# Subseasonal to Seasonal (S2S) Prediction

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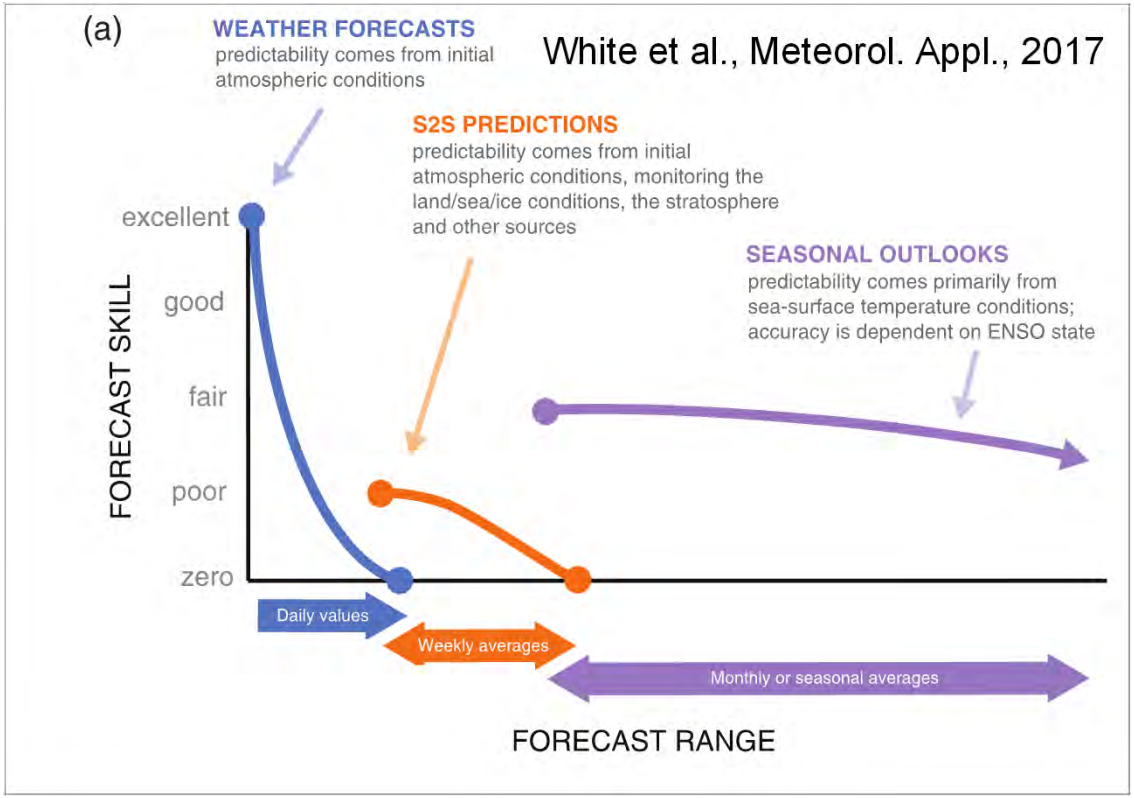
# S2S prediction is a frontier but remains challenging

## S2S: 10 days to one season




Multiagency and international efforts:

**1) WWRP/WCRP S2S project**

**2) SubX (Participation in the NOAA/MAPP S2S Task Force)**

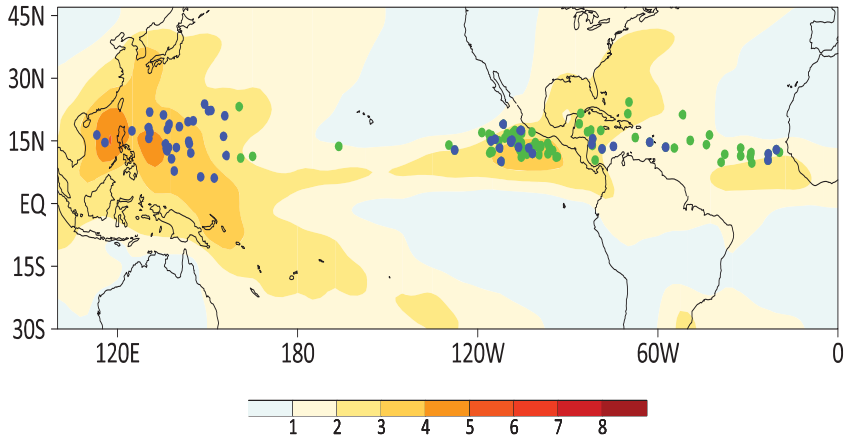
➢ Falling into the time range of '**the Weather Act**' in 2017 (hours~2 years)

# Subseasonal TC prediction

## FLOR-DPC
**(*Double-Plume Convection Scheme*)**

**Two-week TC genesis prediction**

*Running a model in forecast mode provides important verification of the newly developed convection scheme (DPC)*



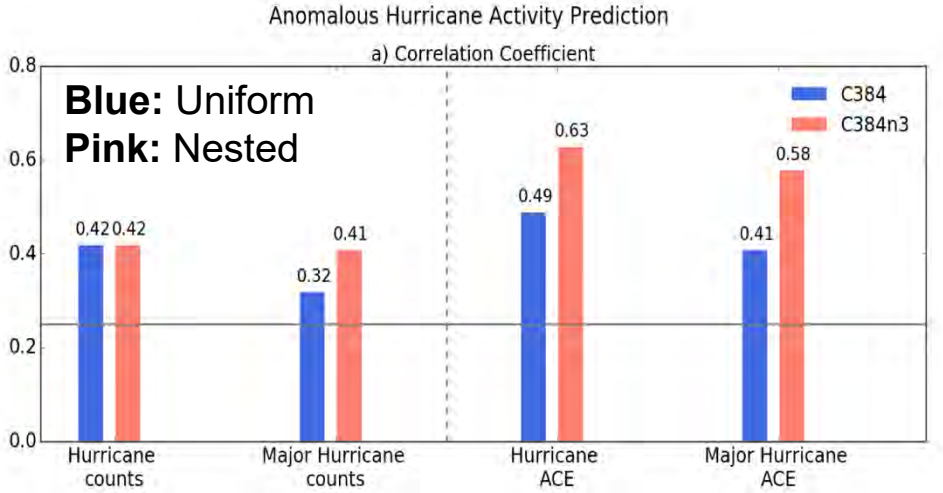

**30% of TCs can be skillfully predicted with 1-2 week lead time**

**Initialization:** Nudging U,V,T,SLP and SST **(11 y)**

Jiang et al., J. Clim. 2018 ; Xiang et al., MWR 2015

## HiRAM

**Monthly total hurricane activity**




Gao et al., GRL 2019

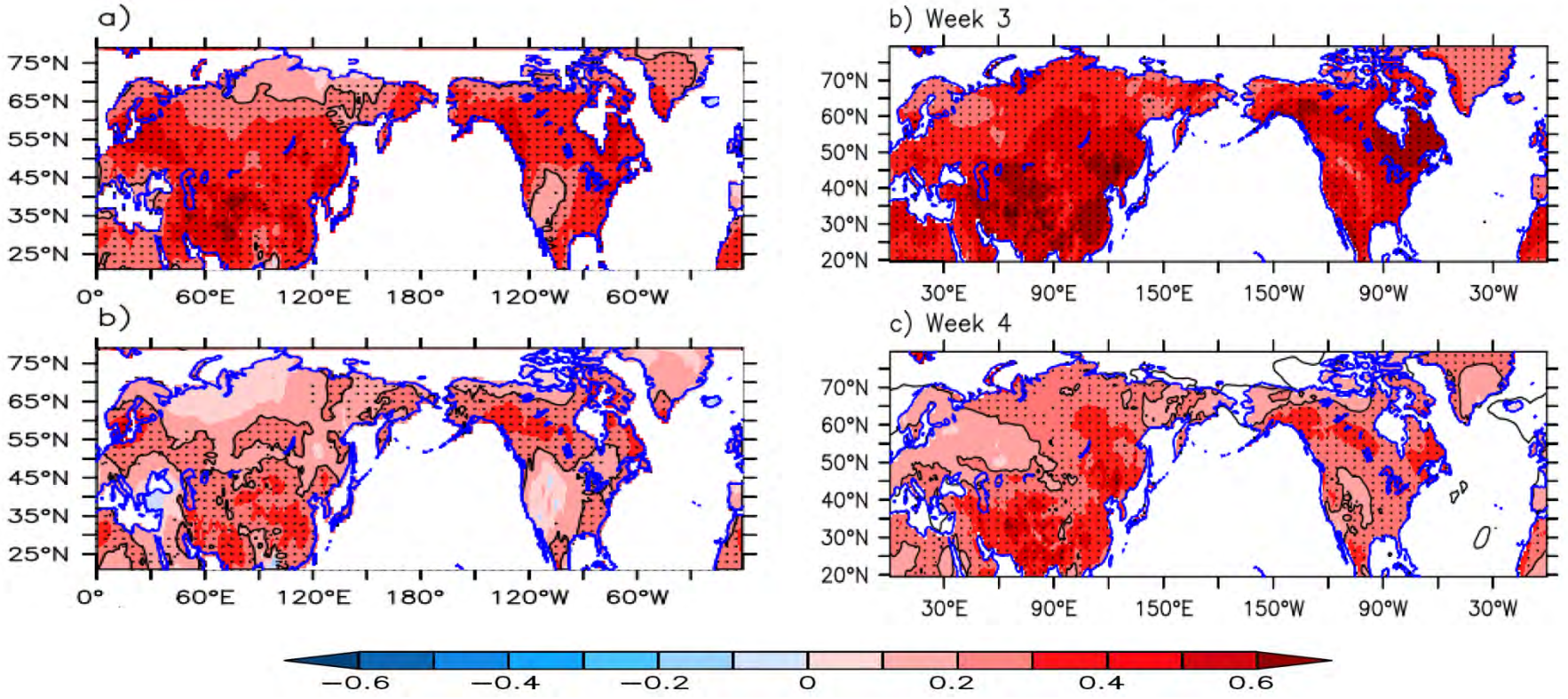
Seasonal hurricane prediction skill:
**r = 0.88** (Chen and Lin 2013)

# Week 3-4 prediction of wintertime temperature

**FLOR-DPC** **ECMWF**

**W3**

**W4**



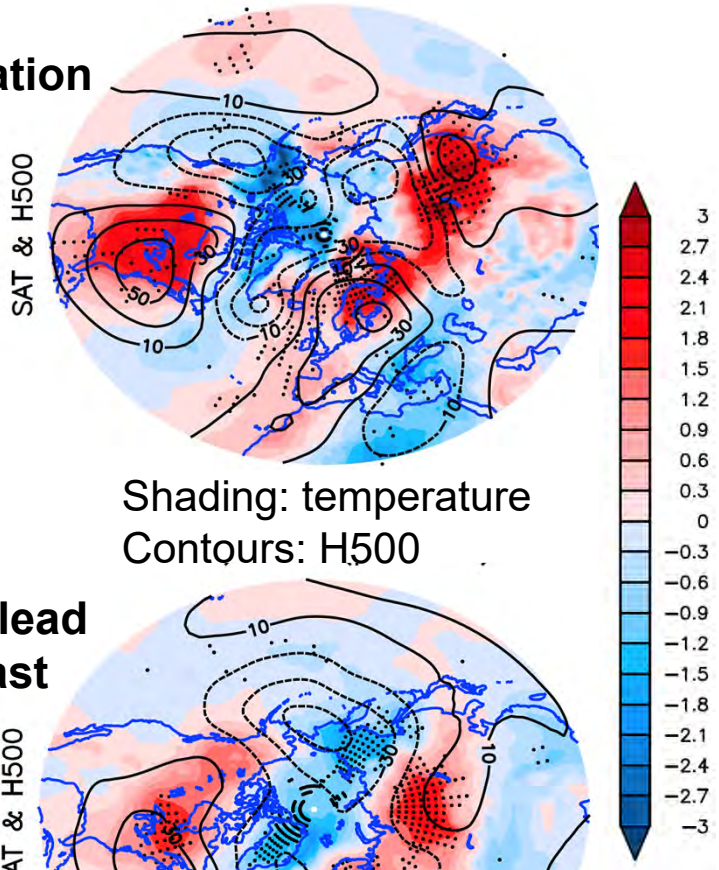

Xiang et al., GRL 2019

The dots denote the region with the correlation skill significant at the 5% significance level

# Predictability sources: 1) MJO

## 3 weeks after MJO phase 3

**Observation**




Shading: temperature
Contours: H500

**3-week lead forecast**

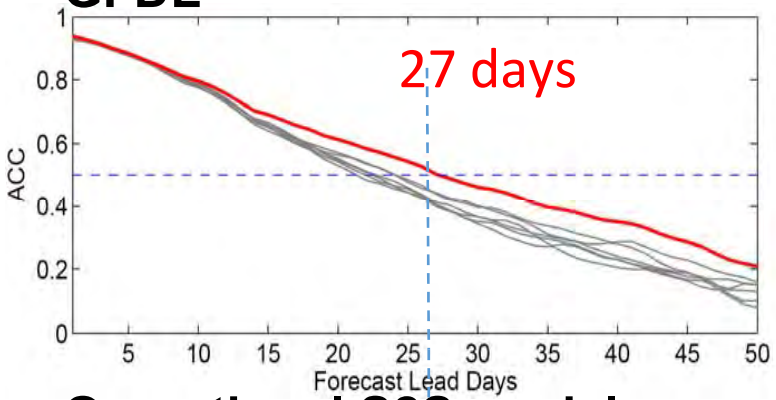



Xiang et al., GRL 2019

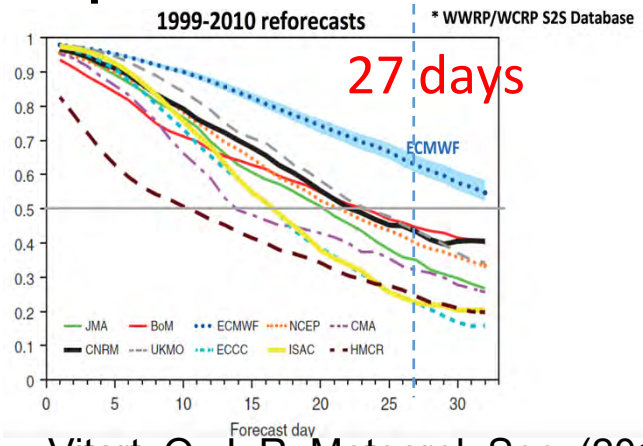
## MJO prediction skill

Xiang et al., J. Clim., 2015

**GFDL**



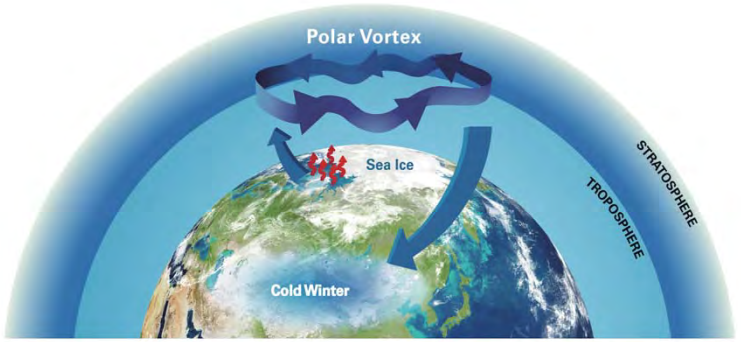

**Operational S2S models**



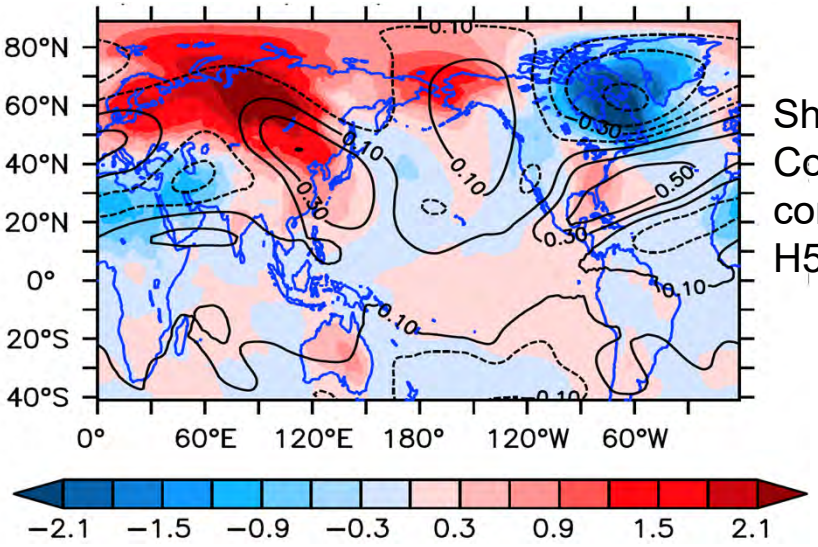

Vitart, Q. J. R. Meteorol. Soc. (2017)

# Predictability sources: 2) Stratospheric impact

Stratospheric Polar Vortex

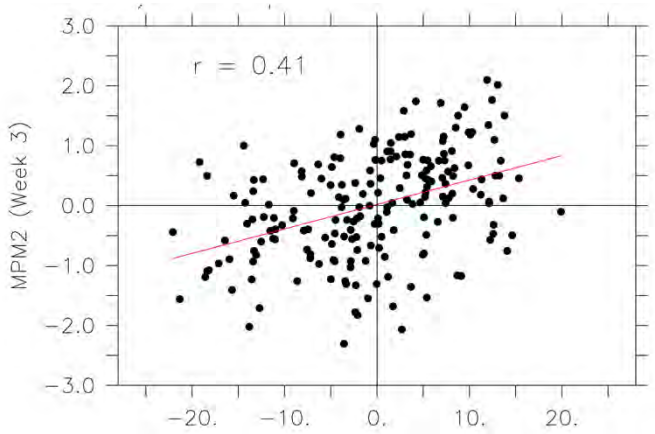



**One of the most predictable modes for t2m (NAO)**




Shading: t2m
Contours: correlation with H500

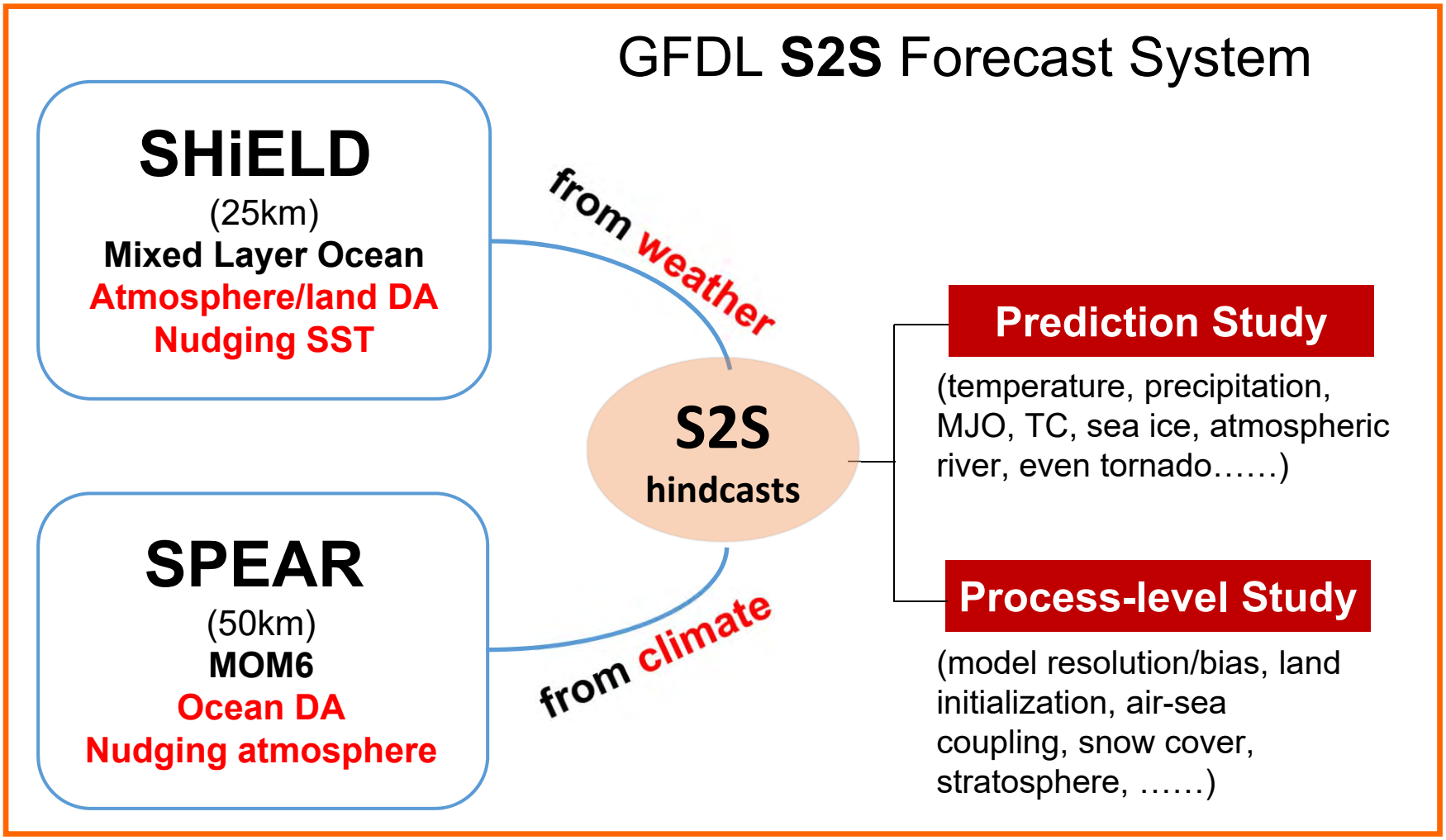
**NAO mode at Week 3**




Stratospheric Polar Vortex from **initial condition**

Xiang et al., GRL 2019

# Future Plans

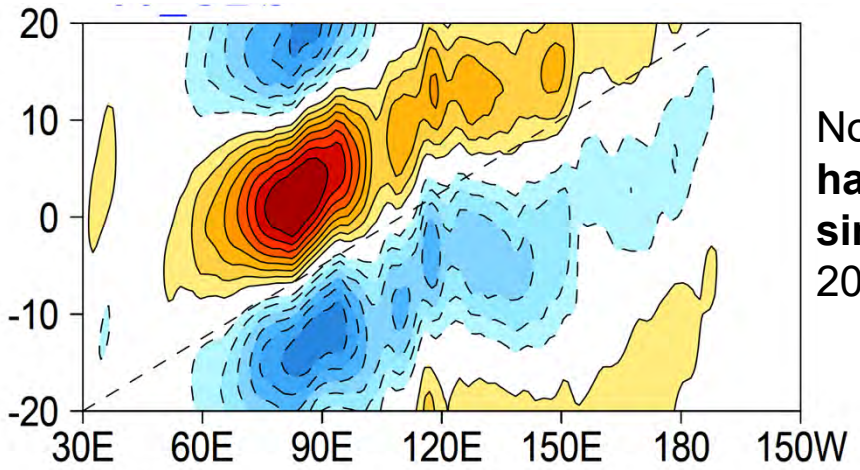



➢ **Goal: Improving our understanding and prediction skill of S2S prediction**

# MJO simulations in SHiELD and SPEAR

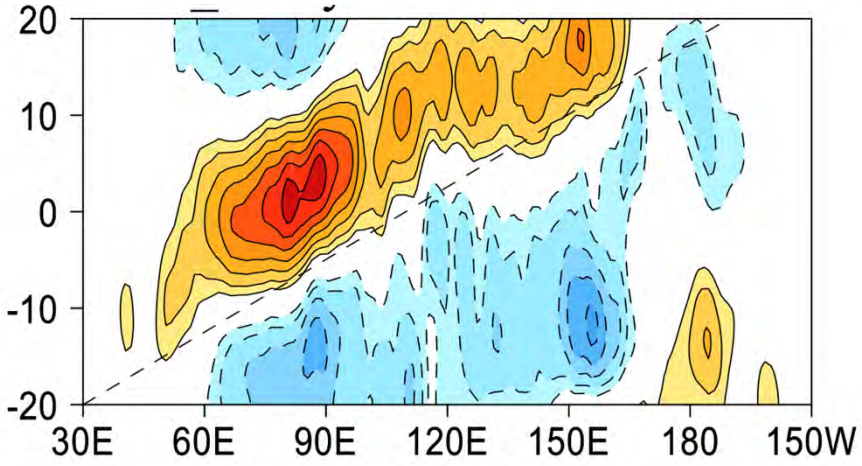
Lag–longitude diagram of intraseasonal precipitation anomalies (10S-10N)

**Obs**

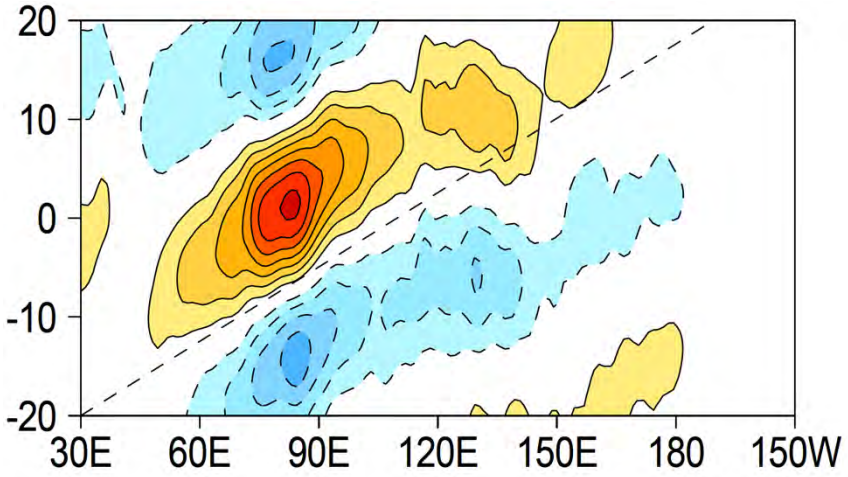



Note that **CM2.1 and CM3 have poor MJO simulations** (Kim et al. 2009; Donner et al. 2011)

**SHiELD**




**SPEAR**

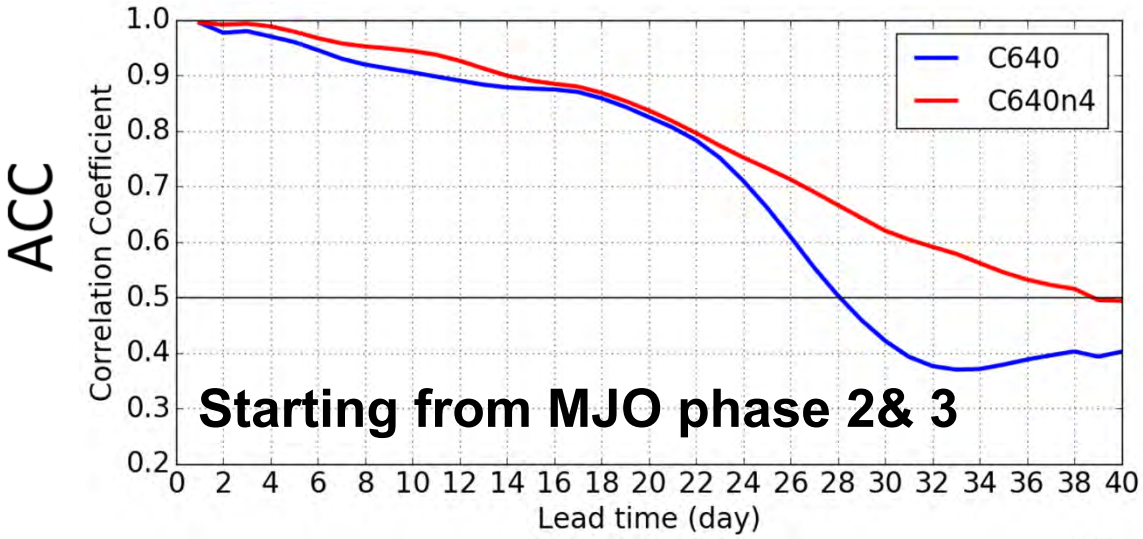


# Nested configuration of SHiELD improves MJO prediction

16km global uniform

4km over Maritime Continent

VS




Black: uniform grid
Red: nested grid

During DYNOMO period (2011-12)

**--- Kun Gao's poster**

# Challenges for S2S prediction

**S2S prediction is still at its infancy and developing stage!**

- **Lack of understanding of predictability sources**
- **Intrinsic model errors**
- **Imperfect initial conditions (land, sea ice …)**
- **No standard metrics**
- **High computational costs**

……

# Summary

- We have made progress in S2S prediction using the previous generation of GFDL models (**FLOR-DPC, HiRAM**): TC, MJO, temperature and predictability sources.

- Newly developed S2S prediction system (**SHiELD and SPEAR**) combines weather and climate perspective.

- Running a model in forecast mode provides important verification of a newly developed scheme, providing feedback to guide model development.