MWR L1B Product Description
V003

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Table of Contents

1 Introduction

The purpose of this document is to describe CONAE's Microwave Radiometer L1B product to the end users.

It contains summary information on the sensor, the applied processing, and the product's data format.

2 SAC-D/Aquarius Mission

The ***SAC-D/Aquarius*** mission is framed in a cooperation program between CONAE and NASA's Goddard Space Flight Center and Jet Propulsion Lab.

The objectives of the SAC-D/Aquarius Mission are to provide sensing of ocean salinity, ocean winds, rain, sea ice, sea surface temperature, soil moisture, high temperature events (fires and volcanic activities), nighttime light sources, atmospheric temperature/humidity/pressure, and space environment, distributing also autonomous data acquired from remote ground stations.

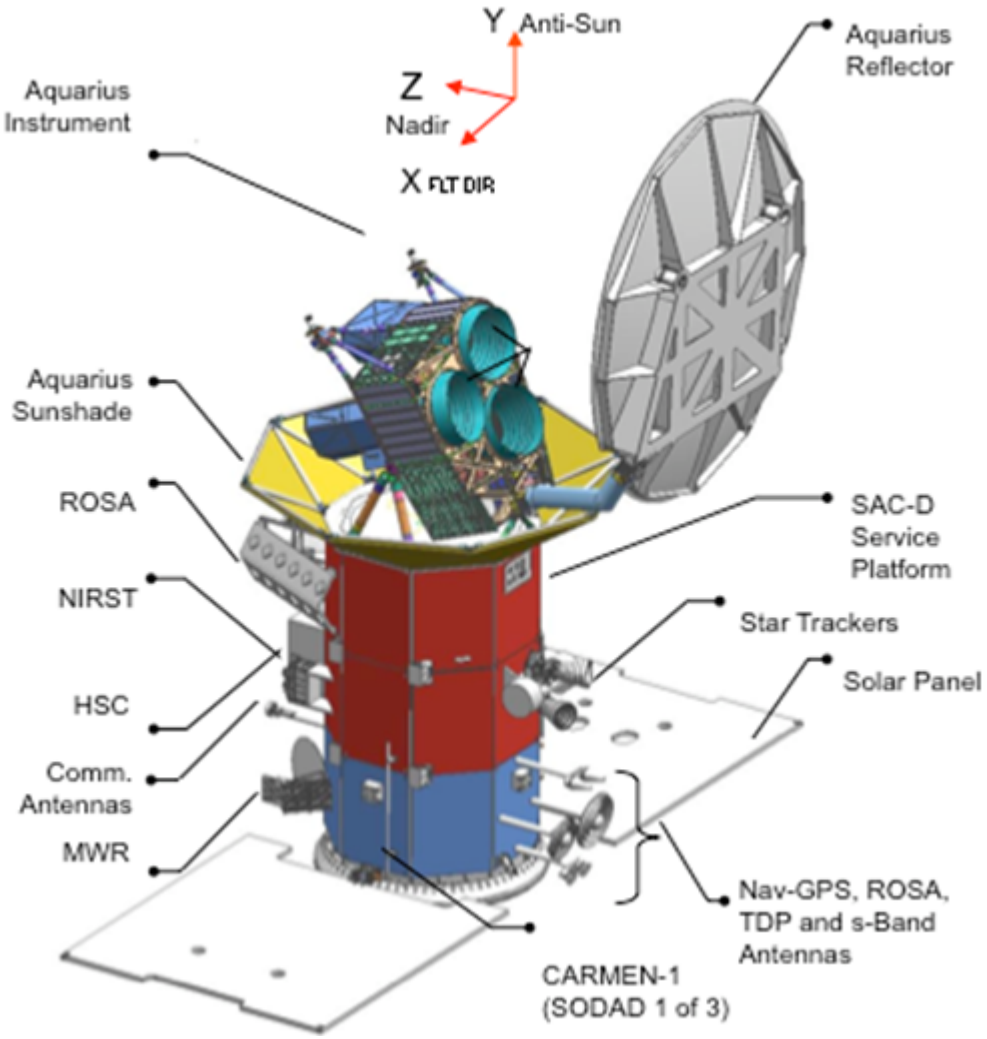

Figure 2.0.-a: The SAC-D spacecraft

3 MWR Sensor

The MWR (MicroWave Radiometer) Sensor consists of two microwave radiometers.

The K band radiometer is aft-looking. Operates at central frequency of 23.8 GHz, and measures horizontal polarization.

The Ka band radiometer is forward-looking. Operates at central frequency of 36.5 GHz, and measures vertical, horizontal, and $\pm$ 45° polarizations.

Both radiometers view toward the night side of the orbit, 272 km across track, with a swath width of 380 km, providing global coverage in a 7 day period. As this swath overlaps with the swath of Aquarius, MWR data complements sea surface salinity retrievals.

The swath is composed of 8 beam measurements, of 50 km width each one, approximately. Each one of the five bands of the sensor (K H, Ka H, Ka V, Ka +45, Ka -45), generates this measurements every 1.92 seconds.

The data is first calibrated to input temperature to the antenna, and then used to generate geophysical retrievals.

The main objectives of the sensor are to provide measurements of:

- surface wind
- rainfall
- water vapor
- sea ice

4 MWR L1B Product

The MWR L1B product is a MWR calibrated data product. Radiometric correction to input temperature to the antenna is applied, and geolocation information for each measurement is provided.

It contains:

- MWR measurements calibrated to input temperature to antenna
- Geolocalization information for each measurement
- Auxiliar information for each measurement: surface type, ascending pass flag
- Quality flags for missing, invalid data

This product is the main input in the generation of MWR geophysical retrievals. It contains almost all the info needed, and used, for this processing.

4.1 Reference system for MWR products

As MWR continuously acquires data, a segmentation of the acquisition is required to deliver products to the users.

In coincidence with Aquarius products, one MWR product is generated for orbit, considering as orbit start time the time when the spacecraft crosses the south pole. A typical orbit elapse 5871 seconds (almost 1 hour 40 minutes).

The data contained in the product starts 10 minutes before the orbit start, and ends 10 minutes after the orbit end, in the so called overlapped orbit, of 7071 seconds (almost two hours) of approximate duration.

Every 7 days, or 103 orbits, the sensor acquires data over the same zone. For this reason, MWR products are classified in cycles (counter of 7 days periods), and pass in cycle (counter of orbits inside a cycle).

For easy cross reference with Aquarius products, the same cycle counter and pass in cycle counter criteria is used. This is also true for orbit number criteria.

As orbits with succesive pass in cycle counters are not geographically adjacent, a different reference system was also defined: the MWR reference system pass id.

In this system, there are also 103 pass ids inside a cycle, but the ids where selected such that successive pass ids represent geographically adjacent orbits. The counter starts at pass id 1, for the orbit whose longitude of ascending node is 0, and increments to the east.

Information on the timing of the product, and the reference ids associated to its orbit, is contained in the product's metadata.

4.2 Calibrated measurements

The digital counts, temperature of different components of the sensor, and the parameters obtained by calibration procedures, are used to get the input temperature to the antenna for each measurement.

The parameters used for this radiometric correction are obtained from post-launch characterizations, resulting from the joint work of personal of CONAE and CFRSL (Central Florida Remote Sensing Laboratory, University of Central Florida, EEUU). This work is based in the geographic registration of MWR data with WINDSAT sensor data, and the radiometric fit between them. The radiometric calibration data used to generate the product is the last version obtained to the date. Its CONAE update id is 3.0. Its CFRSL version number is 4.0.

4.3 Geolocation info

The standard geolocation technique of intersecting the line of sight of the beams with an earth model is used as the basis for obtaining the geographic information associated to each measurement.

This technique relies in the accuracy of satellite position, velocity, and orientation measurements, and in the quality of geolocation parameters obtained by calibration procedures.

The obtained geolocation parameters are:

- Latitude
- Longitude
- Range to spacecraft
- Zenith angle to spacecraft (incidence angle)
- Azimuth angle to spacecraft

- Zenith angle to sun
- Azimuth angle to sun
- Zenith angle to moon
- Azimuth angle to moon

Depending on the user needs, geodetic coordinates representing the -3dB contour of each beam can be also included in the product.

The parameters used for geolocation are mainly based in pre-launch measurements of antenna pattern and alignment matrices, made by personal of CONAE and UNLP (Universidad Nacional de la Plata, Argentina), at CETT (Centro Espacial Teófilo Tabanera, CONAE), UNLP, and INPE (Instituto Nacional de Pesquisas Espaciais, Brasil) installations. The geometric calibration data used to generate the product is the last version obtained with pre-launch characterizations. Its CONAE update id is 1.0.

4.4 Auxiliar info

A indicator of kind of surface associated to each measurement is provided. The surface is classified into:

- land
- ocean
- coast
- near coast
- ice
- possible ice

A indicator of whether the spacecraft is ascending or descending is also appended as complementary information.

5 Data format

The product is delivered as a tar gzipped file (.tar.gz), of name

EO_YYYYMMDD_hhmmss_CUSS_SACD_MWR_L1B_SCI_ORB_000_VVV.tar.gz

Where:

- YYYYMMDD_hhmmss refers to the start of the overlapped orbit
- CUSS refers to the CONAE service which generates, archives and distributes the products

- SCI indicates that the product contains only science data
- PPP refers to inside cycle MWR orbit number.
- 000 refers to CUSS filename convention (to refer to kind of product inside specific level)
- VVV refers to version number.

Once extracted, a directory of the same name is generated,

EO_YYYYMMDD_hhmmss_CUSS_SACD_MWR_L1B_SCI_ORB_000_VVV/.

It contains the following files:

- EO_YYYYMMDD_hhmmss_CUSS_SACD_MWR_L1B_SCI_PPP_000_VVV.h5
- EO_YYYYMMDD_hhmmss_CUSS_SACD_MWR_L1B_SCI_PPP_000_VVV.xml

The main data and metadata contents for the product are present in the file, which is in HDF5 data format:

EO_YYYYMMDD_hhmmss_CUSS_SACD_MWR_L1B_SCI_PPP_000_VVV.h5,

The file EO_YYYYMMDD_hhmmss_CUSS_SACD_MWR_L1B_SCI_PPP_000_VVV.xml also contains metadata related to the acquisition, with fields and conventions common to all CONAE products. The files present in the support directory are related to the processing and interpretation of this .xml file.

5.1 HDF5 Data format

While a complete description of all the HDF5 attributes and datasets is present in a companion document, ”MWR L1B Product HDF5 Data Format Reference”, this section try to guide the user in a first approach to the product contents.

5.1.1 Attributes

All metadata for the product is available as HDF5 attributes, in the group /Global Metadata/.

There are subgroups related to the sensor, the mission, the orbit (kepler) parameters, the production center and time, and the description of the data contained in the product.

Some important attributes for first sight are:

Attributes related to the product’s orbit:

- /Global Metadata/Acquisition/Orbit Number
- /Global Metadata/Acquisition/Cycle Number
- /Global Metadata/Acquisition/Pass Number in Cycle

- /Global Metadata/Acquisition/Mwr Reference System Pass Number
- /Global Metadata/Acquisition/Overlapped Orbit Start Time UTC
- /Global Metadata/Acquisition/Overlapped Orbit End Time UTC

Attributes related to the product's data:

- /Global Metadata/Acquisition/Start Time UTC
- /Global Metadata/Acquisition/End Time UTC
- /Global Metadata/Acquisition/Length Seconds
- /Global Metadata/Product/Stats/Number of MWR lines

5.1.2 Datasets

HDF5 datasets contains the measured data. They are present in all the groups except the /Global Metadata/ group.

There are groups related to the calibrated measurement, to the geolocation data, and to the auxiliar data.

All datasets contain companion attributes that further describe its contents.

Some important datasets for first sight are:

Datasets related to MWR calibrated data:

- /MWR Calibrated Radiometric Data/k_h_antenna_temperature
- /MWR Calibrated Radiometric Data/ka_h_antenna_temperature
- /MWR Calibrated Radiometric Data/ka_v_antenna_temperature

Datasets related to geolocation of each measurement (K H band as example):

- /Geolocation Data/k_h_latitude
- /Geolocation Data/k_h_longitude
- /Geolocation Data/k_h_range_to_spacecraft
- /Geolocation Data/k_h_zenith_angle_to_spacecraft
- /Geolocation Data/k_h_azimuth_angle_to_spacecraft