

Could mid-latitude weather forecasts be improved by better knowledge of the polar atmosphere?

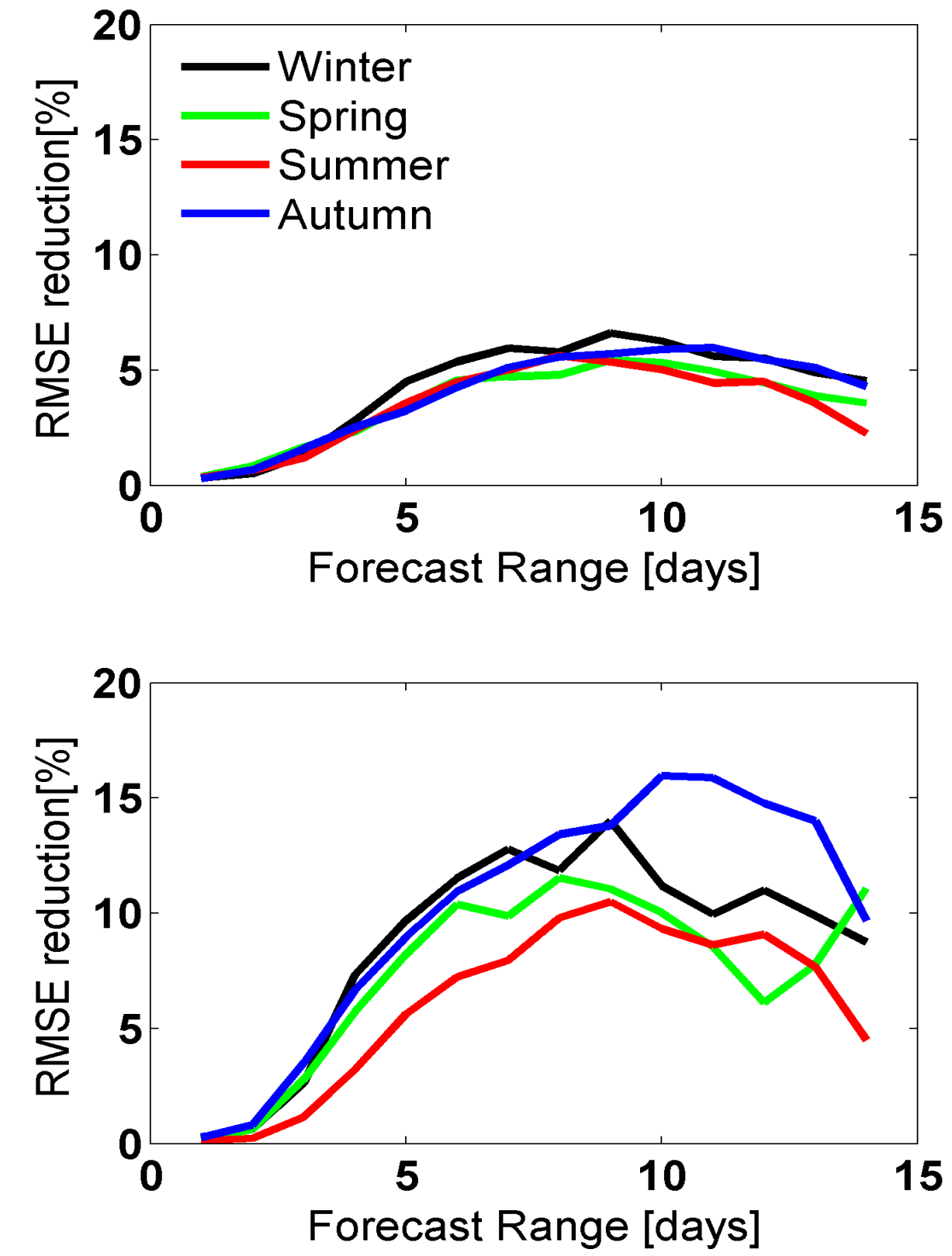
Questions

What is the influence of the polar atmosphere on the mid-latitude weather and climate?
 What is the influence of a better simulated Arctic / Antarctic atmosphere on the quality of mid-latitude weather forecasts?
 How does this compare to the influence of tropical regions?

Experiments

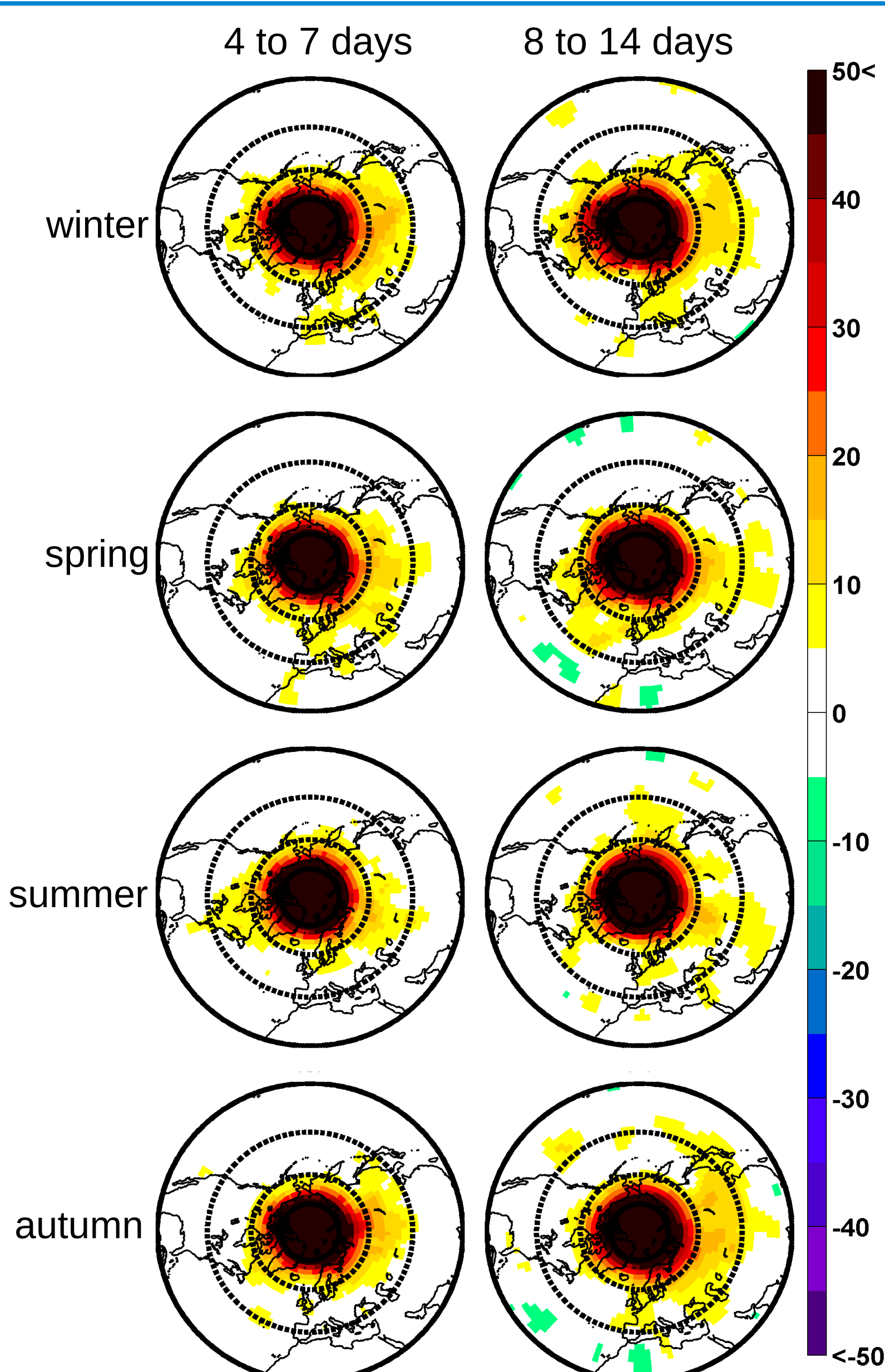
Relaxation experiments with the Integrated Forecast System (IFS) of the European Centre for Medium-Range Weather Forecasts (ECMWF)
 Pairs of forecasts with and without relaxation towards reanalysis data north of 75 N and south of 75 S

Arctic influence



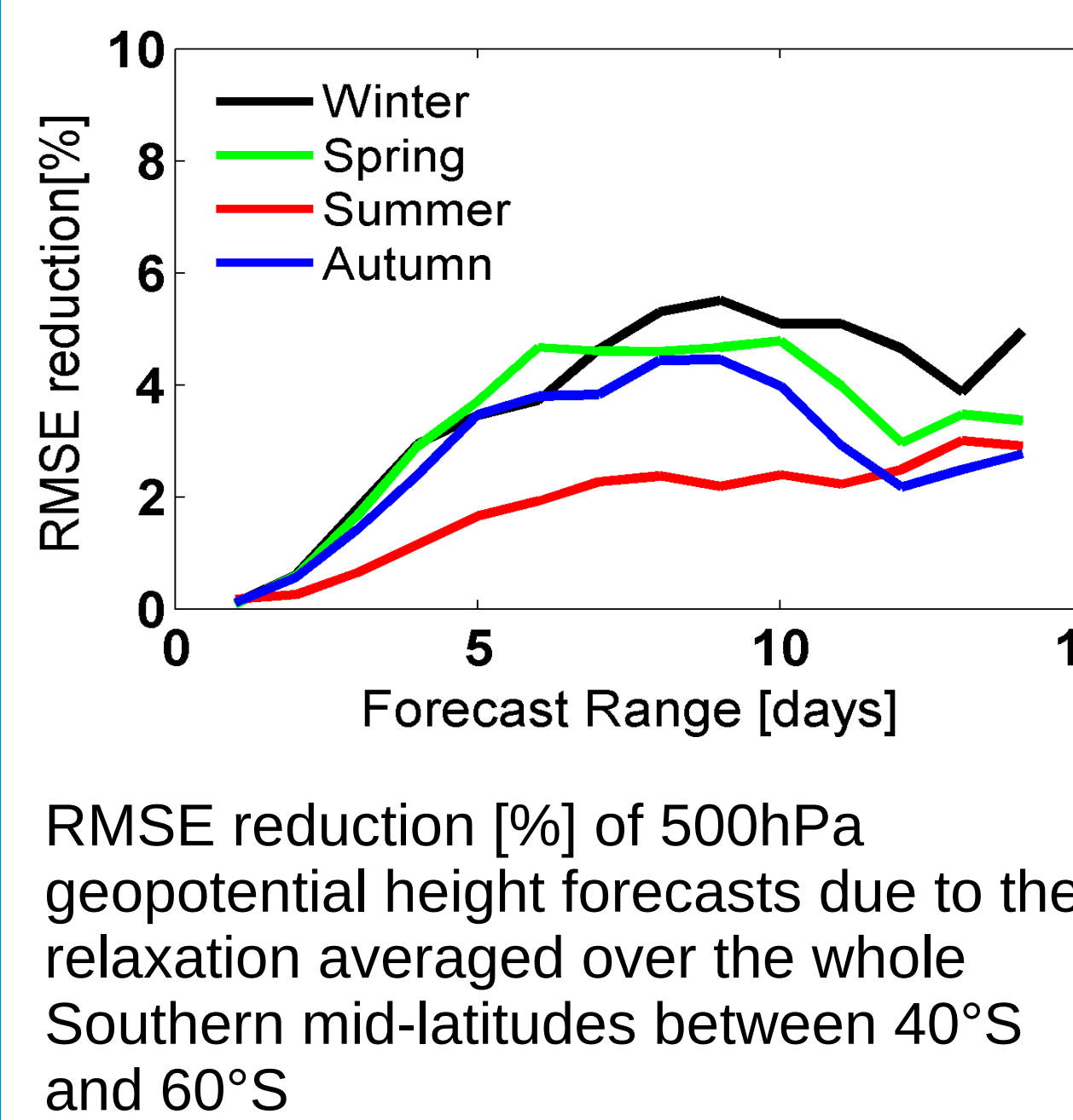
RMSE reduction [%] of 500hPa geopotential height forecasts due to the relaxation:
 (upper) averaged over the whole Northern mid-latitudes between 40°N and 60°N,
 (lower) averaged over northern Asia (40°N to 60°N, 60°E to 120°E)

Key result: RMSE reduction on average only around 5% but pronounced regional differences: northern Asia!



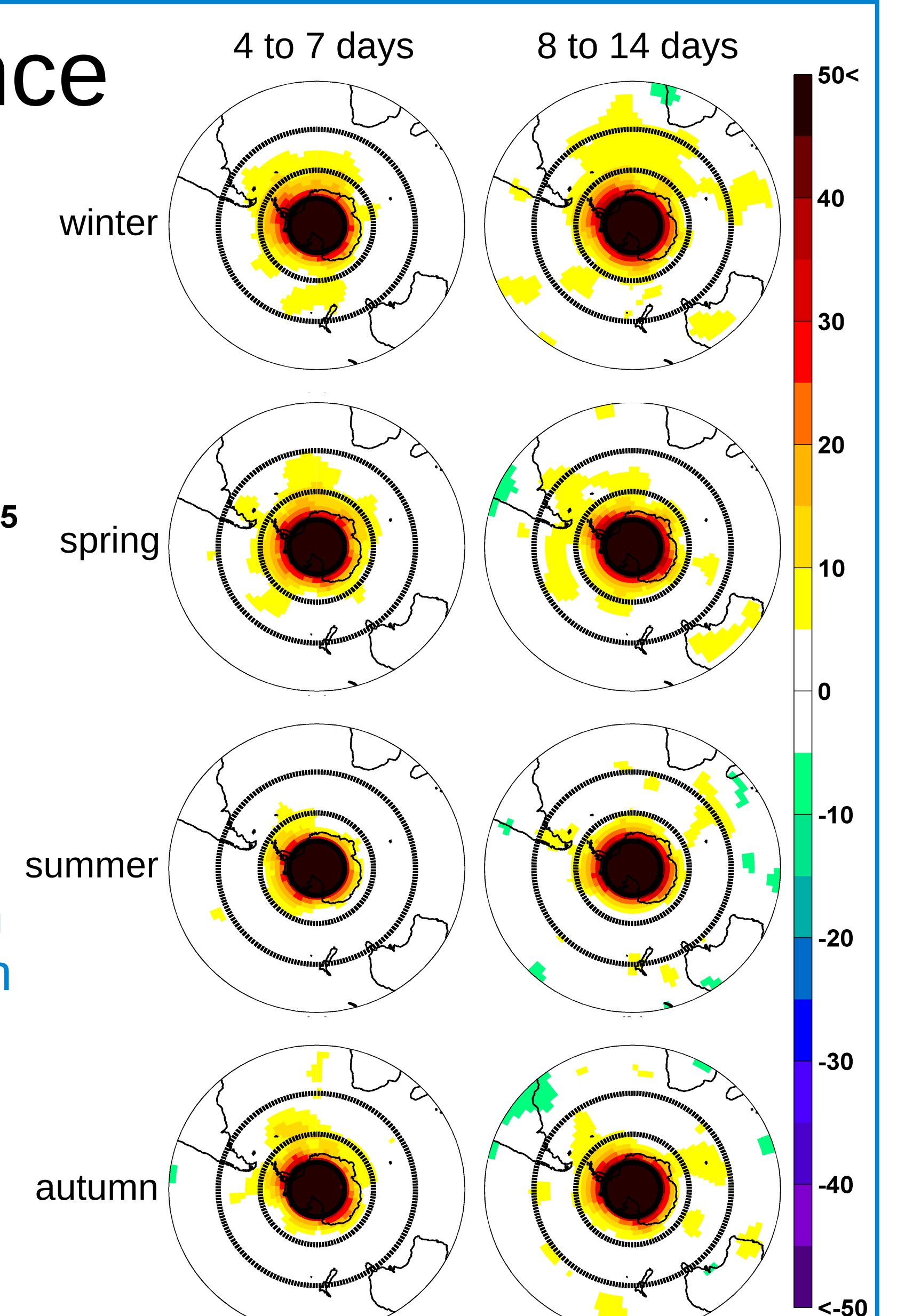
RMSE reduction [%] of the 500 hPa geopotential height forecasts for the Northern Hemisphere north of 20°N due to the relaxation

Antarctic influence

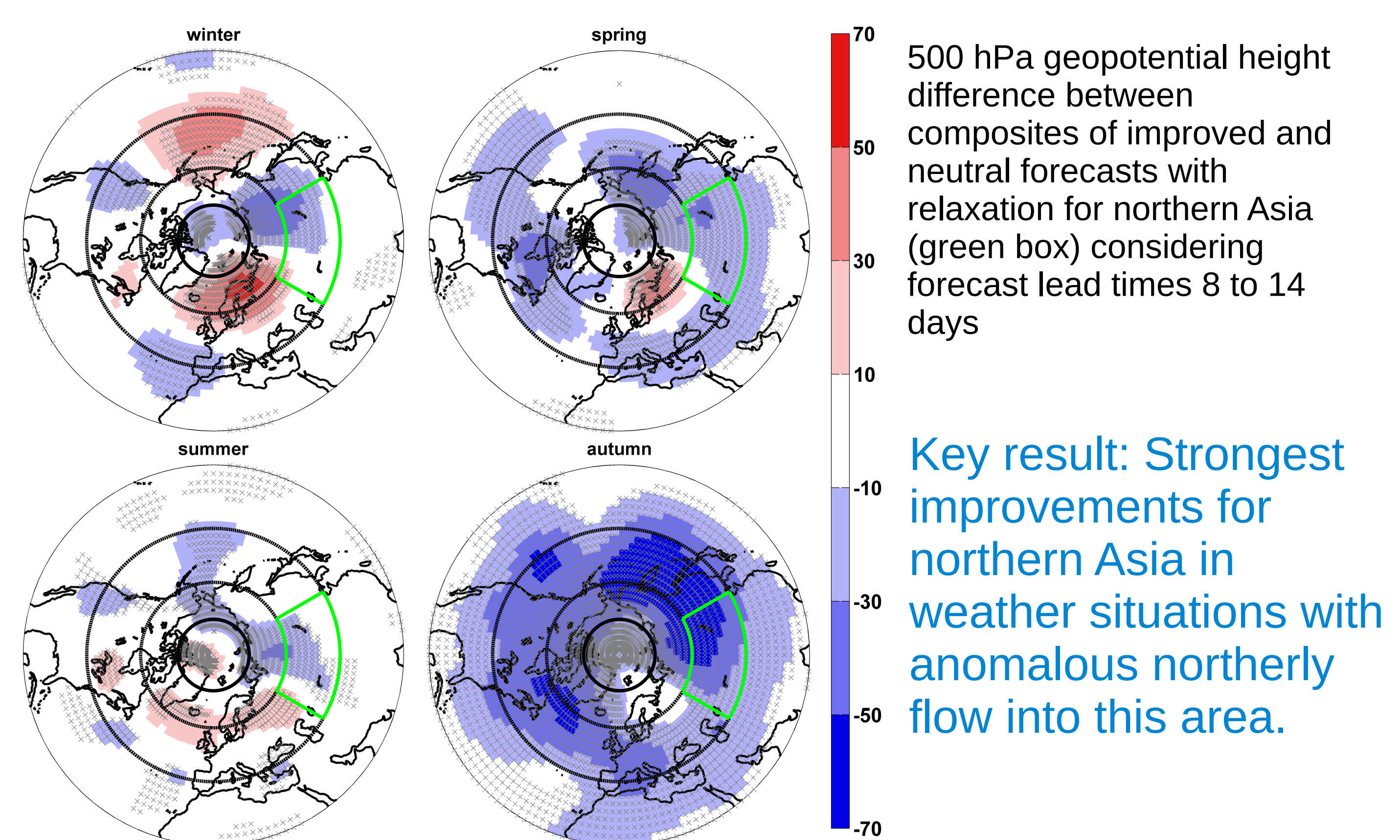


RMSE reduction [%] of 500hPa geopotential height forecasts due to the relaxation averaged over the whole Southern mid-latitudes between 40°S and 60°S

Key results: RMSE reduction slightly less than for Northern Hemisphere, especially in summer. No pronounced regional differences; tendency for stronger improvements downstream of southern South America

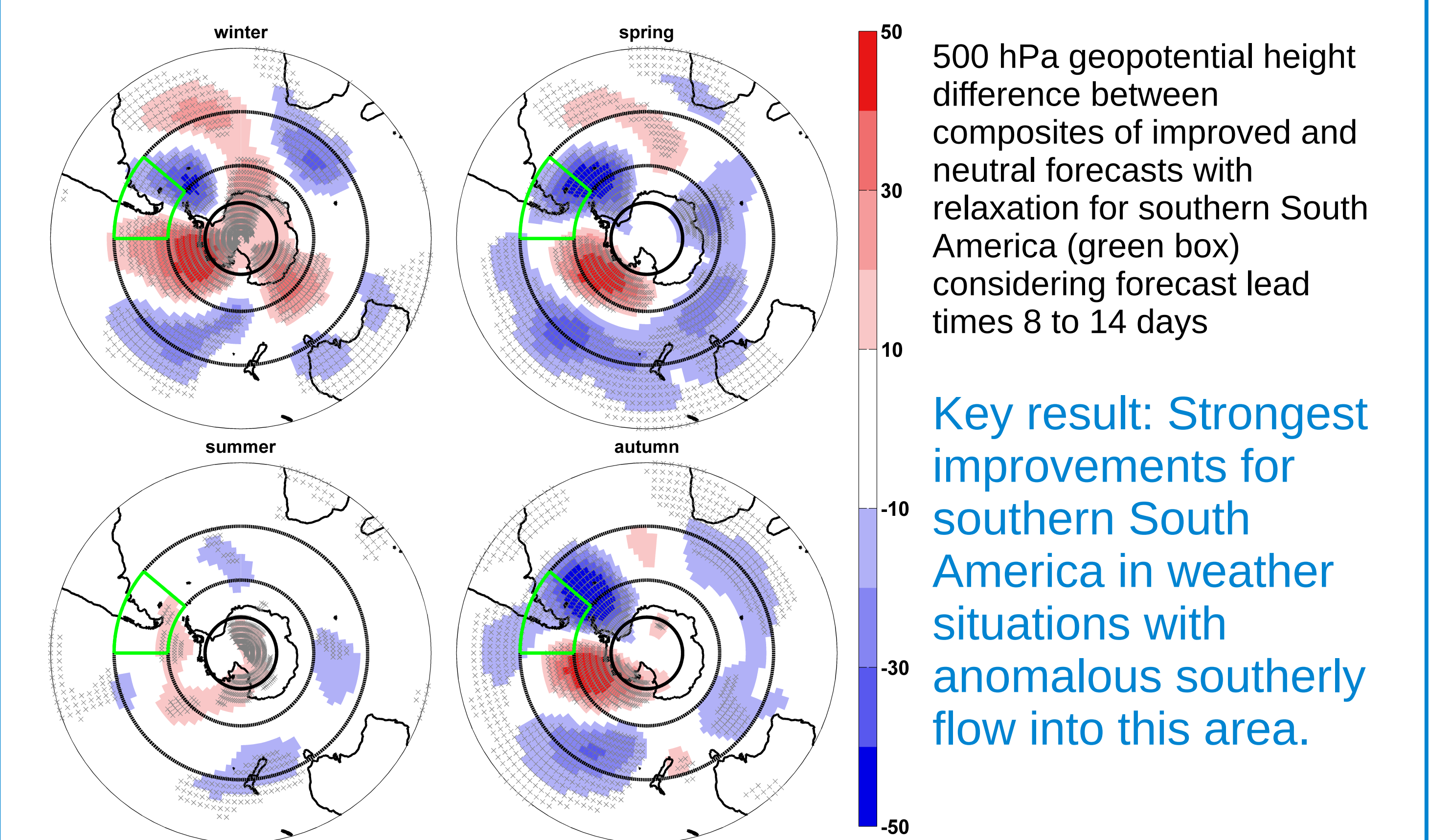


RMSE reduction [%] of the 500 hPa geopotential height forecasts for the Southern Hemisphere south of 20°S due to the relaxation



500 hPa geopotential height difference between composites of improved and neutral forecasts with relaxation for northern Asia (green box) considering forecast lead times 8 to 14 days

Key result: Strongest improvements for northern Asia in weather situations with anomalous northerly flow into this area.

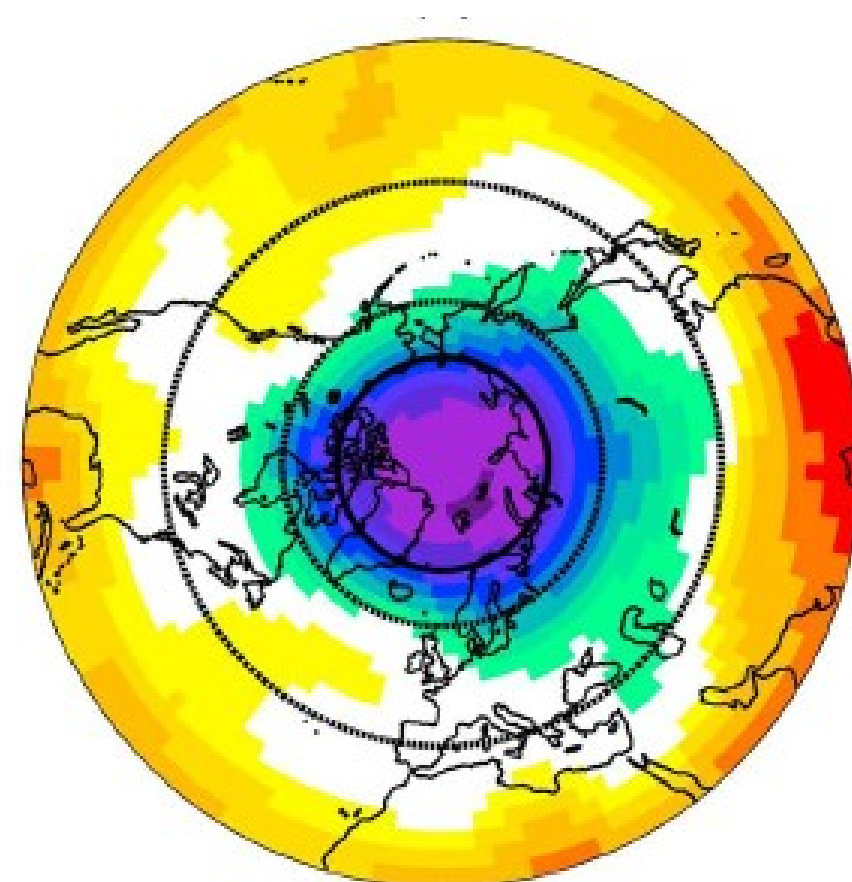


500 hPa geopotential height difference between composites of improved and neutral forecasts with relaxation for southern South America (green box) considering forecast lead times 8 to 14 days

Key result: Strongest improvements for southern South America in weather situations with anomalous southerly flow into this area.

Discussion and conclusions

- Northern Asia benefits most from better simulated Arctic: key region for Arctic – mid-latitude link confirmed with very different method!
- Continental areas: stronger Arctic influence (climatological troughs!), over sea stronger tropical influence



Difference in the relative reduction of RMSE between experiments with tropical and Arctic relaxation for days 11 to 30. Negative values indicate that Arctic relaxation is more efficient than tropical relaxation in reducing Z500 RMSE

- Over Southern Hemisphere southern South America important – link to ENSO!
- Large-scale circulation changes in the future → influence of the polar regions may change!
- Quality of mid latitude forecasts may be affected