

# Impact of SST and soil moisture on seasonal rainfall prediction over the Sahel

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# Outline

- NCEP CFS and Model Experiments
- Climatology and Interannual Variability
- SST Impacts
- Role of Soil Moisture
- Conclusions

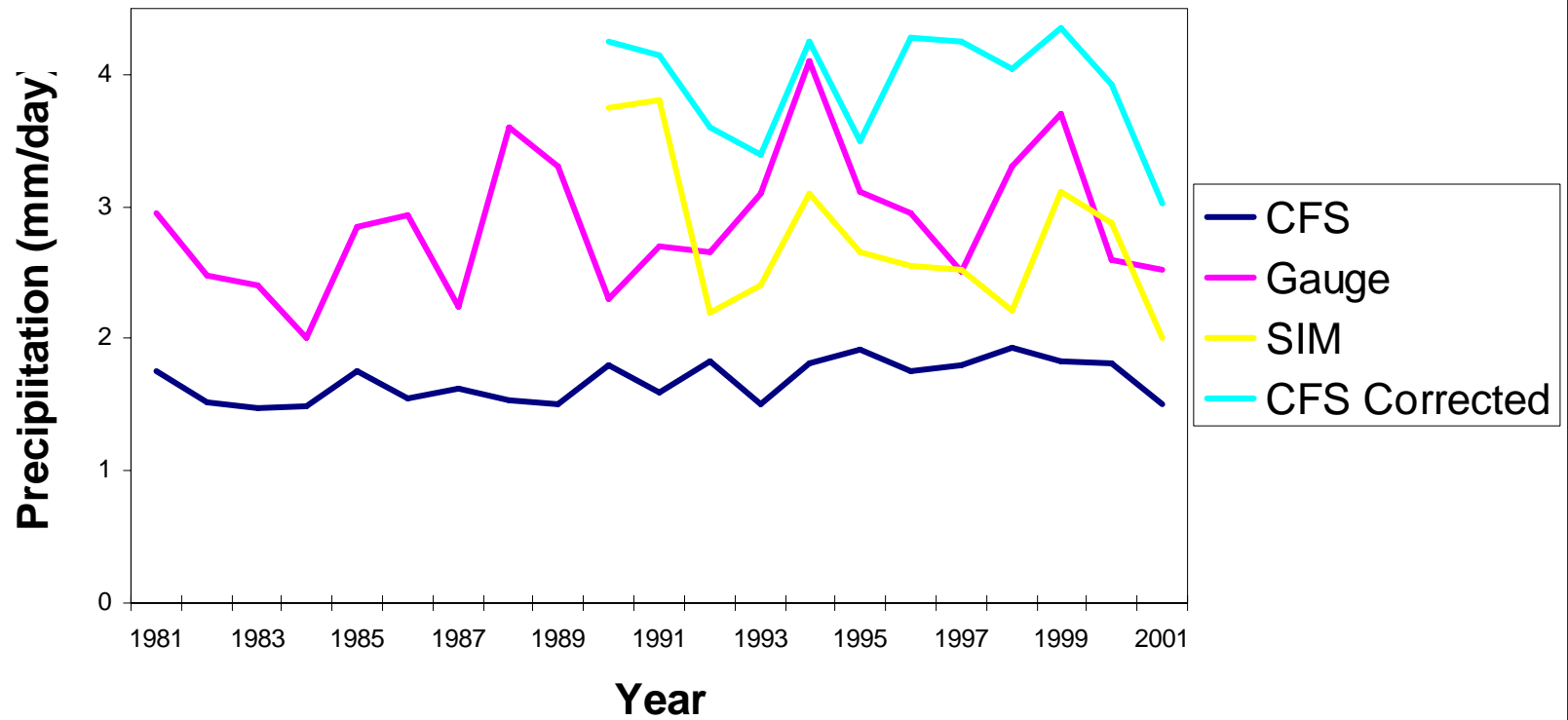
# Objectives

- To use the NCEP coupled forecast system (CFS), observed precipitation data, and NCEP reanalysis to document the forecast errors of seasonal rainfall over the Sahel.
- To diagnose the causes of model errors and to understand the underlying physics that governs rainfall variability over the Sahel by comparing the CFS forecasts with model seasonal simulations (SIMs) and the Atmospheric Model Intercomparison Project (AMIP) runs.

# CFS and Model Experiments

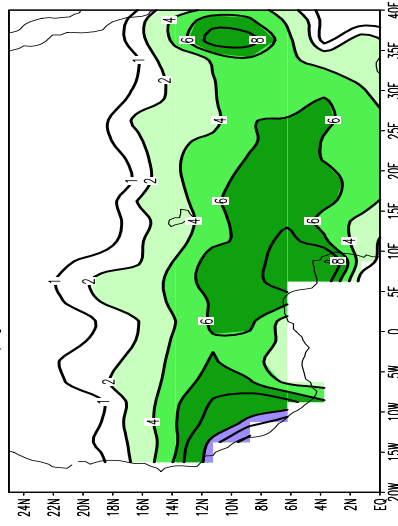
- CFS: GFS & MOM3 from GFDL (Saha et al., 2005)
- Ensemble Simulations
  - GFS T62L64, 5 members, different initial conditions 6 hours apart
  - AGCM forced by observed SST
- AMIP (continued run from 12/1/1949)
- CFS Corrected
  - Ensemble Forecasts 1990-2001, GFS T62L128
  - 5 members
  - Predicted SSTs from the CFS with systematic errors corrected

## Precipitation Time Series

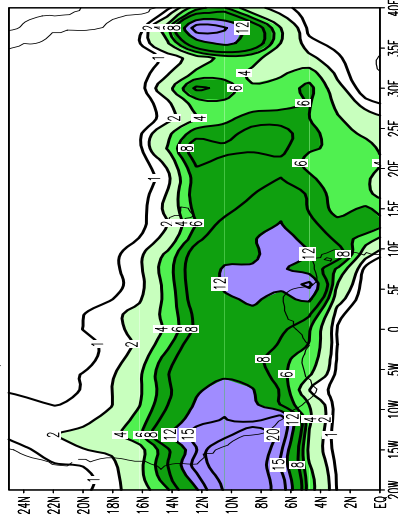


# Precipitation Distribution across West Africa

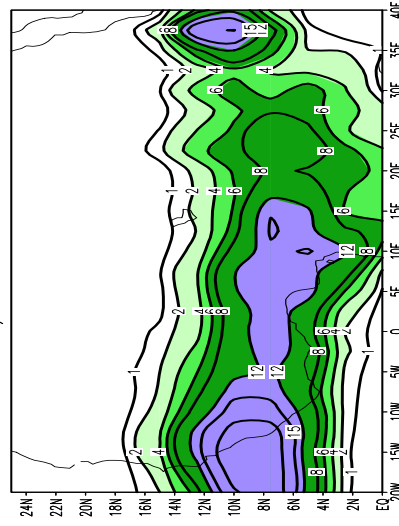
rainfall climatology (JAS)  
a) gridded Chen 1990-2001



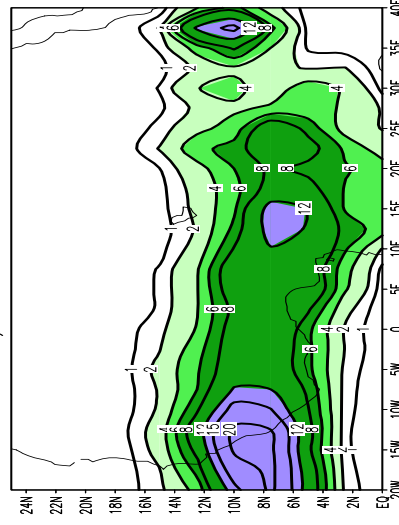
d) CFS corrected 1990-2001



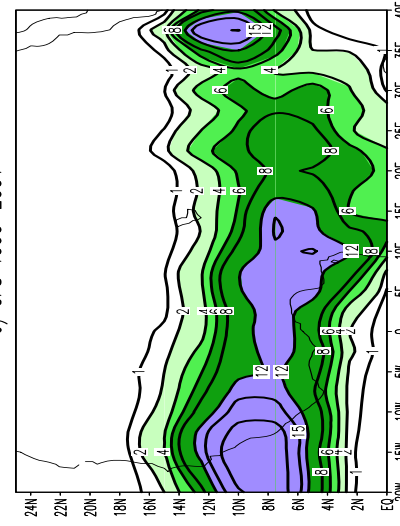
b) CFS 1981-2001



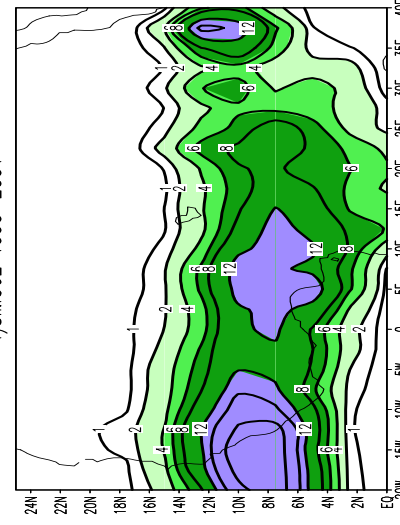
e) AMIP62 1990-2001



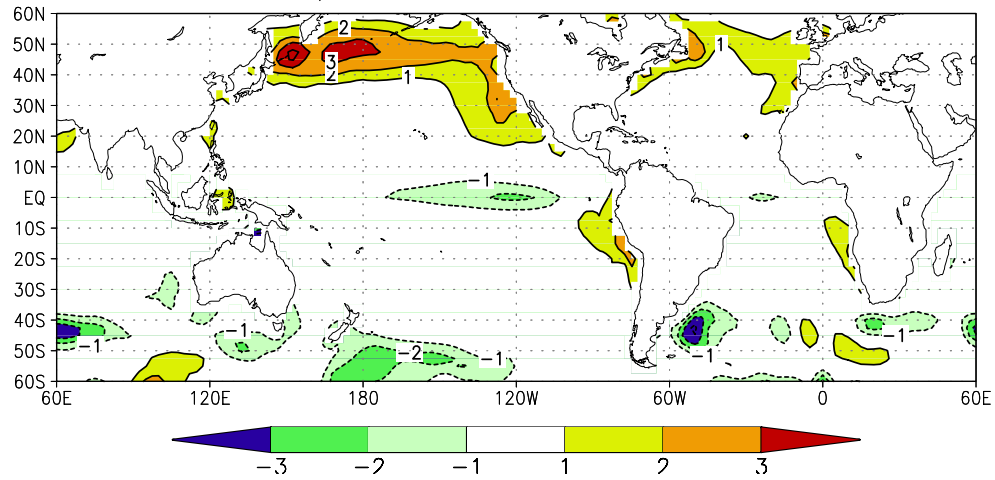
c) CFS 1990-2001



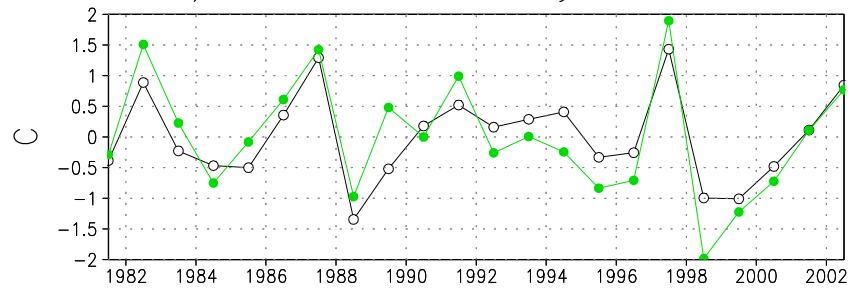
f) SIMU62 1990-2001



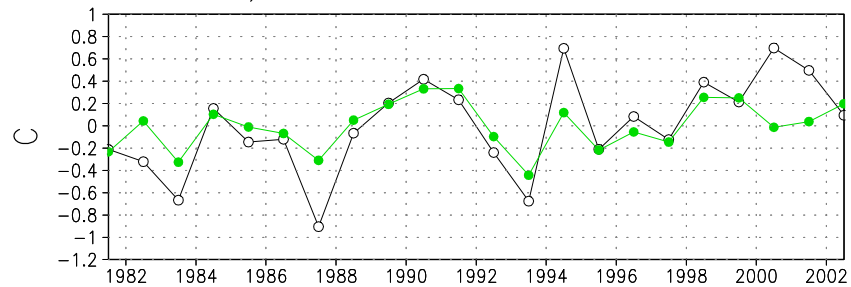
a) SST diff Fcst-CDAS



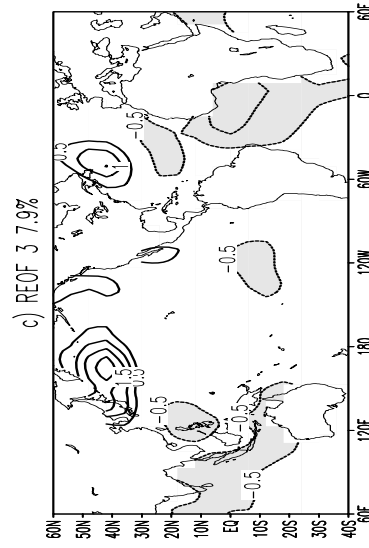
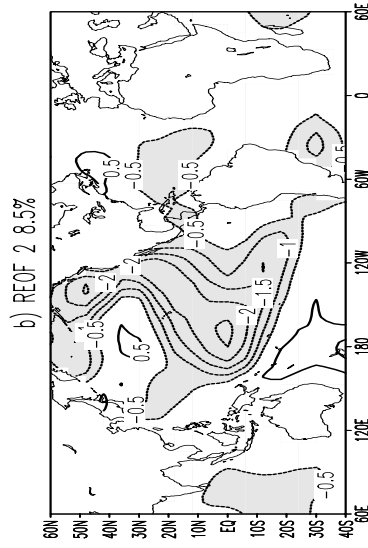
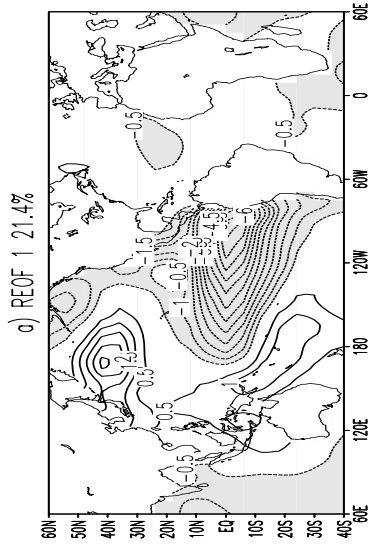
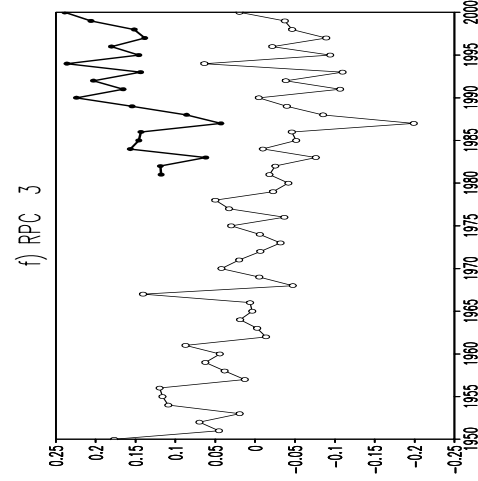
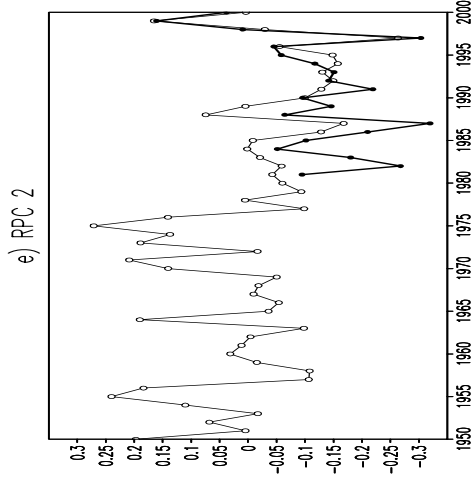
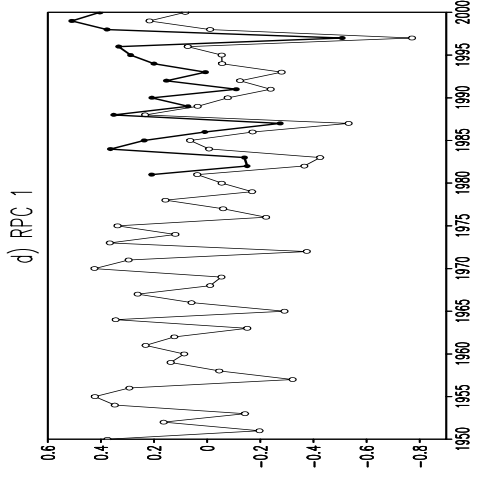
b) Nino 3.4 anomaly  $ac=0.86$



c) North Pacific  $AC=0.76$



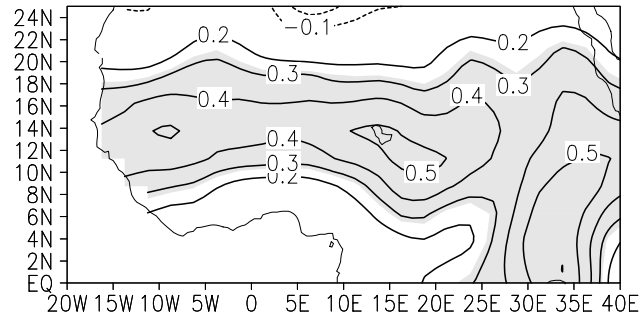
# Rotated Empirical Orthogonal Function on the JAS SST



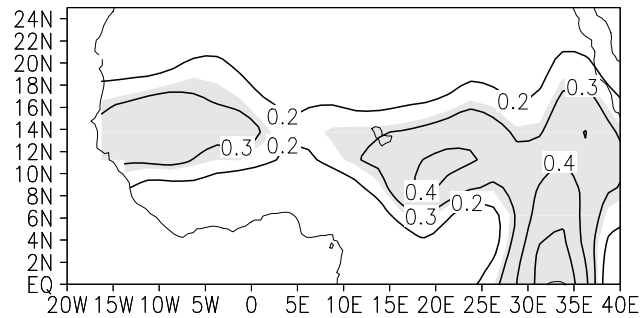
# Correlation Maps between RPCs and rainfall for observations

corr (RPC,rain) obs

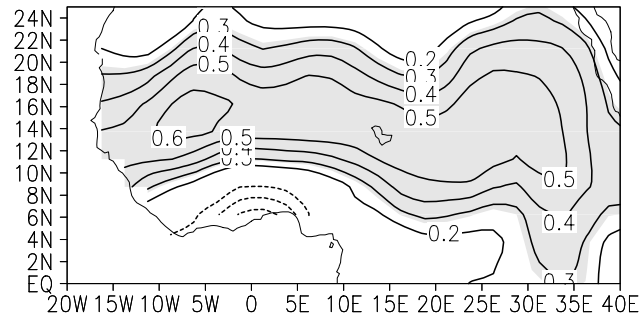
a) REOF 1



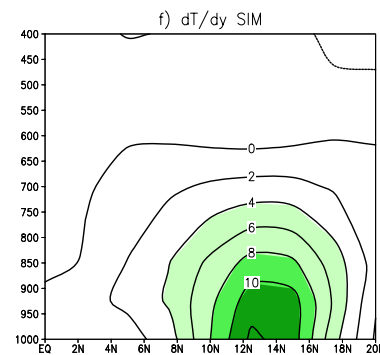
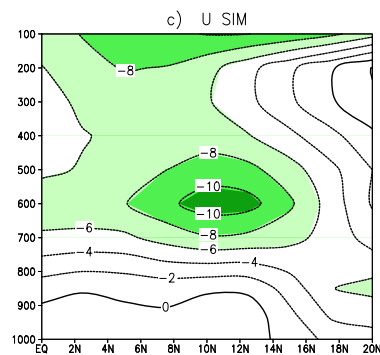
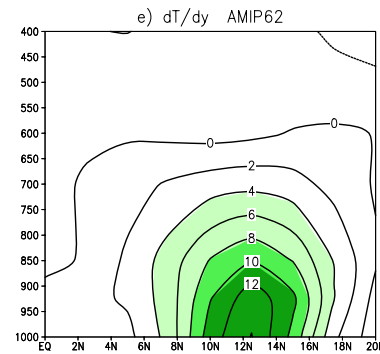
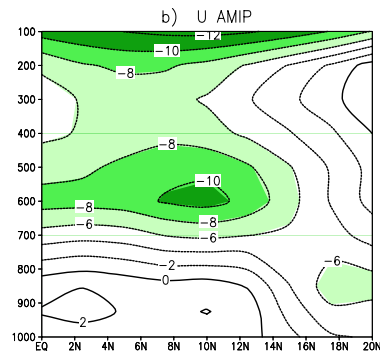
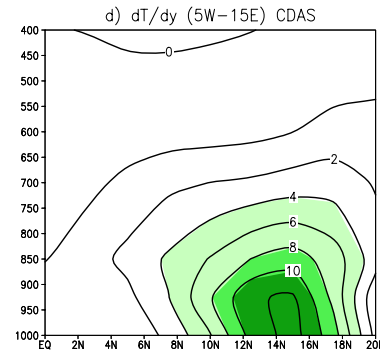
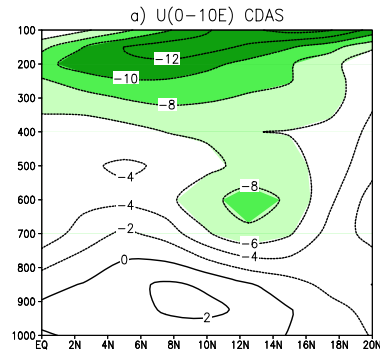
b) REOF 2



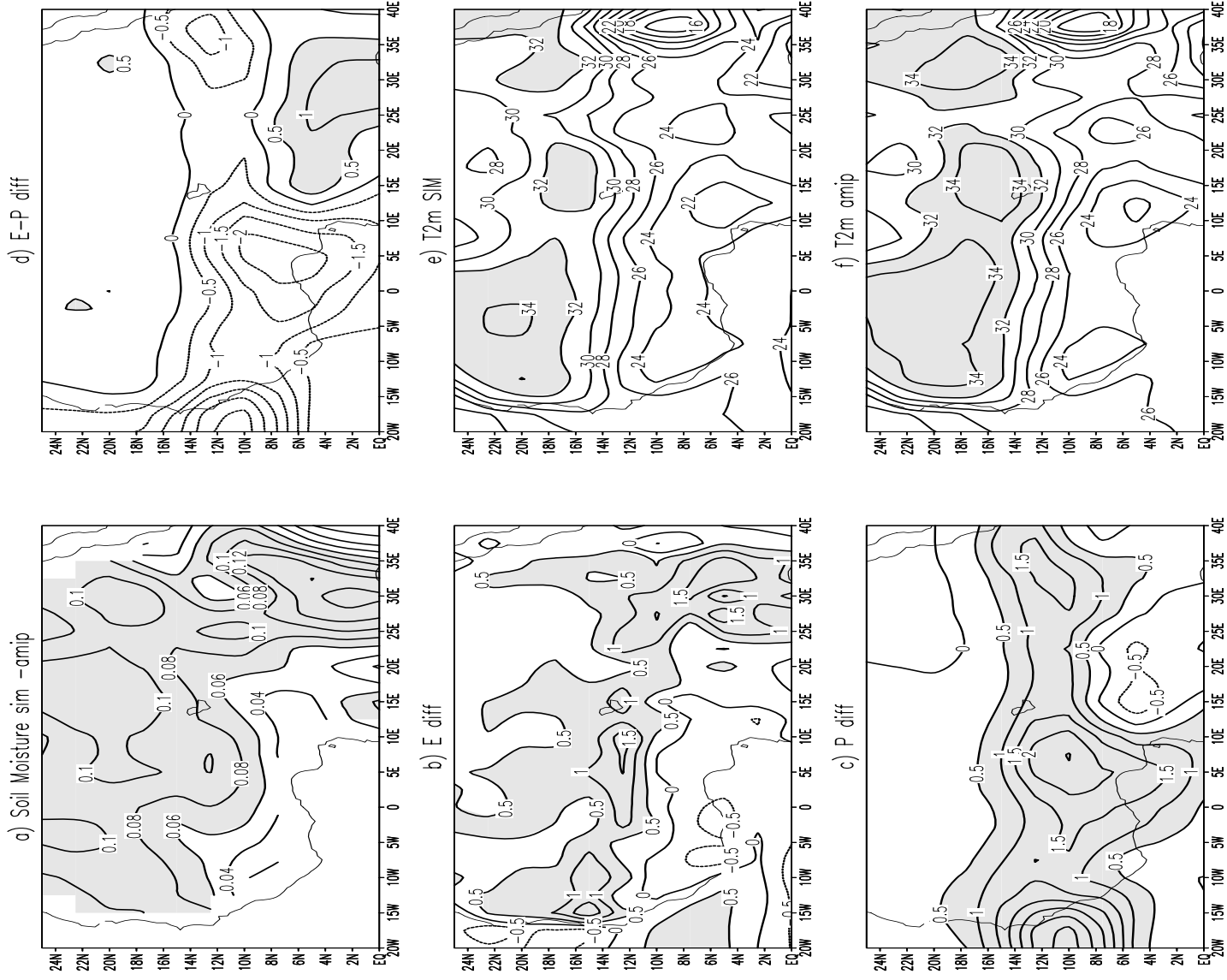
c) REOF 3



# Vertical Profile of U and $dT/dy$ in CDAS, AMIP, and Model Simulation



# Surface Flux Difference between Model Simulation and AMIP



# Discussions

- SSTs have dominant influence on rainfall over the Sahel on the seasonal time scales. Systematic errors in the CFS predicted SSTs contribute to damping precipitation forecasts over the Sahel toward the climatological mean. These errors resemble the decadal SST mode. The model simulations and CFS (corrected) have better representation of the position of the AEJ and the spatial distribution of rainfall across West Africa. They also show more realistic interannual rainfall variability.
- Comparisons between AMIP run and simulations demonstrated that soil moisture feedback mechanism may also contribute to the southward shift of the AEJ and rainfall. The AMIP run shows the southward shift of the AEJ, while the SIMs provide a better representation of the jet location and rainfall spatial pattern.
- As it is well known, the most important contribution to rainfall variability over the Sahel is the decadal mode, which is better produced when the interactive vegetation is added to the model. Therefore, a land-surface interaction model coupled with the CFS will improve precipitation forecasts over the Sahel.