

WindSat SDR Format

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WindSat Ground Data Processing version 2.0.0

The Sensor Data Record (SDR) file contains calibrated, collocated, averaged brightness temperatures for all WindSat channels. The file is composed of data records spaced in time for every fourth 37 GHz VH measurement along scan and every scan along track. This results in approximately at 12.5-by-12.5 km grid locally.

The SDR Processor (SDRP) reads the Temperature Data Records (TDRs), resamples the data to the 37 V/H grid, applies portion of the antenna pattern correction that accounts for spillover. Corrections for along-scan biases are included in the spillover correction. The data are then averaged to common spatial resolutions. The file extension indicates the averaged spatial resolution: *.sdrLowRes is an SDR file with common cell sizes at a 50 km by 71 km resolution, *.sdrMidRes is at a 35 km by 53 km resolution, and *.sdrHiRes is at a 25 km x 35 km resolution. After resampling, the remaining antenna pattern corrections are applied. The SDRP also corrects for polarization rotation angle (PRA) variations, which change the polarization basis of the antenna and. Finally, the data are put in the form of collocated four-element modified Stokes vectors for 10, 18 and 37 GHz; the 6 and 23 channels are in two-element (V, H) vectors.

The swath of the SDR data is based on the common swath of all channels at 10.7, 18.7, 23.8 and 37.0 GHz. Because of the feed placement and resulting antenna beam scanning, the 6.8 swath is offset from the other channels. Therefore, approximately one-fourth of the forward swath does not include 6.8 GHz data. For similar reasons, the aft swath contains almost no 6.8 data. The *.sdrMidRes and *.sdrHiRes files contain no 6.8 GHz data at all because the cell sizes are less than the resolution of the 6.8 GHz measurements. Brightness temperatures may also be unavailable at swath edges for the 10.7 and 23.8 GHz channels. Any unavailable brightness temperatures are set to NOVAL (-9999).

The file name contains a unique descriptor of the data set. For example, consider the file

wndmi_fws_d20031112_s165348_e183421_r04402_c200PDDJHLFG.sdrLowRes

wndmi_fws is the mission identifier

d field is the date (YYYYMMDD)

s is the start time of the data in the raw file (HHMMSS)

e is the end time of the data in the raw file (HHMMSS)

r is the revolution or orbit number of the mission at the start of the file

c describes the processing version, including WindSat software release and all static files

(*Note on start and end time:* The start and end times of the data in the SDR differ from the times indicated by the file name. This is the result of the averaging,

resampling and filtering within the processing code. The difference is usually less than one minute.)

The SDR file is in netCDF, with the following variables and attributes:

downlink_id	Compressed downlink filename	String
scan	Scan number of swath rows	4-byte int
fore_downcount	Downcount number of forward swath columns	2-byte int
fore_jd	Seconds since 1200Z, 1 Jan 2000; FillValue: 0.0	8-byte float
fore_lat	Degrees latitude	4-byte float
fore_lon	Degrees longitude	4-byte float
fore_scanangle	Angle between look and flight direction units: Radians	4-byte float
fore_caa	Compass azimuth angle units: Radians	4-byte float
fore_eia068 fore_eia107 fore_eia187 fore_eia238 fore_eia370	Earth incidence angle; One for each frequency: 068, 107, 187, 238, 370; units: Radians NoValue: 0.0	4-byte float
fore_pra068 fore_pra107 fore_pra187 fore_pra238 fore_pra370	Polarization Rotation Angle; One for each frequency: 068, 107, 187, 238, 370; units: Radians NoValue: 0.0	4-byte float
fore_surface	Surface Type (see below for list)	1-byte
fore_rad068 fore_rad107 fore_rad187 fore_rad238 fore_rad370	Brightness Temperature; One for each frequency: 068, 107, 187, 238, 370; 6.8 and 23.8 GHz are V / H polarizations; 10.7, 18.7, and 37 GHz are V / H / 3 rd / 4 th Stokes parameters; units: Kelvin NoValue: -9999.0	4-byte float
fore_rlos	Line-of-Sight coordinates; coordinates: North-East-Down	3x 4-byte float

fore_rsat	Earth-Centered-Fixed coordinates	3x 4-byte float
fore_land2water	PPT land, if a water measurement; OutOfBounds: 127 is reported for more than 100 PPT land	1-byte
fore_water2land	PPT water, if a land measurement; OutOfBounds: 127 is reported for more than 100 PPT water	1-byte
fore_sdr_qc_flags	Quality Control Flags (see below); FillValue = 0	4-byte int

Fore_rad is an N x 80 x 4 swath for 10.7, 18.7, and 37 GHz, and an N x 80 x 2 swath for 6.8 and 23.8 GHz. N is the number of scans in the file; 80 is the number of measurement pixels in a fore swath. Every other “fore” variable is an N x 80 swath. The MidRes and HiRes files have no 068 variables (rad, pra, and eia).

There is an “aft” variable corresponding to each “fore” variable, of size N x 41. *Aft_rad* is N x 41 x 4, or N x 41 x 2. 41 is the number of measurement pixels in the aft swath.

Explanation of variables:

Scan is the number of BAPTA spins beginning at the the start of the TDR file. This number is incremented when a sync mark is crossed

DownCount is the 37 GHz VH downcount number associated with this measurement and pixel location.

JD is the time of the measurement in Julian Day 2000 format, the number of seconds since January 1, 2000 noon GMT. JD2000 can be converted to ‘seconds past midnight’ by $SPM = (JD2000 + 43200) \text{ modulus } 86400$

Latitude and *Longitude* is the location of the pierce point projected onto the earth (degrees). Range of the longitude is $\pm 180^\circ$.

Scan Angle is the angular scan position (radians) of the data, where Scan Angle equal to -90° is referenced to the X-axis of WindSat (0° is along the velocity vector; 90° is under the warm load).

EIA contains the earth incidence angles of the 5-feedhorn frequencies (radians). For the bands with three feeds, and therefore three EIAs, only the V/H EIA is written. EIA differences among the three horns at any one band are less than 0.02° .

PRA is the polar rotation angle of the 5-feedhorn frequencies (radians). For the bands with three feeds, and therefore three EIAs, only the V/H PRA is written. PRA differences among the three horns at any one band are negligible.

CAA is the compass azimuth angle, or the radiometer viewing angle, at the pierce point (radian) relative to north for the 37 GHz V/H horn. North equals 0°, and the CAA increases clockwise.

RLOS_NED is the line-of-site vector in the north-east-down coordinate system (meters).

RSAT_ECF is the location of the satellite at the 37-GHz VH measurement time in the Earth-Centered-Fixed coordinate system (meters).

Surface type is an integer value where:

- 0 = LAND
- 1 = NOT USED
- 2 = NEAR COAST
- 3 = ICE
- 4 = POSSIBLE ICE
- 5 = OCEAN
- 6 = COAST
- 7 = SPARE

land2water is the amount of land contamination in a water pixel; it is expressed in parts per thousand.

water2land is the amount of water contamination in a land pixel; it is expressed in parts per thousand.

sdr_qc_flags is a bit pattern indicating errors in the processing or quality control flags. The table below gives the definition of the flags.

SDR_QC_Flags

Bit	Significance
0-7	Reserved
8	forward/aft scan (bit set to 1 for forward part of scan, 0 for Aft scan)
9	ascending/desending orbit flag (1 for ascending, 0 for descending)

10	Reserved
11	Gains Applied (1 = Gains applied to data, 0 = gains could not be applied)
12	Glare angle (sun glint) invalid because no sun vector or LOS doesn't pierce earth if set to 1
13-18	Glare Angle (glare angle goes 0 to 30 for 0 to 60 degree, 31 is > 60 deg, 32 is invalid)
19-23	Cold Load Flag (1 if RFI or moon contamination present in scan). This flag indicates that the cold sky calibration data was contaminated with RFI or lunar intrusion. There is one bit for each frequency band (6.8: bit 19; 10.7: bit 20; ... 37.0: bit 23). A mitigation algorithm is used to modify the cold load temperature used for calibration.
24-28	Frequency specific warm load flag indicating presence of thermal gradients. There is one bit for each frequency band (6.8: bit 24; 10.7: bit 25; ... 37.0: bit 28). A mitigation algorithm is used to modify the warm load temperature used for calibration.
29	Attitude Transient; the satellite attitude is changing too rapidly for accurate resampling