Experimental Intraseasonal Forecasting of Monsoon and Tropical Cyclogenesis

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APCS, Honolulu, Oct. 17-20, 2011

Global Impacts of Madden-Julian Oscillation / ISO

Goswami et al (2003)

Maloney and Hartmann (2000)

Courtesy Xian-an Jiang

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Outline

(I), Intraseasonal Forecasting of 2008 Summer Monsoon in Four GCMs (UH, CFSv1/v2, ECMWF)

(II), Intraseasonal Forecasting of Tropical Cyclogenesis of Nargis (2008)

UH Hybrid coupled GCM (UH)

- **Atmospheric component:**

  ECHAM-4 T106L19 AGCM

  (Roeckner et al. 1996)

- **Ocean component:**

  Wang-Li-Fu intermediate upper ocean model (0.5°x0.5°)

  (Wang et al. 1995; Fu and Wang 2001)

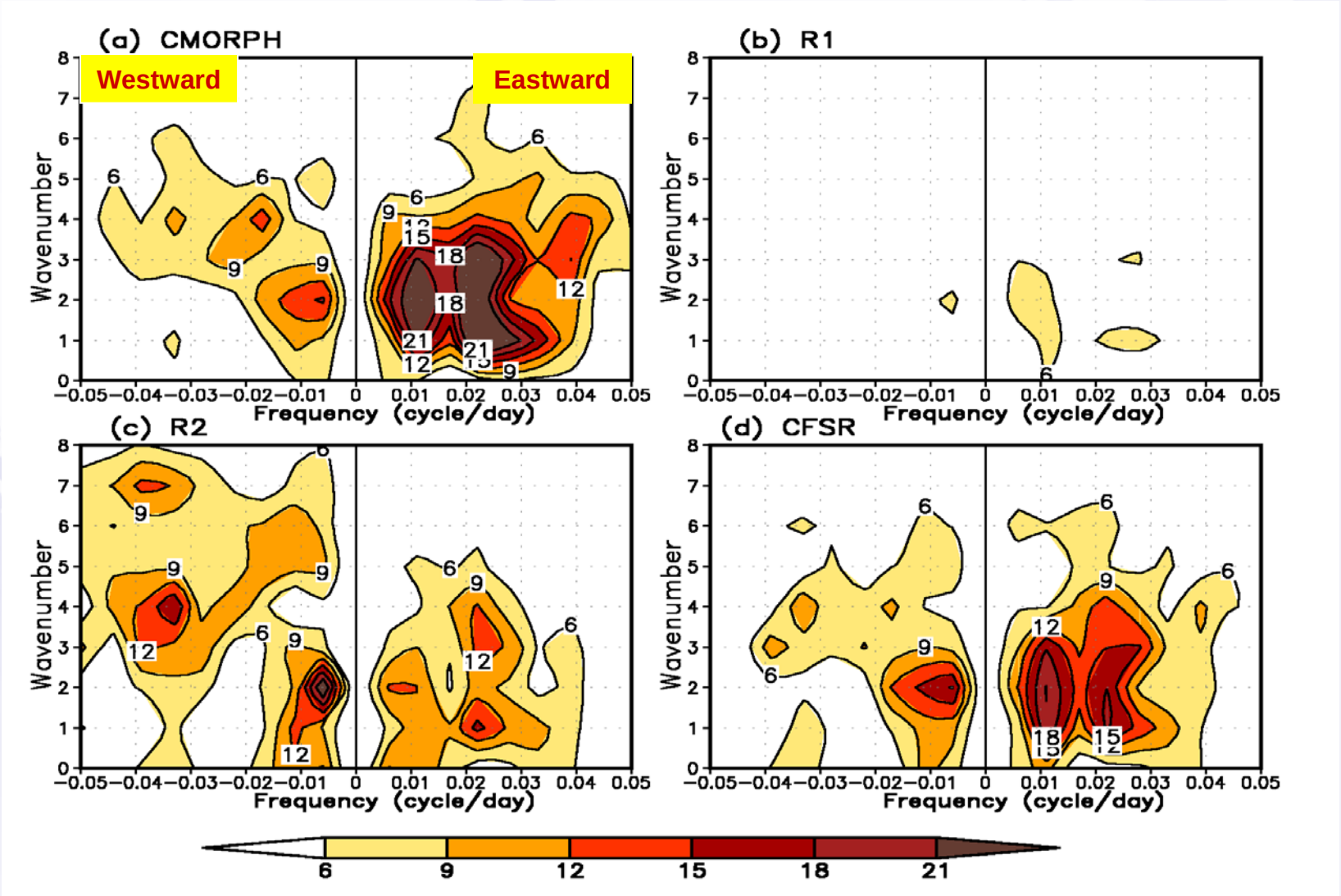
  - Wang, Li, and Chang (1995): upper-ocean thermodynamics
  - McCreary and Yu (1992): upper-ocean dynamics
  - Jin (1997) : mean and ENSO (intermediate fully coupled model)
  - Zebiak and Cane (1987): ENSO (intermediate anomaly coupled model)

- **Fully coupling without heat flux correction**
- **Coupling region: Tropical Oceans (30°S-30°N)**
- **Coupling interval: Once per day**

Three Key Components of MJO / ISO Prediction

Global Model	Boundary Conditions	Initial Conditions
Fu et al. 2008: (Shallow convection) Fu and Wang 2009: (Stratiform rainfall)	Fu et al. 2003, 2007 (Air-sea coupling)	Fu et al. 2009, 2011 (Signal-recovered NCEP R1/R2)
↓	↓	↓
• Higher resolution • Better Physics	• Higher-resolution • SST diurnal cycle	• NCEP/FNL/CFSR

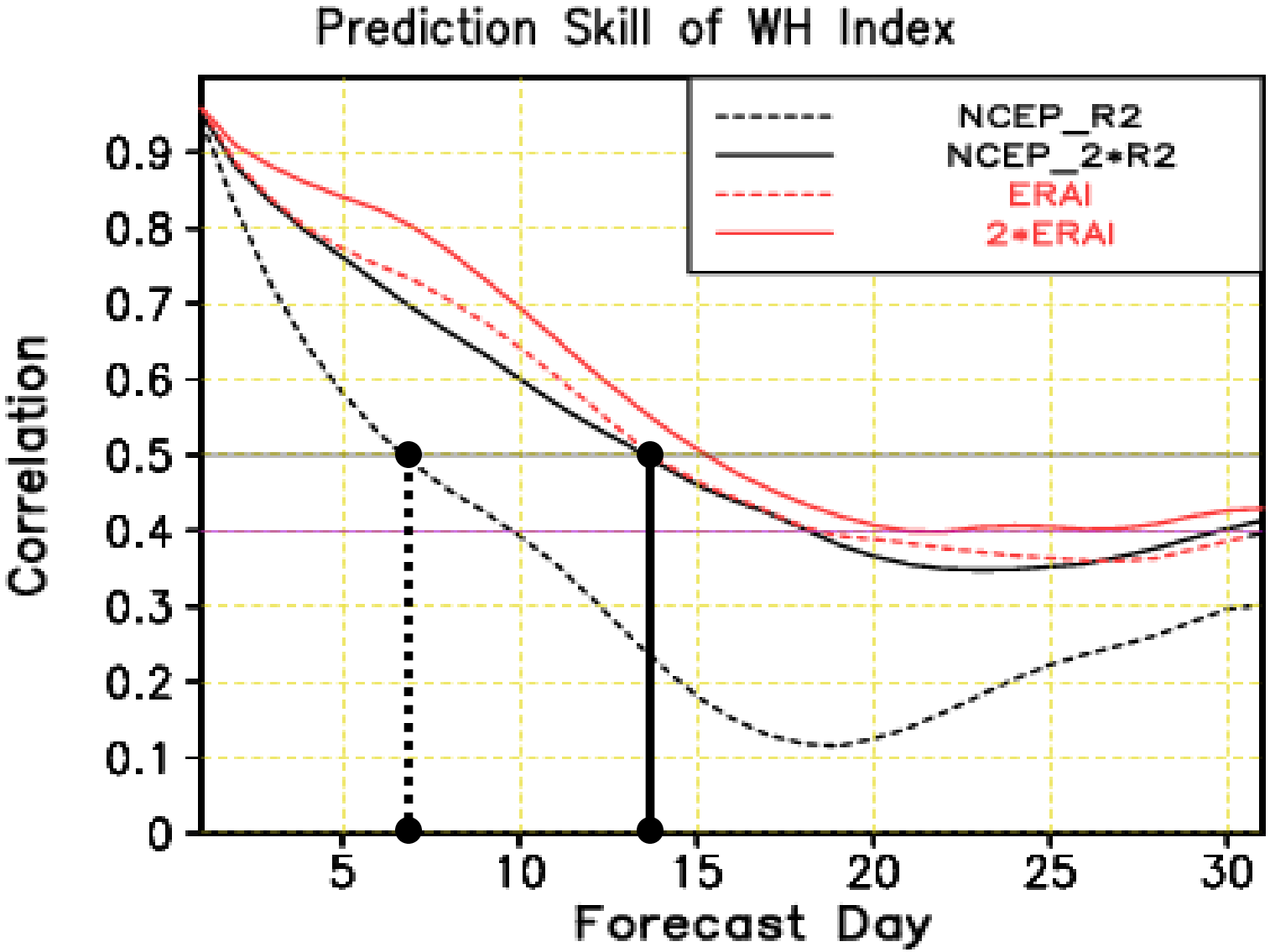
MJO Intensity in Different Reanalysis Datasets



Wang, JD, WQ Wang, XH Fu, KH Seo, 2011

APCS, Honolulu, Oct. 17-20, 2011

MJO Prediction Skill Measured with WH-index



Fu et al. (2011)

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(I), 2008 Monsoon Forecasting in Four GCMs (CFSv1/v2, UH, ECMWF)

(YOTC/AMY target year)

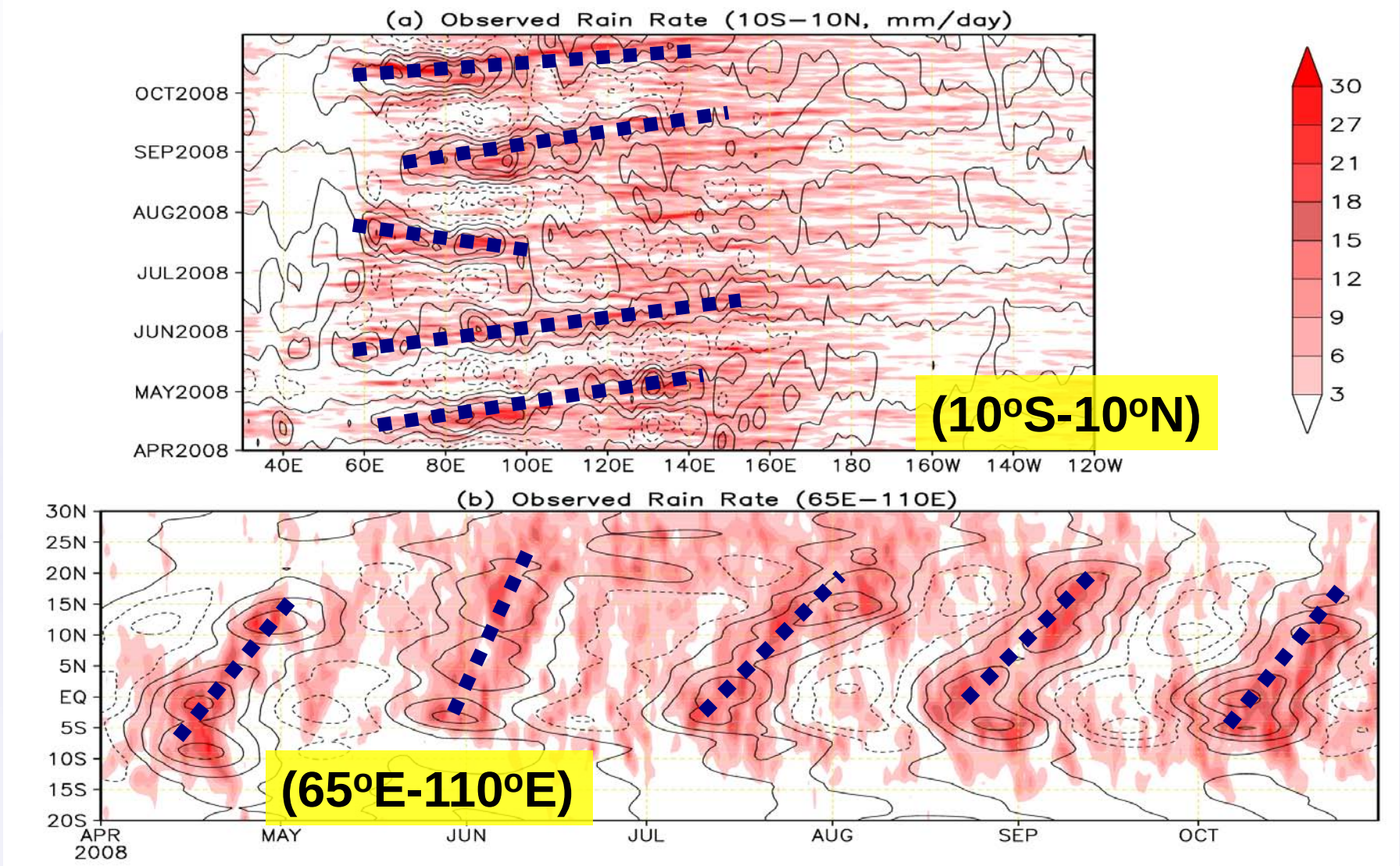
CFSv1: NCEP R2

CFSv2: CFSR

UH: FNL (~CFSR)

ECMWF: ERA-Interim

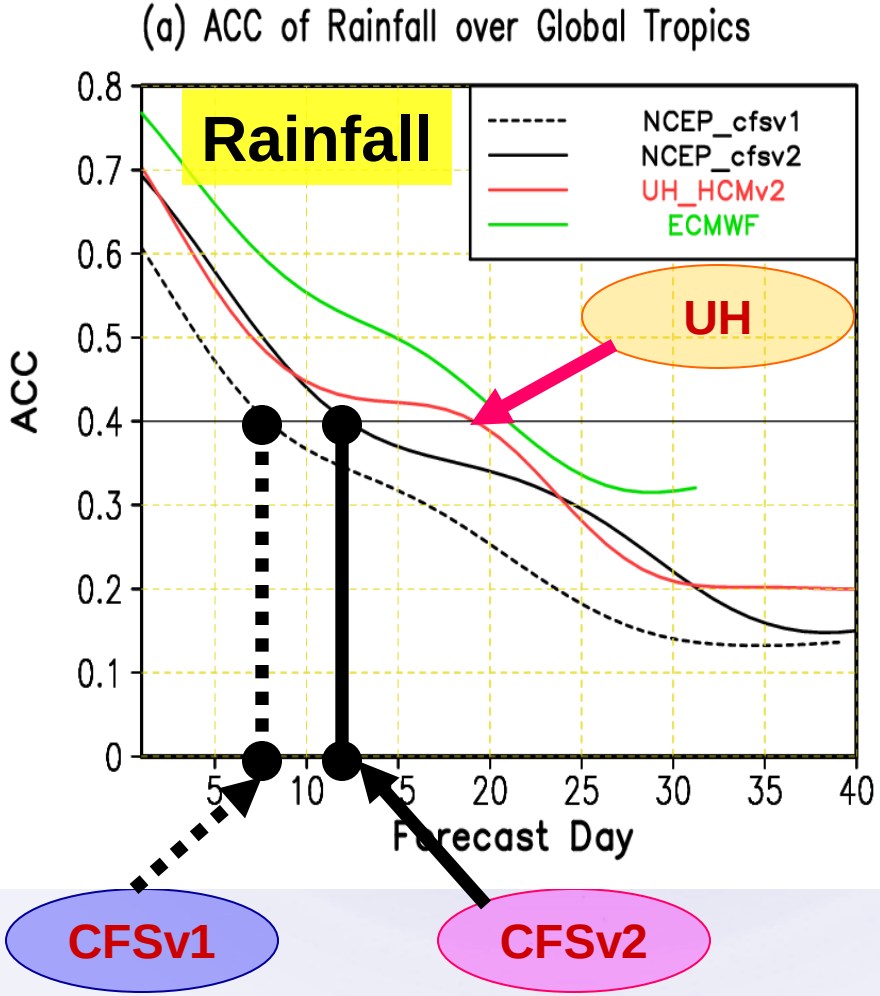
Observed Rainfall Evolution in 2008 Summer

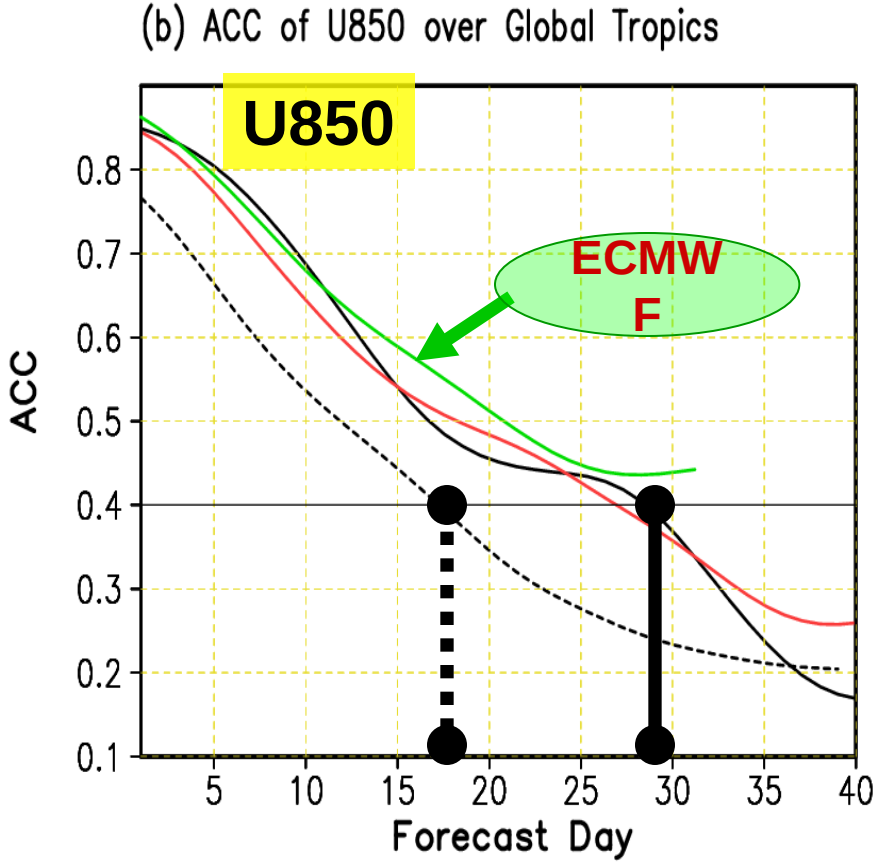


Experimental Monsoon Prediction with UH Model

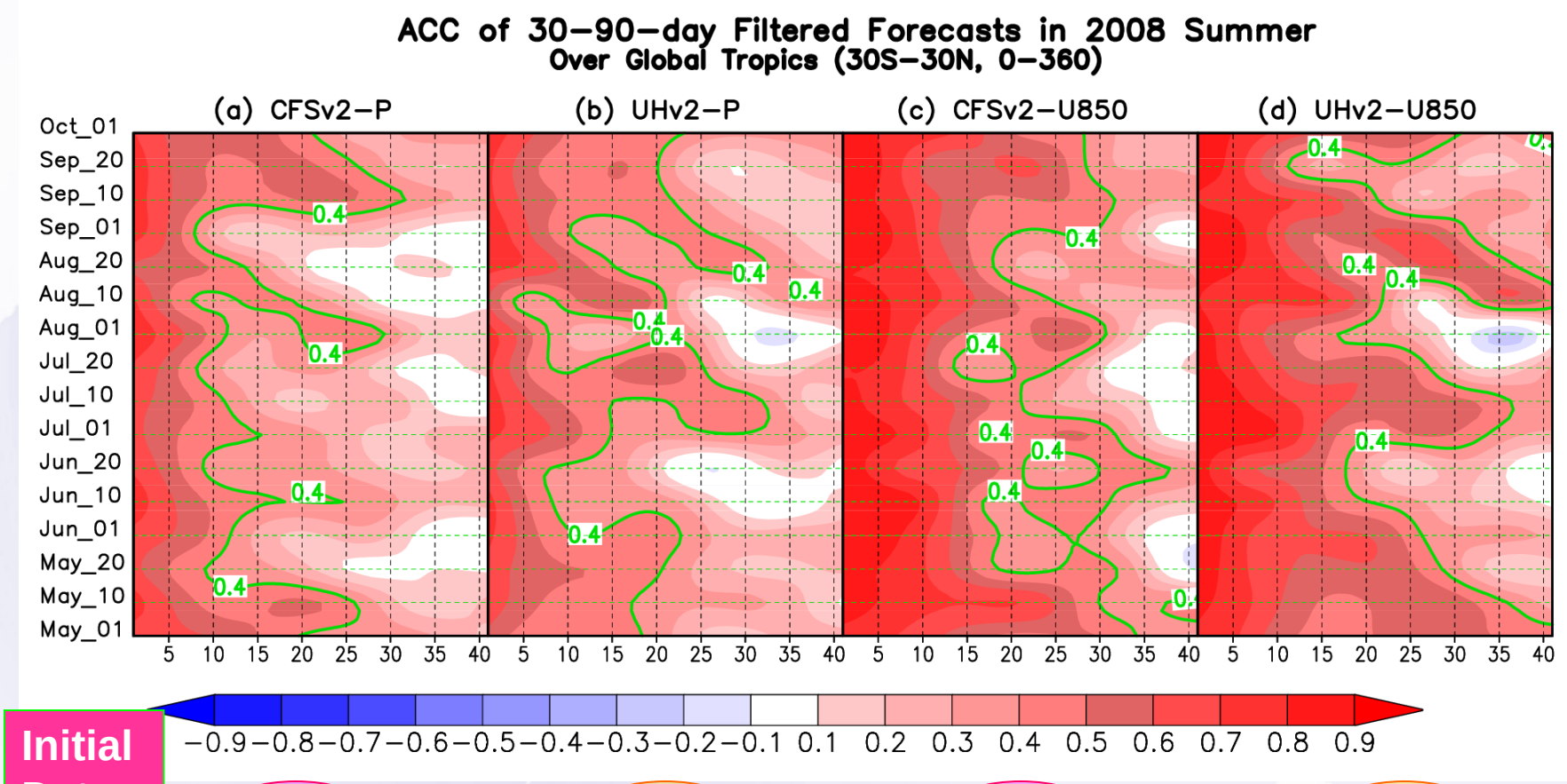
- **Target Period:** May-October 2008
- **Forecast Interval:** Every 10 days, totally 16 forecasts
- **10 Ensembles:** Perturbations are 10% of daily differences
- **Integration Length:** 45 days
- **Initial Conditions:** NCEP FNL
- **Skill Measure:** Anomaly Correlation Coefficient over global tropics.

Averaged Prediction Skills of 2008 Summer Monsoon over Global Tropics (30°S-30°N)





Monsoon Prediction Skills for CFSv2 and UH over Global Tropics (30°S-30°N)



Initial Dates

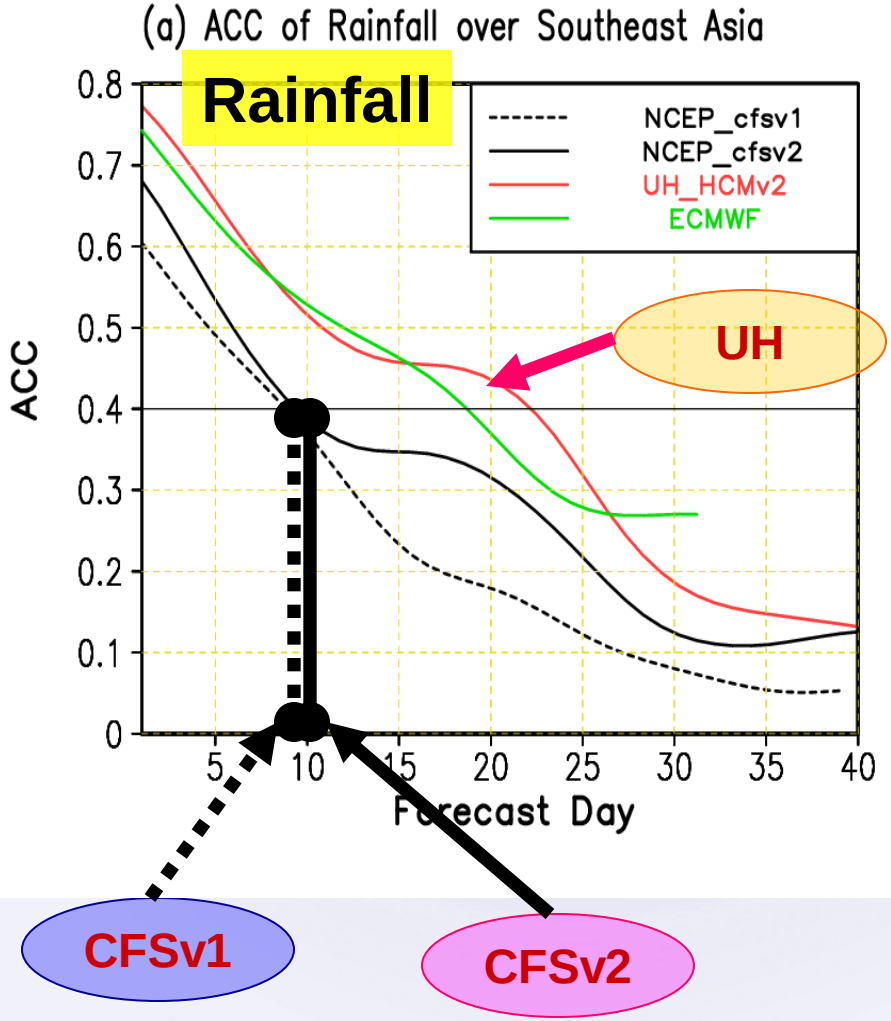
CFSv2 Prep

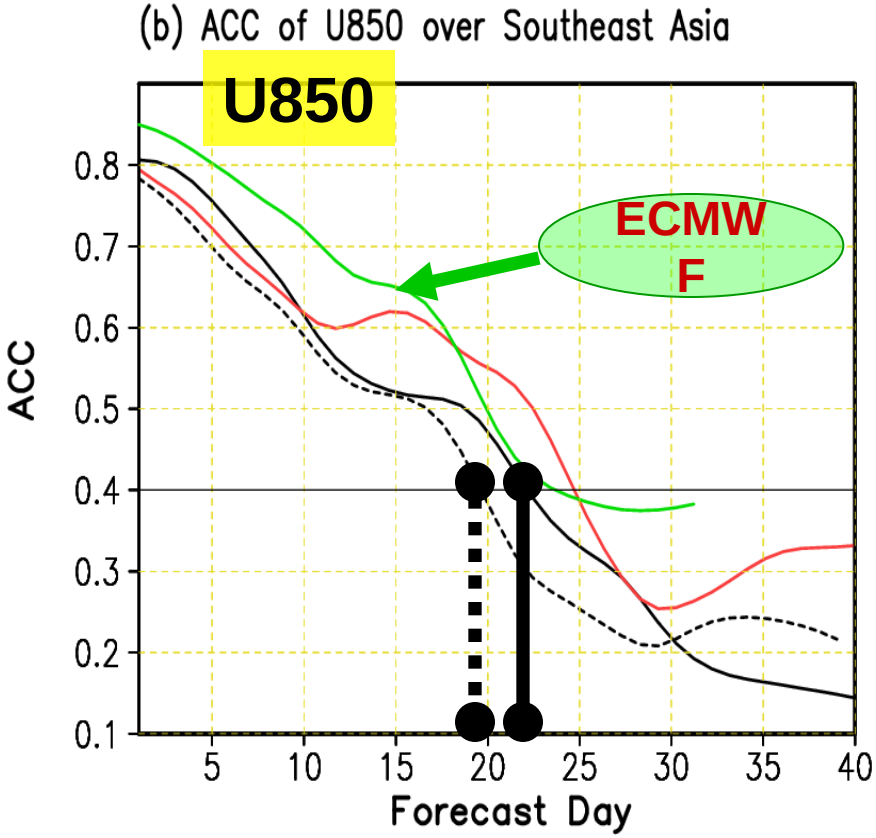
UH Prep

CFSv2 U850

UH U850

Averaged ISO Prediction Skills in 2008 Summer over Southeast Asia (10N-30N, 60E-120E)





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(II), Tropical Cyclone Nargis (2008)

(April 25-May 3)

Model: UH (T106)
Initial Condition: FNL Analysis
Initial Date: April 10, 2008

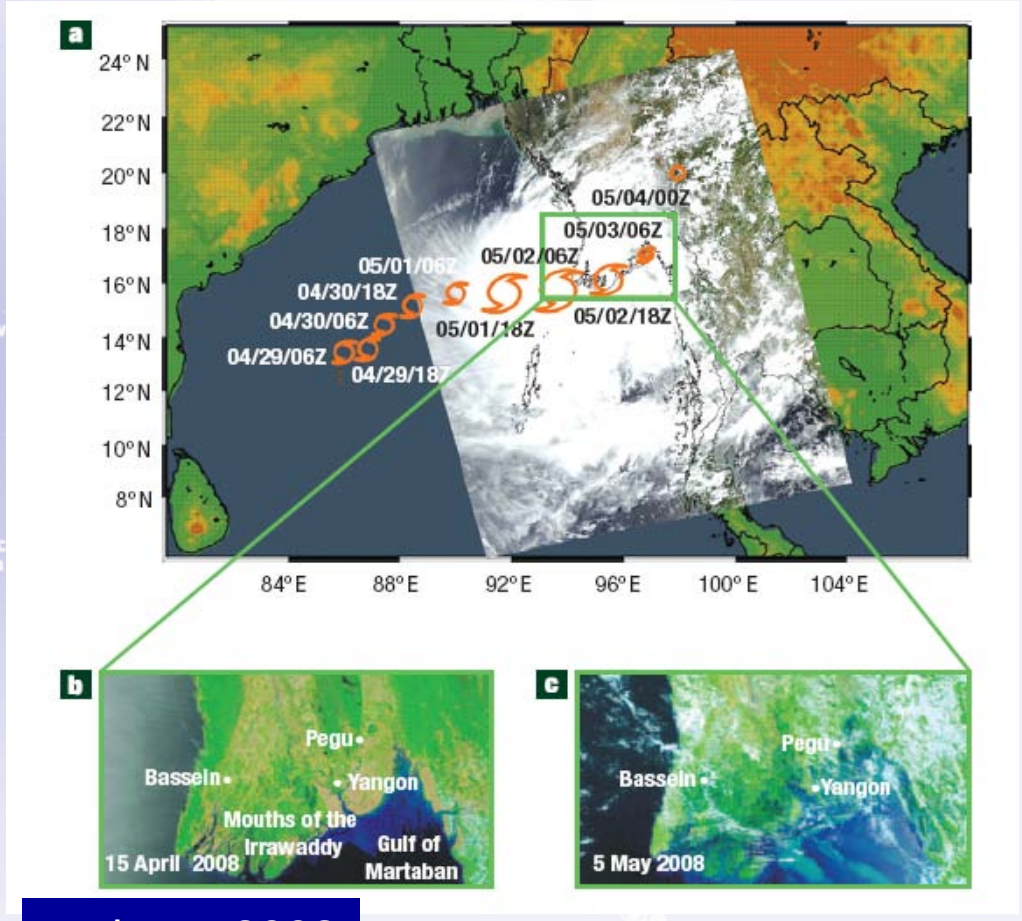
Fu and Hsu 2011, GRL

Extended-range Forecasting of Tropical Cyclogenesis of "Nargis" (2008)

JTWC issued TC formation alert on April 25, 2008

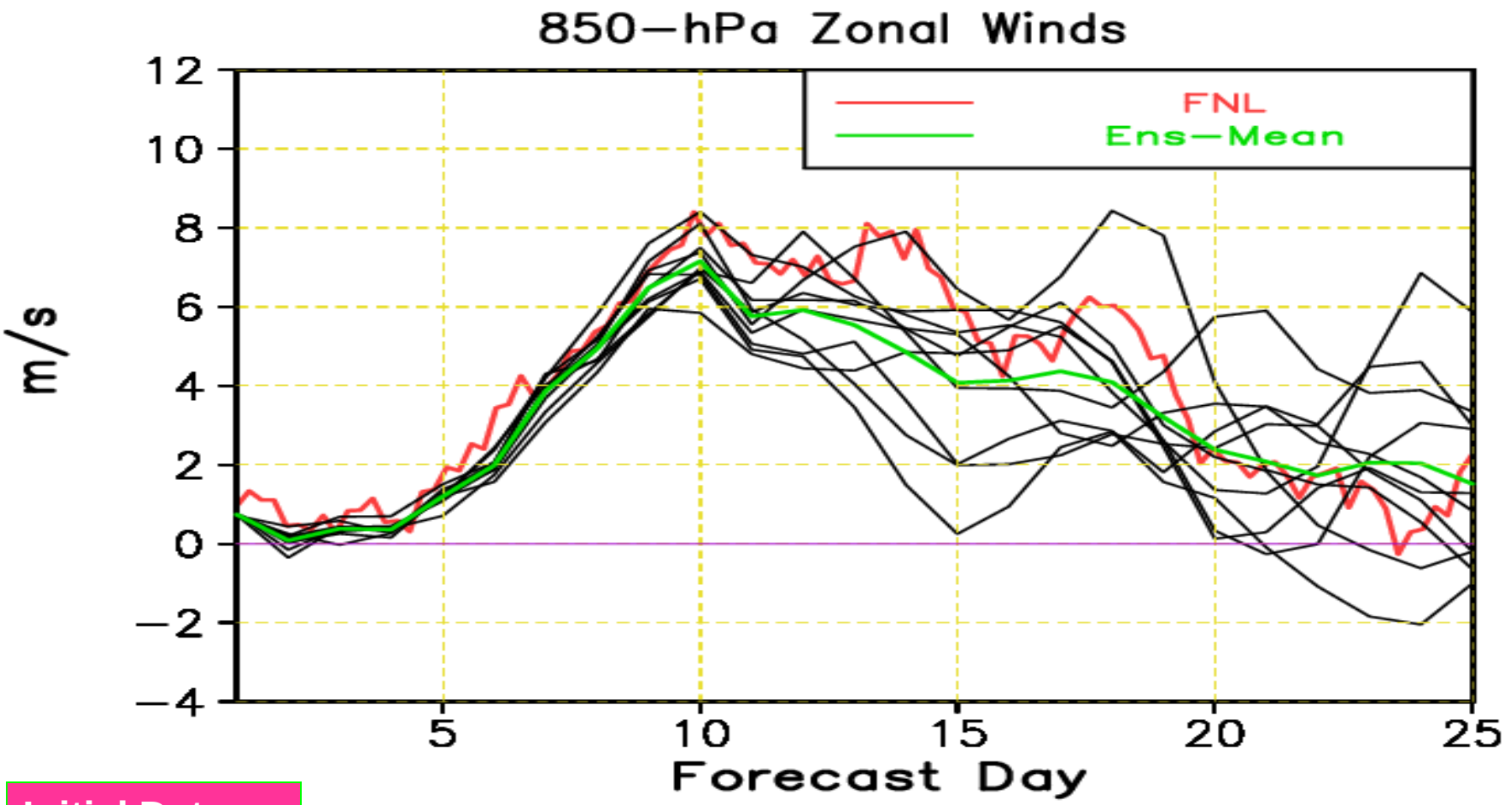
IMD issued TC warning on April 27, 2008

The "Nargis" claimed over 130,000 lives and caused $10 billion dollars in damage, was ranked the 7th deadliest cyclone of all time.



Webster 2008

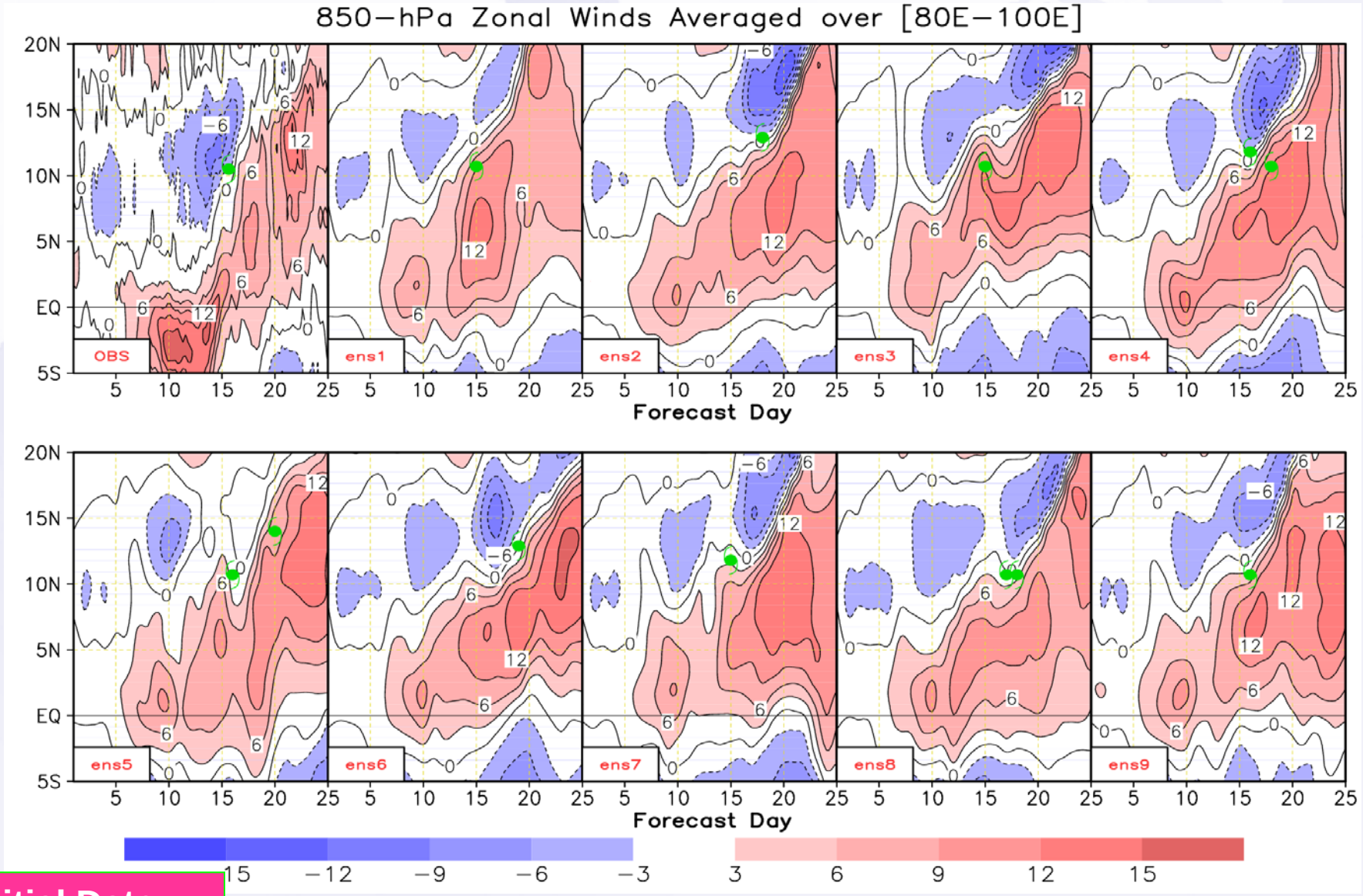
Forecasted Westerly Wind Bursts Associated with the Development of a MJO Event



Initial Date: April 10, 2008

Over Equatorial IO (5°S-5°N, 70°E-100°E)

Northward-propagating ISO and TC Nargis (2008)



Initial Date: April 10, 2008

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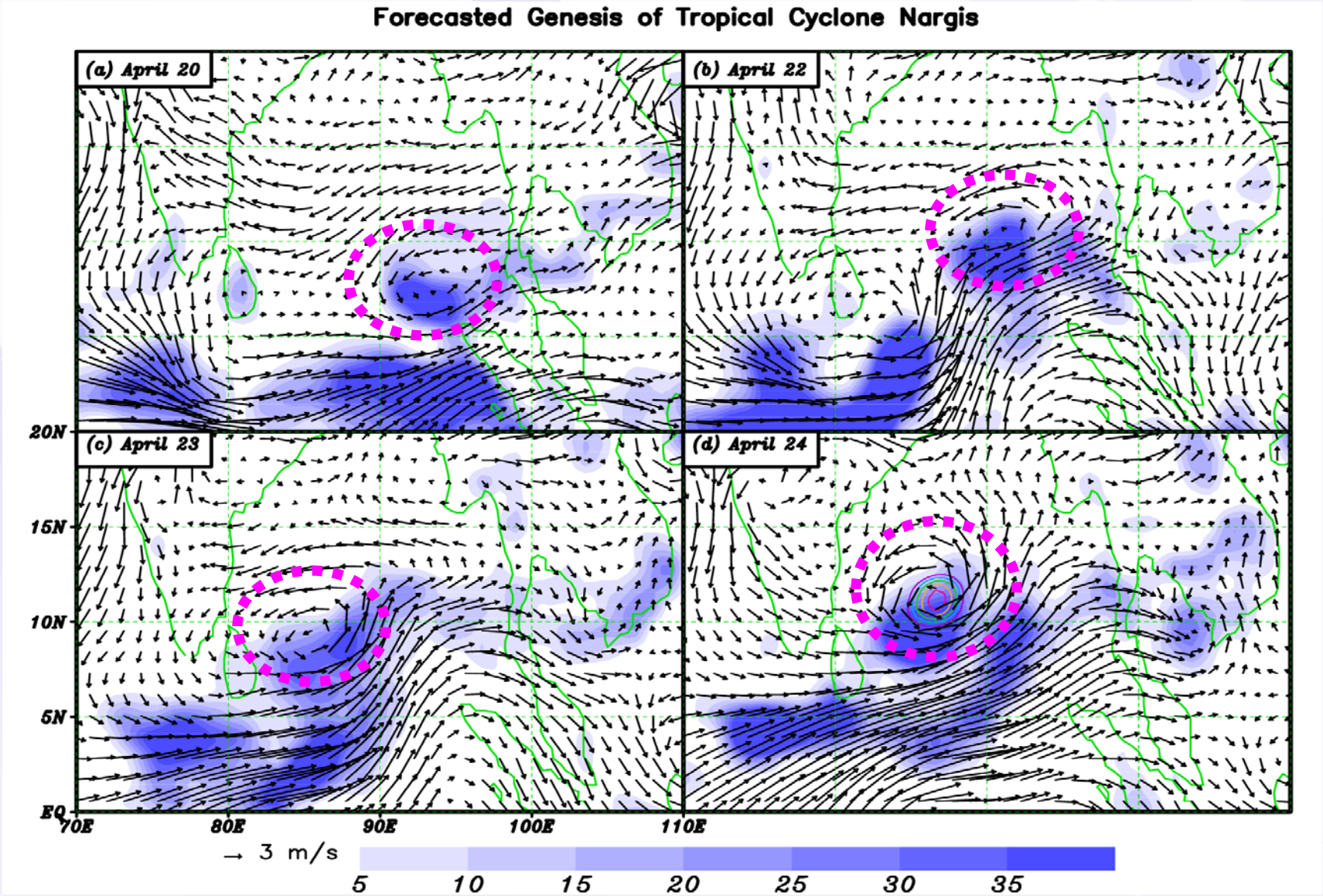
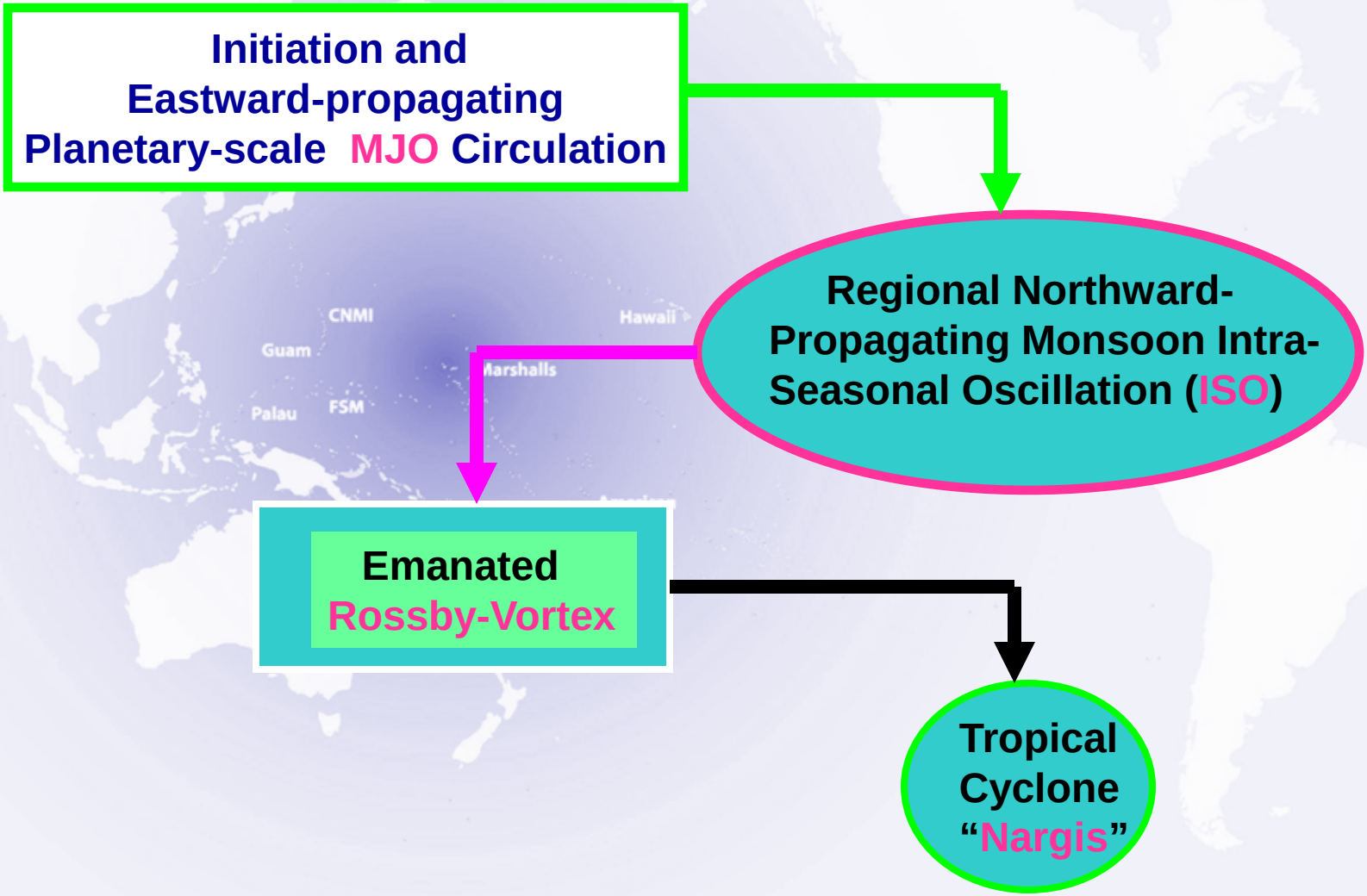
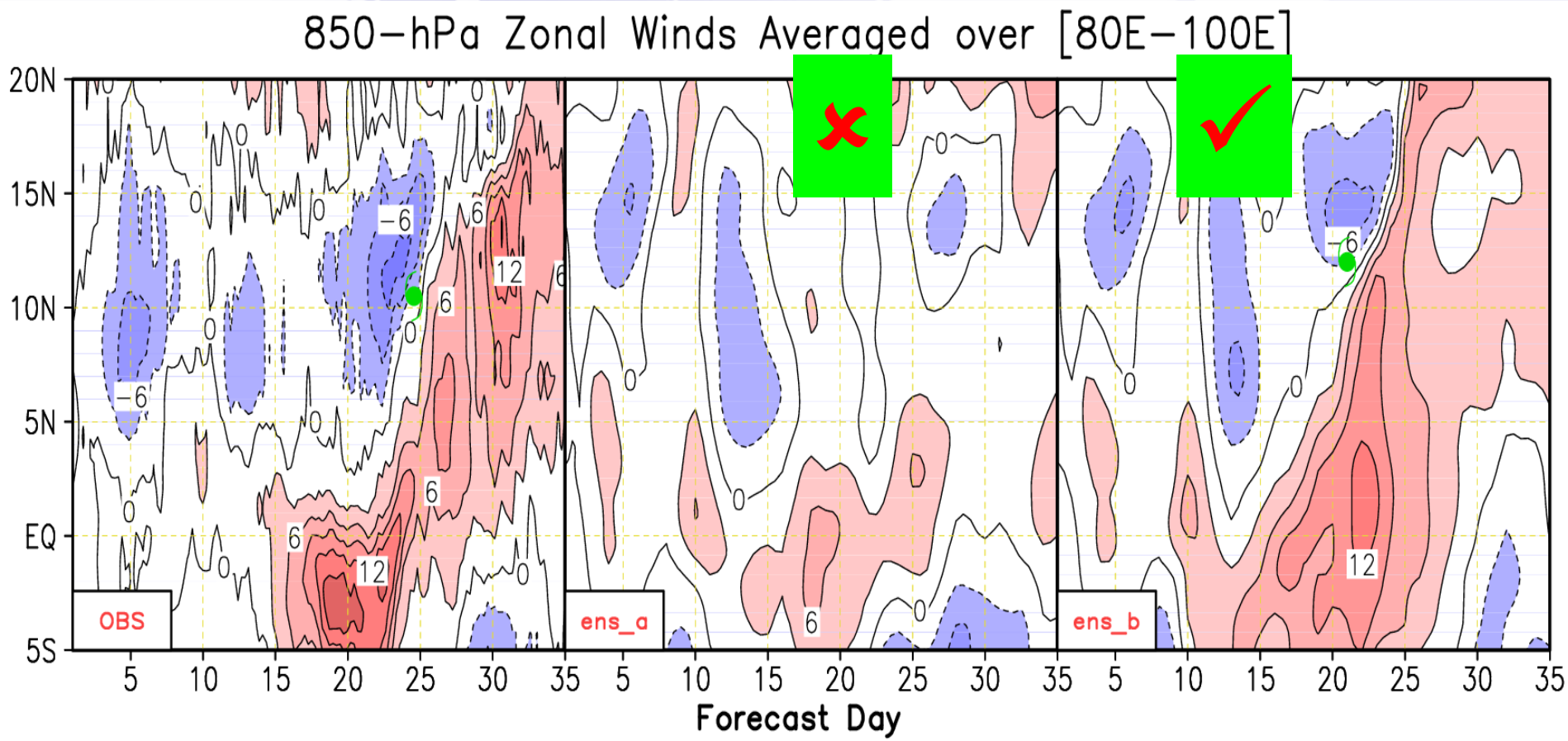
Forecasted Genesis Process of TC Nargis (2008)



Multi-Scale Interactions Captured in This Forecast



Prospect: One-month lead Forecast



Initial Date: April 01, 2008

Summary

- The representation of MJO in CFSR is much better than that in R1 and R2. Doubling MJO/ISO intensity in R2 increases MJO predictability from one week to two weeks.

- The prediction skill of 2008 summer monsoon is much higher in CFSv2 than that in CFSv1. UH model has similar skill as the CFSv2 and ECMWF.

- If MJO and associated northward-propagating ISO are well predicted, tropical cyclogenesis of Nargis (2008) can be forecasted with a lead time of at least two weeks.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Thank you!
07.02.2004
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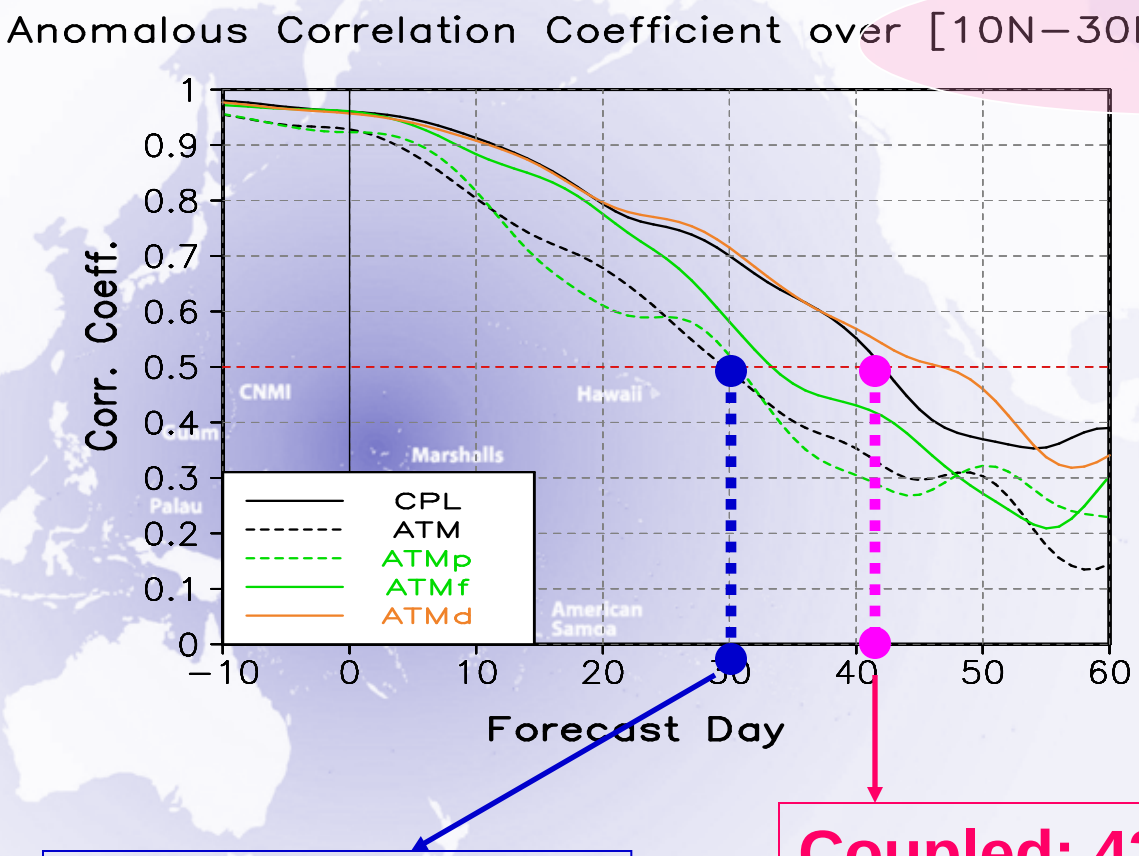
Potential

ISO Predictability Measured by ACC



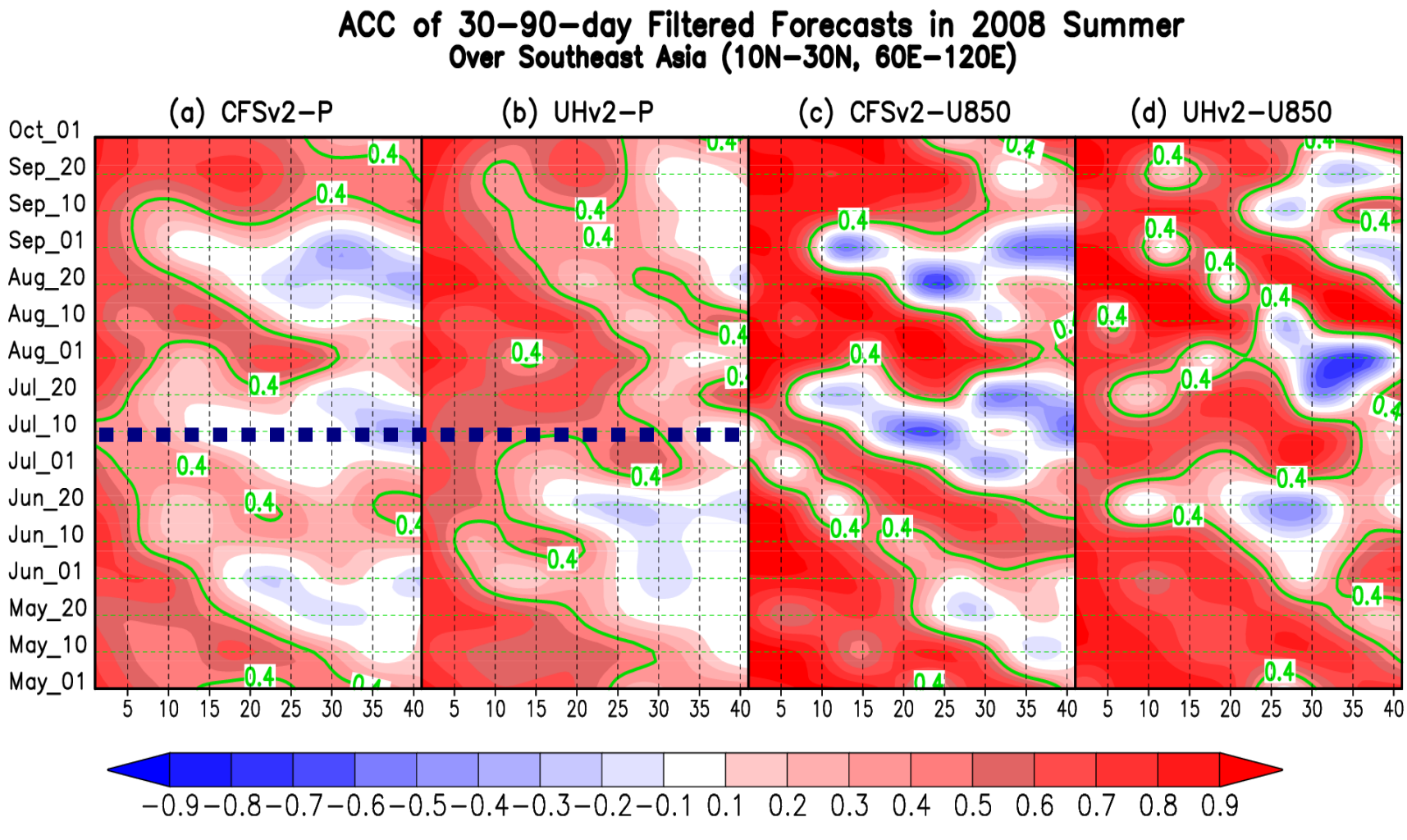
ACC

Coupled: 42 days

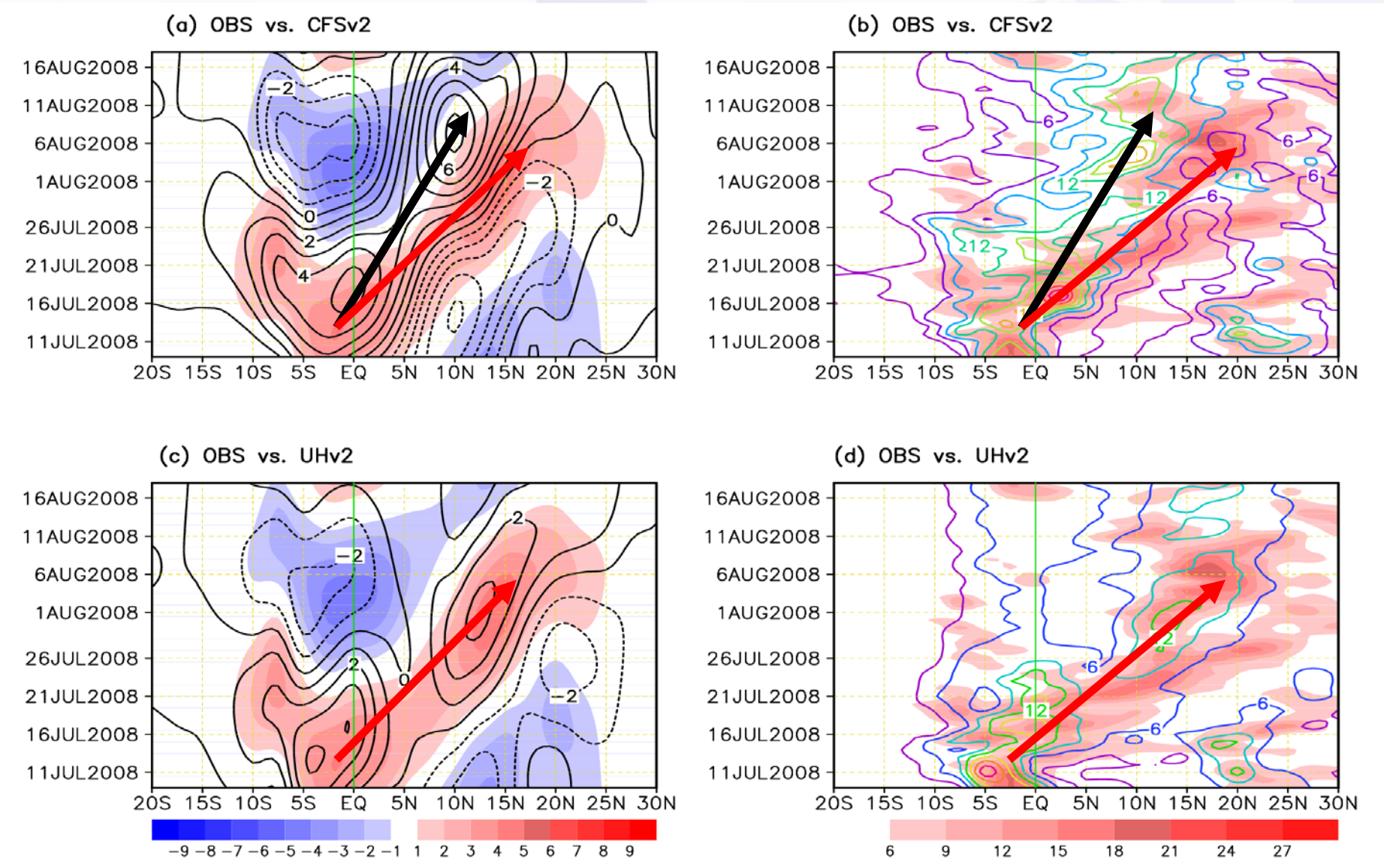
Atmosphere-only: 30 days

Fu et al. (2007)

ISO Prediction Skills for CFSv2 and UHv2 over Southeast Asia (10N-30N, 60E-120E)



Northward-Propagating ISO in CFSv2 and UHv2



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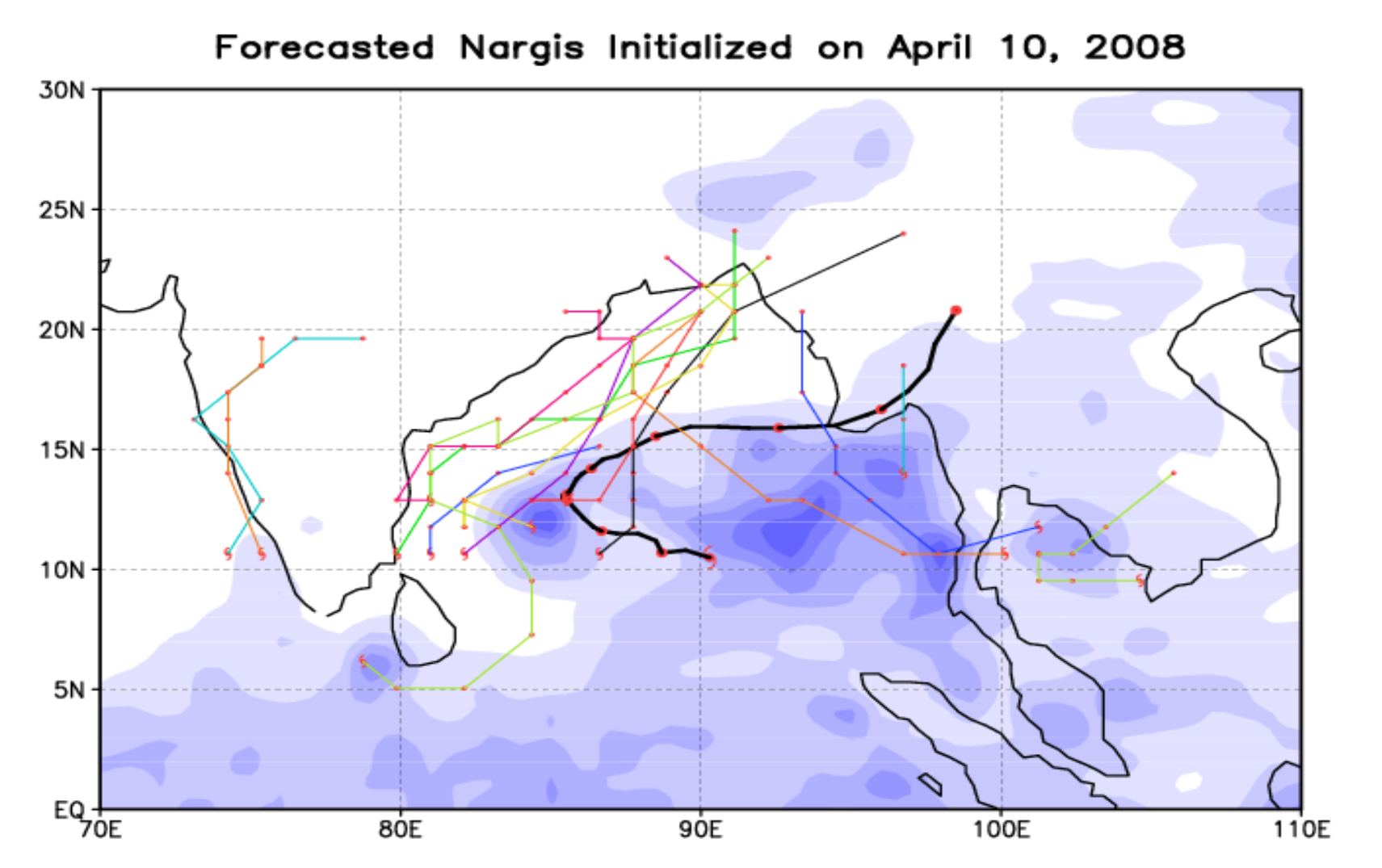
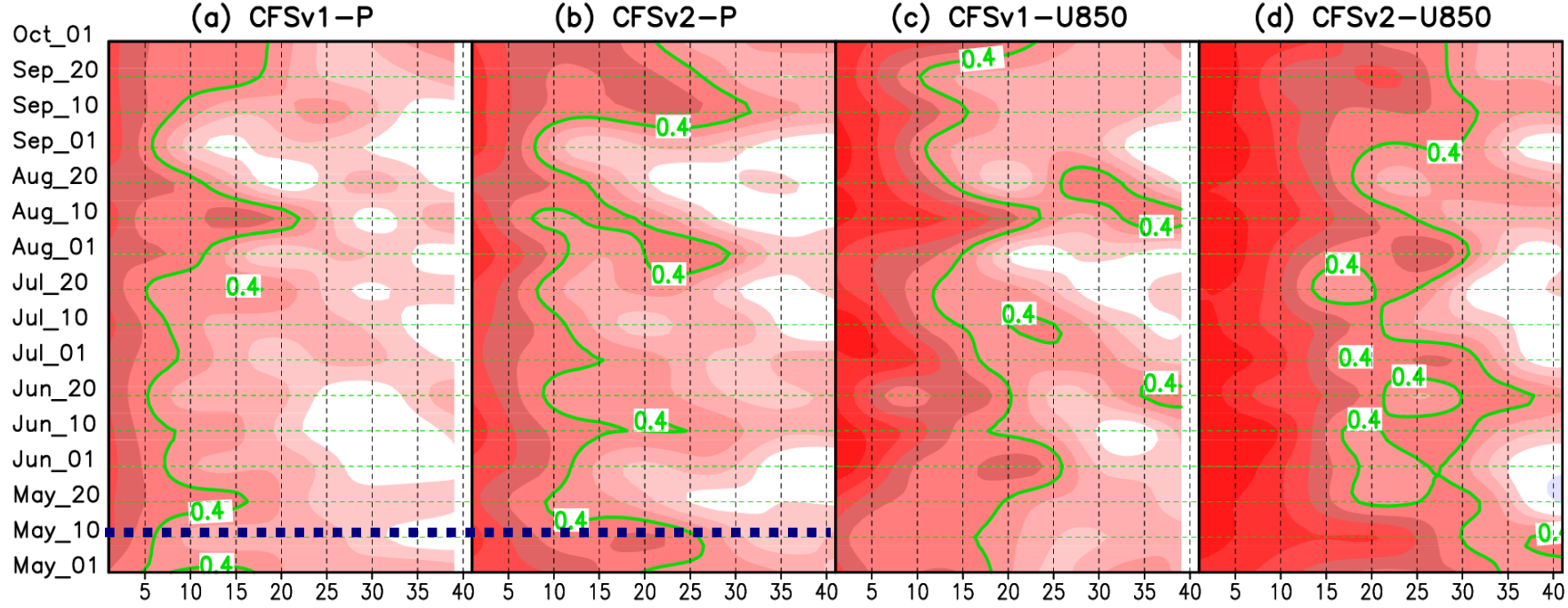
Observed and Forecasted TC Nargis (2008)



Monsoon Prediction Skills for CFSv1 and v2 over Global Tropics (30°S-30°N)



Initial Dates

CFSv1 Prep

CFSv2 Prep

CFSv1 U850

CFSv2 U850