

# FISH50:Florida Climate Institute Seasonal Hindcasts at 50km grid resolution

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# Objectives

- What is FISH50?
- Deterministic forecast results
- Probabilistic forecast results
- Comparison of FISH50 with NMME models

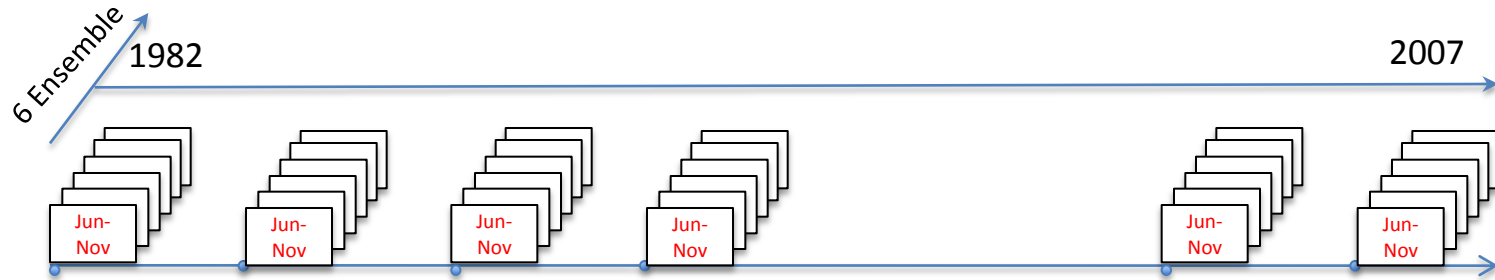
# FISH50 Design

- FISH50 have been done for the period 1982-2008 (plans are to update to 2012)
- The seasonal hindcasts have been initiated in the last (first) week of May (June) of each year
- Each seasonal hindcast has 6 ensemble members (to account for uncertainty in forecasts)
- Each seasonal hindcasts is for a duration of 6 months.
- So a June forecast is 0 month lead, July forecast is 1 month lead...., November forecast is 5 month lead
- Or alternative June-July-Aug is 0 season lead FISH50 and Sept-Oct-Nov is 1 season lead FISH50
- Similar winter seasonal hindcasts initiated in last (first) week of November (December) of each year for 1982-2008 is underway.

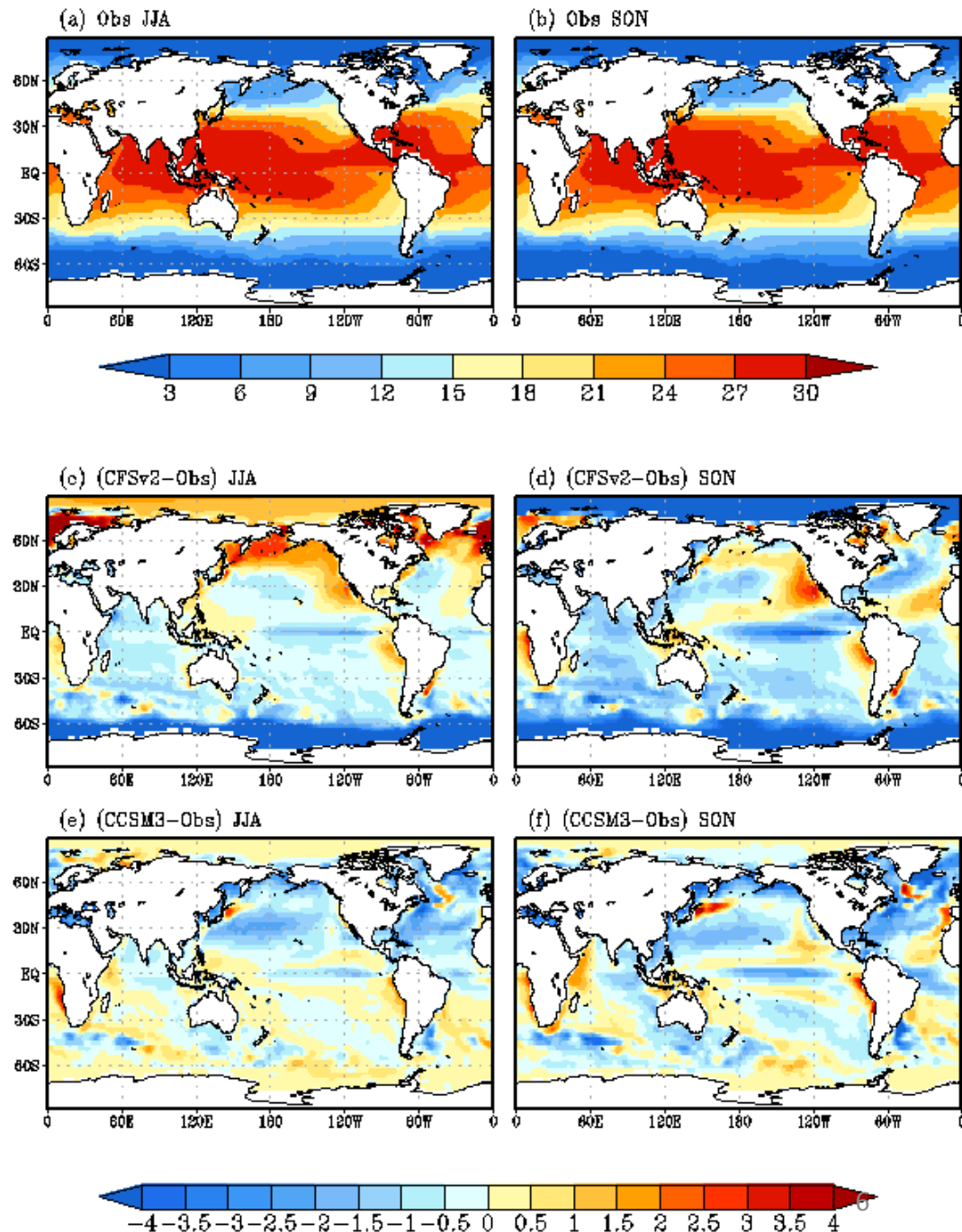
# FISH50 features

- They are global forecasts and run at 50km grid resolution
- We use two models of the NMME monthly mean bias corrected (in a special way) SST forecast to make FISH50

# FISH50: Florida Climate Institute-FSU Seasonal Hindcast at 50 Km



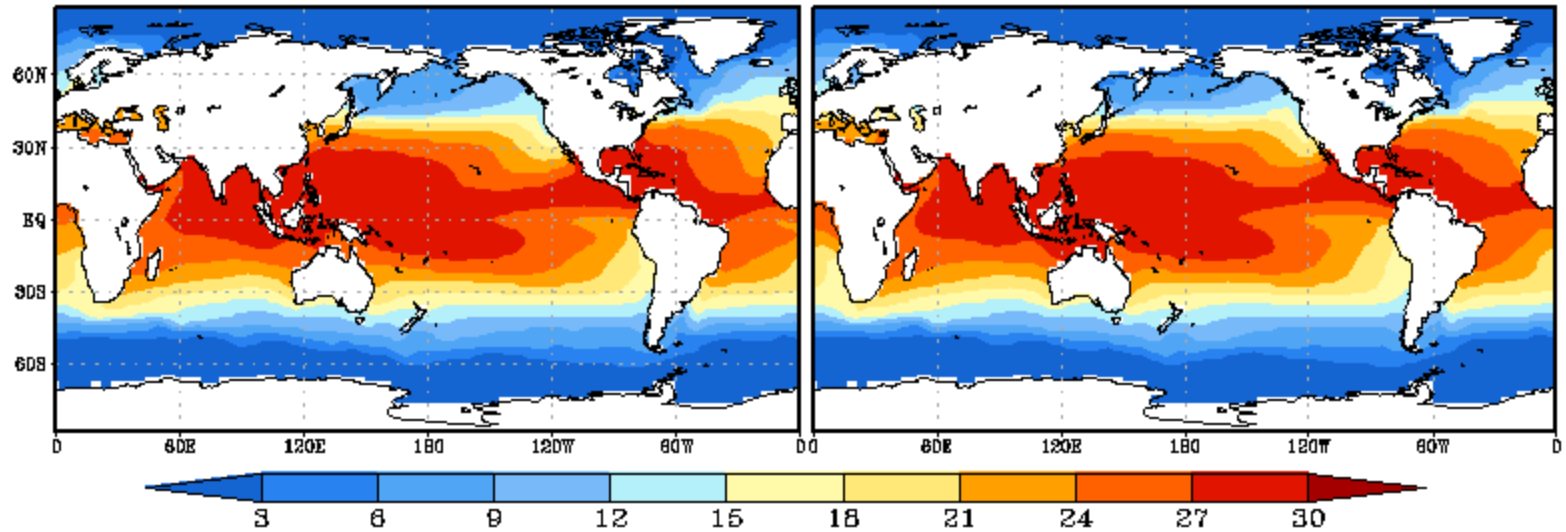
Boreal Summer/Fall (1982-2008) SST climatology from observation, and the bias from CFSv2 and CCSM3 relative to observation



# ERSSTv3 climatology (1955-1981) in JJA and SON

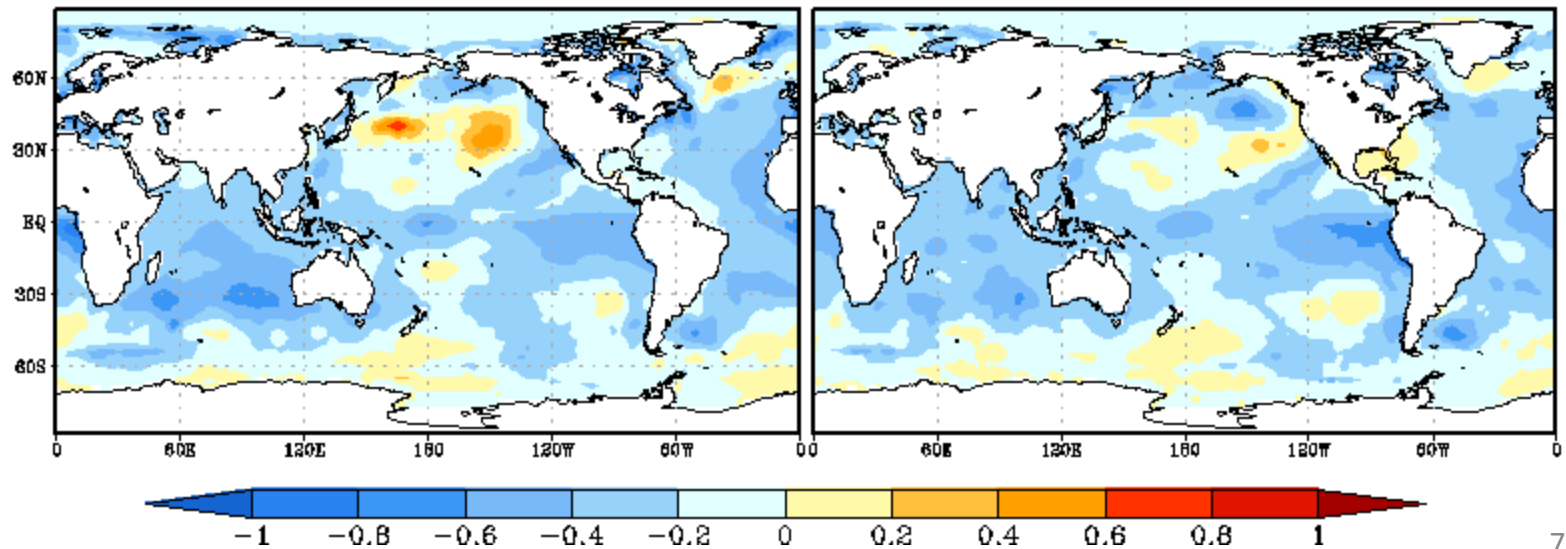
(a) (1955-1981) JJA

(b) (1955-1981) SON



(c) (1955-1981)-(1982-2008) JJA

(d) (1955-1981)-(1982-2008) SON



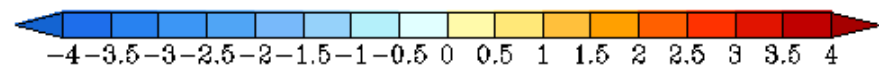
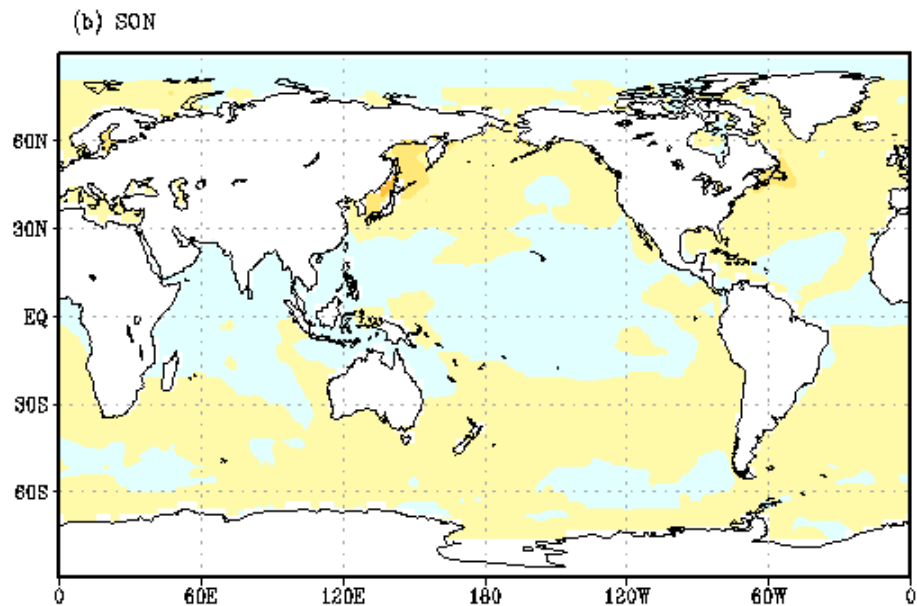
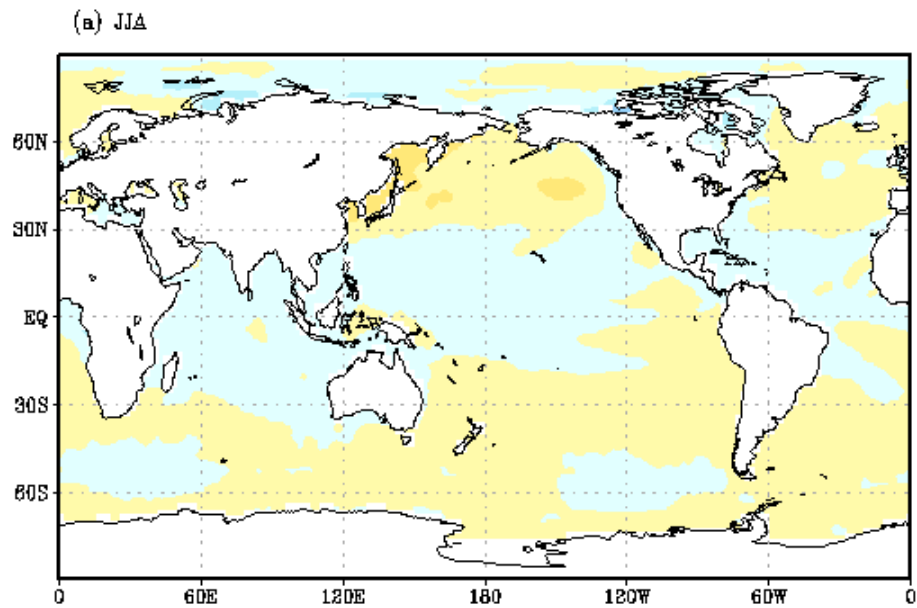
Climatological SST bias (1982-2008) in JJA (at zero lead) and SON (one season lead) from FISH50.

$$SST_F = SST_{OLF} + SSTA_{MME}$$

$SST_F$ : is used in FISH50

$SST_{OLF}$ : is the observed low pass filtered SST used to replace the model climatology

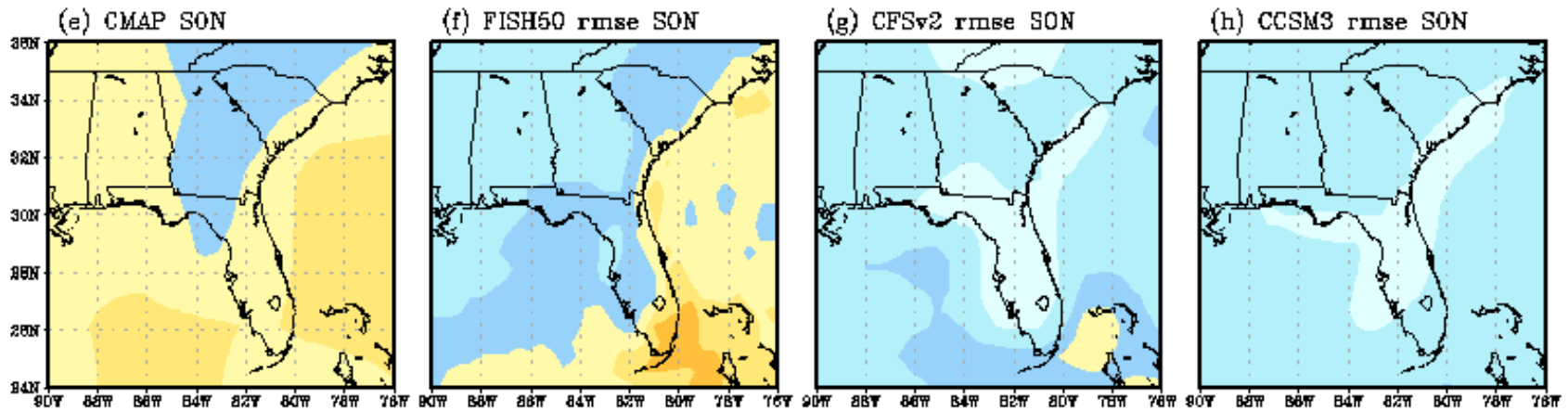
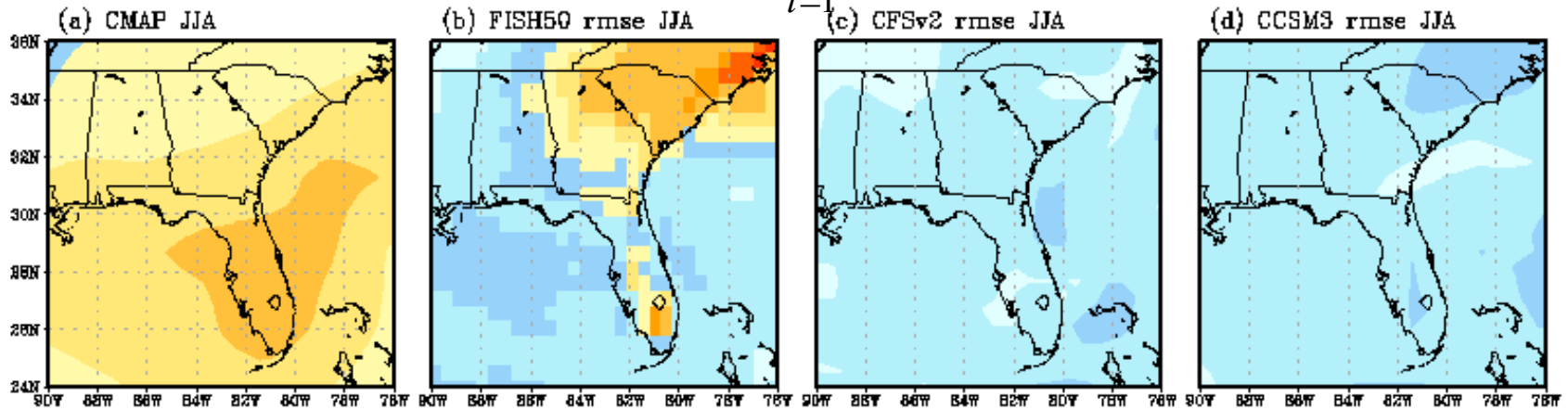
$SSTA_{MME}$ : is the multi-model forecast SST anomaly from CFSv2 and CCSM3



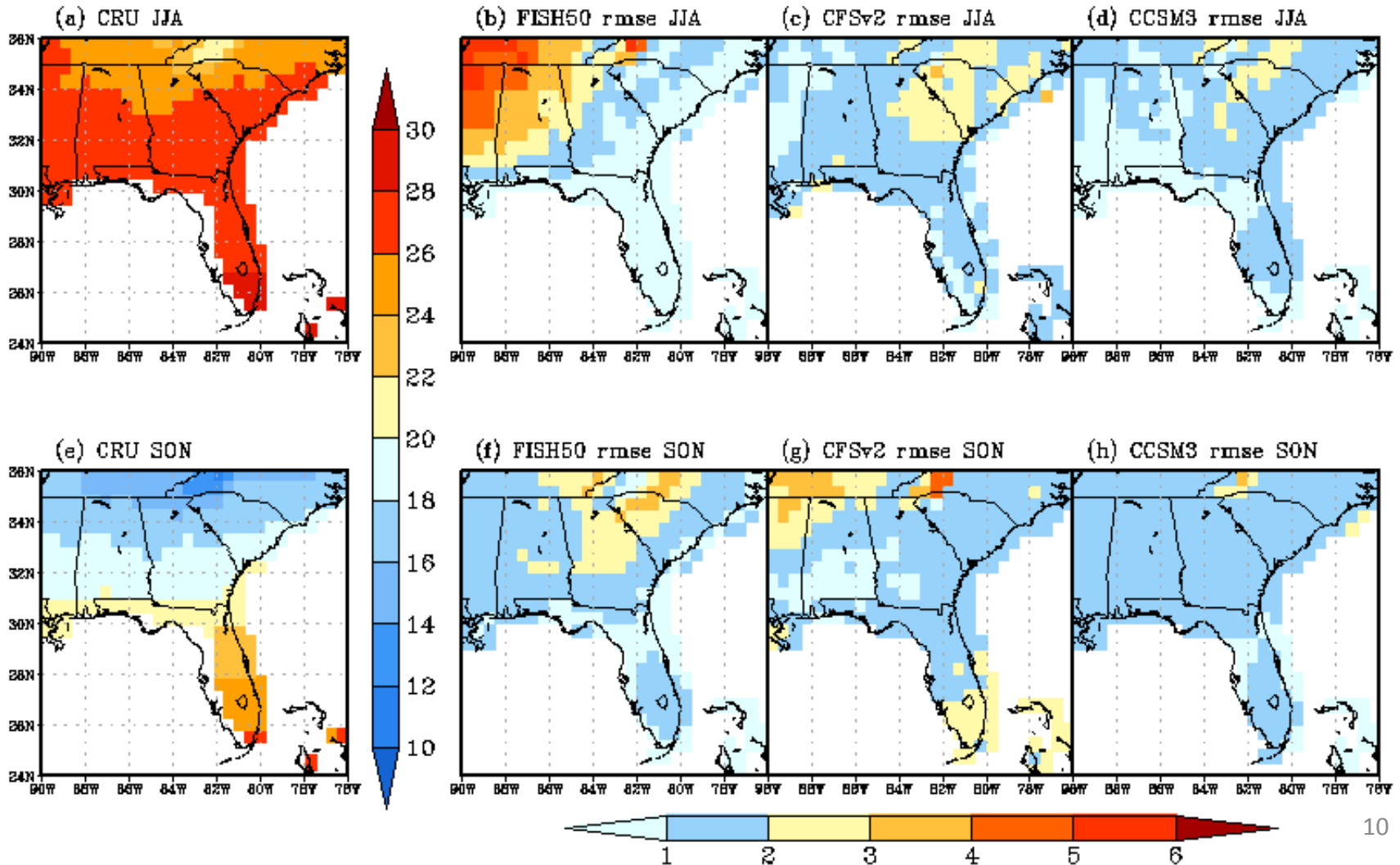


Observed climatology of precipitation in JJA and SON, and the RMSE of ensemble mean precipitation from FISH50, CFSv2 and CCSM3.

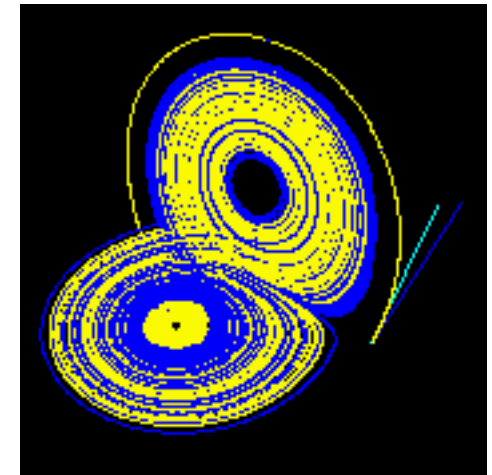
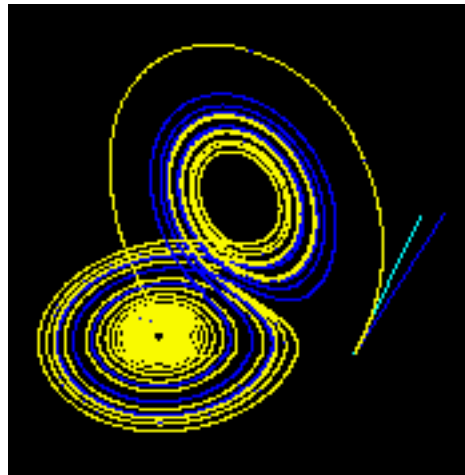
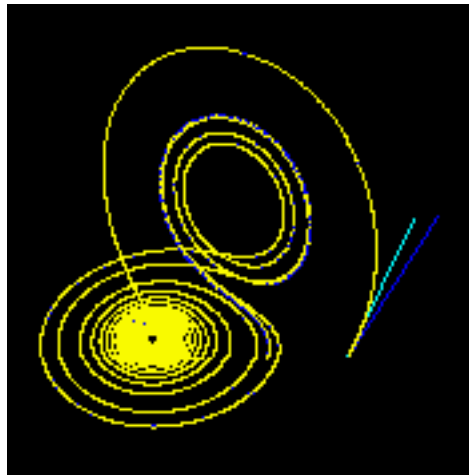
$$RMSE = \frac{1}{N} \sum_{i=1}^{N(=27\text{years})} (M_i - O_i)^2$$



# Observed climatology of surface temperature in JJA and SON, and the RMSE of ensemble mean precipitation from FISH50, CFSv2 and CCSM3.



“The flap of a butterfly wing in the Amazon could cause a hurricane in the Atlantic” Dr. Ed Lorenz, Father of CAOS



3-D evolution of the 2 trajectories starting at two initial points  
Initial conditions were different by only by  $10^{-5}$  in the x-coordinate.

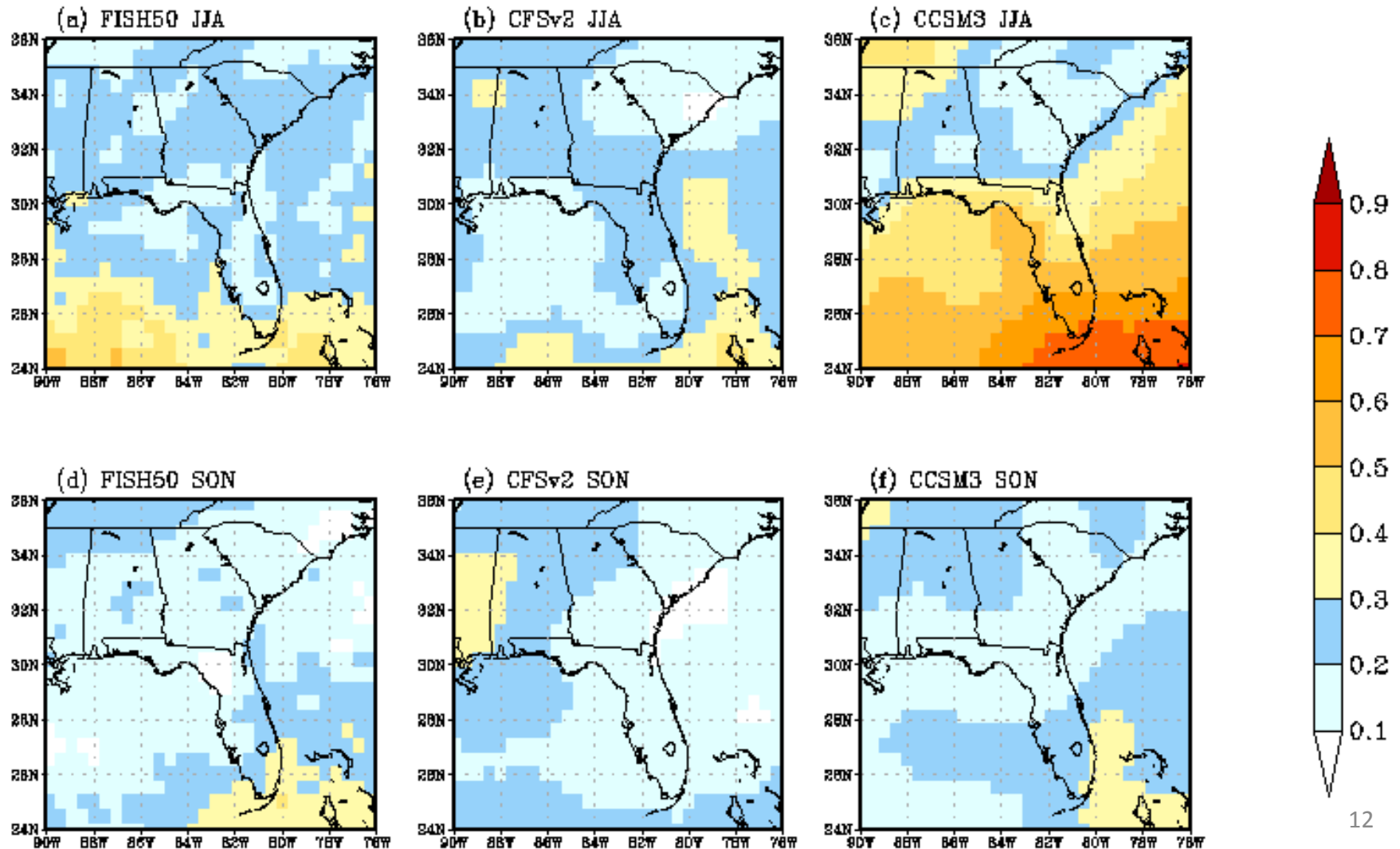
The divergence of the solutions happen because

- The model is non-linear
- The model is imperfect
- The initial conditions from when the model is started is imperfectly known

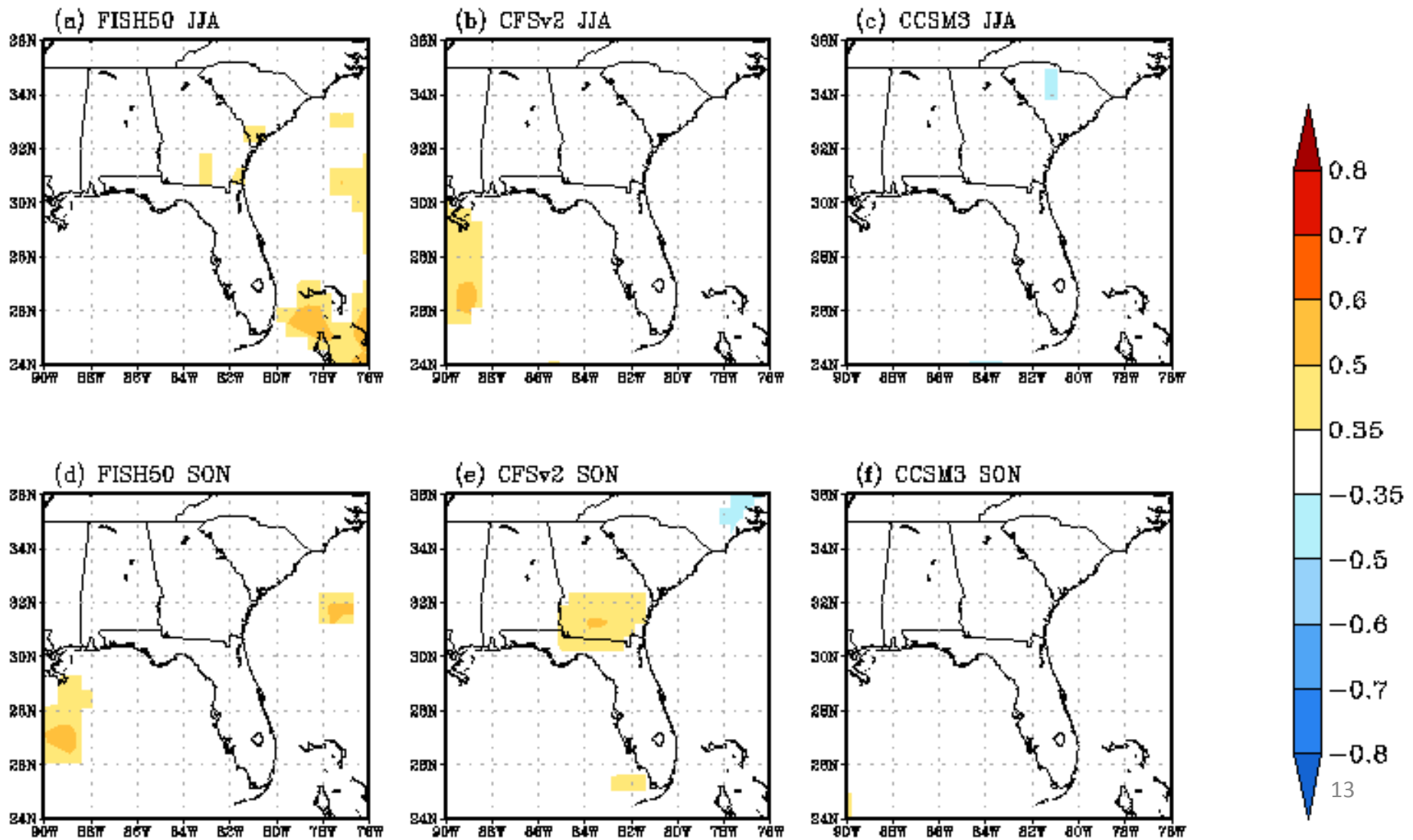
If any of the above conditions are not met then divergence of solution will occur.

But if you have have non-linear model but the model is perfect and initial conditions are known that the blue and yellow trajectories will be indistinguishable.

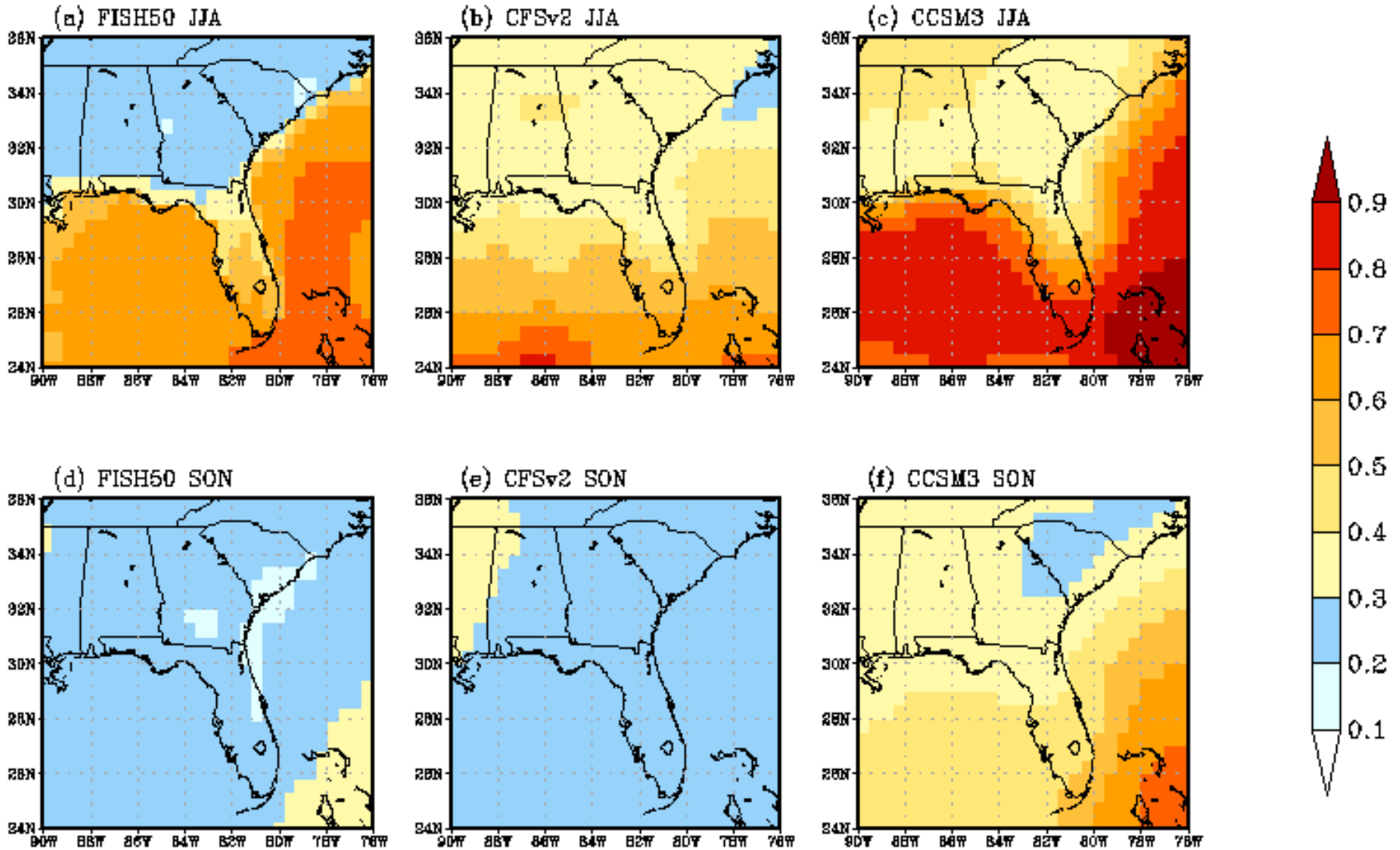
The signal to noise ratio of precipitation for JJA and SON from FISH50, CFSv2 and CCSM3.



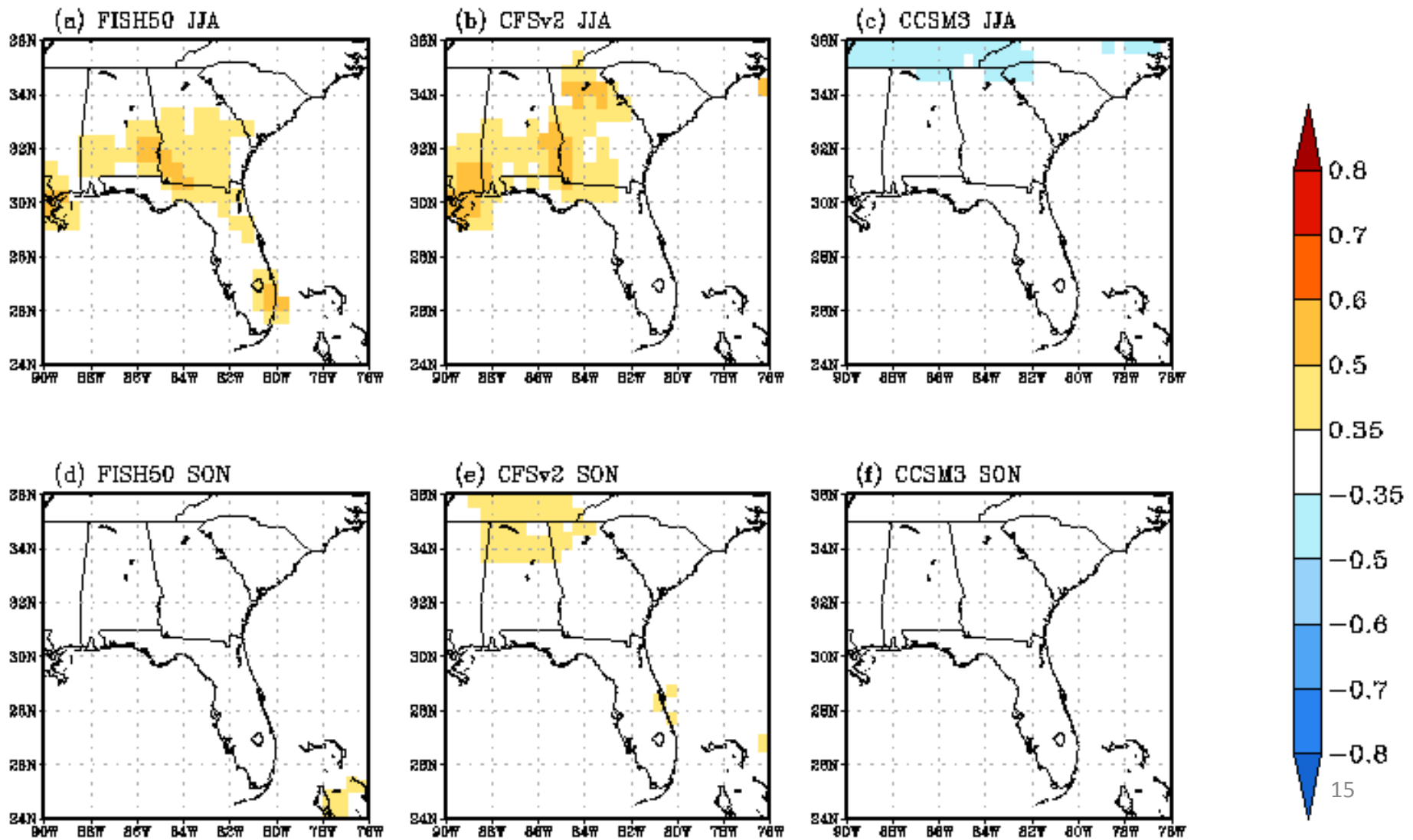
The correlation of ensemble mean precipitation for JJA and SON from FISH50, CFSv2 and CCSM3.



# The signal to noise ratio of surface temperature for JJA and SON from FISH50, CFSv2 and CCSM3.



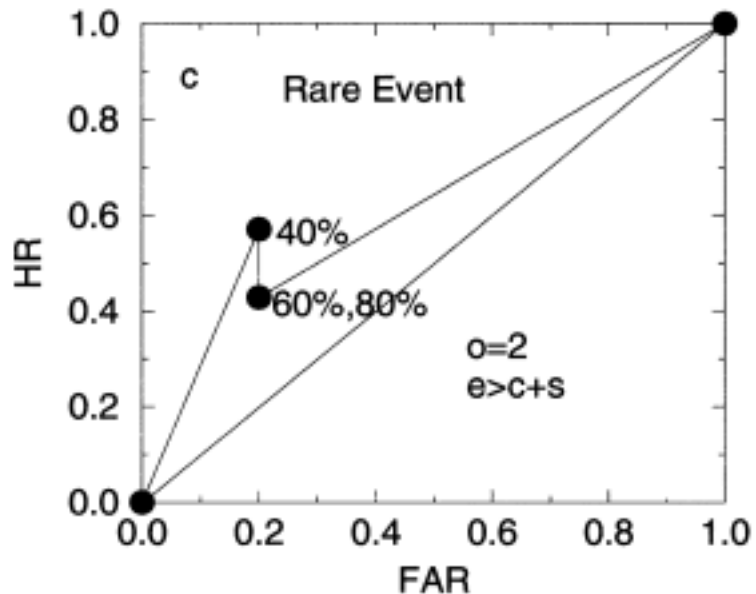
# The correlation of ensemble mean surface temperature for JJA and SON from FISH50, CFSv2 and CCSM3.



# Probability forecast

Contingency Table

Is the event observed?	Does the ensemble probability for the event exceed the threshold?	
	Yes	No
Yes	Hit (H)	Miss (M)
No	False Alarm (FA)	Correct Rejection (CR)



$$HR \equiv HitRate = \frac{H}{H + M}$$

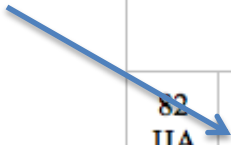
$$FAR \equiv FalseAlarmRate = \frac{FA}{FA + CR}$$

So if area under the curve exceeds 0.5 then it is better than climatology (represented by the diagonal).



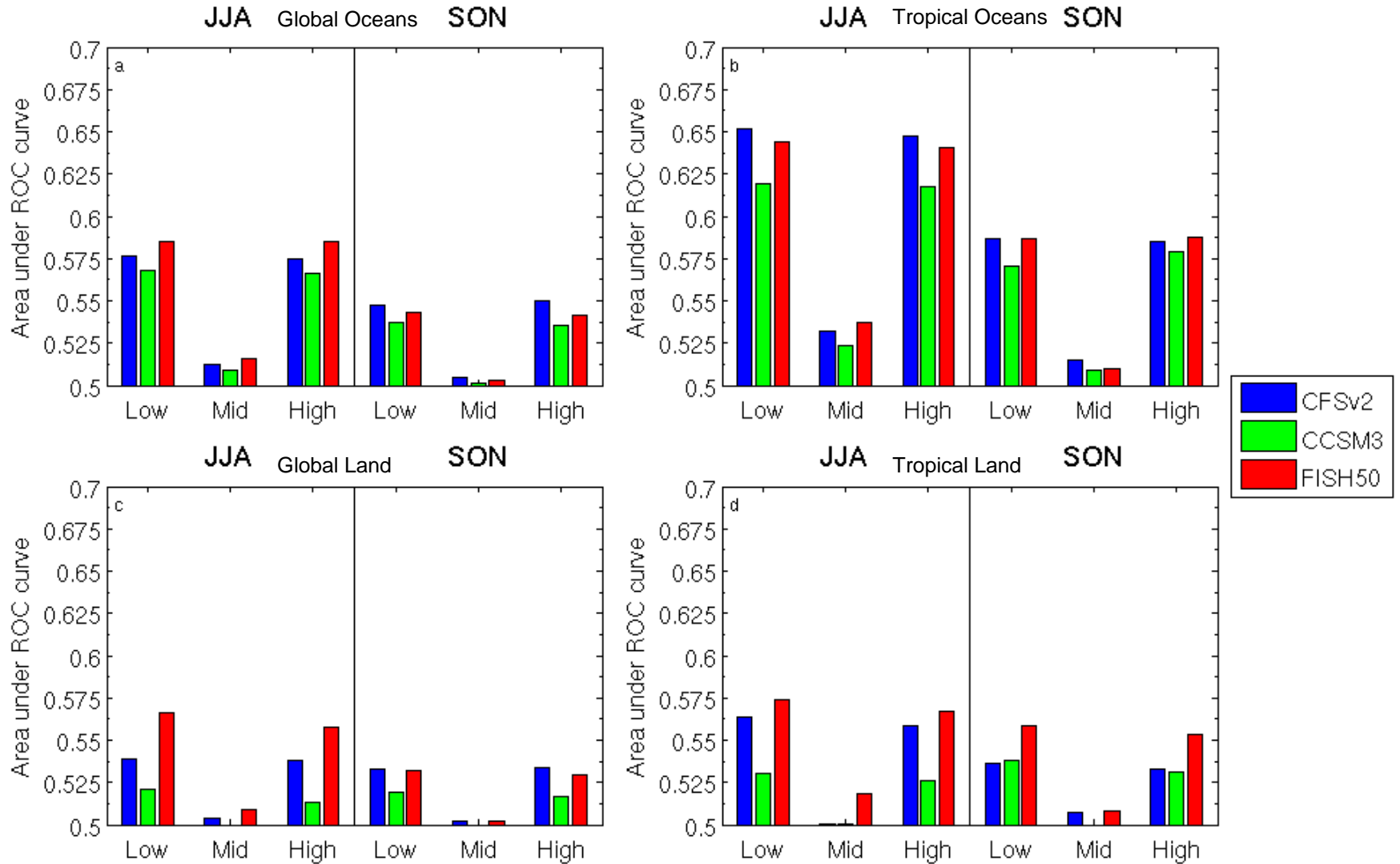
Example: There are 6 ensemble members for 9 seasons (83-90) and the event we are trying to verify our forecasts for, is JJA rainfall anomaly in the upper quartile.

This column represents the number of ensemble members out of 6 which forecast the event for the JJA season for a particular grid point.



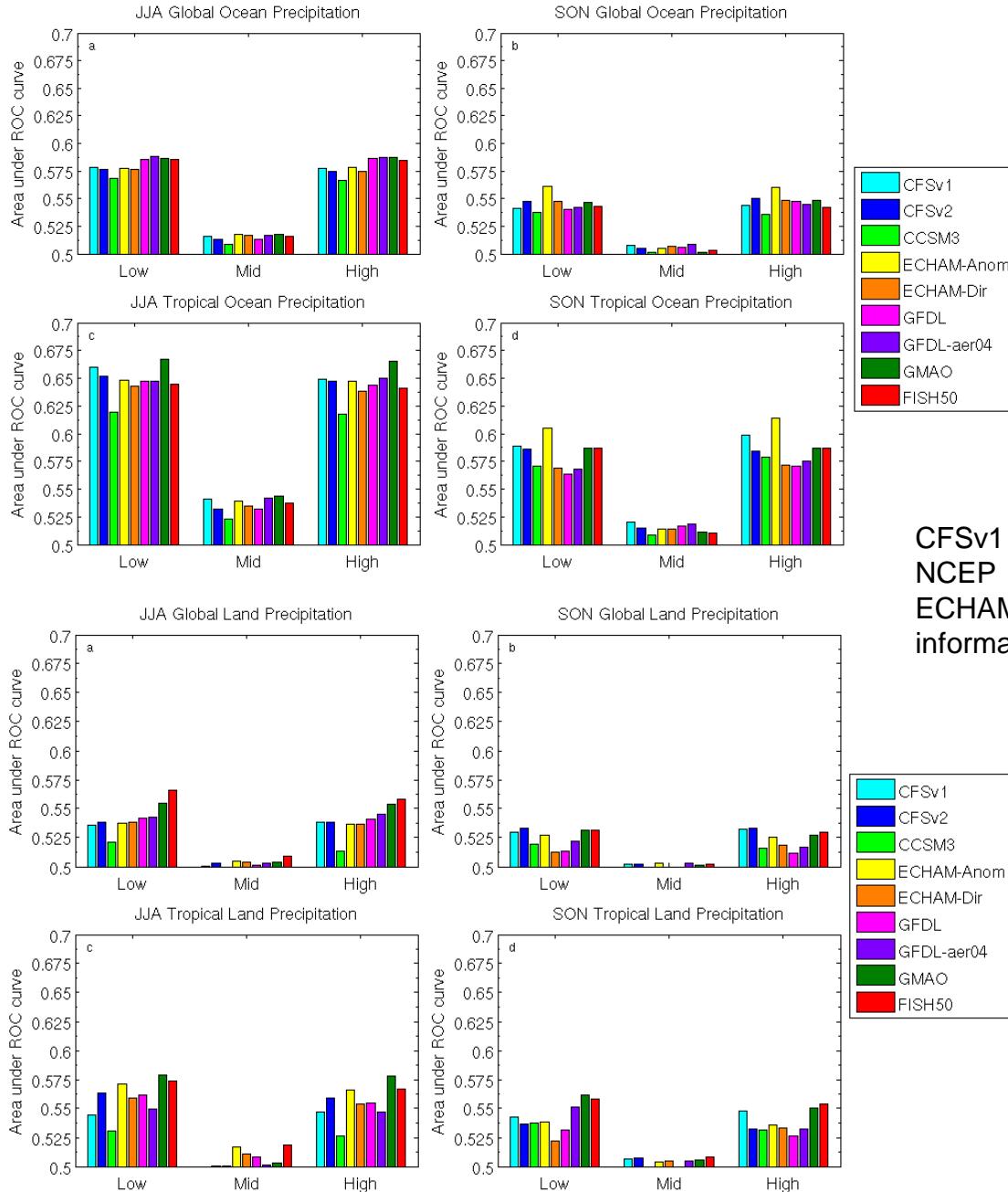
Is the event observed?			Do 1/6 <sup>th</sup> of the ensemble members forecast the event?	Do 2/6 <sup>th</sup> of the ensemble members forecast the event?	Do 3/6 <sup>th</sup> of the ensemble members forecast the event?	Do 4/6 <sup>th</sup> of the ensemble members forecast the event?	Do 5/6 <sup>th</sup> of the ensemble members forecast the event?
82 JJA	2/6	Yes	H	H	M	M	M
83	2/6	No	FA	FA	CR	CR	CR
84	5/6	No	FA	FA	FA	FA	FA
85	4/6	Yes	H	H	H	H	M
86	3/6	Yes	H	H	H	M	M
87	1/6	No	FA	CR	CR	CR	CR
88	5/6	Yes	H	H	H	H	H
89	2/6	No	FA	FA	CR	CR	CR
90	1/6	Yes	H	M	M	M	M
HR	=H/(H+M)		5/(5+0)=1	4/(4+1)=4/5	3/(3+2)=3/5	2/(2+3)=2/5	1/(1+4)=1/5
FAR	=FA/(FA+CR)		4/(4+0)=1	3/(3+1)=3/4	1/(1+3)=1/4	1/(1+3)=1/4	1/(1+3)=1/4

# Area under ROC for precipitation forecast for.....



# How do we stack up with the rest of NMME

Area under ROC for precipitation forecast

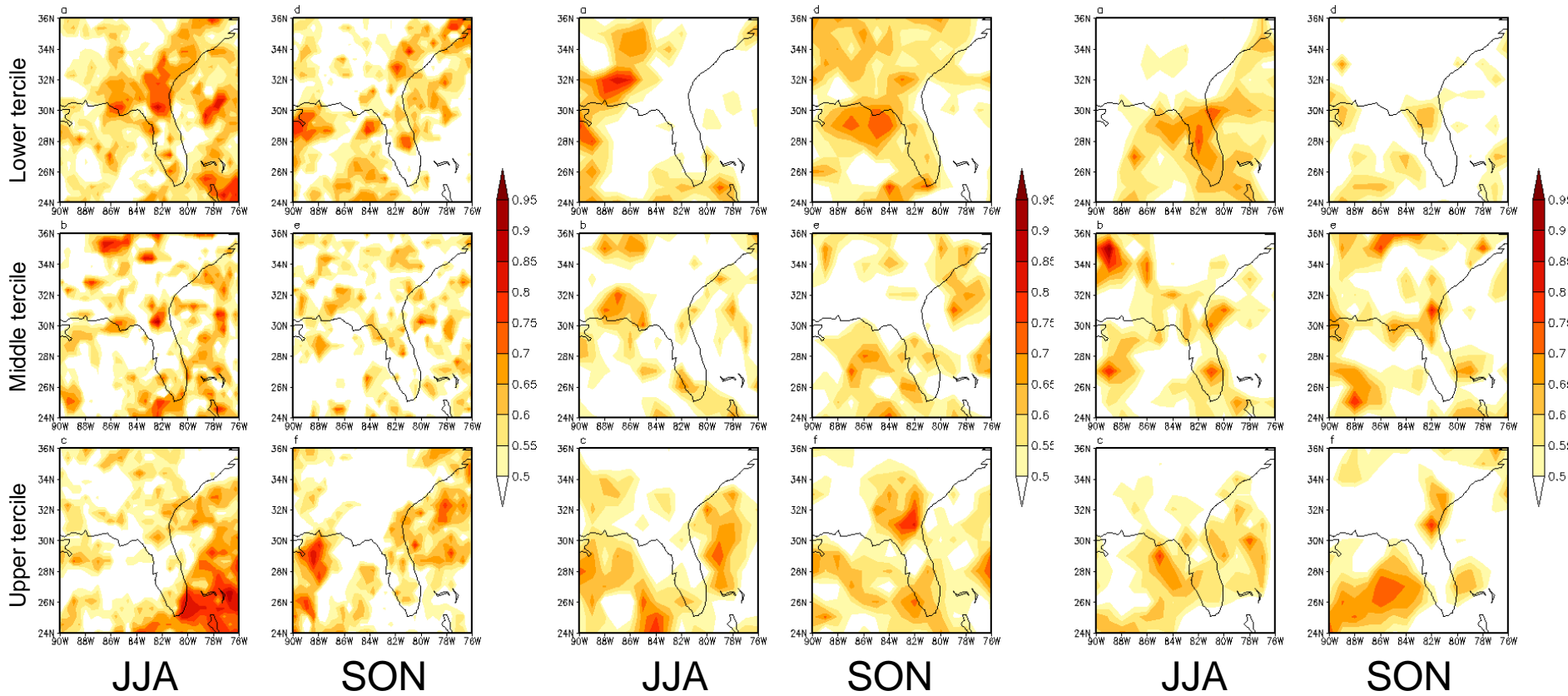


CFSv1 is decommissioned by NCEP  
 ECHAM-Anom has some future information used— “cheating”

# FISH50

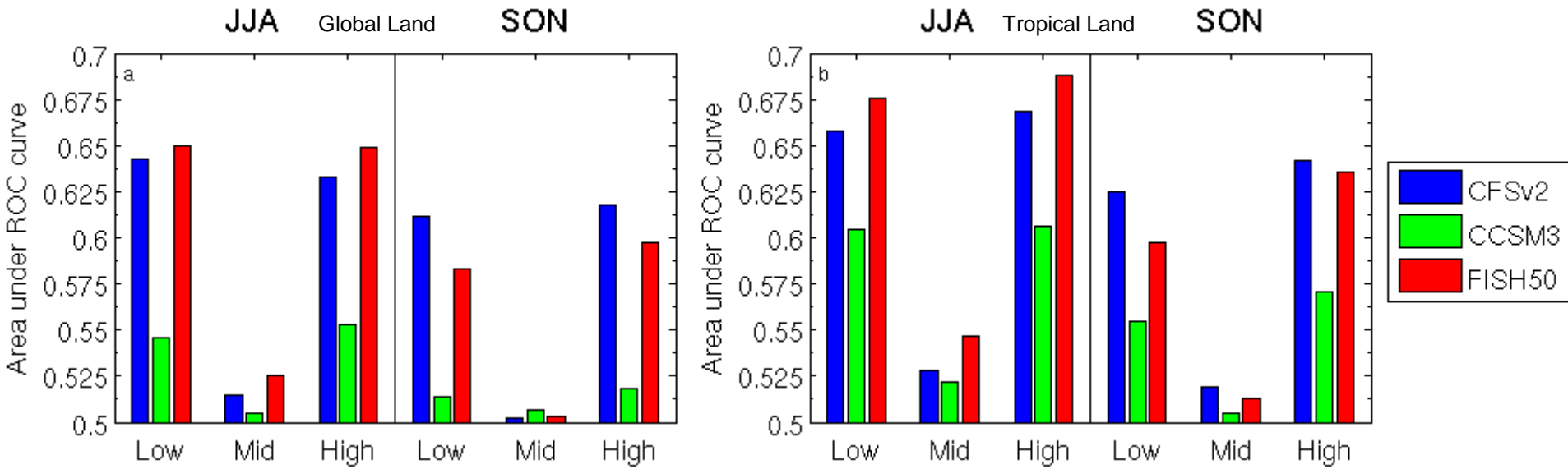
# CFSv2

# CCSM3



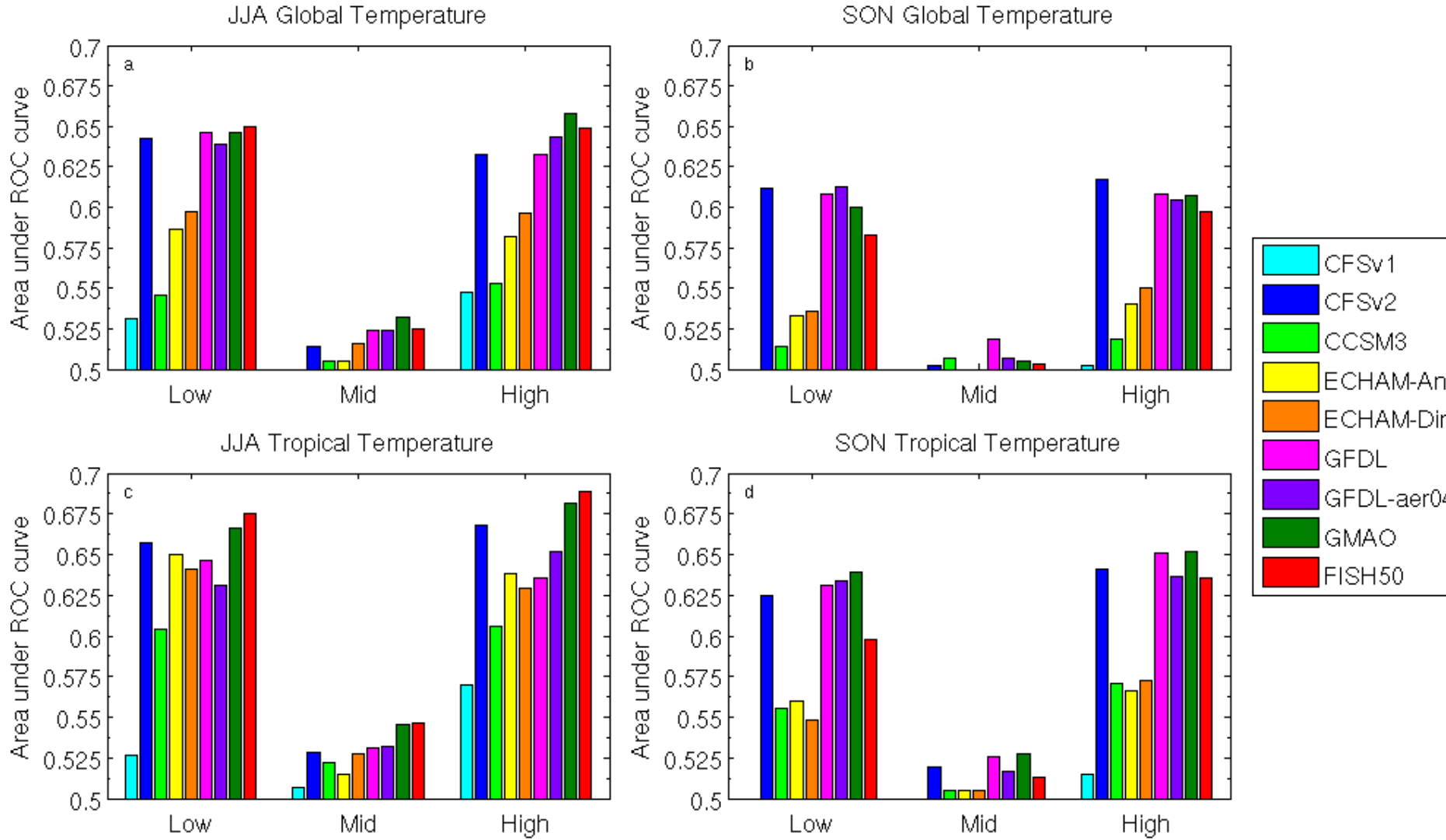
Area under the ROC for seasonal mean precipitation

# Area under ROC for surface temperature forecast for.....



# How do we stack up with the rest of NMME

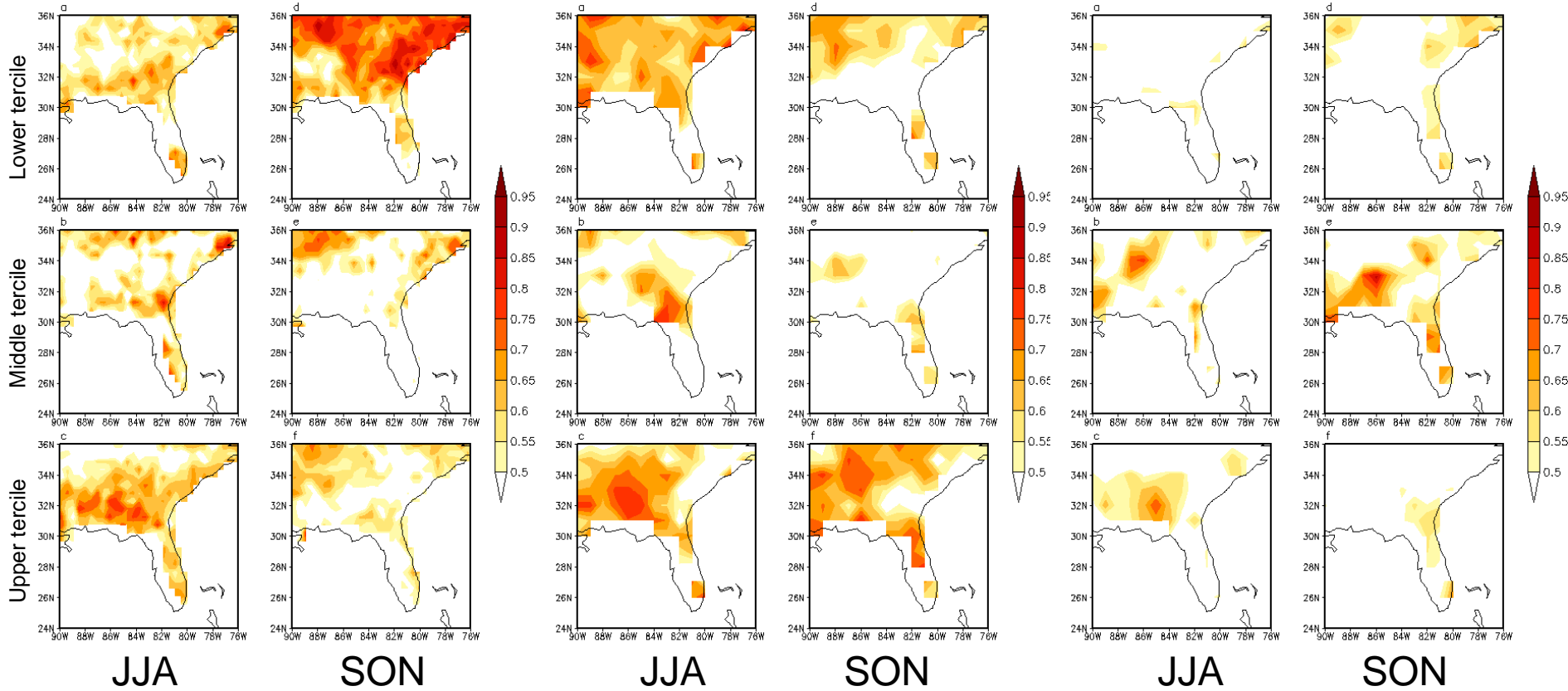
## Area under ROC for surface temperature forecast



# FISH50

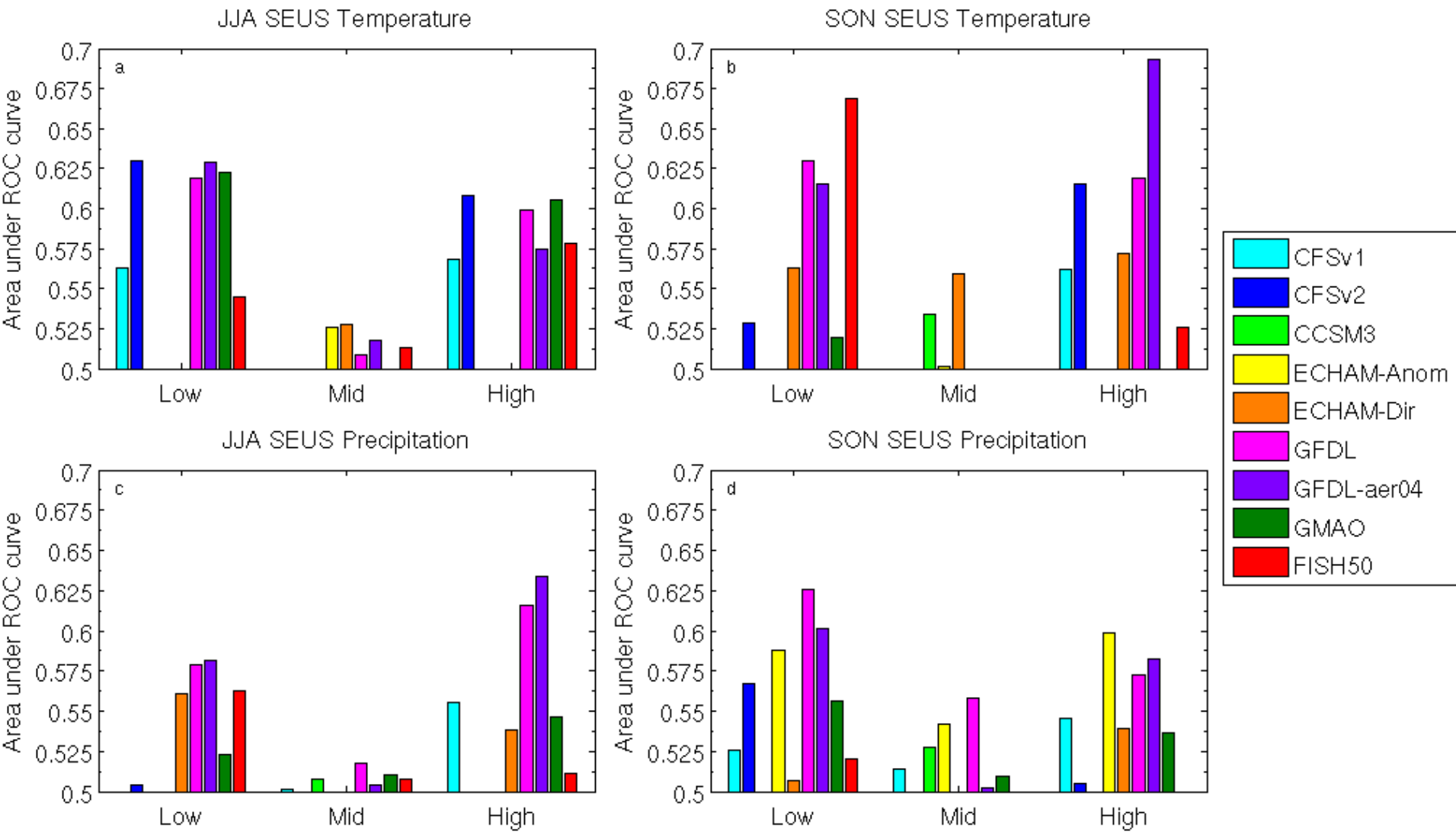
# CFSv2

# CCSM3



Area under the ROC for seasonal mean temperature

# How do we stack up with the rest of NMME for the Southeastern US

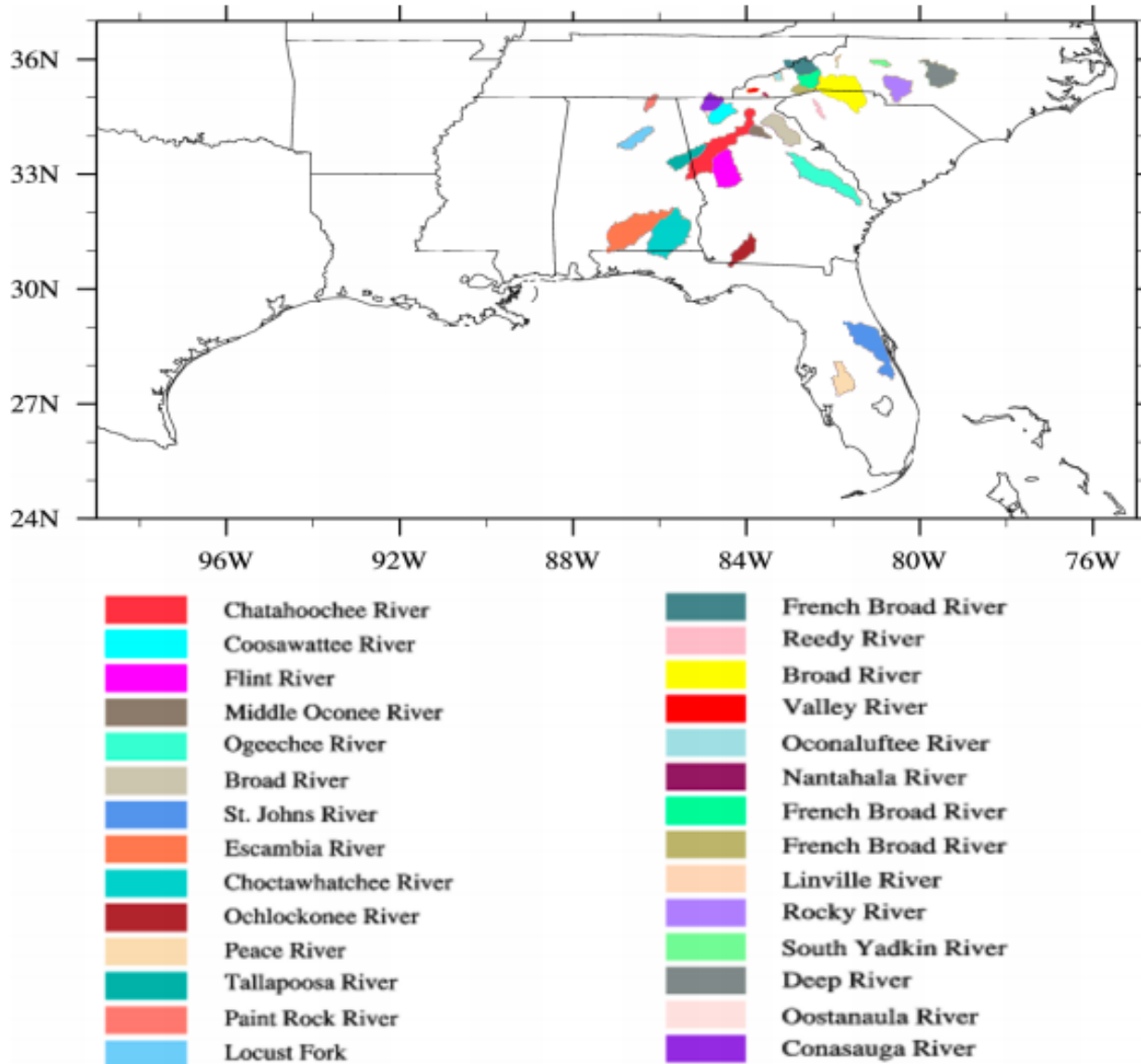


Remember any color that appears in this picture suggests that model forecast is better than climatology. Absence of any color also means that models are poorer than climatology.

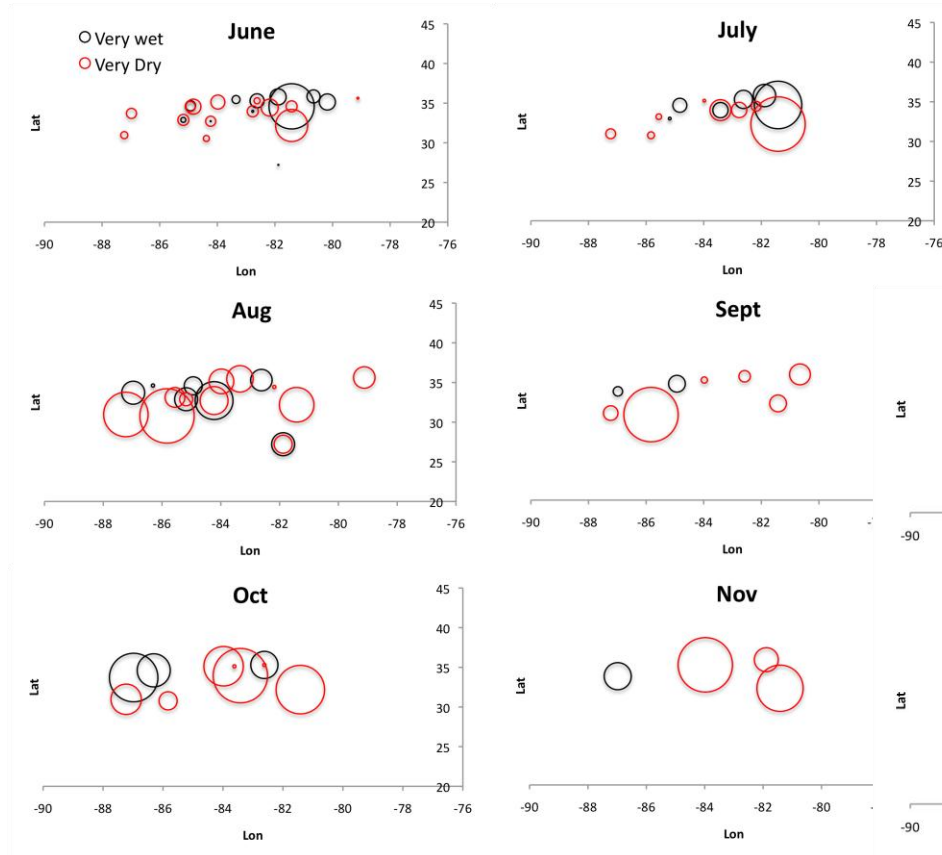


# Implication from FISH50 results

The watersheds



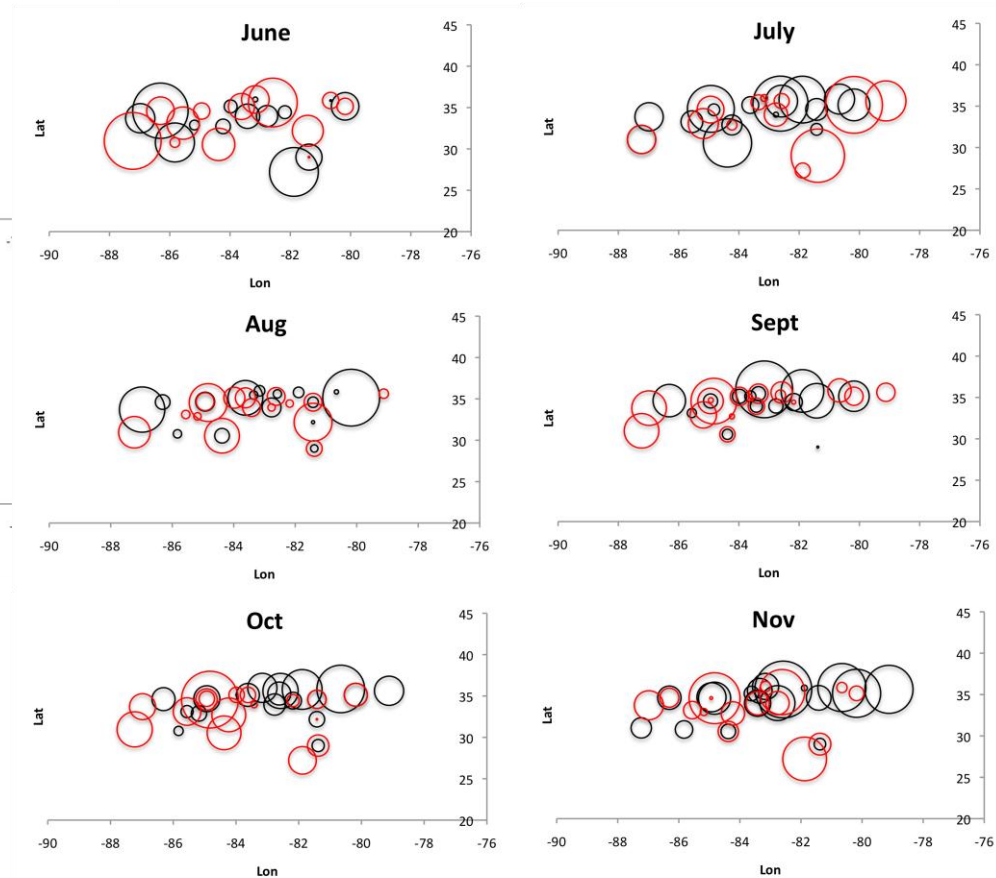
# Area under ROC curve: Resample from historical observation using FISH50



AROC for intermediate quartiles

AROC for extreme quartiles

Appearance of bubble means that the forecast from FISH50 is better than climatology for that watershed.



# Conclusions

- Probabilistic seasonal climate forecasts is the way to go
- FISH50 is demonstrating that we can make credible seasonal forecasts of streamflow over several watersheds in the southeastern US that is better than just saying that rainy season is in the summer and dry season is in the winter.
- Other models in NMME should potentially be used in addition to FISH50 for the SEUS
- FISH50 could probably be further improved, but for the moment this is a home run!
- Remember this is just the summer and fall forecasts. The winter and spring forecasts is anticipated to be much better!

# Issues to consider.....

- More ensemble members
- Start at different times of the year besides June 1 and December 1
- Improve FISH50 model