

# Improving seasonal forecast skill using a post-processing method

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# *Outline*

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*1. Motivation*

*2. Models and data*

*3. Post-processing method*

*4. Forecast skill before and after the post-processing*

*5. Summary*

# *Motivation*

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- *Main source of forecast skill beyond a few weeks*
  - *external forcing such as SST anomalies*
  - *response to external forcing is biased and model dependent*
- *Previous results*
  - *Lin et al. (2005): Z500 (DJF)*
  - *Lin et al. (2008): Canadian precipitation (DJF)*
- *How about other variables? seasons? areas?*

## *Models and data*

- *Historical Forecasting Project (HFP2)*
- *Four models used in the HFP2*
  - a) *2 climate models: GCM2 and GCM3*
  - b) *2 NWP models: SEF and GEM*
- *For each model, 10 members and four-month forecasts*
  - *JFMA, FMAM ... DJFM (1969 – 2001)*
- *The SST*
  - *SST anomaly of the previous month was persisted through the forecasts*
  - *added to the time-dependent climatological SST*

## *Models and data*

- *Here focus on:*
  - *Ensemble-mean of the 10 model integrations*
    - *forced signal*
  - *Average of first 3 months*
  - *Variables : SAT, precipitation*
  - *Domain : North America*
  - *Verification data: CRU TS 2.1 dataset*

# Post-processing method

- *SVD analysis*

- *use: the SST anomaly and the predicted Z500*

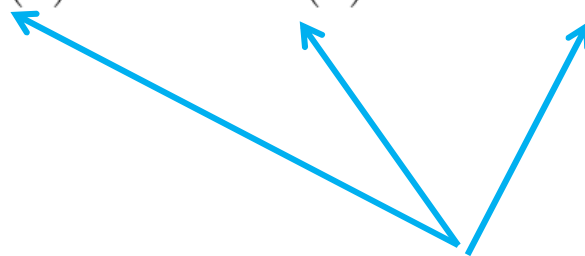
- *expansion coefficients of the Z500:  $C_1(t)$ ,  $C_2(t)$  and  $C_3(t)$*

- *For each grid point in space, the statistical model is:*

$$T_o(t) = a_1 C_1(t) + a_2 C_2(t) + a_3 C_3(t) + \epsilon$$



Observed variable of interest



From predictions

## *Post-processing method*

- *For the forecast year*

*After the dynamical forecast is done*

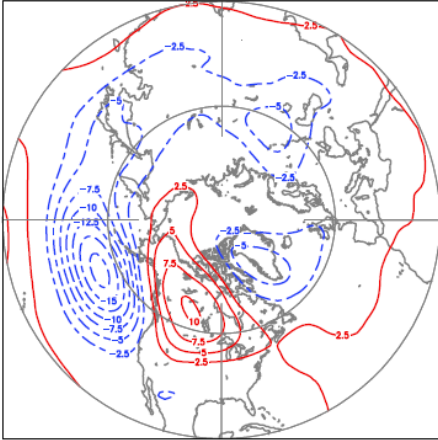
$$T(t_f) = a_1 C_1(t_f) + a_2 C_2(t_f) + a_3 C_3(t_f)$$

# SVD analysis

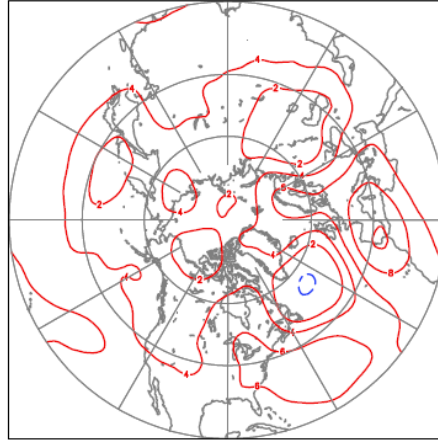
## GCM3

## NCEP

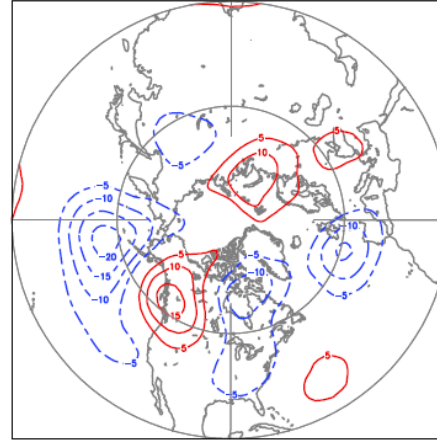
(a) GCM3 SVD1 z500 (SON)



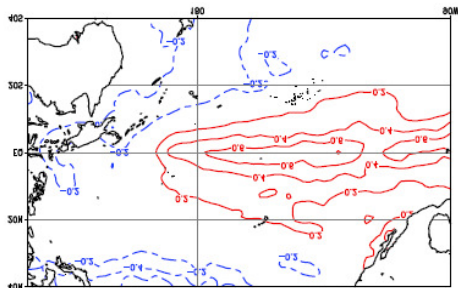
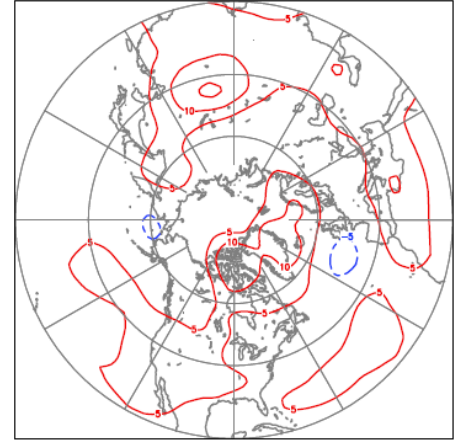
(b) GCM3 SVD2 z500 (SON)



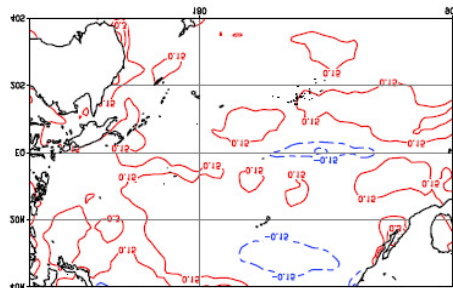
(a) NCEP SVD1 z500 (SON)



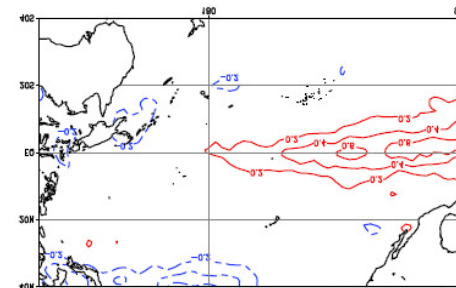
(b) NCEP SVD2 z500 (SON)



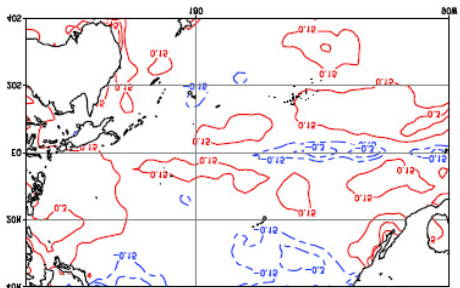
(c) GCM3 SVD1 z200 (SON)



(d) GCM3 SVD2 z200 (SON)



(e) NCEP SVD1 z200 (SON)

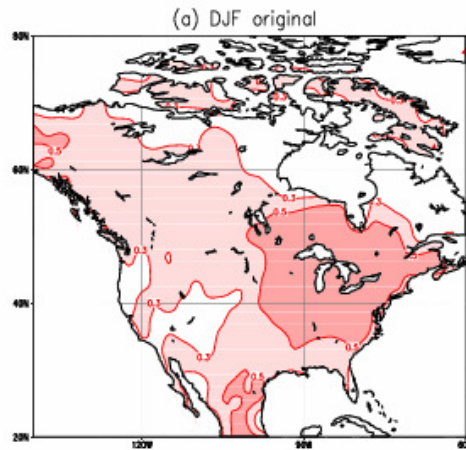


(f) NCEP SVD2 z200 (SON)

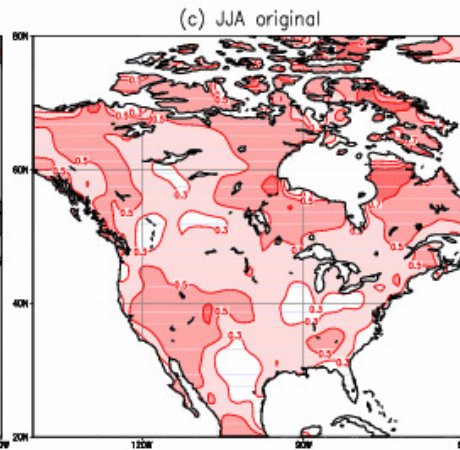


# Original forecast skill (SAT)

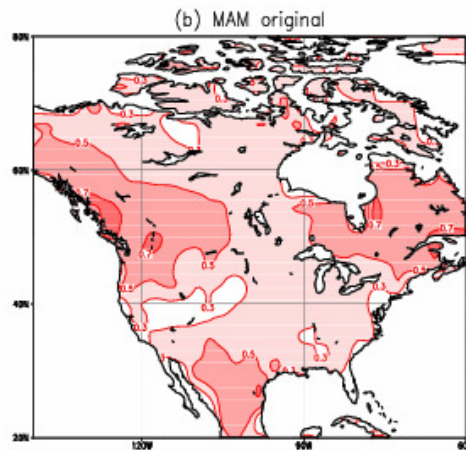
*DJF*



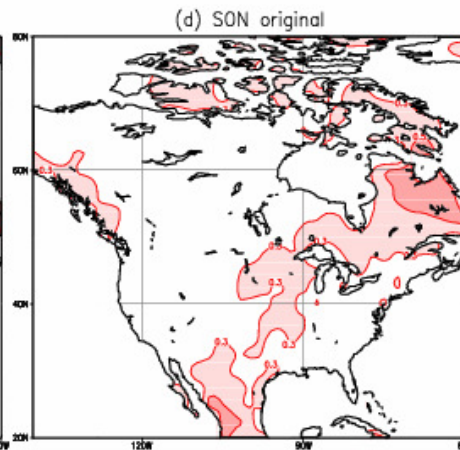
*JJA*



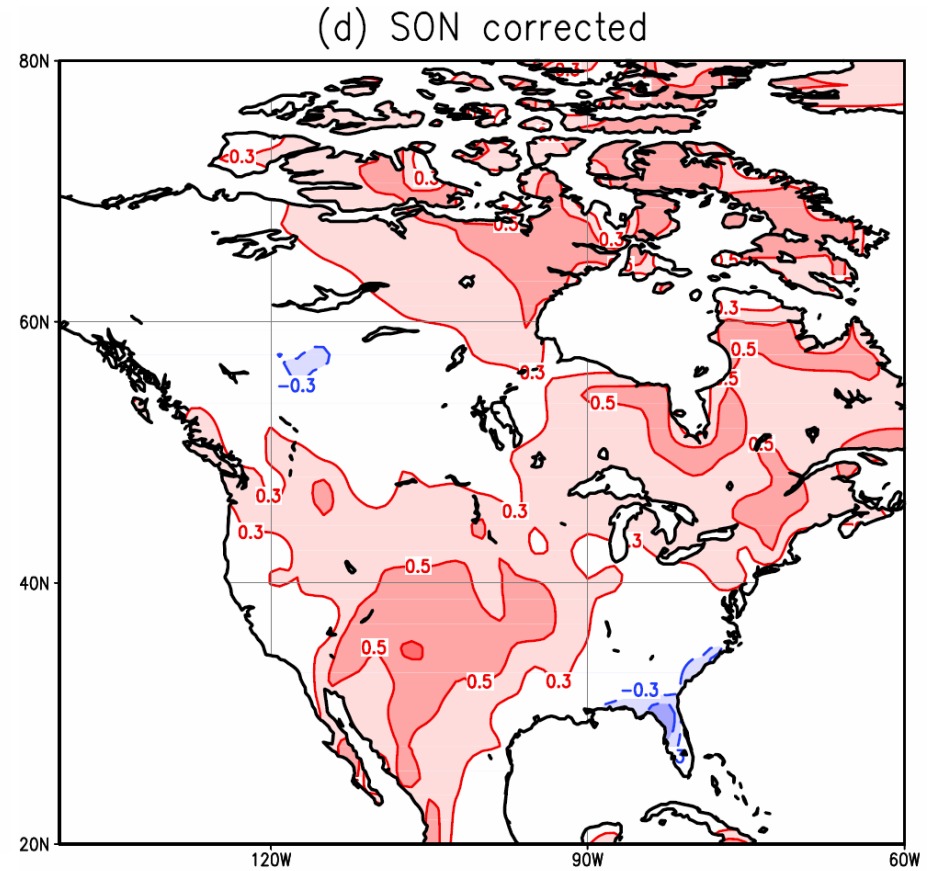
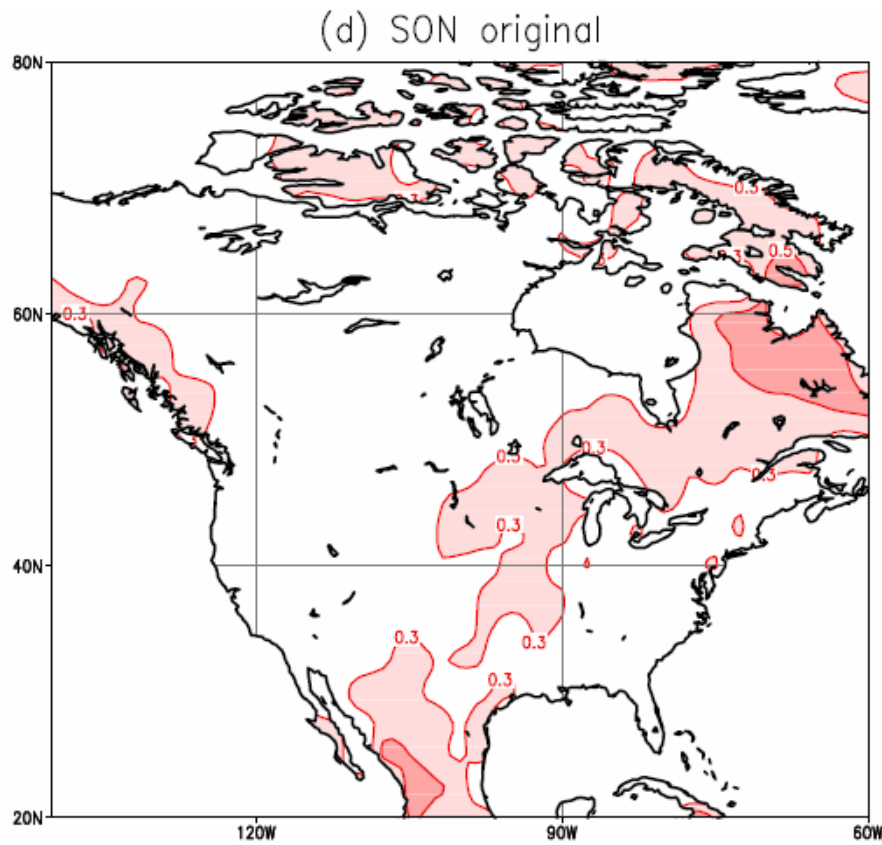
*MAM*



*SON*

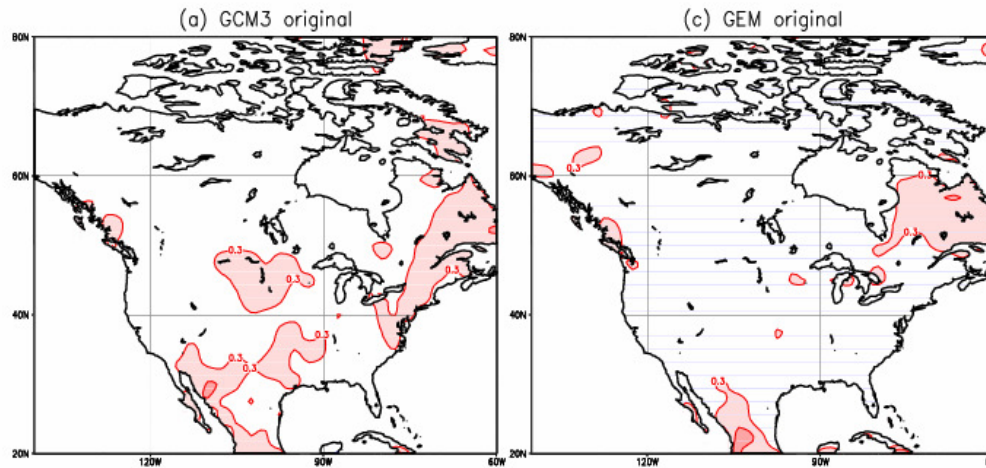


# *Forecast skill before and after the post-processing (SAT - SON)*



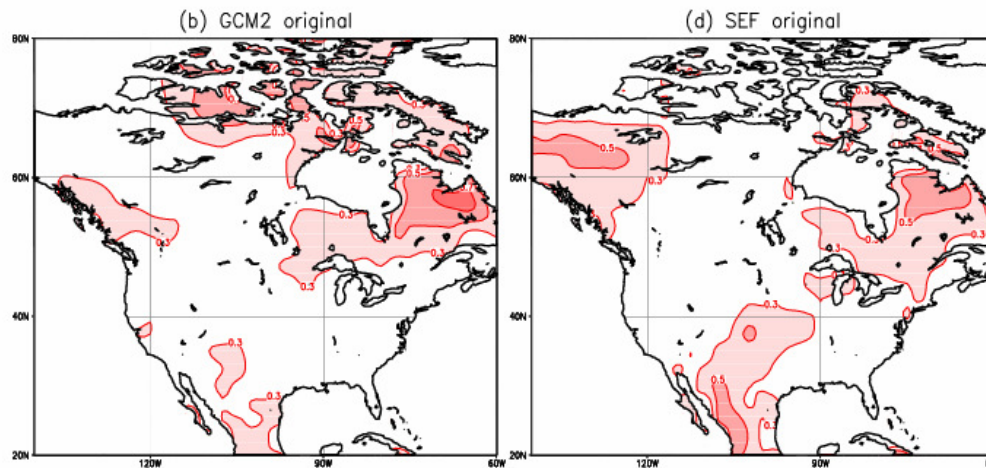
# Original forecast skill (SAT - SON) for four GCMs

**GCM3**

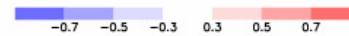
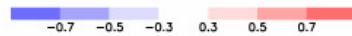


**GEM**

**GCM2**

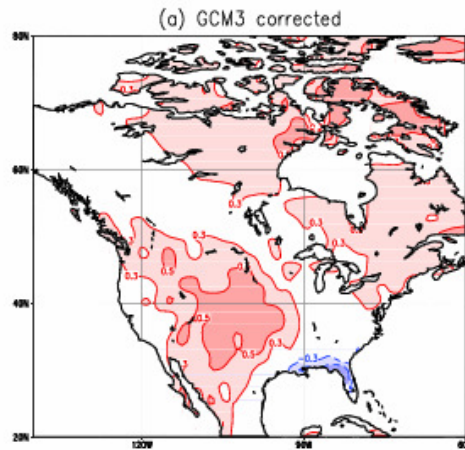


**SEF**

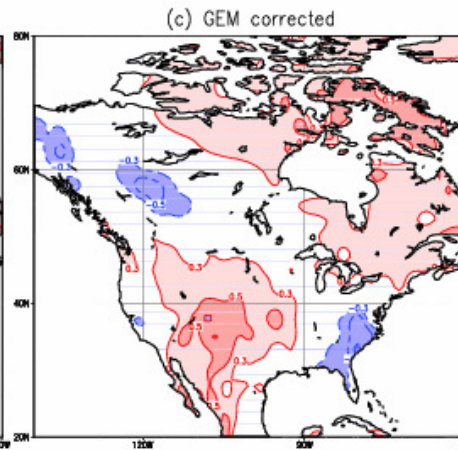


# Forecast skill after the post-processing (SAT - SON) for four GCMs

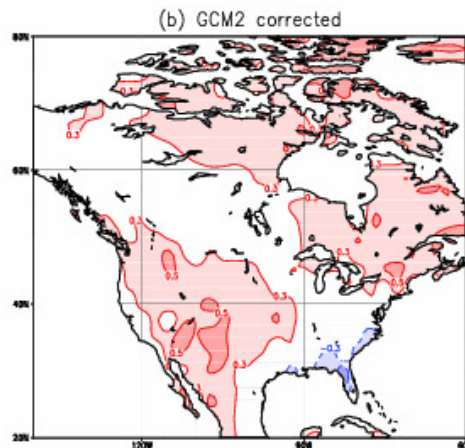
*GCM3*



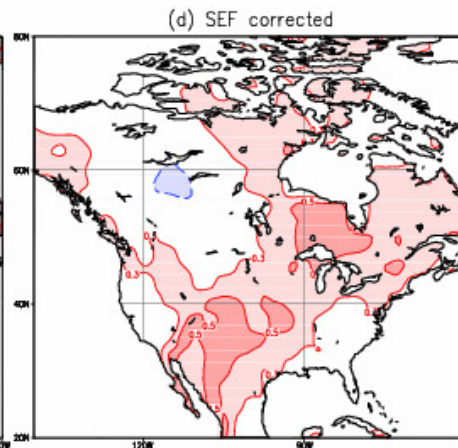
*GEM*



*GCM2*

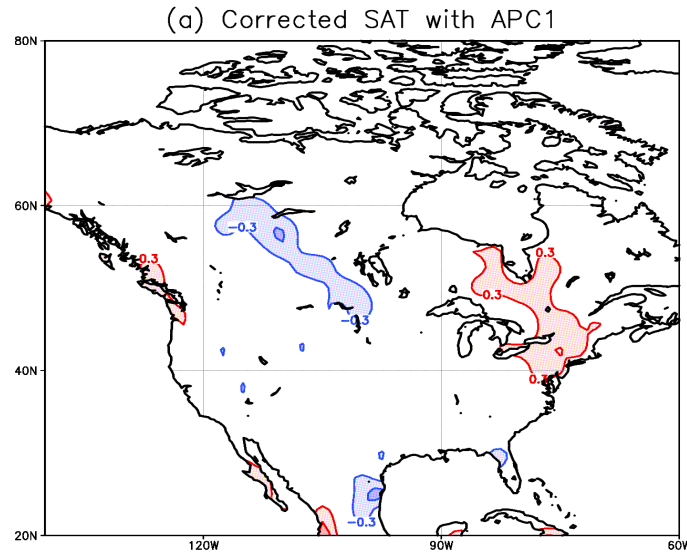


*SEF*

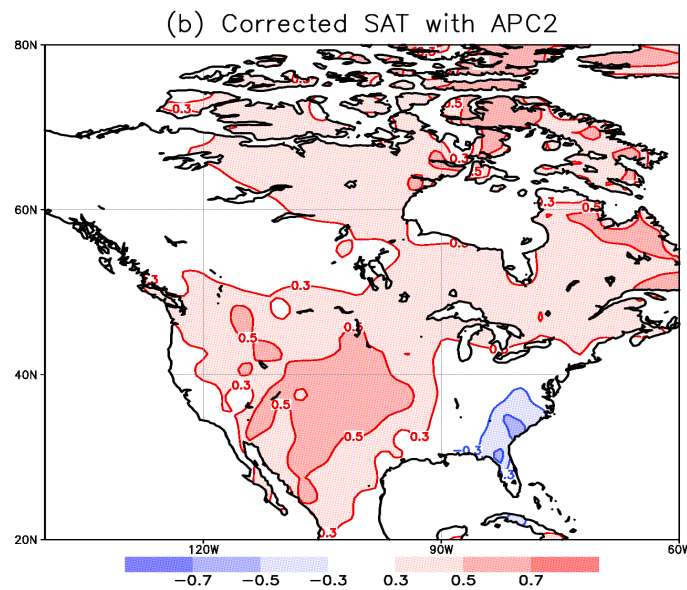


# *Forecast skill of the post-processed forecasts by SVD1 or SVD2*

*APC1*

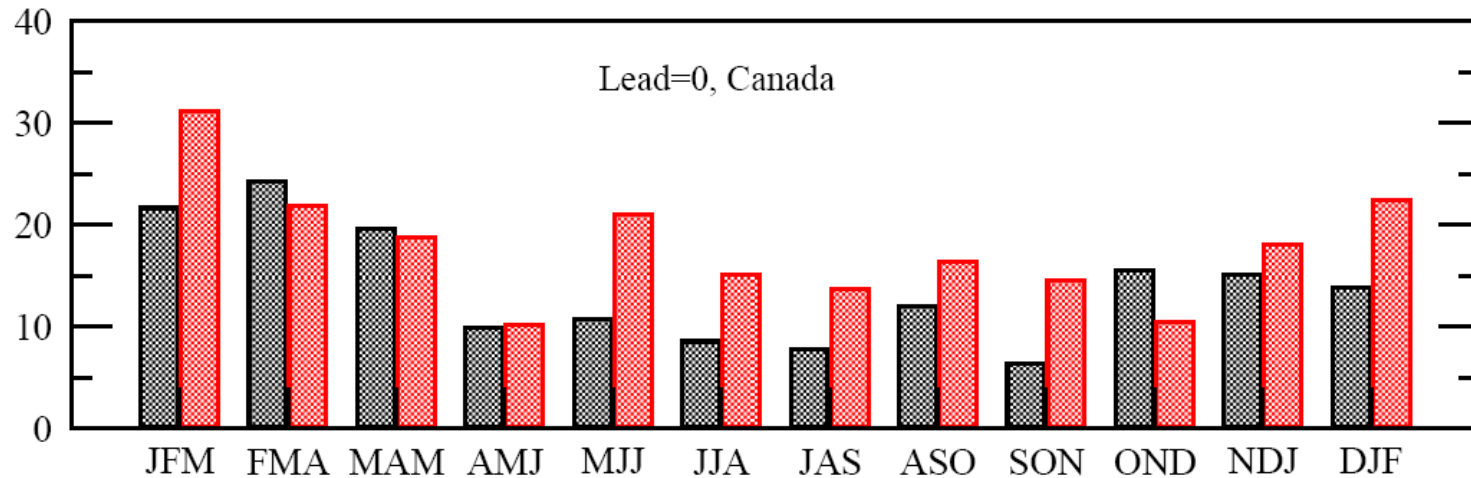
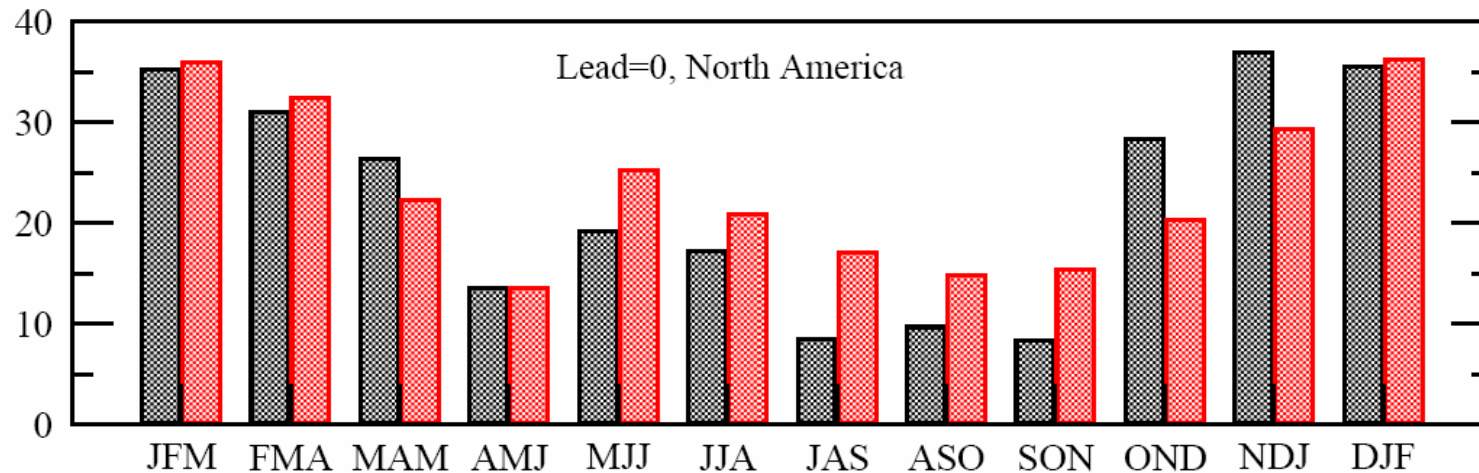


*APC2*



## Percentage area of significant skill (precipitation)

Precipitation skill, percentage area of skill greater than 0.3



## Summary

- SAT
- *The original forecast skill is at a minimum in SON over North America*
- *Significant improvement of the forecast skill in SON was achieved over north-eastern Canada and south-western United States*
- *The post-processed forecasts are quite consistent among the GCMs*
- *The improvement of the post-processed ensemble forecasts benefit mainly from the second SVD mode.*

# Summary

## Precipitation

- *For entire North America*  
*The post-processing degraded the forecasts in OND and NDJ but improved them in MJJ through SON according to the percentage of area with significant skill*
- *For Canada*  
*8 of the 12 “seasons” were improved to some degree*



*Thank you!*



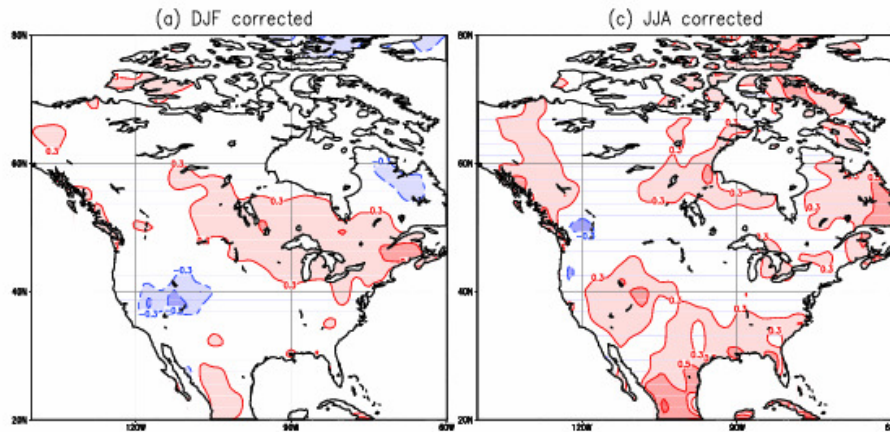




# Forecast skill after the post-processing (SAT)

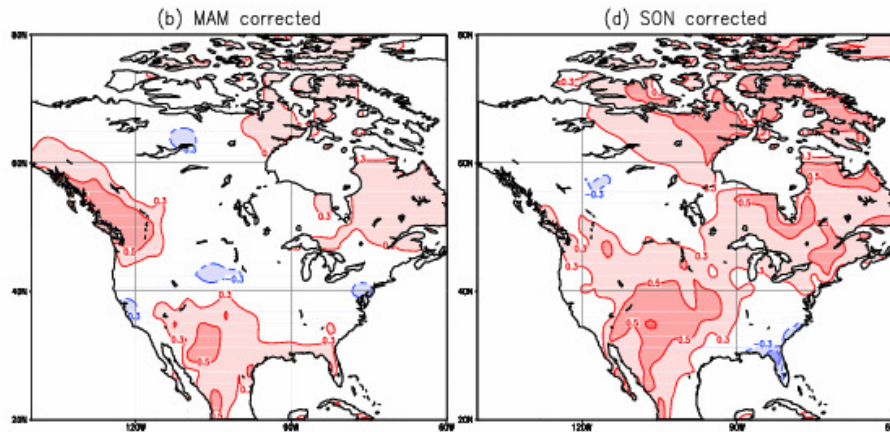
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*DJF*

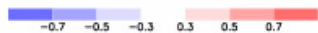


*JJA*

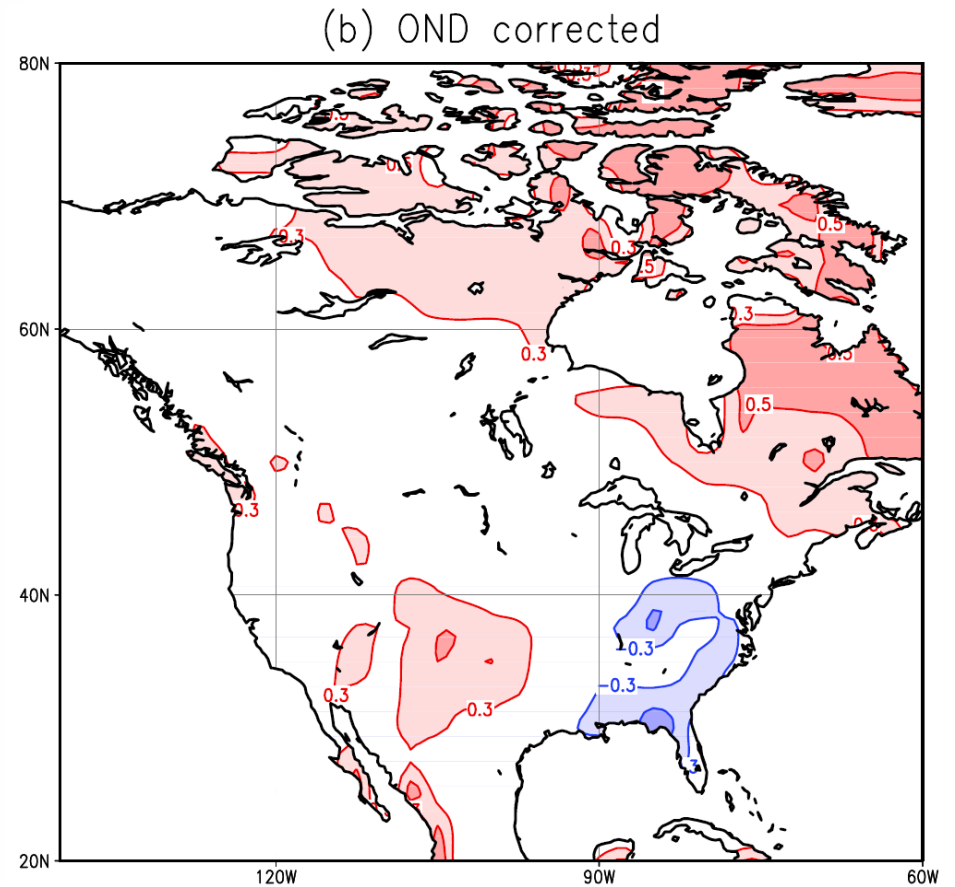
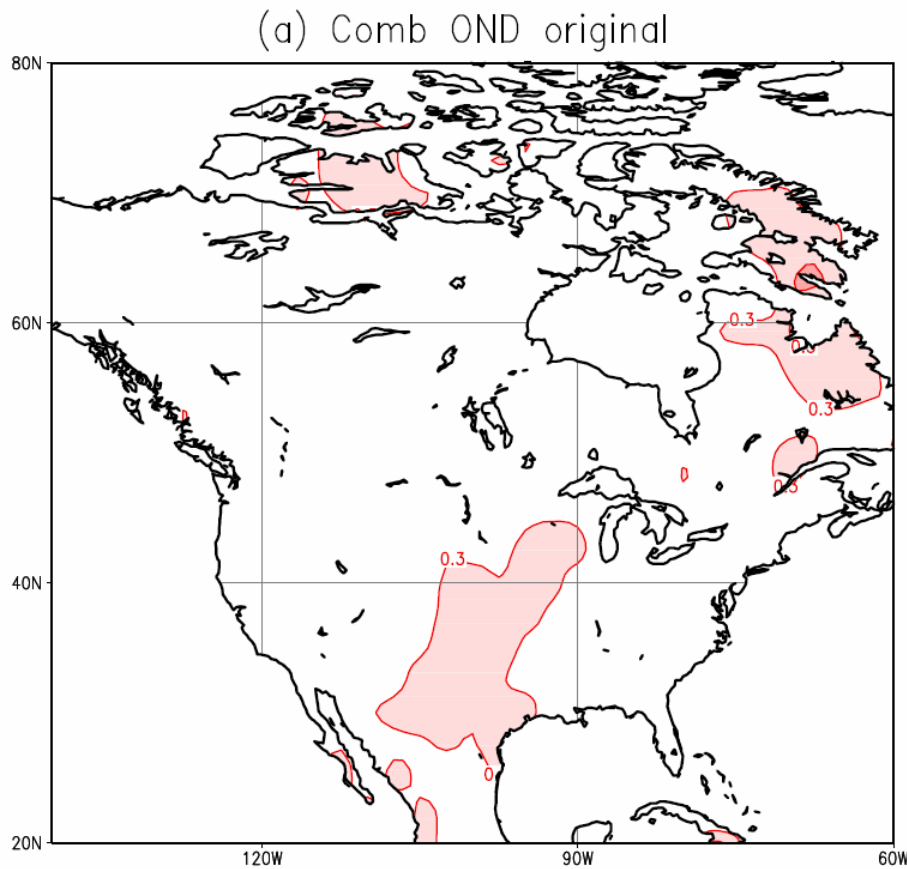
*MAM*



*SON*

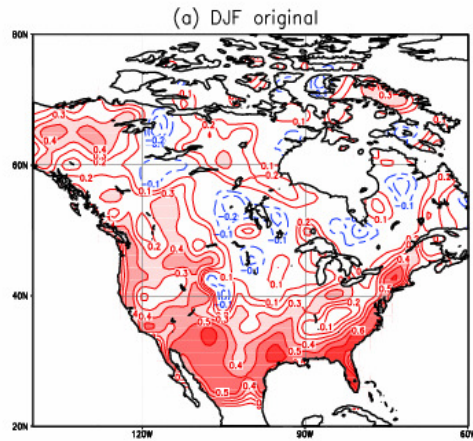


# *Forecast skill before and after the post-processing for OND (SAT)*

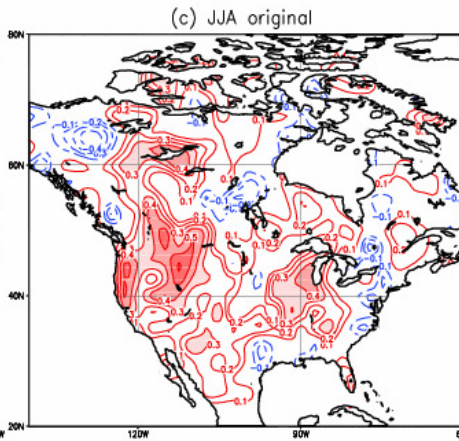


# Original Forecast skill (precipitation)

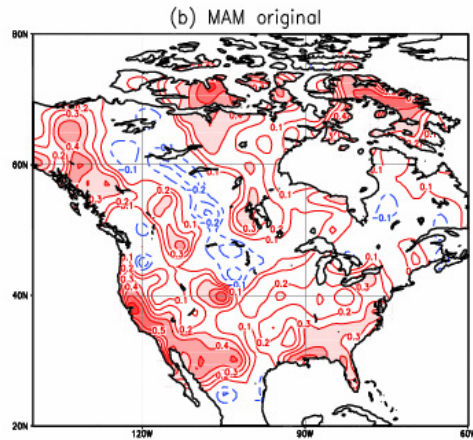
*DJF*



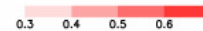
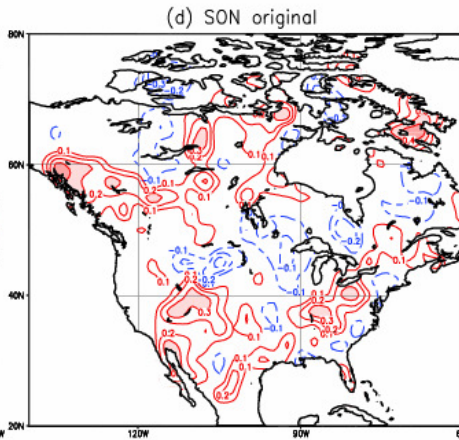
*JJA*



*MAM*

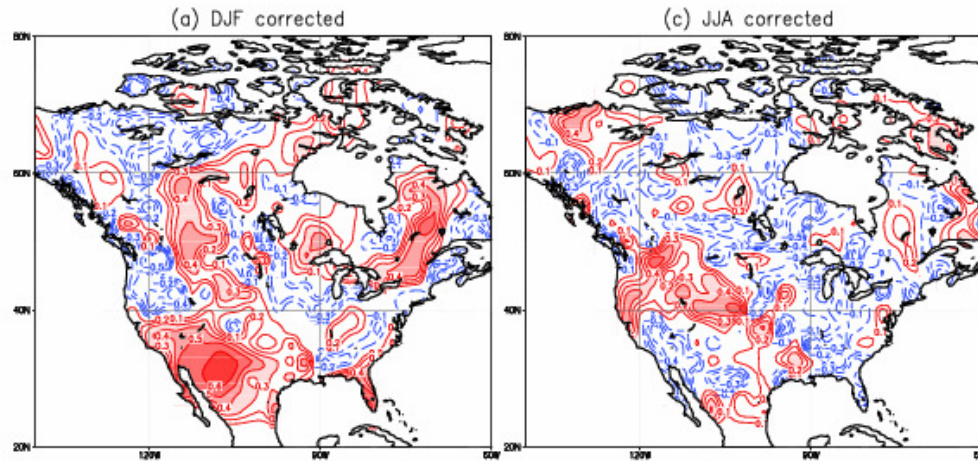


*SON*



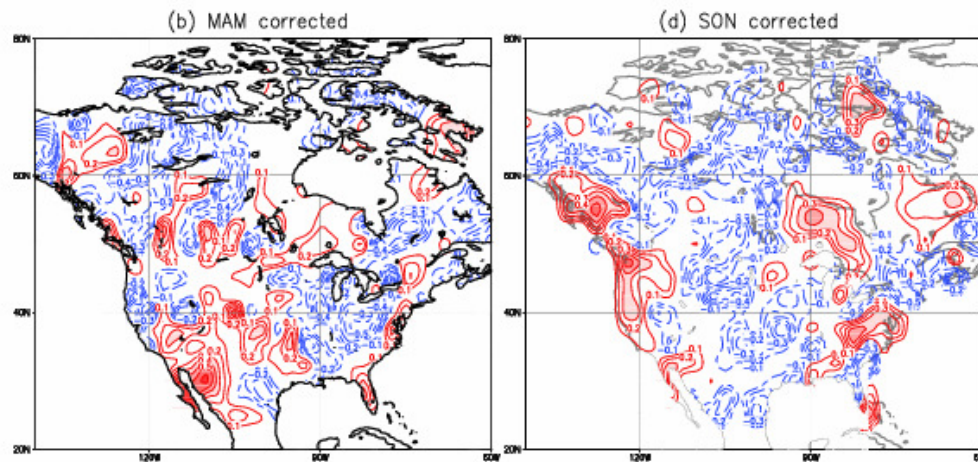
# Forecast skill after the post-processing (precipitation)

**DJF**



**JJA**

**MAM**

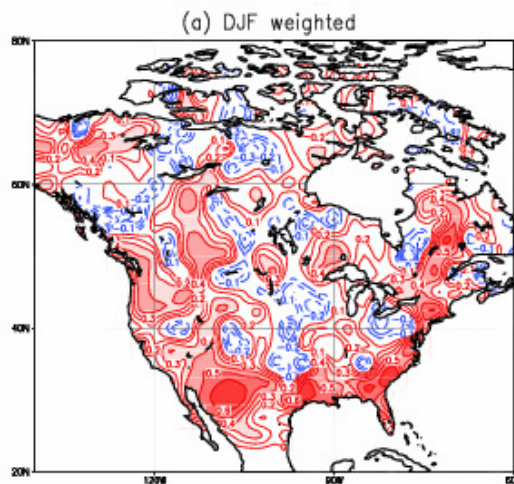


**SON**

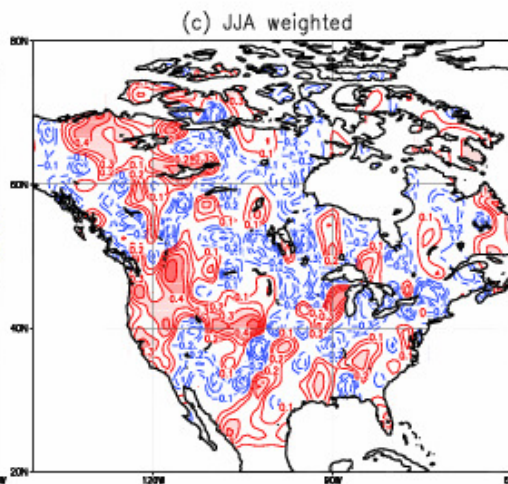


# Forecast skill of the weighted forecast (precipitation)

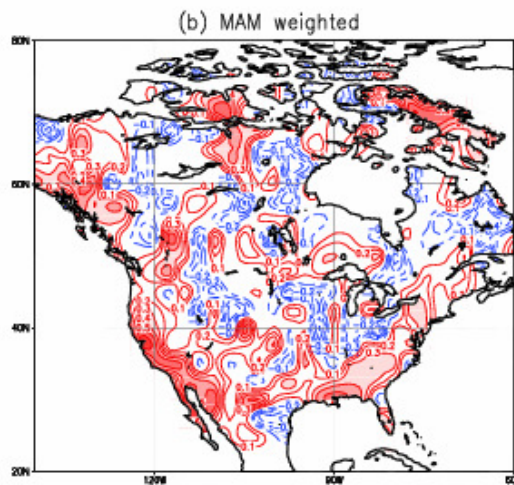
*DJF*



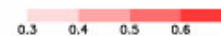
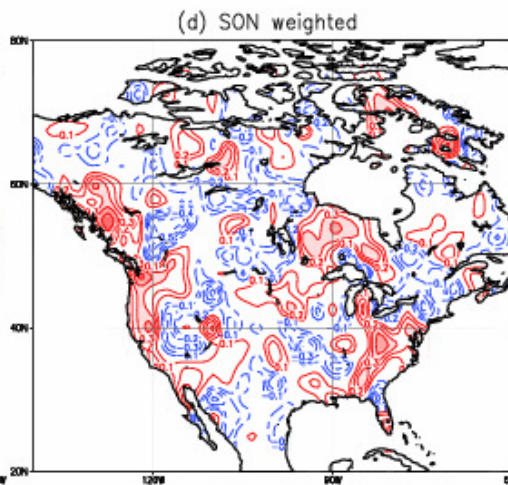
*JJA*



*MAM*



*SON*



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