Impact of atmospheric synoptic-to-intraseasonal oscillations on Indian Ocean multi-scale SST variability

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1. Background

Atmospheric ISOs (10-90 day)-Observed in tropical Indian & Pacific: wind and convection

30-90 day ISOs-MJO; wavenumber 1-3;

NH winter: east & southward;

NH summer: east & northward;

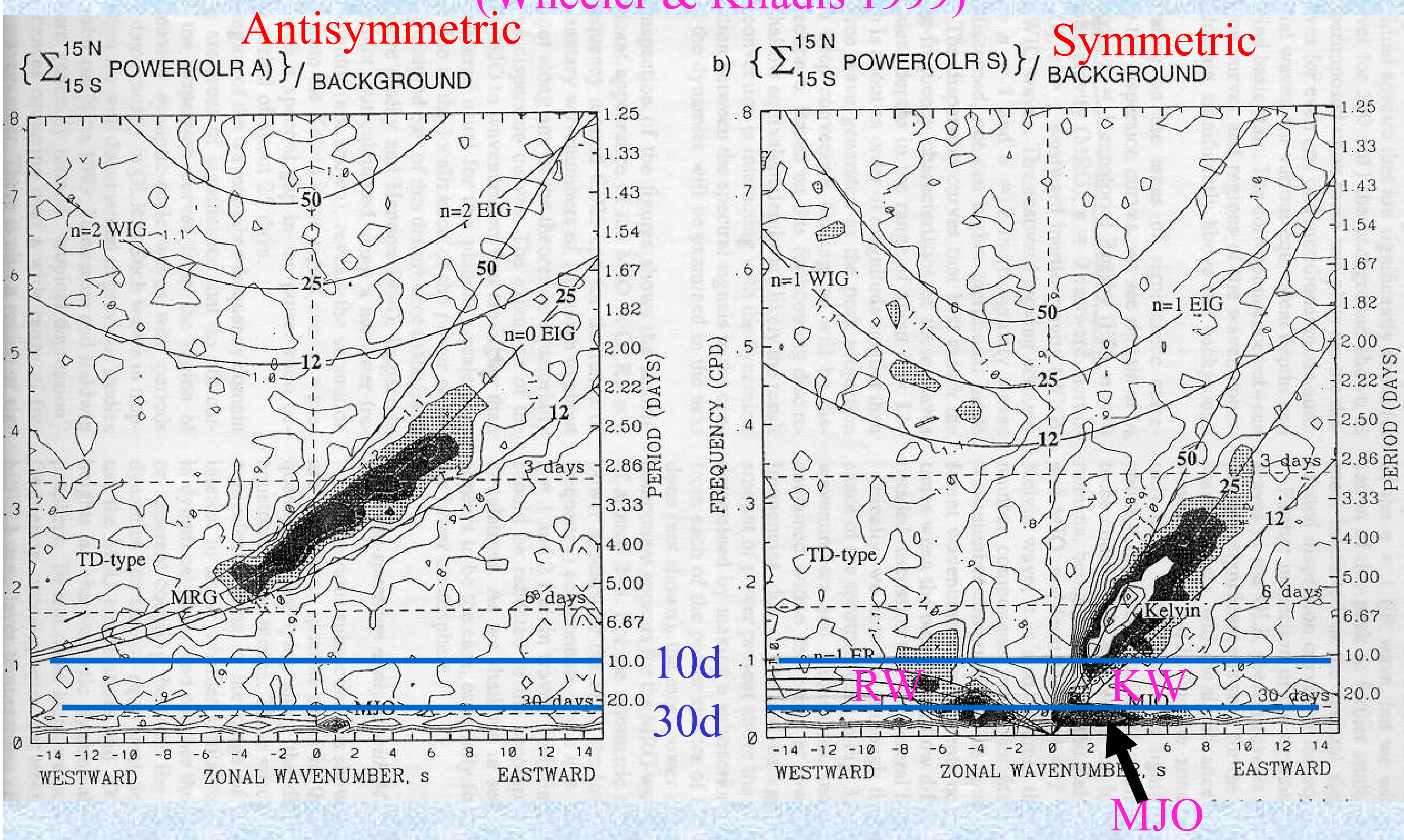
10-30 day ISOs: convectively coupled Kelvin & Rossby waves; wavenumber 5-6;

Synoptic variability: Period<10 days:

convectively coupled Kelvin & Yanai waves (OLR)

Dispersion relation for convectively coupled EQ waves (OLR)

(Wheeler & Kiladis 1999)



Climatic importance

[1] Coupling on intraseasonal timescales =>improve ISOs phase & direction of propagation; Large-amplitude intraseasonal SST=> coupled processes=>improve ISOs simulation;

[2] Monsoon, ENSO, Dipole → Prediction & predictability

[3] Rectify into seasonal-to-interannual variability
Mean state

Overall Goal

Utilize multi-year QuikSCAT winds, winds during QuikSCAT/Midori-2 frequently sampled period, other satellite & in situ data, combined with OGCM experiments => Quantify the roles of synoptic-to-itraseasonal variability in causing multi-scale SST variability in the tropical Indian Ocean.

Objectives

- Explore intraseasonal SST variability induced by the MJO and submonthly ISOs, understand the processes involved;
- Investigate the structure of atmos. synoptic variability & impacts on synoptic SST;
- Quantify effects of synoptic variability, submonthly ISOs and MJO on seasonal-to-itnerannual SST variability and mean state;
- Validate QuikSCAT winds by comparing with in situ data (Y. Masumoto) & examining accuracy of model simulation forced by QuikSCAT and NCEP , ERA-40 reanalysis products.

2. Datasets and models

- Data: a) 3-day **QuikSCAT winds** (1999-pres), b) daily QuikSCAT/Midori-2 winds (Aril 10-Oct 24 2003), c) daily NOAA satellite **OLR** (1979-pres);

  d) ISCCP daily net surface short and long wave fluxes, e) 3-day Topex/Poseidon/Jason sea level (L. Fu), f) TRMM SST; g) In situ ADCP mooring(Y.Masumoto), TRITON buoys;

- Models: the **OGCM**-the Hybrid Coordinate Ocean Model (HYCOM), forced by the above fields;

  Dynamics: a linear continuously stratified model.

Experiment period: 1999-pres

Experiment	Forcing	Description
MR	3-day mean	Complete
EXP0	+daily Qscat/Mid.2	Add synoptic
EXP1	Lowpass 90-day	Remove all ISO
EXP2	Lowpass 30-day	Rm submon. ISO
EXP3	Lp90 wind stress	Rm ISO wind stress
EXP4	Lp90 stress+speed	Rm ISO winds
EXP5	Lp90 solar rad.	Rm ISO solar rad.
EXP6	Lp90 rain	Rm ISO rainfall

3. Preliminary results

MJO event
Jan 1,1999

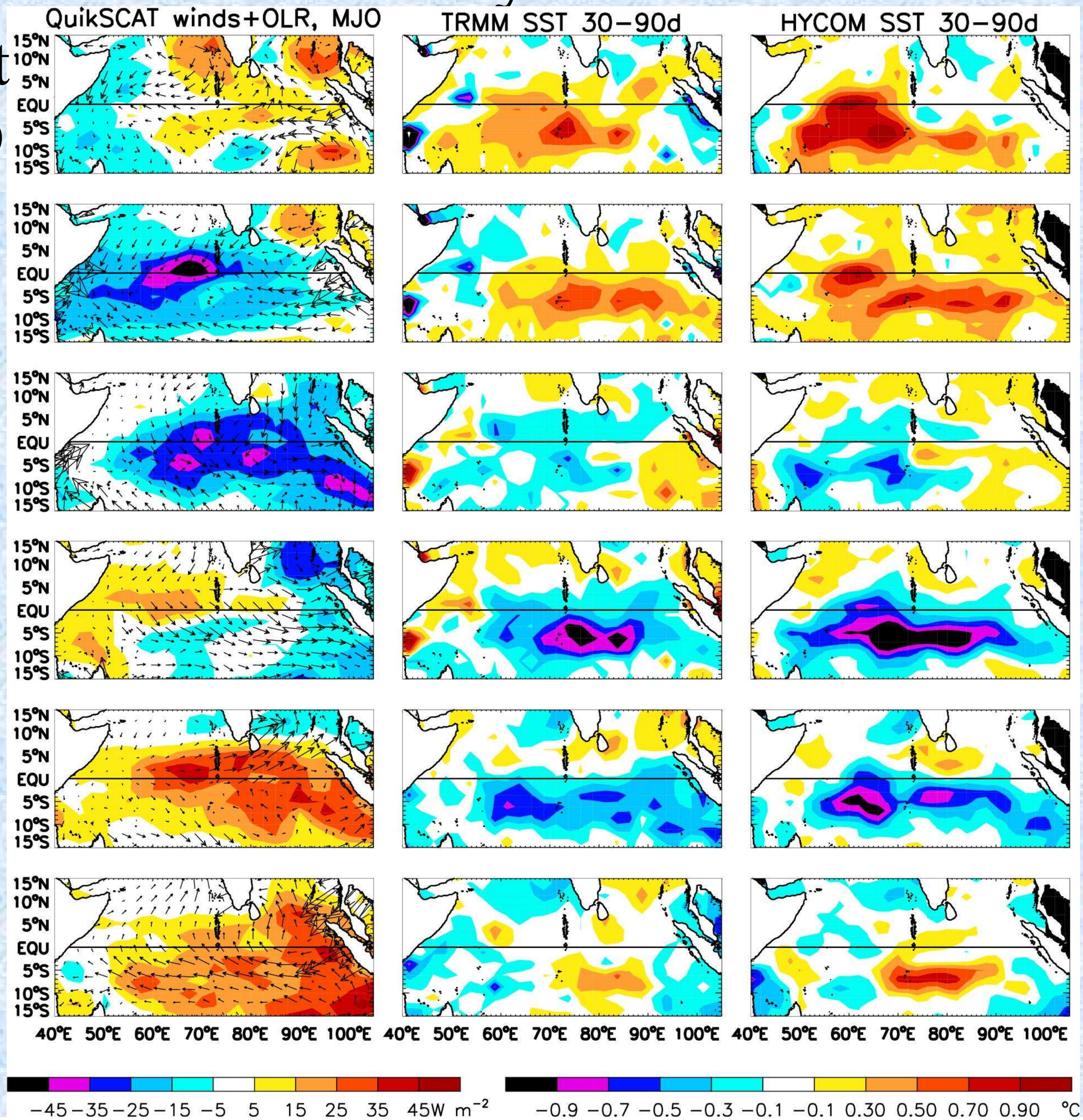
Jan 10

Jan 19

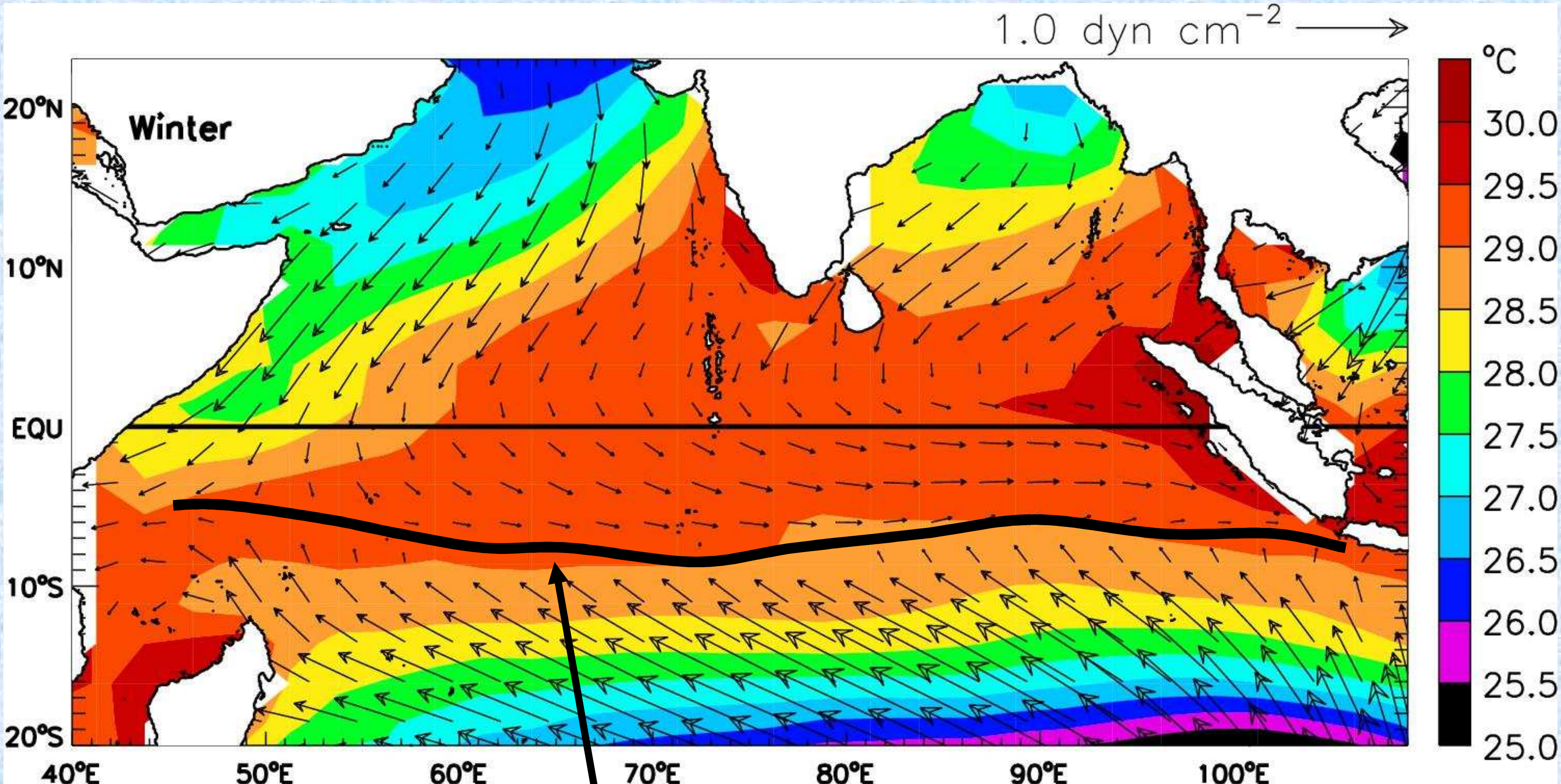
Jan 28

Feb 6

Feb 15



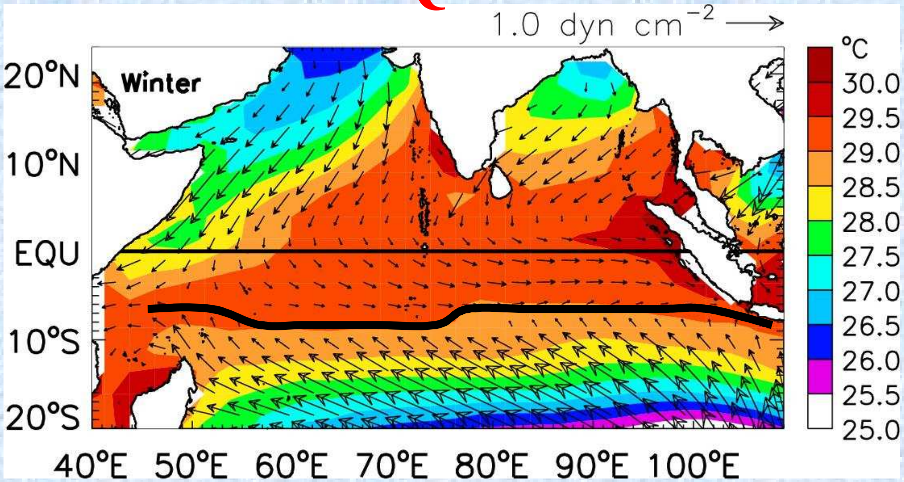
Northern winter (Nov-Apr average) TRMM SST & QuiSCAT winds,99-03



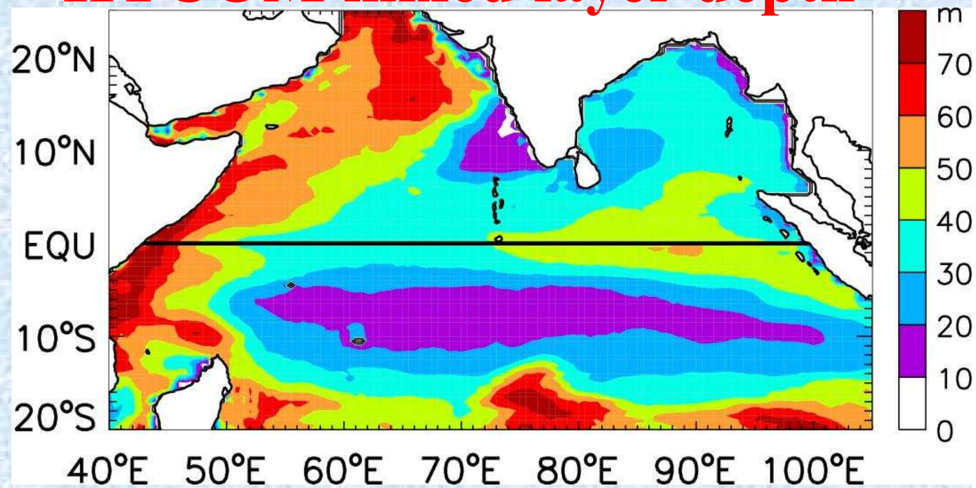
ITCZ

Northern winter (Nov-Apr mean 99-2003)

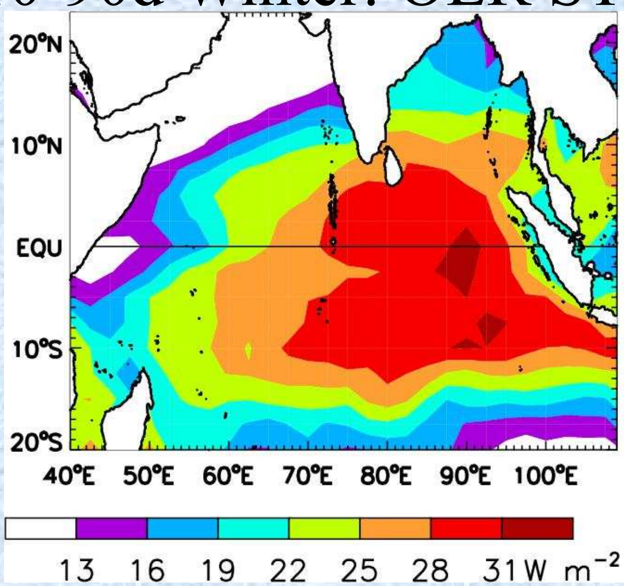
TRMM SST + QuikSCAT winds



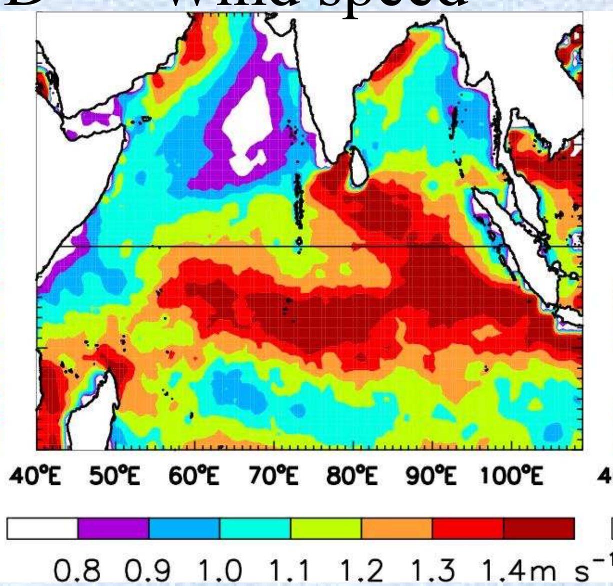
HYCOM mixed layer depth



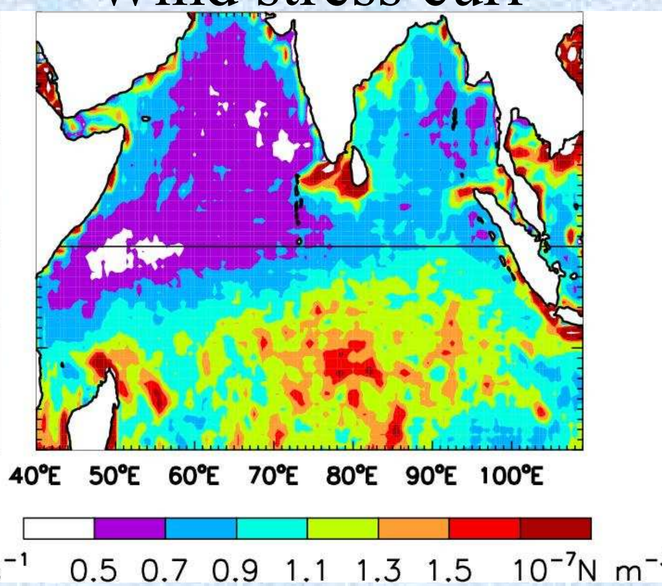
10-90d Winter: OLR STD



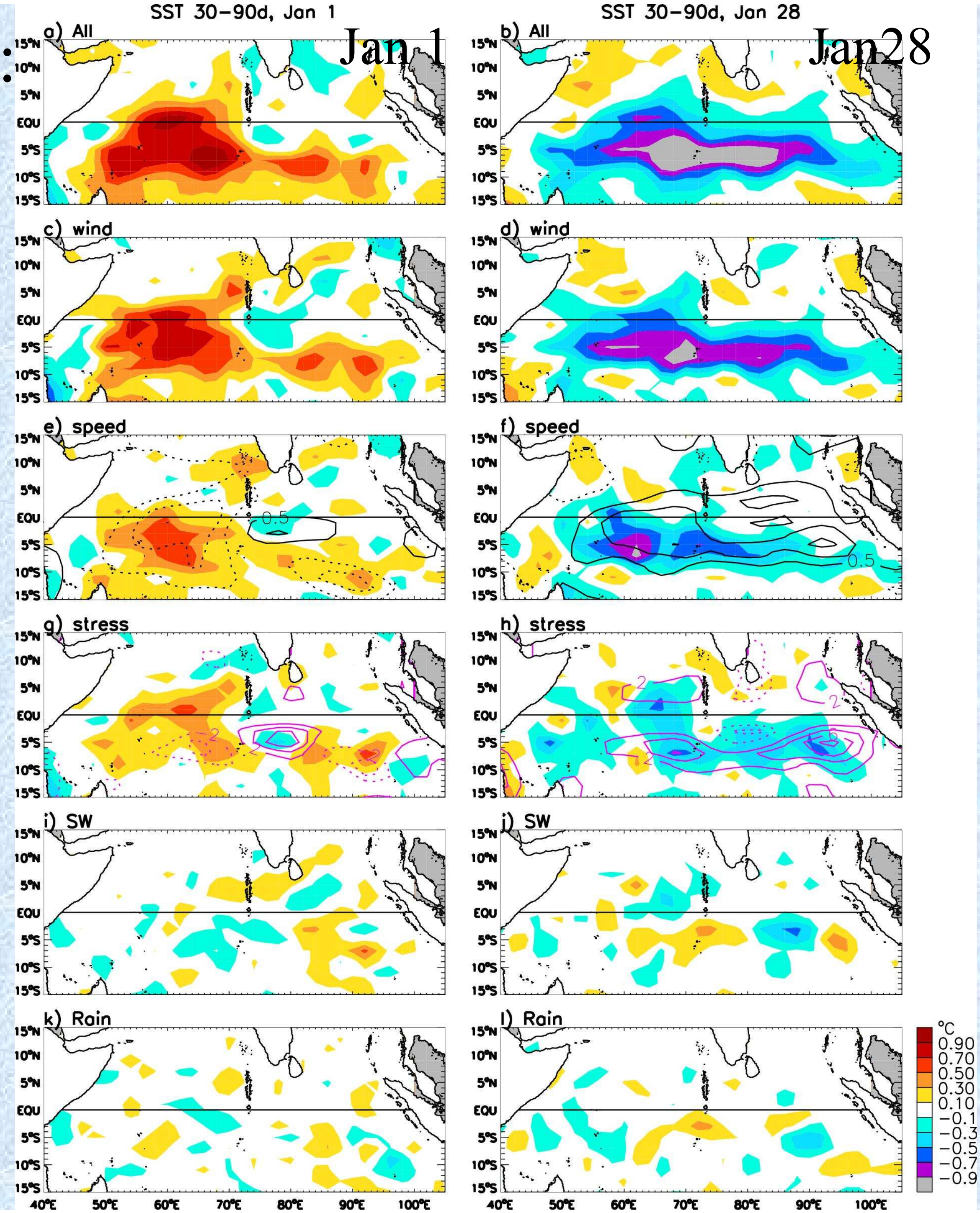
Wind speed



Wind stress curl



HYCOM solutions: processes for the MJO event, 1999



Submonthly ISO event 2003,Jan 27

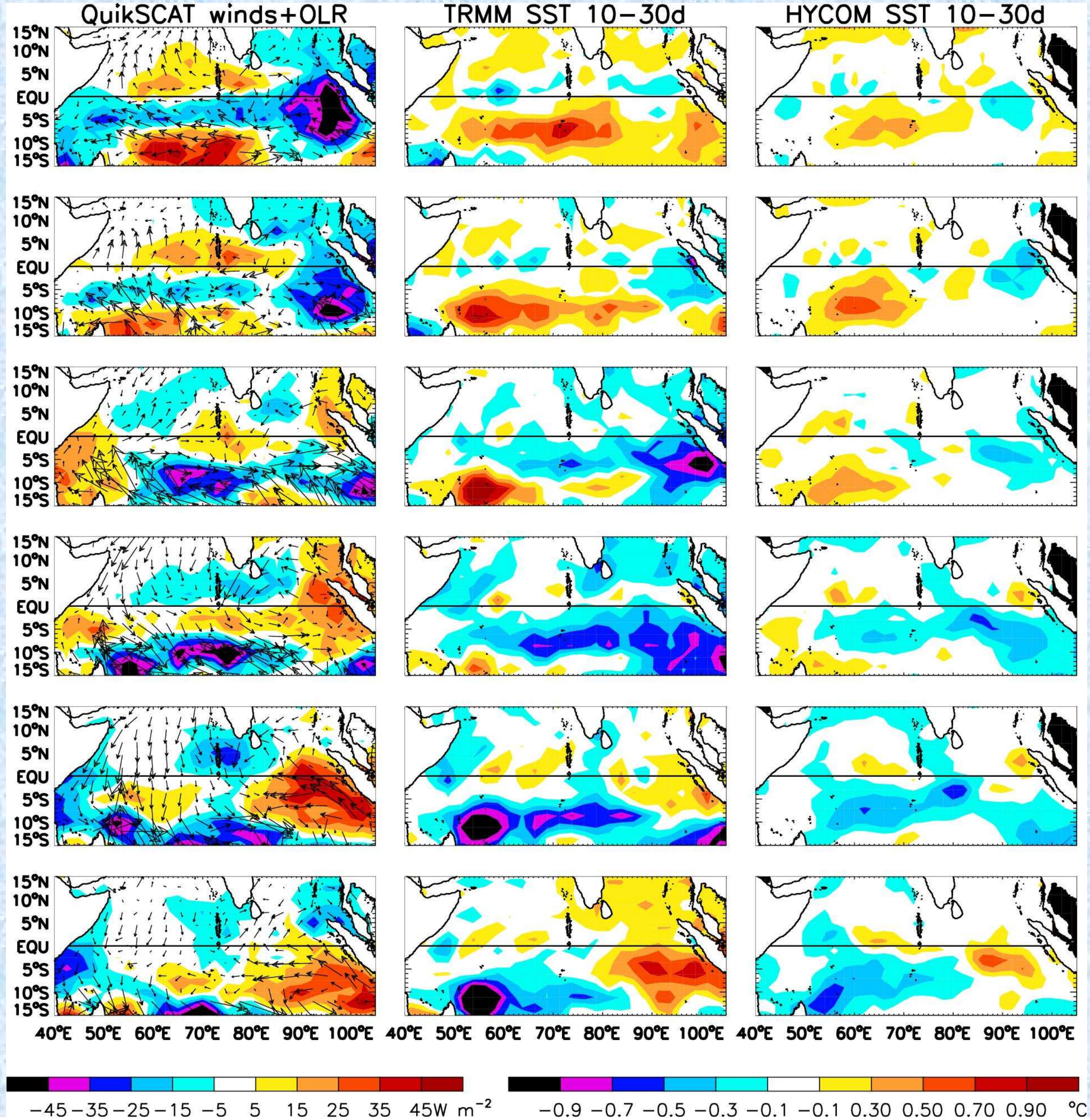
Jan 30

Feb 2

Feb 5

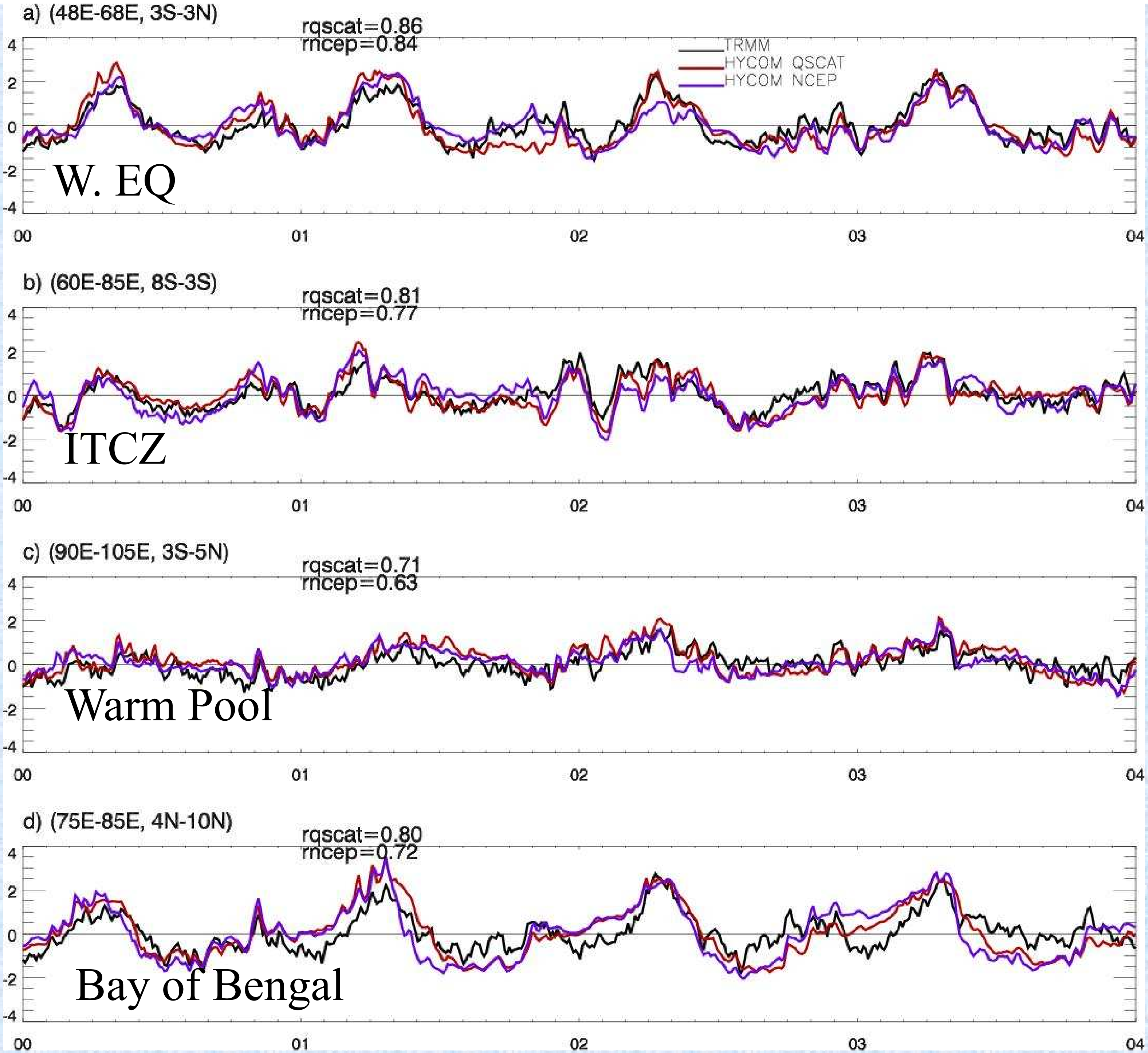
Feb 8

Feb 11



4. **Future work**

- Explore intraseasonal SST variability induced by the MJO and submonthly ISOs, understand the processes (summer);
- Investigate the structure of atmos. synoptic variability & impacts on synoptic SST;
- Quantify effects of synoptic variability, submonthly ISOs and MJO on seasonal-to-itnerannual SST variability and mean state;
- Validate QuikSCAT winds by comparing with in situ data & examining accuracy of model simulation forced by QuikSCAT and NCEP reanalysis products.


a) (48E-68E, 3S-3N)
rqscat=0.86
rncep=0.84
TRMM
HYCOM QSCAT
HYCOM NCEP
W. EQ
b) (60E-85E, 8S-3S)
rqscat=0.81
rncep=0.77
ITCZ
c) (90E-105E, 3S-5N)
rqscat=0.71
rncep=0.63
Warm Pool
d) (75E-85E, 4N-10N)
rqscat=0.80
rncep=0.72
Bay of Bengal
00
01
02
03
04