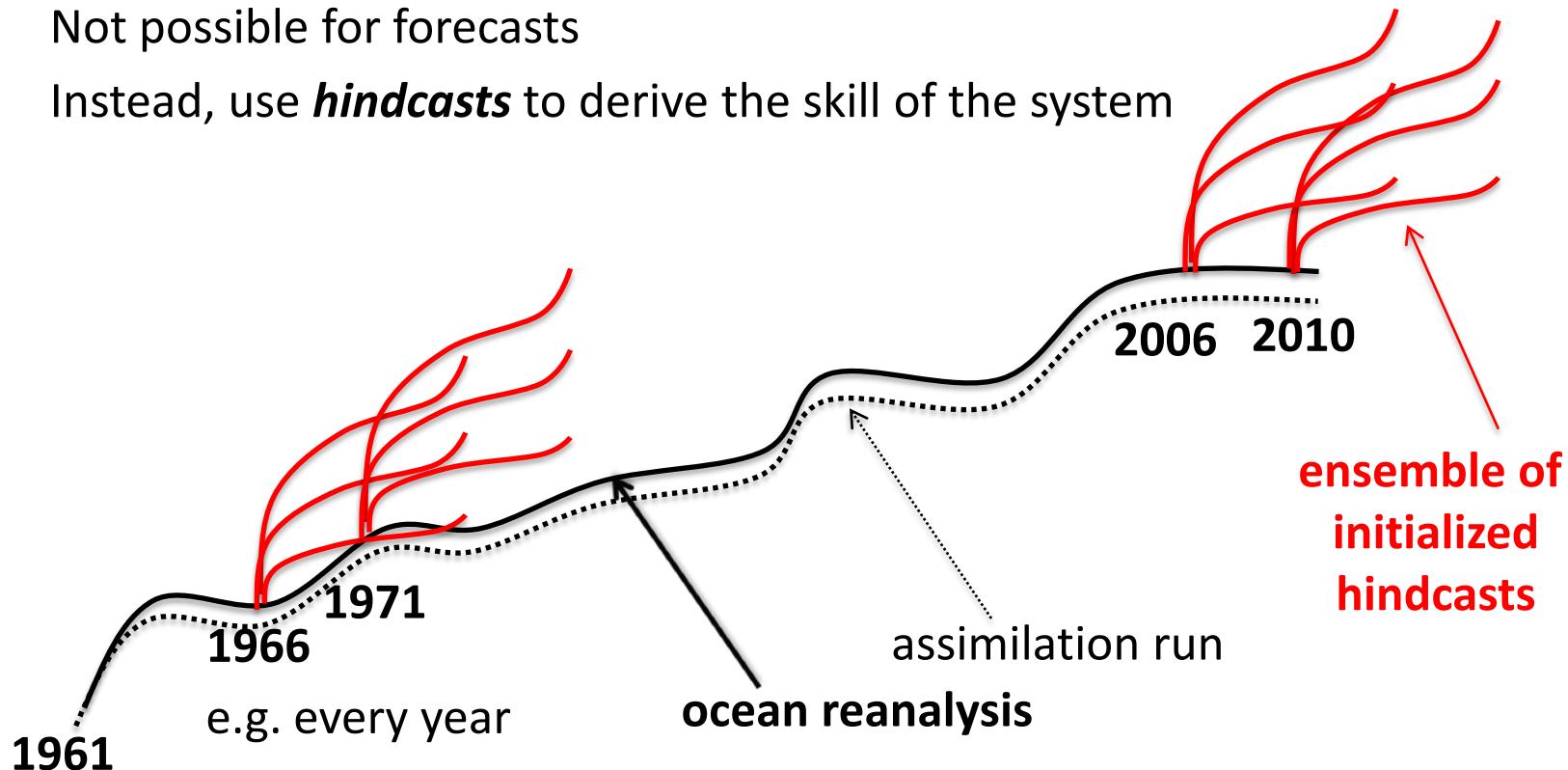
Decadal Climate Predictions



- Aim: predict natural **internal variability** over the next few years
- Forecast System:
 - Earth System Model
 - Initialization with observations (Atmosphere, Ocean, Sea Ice, Land, ...)
- Assess the uncertainty via ensemble simulations

Decadal Climate Predictions

- Verification of climate predictions?
- Not possible for forecasts
- Instead, use ***hindcasts*** to derive the skill of the system



Slide: Thanks to Iuliia Polkowa, Institute of Oceanography, University of Hamburg

Multivariate 2D Visualizations used in the Domain

Quantify success: RMS Skill Score (color) and Significance > 95 % (black dots)

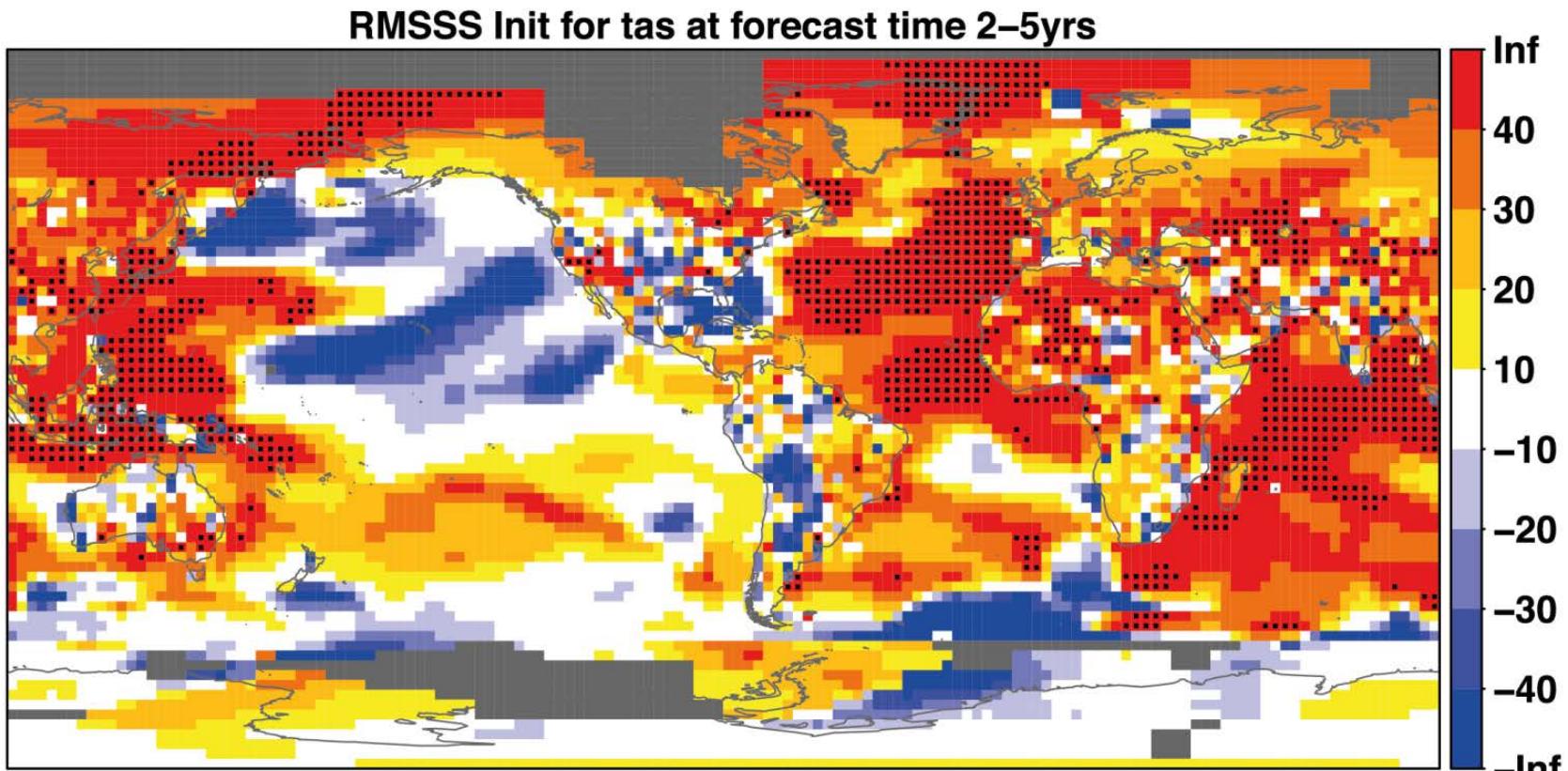


Figure shows temporal mean for year 2-5.

- Only limited information on the spatio-temporal structure of the skill!
- Only one threshold value visualized

The Data used

- 3 Quantities
 - **2m temperature anomalies** over 2014-2023, ensemble mean (12 months running mean)
 - **Predictive skill:** Pearson's correlation between prediction and reanalysis (based on hindcasts)
 - **Ensemble standard deviation**

Model system

MiKlip Baseline 1

MPI-ESM Earth System Model (T63L47 /1.5 deg L40)

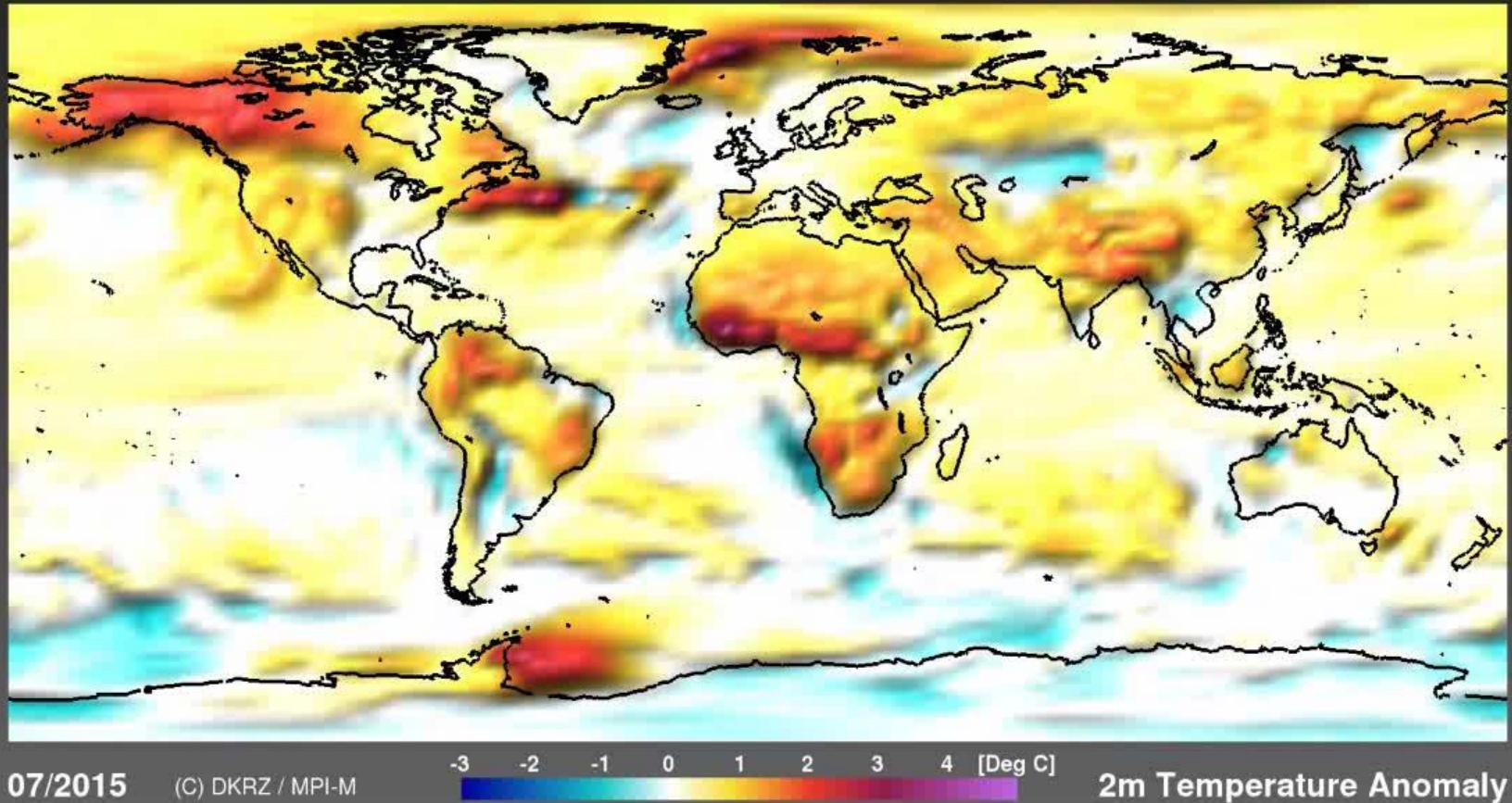
Initialization with ORAS4 ocean reanalyses (T & S anomalies), ERA40/ERA-Interim

Yearly initialization for 1961-2010

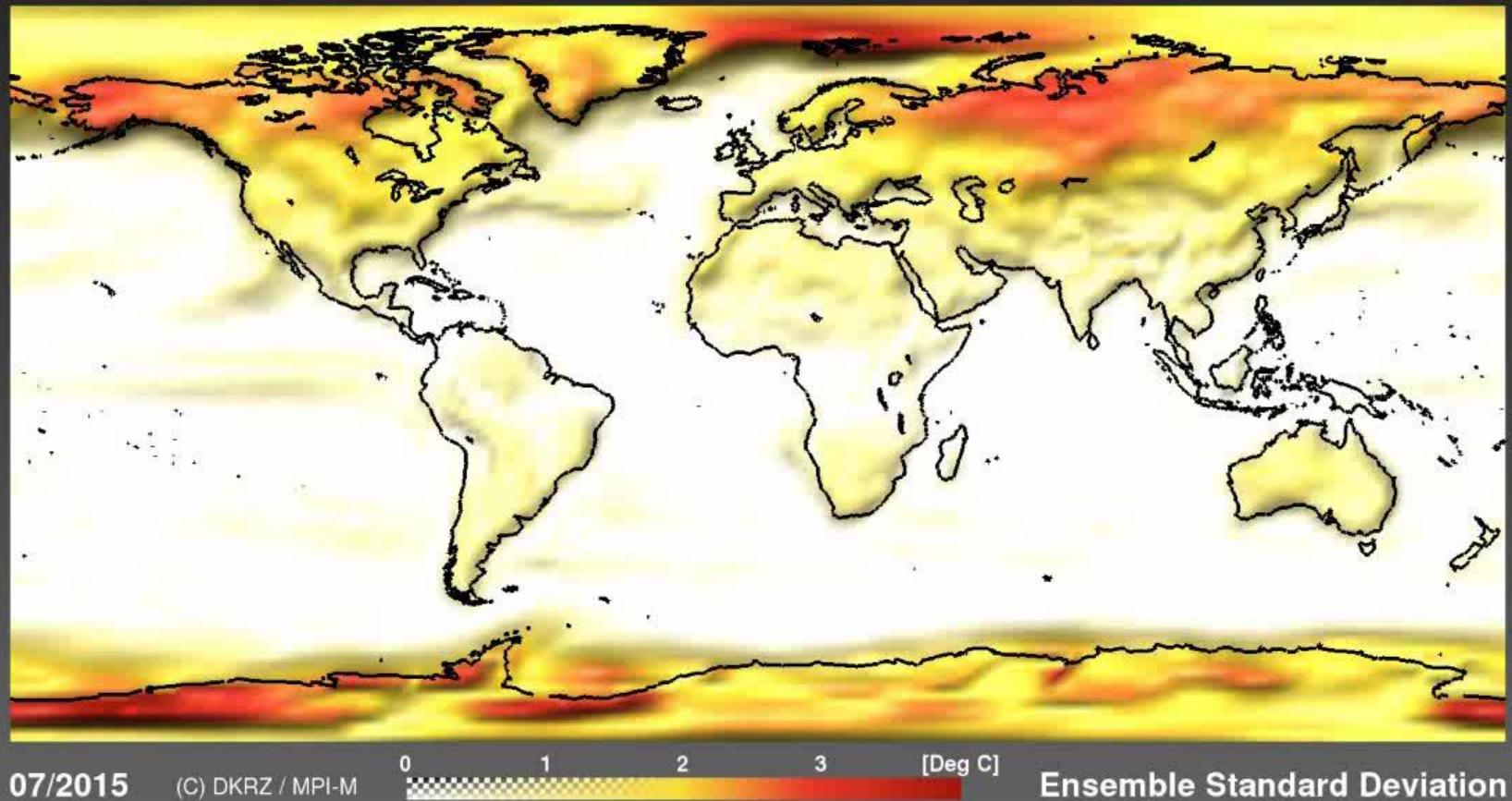
10 ensemble members

Described in Pohlmann et al., GRL 2013, DOI: 10.1002/2013GL058051

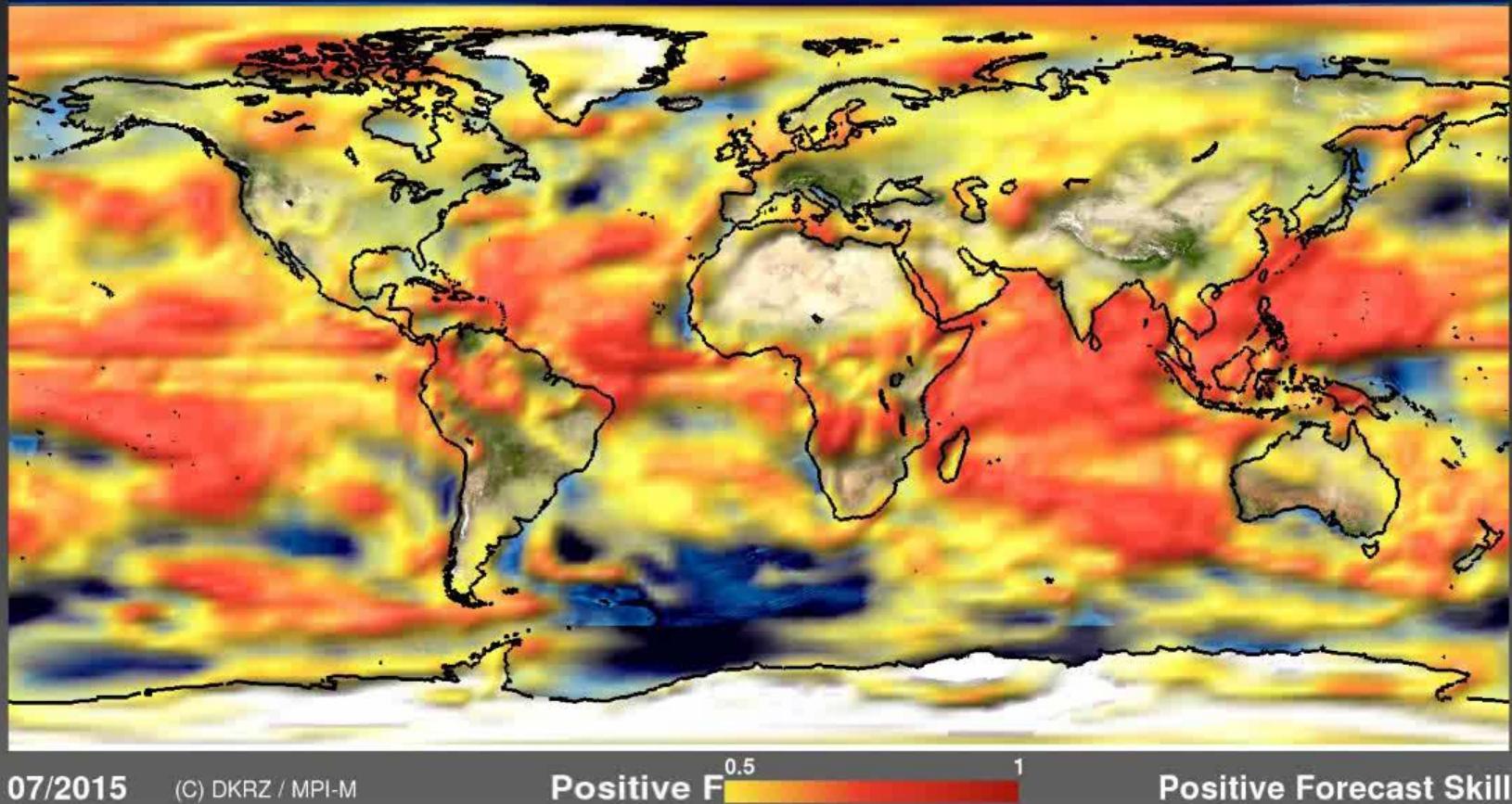
Temporal Patterns: 2m Temperature Anomaly



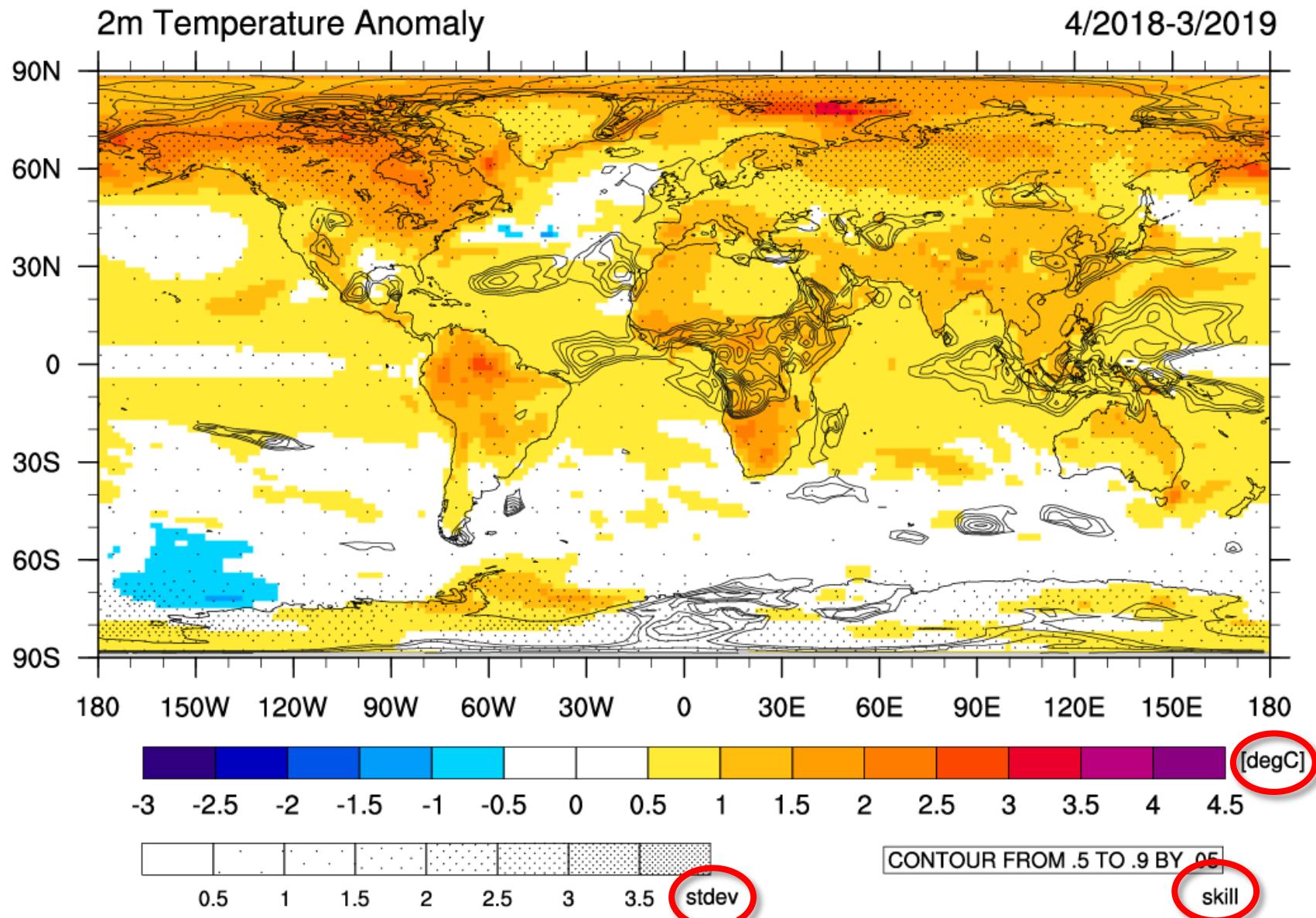
Temporal Patterns: Ensemble Standard Deviation



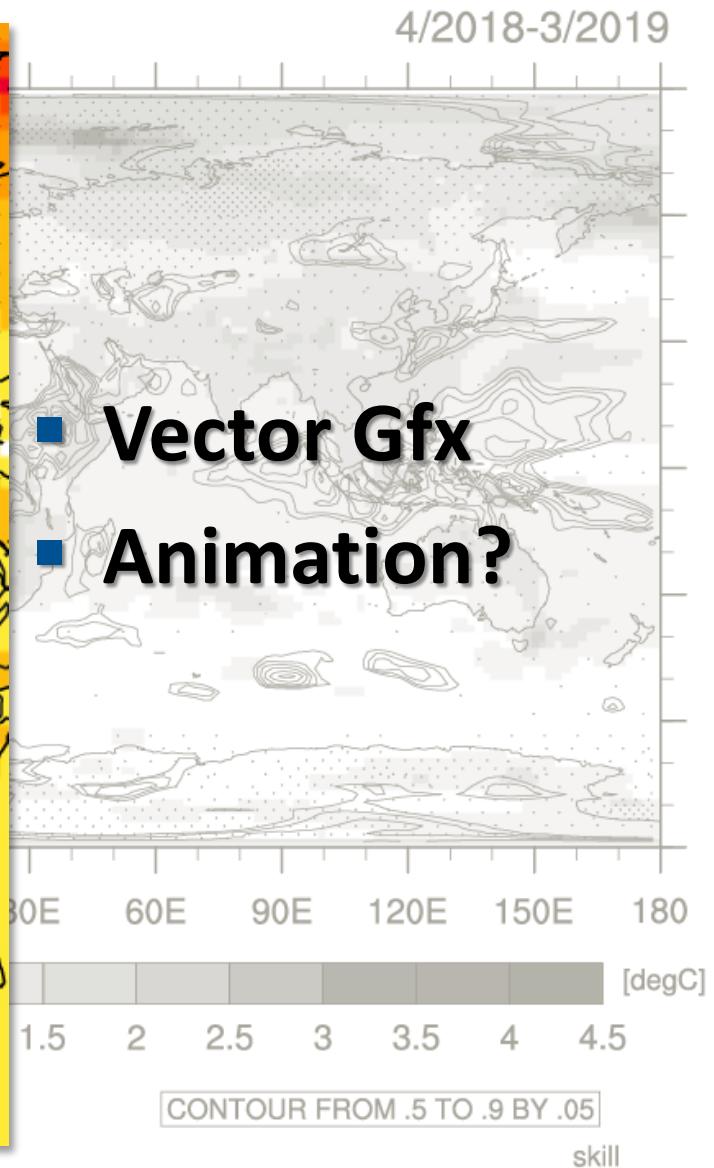
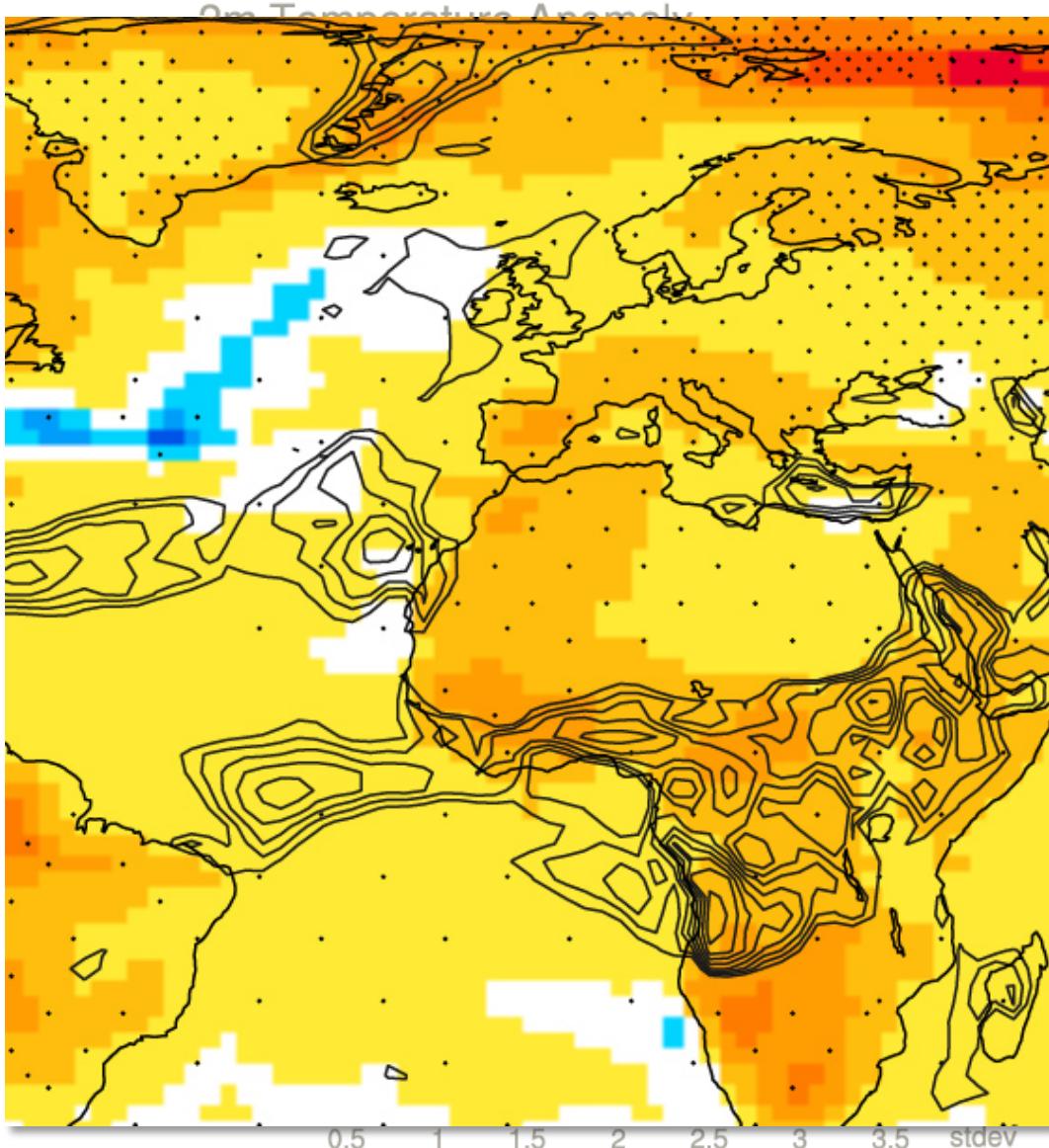
Temporal Patterns: Positive Skill / 2m Temperature



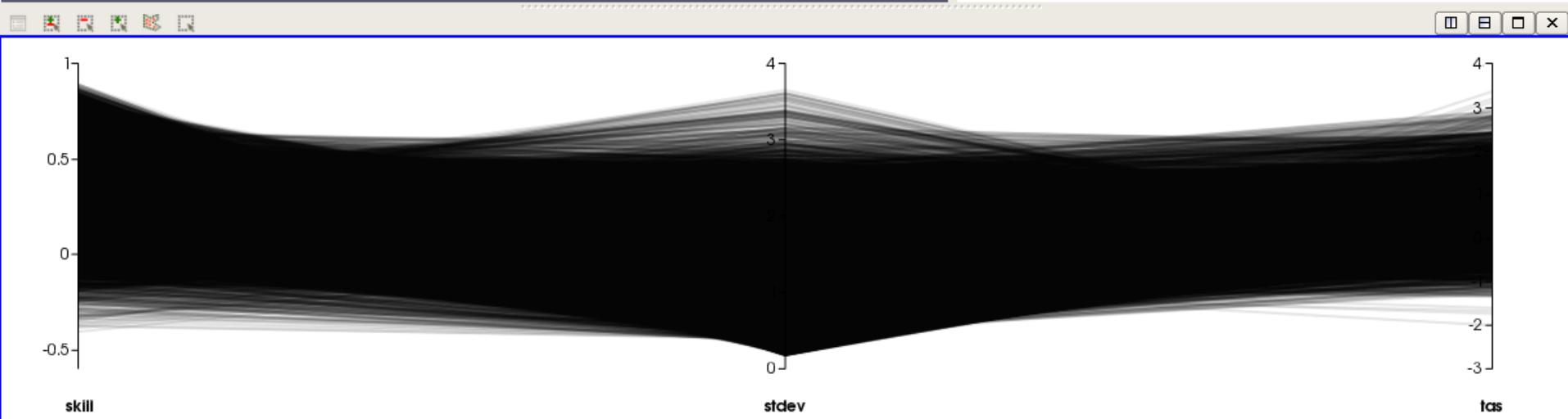
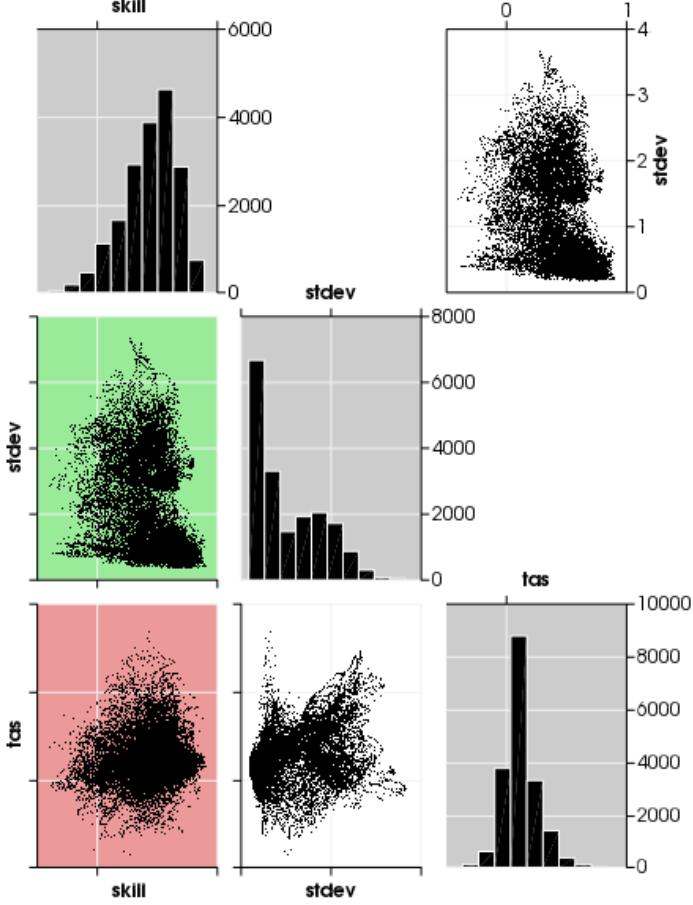
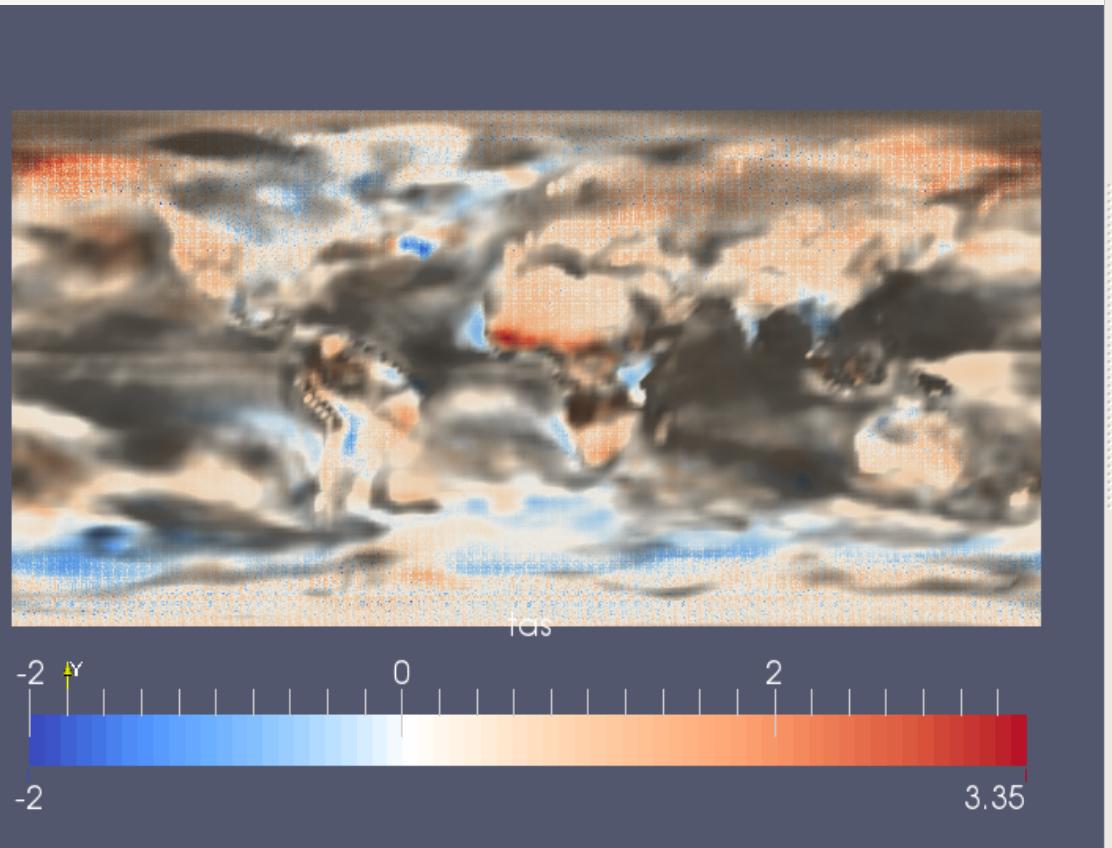
NCL – NCAR Command Language



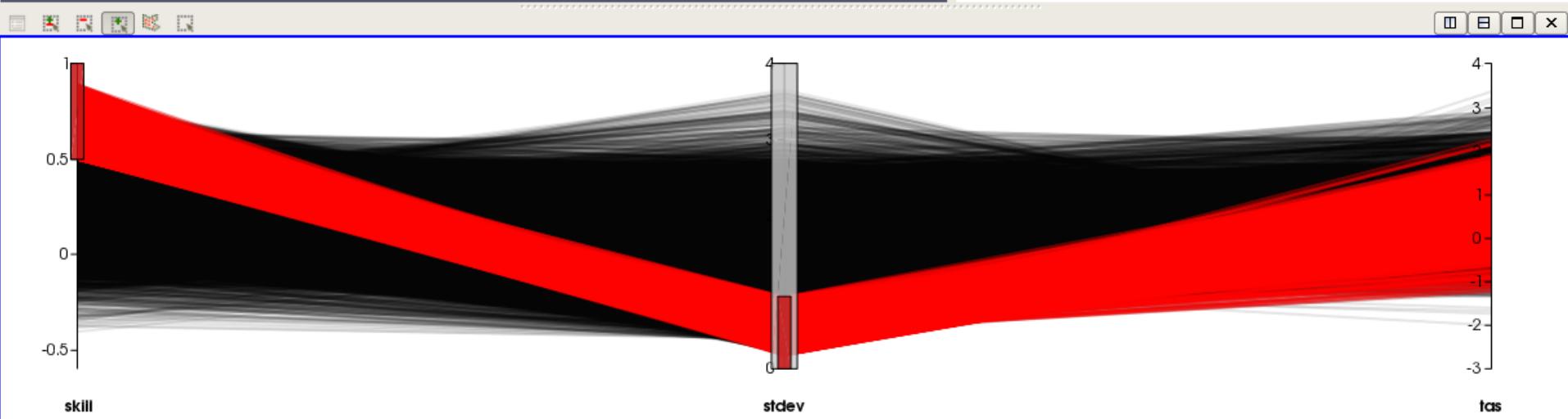
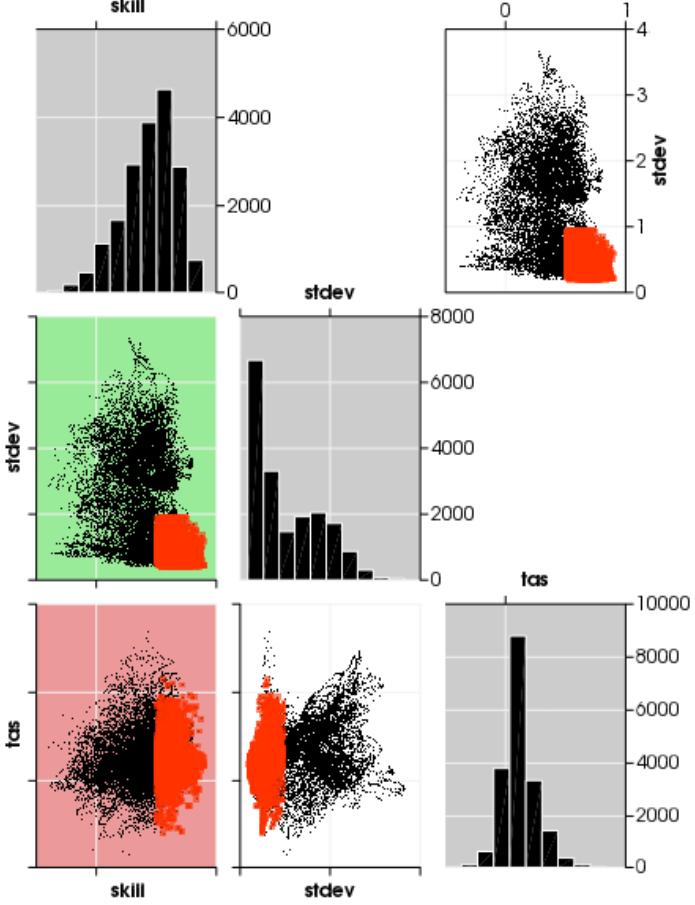
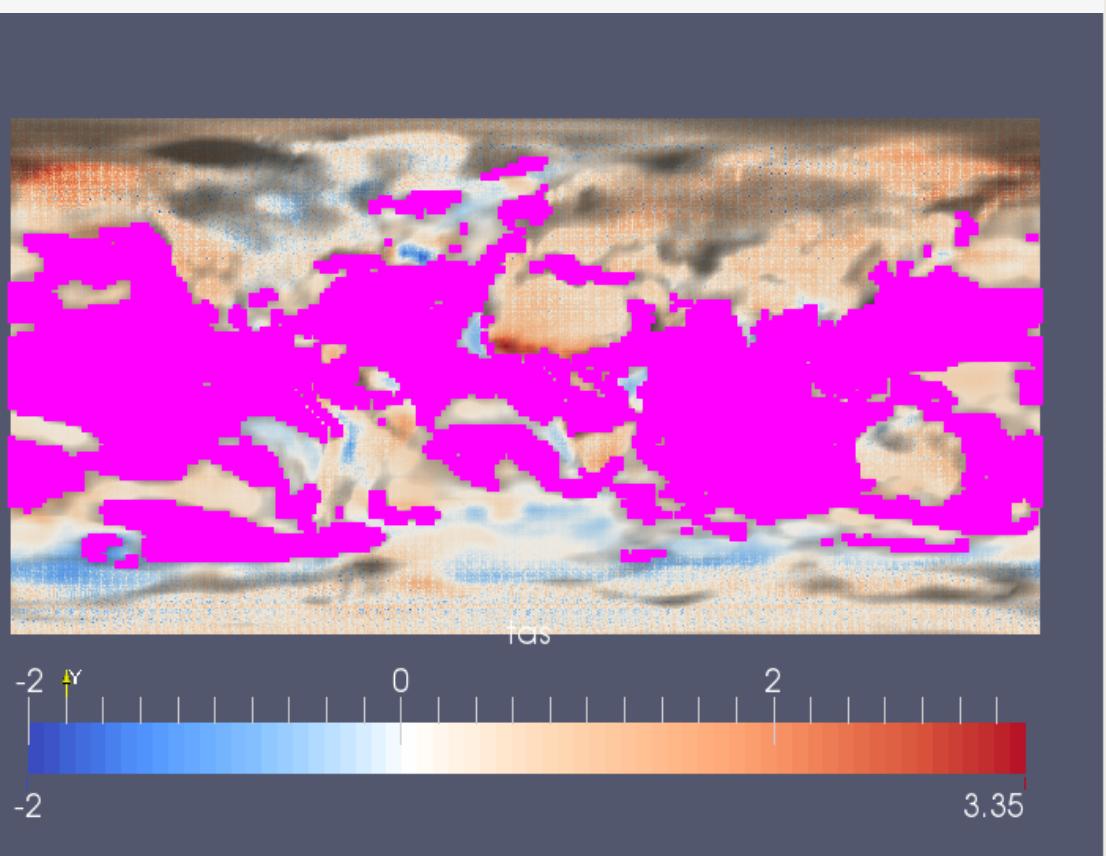
NCL – NCAR Command Language

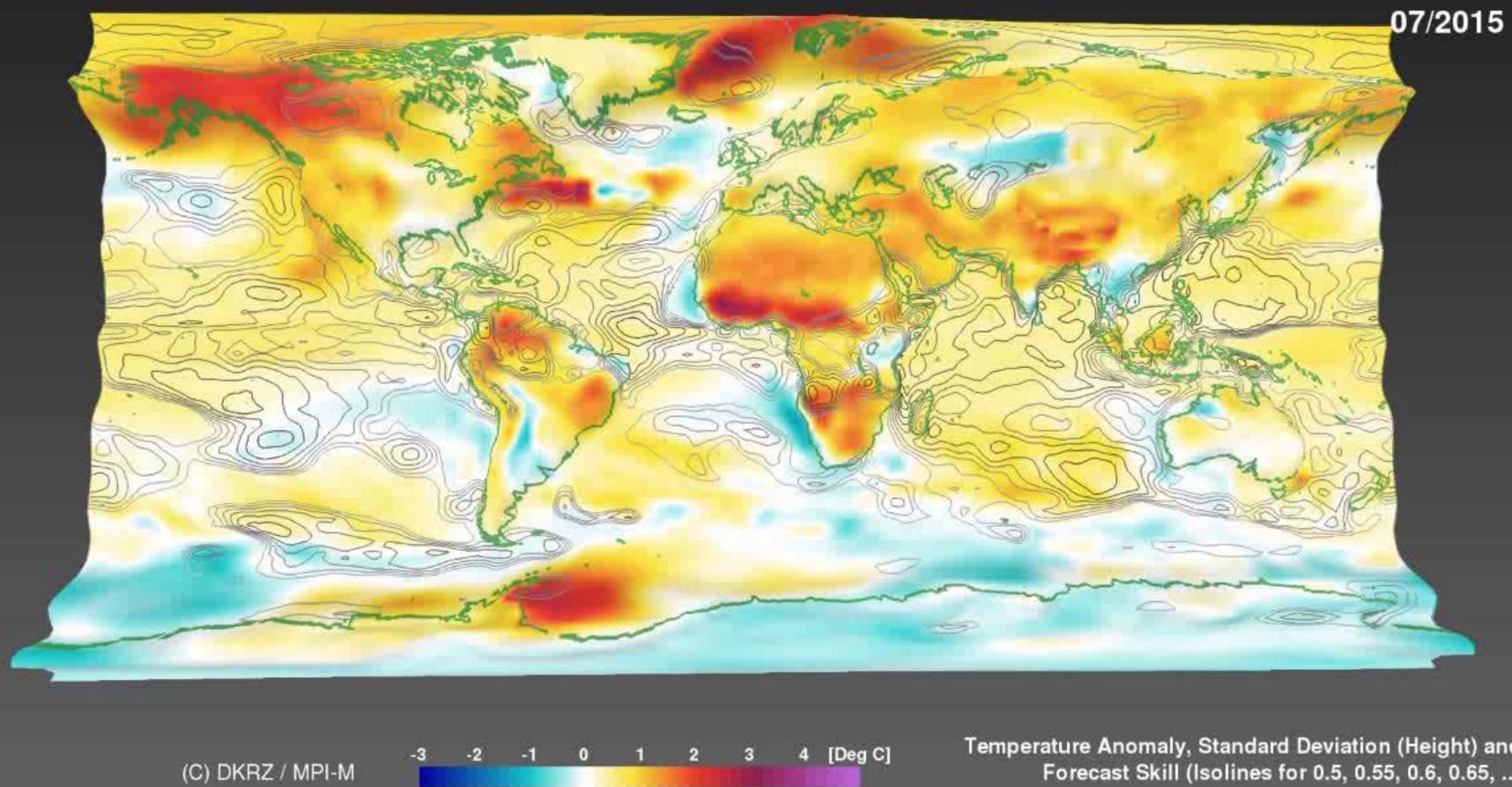


ParaView



ParaView

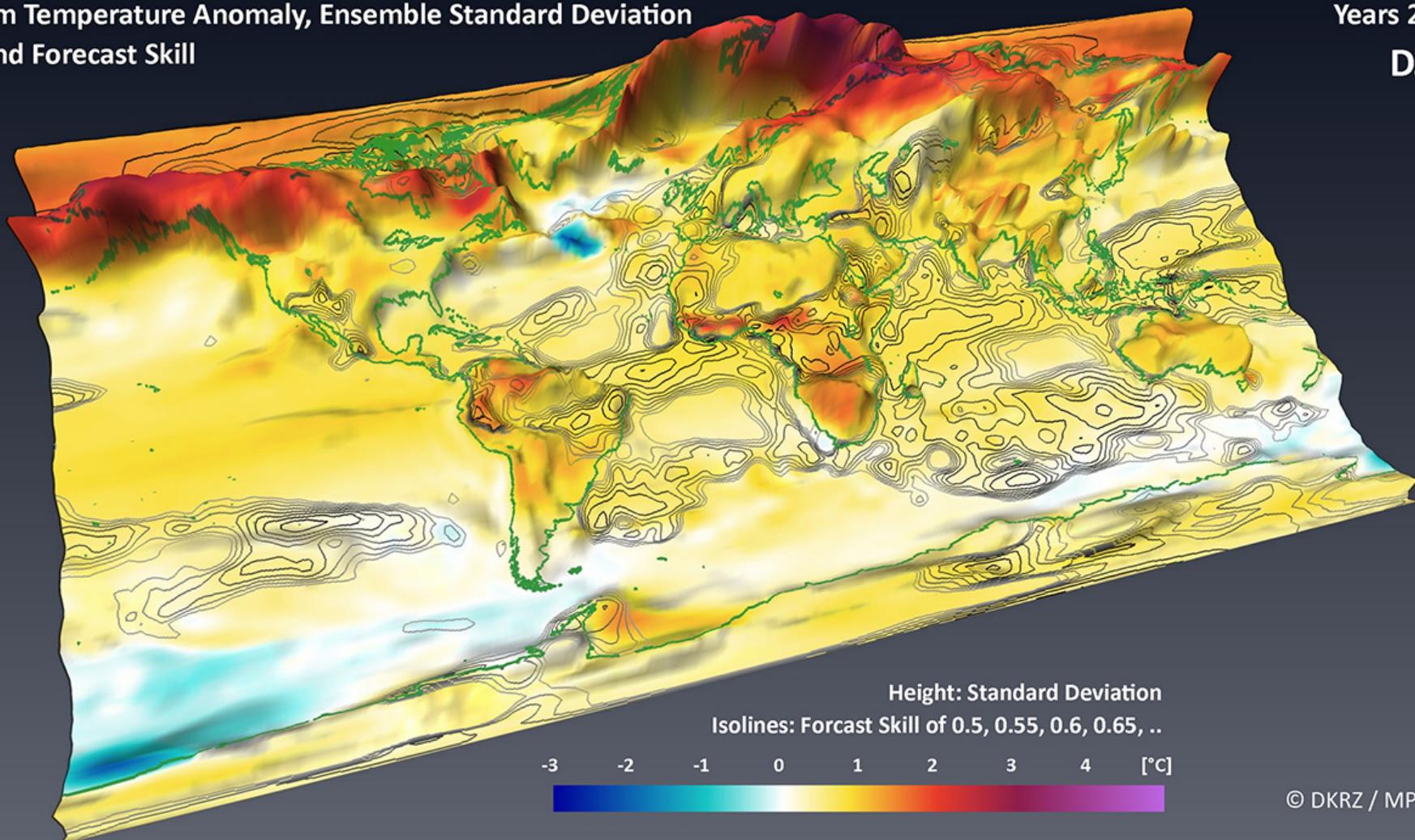




Winter

2m Temperature Anomaly, Ensemble Standard Deviation
and Forecast Skill

Years 2-5
DJF



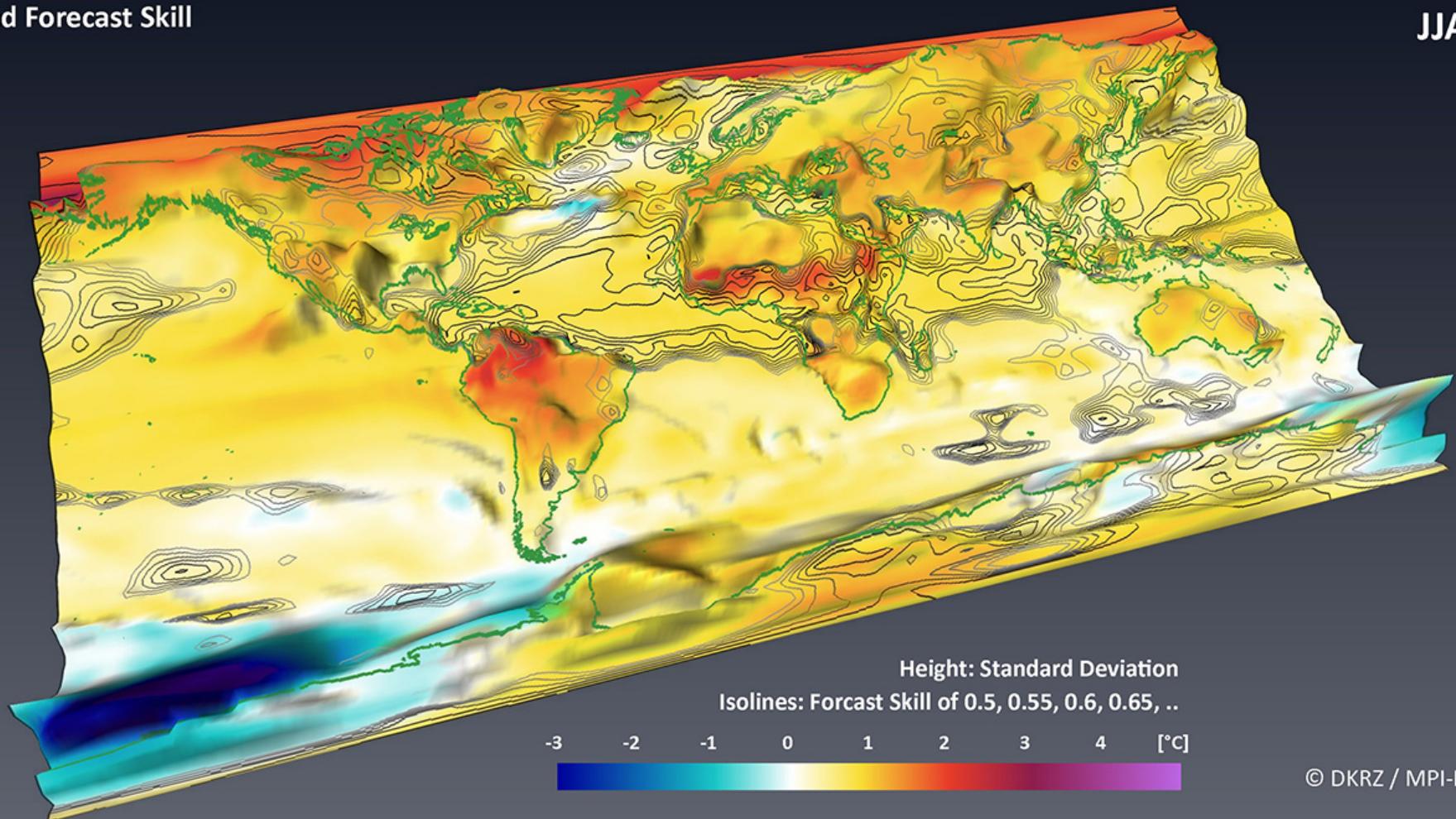
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Summer

2m Temperature Anomaly, Ensemble Standard Deviation
and Forecast Skill

Years 2-5

JJA



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Conclusions

- Joint analysis of data and related uncertainty data
 - 2m temperature anomaly
 - predictive skill
 - internal variability (standard deviation)
- Solutions for 3 different visualization tools
 - **NCL**: 2 line based techniques for overlay
 - **ParaView**: interactive analysis based on linked views & brushing
 - **Avizo**: Animated 3D visualization of 2D data
 - No swiss army knife found – each tool has strengths and weaknesses

Thank You!

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