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MEGHA – TROPIQUES

Updated MT-ROSA Product Definition Document

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AUTHORS: ISRO: Jignesh Kshatriya, Parikshit Parasher, Abhineet Shyam				
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1.0 Introduction

GPS (Global Positioning System) radio occultation (RO) is an interesting and relatively new remote sensing method for the limb sounding of the atmosphere. The GPS constellation comprises of 32 satellites ranging from G1 to G32. The ROSA (Radio Occultation Sounding of the atmosphere) Receiver is a GPS Receiver supplied by TAS-I, Italy for space-borne applications, specifically conceived for atmospheric sounding by radio occultation, which is able to determine position, velocity and time using GPS signals.

Radio Occultation Sounding of the atmosphere is a technique for obtaining vertical profiles of atmospheric pressure, temperature, water vapour partial pressure and electron density; having salient features such as

- Self-calibrating (Accuracy & Long Term Stability)
- Fine Vertical Resolution
- All Weather Conditions
- Low Power & Cost / Compact
- Horizontal resolution: 300 km in upper troposphere to 150-200 km in lower troposphere vertical resolution: 0.5 km in lower troposphere to 1.5 km in lower stratosphere

First, excess phase data corresponding to troposphere and ionosphere is generated using level-0 data and GPS ephemeris. Using excess phase data along with various other inputs like satellite position and velocity vectors, bending angle and refractivity profiles are generated (L1D Product). Once refractivity profile is generated, the other profiles viz., temperature, pressure and humidity can also be generated (L2 Product).

A data products generation L1 software has been designed, developed and is operationalized at ISSDC, Bengaluru and L2 software at MOSDAC, Ahmedabad. L1D & L2 products are hosted at MOSDAC for further dissemination to users. (www.mosdac.gov.in).

NetCDF File formats and file name conventions are provided below:

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2.0 Level-1D Products:

Following is the brief description of products generated.

Level-1D: It is the profile of the behaviour of the bending angle with respect to impact parameter of all occulting events and shall be archived. The accuracy of bending angle will be about 0.1 μ rad. Typically, the range of bending angle is from 0.1 μ rad to 20 mrad. It also contains profile of the refractivity with respect to height of all occulting events and shall also be archived. The accuracy of refractivity will be about 0.1. Typically, the range of refractivity is from 0.1 to 300. It also contains the information of lat/lon profiles with respect to height.

Level-1D parameters will be provided in Network Common Data Form (NetCDF) format.

2.1 NetCDF Format Document Level – 1D

Objectives:

To generate NetCDF formatted Level 1D product

Output:

1. Raw & Optimized bending angle profile as a function of impact parameter
2. Refractivity profile as a function of height

Name Template: **atm_prf_REFGPS_SSS_OCCNNN_GPSGG_RIII_str_vervvvv_1d.nc**

NNN Occultation event number
GG GNSS id (G28 = GPS satellite 28)
III Record number
str String of the sensor data file
SSS igu - Ultra-rapid, igr - Rapid, igs - Final
vvvv Version Number (ex: 1_06)

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For instance,

str = PLDXXSTNSATORBNOAPIdYYDDDDHHMMSSMSE

Example file = PLDXXSTNSATORBNOAPIdYYDDDDHHMMSSMSE.raw

Format Description:

Item	Description	No of Characters
PLDXX	Data Name	5
STN	Station Name	3
SAT	Satellite Name	3
ORBNO	Orbit number	5
APId	Application ID	4
YY	Year	2
DDD	Day of the year	3
HH	Hours	2
MM	Minutes	2
SS	Seconds	2
MSE	Milli-seconds	3
DOT	Period character	1
raw	File name extension for Data identification	3
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File name Convention for ROSA dump files

Example: ROS01BL1MT100001015308010203444444.raw

Station : BL1

Mission : Megha Tropiques

Orbit Number : 00001

Time : 08:010:20:34:44:444

Global Data

occsatId

- **Description:** The complete ID for this occultation
- **Data Type:** int

setting

- **Description:** Flag indicating rising or setting occultation (0: rising; 1: setting)
- **Data Type:** int

roc

- **Description:** Local radius of curvature of reference ellipsoid for the occultation point
- **Data Type:** double

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egm96_undulation

- **Description:** The height of EGM-96 geoid above the reference ellipsoid at the occultation point
- **Data Type:** double

latitude

- **Description:** Latitude of perigee point at occultation point
- **Data Type:** double
- **Units:** deg

longitude

- **Description:** Longitude of perigee point at occultation point
- **Data Type:** double
- **Units:** deg

year

- **Description:** Year of the occultation event
- **Data Type:** int

month

- **Description:** Month of the occultation event
- **Data Type:** int

day

- **Description:** Day of the occultation event
- **Data Type:** int

hour

- **Description:** Hour of the occultation event
- **Data Type:** int

minute

- **Description:** Minute of the occultation event
- **Data Type:** int

second

- **Description:** Second of the occultation event

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- **Data Type:** int

soft_ver

- **Description:** Software version
- **Data Type:** double

center

- **Description :** Originating centre
- **Data Type:** char

Profile Data

bend_ang

- **Description:** Raw (unoptimized) Bending Angle
- **Data Type:** double
- **Units:** radians
- **Valid Range:** 0.0, 0.05
- **Fill Value:** -999.0

opt_bend_ang

- **Description:** Optimized Bending Angle
- **Data Type:** double
- **Units:** radians
- **Valid Range:** 0.0, 0.05
- **Fill Value:** -999.0

impact_parameter

- **Description:** Impact Parameter
- **Data Type:** double
- **Units:** meters
- **Valid Range:** 6200000.0., 6600000.0
- **Fill Value:** -999.0

msl_alt

- **Description:** height for refractivity
- **Data Type:** double
- **Units:** meters
- **Valid Range:** 0.0, 60000.0
- **Fill Value:** -999.0

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refractivity

- **Description:** Refractivity
- **Data Type:** double
- **Units:** N-units
- **Valid Range:** 0.0, 450.0
- **Fill Value:** -999.0

lat

- **Description:** Latitude of perigee point at occultation point
- **Data Type:** double
- **Units:** deg
- **Valid Range:** -90.0, 90.0
- **Fill Value:** -999.0

lon

- **Description:** Longitude of perigee point at occultation point
- **Data Type:** double
- **Units:** deg
- **Valid Range:** -180.0, 180.0
- **Fill Value:** -999.0

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3.0 Level-2 Products:

Following is the brief description of products generated.

Level-2: It is the profile of the behaviour of the temperature, pressure (dry & wet) and water vapor partial pressure with respect to height of all occulting events and shall be archived.

Level-2 parameters will be provided in NetCDF format.

3.1 NetCDF Format Document Level – 2

Objectives:

To generate NetCDF formatted Level 2 product

Output:

An atmospheric occultation profile with eight parameters viz., height, observed refractivity, dry temperature, dry pressure, temperature, pressure level, water vapour partial pressure, analyzed refractivity is given.

Name Template: **atm_prf_REFGPS_SSS_OCCNNN_GPSGG_RIII_str_vervvvv_1d.l2.nc**

NNN Occultation event number
GG GNSS id (G28 = GPS satellite 28)
III Record number
str String of the sensor data file
SSS igu - Ultra-rapid, igr - Rapid, igs - Final
vvvv Version Number (ex: 1_06) of Level 1 software

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Global Data

OccsatId

- **Description:** The complete ID for this occultation
- **Data Type:** int

Latitude

- **Description:** Latitude of perigee point at occultation point
- **Data Type:** double
- **Units:** deg

Longitude

- **Description:** Longitude of perigee point at occultation point
- **Data Type:** double
- **Units:** deg

Year

- **Description:** Year of the occultation event
- **Data Type:** int

Month

- **Description:** Month of the occultation event
- **Data Type:** int

Day

- **Description:** Day of the occultation event
- **Data Type:** int

Hour

- **Description:** Hour of the occultation event
- **Data Type:** int

Minute

- **Description:** Minute of the occultation event
- **Data Type:** int

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Second

- **Description:** Second of the occultation event
- **Data Type:** int

Tropopause

- **Description:** Height of first tropopause (km)
- **Data Type:** double

WV_Height

- **Description:** Maximum height for water vapour partial pressure retrieval (km)
- **Data Type:** double

Flag

- **Description:** Flag bits describing various procedures adopted during processing under the defined condition
- **Data Type:** char

Flag_Description

- **Description:** Detailed definition of flag bits
- **Data Type:** char

Product_Generation_date

- **Description:** Day on which the product is generated; 'may differ from measurement date.'
- **Data Type:** char

OriginatingCentre

- **Description:** Originating centre
- **Data Type:** char

Software_Version

- **Description:** Level 2 Software Version
- **Data Type:** char

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Profile Data

MSL_Alt

- **Description:** MSL Altitude
- **Data Type:** float
- **Units:** km
- **Valid Range:** 0.0, 60.0
- **Fill Value:** -999.0

OBS_REF

- **Description:** Observed refractivity
- **Data Type:** float
- **Units:** N-units
- **Valid Range:** 0.0, 500.0
- **Fill Value:** -999.0

Dry_T

- **Description:** Dry Temperature
- **Data Type:** float
- **Units:** Kelvin
- **Valid Range:** 73.0, 373.0
- **Fill Value:** -999.0

Dry_P

- **Description:** Dry Pressure
- **Data Type:** float
- **Units:** mb
- **Valid Range:** 0.0, 1500.0
- **Fill Value:** -999.0

Temperature

- **Description:** Temperature
- **Data Type:** float
- **Units:** Kelvin
- **Valid Range:** 123.0, 373.0
- **Fill Value:** -999.0

Pressure

- **Description:** Pressure Level
- **Data Type:** float

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- **Units:** mb
- **Valid Range:** 0.0, 1200.0
- **Fill Value:** -999.0

WVPRES

- **Description:** H₂O Vapour Partial Pressure
- **Data Type:** float
- **Units:** mb
- **Valid Range:** 0.0, 60.0
- **Fill Value:** -999.0

Lat

- **Description:** Latitude
- **Data Type:** float
- **Units:** deg
- **valid range:** -90.0,90.0
- **Fill Value:** -999.0

Lon

- **Description:** Longitude
- **Data Type:** float
- **Units:** deg
- **valid range:** -180.0,180.0
- **Fill Value:** -999.0

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ROSA Tar File Naming Convention

Filename:

PLDXXSTNSATORBNOAPIdYYDDDDHHMMSSMSE_vvvv_vv_GGG
GG_LLL_TTT.tar

**ROS01HBKMT102780015312116230640775_ver1_01_p1of1_L1U_t0
1.tar**

Item	Description	No of Characters
PLDXX	Data Name	5
STN	Station Name	3
SAT	Satellite Name	3
ORBNO	Orbit number	5
APId	Application ID	4
YY	Year	2
DDD	Day of the year	3
HH	Hours	2
MM	Minutes	2
SS	Seconds	2
MSE	Mili-seconds	3
vvvv_vv	Version no. of core s/w	7
GGGGG	No. of GPS files used during product generation	5
LLL	L1U/L1R/L1S	3
TTT	Tar no.	3