

# Prediction skill of the MJO teleconnection signals in the NASA GEOS subseasonal reforecasts

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## Introduction

The Madden Julian Oscillation (MJO) is an important source of predictability in the subseasonal timescale. The objective of this study is to investigate the impact of MJO teleconnections on forecast accuracy at 2-3 week lead over North America. To this end, we utilize a suite of subseasonal reforecasts performed with the latest NASA GEOS seasonal-to-subseasonal (S2S) system.

## Model Description

**Atmosphere:** NASA GEOS run at 1/2 degree horizontal resolution and 72 vertical layers

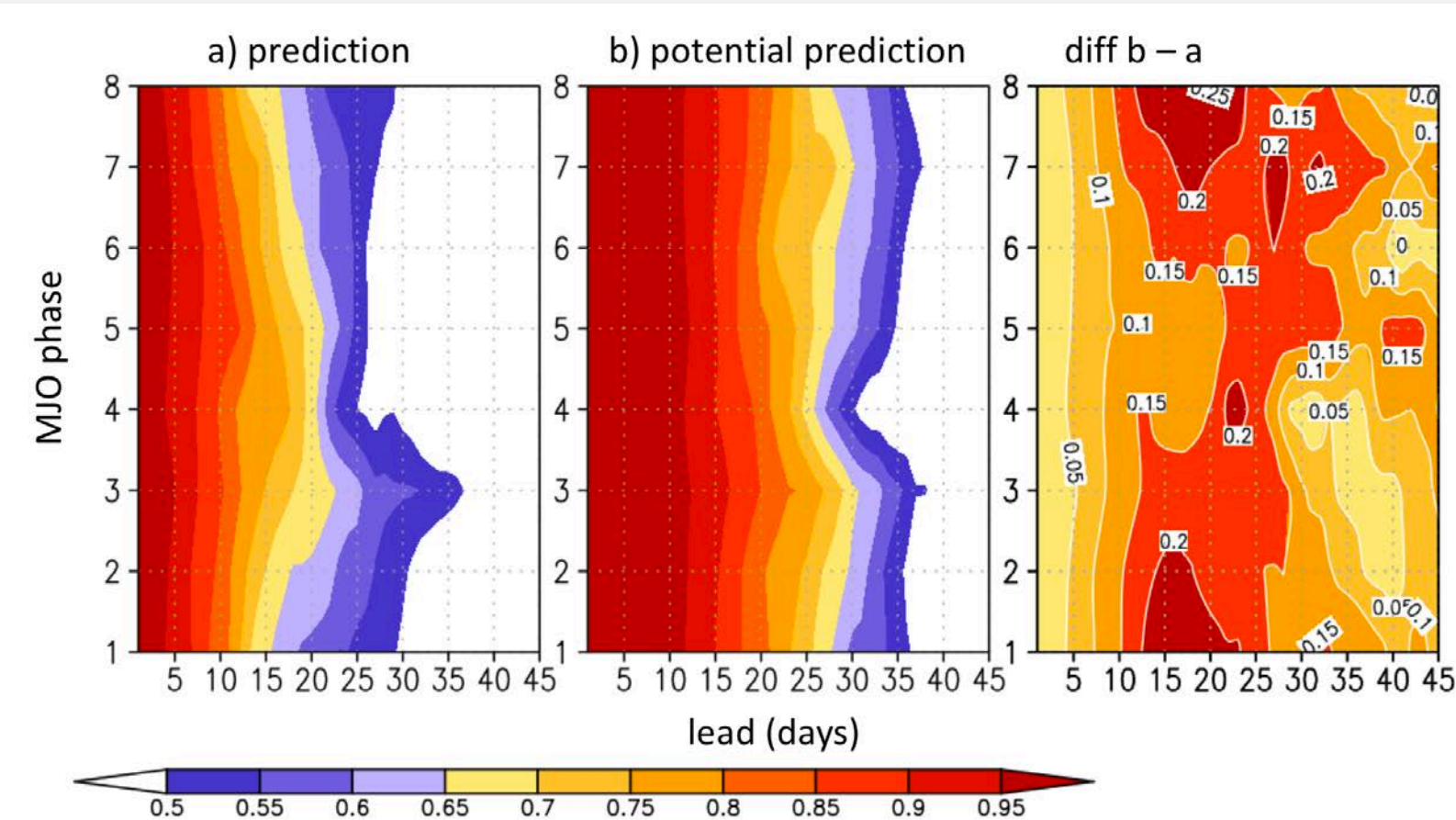
**Ocean:** Modular Ocean Model Version 5 (MOM5) of Geophysical Fluid Dynamics Laboratory run at 1/2 degree horizontal resolution and 40 vertical layers

**Land:** Catchment land surface model

**Sea ice:** Los Alamos Sea Ice model (CICE)

**Initialization of the reforecasts:** Atmosphere from the Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2); ocean and the sea ice from GMAO ocean analysis; and land from MERRA-2 land fields which are based on observations-corrected precipitation. The reforecasts are initialized every 5 days with a total of 73 start dates per year.

## MJO prediction skill and predictability

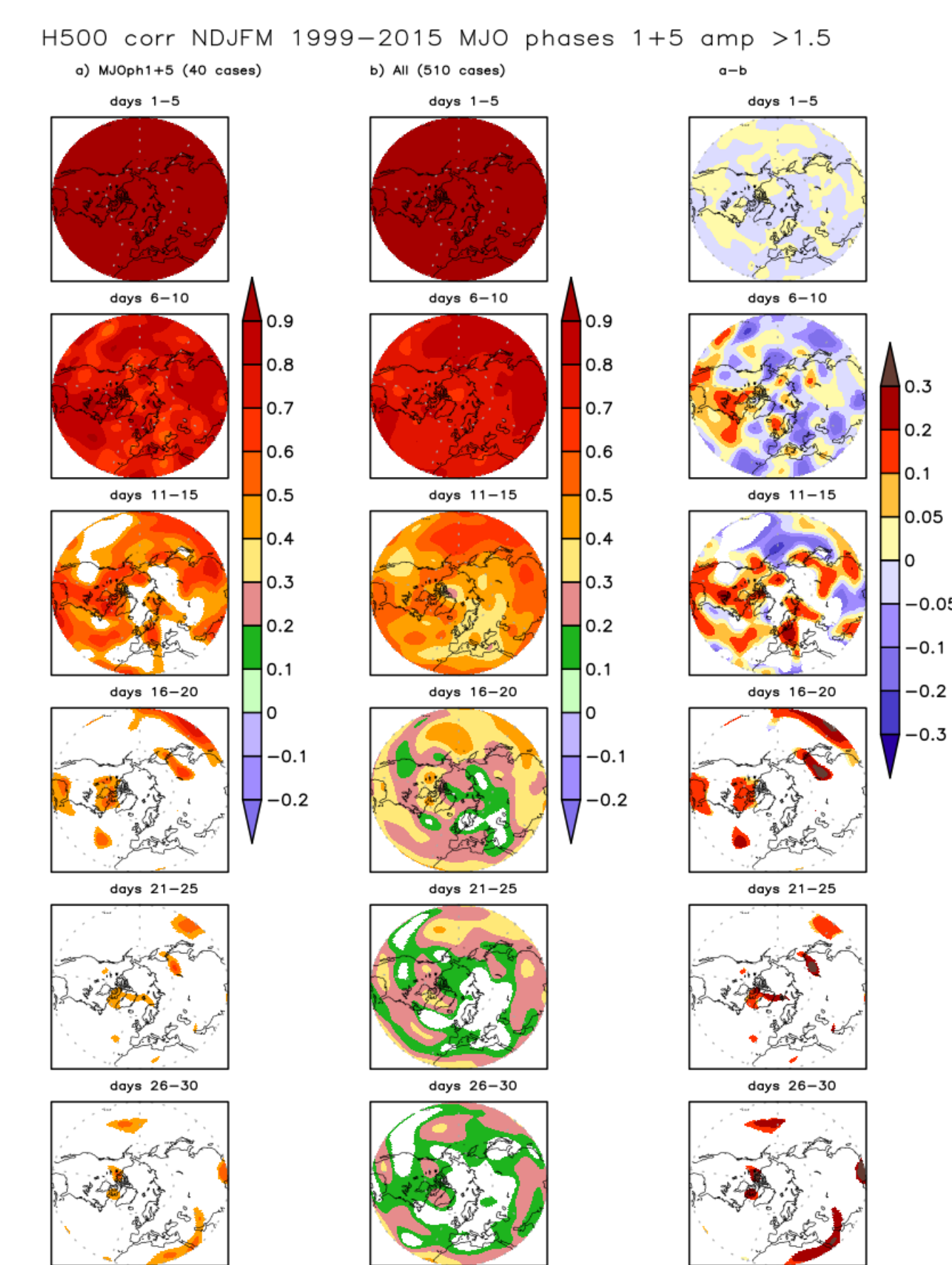


Pronounced increase for cases that are initialized in MJO phases 2 and 3. The upper limit of predictability is computed by taking one ensemble member as the truth and verifying ensemble mean of the rest against that. Scope for improved prediction mainly lies between forecast leads 15-25 days.

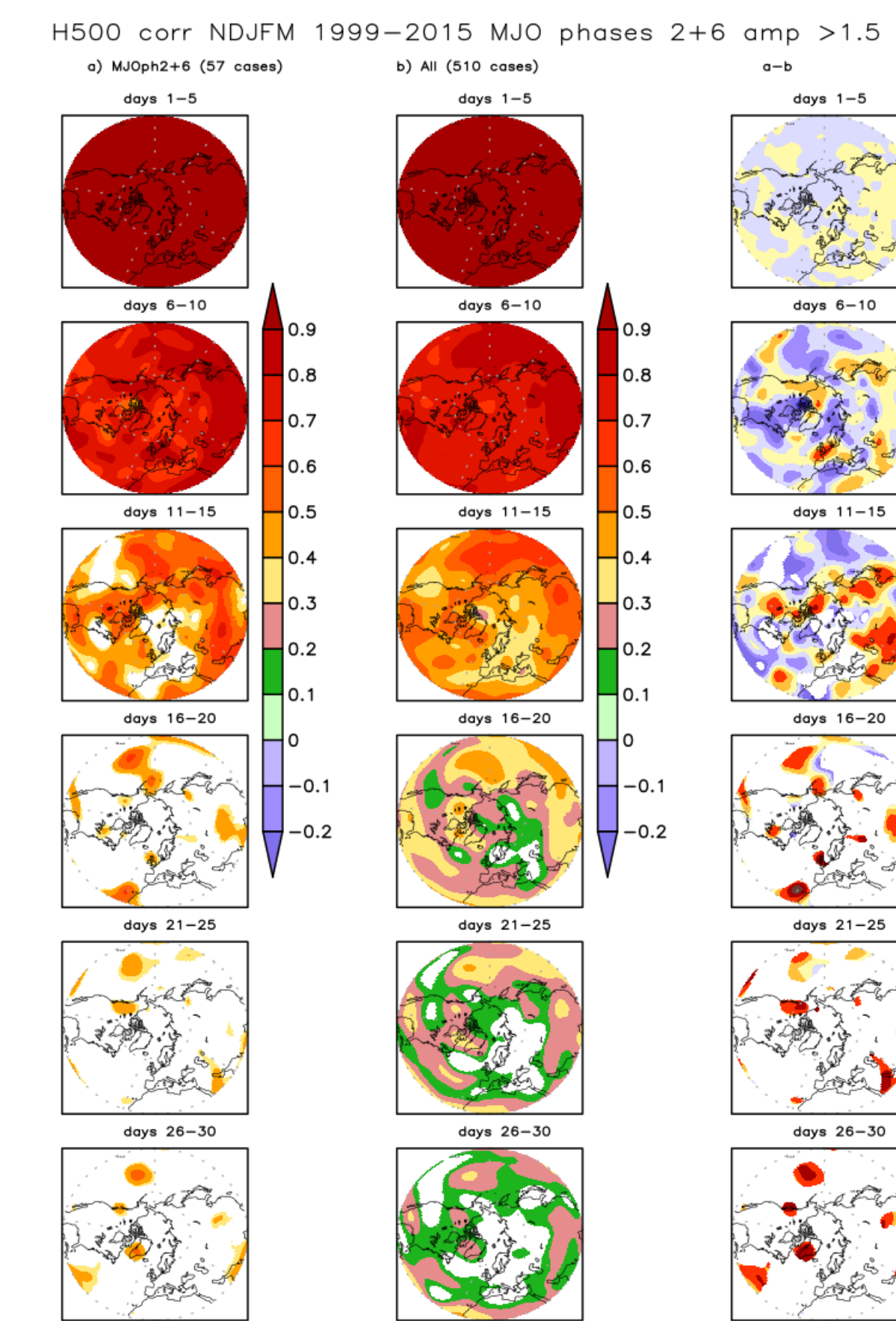
## MJO teleconnection signals - Correlation skill and Composites of H500

### H500 correlation skill

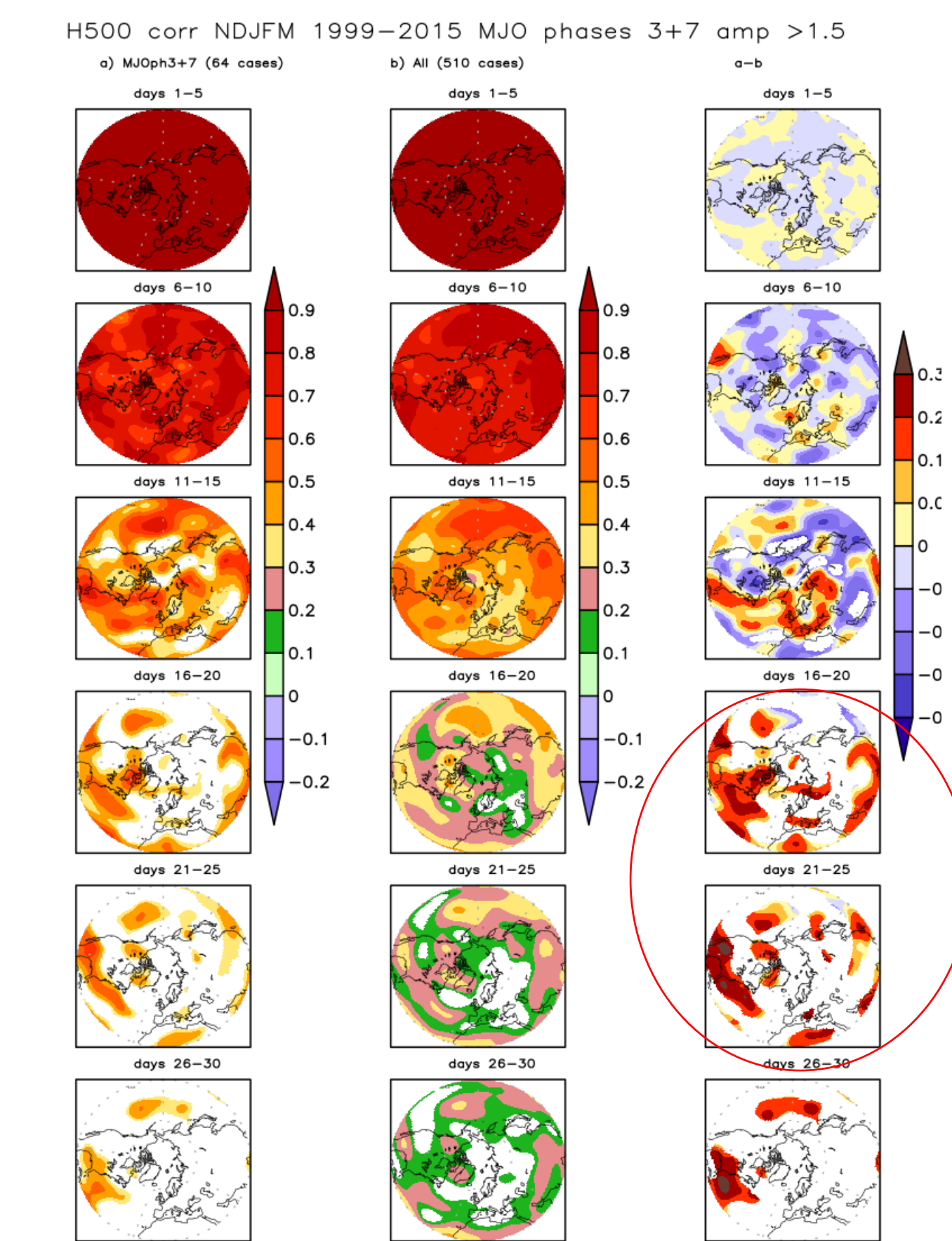
#### MJO phases 1,5



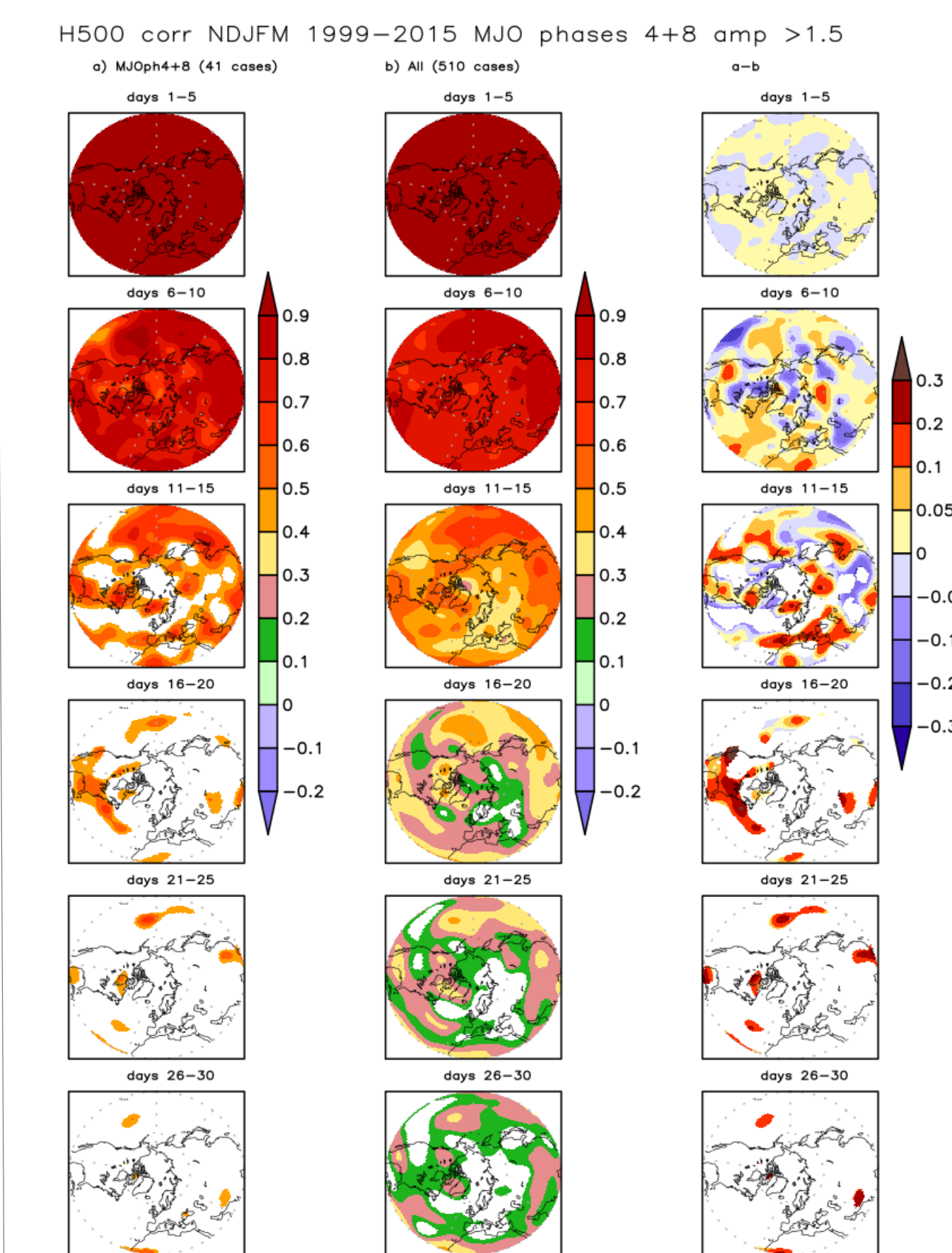
#### MJO phases 2,6



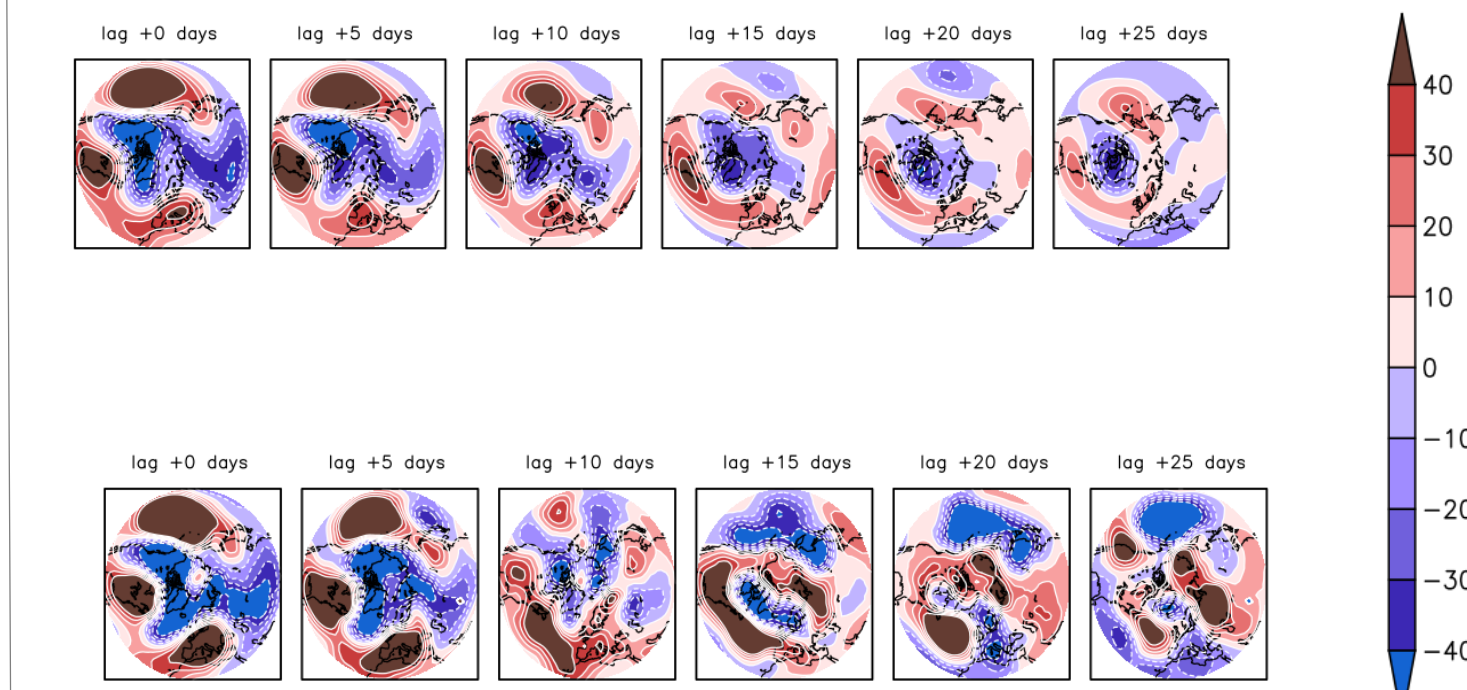
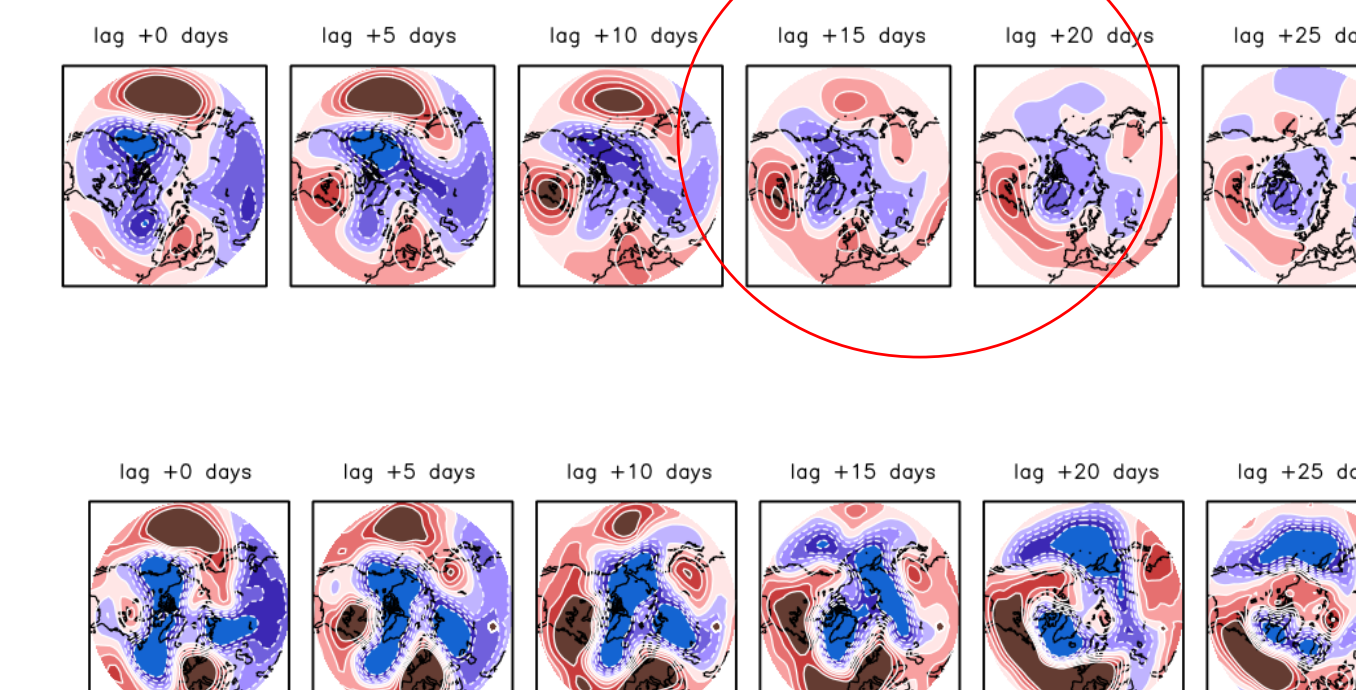
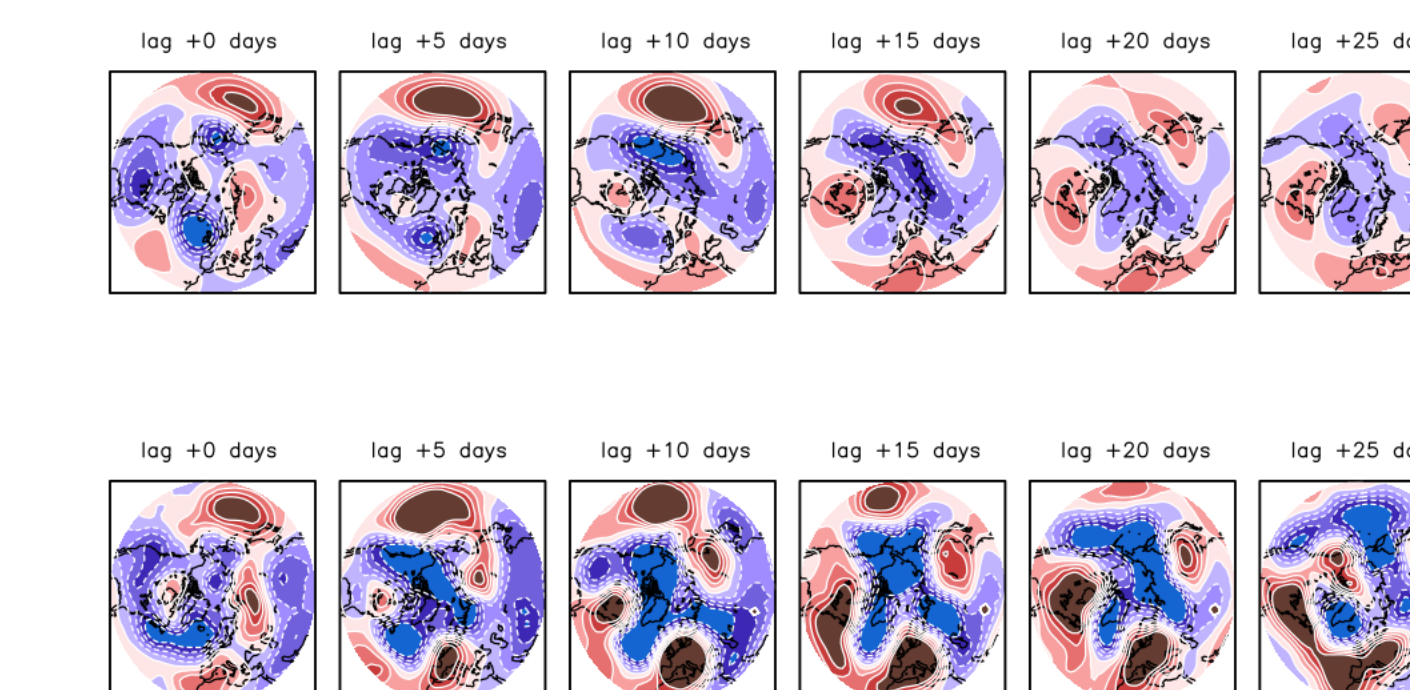
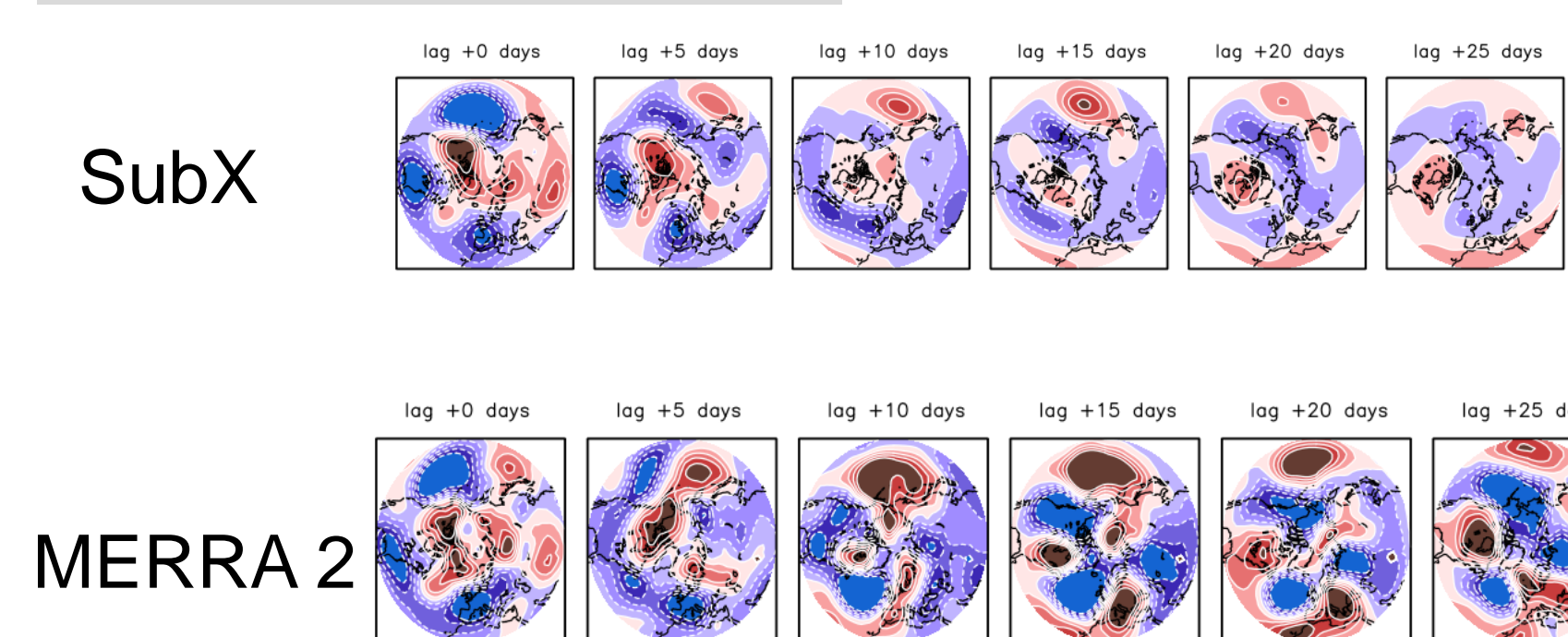
#### MJO phases 3,7



#### MJO phases 4,8



### H500 composites



## Conclusions

- 1) The GEOS SubX reforecasts show reasonably good skill in predicting the MJO. The RMM index based skill metrics show that anomaly correlation of 0.5 is reached around forecast lead of 29-30 days. The skill is increased up to 35 days for MJO events initialized in phase 3, where convection is centered in the central tropical Indian Ocean.
- 2) Suppressed or enhanced convection over the tropical western Pacific in relation to the MJO activity (MJO phases 3, 7) is generally known to produce a simultaneous PNA-like pattern characterized by height anomalies in the North Pacific. Within 10-15 days after the respective MJO phase, this extratropical anomalies propagate to the east forming height anomalies over the eastern US, North Atlantic and Europe, projecting on to an NAO-like pattern.
- 3) SubX hindcasts examined here produce these teleconnections reasonably well, especially the signal over the eastern US. The signal across the North Atlantic and Europe is where the model fails mostly. This appears to be a prevailing issue, being observed in the models participating the international S2S project as well.
- 4) Forecasts initialized in MJO phases 3 or 7 appear to be beneficial in the subseasonal timescale over midlatitudes. Compared to all forecasts, a notable improvement in skill in weeks 2-3 is seen for these special cases.

