

*Regional Cooperation for
Limited Area Modeling in Central Europe*



BATOR

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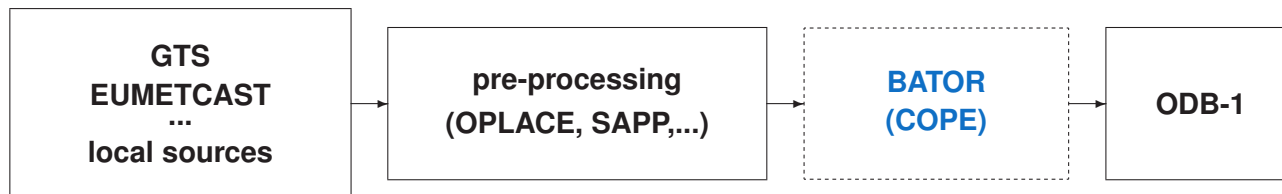


ARSO METEO
Slovenia





- **pre-processing** - preparation for use in NWP (DA, verification, nowcasting, ...)
 - data reception, decoding, conversion to the local database,
 - simple quality control QC, SAF NWC (SEVIRI, AMV),
 - demanding on local installation & maintenance for small NMS



- **pre-processing** - preparation for use in NWP (DA, verification, nowcasting, ...)
 - data reception, decoding, conversion to the local database,
 - simple quality control QC, SAF NWC (SEVIRI, AMV),
 - demanding on local installation & maintenance for small NMS
- **BATOR** - master for conversion observation files to ODB-1 format
 - supported input file formats: ASCII (OBSOUL), BUFR, GRIB, NetCDF, HDF5
 - obs error, eventually other meta-data, assignment
 - selection of instruments & satellite channels
 - pre-filtering of satellite and radar data (e.g. take one pixel out of N, etc.)
 - geographical selection (LAMFLAG)
 - blacklisting
- **COPE** - an alternative tool developed & maintained by ECMWF
- **ODB-1** - dedicated talk

- **Input:**

- **NAMELIST** - main namelist
- **refdata / batormap** - list of all input data files
- **param.cfg** - configuration file for decoding BUFR, NETCDF, HDF5 data
- **[LISTE_NOIRE_DIAP, LISTE_LOC]** - optional blacklist namelists
- **list_gpssol** - extra namelist for GPS data
- **nam_LAMFLAG** - extra namelist for geographical selection
- **ficdate** - timeslot definition file (**deprecated from cy42_op1** replaced by env)

- **Execution is controlled by a set of environmental variables:**

```
export ODB_IO_METHOD=1
export ODB_CMA=database type definition
export IOASSIGN= path to IOASSIGN file - the directory structure of the database
export ODB_SRCPATH_ECMA = the location of ODB sub-bases' description files
export ODB_DATAPATH_ECMA = the location of ODB sub-bases' data files
export BATOR_NBPOOL= the number of the pools in the ODB sub-bases (parallelization)
export BATOR_LAMFLAG= 0/1 geographical selection
# timeslot definitions (mandatory from cy42_op1)
BATOR_NBSLOT BATOR_CENTER_LEN BATOR_WINDOW_LEN BATOR_WINDOW_SHIFT BATOR_SLOT_LEN
```

- **Execution:**

```
./create_ioassign -l$ODB_CMA -n$BATOR_NBPOOL
mpirun -np 1 ./BATOR
```

- **Output: ODB-1**

- supported input file formats: OBSOUL (ASCII), BUFR, GRIB, NETCDF, HDF5
- input data files are defined in **refdata** (deprecated from **cy42_op1**)

```
conv OBSOUL conv $YYYYMMDD $NT  
synop BUFR synop $YYYYMMDD $NT
```

...

- **refdata** is replaced by **batormap**

```
conv conv OBSOUL conv  
conv synop BUFR synop  
conv temp BUFR temp
```

...

	column description of batormap	Type
1	ECMA extension in which data will be stored	up to 8 characters
2	data file name extension	up to 8 characters
3	data file format	up to 8 characters
4	kind of data or instrument (must match kind in <code>bator_initlong()</code>)	up to 16 characters

- corresponding input file names:

```
OBSOUL.conv  
BUFR.synop ...
```

- **OBSOUL (ASCII) - simple (suitable for a new data or a single observation testing)**

- **file format**

date time

rec1

rec2

...

date: *yyyymmdd*

time: *hhmmss*

record: *n header body1 ... bodyk*

	Header Description	Type
1	observation type (obstype@hdr)	integer
2	observation code	integer
3	latitude	real
4	longitude	real
5	station/satellite identification	character
6	date <i>yyyymmdd</i>	integer
7	time <i>hh</i>	integer
8	altitude	real
9	number of parameters (= #bodies)	integer
10	observation quality flags	integer
11	site dependant	integer

	Body Description	Type
1	type of parameter (varno@body)	integer
2	first vertical coordinate	real
3	second vertical coordinate	real
4	observed or measured parameter	real
5	parameter quality flag	integer

Variable	Value	Observation type
NSYNOP	1	SYNOP, SYNOP_SHIP, SYNOR
NAIREP	2	AIREP, AMDAR, ACAR, ...
NSATOB	3	SATOB
NDRIBU	4	DRIBU, DRIFTER, BUOY, BATHY, TESAC
NTEMP	5	TEMP, TEMP-SHIP, TEMP_DROP

- for complete obstype definitions see [obstype.h](#), [yomcoctp.F90](#)

	Value	variable name [unit]	varno_module
NVNUMB(1)	3	u-wind component [m/s]	varno%u
NVNUMB(2)	4	v wind component [m/s]	varno%v
NVNUMB(3)	1	geopotential [J/kg]	varno%z
...			

- for variable definitions see [varno.h](#), [yomvnmb.F90](#), [suvnmb.F90](#), [varno_module.F90](#)

	Value	satellite sensor
INST_ID_HIRS	0	HIRS
INST_ID_AMSUA	3	AMSU-A
...		

- for sensor definitions see [sensor.h](#), [rttov_const.F90](#) ([yomtgrad.F90](#) in older cycles)

BATOR input formats - OBSOUL



Examples of records: n header body1 ... bodyk

SYNOP record:

```
42 1 10000014 50.01700 14.45000 '11520 ' 20100915 90000 304.0000 6 1111 100000
1 -101220.0 1.7000000E+38 0.0000000E+00 2064 39 97680.00 1.7000000E+38 288.8600 2048
58 97680.00 1.7000000E+38 71.00000 2048 7 97680.00 1.1426964E-03 8.0968356E-03 2048
41 97680.00 4.000000 260.0000 2048 91 97680.00 1.7000000E+38 80.00000 2048
```

AMDAR record:

```
22 2 10031144 67.60500 105.87334 LH715 20100915 83400 10600.00 2 11111 0
2 10600.00 1.7000000E+38 229.5000 4111 3 10600.00 6.200000 256.0000 4111
```

TEMP record:

```
897 5 10003035 50.00000 14.45000 '11520 ' 20190107 000000 303.0000 177 11111 0
1 99200.00 1.7000000E+38 2969.400 3680
39 99200.00 1.7000000E+38 272.5000 3680
58 99200.00 1.7000000E+38 96.00000 3680
7 99200.00 5.0914619E-04 3.4909793E-03 3680
41 99200.00 1.000000 245.0000 3680
1 92500.00 1.7000000E+38 8388.800 2560
2 92500.00 1.7000000E+38 269.2900 2560
29 92500.00 1.7000000E+38 100.0000 2560
7 92500.00 4.1719535E-04 2.9799668E-03 2560
3 92500.00 7.000000 340.0000 2560
```


- BUFR - most common format for conventional and satellite observations
- WMO FM 94 BUFR format specification:

http://www.wmo.int/pages/prog/www/WMOCodes/WMO306_vI2/LatestVERSION/LatestVERSION.html

- **NAMELIST**

```
&NADIRS
```

```
InbTypeBufr = 200 # number of BUFR templates to read in param.cfg (default=0)
```

```
/
```

```
&BUFR
```

```
NFREQVERT_TPHR=400, # high-resolution sounding switches
```

```
TEMPSONDSPLIT=.TRUE.,
```

```
NBTEMPMAXLEVELS=8000,
```

```
TS_* # satellite sensor and channel selection. Index matches satellite ID.
```

```
TS_GEOWIND(70)%T_SELECT%CSERIES='MSG',
```

```
TS_GEOWIND(70)%T_SELECT%ICEPCANAL(1:7)=1,2,0,-9,5,-9,3,
```

```
TS_GEOWIND(70)%T_SELECT%LCANAL(1:3)=.TRUE.,.TRUE.,.TRUE.,
```

```
...
```

```
/
```

- export **BUFR_TABLES=..path_to_your_BUFR_tables/**

BATOR (cy43t2) still uses ECMWF emos library & consistent tables have to be used !

e.g. Meteo France uses libbufr_383MF (available within auxlib_installer.2.3)

- HDF5 format is used for OPERA radar data and some satellite data
- OPERA HDF5 format specification:

http://eumetnet.eu/wp-content/uploads/2017/01/OPERA_hdf_description_2014.pdf

- **NAMELIST**

&NADIRS

```
InbTypeHdf5 = 2 # number of HDF5 templates to read in param.cfg (default=0)
```

```
InbTypeNetcdf = 1 # number of NETCDF templates to read in param.cfg (default=0)
```

/

&HDF5

```
HODIM% # type containing required component to pre-process OPERA data
```

```
HMTVZA(:)% # array of MTVZA data type. Index matches satellite ID.
```

/

&NETCDF

```
NSEVIRI(:)%, # array of SEVIRI data type. Index matches satellite ID.
```

/

- **BATOR (cy43t2) requires modules from netcdf (4.4.4) and hdf5 (1.8.16) libraries (hdf5 should be compiled with `-enable-fortran -enable-fortran2003`)**
- for more details see

<http://www.umn-cnrm.fr/gmapdoc/spip.php?article229&lang=en>

- **param.cfg** configuration file to decode BUFR, NETCDF and HDF5 files

```
# STRUCTURE DESCRIPTION :  
# elements inside square brackets are optional & keywords must be written from the first column.  
# BE CAREFUL : this file is case sensitive
```

```
# BEGIN sensor - sensor must be in lowercase with name as defined bator_decodbufr_mod  
# a b c d  
# [codage n1 desc1] - codage is used to check the BUFR file structure with ktldst(),  
# [codage n2 desc2] - desc1... descn = BUFR descriptor FXY (must be unique)  
# ...  
# [codage nn descn]  
# [control n1 val1] - control is used to perform tests like number of channels  
# [control n2 val2] - val1... valn = integer value used as reference for control  
# ...  
# [control nn valn]  
# [offset n1 inc1] - offset defines a value to perform jump  
# [offset n2 inc2] - inc1... incn = integer value used as a jump  
# ...  
# [offset nn1 incn]  
# [values pos1 desc1] - values are descriptors which will be used for decoding BUFR file  
# [values pos1 desc2] - pos1... posn = index in the VALUES array (libemos)  
# ...  
# [values posn descn]  
# END sensor
```

```
# a is the number of 'codage' parameter defined  
# b is the number of 'control' parameter defined  
# c is the number of 'offset' parameter defined  
# d is the number of 'values' parameter defined
```

- **example for BUFR TEMP**

```
BEGIN temp
8 0 1 21
codage 1 309052
codage 2 -001081
codage 3 -001082
codage 4 -002067
codage 5 -002095
codage 6 -002096
codage 7 -002097
codage 8 -025061
offset 1 10
values 1 001001 WMO block number
values 2 001002 WMO station number
values 3 001011 station identifier
values 4 002011 Radiosonde type
values 9 004001 Year
values 15 005001 Latitude (high accuracy)
values 16 006001 Longitude (high accuracy)
...
values 39 011002 Wind speed
END sensor
```

- **param.cfg** configuration file to decode BUFR,NETCDF and HDF5 files
- **unrecognized file (or data content) is rejected** with warnings only !

```
*** INFO - BATOR : File BUFR.geowind prefetched - NbOBS= 32637 NbWag= 65274  
*** INFO - BATOR : reading data from BUFR.geowind
```

```
BUFR TABLES TO BE LOADED B0000000000000012000.TXT,D0000000000000012000.TXT
```

```
* WARNING - BATOR : template inconnu pour fichier N. 1
```

```
310014 222000 236000 101103 31031 1031
```

```
1032 101004 33007 222000 237000 1031
```

```
1032 101004 33035 222000 237000 1031
```

```
1032 101004 33036 222000 237000 1031
```

```
1032 101004 33007 222000 237000 1031
```

```
1032 101004 33035 222000 237000 1031
```

```
1032 101004 33036
```

```
...
```

```
30 not recognised BUFR file as geowind .
```

```
Selected Obs = 0 --> 0 datas.
```

```
Total selected Obs = 0 --> 0 datas.
```

- LISTE_NOIRE_DIAP

```
! format(i2,1x,10x,1x,i3,1x,i3,1x,a8,1x,8x,1x,180a)
1 SYNOP 11 1 02045 03061996
5 TEMPMOBIL 37 58 AMDAR 28032002
6 PROFILER 34 4 70197 01062002
6 PROFILER 34 4 70197 0 PROF2 700 400 1 1 0
6 PROFILER 34 3 70197 0 PROF2 700 400 1 1 1 H06 H18
```

Column	Description	Format
1	Observation type (obstype@hdr)	i2
2	Observation name	a10
3	Observation codetype (codetype@hdr)	i3
4	Parameter ID (varno@body)	i3
5	Station ID (statid@hdr)	a8
6	The starting date of blacklisting yyyymmdd	a8
7	Optional layers blacklisting keyword for PROFn	a180

PROF_n P₁ P₂ ... P_{n-1} I₁ I₂ ... I_{n-1}

- **n** can be at most 9 indicating the involved layers
- **P_i** values specify the bottom and top levels of pressure layers (in hPa).
The first layer is always [1000,P₁]
- **I_i** indicate if blacklisting should be applied (=1) or not (=0) to given layer
- **Hxx** keyword specifies the analysis hour to be blacklisted e.g. H00, H06,...

- **LISTE_NOIRE_DIAP - particularities**
- **blacklisting of certain parameters involves automatic blacklisting of other parameter**

obstype	specified parameter	blacklisted parameters
SYNOP	39 (t2)	39 (t2), 58 (rh2), 7 (q)
SYNOP	58 (rh2)	58 (rh2), 7 (q)
TEMP	1 (z)	1 (z), 29 (rh), 2 (t), 59 (td), 7 (q)
TEMP	2 (t)	2 (t), 29 (rh), 7 (q)
TEMP	29 (rh)	29 (rh), 7 (q)

- **some examples for TEMP**

to remove 2 (t), 29 (rh), 7 (q)

```
5 TEMP 35 2 11520 0
```

to remove all parameters for station 11520

```
5 TEMP 35 1 11520 0
```

```
5 TEMP 35 3 11520 0
```

```
5 TEMP 35 39 11520 0
```

```
5 TEMP 35 58 11520 0
```

```
5 TEMP 35 41 11520 0
```

```
5 TEMP 35 42 11520 0
```

- **LISTE_LOC**

```
! format i1 i2 i3 a8 i3 i3 (a3i2)
x xx xxx xxxxxxxx xxx xxx XXXXx xxxxxxxx xxxxxxxx (1x,x7)
!-----
N 2 144 29
N 3 90 054
N 3 90 056
N 3 90 054 ZONB4 -50 50 7 107
N 3 90 055 ZONB4 -50 50 -53 47
N 6 134 3 PROF2 850 250 1 0 1
N 7 210 208 3 TOVS6 10 11 12 13 14 15
```

Column	Description	Format
1	Type of action: N for blacklisted	a1
2	The observation type (obsytp@hdr)	i3
3	The observation code-type (codetype@hdr)	i4
4	The satellite ID with leading zeros (satid@sat)	a9
5	The centre that produced the satellite data	i4
6	The parameter ID (varno@body) or the satellite sensor ID (sensor@hdr)	i4
7	Optional keywords of ZONx4, TOVSn, PPPPn, PROFn	

Blacklisting - LISTE_LOC

TOVS_n C1 C2 ... C_n

- can be applied to ATOVS radiances
- n can be at most 9 indicating the involved channels
- the C_i values specify the **channels to be blacklisted**

PPPP_n P1 P2 ... P_n

- can be applied to blacklist different pressure levels
- n can be at most 9 indicating the involved levels
- the P_i values specify the **pressure levels (in hPa) to be blacklisted**

PROF_n P1a P2 ... P_{n-1} I1 I2 ... I_{n-1}

- n can be at most 9 indicating the involved layers
- the P_i values specify the bottom and top levels of **pressure layers (in hPa)**.
The first layer is always [1000,P1]
- the I_i values indicate if blacklisting should be applied (=1) or not (=0) to the given layer.

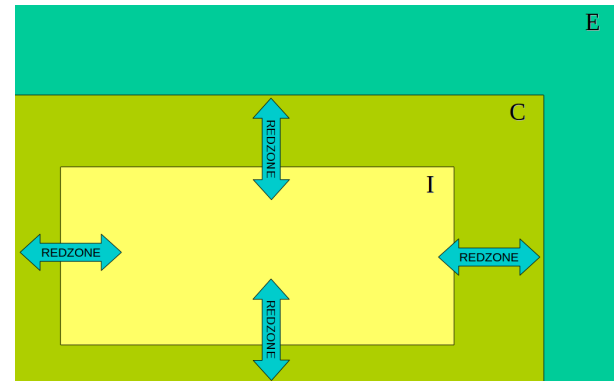
ZON_{x4} ϕ_{min} ϕ_{max} λ_{min} λ_{max}

- can be applied to SATOB/GEOWIND data
- if **x=B** then the pixels with $\lambda < \lambda_{min}$ or $\lambda > \lambda_{max}$ or $\phi < \phi_{min}$ or $\phi > \phi_{max}$ will be blacklisted.
- if **x=C** then the pixels with $(\lambda > \lambda_{min}$ and $\lambda < \lambda_{max})$ or $\phi < \phi_{min}$ or $\phi > \phi_{max}$ will be blacklisted.

Geographical selection (LAMFLAG)

- program to perform a geographical and observational selection
- mandatory for LAM
- formerly a separate program, but from CY30 **integrated within BATOR**
- invoked via environment variable
export `BATOR_LAMFLAG=1`
- requires a specific namelist **NAM_lamflag**

```
&NAMFOBS # types of observation to select
  LSYNOP LSATOB LTEMP LSATEM ...
/
&NAMFGEOM # the limits of the domain and
  reduction if C+I zone
  ELATO ELON ELATC ELONC ELAT1 ELON1
  EDELX EDELY NDLUN NDGUN NDLUX NDGUX
  REDZONE REDZONE_N REDZONE_W ...
/
```



- **ficdate** timeslot definition file (**deprecated from cy42_op1**)
- **1 timeslot for 3DVAR, e.g. for 6H 3DVAR on 2018071800**
20100717210000
20100718030000
- **replaced by environment variables:**
export **ODB_ANALYSIS_DATE**=*analysis date (YYYYMMDD)*
export **ODB_ANALYSIS_TIME**=*analysis time (HHmmss)*
export **BATOR_NBSLOT**=*number of timeslot*
export **BATOR_WINDOW_LEN**=*width of the assimilation window (in minutes)*
export **BATOR_WINDOW_SHIFT**=*shift of the window relative to analysis time (must be negative)*
export **BATOR_CENTER_LEN**=*width of centered timeslot (in minutes)*
export **BATOR_SLOT_LEN**=*width of standard timeslot (in minutes)*
- **e.g. for 6H 3DVAR**
BATOR_NBSLOT=1
BATOR_CENTER_LEN=0
BATOR_WINDOW_LEN=360
BATOR_WINDOW_SHIFT=-180
BATOR_SLOT_LEN=0
- **for more examples see**
https://www.umn-cnrm.fr/gmapdoc/IMG/pdf/bator_changes.cy42_op1.pdf

- **BATOR** defines observation error for conventional data (bator_init.F90)

```
! ECTERO(iotp, istp, ivnm, niveau)  istp=1,2 pour synop  1 0 5 pour satob  cf ecrerrstat
! SYNOP : variables initialisees 1, 11, 39, 41, 42, 58, 80, 92 - non init. 7, 91
ECTERO(NSYNOP, :, 1, 1) = Z VAL                                ! geopotentiel  itsp=1 ou 2 (ship)
ECTERO(NSYNOP, :, 39, 1) = 1.4_JPRB                            ! temperatures  itsp=1 ou 2 (ship)
ECTERO(NSYNOP, 1, 41:42, 1) = 2.0_JPRB                        ! vents  itsp=1
ECTERO(NSYNOP, 2, 41:42, 1) = 3.0_JPRB                        ! vents  itsp=2 (ship)
ECTERO(NSYNOP, :, 58, 1) = 0.1_JPRB                           ! humidite  itsp=1 ou 2 (ship)
ECTERO(NSYNOP, :, 80, 1) = 0.1_JPRB ; ECTERO(NSYNOP, :, 92, 1) = 0.1_JPRB
ECTERO(NSYNOP, :, 11, 1) = 1.5_JPRB                           ! RR, q neige  itsp=1 ou 2 (ship)
! Ts  itsp=1 ou 2 (ship)

! AIREP : variables initialisees 2, 3, 4
ECTERO(NAIREP, 1, 2, 1:19) = (/ 1.4_JPRB, 1.3_JPRB, 1.2_JPRB, 1.1_JPRB, & ! airep tempe
& 1.0_JPRB, 1.0_JPRB, 1.0_JPRB, 1.0_JPRB, 1.0_JPRB, 1.1_JPRB, &
& 1.1_JPRB, 1.2_JPRB, 1.3_JPRB, 1.4_JPRB, 1.5_JPRB, 1.6_JPRB, &
& 1.7_JPRB, 1.8_JPRB, 2.1_JPRB /)
! ECTERO(NAIREP, 1, 2, 1:19) = ECTERO(NAIREP, 1, 2, 1:19) / 1.1_JPRB
ECTERO(NAIREP, 1, 3, 1:19) = (/ 2.3_JPRB, 2.3_JPRB, 2.3_JPRB, 2.2_JPRB, & ! airep vent
& 2.2_JPRB, 2.3_JPRB, 2.4_JPRB, 2.5_JPRB, 2.7_JPRB, 3.0_JPRB, &
& 3.1_JPRB, 3.1_JPRB, 3.1_JPRB, 3.1_JPRB, 3.1_JPRB, 3.1_JPRB, &
& 3.2_JPRB, 3.3_JPRB, 3.8_JPRB /)
ECTERO(NAIREP, 1, 4, 1:19) = ECTERO(NAIREP, 1, 3, 1:19)
```

- **resetting/tuning via namelist**

&NADIRS

ECTERO(, , , , ,) # observation errors can be set via namelist

SIGMAO_COEF(:) # obs error scaling for each observation type

/

Acknowledgments

- **F. Guillaume BATOR namelist documentation**
- **F. Guillaume How to write a param.cfg file**
<http://www.umr-cnrm.fr/gmapdoc/spip.php?article229&lang=en>
- **BATOR changes CY42_op1.02**
https://www.umr-cnrm.fr/gmapdoc/IMG/pdf/bator_changes.cy42_op1.pdf
- **ALADIN maintenance & phasing training course**
http://owww.met.hu/omsz.php?almenu_id=omsz&pid=seminars&pri=9
<http://www.umr-cnrm.fr/gmapdoc/spip.php?article208>

Thank you for your attention !