MJO Evaluation for GEFS 35-day Experiments for SubX

Wei Li

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Qin Zhang, Malaquias Peña, Xingren Wu, Wanqiu Wang, Ping Liu, Xu Li

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Outline

- MJO skill, index
- MJO propagation
- Forecast skill of the key components of MJO
- Dependence of MJO skill on ensemble size
- Dependence of MJO skill on analysis data
- MJO skill of 18yr reforecast

Experiments and Data

- Operational Version:
  - GEFSv11 extended to 35 day forecast (**STTP**);
  - T574 (33 km) for 0-8 days, T382 (55km) after 8days.

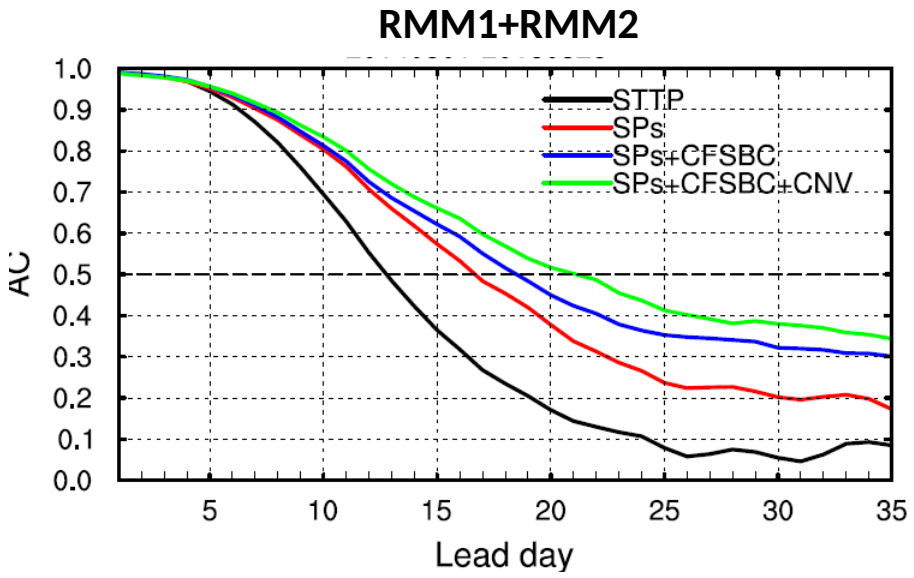
- Experiments:
  - SPPT+SHUM+SKEB (**SPs**) with control version of SST;
  - SPs with bias corrected CFSv2 forecast SST (**SPs+CFSBC**);
  - SPs with bias corrected CFSv2 forecast SST and scale aware convection scheme (**SPs+CFSBC+CNV**) ;

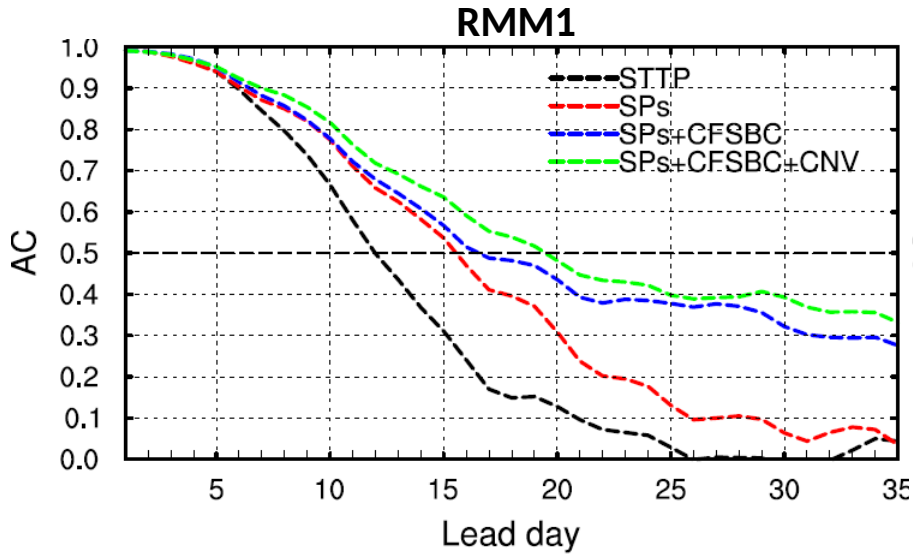
  All experiment cover the period of 20140501-20160526, 5-day interval.

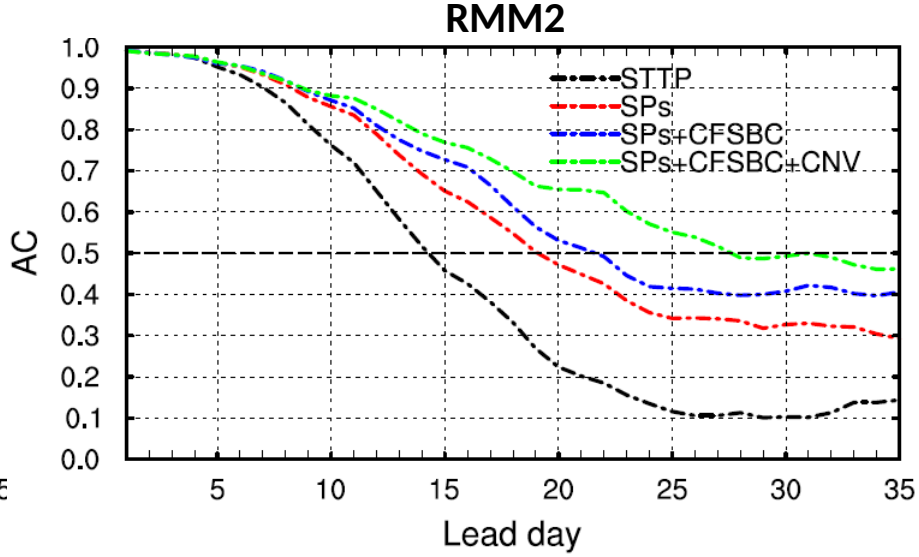
- Analysis data:
  - GDAS during 20140101-20161031; NCEP reanalysis for U and NOAA OLR.

- Both forecast and analysis data using daily mean

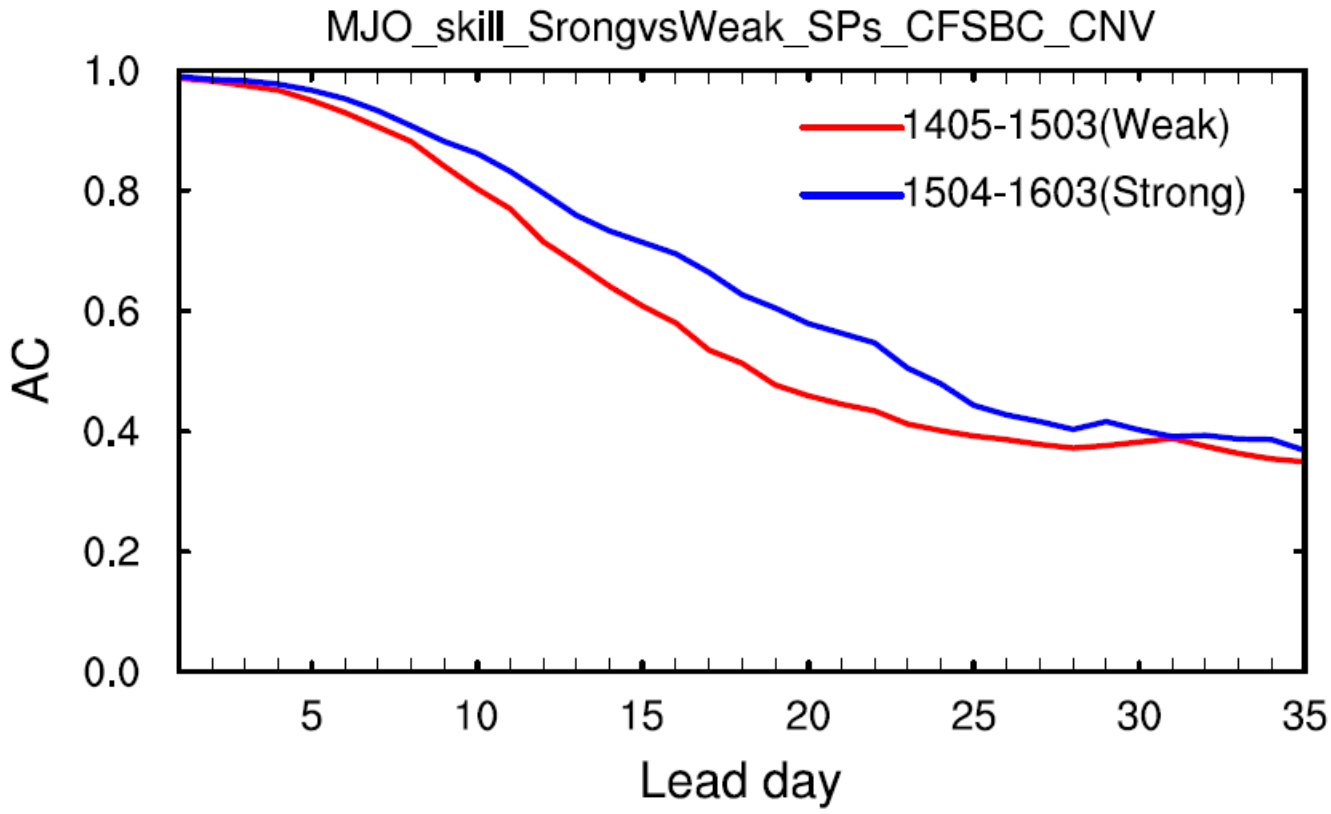
WH-MJO Forecast Skills for 2-yr Experiments



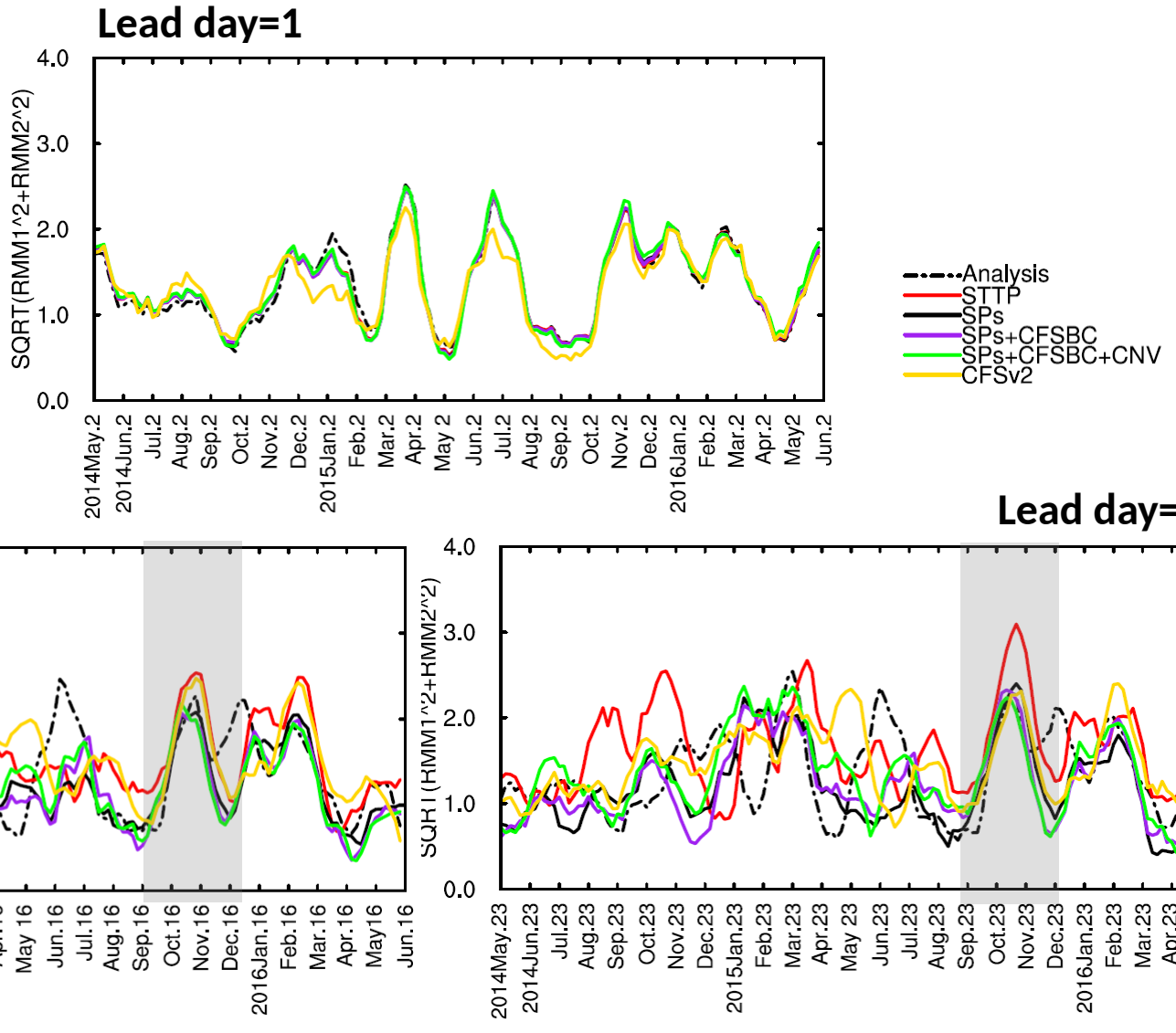




Strong vs Weak Period



MJO index


Lead day=1
SQRT(RMM1^2+RMM2^2)
4.0
3.0
2.0
1.0
0.0
2014May.2
2014Jun.2
Jul.2
Aug.2
Sep.2
Oct.2
Nov.2
Dec.2
2015Jan.2
Feb.2
Mar.2
Apr.2
May 2
Jun.2
Jul.2
Aug.2
Sep.2
Oct.2
Nov.2
Dec.2
2016Jan.2
Feb.2
Mar.2
Apr.2
May2
Jun.2
Analysis
STTP
SPs
SPs+CFSBC
SPs+CFSBC+CNV
CFSv2
Lead day=15
SQRT(RMM1^2+RMM2^2)
4.0
3.0
2.0
1.0
0.0
2014May.16
2014Jun.16
Jul.16
Aug.16
Sep.16
Oct.16
Nov.16
Dec.16
2015Jan.16
Feb.16
Mar.16
Apr.16
May 16
Jun.16
Jul.16
Aug.16
Sep.16
Oct.16
Nov.16
Dec.16
2016Jan.16
Feb.16
Mar.16
Apr.16
May16
Jun.16
Lead day=22
4.0
3.0
2.0
1.0
0.0
2014May.23
2014Jun.23
Jul.23
Aug.23
Sep.23
Oct.23
Nov.23
Dec.23
2015Jan.23
Feb.23
Mar.23
Apr.23
May 23
Jun.23
Jul.23
Aug.23
Sep.23
Oct.23
Nov.23
Dec.23
2016Jan.23
Feb.23
Mar.23
Apr.23
May23
Jun.23

MJO evolution

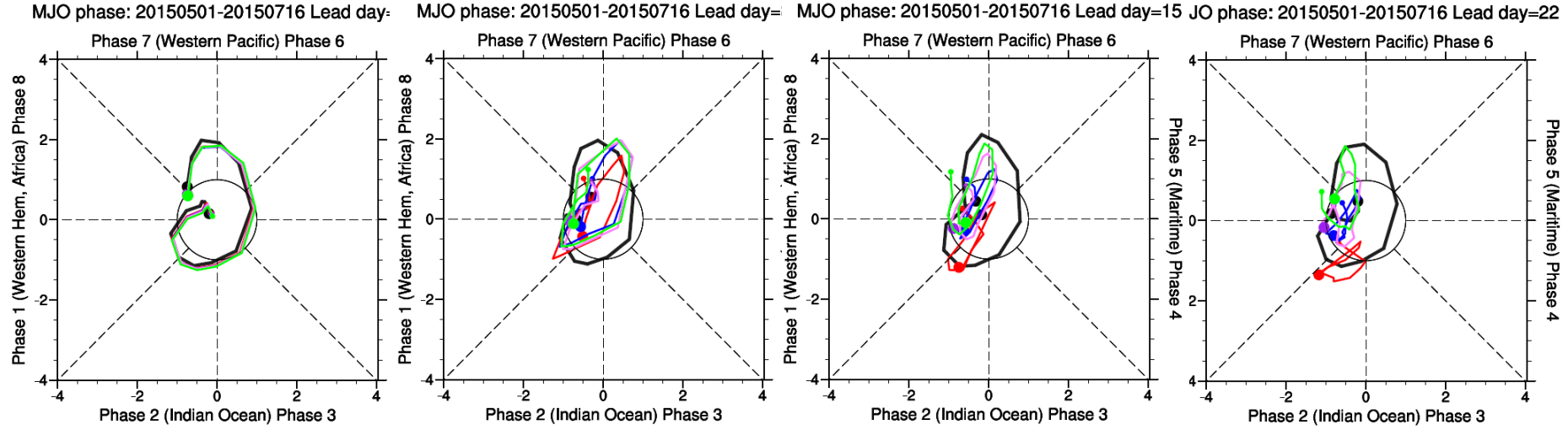
lead 1

lead 8

lead 15

lead 22

20150501-20150716



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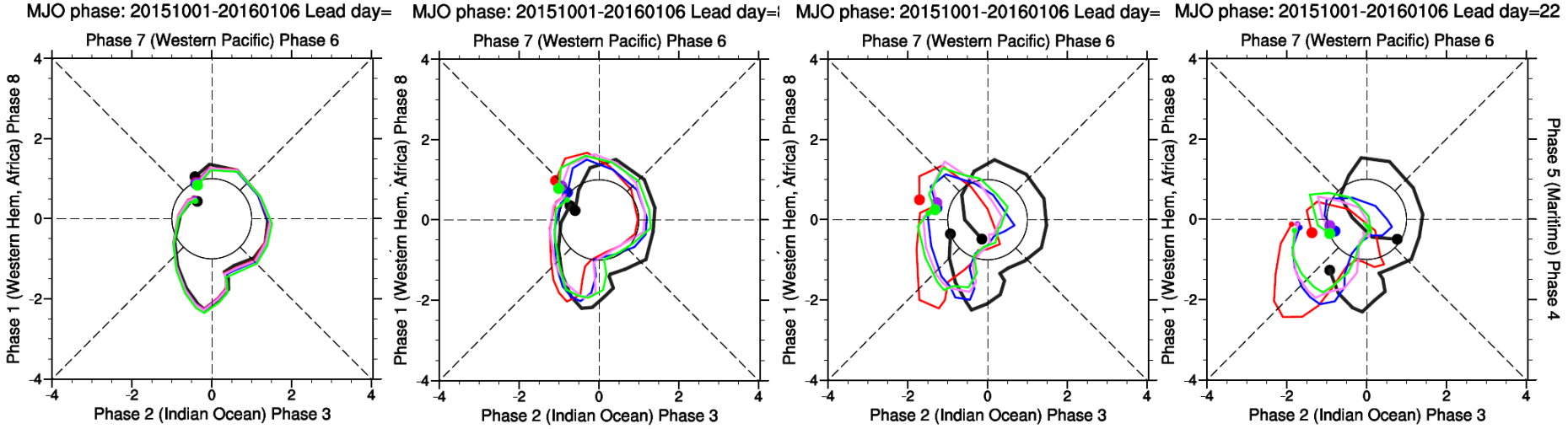
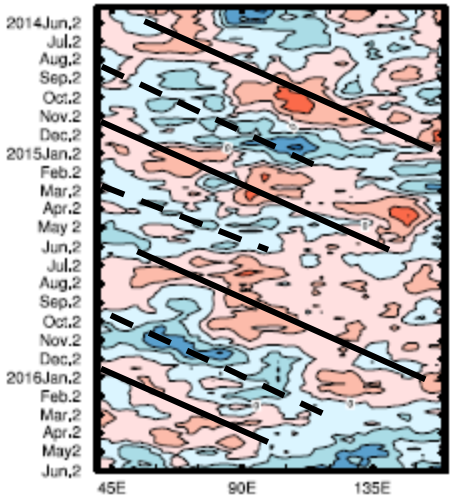


GDAS STTP SPs SPs_CFSBC SPs+CFSBC+CNV

MJO propagation : lead day=1

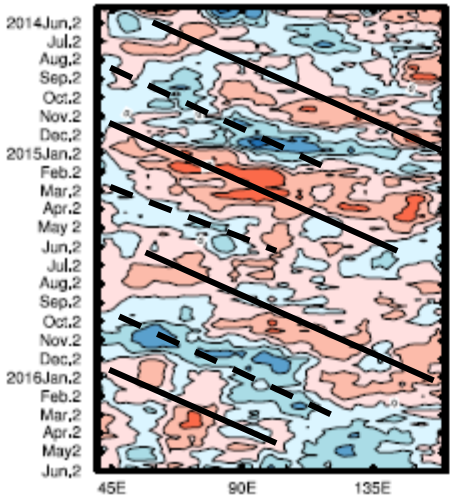
NOAA

olr_anal Lead day=1 rave=9



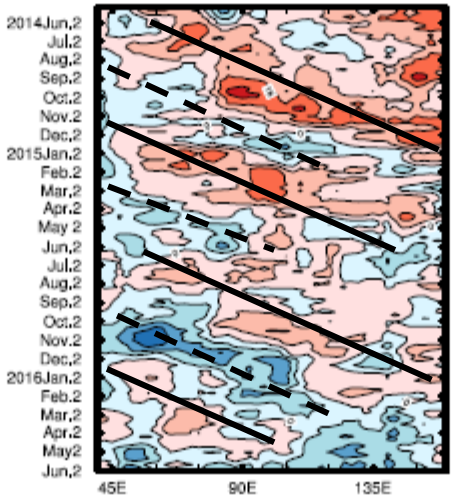
GDAS

olr_anal Lead day=1 rave=9



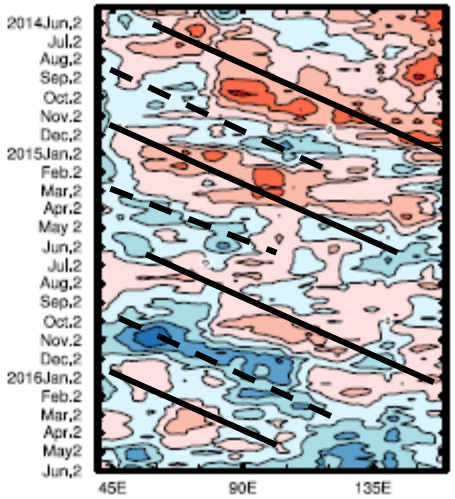
STTP

olr_sttp Lead day=1 rave=9



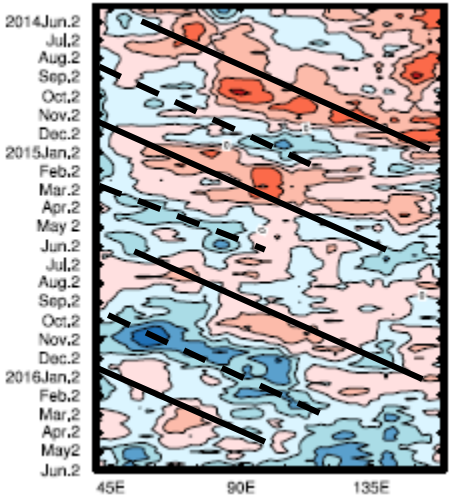
SPs

olr_sps Lead day=1 rave=9



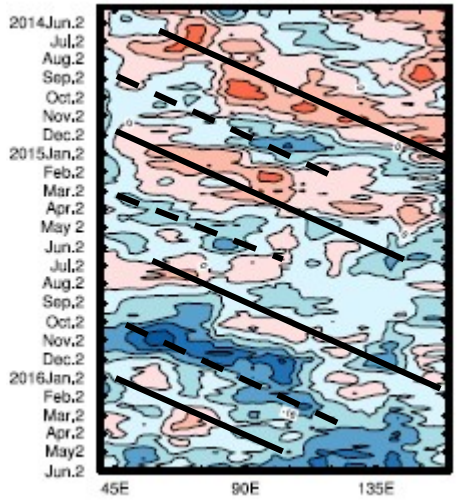
SPs+CFSBC

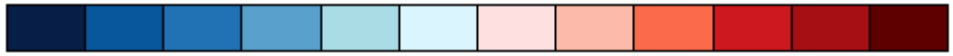
olr_sps_cfsbc Lead day=1 rave=9



SPs+CFSBC+CNV

olr_sps_cfsbc_cnv Lead day=1 rave=9



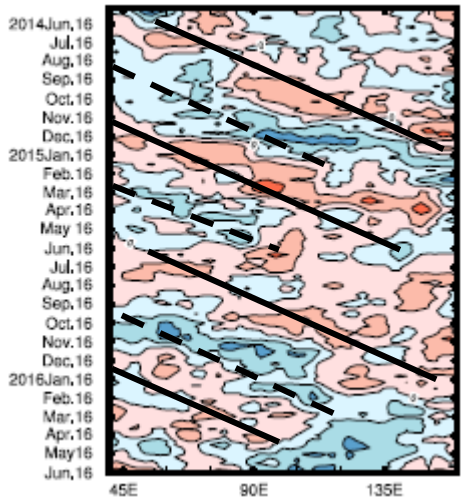


W m^2

MJO propagation : lead day=15

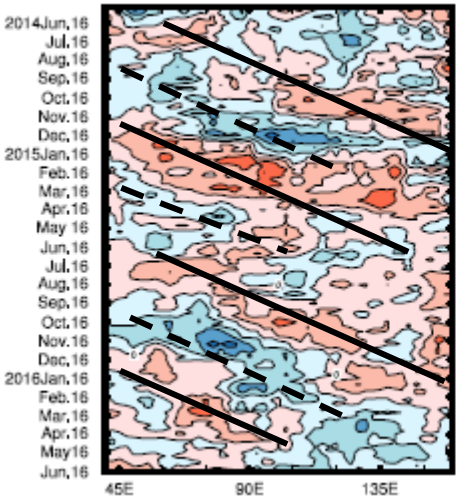
NOAA

olr_anal Lead day=15 rave=9



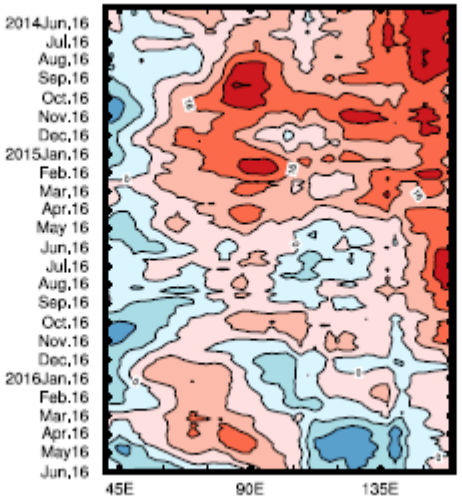
GDAS

olr_anal Lead day=15 rave=9



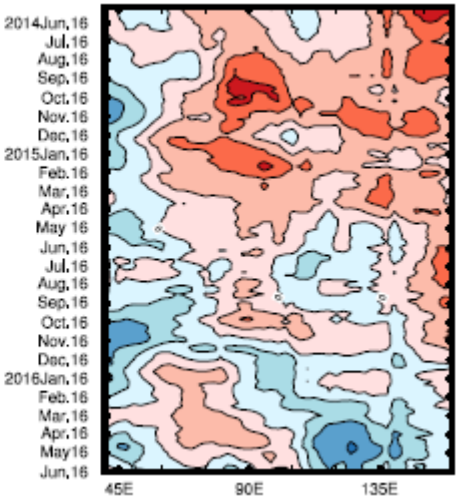
STTP

olr_sttp Lead day=15 rave=9



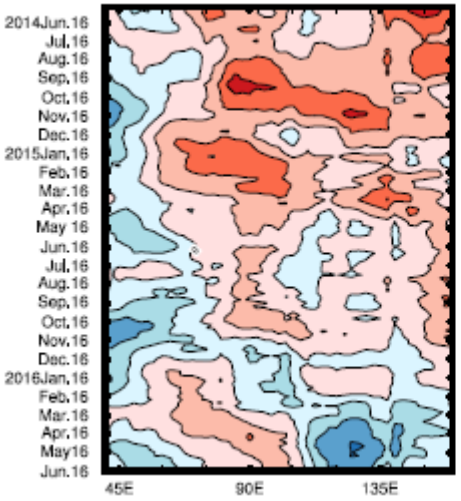
SPs

olr_sps Lead day=15 rave=9



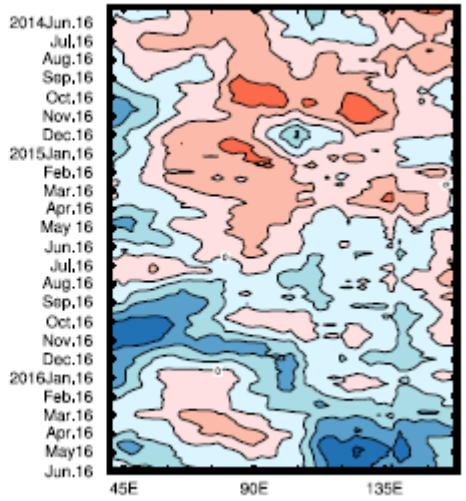
SPs+CFSBC

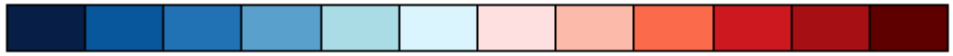
olr_sps_cfsbc Lead day=15 rave=9



SPs+CFSBC+CNV

olr_sps_cfsbc_cnv Lead day=15 rave=9



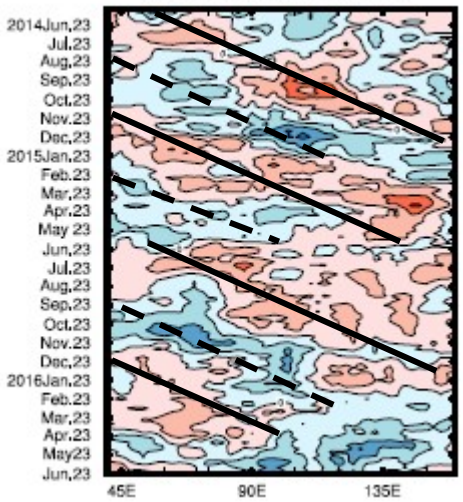


W m^2

MJO propagation : lead day=22

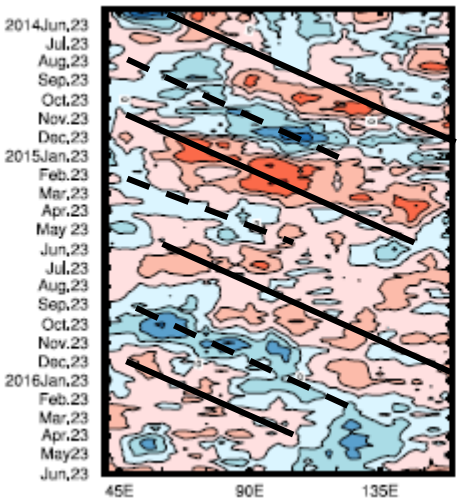
NOAA

olr_anal Lead day=22 rave=9



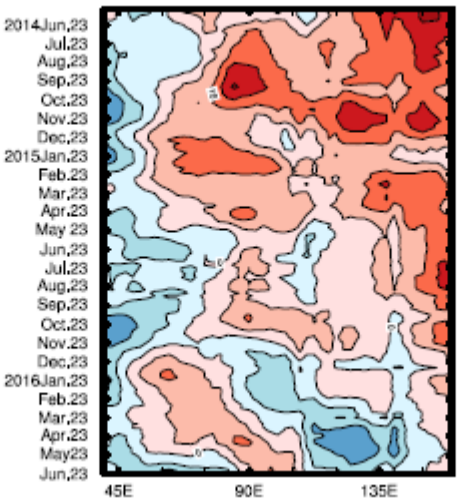
GDAS

olr_anal Lead day=22 rave=9



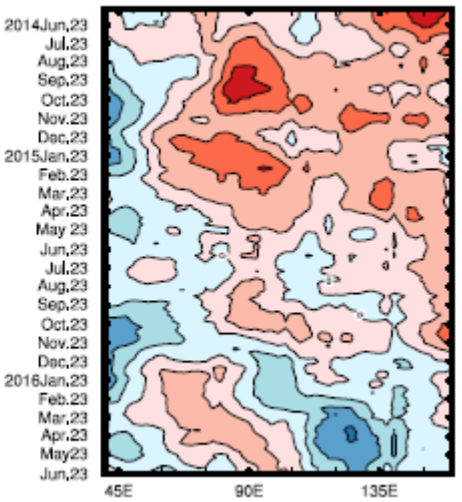
STTP

olr_sttp Lead day=22 rave=9



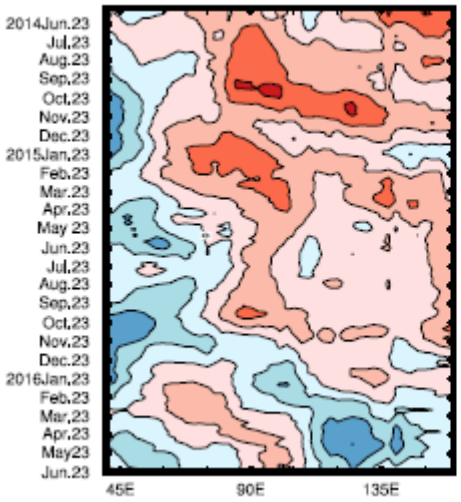
SPs

olr_sps Lead day=22 rave=9



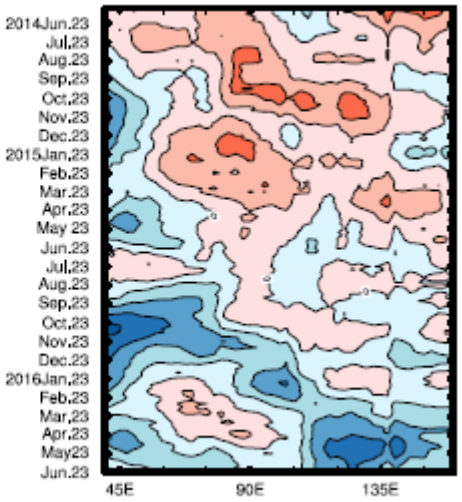
SPs+CFSBC

olr_sps_cfsbc Lead day=22 rave=9

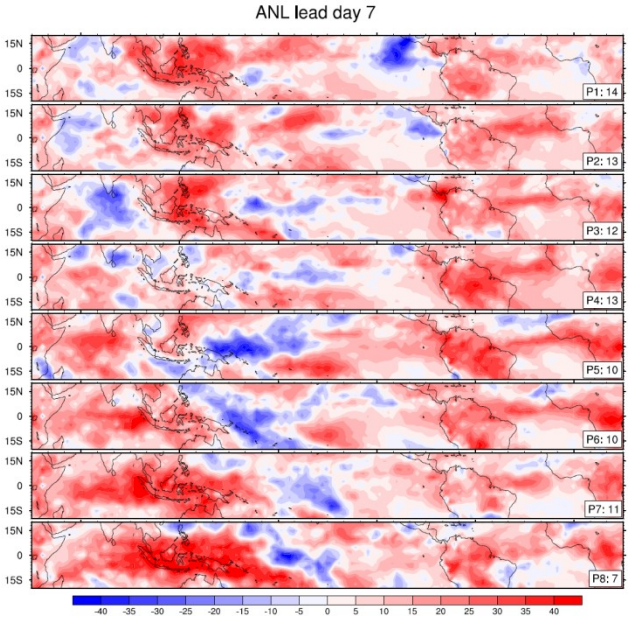


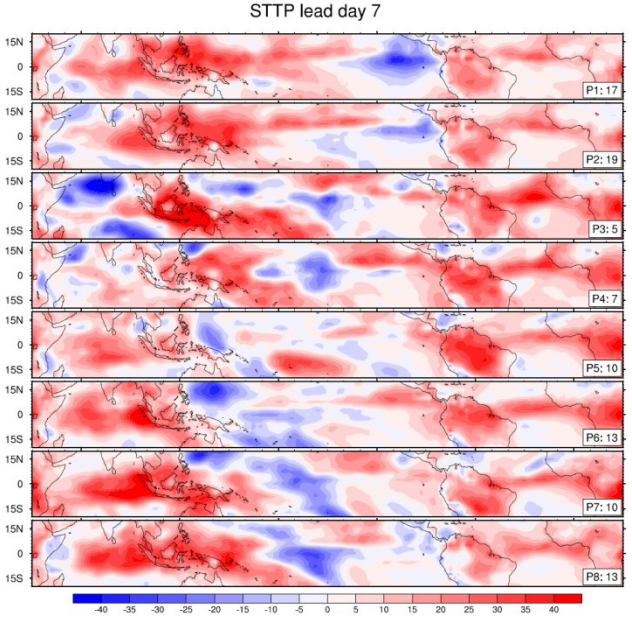
SPs+CFSBC+CNV

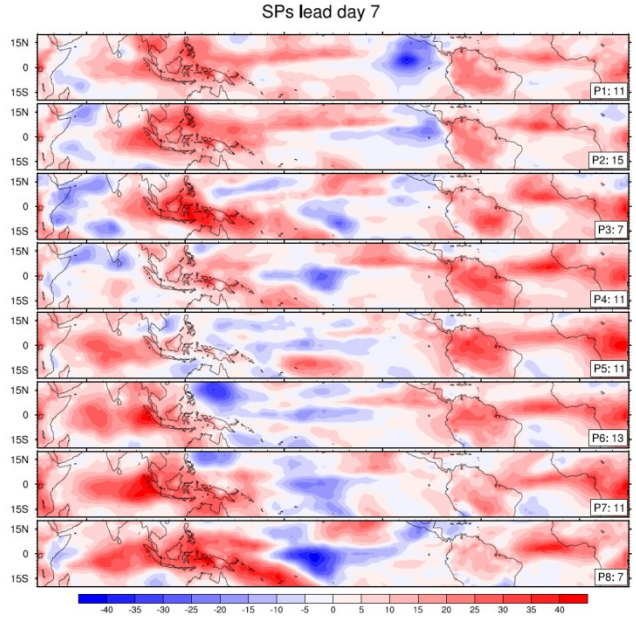
olr_sps_cfsbc_cnv Lead day=22 rave=9

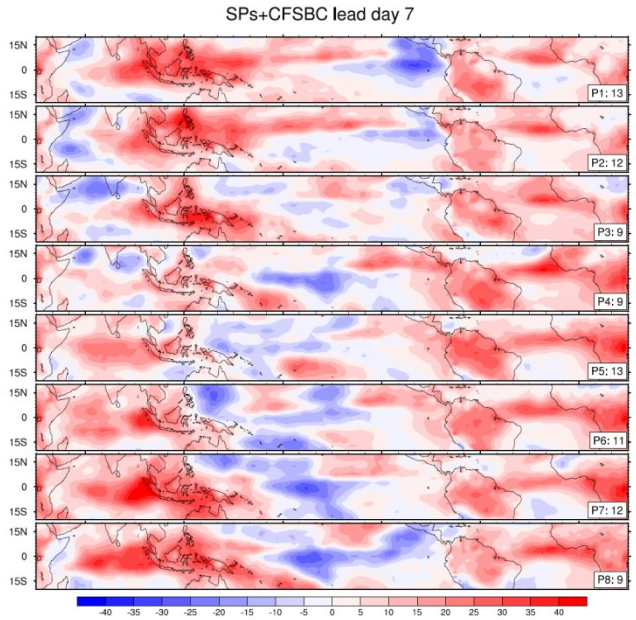


Composite MJO phase: OLR anomaly (Lead day=7)

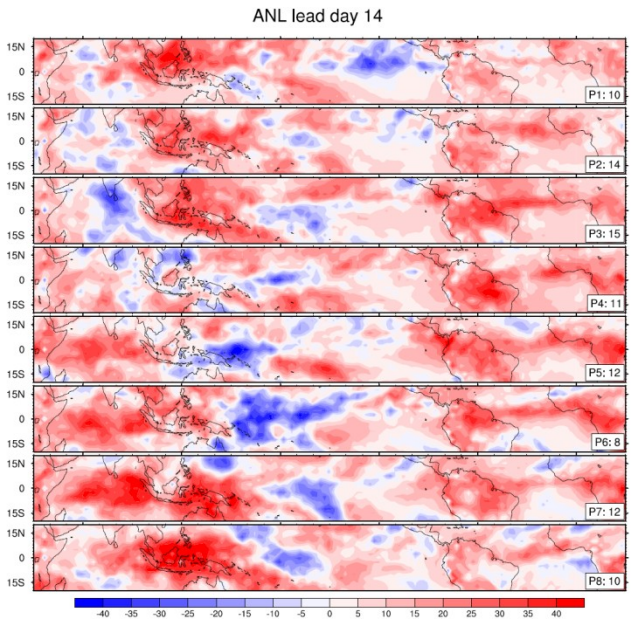


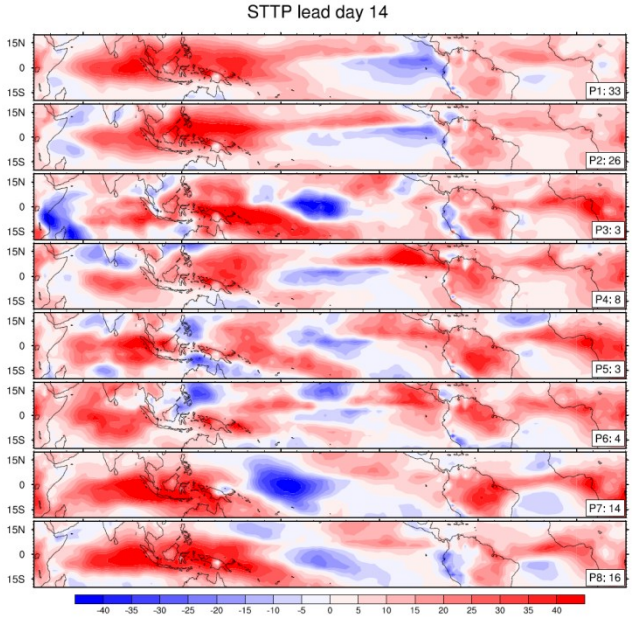


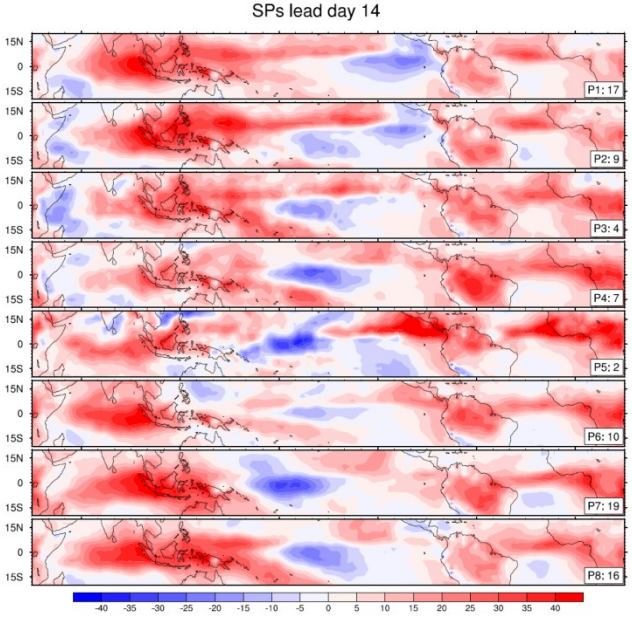


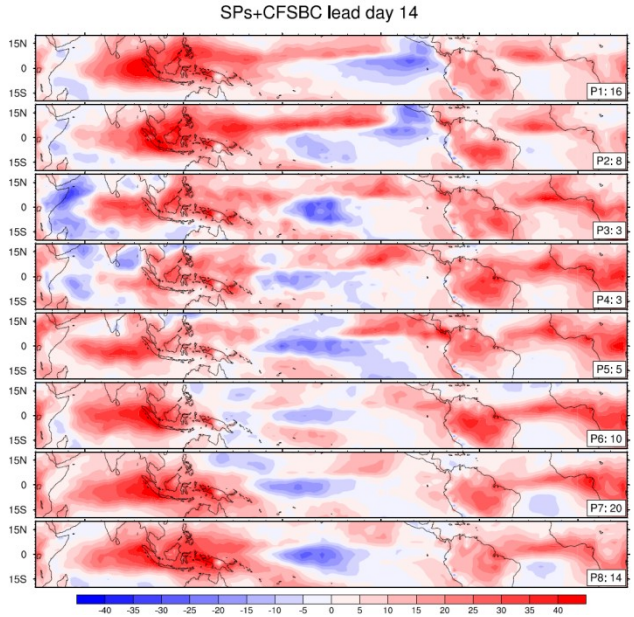


Composite MJO phase: OLR anomaly (Lead day=14)

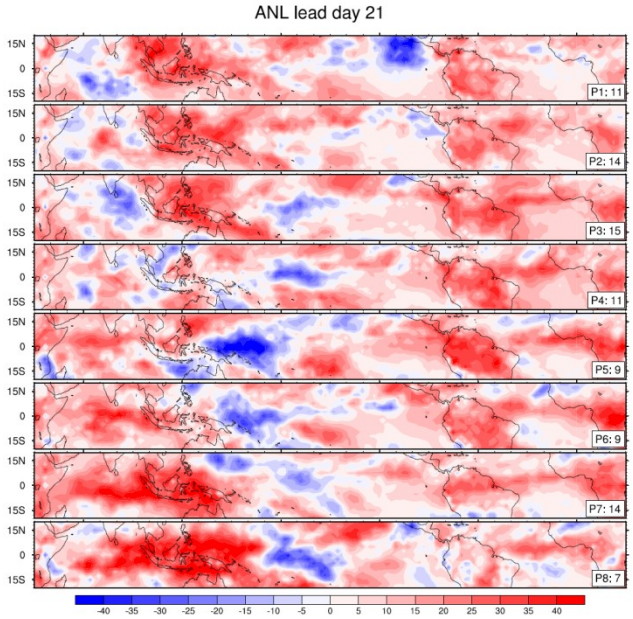


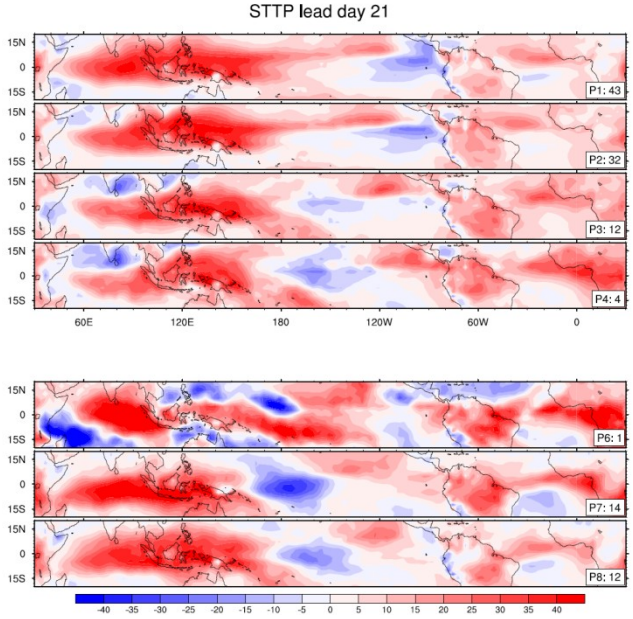


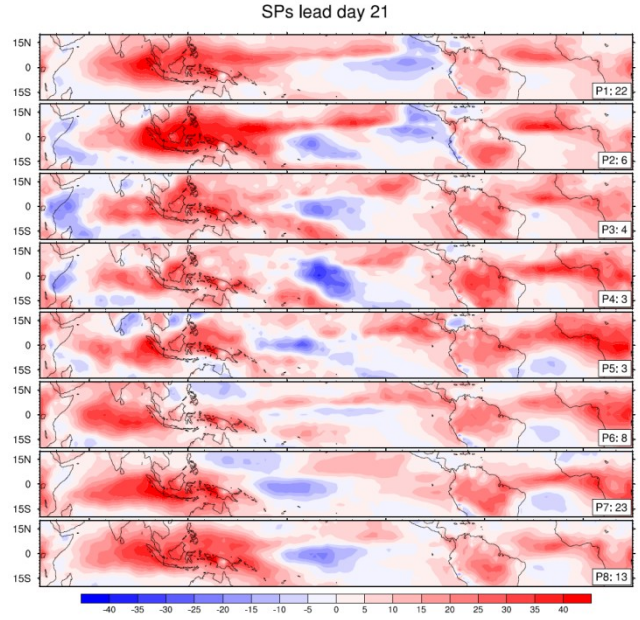


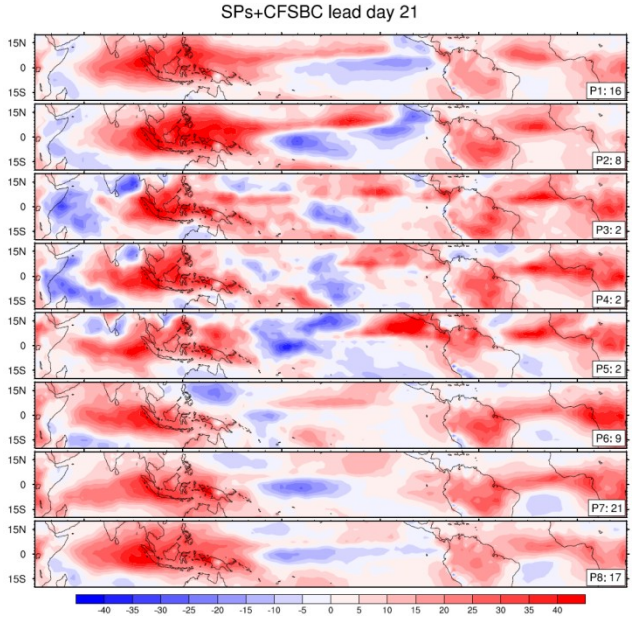


Composite MJO phase: OLR anomaly (Lead day=21)

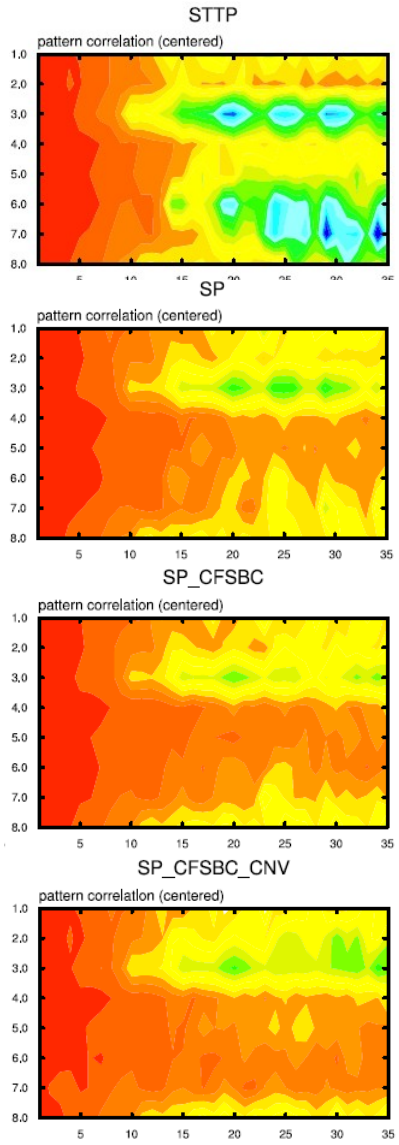


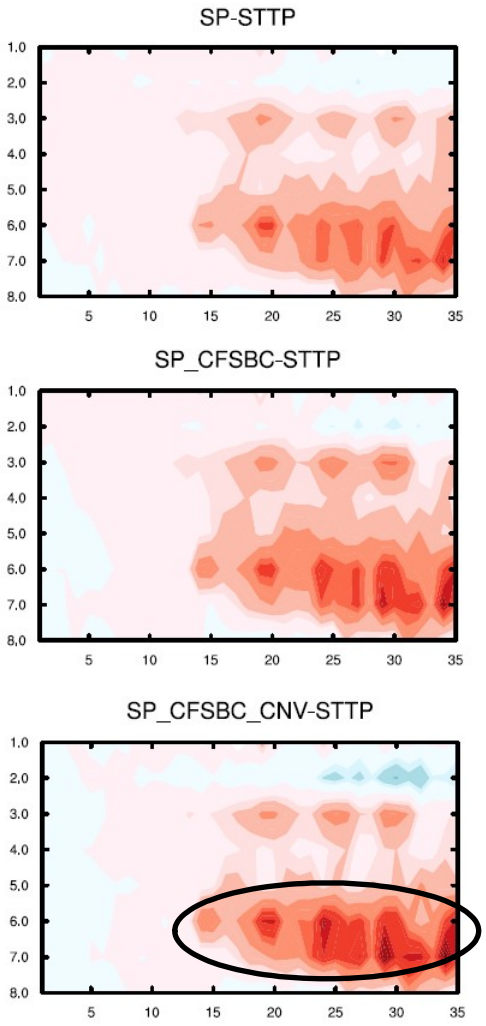


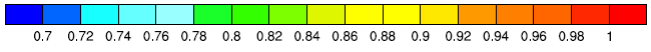


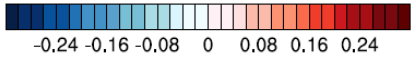


Skill as a Function of Phase and Lead Time: U200

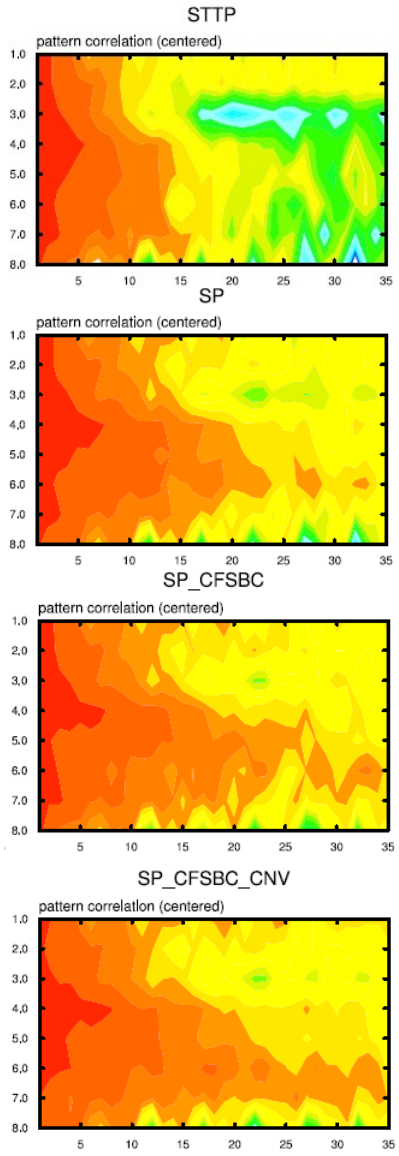


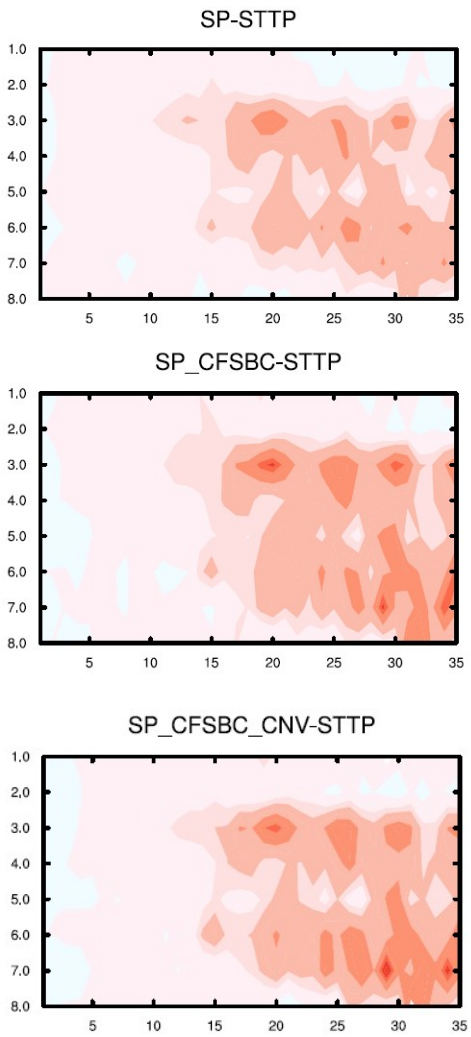


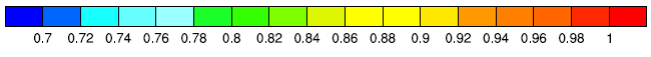


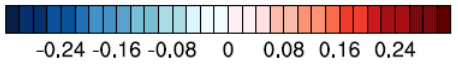


Skill as a Function of Phase and Lead Time: U850

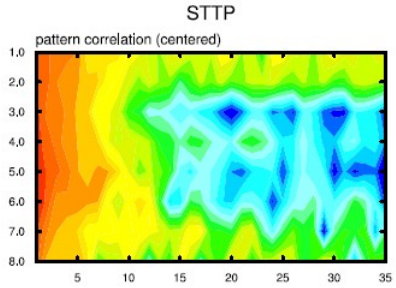


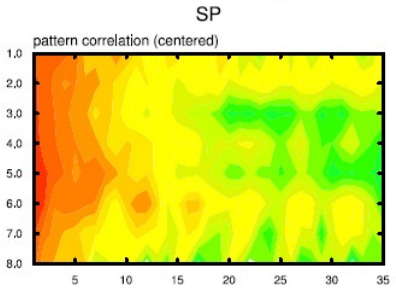


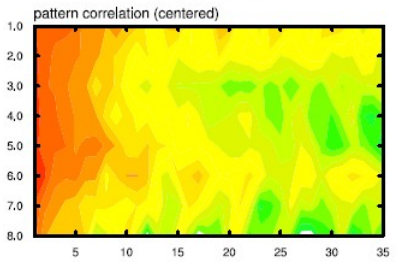


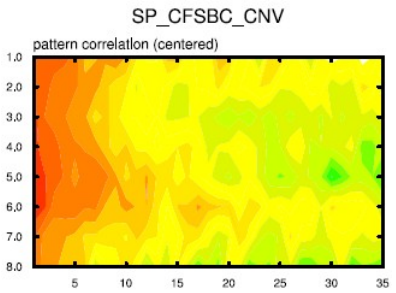


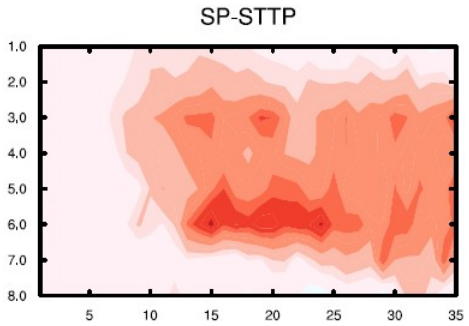
Skill as a Function of Phase and Lead Time: OLR

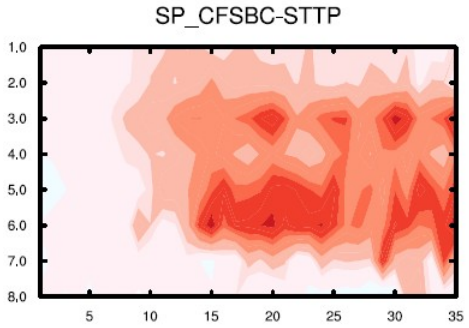


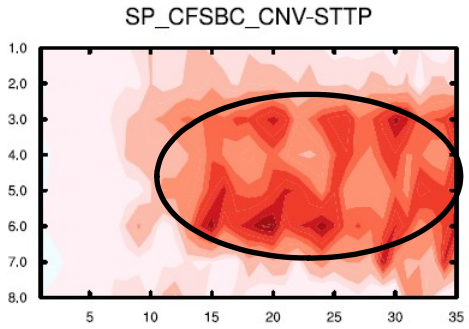


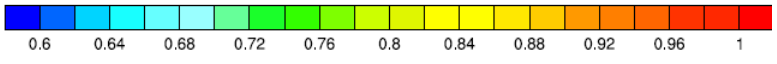


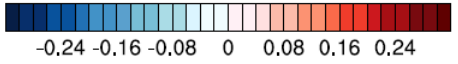




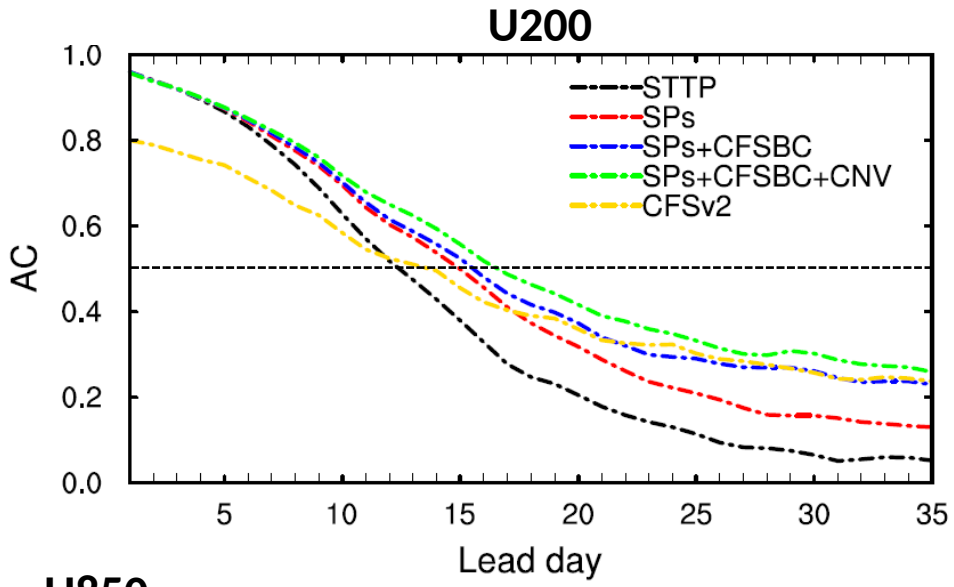


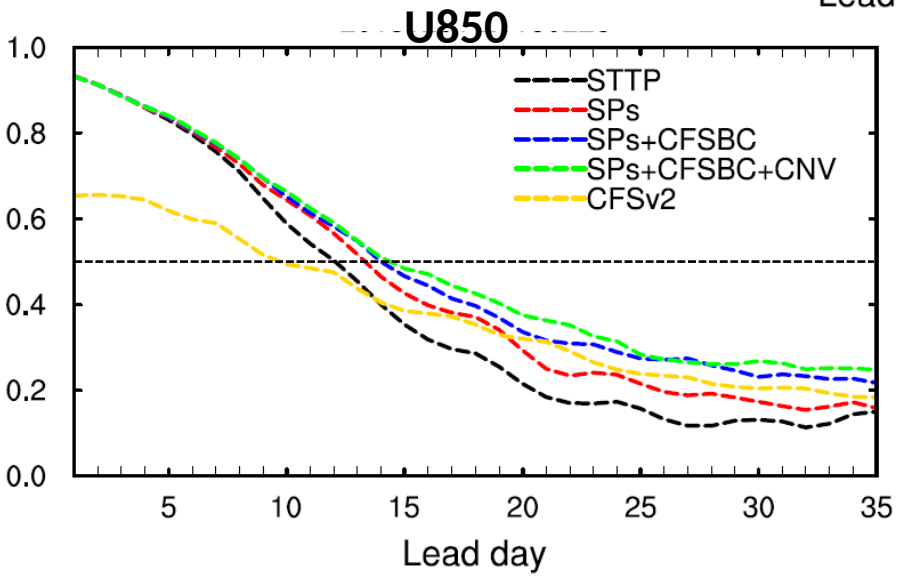


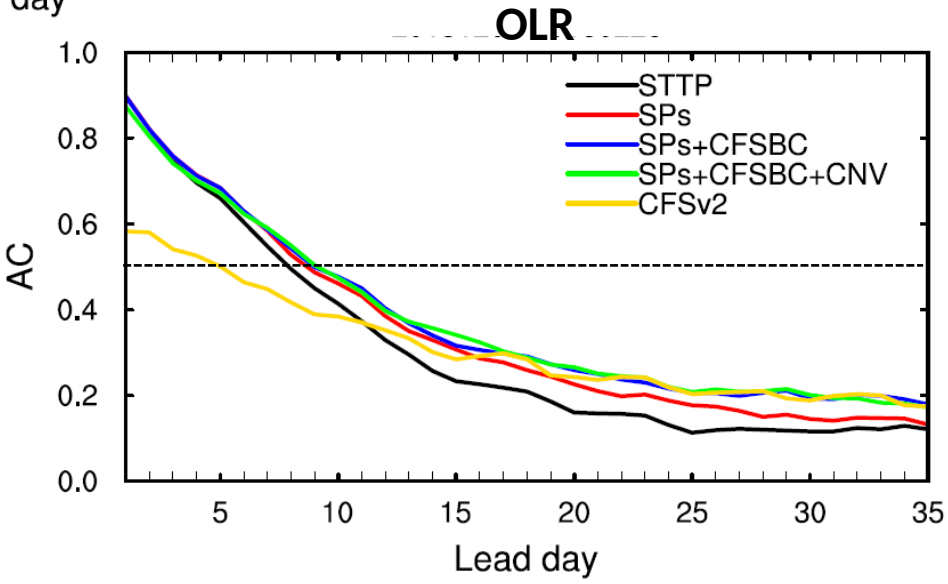




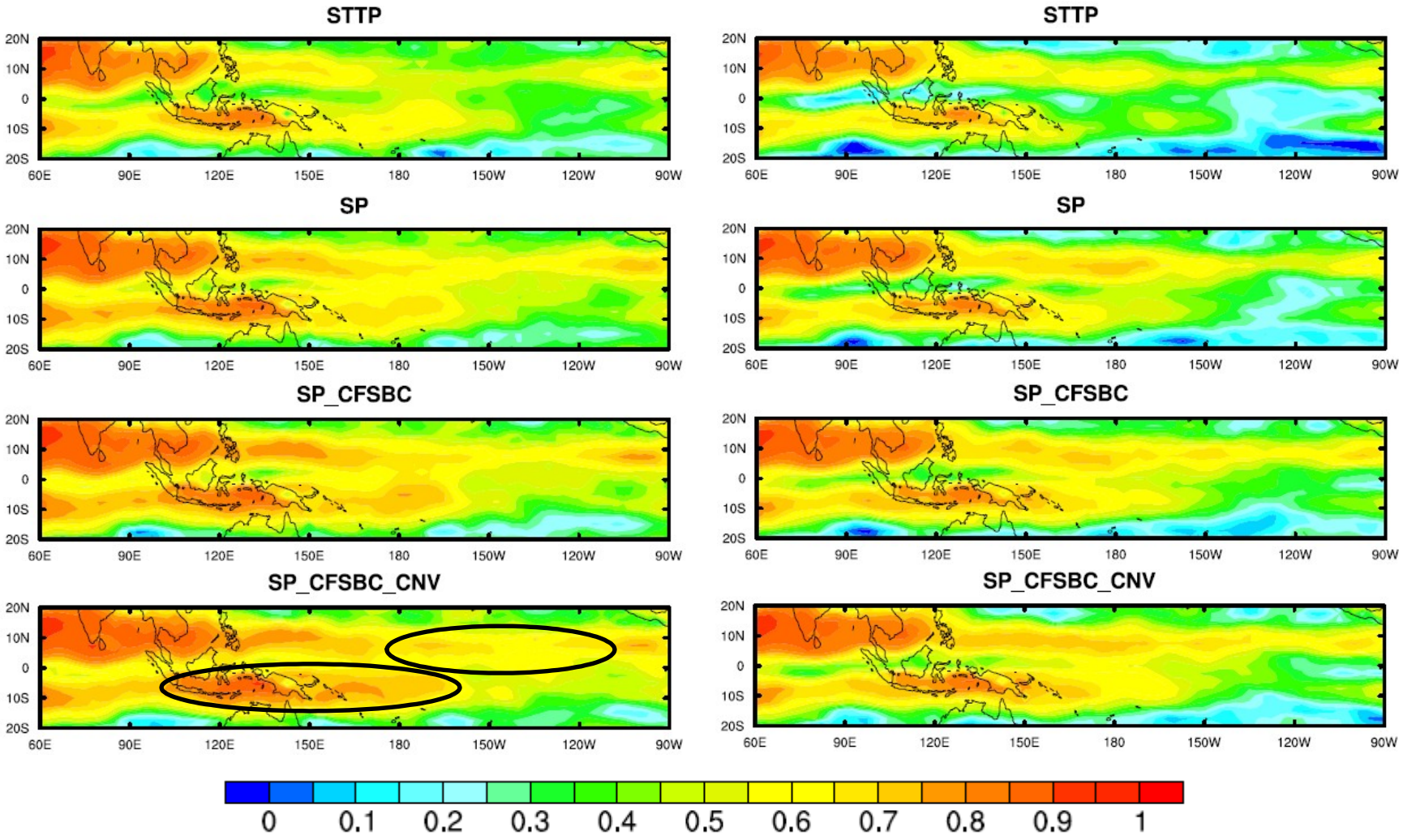
Contribution of Variables



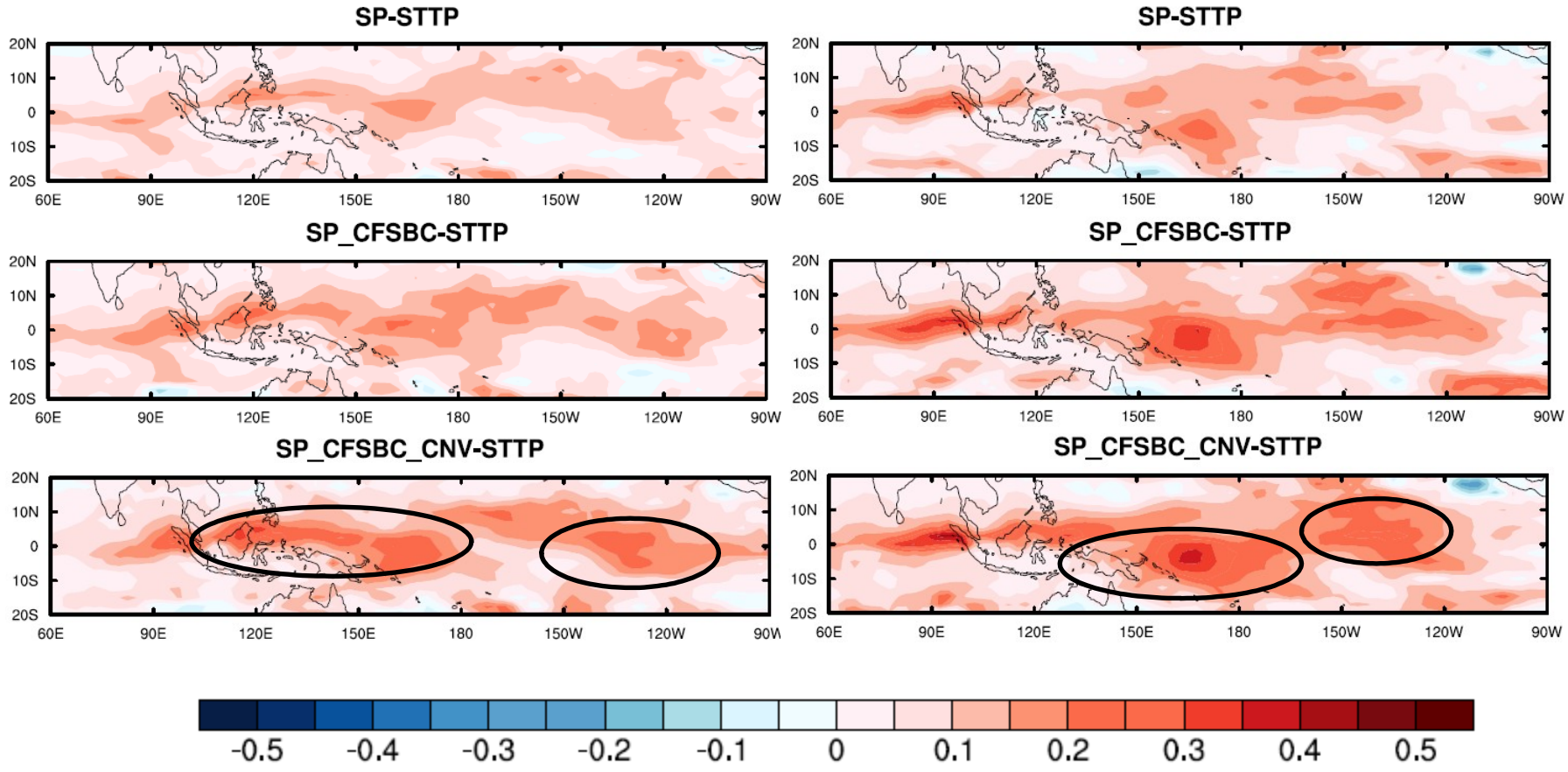




Correlation Map: U850

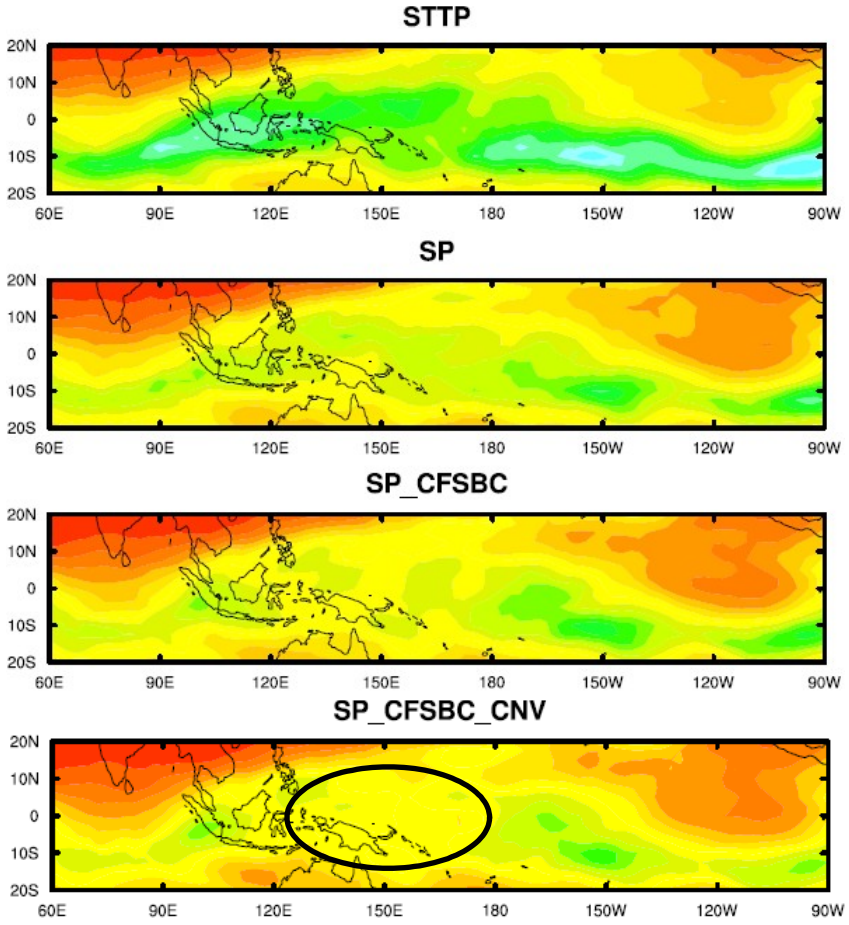


Correlation Map Diff from STTP: U850

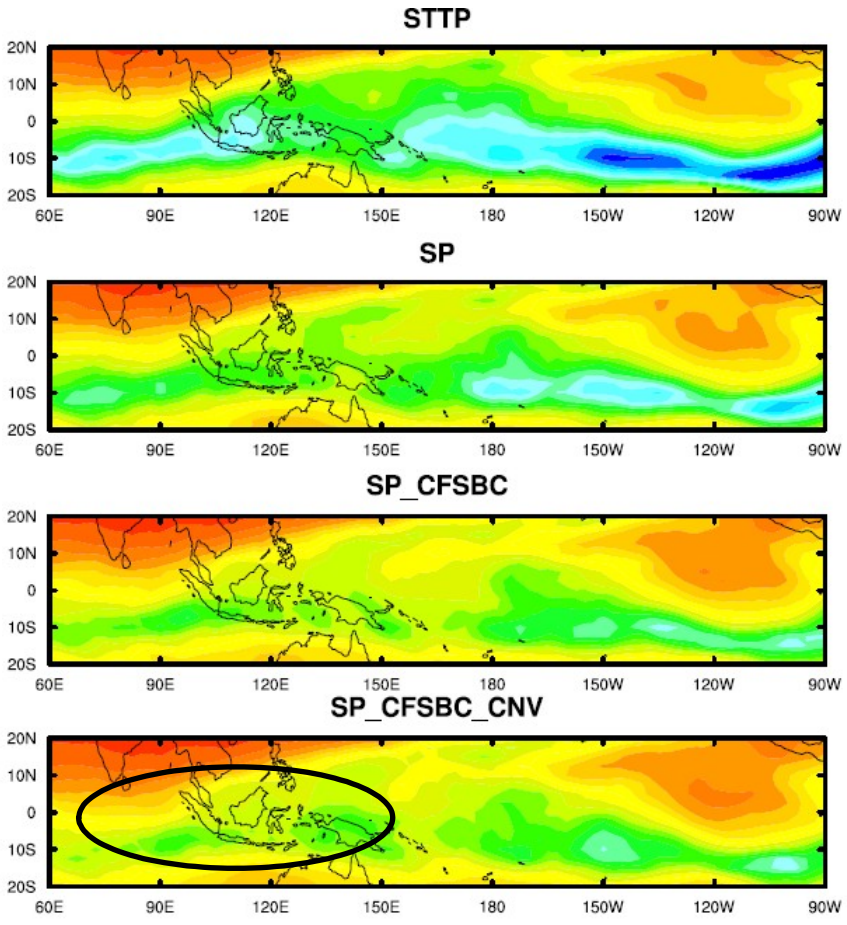


Correlation Map: U200

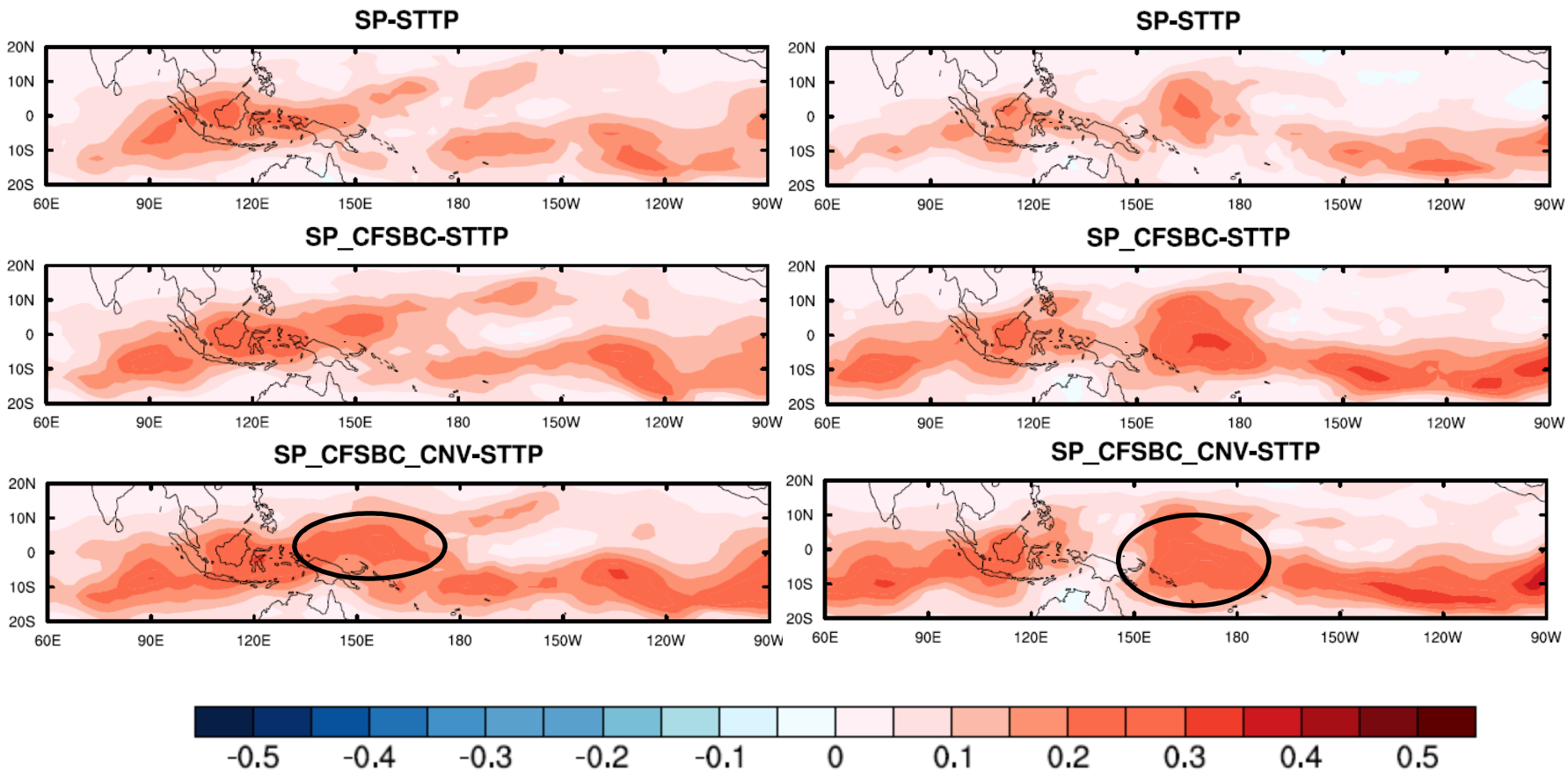
Lead day=15



Lead day=22



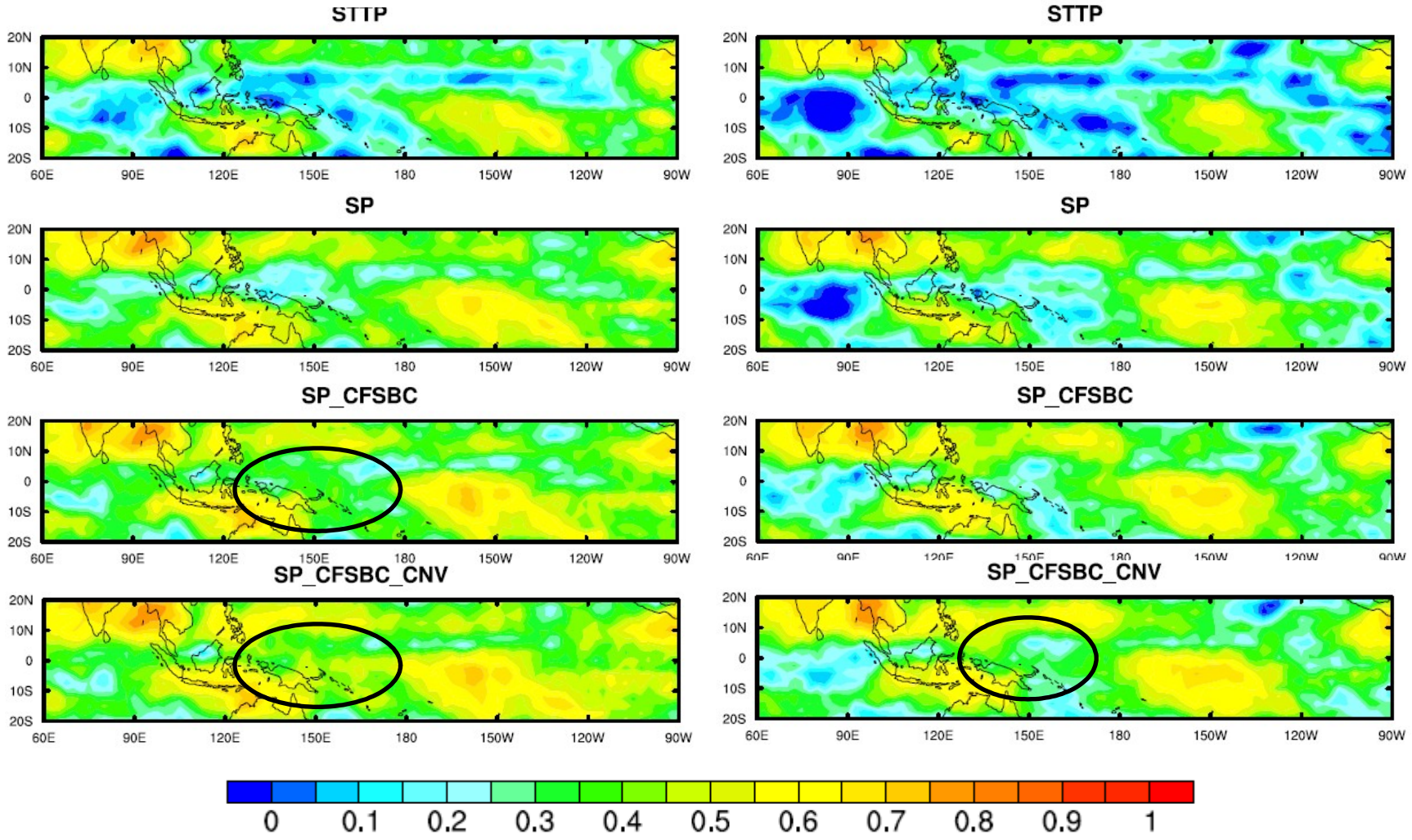
Correlation Map Diff from STTP: U200



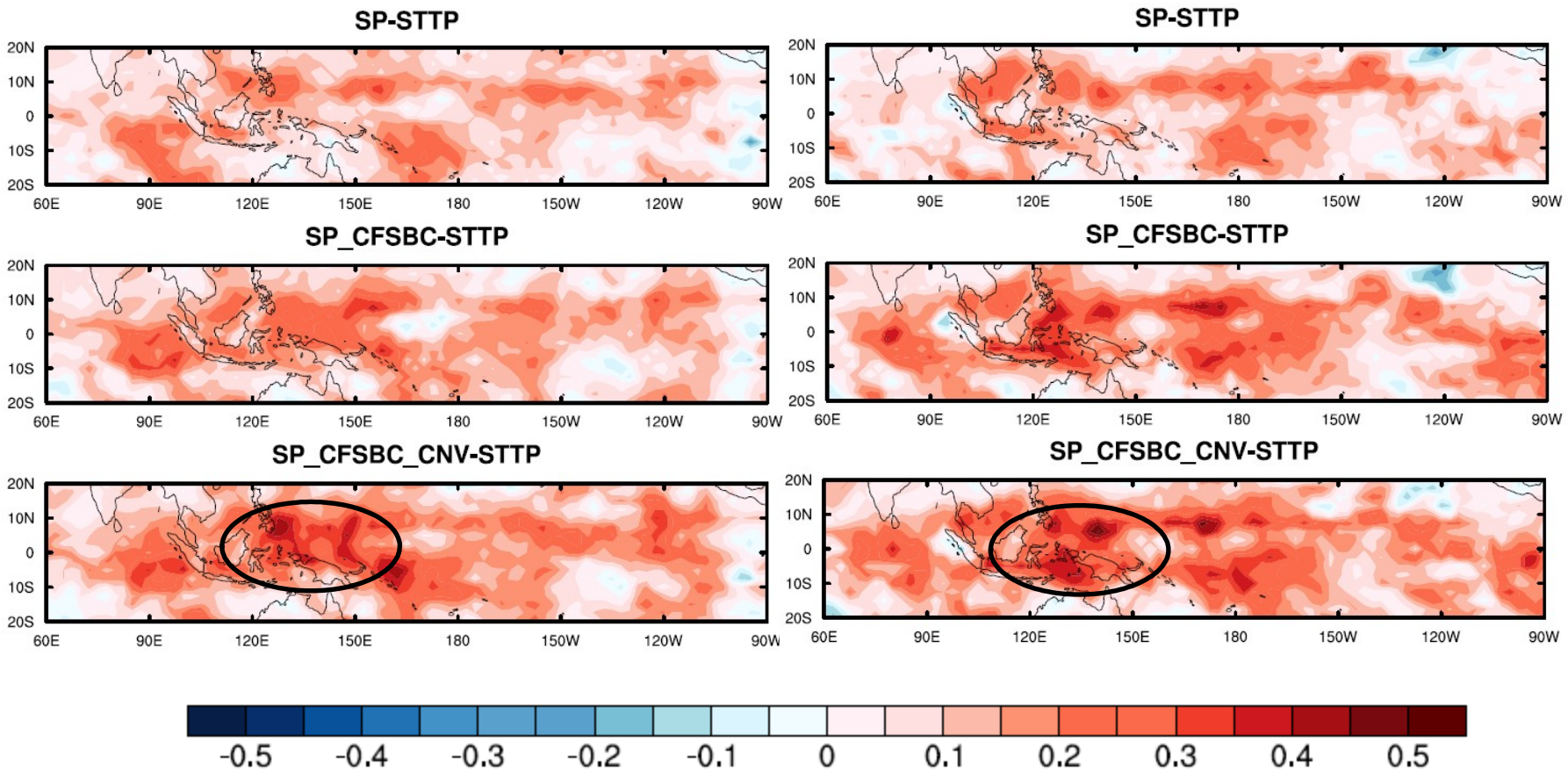
Correlation Map: OLR

Lead day=15

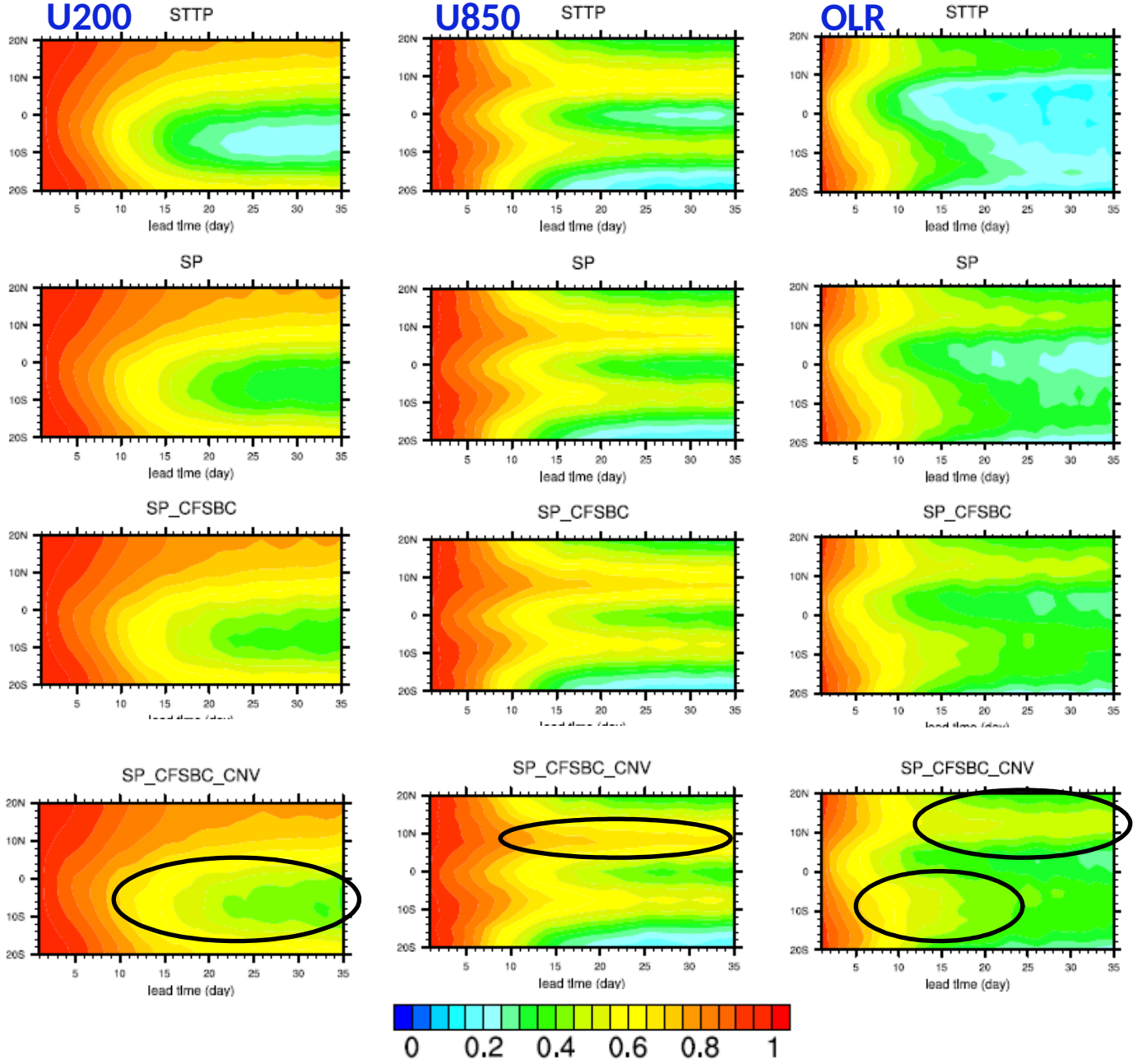
Lead day=22



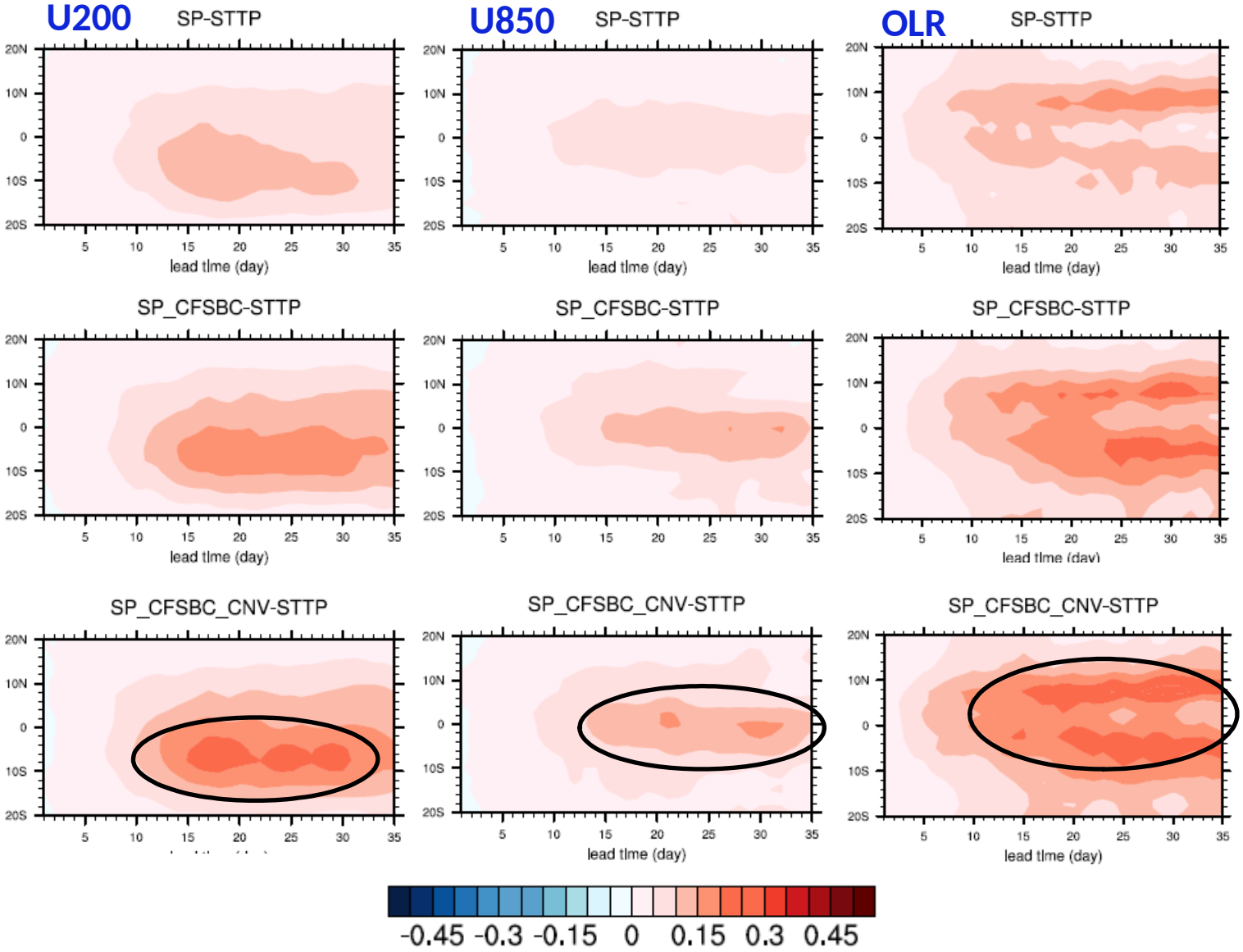
Correlation Map Diff from STTP: OLR



CORR as a function of lead time

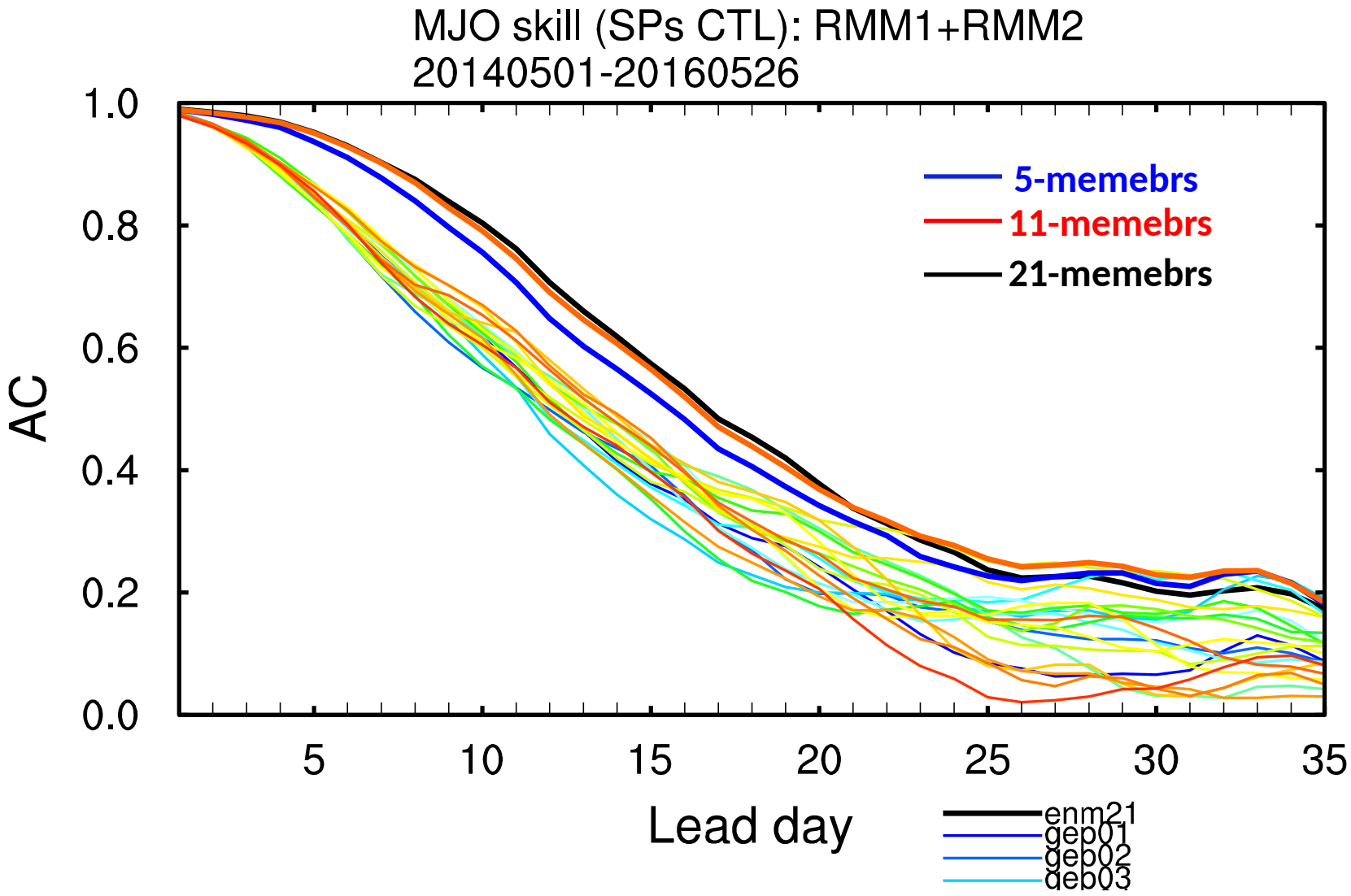


CORR DIFF as a function of lead time

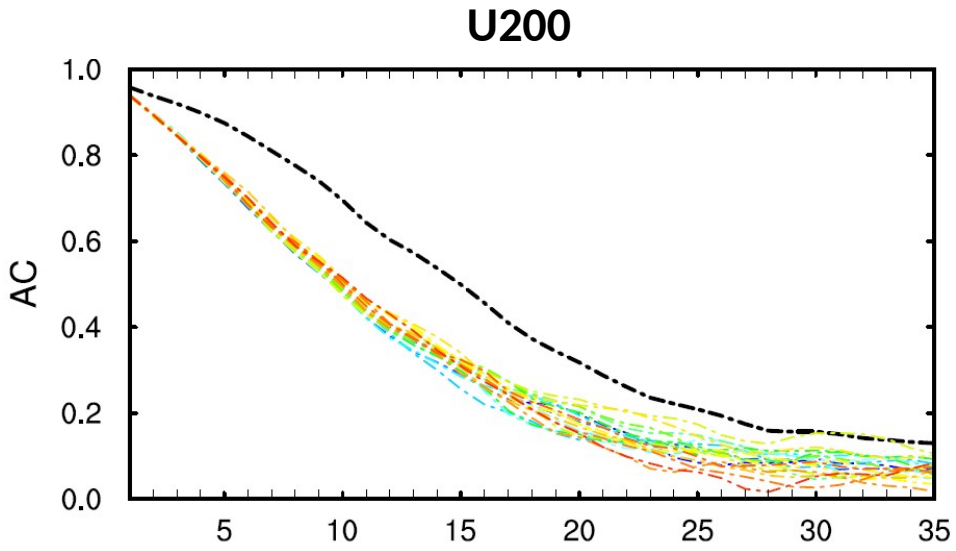


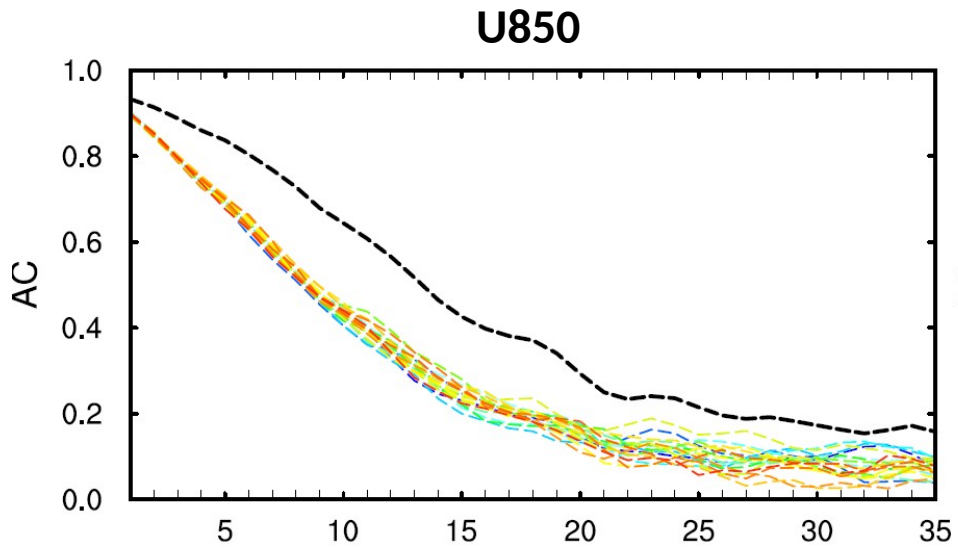
MJO skill: Dependence on Ensemble Size

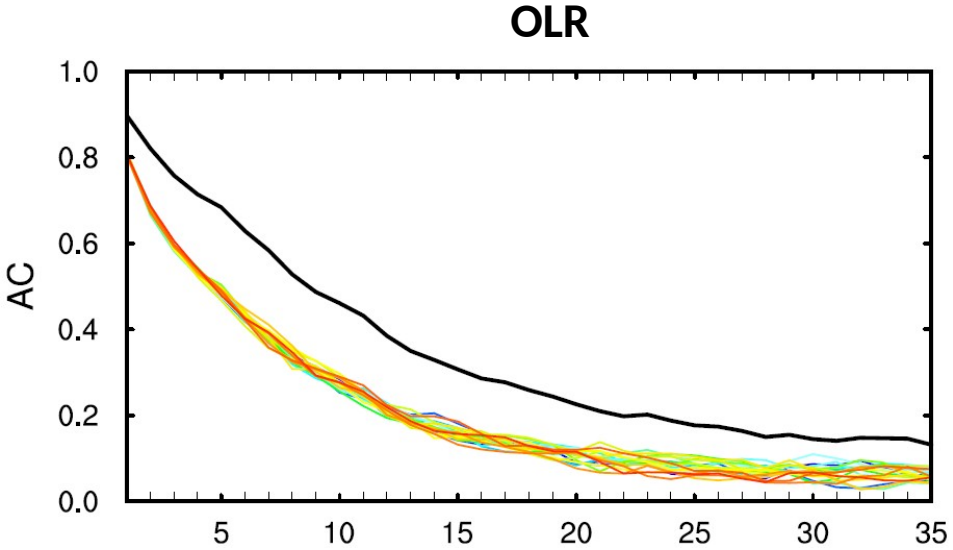
WH-MJO Forecast Skills: Ensemble mean vs each member

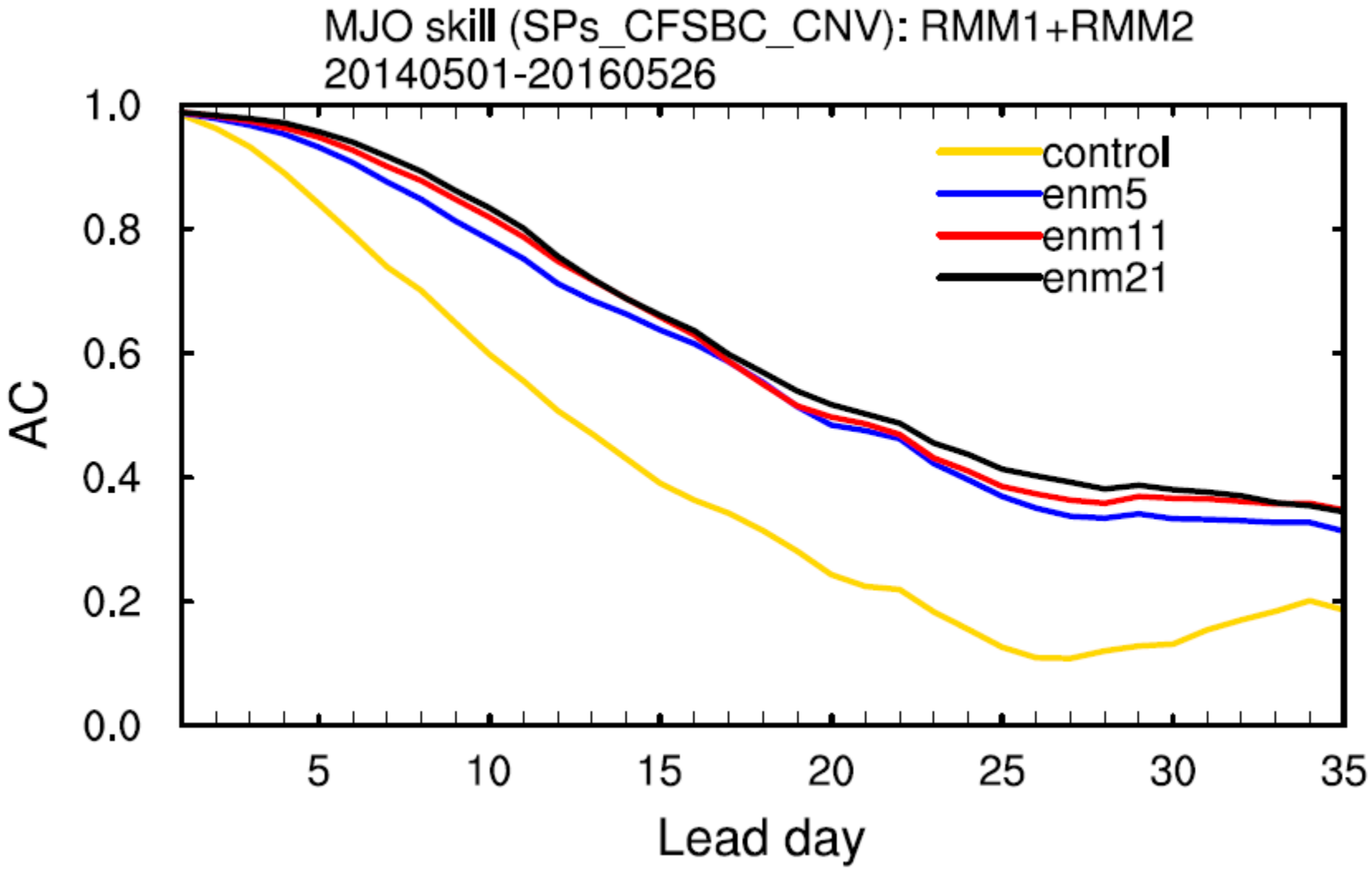


Contribution of Variables



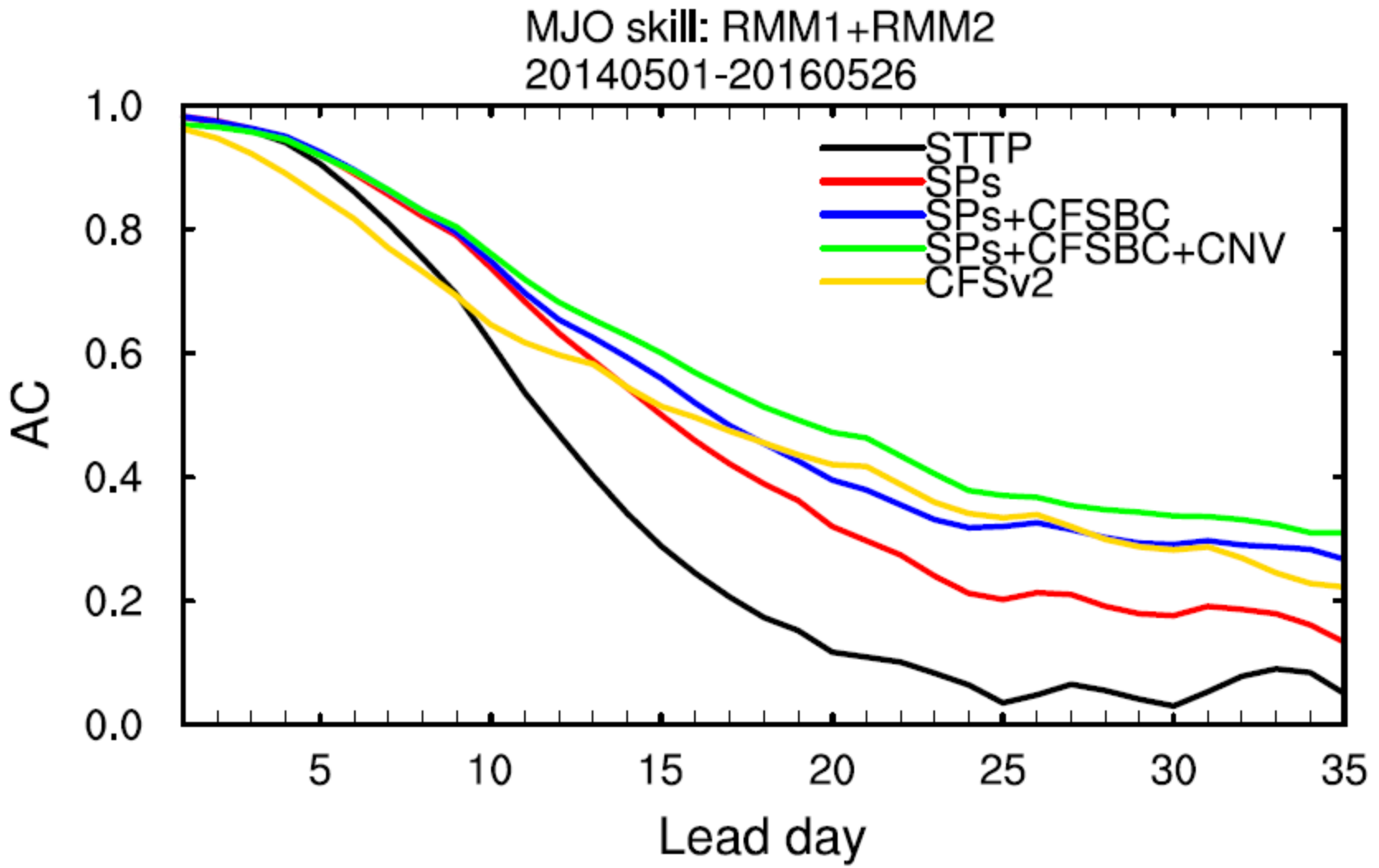




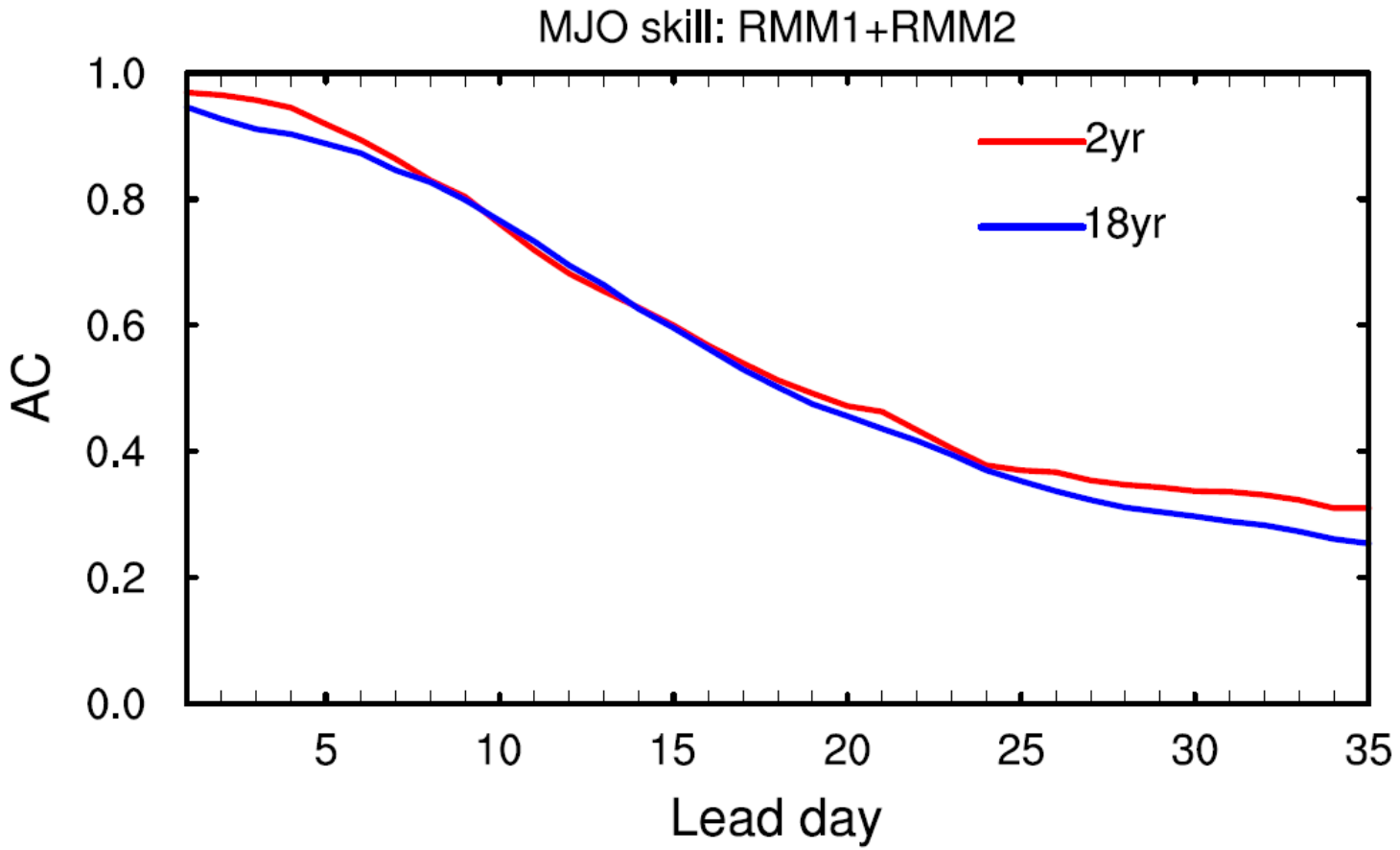

MJO skill (SPs_CFSBC_CNV): RMM1+RMM2
20140501-20160526
control
enm5
enm11
enm21
AC
1.0
0.8
0.6
0.4
0.2
0.0
5
10
15
20
25
30
35
Lead day

MJO skill: Using Different Analysis Data

OLR: NOAA
U: NCAR/NCEP Reanalysis


MJO skill: RMM1+RMM2
20140501-20160526
AC
Lead day
1.0
0.8
0.6
0.4
0.2
0.0
5
10
15
20
25
30
35
STTP
SPs
SPs+CFSBC
SPs+CFSBC+CNV
CFSv2

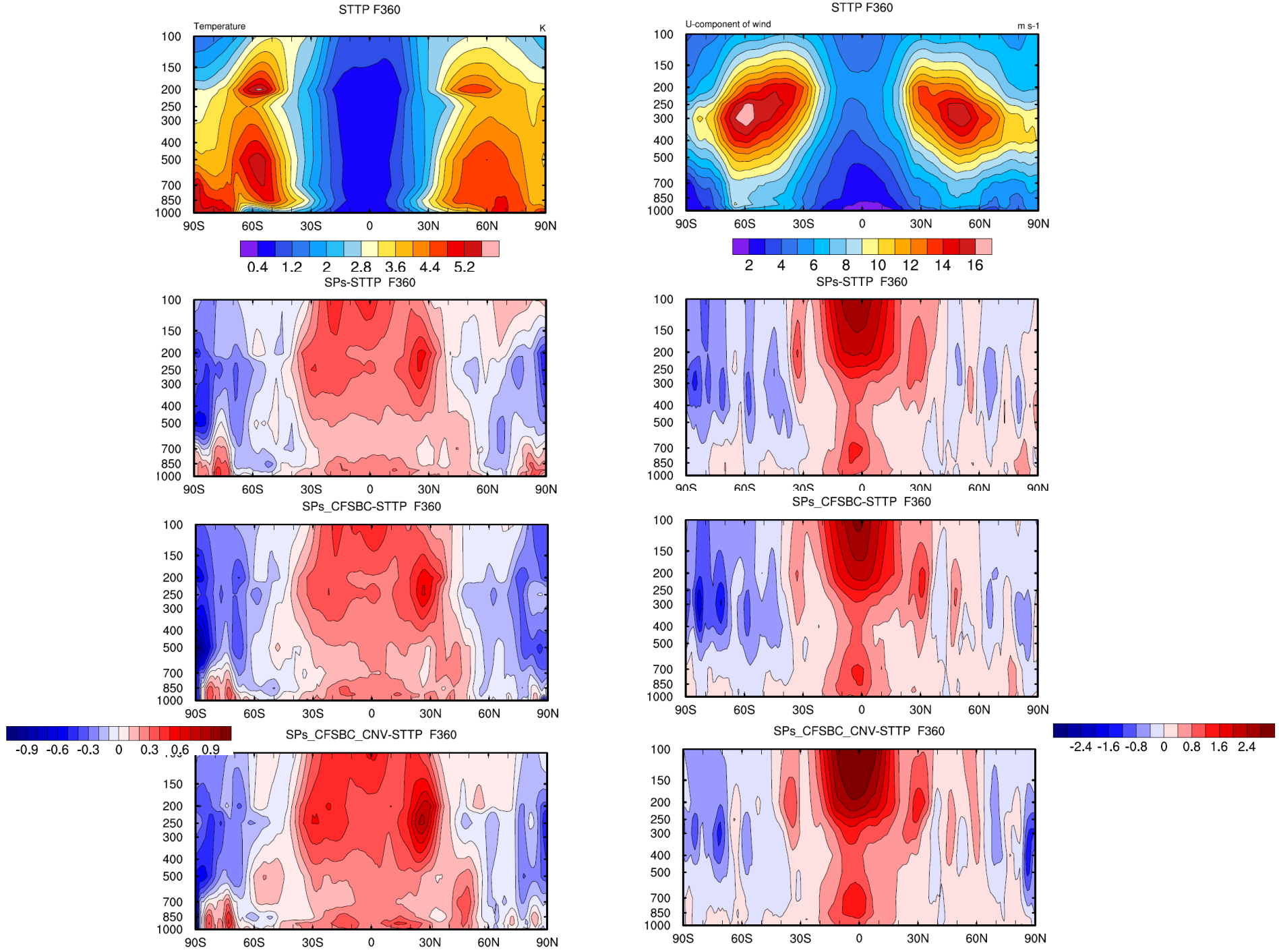
MJO skill: 18 yrs



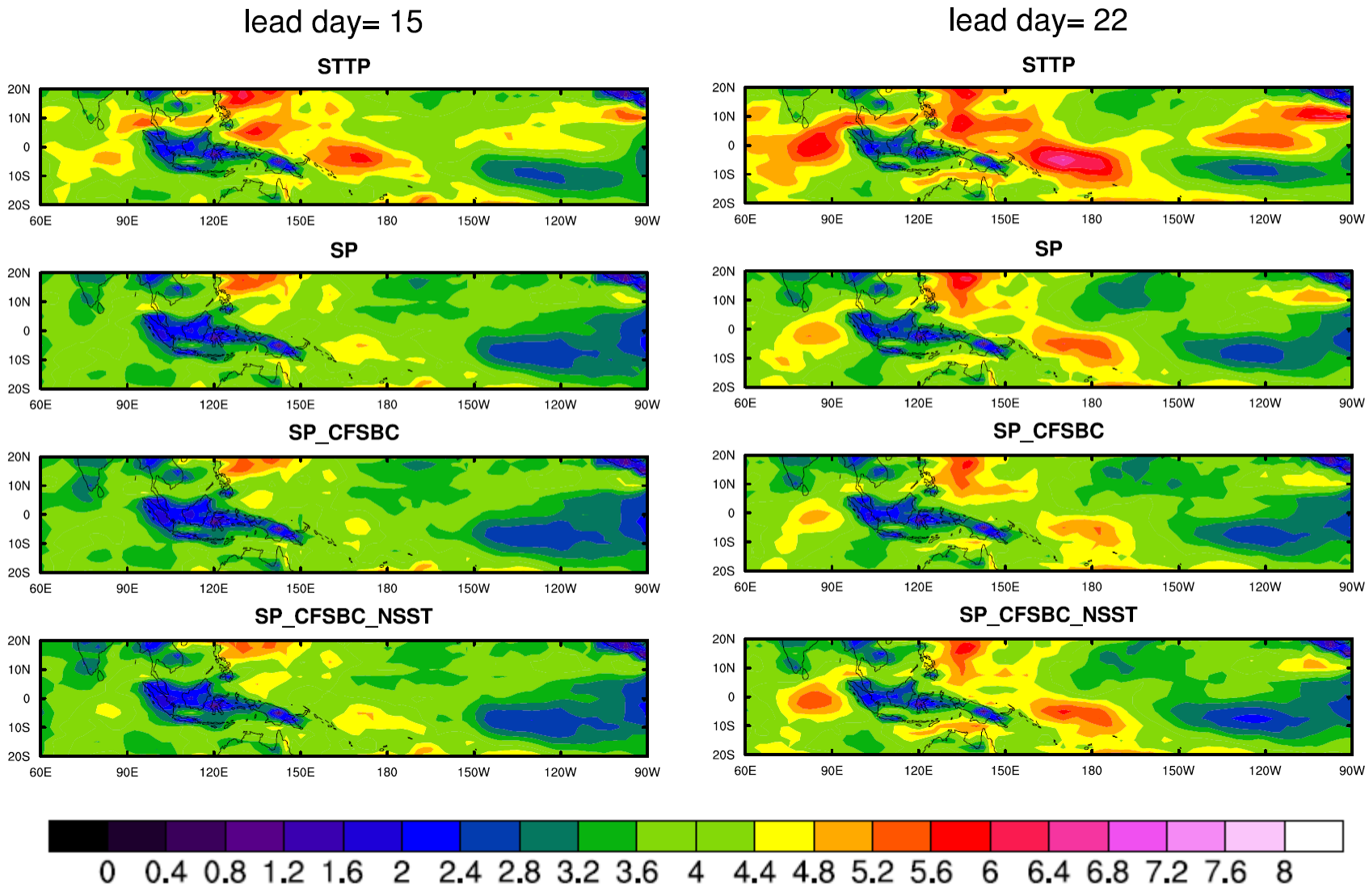
OLR: NOAA

U: NCAR/NCEP Reanalysis

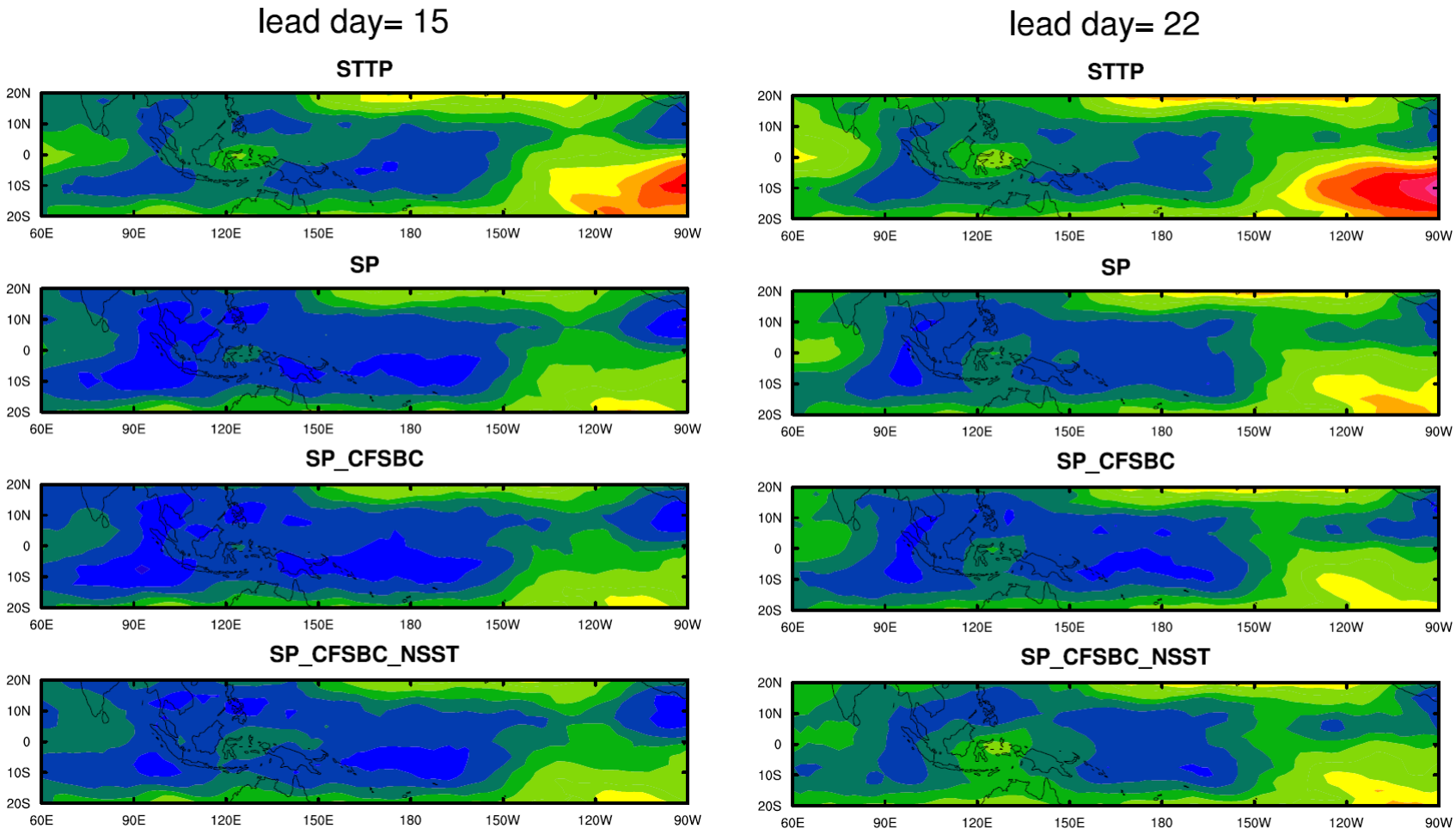
Backup Slides


STTP F360
Temperature
K
100
150
200
250
300
400
500
700
850
1000
90S 60S 30S 0 30N 60N 90N
0.4 1.2 2 2.8 3.6 4.4 5.2
STTP F360
U-component of wind
m s-1
2 4 6 8 10 12 14 16
SPs-STTP F360
SPs_CFSBC-STTP F360
SPs_CFSBC_CNV-STTP F360
-0.9 -0.6 -0.3 0 0.3 0.6 0.9
-2.4 -1.6 -0.8 0 0.8 1.6 2.4

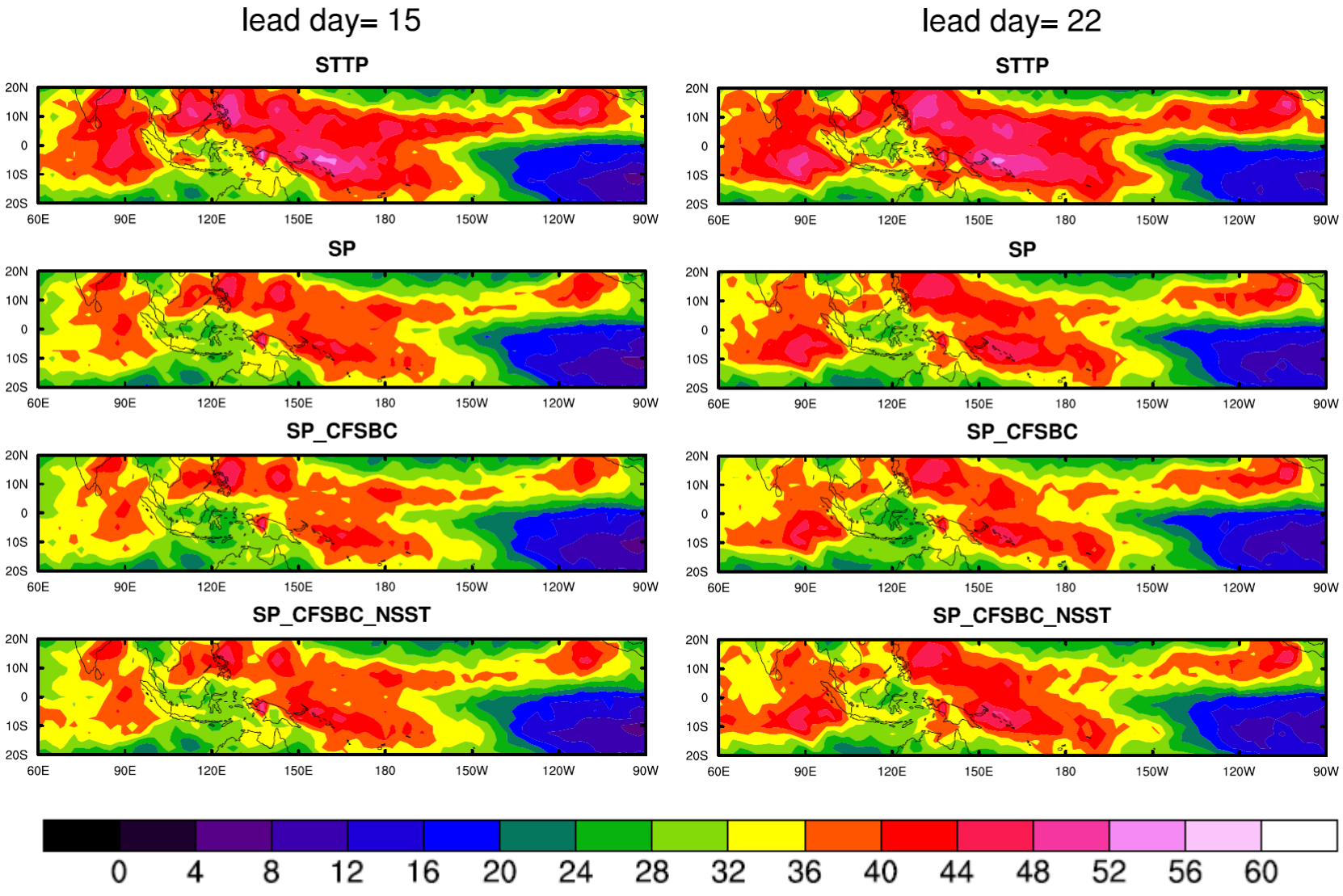
RMSE Map: U850



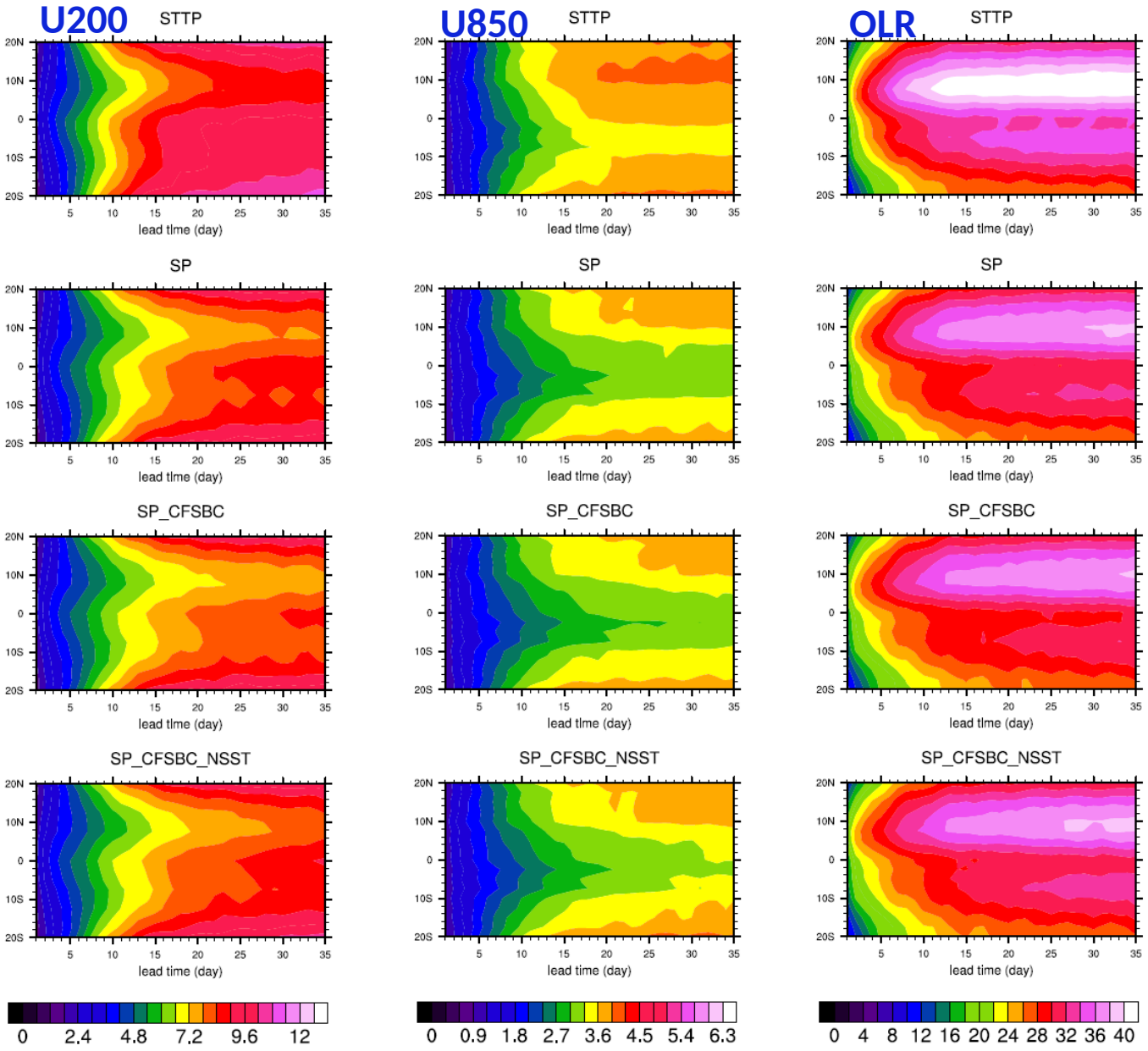
RMSE Map: U200



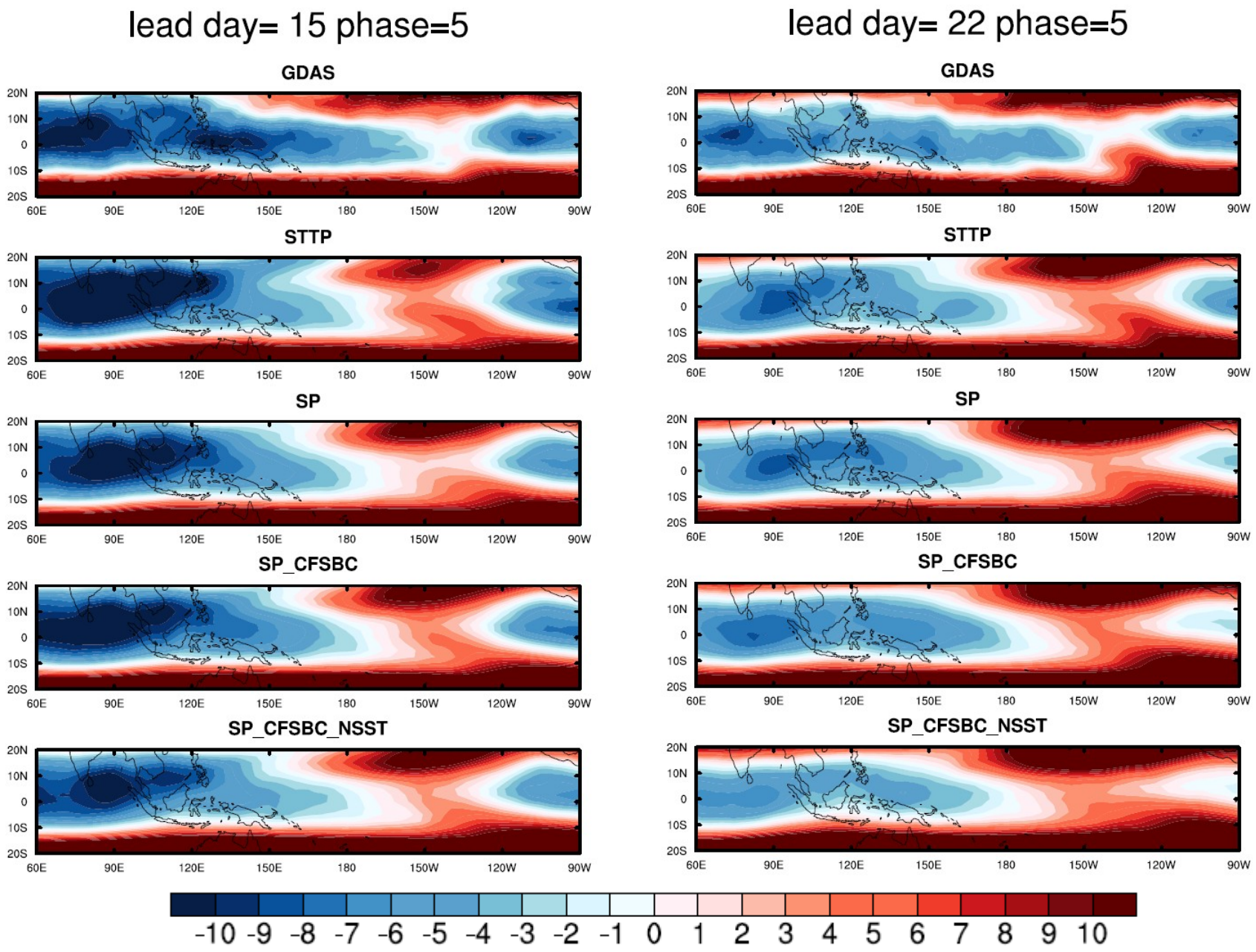
RMSE Map: OLR


lead day= 15
lead day= 22
STTP
SP
SP_CFSBC
SP_CFSBC_NSST
20N
10N
0
10S
20S
60E
90E
120E
150E
180
150W
120W
90W
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60

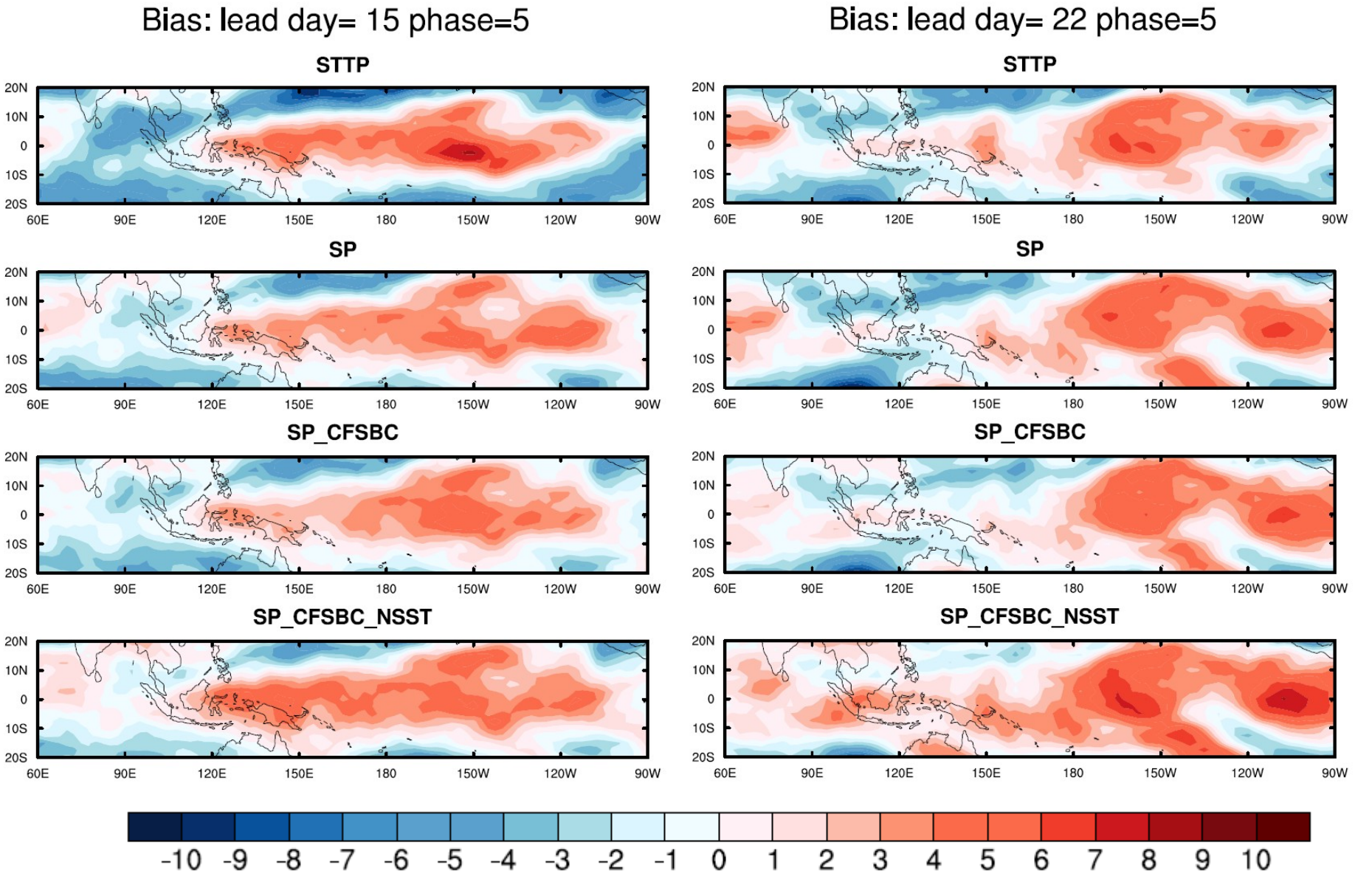
RMSE as a function of lead time



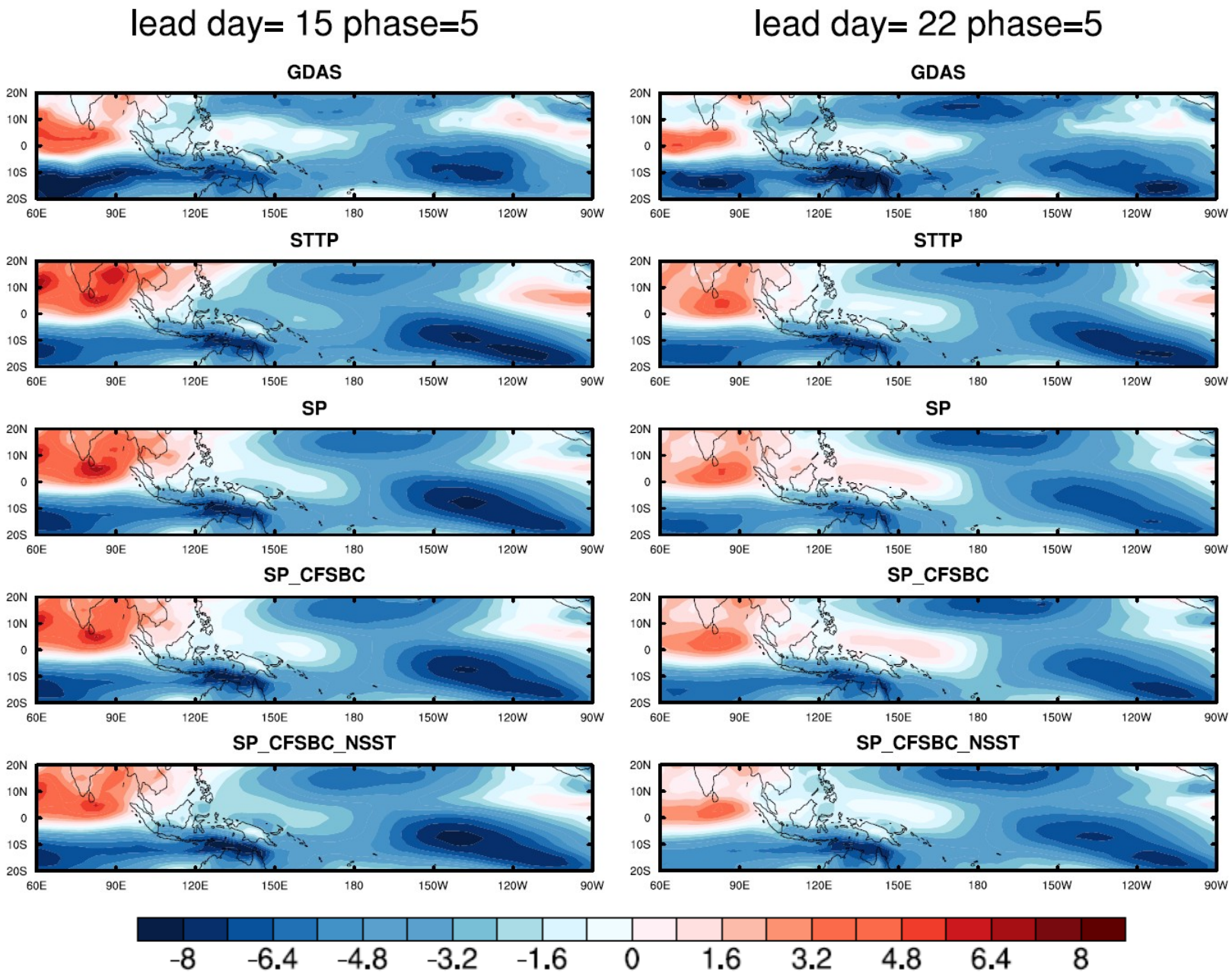
MJO Composite: U200



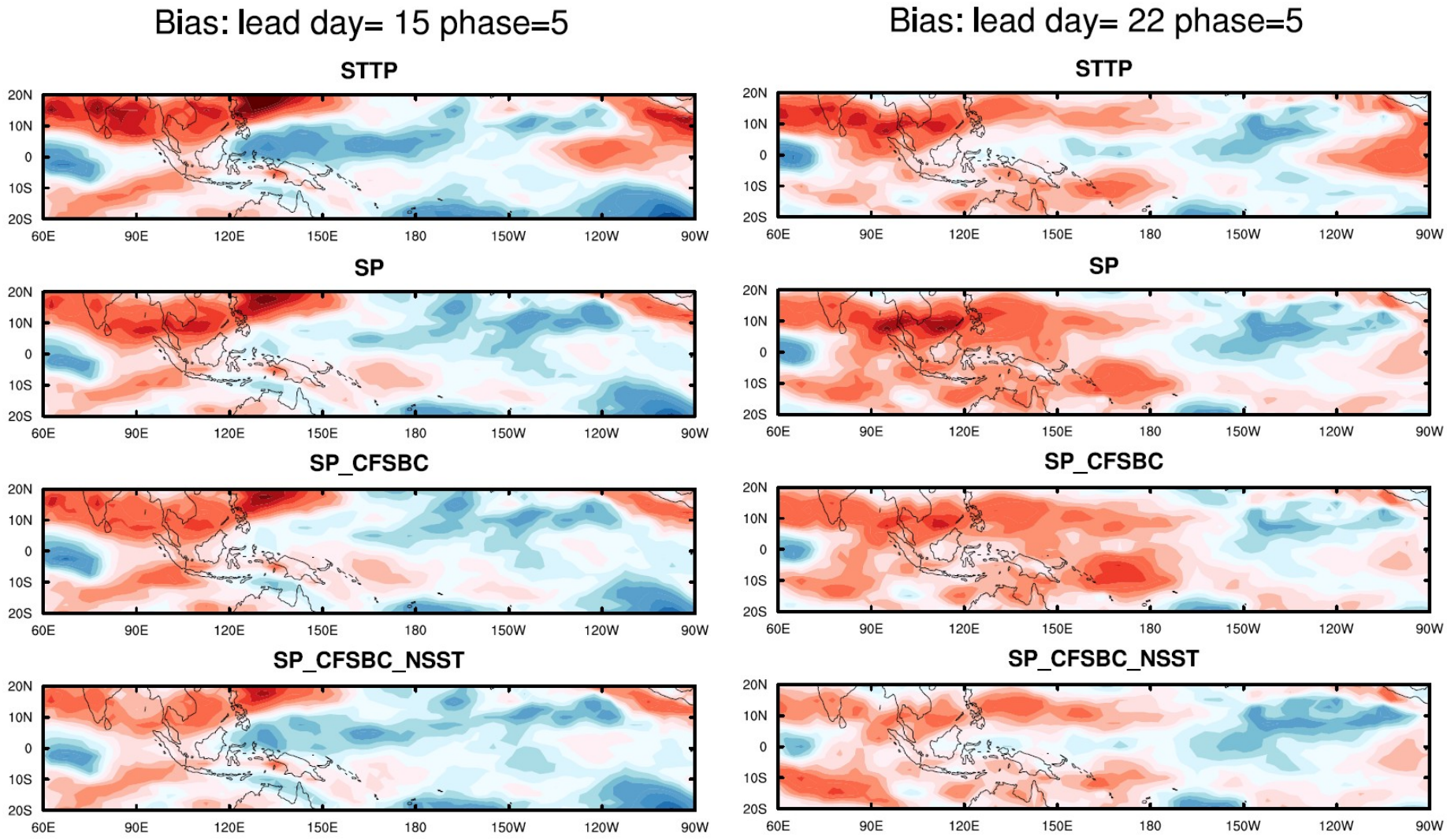
MJO Composite: U200 Bias



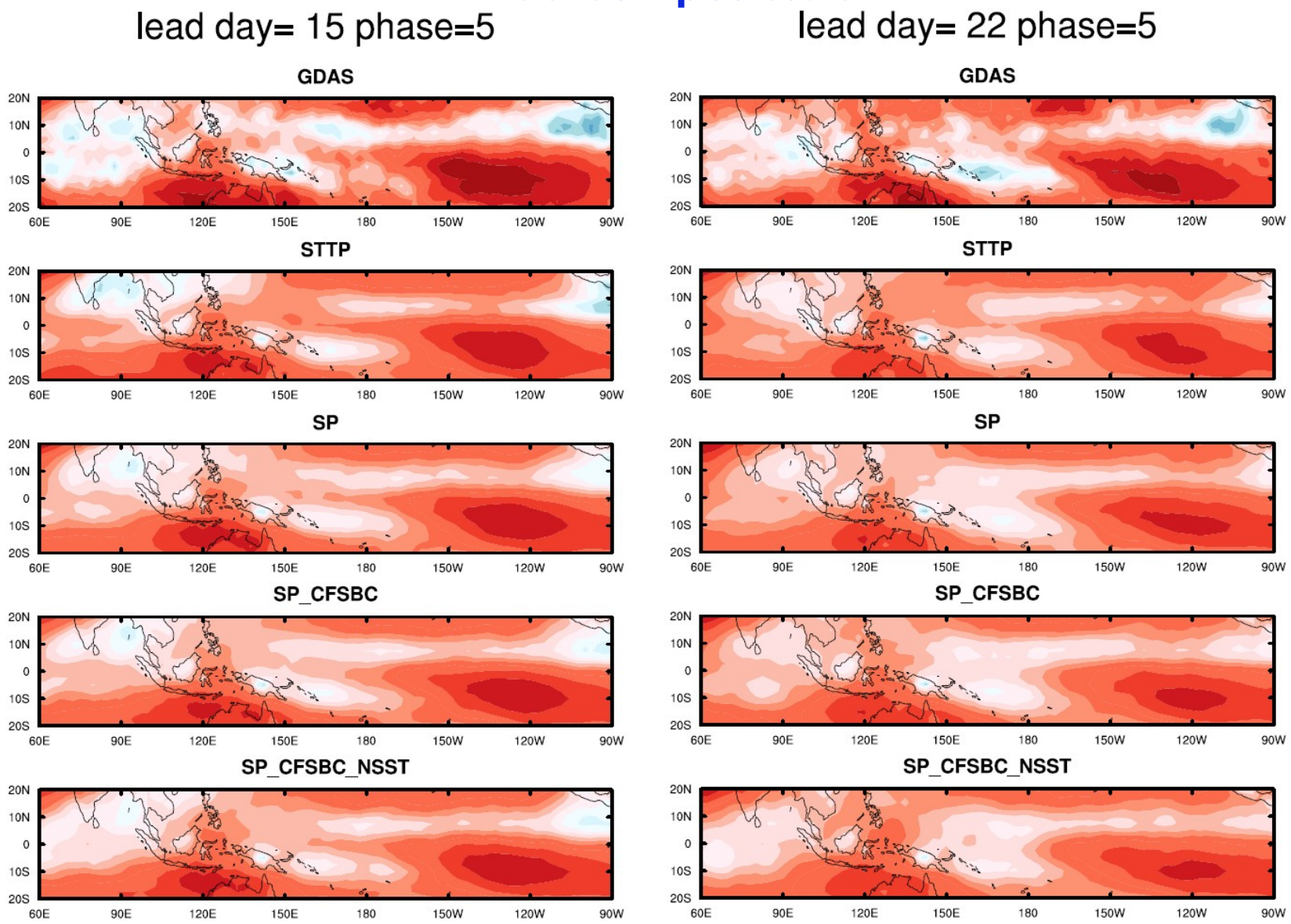
MJO Composite: U850



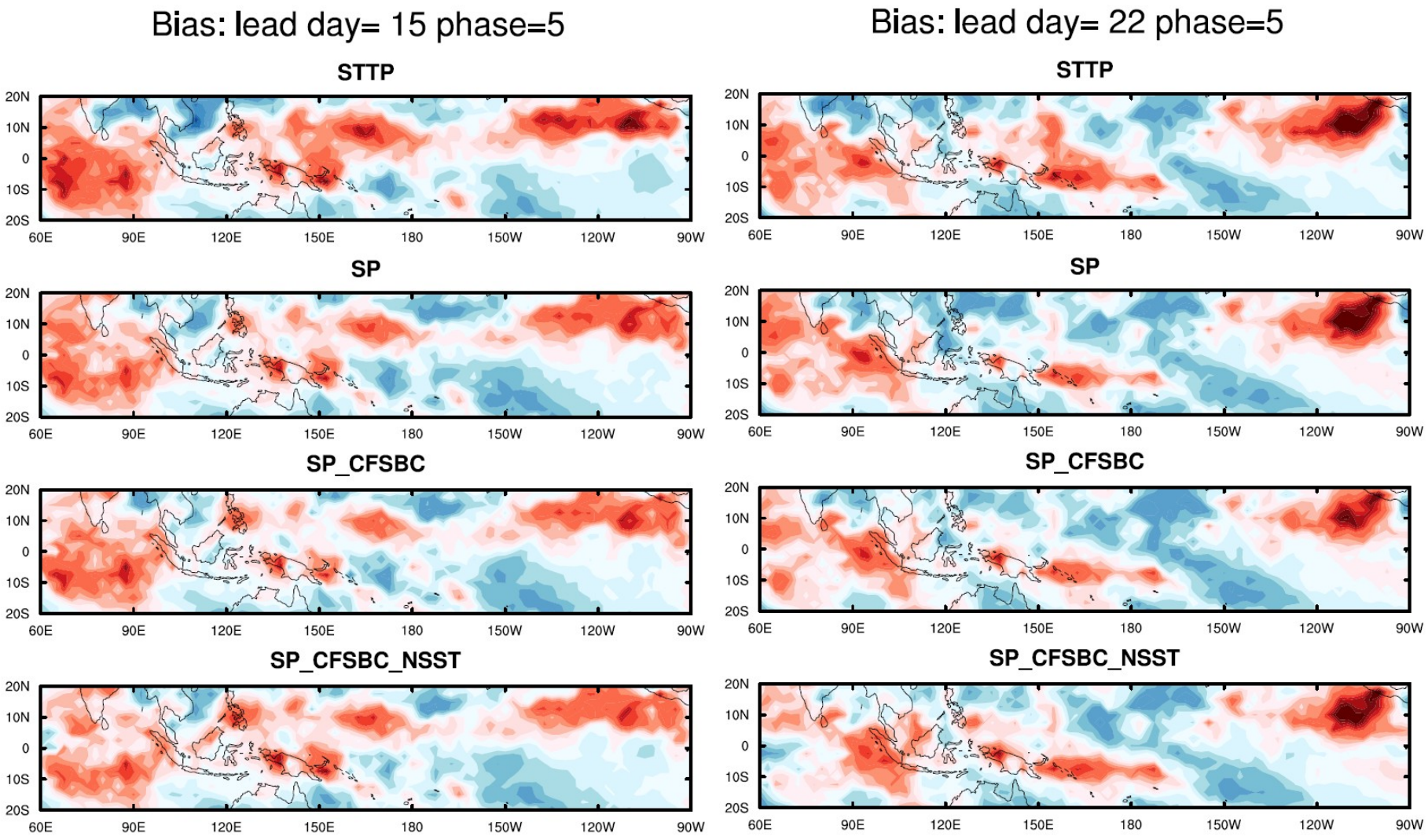
MJO Composite: U850 Bias



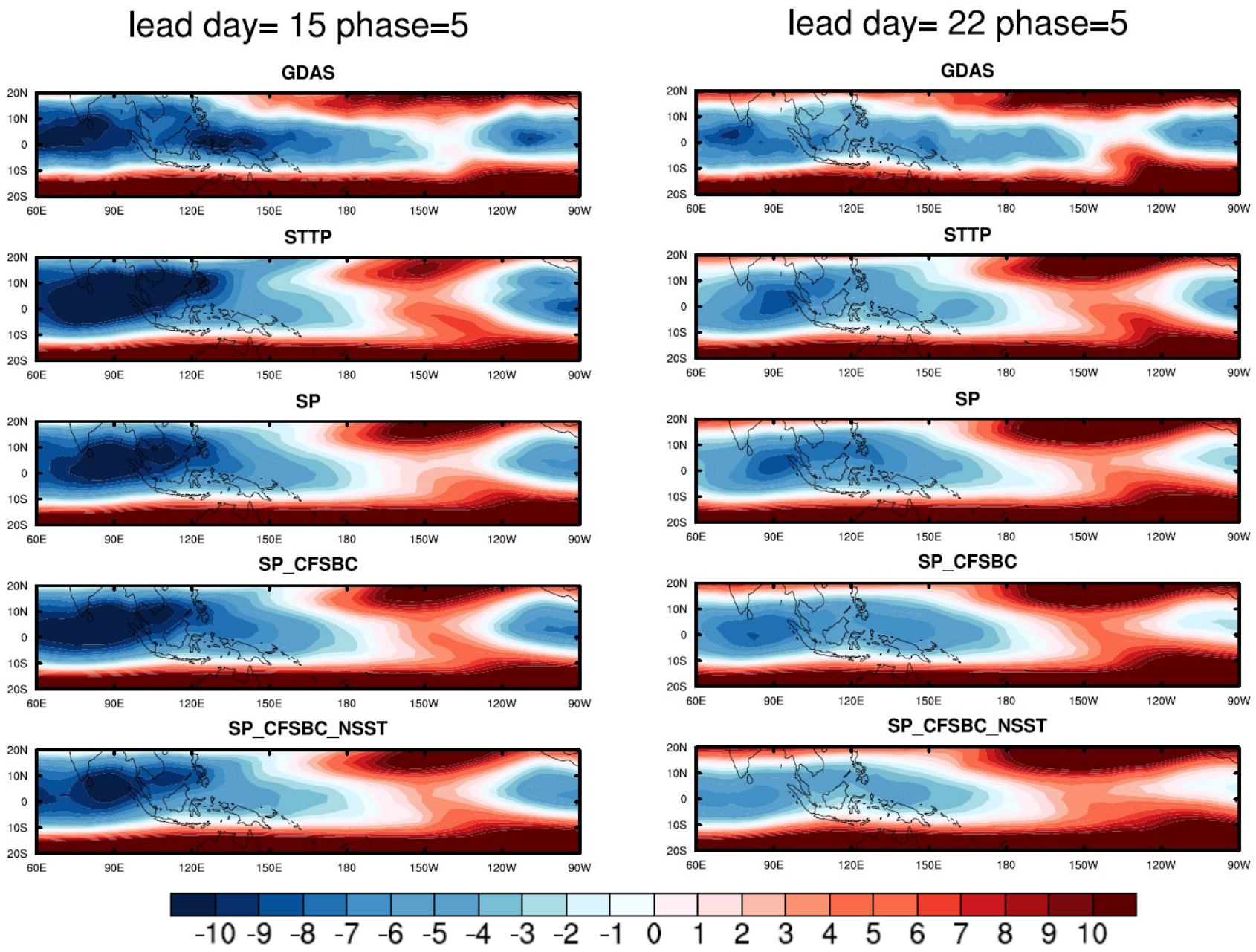
MJO Composite: OLR



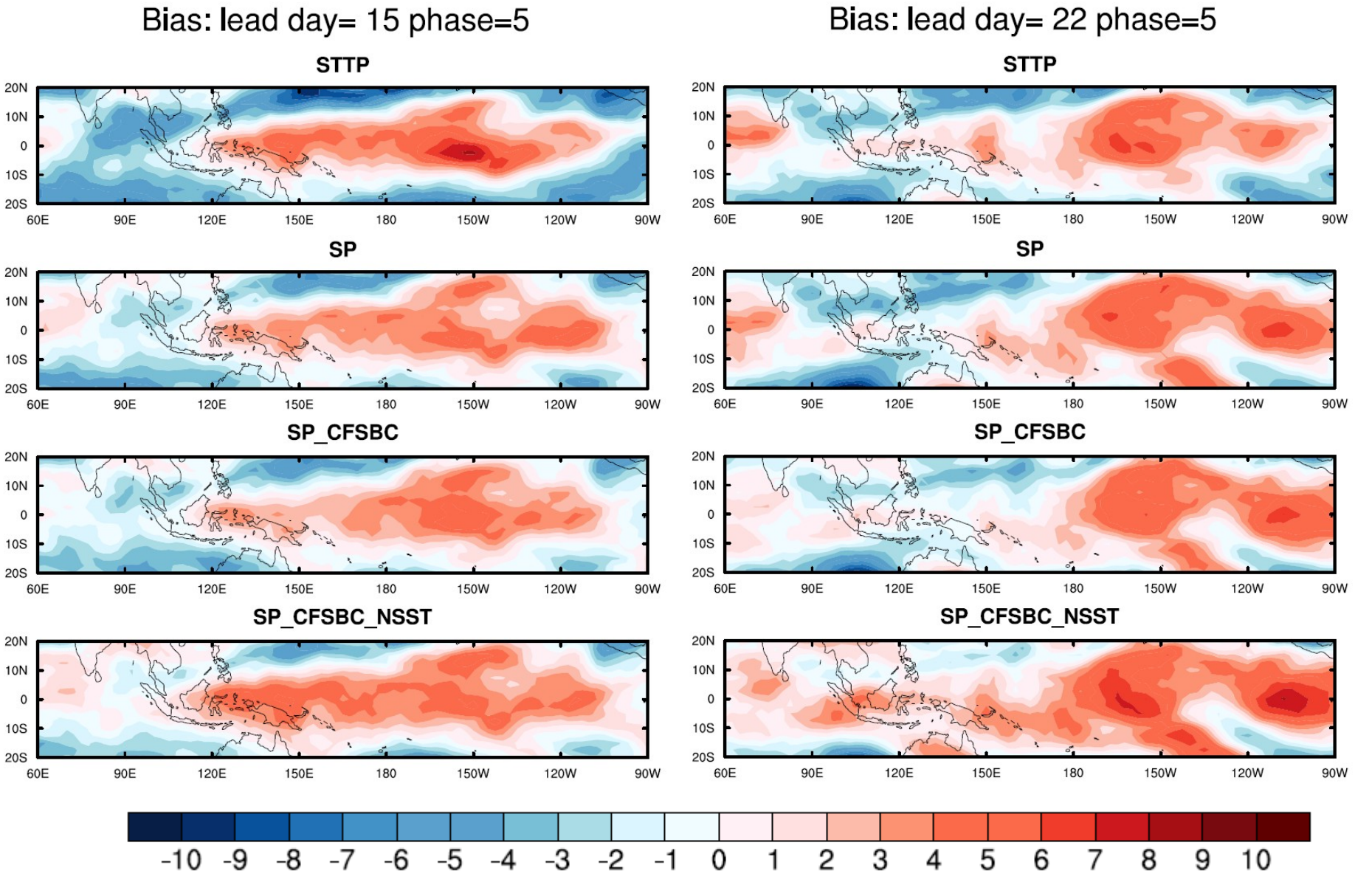
MJO Composite: OLR Bias



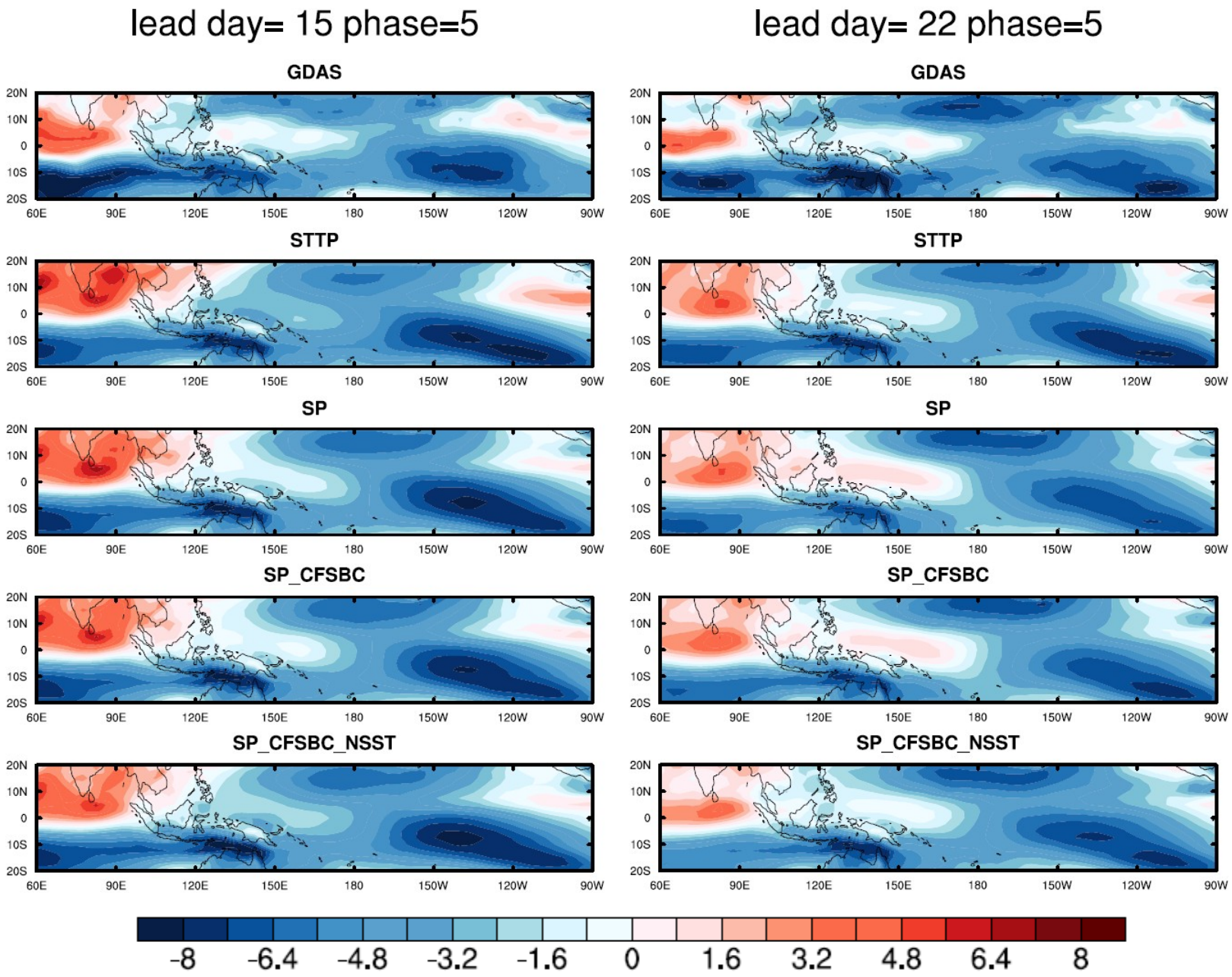
MJO Composite: U200



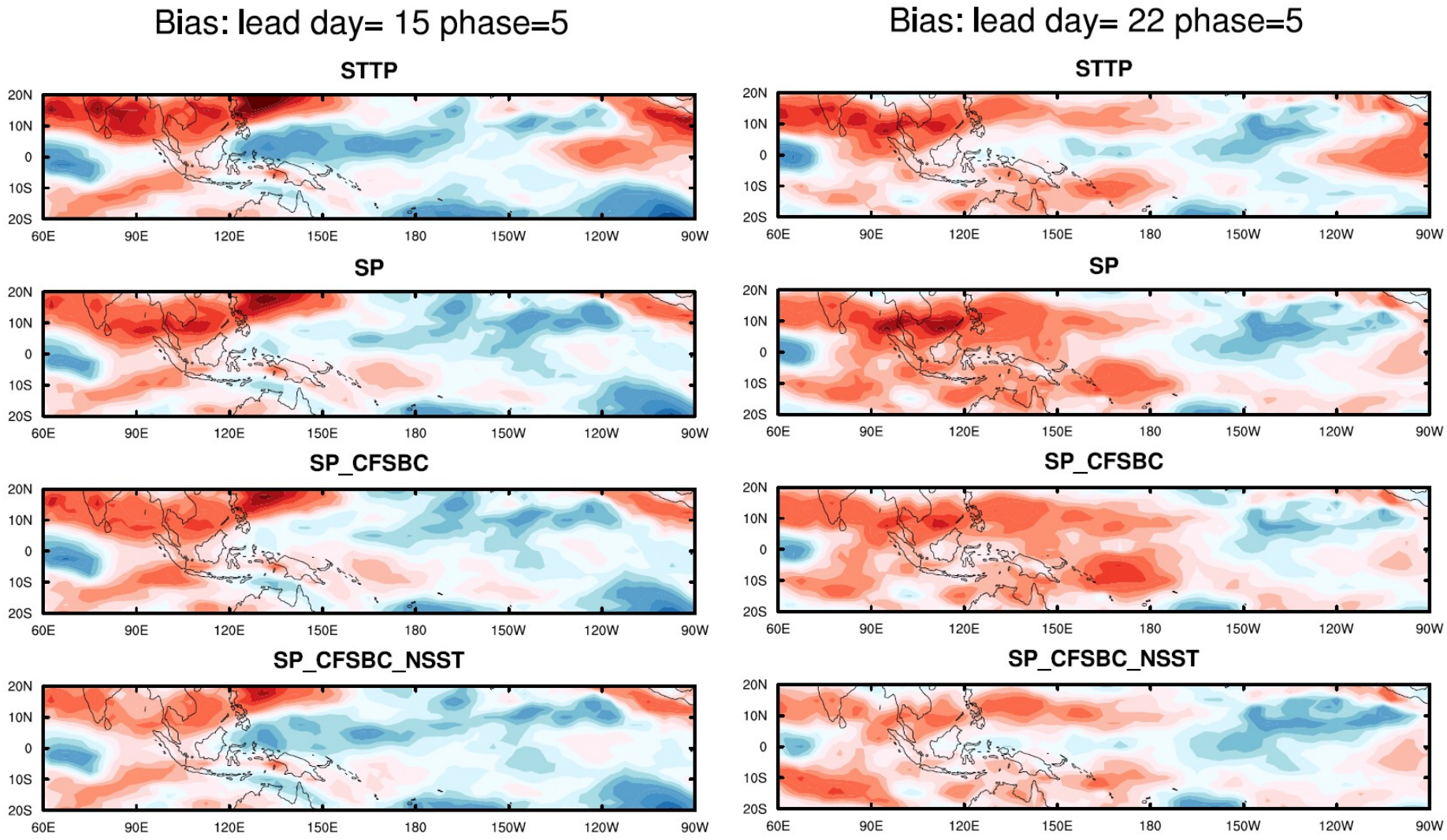
MJO Composite: U200 Bias



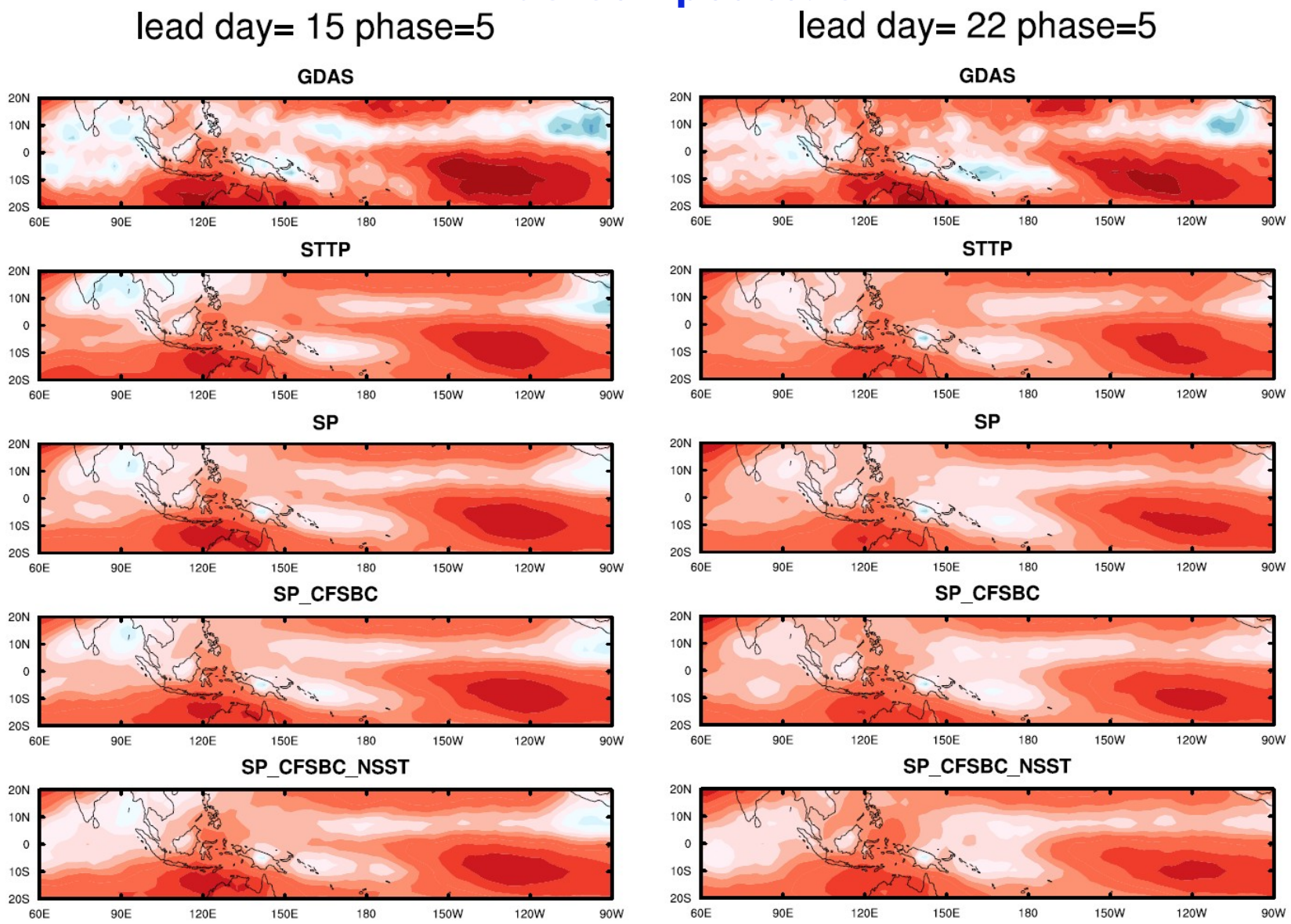
MJO Composite: U850



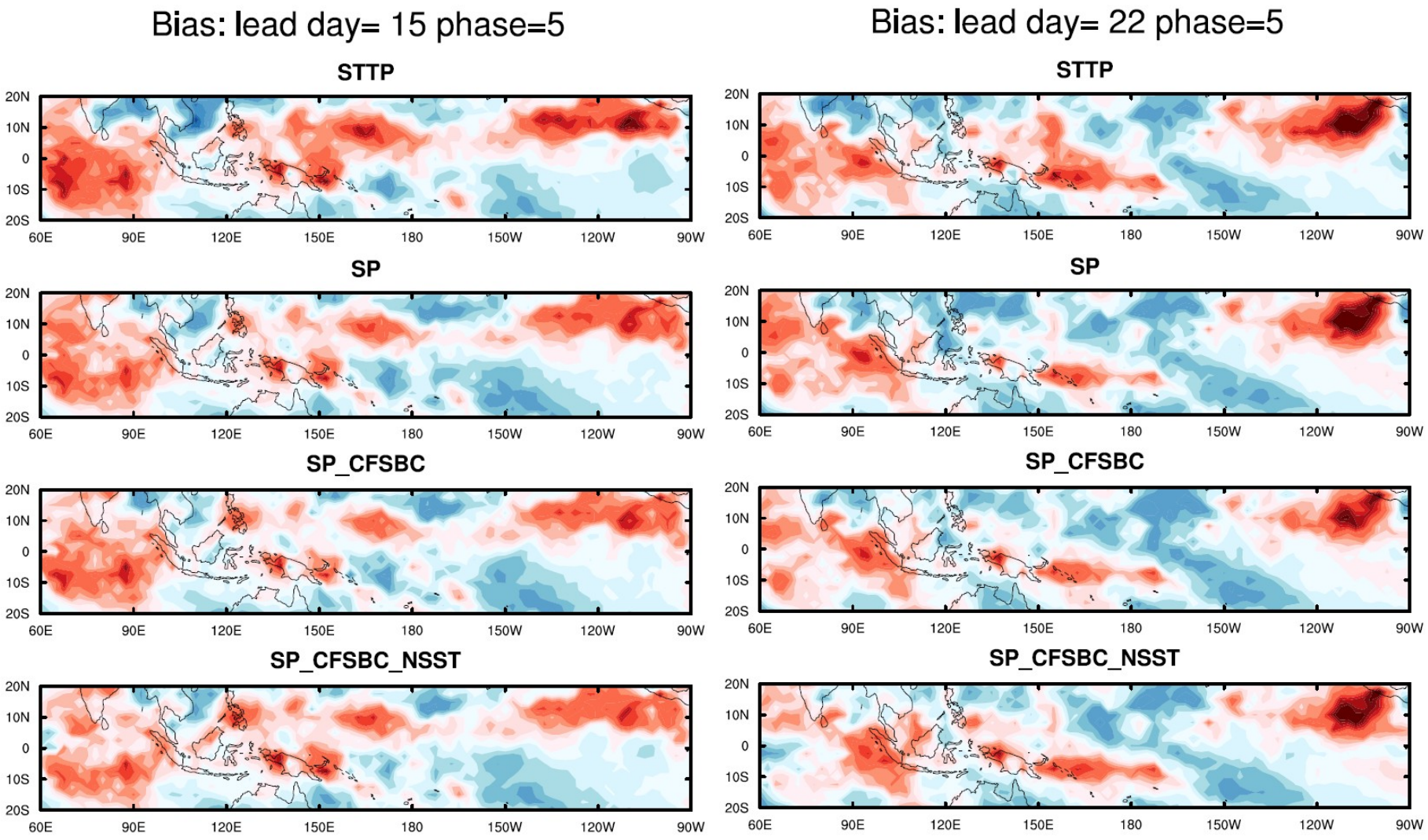
MJO Composite: U850 Bias



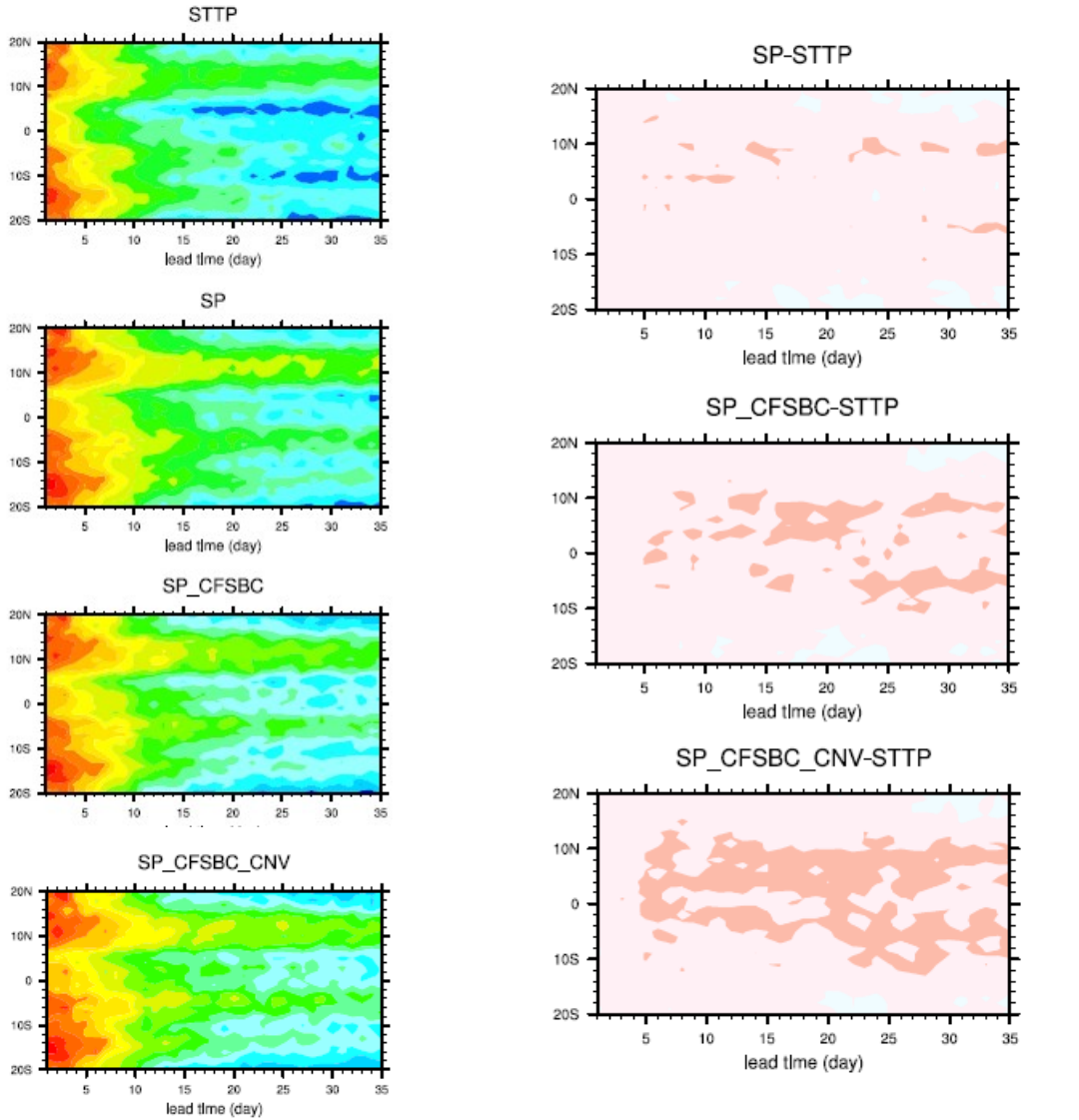
MJO Composite: OLR



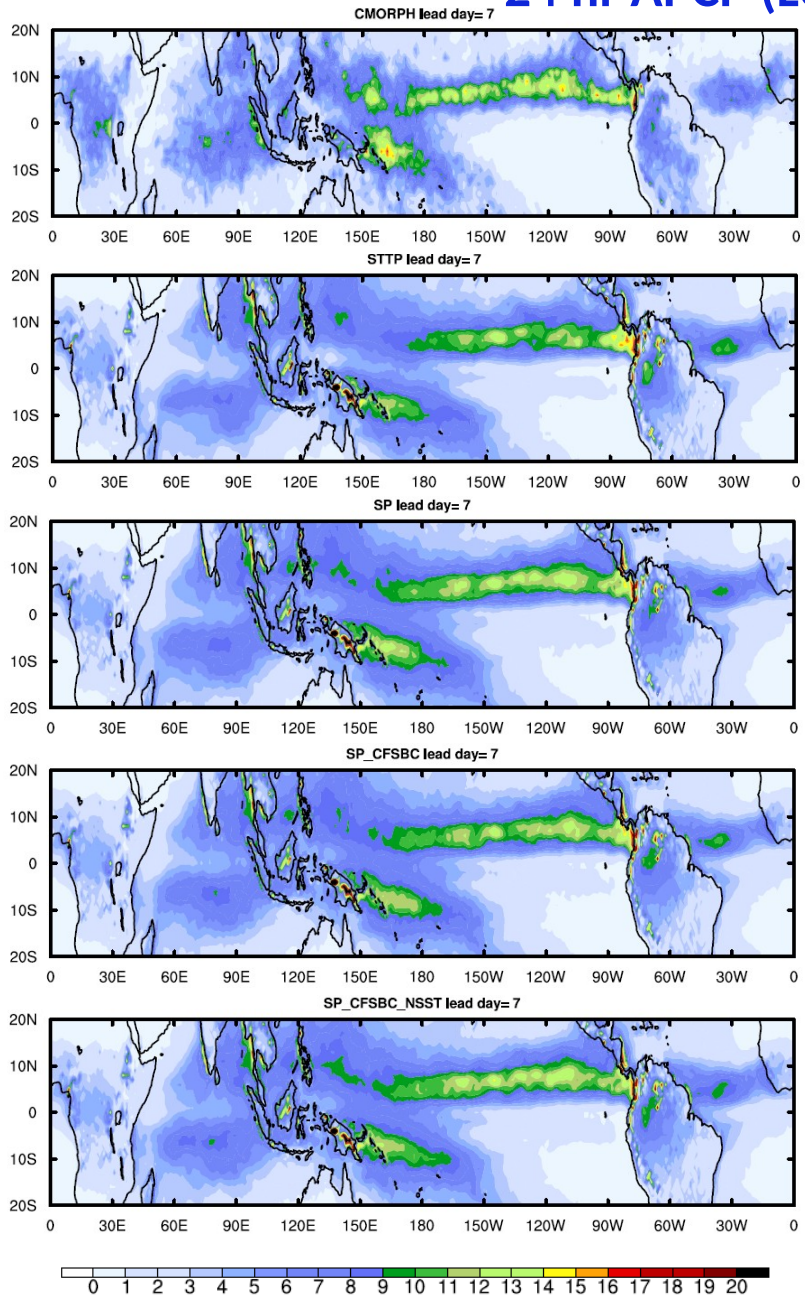
MJO Composite: OLR Bias



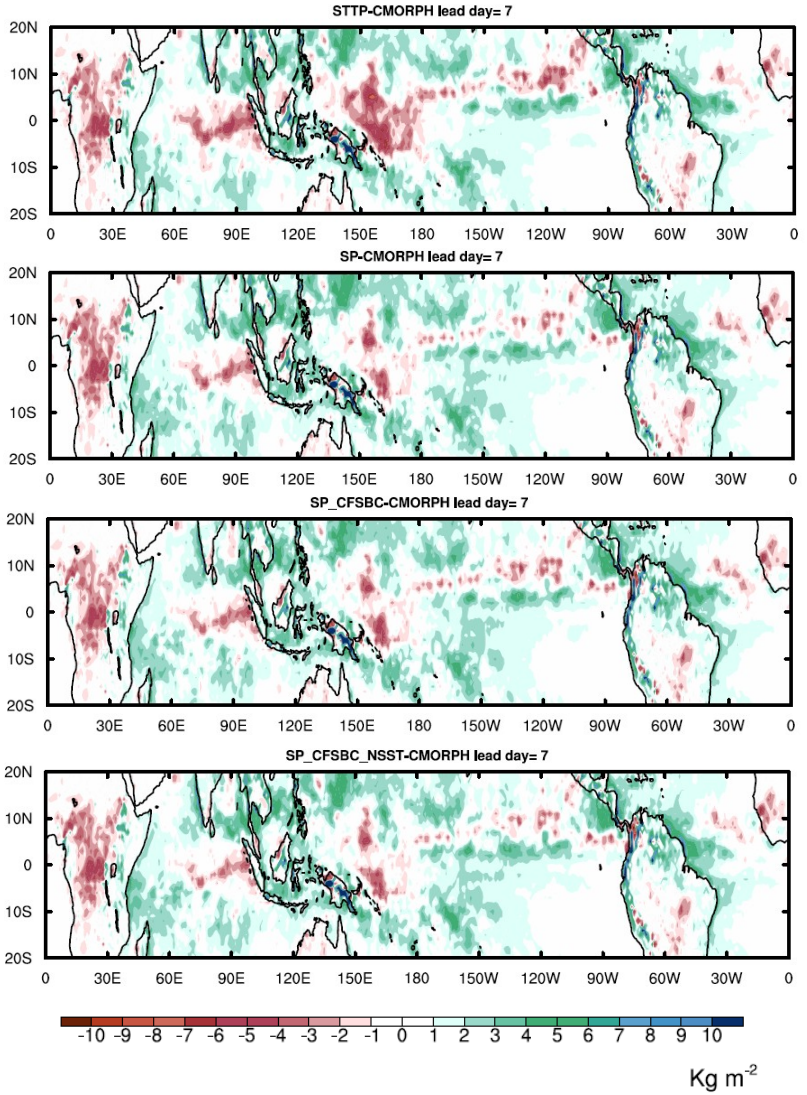
CORR as a function of lead time: APCP



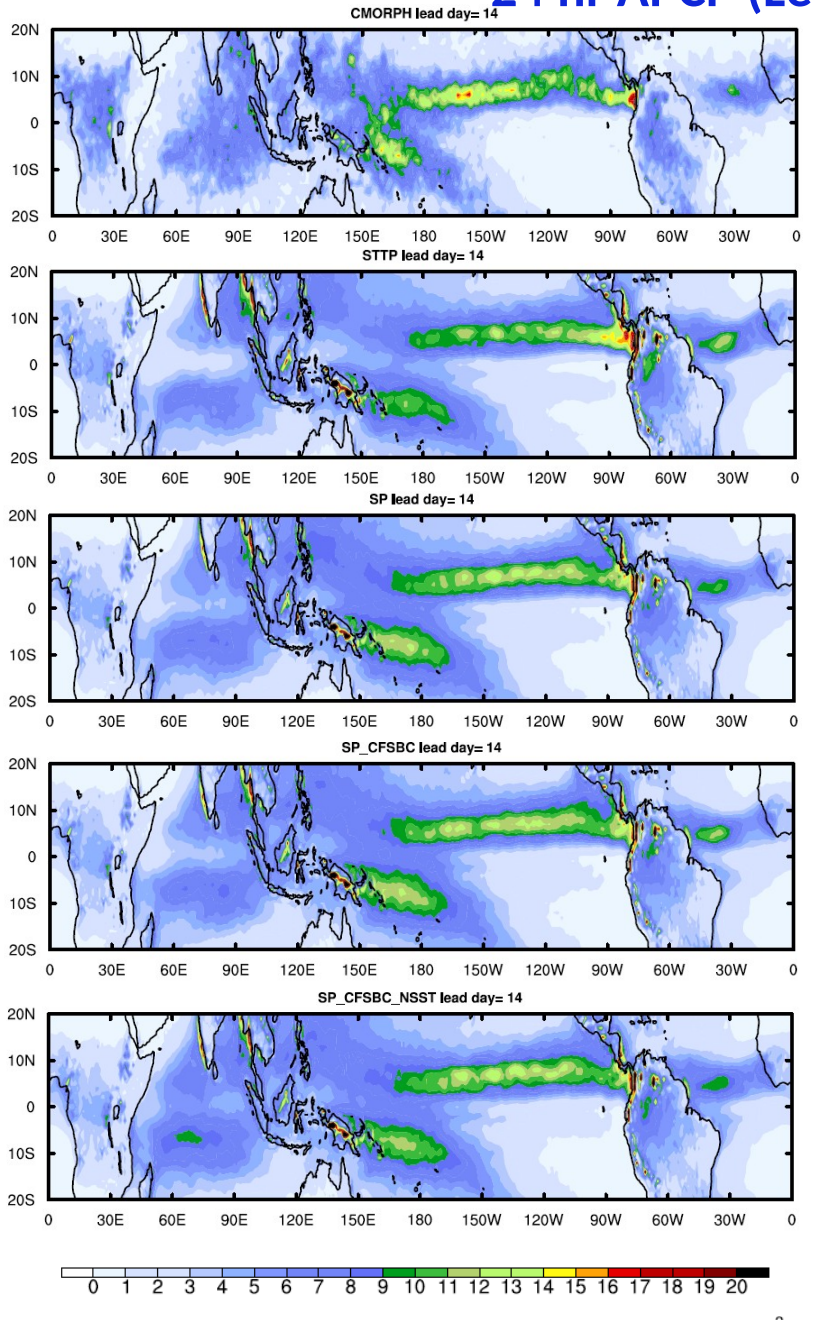
24 hr APCP (Lead day=7), 2yr ave.



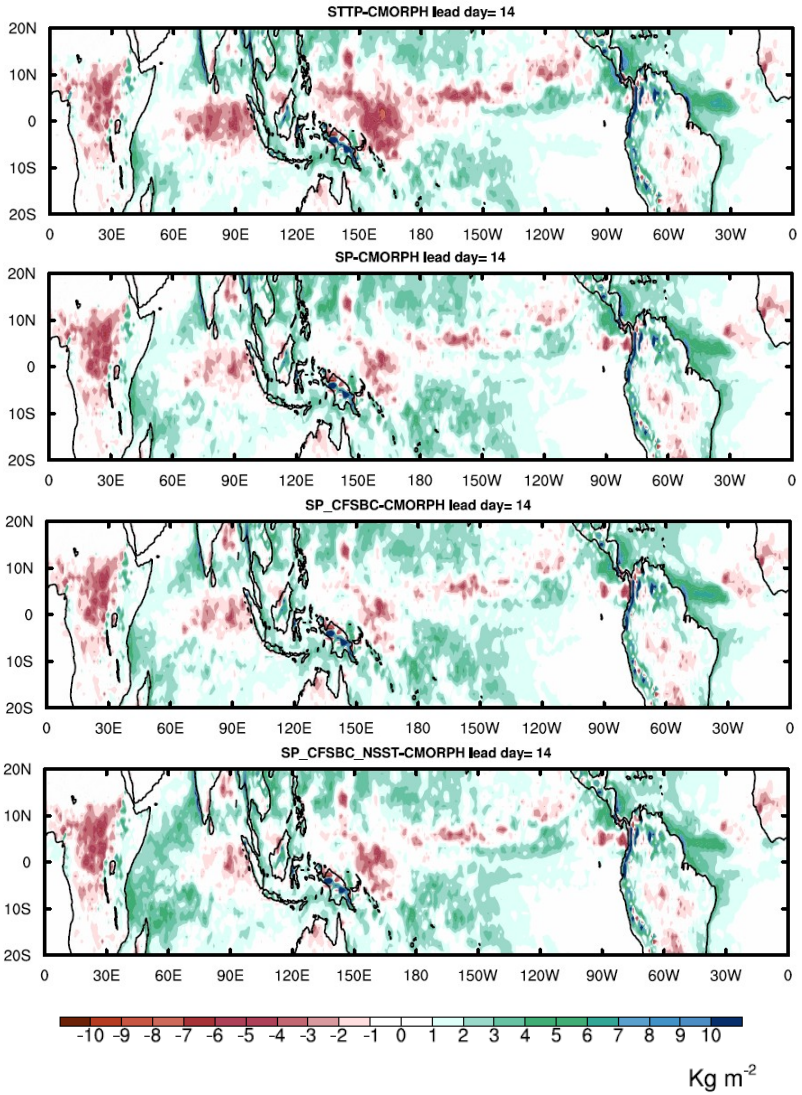
Difference Maps



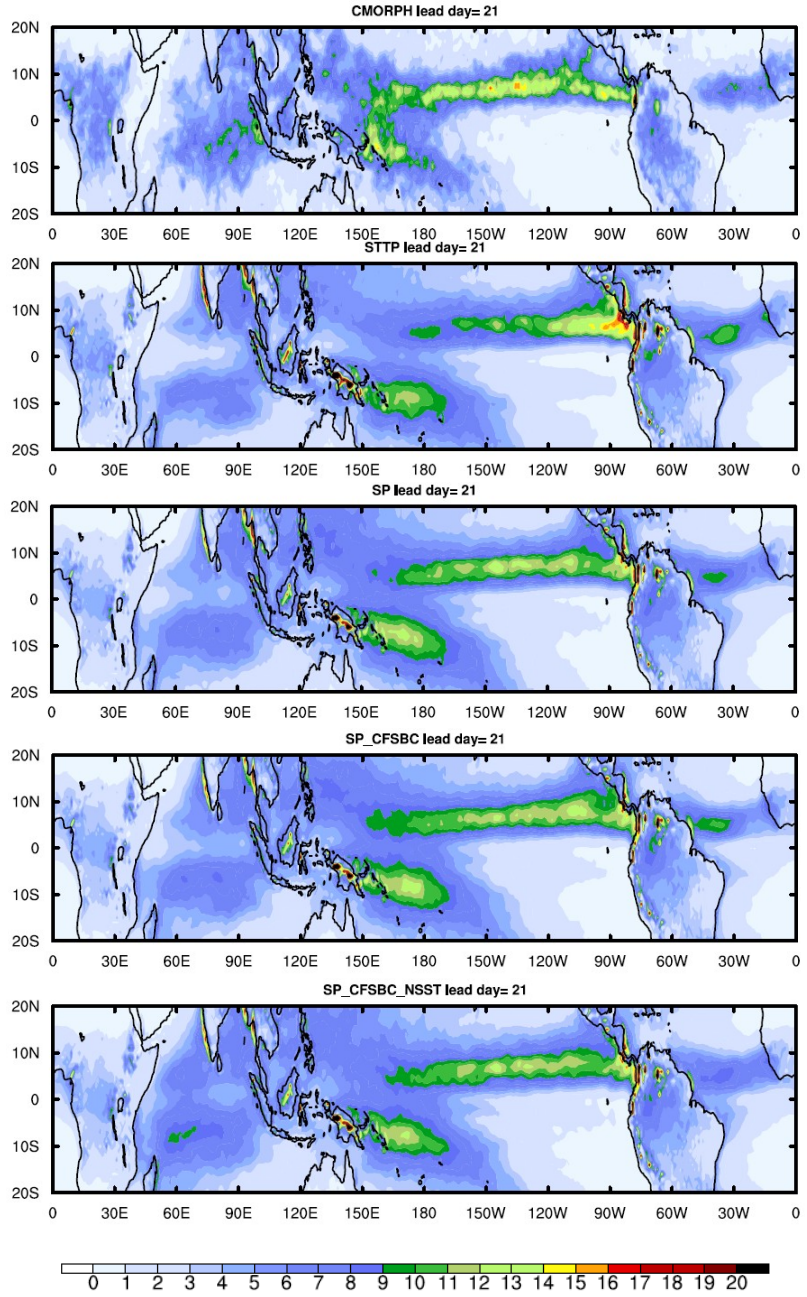
24 hr APCP (Lead day=14), 2yr ave.



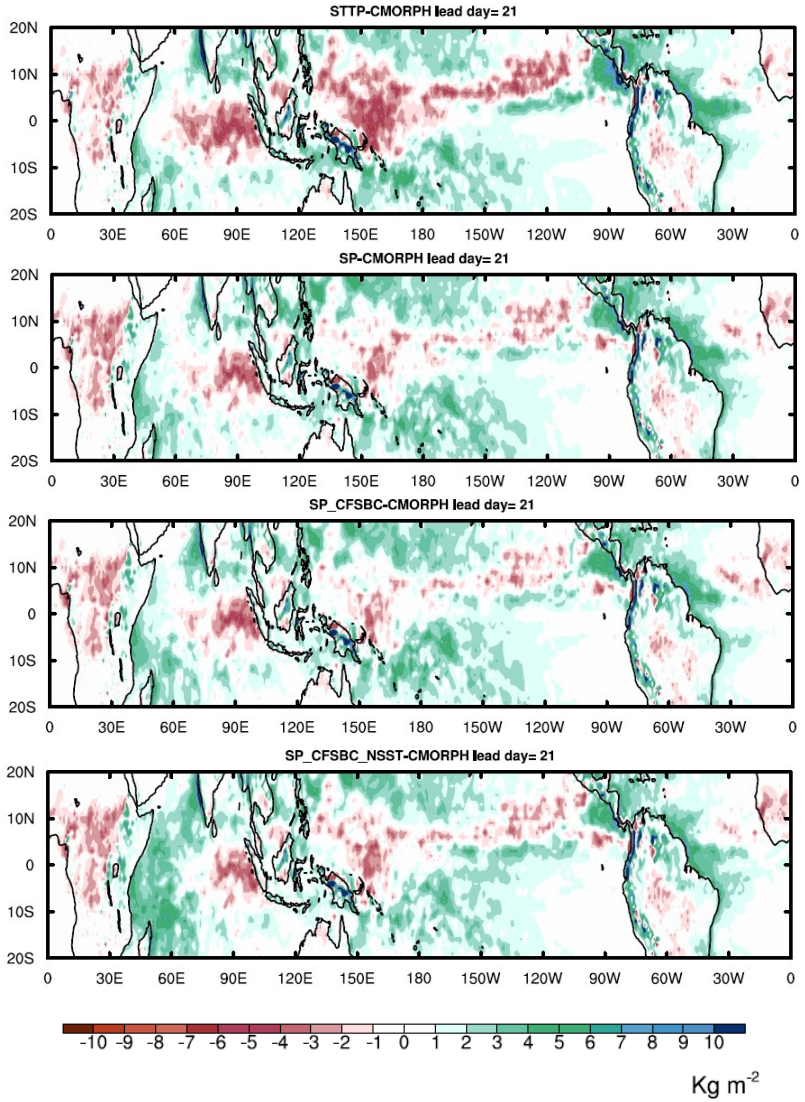
Difference Maps



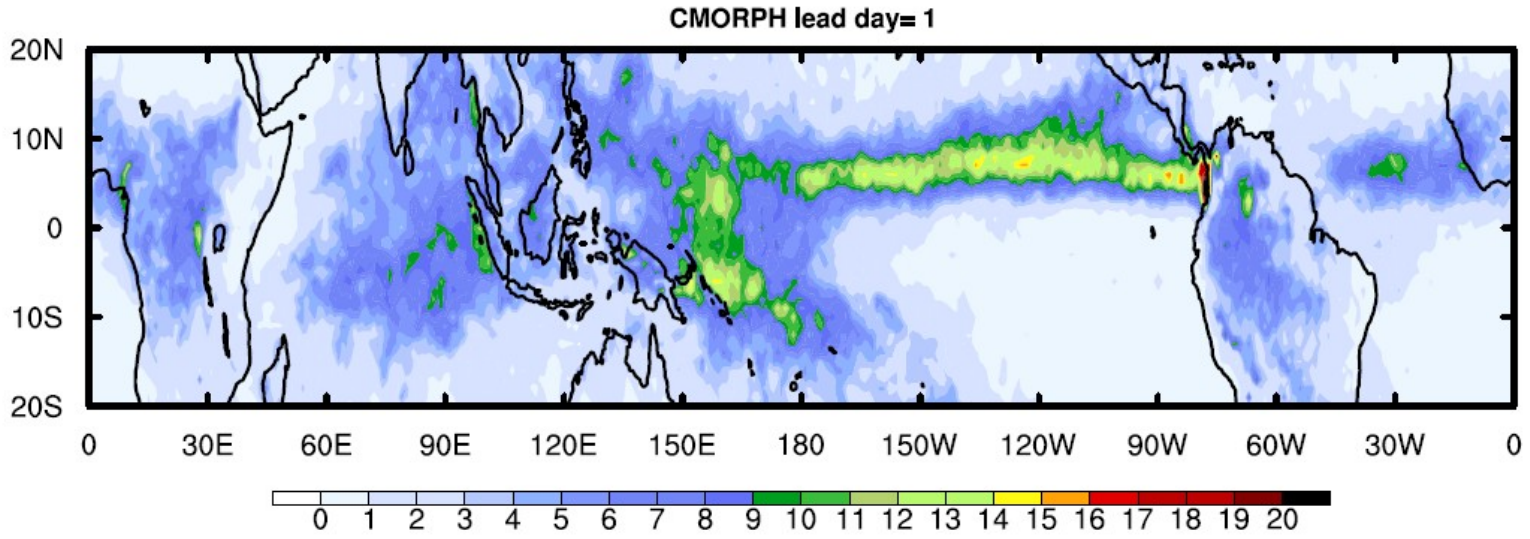
24 hr APCP (Lead day=21), 2yr ave.



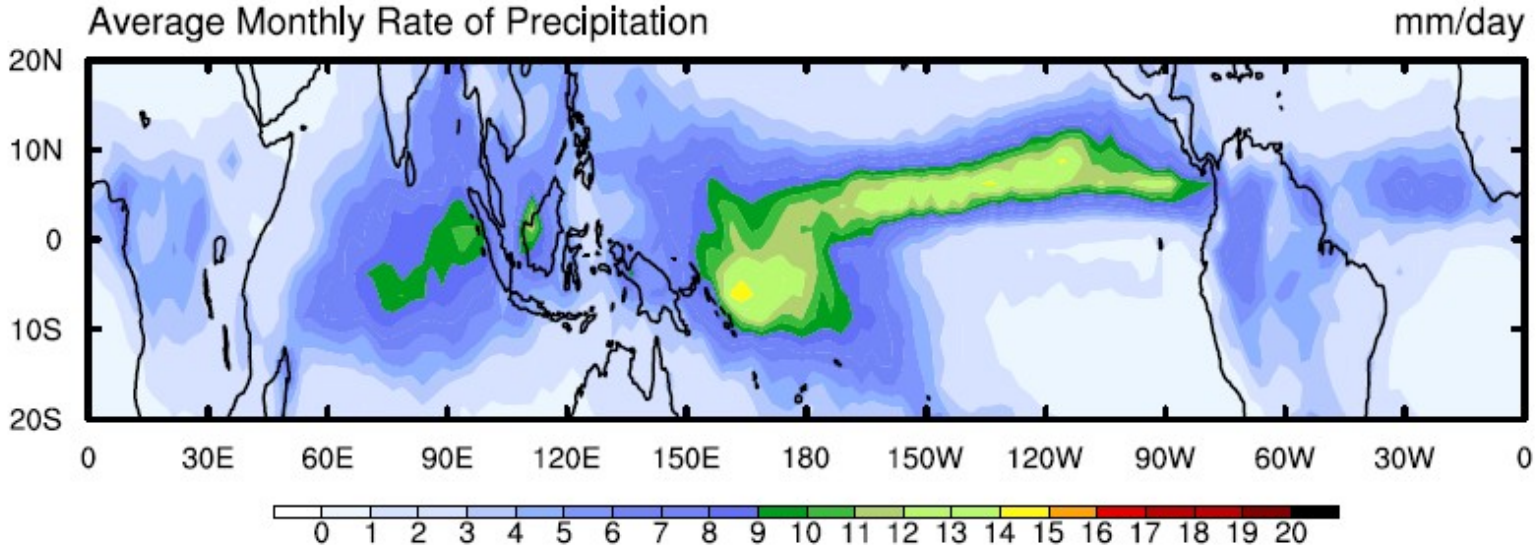
Difference Maps

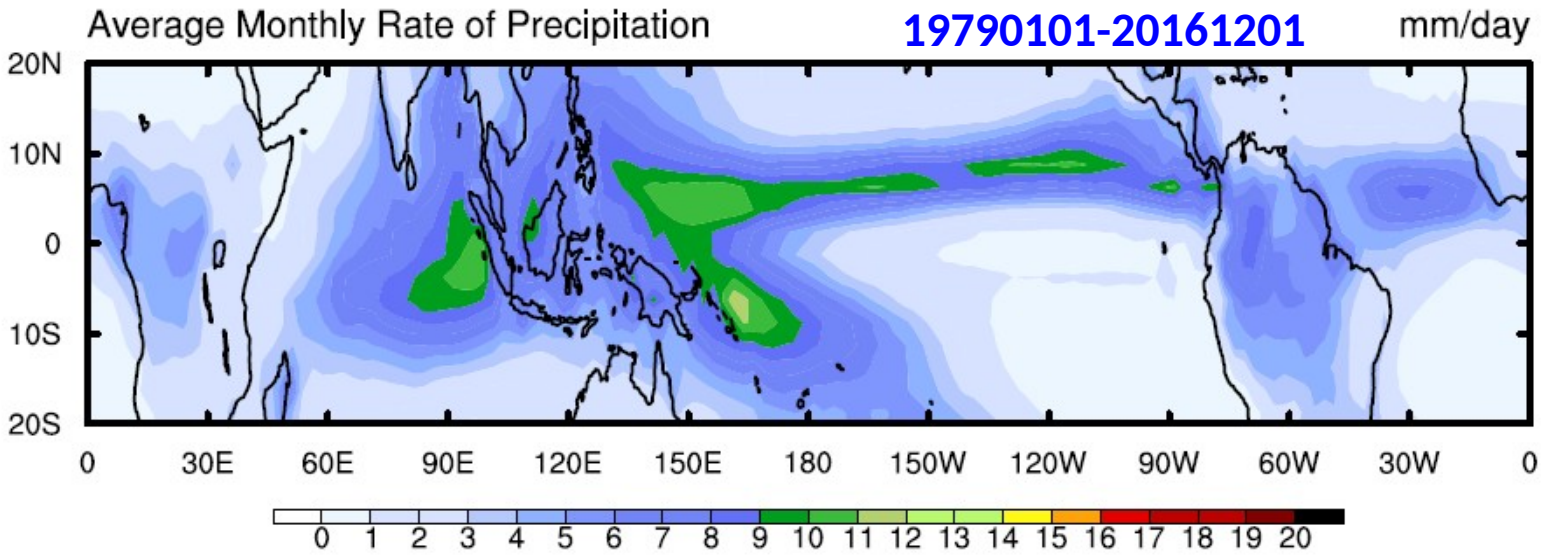


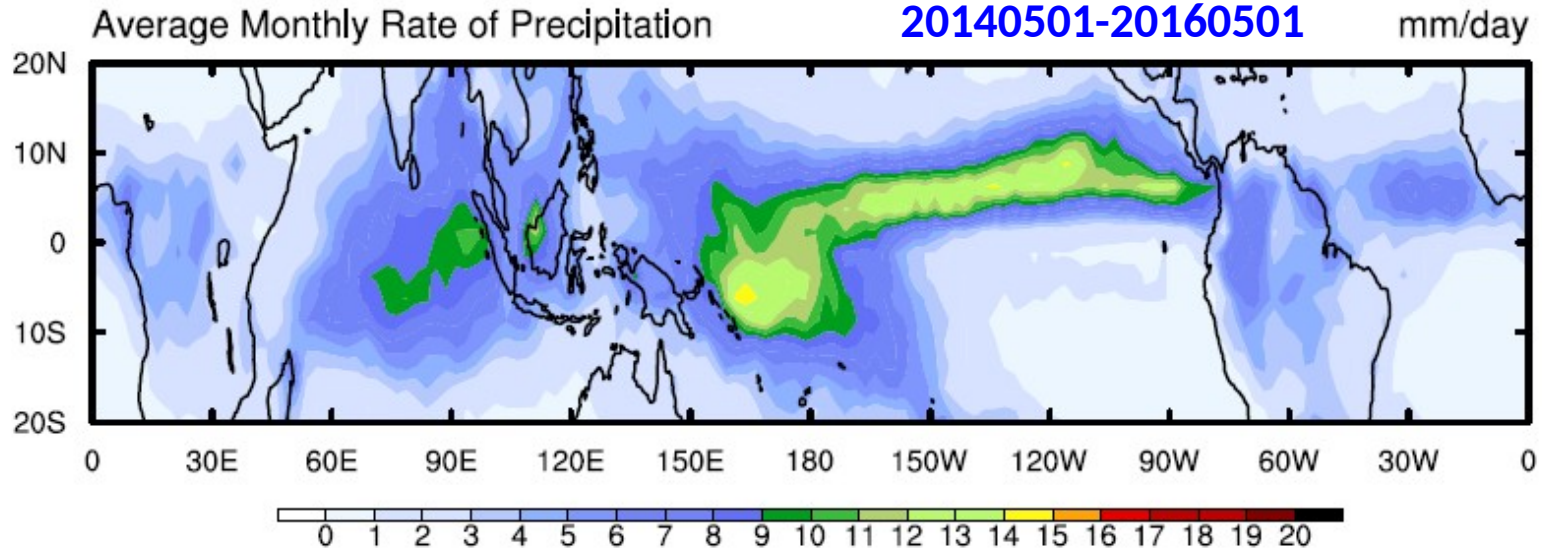
20140501-20160526
24hr accumulated precipitation



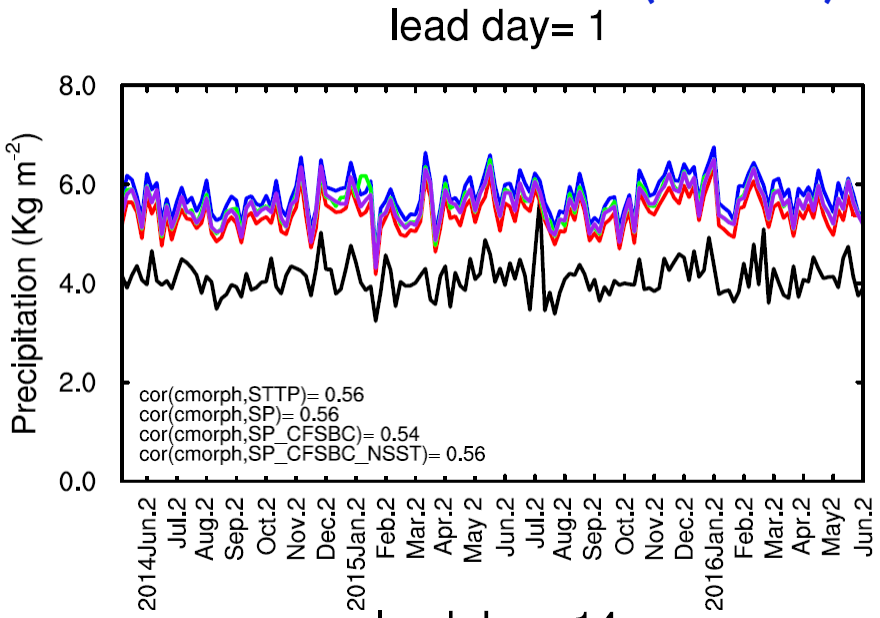
CMAP

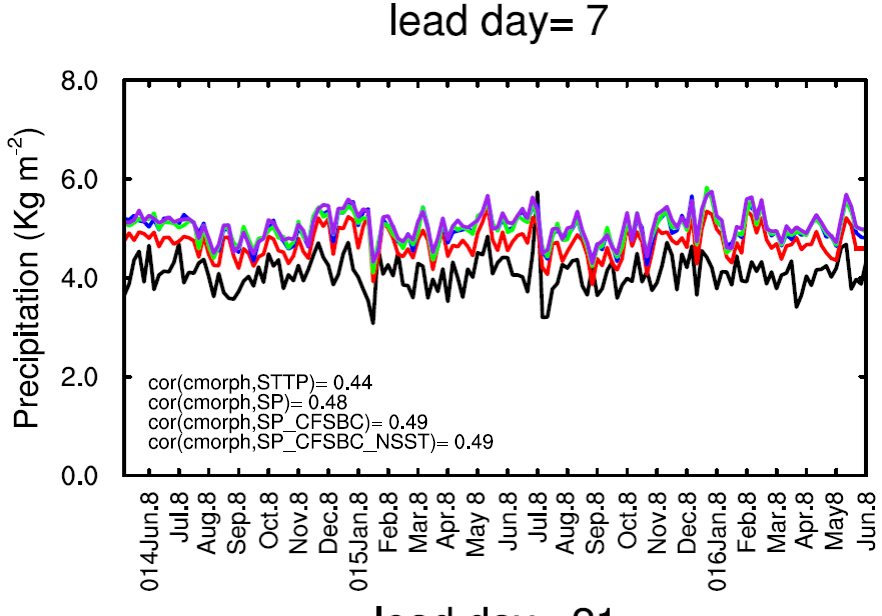


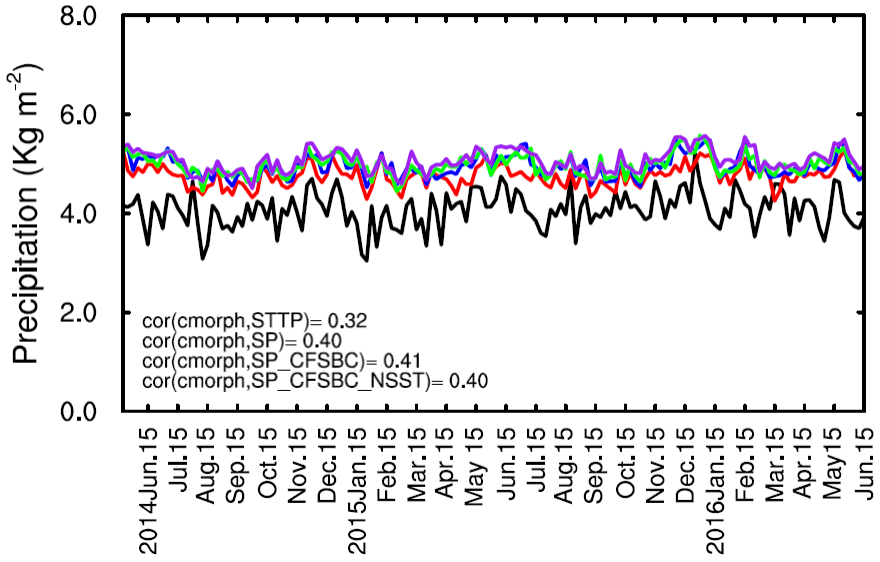

Average Monthly Rate of Precipitation
19790101-20161201
mm/day
20N
10N
0
10S
20S
0
30E
60E
90E
120E
150E
180
150W
120W
90W
60W
30W
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

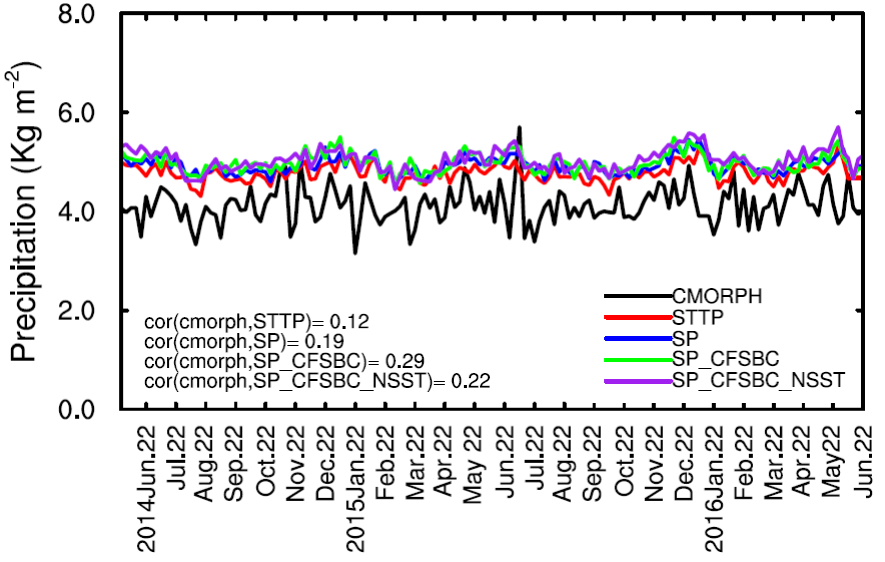

Average Monthly Rate of Precipitation
20140501-20160501
mm/day
20N
10N
0
10S
20S
0
30E
60E
90E
120E
150E
180
150W
120W
90W
60W
30W
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

(15S-15N) Latitude Band Ave



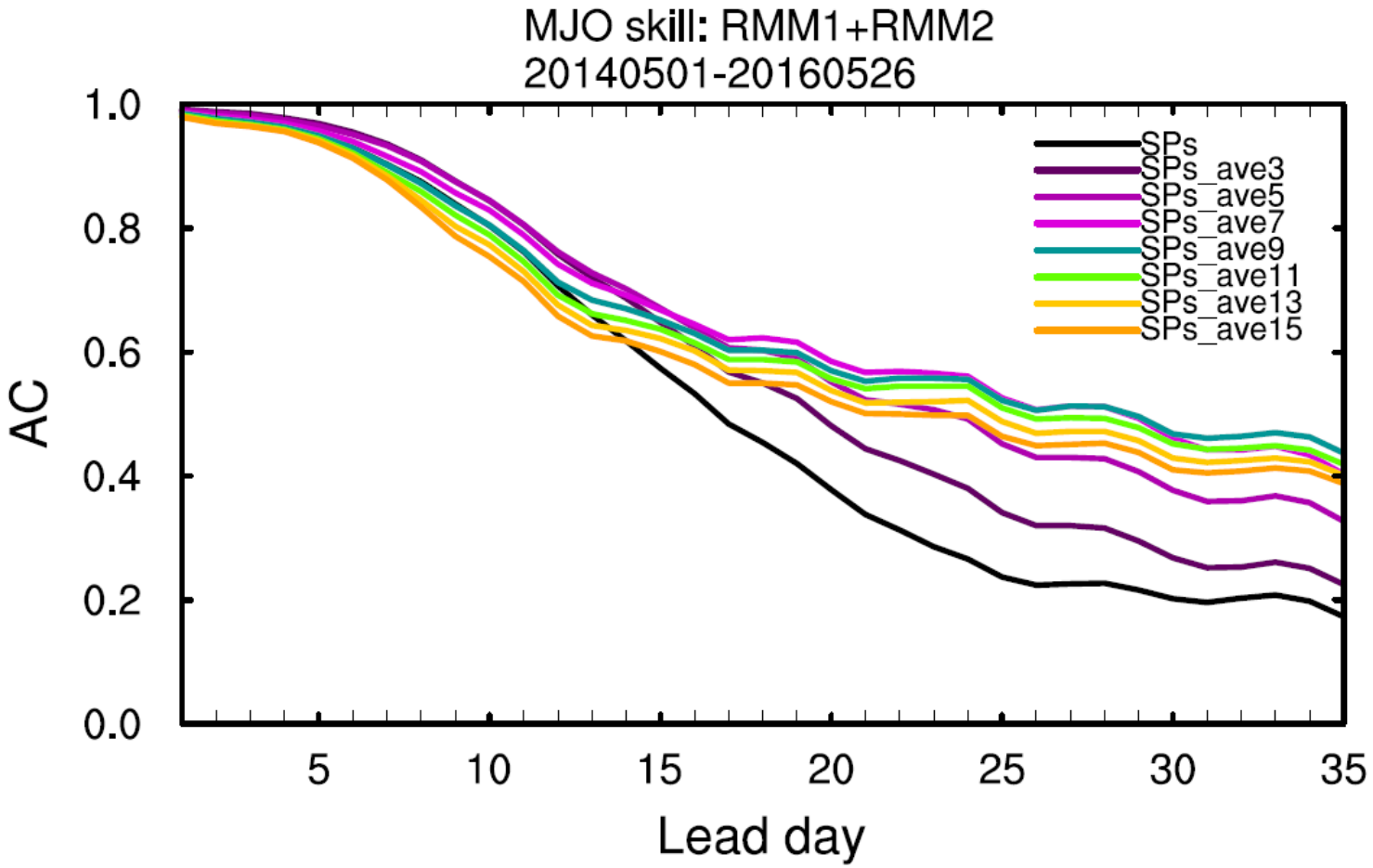


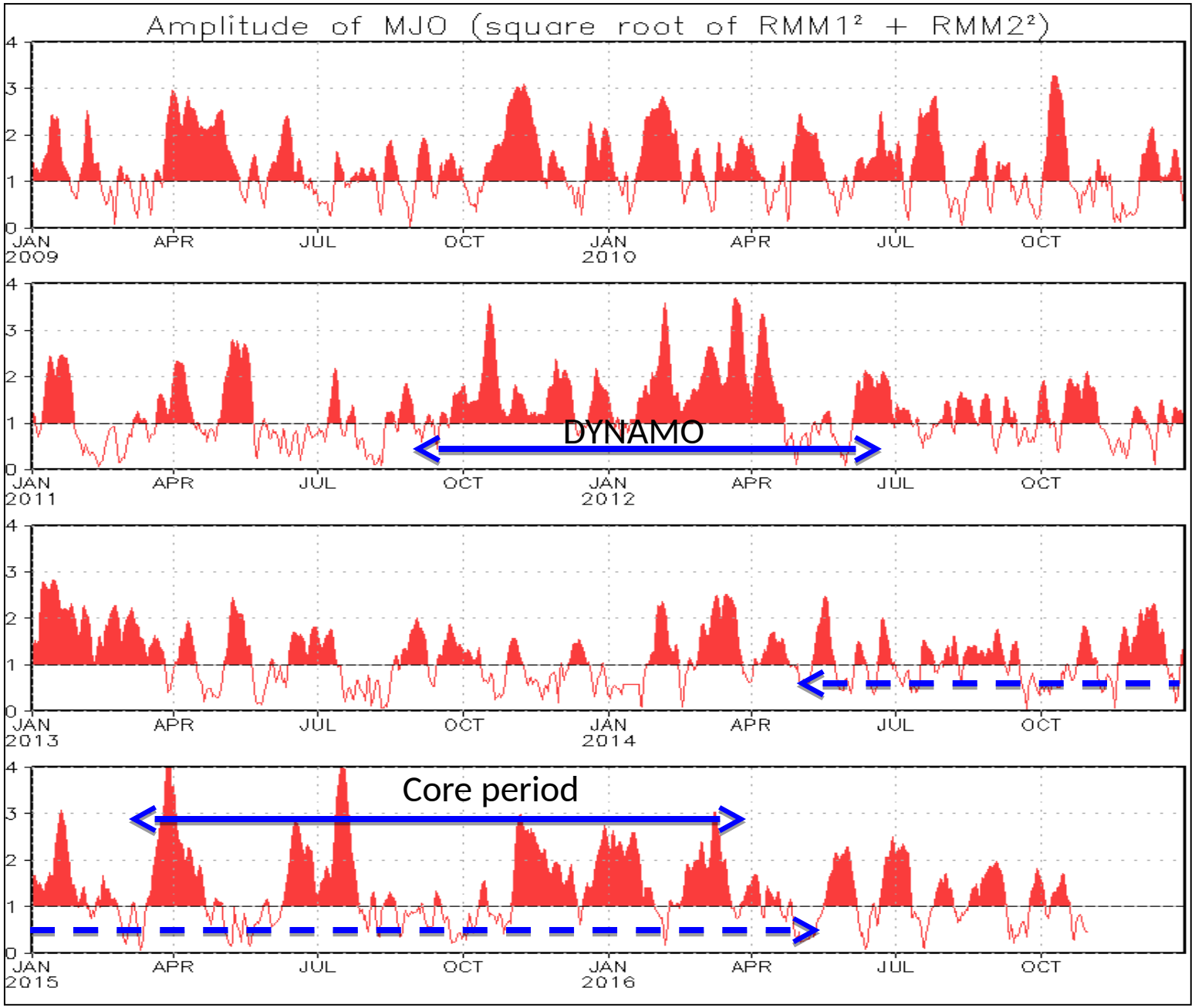




WH-MJO Forecast Skills After Smoothing

SPs case




Amplitude of MJO (square root of RMM1² + RMM2²)
0
1
2
3
4
JAN
2009
APR
JUL
OCT
JAN
2010
APR
JUL
OCT
JAN
2011
APR
JUL
OCT
JAN
2012
APR
JUL
OCT
DYNAMO
JAN
2013
APR
JUL
OCT
JAN
2014
APR
JUL
OCT
JAN
2015
APR
JUL
OCT
JAN
2016
APR
JUL
OCT
Core period