

Experimental Seasonal Forecasting for ASEAN Cities

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Scope

- Climate Predictability Tool (CPT)
- Seasonal Forecasts for Singapore/ASEAN
- Forecasts performance over Singapore
- PCR and CCA comparison results

CPT

- Statistical prediction tool, developed by IRI, used for constructing seasonal climate forecast model.
- It can produce model validation (x-validation & retrospective forecast) and produce forecast with updated predictor data.
- Introduced during the ASMC-IRI Workshop conducted May 2007.
- Offers choice of Canonical Correlation Analysis (CCA) or Principal Components Regression (PCR) techniques for model construction.

Seasonal Forecast for Singapore/ASEAN

- CPT used by MSD to generate monthly/3-monthly rolling seasonal forecasts for rainfall over Singapore/ASEAN region.
- Provides MSD with an objective further outlook of the rainfall anomaly patterns.
- Previously, further outlook is based mainly on climatological history, and for shorter periods, based on medium-range model forecasts.

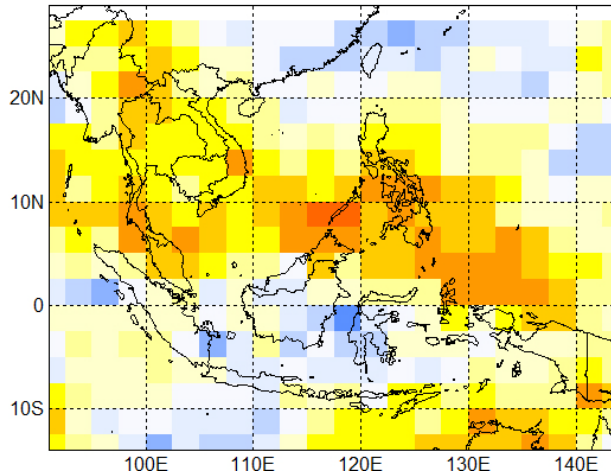
Seasonal Forecast for Singapore/ASEAN (Config)

- Employ the MOS (Model Output Statistics) design approach, with ECHAM retrospective forecasts as predictors and, local station rainfall (SG) and NASA GPCP Satellite-Gauge combined precipitation (ASEAN) as predictands.
- Both ECHAM model outputs and NASA GPCP rainfall obtained from IRI/LDEO Climate Data Library.
- Cross-validation method (window-width: 5) used for 20-30 years of available training data.

Skill Scores (GPCP, Rain Gauge)

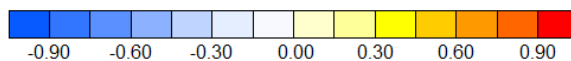
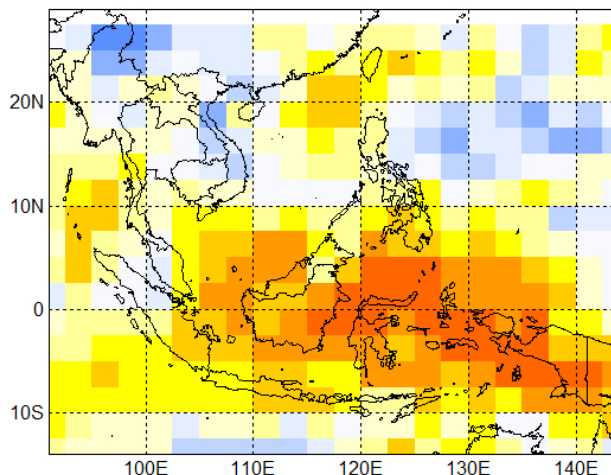
MAM – GPCP

Pearson's Correlation

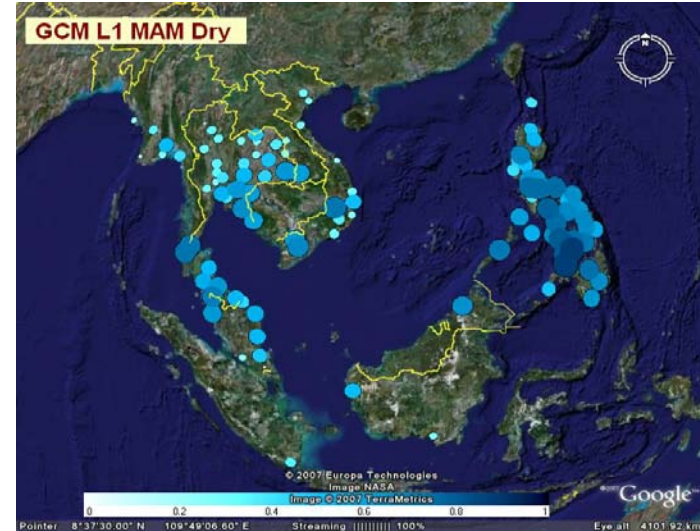


ASO – GPCP

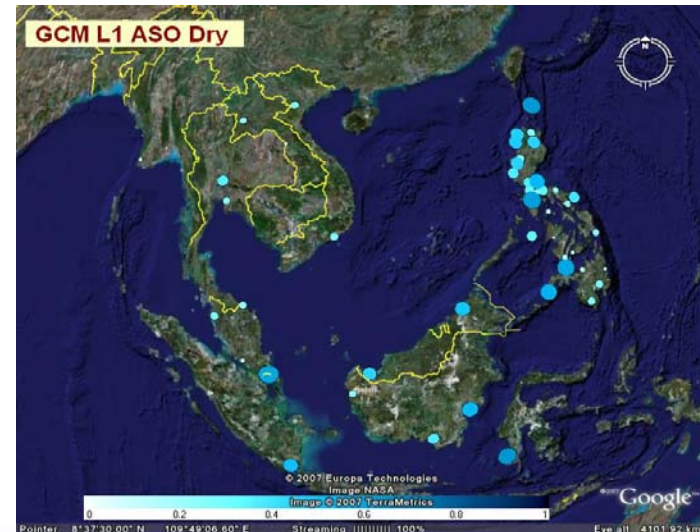
Pearson's Correlation



MAM – Rain Gauge



ASO – Rain Gauge

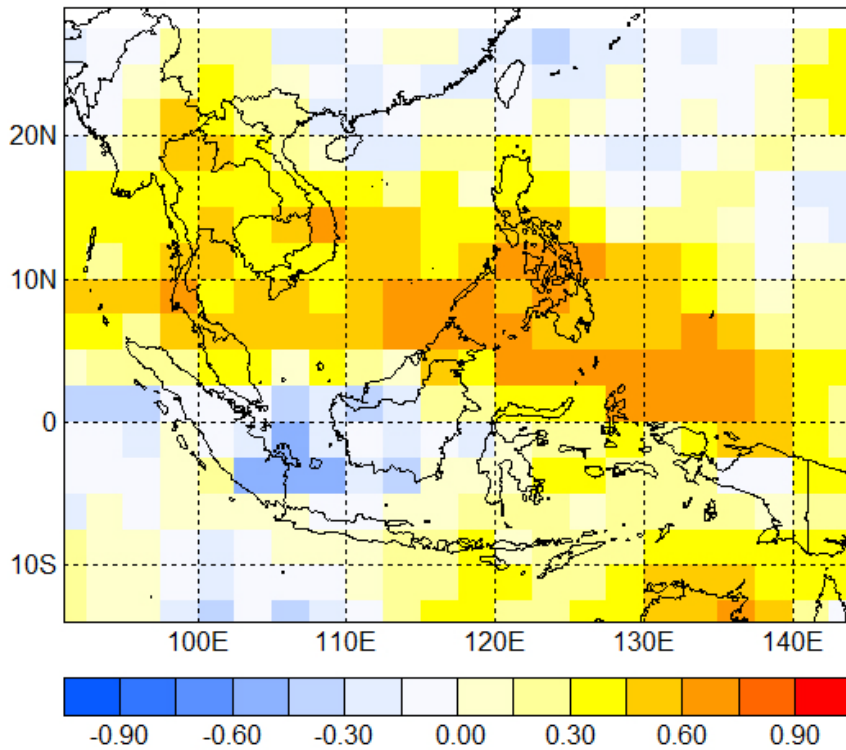


Experimenting with CCA/PCR in Regional Forecast

- Both are variants of multiple linear regression techniques.
- Main difference: PCR uses a set of predictors to predict one predictand element at a time, CCA uses a set of predictors collectively to predict a set of predictands collectively.
- Motivation to use CCA: Gridded NASA GPCP rainfall data as predictands offers possibility of making more meaningful predictions (1) by considering inter-grid patterns and (2) guard against fitting predictions to random noise/fluctuations of individual predictands.

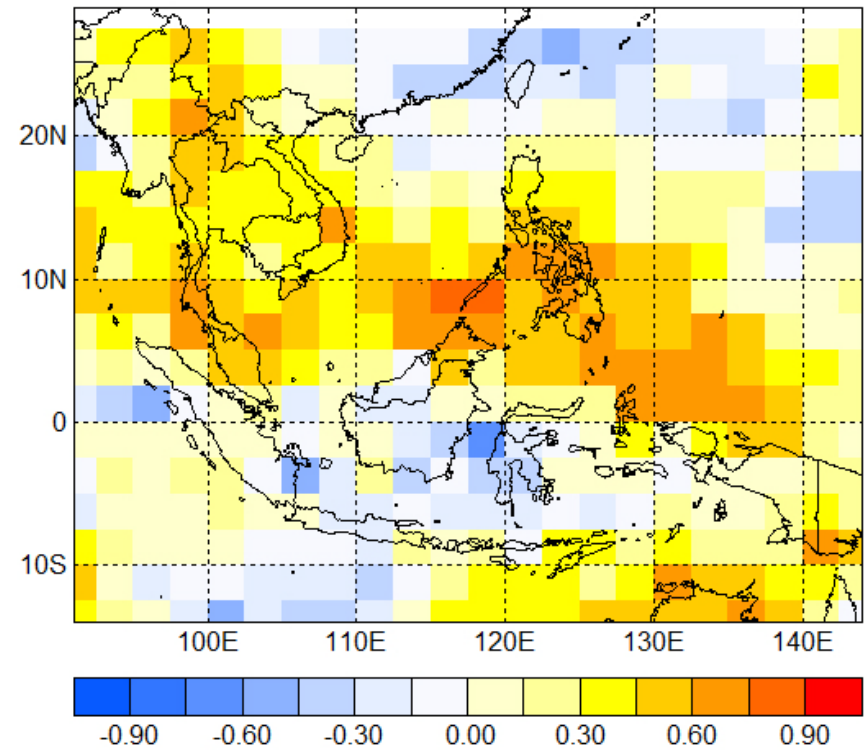
Skill Scores – MAM

Pearson's Correlation



CCA

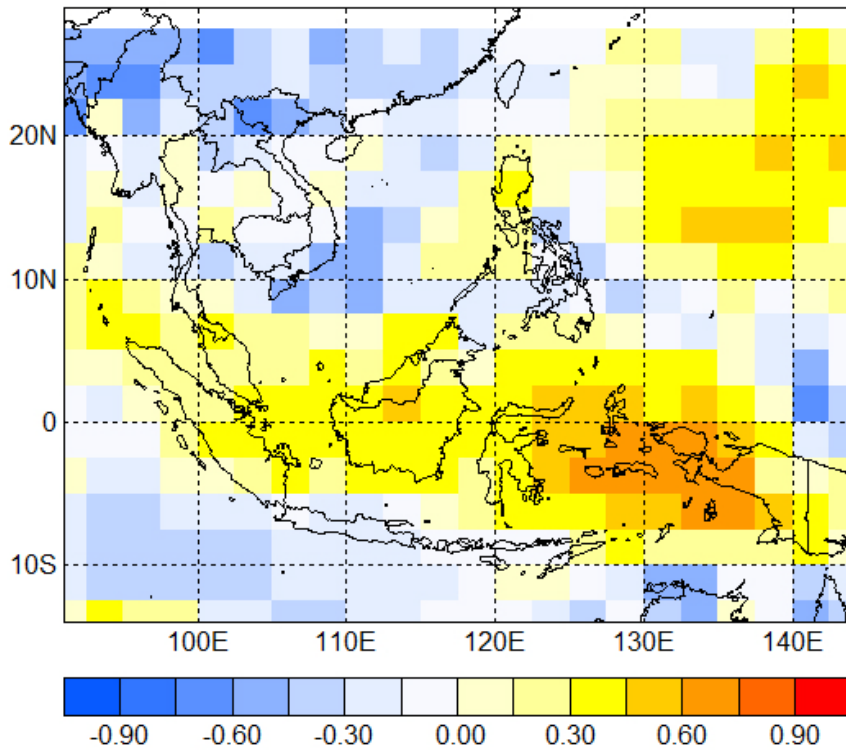
Pearson's Correlation



PCR

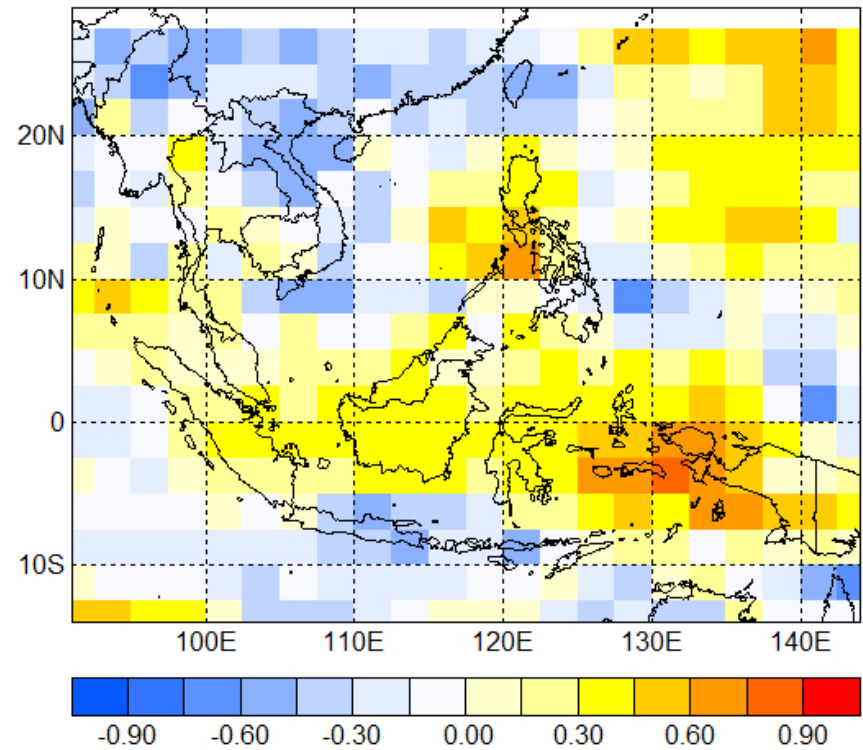
Skill Scores - JJA

Pearson's Correlation



CCA

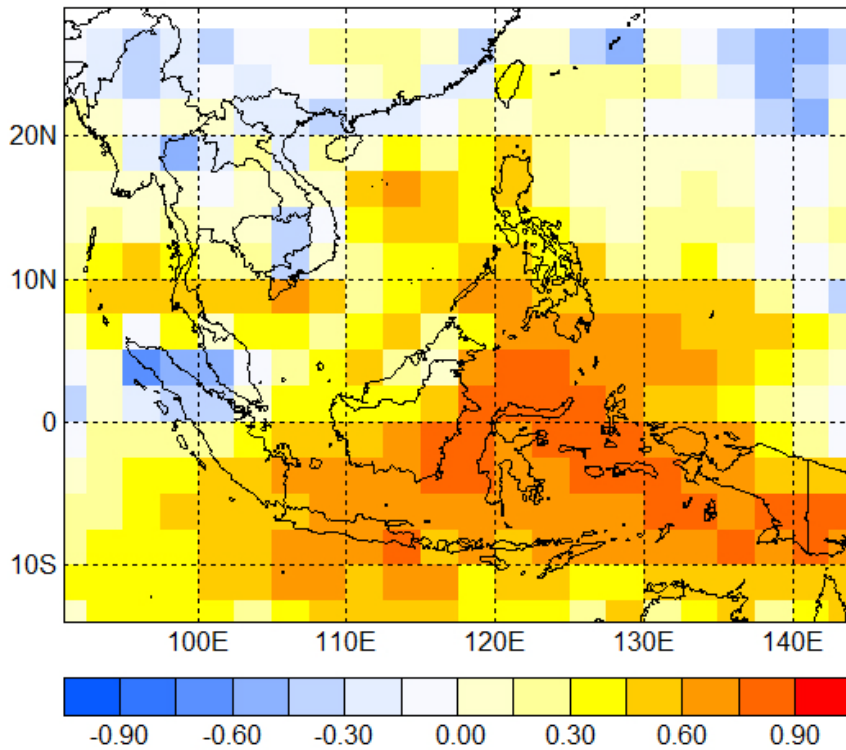
Pearson's Correlation



PCR

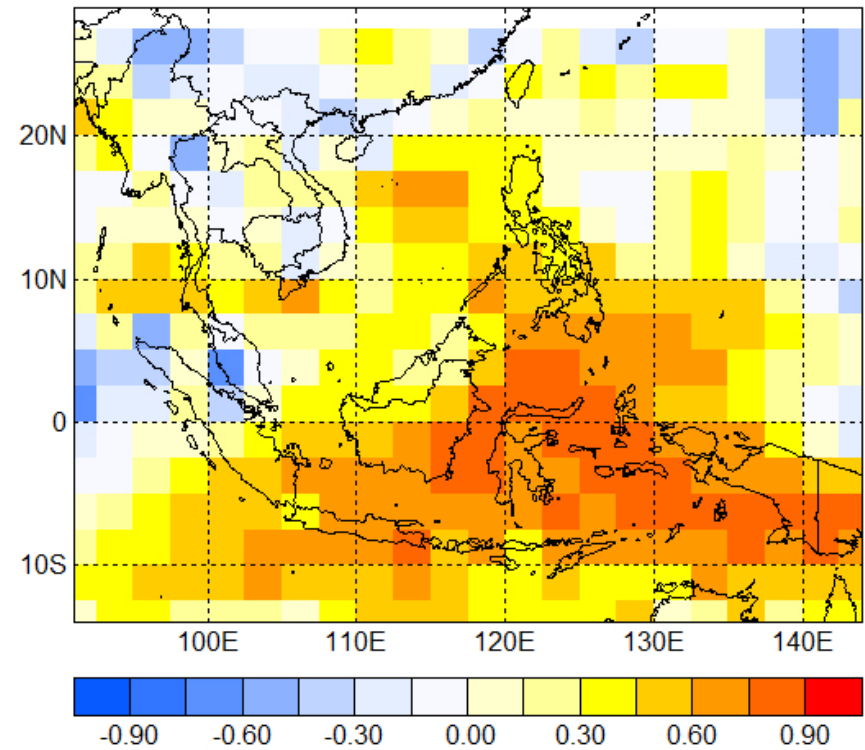
Skill Scores – SON

Pearson's Correlation



CCA

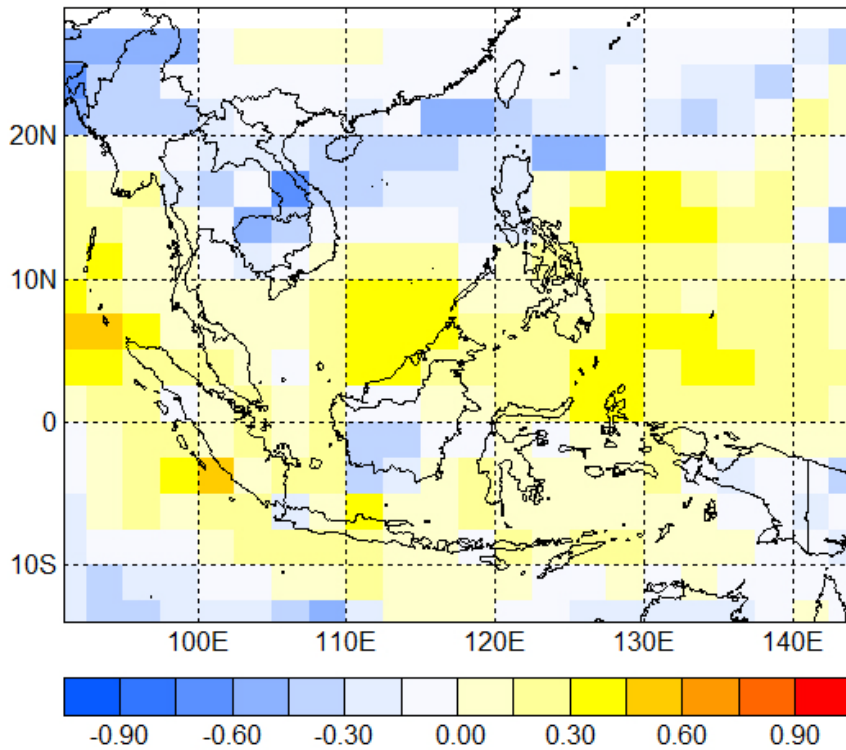
Pearson's Correlation



PCR

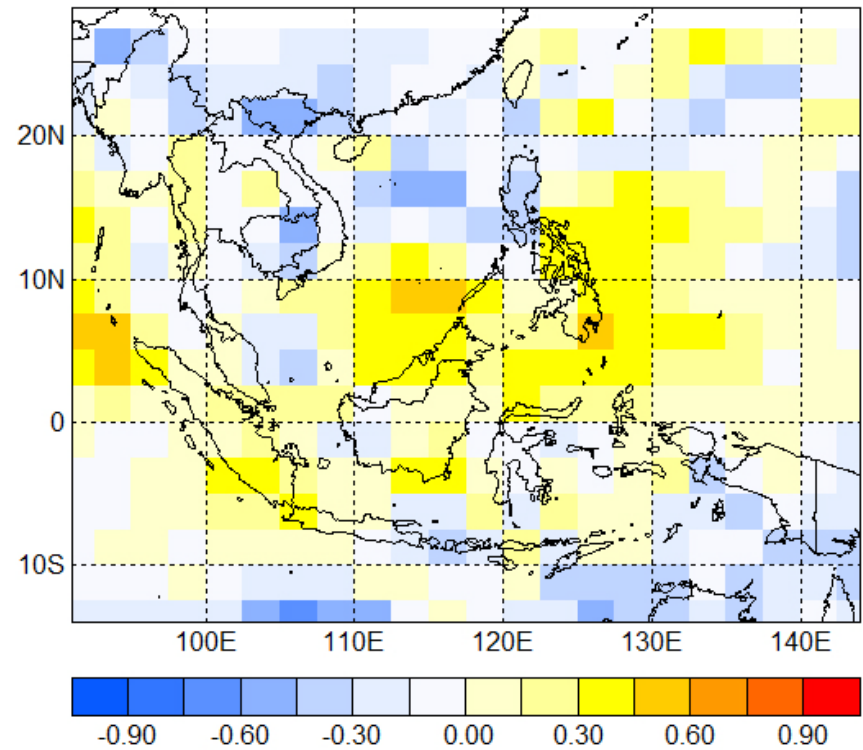
Skill Scores – DJF

Pearson's Correlation



CCA

Pearson's Correlation

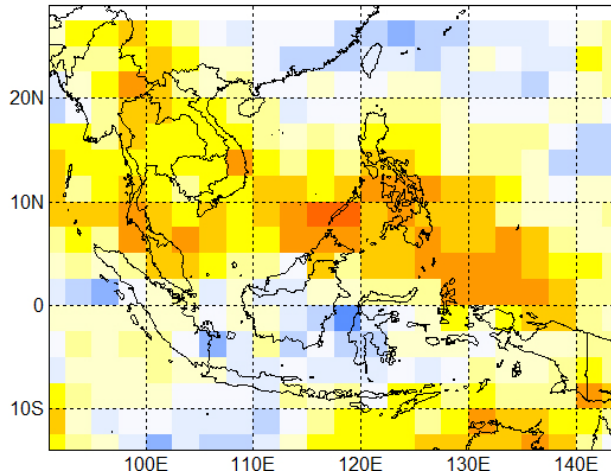


PCR

Skill Scores (MAM, JJA, SON, DJF)

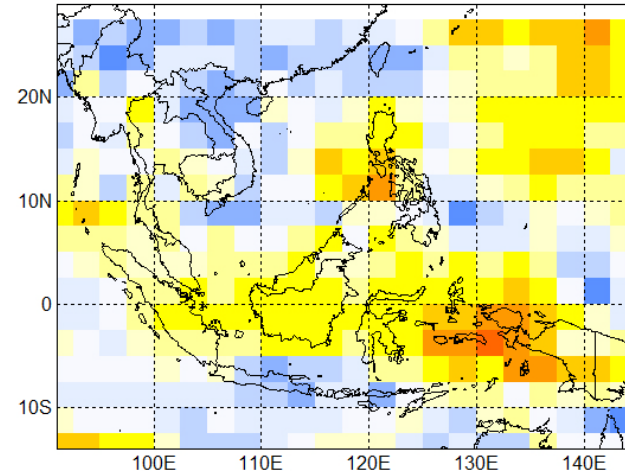
MAM – Intermonsoon

Pearson's Correlation



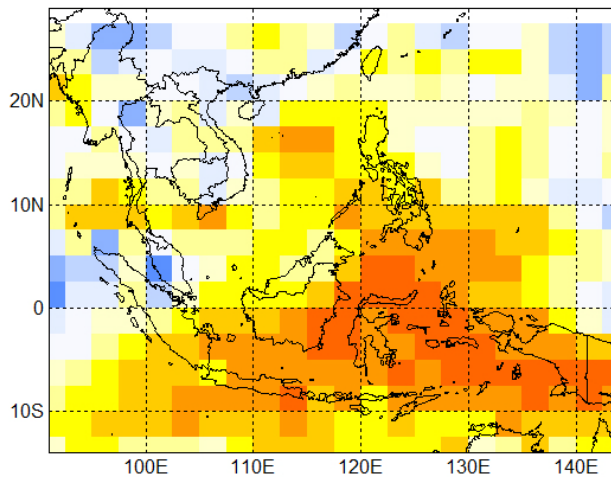
JJA – SW Monsoon

Pearson's Correlation



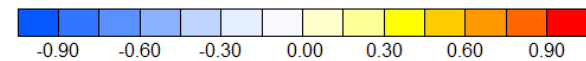
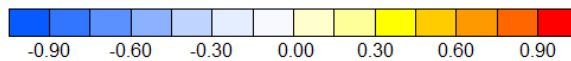
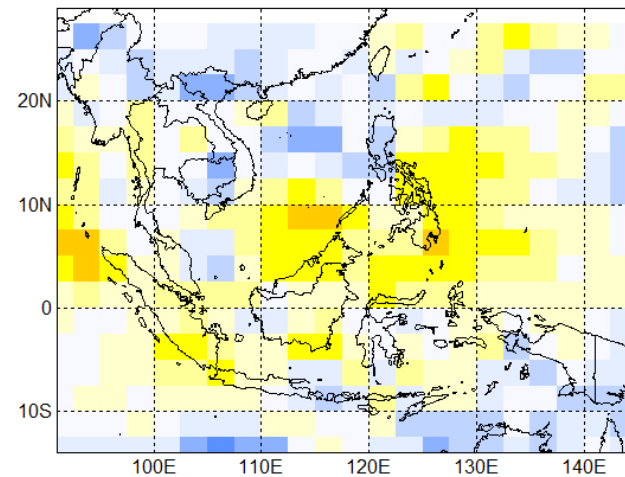
SON – Intermonsoon

Pearson's Correlation



DJF – NE Monsoon

Pearson's Correlation

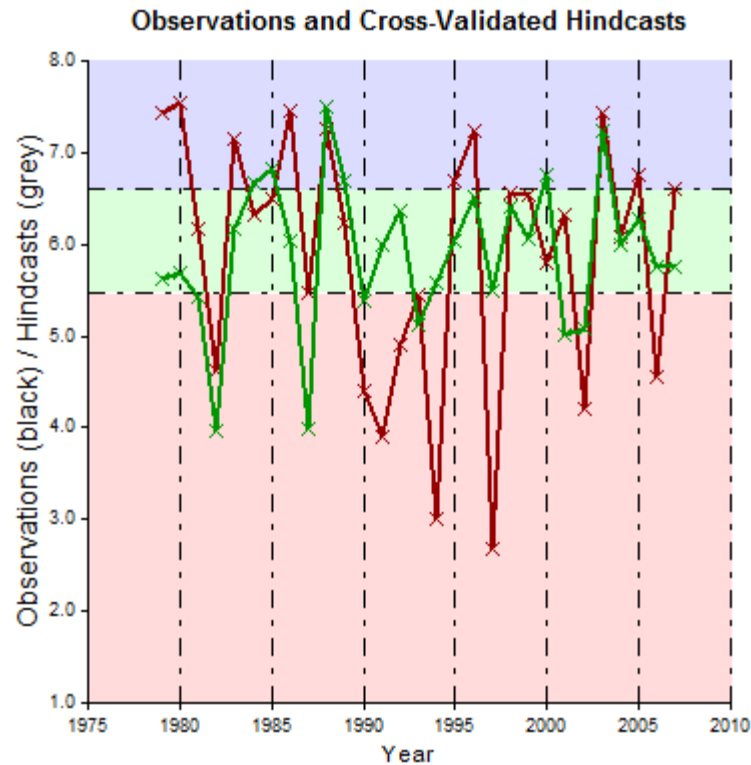


Comparing Results: CCA vs PCR

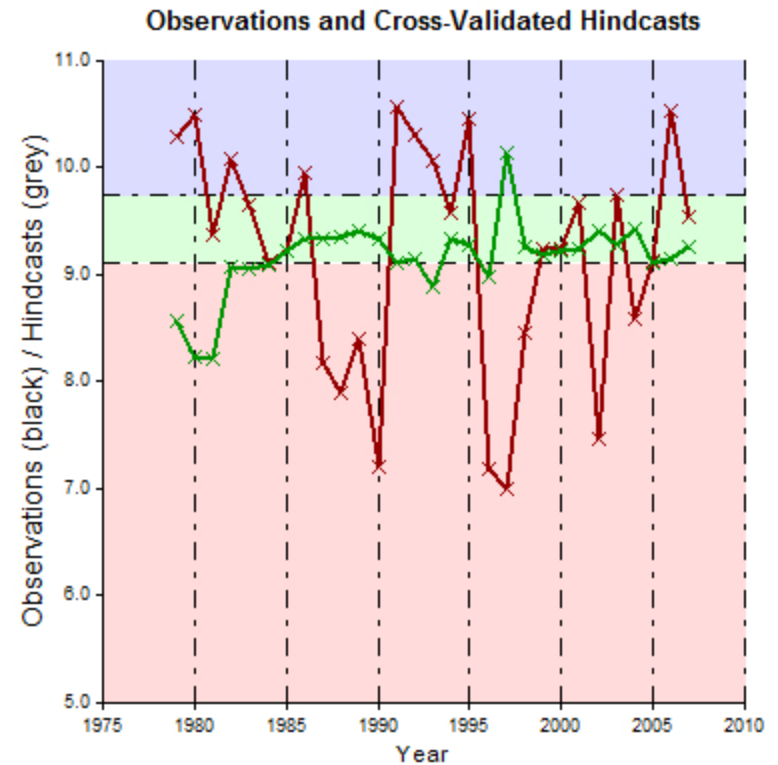
- Performance between CCA and PCR are assessed for grid over Singapore.
- Four basic performance measures are compared: Pearson's Correlation, Root Mean Sq Error, Mean Abs Error and Hit Score.

Forecasts Performance over Singapore (Grid: 1.25N, 103.7E)

- Sample Output



ASO, Skill Score: 0.4422



OND, Skill Score: -0.4945

Some Results

- For Pearson's Correlation, PCR performs better than CCA for 7 seasons.
- For both Root Mean Sq & Mean Abs Error, CCA performs better than PCR for 7 & 6 seasons respectively.
- For Hit Score (categorical measure), both perform equally well, but CCA has slightly higher mean Hit Score across the seasons.

Preliminary Findings

- Regional forecast: Generally, both CCA and PCR perform better during the inter-monsoon seasons (e.g. MAM, SON) than the NE (DJF) or SW (JJA) monsoon.
- CCA vs PCR: From preliminary performance measures, CCA offers potential of providing better forecasts.
- CCA seems to perform better during the SW/NE Monsoon period where relationships between the individual predictands and their neighbouring grids are more likely to exist.

Future Work

- Establish the cause for difference of predictability in seasons with supporting data.
- Further investigate to ascertain if the difference in performance between CCA and PCR is statistically significant across all grids, and if there are any physical reasons to explain the significance.