How to get the observations for WRF-Var

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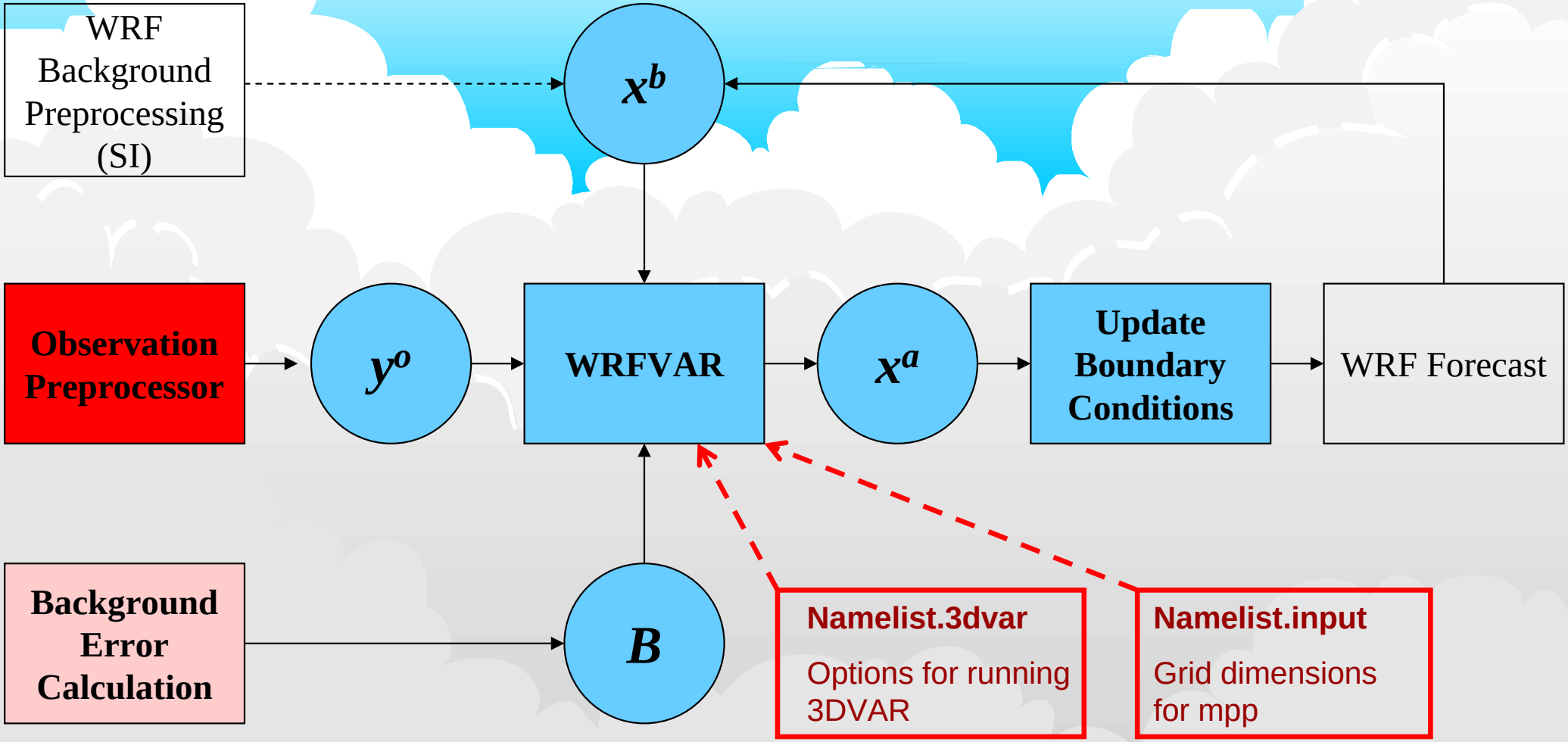
WRF-Var in the WRF Modeling System



The observations are one of the important input files for WRF-Var, no observations will be no data assimilation.

The data format of observations accepted by WRF-Var

1. **Official format: BUFR --- International WMO standard format (not fully tested in WRF-Var).**

2. **Format for research: ASCII (MM5/LITTLE_R) format (Current working format)**

   **** Radar OBS (Radial velocity and reflectivity) format**

WMO standard format --- BUFR

- Currently we do not have the conversion program available from other format of observation data to the BUFR data file.
- NCEP provides the BUFR format observations since May 1995. The data can be downloaded from NCAR Mass Storage System (MSS). The data inventory can be obtained through ftp.
- A data file from MSS includes the OBS for several days. You need to extract the files you needed. We haven't tried to use these data yet, here just provide a way to get the BUFR data. Please feed back your experiences to get and use the BUFR format observations.

Shell script to get the BUFR OBS inventory for NCEP Eta analysis

```
#
cat >! ftp.cmd << EOF1
Open ncardata.ucar.edu
user anonymous ${user-email-address}
cd datasets/ds609.2/inventories
get eta.inv
EOF1
#
ftp –n < ftp.cmd
#
```

A file “eta.inv” will be obtained after executed the ftp shell script. You can look at this file to find the BUFR OBS files which you needed:

<20040507 ds609.2>

To use the NCEP Eta 3D, SF, BUFR and PREC data from NCAR/SCD/DSS ds609.2 dataset, we recommend users to access the reorganized MSS vsns listed below.
The complete tar lists can be found at
ftp://ncardata.ucar.edu/datasets/ds609.2/inventories/TARLST/

-SD:Starting day of the month, ED:Ending day of the month,

-/DSS/	MSS SIZE (BYTE)	YYYY.MM	TYPE	SD-ED	UNIX TAR SIZE (BYTE)
G40455	609480704	1995.05	BUFR	1-31	608141312
G41492	1331208192	2004.04	BUFR	01-05	1328283648
G41493	1331208192	2004.04	BUFR	06-10	1328283648
G41494	1331208192	2004.04	BUFR	11-15	1328283648
G41495	1331208192	2004.04	BUFR	16-20	1328283648
G41496	1331208192	2004.04	BUFR	21-25	1328283648
G41497	1331208192	2004.04	BUFR	26-30	1328283648

- Each /DSS/G* on MSS is a cosblocked unix tar file with a fixed block size of 32768 bytes.
- For NCAR users who retrieve the G vsns themselves, the following commands will result
- a plain unix tar file:
- msread -fBI Gvsn /DSS/Gvsn -- (as a disk file)
- msexport -fBI -Mf -b32768 Gvsn output_media -- (as a unix tar file on output_media)
-

Format for research --- ASCII (MM5/LITTLE_R)

- Anyone familiar with MM5 modeling system should be familiar with the MM5/LITTLE_R format (OBS report-based format).
- It is easy to manipulate an ASCII format file, look, edit,…., and 'cat' all the data together.
- A 3DVAR OBS preprocessor program available to convert the LITTLE_R format OBS to a WRF-Var ASCII OBS file. The users' duty is just to convert the OBS in any format to the LITTLE_R format.

  The 3DVAR OBS preprocessor program can be obtained from:

  http://www.mmm.ucar.edu/individual/guo/3DVAR_code_data.htm

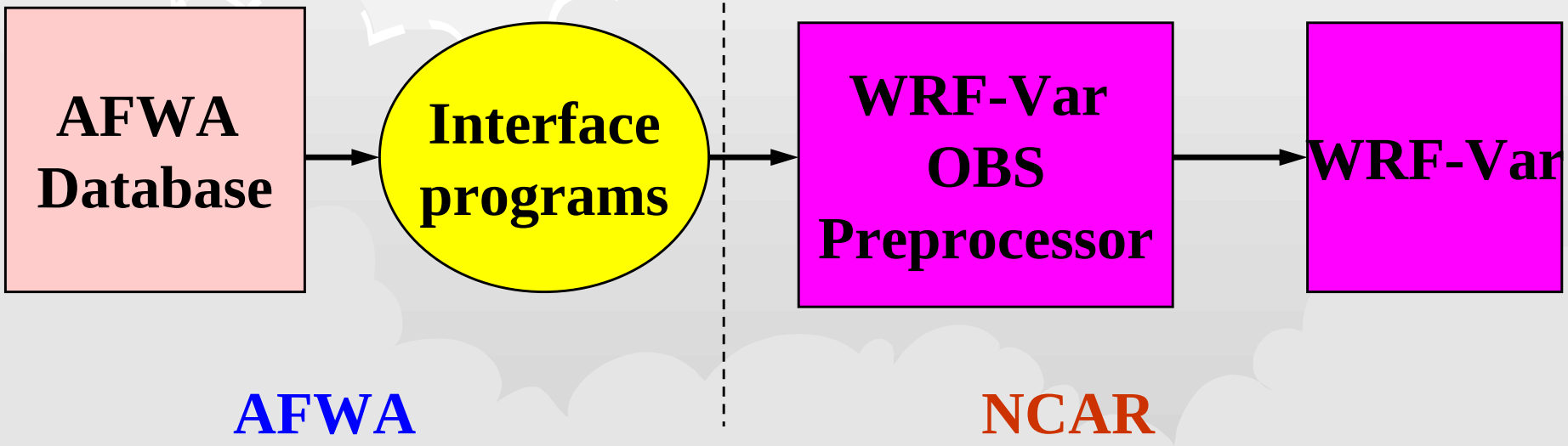
  Click "3DVAR Pre-processing Source Code".

  The presentation for this 3DVAR preprocessor can be found from:

  http://www.mmm.ucar.edu/individual/guo/OBSPROC/Slides1.html

Interface programs in AFWA

- Programs to convert the data format from AFWA observation database to MM5/LITTLE_R format to provide the OBS input file to WRF-Var OBS preprocessor (Richard Ritz, …, AFWA)



- In NCAR, MM5 Utility ***fetch.csh*** will obtain the OBS data file in LITTLE_R format from NCAR archive.

Why do we need the OBS preprocessor?

To make the OBS data file suitable for WRF-Var needs

- Clean out the unnecessary information for WRF-Var, and keep the necessary information for WRF-Var

  For example (Sam case 1999081912Z),

  LITTLE_R obs file : 40425051 bytes,

  3DVAR obs file : 3934484 bytes)

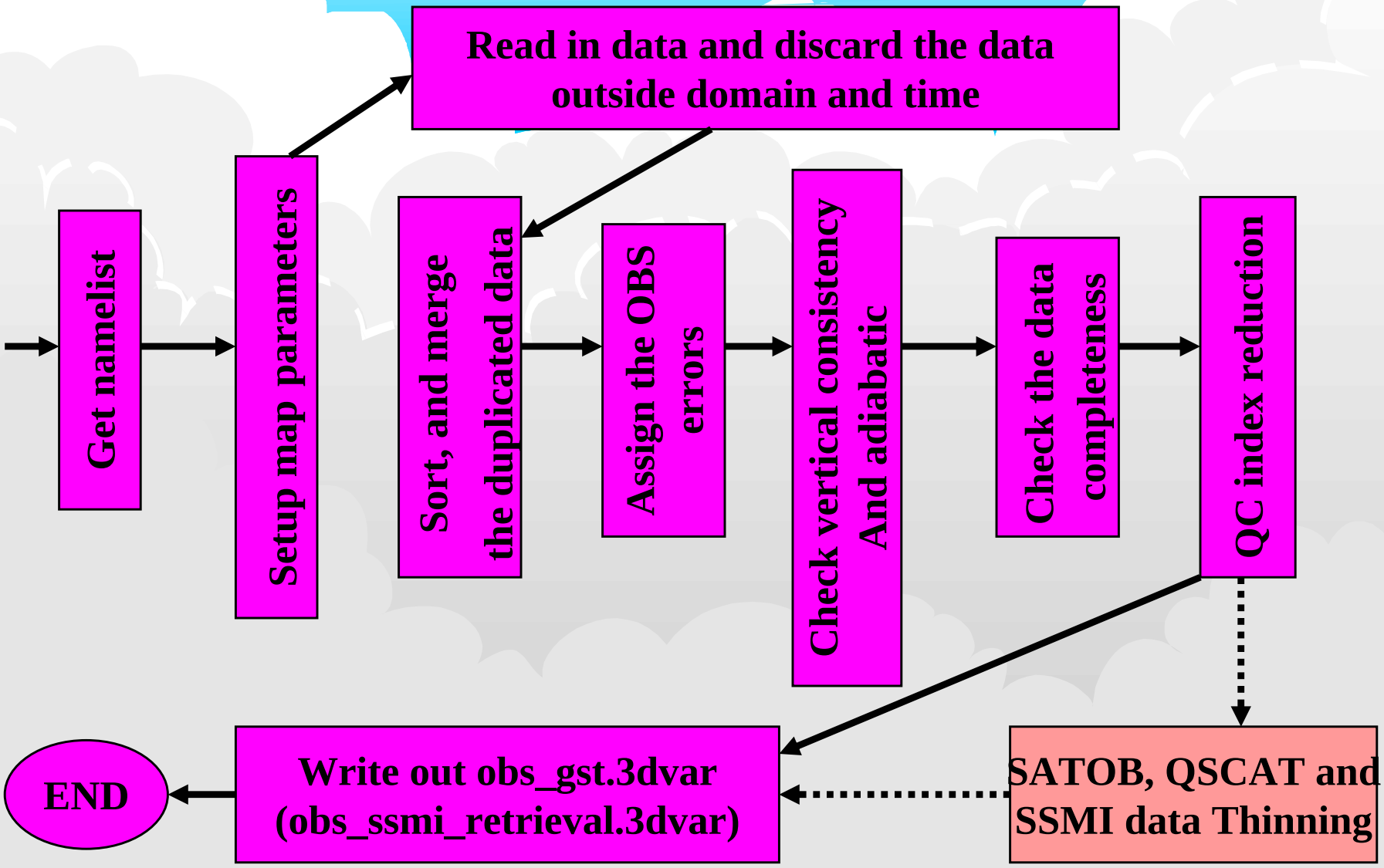
- Save the OBS data processing time, the OBS file can be used for multiple times of WRF-Var experiments.
- Still to keep in ACSII format for easy manipulation (look, check, and edit), especially for research purpose.

Tasks of the WRF-Var OBS preprocessor

- Remove the observations outside the time range and domain (horizontal and top)
- Retrieve the pressure or height based on the observed information with the hydrostatic assumption
- Re-order and merge the duplicate (time and location) data reports
- Assign the observation errors to the different types of observations
- Check the vertical consistency and super adiabatic for the multi-level observations
- Complete thinning with the SATOB, SSMI, and QSCAT data
- Write out OBS file in format for WRF-Var input

  → GTS data and SSMI data
- Plot the distribution for each type of observations →MAP_plot

Flow chart of OBS preprocessor



Types of observations to be processed

→18 types (SYNOP, SHIPS, METAR,
TEMP , AIREP, PILOT , AMDAR,
SATOB, SATEM, SSMT1, SSMT2, SSMI,
GPSPW, GPSZD, GPSRF, QSCAT, BOGUS)

* Radar radial velocity and reflectivity

Observations errors

→ NCEP OBS error (Parrish and Derber 1992)

→US Air Force (AFWA) OBS error file

→Directly from the observation reports

MAP_plot

→Program to plot the distribution of each type of observations.

WMO code for each type of observations

Name	WMO code	WMO code name
SYNOP	12, 14	SYNOP, SYNOP MOBIL
SHIP	13	SHIP
METAR	15, 16	METAR, SPECI
PILOT	32, 33, 34	PILOT, PILOT SHIP, PILOT MOBIL
SOUND	35, 36, 37, 38	TEMP, TEMP SHIP, TEMP DROP, TEMP MOBIL
AMDAR	42	AMDAR
SATEM	86	SATEM
SATOB	88	SATOB
AIREP	96, 97	AIREP
GPSPW	111	GPSPW (Ground-based GPS precipitable water)
GPSZD	114	GPSZD (Ground-based GPS Zenith Total Delay)
GPSRF	116	GPSRF (Space-based GPS Refractivity)
SSMT1	121	SSMT1
SSMT2	122	SSMT2
SSMI	125	SSMI
TOVS	131	TOVS
BOGUS	135	TCBOU (Typhoon bogus), BOGUS (other bogus)
QSCAT	281	Quik SCAT level-2B SeaWind
OTHER		UNKNOWN

Input and output files for OBS preprocessor

3 *Input files*

- **OBS decoded file (Reports) in little_r format**
  - **A report (F90 pointer linking structure)**
    - ❖ **header record (fields)**
    - ❖ **Level*1* data record (fields)**
    - **……**
    - ❖ **Level*n* data record (fields)**
    - ❖ **Ending record (fields)**
    - ➢ **3 Integers in format(3i7)**
- **Namelist file (*namelist.3dvar_obs*) (See: README.namelist)**
  - **Record1: input file names**
  - **Record2: analysis times**
  - **Record3: Maximum number of observations allowed**
  - **Record4: quality control switches**
  - **Record5: print switches**
  - **Record6: define the reference state: ptop, etc.**
  - **Record7: Geographic parameters**
  - **Record8: Domain settings**
- **AFWA OBS errors file: *obserr.txt* (provided by 3DVAR system)**

Output files

Obs_gts.3dvar **and** ***obs_ssmi_retrieval.3dvar***

Header: the information for this OBS file and data format

Data : header record and data records for each of levels

- **These are the OBS input file to WRF-Var program**
- ***obs_ssmi_retrieval.3dvar*** **needed only when SSMI retrieval data available**
- **These files can be used as input to MAP_plot to obtain the gmeta plot file with NCAR GRAPHICS**

3dvar_obs.out ---- a program execution log file

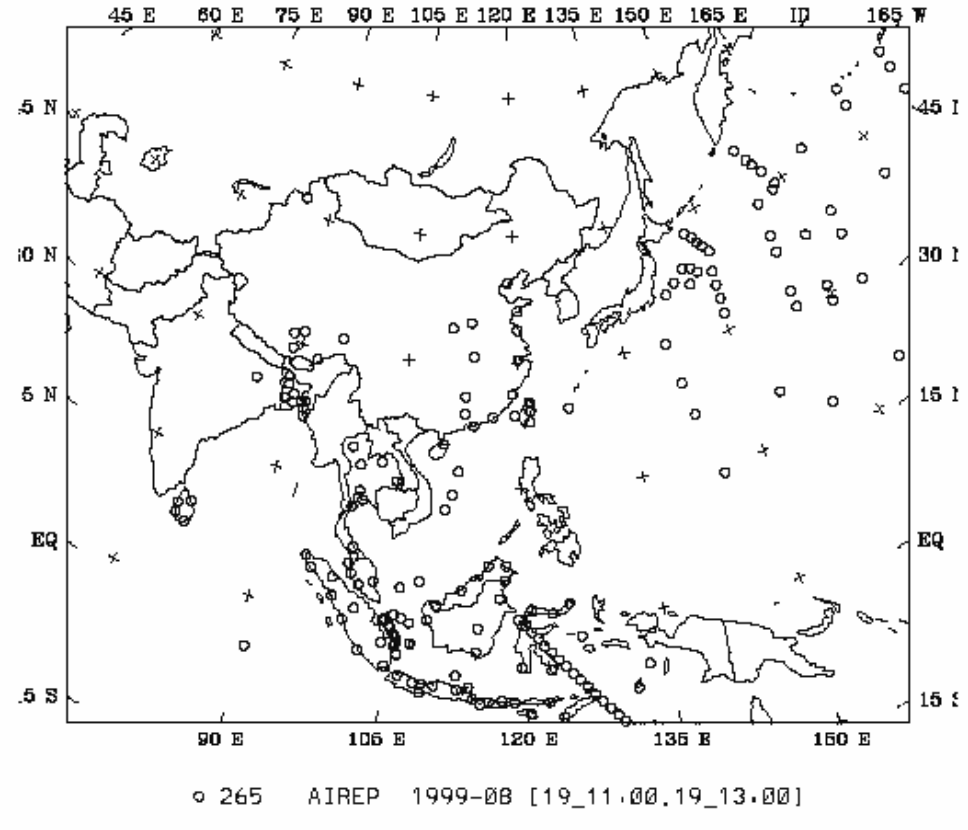
The printing out from the program execution. It can used to monitor the execution and to identify the troubles if any

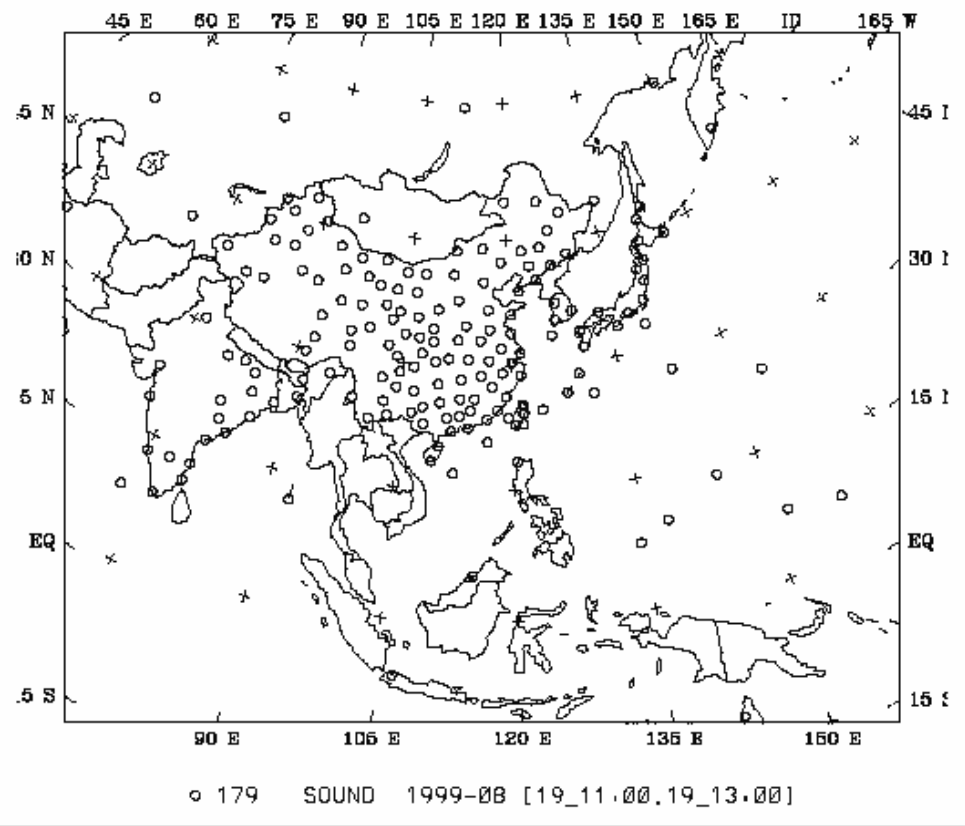
Diagnostic files depended on the print switches in namelist

How to plot the OBS distribution?

- Go to the directory *3DVAR_OBSPROC/MAP_plot*
- Modify the shell script *Map.csh*
  - » To fill in *TIME_ANALYSIS*, etc., and *OBSDATA* file name
- Run shell script *Map.csh*
  - » You will have a gmeta file: *gmeta.${TIME_ANALYSIS}* to show the the distribution of observations contained in *OBSDATA* file.

Distribution for each type of observations





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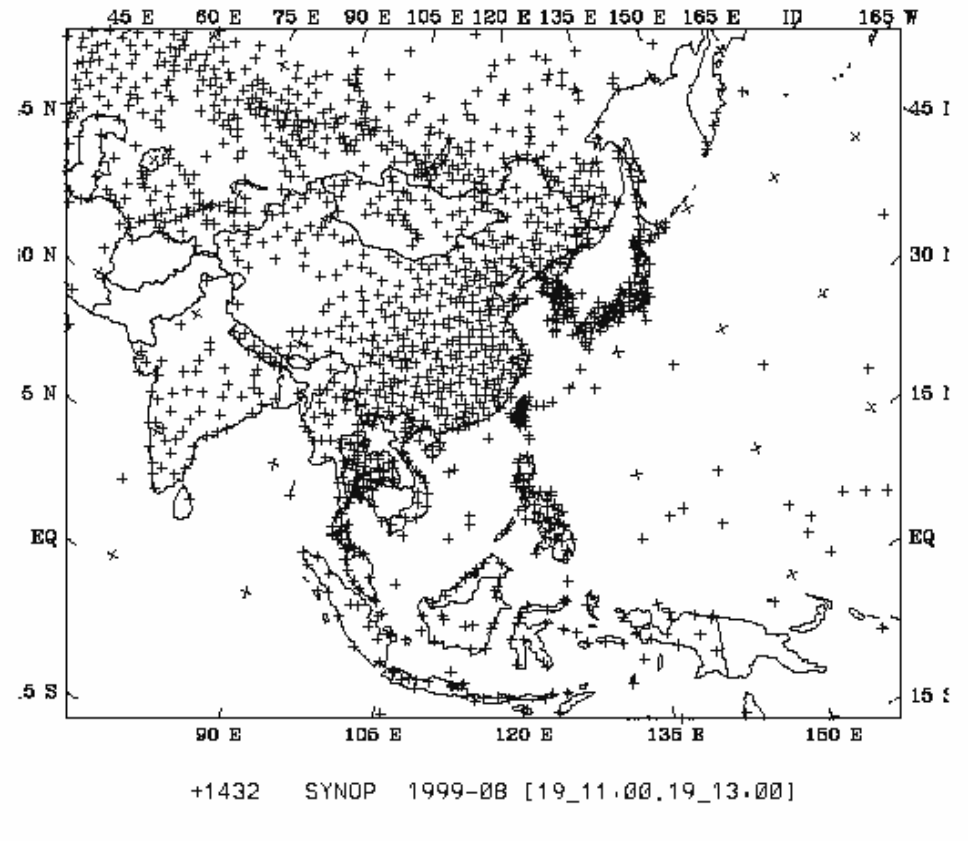

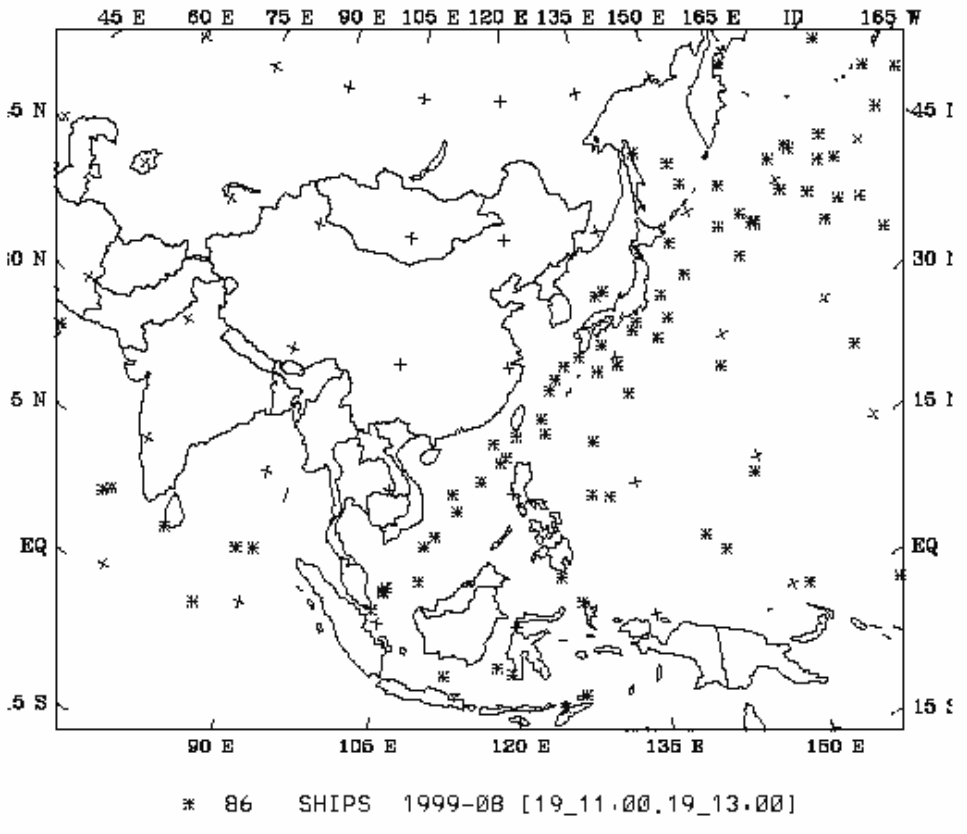

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