



The Abdus Salam
**International Centre
for Theoretical Physics**



Interannual variability and predictability assessment of JJA surface air temperature over the Arabian Peninsula in North American Multimodel Ensemble.

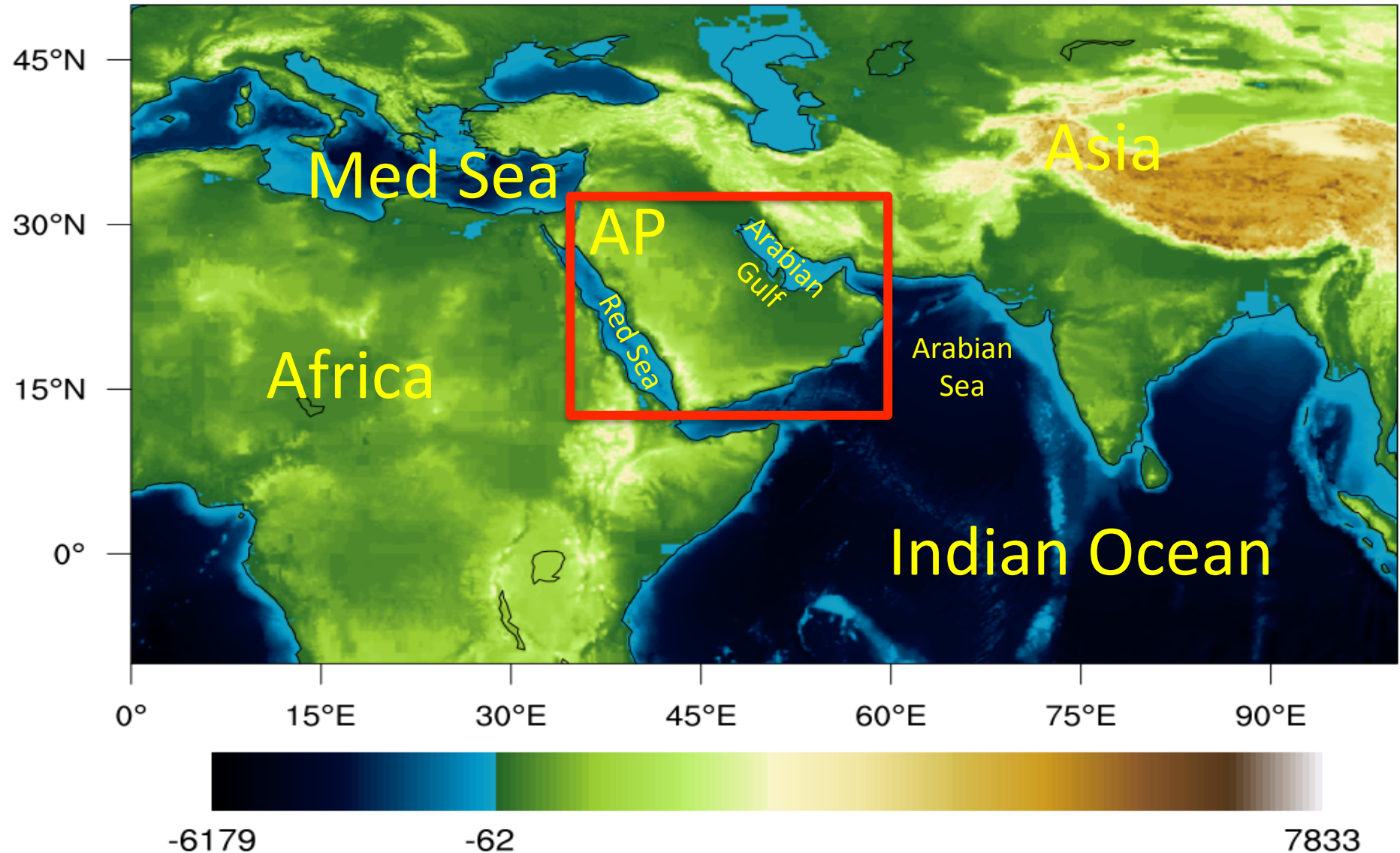
Muhammad Azhar Ehsan
[**mehsan@ictp.it**](mailto:mehsan@ictp.it)

Contributors

Fred Kucharski, Mansour Almazroui
M. Ismail

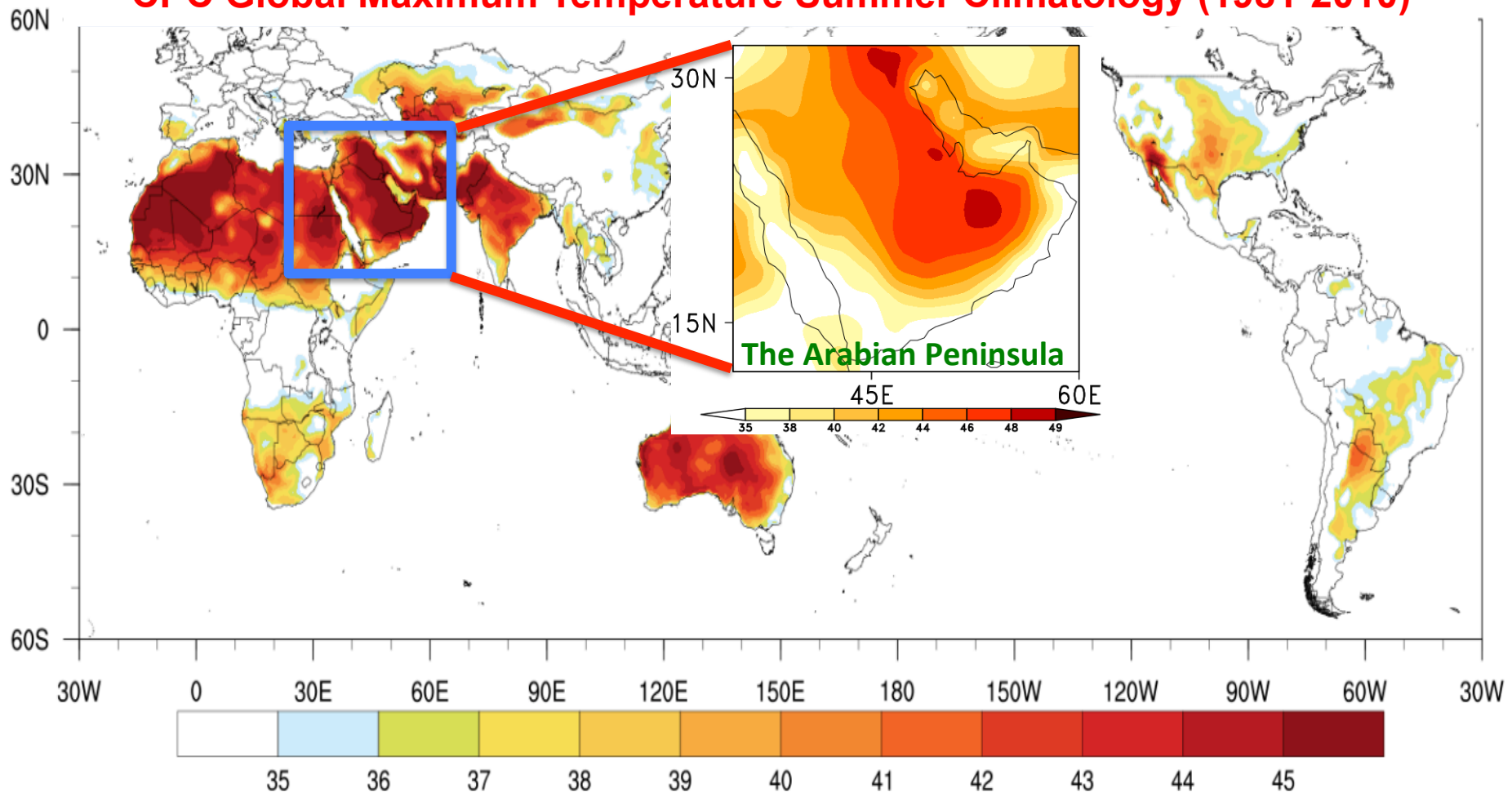
**EMS Annual Meeting: European Conference for Applied Meteorology and
Climatology 2018 | 3–7 September 2018 | Budapest, Hungary**

Arabian Peninsula (AP) and its Neighborhood

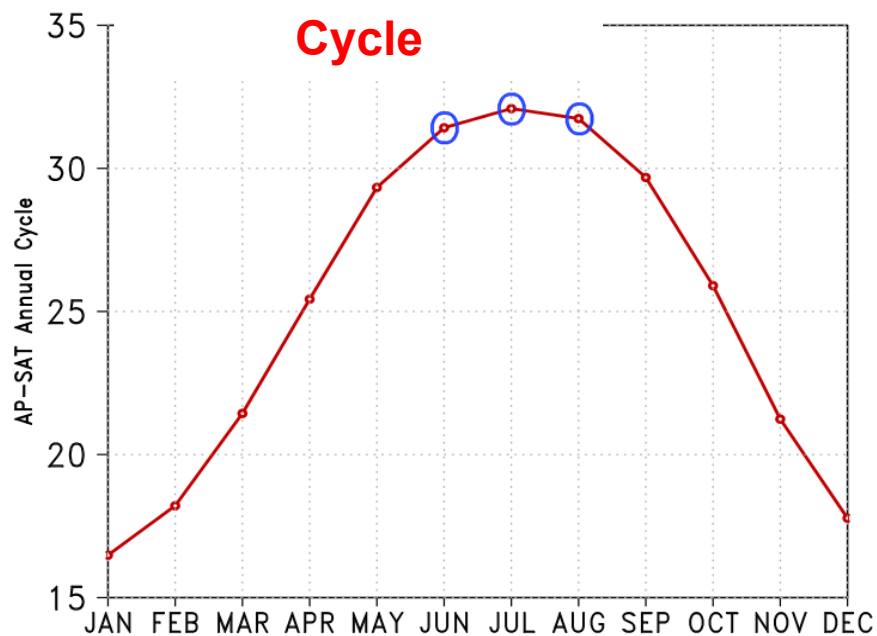


Hottest Locations in the World?

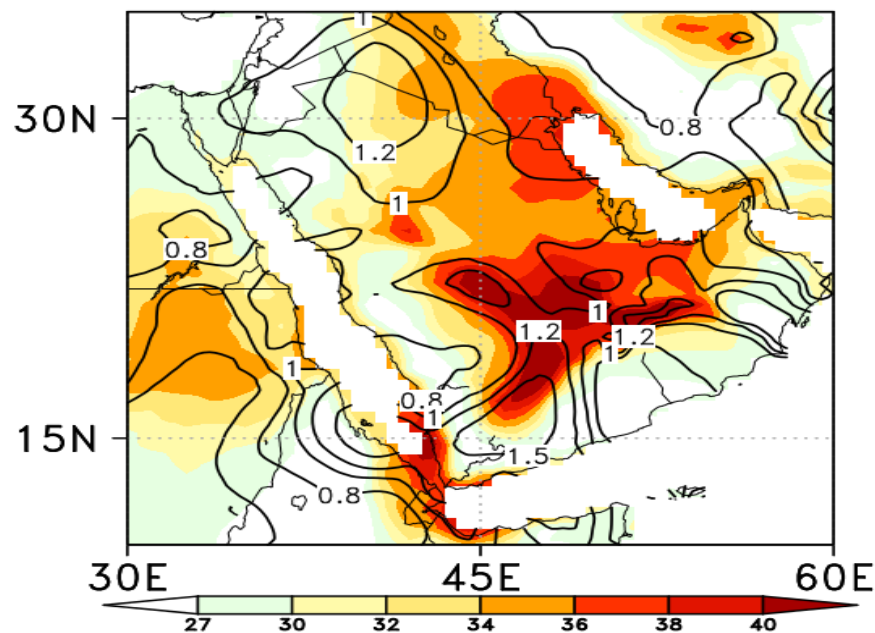
CPC Global Maximum Temperature Summer Climatology (1981-2010)



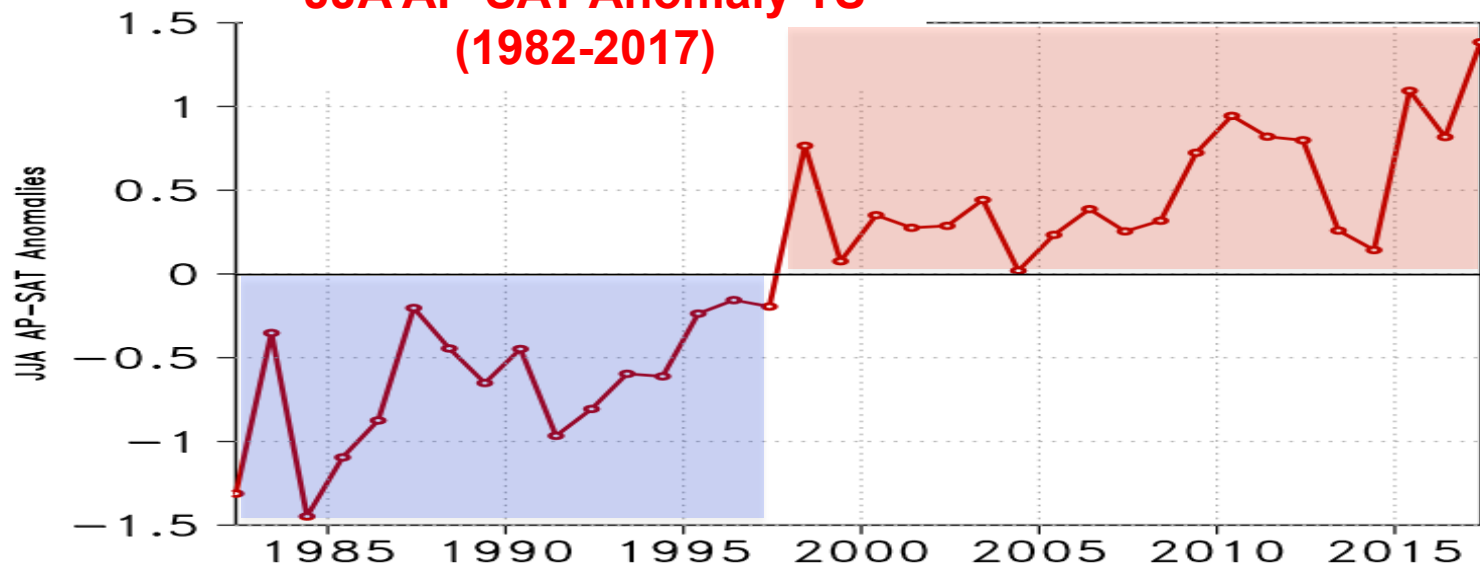
AP-SAT Annual Cycle



JJA AP-SAT Clim. & Var.



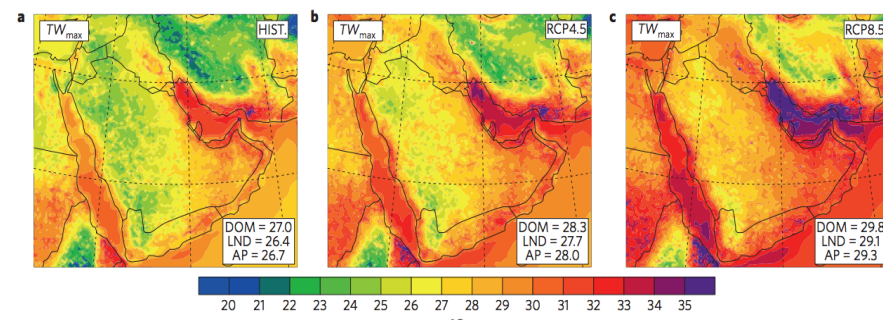
JJA AP-SAT Anomaly TS (1982-2017)



Future temperature in southwest Asia projected to exceed a threshold for human adaptability

Jeremy S. Pal^{1,2} and Elfatih A. B. Eltahir^{2*}

A human body may be able to adapt to extremes of dry-bulb temperature (commonly referred to as simply temperature) through perspiration and associated evaporative cooling provided that the wet-bulb temperature (a combined measure of temperature and humidity or degree of ‘mugginess’) remains below a threshold of 35 °C. (ref. 1). This threshold defines a limit of survivability for a fit human under well-ventilated outdoor conditions and is lower for most people. We project



MENU ▾

nature
climate change

News & Views | Published: 26 October 2015

Climate extremes

The worst heat waves to come

Christoph Schär ✉

Nature Climate Change **6**, 128–129 (2016) | [Download Citation](#) ⚡

The combination of high temperatures and humidity could, within just a century, result in extreme conditions around the Persian Gulf that are intolerable to humans, if climate change continues unabated.

Prediction and OBS Datasets

6-NMME CGCM Seasonal Forecast Models are;

✧ NCEP-CFSv2	(24)
✧ NASA-GMAO-062012	(11)
✧ COLA-RSMAS-CCSM4	(10)
✧ GFDL-CM2p1-Aer04	(10)
✧ GFDL-CM2p5-FLOR-A06	(12)
✧ GFDL-CM2p5-FLOR-B01	(12)

✓ GHCN_CAMS TREF

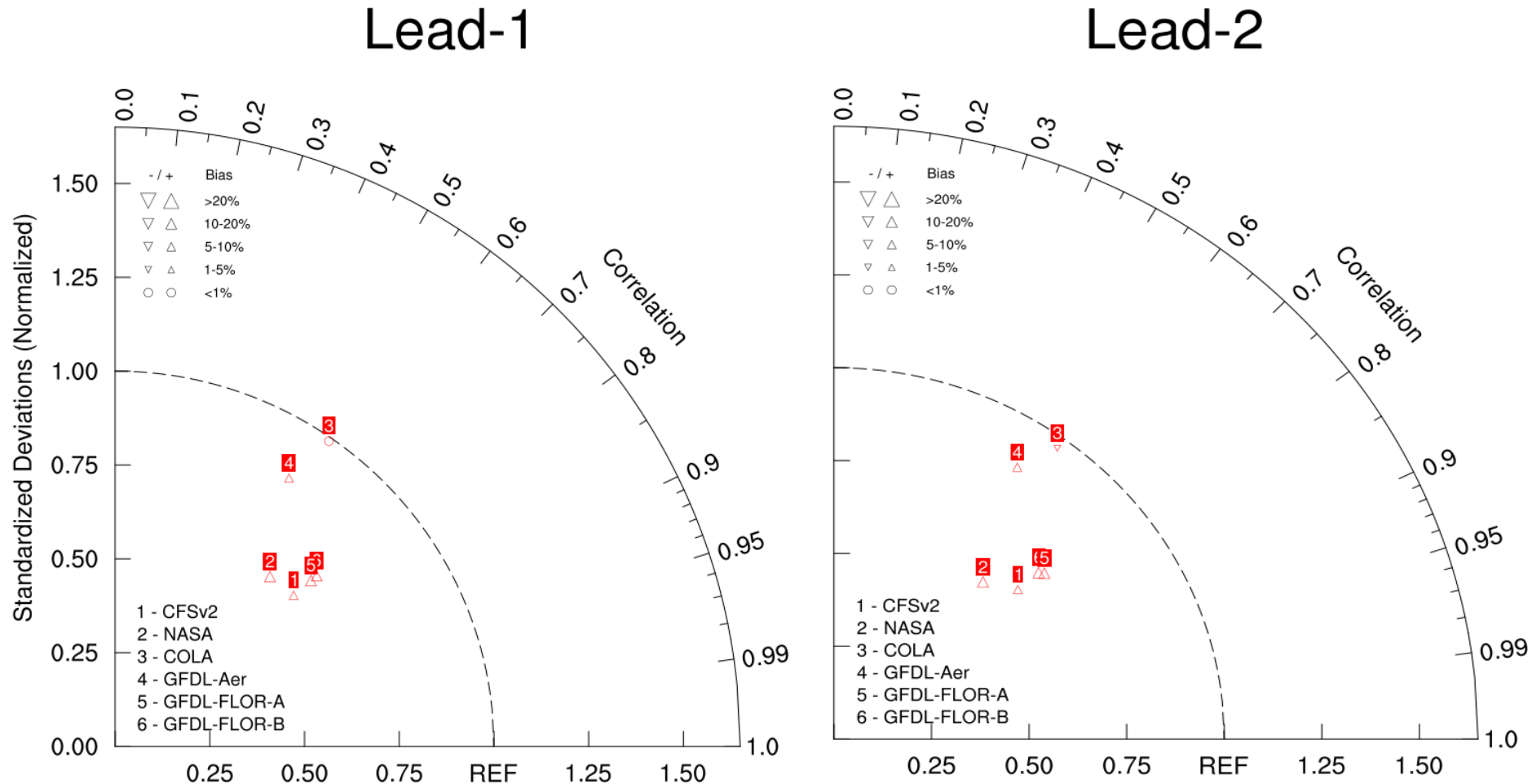
✓ HadISST SST

Period: 36 years reforecasts (1982-2017)

Target: June-July-August (JJA)

Initialized: 1 May and 1 Apr (Lead-1 & Lead-2)

Fidelity of CGCMs Predictions



CFSv2 has high corr. Low relative Bias, yet its Amplitude of variation is low as compared to Observation.

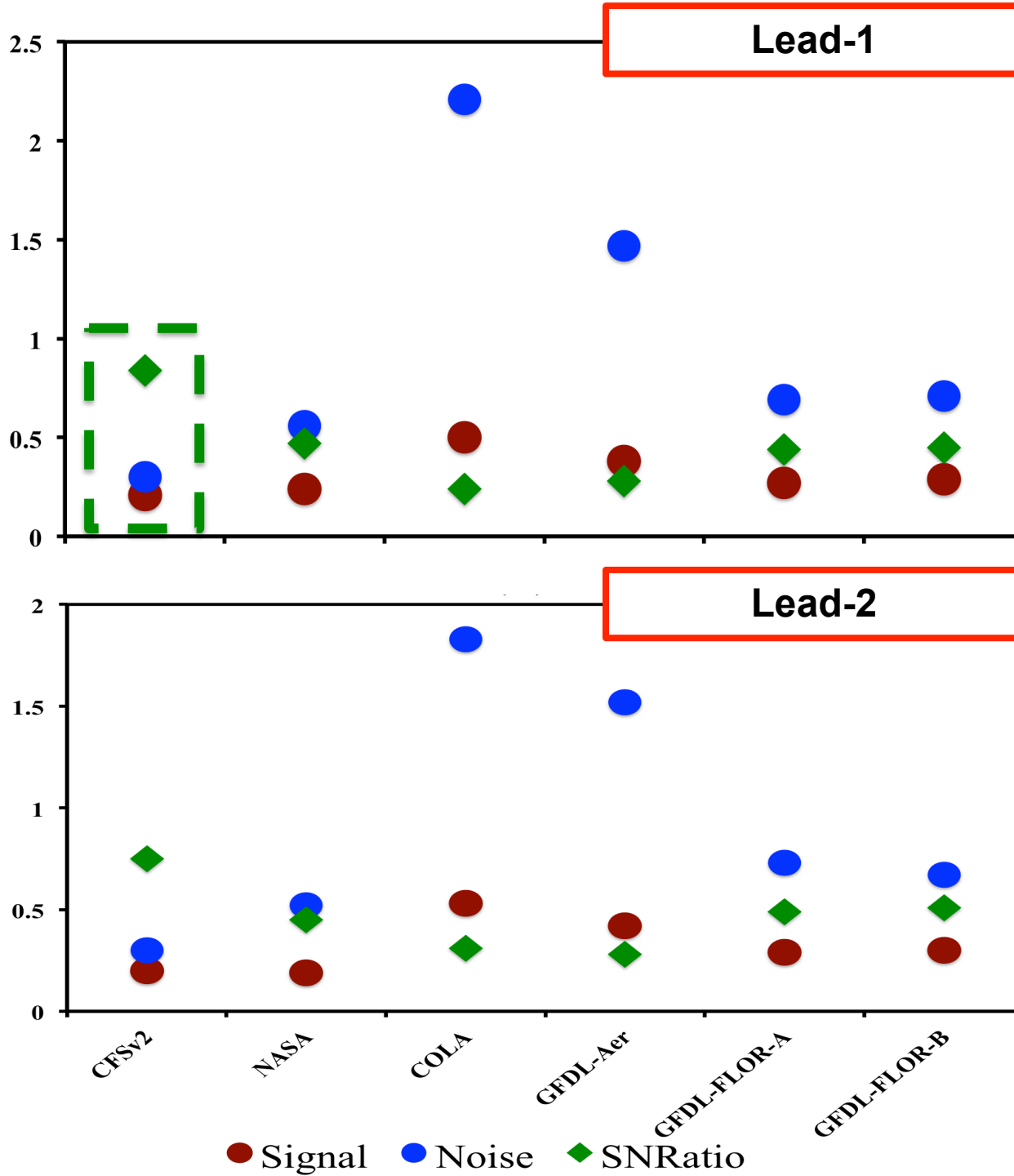
Potential Predictability Assessment Methods

Potential predictability is a model dependent quantity.

Several different techniques have been employed to study the potential and actual predictability.

These includes;

- ✓ Signal, Noise and Signal-to-Noise Ratio
- ✓ R_{limit}
- ✓ Perfect Model Correlation
- ✓ Prediction Skill (Correlation between Model and Observation)



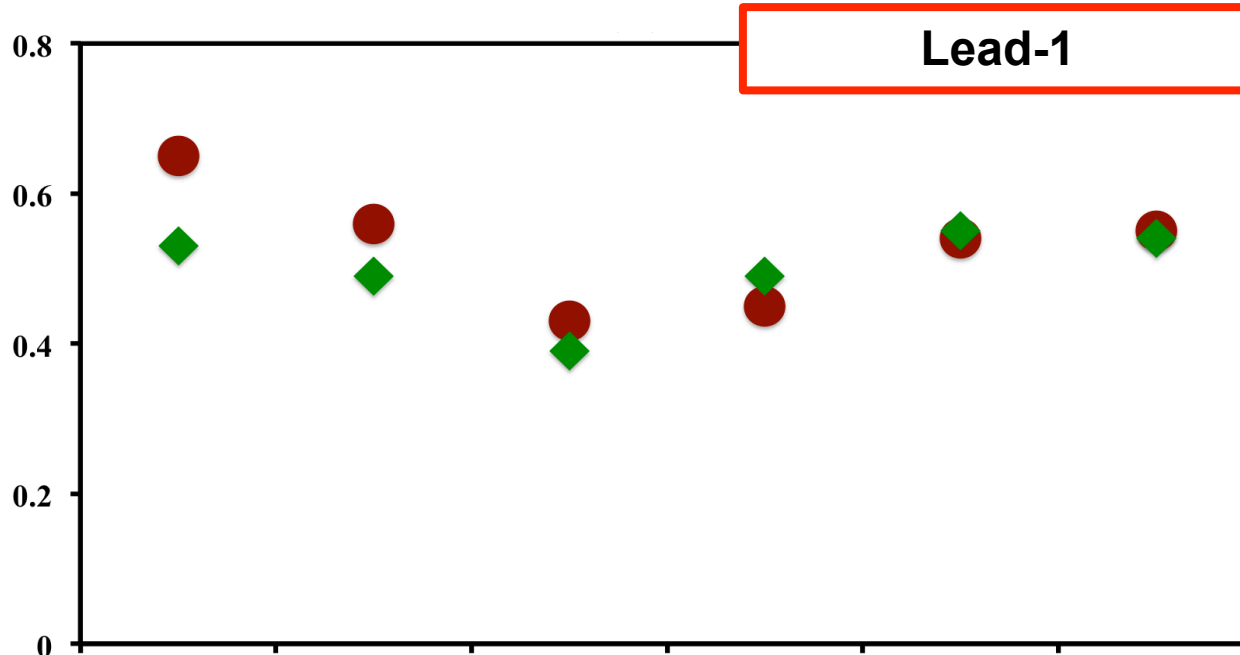
Variance of ensemble mean
(Response of SST forcing)

$$Signal = \frac{1}{N-1} \sum_{i=1}^N (\bar{M}_i - \bar{\bar{M}})^2$$

“Spread” among individual Ensemble members
(Chaotic Atm. Noise)

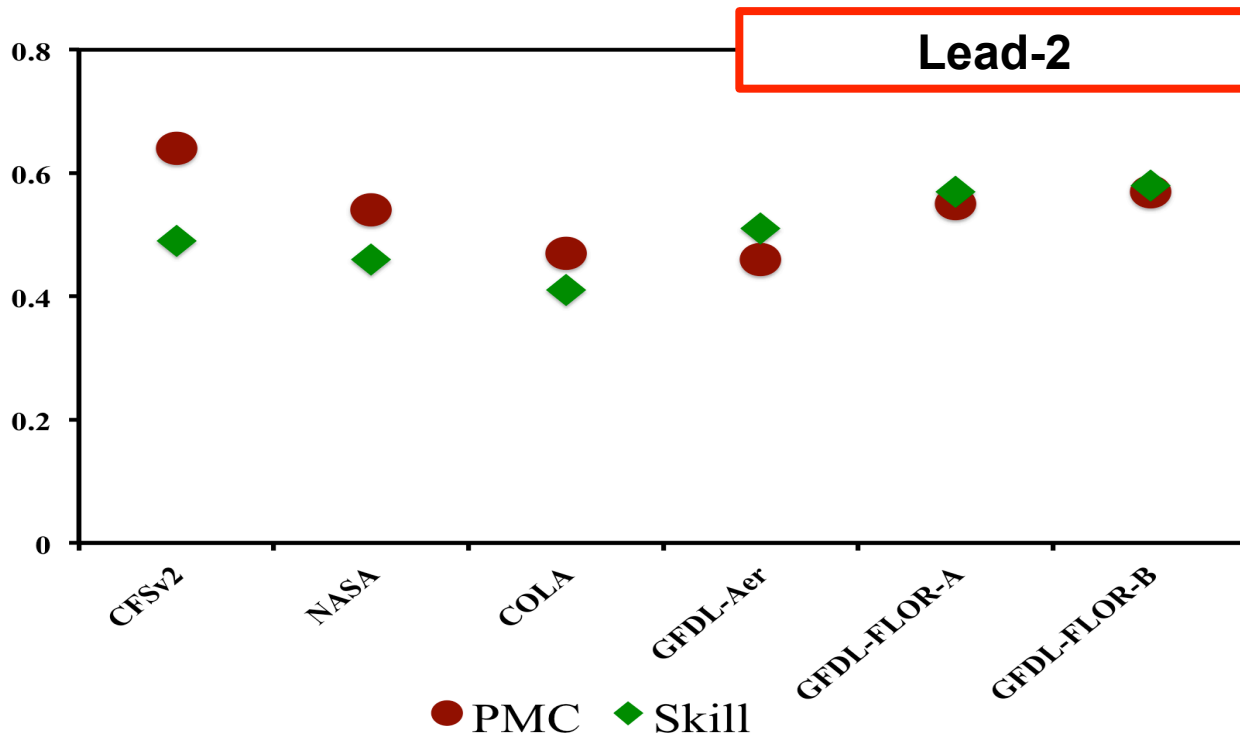
$$Noise = \frac{1}{N(n-1)} \sum_{i=1}^N \sum_{j=1}^n (M_{ij} - \bar{M}_i)^2$$

“Potential Predictability” is defined as the Signal/Noise.
Higher the SNRatio, higher the PP.



Perfect Model Corr. (PMC)

(Corr. between a **member of ensemble** forecast and **ensemble average of rest** can give a measure of predictive information available in that **ensemble member**)

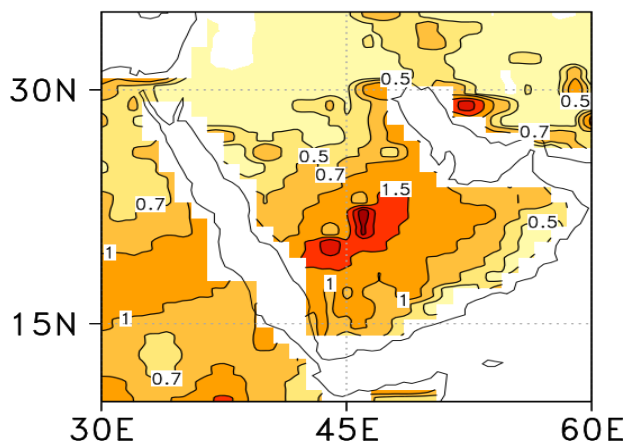


Obs. Corr. (Skill)

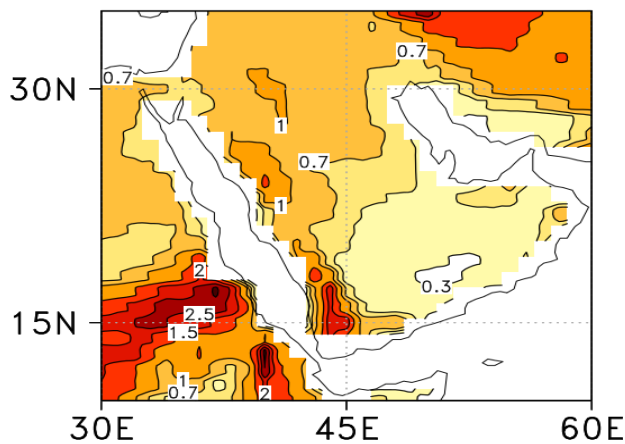
(Correlation between Obs. And forecasted Ensemble Mean summer AP-SAT anomalies.)

Potential Predictability: Signal/Noise

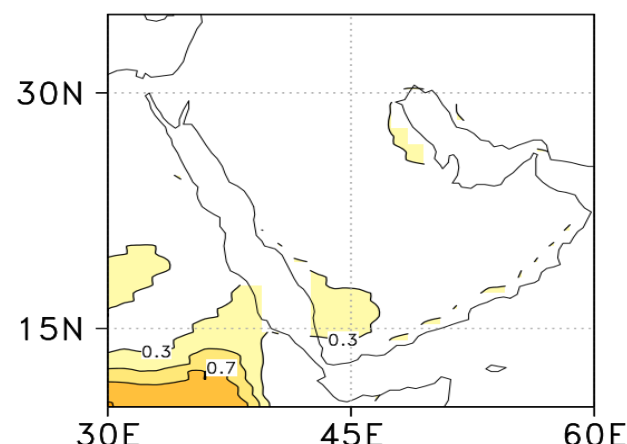
NCEP-CFSv2



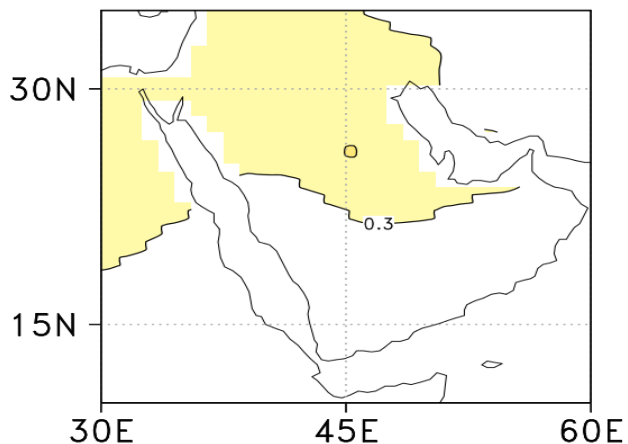
NASA



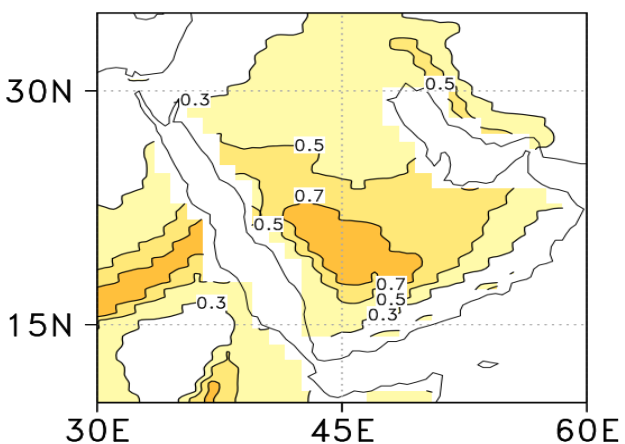
COLA



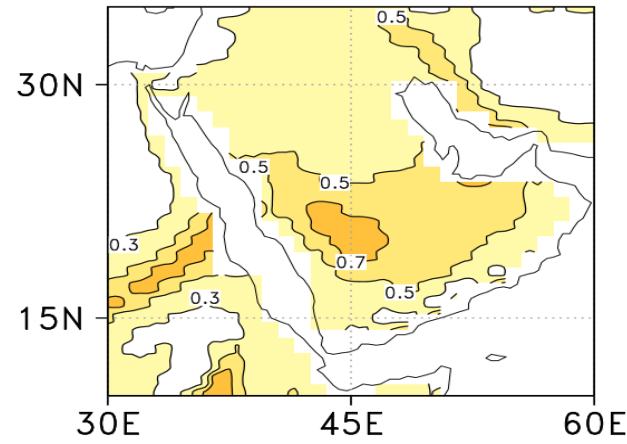
GFDL-Aer



GFDL-FLOR-A

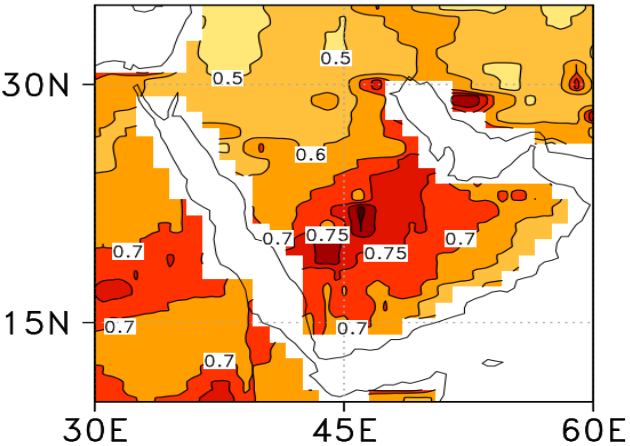


GFDL-FLOR-B

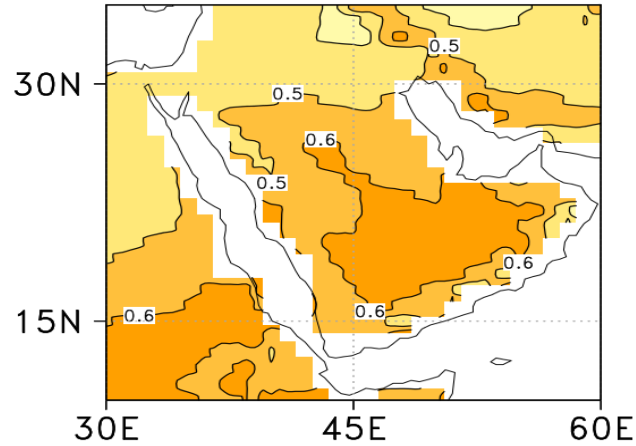


Potential Predictability: PMC

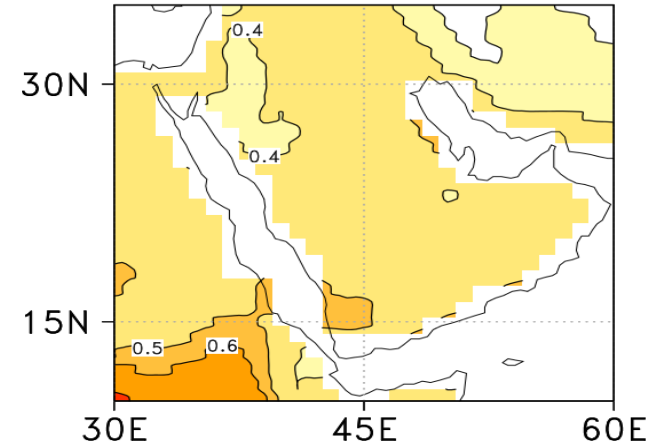
NCEP-CFSv2



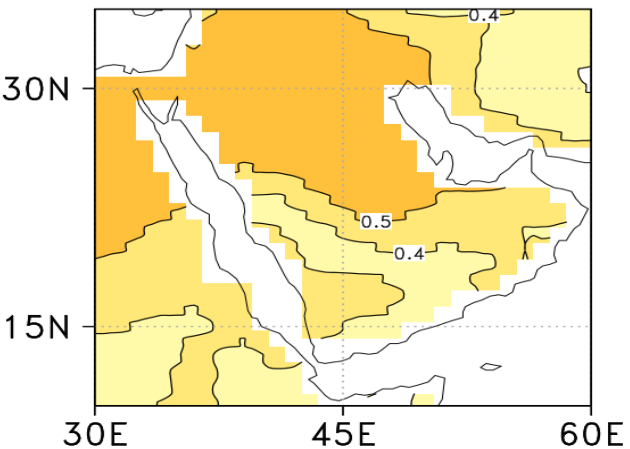
NASA



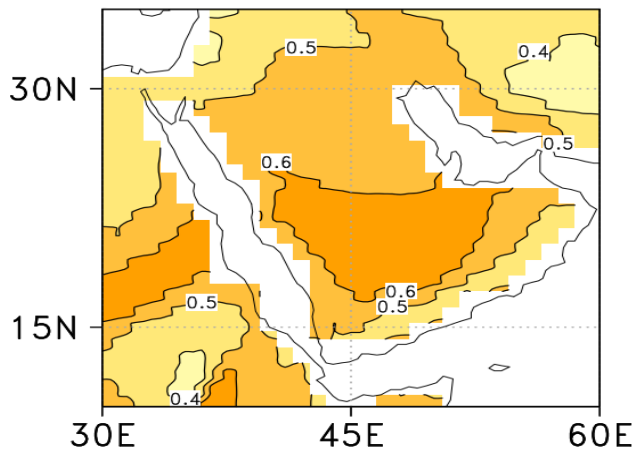
COLA



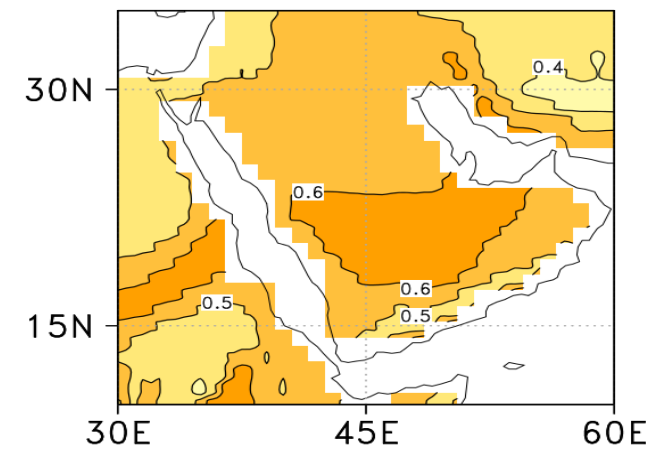
GFDL-Aer



GFDL-FLOR-A

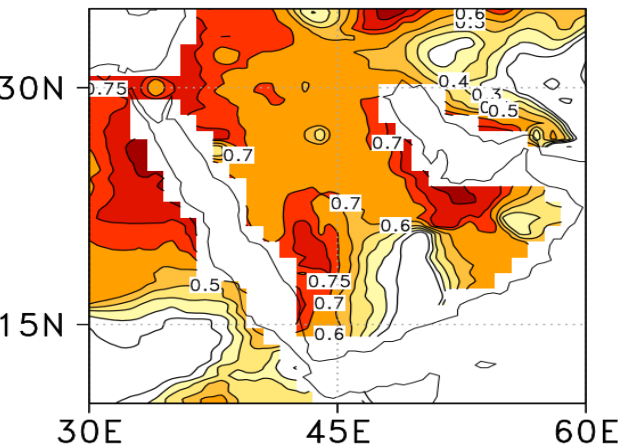


GFDL-FLOR-B

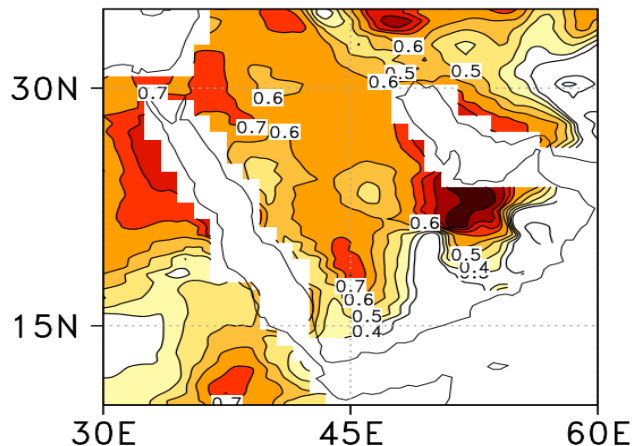


Prediction Skill: ACC

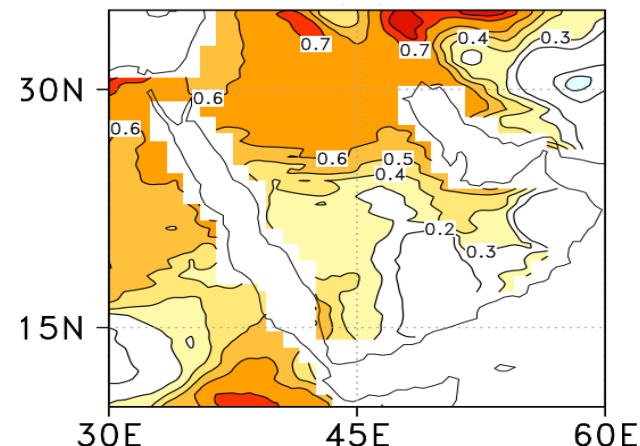
NCEP-CFSv2



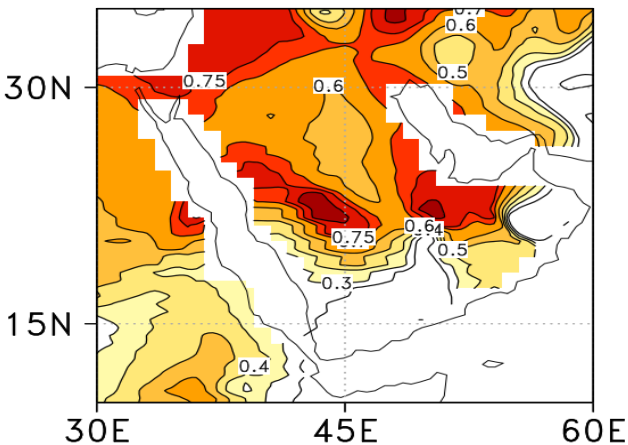
NASA



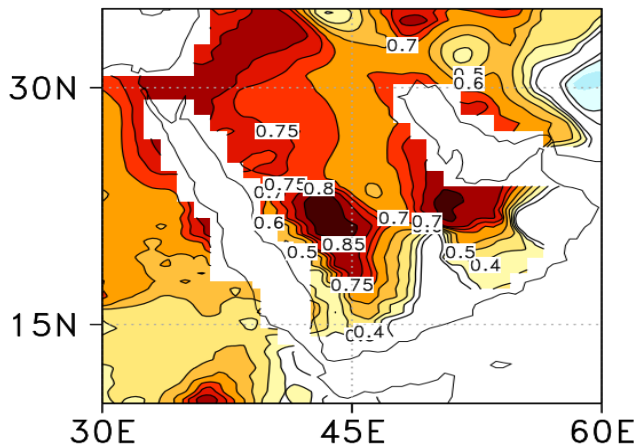
COLA



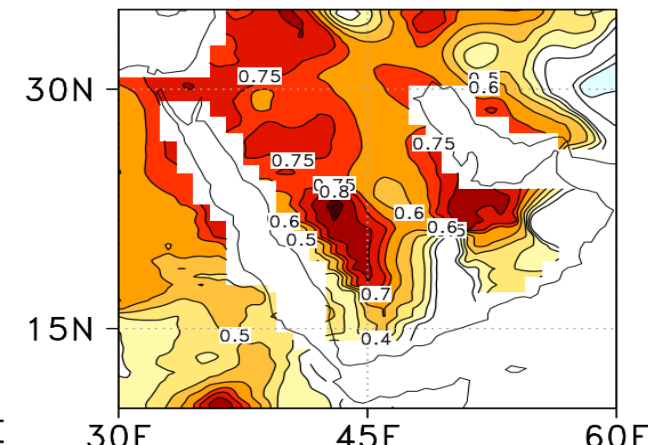
GFDL-Aer



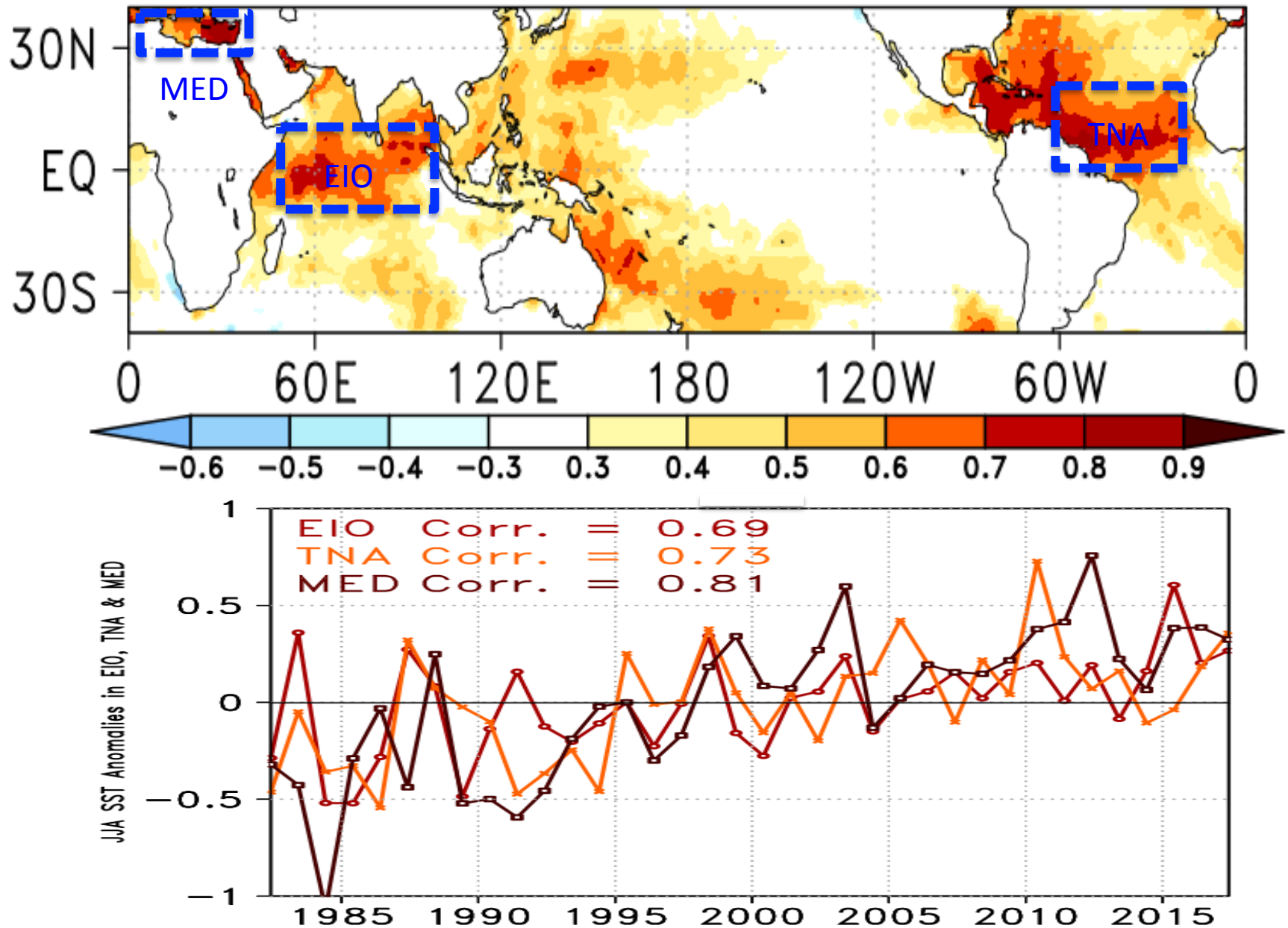
GFDL-FLOR-A



GFDL-FLOR-B



Possible Sources of Predictability: OBS



Dominant Atmospheric Configurations (L & U)

At Lower levels:

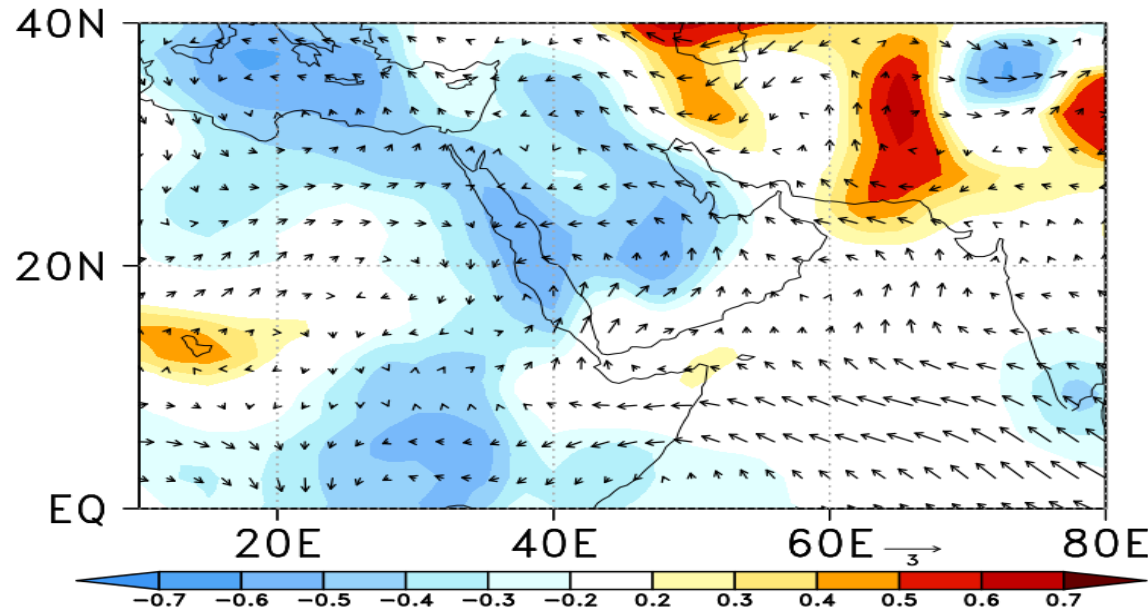
Low Pressure center is evident with lower level cyclonic circulations over the AP Region. Typical for Desert regions in summer.

At Upper levels:

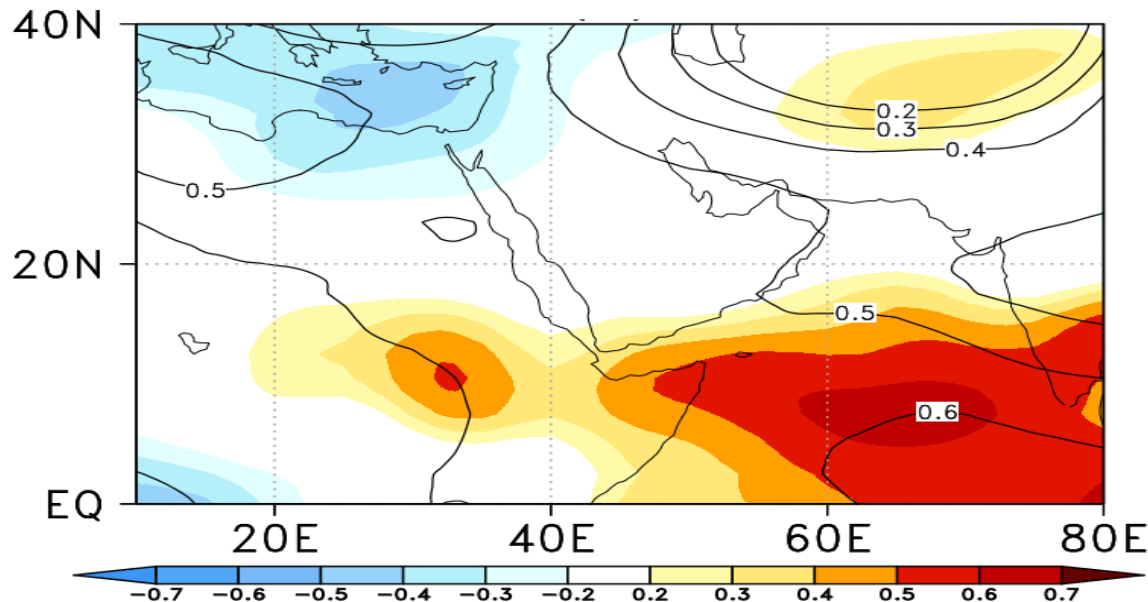
Positive correlation with the Z200 all over the region.

The Asian Jet is weakening in Summer, which closely related to high temperature over the AP.

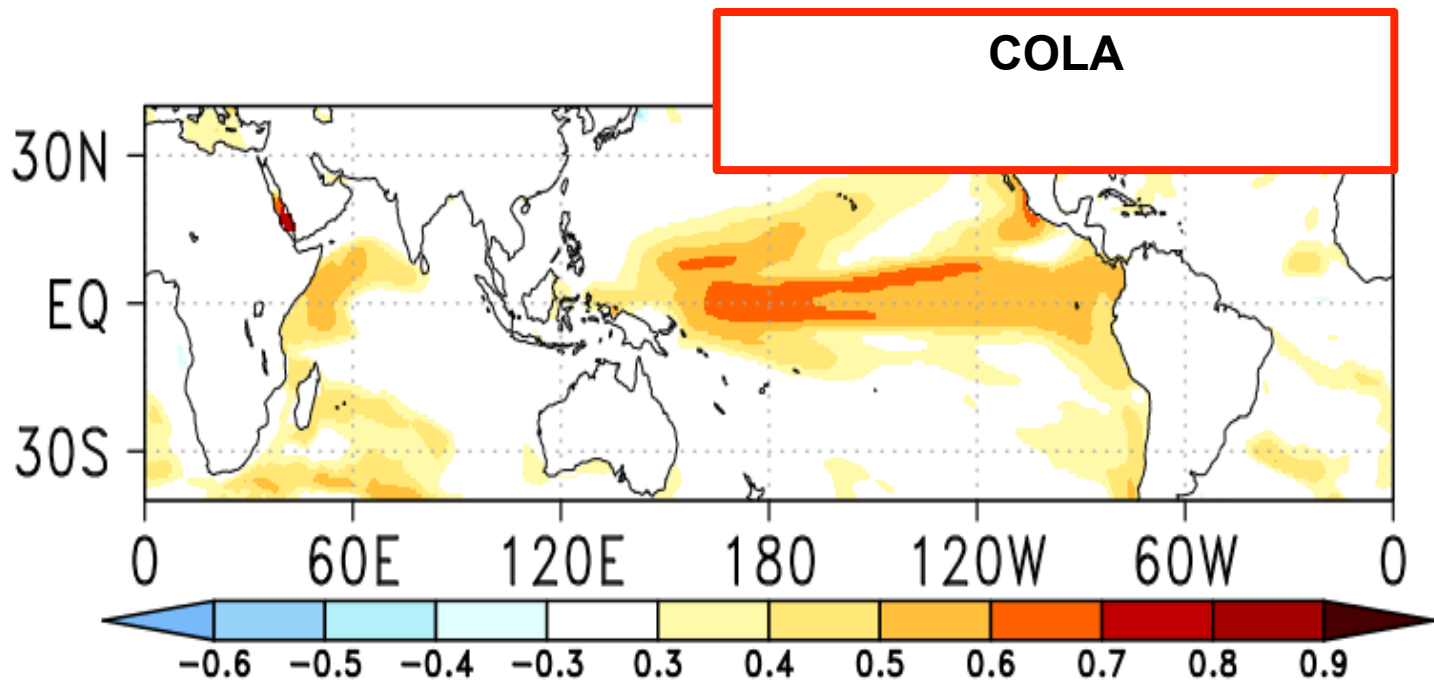
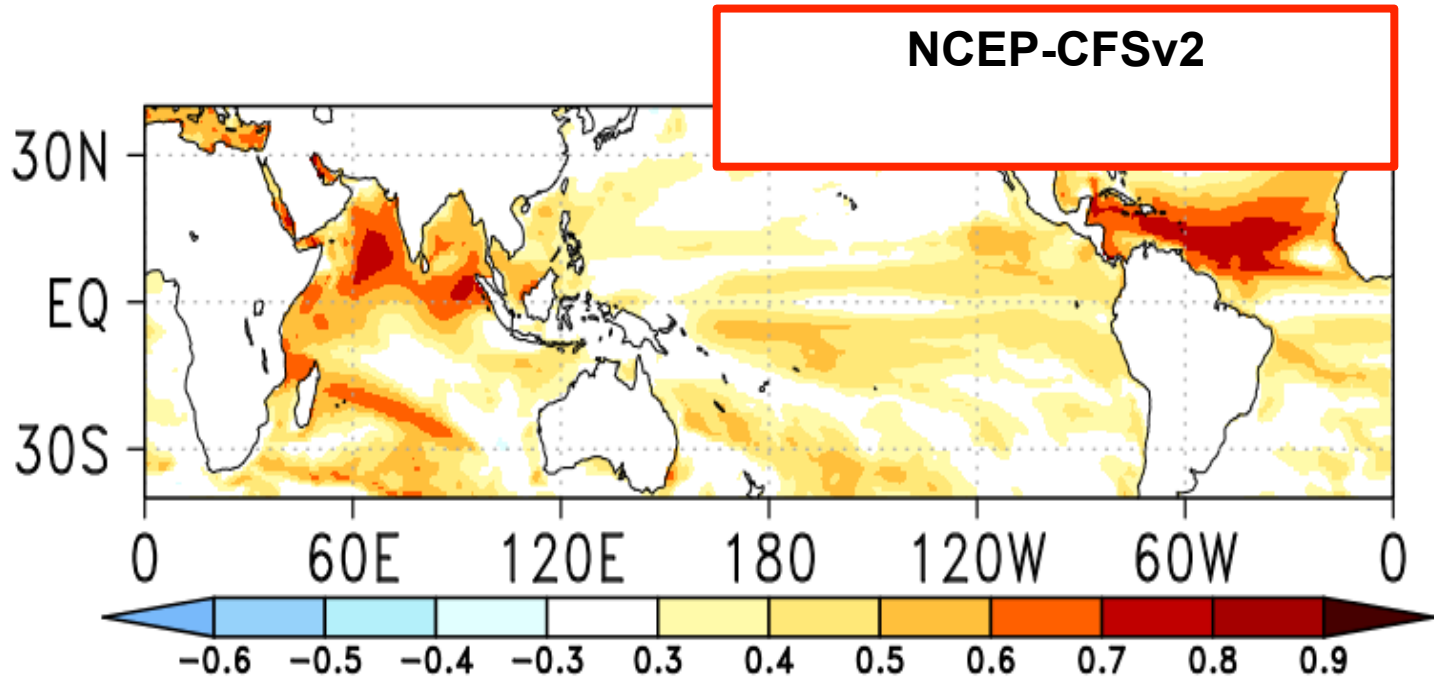
Corr. & Reg. of AP-SAT with
MSLP & 850 hPa Winds



Corr. of AP-SAT with Z & U at 200 hPa



Possible Sources of Predictability: Predictions



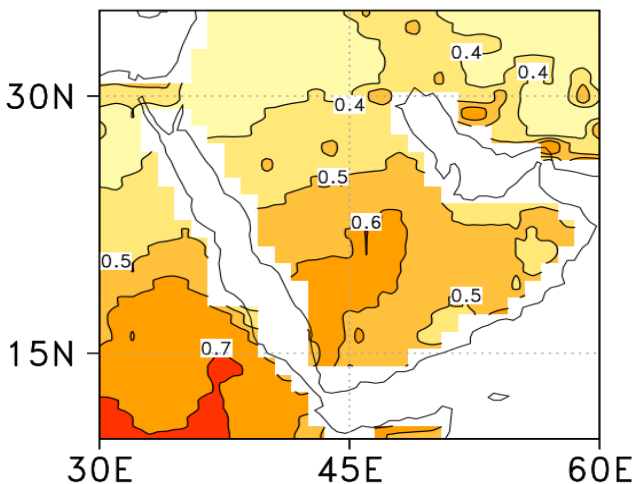
Summary and Conclusion

This study investigates the variability, potential predictability and skill assessment of summer AP-SAT in NMME CGCM prediction models. Main conclusion of study are;

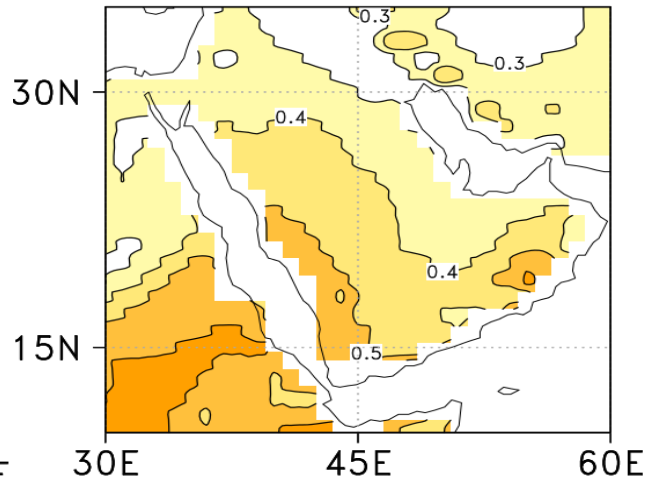
- ✓ **Summer AP-SAT** have robust increasing trend, and well correlated with EIO, TNA and MED SSTs.
- ✓ **CFSv2 provides high** SNRatio, Perfect Model Correlation, Skill, AP-SAT & G-SSTs connections as compared to other NMME models.
- ✓ **Further research is in progress** to pinpoint the underlying Physical Mechanism.

Potential Predictability (PMC): (Detrended Data)

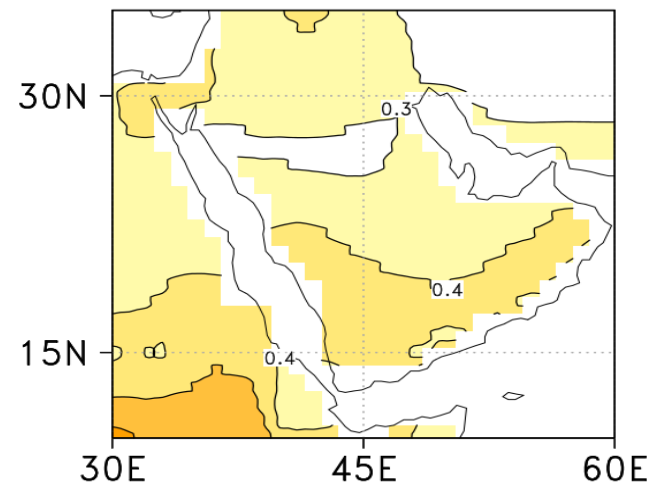
NCEP-CFSv2



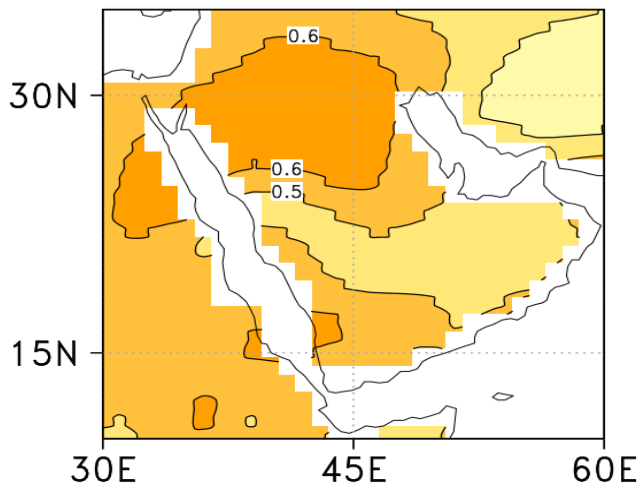
NASA



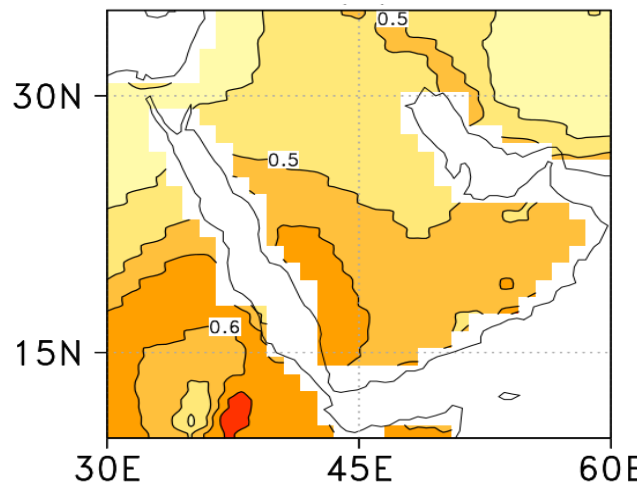
COLA



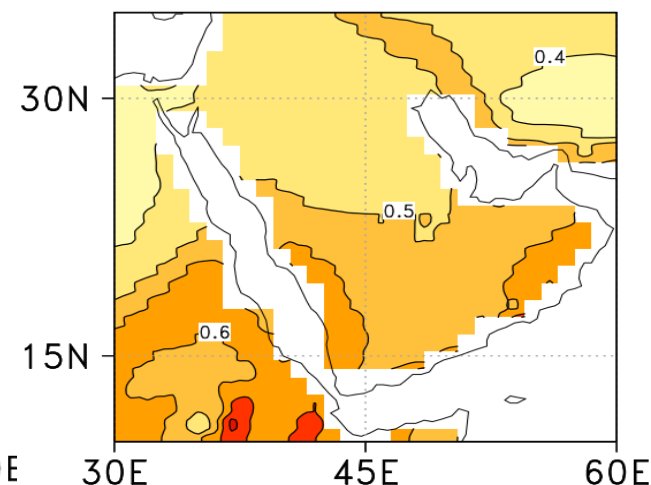
GFDL-Aer



GFDL-FLOR-A



GFDL-FLOR-B



Thank you for your attention!

M. Azhar Ehsan (mehsan@ictp.it)

Prediction Skill: Anomaly Pattern Correlation Coefficient

