Observation Pre-processor for WRF-Var

Yong-Run Guo

National Center for Atmospheric Research
P.O.Box 3000, Boulder, CO 80307

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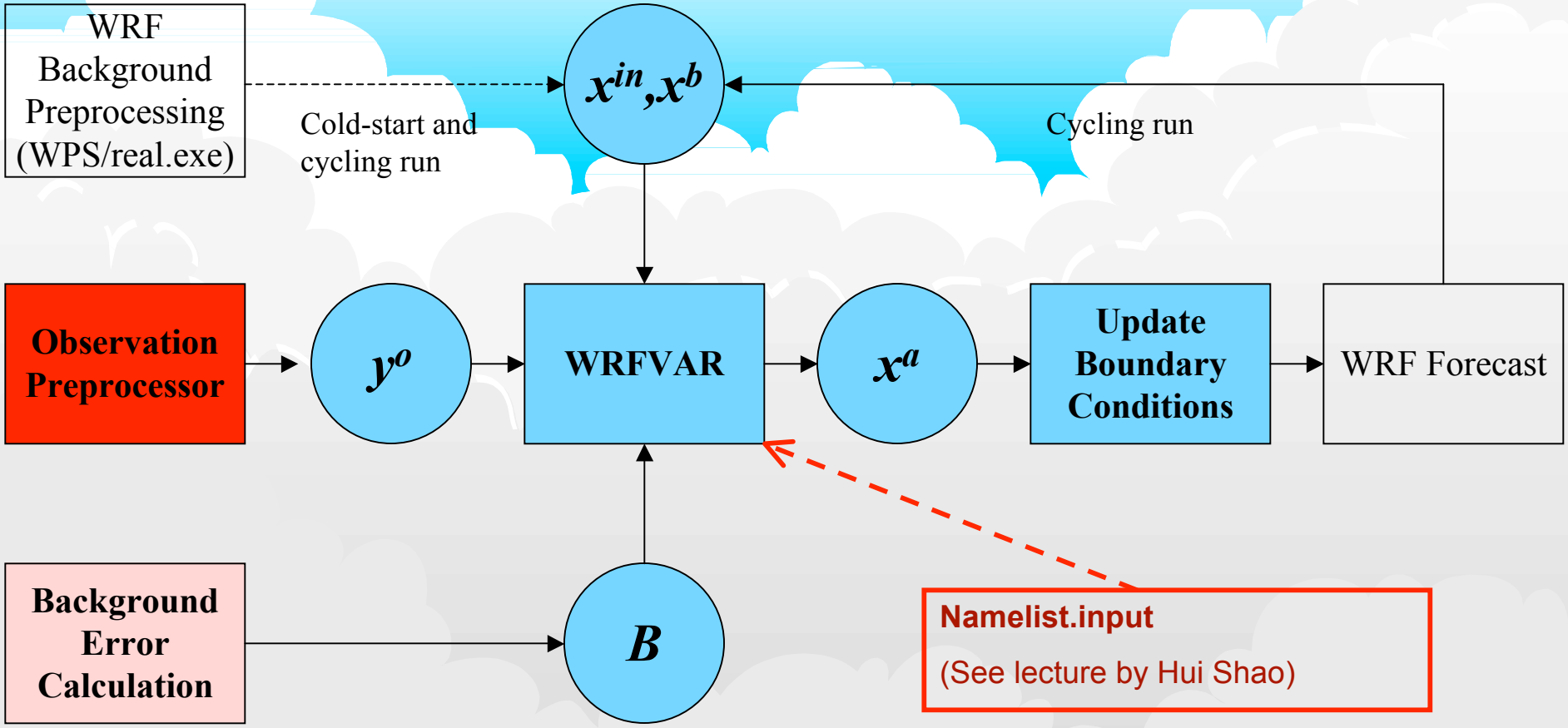
Thanks to everyone in NCAR/MMM/WRFDA group, especially to Hui-Chuan Lin, Zhiquan Liu, Hans Huang, and Jim Bresch

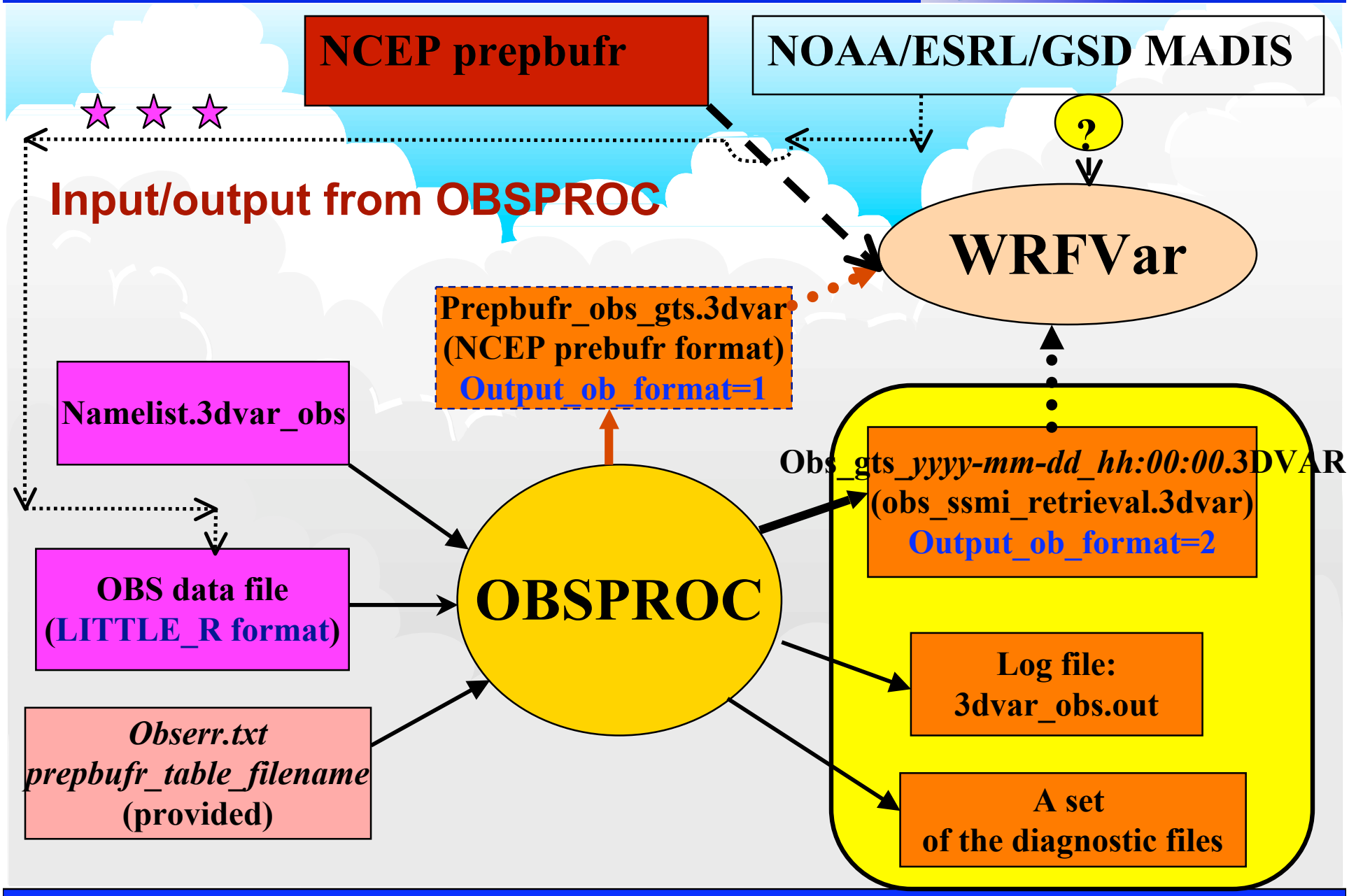
obsproc and WRFVar

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.

* In certain cases, no obs WRF-Var run is still useful (e.g. using *RIP4 diff* to plot increments when cycling run conducted).


NCEP prepbufr
NOAA/ESRL/GSD MADIS
?
Input/output from OBSPROC
WRFVar
Prepbufr_obs_gts.3dvar
(NCEP prebufr format)
Output_ob_format=1
Namelist.3dvar_obs
Obs_gts_yyyy-mm-dd_hh:00:00.3DVAR
(obs_ssmi_retrieval.3dvar)
Output_ob_format=2
OBS data file
(LITTLE_R format)
OBSPROC
Log file:
3dvar_obs.out
Obserr.txt
prepbufr_table_filename
(provided)
A set
of the diagnostic files

Sources of the Observation data

There are 3 observation data sources available:

- NCEP prepbufr files: real-time and archived;

Not fully tested (ob_format=1)

- NOAA/ESRL/GSD MADIS files: real-time and archived;

Not fully tested (ob_format=3 ?)

- **NCAR archived observation data files (LITTLE_R format) via obsproc (ob_format=2)**

The impact of the different observation data sources on the final analysis should be investigated.

prepbufr observation data from NCEP ftp site:

You can download the NCEP real-time prepbufr observation data from

ftp://ftp.ncep.noaa.gov/pub/data/nccf/com/gfs/prod/

The NCEP GDAS archived prepbufr data can be downloaded from

http://nomads.ncdc.noaa.gov/data/gdas

Or you can download the archived prepbufr observation data from NCAR MSS:

mss:/LIUZ/GDAS/*yyyymm*/*yyyymmddhh*/gdas1.t*hh*z.prepbufr.unblok.nr
(using var/obsproc/lib/cwordsh/cwordsh to add the blocking informationto the BUFR file in the little-endian (Linux/PGI) system) or

mss:/LIUZ/GDAS/*yyyymm*/*yyyymmddhh*/gdas1.t*hh*z.prepbufr.nr
(can be directly used in big-endian machine, such as IBM)

The archived data are available starting from **20060718Z** to date, every 6 hours.

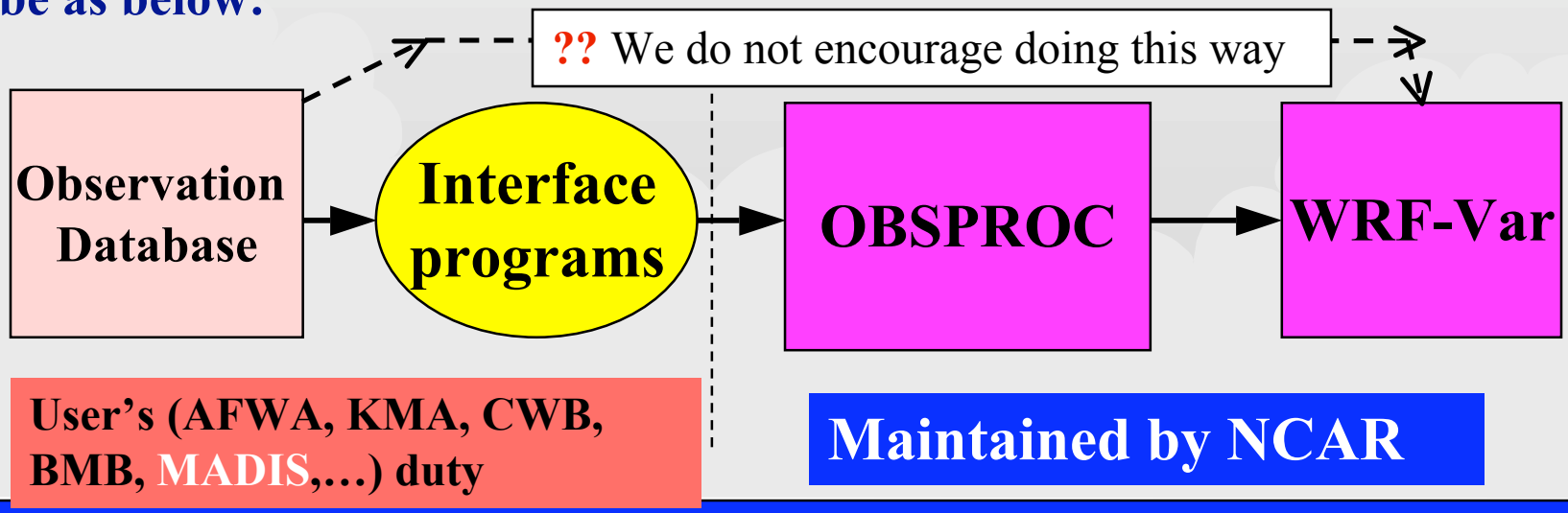
NOAA/ESRL/GSD MADIS (files available back to July 1, 2001)

The interface program to ingest the MADIS data to WRF-Var was developed by Michael F. Barth, NOAA/GSD. The information for MADIS data can be found from

http://madis.noaa.gov/

NCAR is merging the code to WRFDA released code as ob_format=3, but it is still in testing.

The better way to ingest OBS data from a database to WRF-Var should be as below:



NCAR archived observation files

- The NCEP ADP observation data (upper air from **20 December 1972** to 28 February 2007 and surface data from **10 February 1975** to 28 February 2007) may also be downloaded.
  http://www.mmm.ucar.edu/mm5/mm5v3/data/free_data.html

Then use a MM5 utility FETCH (http://www.mmm.ucar.edu/mm5/src/) to convert these ADP data to **LITTLE_R** format data (Recently we did not try this procedure, and not sure if it is still working properly).

- Conventional **LITTLE_R** observation data can also be downloaded from NCAR MSS:

  mss:/BRESCH/RT/DATA/*yyyymm*/obs.*yyyymmddhh*.gz (available starting from **2003040800Z**, every 6 hours)

  mss:/RTFCST/ARCHIVE/RAIN/init.*yyyymmddhh*.tar (available starting from **1999012400Z to 2004072612Z**, every 12 hours)

WRFDA/obsproc for the LITTLE_R observation file

The purpose of obsproc:

to ingest the *intermediate format (LITTLE_R)* OBS data file and prepare the *OBS data file suitable for WRF-Var* needs (3DVAR, FGAT, 4DVAR, etc.)

Basic function of the obsproc:

- Screening of the conventional observations (time window, domain, duplication, etc.), and keep the necessary information for WRF-Var assimilation
- Assign the observation errors to each of the observations
- Do the basic quality control (gross check and consistent check)
- Save *a processed OBS file*, which can be repeatedly used for multiple times of WRF-Var experiments.

  ** to avoid to use any of the model meteorological fields in obsproc.

Input obs file: LITTLE_R format

- The ***input file*** to 3DVAR_OBSPROC is the LITTLE_R format (see below)

  This is a ***report-based*** file, so all types of the observation data can be easily '*cat*'ted together to form a monolithic file, which is an ASCII file and easily to read, edit,…..

- Users' duty is just to develop an interface program to convert their own observations in any format to the LITTLE_R(ASCII) file. The LITTLE_R obs file can be processed by OBSPROC, and an observation file suitable for WRFVar assimilation will be produced.

- The available observation data in LITTLE_R format have the longest archive history: upper air since 1972, and surface since 1975.

Structure of the input OBS (LITTLE_R) file

- *OBS decoded file* in LITTLE_R format is composed of the *Reports*
- *Report* is composed of the *Records (header, data,…, and ending)* *and 3 tail integers* (3I7): -888888-888888-888888
- *Record* is compsed of the *fields*
  - The *fields* in the *header record* (Fortran format in parenthesis)
  - The *fields* in the *data record* (Fortran format in parenthesis)
  - The *fields* in the *ending record*

The details for each of *records* are described below:

The fields in the header record:

No	Field	No	Filed	No	Field
1	Latitude (f20.5)	2	Longitude (f20.5)	3	ID (a40)
4	Name (a40)	5	Platform (a40)	6	Source (a40)
7	Elevation (f20.5)	8	Num_vld_fld (i10)	9	Num_error (i10)
10	Num_warning (i10)	11	Seq_num (i10)	12	Num_dupd (i10)
13	Is_sound (L10)	14	Bogus (L10)	15	Discard (L10)
16	Valid_time%sut (i10)	17	Valid_time%julian (i10)	18	Valid_time%date_char(a20)
19	Slp%data (f13.5)	20	Slp%qc (i7)	21	Ref_pres%data (f13.5)
22	Ref_pres%qc (i7)	23	Ground_t%data (f13.5)	24	Ground_t%qc (i7)
25	SST%data (f13.5)	26	SST%qc (i7)	27	Psfc%data (f13.5)
28	Psfc%qc (i7)	29	Precip%data (f13.5)	30	Precip%qc (i7)
31	T_max%data (f13.5)	32	T_max%qc (i7)	33	T_min%data (f13.5)
34	T_min%qc (i7)	35	T_min_night%data (f13.5)	36	T_min_night%qc (i7)
37	P_tend03%data (f13.5)	38	P_tend03%qc (i7)	39	P_tend24%data (f13.5)
40	P_tend24%qc (i7)	41	Cloud_cvr%data (f13.5)	42	Cloud_cvr%qc (i7)
43	Celling%data (f13.5)	44	Celling%qc (i7)	45	Pw%data (f13.5)
46	Pw%qc (i7)	47	Tb19v%data (f13.5)	48	Tb19v%qc (i7)
49	Tb19h%data (f13.5)	50	Tb19h%qc (i7)	51	Tb22v%data (f13.5)
52	Tb22v%qc (i7)	53	Tb37v%data (f13.5)	54	Tb37v%qc (i7)
55	Tb37h%data (f13.5)	56	Tb37h%qc (i7)	57	Tb85v%data (f13.5)
58	Tb85v%qc (i7)	59	Tb85h%data (f13.5)	60	Tb85h%qc

The fields in the data record (Fortran format in parenthesis)

No	Field	No	Field
1	Pressure%data (f13.5)	2	Pressure%qc (i7)
3	Height%data 9f13.5)	4	Height%qc (i7)
5	Temperature%data (f13.5)	6	Temperature%qc (i7)
7	Dew_point%data (f13.5)	8	Dew_point%qc (i7)
9	Speed%data (f13.5)	10	Speed%qc (i7)
11	Direction%data (f13.5)	12	Direction%qc (i7)
13	U%data (f13.5)	14	U%qc (i7)
15	V%data (f13.5)	16	V%qc (i7)
17	RH%data (f13.5)	18	RH%qc (i7)
19	Thickness%data (f13.5)	20	Thickness%qc (i7)

The fields in the ending record

No	field	No	field	No	field	No	field
1	-777777.00000	2	0	3	-777777.00000	4	0
5	-888888.00000	6	0	7	-888888.00000	8	0
9	-888888.00000	10	0	11	-888888.00000	12	0
13	-888888.00000	14	0	15	-888888.00000	16	0
17	-888888.00000	18	0	19	-888888.00000	20	0

Remarks

1.The tail fields in the header record are not need to be all filled in. For example, if no SSMI Tb (brightness temperature) available, the header record may only have 46 fields.

2.For certain type of observations, the some of the fields in data record are just used as the storage, not the actual data as the field's name. For example, for QuikScat SeaWind, the fields: U%data and V%data are used to store the observation errors of speed and direction, respectively.

3.For certain types of observations, such as GPSREF, etc., the observation data are not the wind, temperature, moisture, etc., so specific arrangements are made with the fields to hold the refractivity, perigee point location, etc.

GPS RO data format

Content of the level record in little_r file:

Press.	Geo height	Temp.	Dew-p	speed	Dir.	u	v	rh	thick
Miss.	height	miss	Refractivity	Impact parameter	Azimuth angle	latitude	longitude	Bending angle	Opt. bending

The units of parameters for GPSRO data in little_r file:

press	latitude	longitude	height	temp	Refractivity	Azimuth angle	Impact parameter *1.e-3	Bending angle*1.e7
Ref. Atmos	N	E	m	miss	N	Deg.		rad

Output from WRFDA/var/obsproc

1. NCEP *prepBUFR* format (not fully tested yet!)

In obsproc namelist.3dvar_obs

&record9

prepbufr_output_filename='*prepbufr_obs_gts.3dvar*'

prepbufr_table_filename='*prepbufr_table_filename*'

output_ob_format=1 (or 3)

In WRFVar namelist.input,

&wrfvar3

ob_format=1,

The prepbufr file is a binary file, and an endian dependent file. See

http://www.nco.ncep.noaa.gov/sib/decoders/BUFRLIB/toc/cwordsh/

2, ASCII format --- Easy to manipulate: read, edit, etc. and *endian* independent (fully supported)

In obsproc namelist.3dvar_obs

&record9

output_ob_format=2 (or 3)

```
;     Select the obs_gts (ASCII) files used for 3DVAR, FGAT,
        and 4DVAR:
 use_for             = '3DVAR',  ; '3DVAR' obs file, same as
                                 before, default
                                 ; 'FGAT ' obs files for FGAT
                                 ; '4DVAR' obs files for 4DVAR
;      num_slots_past and num_slots_ahead are used ONLY for
FGAT     and 4DVAR:
num_slots_past    = 3, ; the number of time slots before
                         time_analysis
num_slots_ahead   = 3, ; the number of time slots after
                         time_analysis
```

In WRFVar namelist.input,

&wrfvar3

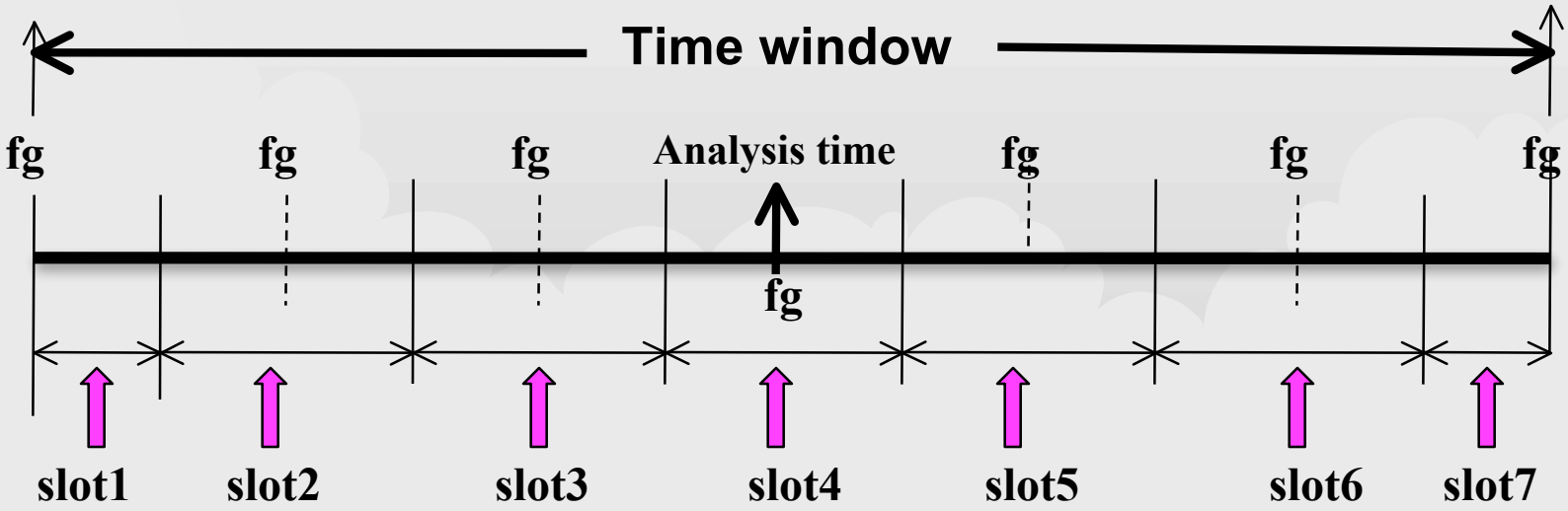
ob_format=2,

3DVAR, FGAT, and 4DVAR have the different requirements:

3DVAR ---- not allowed the time duplicate observation ***within time window***

FGAT ---- multiple time slots within the time window, but not allowed the time duplicate observation ***within time window***
(First Guess at Appropriate Time)

4DVAR ---- multiple time slots within the time window, but not allowed the time duplicate observation ***within time slots***.



Output filenames for WRFVar

For 3DVAR,

obs_gts_yyyy-mm-dd_hh:00:00.3DVAR

For FGAT,

obs_gts_yyyy-mm-dd_hh:00:00.FGAT

For 4DVAR,

obs_gts_yyyy-mm-dd_hh:00:00.4DVAR

1, Obs_gts_yyyy-mm-dd_hh:00:00.3DVAR 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

2, 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

3, Diagnostic files depended on the print switches in namelist

3dvar_obs.exe >&! 3dvar_obs.out

File: *obs_gts_yyyy-mm-dd_hh:00:00.3DVAR*

```
TOTAL =   8169, MISS. =-888888.,
SYNOP =   1432, METAR =    164, SHIP  =     86, BUOY  =      0, TEMP  =    179, AMDAR =      0,
AIREP =    265, PILOT =      0, SATEM =      0, SATOB =   6043, GPSPW =      0, SSMT1 =      0,
SSMT2 =      0, TOVS  =      0, QSCAT =      0, PROFL =      0, OTHER =      0,
PHIC  =  28.50, XLONC = 116.00, TRUE1 =  10.00, TRUE2 =  45.00, XIM11 =   1.00, XJM11 =   1.00,
TS0   = 275.00, TLP   =  50.00, PTOP  =  7000., PS0   =100000.,
IXC   =     67, JXC   =     81, IPROJ =      1, IDD   =      1, MAXNES=     10,
NESTIX=     67,     67,     67,     67,     67,     67,     67,     67,     67,     67,
NESTJX=     81,     81,     81,     81,     81,     81,     81,     81,     81,     81,
NUMC  =      1,      1,      1,      1,      1,      1,      1,      1,      1,      1,
DIS   = 135.00,   0.00,   0.00,   0.00,   0.00,   0.00,   0.00,   0.00,   0.00,   0.00,
NESTI =      1,      1,      1,      1,      1,      1,      1,      1,      1,      1,
NESTJ =      1,      1,      1,      1,      1,      1,      1,      1,      1,      1,
INFO  = PLATFORM, DATE, NAME, LEVELS, LATITUDE, LONGITUDE, ELEVATION, ID.
SRFC  = SLP, PW (DATA,QC,ERROR).
EACH  = PRES, SPEED, DIR, HEIGHT, TEMP, DEW PT, HUMID (DATA,QC,ERROR)*LEVELS.
INFO_FMT = (A12,1X,A19,1X,A40,1X,I6,3(F12.3,11X),6X,A5)
SRFC_FMT = (F12.3,I4,F7.2,F12.3,I4,F7.2)
EACH_FMT = (3(F12.3,I4,F7.2),11X,3(F12.3,I4,F7.2),11X,1(F12.3,I4,F7.2)))
#------------------------------------------------------------------------------#
FM-35 TEMP   1999-08-19_11:00:00  AHMADABAD / INDIA                17     23.070          72.630          55.000          42647
 -888888.000 -88 200.00 -888888.000 -88   0.20
  100000.000   0 100.00      3.000   0   1.10    225.000   0   5.00          53.000   0   7.00    305.550   0   1.00    298.550   0   1.00          65.984   0  15.00
   92500.000   0 100.00      3.000   0   1.10    220.000   0   5.00         745.000   0   7.48    300.550   0   1.00    295.550   0   1.00          73.714   0  12.60
   91600.000   0 100.00 -888888.000 -88   1.10 -888888.000 -88   5.00         830.000   0   7.54    300.150   0   1.00    295.150   0   1.00          73.653   0  12.30
   87300.000   0 100.00 -888888.000 -88   1.10 -888888.000 -88   5.00        1251.000   0   7.84    297.350   0   1.00    291.350   0   1.00          68.712   0  10.82
   85000.000   0 100.00      6.000   0   1.10    250.000   0   5.00        1498.000   0   8.00    295.350   0   1.00    290.750   0   1.00          74.809   0  10.00
   79200.000   0 100.00 -888888.000 -88   1.13 -888888.000 -88   5.00        2104.000   0   8.22    290.750   0   1.00    288.550   0   1.00          86.755   0  10.00
   78000.000   0 100.00 -888888.000 -88   1.18 -888888.000 -88   5.00        2238.000   0   8.27    292.950   0   1.00    281.950   0   1.00          48.599   0  10.00
   70700.000   0 100.00 -888888.000 -88   1.39 -888888.000 -88   5.00        3076.000   0   8.57    289.950   0   1.00    268.950   0   1.00          23.245   0  10.00
   70000.000   0 100.00      2.000   0   1.40     30.000   0   5.00        3168.000   0   8.60 -888888.000 -11   1.00 -888888.000 -11   1.00    -888888.000 -11  10.00
   61100.000   0 100.00 -888888.000 -88   1.76 -888888.000 -88   5.00        4312.000   3  10.01    282.350   0   1.00    271.350   0   1.00          45.937   0  10.00
   60000.000   0 100.00 -888888.000 -88   1.80 -888888.000 -88   5.00        4463.000   3  10.20    281.350   0   1.00    272.350   0   1.00          52.920   0  10.00
   57400.000   0 100.00 -888888.000 -88   1.90 -888888.000 -88   5.00        4828.000   3  10.66    279.150   0   1.00    274.150   0   1.00          70.188   0  10.00
   52700.000   0 100.00 -888888.000 -88   2.14 -888888.000 -88   5.00        5526.000   3  11.55    275.550   0   1.00    272.650   0   1.00          81.128   0  10.00
   50300.000   0 100.00 -888888.000 -88   2.28 -888888.000 -88   5.00        5902.000   3  12.04    273.350   0   1.00    269.650   0   1.00          76.187   0  10.00
   50200.000   0 100.00 -888888.000 -88   2.29 -888888.000 -88   5.00        5918.000   3  12.06    273.150   0   1.00    269.450   0   1.00          76.157   0  10.00
   50000.000   0 100.00      3.000   0   2.30     95.000   0   5.00        5950.000   0  12.10    272.850   0   1.00    269.250   0   1.00          76.682   0  10.00
   46900.000   0 100.00      2.000   0   2.42    100.000   0   5.00        6461.000   3  12.90    270.450   0   1.00    266.250   0   1.00          72.904   0  10.00
FM-35 TEMP   1999-08-19_11:00:00  BOMBAY / SANTACRUZ / INDIA              25     19.120          72.850          14.000          430
.....
```

# of observations

Model domain information

Data format

Types of observations to be processed

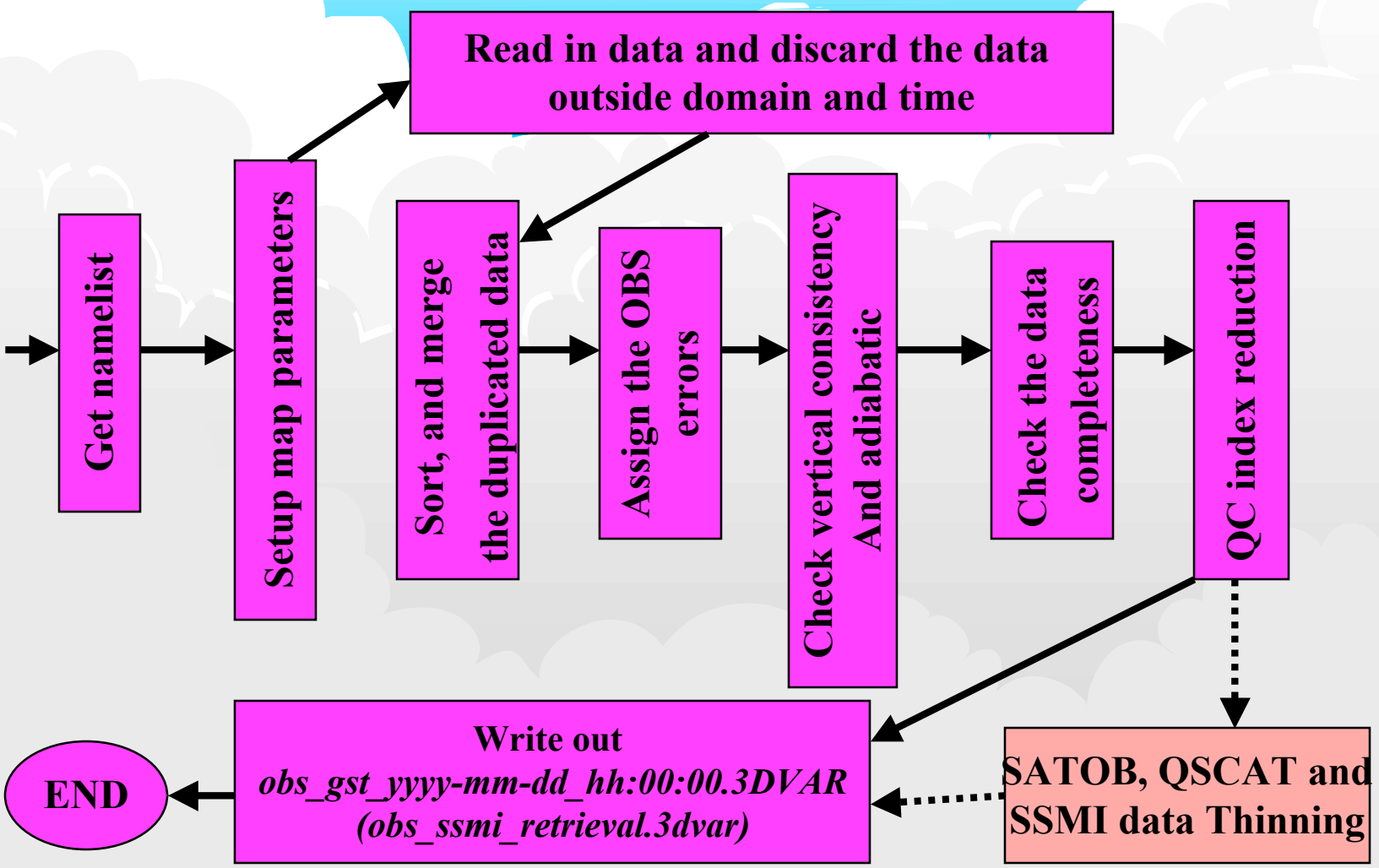
→18 types (SYNOP, SHIPS, METAR, TEMP , AIREP, PILOT , AMDAR, PROFL, SATOB, SATEM, SSMT1, SSMT2, SSMI, GPSPW/GPSZD, GPSRF, QSCAT, BOGUS)

Each type of the observations is identified by its WMO code in WRF-Var. If the standard WMO code is not available to a new data type, user should assign a 3-digit code to that data type.

WMO code for each type of observations

No.	Name	WMO code	WMO code name
1	SYNOP	12, 14	SYNOP, SYNOP MOBIL
2	SHIP	13	SHIP
3	METAR	15, 16	METAR, SPECI
4	PILOT	32, 33, 34	PILOT, PILOT SHIP, PILOT MOBIL
5	SOUND	35, 36, 37, 38	TEMP, TEMP SHIP, TEMP DROP, TEMP MOBIL
6	AMDAR	42	AMDAR
7	SATEM	86	SATEM
8	SATOB	88	SATOB
9	AIREP	96, 97	AIREP
10	GPSPW	111	GPSPW (Ground-based GPS precipitable water)
11	GPSZD	114	GPSZD (Ground-based GPS Zenith Total Delay)
12	GPSRF	116	GPSRF (Space-based GPS Refractivity)
13	SSMT1	121	SSMT1
14	SSMT2	122	SSMT2
15	SSMI	125	SSMI
16	PROFL	132	WIND PROFILER
17	BOGUS	135	TCBOU (Typhoon bogus), BOGUS (other bogus)
18	QSCAT	281	Quik SCAT level-2B SeaWind
19	OTHER		UNKNOWN

Flow chart of OBS preprocessor



Tasks of the OBS preprocessor: obsproc

1, To perform a time-windowed and, in case of regional application (domain_check_h = .TRUE.), geographically-filtered dump of the ingested observations

Currently, there is *no time-check for observation data in WRF-Var assimilation code*, so to select the observation data within a suitable time-window must be performed in OBSPROC.

For the regional application with the IPROJ = 1 (Lambert conformal), 2 (Polar Stereographic), or 3 (Mercator), there is a geographic-filtered performed based on the model domain settings. For the global application of WRF-Var, it should set IPROJ = 0 and no geographic-filtered is performed.

Gross check during the data ingestion:

Any mistakes (unexpected, no logical,…) could be happened in the raw observation data, the data screening through the gross check is a tedious work.

- Ignore the data with the invalid WMO code.
- Any data values in header record > 888887 or < -888887 or pressure%data <= 0.0, etc., will be regarded as missing.
- Elevations for SHIP and BUOY data outside the Great Lakes are always set to zero. If the pressure < 85,000 Pa for SHIP and BUOY, the data are tossed out.
- Gross pressure/height consistent check based on the reference atmosphere defined by namelist variables: base_pres, base_temp, and base_lapse
- If both pressure and height are missing, the whole data are discarded.
- ……

Tasks of the OBS preprocessor: 3DVAR_OBSPROC (cont.)

2, Sort and merge the duplicated data

- To retrieve the pressure or height based on the observed information with the hydrostatic assumption

- To remove the duplicate reports of observations:

  for 3DVAR and FGAT only observations ***nearest to the analysis time*** are kept,

  for 4DVAR, the observations ***nearest to the central time of each of the time slots*** are kept.

- To re-order (from bottom to top) and merge the data reports with the same ***platform, time, and location*** based on the pressure.

Tasks of the OBS preprocessor: 3DVAR_OBSPROC (cont.)

3, To assign the observation errors to the different types of observations

Sources of the observations errors:

→ Directly from the observation reports (GPS PW/ZTD, QSCAT,etc.)

→ US Air Force (AFWA) OBS error file: *obserr.txt*

→ NCEP OBS error (Parrish and Derber 1992)

4, To perform the quality control (QC) for soundings

- Vertical consistency check: super adiabatic check and wind shear check (qc_test_vert_consistency=.true.)
- Dry convective adjustment (qc_test_convecctive_adj =.true.)
- To discard the data above the model top ($p<p_{top}$) in the upper-air observations (remove_above_lid = .true.)

Tasks of the OBS preprocessor: 3DVAR_OBSPROC (cont.)

8, To complete thinning with the *SATOB, SSMI,* and *QSCAT* data

The data points nearest to the model grid-points will be picked up for assimilation for SATOB, SSMI, and QSCAT.

9, To write out the OBS files in ASCII format as the WRF-Var input

→ GTS data (*obs_gts_yyyy-mm-dd_hh:00:00.3DVAR*): pressure, Wind, height, temperature, dew-point, RH, thickness, etc.

→ SSMI data (*obs_ssmi_retrieval.3dvar*): PW and surface wind speed

10, To plot the distribution for each type of observations

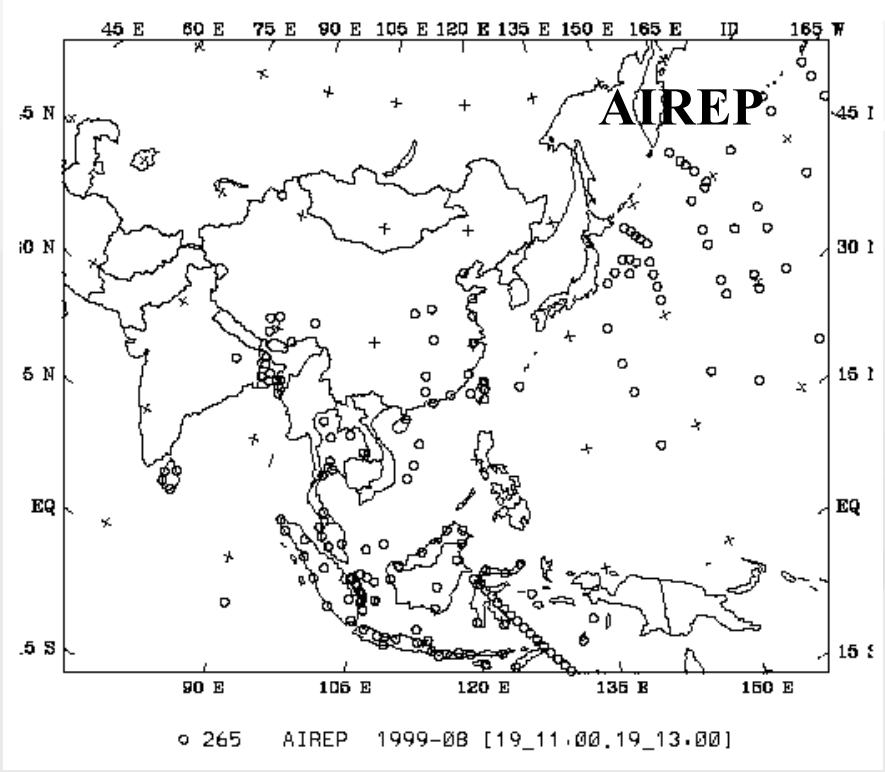
→MAP_plot

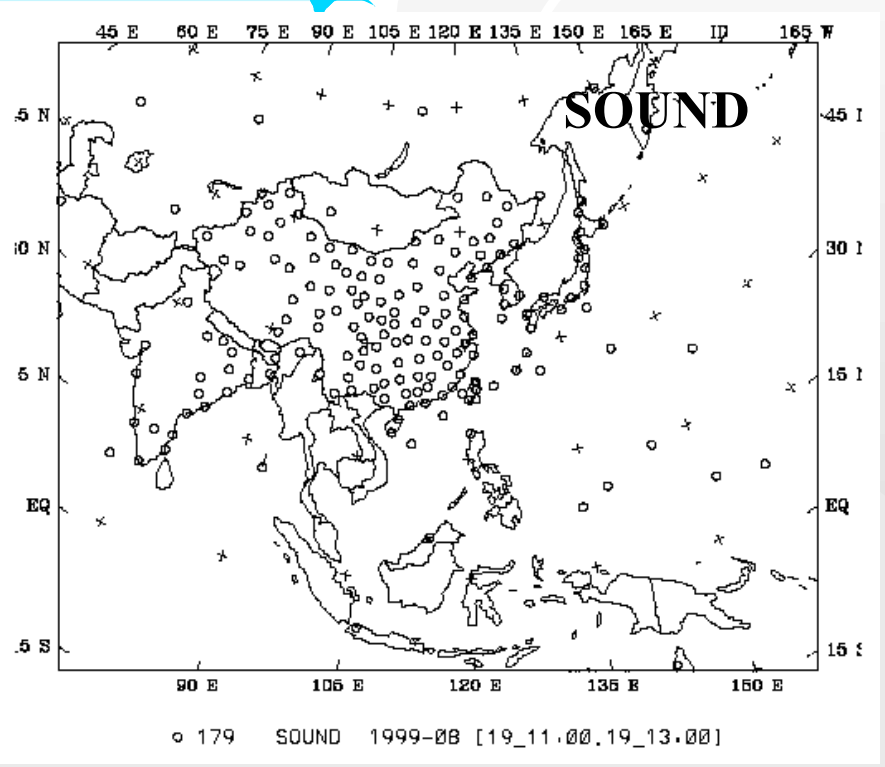
How to plot the OBS distribution?

- Go to the directory WRFDA/*var/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.

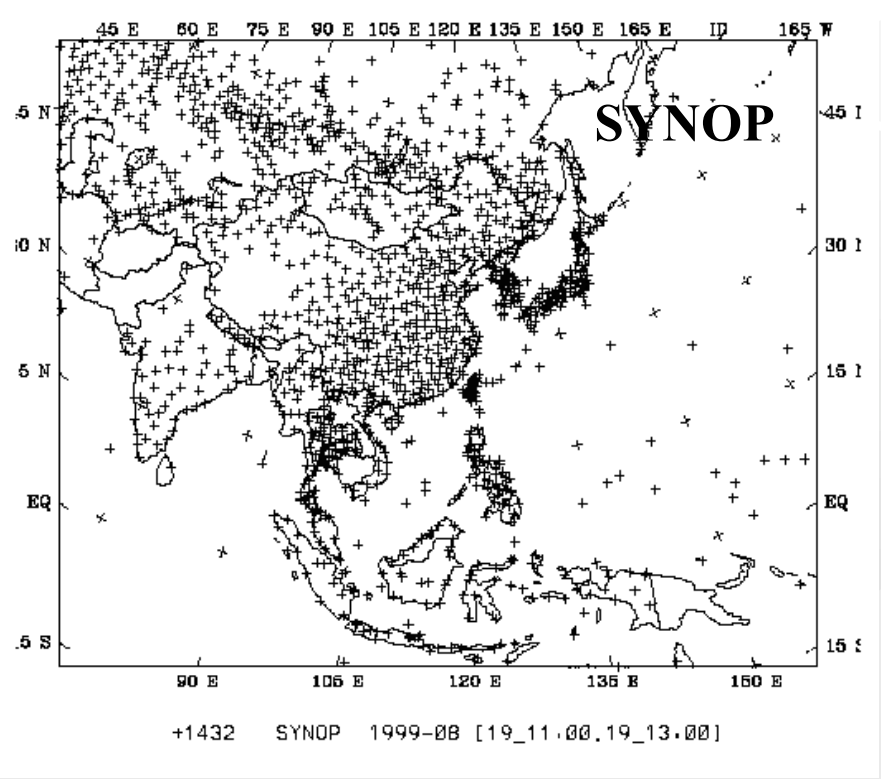
Or copy the *Map.csh* from WRFDA/*var/obsproc/MAP_plot* to your working directory, edit it, and run it.

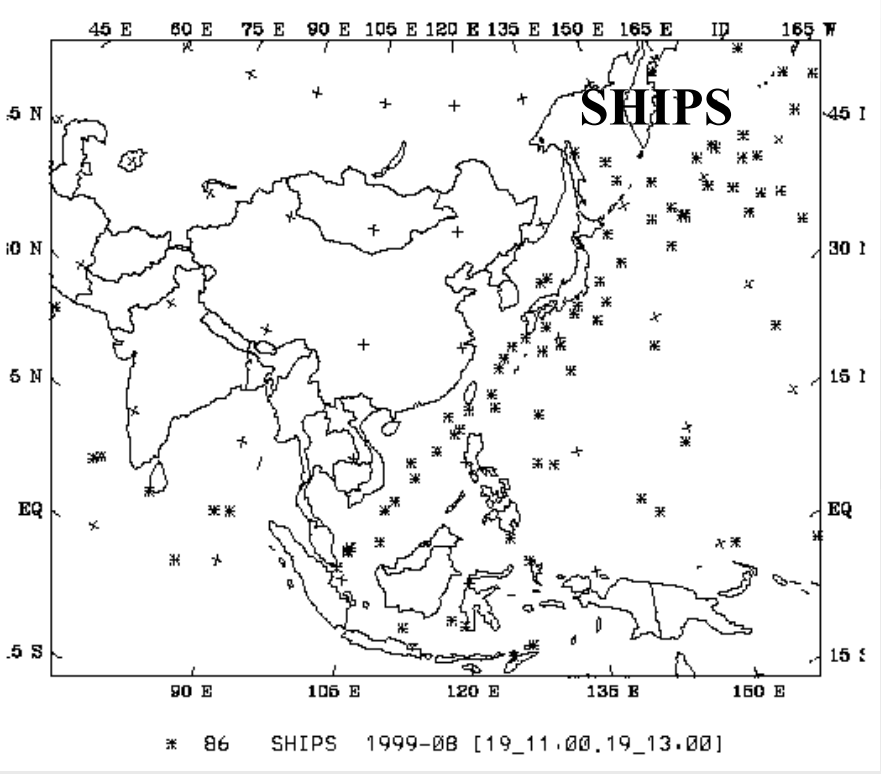
Distribution for each type of observations



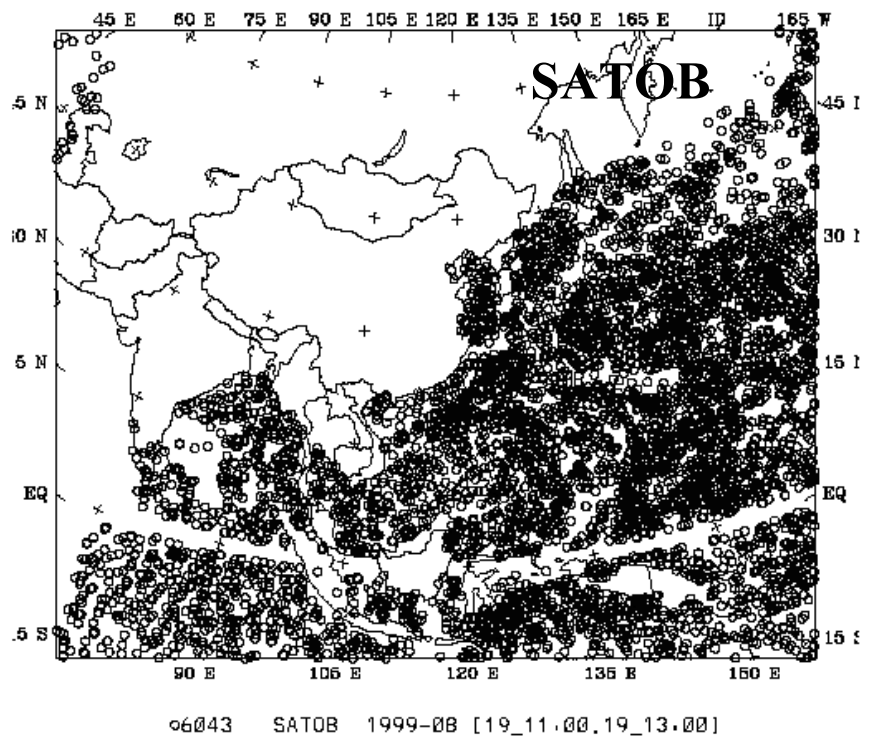


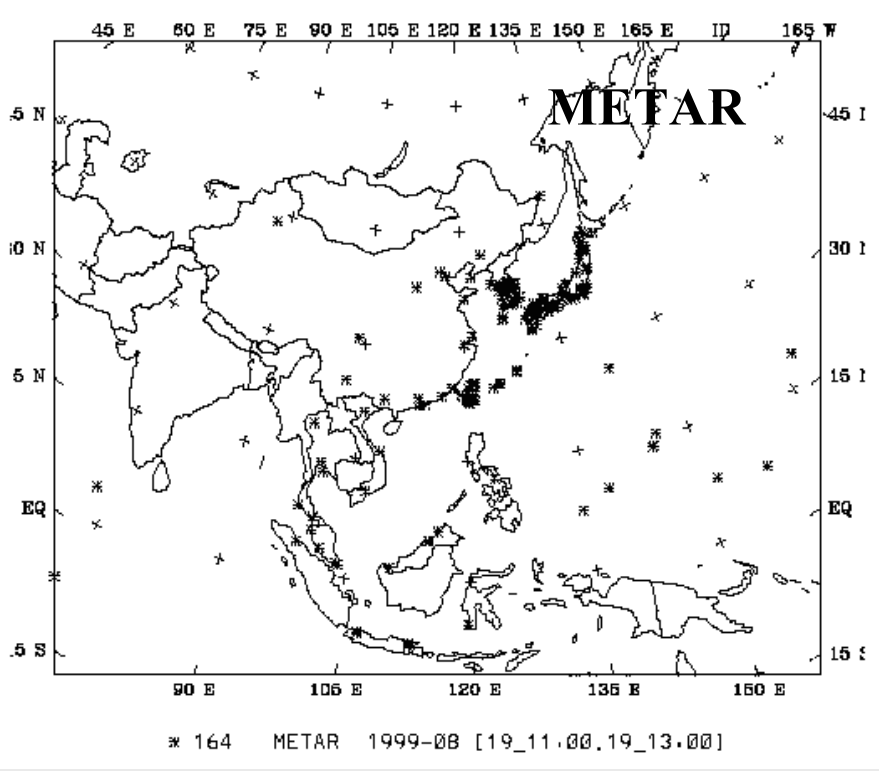
Distribution for each type of observations





Distribution for each type of observations





Introduction to run *obsproc*

- Compiling the obsproc

  cd /wrfhelp/SOURCE_CODE/WRFDA/var/obsproc

  make

- **Edit the namelist.3dvar_obs**

  ***OBS data file**: /wrfhelp/DATA/VAR/Con200/ob/2007010200/ob.little_r*

  /wrfhelp/SOURCE_CODE/WRFDA/var/obsproc 3dvar_obs.exe >&! 3dvar_obs.out

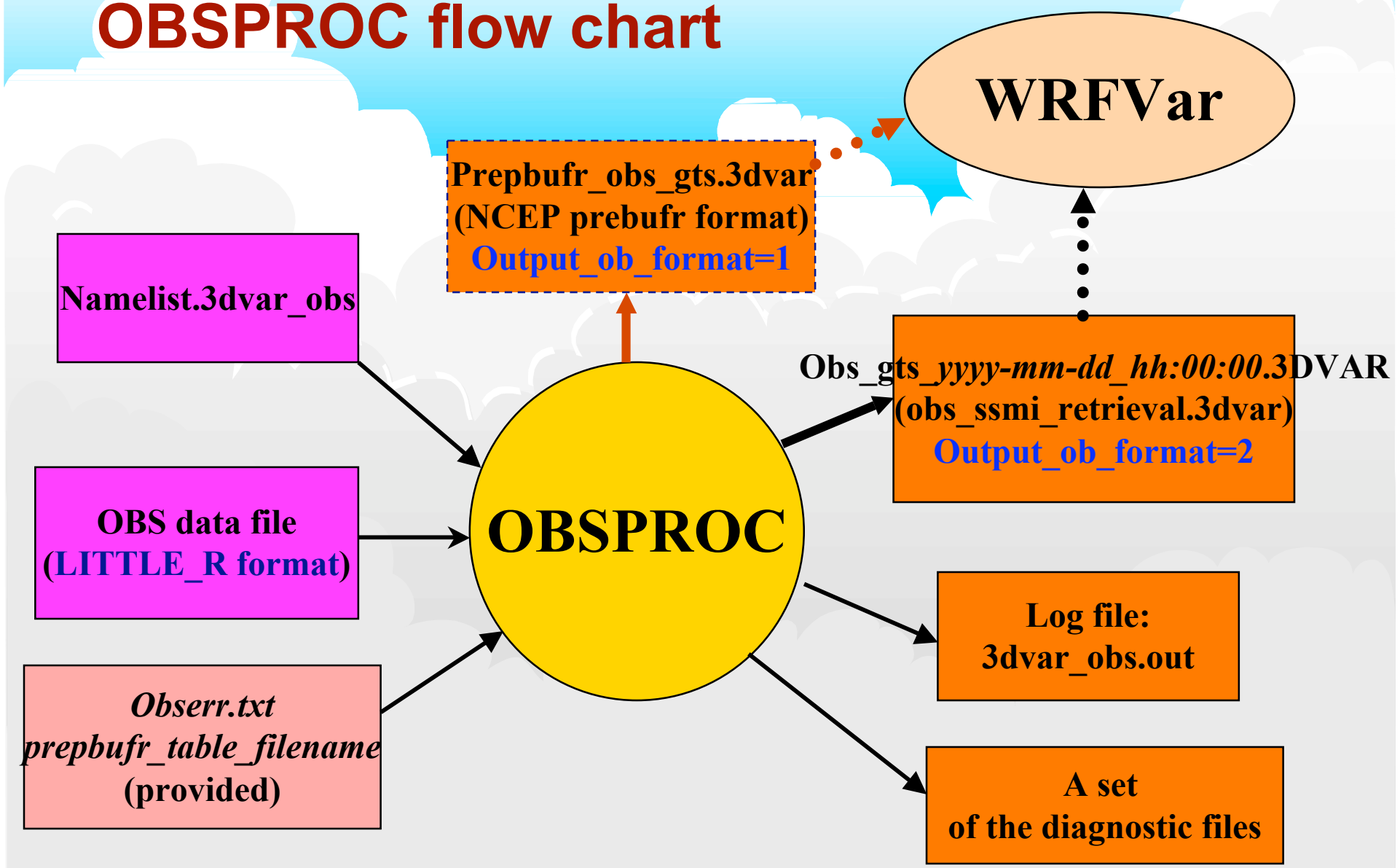
- Plot the horizontal distribution of the observations

  cp /wrfhelp/SOURCE_CODE/WRFDA/var/obsproc MAP_plot/Map.csh Map.csh

  edit MAP.csh

  Map.csh

OBSPROC flow chart



Input files for OBS preprocessor (obsproc)

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
Record9: Output format: prebufr, ascii, or both

- AFWA OBS errors file: *obserr.txt* (provided by 3DVAR system)
- Prebufr table file: *prepbufr_table_filename* (used only for output_ob_format=1 or 3)

OBSPROC namelist variables.

&record1

obs_gts_filename	name and path of decoded observation file
fg_format	'MM5' for MM5 application, 'WRF' for WRF application
obserr.txt	name and path of observational error file
first_guess_file	name and path of the first guess file (Only for MM5 application)

&record2

time_window_min	Beginning of time window (included) as ccyy-mm-dd_hh:mn:ss
time_analysis	Ananlysis time as ccyy-mm-dd_hh:mn:ss
time_window_max	End of time window (included) as ccyy-mm-dd_hh:mn:ss ** Note : Only observations between [time_window_min, time_window_max] will kept.

&record3

max_number_of_obs	Maximum number of observations to be loaded, ie in domain and time window, this is independent of the number of obs actually read.
fatal_if_exceed_max_obs	.TRUE.: will stop when more than max_number_of_obs are loaded .FALSE.: will process the first max_number_of_obs loaded observations.

&record4

qc_test_vert_consistency	.TRUE. will perform a vertical consistency quality control check on sounding
qc_test_convective_adj	.TRUE. will perform a convective adjustment quality control check on sounding
qc_test_above_lid	.TRUE. will flag the observation above model lid
remove_above_lid	.TRUE. will remove the observation above model lid
domain_check_h	.TRUE. will discard the observations outside the domain
Thining_SATOB	.FALSE.: no thinning for SATOB data. .TRUE.: thinning procedure applied to SATOB data.
Thining_SSMI	.FALSE.: no thinning for SSMI data. .TRUE.: thinning procedure applied to SSMI data.
Thining_QSCAT	.FALSE.: no thinning for SATOB data. .TRUE.: thinning procedure applied to SSMI data.

&record6

x_left	West border of sub-domain, not used
x_right	East border of sub-domain, not used
y_bottom	South border of sub-domain, not used
y_top	North border of sub-domain, not used
ptop	Reference pressure at model top
ps0	Reference sea level pressure
base_pres	Same as ps0. User must set either ps0 or base_pres.
ts0	Mean sea level temperature
base_temp	Same as ts0. User must set either ts0 or base_temp.
tlp	Temperature lapse rate
base_lapse	Same as tlp. User must set either tlp or base_lapse.
pis0	Tropopause pressure, the default = 20000.0 Pa
base_tropo_pres	Same as pis0. User must set either pis0 or base_tropo_pres
tis0	Isothermal temperature above tropopause (K), the default = 215 K.
base_start_temp	Same as tis0. User must set either tis0 or base_start_temp.

&record7	
IPROJ	Map projection (0 = Cylindrical Equidistance, 1 = Lambert Conformal, 2 = Polar stereographic, 3 = Mercator)
PHIC	Central latitude of the domain
XLONC	Central longitude of the domain
TRUELAT1	True latitude 1
TRUELAT2	True latitude 2
MOAD_CEN_LAT	The central latitude for the Mother Of All Domains
STANDARD_LON	The standard longitude (Y-direction) of the working domain.
&record8	
IDD	Domain ID (1=< ID =< MAXNES), Only the observations geographically located on that domain will be processed. For WRF application with XLONC /= STANDARD_LON, set IDD=2, otherwise set 1.
MAXNES	Maximum numbe of domains as needed.
NESTIX	The I(y)-direction dimension for each of the domains
NESTJX	The J(x)-direction dimension for each of the domains
DIS	The grid size for each of the domains. For WRF application, always set NESTIX(1),NESTJX(1), and DIS(1) based on the infomation in wrfinput.
NUMC	The mother domain ID number for each of the domains
NESTI	The I location in its mother domain of the nest domain's low left corner -- point (1,1)
NESTJ	The J location in its mother domain of the nest domain's low left corner -- point (1,1). For WRF application, NUMC(1), NESTI(1), and NESTJ(1) are always set to be 1.

&record9

prepbufr_output_filenam e	Name of the prebufr OBS file.
prepbufr_table_filename	'prepbufr_table_filename' ; not change
output_ob_format	output 1, prebufr OBS file only; 2, ASCII OBS file only; 3, Both prebufr and ASCII OBS files.
use_for	'3DVAR' obs file, same as before, default 'FGAT ' obs files for FGAT '4DVAR' obs files for 4DVAR
num_slots_past	the number of time slots before time_analysis
num_slots_ahead	the number of time slots after time_analysis
write_synop	If keep synop obs in obs_gts (ASCII) files.
write_ship	If keep ship obs in obs_gts (ASCII) files.
write_metar	If keep metar obs in obs_gts (ASCII) files.
write_buoy	If keep buoy obs in obs_gts (ASCII) files.
write_pilot	If keep pilot obs in obs_gts (ASCII) files.
write_sound	If keep sound obs in obs_gts (ASCII) files.
write_amdar	If keep amdar obs in obs_gts (ASCII) files.
write_satem	If keep satem obs in obs_gts (ASCII) files.
write_satob	If keep satob obs in obs_gts (ASCII) files.
write_airep	If keep airep obs in obs_gts (ASCII) files.
write_gpspw	If keep gpspw obs in obs_gts (ASCII) files.
write_gpsztd	If keep gpsztd obs in obs_gts (ASCII) files.
write_gpsref	If keep gpsref obs in obs_gts (ASCII) files.
write_gpseph	If keep gpseph obs in obs_gts (ASCII) files.

write_ssmt1	If keep ssmt1 obs in obs_gts (ASCII) files.
write_ssmt2	If keep ssmt2 obs in obs_gts (ASCII) files.
write_ssmi	If keep ssmi obs in obs_gts (ASCII) files.
write_tovs	If keep tovs obs in obs_gts (ASCII) files.
write_qscat	If keep qscat obs in obs_gts (ASCII) files.
write_profl	If keep profile obs in obs_gts (ASCII) files.
write_bogus	If keep bogus obs in obs_gts (ASCII) files.
write_airs	If keep airs obs in obs_gts (ASCII) files.