Development of using METplus in the FV3GFS workflow

NCWCP METplus Tutorial

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Current status

- The current operational verification package for global models is the NCEP-EMC Global NWP Model Verification Package
  - Uses VSDB (Verification Statistics DataBase)
- Built into the parallel GFS workflow, verification statistics computed on the fly, i.e. within the workflow (indicated by * below) or can be run "offline"
- The package can run various types of verification:
  1. Grid-to-Grid *
  2. Scorecard
  3. Grid-to-Obs *
  4. Precipitation *
  5. 2D (Spatial) Maps
  6. Fit-to-Obs
  7. Tropical Cyclone
  8. Analysis Increment Graphics for Data Assimilation
- Transfers images and a website template to a web server specified by the user for easy display of results

Verification in the Fv3GFS workflow

- How GFS verification is done in the FV3GFS workflow ("master" branch of fv3gfs repo on VLab)

GFS verification done during the *gfs_vrfy* task

⬇

Task runs the script *vrfy.sh*

⬇

First loads FV3GFS workflow modules and
source config (*config.base* and *config.vrfy*) and machine runtime files

⬇

Then runs VSDB (script: *vsdbjob.sh*, acts as interface between workflow and VSDB package)
user requested verification with requested settings...
<u>grid-to-grid verification</u> - to compute partial sums
<u>grid-to-obs verification</u> - to compute partial sums
<u>precipitation verification</u> - to compute contingency table counts

Transition to METplus

- EMC working toward unifying all model verification under DTC's Model Evaluation Tools (MET) plus

NEED TO TRANSITION FROM USING VSDB TO METplus in FV3GFS workflow
Target version to use in: Global FV3 - GFS-FY21 v16

Development being done in the "vrfy_metplus" branch in fv3gfs repo on VLab

Current Status of the transition to METplus

- Uses with METV6.1 and METplusV1.0
- New script created to interface FV3GFS workflow and METplus (*metplusjob.sh*); this is where METplus is run
- *vrfy.sh* has new section that calls *metplusjob.sh*
- *config.base* and *config.vrfy* set environment new variables to run METplus
- Able to run on WCOSS Cray machines (Luna and Surge) and Theia
  - Luna/Surge: /gpfs/hps3/emc/global/noscrub/emc.glopara/git/verif/METplus/
  - Theia: /scratch3/NCEPDEV/global/save/glopara/git/verif/METplus/
- Fixed files used by METplus, i.e. masking regions and climo files, set up
  - Luna/Surge: /gpfs/hps3/emc/global/noscrub/emc.glopara/git/fv3gfs/fix/fix_verif
  - Theia: /scratch3/NCEPDEV/global/save/glopara/git/git/fv3gfs/fix/fix_verif

Current Status of the transition to METplus

- All verification run by VSDB has been connected into the workflow using METplus, i.e.

grid-to-grid verification - to compute partial sums

grid-to-obs verification - to compute partial sums

precipitation verification - to compute contingency table counts

* Note: VSDB precipitation verification uses CPC rain gauge data as truth. After discussion among EMC personnel, it has been decided to use Climatology-Calibrated Precipitation Analysis (CCPA).

METplus in the FV3GFS workflow

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Fv3gfs

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Overview   Activity   Roadmap   Issues   Gantt   Calendar   News   Documents   Wiki   Files   **Repository**   Settings

FV3GFS / PARM / VERIF @ VRFY_METPLUS   Statistics | Branch: vrfy_metplus | Tag: | Revision:

Machine related
METplus .conf
files

Size

+ machine_config

MET config files customized
for use in workflow

+ met_config

+ metplus_config

Use case
customized
METplus .conf
files

METplus in the FV3GFS workflow

METplus in the FV3GFS workflow

METplus in the FV3GFS workflow

📈 Statistics | Branch: vrfy_metplus ⇕ | Tag: ⇕ | Revision:

History | View | Embedded | Annotate | Download (641 Bytes)

```
 1  #
 2  # Machine Conf file for WCOSS_C (Surge/Luna): contains directories and paths to
 3  # non-METplus executables needed to run METplus
 4  #
 5  [dir]
 6  #
 7  METPLUS_BASE = {ENV[metplushome]}
 8  PARM_BASE = {METPLUS_BASE}/parm
 9  MET_INSTALL_DIR = /usrx/local/dev/met/{ENV[METver]}
10  MET_BASE = {MET_INSTALL_DIR}/share/met
11  #
12  [exe]
13  # NON-MET executables
14  WGRIB2 = /gpfs/hps/nco/ops/nwprod/grib_util.v1.0.3/exec/wgrib2
15  RM_EXE = /bin/rm
16  CUT_EXE = /usr/bin/cut
17  TR_EXE = /usr/bin/tr
18  NCAP2_EXE = /usrx/local/dev/nco/4.4.4/gnu/sandybridge/bin/ncap2
19  CONVERT_EXE = /usr/bin/convert
20  NCDUMP_EXE = /usrx/local/dev/NetCDF/4.2/intel/sandybridge/bin/ncdump
21  EGREP_EXE = /usr/bin/grep
```

METplus in the FV3GFS workflow

METplus in the FV3GFS workflow

FV3GFS / PARM / VERIF / MET_CONFIG / 📈 Statistics | Branch: `vrfy_metplus` ▼ | Tag: ▼ | Revision: [   ]
METV6.1 @ VRFY_METPLUS

Name	Size
📄 GridStatConfig_anom	4.04 KB
📄 GridStatConfig_anom_height	4.08 KB
📄 GridStatConfig_precip	4.2 KB
📄 GridStatConfig_pres	4.05 KB
📄 GridStatConfig_sfc	4.41 KB
📄 PB2NCConfig_conus_sfc	3.32 KB
📄 PB2NCConfig_upper_air	3.29 KB
📄 PointStatConfig_conus_sfc	5.06 KB
📄 PointStatConfig_upper_air	4.31 KB
📄 STATAnalysisConfig_VSDBformat	1.7 KB

```
70      file_name = [ "${metplusfix}/climo_files/cmean_1d.1959${MET_VALID_HHMM}" ];
71
72      regrid = {
73          method      = BILIN;
74          width       = 2;
75          vld_thresh  = 0.5;
76          shape       = SQUARE;
77      }
78
79      time_interp_method = NEAREST;
80      match_day          = TRUE;
81      time_step          = 21600;
82  }
83
84  climo_stdev = climo_mean;
85  climo_stdev = {
86      file_name = [];
87  }
88
89  climo_cdf_bins = 1;
90  write_cdf_bins = FALSE;
91
92  ////////////////////////////////////////////////////////////////////////////////
93
94  //
95  // Verification masking regions
96  //
97  mask = {
98      grid = [ "G002" ];
99      poly = [ "${metplusfix}/vx_mask_files/grid2grid/NHX.nc",
100             "${metplusfix}/vx_mask_files/grid2grid/SHX.nc",
101             "${metplusfix}/vx_mask_files/grid2grid/TRO.nc",
102             "${metplusfix}/vx_mask_files/grid2grid/PNA.nc" ];
103 }
```

METplus in the FV3GFS workflow

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fv3gfs

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Use case
customized
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METplus in the FV3GFS workflow

METplus in the FV3GFS workflow

```
29  LOOP_METHOD = times
30  # List of applications to run
31  PROCESS_LIST = GridStat
32
33  MODEL_TYPE = {ENV[exp]}
34  OB_TYPE = {ENV[obtype]}_anl
35
36  #GridStat
37  #FCST
38  FCST_NATIVE_DATA_TYPE = GRIB
39
40  #OB
41  OBS_NATIVE_DATA_TYPE = GRIB
42
43  #info on forecast leads and init to process
44  LEAD_SEQ = {ENV[fhr_list_config]}
45  FCST_MAX_FORECAST = {ENV[fhrmax]}
46  FCST_INIT_INTERVAL = {ENV[fhrout]}
47
48  #list of variables to compare
49  FCST_IS_PROB = false
50
51  FCST_VAR1_NAME = HGT
52  FCST_VAR1_LEVELS = P1000, P700, P500, P250
53
54  GRID_STAT_CONFIG = {ENV[metplusconfig]}/met_config/METV{ENV[METver]}/GridStatConfig_anom_height
```

METplus in the Fv3GFS workflow

metplusjob.sh
(typelist="anom pres, sfc")


```
for type in $typelist ; do
    export type=${type}
    export savedir=${metplussave}/${type}/${vhr}Z/${exp}
    mkdir -p ${savedir}
    export work=${rundir_g2g1}/make_met_data/${type}/${exp}
    mkdir -p $work
    echo "==== running METplus grid-to-grid for ${type} for ${VDATE} ${exp} ===="
    if [ ${type} = anom ] ; then
        ${metplushome}/ush/master_metplus.py -c ${metplusconfig}/metplus_config/METplus-${METPLUSver}/grid2grid_${type}_step1a.conf -c ${metplusconfig}/machine_config/machine.${machine}
        ${metplushome}/ush/master_metplus.py -c ${metplusconfig}/metplus_config/METplus-${METPLUSver}/grid2grid_${type}_step1b.conf -c ${metplusconfig}/machine_config/machine.${machine}
        ${metplushome}/ush/master_metplus.py -c ${metplusconfig}/metplus_config/METplus-${METPLUSver}/grid2grid_${type}_step1c.conf -c ${metplusconfig}/machine_config/machine.${machine}
        cp ${rundir_g2g1}/VSDB_format/${type}/${vhr}Z/${exp}/*.stat ${savedir}/.
    elif [ $type = pres -o $type = sfc ] ; then
        ${metplushome}/ush/master_metplus.py -c ${metplusconfig}/metplus_config/METplus-${METPLUSver}/grid2grid_${type}_step1.conf -c ${metplusconfig}/machine_config/machine.${machine}
        cp ${rundir_g2g1}/VSDB_format/${type}/${vhr}Z/${exp}/*.stat ${savedir}/.
    else
        echo "ERROR: grid-to-grid ${type} is not supported."
        mkdir -p ${work}/${VDATE}00
        echo "grid-to-grid ${type} is not supported."  >> ${work}/${VDATE}00/error_${VDATE}.txt
    fi
done
```
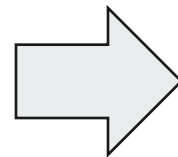
An example of METplus grid-to-grid use case being run in the FV3GFS workflow

Calls METplus with workflow use case METplus .conf file (with customized MET config file) and machine METplus .conf files

Future work and summary

- Need to run and test using METV8.0 and METplusV2.0
- Need to set up METplus in FV3GFS workflow on other machines: WCOSS Dell machines, Jet?, Gaea?
- Script clean up
- Set up way for model developers to view their results:
  - METplus plotting scripts
  - METviewer

- "master" branch of fv3gfs repo not yet using METplus verification (still using VSDB)
- "vrfy_metplus" branch of fv3gfs repo is where the development is being done to bring METplus into the FV3GFS workflow
- METplus verification is targeted to be in the workflow for use in the Global FV3 - GFS-FY21 v16

METplus in the Fv3GFS workflow

config.base

```
export METver="6.1"
export METPLUSver="1.0"
export BASE_VERIF_METPLUS="$BASE_GIT/verif/METplus/METplus-$METPLUSver"
```

config.vfry

```
export VRFY_STEP1="YES"       # Run METplus verification step 1: partial sum and/or contingency table counts
export VRFY_STEP2="NO"        # Run METplus verification step 2: make plots
export VRFY_GRID2GRID="YES"   # Run METplus desired steps for grid-to-grid verification
export VRFY_GRID2OBS="YES"    # Run METplus desired steps for grid-to-obs verification
export VRFY_PRECIP="YES"      # Run METplus desired steps for precipitation verification
```

config.vfry

```
# METplus, Verify grid-to-grid, and/or grid-to-obs, and/or precipitation options
#--------------------------------------------------------------------
# All these call $METPLUSSH

if [ "$CDUMP" = "gfs" ] ; then
    if [ $VRFY_STEP1 = "YES" -o $VRFY_STEP2 = "YES" ]; then
        if [ $VRFY_PKCG2RUN = "METPLUS" -o $VRFY_PKCG2RUN = "BOTH" ]; then
            export VRFYBACKDATE=24                             # execute step 1 metplusjob for the previous x hour
s
            export VRFYBACKDATE_PRCP=24                        # additonal back up time for QPF verification data
to allow observation data to come in
            export metplussave="$NOSCRUB/archive/metplus_data" # place to save METplus database
            export metplushome=$BASE_VERIF_METPLUS            # location of global verification scripts
            export metplusconfig="$PARMgfs/verif"             # location of configuration files to run METplus
            export export metplusfix="$FIXgfs/fix_verif"      # location of fix files to run METplus
            export METPLUSSH="$USHgfs/metplusjob.sh"          # METplus job script
            export vfhmin=$FHMIN_GFS                          # start verification forecast hour
            export vfhmax=$FHMAX_GFS                          # end verification forecast hour
            export vhr_rain=$FHMAX_GFS                        # needed to create 0.25 deg grib1 files
            export ftyplist="pgbf"                            # file types: pgbf, pgbq, or flxf
            export ptyplist="APCP"                           # precip types in GRIB: PRATE or APCP
            export anltype="gfs"                              # default=gfs, analysis type (gfs or gdas) for veri
fication
            export rain_bucket=6                              # accumulation bucket in hours. bucket=0 -- continu
ous accumulation
            export g2g_sfc="YES"                              # include the group of surface variables for grid-t
o-grid verification

            export STEP2_START_DATE="$SDATE"                  # starting date for METplus plots
            export STEP2_END_DATE="$EDATE"                    # ending date for METplus plots
            export webhost="emcrzdm.ncep.noaa.gov"            # webhost(rzdm) computer
            export webhostid="$USER"                          # webhost(rzdm) user name
            export SEND2WEB="NO"                              # whether or not to send maps to webhost
            export WEBDIR="/home/people/emc/www/htdocs/gmb/${webhostid}/METplus/$PSLOT"
            export mdlist="gfs $PSLOT "                       # exps (up to 10) to compare in maps
        fi
    fi
fi
```

vrfy.sh

```
###########################################################
echo
echo "=============== START TO RUN METPLUS VERIFICATION ==============="
if [ $CDUMP = "gfs" ]; then

    if [ $VRFY_PKCG2RUN = "METPLUS" -o $VRFY_PKCG2RUN = "BOTH" ]; then
        if [ $VRFY_STEP1 = "YES" -o $VRFY_STEP2 = "YES" ]; then

            xdate=$(echo $($NDATE -${VRFYBACKDATE} $CDATE) | cut -c1-8)
            export ARCDIR1="$NOSCRUB/archive"
            export rundir="$RUNDIR/$CDUMP/$CDATE/vrfy/metplus_exp"
            export COMROT="$ARCDIR1/dummy"

            $METPLUSSH $xdate $xdate $CDATE $cyc $PSLOT $CDUMP $rundir $ARCDIR1

        fi
    fi
fi


###########################################################
```

With environment variables set, through running workflow config files, the interface script *metplusjob.sh* can be run

QPF against gauges or analysis?

Under ideal conditions - scrupulously QC'd and more or less evenly distributed gauges - verifying gridded forecast against gauges is IDEAL - eliminate the artifice of mapping fcst/analysis to verifying grids.

In reality there are many issues with gauges:

1) Gauge QC problem ~20% of gauge reports are questionable. Occasionally purported gauge location can be way off (recent case: 610 miles away)
2) With scores such as threat and bias that appeal to intuition, uneven distribution of gauges might leave a skewed impression on your audience. Not an issue when you talk to trained statisticians, otherwise you might have a problem.

F H O

Slide from Ying Lin