Seasonal MME Forecast Training 1

Lecturer : Lee, Doo Young

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

HINDCAST case :

A script and source program files for running MME-I for hindcast are available at the directories**.** 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
```

Seasonal MME Forecast Training 2

Lecturer: Soo-Jin Sohn

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

To make a seasonal prediction, one of **prec**, **t850**, and **z500** 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, the year loop in synth.sh should be set 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 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. 2. After successful run of the scripts, result files are available at the directory out.

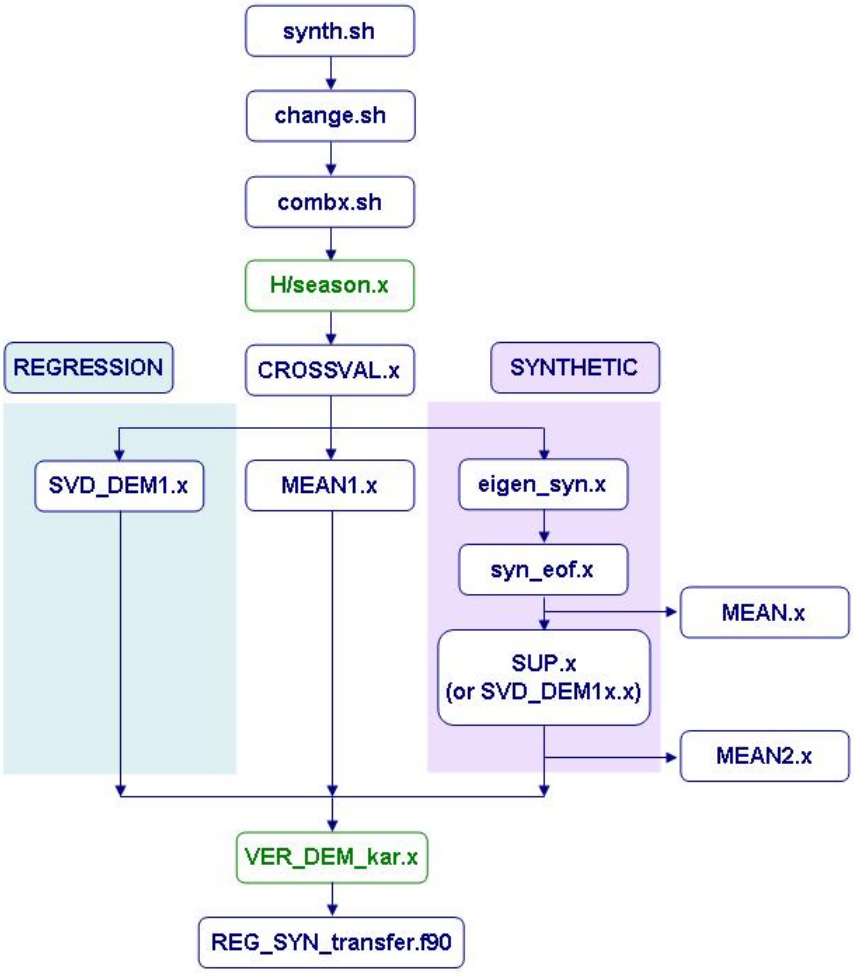

Fig. 1. Flow diagram of REGRESSION and SYNTHEIC