

Climate Forecast System Development Team at CWB

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Abstract

The CWB Seasonal Climate Forecast System (CFS) developed at the Research and Development Center at Central Weather Bureau of Taiwan became operational in December 2009. It is a two-tier forecast system consists of 3 major components: statistical-dynamical SST forecast module (CWB-OPGSST), global atmosphere forecast system (GFS), and statistical downscaling module. CWB-OPGSST uses a point-wise multi-linear regression multi-model super ensemble scheme with 4 statistical models and 2 intermediate air-sea coupled dynamical models to predict sea surface temperature between 60S and 60N. In addition to CWB-OPGSST, the SST generated by NCEP CFS (NCEP-SST) is used as another forecasted condition. Two atmospheric general circulation models (AGCM), CWB Global Forecast System (CWB-GFS) and ECHAM5, are used to predict the atmosphere part. The operational system CWB 2-tier CFS1 is formed by 4 suites of different combinations of forecasted SST and AGCM, namely, CWB-GFS/CWB-OPGSST, CWB-GFS/NCEP-SST, ECHAM5/CWB-OPGSST, and ECHAM5/NCEP-SST. Each suite has 10 members, differentiated by different initial conditions for the atmosphere and ocean occurring on 10 sequential days. Each member integrates for 7 months. For the hindcast runs the atmospheric initial conditions are obtained from NCEP Reanalysis-2, while for the forecast runs the initial conditions are obtained from NCEP GDAS available at NCEP. Singular Vector Decomposition (SVD) method is used to downscale large-scale parameters to 9 weather stations in Taiwan.

Models in CWB 2-tier CFS

CWB seasonal Climate Forecast System (CFS) Model Components

Atmospheric Model
CWB GAM T42L18
ECHAM5 T42L19

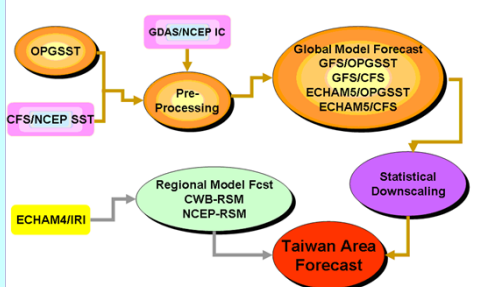
CWB Optimal Global SST forecast module (OPGSST)

-Statistical & Dynamical SST Forecast Models -
Dynamical Models: modified CZ intermediate air-sea coupled models (ICM2a, ICM2b)
Statistical Models: Persistence, NINOp67, Psp3f1, TPOHC
Prediction Integration Method: MLR MMSE scheme

NCEP CFS SST

Forecast / Hindcast Procedure

CWB 2-Tier Climate Forecast System



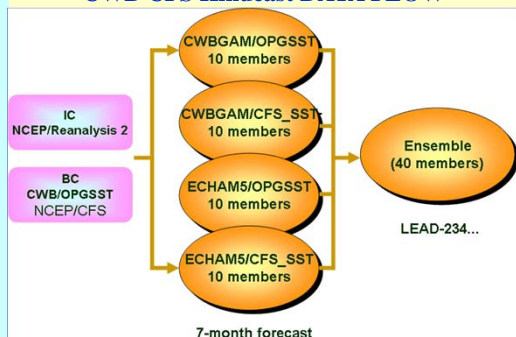
CWB CFS Hindcast DATA BASE

- For each AGCM+ISST Suite
 - Control run initialized at 12Z on the last day of each month, 1981-2005
 - Extra 9 members initialized prior to control run initial time in progressively 24 hours interval
 - Each hindcast is integrated for 7 months

In total 4 Suites:

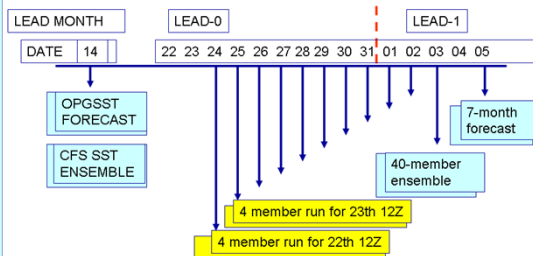
CWB/GAM+CWB/OPGSST, CWB/GAM+NCEP/CFSSST, ECHAM5+CWB/OPGSST, ECHAM5+NCEP/CFSSST

CWB CFS Hindcast DATA FLOW

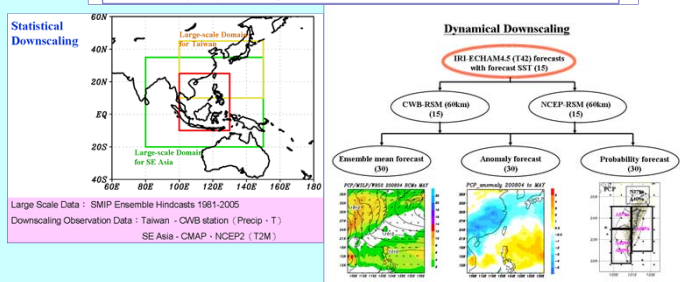


Operational Procedure

CWB CFS Operational Forecast Schedule



- There are 4 members run in the last 10 day of lead-0 month, one for each modules (GFS/OPGSST - GFS/CFS - ECHAM/OPGSST and ECHAM/CFS).
- Each member needs about 40 minutes for model integration and another 30 minutes for post processing.



Forecast Prodct Example

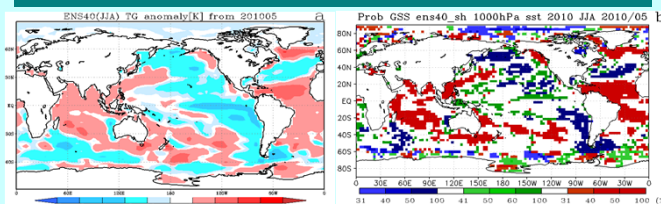


FIG 1. SST forecast for JJA 2010, (a) anomaly, (b) probability forecast mask with Gerrity Skill Score (GSS) > 0. The first forecast month is May 2010.

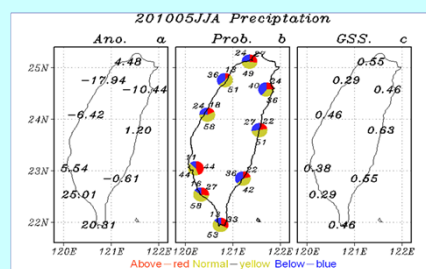


FIG 2. Ensemble precipitation forecast from statistical downscaling for 2010 JJA, (a) anomaly, (b) probability, (c) GSS.

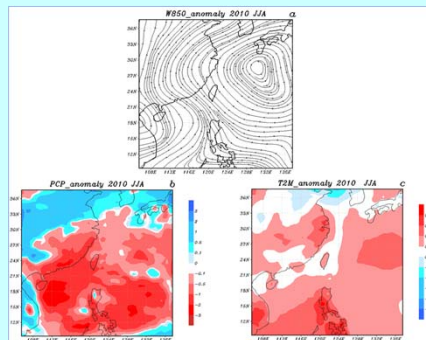


FIG 3. Ensemble forecast by dynamical downscaling for JJA 2010. From (a) to (c) are 850 hPa wind anomaly, precipitation anomaly, and 2-meter temperature anomaly. The first forecast month is May.

On-Going Development

- Upgrade CWBGAM T42L18 to T119L40
- Improve model usages for climate extremes (cold surge, heat wave, torrential rains, drought, strong winds) outlook
- Develop one-tier Seasonal Forecast System