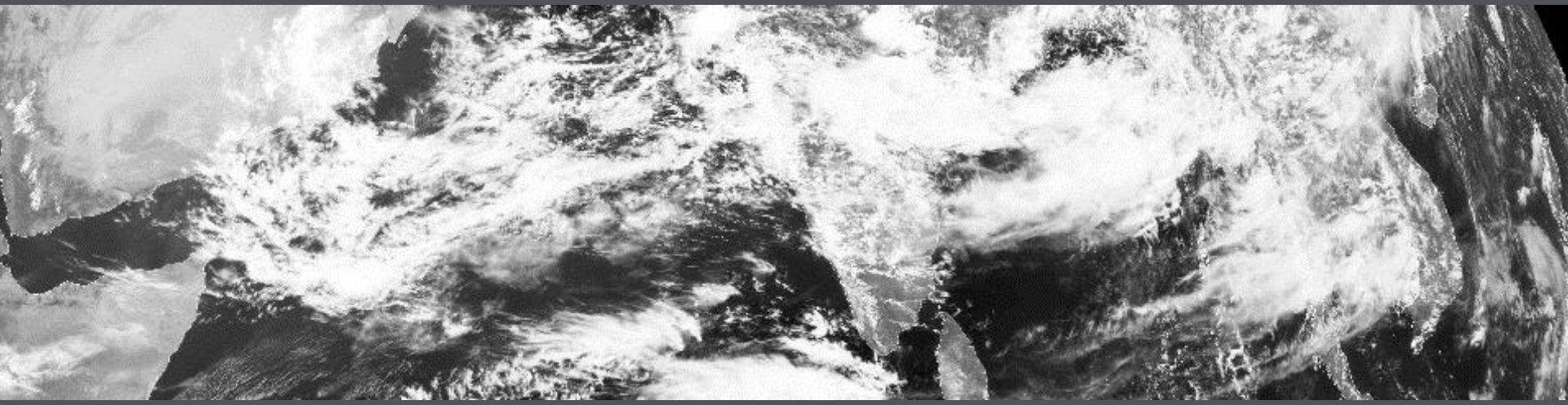
Department of Meteorology

NERC SCIENCE OF THE ENVIRONMENT

University of Reading

The Circumglobal Teleconnection in the ECMWF Seasonal Forecast Model



Jonathan Beverley

Steve Woolnough, Laura Baker, Stephanie Johnson, Antje Weisheimer

Motivation

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- Recent extreme weather events have highlighted the need for more accurate long-range forecasts of the European summer
- Seasonal predictions for the European winter have improved in recent years, whereas skill for the summer is still low
- The range of influences on European circulation mean forecasting is inherently difficult as there are many different factors to consider

- This project is focussing on the potential influence of the Asian summer monsoon on Europe, and its potential as a source of predictability for sub-seasonal to seasonal forecasts for the European summer

Background – the CGT

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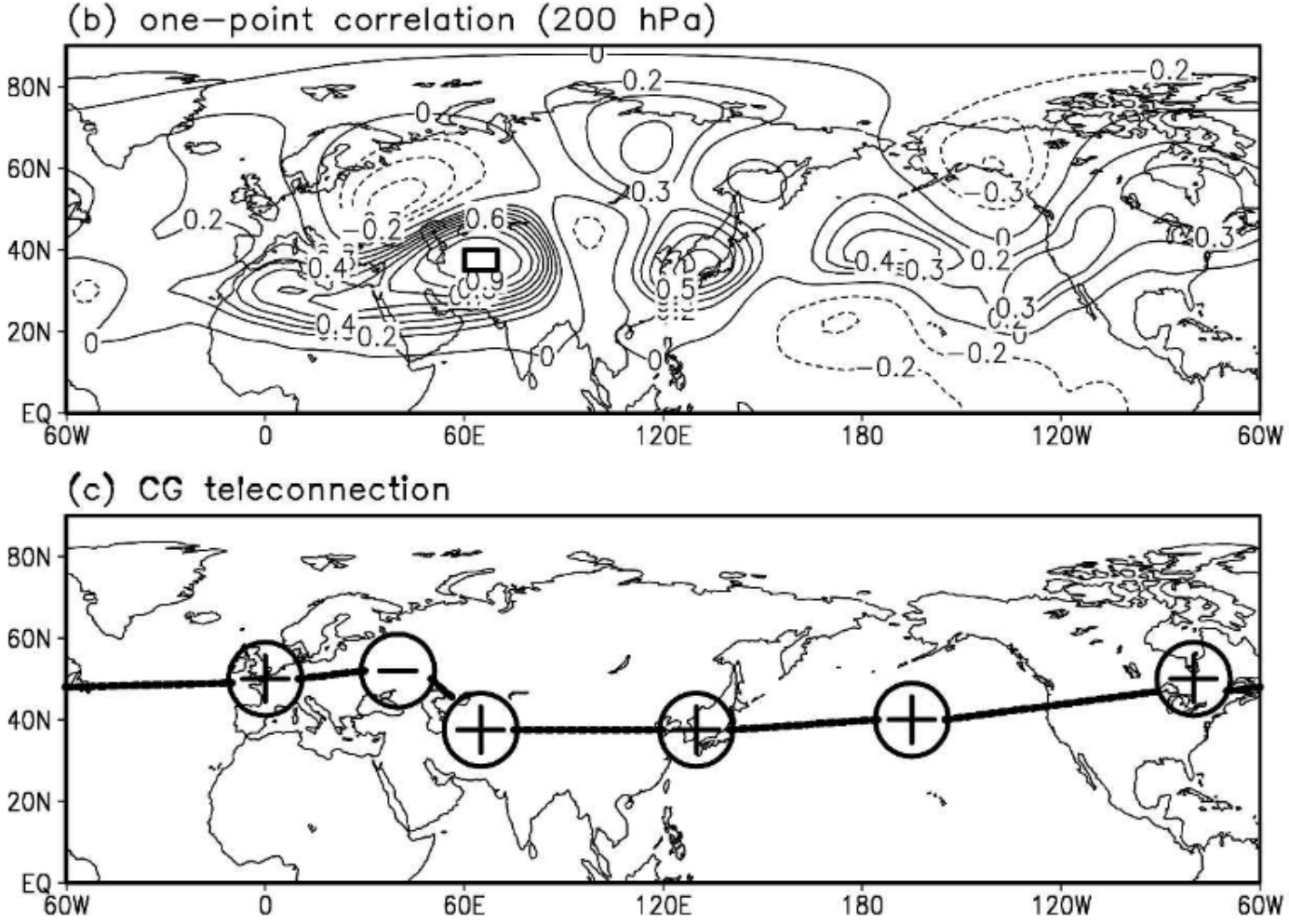

Taken from Ding and Wang (2005)

Model overview

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- We evaluate the performance of the model at capturing this teleconnection mechanism
- Model details:
  - Four month seasonal hindcasts using Cycle 41R1 of the ECMWF model
  - Hindcasts initialised on 1st May
  - 25 ensemble members
  - Start dates between 1981-2014

Model skill

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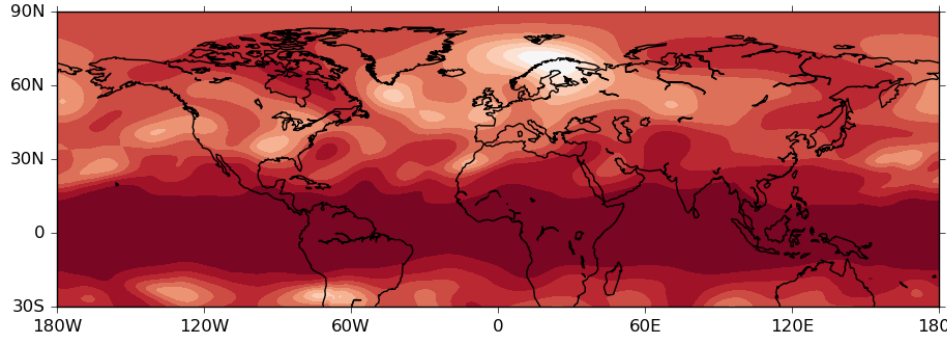
Skill of ensemble mean 200hPa geopotential height w.r.t. ERA-Interim

May



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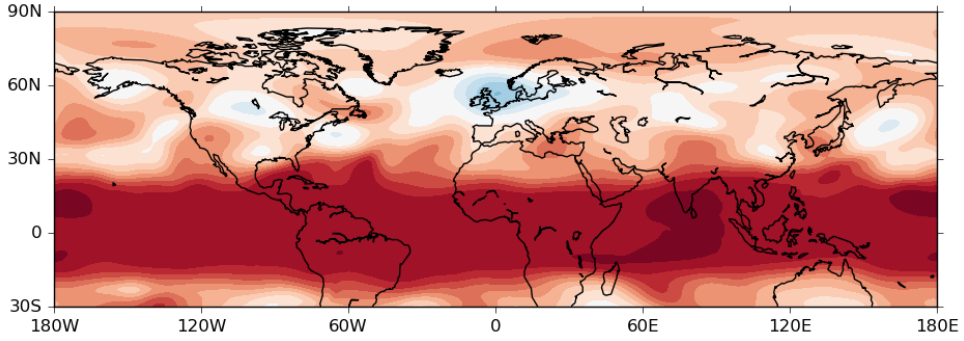

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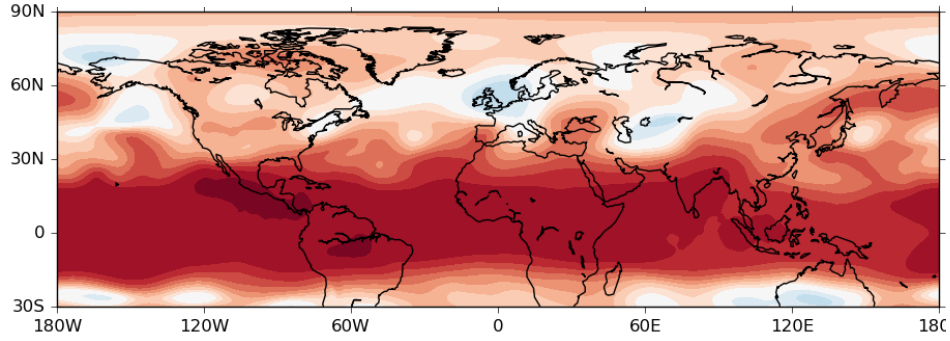
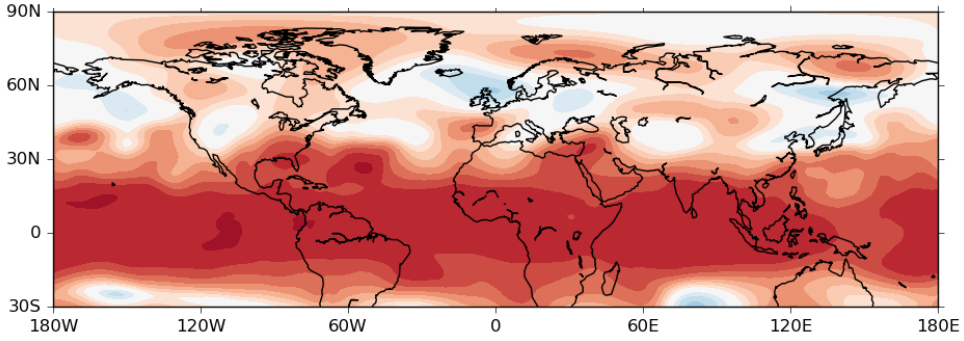
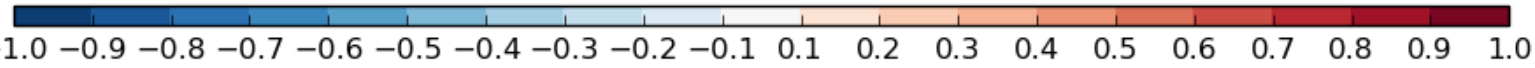


August





Beverley et al. (2018)

Model skill

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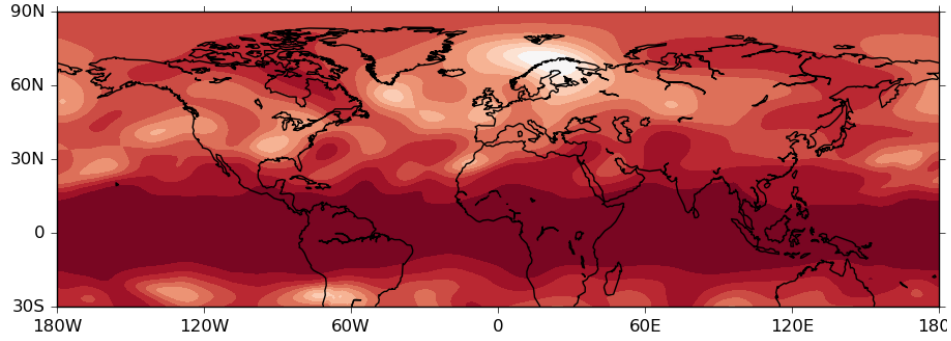
Skill of ensemble mean 200hPa geopotential height w.r.t. ERA-Interim

May



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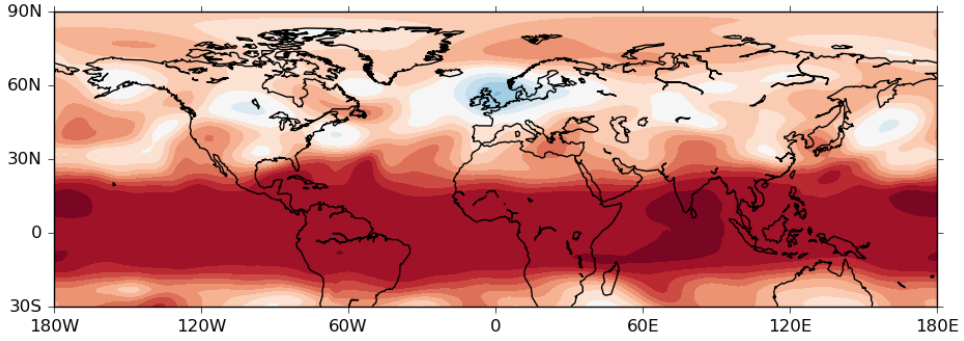

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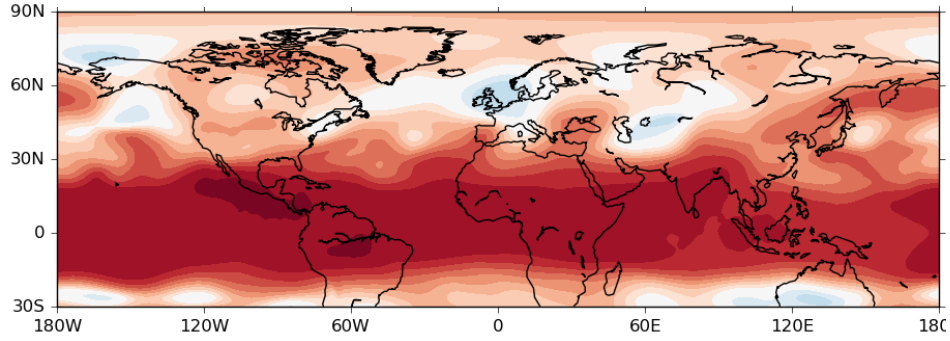

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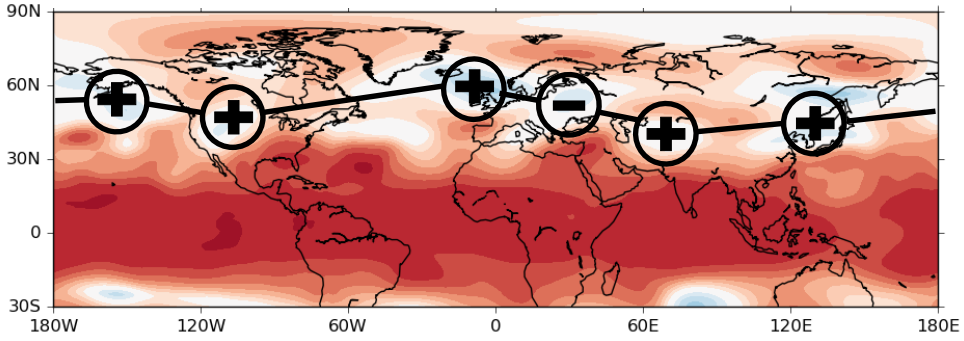

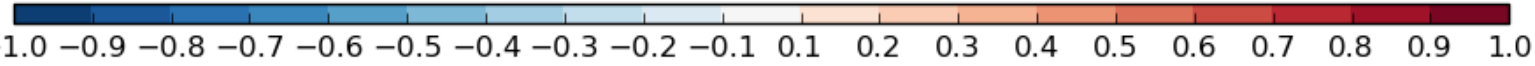

Beverley et al. (2018)

Model CGT - August

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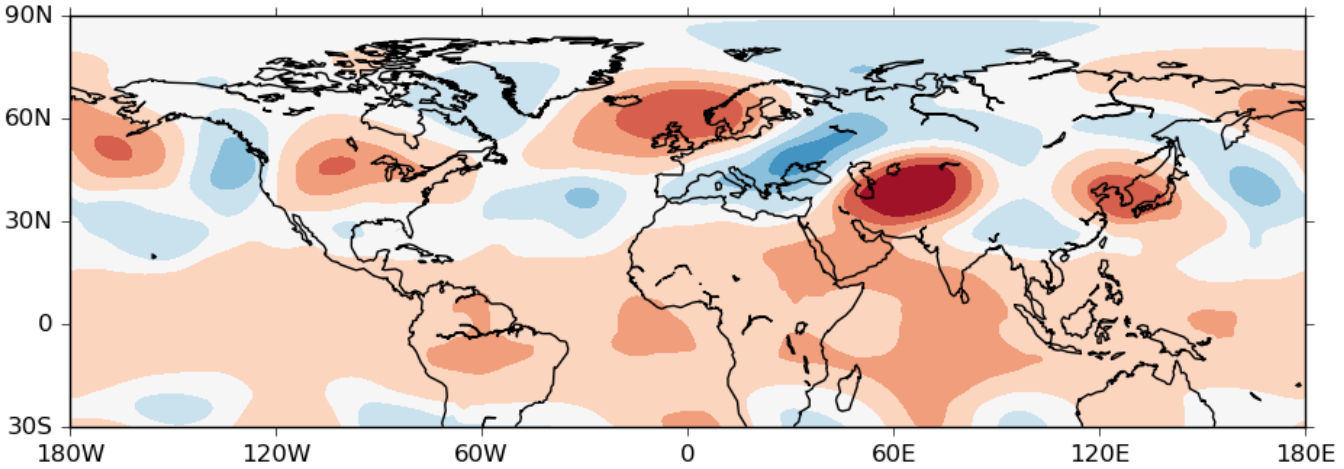
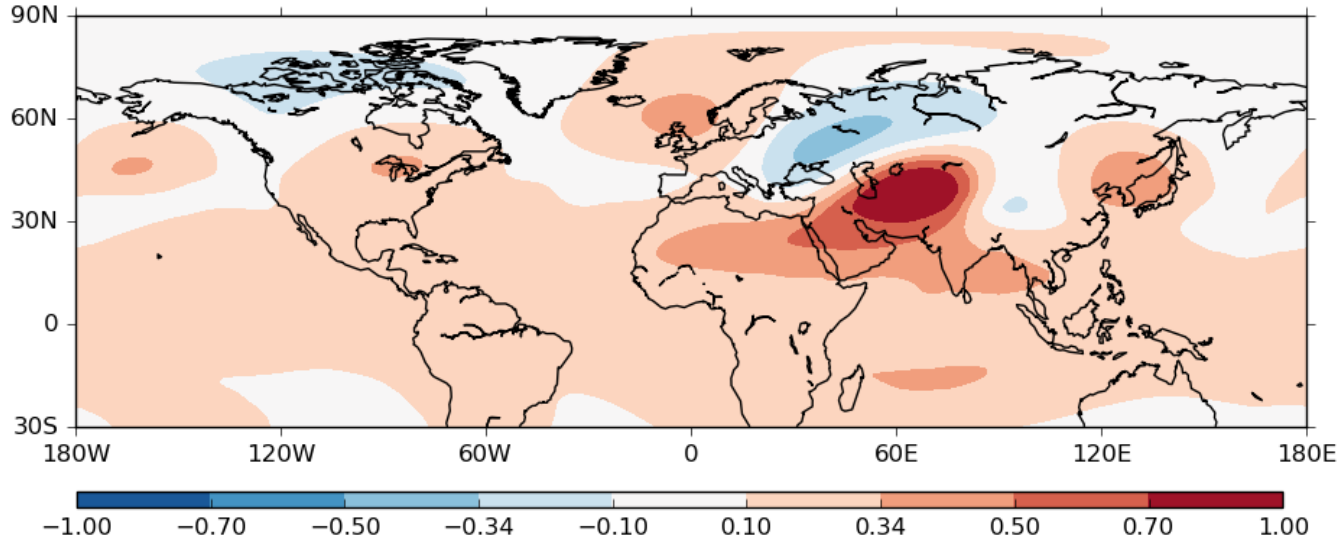
Observed CGT correlations (200 hPa geopotential height)



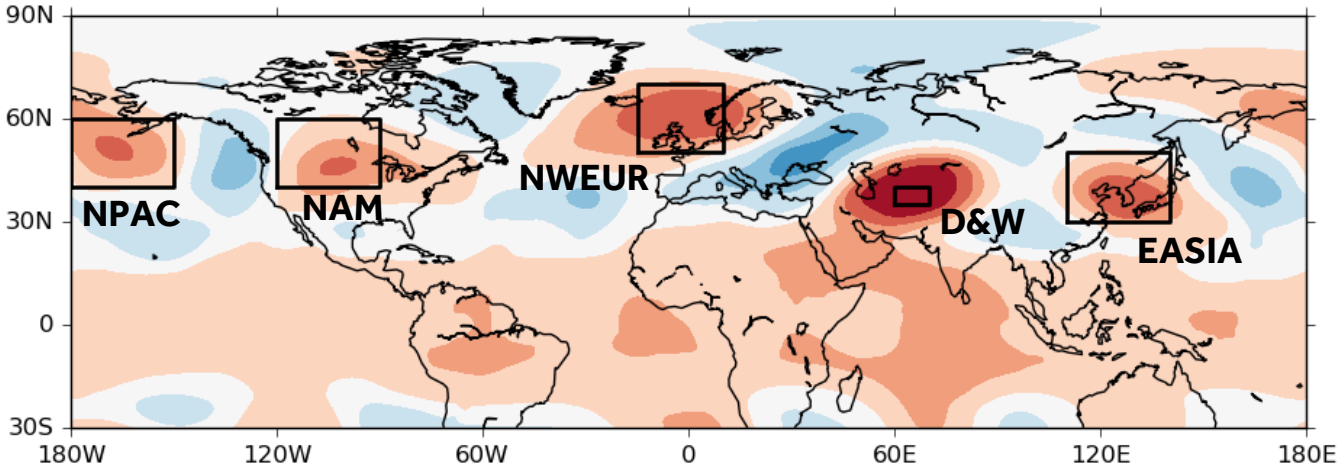
Model CGT correlations (average of 25 ensemble members)



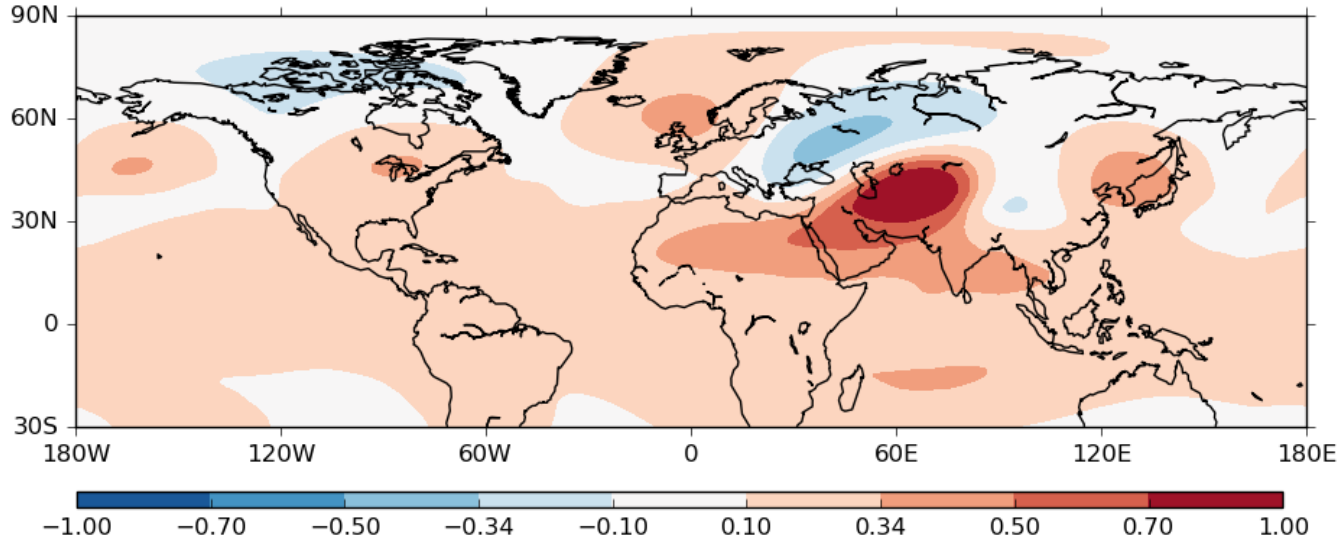
Model CGT - August

University of Reading

Observed CGT correlations (200 hPa geopotential height)

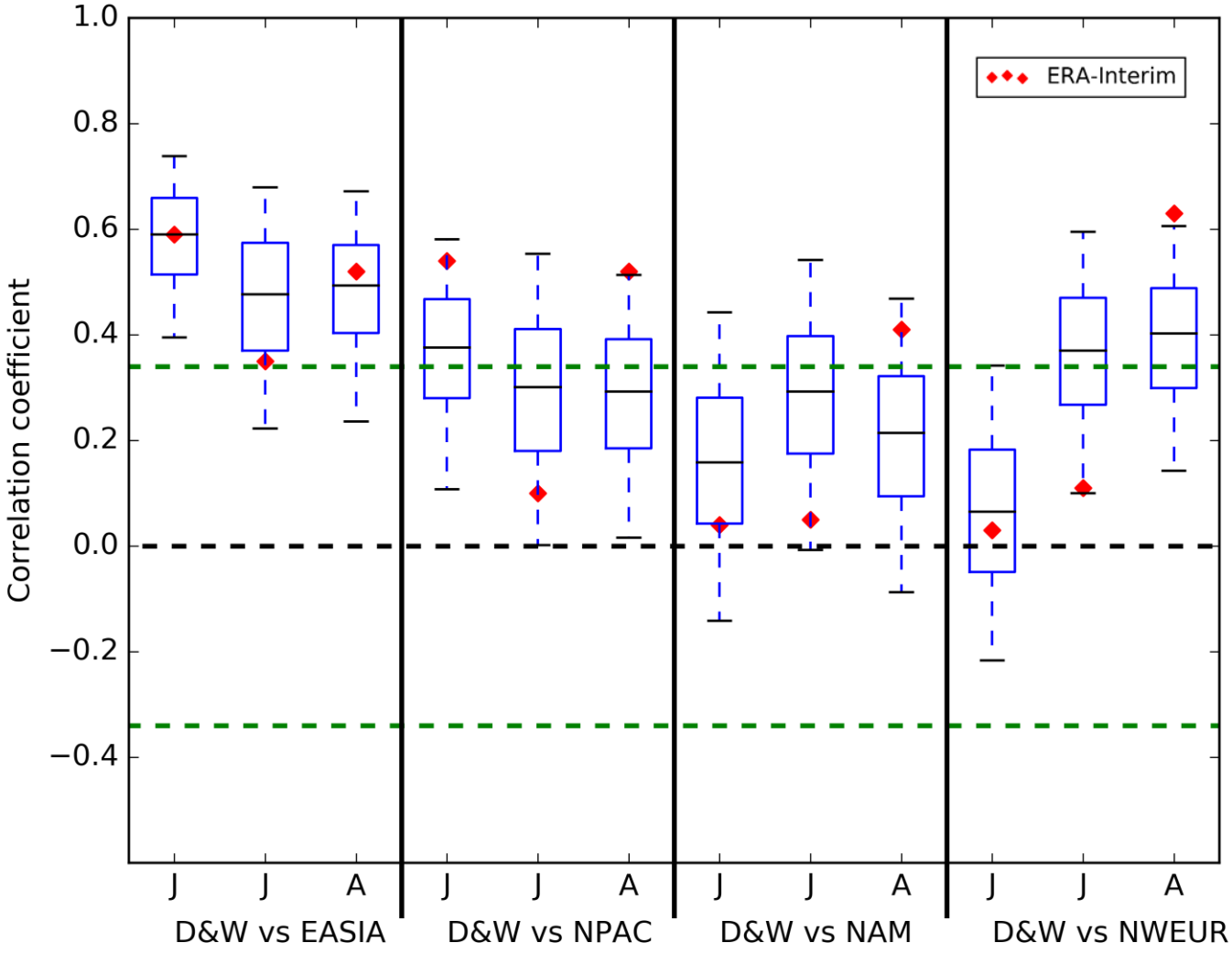


Model CGT correlations (average of 25 ensemble members)



Model correlations

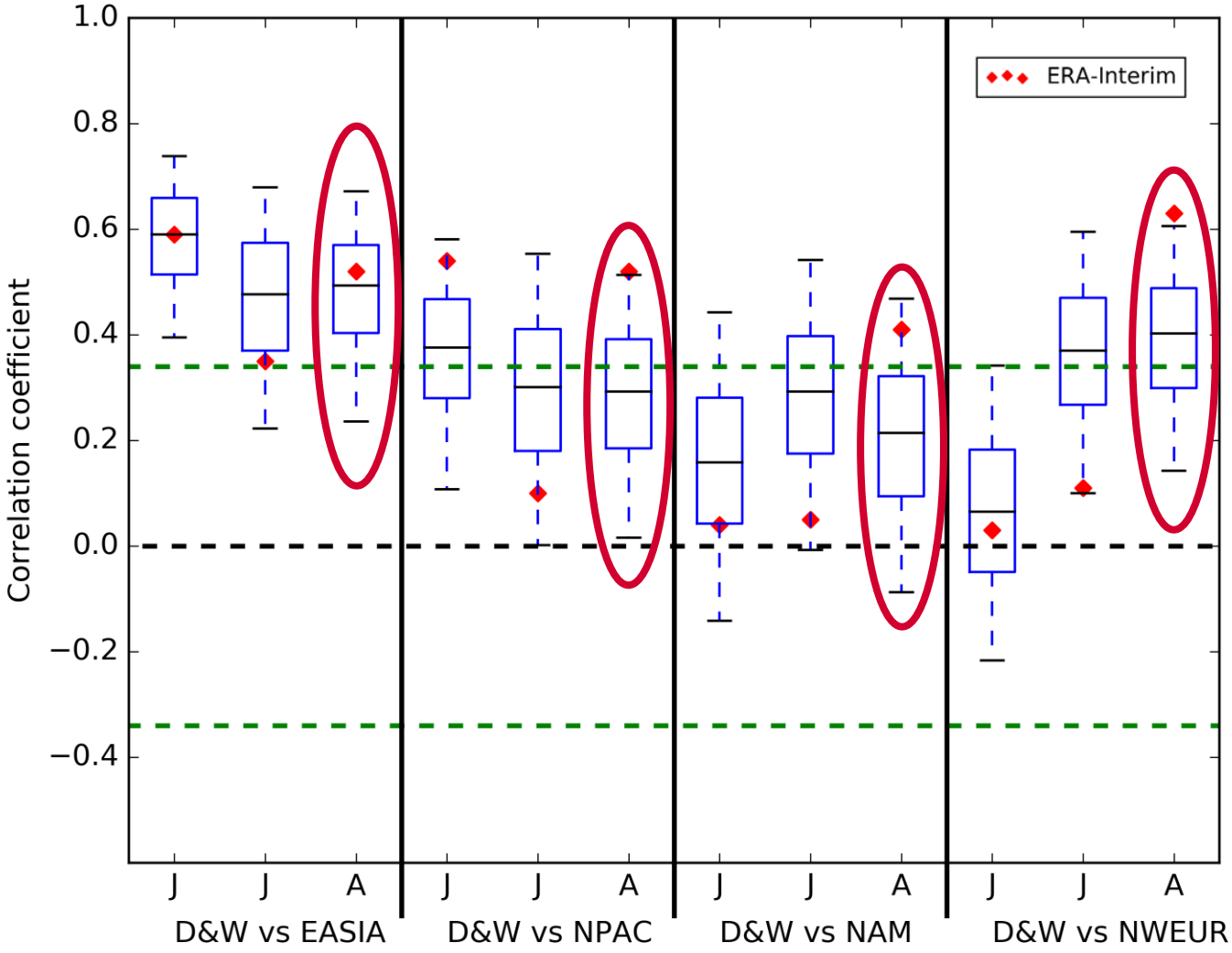
University of Reading



Beverley et al. (2018)

Model correlations

University of Reading



Beverley et al. (2018)

RWS and divergence - August

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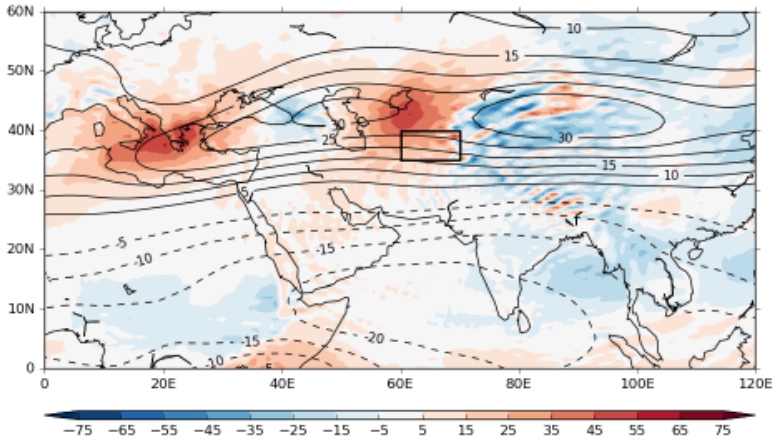
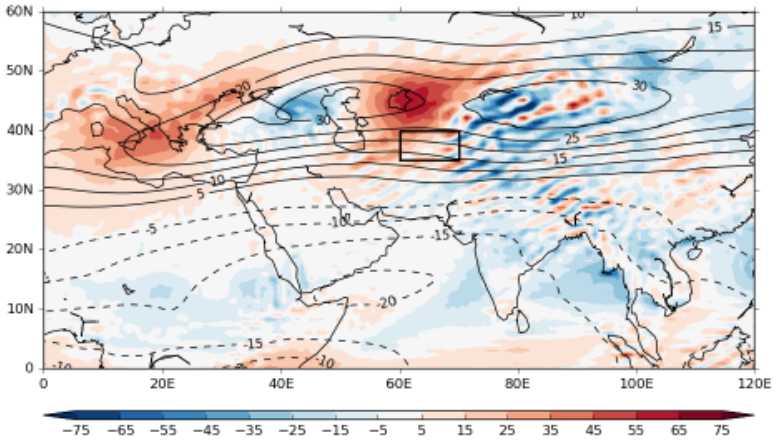
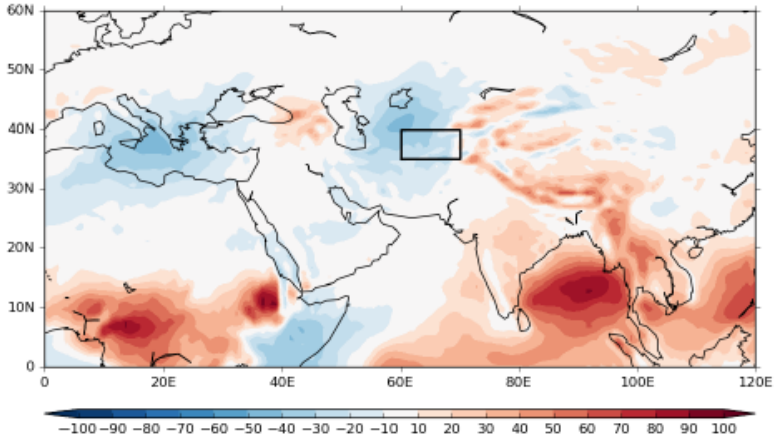
ERA-I RWS



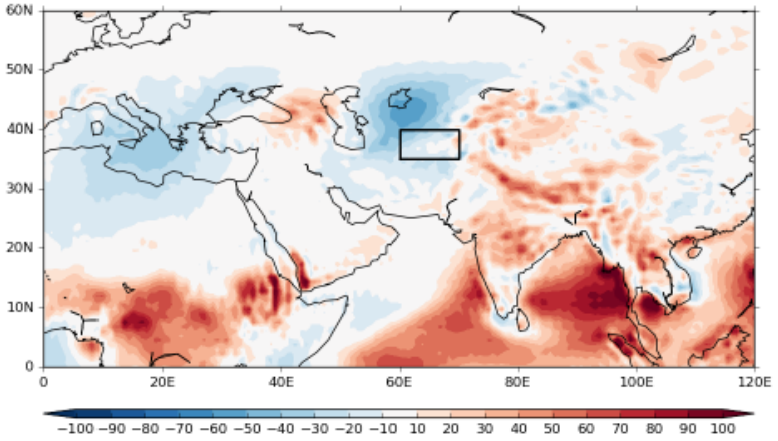
Model RWS



ERA-I Divergence



Model Divergence



Beverley et al. (2018)

Model jet bias

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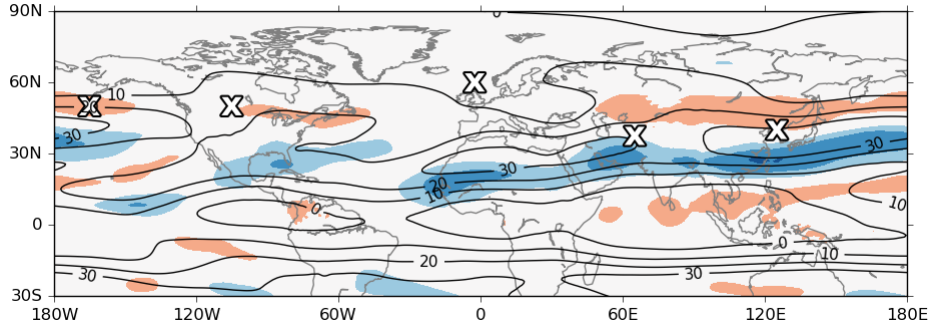
ERA-Interim zonal wind - black contours
Model zonal wind anomalies w.r.t. ERA-Interim - coloured contours

May



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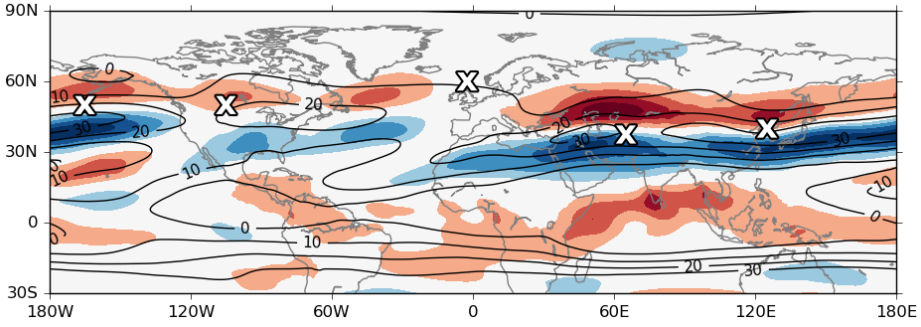

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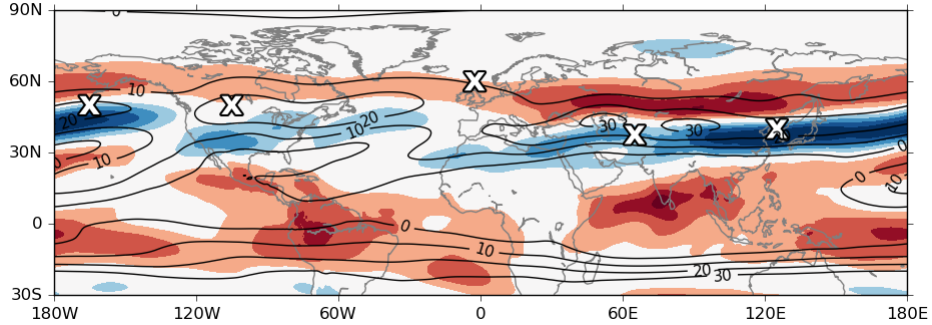
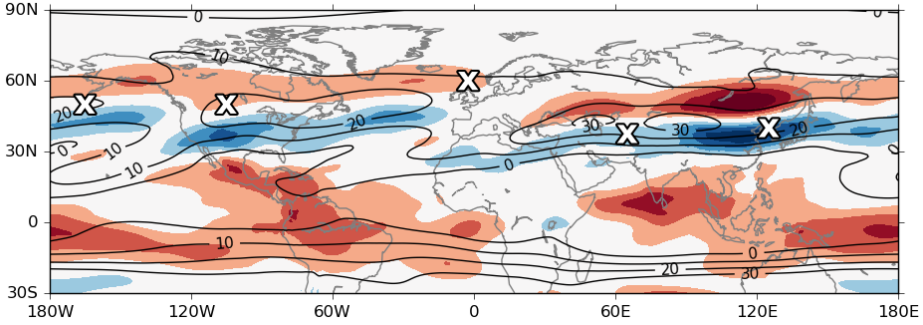
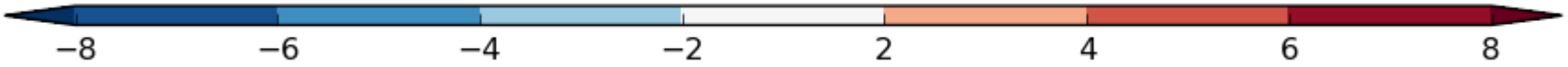


August





Positive (red) – Model zonal wind too strong
Negative (blue) – Model zonal wind too weak

Beverley et al. (2018)

Model skill

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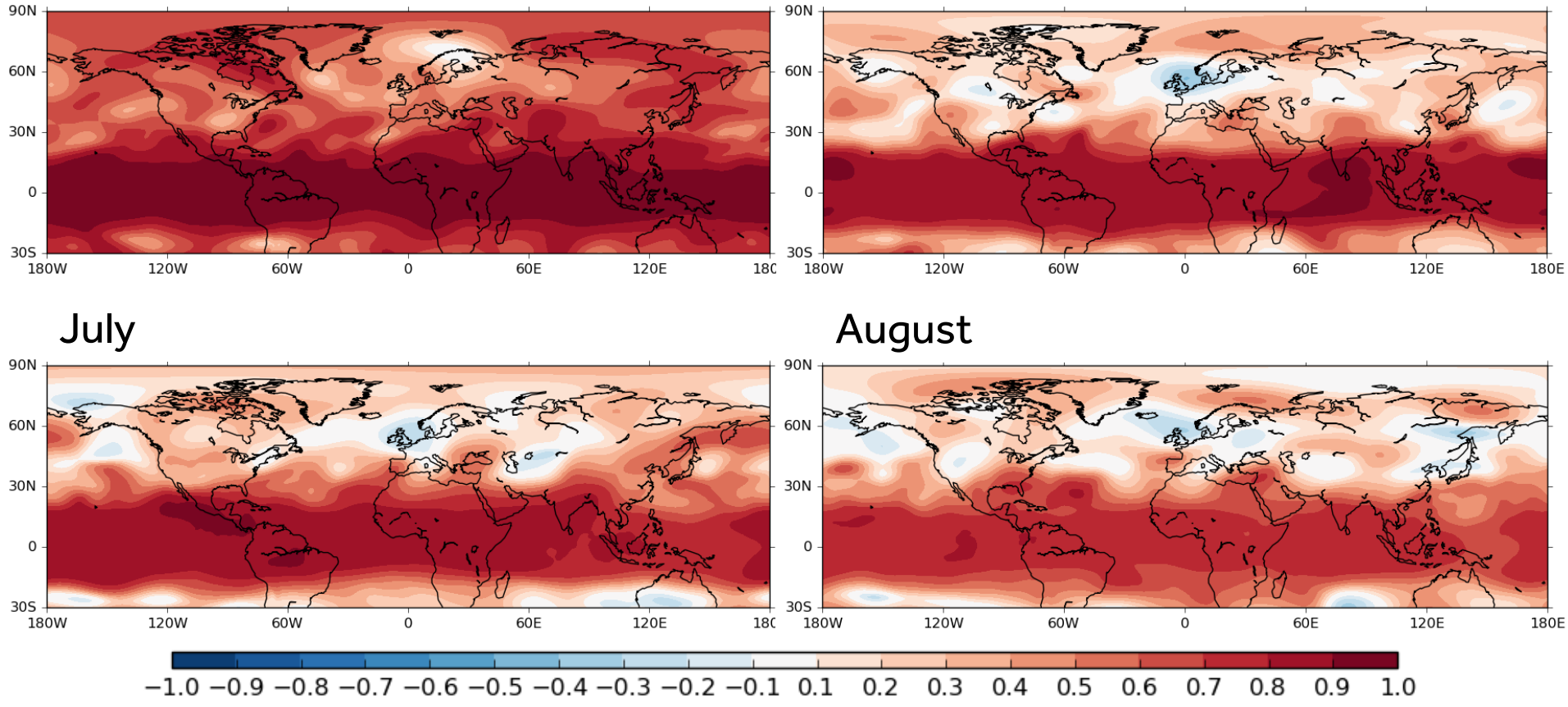
Skill of ensemble mean 200hPa geopotential height w.r.t. ERA-Interim

May

June

July

August



Beverley et al. (2018)

Model experiments - August

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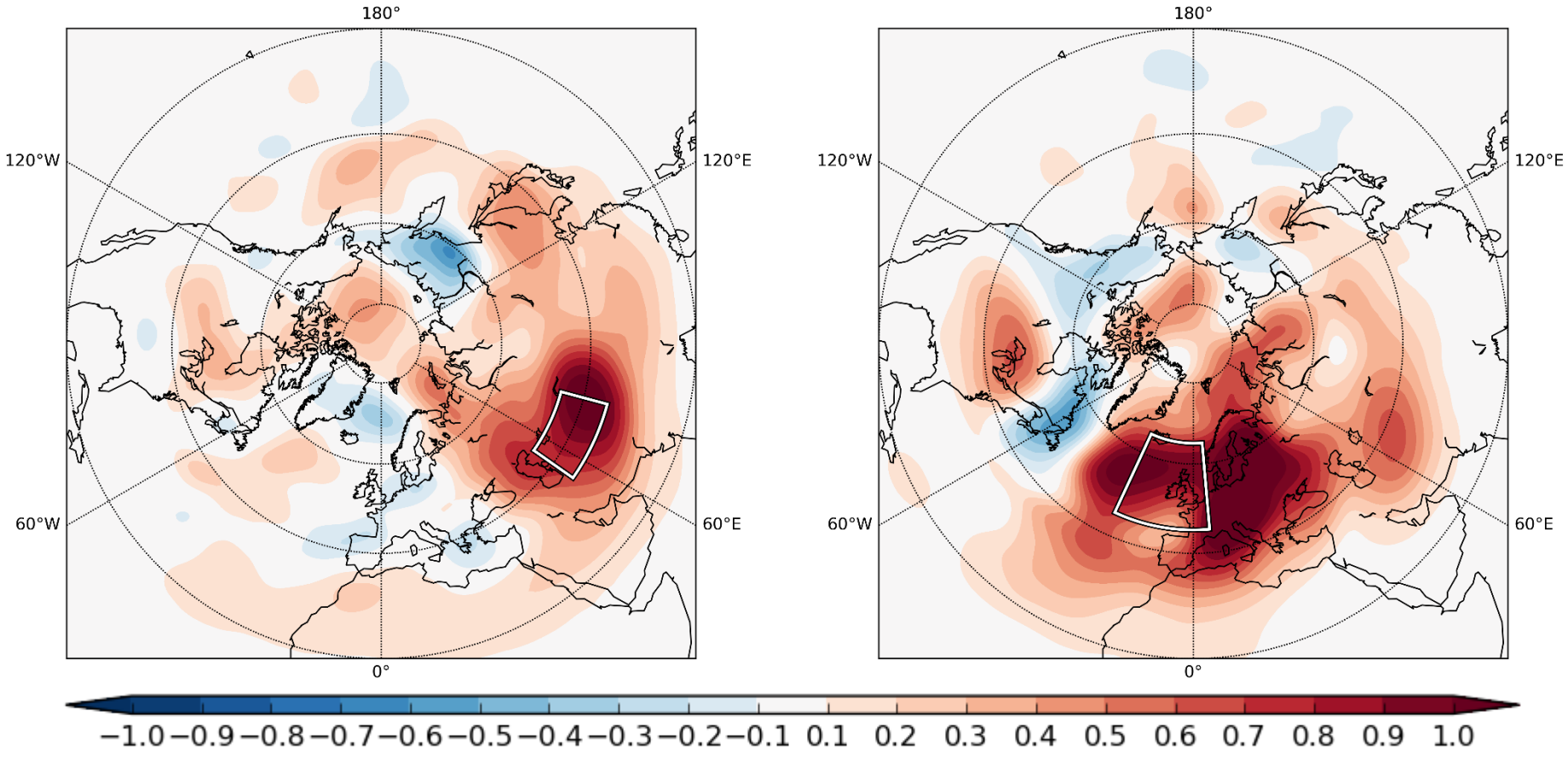
West-central Asia relaxation

Northwest Europe relaxation



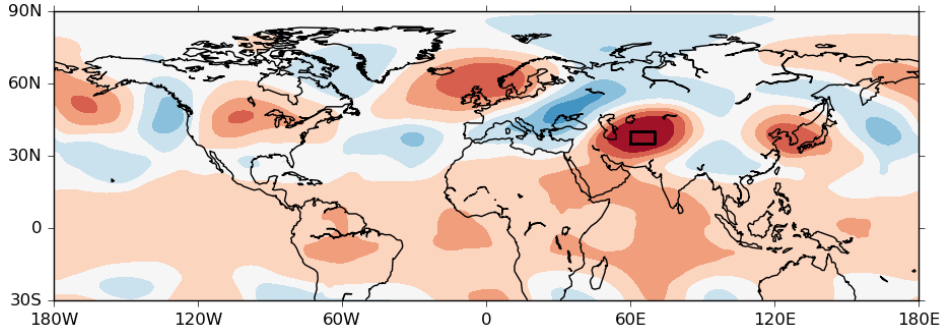
Z200 skill change w.r.t. control experiment

Model experiments - August

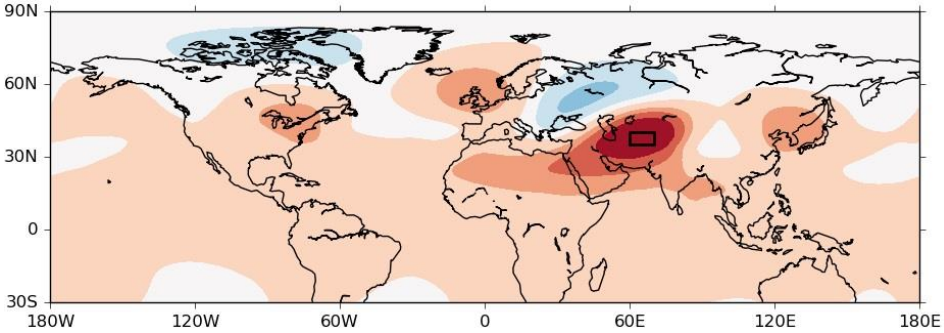
University of Reading

CGT correlations

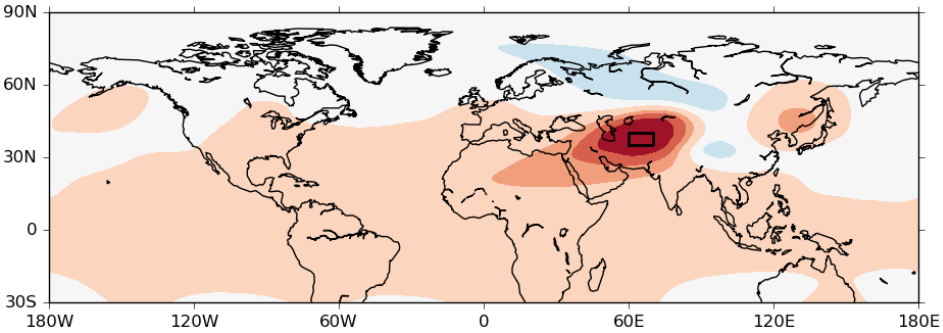
ERA-Interim



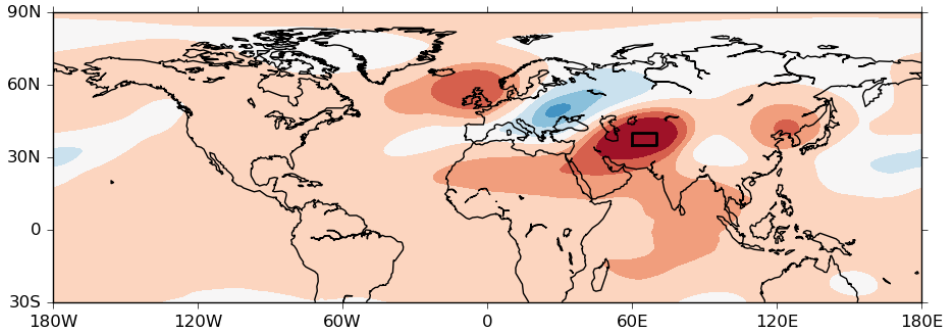
Control



West-central Asia relaxation



Northwest Europe relaxation



Conclusions

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- Model representation of the Circumglobal Teleconnection (CGT) is too weak
- Significant errors in the forecasting of 200 hPa geopotential height, an important variable in the CGT
- Centre of RWS in west-central Asia in model displaced to the north and east, partly associated with a northerly jet bias
- Large zonal wind biases across northern hemisphere indicate that the jet stream in the model is located too far to the north – implications for Rossby wave source and propagation

Conclusions

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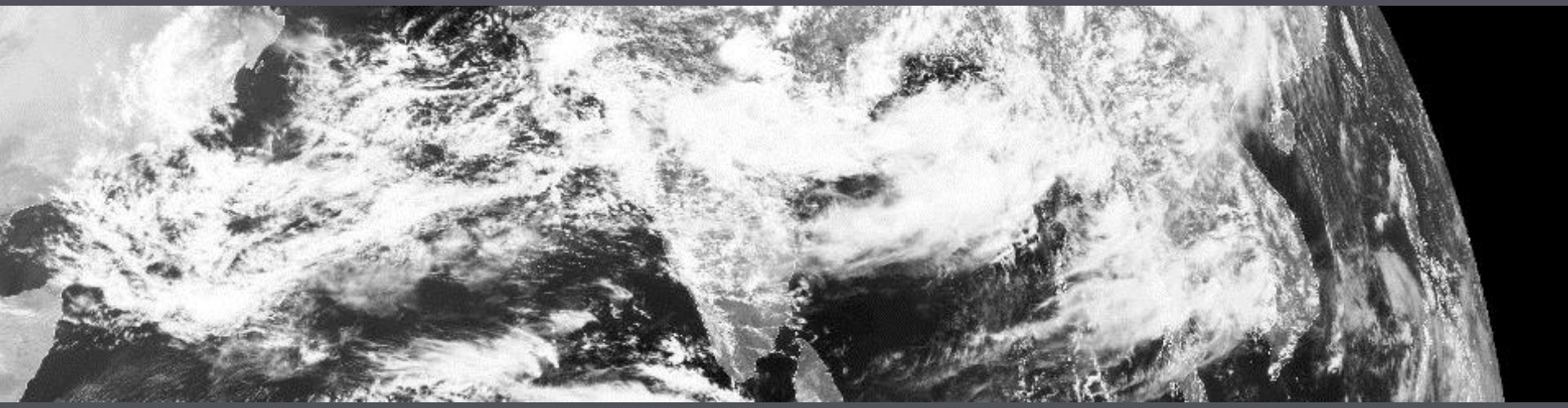
- Relaxation experiments:
  - Northwest Europe relaxation results in a greater hemispheric increase in Z200 skill than the west-central Asia relaxation
  - West-central Asia relaxation does not improve skill over Europe, but northwest Europe relaxation results in improved skill in west-central Asia
  - Representation of the CGT in the west-central Asia relaxation is marginally worse than in the control, but the Europe --> Asia portion of the wavetrain is improved in the northwest Europe relaxation

References:

Ding and Wang (2005): Circumglobal teleconnection in the northern hemisphere summer. *J. Clim.*

Beverley et al. (2018): The northern hemisphere circumglobal teleconnection in a seasonal forecast model and its relationship to European summer forecast skill. *Clim. Dyn.*



Thanks for listening

Any questions?

j.beverley@pgr.reading.ac.uk

@JBeverley93

Experiment I

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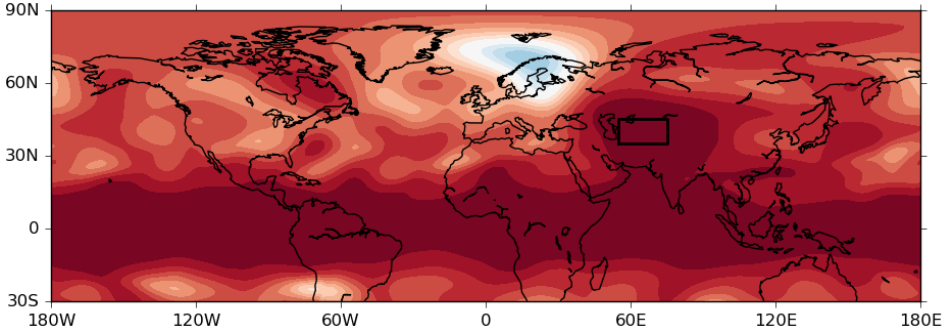
Skill of ensemble mean 200hPa geopotential height – experiment I

May



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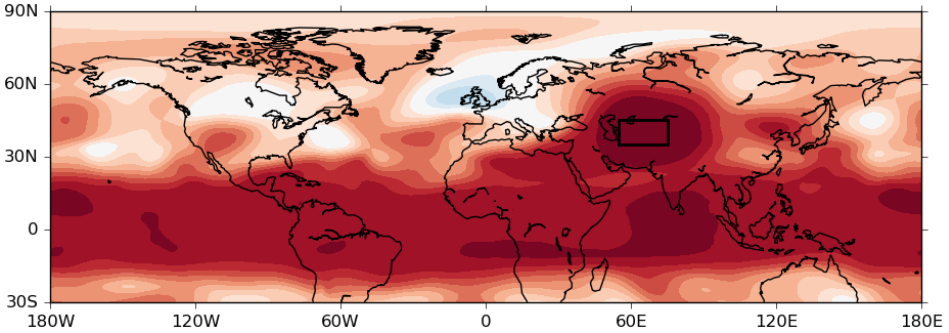

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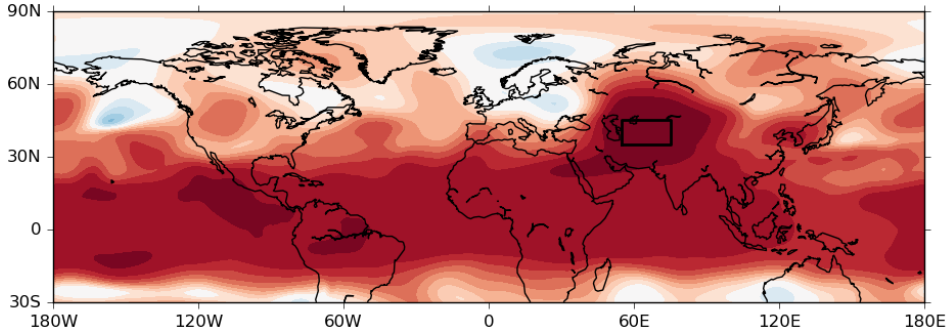
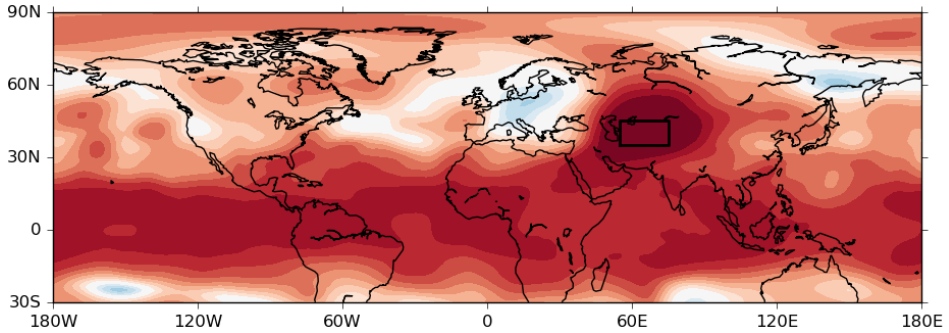
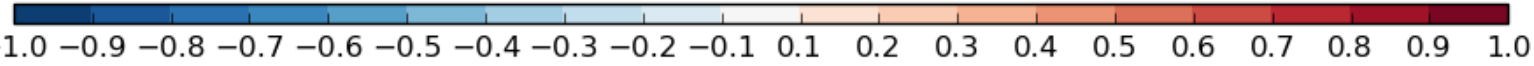


August





Experiment I

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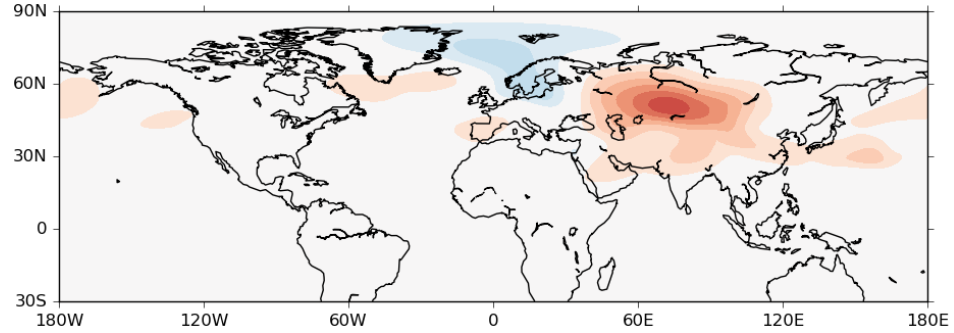
Difference in Z200 skill between experiment I and control

May



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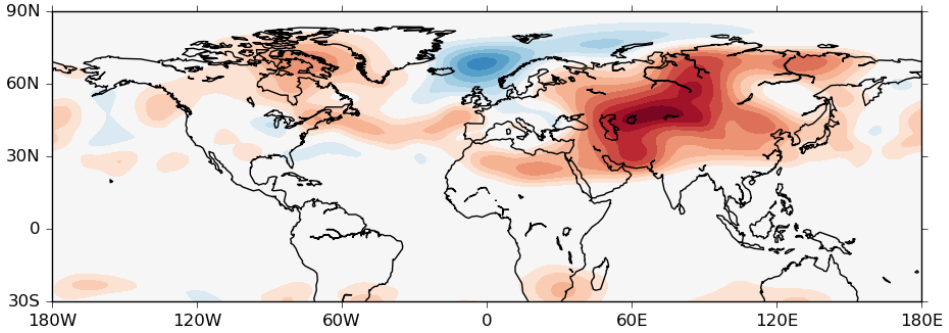

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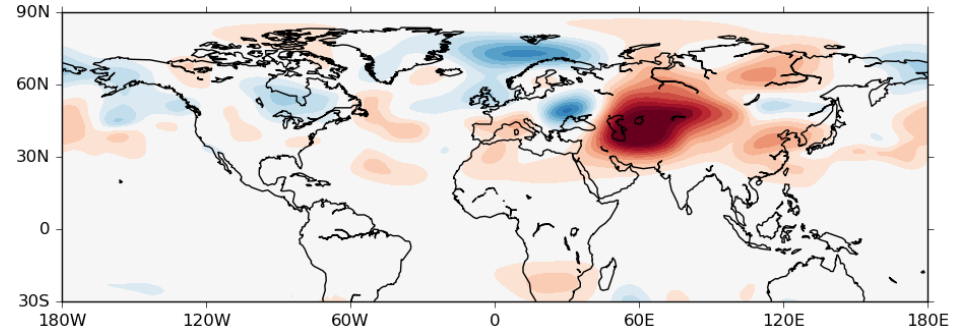
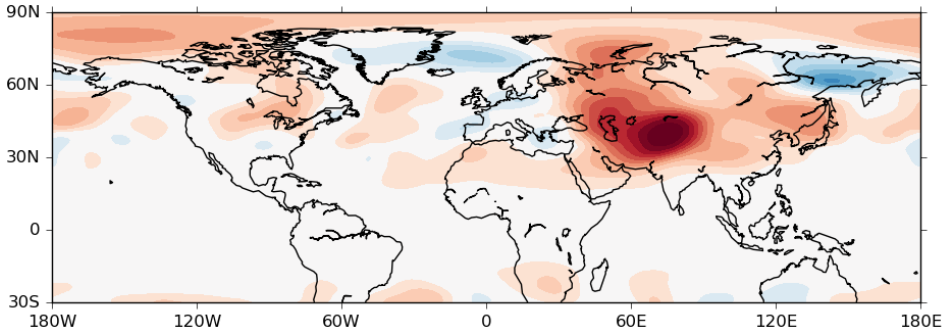
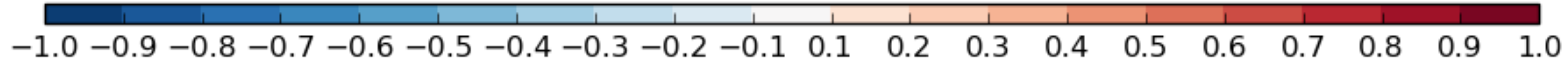


August





Experiment I

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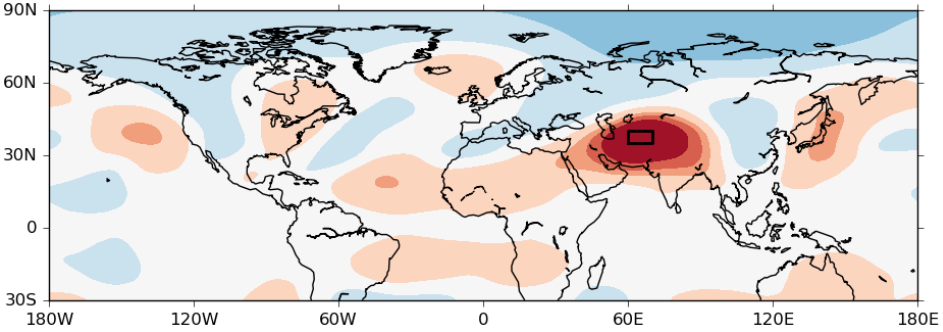
CGT correlations – experiment I

May



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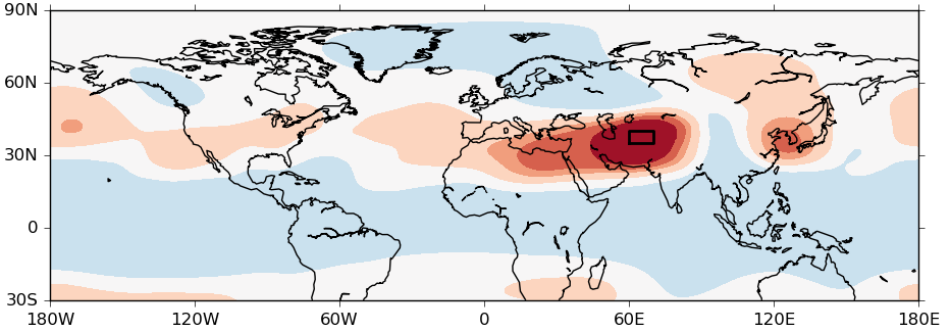

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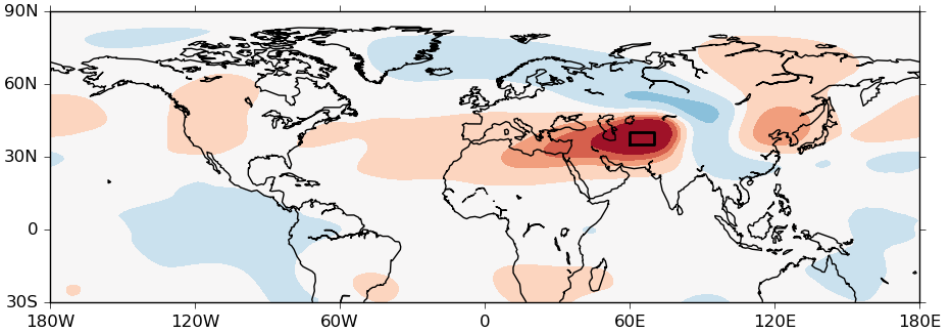
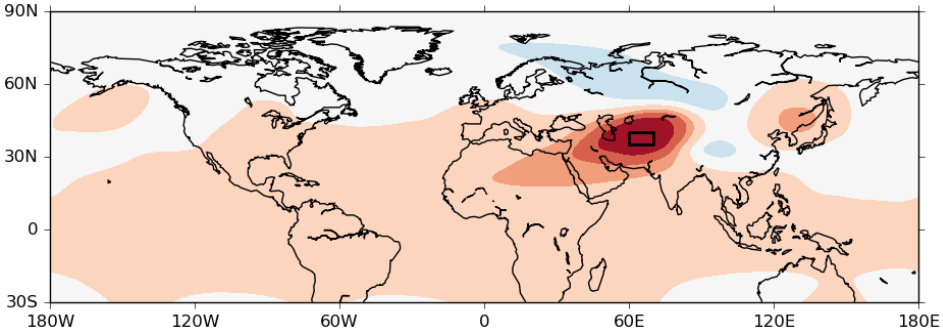
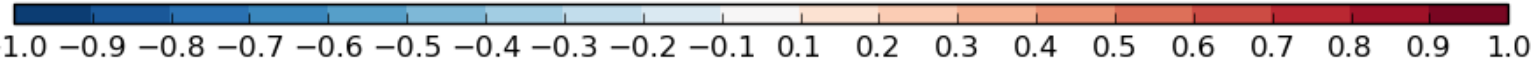


August





Experiment I - August

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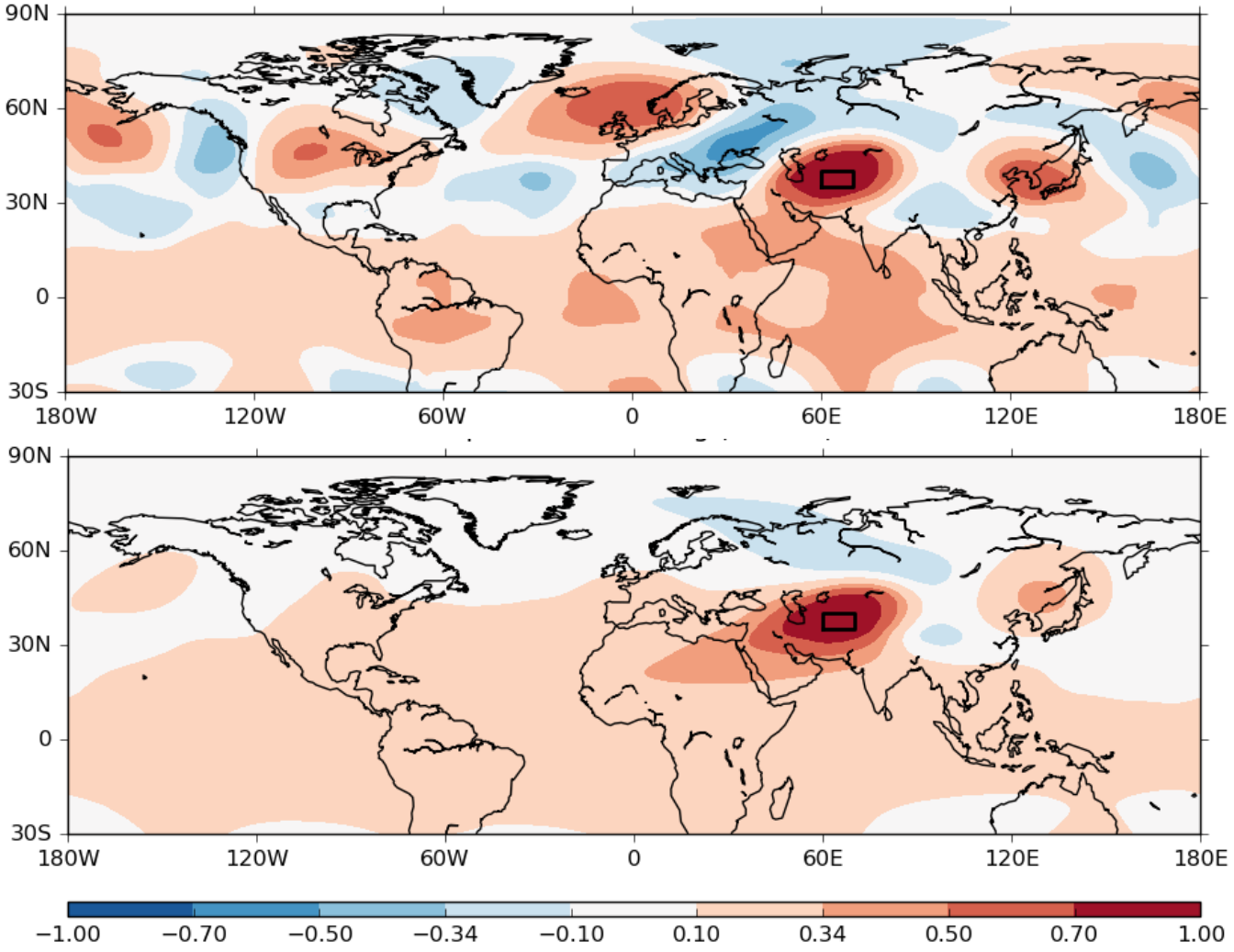
Observed correlations (200 hPa geopotential height)

Model correlations (average of 25 ensemble members)



Experiment I

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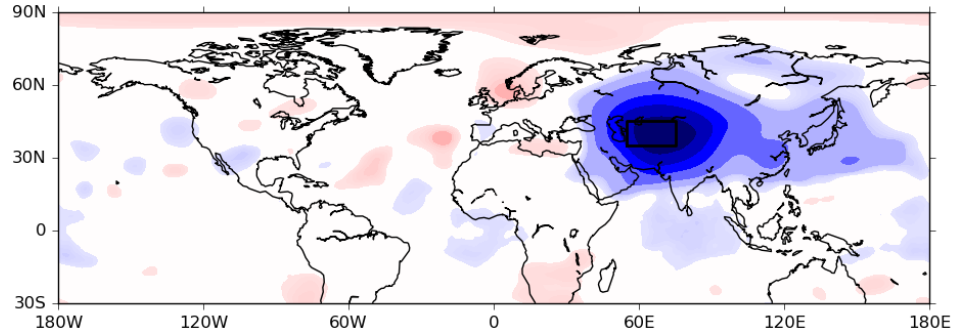
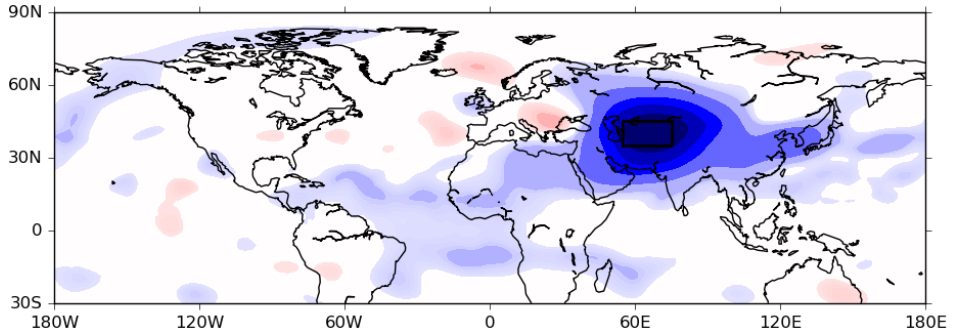
Standard deviation ratio – Experiment I / Control

May



June



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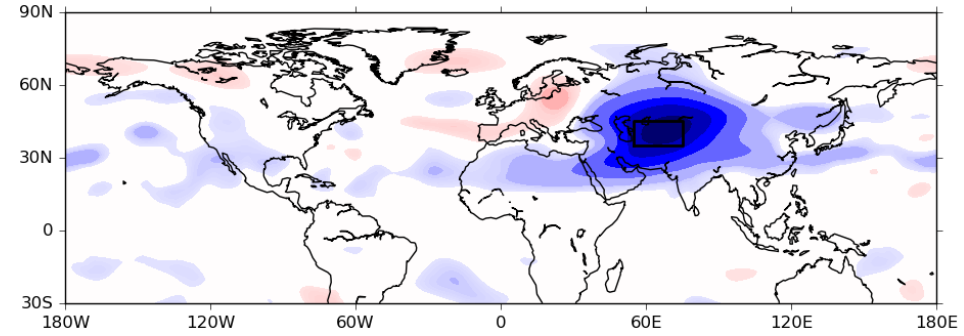
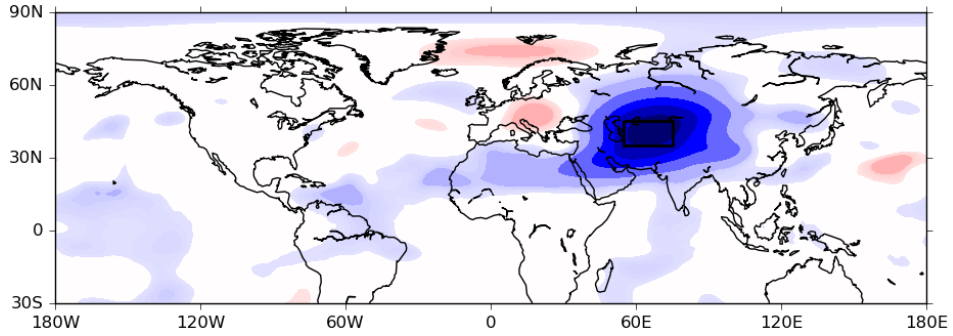
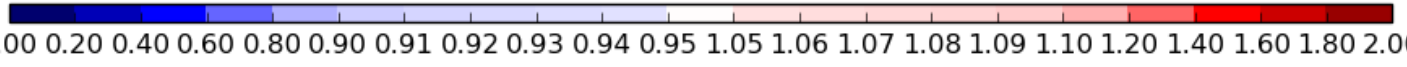


August



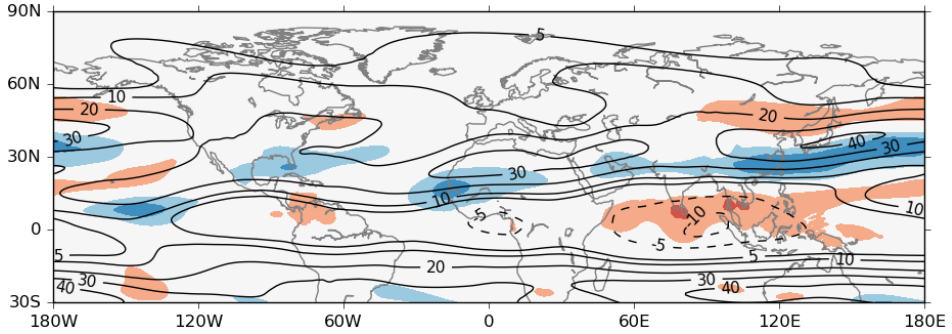


Experiment I

University of Reading

ERA-Interim zonal wind - black contours
Model zonal wind anomalies - coloured contours

May



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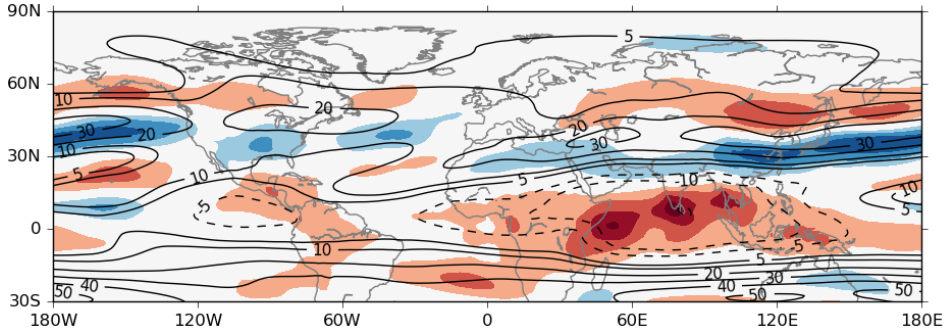
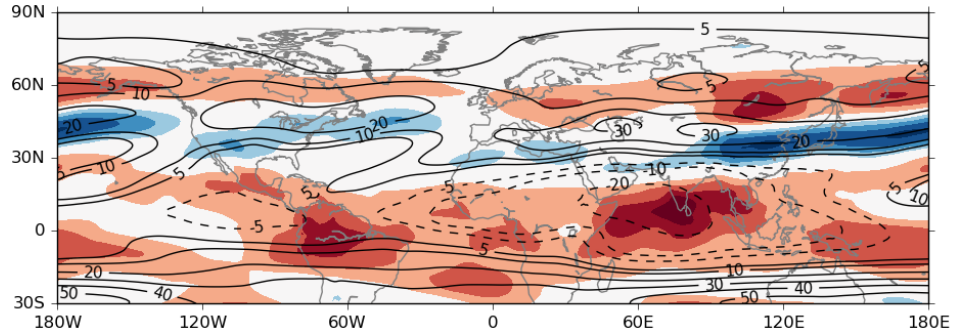


July



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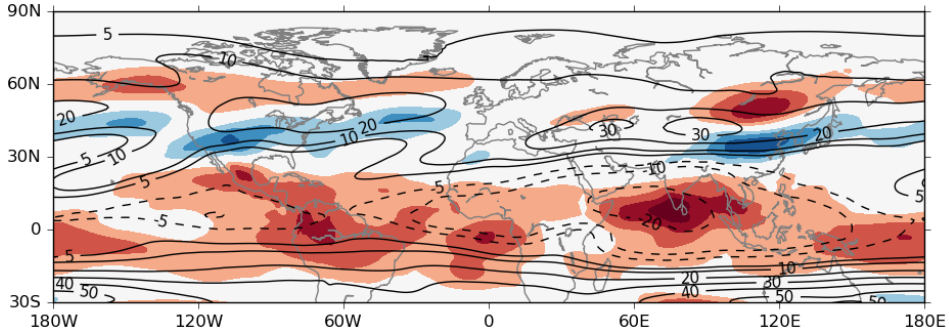
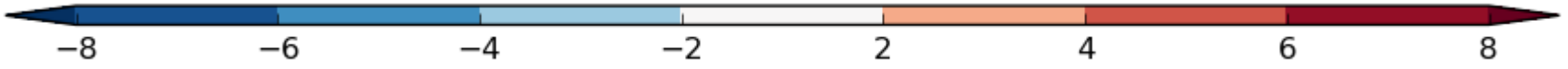


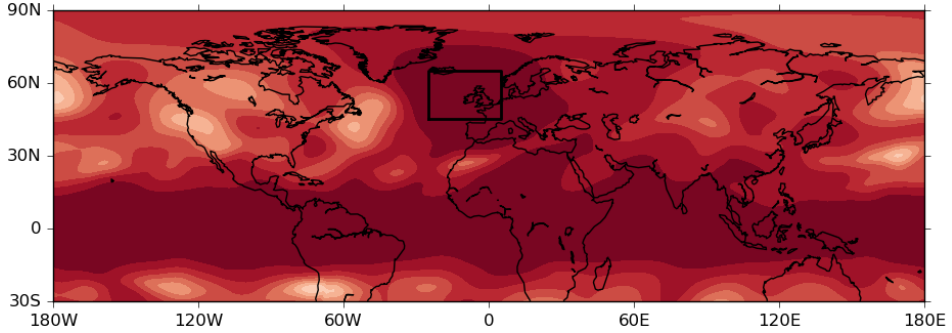


Experiment II

University of Reading

Skill of ensemble mean 200hPa geopotential height – experiment II

May



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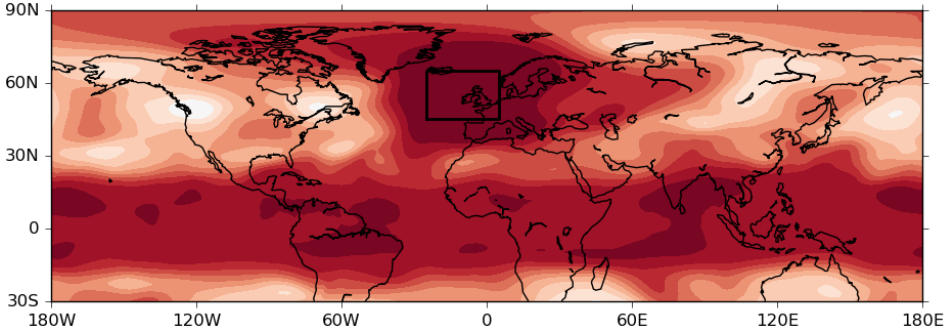

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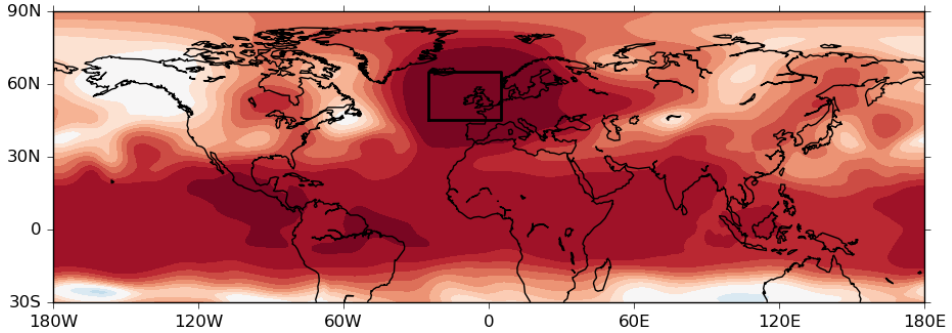

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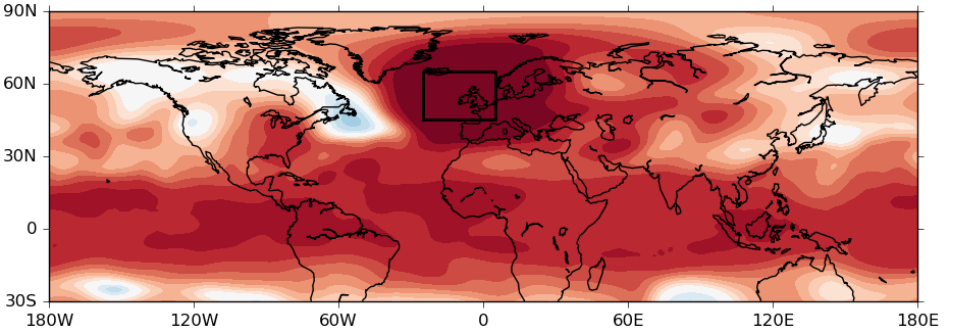
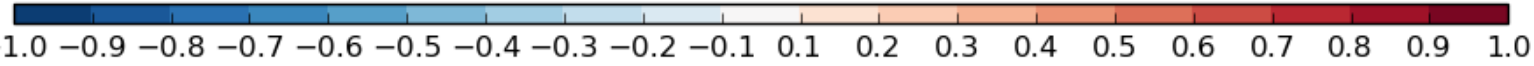


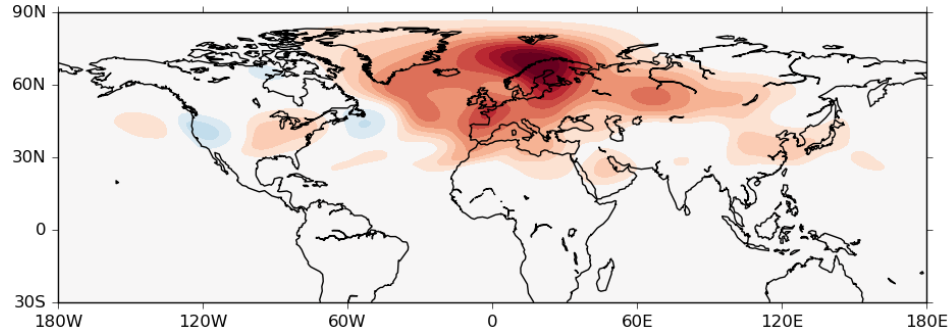


Experiment II

University of Reading

Difference in Z200 skill between experiment II and control

May



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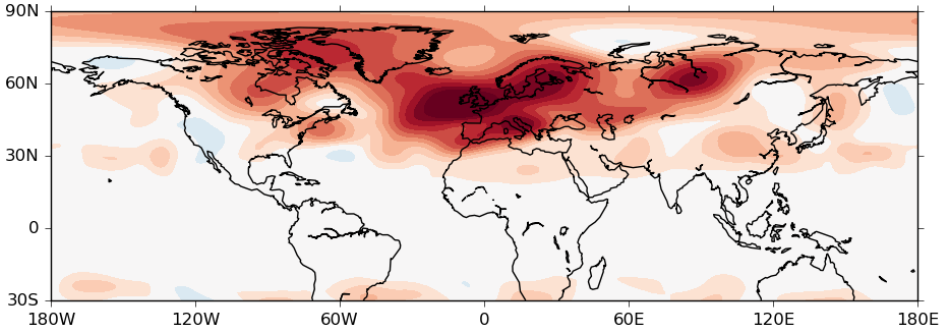

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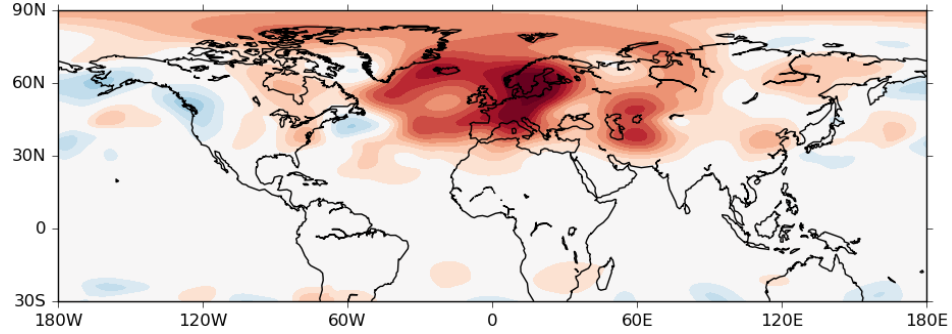

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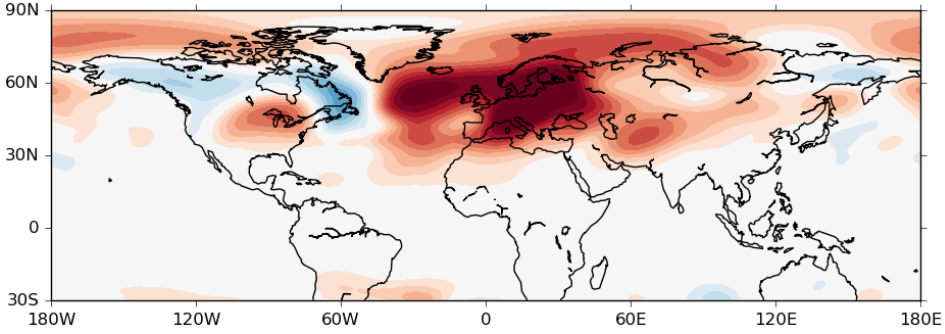
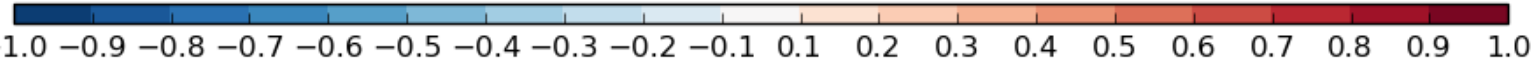


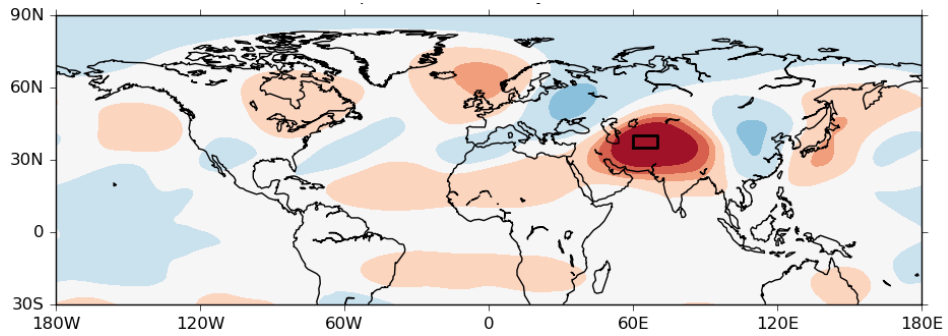


Experiment II

University of Reading

CGT correlations – experiment II

May



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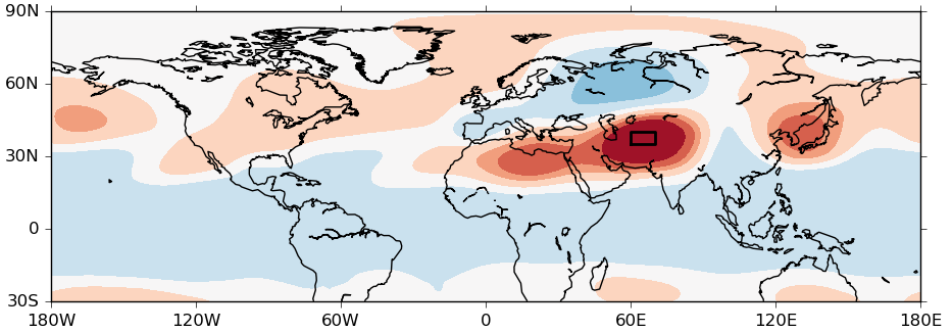

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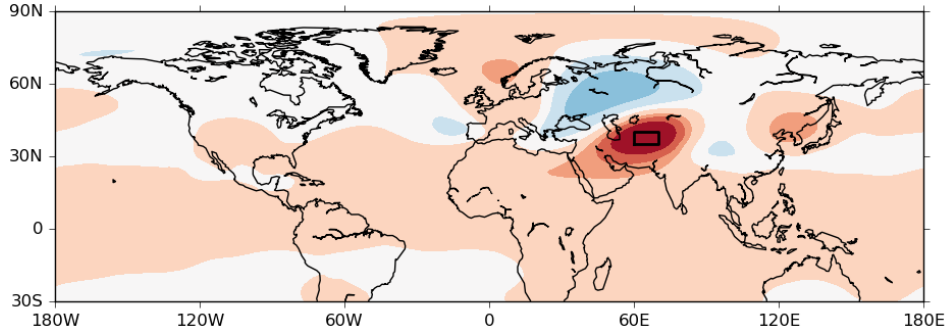

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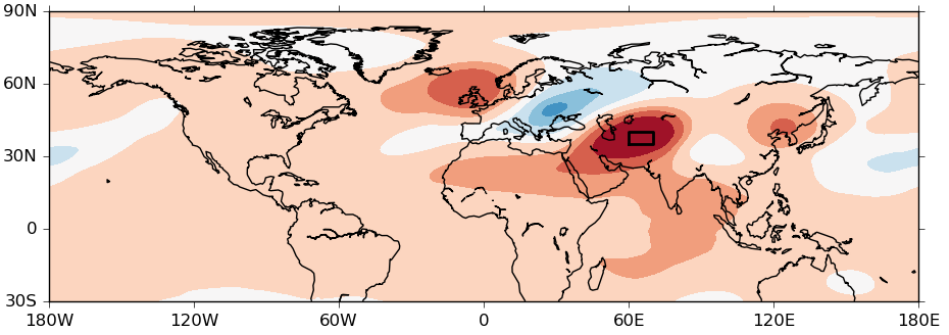
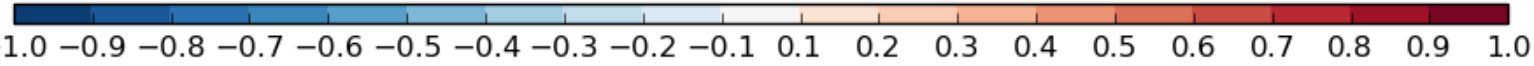


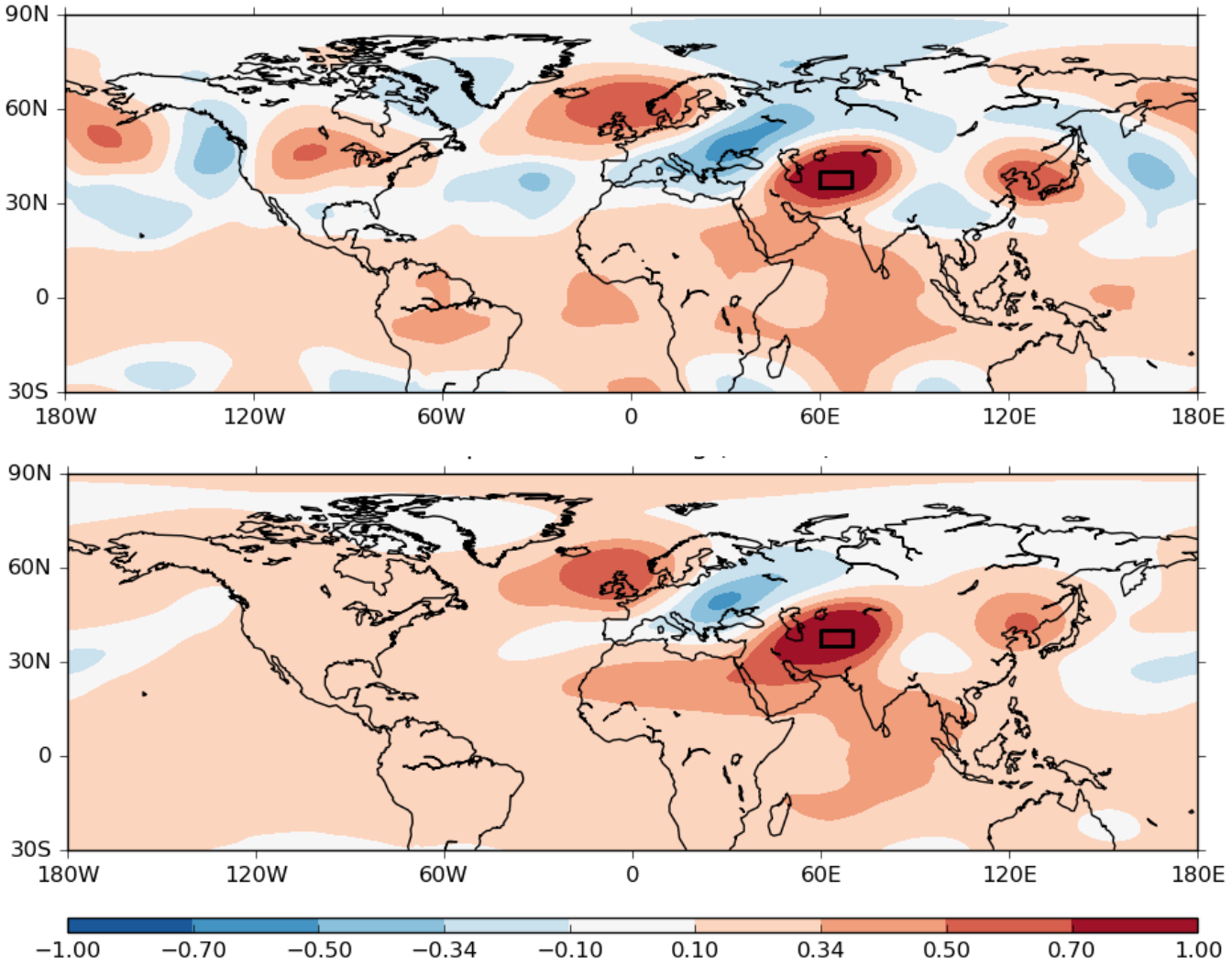


Experiment II - August

University of Reading

Observed correlations (200 hPa geopotential height)

Model correlations (average of 25 ensemble members)

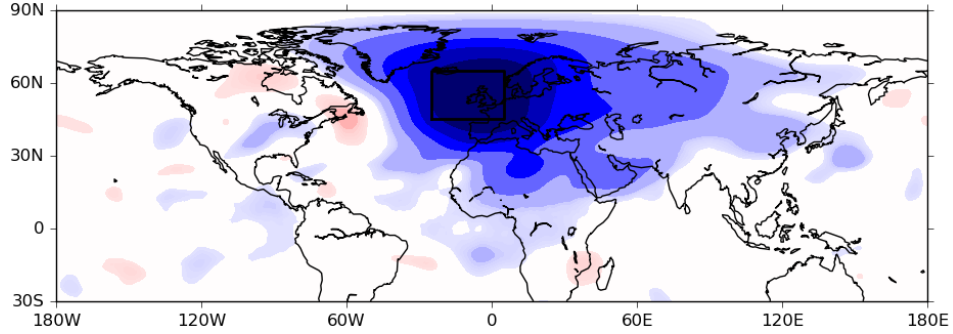


Experiment II

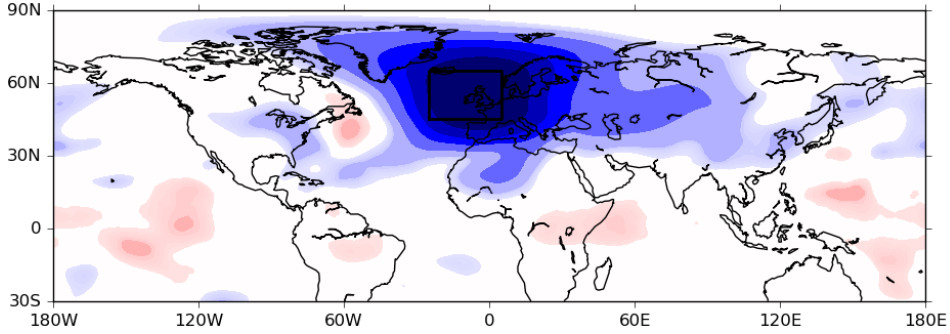
University of Reading

Standard deviation ratio – Experiment II / Control

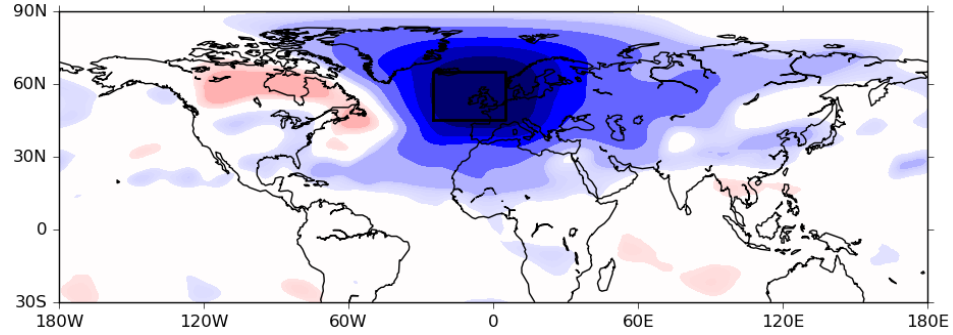
May



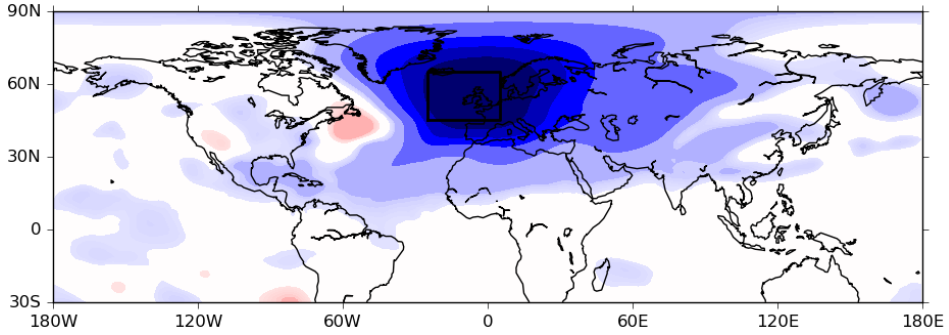
June

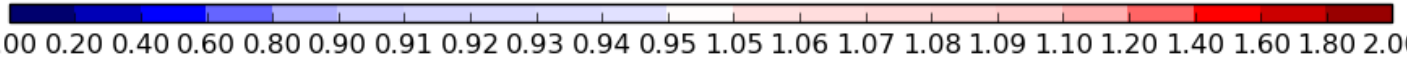


July



August



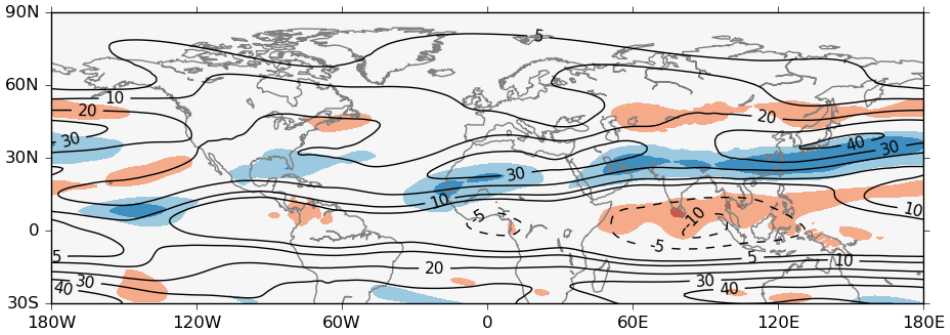


Experiment II

University of Reading

ERA-Interim zonal wind - black contours
Model zonal wind anomalies - coloured contours

May



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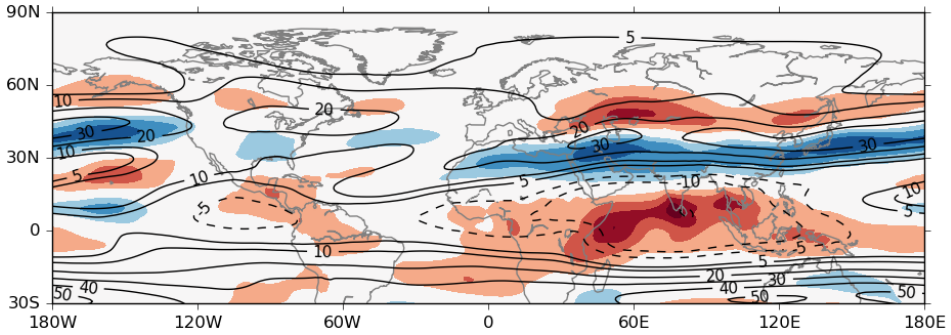

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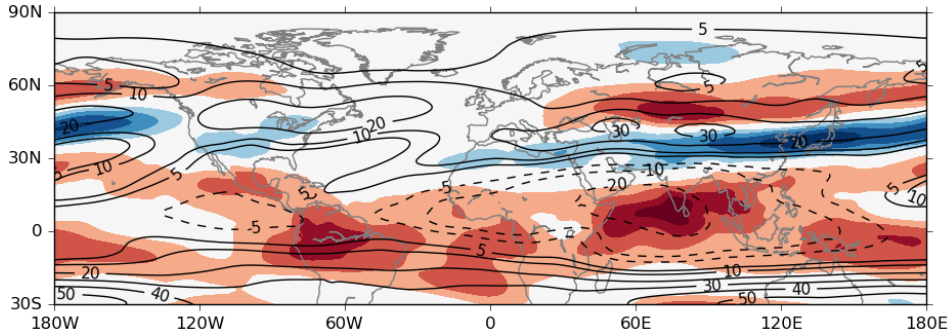
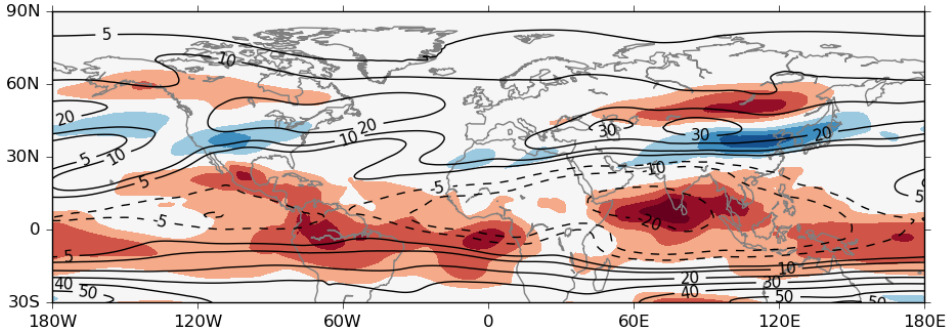
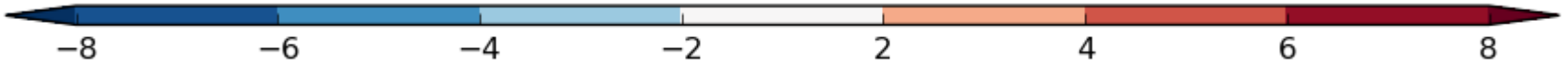


August



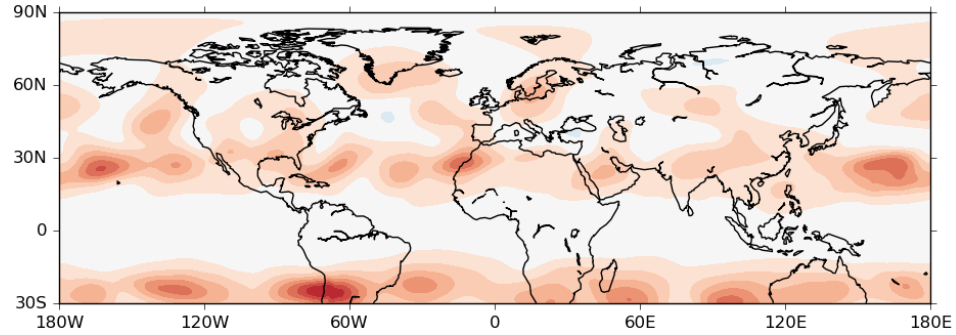


Future work

University of Reading

Difference in Z200 skill between tropical relaxation and control

May



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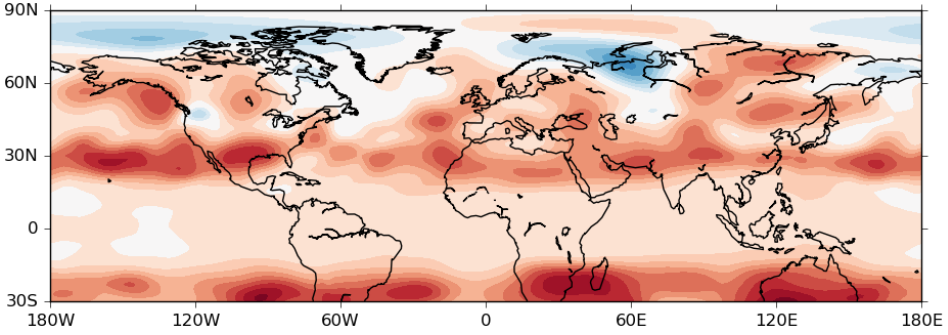

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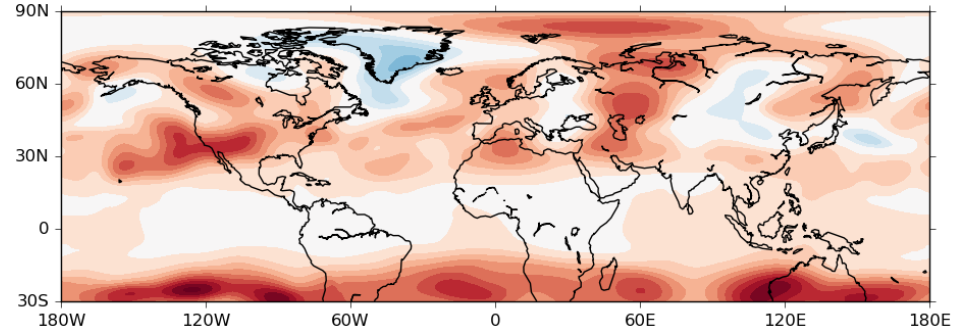

August