



# BUFR and GRIB2 Reformatting System Development at PPS



Yi Song and Erich Stocker  
Precipitation Processing System, NASA/GSFC, Greenbelt, MD 20771

## Abstract

A reformatting system that will convert the Global Precipitation Measurement (GPM) products into Binary Universal Form for the Representation of meteorological data (BUFR) and GRIdded Binary Edition 2 (GRIB2) formatted files is under development at NASA/GSFC Precipitation Processing System (PPS). This Reformatting System will convert the products of the Tropical Rainfall Measuring Mission (TRMM), GPM, and their constellation satellites into BUFR and GRIB2 files. The current toolkit development schedule consists of four phases, each adding new tailoring capabilities. In phase 1, the common calibrated brightness temperature products (1C) for the GPM core and constellation satellites will be converted into BUFR files. In phase 2, this software system will reformat the Integrated Multi-satellitE Retrievals for GPM (IMERG) 30-minute and monthly data into GRIB2 files. In phase 3, the GPM GMI Goddard Profiling Algorithm (GPROF) products and GPM constellation satellites GPROF products will be converted into BUFR files. In phase 4, this software will reformat daily and monthly GPM GMI and GPM constellation satellites GPROF products, and the Dual-frequency precipitation radar (DPR) products into GRIB2 files. Currently, the system has implemented the phase 1 task and part of phase 2 goal. The implemented part of converter is running at the PPS. Its BUFR/GRIB2 files can be requested through the PPS Science Team On-line Request Module (STORM). The GRIB2 entries for phase 2 IMERG and BUFR table for phase 3 GPROF products have been approved, and will be published at WMO web site this November. The details of this system design and its products will be discussed.

## System Design

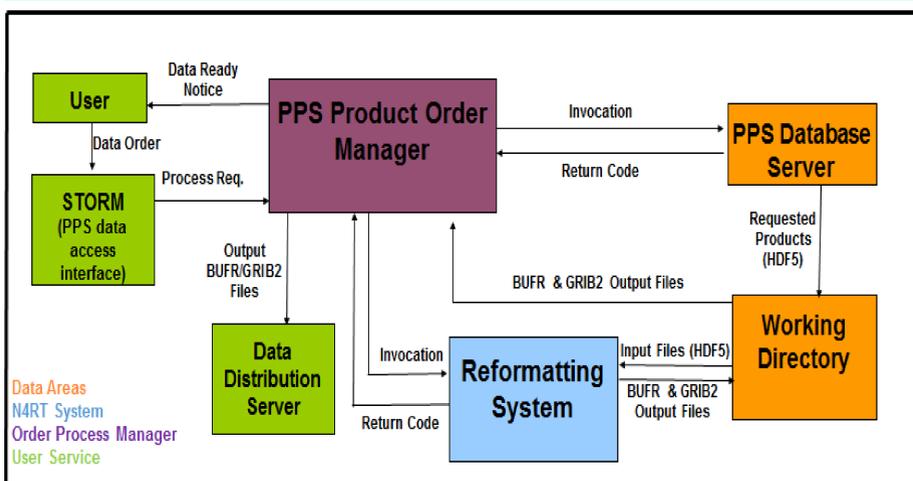
### External interfaces:

- PPS is the data processing system for the GPM Mission and the Tropical Rainfall Measuring Mission (TRMM) within NASA/GSFC.
- STORM (<https://storm.pps.eosdis.nasa.gov>) is a publicly available Web-based data access interface for the PPS.
- The Reformatting System code will run as a stand-alone unit within PPS.

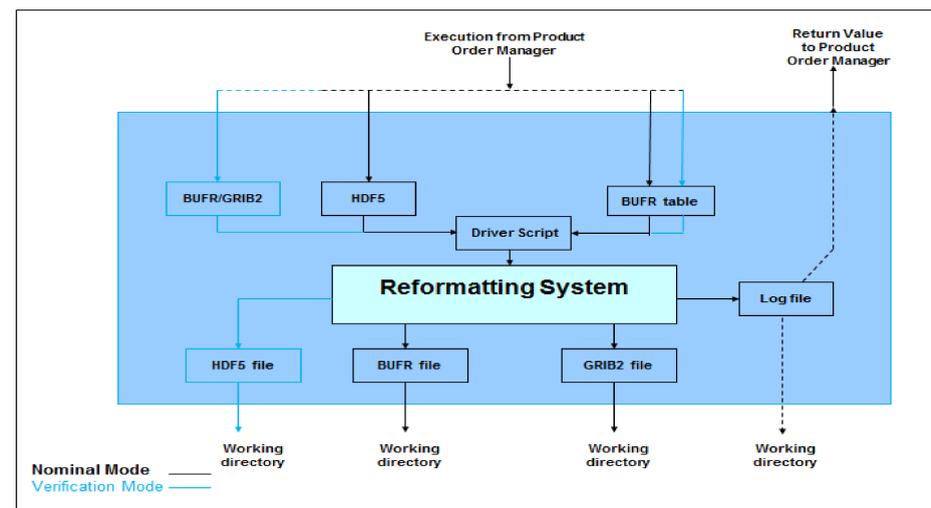
### Composed of 4 Components:

- HDF2BF: Converts HDF5 file (input) to BUFR file (output).
- HDF2GB: Converts HDF5 file (input) to GRIB2 file (output).
- BF2HDF: Converts BUFR file (input) to HDF5 file (output).
- GB2HDF: Converts GRIB2 file (input) to HDF5 file (output).

## Reformatting System Interfaces



## Reformatting System Data Flow



## Main Entries of GPROF Precipitation BUFR Table

Satellite ID	Instrument ID	Year
Month	Day	Hour
Minute	Second	Scan Line Number
Field of View Number	Latitude	Longitude
Sun Glint Angle	Surface Type	Probability of Precipitation
Surface Precipitation	Frozen Precipitation	Convective Precipitation
Quality Flag		

## Variables in IMERG GRIB2 File

Map projection	Latitudes of first/last grid point	Latitude direction and increment
Longitude of first/last grid point	Longitude direction and increment	Number of points along a parallel
Number of points along a meridian	Precipitation	Probability of Liquid Precipitation
Random Error Estimate of Precipitation		

## Variables in GPROF GRIB2 File

Map projection	Latitudes of first/last grid point	Latitude direction and increment
Longitude of first/last grid point	Longitude direction and increment	Number of points along a parallel
Number of points along a meridian	Surface Precipitation	Convective Precipitation
Frozen Precipitation		

## Main Entries of Common Calibrated Brightness Temperature (1C) BUFR Table

Satellite ID	Instrument ID	Measurement Type
Scan Line Number	Field of View Number	Latitude (high accuracy)
Longitude (high accuracy)	Satellite Height	Year
Month	Day	Hour
Minute	Second	Channel Number
Satellite Channel Frequency	Antenna Polarization	Quality Flag
Satellite Zenith Angle	Sun Glint Angle	Channel Brightness Temperature

## Available Common Calibrated Brightness Temperature BUFR Data

Data Type	Start of Data	End of Data
TRMM TMI Level 1C	1997-12-07 23:57:17	2015-04-08 15:25:02
GPM GMI Level 1C	2014-03-04 17:59:32	Now
Aqua AMSRE Level 1C	2002-06-01 15:48:29	2011-10-04 07:44:29
DMSP F11 SSMI Level 1C	1997-11-30 23:36:30	2000-05-16 16:57:56
DMSP F13 SSMI Level 1C	1997-11-30 22:29:40	2009-11-20 01:08:59
DMSP F14 SSMI Level 1C	1997-11-30 22:03:14	2008-08-24 00:48:17
DMSP F15 SSMI Level 1C	2000-02-23 09:49:02	2006-08-14 01:23:04
DMSP F16 SSMIS Level 1C	2005-11-20 02:35:27	Now
DMSP F17 SSMI Level 1C	2008-03-19 10:14:53	Now
DMSP F18 SSMI Level 1C	2010-03-08 00:32:16	Now
GCOM AMSR2 Level 1C	2012-07-02 22:31:17	Now
Metop-A MHS Level 1C	2006-12-04 23:27:59	Now
Metop-B MHS Level 1C	2013-04-23 21:51:52	Now
MT1 SAPHIR Level 1C	2011-10-13 04:12:29	Now
NOAA 15 AMSU-B Level 1C	2000-01-01 01:16:38	2010-09-15 02:12:20
NOAA 16 AMSU-B Level 1C	2000-10-04 12:12:03	2010-05-01 02:31:07
NOAA 17 AMSU-B Level 1C	2002-06-28 19:13:47	2009-12-18 01:33:07
NOAA 18 MHS Level 1C	2005-05-25 16:54:59	Now
NOAA 19 MHS Level 1C	2009-02-25 00:52:34	Now
NPP ATMS Level 1C	2011-12-09 23:39:12	Now
GPM GMI Remapped Level 1C	2014-03-04 17:59:32	Now

## Product Quality Assurance

- All the encoded BUFR/GRIB2 files will be decoded with both NCEP and ECMWF BUFR/GRIB2 libraries and their contents will be verified before they are released.
- The produced BUFR/GRIB2 files will be directed back into the Reformatting Software to generate new HDF5 files, and compare to the source input files before they are released.
- Only the WMO approved BUFR table and GRIB2 template/entry will be used.
- Only the official NCEP and ECMWF BUFR/GRIB2 libraries will be used in the reformatting system.

## Future Work for the BUFR/GRIB2 Converter

- Implement the functions to convert IMERG data into GRIB2 files and GPM GPROF products into BUFR files after the WMO publishes the approved IMERG entries and GPROF BUFR table this November.
- Work with users and do our best for customers' request. The GPM mission is designed to unify and advance precipitation measurements from a constellation of microwave sensors. The PPS is to process, analyze and archive data from the GPM mission, partner satellites and the TRMM mission. If you are interested in any PPS data in BUFR/GRIB2 format, please contact [helpdesk@mail.pps.eosdis.nasa.gov](mailto:helpdesk@mail.pps.eosdis.nasa.gov).