

Is the **well-below-normal** seasonal precipitation easier to predict than the **below-normal**?

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APEC Climate Center 2007 Symposium 2007 September 18-20

Motivation

- Relatively extreme seasonal variation can have more impact on society and environment
- But are they more difficult to predict?



2-Tier Scenario SSTA Multi-Model Ensemble Dynamical Seasonal Forecast System

Boundary Conditions

1. NCEP/CFS hindcast SST (bias corrected) 1981-2006, and forecast SST 2007
2. CWB OPGSST hindcast SST 1981-2006, and forecast SST 2007

Initial Conditions

1. AMIP2 ensemble runs updated with most recent observed SST
2. NCEP Reanalysis-2

Climate Models

ECHAM4
NCEP/GSM
NCAR/CCM3
CWB/GFS
ECHAM5

1. 10-member single model ensemble forecasts with scenario SST for the next 6 months
2. 80-member multi-model ensemble forecasts

Deterministic
Anomalies
Categories

Probabilistic
Categories

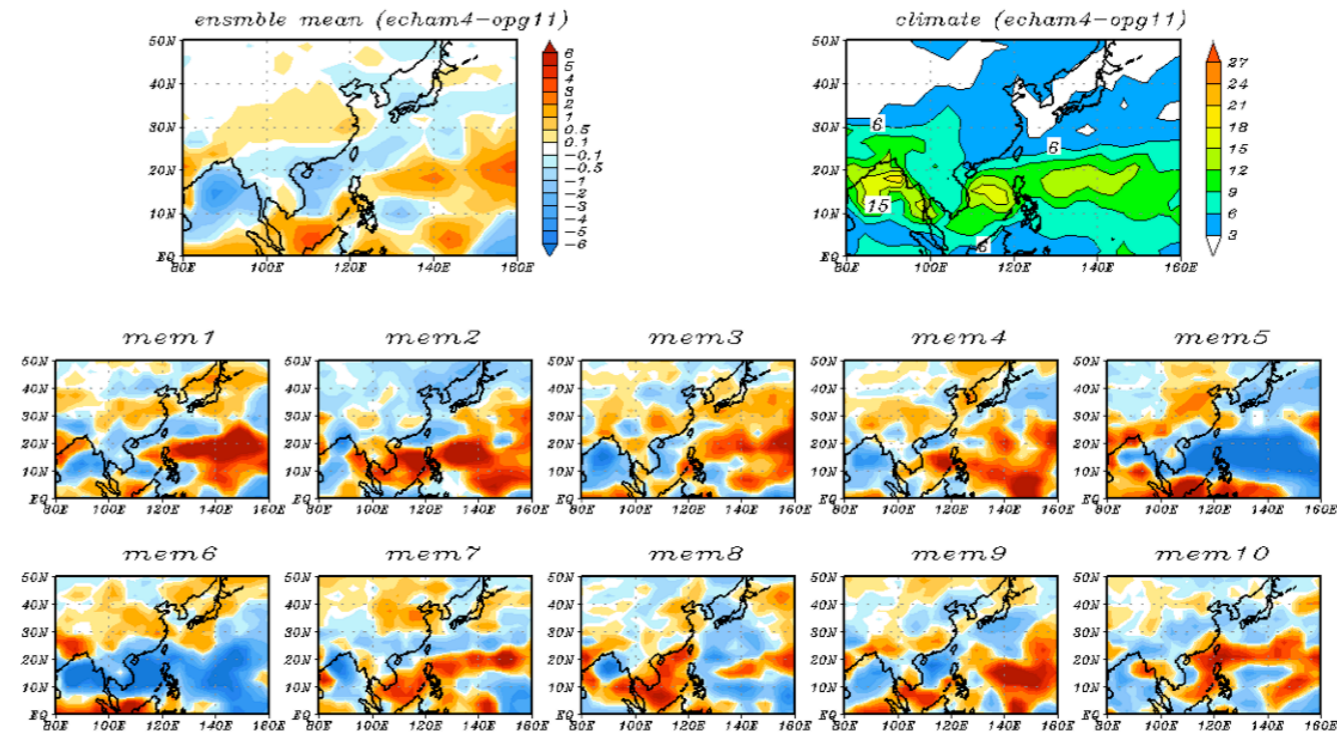
Hindcast verification and
skill assessment, 1981-2006

Hindcast assessment

Hindcast skill verification

- Cross-validated hindcast data for 1981-2003 period

ECHAM4 / OPGSSTA



For hindcasts from 1981-2003

220 cross-validated members to determine climatology and threshold for 3-categories forecasts

determine the 3-categories probability of the forecast year based on 10 members

Hindcast skill verification

- 80(10)-members multi(single)-model ensemble forecast
-Categories

Either deterministic (which one more likely) or
probabilistic (probability for each categories)

45%-10%-45%, 40%-20%-40%, 33%-33%-33%

30%-40%-30%, 20%-60%-20%, 15%-70%-15%

- Equitable threat score (ETS) for deterministic forecast

$$ETS = \frac{hits - hits_{random}}{hits + misses + false\ alarms - hits_{random}}$$

- Grid-point and area aggregated ROC skill score
- Area aggregated reliability diagram and brier skill score

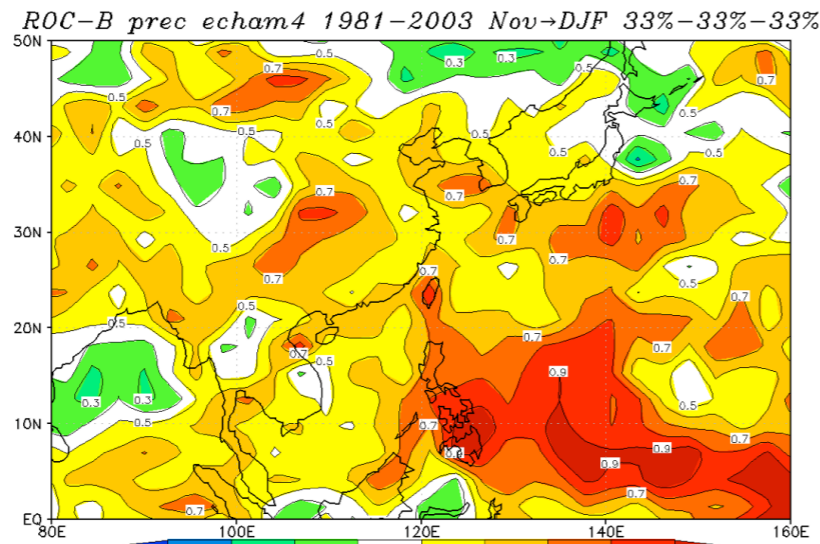
Prob. hindcast ROC Score (Outer Qunitiles vs. Terciles)

Nov-> DJF

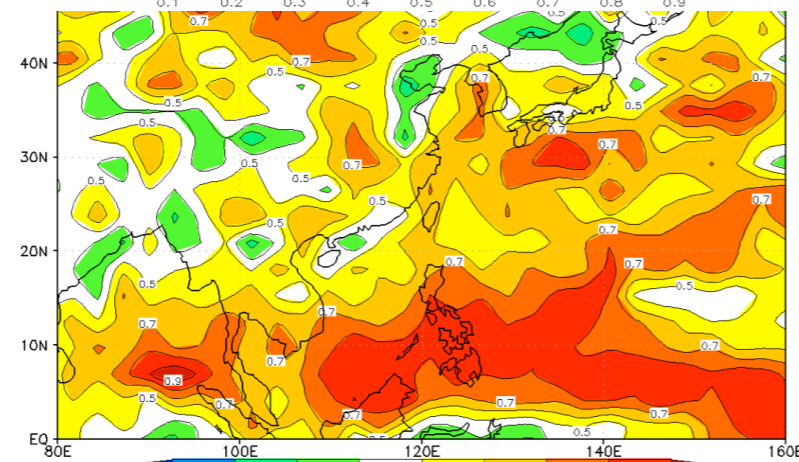
Below Normal (<33%)

vs. Well Below Normal (<20%)

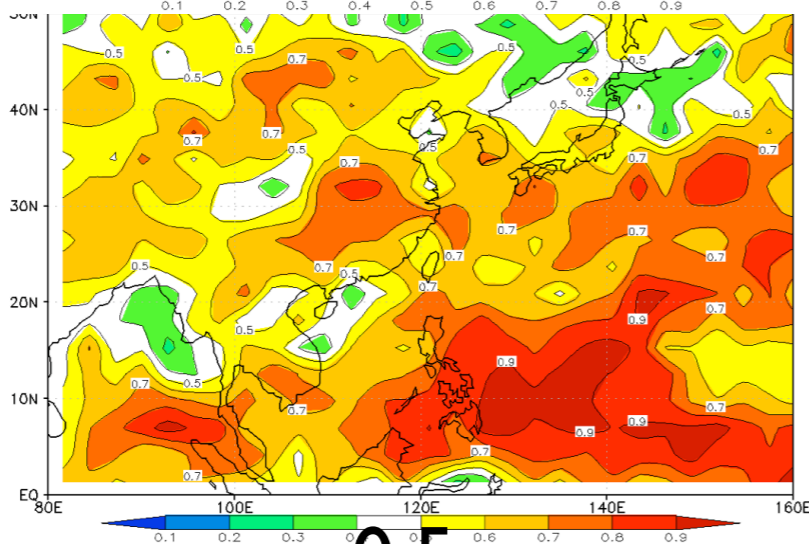
ECHAM4
NCEP/CFS



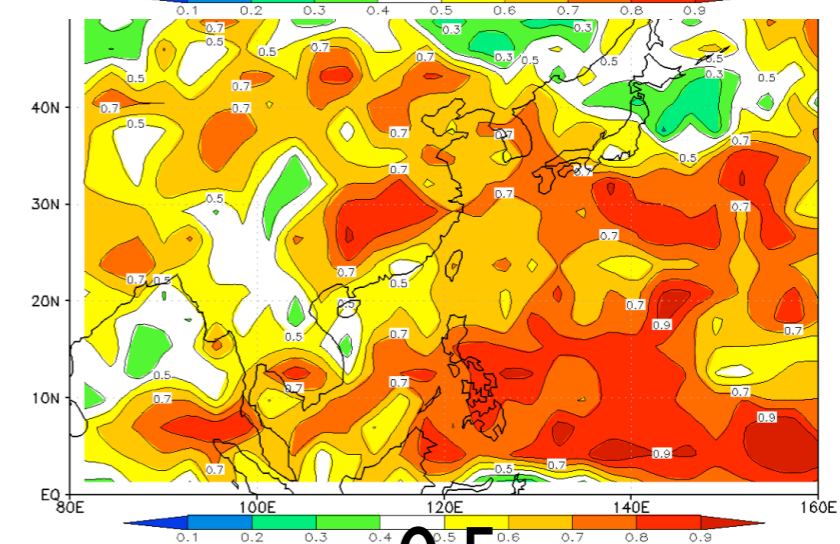
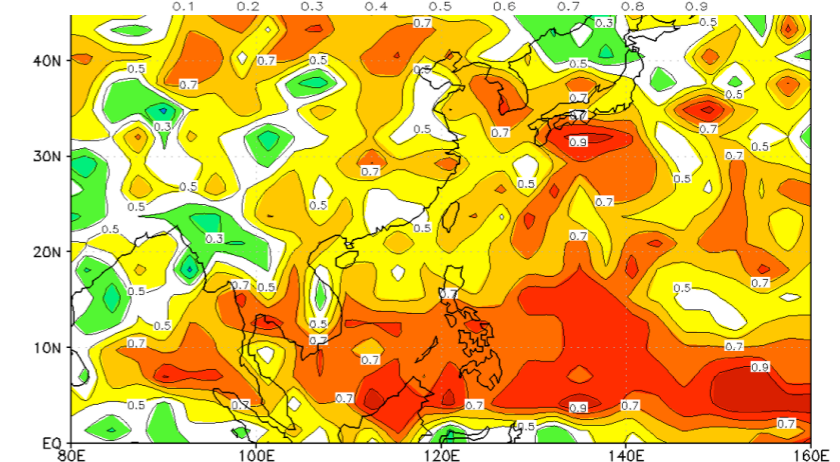
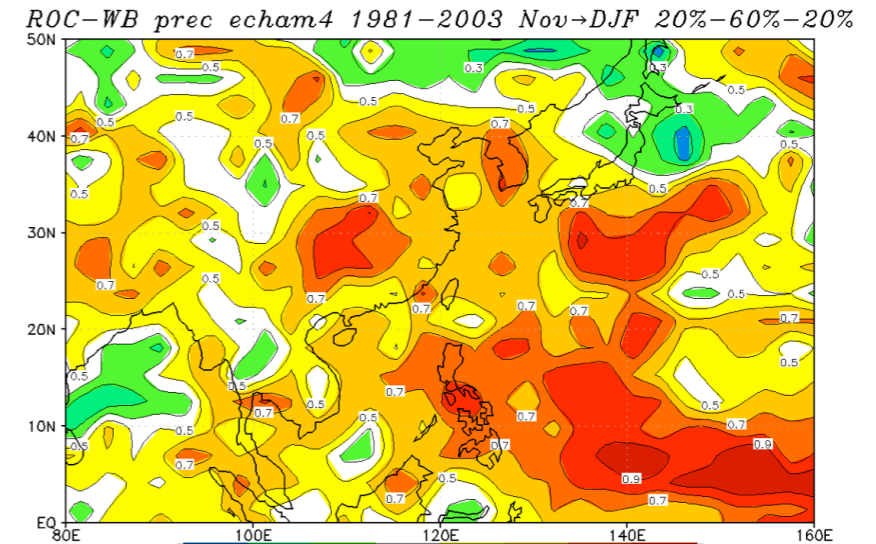
CWB/GFS
NCEP/CFS



Multi-Model
Ensembl



0.5



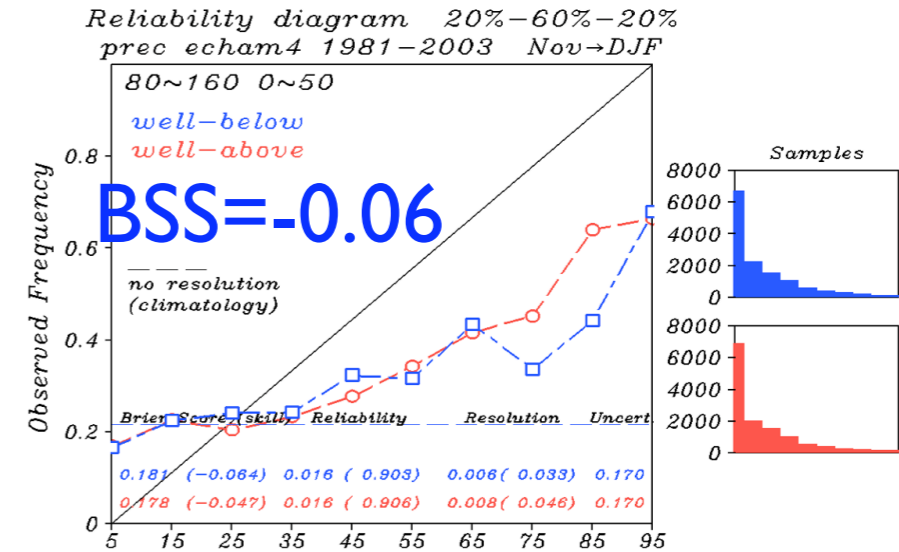
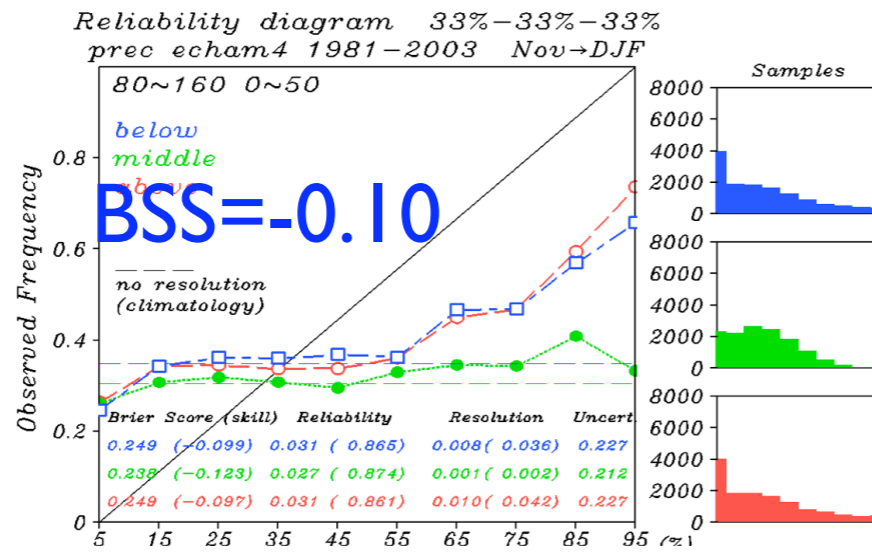
0.5

Prob. hindcast Reliability (Outer Quintiles vs. Terciles)

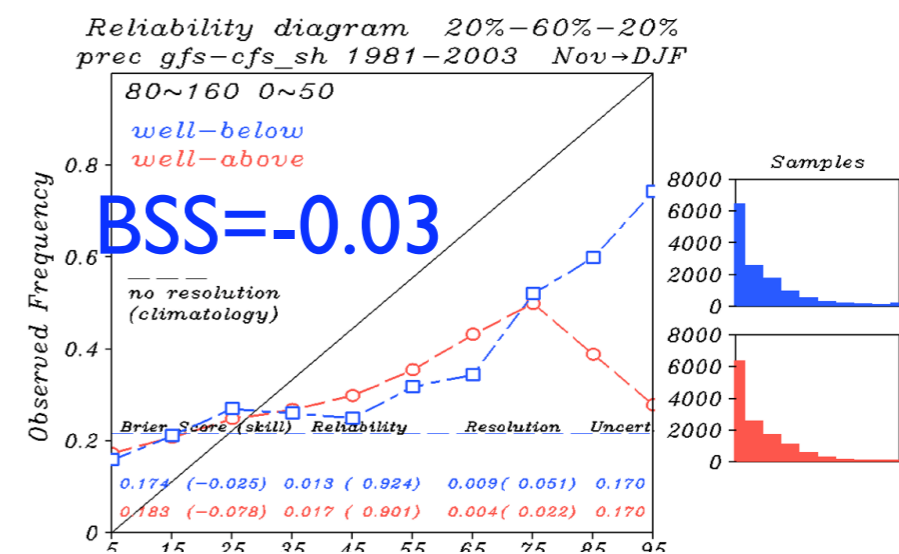
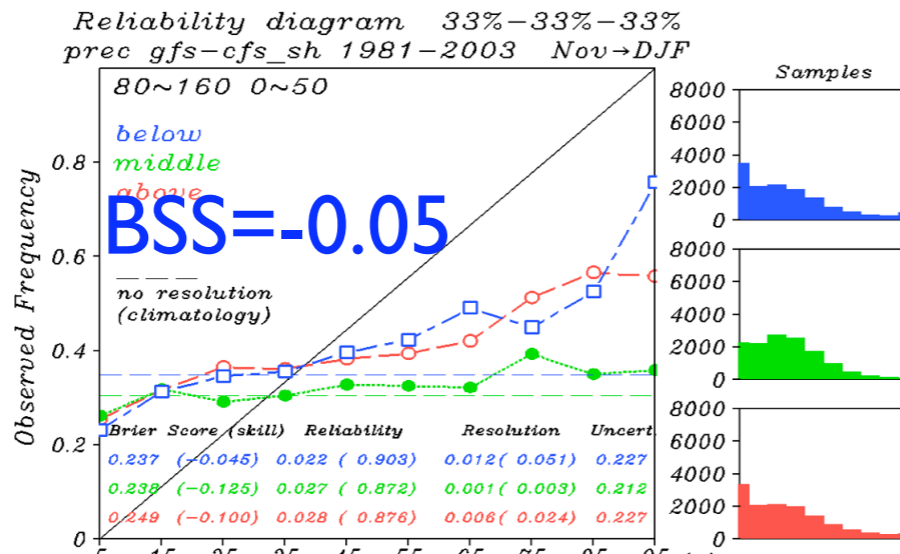
Nov-> DJF

Below Normal (<33%) vs. Well Below Normal (<20%)

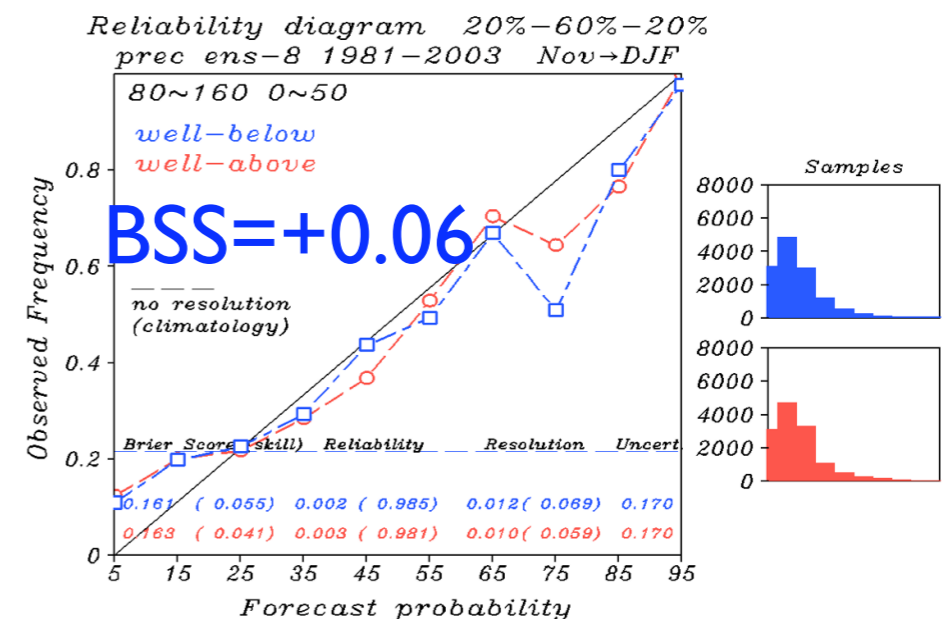
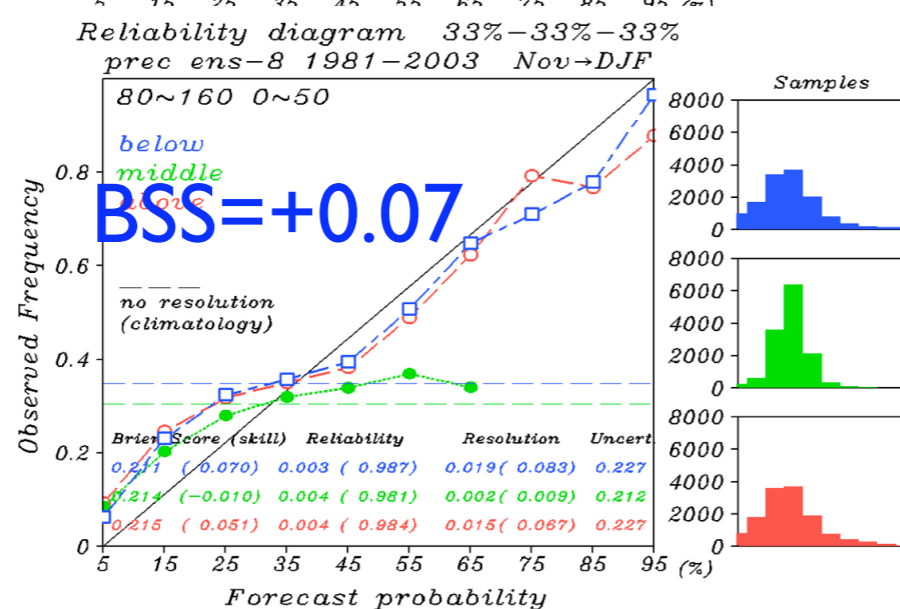
ECHAM4
NCEP/CFS



CWB/GFS
NCEP/CFS

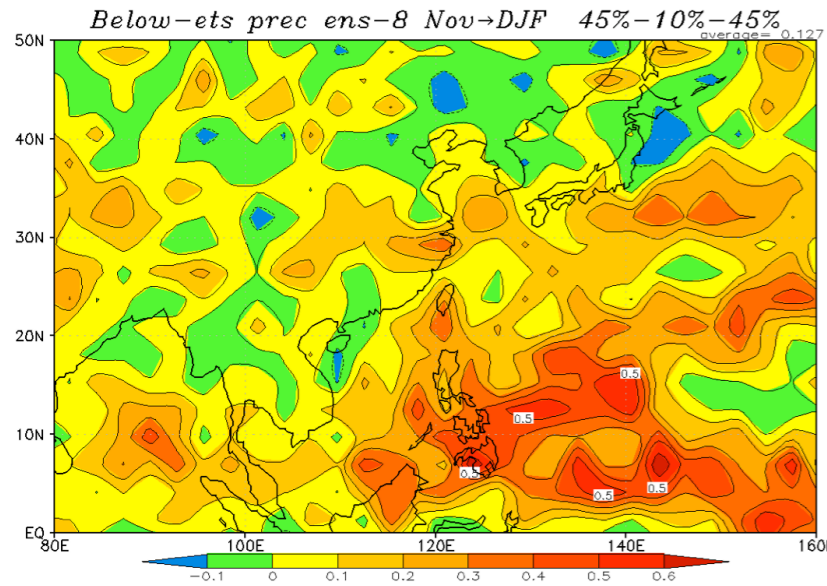


Multi-Model
Ensembl

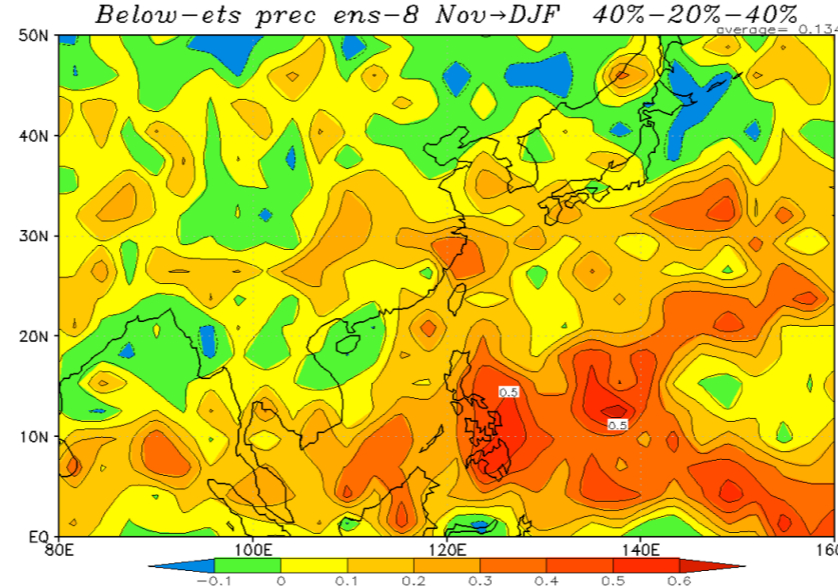


Equitable Threat Score (ETS) for Multi-model Ensemble Hindcast (Nov-DJF)

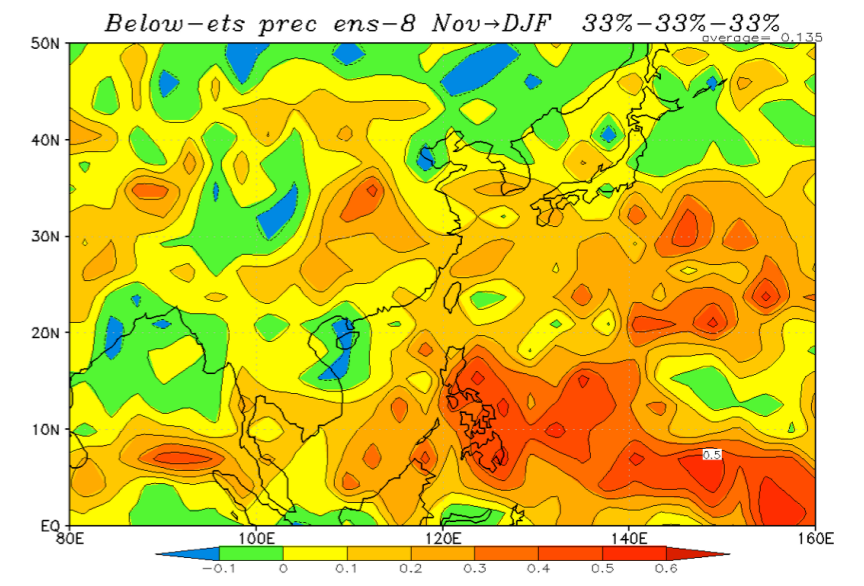
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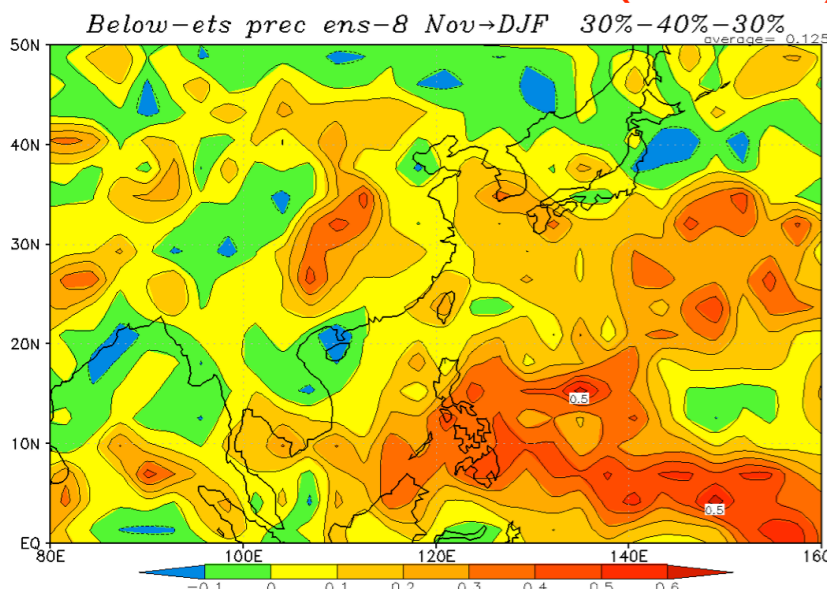
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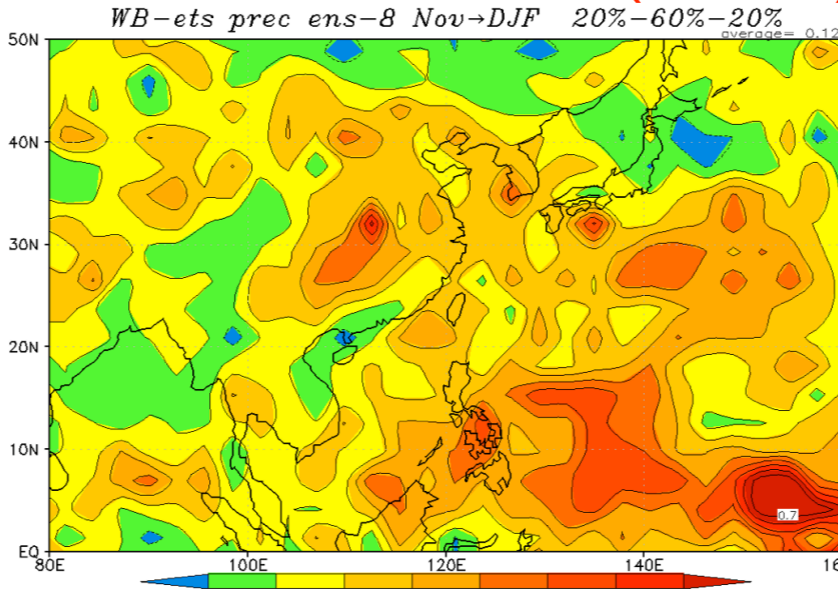
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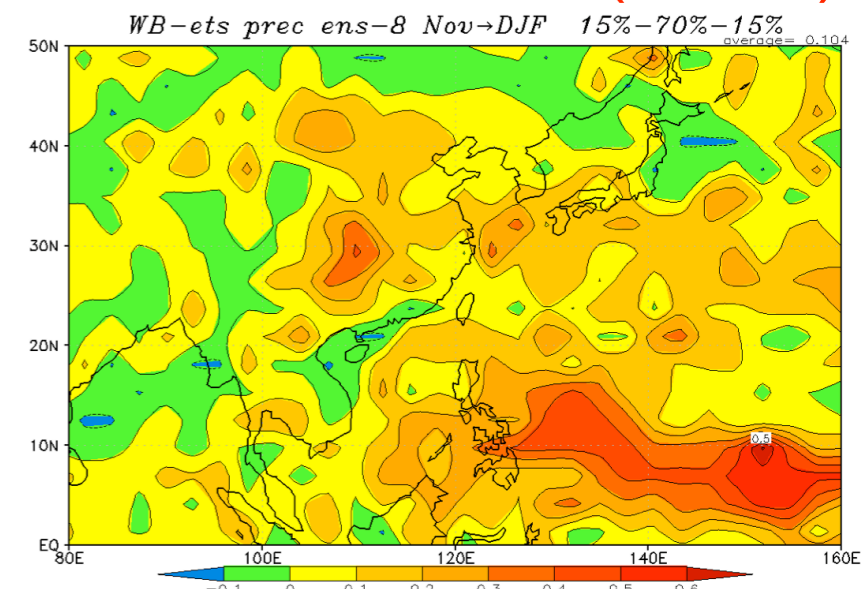
Below Normal (<30%)



Below Normal (<20%)

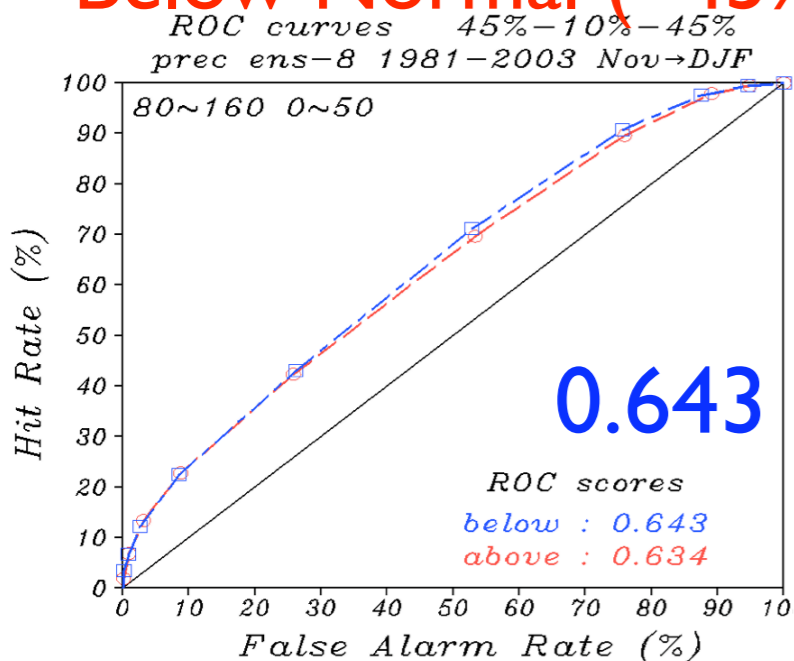


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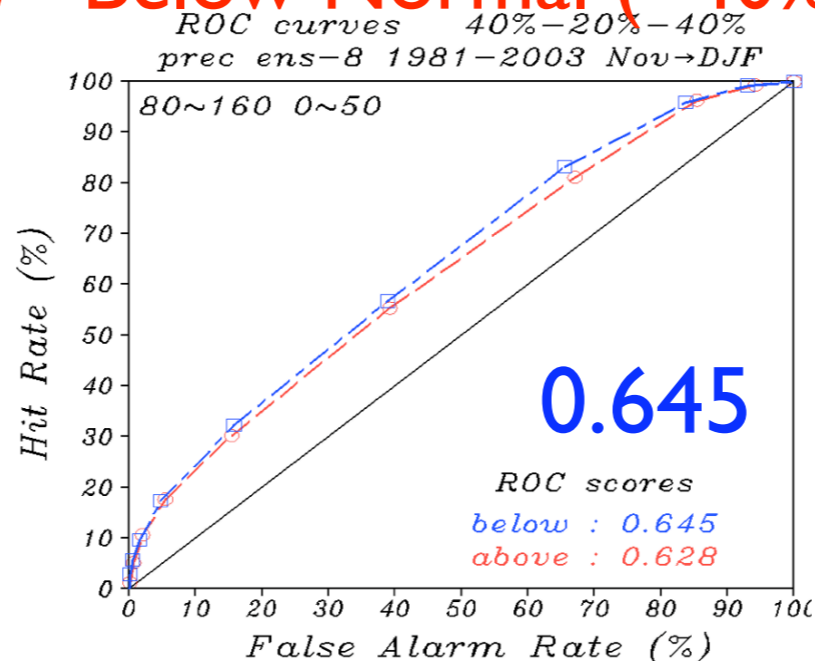


Area Aggregated ROC Score for Multi-model Ensemble Hindcast (Nov-DJF)

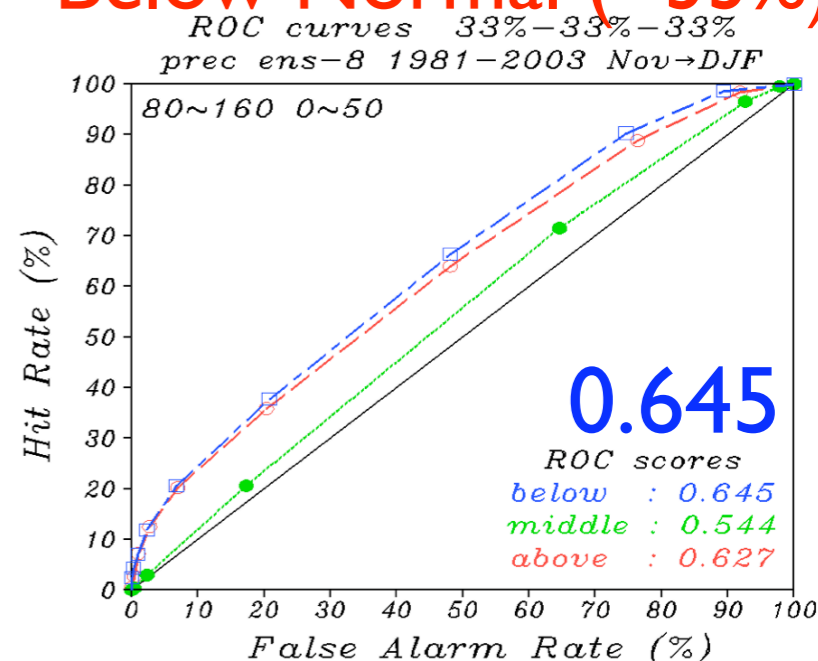
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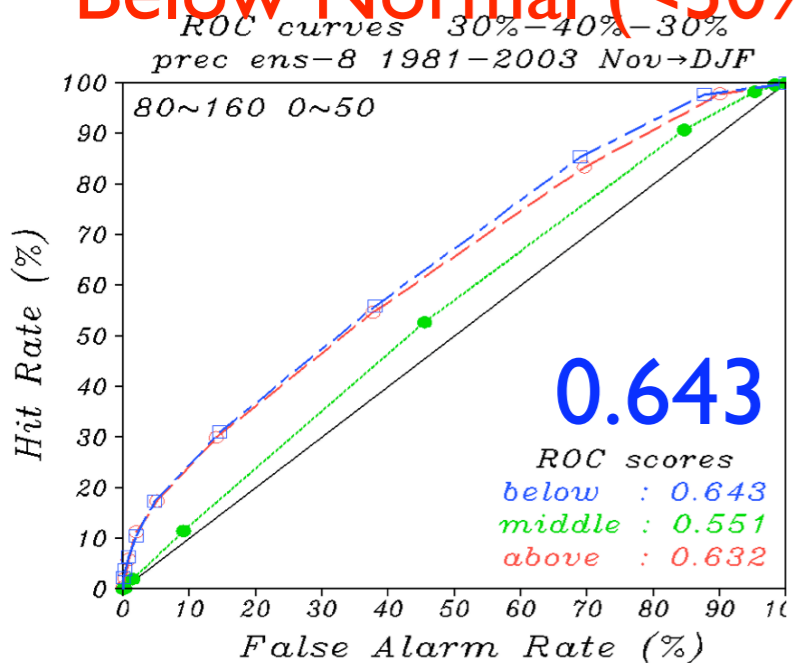
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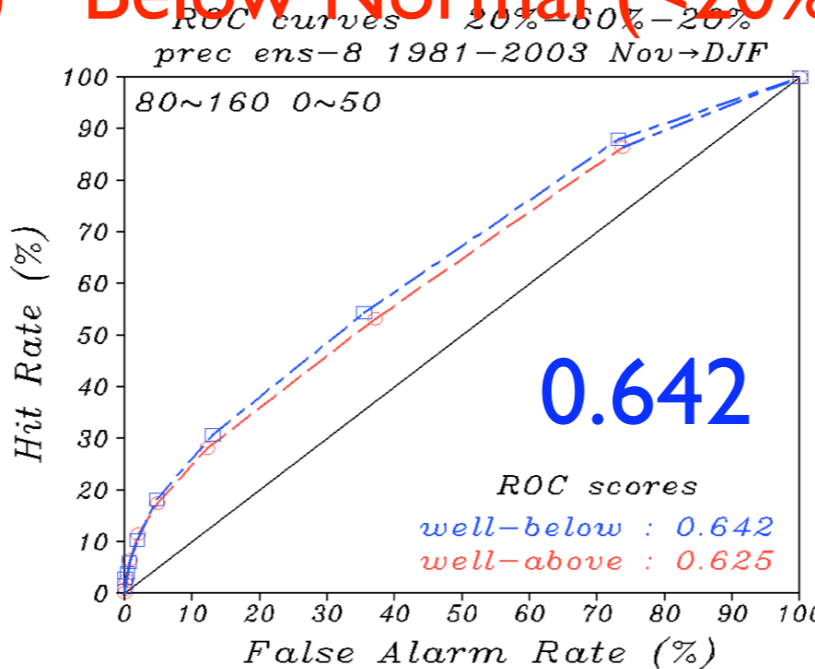
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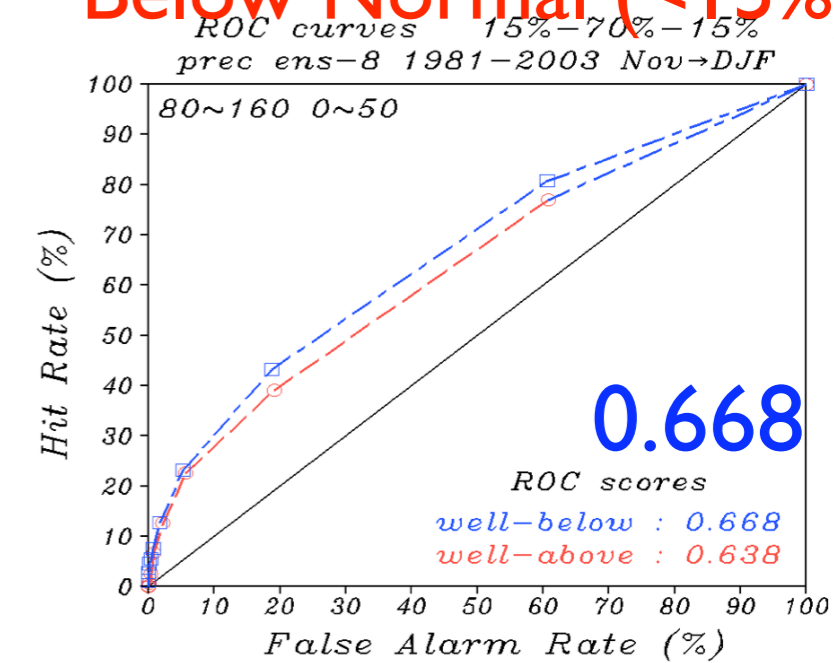
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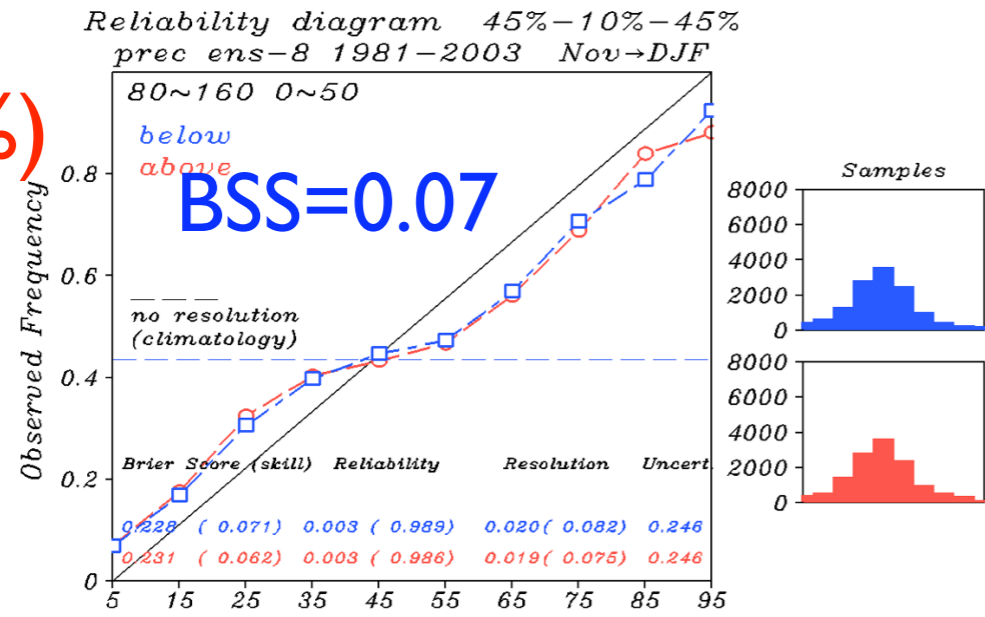
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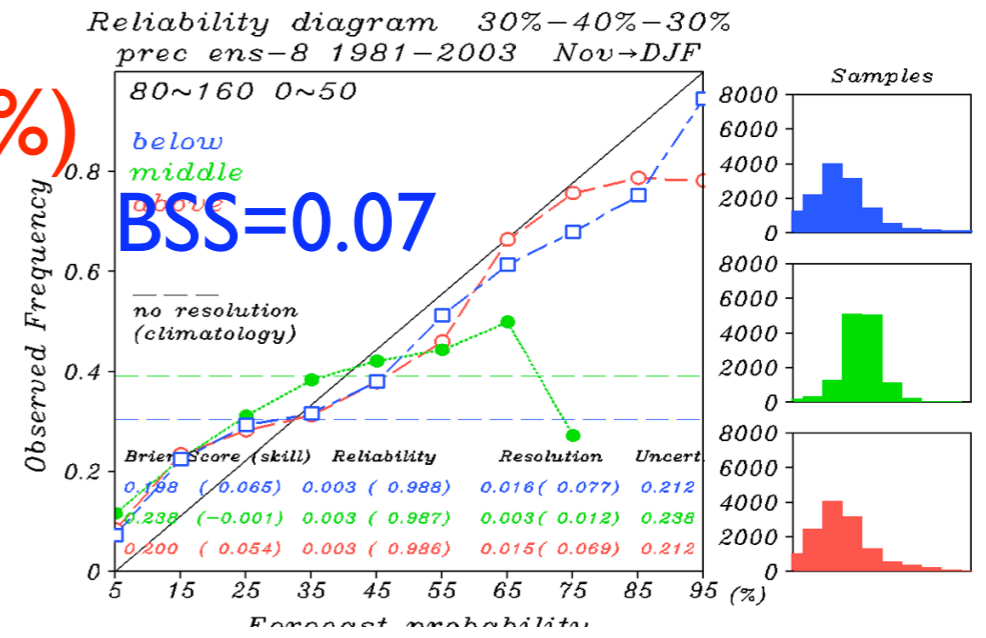
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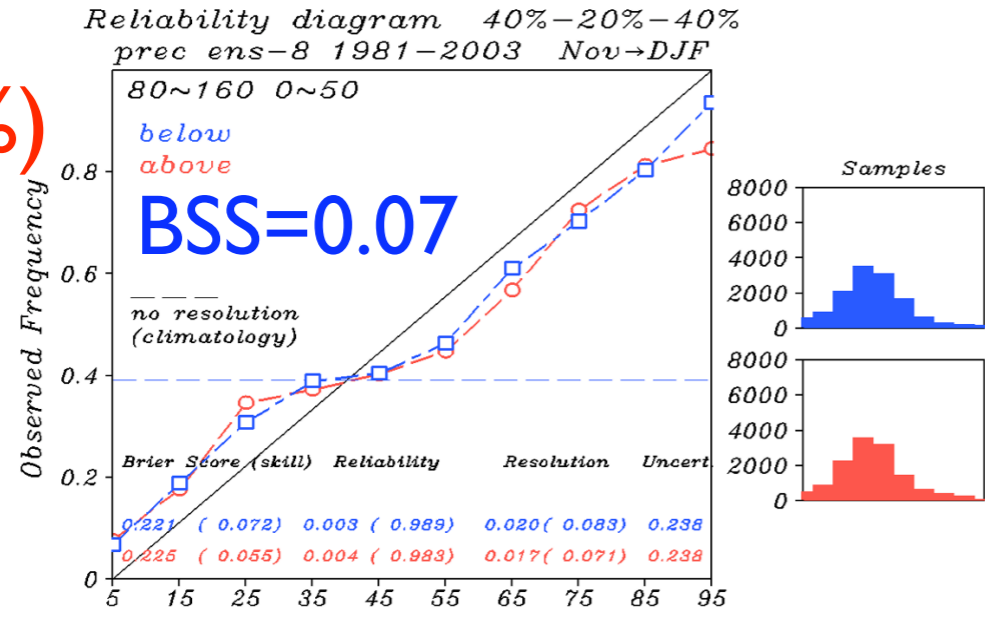
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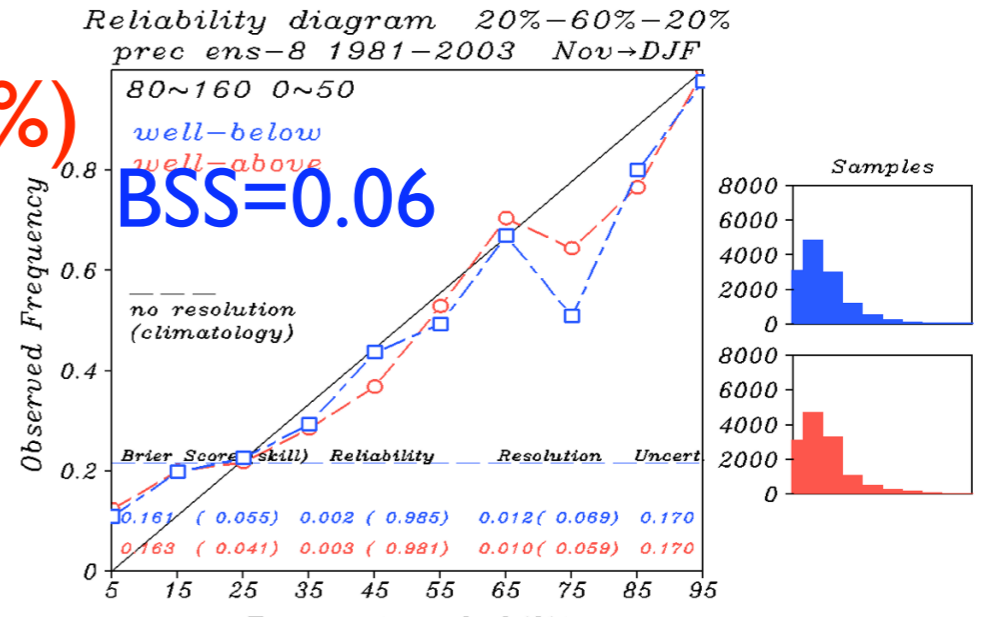
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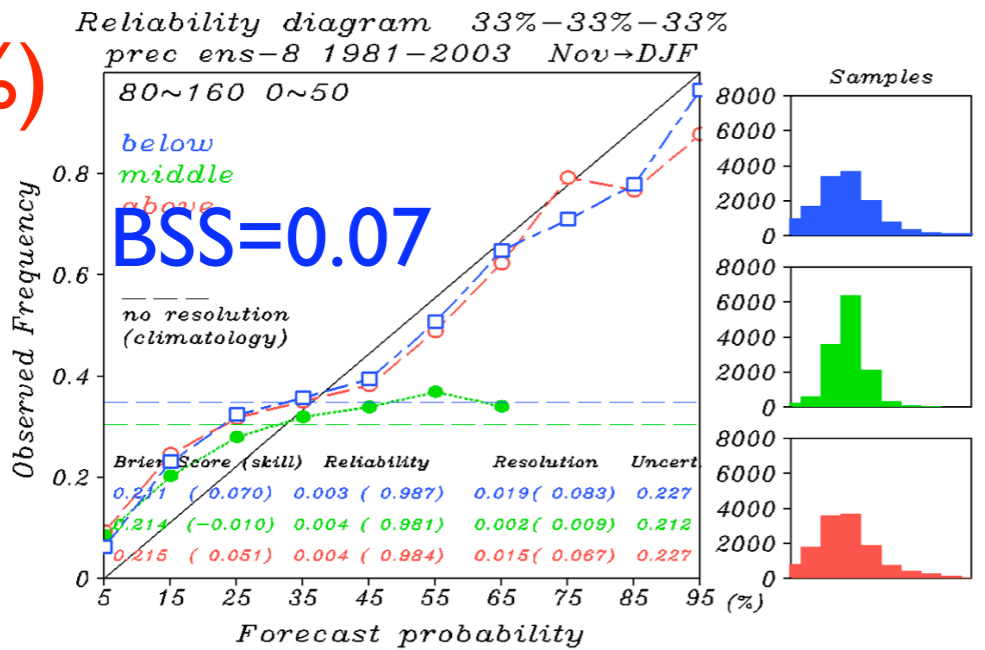
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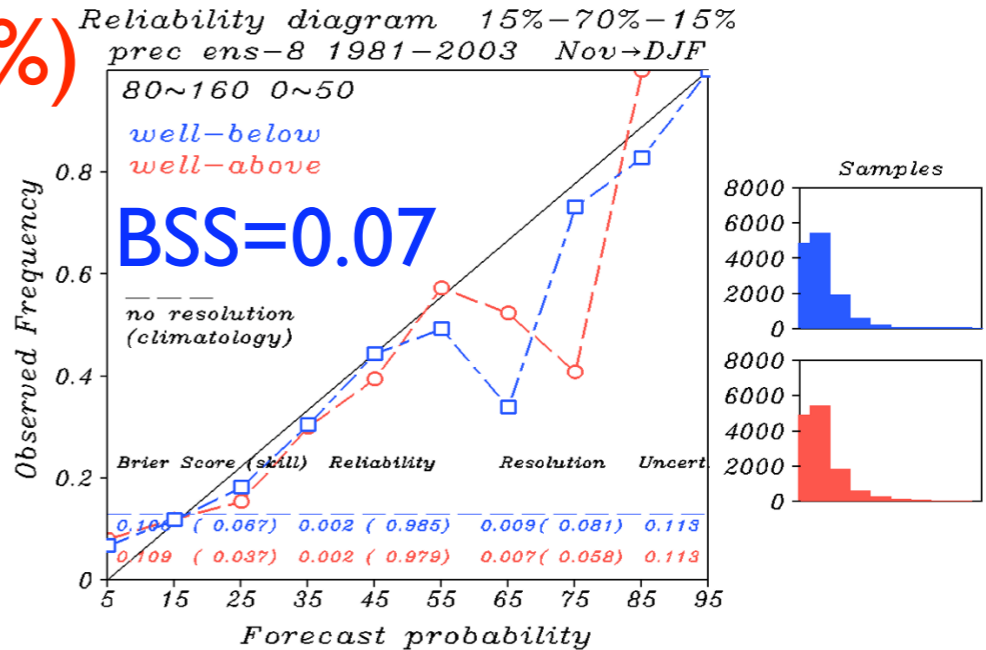
(<20%)



(<33%)



(<15%)



Concluding remarks

- For relatively extreme seasonal dry condition, in general the hindcast skill scores (in term of several different measures) is very similar to simple 2 categories forecast (positive or negative anomalies).
- The same for wet condition
- Also apply to individual model or different seasons