Remote Sensing Systems
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Aquarius L2 RSS Testbed

Data Set Description and User Manual

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Processing notes, content and brief description of Aquarius L2 RSS Testbed data set.

1 Processing and Algorithm

1.1 Purpose

- The RSS Testbed Aquarius L2 data set is an evaluation data set, which was produced with an improved algorithm, whose performance is significantly better than the current ADPS V2.0 L2 data set.
- The RSS testbed processing algorithm will be step by step integrated into the upcoming ADPS V3.0, which is expected to be released in late 2013.
- The RSS Testbed data are valid and to be used over open ocean only.

1.2 Major Differences from ADPS V2.0

1. The RSS Testbed uses combined scatterometer/radiometer wind speed instead of NCEP wind speed in the surface roughness correction.
2. The RSS Testbed uses V-pol and H-pol in the SSS retrieval based on an MLE, whereas ADPS V2.0 uses only V-pol.
3. The RSS Testbed uses liquid cloud water absorption form SAC-D Microwave Radiometer MWR in the atmospheric correction and for rain flagging.
4. The RSS Testbed uses an empirical adjustment to the reflected galactic radiation in order to mitigate the biases between the ascending and descending swaths that are prevalent in ADPS V2.0.
5. The RSS Testbed contains collocated EDR fields from SAC-D MWR, SSMIS F17 and WindSat.
6. The RSS Testbed data uses an adjustment of the noise diode temperature TND only for the drift and wiggle correction.

1.3 Version Control

1. Version 1: November 27, 2012.
    - HH and HH-H wind speeds.
    - Improved surface roughness correction.
    - Collocated MWR fields.
    - Collocated Imager fields (SSMIS F17, WindSat).
2. Version 2: March 14, 2013.
    - Added empirical adjustment of reflected galactic radiation.

1.4 Algorithm Flow

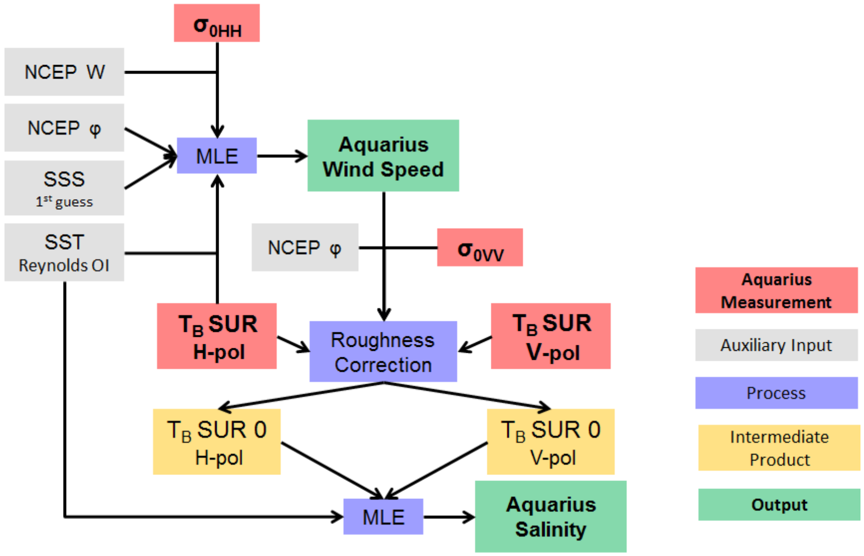

Figure : Basic flow of the algorithm producing the RSS Testbed data.

Figure shows the basic flow of the algorithm for the RSS Testbed data set.

2 Data and Support Files

- FTP access: ftp://Aquarius:saltyH2O@ftp.remss.com/Aquarius
- The Aquarius L2 RSS Testbed data are ordered by orbit (rev) number and named as *XXXXX.dat*, where *XXXXX* stands for the 5-digit orbit number.
- The files contain the Aquarius L2 arrays, which were and written sequentially in binary format. They were created on a MS Windows platform.
- The support directory contains a FORTRAN90 module defining the arrays and a reader routine *RSS_testbed.f90*.
- The support directory contains an IDL read routine *read_AQ_L2_RSS_Testbed.pro*.
- The support directory contains a MATLAB read routine *read_AQ_L2_RSS_Testbed.m.*
- The support directory contains an ASCII file that maps orbit numbers to the names of the ADPS granule (*aquarius_orbit_table.txt*).
- The support directory contains an ASCII file listing bad orbits for which no L2 output was produced due to S/C, maintenance maneuvers or for which possible degradation exists due to moon intrusion in the star trekker (*AQ_badorbits.txt*).

3 Content of Data Files

3.1 Parameters

- Placeholder for invalid or missing floating number data is -9999.
- **max_cyc** = 5000: Total number of cycles in data files. The cycles are based on the L1 radiometer files, which contain overlapping tails between adjacent orbits plus additional buffer. All buffers contain invalid data. The overlapping tails contain no surface roughness correction or sea surface salinity. Checking of the master QC flat *iflag_qc_master* bits 1 - 3 (see section 4, Table) allows easily to skip over the overlapping tails and the empty buffers.
- **n_rad** = 3: Number of radiometers (horns): 1=inner, 2-middle, 3=outer horn.

3.2 L2 Data

Table lists the L2 data, type and array dimensions:

L2 Variable	Type Dimension	Definition	Unit	Remarks
iorbit	INTEGER(4) scalar	orbit (rev) #		
TND_0_upd	REAL(4) (2, n_rad)	noise diode values after drift correction	K	1=V-pol 2=H-pol
time_utc_2000	REAL(8) (max_cyc)	observation time since 01 January 2000 00Z	sec	
scpos_j2k	REAL(8) (3, max_cyc)	S/C position vector in ECI 2000 system	m	
scvel_j2k	REAL(8) (3, max_cyc)	S/C velocity vector in ECI 2000 system	m/s	
scrpy	REAL(8) (3, max_cyc)	S/C attitude	deg	1=roll 2=pitch 3=yaw

scalt	REAL(8) (max_cyc)	S/C altitude above sub-nadir point	m	
zang	REAL(8) (max_cyc)	S/C orbital angle	deg	0=South 90=Equator ascending 180=North 270=Equator descending 360=South
cellat	REAL(4) (n_rad, max_cyc)	boresight latitude	deg	
cellon	REAL(4) (n_rad, max_cyc)	boresight longitude	deg	
celtht	REAL(4) (n_rad, max_cyc)	boresight Earth incidence angle	deg	
celphi	REAL(4) (n_rad, max_cyc)	boresight azimuthal look relative to N	deg	
pol_rotation_aqu	REAL(4) (n_rad, max_cyc)	total polarization rotation	deg	between Earth and S/C polarization basis
pol_rotation_geo	REAL(4) (n_rad, max_cyc)	geometric part of polarization rotation	deg	between Earth and S/C polarization basis
pol_rotation_ion	REAL(4) (n_rad, max_cyc)	ionospheric part of polarization rotation	deg	between Earth and S/C polarization basis pol_rotation_aqu = pol_rotation_geo + pol_rotation_ion
gland	REAL(4) (n_rad, max_cyc)	land fraction weighted by antenna gain	none	

gice	REAL(4) (n_rad, max_cyc)	sea ice fraction weighted by antenna gain	none	
winspd_NCEP	REAL(4) (n_rad, max_cyc)	NCEP GDAS wind speed	m/s	10 m above sea surface
windir	REAL(4) (n_rad, max_cyc)	NCEP GDAS wind direction	deg	10 m above sea surface
waveht	REAL(4) (n_rad, max_cyc)	significant wave height	m	NCEP WW 3
surtep	REAL(4) (n_rad, max_cyc)	surface temperature	K	Reynolds SST NCEP land surface
sss_ref	REAL(4) (n_rad, max_cyc)	HYCOM SSS	psu	
AO	REAL(4) (n_rad, max_cyc)	O_2 absorption	neper	vertical integrated atmospheric column
AV	REAL(4) (n_rad, max_cyc)	H_2O vapor absorption	neper	vertical integrated atmospheric column
AL	REAL(4) (n_rad, max_cyc)	cloud liquid water absorption	neper	vertical integrated atmospheric column use MWR if available otherwise use NCEP
TRAN	REAL(4) (n_rad, max_cyc)	total atmospheric transmittance	none	

TBUP	REAL(4) (n_rad, max_cyc)	upwelling atmospheric brightness temperature	K	
TBDW	REAL(4) (n_rad, max_cyc)	upwelling atmospheric brightness temperature		
mwr_retcld	REAL(4) (n_rad, max_cyc)	total columnar cloud liquid water retrieved from MWR	mm	
mwr_retran	REAL(4) (n_rad, max_cyc)	surface rain rate retrieved from MWR	mm/ h	
winspd_im	REAL(4) (n_rad, max_cyc)	10m surface wind speed from closest imager	m/s	1 hour, 0.25° matchup WindSat All-Weather if exists otherwise SSMIS F17
vap_im	REAL(4) (n_rad, max_cyc)	total columnar water vapor from closest imager	mm	1 hour, 0.25° matchup WindSat if exists otherwise SSMIS F17
cld_im	REAL(4) (n_rad, max_cyc)	total columnar cloud liquid water from closest imager	mm	1 hour, 0.25° matchup WindSat if exists otherwise SSMIS F17
rain_im	REAL(4) (n_rad, max_cyc)	surface rain rate from closest imager	mm/ h	1 hour, 0.25° matchup WindSat if exists otherwise SSMIS F17

irainflag_ext_im	INTEGER(1)/BYTE (n_rad, max_cyc)	Imager area rainflag	none	1 hour, 0.25° matchup WindSat if exists otherwise SSMIS F17 = 0: no rain in 0.25° by 0.25° cell and no rain in any of the 8 surrounding cells =1: rain in cell or any of the 8 surrounding cells
sigma0_VV	REAL(4) (n_rad, max_cyc)	scatterometer VV backscatter	dB	
sigma0_HH	REAL(4) (n_rad, max_cyc)	scatterometer HH backscatter	dB	
TA	REAL(4) (3, n_rad, max_cyc)	antenna temperature before RFI filter	K	modified Stokes 1=V-pol 2=H-pol 3=U=3rd Stokes
TF	REAL(4) (3, n_rad, max_cyc)	antenna temperature after RFI filter	K	modified Stokes 1=V-pol 2=H-pol 3=U=3rd Stokes
DTA_hat	REAL(4) (3, n_rad, max_cyc)	NEDT before front-end loss correction and before RFI filter	K	modified Stokes 1=V-pol 2=H-pol 3=U=3rd Stokes
DTF_hat	REAL(4) (3, n_rad, max_cyc)	NEDT before front-end loss correction and after RFI filter	K	modified Stokes 1=V-pol 2=H-pol 3=U=3rd Stokes
tagal_dir	REAL(4) (3, n_rad, max_cyc)	correction for intrusion of direct galactic radiation	K	at antenna temperature level classical Stokes 1=I=V+H 2=Q=V-H 3=U=3rd Stokes

tagal_ref	REAL(4) (3, n_rad, max_cyc)	correction for intrusion of reflected galactic radiation	K	at antenna temperature level classical Stokes 1=I=V+H 2=Q=V-H 3=U=3rd Stokes
tagal_spec	REAL(4) (3, n_rad, max_cyc)	correction for intrusion of reflected galactic radiation assuming specular surface	K	at antenna temperature level classical Stokes 1=I=V+H 2=Q=V-H 3=U=3rd Stokes
tasun_dir	REAL(4) (3, n_rad, max_cyc)	correction for intrusion of direct sun radiation	K	at antenna temperature level classical Stokes 1=I=V+H 2=Q=V-H 3=U=3rd Stokes
tasun_ref	REAL(4) (3, n_rad, max_cyc)	correction for intrusion of reflected sun radiation	K	at antenna temperature level classical Stokes 1=I=V+H 2=Q=V-H 3=U=3rd Stokes
tasun_bak	REAL(4) (3, n_rad, max_cyc)	correction for intrusion of backscattered sun radiation	K	at antenna temperature level classical Stokes 1=I=V+H 2=Q=V-H 3=U=3rd Stokes
tamon_ref	REAL(4) (3, n_rad, max_cyc)	correction for intrusion of reflected moon radiation	K	at antenna temperature level classical Stokes 1=I=V+H 2=Q=V-H 3=U=3rd Stokes
solar_flux	REAL(4) (max_cyc)	solar flux	sfu	used in calculation of solar corrections

winspd_HH	REAL(4) (n_rad, max_cyc)	wind speed from scatterometer HH	m/s	10 m above ocean surface
winspd_HHH	REAL(4) (n_rad, max_cyc)	wind speed from scatterometer HH and radiometer H	m/s	10 m above ocean surface
dtb_roughness_corr	REAL(4) (2, n_rad, max_cyc)	surface roughness correction T_B	K	1=V-pol 2=H-pol
ta_earth	REAL(4) (3, n_rad, max_cyc)	TA coming from earth	K	after removing galaxy, sun, moon, but not removing cold space modified Stokes 1=V-pol 2=H-pol 3=U=3rd Stokes
tb_toi	REAL(4) (3, n_rad, max_cyc)	top of ionosphere TB	K	after APC (remove spillover and cross pol) modified Stokes 1=V-pol 2=H-pol 3=U=3rd Stokes
tb_toa	REAL(4) (2, n_rad, max_cyc)	top of atmosphere TB	K	after removing Faraday rotation 1=V-pol 2=H-pol
tb_sur	REAL(4) (2, n_rad, max_cyc)	TB at rough ocean surface	K	after removing atmosphere 1=V-pol 2=H-pol

				after roughness correction
tb_sur0	REAL(4) (2, n_rad, max_cyc)	TB at specular ocean surface	K	tb_sur0 = tb_sur - dtb_roughness_corr 1=V-pol 2=H-pol
tb_sur0_expected	REAL(4) (2, n_rad, max_cyc)	expected TB at specular ocean surface	K	calculated from RTM assuming boresight scenes 1=V-pol 2=H-pol
tb_sur_expected	REAL(4) (2, n_rad, max_cyc)	expected TB at rough ocean surface	K	calculated from RTM assuming boresight scenes tb_sur_expected = tb_sur0_expected + dtb_roughness_corr 1=V-pol 2=H-pol
tb_toa_expected	REAL(4) (2, n_rad, max_cyc)	expected TB at top of atmosphere	K	calculated from RTM assuming boresight scenes 1=V-pol 2=H-pol
tb_toi_expected	REAL(4) (3, n_rad, max_cyc)	expected TB at top of ionosphere	K	calculated from RTM assuming boresight scenes modified Stokes 1=V-pol 2=H-pol 3=U=3rd Stokes
ta_expected	REAL(4) (3, n_rad, max_cyc)	expected TA at antenna after front end loss correction	K	calculated from RTM assuming boresight scenes modified Stokes 1=V-pol 2=H-pol 3=U=3rd Stokes

sss_1	REAL(4) (n_rad, max_cyc)	1st guess SSS used in HH-H wind speed algorithm	psu	Aquarius derived monthly average
sss_aquarius	REAL(4) (n_rad, max_cyc)	Retrieved Aquarius SSS	psu	
tb_err	REAL(4) (n_rad, max_cyc)	SOS consistency check for convergence of SSS retrieval	K	SQRT [SOS(V,H) tb_sur — tb_sur(SSS_Aquarius)]
iflag_qc_master	INTEGER(4) (n_rad, max_cyc)	master Q/C flag	none	see section 4, Table

Table : List of variables in L2 RSS testbed files.

4 Master Q/C Flag

Table lists the bit setting for the 32-bit (=INTEGER(4)) master QC flag *iflag_qc_master*. For obtaining the best retrieved SSS, it is recommended to use only those observations for which no bit is set, i.e. demand that *iflag_qc_master = 0.*

bit set	indicates condition
0	N/A
1	no or invalid radiometer data
2	invalid time or geolocation
3	overlapping tails of L1 files no L2 scatterometer data no roughness correction no SSS retrieval
4	S/C maneuver

	no boresight Earth intersection S/C attitude (roll, pitch, yaw) out of bound
5	ACS mode not equal 5 indicates degraded geolocation
6	bad orbit (see bad orbit list)
7	scatterometer RFI
8	radiometer RFI |TA-TF|>1.0 Kelvin or bit overflow in radiometer counts
9	AQ wind speed retrievals (HH and/or HH-H wind speeds) did not converge
10	full roughness correction could not be performed underpopulated bin in table and/or no SWH
11	severe land contamination *gland>0.01*
12	moderate land contamination *gland>0.001*
13	sea ice contamination *gice>0.001*
14	high galactic radiation *tagal_spec(1)/2.0 > 2.0 Kelvin*
15	high lunar radiation *tamon_ref(1) /2.0 > 0.25 Kelvin*
16	no MWR observation exists
17	MWR observation exists and indicates rain *MWR surface rain rate > 0.25 mm/h*
18	cold SST *sst = surtep - 273.15 < 5.0 Celsius*
19	high wind speed

	W(HH-H) > 20.0 m/s
20	high error or poor or no convergence in SSS retrieval *TB_err> > 0.40 Kelvin*
21	sparse
22	sparse
23	sparse
24	sparse
25	sparse
26	sparse
27	sparse
28	sparse
29	sparse
30	sparse
31	sparse

Table : Bit decoding of master Q/C flag ***iflag_qc_master***.