Can we meet expectations from agriculture and energy generation users?

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Buenos Aires - 04 to 05 March 2013

Model limitations

1. Goal : are models able reproduce interaction between diurnal/synoptic, intraseasonal, annual, interannual and decadal variability. ? - Not quite….unless with very high resolution

2. High resolution models is a solution - seamless prediction - costly!

1. Multiscaling modeling - understanding scale interactions – non linear effects
    1. Going from the diurnal to intraseasonal with atmospheric models
    2. Possible decadal signal in an atmospheric model with parameterized diurnal heating
    3. Coupled atmosphere/ocean/biosphere models:
2. Need probabilistic approach – (DATA MODELING APPROACH) large ensembles to estimate uncertainty due to initial conditions and model parameters/formulation of physical processes - *statistical or data modeling downscaling*)

What users expect from us?

- Certainly more than we can provide…

- Large differences depending on type of activity: (water/solar input)
  - **NOT NECESSARILY total rainfall is more relevant: distribution!!!! In some case: solar energy at the surface**
  - Annual crops such as Soybean – corn and others - shallow root system
  - Sugar cane – sugar and ethanol : deep roots
  - Coffee - deep roots -
  - Forestry – mostly Eucaliptus in Brazil (energy + paper+ construction) – different cycles –
  - Cattle – (milk and beef - different needs)
  - Fruits -

- Large companies: well organized , highly professional staff , require broad range of information - usually have a dedicated internal strategic service to advise managers (market/climate - risk assessment)file://localhost/Users/PedroDias/d/SEMINAR/modelagem/RAIZEN_WCRP_20130304.pptx
  - Internal weather/climate section: use of available information from public services;
  - Contract specialized private service
  - Mixed systems

- Companies (agriculture and energy) often report large differences in the quality of available products (government and private sources);
  - Complaints about the fact that official products in general tend to be too conservative and private products frequently are not consistent (indicating response to external “forcing”).

- Public products are frequently not tailored to user's needs: companies complain that official sources in general tell them what they need but know very little about their activities and how they depend on weather/climate;
  - Up to a certain extent, strategy sector have similar complaint about most private weather/climate services…

- Real time interaction with strategy group is certainly required; not quite feasible in the public sector (except in privatized weather/climate services…) . Public services quite often assume that there is no need for private companies…

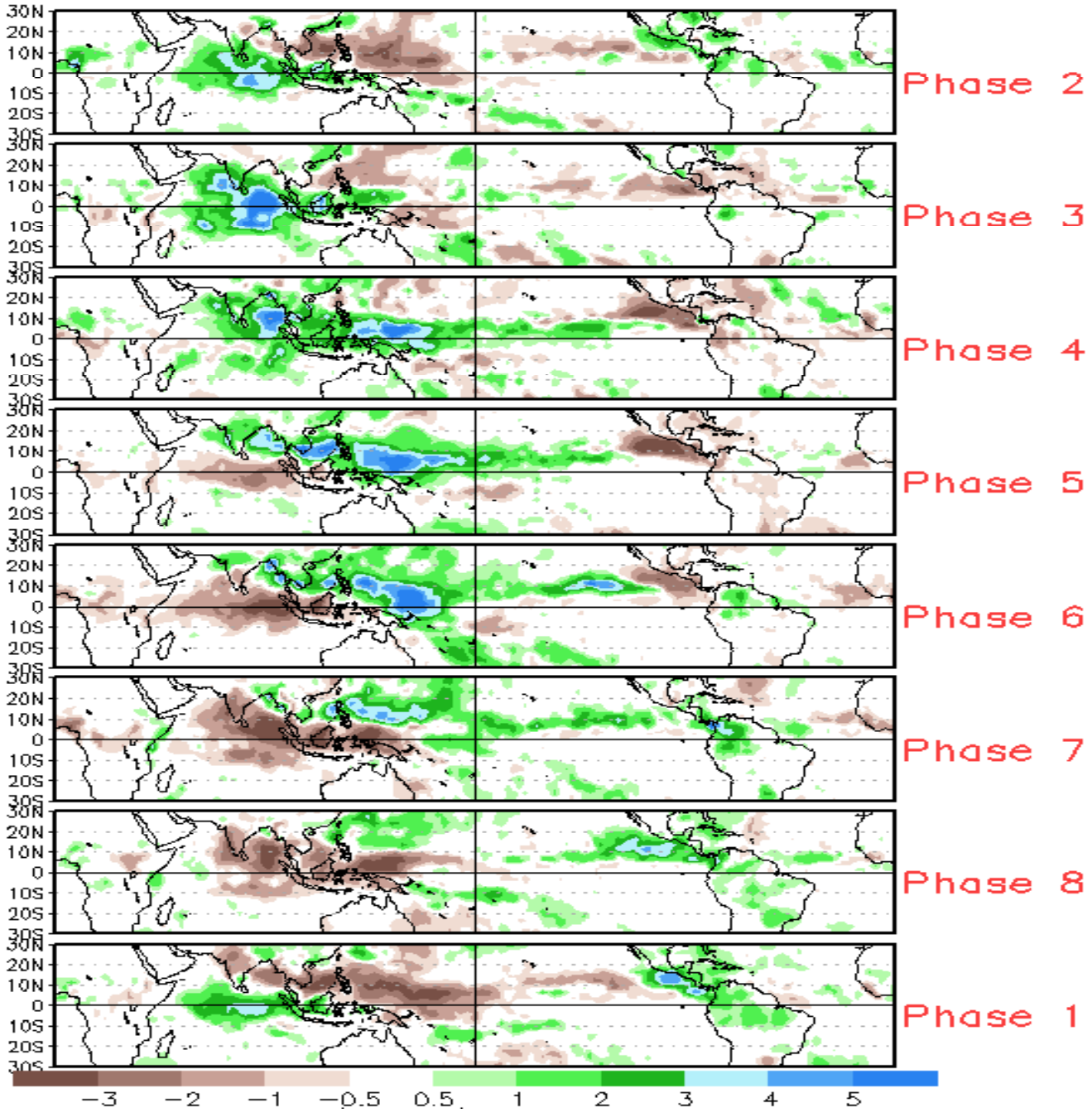
- Many private weather/climate companies don't have the resources (computational, specialized personnel or understanding… of the complexities associated with climate/weather uncertainties in the forecasting mode!! But some do have! And the large enterprises in the agribusiness and energy in general know how to use probabilistic information

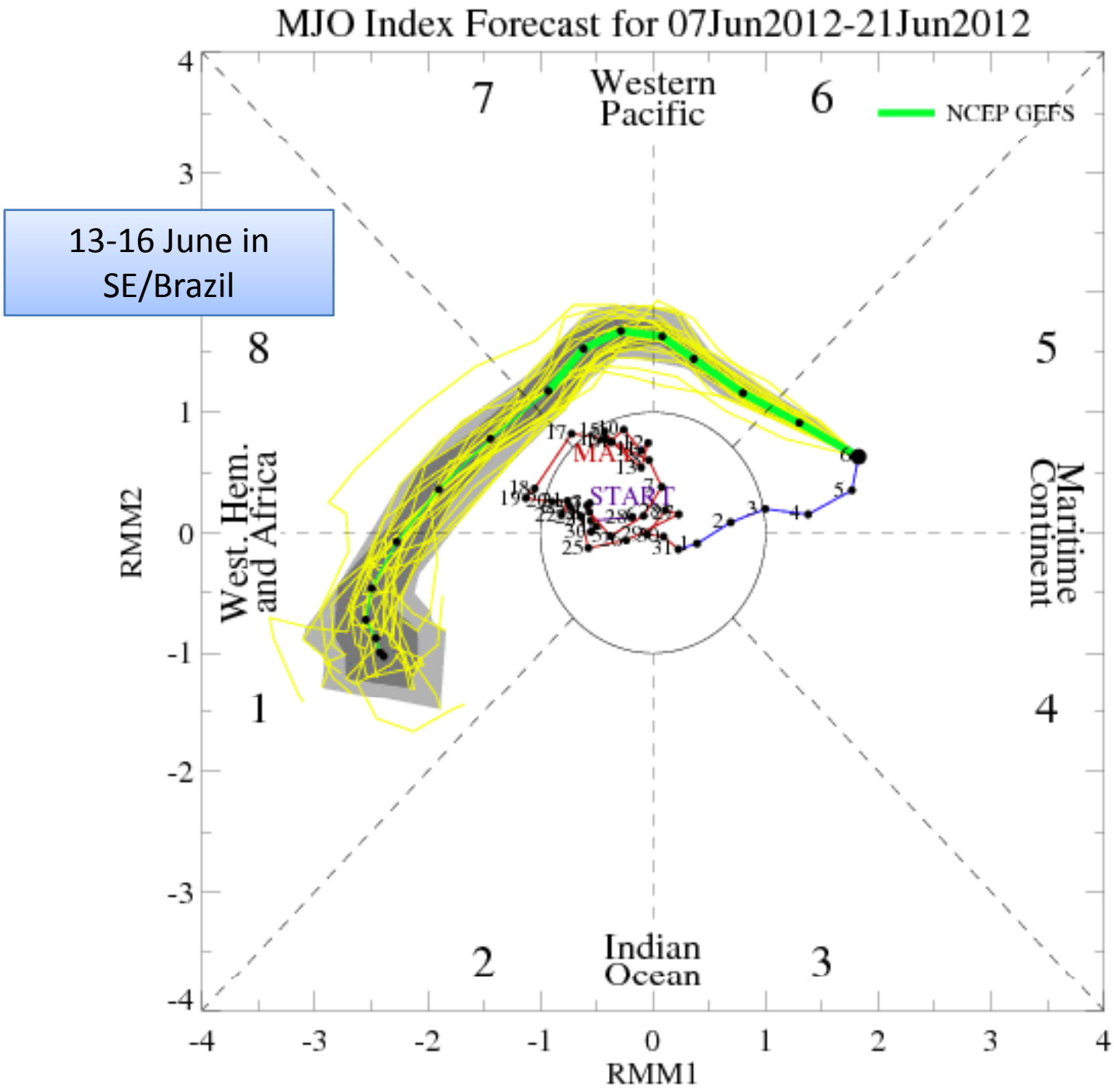
Example of predictability in the intraseasonal timescale…

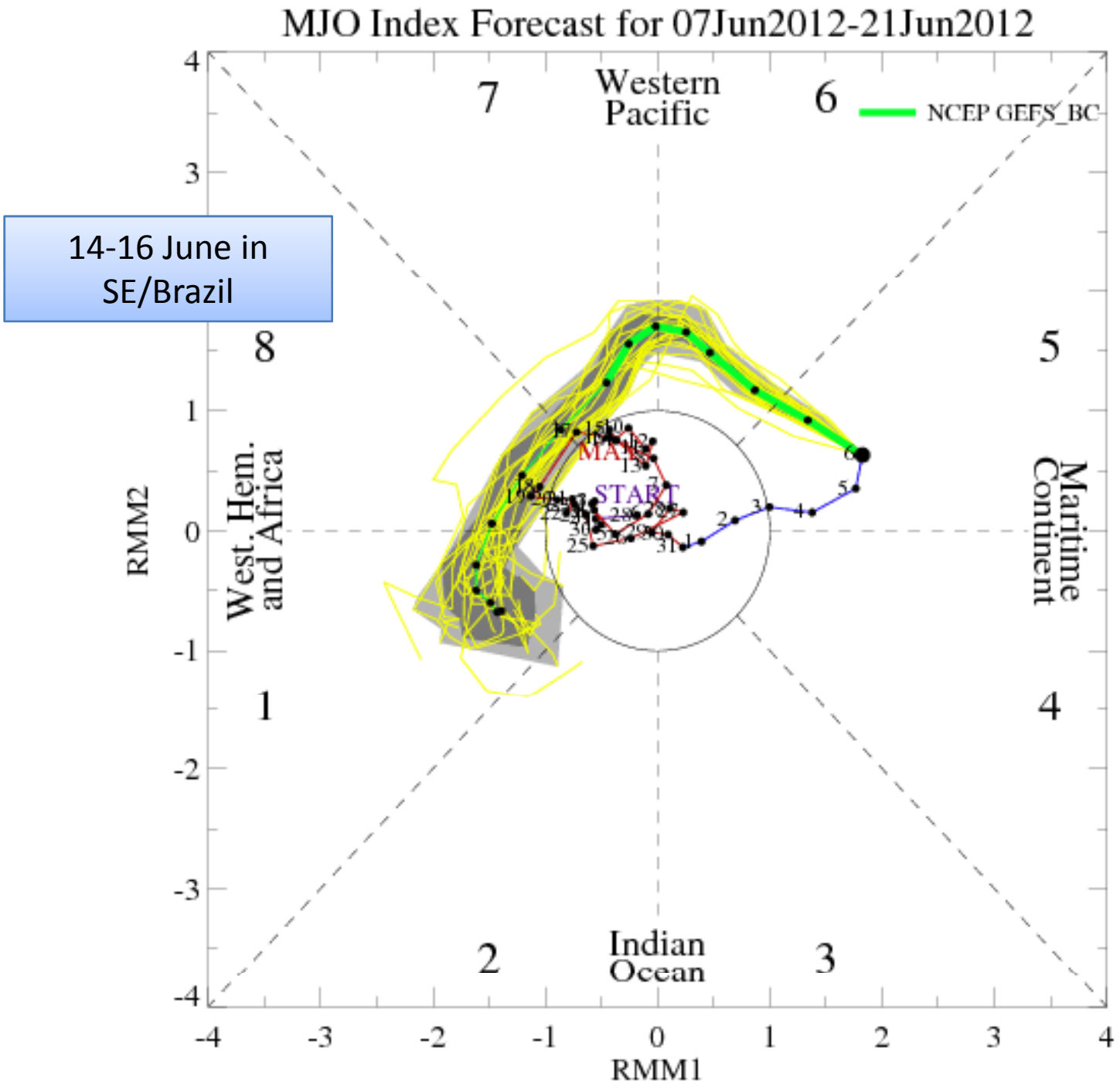
- **Actions in the sugar cane business …**

Precipitation Composite

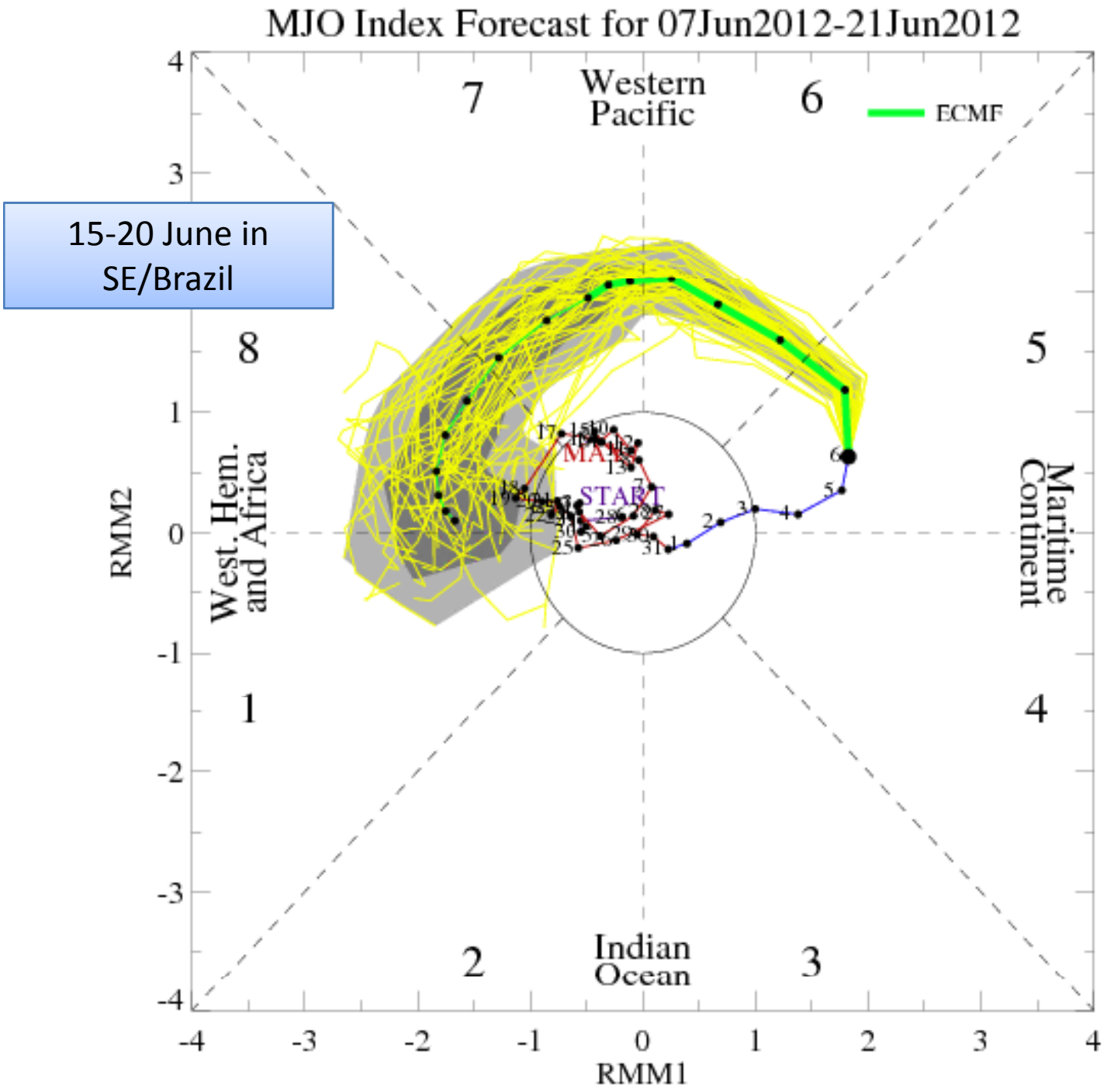
Fase 8 – precipitation in SE Brazil

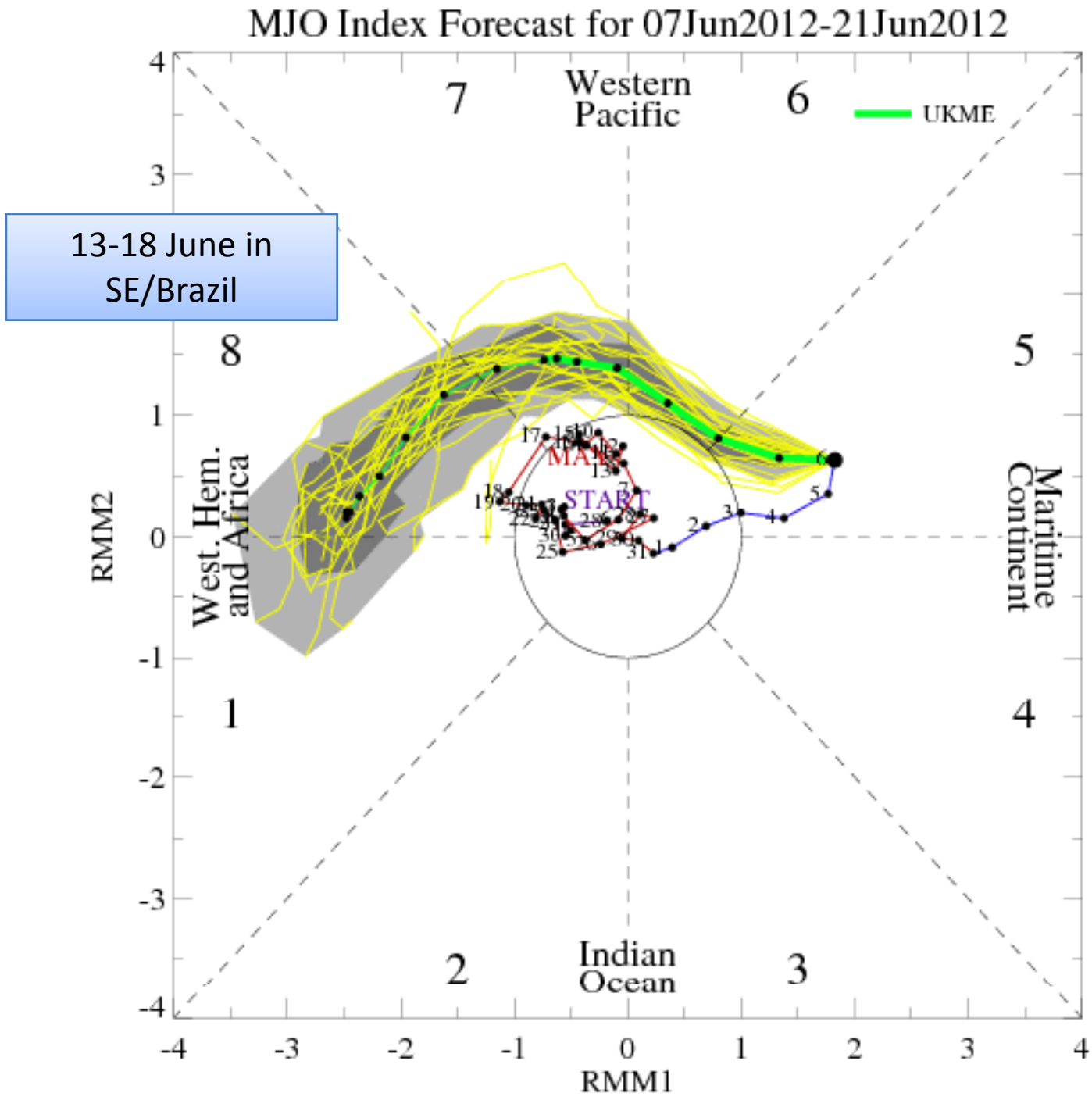



MJO Index Forecast for 07Jun2012-21Jun2012
NCEP GEFS
7
Western Pacific
6
8
5
1
4
2
Indian Ocean
3
West. Hem. and Africa
Maritime Continent
RMM2
RMM1
START
MAY
13-16 June in SE/Brazil



14-16 June in SE/Brazil


MJO Index Forecast for 07Jun2012-21Jun2012
15-20 June in SE/Brazil
ECMF
Western Pacific
Indian Ocean
West. Hem. and Africa
Maritime Continent
7
6
8
5
1
4
2
3
START
RMM1
RMM2


MJO Index Forecast for 07Jun2012-21Jun2012
13-18 June in SE/Brazil
UKME
Western Pacific
Indian Ocean
West. Hem. and Africa
Maritime Continent
START
RMM1
RMM2
1
2
3
4
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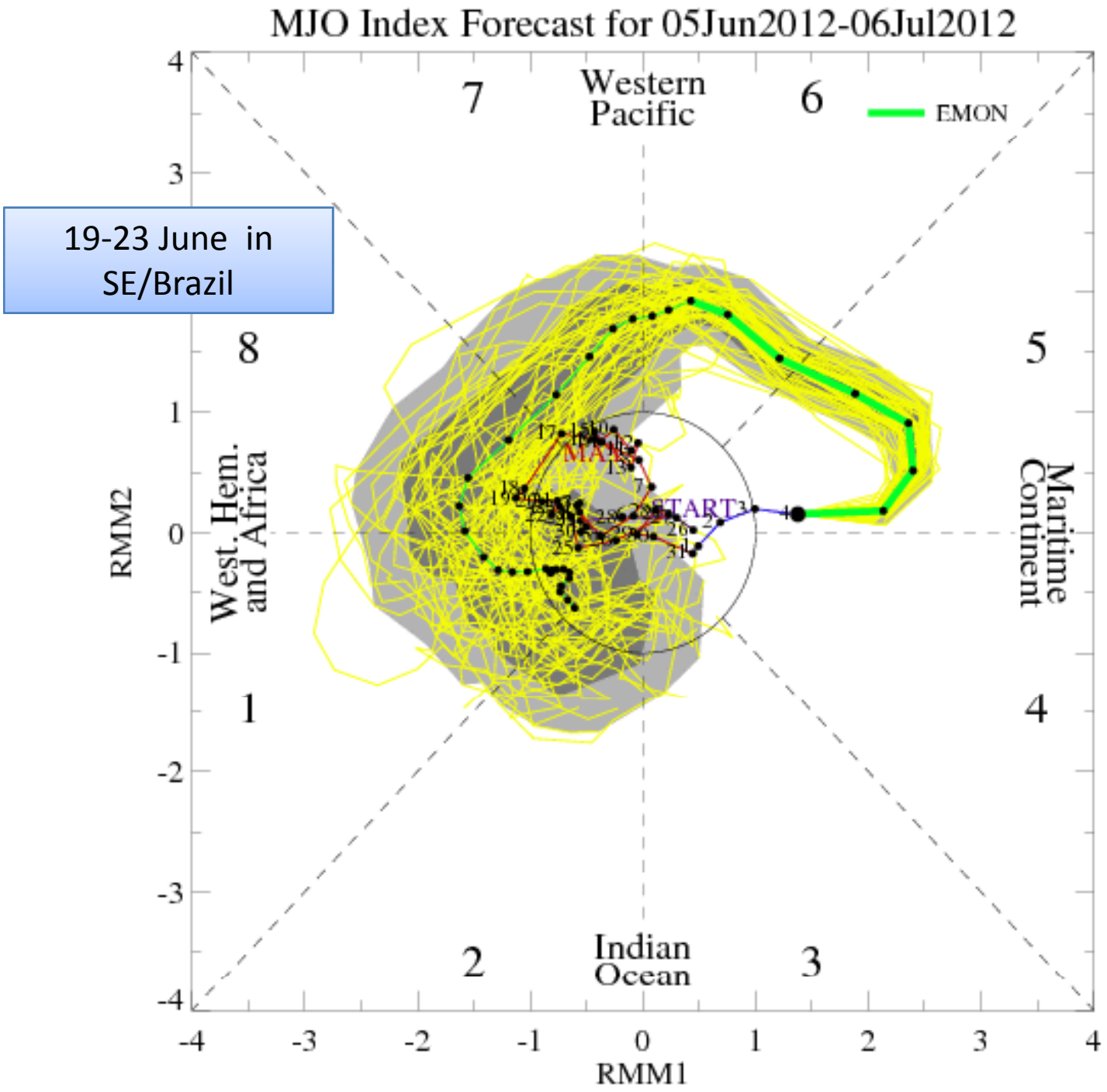
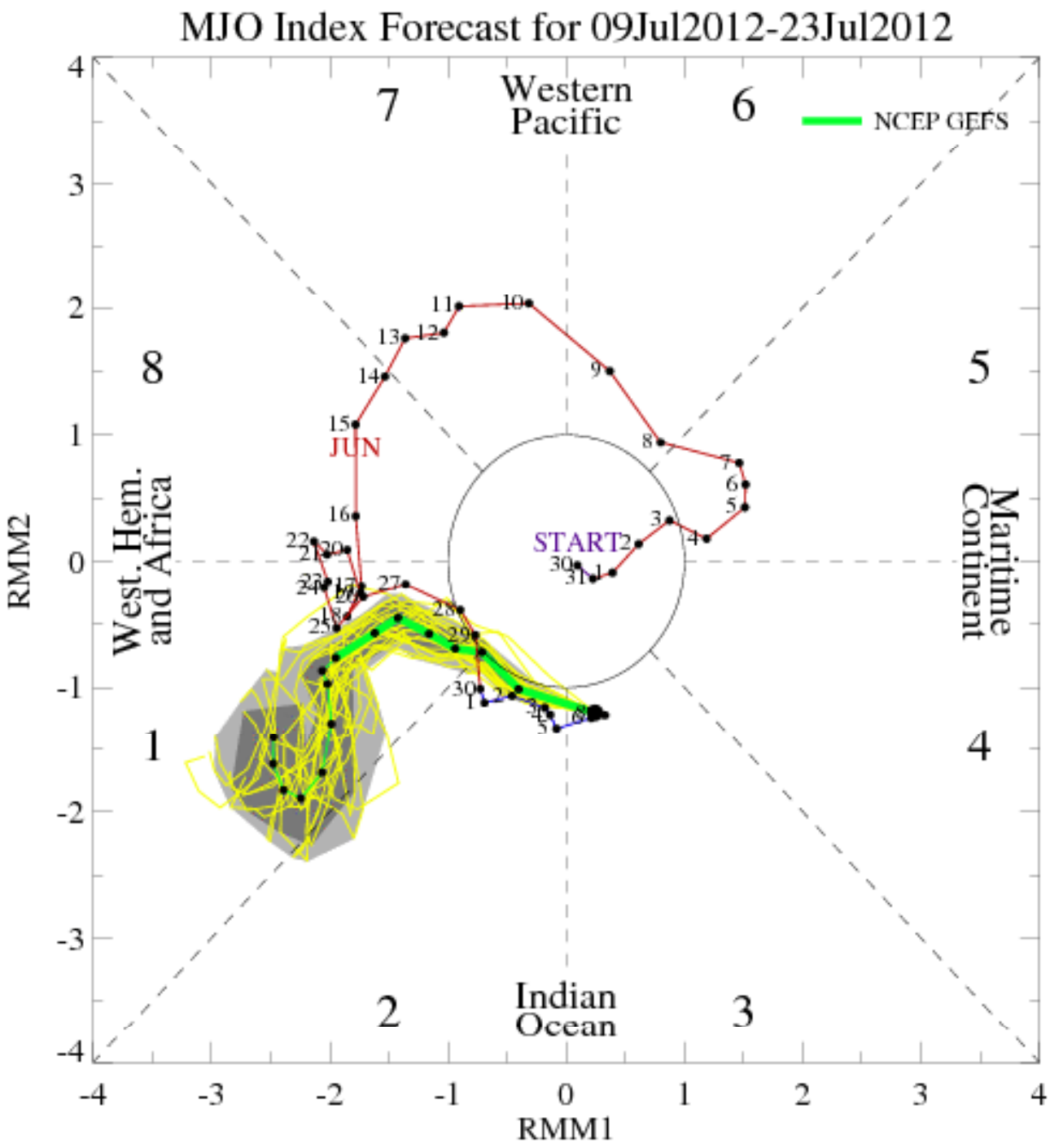
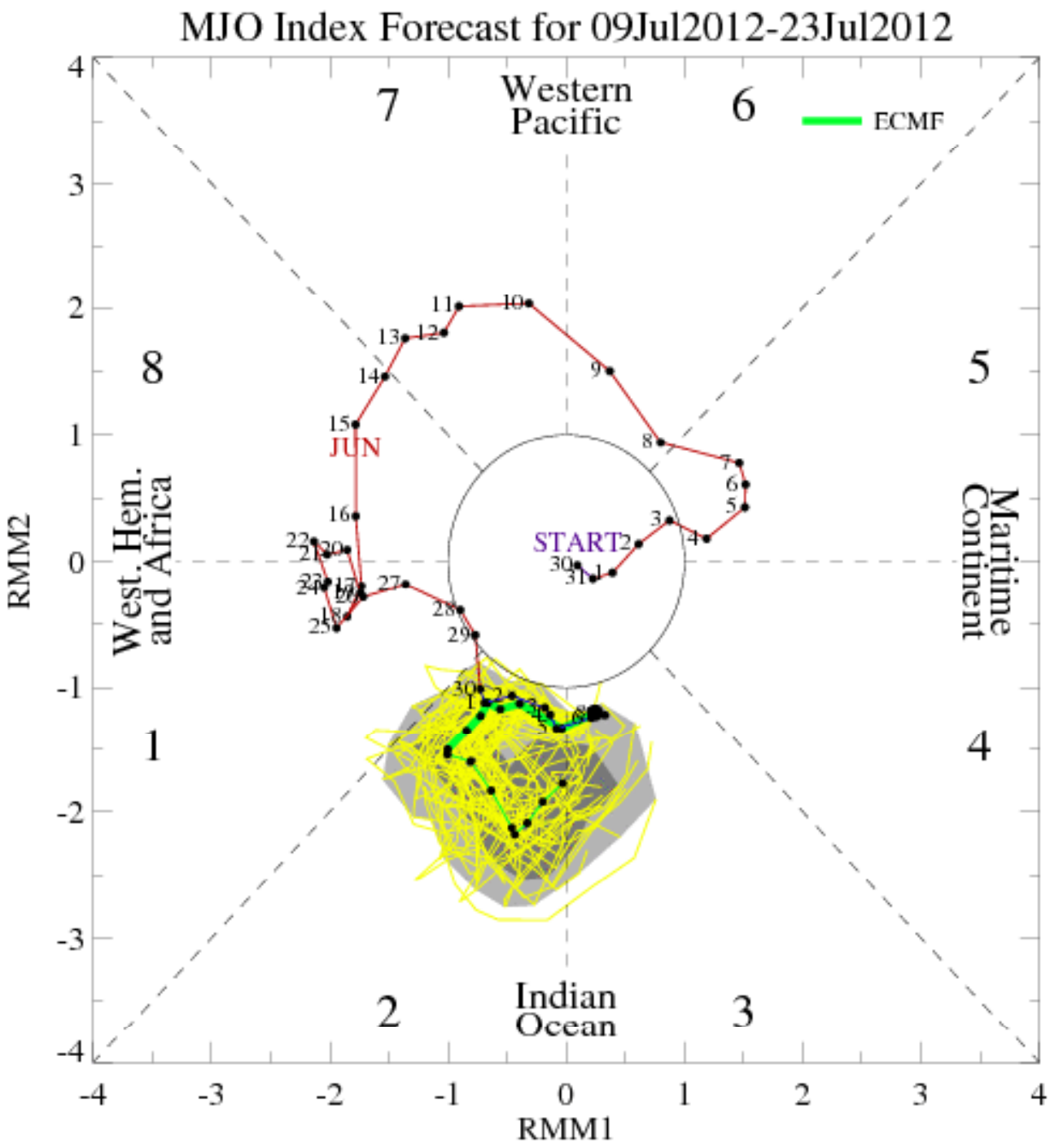
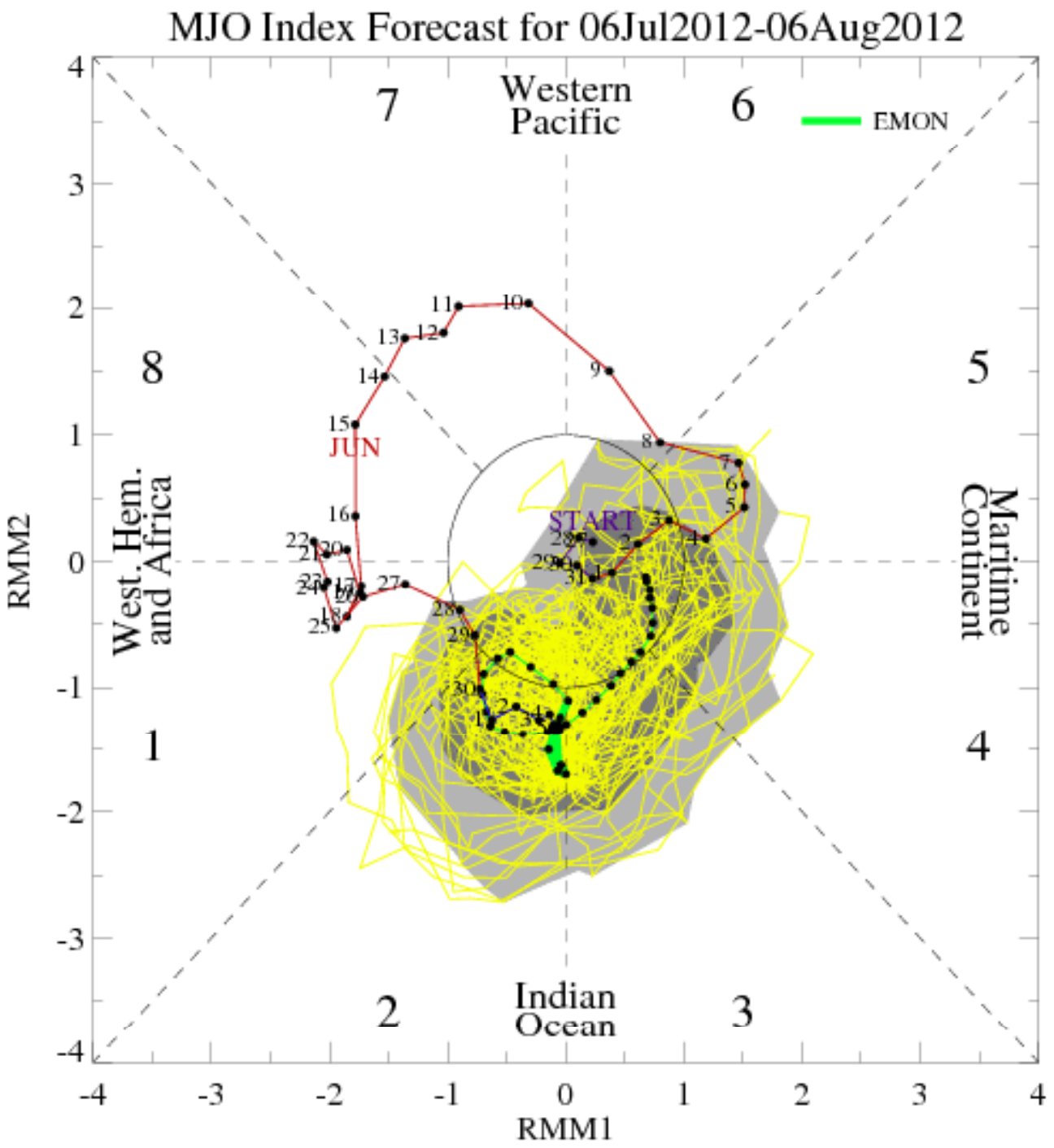
6
7
8


MJO Index Forecast for 05Jun2012-06Jul2012
19-23 June in SE/Brazil
Western Pacific
Indian Ocean
West. Hem. and Africa
Maritime Continent
EMON
RMM1
RMM2
7
6
8
5
1
4
2
3

However….. Sometimes models provide quite inconsistent information in the intraseasonal timescale…


MJO Index Forecast for 09Jul2012-23Jul2012
NCEP GEFS
7
Western Pacific
6
8
5
West. Hem. and Africa
Maritime Continent
1
4
2
Indian Ocean
3
JUN
START
RMM1
RMM2


MJO Index Forecast for 09Jul2012-23Jul2012
ECMF
7
Western
Pacific
6
8
5
West. Hem.
and Africa
Maritime
Continent
1
4
2
Indian
Ocean
3
JUN
START
RMM1
RMM2


MJO Index Forecast for 06Jul2012-06Aug2012
Western Pacific
Indian Ocean
West. Hem. and Africa
Maritime Continent
7
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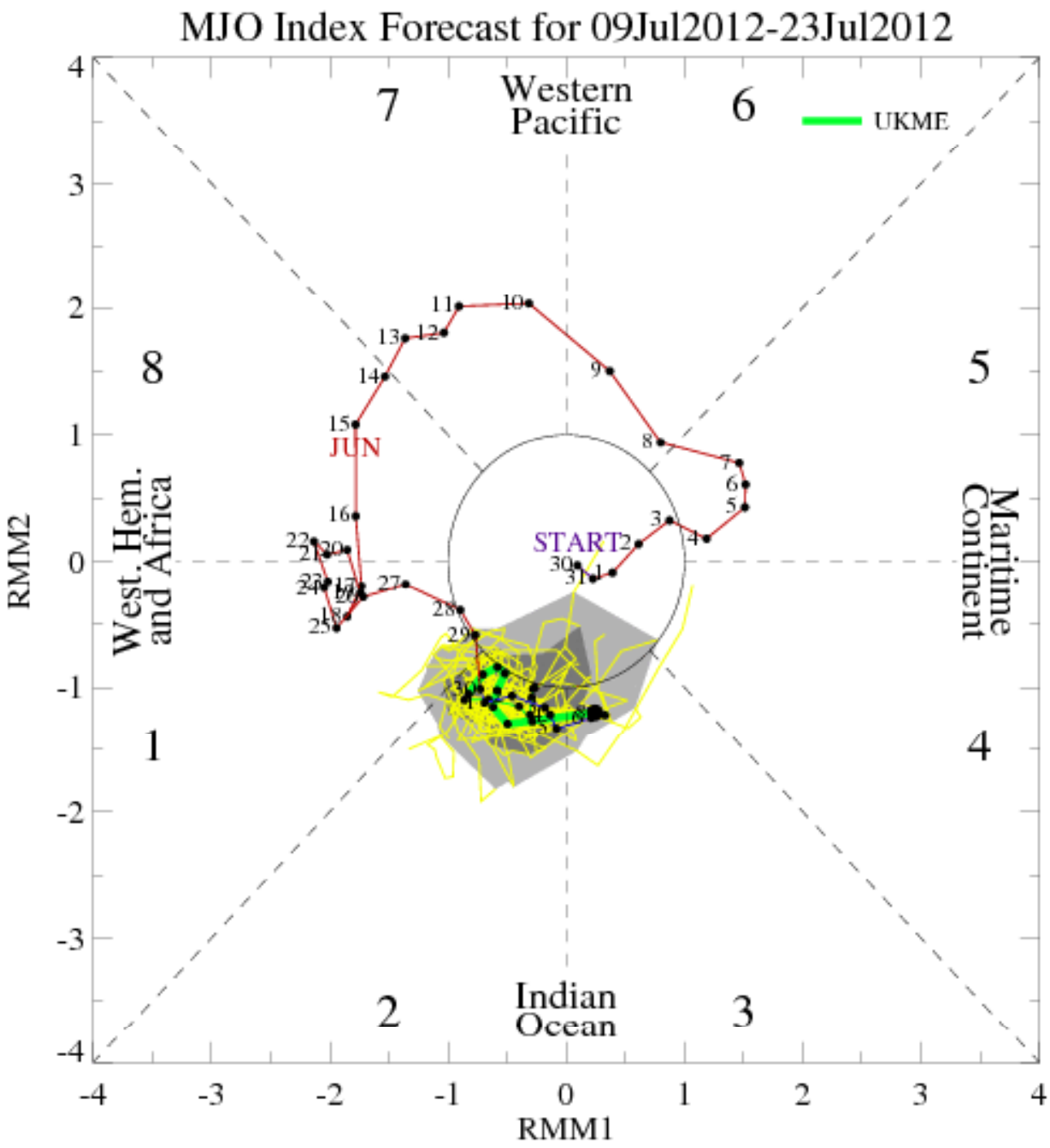
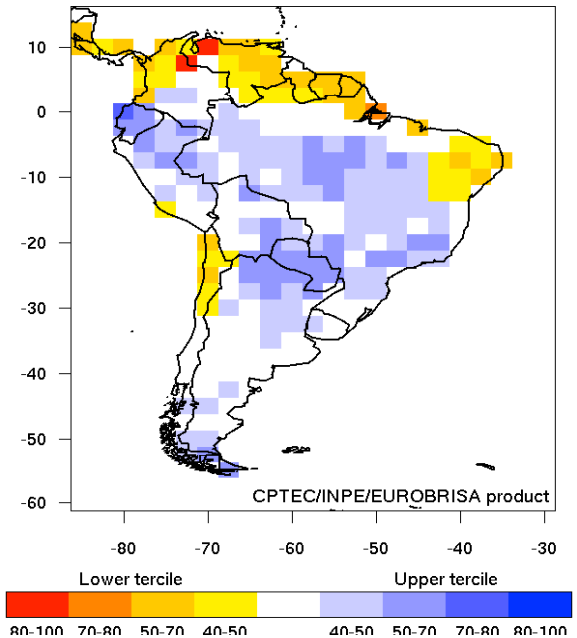
8
5
1
4
2
3
EMON
START
JUN
RMM1
RMM2


MJO Index Forecast for 09Jul2012-23Jul2012
UKME
Western Pacific
Indian Ocean
West. Hem. and Africa
Maritime Continent
7
6
8
5
1
4
2
3
JUN
START
RMM1
RMM2

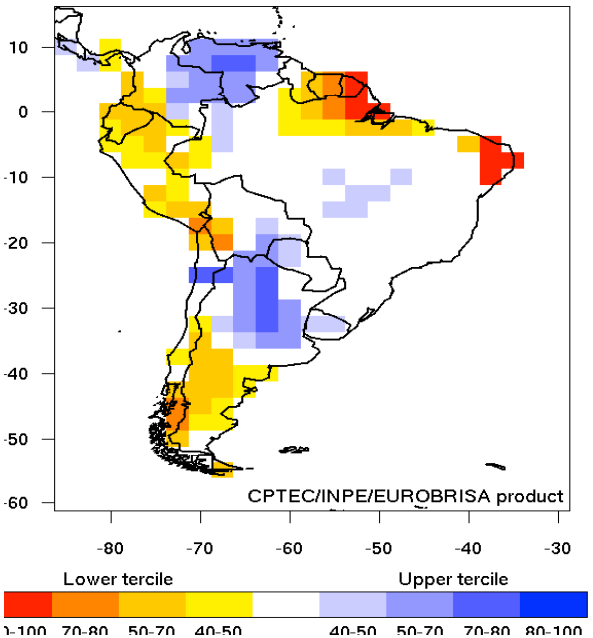
Need regional products for seasonal forecasts - statistical analysis of ensemble products + empirical models

EUROBRISA - CPTEC

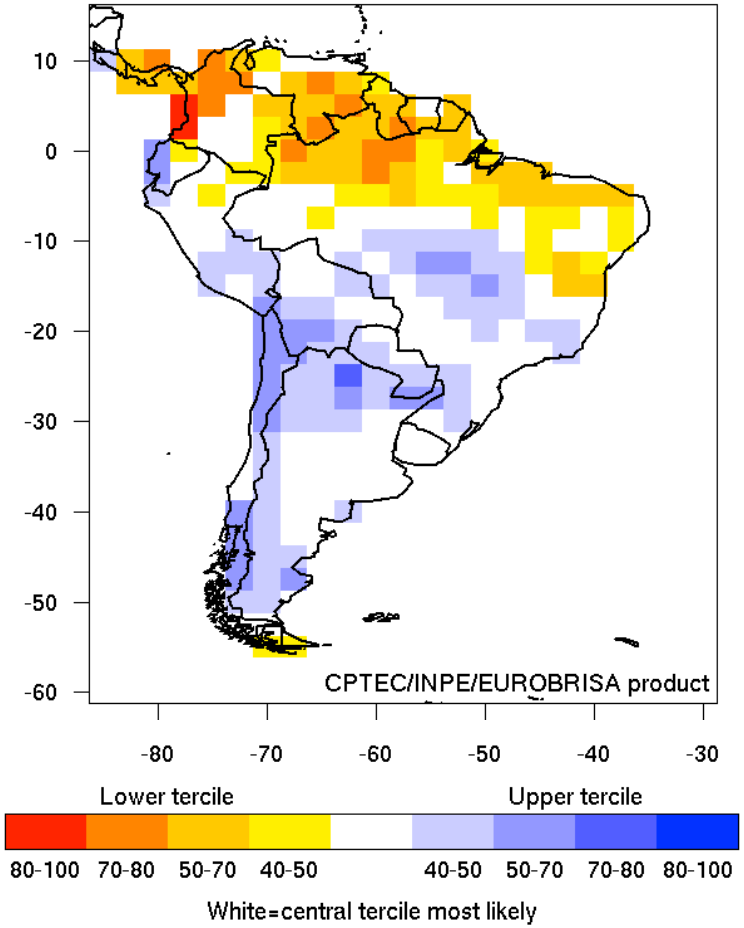
ECMWF: Prob. most likely precip. tercile (%)
Issued: Jun 2012 Valid for JAS 2012



Meteo-France: Prob. most likely precip. tercile (%)
Issued: Jun 2012 Valid for JAS 2012



Integrated: Prob. of most likely precip. tercile (%)
Issued: Jun 2012 Valid for JAS 2012



UKMO: Prob. most likely precip. tercile (%)
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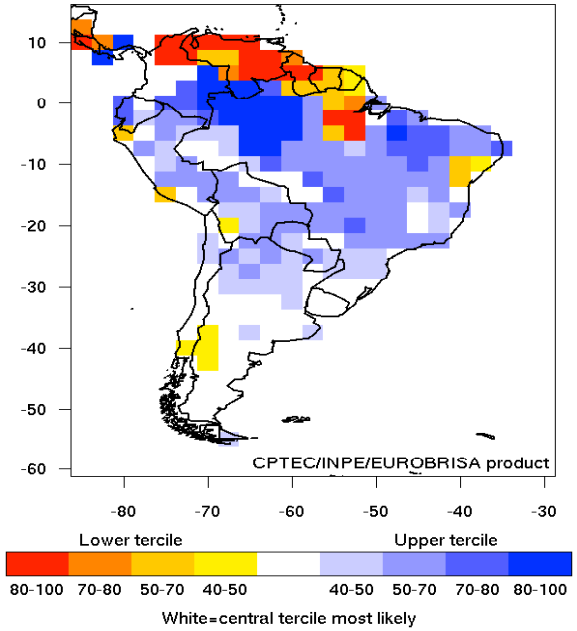

Empirical: Prob. most likely precip. tercile (%)
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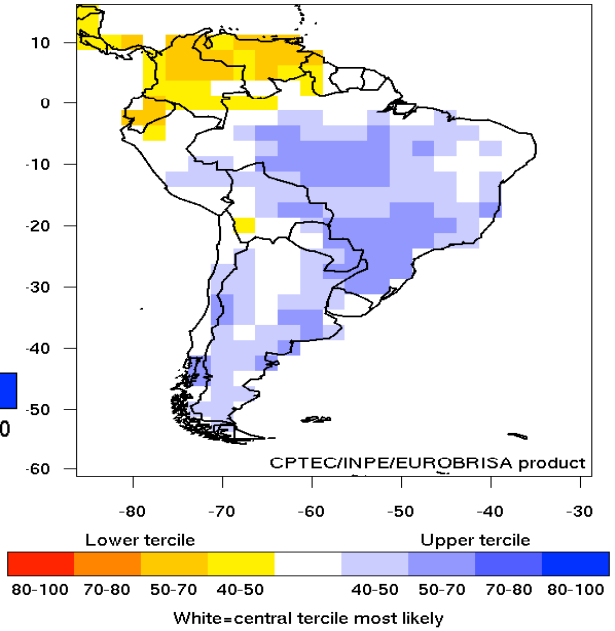
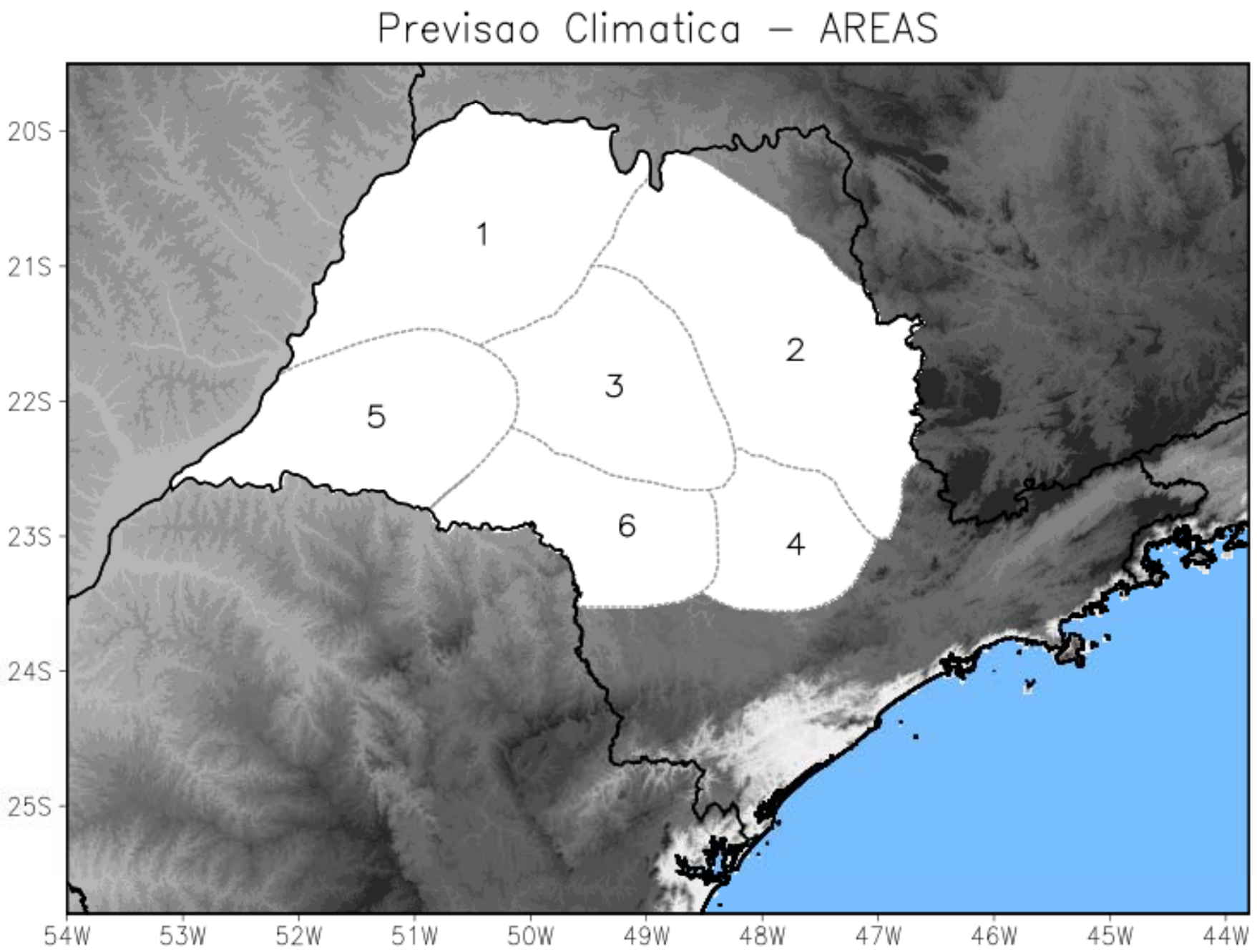
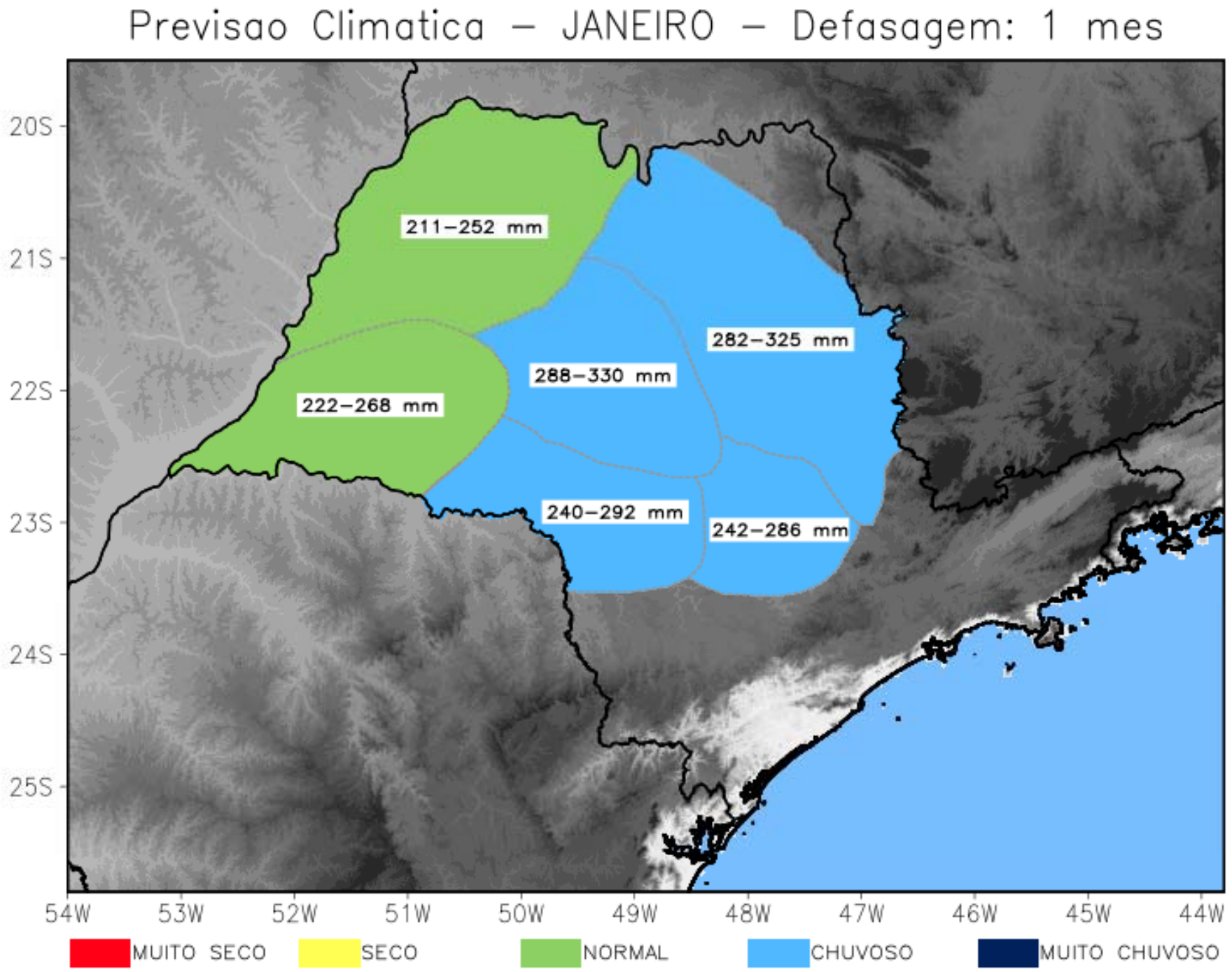
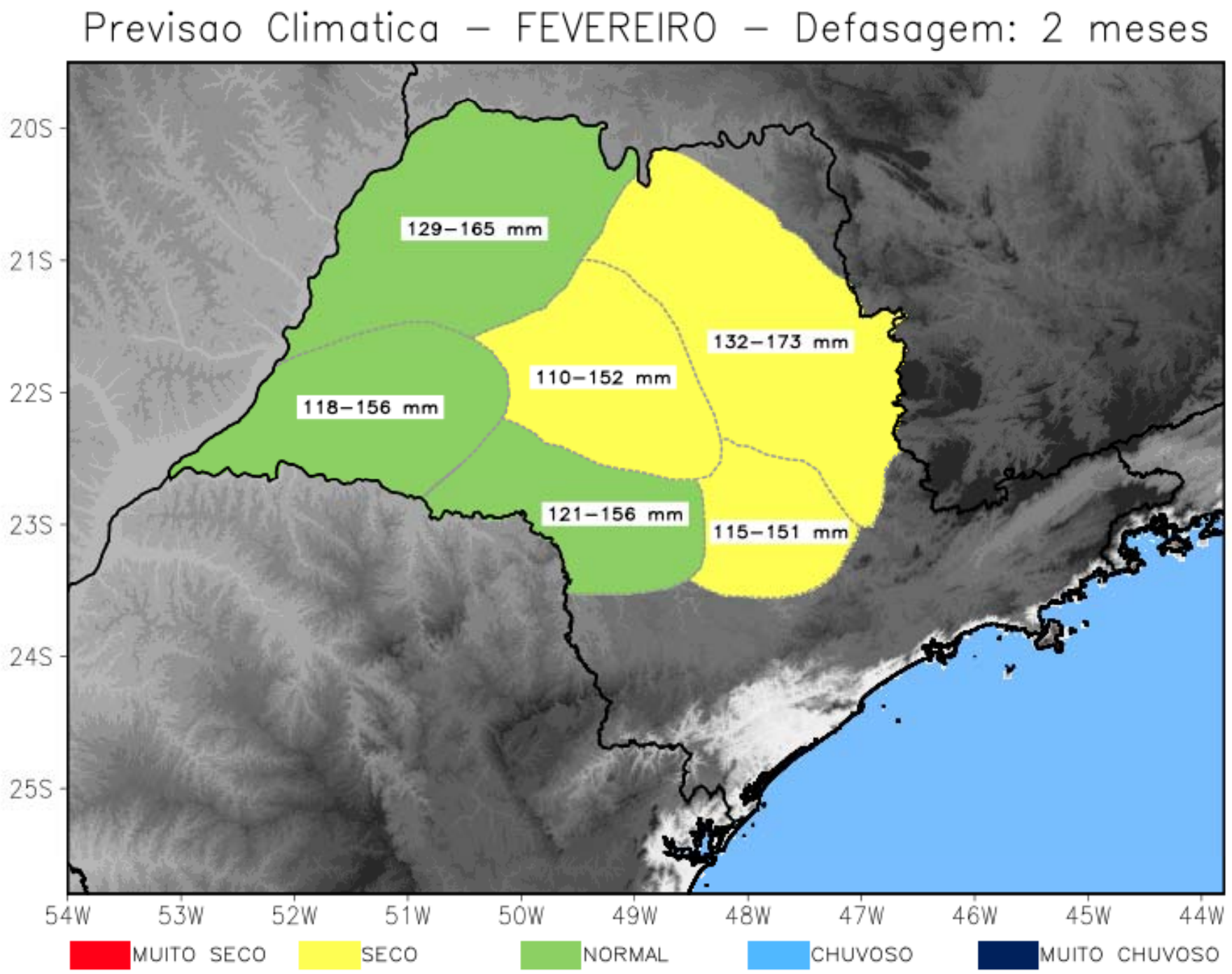
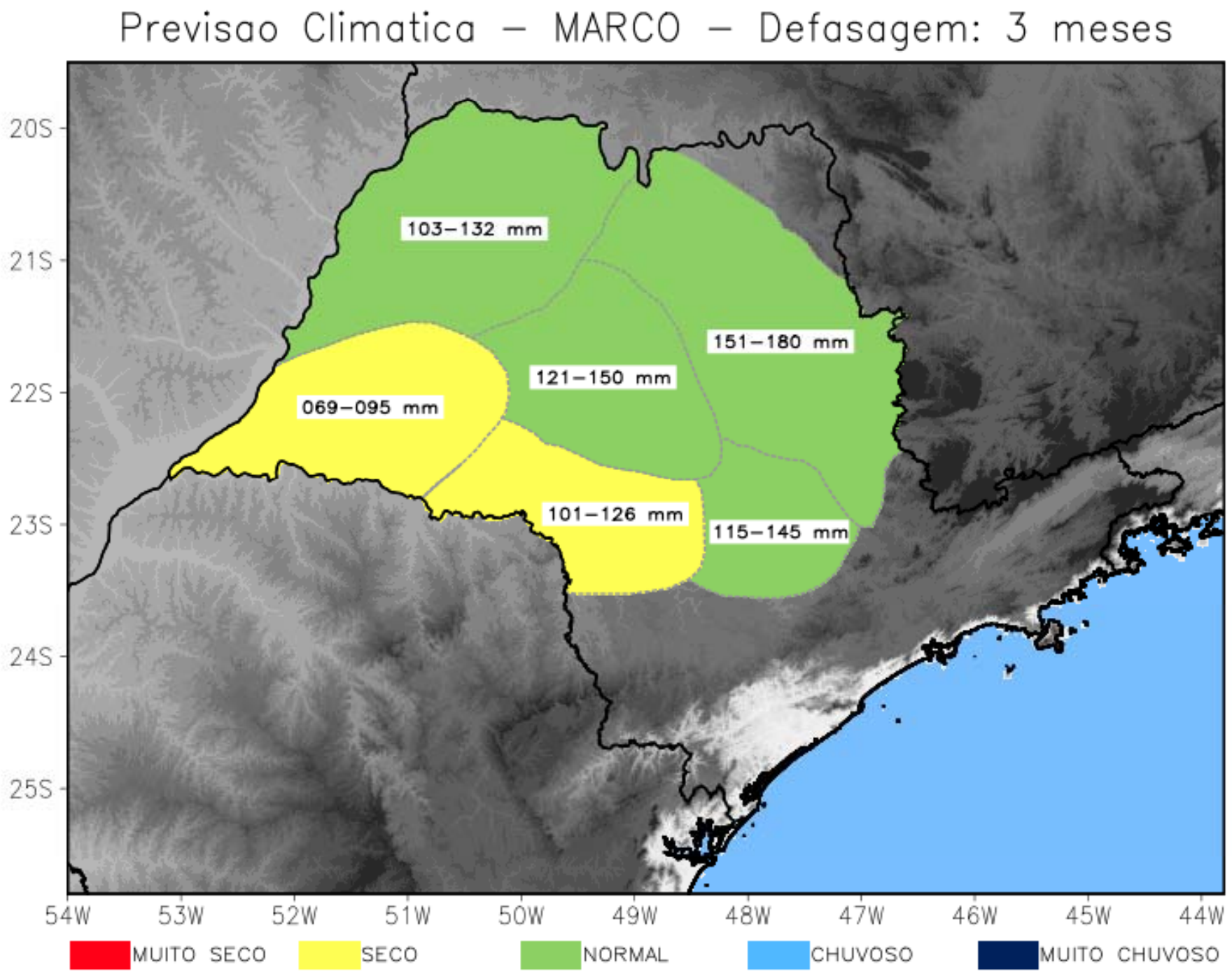
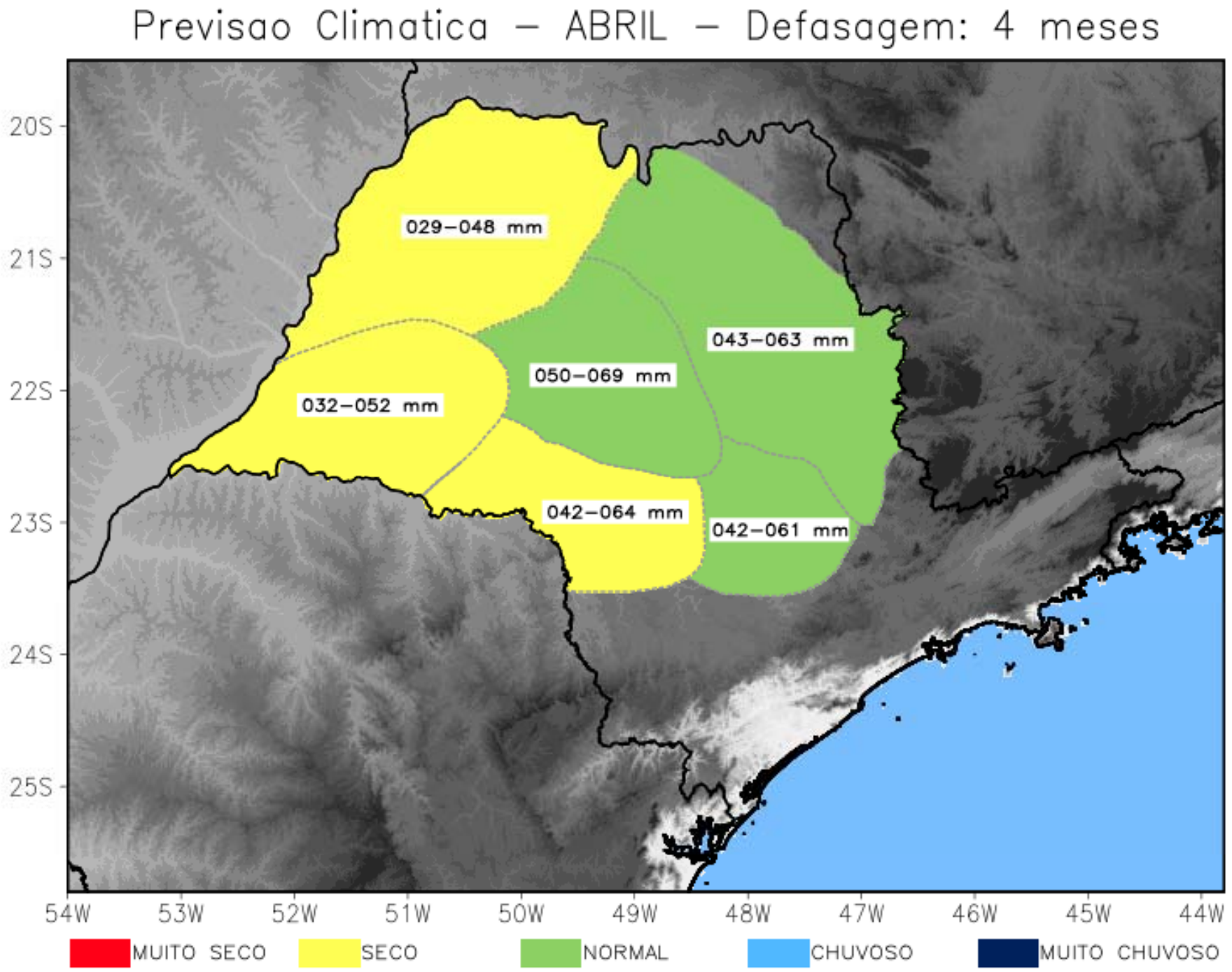



Previsao Climatica – AREAS
1
2
3
4
5
6
20S
21S
22S
23S
24S
25S
54W
53W
52W
51W
50W
49W
48W
47W
46W
45W
44W


Previsao Climatica – JANEIRO – Defasagem: 1 mes
211–252 mm
222–268 mm
288–330 mm
282–325 mm
240–292 mm
242–286 mm
20S
21S
22S
23S
24S
25S
54W
53W
52W
51W
50W
49W
48W
47W
46W
45W
44W
MUITO SECO
SECO
NORMAL
CHUVOSO
MUITO CHUVOSO

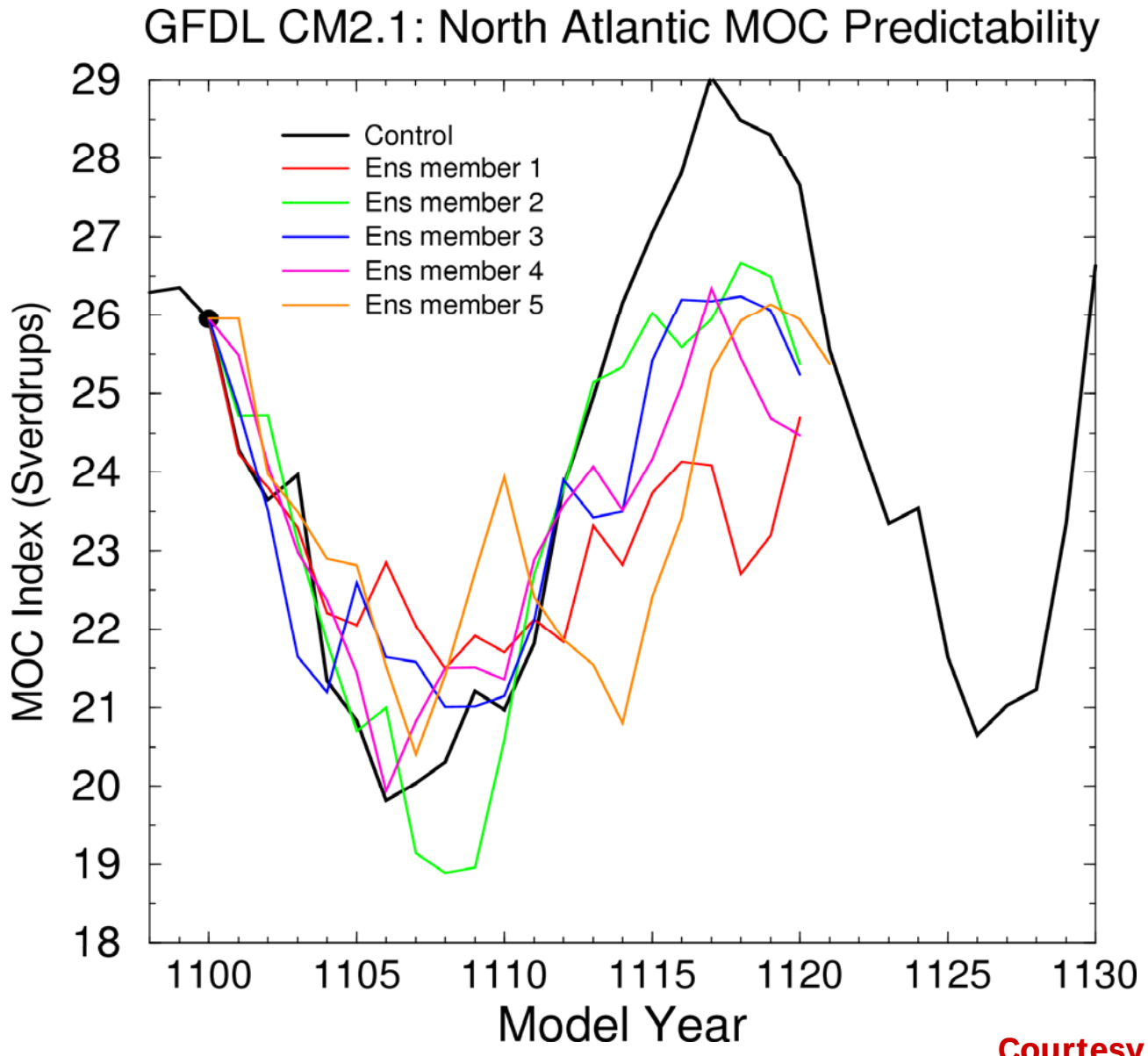

Previsao Climatica – FEVEREIRO – Defasagem: 2 meses
129–165 mm
132–173 mm
110–152 mm
118–156 mm
121–156 mm
115–151 mm
20S
21S
22S
23S
24S
25S
54W
53W
52W
51W
50W
49W
48W
47W
46W
45W
44W
MUITO SECO
SECO
NORMAL
CHUVOSO
MUITO CHUVOSO


Previsao Climatica – MARCO – Defasagem: 3 meses
103–132 mm
151–180 mm
121–150 mm
069–095 mm
101–126 mm
115–145 mm
20S
21S
22S
23S
24S
25S
54W
53W
52W
51W
50W
49W
48W
47W
46W
45W
44W
MUITO SECO
SECO
NORMAL
CHUVOSO
MUITO CHUVOSO


Previsao Climatica – ABRIL – Defasagem: 4 meses
029–048 mm
032–052 mm
050–069 mm
043–063 mm
042–064 mm
042–061 mm
20S
21S
22S
23S
24S
25S
54W
53W
52W
51W
50W
49W
48W
47W
46W
45W
44W
MUITO SECO
SECO
NORMAL
CHUVOSO
MUITO CHUVOSO

- **Need continuous monitoring and interaction with user:**
- **Understand what type of need is required at any particular time**

Decadal Predictability circa 2007



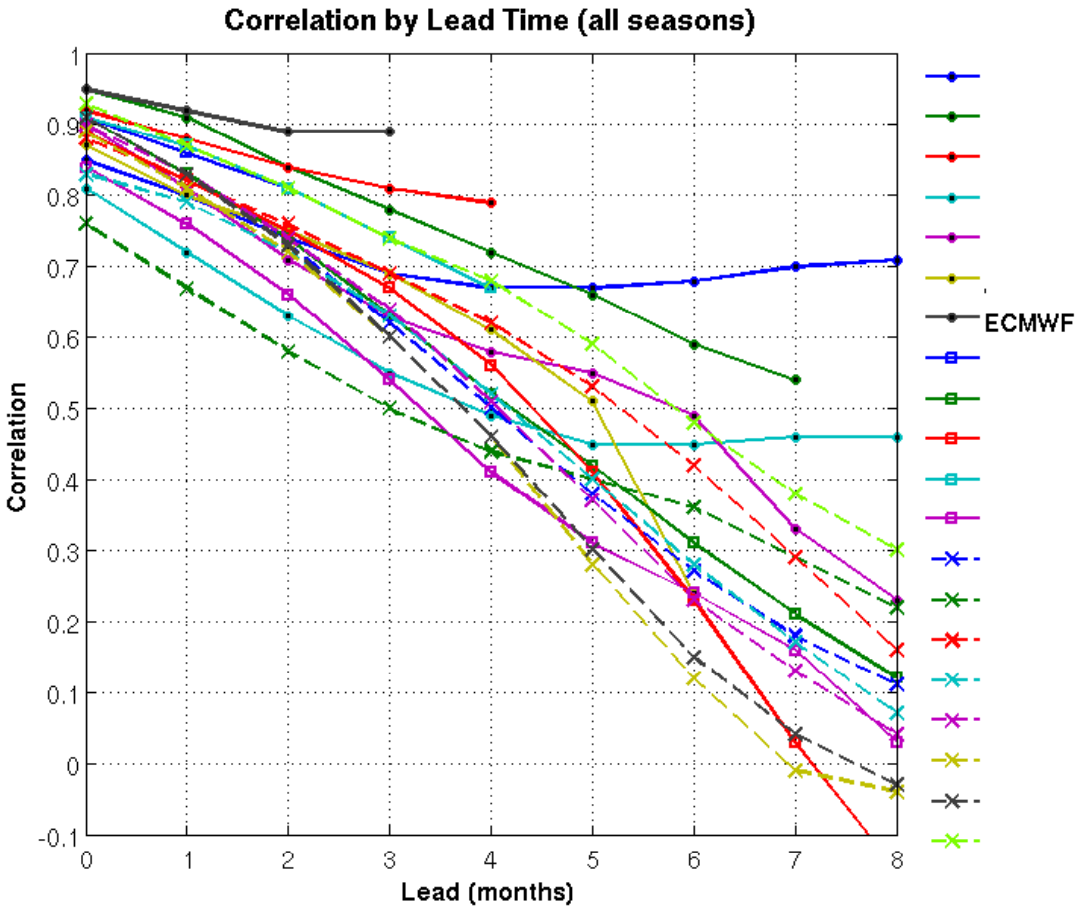
Perturbed ensemble members evolve coherently for two decades

Courtesy of Tom Delworth

ENSO skill: comparison with other seasonal fc. systems

NINO3.4
Anomaly
Correlation

3-month
running
means



From: Barnston et al. 2011: Skill of Real-time Seasonal ENSO Model Predictions during 2002-2011—Is Our Capability Increasing? BAMS, accepted.

Predictability Problems Still Exist

- Progress can be made with current biases
- Better models are coming
- Models can be useful in estimating predictability of climate variations and forced climate response
- Beyond weather to ENSO is the predictable component useful? - indications that yes – decadal predictability beginning to show up!

Conclusion - 1

Possible improvements:

- Add more members – improving estimate of uncertainties associated with model: weather forecasting (TIGGE), climate forecasting (IRI, Eurobrisa…) and IPCC; (very high computational cost!!!)
- Application of Estimation Theory techniques for identifying optimal estimates (Bayesian techniques, ensemble Kalman filters….);

Conclusion - 2

- ***Can we meet expectations from users?***

- Not quite because many don't have a clear understanding of what is "uncertainty".

- For those that do know how to cope with uncertainty, we can help!!!! - RAIZEN example is encouraging. And there are may more.

- There is room for operational, academic and private sectors : we need much better interaction!!!! -> role of Conference