CDA3 :Uncertainties in Model Simulations

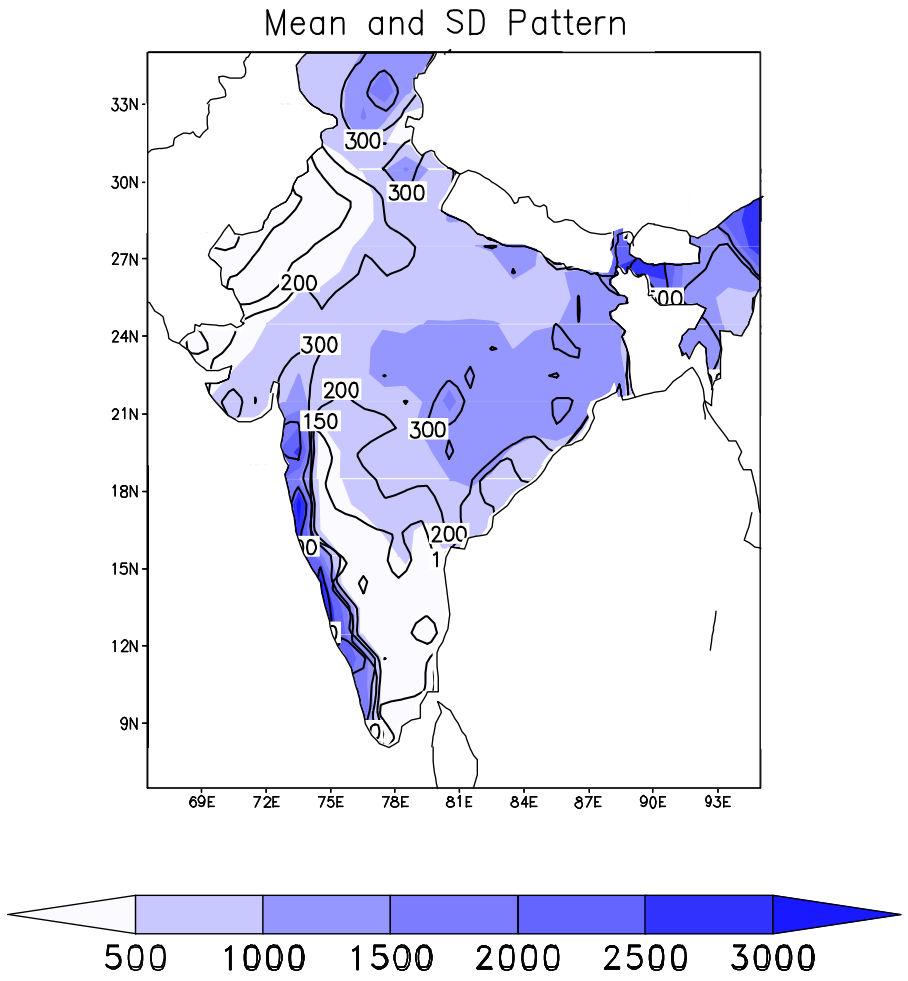
Ashwini Kulkarni
ashwini@tropmet.res.in

CORDEX South Asia Training Workshop
17-20 Oct 2012, IITM, Pune

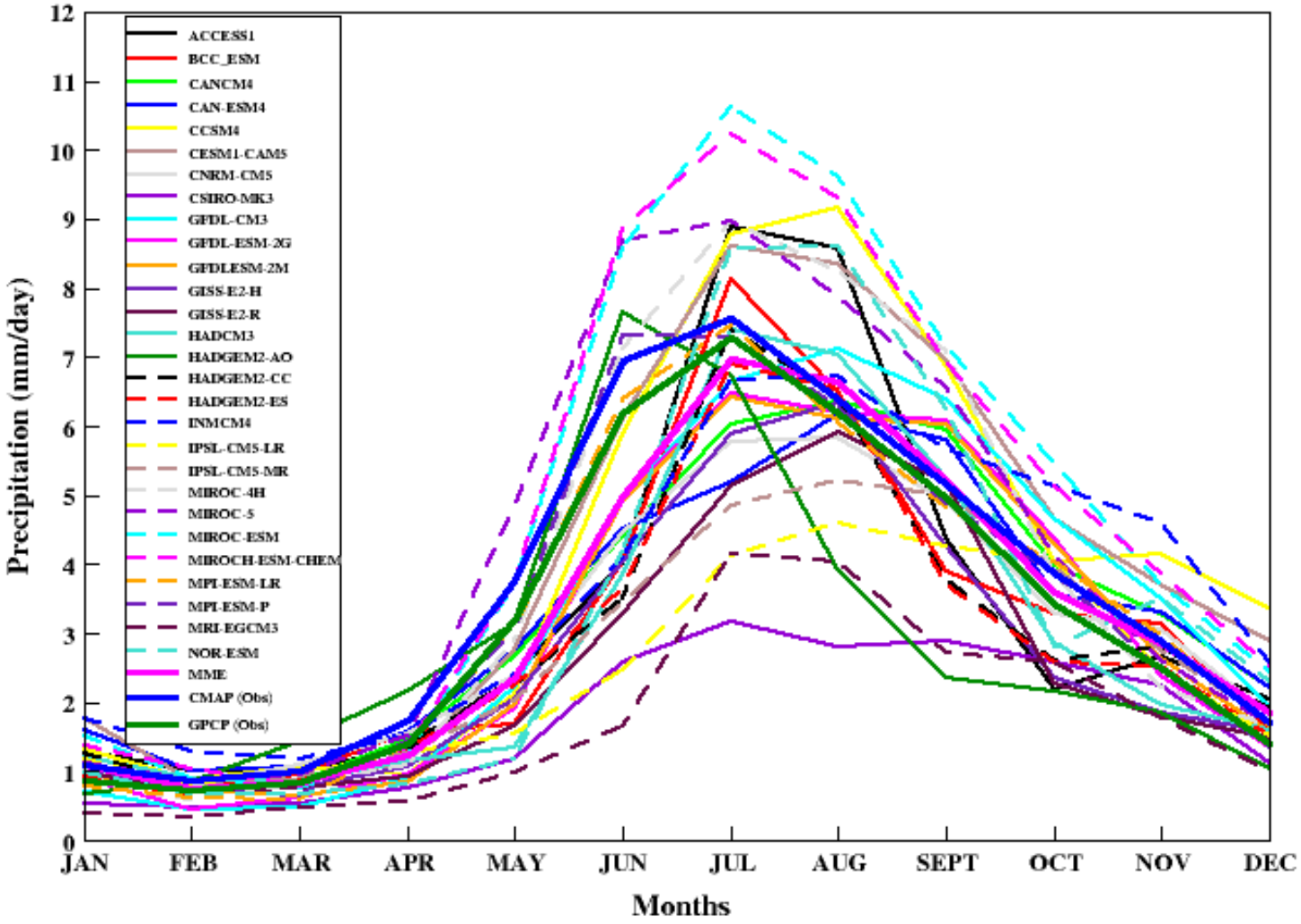
Uncertainties : disagreement among the models to simulate present climate

- Annual Cycles
- Spatial pattern
- Mean
- Variability / spread

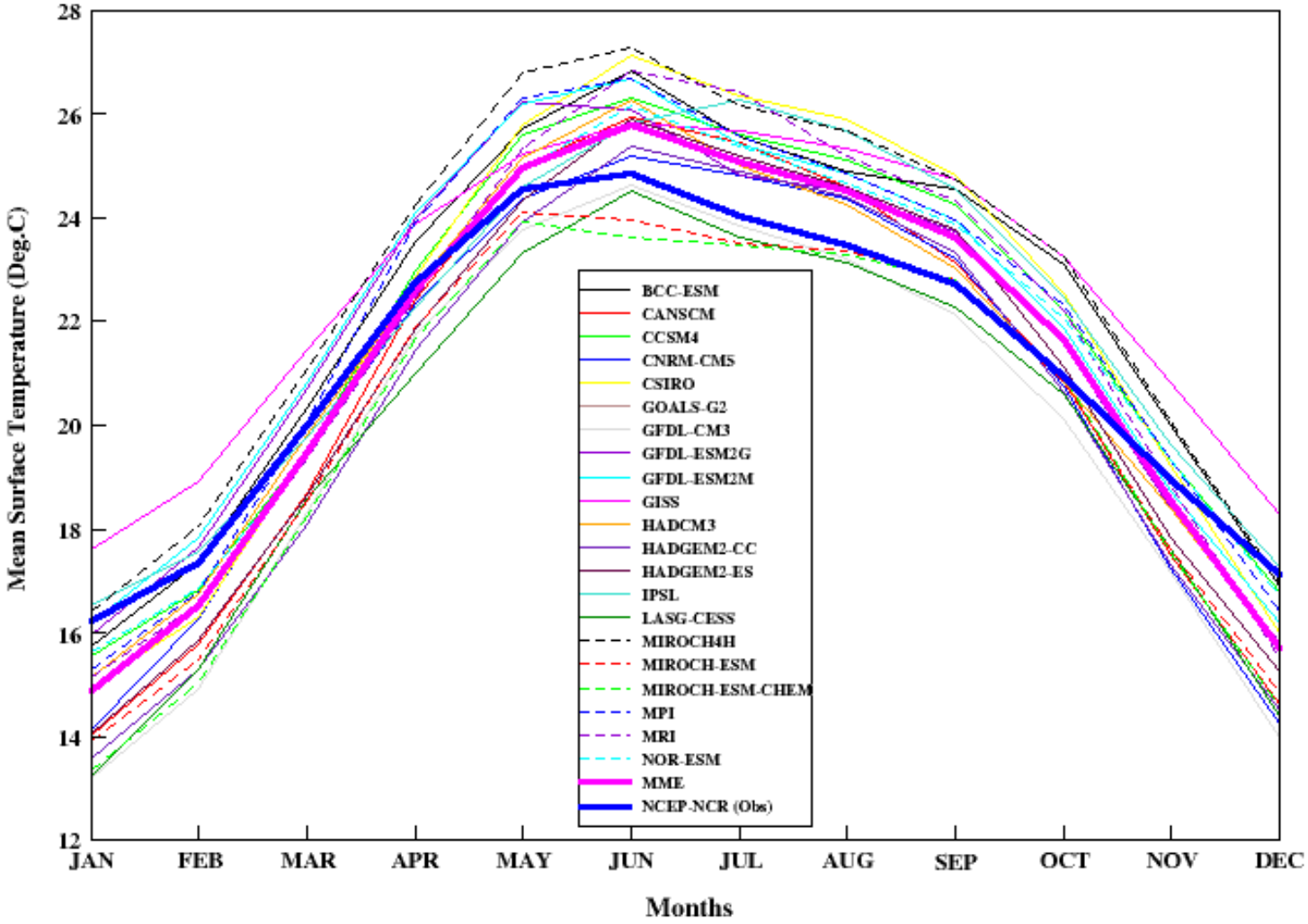
Seasonal (JJAS) Indian monsoon rainfall



Annual Cycle Rainfall : CMIP5
1986-2005



Annual Cycle Temperature : CMIP5
1986-2005



To understand model uncertainties use ensembles consisting of

- multiple model runs with different initial conditions
- Ensembles with different model physics (eg PPE)
- Number of models (multi-model ensembles)
- Combinations of all above

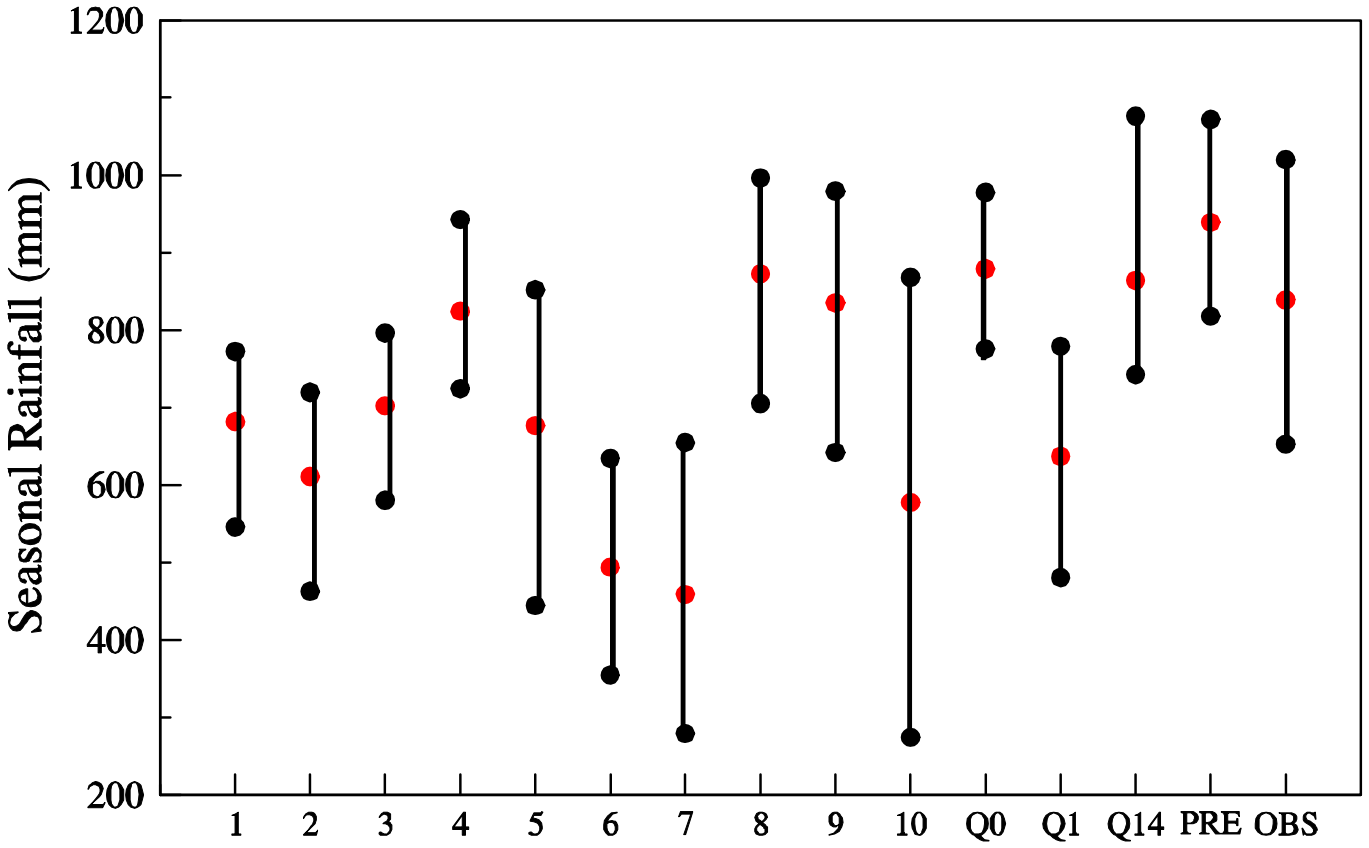
Quantification of uncertainties

- Multivariate EOF (Mu, Jackson…)
- Reliable Ensemble Averaging (Giorgi, Mearns…)
- Hierarchical Modeling/Markov Chain Monte Carlo Simulations (Katz)
- Bayesian Approach/ Hierarchical Bayesian Modeling (Jackson, Katz, Smith, Tebaldi…)
- Probability Density Functions (Collins)

Metrics to measure uncertainties in model simulations

- Bias
- Root Mean Square Error
- Standard deviation
- Pattern Correlation
- Range : Minimum and Maximum

Seasonal Rainfall Simulation : Model Performance



For your region compute

- Bias
- Root Mean Square Error
- Standard deviation
- Pattern Correlation
- Bar Diagram

Use Summer (JJAS) and winter (DJF) Rainfall and temperature

from the given RC model simulations

Formulae

Spatial : At grid i, Mi : Model value Oi : Observation

Mean Bias = $\sum(Mi-Oi)/n$ n : toatal # years used

RMS Error = $\sqrt{\sum(Mi-Oi)^2/n}$

Standard Deviation (σ) = $\sqrt{\sum(Mi-Mbar)^2/n}$ Mbar = $\sum Mi/n$

Coefficient of Variation (CV) = $(\sigma/Mbar)*100$

Range = Max(Mi)-Min(Mi)

Pattern Correlation = Corr (M, O) over space

Temporal : area averaged time series , compute same measures