Introduction to APCC Operational Forecast Procedure

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APCC produces seasonal forecasts of precipitation, T850, Z500 applying five methods:

1. MME – average of bias corrected model ensemble means;
2. Superensemble - multiple regression based blend of model ensemble means (MR);
3. CPPM – Coupled Pattern Projection Method;
4. Synthetic multi-model ensemble (SE) – multiple regression on leading PCs.
5. Probabilistic – position of the forecast PDF in respect to the historical PDF.

APCC data flux diagram is presented in Fig. 1.

All computations are performed in the directory **/apcc01/OPER/SEASON/WORK** in respective subdirectories (DMME and PMME). Software complex for each of the methods consists of the UNIX C script shell and a set of FORTRAN codes. Running instructions and descriptions of the options to be updated are provided in Appendices 5.

Productions from all four MMEs and probabilistic forecast (Appendix 5) are collected in the directory **/apcc01/OPER/SEASON/MME_OUT** in respective subdirectories **(FORECAST, HINDCAST and OUTLOOK)**. In the subdirectory **OUTLOOK**, forecast production and hindcast skill are prepared in Graphic format which are used for the final discussion of the forecast (Fig. 2).

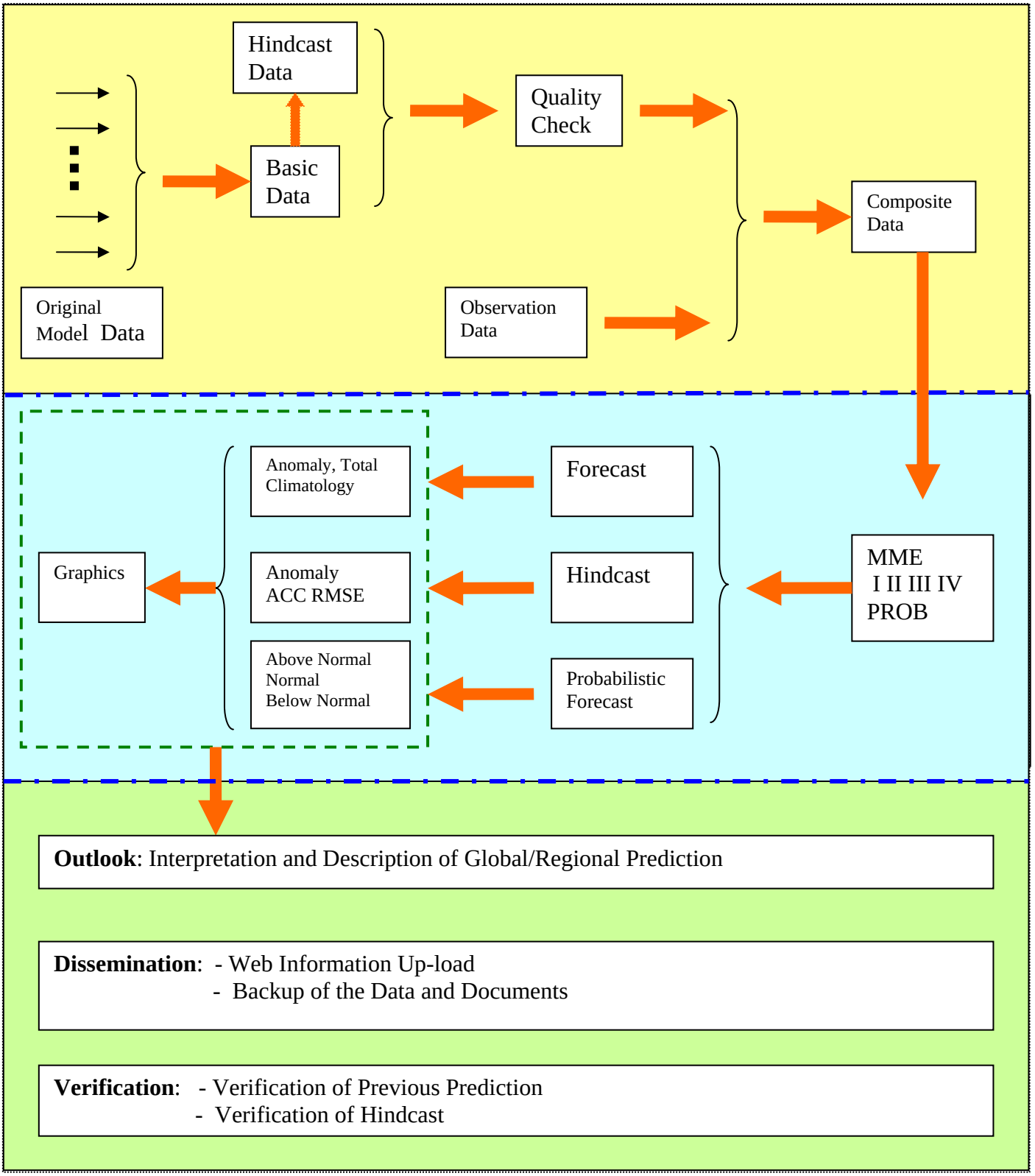


Fig. 1 APCC Data Flux

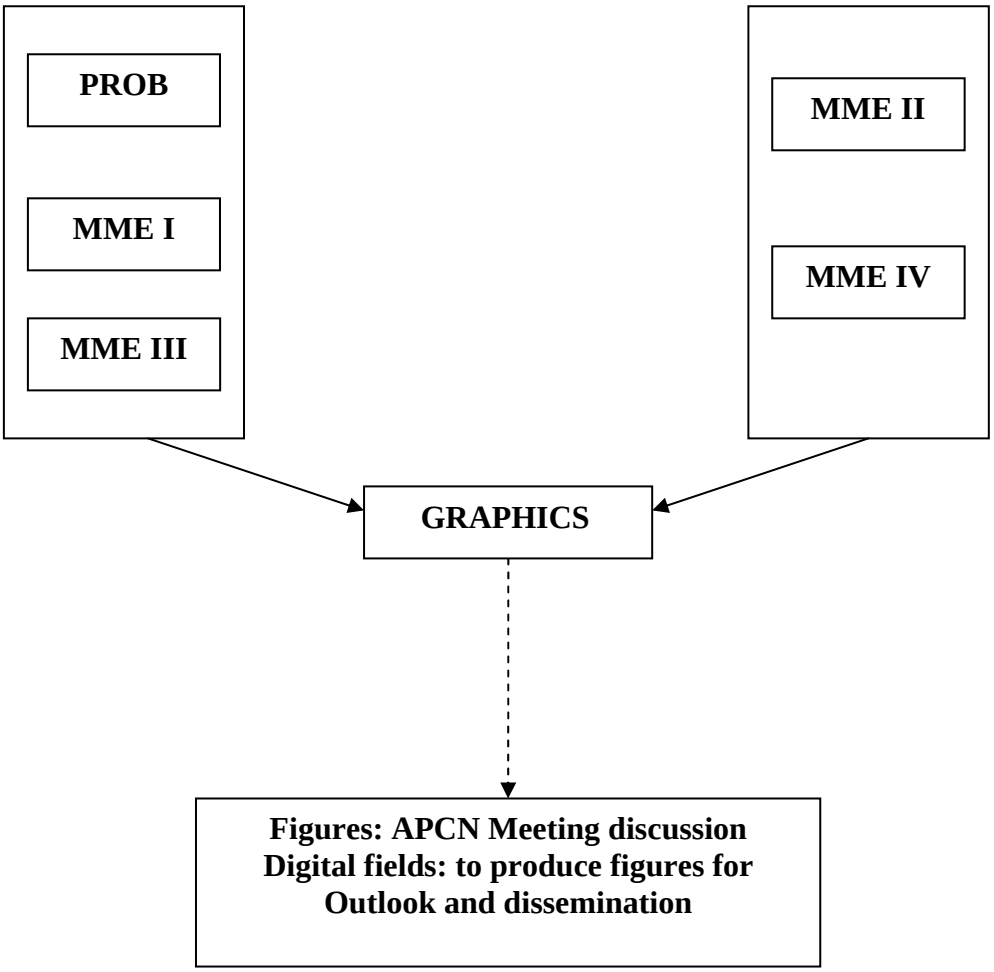


Fig. 2. Production Stage

1. Operational Process For Quality Check of Forecast Data

1.1 Operational Flow

A software package has been developed to make the quality check for all participant model forecast data. The package employs a Unix Shell to joint a FORTRAN main program and some Grads plot files, see the Fig. 3. All the files locate in the following folder:

/apcc01/OPER/SEASON/WORK/QC/source

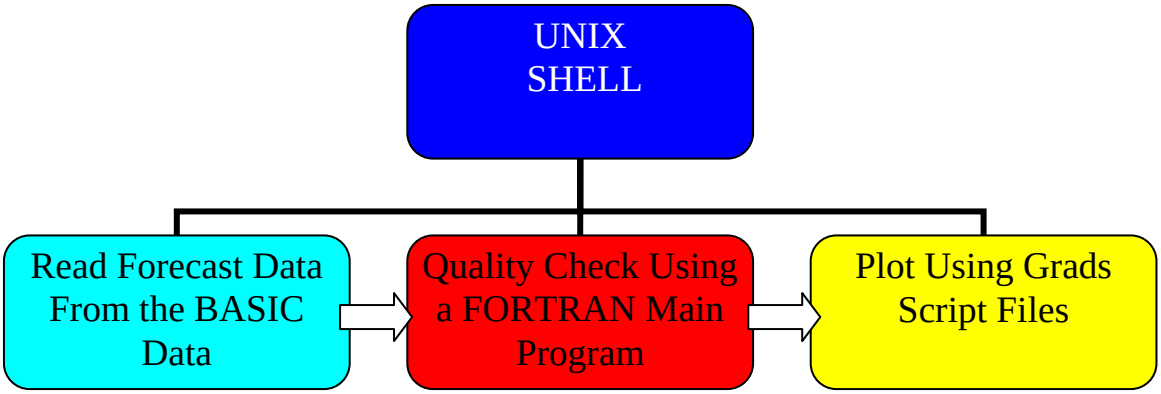


Fig. 3 Quality Check Flow Diagram

The Unix shell of the quality check is named as que_che.sh . It is only needed to change the **year**, **season** and **model name** at the beginning of the shell (shown in the following code), then que_che.sh will perform all the quality check progress.

```
#
TMPDIR='//apcc01/OPER/SEASON/WORK/QC/tmp'
mkdir $TMPDIR; cd $TMPDIR
#
year=2004                              ! Change the year
#season=JJA
#season=MAM
#season=SON
season=DJF                             ! Change the season
#
if test "$season" = "MAM"
then
seas=SPRING
seas1=Mar.
seas2=Apr.
seas3=May
nam_season1=3
nam_season2=4
nam_season3=5
elif test "$season" = "JJA"
then
seas=SUMMER
seas1=June
seas2=July
seas3=Aug.
nam_season1=6
nam_season2=7
nam_season3=8
elif test "$season" = "SON"
then
seas=AUTUMN
seas1=Sep.
seas2=Oct.
seas3=Nov.
nam_season1=9
nam_season2=10
nam_season3=11
elif test "$season" = "DJF"
then
seas=WINTER
seas1=Dec.
seas2=Jan.
seas3=Feb.
nam_season1=12
nam_season2=1
```

```
nam_season3=2
fi
#
################################
#
#    Participant models
#
################################
#
for model in cola cwb gcps gdaps hmc iap iri jma metri mgo nasa ncc ncep      ! Write the model names that need check
do
```

1.2 Forecast Data Source

The software package automatically reads the forecast data from the source of forecast data. The directory for these data is

/apcc01/OPER/SEASON/BASIC/model_name/total/variable

The name of forecast data should be given like this:

prec200608_6m.gdat

where “prec” is the variable, “2006” is the year, “08” is the month, “6m” is ensemble member.

1.3 Output

The software package can automatically create a folder for the forecast year and season. As an example, the quality check results for 2004 winter forecast had been created at

/apcc01/OPER/SEASON/WORK/QC/out/2004DJF

For each model, the software package outputs 11 figures and one check report. The following list their names and functions (taken NCEP as example):

NCEP.extrem.ano.2004.DJF_prec.gif
Checking the root square of anomaly precipitation

NCEP.extrem.ano.2004.DJF_t850.gif
Checking the root square of anomaly T850

NCEP.extrem.ano.2004.DJF_z500.gif
Checking the root square of anomaly Z500

NCEP.average.ano.2004.DJF_prec.gif
Checking the average of anomaly precipitation over 10 regions

NCEP.average.ano.2004.DJF_t850.gif
Checking the average of anomaly T850 over 10 regions

NCEP.average.ano.2004.DJF_z500.gif
Checking the average of anomaly Z500 over 10 regions

NCEP.total.2004.DJF.gif
Checking the monthly total of precipitation, T850 and Z500

NCEP.scatter.2004.DJF.PREC.gif
Checking pattern correlation between precipitation and model climate

NCEP.scatter.2004.DJF.T850.gif
Checking pattern correlation between T850 and model climate

NCEP.scatter.2004.DJF.Z500.gif
Checking pattern correlation between Z500 and model climate

NCEP_harmony_2004_DJF.gif
Checking the harmony among precipitation, T850, Z500 and wind components

ncep.2004.DJF.qua_check.txt

The detailed check report output by software

Detailed introduction to the quality check methods can be referred to APCN Technical Report “Quality Checks of Input Data for APCN MME Forecasting”.

2. MME

The Multi-Model Ensemble (MME) Forecast constructed with bias-corrected data is given by

$$S_t = \overline{O} + \sum_{i=1}^{n} a_i (F_{i,t} - \overline{F_i}) \qquad (1)$$

Where, $F_{i,t}$ is the i^{th} model forecast at time *t*, $\overline{F_i}$ and $\overline{O}$ is the climatology of the i^{th} forecast and observation, respectively, a_i are weights obtained by a minimization procedure during the training period, and *n* is the number of forecast models involved. Therefore, the MME results are generated by the combination of model weights and model forecast anomalies.

MME-I is a simple member model composite. In this scheme, the ensemble mean assigns a weight of *1/N* to each of the *N* member models in anywhere regardless of their relative performance.

RUNNING INSTRUCTIONS

FORECAST case :

A script and source program files for running MME-I for issued season are available at the directories **/apcc01/OPER/SEASON/WORK/DMME/AUTO/MAIN.** The script “**mme1_main.f.csh**” is a UNIX C shell script. To execute the MME-I forecast, the following steps may be used:

1. Change the options in the USER DEFINE of script. The descriptions of each option are following;

- **model** How many models are used ?
- **tyear** How many years ?
- **syer** starting year
- **eyer** ending year

- **tsea** selected season (MAM or JJA or SON or DJF)
- **fsea** selected first month (MAR or JUN or SEP or DEC)
- **numse** first month (3, 6, 9, 12)
- **ordir** basic files directory
- **HDIR** Directory of hindcast data for training
- **WDIR** Mother directory for working
- **period** hindcast period

2. Run the script

3. Check the output in mother-directory/**fcst**. You obtain 4 output data sets and ctl files :

- Bias Corrected data sets :

Anomaly

MME_I.monthly.2006.ano.gdat.ctl, MME_I.monthly.2006.ano.gdat

Total

MME_I.monthly.2006..gdat.ctl, MME_I.monthly.2006.gdat

Climate

MME_I.monthly.clim.gdat.ctl, MME_I.monthly.clim..gdat

- Biased anomaly data sets :

MME_I_B.monthly.2005.ano.gdat.ctl, MME_I_b.monthly.2005.ano.gdat

- Observation :

obs.monthly.clim.gdat

Shell Script - mme1_main.f.csh

You need to correct the parts of the blue and bold character

```
#!/bin/csh -f
#
#########################################################################
# For Multi-Model Ensemble I in terms of Seasonal Forecast
# D. Y. Lee - Feb. 7, 2006
#########################################################################
#      USER DEFINE I : START
#   model = How many models are used ?
#   tyear = How many years ?
#   syer  = starting year
```

```
#   eyer  = ending year
#   tsea = selected season (MAM or JJA or SON or DJF)
#   fsea = selected first month  (MAR or JUN or SEP or DEC)
#   numse = first month  (3, 6, 9, 12)
#   ordir = basic file directory
#   HDIR = Directory of hindcast data for training
#   WDIR = Mother Directory for working
#   period = hindcast period
#   filelist = used model information
###############################################################################
set model = 12       # num of model
set tyear = 2006     # forecast year
set syer  = 1983     # starting year of hindcast data
set eyer  = 2003     # ending year of hindcast data
set tsea = JJA       # marking the season
set fsea = JUN       # marking the 1st month of season
set numse = 6        # marking the 1st month of season (as number)
set ordir = '/apcc01/OPER/SEASON/BASIC'
set HDIR = '/apcc01/OPER/SEASON/MME_IN/2006/JJA'
set WDIR = '/apcc01/OPER/SEASON/WORK/DMME/AUTO/MME1/FORECAST'
set period = 83-03
################################################################### MME-I
cd $WDIR
rm -rf WORK fcst
mkdir -p WORK
mkdir -p fcst
#
cd $WDIR/WORK
#
cat > filelist << EOFN
${HDIR}/OBS.${tsea}.$period.prec.bin
${HDIR}/OBS.${tsea}.$period.t850.bin
${HDIR}/OBS.${tsea}.$period.z500.bin
${HDIR}/OBS.${tsea}.$period.ts.bin
${HDIR}/OBS.${tsea}.$period.t2m.bin
${HDIR}/OBS.${tsea}.$period.u850.bin
${HDIR}/OBS.${tsea}.$period.v850.bin
${HDIR}/OBS.${tsea}.$period.u200.bin
${HDIR}/OBS.${tsea}.$period.v200.bin
${HDIR}/OBS.${tsea}.$period.slp.bin
${HDIR}/OBS.${tsea}.$period.olr.bin
EOFN
#
cat > INFORMATION.h << EOF
      data cap_mod /'CWB', 'GCPS', 'GDAPS_F', 'GDAPS_O', 'HMC', 'IRIF',
     &            'IRI', 'JMA',  'METRI', 'MGO', 'NCC', 'NCEP'/
EOF
#####################################################################
# If variables exist, you can count. if not, write down zero(0).  #
#####################################################################
cat > INFORMATION_0.h << EOF
      data ip   /1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12/
      data it   /1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12/
```

```
    data iz   /1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12/
    data its  /1, 2, 0, 0, 5, 6, 7, 0, 0, 10,  0, 12/
    data it2m /1, 0, 0, 0, 5, 6, 7, 8, 0, 10,  0, 12/
    data iu8  /1, 2, 3, 4, 5, 6, 7, 8, 9, 10,  0, 12/
    data iv8  /1, 2, 3, 4, 5, 6, 7, 8, 9, 10,  0, 12/
    data iu2  /1, 2, 3, 4, 5, 6, 7, 8, 0, 10,  0, 12/
    data iv2  /1, 2, 3, 4, 5, 6, 7, 8, 0, 10,  0, 12/
    data islp  /1, 2, 3, 4, 5, 6, 7, 8, 9, 10,  0, 12/
    data iolr  /0, 2, 0, 0, 5, 6, 7, 0, 0, 10,  0, 12/
EOF
#
cd $WDIR/src
# Old version ##############################################################################
#chmod +x make_mme1_forecast_kang.csh
#./make_mme1_forecast_kang.csh $model $tyear $syer $eyer $tsea $fsea $numse $ordir $HDIR $WDIR
# New version ##############################################################################
chmod +x make_mme1_forecast_dylee.csh
./make_mme1_forecast_dylee.csh $model $tyear $syer $eyer $tsea $fsea $numse $ordir $HDIR $WDIR
#
```

HINDCAST case :

A script and source program files for running MME-I for hindcast are available at the directories **/apcc01/OPER/SEASON/WORK/DMME/AUTO/MAIN.** The script " **mme1_main.h.csh** " is a UNIX C shell script. To execute the MME-I hindcast, the following steps may be used:

1. Change the options in the USER DEFINE of script. The descriptions of each option are following;

- **tyear** How many years ?
- **tsea** selected season (MAM or JJA or SON or DJF)
- **fsea** selected first month (MAR or JUN or SEP or DEC)
- **HDIR** Directory of hindcast data for training
- **WDIR** Mother directory for working
- **period** hindcast period
- **fore_year** forecast year
- **mstart** starting month
- **nystart** e.g.) 1981 is the third year(3) when starting from 1979

2. Run the script

3. Check the output in mother-directory/**fcst**. You obtain the three kinds of output data sets and ctl files :

- **Anomaly field:** MME1.ANOG_$var_$year, MME1.ANOG_$var_$year.ctl
- **Global(East asia) ACC data:** MME1_ACCG(ACCE)_ $var_$year
- **Global(East asia) RMSE data:** MME1_RMSEG(RMSEE)_ $var_$year

Shell Script - mme1_main.h.csh

You need to correct the parts of the blue and bold character

```
#!/bin/csh -f
#
#############################################################################
# For Multi-Model Ensemble in terms of Seasonal Hindcast
# D. Y. Lee - Feb. 7, 2006
#############################################################################
#      USER DEFINE I : START
#   tyear = How many years ?
#   tsea = selected season (MAM or JJA or SON or DJF)
#   fsea = selected first season (MAR or JUN or SEP or DEC)
#   var = used variable name (ex, prec, t850, z500)
#   HDIR = Directory of hindcast data for training
#   WDIR = Mother Directory for working
#   model = How many models are used ?
################################################################ Modification
set tyear = 21          # hindcast total year (21)=> 1983-2003
set tsea = JJA
set fsea = JUN
set HDIR = '/apcc01/OPER/SEASON/MME_IN/2006/JJA'
set WDIR = '/apcc01/OPER/SEASON/WORK/DMME/AUTO/MME1/HINDCAST'
set period = 83-03
set fore_year = 2006
set mstart = 6       # starting month
set nystart = 5      # e.g.) 1981 is the third year(3) when starting from 1979
############################################################## Variables Modification
cd $WDIR
rm -rf WORK fcst tmp
mkdir -p WORK
mkdir -p fcst
#
#foreach var ('t850' 'prec' 'z500' 'u850' 'v850')
#foreach var ('t850')
foreach var ('t850' 'prec' 'z500' 'u850' 'v850' 'u200' 'v200' 't2m')
#############################################################################
rm -f filelist1
```

```
@ model = 0
cd $WDIR/WORK
echo ${var}
#
if ( -e ${HDIR}/OBS.${tsea}.$period.${var}.bin ) then
  set CH_OBS = `ls -l ${HDIR}/OBS.${tsea}.$period.${var}.bin`
  set cap_obs = $CH_OBS[5]
  echo ${HDIR}/OBS.${tsea}.$period.${var}.bin >> filelist1
########
#foreach mod ('GDAPS_F' 'GDAPS_O' 'METRI')
#foreach mod ('GDAPS_F' 'GDAPS_O' 'GCPS' 'METRI')
#foreach mod ('CWB' 'GCPS' 'GDAPS_F' 'GDAPS_O' 'HMC' 'IRIF' 'IRI' 'JMA' 'METRI' 'MGO' 'NCC' 'NCEP')
#foreach mod ('CWB' 'GCPS' 'IRIF' 'IRI' 'METRI' 'MGO' 'NCEP')
foreach mod ('CWB' 'GDAPS_F' 'GDAPS_O' 'HMC' 'JMA' 'MGO' 'NCC')
  if ( -e ${HDIR}/${mod}.${tsea}.$period-fcst.${var}.em.bin ) then
     set CH_MOD = `ls -l ${HDIR}/${mod}.${tsea}.$period-fcst.${var}.em.bin`
     set cap_mod = $CH_MOD[5]
    if ( $cap_obs < $cap_mod ) then
          echo ${HDIR}/${mod}.${tsea}.$period-fcst.${var}.em.bin >> filelist1
          @ model = $model + 1

         if ( $model == 1 ) then
          set mod1 = ${mod}
         else if ( $model == 2 ) then
          set mod2 = ${mod}
         else if ( $model == 3 ) then
          set mod3 = ${mod}
         else if ( $model == 4 ) then
          set mod4 = ${mod}
         else if ( $model == 5 ) then
          set mod5 = ${mod}
         else if ( $model == 6 ) then
          set mod6 = ${mod}
         else if ( $model == 7 ) then
          set mod7 = ${mod}
                else if ( $model == 8 ) then
          set mod8 = ${mod}
         else if ( $model == 9 ) then
          set mod9 = ${mod}
         else if ( $model == 10 ) then
          set mod10 = ${mod}
         else if ( $model == 11 ) then
          set mod11 = ${mod}
         else if ( $model == 12 ) then
          set mod12 = ${mod}
         endif
    endif
  endif
end
########
else
   echo STOP
   exit
```

```
endif
#
##*****************************************************************************
cd $WDIR/src
chmod +x make_mme1_hindcast.csh
./make_mme1_hindcast.csh $tyear $tsea $fsea $HDIR $WDIR $model $var
###############################################################################
cd ${WDIR}/WORK
@ max = $model + 2
@ year = 1
while ( $year <= $tyear )
#
echo dset ^MME1_ANOG_${var}_${year}             >> MME1_ANOG_${var}_${year}.ctl
echo undef 1e20                                 >> MME1_ANOG_${var}_${year}.ctl
echo title MME1 ${tsea} HINDCAT anomaly of ${var}     >> MME1_ANOG_${var}_${year}.ctl
echo xdef 144 linear   0.  2.5                  >> MME1_ANOG_${var}_${year}.ctl
echo ydef  73 linear -90.  2.5                  >> MME1_ANOG_${var}_${year}.ctl
echo tdef   4 linear  ${fsea}${fore_year} 1mo        >> MME1_ANOG_${var}_${year}.ctl
echo zdef   1 linear 1. 1.                      >> MME1_ANOG_${var}_${year}.ctl
echo vars  $max                                 >> MME1_ANOG_${var}_${year}.ctl
#
@ wj = 1
while ( $wj <= $model )
        if ( $wj == 1 ) then
         set dy = ${mod1}
        else if ( $wj == 2 ) then
         set dy = ${mod2}
        else if ( $wj == 3 ) then
         set dy = ${mod3}
        else if ( $wj == 4 ) then
         set dy = ${mod4}
        else if ( $wj == 5 ) then
         set dy = ${mod5}
        else if ( $wj == 6 ) then
         set dy = ${mod6}
        else if ( $wj == 7 ) then
         set dy = ${mod7}
        else if ( $wj == 8 ) then
         set dy = ${mod8}
        else if ( $wj == 9 ) then
         set dy = ${mod9}
        else if ( $wj == 10 ) then
         set dy = ${mod10}
        else if ( $wj == 11 ) then
         set dy = ${mod11}
        else if ( $wj == 12 ) then
         set dy = ${mod12}
        endif

echo ${dy}     1   1   ${var} Anomaly           >> MME1_ANOG_${var}_${year}.ctl
@ wj = $wj + 1
end
#
```

```
echo OBS   1   1   ${var} Anomaly            >> MME1_ANOG_${var}_${year}.ctl
echo MME  1   1   ${var} Anomaly            >> MME1_ANOG_${var}_${year}.ctl
echo ENDVARS                          >> MME1_ANOG_${var}_${year}.ctl
#
@ year = $year + 1
end
############################## Just option (For the combining of the result of ACC,RMSE)
cd $WDIR/src
chmod +x mme1_transfer.csh
./mme1_transfer.csh $fore_year $mstart $nystart $tyear $WDIR $model $var
############################## Just option (For the combining of the result of ACC,RMSE)
cd $WDIR/WORK
mv MME1_* ${WDIR}/fcst
end
```

3. Regression, Synthetic PRODUCTION PROCEDURE

REGRESSION

REGRESSION procedure adopted at APCC is based on point-wise regression, which is carried out using SVD technique Yun et al. (2003). Method of zeroing of smaller singular values is applied. Weights for each member model are computed, so that the error variance is the minimum during training period.

SYNTHETIC

SYNTHETIC is based on application of regression technique on synthetically generated data. The synthetic data are constructed from model prediction based on some selected number of EOF modes from model predictions. One can also use SVD_DEM1x.x for regression (SVD method) instead of SUP.x which is based on Gauss-Jordan elimination method.

OPERATION DESCRIPTION

All scripts and program files for running REGESSION and SYNTHETIC are available at the directories /**apcc01/OPER/SEASON/SRC/DMME/REG_SYN** (Figure 4). **WORK** directory is used for actual run instead of **SRC**. To make a seasonal prediction, one of **prec**, **t850**, and **z500** directories below WORK/*year*/*season*(ex. 2006/SON) should be selected. To run REGESSION and SYNTHETIC,

synth.sh and **combx.sh** scripts are used. synth.sh script creates temporary working (**tmp**) and result (**out**) directories. For example if the data file has 21 years of training data and 1 year of forecast data, the year loop in synth.sh should be set to '22' for forecast and to '1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21' for hindcast.

For each season (eg. for each forecast and hindcast field), some parameters in several programs need to be changed depending on number of member models, length of training data set, number of EOF modes chosen, etc. (Table. 1).To change these parameters, synth.sh executes change.sh script where all necessary parameters are to be set. In the Table. 1., *filename*.x represents executable files. The Fortran programs of the corresponding files are also kept in the same directory.

Table. 1

VARIABLE	DESCRIPTION	PROGRAM
KMEMB	number of member models	season.x, CROSSVAL.x, MEAN.x, MEAL1.x, MEAN2.x, SUP.x, SVD_DEM1.x, SVD_DEM1x.x, SYN_EOF.x, VER_DEM.x
NPTS	total length of training (for hindcast), total length of training + forecast data (for forecast)	season.x, CROSSVAL.x, EIGEN_SYN,x, MEAN.x, MEAL1.x, MEAN2.x, SVD_DEM1.x, SVD_DEM1x.x, SYN_EOF.x, VER_DEM.x
NMONTH	total length of training (for hindcast), total length of training + forecast data (for forecast)	SUP.x
NSINGLE	number of smaller singular values set to zero	SVD_DEM1.x, SVD_DEM1x.x, SYN_EOF.x,
NCYC	data cycle (4 – 3 month data + seasonal mean)	season.x, CROSSVAL.x, EIGEN_SYN.x, MEAN.x, MEAL1.x, MEAN2.x, SUP.x, SVD_DEM1.x, SVD_DEM1x.x, SYN_EOF.x, VER_DEM.x
NMOD	number of EOF modes selected	SYN_EOF.x,

Then script synth.sh executes the shell scipts combx.sh. The list of input files and their path are set in the combx.sh script. The script compiles and executes all program fiels. The list and the path of data files should be changed in combx.sh. The executable procedure is same as Fig. 5.

After successful run of the scripts, result files are available at the directory out. These forecast files are used by GrADS scripts **write.ano.gs** and **write.total.gs** to reformat the data files which can be utilized for visualization and graphics using standard APCC graphic scripts.

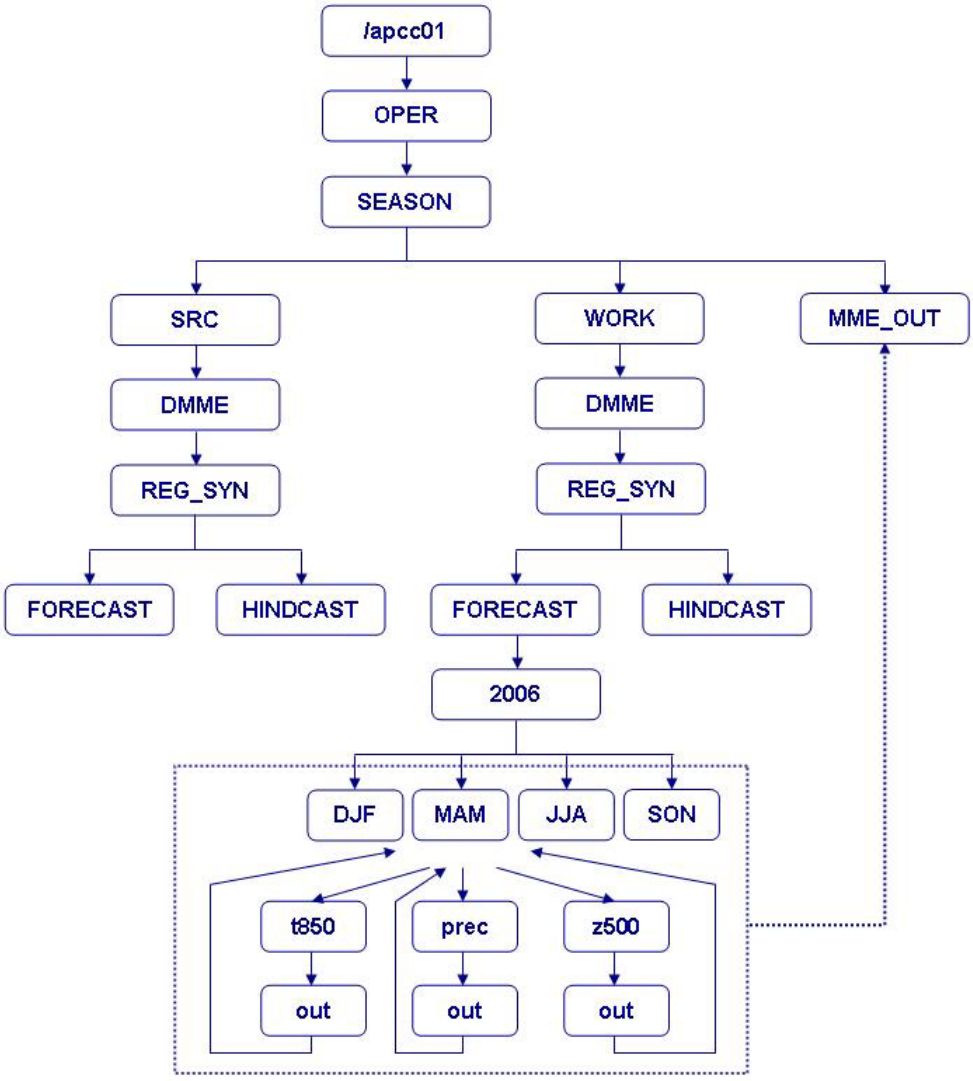


Fig. 4. Directory structure for REGRESSION and SYNTHETIC

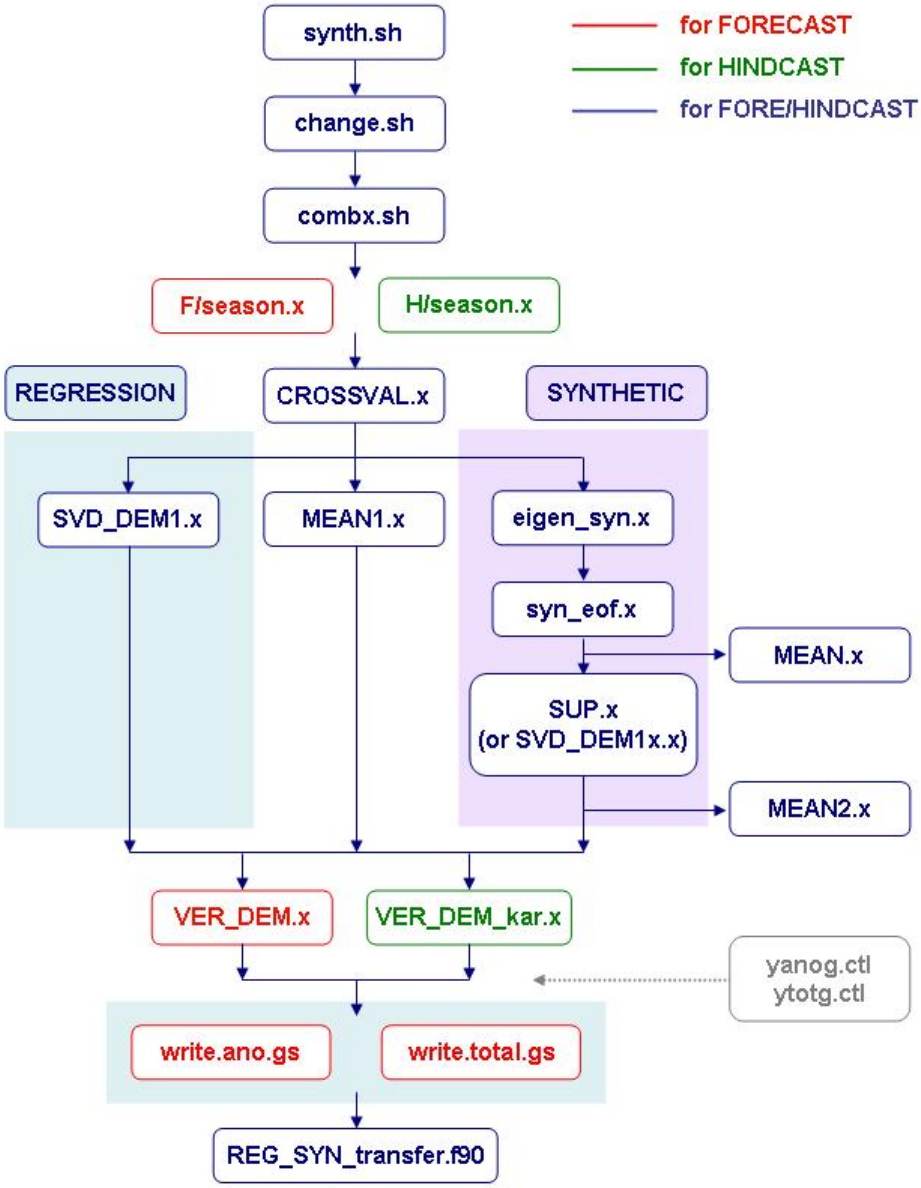


Fig. 5. Flow diagram of REGRESSION and SYNTHEIC

4. Coupled Pattern Projection Method (CPPM)

CPPM is a statistical downscaling MME. First, the coefficient of transfer function is determined from relationship between observation and historical forecast data of model by searching for higher correlation coefficient between

the target point and predictor area. After that, the model output of corresponding year is modified from these coefficients. Finally, the statistically corrected data is used for MME procedure. The model weight of MME is performed in a pointwise manner, therefore, the application of this statistical procedure can be thought as a kind of MME based on spatial pattern relationship between observation and model forecast.

RUNNING INSTRUCTIONS

FORECAST case :

A script and source program files for running CPPM for issued season are available at the directory: **/apcc01/OPER/SEASON/WORK/DMME/CPPM/FORECAST/src.** The script "cppm_forecast.csh" is a UNIX C shell script. To execute the CPPM forecast, the following steps may be used:

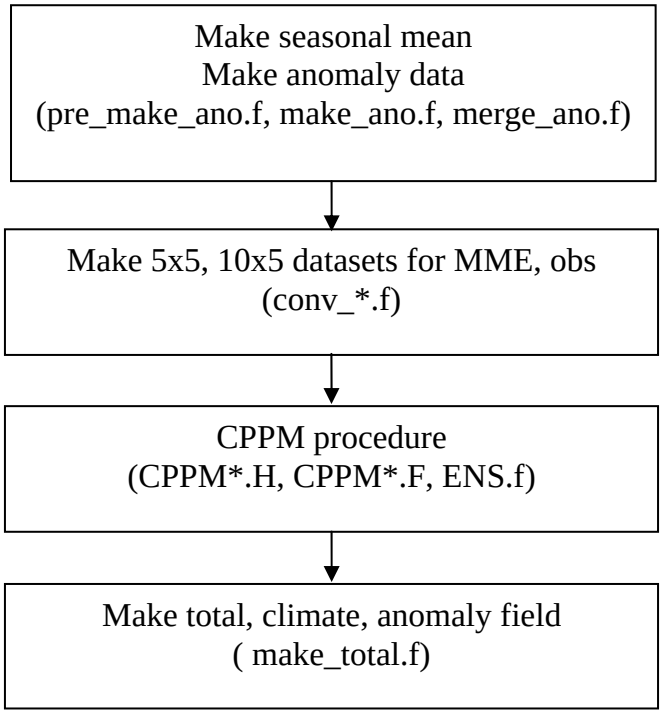
1. Change the options in the USER DEFINE of script. The descriptions of each option are following;
   - **total_year** How many years for training ?
   - **first_year** first year
   - **last_year** last year (issued year)
   - **used_model** How many models are used ?
   - **season** issued season
   - **HIND_DIR** directory of hindcast data for training
   - **MME1_DIR** directory of MME_I forecast and observation climate
   - **WORK_DIR** mother directory of working
   - **filelist** used model information for precipitation
   - **filelist1** used model information for t850

2. Run the script

3. Check the output in mother-directory/fcst. You obtain 3 output data sets and ctl files :
   Anomaly MME_III.monthly.2005.ano.gdat.ctl, MME_III.monthly.2005.ano.gdat
   Total MME_III.monthly.2005.gdat.ctl, MME_III.monthly.2005.gdat

Climate MME_III.monthly.clim.gdat.ctl, MME_III.monthly.climate..gdat

The flow diagram of CPPM script is as follows;



HINDCAST case :

A script and source program files for running CPPM for hindcast are available at the directories **/apcc01/OPER/SEASON/WORK/DMME/CPPM/HINDCAST/src.** The script "cppm.csh" is a UNIX C shell script. To execute the CPPM hindcast should follow the following steps:

1. Change the options in the USER DEFINE of script. The descriptions of each option are following;
   - **total_year** How many years for training ?
   - **first_year** first year
   - **last_year** last year
   - **used_model** How many models are used ?
   - **season** issued season

- **first_season** the first month in the season
- **HIND_DIR** directory of hindcast data for training
- **WORK_DIR** mother directory of working
- **filelist** used model information for precipitation
- **filelist1** used model information for t850

2. Run the script: **cppm.csh**

3. Change the options in **cppm_transfer.sh. The variables which should be set are as follows:**

- **year** The forecast year
- **used_model** How many models are used ?
- **season** issued season
- **mstart** the first month in the season
- **nystart** the number of the start year based on 1979
- **numyear** total year for the hindcast period

4. Run the script: **cppm_transfer.sh .**

5. Check the output at:

/apcc01/OPER/SEASON/WORK/DMME/CPPM/HINDCAST/fcst.

The three kinds of output data sets and ctl files are produced:

- **Anomaly field:** MME3.ANOG_$var_$year, MME3.ANOG_$var_$year.ctl
- **Global(East asia) ACC data:** MME3_ACCG(ACCE)_ $var_$year
- **Global(East asia) RMSE data:** MME3_RMSEG(RMSEE)_ $var_$year

In addition, the following data for plotting bar figures are also produced:

MME3_ACCG_prec.dat

MME3_ACCE_prec.dat

MME3_ACCE_t850.dat

MME3_ACCG_t850.dat

MME3_RMSEE_t850.dat

MME3_RMSEG_prec.dat

MME3_RMSEE_prec.dat

MME3_RMSEG_t850.da

The flow diagram of CPPM script is as follows;