

GloBUS

Decoding meteorological messages



The decoding of incoming messages requires efficient, high performance software which is not only able to handle current formats, but which will also be able to cope with new formats developed in the future. The GloBUS system, which is designed for the efficient decoding of more than one million incoming messages every day, fully meets these requirements.

The GloBUS software for decoding meteorological messages integrates various codes and the conversion into a number of output formats, such as for example GRIB or BUFR. The decoding is either completed in a batch process or via a graphical user interface.

GloBUS can be used universally, on notebooks as well as in a client/server environment on supercomputers.

The existing version of GloBUS is being up-dated to include the new GRIB Edition 2 and BUFR Edition 4 formats developed by the WMO.

Prominent features of GloBUS are:

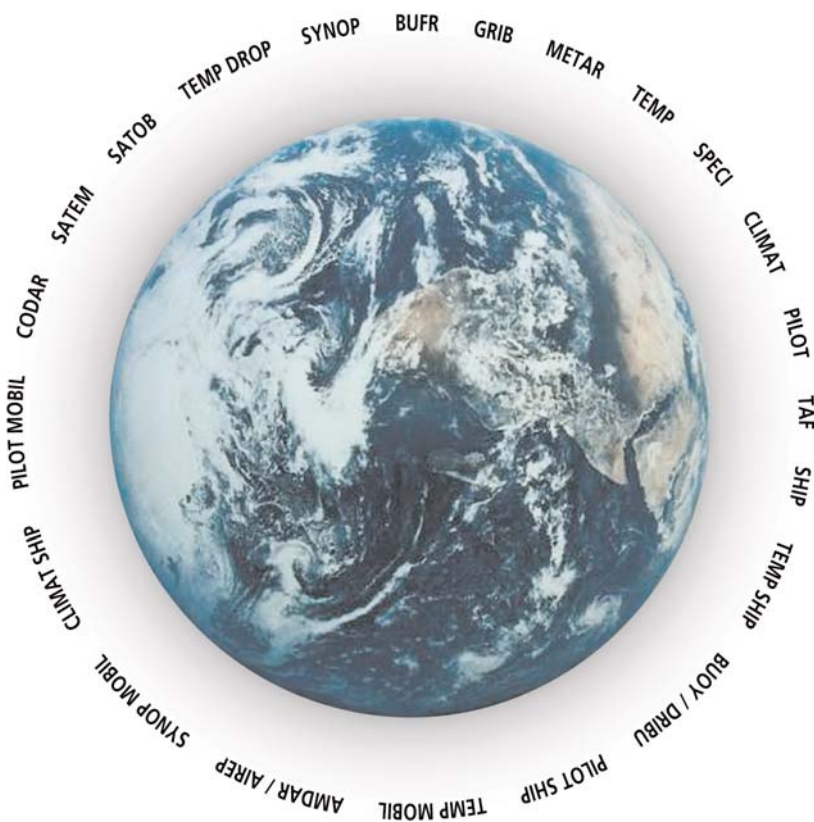
- OS-independent client/server or stand-alone application
- Developed in the programming language Java
- parallel read-, convert- and output-modes
- designed to include new keys and output formats
- several input/output media (file system, database, Internet, etc.)

This results in a highly scalable system for input and processing of coded weather reports

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Basically, all WMO codes can be used as input formats for GloBUS. Currently, a selection of WMO and ICAO codes have been implemented. These include SYNOP, SYNOP MOBIL, METAR, SPECI, TAF, AIRMET, GAMET, SIGMET, CODAR, AMDAR/AIREP, TEMP, TEMP SHIP, TEMP DROP, TEMP MOBIL, SATEM, SATOB, BUFR, SHIP, BUOY, PILOT, PILOT SHIP, PILOT MOBIL, CLIMAT, CLIMAT SHIP, GRIB as well as GAFOR, MREP and WEHI. In addition, several NATO codes are implemented.



The introduction of new reporting formats, such as developed in 2002 at the meetings of the COMMISSION FOR BASIC SYSTEMS of the WMO, is fully supported by the modular software architecture of GloBUS.

Also, GloBUS is the optimum choice for efficient processing of BUFR coded Radar data.

The system is not bound to one or more fixed output formats. Basic formats are FM 94 BUFR and FM 92 GRIB as well as raw data and a universal CORBA object. The inclusion of further formats is planned.

Output is independent of input. Each incoming report in an implemented input format can be converted into any implemented output format.

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During decoding, the data is analysed by scanners and parsers. Each implemented key has its own compiler that processes the data in several stages and generates an internal standard object.

This standard object decouples input format from output format. Because of this each output format needs only a single converter instead of one for every input format.

Together with the software tools comprised by the product BUFR-World a full range of software systems for reading, interpreting, editing, and viewing BUFR coded data is available.

The screenshot displays the BUFR-Baum software interface. On the left, a tree view shows the structure of a BUFR message (synop_bufr_33927) with sections 0 through 4. Section 4 is expanded to show data subsets, including fields like 'WMO BLOCK/STATION NUMBER', 'SHIP OR MOBILE LAND', 'WMO REGION NUMBER', 'TYPE OF STATION', 'DATE', 'HOUR/MINUTE', 'LATITUDE/LONGITUDE', and 'HEIGHT OF STATION GROUND'. On the right, a window titled 'BUFR-Ausgabe' shows a table of decoded data fields with their values and significance.

Field Number	Field Name	Value
004005	MINUTE	0
end Sequence 301012		
301021	Sequence	
005001	LATITUDE (HIGH ACCURACY)	24.43
006001	LONGITUDE (HIGH ACCURACY)	54.65
end Sequence 301021		
007030	HEIGHT OF STATION GROUND ABOVE MEAN SEA	16.0
007031	HEIGHT OF BAROMETER ABOVE MEAN SEA LEVEL	27.0
007007	HEIGHT	Missing
033024	STATION ELEVATION QUALITY MARK (MOBIL)	Missing
031021	ASSOCIATED FIELD SIGNIFICANCE	6
022043	SEA/WATER TEMPERATURE	Missing
008002	ASSOCIATED FIELD (Significance: 6; data width: 9)	Missing
022043	ASSOCIATED FIELD (Significance: 6; data width: 9)	Missing
008002	VERTICAL SIGNIFICANCE (SURFACE OBSERV.)	0.0
022043	ASSOCIATED FIELD (Significance: 6; data width: 9)	Missing
020011	CLOUD AMOUNT	Missing

The implementation of new input codes requires the implementation of an appropriate new compiler for processing reports. The codes format needs to be analysed and the appropriate parser created.

Currently, output is possible as BUFR and GRIB as well as CORBA objects. A component is also planned for generating application-specific formats (e.g. XML). Basically any output format may be implemented, so that the reports may be imported into other programs and processed there.

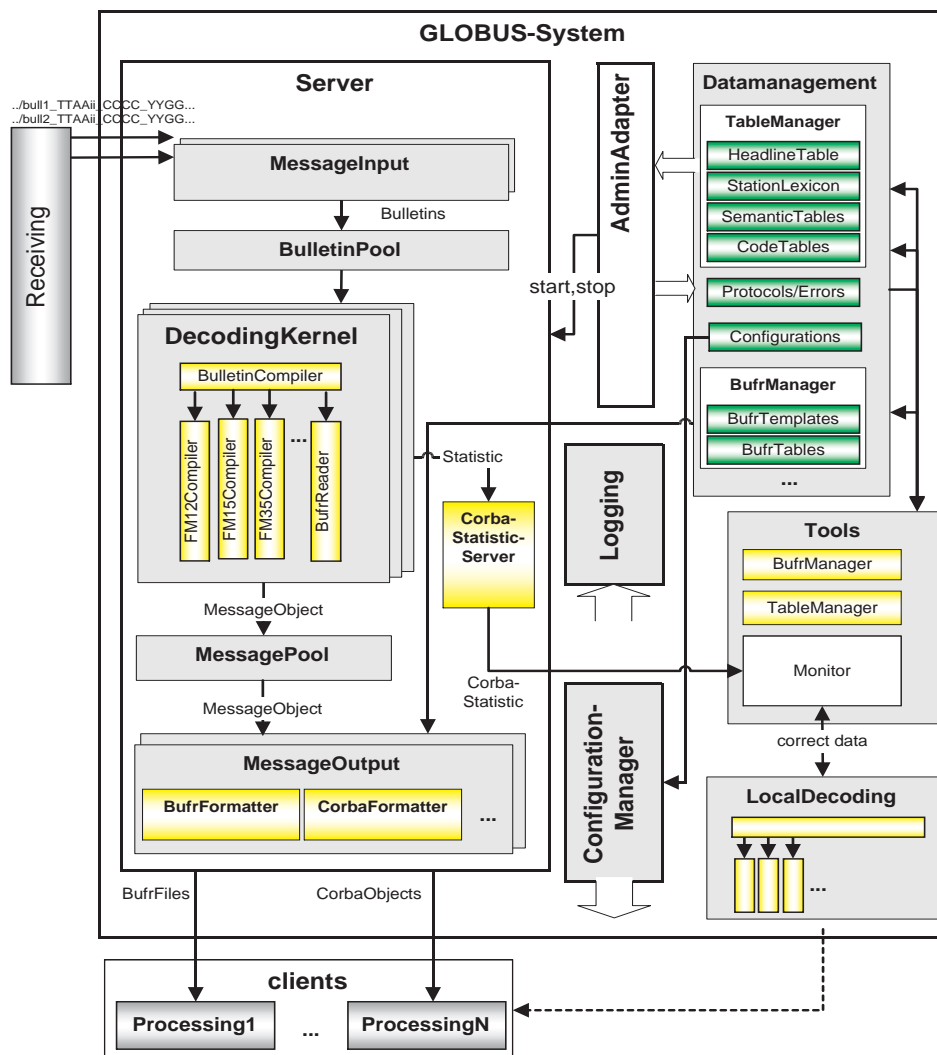
The modular architecture and high scalability make GloBUS an extremely flexible and adaptable system for decoding meteorological messages.

GloBUS

Decoding meteorological messages

GloBUS contains the following components: decoding server, data storage, tools and local decoding. The decoding server contains the input module for receiving the data, the decoding core and the output module with standard formats.

GloBUS is designed to be integrated in the processing chain from the assimilation of meteorological data to archiving.



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BUFR Tools

Viewing and Editing BUFR reports



The FM 94 BUFR standard is becoming increasingly important worldwide. A large proportion of the exchange of meteorological data will be making use of this code form. Because of its binary structure special software is required to view, edit, write, and read BUFR messages.

BUFR Tools comprises several tools to ease the daily work of the operators.

The following tools are available in BUFR Tools:

- BUFR Viewer: Graphics presentation of BUFR-reports
- BUFR Table manager: Administration of descriptors
- BUFR Template Manager: For the production of BUFR templates
- BUFR Interpreter: Interprets BUFR-reports
- BUFR Writer: Creation of BUFR-reports

All tools are regularly updated to be compliant to the latest version of the WMO Manual on Codes, publication No. 306.

BUFR Tools was originally developed as additional tool library for GloBUS which is a powerful decoding system. Technically, GloBUS is not required to run the BUFR-World tools.

The BUFR Tools tools can be installed either on laptops or on high performance computers.

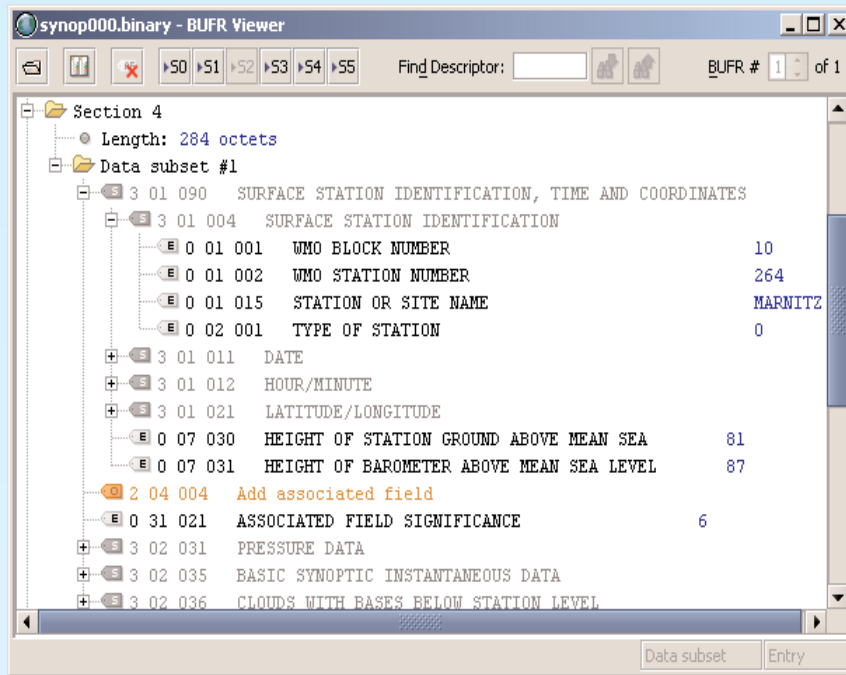
Some special features of BUFR Tools are

- Operating system independent Java programs
- Full support of BUFR Edition 3 and 4
- Can be executed as applications or integrated as Java software library

BUFR Tools

Viewing and Editing BUFR reports

The BUFR Viewer provides a clear graphics presentation of a BUFR-message, which cannot be read with a text editor. The Viewer can be used to check the contents of the



messages, and the user can navigate within a BUFR tree structure. Two sub-messages of a BUFR-message can be presented in parallel. This allows a simple comparison of BUFR sub-messages. The quality information (associated fields) of the BUFR elements can be switched on and off as required.

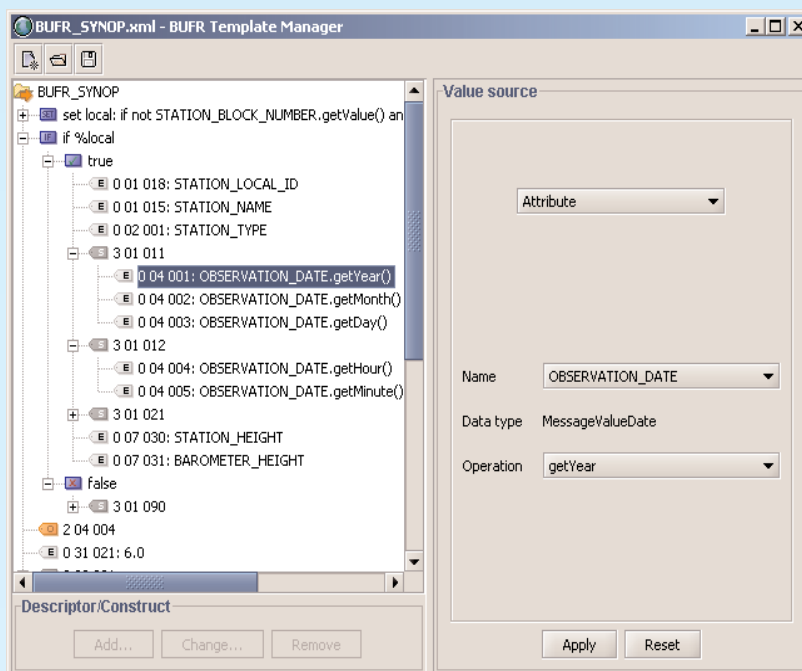
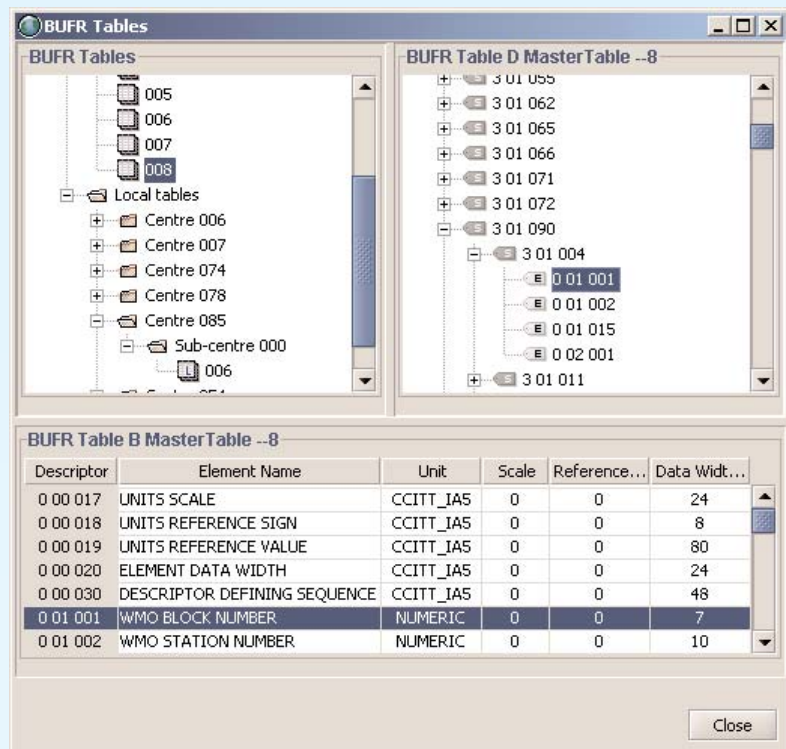
Further, the BUFR-messages can be stored in an operator readable ASCII file. An extract of an example is given below.

```
.....
301090 ***** Sequence (Start)
301004 ***** Sequence (Start)
001001 WMO BLOCK NUMBER          NUMERIC          7 bits          10          [ 10 ]
001002 WMO STATION NUMBER        NUMERIC          10 bits         264         [ 264 ]
001015 STATION OR SITE NAME      CCITT_IA5        160 bits        MARNITZ    [ MARNITZ ]
002001 TYPE OF STATION           CODE_TABLE       2 bits          0           [ 0 ]
***** End of sequence (301004)
301011 ***** Sequence (Start)
004001 YEAR                      YEAR             12 bits         2006        [ 2006 ]
004002 MONTH                     MONTH            4 bits          10           [ 10 ]
004003 DAY                       DAY              6 bits          2            [ 2 ]
***** End of sequence (301011)
301012 ***** Sequence (Start)
004004 HOUR                      HOUR             5 bits          9            [ 9 ]
004005 MINUTE                    MINUTE           6 bits          0            [ 0 ]
***** End of sequence (301012)
301021 ***** Sequence (Start)
005001 LATITUDE (HIGH ACCURACY)     DEGREE           25 bits        10**5 -9000000 1433200 [ 53,32 ]
006001 LONGITUDE (HIGH ACCURACY) DEGREE           26 bits        10**5 -18000000 19193000 [ 11,93 ]
***** End of sequence (301021)
007030 HEIGHT OF STATION GROUND ABOVE MEAN SEA M 17 bits        10**1 -4000    4810    [ 81 ]
007031 HEIGHT OF BAROMETER ABOVE MEAN SEA LEVELM 17 bits        10**1 -4000    4870    [ 87 ]
***** End of sequence (301090)
204004 ***** Add associated field
.....
```

BUFR Tools

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When working with the FM 94 BUFR code form the administration of BUFR Descriptor Tables is of great importance. The BUFR Descriptor Manager can be used for the administration of descriptors which are brought together in these tables. It provides a tree structure presentation of the sequence descriptors and a tabular presentation of element descriptors of all global and local descriptor tables known to the system.



The BUFR Template Manager is a tool to produce BUFR templates for the interpretation of BUFR messages. In a BUFR template, the attributes of the internal report object are allocated to the BUFR descriptors. For this the elements of the special template language can be used. The template language contains many elements to control the interpretation.

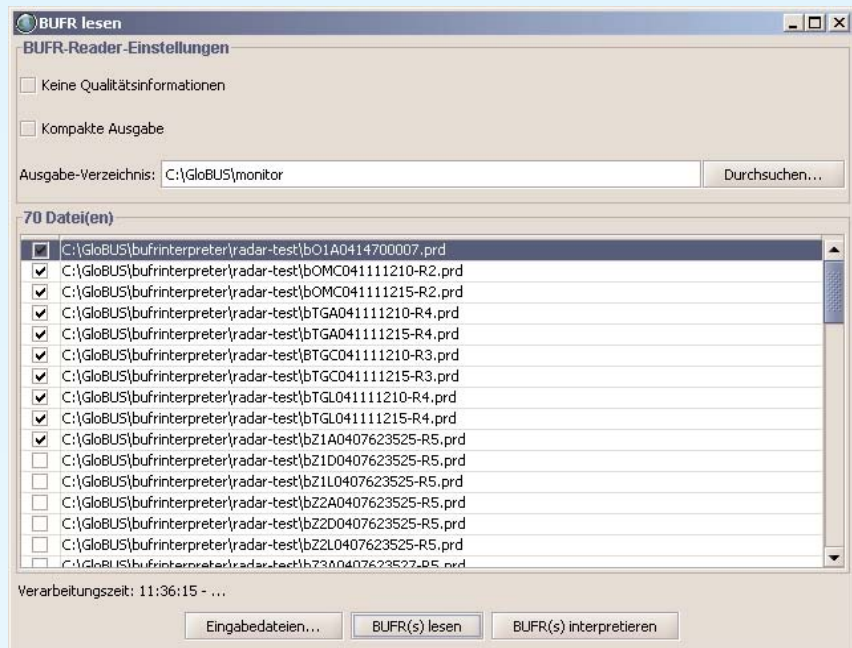
BUFR Tools

Viewing and Editing BUFR reports

The BUFR-Interpreter is a tool for interpreting BUFR messages.

This involves analysing the message and storing the interpretation in a readable ASCII-file.

The interpretation is based on pre-defined BUFR-templates. If a BUFR-message has several sub-messages then a series of internal report objects are created. The output files of the BUFR Interpreter contain the ASCII presentation of these internal report objects.



BUFR Templates for writing can be used to create new BUFR messages from the available data. This can be done by an external Java application. Further, predefined objects can be read in ASCII format. An extract of an example is given below.

```
.....  
BAROMETER_HEIGHT :           87.0  
WEATHER_PRESENT :             101  
CLOUD_LOWEST_BASE_HEIGHT :    2500.0  
HORIZONTAL_VISIBILITY :       20000.0  
CLOUD_COVER_TOTAL :           62.0  
WIND_DIRECTION_SURFACE :      120.0  
WIND_SPEED_SURFACE :          0.51444  
TEMPERATURE_AIR :             294.65  
TEMPERATURE_DEWPOINT :        293.85  
WAVES_SWELL_DIRECTION_LIST :  [dim 0; count: 2 --> 190.0; 230.0]  
WAVES_SWELL_PERIOD_LIST :     [dim 0; count: 2 --> 34.0; 52.0]  
WAVES_SWELL_HEIGHT_LIST :    [dim 0; count: 2 --> 23.0; 25.0]  
.....
```

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