ERS-2

Product Handbook

ERS-2 Reprocessing for
the Study of the Continental Surfaces

ERS2-RDK-V1.1
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Written by	Fabien Blarel	
Checked by	Sara Fleury, Nicolas Fuller, Frédéric Frappart, Benoit Legresy, Fernando Niño	
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1 Introduction

1.1 Purpose and scope of this user guide

This document presents the ERS-2 data product *-release CTOH_ERS-2_2015_01-* processed by the CTOH at the LEGOS Laboratory. This document will be modified and updated for each new release provided by the CTOH.

1.2 The CTOH re-processing project

The CTOH re-processing project is tailored to obtain the most accurate information possible from ERS-2 data incontinental surfaces. As such,it is complementary to the REAPER project [1].

The first goal of the CTOH project is to reprocess, at a global scale, ERS-2 waveforms using a new implementation of the ICE-2 retracker (Legresy et al. 2005) [2] using thebest orbit available (Rudenko et al. 2014) [3]. During the process, new values of the ICE-1 retracking are also obtained,for the low, medium and high leading edge levels (corresponding to 25, 50 and 75% threshold values)

The second goal of the project is to improve the consistency between the ERS-2 data and ENVISAT V2.1 data, and provide better quality times series spanning the period of the two missions. For this, the calculation of some corrections particularly relevant for continental surfaces have been improved (e.g. tropospheric correction, doppler slope correction).

1.3 Dataset identification

This ERS-2 data product is identified using a Digital Object Identifier (DOI): doi:10.6096/CTOH_ERS-2_2015_01. The product should be cited as CTOH, (2015), as detailed below. The associated science reference article by Legresy et al (2015) should also be mentioned :

CTOH. 2015. « Dataset: Altimetric data of the ERS-2 mission ». *OMP-INSU-UPS-IRD*. doi:10.6096/CTOH_ERS-2_2015_01.

F. Frappart, Legrésy, B., F. Nino, F. Blarel, N. Fuller, S. Fleury, et F. Birol. 2016. « *An ERS-2 altimetry product compatible with ENVISAT for continental and ice surface studies.* ». Remote Sensing of Environment.

2 Improvements on previous products

2.1 Orbit

The orbit computed by Rudenko et al. 2014 [3] has been used; it is an upgrade of the REAPER combined orbit [4] which is used for ESA's REAPER ERS product. Using this orbit we obtain an improvement of data consistency, particularly a reduction of standard deviation t crossovers; cross-validation with the ENVISAT V2.1 data during the tandem phasealso shows an improvement over the REAPER combined orbit.

2.2 Tropospheric corrections

The tropospheric corrections have been improved over continental surfaces by using the re-analysed meteorological data ERA Interim form European Center for Medium Range Weather Forecasting (ECMWF). The algorithm has been also changed by taking into account the surface elevation measured by the radar altimeter rather than the Digital Elevation Model (DEM). This improvement shows that this correction becomes more relevant over continental surfaces (Blarel et al. 2010)[5].
The dry tropospheric correction is already available in the ERS-2 release (ESA REA-UG-PHB-7003). The wet tropospheric correction will be soon available due to an important amount of data to process. Nevertheless the CTOH product has been completed by a copy of the wet tropospheric correction from the ERS-2 REAPER product which is computed using ECMWF ERA Interim data and a DEM.

2.3 Doppler slope correction

The doppler slope correction has been reimplemented following the recommendations of Blarel et al. 2012 [6]. The main result of this study shows that this correction depends strongly on the accuracy of the surface slope but it also depends to the real surface observed by the altimeter. In this case the DEM used in the previous ERS-2 product is not enough relevant to calculate it. Specifically for cryosphere areas or hydrology areas where the topography is always changing. Following the recommandation, this correction has been thun recomputed using a more accruate surface slope obtain directly from the altimeter mesaurement.

2.4 Ionospheric Correction

Ionospheric corrections have also been consolidated into a homogeneous dataset, using the New Ionospheric Climatology 2009 (NIC09) [7] model until 1998 and the GPS Ionosphere Maps (GIM) [8] after that.

2.5 Cross-validation

The ERS-2/ENVISAT cross-validation has been done using the 11 cycles of the tandem phase (ERS2: cycle 75 to 85 and ENVISAT V2.1: cycle 7 to 17). From the cross-validation for each ICE-1 and ICE-2 parameters we observe:

- a strong linear dependency of the parameters difference at crossover with the orbit altitude over ocean; we have not yet found a clear technical explanation for this.

- a bias due to the different bandwidth mode over continental surfaces (ERS-2 in "ice mode" (BW=82.5Mhz) and ENVISAT-V2.1 in "ocean mode" (BW=320Mhz)). The bias observed over Antarctica and those over Greenland are very similar for all ICE-1 and ICE-2 parameters; these observations suggest that these inter-mode biases are constant, to a good approximation.

These preliminary results have been presented for the OSTST 2014 [9]. All detailed results will be available soon in the cross-validation report in the CTOH web site.

2.6 Inter-calibration

From the cross-validation, we have calculated an inter-mission biasfor the ERS-2 mission relative toto the ENVISAT v2.1 mission. This bias has benn calculated as having two components: the large scale inter-mission bias and an inter-mode bias over continental surfaces.

The first component has been calculated over ocean and for each ICE-1 and ICE-2 parameters. We calculated linear functions of the orbit altitude and systematic bias which characterize as empirical large scale offset functions. Once corrected for these large scale offset functions, the two missions show an overall good agreement.

Over continental surfaces and specifically over cryosphere, we estimated statically the inter-mode bias correction as it shows in the table below:

Bias ERS2/ENVISAT Inter-mode	**ICE-1 Ice-mode**	**ICE-2 Ice-mode**
Backscatter (dB)	-0.838	0.921
Range (m)	0.432	-0.205
Leading Edge Width (m)		-0.718
Trailing Edge Slope ($10^6 s^{-1}$)		-0.360

The inter-mission bias is available for each ICE-1 and ICE-2 parameters in the data ERS-2 product as named:

- ice1_range_intermission_corr_20hz: Inter-mission correction of the ICE-1 range.
- ice1_sig0_intermission_corr_20hz: Inter-mission correction of the ICE-1 Backscatter.
- ice2_range_intermission_corr_20hz: Inter-mission correction of the ICE-2 range.
- ice2_sig0_intermission_corr_20hz: Inter-mission correction of the ICE-2

Backscatter.

- ice2_le_with_intermission_corr_20hz: Inter-mission correction of the ICE-2 Leading edge Width.
- ice2_1st_te_slope_intermission_corr_20hz: Inter-mission correction of the ICE-2 Trailing edge Slope.

2.7 Flags records

The data status had been improved to help users to edit the right data due to issues observed in the data:

- ctoh_flag: This flag indicating the validity of time data (no jumps, always increasing) at 1 Hz
  ctoh_flag = 0 time tag is ok.
  For details see the section 3.1.
- ice2_flag_20hz: This flag indicate the ICE-2 retracker estate:
  ice-2_flag_20hz = 0 –> All ICE-2 parameters are Ok
  ice-2_flag_20hz = 1 –> ICE-2 parameters are Ok but no backscatter
  ice-2_flag_20hz = 2 –> NOK
- alt_flag_ocean1_ice0_20hz: This flag indicates the altimeter operating mode:
  ocean mode : 330MHz Band Width, flag value = 1
  ice mode : 82.5MHz Band Width, flag value = 0
  This flag does not indicate the actual surface type (from ESA WAP product). **This flag is impacted by calibration mode issues.** The CTOH has solved this problem and produce this flag_ocean1_ice0_20hz corrected flag.
- flag_ocean1_ice0_20hz: This flag indicating operating mode:
  ocean mode : 330MHz Band Width, flag value = 1
  ice mode : 82.5MHz Band Width, flag value = 0
  This flag does not indicate the actual surface type. This is a original CTOH's flag corrected of the calibration mode issues found in the alt_flag_ocean1_ice0_20hz flag parameter in the ESA WAP product.

- calib_mode_flag_20hz: This flag is deduced by the CTOH from alt_flag_ocean1_ice0_20hz and the calibration period observed every 2400 20hz-ressords.
  calib_mode_flag_20hz = 0 → Ok.
  calib_mode_flag_20hz > 0 → NOK. Data impacted by the calibration mode. Data not usable.
  For details see the section 3.1.

3 Overview of data quality

3.1 Known issues in ERS2-RDK-V1.0

- *non-monotonous time*
  We have found in about 20% ofpasses that time is not always increasing (i.e. successive points show a step back in time, clearly unrealistic). This problem of time is also reported as overlapping ranges of time in WAP files in the Reaper RA L2 Validation report by Scharroo (https://earth.esa.int/documents/10174/1511090/REA-TR-VAL-L2-7001-3-1.pdf). Furthermore, the regularity of the 1Hz time is also checked.

  If a record arrives before the expected time (less than 1 sec between altimetry packets) there is no clear explanation and there is, usually, sample overlapping. The ctoh_flag to a value of 1 indicates this is the case.

  If a record arrives after the expected time, it is frequently either because of lost data or because of additional delays linked to surface slope topography. As before, ctoh_flag indicates if the data are valid or not.
-
- *Waveform peak problem*
  We found waveforms present a very sharp peak every 2400 records. This problem is visible in retrackers Ocean, ICE-1 and ICE-2 – all of them giving unphysical values. It appears that is the result of a cyclic perturbation due to on-board procedures (calibration?).
  The CTOH has created the `calib_mode_flag_20hz` flag in order to remove these bad records (section 2.7).
- *Trailing edge slope:*
  The standard deviationof the ERS2 trailing edge slope (TeS) shows an anomalous feature around 13°N which is consistently observed but remains unexplained. ICE-2 data between latitudes 5 to 20°N are to be used with caution. This issue has been presented for the OSTST 2014 [9].
- *Orbit control*
  During the ERS2 mission life, the orbit control was impacted by the lost of gyroscope after the cycle 60. This problem impact the repeatability of the passes and the consistency of the time series of the parameters. This issue is not specific to CTOH reprocessing, but it is particularly important to take it into account when using data for continental surfaces[10].

4 Product descriptions and conventions

The CTOH re-processing is oriented for continental surfaces and it is complementary to the REAPER re-processing. The data naming conventions and the format (NetCDF) used for this product are hence as close as possible to those from ESA's REAPER product.

Nevertheless, some particularities remain, which we describe hereinafter..

4.1 Time

Measurement time is stored as a double-precision floating-point number, counting in seconds from 1st January 1990. The 1Hz time is the average of the twenty 20Hz times it was derived from.

4.2 Orbit Altitude

The orbit altitude (`alt` and `alt_20hz`) and also the coordinates (`lon`, `lon_20hz`, `lat` and `lat_20hz`) have been estimated by interpolating the time from the WAP data and the Rudenko et al. [3] orbit with reference to the WGS84 ellipsoid. This ellipsoid is the same as forENVISAT-v2.1.

4.3 Range corrections

The ranges supplied in the CTOH ERS-2 product are for retracker ICE-1 and retracker ICE-2. For all of them the doppler correction (`doppler_orbit_corr_20hz`) and the instrumental correction (`inst_range_corr`) and the inter-mission correction (ice1_range_inter-mis_corr_20hz for ICE-1 range or ice2_range_inter-mis_corr_20hz for ICE-2 range) *have been already applied*.

4.4 Geophysical range corrections

The convention for correction is that to apply them, they should be added to range (or subtracted from elevation, if not already applied). It is possible that some corrections to range have missing values. In that case, there value is set to the value indicated by the *FillValue* attribute of the corresponding variable.

4.5 ICE-2 Waveform parameters

The ICE-2 waveform parameters (leading edge width, trailing edge slope and backscatter) are already corrected of the inter-mission correction (`ice2_???? _intermission_corr_20hz`) supplied in the ERS-2 product.

4.6 Doppler correction

The Doppler correction has been computed using the orbit described in Rudenko et al 2014 [3].

4.7 Doppler Slope correction

The doppler sloper correction has been computed as shown inBlarel et al. Proceeding 2012 [6].

4.8 Instrument correction

The instrumental correction is copied from the original WAP data supplied by ESA.

5 Data access

5.1 CTOH Database

The data are available on CTOH web site: http://ctoh.legos.obs-mip.fr/products/ers-2

The users have to fill request form to have access to this ERS-2 product.

6 Conventions of data usage

The surface elevation is obtained by making the difference between the orbit altitude and the altimetric range. Some corrections are applied to the altimetric range to take into account the atmospheric propagation and the geophysical perturbations on the radar signal [11]. By convention these corrections are added to the altimetric range. Some of them are given at 1 Hz and have to be interpolated to 20 Hz in order to apply to the range.

The user can choose between two range retrackers: ICE-1 and ICE-2. They have both their own specificity for continental study but the atmospheric and geophysical corrections are identical.

In order to help the users on using this ERS-2 product, we present some practical use cases of height profile calculations.

6.1 Height profile for continental surfaces

To calculate the *alti* surface elevation over the cryosphere using the ICE-2 retracker range:

```
alti= alt_20hz
      -(ice2_range_20hz
           +model_dry_tropo_corr_20hz
           +model_wet_tropo_corr_20hz
           +gim_ku                        (or  iono_nic09)
           +solid_earth_tide
           +load_tide
           +pole_tide
           +doppler_slope_corr_20hz)
```

Please note that the ICE-2 range (`ice2_range_20hz`) used is already corrected by:

- Doppler correction calculated by the CTOH from the new orbit of Rudenko et al. 2014 (`doppler_orbit_corr_20hz`),
- Instrumental correction given by ESA (`inst_range_corr`),
- Inter-mission correction calculated by the CTOH in order to homogenize ERS-2 and ENVISAT v2.1 missions (`ice2_range_intermission_corr_20hz`).

Over continental surfaces the atmospheric perturbations of the troposphere could not be estimated from the Micro Wave Radiometer (MWR). The only way to correct them is to use the model dry and wet tropospheric correction (`model_dry_tropo_corr_20hz and model_wet_tropo_corr_20hz`) from the

ECMWF atmospheric model. The CTOH has computed those corrections using the altimetric elevation deduced from the range ICE-1 at 20hz [5]. These corrections are particularly important for continental surfaces and supplied at 20hz for this reason.

The Ionospheric corrections have also been consolidated into a homogeneous dataset, using the New Ionospheric Climatology 2009 (`iono_nic09`) model until 1998 and the GPS Ionosphere Maps (`gim_ku`) after that year.

Tidal corrections (`solid_earth_tide, load_tide, pole_tide`) have been calculated through the same algorithms used by ENVISAT v2.1

The doppler slope correction (`doppler_slope_corr_20hz`) corrects the doppler effect induced by the slope surfaces over continental surfaces.

CTOH provides several editing flags; they are detailed in section 2.7. We recommend to use the flags:

- `ctoh_flag` to edit the data having a time tag not monotonous,
- `calib_mode_flag_20hz` flag to edit the measurement impacted by the calibration mode,
- `ice2_flag_20hz` flag to edit the measurement when the ICE-2 retracker do not manage to slove the waveform modeling,
- `flag_ocean1_ice0_20hz` to select the right operating bandwidth mode: ice or ocean. In this case of continental surfaces, the radar operating mode was most of the time in ice mode.

6.2 Height profile for hydrology

For hydrology, the calculation is similar to that of the continental case in the previous section and the calculation of the height profile using the ICE-1 retracker is:

```
alti= alt_20hz
      -(ice1_range_20hz
           +model_dry_tropo_corr_20hz
           +model_wet_tropo_corr_20hz
           +gim_ku                    (or iono_nic09)
           +solid_earth_tide
           +load_tide
           +pole_tide
           +doppler_slope_corr_20hz)
```

Previous studies in hydrology showed that among ranges estimated using the commonly available retracking algorithm, the ones obtained using the Offset Center of Gravity (OCOG) [12] or Ice-1 [13], and Ice-2 [14] retracking algorithms provide the best accuracy when compared to in situ measurements [15]–[17].

7 Product Parameters Overview

The following table presents the origin of the parameters contained in the CTOH ERS-2 product; most of them are computed by CTOH for continental surfaces (but available on the global product), but we do copy into our product some geophysical parameters from ESA's REAPER ERS-2 product release REA-UG-PHB-7003 (with ESA's permission, which we gratefully acknowledge). The origin of all parameters is clearly stated as part of the product's NetCDF *comment* attribute metadata.

Field	From the ESA Original data WAP	From the ERS-2 GDR of the ESA Reaper release	Re-processed by the CTOH
time	x		
meas_ind			x
time_20hz			x
lat			x
lon			x
lat_20hz			x
lon_20hz			x
alt_20hz			x
alt_flag_ocean1_ice0_20hz			x
inst_range_corr	x		
ice2_range_numval			x
ice2_sig0_numval			x
ice2_flag_20hz			x
ice2_range_20hz			x
ice2_le_width_20hz			x
ice2_1st_te_slope_20hz			x
ice2_sig0_20hz			x
ice1_range_20hz			x
ice1_range_medium_20hz			x
ice1_range_high_20hz			x
ice1_sig0_20hz	x		

tracker_range_20hz	X		
ctoh_flag			X
solid_earth_tide	X		
rad_water_vapour	X		
rad_liquid_water	X		
inst_agc_corr	X		
agc_20hz	X		
doppler_range_corr_20hz			X
doppler_orbit_corr_20hz			X
doppler_slope_corr_20hz			X
along_track_surface_slope_20hz			X
footprint_length_20hz			X
surface_pressure_20hz			X
model_dry_tropo_corr_20hz			X
temp_2m_ecmwf			X
mean_sea_level_pressure_ecmwf			X
iono_nic09			X
flag_ocean1_ice0_20hz			X
calib_mode_flag_20hz			X
wet_tropo_cls			X
gim_ku			X
ocean_tide_l_GOT00			X
ocean_tide_FES_04			X
ocean_tide_GOT47			X
ib_MOG2D_NF			X
ib_ECMWF_NF			X
ib_MOG2D_hf			X
ib_ECMWF_bf			X
mss_cnes_cls_11			X
mdt_cnes_cls_09			X
mdt_cnes_cls_09_med			X
geoid_goce			X
geoid_egm08			X
mss_dtu_13			X
geoid_grace			X

mss_cnes_cls_10			x
gridone			x
dist_to_coast_leuliette			x
dist_to_coast_stumpf			x
geoid_eigen6c3			x
gebco08			x
ice1_range_intermission_corr_20hz			x
ice1_sig0_intermission_corr_20hz			x
ice2_range_intermission_corr_20hz			x
ice2_sig0_intermission_corr_20hz			x
ice2_le_width_intermission_corr_20hz			x
ice2_1st_te_slope_intermission_corr_20hz			x
load_tide_sol2_reaper		x	
ocean_tide_sol1_reaper		x	
ocean_tide_sol2_reaper		x	
pole_tide_reaper		x	
ocean_tide_non_equil_reaper		x	
tb_365_reaper		x	
rad_wet_tropo_corr_reaper		x	
model_wet_tropo_corr_reaper		x	
tb_238_reaper		x	
ocean_tide_equil_reaper		x	
load_tide_sol1_reaper		x	

8 Detailed ERS-2 product parameters

time

```
double time(time) ;
      time:comment = "ESA shifted time (-157766400.0 sec), initially
defined in seconds since 1985-01-01" ;
      time:units = "seconds since 1990-01-01" ;
      time:calendar = "gregorian" ;
```

meas_ind

```
short meas_ind(meas_ind) ;
      meas_ind:long_name = "elementary measurement index" ;
      meas_ind:units = "count" ;
      meas_ind:comment = "Set to be compliant to CF-1.1 convention. Counts
0..19" ;
```

lat

```
int lat(time) ;
      lat:long_name = "latitude" ;
      lat:standard_name = "latitude" ;
      lat:units = "degrees_north" ;
      lat:comment = “CTOH recalculated latitude using the orbit solution
based on the stationary geopotential model (developed by GFZ and
CNES/GRGS). Reference: S. Rudenko, D. Dettmering, S. Esselborn, T. Schöne,
C. Förste, J.-M. Lemoine, M. Ablain, D. Alexandre, et K.-H. Neumayer,
« Influence of time variable geopotential models on precise orbits of
altimetry satellites, global and regional mean sea level trends », Advances
in Space Research, vol. 54, n° 1, p. 92-118, juill. 2014.\n" ;
      lat:scale_factor = 1.e-06f ;
```

lon

```
int lon(time) ;
      lon:long_name = "longitude" ;
      lon:standard_name = "longitude" ;
      lon:units = "degrees_east" ;
      lon:comment = "CTOH recalculated longitude using the orbit solution
based on the stationary geopotential model (developed by GFZ and
CNES/GRGS). Reference: S. Rudenko, D. Dettmering, S. Esselborn, T. Schöne,
C. Förste, J.-M. Lemoine, M. Ablain, D. Alexandre, et K.-H. Neumayer,
« Influence of time variable geopotential models on precise orbits of
altimetry satellites, global and regional mean sea level trends », Advances
in Space Research, vol. 54, n° 1, p. 92-118, juill. 2014.\n" ;
      lon:scale_factor = 1.e-06f ;
```

time_20hz

```
double time_20hz(time, meas_ind) ;
      time_20hz:long_name = "CTOH high frequency time" ;
      time_20hz:comment = "CTOH recalculated high frequency time stamp
(seconds after 1st January 1990)." ;
      time_20hz:units = "seconds since 1990-01-01" ;
      time_20hz:calendar = "gregorian" ;
```

lat_20hz

```
int lat_20hz(time, meas_ind) ;
      lat_20hz:long_name = "CTOH latitude high frequencey" ;
```

```
      lat_20hz:standard_name = "latitude" ;
      lat_20hz:units = "degrees_north" ;
      lat_20hz:comment = "CTOH recalculated high frequency latitude using
the orbit solution based on the stationary geopotential model (developed by
GFZ and CNES/GRGS). Reference: S. Rudenko, D. Dettmering, S. Esselborn, T.
Schöne, C. Förste, J.-M. Lemoine, M. Ablain, D. Alexandre, et K.-H.
Neumayer, « Influence of time variable geopotential models on precise
orbits of altimetry satellites, global and regional mean sea level
trends », Advances in Space Research, vol. 54, n° 1, p. 92-118, juill.
2014.\n" ;
      lat_20hz:scale_factor = 1.e-06f ;
      lat_20hz:_FillValue = -2147483647 ;
```

lon_20hz

```
int lon_20hz(time, meas_ind) ;
      lon_20hz:long_name = "CTOH longitude high frequency" ;
      lon_20hz:standard_name = "longitude" ;
      lon_20hz:units = "degrees_east" ;
      lon_20hz:comment = "CTOH recalculated high frequencey longitude using
the orbit solution based on the stationary geopotential model (developed by
GFZ and CNES/GRGS). Reference: S. Rudenko, D. Dettmering, S. Esselborn, T.
Schöne, C. Förste, J.-M. Lemoine, M. Ablain, D. Alexandre, et K.-H.
Neumayer, « Influence of time variable geopotential models on precise
orbits of altimetry satellites, global and regional mean sea level
trends », Advances in Space Research, vol. 54, n° 1, p. 92-118, juill.
2014.\n" ;
      lon_20hz:scale_factor = 1.e-06f ;
      lon_20hz:_FillValue = -2147483647 ;
```

alt_20hz

```
int alt_20hz(time, meas_ind) ;
      alt_20hz:long_name = "CTOH altitude high frequency" ;
      alt_20hz:standard_name = "altitude_ellipsoid" ;
      alt_20hz:units = "m" ;
      alt_20hz:comment = "CTOH recalculated high frequency altitude using
the orbit solution based on the stationary geopotential model (developed by
GFZ and CNES/GRGS). Reference: S. Rudenko, D. Dettmering, S. Esselborn, T.
Schöne, C. Förste, J.-M. Lemoine, M. Ablain, D. Alexandre, et K.-H.
Neumayer, « Influence of time variable geopotential models on precise
orbits of altimetry satellites, global and regional mean sea level
trends », Advances in Space Research, vol. 54, n° 1, p. 92-118, juill.
2014.\n" ;
      alt_20hz:scale_factor = 0.001f ;
      alt_20hz:_FillValue = -2147483647 ;
```

alt_flag_ocean1_ice0_20hz

```
byte alt_flag_ocean1_ice0_20hz(time, meas_ind) ;
      alt_flag_ocean1_ice0_20hz:standard_name = "flag_ocean1_ice0" ;
      alt_flag_ocean1_ice0_20hz:long_name = "Flag for ocean/ice
discrimination" ;
      alt_flag_ocean1_ice0_20hz:comment = "Flag indicating ocean (1) or ice
(0) mode for the altimeter (from ESA WAP data)" ;
      alt_flag_ocean1_ice0_20hz:_FillValue = -127b ;
```

inst_range_corr

```
int inst_range_corr(time) ;
```

```
      inst_range_corr:long_name = "Internal Range Correction given by ESA
WAP original file" ;
      inst_range_corr:units = "m" ;
      inst_range_corr:scale_factor = 1.e-06f ;
```

ice2_range_numval

```
int ice2_range_numval(time) ;
      ice2_range_numval:long_name = "number of correctly retracked
waveforms for range using CTOH\'s Ice-2 retracker" ;
      ice2_range_numval:standard_name = "number of valid points in ice2
retracker" ;
      ice2_range_numval:units = "count" ;
```

ice2_sig0_numval

```
int ice2_sig0_numval(time) ;
      ice2_sig0_numval:long_name = "number of correctly retracked waveforms
giving backscatter using CTOH\'s Ice-2 retracker" ;
      ice2_sig0_numval:standard_name = "number of valid points in ice2
retracker" ;
      ice2_sig0_numval:units = "count" ;
```

ice2_flag_20hz

```
byte ice2_flag_20hz(time, meas_ind) ;
      ice2_flag_20hz:long_name = "High frequency flag for ice-2 retracking
out 0=ok, 1= range ok but no backscatter, 2=NOK" ;
      ice2_flag_20hz:standard_name = "ice2_flag_20hz" ;
      ice2_flag_20hz:comment = "VERY IMPORTANT variable for filtering CTOH
ice2 parameters" ;
      ice2_flag_20hz:_FillValue = -127b ;
```

ice2_range_20hz

```
int ice2_range_20hz(time, meas_ind) ;
      ice2_range_20hz:long_name = "range high frequency (calculated by
CTOH)" ;
      ice2_range_20hz:standard_name = "range" ;
      ice2_range_20hz:units = "m" ;
      ice2_range_20hz:comment = "range with internal_range_correction" ;
      ice2_range_20hz:add_offset = 800000.f ;
      ice2_range_20hz:scale_factor = 0.001f ;
      ice2_range_20hz:_FillValue = -2147483647 ;
```

ice2_le_width_20hz

```
int ice2_le_width_20hz(time, meas_ind) ;
      ice2_le_width_20hz:long_name = "recalculated high frequency leading
edge with CTOH\'s Ice-2 retracker" ;
      ice2_le_width_20hz:standard_name = "leading_edge_width" ;
      ice2_le_width_20hz:units = "m" ;
      ice2_le_width_20hz:scale_factor = 0.001f ;
      ice2_le_width_20hz:_FillValue = -2147483647 ;
```

ice2_1st_te_slope_20hz

```
int ice2_1st_te_slope_20hz(time, meas_ind) ;
      ice2_1st_te_slope_20hz:long_name = "recalculated high frequency
trailing edge slope with CTOH\'s Ice-2 retracker" ;
      ice2_1st_te_slope_20hz:standard_name = "trailing_edge" ;
```

```
      ice2_1st_te_slope_20hz:units = "1/s" ;
      ice2_1st_te_slope_20hz:scale_factor = 1.f ;
      ice2_1st_te_slope_20hz:_FillValue = -2147483647 ;
```

ice1_sig0_20hz

```
short ice1_sig0_20hz(time, meas_ind) ;
      ice1_sig0_20hz:long_name = "ESA-provided ice1 sigma0" ;
      ice1_sig0_20hz:standard_name = "sigma0_backscatter" ;
      ice1_sig0_20hz:units = "dB" ;
      ice1_sig0_20hz:scale_factor = 0.01f ;
      ice1_sig0_20hz:_FillValue = -32767s ;
```

ice2_sig0_20hz

```
short ice2_sig0_20hz(time, meas_ind) ;
      ice2_sig0_20hz:long_name = "recalculated high frequency backscatter
from CTOH\'s Ice-2 retracker" ;
      ice2_sig0_20hz:standard_name = "sigma0_backscatter" ;
      ice2_sig0_20hz:units = "dB" ;
      ice2_sig0_20hz:scale_factor = 0.01f ;
      ice2_sig0_20hz:_FillValue = -32767s ;
```

ice1_range_20hz

```
int ice1_range_20hz(time, meas_ind) ;
      ice1_range_20hz:long_name = "ice-1 range (25% leading edge) high
frequency (calculated by CTOH based on WAP low_retrack_point)" ;
      ice1_range_20hz:standard_name = "range_ice1" ;
      ice1_range_20hz:units = "m" ;
      ice1_range_20hz:add_offset = 800000.f ;
      ice1_range_20hz:comment = "range with internal_range_correction using
WAP\'s low_retrack_point" ;
      ice1_range_20hz:scale_factor = 0.001f ;
      ice1_range_20hz:_FillValue = -2147483647 ;
```

ice1_range_medium_20hz

```
int ice1_range_medium_20hz(time, meas_ind) ;
      ice1_range_medium_20hz:long_name = "ice-1 range (50% leading edge)
high frequency (calculated by CTOH based on WAP medium_retrack_point)" ;
      ice1_range_medium_20hz:standard_name = "range_ice1_medium" ;
      ice1_range_medium_20hz:units = "m" ;
      ice1_range_medium_20hz:add_offset = 800000.f ;
      ice1_range_medium_20hz:comment = "range with
internal_range_correction using WAP\'s medium_retrack_point" ;
      ice1_range_medium_20hz:scale_factor = 0.001f ;
      ice1_range_medium_20hz:_FillValue = -2147483647 ;
```

ice1_range_high_20hz

```
int ice1_range_high_20hz(time, meas_ind) ;
      ice1_range_high_20hz:long_name = "ice-1 range (75% leading edge) high
frequency (calculated by CTOH based on WAP high_retrack_point)" ;
      ice1_range_high_20hz:standard_name = "range_ice1_high" ;
      ice1_range_high_20hz:units = "m" ;
      ice1_range_high_20hz:add_offset = 800000.f ;
      ice1_range_high_20hz:comment = "range with internal_range_correction
using WAP\'s high_retrack_point" ;
      ice1_range_high_20hz:scale_factor = 0.001f ;
      ice1_range_high_20hz:_FillValue = -2147483647 ;
```

tracker_range_20hz

```
int tracker_range_20hz(time, meas_ind) ;
	tracker_range_20hz:long_name = "20 Hz Ku band altimeter range (no retracking), from WAP" ;
	tracker_range_20hz:standard_name = "altimeter_range" ;
	tracker_range_20hz:units = "m" ;
	tracker_range_20hz:add_offset = 800000.f ;
	tracker_range_20hz:comment = "All instrumental corrections included" ;
	tracker_range_20hz:scale_factor = 0.001f ;
	tracker_range_20hz:_FillValue = -2147483647 ;
```

ctoh_flag

```
int ctoh_flag(time) ;
	ctoh_flag:_FillValue = 999999 ;
	ctoh_flag:comment = "CTOH recommend not to use (1: unconsistent time)" ;
	ctoh_flag:ctoh_edit_date = "2015-01-14 14:46" ;
```

solid_earth_tide

```
int solid_earth_tide(time) ;
	solid_earth_tide:long_name = "Solid earth tide (Cartwright Edden Tayler model)" ;
	solid_earth_tide:units = "m" ;
	solid_earth_tide:scale_factor = 0.001f ;
	solid_earth_tide:comment = "WAP field name:  Earth Tide (range -1.0 to 1.0)" ;
```

rad_water_vapour

```
int rad_water_vapour(time) ;
	rad_water_vapour:long_name = "Total integrated water vapour, Q [GFA]" ;
	rad_water_vapour:units = "kg/m^2 x 10 range 0 to 550" ;
	rad_water_vapour:comment = "WAP field name: q_gfa (Total integrated water vapour)" ;
	rad_water_vapour:scale_factor = 0.1f ;
	rad_water_vapour:_FillValue = -2147483647 ;
```

rad_liquid_water

```
int rad_liquid_water(time) ;
	rad_liquid_water:long_name = "radiometer liquid water content" ;
	rad_liquid_water:source = "MWR" ;
	rad_liquid_water:units = "kg/m^2" ;
	rad_liquid_water:scale_factor = 0.1f ;
	rad_liquid_water:comment = "WAP field name: l (Total liquid water, range 0 to 120)" ;
	rad_liquid_water:_FillValue = -2147483647 ;
```

inst_agc_corr

```
int inst_agc_corr(time) ;
	inst_agc_corr:long_name = "ESA provided AGC Internal Correction in WAP original file" ;
	inst_agc_corr:units = "dB" ;
	inst_agc_corr:scale_factor = 0.01f ;
```

agc_20hz

```
short agc_20hz(time, meas_ind) ;
      agc_20hz:long_name = "ESA-provided corrected automatic gain control" ;
      agc_20hz:standard_name = "AGC" ;
      agc_20hz:units = "dB" ;
      agc_20hz:scale_factor = 0.01f ;
      agc_20hz:_FillValue = -32767s ;
```

9 Detailed original CTOH added parameters and corrections.

doppler_range_corr_20hz

```
short doppler_range_corr_20hz(time, meas_ind) ;
      doppler_range_corr_20hz:_FillValue = -32767s ;
      doppler_range_corr_20hz:units = "m" ;
      doppler_range_corr_20hz:scale_factor = 0.001 ;
      doppler_range_corr_20hz:long_name = "Full doppler correction (due to
the orbit rate and the surface height rate) to altimeter range" ;
      doppler_range_corr_20hz:comment = "Doppler range correction: Doppler
correction computed from the range (ICE-1) variation measured by the radar
altimeter. This is integration of the doppler effect due to the orbit
variation and the doppler effect due to the surface heigth variation.  See
proceeding: F. Blarel et al, INVESTIGATIONS ON THE ENVISAT RA2 DOPPLER
SLOPE CORRECTION FOR ICE SHEETS, ESA Living Planet Symposium, 28 June - 2
July 2010, Bergen, Norway." ;
```

doppler_orbit_corr_20hz

```
short doppler_orbit_corr_20hz(time, meas_ind) ;
      doppler_orbit_corr_20hz:_FillValue = -32767s ;
      doppler_orbit_corr_20hz:units = "m" ;
      doppler_orbit_corr_20hz:scale_factor = 0.001 ;
      doppler_orbit_corr_20hz:long_name = "Doppler correction to altimeter
range" ;
      doppler_orbit_corr_20hz:comment = "Doppler orbit correction: Doppler
correction computed from the orbit variation given by Altitude of CoG above
reference ellipsoid. WARNING: To apply this correction, take care to remove
from the range parameter (hz18_ku_ice2) the doppler correction
(hz18_ku_dop_corr correcting the orbit variation effect) already applied.
See proceeding: F. Blarel et al, INVESTIGATIONS ON THE ENVISAT RA2 DOPPLER
SLOPE CORRECTION FOR ICE SHEETS, ESA Living Planet Symposium, 28 June - 2
July 2010, Bergen, Norway." ;
```

doppler_slope_corr_20hz

```
short doppler_slope_corr_20hz(time, meas_ind) ;
      doppler_slope_corr_20hz:_FillValue = -32767s ;
      doppler_slope_corr_20hz:units = "m" ;
      doppler_slope_corr_20hz:scale_factor = 0.001 ;
      doppler_slope_corr_20hz:long_name = "Doppler slope correction to
altimeter range" ;
      doppler_slope_corr_20hz:comment = "Doppler slope correction: Doppler
correction computed from the surface heigth variation measured by the radar
altimeter (ICE-1).  See proceeding: F. Blarel et al, INVESTIGATIONS ON THE
ENVISAT RA2 DOPPLER SLOPE CORRECTION FOR ICE SHEETS, ESA Living Planet
Symposium, 28 June - 2 July 2010, Bergen, Norway." ;
```

along_track_surface_slope_20hz

```
short along_track_surface_slope_20hz(time, meas_ind) ;
      along_track_surface_slope_20hz:_FillValue = -32767s ;
      along_track_surface_slope_20hz:units = "m/km" ;
      along_track_surface_slope_20hz:scale_factor = 0.001 ;
      along_track_surface_slope_20hz:long_name = "Along track surface
height slope" ;
      along_track_surface_slope_20hz:comment = "Along track Surface slope
computed from range (ICE-1) and orbit rate difference and taking to in
```

```
account the ctoh_footprint_length size." ;
```

footprint_length_20hz

```
short footprint_length_20hz(time, meas_ind) ;
      footprint_length_20hz:_FillValue = -32767s ;
      footprint_length_20hz:units = "km" ;
      footprint_length_20hz:scale_factor = 0.001 ;
      footprint_length_20hz:long_name = "footprint range" ;
      footprint_length_20hz:comment = "Size of the footprint length used to
estimated the dopplers corrections computed by the CTOH." ;
```

surface_pressure_20hz

```
short surface_pressure_20hz(time, meas_ind) ;
      surface_pressure_20hz:_FillValue = -32767s ;
      surface_pressure_20hz:scale_factor = 10. ;
      surface_pressure_20hz:units = "Pa" ;
      surface_pressure_20hz:long_name = "air pressure" ;
      surface_pressure_20hz:source = "ECMWF ERA Interim" ;
      surface_pressure_20hz:comment = "Surface pressure computed form Mean
sea level pressure (ECMWF ERA Interim), t2m (ECMWF ERA Interim) and the
altimetric surface heigh measure(=alt_sat+ice1_range). See proceeding:
Blarel and Legresy, Investigations On The Envisat Ra2 Dry Tropspheric
Correction, ESA Living Planet Symposium, Edinburgh, United Kingdom, 2013.
" ;
```

model_dry_tropo_corr_20hz

```
short model_dry_tropo_corr_20hz(time, meas_ind) ;
      model_dry_tropo_corr_20hz:_FillValue = -32767s ;
      model_dry_tropo_corr_20hz:scale_factor = 0.001 ;
      model_dry_tropo_corr_20hz:units = "m" ;
      model_dry_tropo_corr_20hz:long_name = "model dry tropospheric
correction" ;
      model_dry_tropo_corr_20hz:comment = "Dry tropospheric correction
computed from surface_pressure_20hz using relationship of Saastamoinen
(1972) and revisited by Davis et al. (1985). See proceeding: Blarel and
Legresy, Investigations On The Envisat Ra2 Dry Tropspheric Correction, ESA
Living Planet Symposium, Edinburgh, United Kingdom, 2013. " ;
```

temp_2m_ecmwf

```
short temp_2m_ecmwf(time) ;
      temp_2m_ecmwf:_FillValue = -32767s ;
      temp_2m_ecmwf:scale_factor = 0.01 ;
      temp_2m_ecmwf:units = "K" ;
      temp_2m_ecmwf:long_name = "2 metre temperature" ;
      temp_2m_ecmwf:source = "ECMWF ERA Interim" ;
      temp_2m_ecmwf:comment = "2 metre temperature along track
interpolated" ;
```

mean_sea_level_pressure_ecmwf

```
short mean_sea_level_pressure_ecmwf(time) ;
      mean_sea_level_pressure_ecmwf:_FillValue = -32767s ;
      mean_sea_level_pressure_ecmwf:scale_factor = 10. ;
      mean_sea_level_pressure_ecmwf:units = "Pa" ;
      mean_sea_level_pressure_ecmwf:long_name = "Mean sea level pressure" ;
      mean_sea_level_pressure_ecmwf:source = "ECMWF ERA Interim" ;
      mean_sea_level_pressure_ecmwf:comment = "Mean sea level pressure
```

```
along track interpolated" ;
```

iono_nic09

```
short iono_nic09(time) ;
      iono_nic09:long_name = "Modelled Ionospheric Correctionon Ku band,
NIC09." ;
      iono_nic09:standard_name =
"altimeter_range_correction_due_to_ionosphere" ;
      iono_nic09:units = "m" ;
      iono_nic09:_FillValue = -32767s ;
      iono_nic09:comment = "NIC09 correction computed by the CTOH by using
the nicsubs module (ftp://ibis.grdl.noaa.gov/pub/remko/nic09. Revision 1.6
2010/12/22 15:01:49) supplied by: Reference: Scharroo, R., and W. H. F.
Smith, A global positioning system-based climatology for the total electron
content in the ionosphere, J. Geophys. Res., 115, A10318, 2010,
doi:10.1029/2009JA014719." ;
      iono_nic09:scale_factor = 0.001f ;
```

flag_ocean1_ice0_20hz

```
int flag_ocean1_ice0_20hz(time, meas_ind) ;
      flag_ocean1_ice0_20hz:_FillValue = 2147483647 ;
      flag_ocean1_ice0_20hz:comment = "Flag ocean/ice mode out of
calibration modes. Deduced by CTOH from alt_flag_ocean1_ice0_20hz and
calib_mode_flag_20hz" ;
      flag_ocean1_ice0_20hz:units = "flag" ;
      flag_ocean1_ice0_20hz:dims = "(\'time\', \'meas_ind\')" ;
      flag_ocean1_ice0_20hz:type = "i" ;
      flag_ocean1_ice0_20hz:ctoh_edit_date = "2015-01-15 16:56" ;
```

calib_mode_flag_20hz

```
int calib_mode_flag_20hz(time, meas_ind) ;
      calib_mode_flag_20hz:_FillValue = 2147483647 ;
      calib_mode_flag_20hz:comment = "flag>0: Data not usable. Probably in
calibration mode. Deduced by CTOH from:  1/ alt_flag_ocean1_ice0_20hz (2
lonely successive peaks) and 2/ period of calibration (every 2400 20hz-
records) for the intermediate peaks" ;
      calib_mode_flag_20hz:units = "flag" ;
      calib_mode_flag_20hz:dims = "(\'time\', \'meas_ind\')" ;
      calib_mode_flag_20hz:type = "i" ;
      calib_mode_flag_20hz:ctoh_edit_date = "2015-01-15 16:56" ;
```

wet_tropo_cls

```
int wet_tropo_cls(time) ;
      wet_tropo_cls:_FillValue = 32767 ;
      wet_tropo_cls:units = "m" ;
      wet_tropo_cls:long_name = "wet_tropo_cls" ;
      wet_tropo_cls:scale_factor = 0.001 ;
      wet_tropo_cls:comment = "Wet troposphere correction calculated by CLS
over the continents using NCEP data \tWet troposphere correction over the
continents is either incorrect or not available on MGDRs. The program
calculates the correction at the correct altitude, interpolated from the
gridded NCEP levels. MERCIER (2003), Satellite altimetry over non ocean
areas : an improved wet tropospheric correction from meteorological models,
Joint EGS-AGU meeting, Nice, Spring 2003. Used: corr_ssh = (alt - (range_ku
+ solid_earth_tide + ctoh1:iono_lis + pole_tide + inv_barom_corr +
model_dry_tropo_corr + mean_sea_surface))/1000." ;
```

```
      wet_tropo_cls:ctoh_edit_date = "2015-01-14 21:30" ;
```

gim_ku

```
int gim_ku(time) ;
      gim_ku:_FillValue = -2147483648 ;
      gim_ku:units = "m" ;
      gim_ku:long_name =  ;
      gim_ku:scale_factor = 0.001 ;
      gim_ku:comment = "The GIM ionospheric correction is based on Total
Electron Content (TEC) grids which are operationally produced by JPL in
delayed time (5 days) as well as in near real time (10 hours). B.A., ,
I.L., Ho, C.M., Lindqwister, U.J., Mannucci, A.J., Pi, X., Reyes, M.J.,
Sparks, L.C., Wilson, B.D.,(1999). Automated daily process for global
ionospheric total electron content maps and satellite ocean altimeter
ionospheric calibration based on Global Positioning System data Journal of
Atmospheric and Solar-Terrestrial Physics 61 1205-1218" ;
      gim_ku:ctoh_edit_date = "2015-01-14 21:30" ;
```

ocean_tide_l_GOT00

```
int ocean_tide_l_GOT00(time) ;
      ocean_tide_l_GOT00:_FillValue = 32767 ;
      ocean_tide_l_GOT00:units = "m" ;
      ocean_tide_l_GOT00:long_name = "Ocean Tide using GOT 00 model" ;
      ocean_tide_l_GOT00:scale_factor = 0.001 ;
      ocean_tide_l_GOT00:comment = "Ocean tide correction from the GOT2000
tidal model developed at GSFC.\n    Warning: Does not include the load tide
(unlike ocean_tide_sol1), nor the permanent tide (like ocean_tide_sol1)." ;
      ocean_tide_l_GOT00:ctoh_edit_date = "2015-01-14 21:30" ;
```

ocean_tide_FES_04

```
int ocean_tide_FES_04(time) ;
      ocean_tide_FES_04:_FillValue = 32767 ;
      ocean_tide_FES_04:units = "m" ;
      ocean_tide_FES_04:long_name = "Ocean Tide using FES 2004 model" ;
      ocean_tide_FES_04:scale_factor = 0.001 ;
      ocean_tide_FES_04:comment = "Ocean tide correction from the FES model
developed at LEGOS, Toulouse.  F. LYARD, F. LEFEBRE, LETTELIER, T., Francis
O. (2004). Modeling the global ocean tides: modern insights from FES2004.
Ocean dynamics 2006. 10.1007/s10236-006-0086-x.\n    Warning: Does not
include the load tide (unlike ocean_tide_sol2), nor the permanent tide
(like ocean_tide_sol2)." ;
      ocean_tide_FES_04:ctoh_edit_date = "2015-01-14 21:30" ;
```

ocean_tide_GOT47

```
int ocean_tide_GOT47(time) ;
      ocean_tide_GOT47:_FillValue = 32767 ;
      ocean_tide_GOT47:units = "m" ;
      ocean_tide_GOT47:long_name = "Ocean Tide using GOT 4.7 model" ;
      ocean_tide_GOT47:scale_factor = 0.001 ;
      ocean_tide_GOT47:comment = "Tide Predictions in Shelf and Coastal
Waters: Status and Prospects. Ray R. D., Egbert G. D., Erofeeva S. Y. in,
Coastal Altimetry, Ed. Vignudelli S., Kostianoy A., Cipollini P.,
Benveniste J., Springer." ;
      ocean_tide_GOT47:ctoh_edit_date = "2015-01-14 21:30" ;
```

ib_MOG2D_NF

```
int ib_MOG2D_NF(time) ;
      ib_MOG2D_NF:_FillValue = 999999 ;
      ib_MOG2D_NF:units = "m" ;
      ib_MOG2D_NF:long_name = "Inverted Barometer from MOG2D model" ;
      ib_MOG2D_NF:scale_factor = 1.e-05 ;
      ib_MOG2D_NF:comment = "Barotropic ocean response to ECMWF wind and
surface pressure forcing (6h), calculated using the MOG2D barotropic model.
Includes the total non-isostatic ocean response to surface forcing. This
correction replaces the standard inverse barometer correction or ib_ECMWF.
CARRERE L., LYARD F. (2003) Modeling the barotropic response of the global
ocean to atmospheric wind and pressure forcing - comparisons with
observations. Geophysical Res. Lett. vol. 30, n. 6,1275,
doi:10:1029/2002GL016473." ;
      ib_MOG2D_NF:ctoh_edit_date = "2015-01-14 21:30" ;
```

ib_ECMWF_NF

```
int ib_ECMWF_NF(time) ;
      ib_ECMWF_NF:_FillValue = 999999 ;
      ib_ECMWF_NF:units = "m" ;
      ib_ECMWF_NF:long_name = "Inverted Barometer from ECMWF" ;
      ib_ECMWF_NF:scale_factor = 1.e-05 ;
      ib_ECMWF_NF:comment = "Inverted barometer effect calculated from 6-
hourly ECMWF surface pressure data and referenced to the global mean
surface pressure over the oceans and sea-ice. Improvement to the IB
response calculated by AVISO for TOPEX which is relative to a constant 1013
mbar reference surface. The new version conserves mass over the ocean." ;
      ib_ECMWF_NF:ctoh_edit_date = "2015-01-14 21:30" ;
```

ib_MOG2D_hf

```
int ib_MOG2D_hf(time) ;
      ib_MOG2D_hf:_FillValue = 999999 ;
      ib_MOG2D_hf:units = "m" ;
      ib_MOG2D_hf:long_name = "Hight Frequency MOG2D Inverted Barometer" ;
      ib_MOG2D_hf:scale_factor = 1.e-05 ;
      ib_MOG2D_hf:comment = "ib_MOG2D_NF for periods smaller than 20 days."
;
      ib_MOG2D_hf:ctoh_edit_date = "2015-01-14 21:30" ;
```

ib_ECMWF_bf

```
int ib_ECMWF_bf(time) ;
      ib_ECMWF_bf:_FillValue = 999999 ;
      ib_ECMWF_bf:units = "m" ;
      ib_ECMWF_bf:long_name = "Low Frequency ECMWF Inverted Barometer" ;
      ib_ECMWF_bf:scale_factor = 1.e-05 ;
      ib_ECMWF_bf:comment = "ib_ECMWF_NF for periods greater than 20 days."
;
      ib_ECMWF_bf:ctoh_edit_date = "2015-01-14 21:30" ;
```

mss_cnes_cls_11

```
int mss_cnes_cls_11(time) ;
      mss_cnes_cls_11:_FillValue = 2147483647 ;
      mss_cnes_cls_11:scale_factor = 0.001 ;
      mss_cnes_cls_11:CreatedBy = "MSSAscii2Grille" ;
      mss_cnes_cls_11:Title = "Mean sea surface CNES CLS 2011" ;
      mss_cnes_cls_11:FileType = "GRID_DOTS" ;
```

```
      mss_cnes_cls_11:_type_ = "<i4" ;
      mss_cnes_cls_11:long_name = "Mean sea surface heights" ;
      mss_cnes_cls_11:OriginalName = "MSS_CNES_CLS_2011.xyz" ;
      mss_cnes_cls_11:units = "m" ;
      mss_cnes_cls_11:CreatedOn = "08-MAR-2011" ;
      mss_cnes_cls_11:ctoh_edit_date = "2015-01-14 21:26" ;
```

mdt_cnes_cls_09

```
double mdt_cnes_cls_09(time) ;
      mdt_cnes_cls_09:_FillValue = 1.84467440737096e+19 ;
      mdt_cnes_cls_09:CreatedBy = "rio@px-124.cls.fr" ;
      mdt_cnes_cls_09:title = "MDT CNES-CLS09 V1.1" ;
      mdt_cnes_cls_09:FileType = "GRID_DOTS" ;
      mdt_cnes_cls_09:_type_ = "<f8" ;
      mdt_cnes_cls_09:long_name = "Mean Dynamic Topography" ;
      mdt_cnes_cls_09:OriginalName = "MDT_CNES-CLS09_v1.1.nc" ;
      mdt_cnes_cls_09:units = "m" ;
      mdt_cnes_cls_09:CreatedOn = "11-MAR-2010 16:50:55:000000" ;
      mdt_cnes_cls_09:ctoh_edit_date = "2015-01-14 21:50" ;
```

mdt_cnes_cls_09_med

```
float mdt_cnes_cls_09_med(time) ;
      mdt_cnes_cls_09_med:_FillValue = 1.844674e+19f ;
      mdt_cnes_cls_09_med:CreatedBy = "rio@px-124.cls.fr" ;
      mdt_cnes_cls_09_med:title = "SMDT MED07 recalee a Gibraltar (offset
de 0.025 m)" ;
      mdt_cnes_cls_09_med:FileType = "GRID_DOTS" ;
      mdt_cnes_cls_09_med:_type_ = "<f4" ;
      mdt_cnes_cls_09_med:long_name = "Topographie Dynamique Moyenne MED07"
;
      mdt_cnes_cls_09_med:OriginalName = "smdt_med07_recale.nc" ;
      mdt_cnes_cls_09_med:units = "m" ;
      mdt_cnes_cls_09_med:CreatedOn = "29-APR-2010 16:12:33:000000" ;
      mdt_cnes_cls_09_med:ctoh_edit_date = "2015-01-14 22:01" ;
```

geoid_goce

```
double geoid_goce(time) ;
      geoid_goce:scale_factor = 1 ;
      geoid_goce:doc = "Computed from GOCE with a correction to refer the
value to the mean tide system i.e. includes the permanent tide (zero
frequency). Number of considered frequences : HS240 which is equivalent to
a spatial resolution of: 0.75 degrees. The intermediate cartesian grid
resolution is of 0.2 degrees.  Elipsoid:T/P." ;
      geoid_goce:_type_ = "<f8" ;
      geoid_goce:coordinates = "lat lon" ;
      geoid_goce:units = "m" ;
      geoid_goce:original_file = "grille_geoide_ponct.EIGEN-GOCE14p" ;
      geoid_goce:ref = "http://icgem.gfz-poztsdam.de/ICGEM/ICGEM.html" ;
      geoid_goce:ctoh_edit_date = "2015-01-14 22:06" ;
```

geoid_egm08

```
double geoid_egm08(time) ;
      geoid_egm08:scale_factor = 1 ;
      geoid_egm08:doc = "Computed from EGM2008 with a correction to refer
the value to the mean tide system i.e. includes the permanent tide (zero
frequency). Number of considered frequences : HS2400 which is equivalent to
```

```
a spatial resolution of 0.075 degrees. The intermediate cartesian grid
resolution is of 0.033 degrees. Elipsoid:T/P (a_tp= 6378136300.0_16,
e_tp=1/298.257_16)." ;
      geoid_egm08:_type_ = "<f8" ;
      geoid_egm08:coordinates = "lat lon" ;
      geoid_egm08:contact = "ctoh_products@legos.obs-mip.fr" ;
      geoid_egm08:units = "m" ;
      geoid_egm08:original_file =
"grid_geoide_ponc_2mn_egm2008_2190_mean_tide_ctte_Topex" ;
      geoid_egm08:ref = "http://earth-
info.nga.mil/GandG/wgs84/gravitymod/egm2008" ;
      geoid_egm08:ctoh_edit_date = "2015-01-14 22:20" ;
```

mss_dtu_13

```
int mss_dtu_13(time) ;
      mss_dtu_13:scale_factor = 0.001 ;
      mss_dtu_13:source = "Danish National Space Center" ;
      mss_dtu_13:_type_ = "<i4" ;
      mss_dtu_13:title = "DTU13MSS_1min.mss.nc" ;
      mss_dtu_13:actual_range = "[-105.566   86.767]" ;
      mss_dtu_13:Conventions = "COARDS/CF-1.0" ;
      mss_dtu_13:long_name = "mean sea surface height" ;
      mss_dtu_13:units = "m" ;
      mss_dtu_13:node_offset = "1" ;
      mss_dtu_13:ctoh_edit_date = "2015-01-14 22:35" ;
```

geoid_grace

```
double geoid_grace(time) ;
      geoid_grace:units = "m" ;
      geoid_grace:_type_ = "<f8" ;
      geoid_grace:original_file = "GGM02_GHT_GRAV_meantide.GRID" ;
      geoid_grace:scale_factor = 0.001 ;
      geoid_grace:doc = "From GGM02 grid of 0.5 degrees. See http://earth-
info.nga.mil/GandG/wgs84/gravitymod/egm2008" ;
      geoid_grace:ctoh_edit_date = "2015-01-14 22:50" ;
```

mss_cnes_cls_10

```
int mss_cnes_cls_10(time) ;
      mss_cnes_cls_10:_FillValue = 2147483647 ;
      mss_cnes_cls_10:comment = "The mean sea surface has been computed
using a 15-year of TP, ERS1 and ERS2, GFO, JASON1, ENVISAT mean profile
with a spatial resolution of 2\'. It is referenced to 1993-1999 period. The
MSS contains over ocean, the mean geoid plus the mean ocean dynamic
topography (1993-1999);  over land, the EIGEN_GRACE_5C mean geoid; and in
coastal areas a smooth extrapolation/relaxation of the ocean values (geoid
+ MDT) toward the EIGEN_GRACE_5C geoid." ;
      mss_cnes_cls_10:scale_factor = 0.001 ;
      mss_cnes_cls_10:CreatedBy = "MSSAscii2Grille" ;
      mss_cnes_cls_10:Title = "Surface moyenne oceanique CNES CLS 2010" ;
      mss_cnes_cls_10:FileType = "GRID_DOTS" ;
      mss_cnes_cls_10:_type_ = "<i4" ;
      mss_cnes_cls_10:long_name = "Hauteurs de surface moyenne oceanique" ;
      mss_cnes_cls_10:OriginalName = "MSS_CNES_CLS_10" ;
      mss_cnes_cls_10:units = "m" ;
      mss_cnes_cls_10:CreatedOn = "03-MAI-2010" ;
      mss_cnes_cls_10:ctoh_edit_date = "2015-01-14 23:06" ;
```

gridone

```
short gridone(time) ;
      gridone:scale_factor = 1. ;
      gridone:source = "1.00" ;
      gridone:title = "GEBCO One Minute Grid" ;
      gridone:_type_ = "<i2" ;
      gridone:add_offset = 0. ;
      gridone:long_name = "Bathymetry from GEBCO One Minute Grid (gridone)"
;
      gridone:units = "m" ;
      gridone:node_offset = "0" ;
      gridone:ctoh_edit_date = "2015-01-14 23:21" ;
```

dist_to_coast_leuliette

```
float dist_to_coast_leuliette(time) ;
      dist_to_coast_leuliette:comment = "Gridded distance to nearest coast
(>400km2) computed by Eric Leuliette - NOAA/Lab for Satellite Altimetry
using GMT tools and GSHHS coastline" ;
      dist_to_coast_leuliette:title = "Distance to nearest coast (>400km2)
2 minutes gridded map " ;
      dist_to_coast_leuliette:actual_range = "[-2513.44677734
3819.88769531]" ;
      dist_to_coast_leuliette:_type_ = "<f4" ;
      dist_to_coast_leuliette:Conventions = "COARDS/CF-1.0" ;
      dist_to_coast_leuliette:long_name = "distance to coast" ;
      dist_to_coast_leuliette:GMT_version = "4.3.1" ;
      dist_to_coast_leuliette:contact = "Eric.Leuliette@noaa.gov
ctoh_products@legos.obs-mip.fr" ;
      dist_to_coast_leuliette:units = "km" ;
      dist_to_coast_leuliette:node_offset = "0" ;
      dist_to_coast_leuliette:credits = "Eric Leuliette, NOAA Laboratory
for Satellite Altimetry" ;
      dist_to_coast_leuliette:institutions = "NOAA Laboratory for Satellite
Altimetry (original grid). LEGOS/CTOH (interpolation alongtracks)" ;
      dist_to_coast_leuliette:ctoh_edit_date = "2015-01-14 23:36" ;
```

dist_to_coast_stumpf

```
double dist_to_coast_stumpf(time) ;
      dist_to_coast_stumpf:comment = "Original grid provided by  Richard P.
Stumpf from NOAA National Ocean Service. Computed with GMT using the World
Vector Shoreline (WVS) and decimated to the intermediate resolution:
http://gmt.soest.hawaii.edu/gmt/doc/gmt/html/GMT_Docs/node222.html. It
includes all the islands." ;
      dist_to_coast_stumpf:reference =
"http://oceancolor.gsfc.nasa.gov/DOCS/DistFromCoast/" ;
      dist_to_coast_stumpf:title = "Distance to nearest coastline from a
0.04 degrees resolution grid" ;
      dist_to_coast_stumpf:_type_ = "<f8" ;
      dist_to_coast_stumpf:coordinates = "lon lat" ;
      dist_to_coast_stumpf:contact = "ctoh_products@legos.obs-mip.fr" ;
      dist_to_coast_stumpf:units = "km" ;
      dist_to_coast_stumpf:original_file = "dist2coast.signed.txt" ;
      dist_to_coast_stumpf:history = "Wed Jan 26 18:21:17 2011: ncatted -a
comment,global,c,c,Original grid provided by  Richard P. Stumpf from NOAA
National Ocean Service. Computed with GMT using the World Vector Shoreline
```

```
(WVS) and decimated to the intermediate resolution:
http://gmt.soest.hawaii.edu/gmt/doc/gmt/html/GMT_Docs/node222.html. It
includes all the islands. dist2coast.signed.nc\nConversion to netcdf by
CTOH www.ctoh.legos.obs-mip.fr" ;
      dist_to_coast_stumpf:ctoh_edit_date = "2015-01-14 23:50" ;
```

geoid_eigen6c3

```
int geoid_eigen6c3(time) ;
      geoid_eigen6c3:scale_factor = 0.001 ;
      geoid_eigen6c3:doc = "Computed from GOCE with a correction to refer
the value to the mean tide system i.e. includes the permanent tide (zero
frequency). Warning: This \'C\' model has assimilated altimetry data. Thus
it is better than the \'S\' model, but it is not suitable to compute MSS or
MDT from altimetry as the data would be correlated. Number of considered
frequences : HS1949 which is equivalent to a spatial resolution of: 10km or
0.09 degrees. The intermediate cartesian grid resolution is of 0.02
degrees.  Elipsoid:T/P:
gm0=0.39860044150000E+15,a0=0.63781363000000E+07,uapl0=0.29825700000000E+03
,om0=0.72921150000000E-04.. Data provided by Jean-Michel Lemoine from
GET/LEGOS team, on may 2014." ;
      geoid_eigen6c3:_type_ = "<i4" ;
      geoid_eigen6c3:coordinates = "lat lon" ;
      geoid_eigen6c3:add_offset = 0L ;
      geoid_eigen6c3:units = "m" ;
      geoid_eigen6c3:original_file = "grille_EIGEN-
6C3stat.mean_tide.dg_1949.5_min" ;
      geoid_eigen6c3:ref = "http://icgem.gfz-
potsdam.de/ICGEM/documents/Foerste-et-al-EIGEN-6C3stat.pdf" ;
      geoid_eigen6c3:ctoh_edit_date = "2015-01-15 00:05" ;
```

gebco08

```
int gebco08(time) ;
      gebco08:scale_factor = 1. ;
      gebco08:source = "20100927" ;
      gebco08:title = "GEBCO_08 Grid" ;
      gebco08:_type_ = "<i4" ;
      gebco08:add_offset = 0. ;
      gebco08:long_name = "Bathymetry from GEBCO Half A Minute Grid
(gebco_08)" ;
      gebco08:units = "m" ;
      gebco08:node_offset = "1" ;
      gebco08:ctoh_edit_date = "2015-01-15 00:21" ;
```

ice1_range_intermission_corr_20hz

```
short ice1_range_intermission_corr_20hz(time, meas_ind) ;
      ice1_range_intermission_corr_20hz:_FillValue = -32767s ;
      ice1_range_intermission_corr_20hz:units = "m" ;
      ice1_range_intermission_corr_20hz:scale_factor = 0.001 ;
      ice1_range_intermission_corr_20hz:long_name = "ICE-1 Range Cross-
validation Correction" ;
      ice1_range_intermission_corr_20hz:comment = "ICE-1 Range correction
to apply to ICE-1 ranges to have this ERS-2 release product consistent with
the ICE-1 range of the ENVISAT-V2.1 product. This correction correct the
inter-mission crossover difference to the satellites altitude (alt_20hz).
It is already applied to the ICE-1 ranges parameters. It had been estimated
by the CTOH in the Cross-Validation report available on it web site. Ref: "
```

```
;
```

ice1_sig0_intermission_corr_20hz

```
short ice1_sig0_intermission_corr_20hz(time, meas_ind) ;
      ice1_sig0_intermission_corr_20hz:_FillValue = -32767s ;
      ice1_sig0_intermission_corr_20hz:units = "dB" ;
      ice1_sig0_intermission_corr_20hz:scale_factor = 0.001 ;
      ice1_sig0_intermission_corr_20hz:long_name = "ICE-1 Backscatter
Cross-validation Correction" ;
      ice1_sig0_intermission_corr_20hz:comment = "ICE-1 Backscatter
correction to apply to ICE-1 Backscatter to have this ERS-2 release product
consistent with the ICE-1 backscatter of the ENVISAT-V2.1 product. This
correction correct the inter-mission crossover difference to the satellites
altitude (alt_20hz). It is already applied to the ICE-1 Backscatter
parameter. This correction had been estimated by the CTOH in the Cross-
Validation report available on it web site. Ref: " ;
```

ice2_range_intermission_corr_20hz

```
short ice2_range_intermission_corr_20hz(time, meas_ind) ;
      ice2_range_intermission_corr_20hz:_FillValue = -32767s ;
      ice2_range_intermission_corr_20hz:units = "m" ;
      ice2_range_intermission_corr_20hz:scale_factor = 0.001 ;
      ice2_range_intermission_corr_20hz:long_name = "ICE-2 Range Cross-
validation Correction" ;
      ice2_range_intermission_corr_20hz:comment = "ICE-2 Range correction
to apply to ICE-2 ranges to have this ERS-2 release product consistent with
the ICE-2 range of the ENVISAT-V2.1 product. This correction correct the
inter-mission crossover difference to the satellites altitude (alt_20hz).It
is already applied to the ICE-2 range parameter. This correction had been
estimated by the CTOH in the Cross-Validation report available on it web
site. Ref: " ;
```

ice2_sig0_intermission_corr_20hz

```
short ice2_sig0_intermission_corr_20hz(time, meas_ind) ;
      ice2_sig0_intermission_corr_20hz:_FillValue = -32767s ;
      ice2_sig0_intermission_corr_20hz:units = "dB" ;
      ice2_sig0_intermission_corr_20hz:scale_factor = 0.001 ;
      ice2_sig0_intermission_corr_20hz:long_name = "ICE-2 Backscatter
Cross-validation Correction" ;
      ice2_sig0_intermission_corr_20hz:comment = "ICE-2 Backscatter
correction to apply to ICE-2 Backscatter to have this ERS-2 release product
consistent with the ICE-2 backscatter of the ENVISAT-V2.1 product. This
correction correct the inter-mission crossover difference to the satellites
altitude (alt_20hz). It is already applied to the ICE-2 Backscatter
parameter. This correction had been estimated by the CTOH in the Cross-
Validation report available on it web site. Ref: " ;
```

ice2_le_width_intermission_corr_20hz

```
short ice2_le_width_intermission_corr_20hz(time, meas_ind) ;
      ice2_le_width_intermission_corr_20hz:_FillValue = -32767s ;
      ice2_le_width_intermission_corr_20hz:units = "m" ;
      ice2_le_width_intermission_corr_20hz:scale_factor = 0.001 ;
      ice2_le_width_intermission_corr_20hz:long_name = "ICE-2 Leading Edge
Width Cross-validation Correction" ;
      ice2_le_width_intermission_corr_20hz:comment = "ICE-2 Leading Edge
Width correction to apply to ICE-2 Leading Edge Width to have this ERS-2
```

```
release product consistent with the ICE-2 Leading Edge Width of the
ENVISAT-V2.1 product. This correction correct the inter-mission crossover
difference to the satellites altitude (alt_20hz). It is already applied to
the ICE-2 Leading Edge Width parameter. This correction had been estimated
by the CTOH in the Cross-Validation report available on it web site. Ref: "
;
```

ice2_1st_te_slope_intermission_corr_20hz

```
short ice2_1st_te_slope_intermission_corr_20hz(time, meas_ind) ;
      ice2_1st_te_slope_intermission_corr_20hz:_FillValue = -32767s ;
      ice2_1st_te_slope_intermission_corr_20hz:units = "s⁻¹" ;
      ice2_1st_te_slope_intermission_corr_20hz:scale_factor = 0.001 ;
      ice2_1st_te_slope_intermission_corr_20hz:long_name = "ICE-2 Trailing
Edge Slope Cross-validation Correction" ;
      ice2_1st_te_slope_intermission_corr_20hz:comment = "ICE-2 Trailing
Edge Slope correction to apply to ICE-2 Trailing Edge Slope to have this
ERS-2 release product consistent with the ICE-2 Trailing Edge Slope of the
ENVISAT-V2.1 product. This correction correct the inter-mission crossover
difference to the satellites altitude (alt_20hz). It is already applied to
the ICE-2 Trailing Edge Slope parameter. This correction had been estimated
by the CTOH in the Cross-Validation report available on it web site. Ref: "
;
```

10 Detailed parameters and corrections interpolated from ERS-2 Reaper Product.

load_tide_sol2_reaper

```
short load_tide_sol2_reaper(time) ;
      load_tide_sol2_reaper:_FillValue = 32767s ;
      load_tide_sol2_reaper:comment = "Data interpolated from product
ers2.r by CTOH. This value can be added to the corresponding ocean tide
height value recorded in the product (ocean_tide_sol2). See
 REAPER User Handbook." ;
      load_tide_sol2_reaper:scale_factor = 0.001 ;
      load_tide_sol2_reaper:source = "FES2004" ;
      load_tide_sol2_reaper:_dimensions_ = "(u\'time\',)" ;
      load_tide_sol2_reaper:coordinates = "lon lat" ;
      load_tide_sol2_reaper:long_name = "load tide height for geocentric
ocean tide (solution 2)" ;
      load_tide_sol2_reaper:_nb_cycles_ = "1" ;
      load_tide_sol2_reaper:_nc_data_type_ = "<i2" ;
      load_tide_sol2_reaper:units = "m" ;
      load_tide_sol2_reaper:institution = "CLS" ;
      load_tide_sol2_reaper:_nb_hf_per_record_ = "1" ;
      load_tide_sol2_reaper:ctoh_edit_date = "2015-05-20 22:29" ;
```

ocean_tide_sol1_reaper

```
short ocean_tide_sol1_reaper(time) ;
      ocean_tide_sol1_reaper:_FillValue = 32767s ;
      ocean_tide_sol1_reaper:comment = "Data interpolated from product
ers2.r by CTOH. Solution 1 corresponds to GOT4.7 model. This is the pure
ocean tide, not including the corresponding loading tide
(load_tide_sol1) and equilibrium long-period ocean tide height
(ocean_tide_equil). The permanent tide (zero frequency) is not included in
this parameter because it is included in the geoid and mean sea surface (
geoid, mean_sea_surface). See REAPER User Handbook." ;
      ocean_tide_sol1_reaper:scale_factor = 0.001 ;
      ocean_tide_sol1_reaper:source = "GOT4.7" ;
      ocean_tide_sol1_reaper:_dimensions_ = "(u\'time\',)" ;
      ocean_tide_sol1_reaper:coordinates = "lon lat" ;
      ocean_tide_sol1_reaper:long_name = "ocean tide height (solution 1)" ;
      ocean_tide_sol1_reaper:_nb_cycles_ = "1" ;
      ocean_tide_sol1_reaper:_nc_data_type_ = "<i2" ;
      ocean_tide_sol1_reaper:units = "m" ;
      ocean_tide_sol1_reaper:institution = "CLS" ;
      ocean_tide_sol1_reaper:_nb_hf_per_record_ = "1" ;
      ocean_tide_sol1_reaper:ctoh_edit_date = "2015-05-20 22:29" ;
```

ocean_tide_sol2_reaper

```
short ocean_tide_sol2_reaper(time) ;
      ocean_tide_sol2_reaper:_FillValue = 32767s ;
      ocean_tide_sol2_reaper:comment = "Data interpolated from product
ers2.r by CTOH. Solution 2 corresponds to FES2004 model. This is the pure
ocean tide, not including the corresponding loading tide
 (load_tide_sol2) and equilibrium long-period ocean tide height
(ocean_tide_equil). The permanent tide (zero frequency) is not included in
this parameter because it is included in the geoid and mean sea surface
```

```
(geoid, mean_sea_surface). See REAPER User Handbook." ;
      ocean_tide_sol2_reaper:scale_factor = 0.001 ;
      ocean_tide_sol2_reaper:source = "FES2004" ;
      ocean_tide_sol2_reaper:_dimensions_ = "(u\'time\',)" ;
      ocean_tide_sol2_reaper:coordinates = "lon lat" ;
      ocean_tide_sol2_reaper:long_name = "ocean tide height (solution 2)" ;
      ocean_tide_sol2_reaper:_nb_cycles_ = "1" ;
      ocean_tide_sol2_reaper:_nc_data_type_ = "<i2" ;
      ocean_tide_sol2_reaper:units = "m" ;
      ocean_tide_sol2_reaper:institution = "CLS" ;
      ocean_tide_sol2_reaper:_nb_hf_per_record_ = "1" ;
      ocean_tide_sol2_reaper:ctoh_edit_date = "2015-05-20 22:29" ;
```

pole_tide_reaper

```
short pole_tide_reaper(time) ;
      pole_tide_reaper:_FillValue = 32767s ;
      pole_tide_reaper:comment = "Data interpolated from product ers2.r by
CTOH. See REAPER User Handbook." ;
      pole_tide_reaper:scale_factor = 0.001 ;
      pole_tide_reaper:source = "Wahr [1985]" ;
      pole_tide_reaper:_dimensions_ = "(u\'time\',)" ;
      pole_tide_reaper:coordinates = "lon lat" ;
      pole_tide_reaper:long_name = "geocentric pole tide height" ;
      pole_tide_reaper:standard_name =
"sea_surface_height_amplitude_due_to_pole_tide" ;
      pole_tide_reaper:_nb_cycles_ = "1" ;
      pole_tide_reaper:_nc_data_type_ = "<i2" ;
      pole_tide_reaper:units = "m" ;
      pole_tide_reaper:institution = "CLS" ;
      pole_tide_reaper:_nb_hf_per_record_ = "1" ;
      pole_tide_reaper:ctoh_edit_date = "2015-05-20 22:29" ;
```

ocean_tide_non_equil_reaper

```
short ocean_tide_non_equil_reaper(time) ;
      ocean_tide_non_equil_reaper:_FillValue = 32767s ;
      ocean_tide_non_equil_reaper:comment = "Data interpolated from product
ers2.r by CTOH. This parameter is computed as a correction to the parameter
ocean_tide_equil. This value can be added to ocea
n_tide_equil (or ocean_tide_sol1, ocean_tide_sol2) so that the resulting
value models the total non equilibrium ocean tide height. See REAPER User
Handbook." ;
      ocean_tide_non_equil_reaper:scale_factor = 0.001 ;
      ocean_tide_non_equil_reaper:source = "FES2004" ;
      ocean_tide_non_equil_reaper:_dimensions_ = "(u\'time\',)" ;
      ocean_tide_non_equil_reaper:coordinates = "lon lat" ;
      ocean_tide_non_equil_reaper:long_name = "non-equilibrium long-period
ocean tide height" ;
      ocean_tide_non_equil_reaper:standard_name =
"sea_surface_height_amplitude_due_to_non_equilibrium_ocean_tide" ;
      ocean_tide_non_equil_reaper:_nb_cycles_ = "1" ;
      ocean_tide_non_equil_reaper:_nc_data_type_ = "<i2" ;
      ocean_tide_non_equil_reaper:units = "m" ;
      ocean_tide_non_equil_reaper:institution = "CLS" ;
      ocean_tide_non_equil_reaper:_nb_hf_per_record_ = "1" ;
      ocean_tide_non_equil_reaper:ctoh_edit_date = "2015-05-20 22:29" ;
```

tb_365_reaper

```
short tb_365_reaper(time) ;
      tb_365_reaper:_FillValue = 32767s ;
      tb_365_reaper:quality_flag = "interp_flag_tb rad_state_" ;
      tb_365_reaper:scale_factor = 0.01 ;
      tb_365_reaper:long_name = "36.5 GHz main beam brightness temperature"
;
      tb_365_reaper:_dimensions_ = "(u\'time\',)" ;
      tb_365_reaper:coordinates = "lon lat" ;
      tb_365_reaper:_nb_cycles_ = "1" ;
      tb_365_reaper:standard_name = "surface_brightness_temperature" ;
      tb_365_reaper:_nc_data_type_ = "<i2" ;
      tb_365_reaper:units = "K" ;
      tb_365_reaper:comment = "Data interpolated from product ers2.r by
CTOH. Brightness temperature measured by the microwave radiometer at 36.5
GHz and cross-calibrated with ENVISAT. This is an avera
ged, 1 Hz value computed from the valid 20 Hz measurements." ;
      tb_365_reaper:_nb_hf_per_record_ = "1" ;
      tb_365_reaper:ctoh_edit_date = "2015-05-20 22:29" ;
```

rad_wet_tropo_corr_reaper

```
short rad_wet_tropo_corr_reaper(time) ;
      rad_wet_tropo_corr_reaper:_FillValue = 32767s ;
      rad_wet_tropo_corr_reaper:quality_flag = "qual_rad_1hz
interp_flag_tb" ;
      rad_wet_tropo_corr_reaper:scale_factor = 0.001 ;
      rad_wet_tropo_corr_reaper:source = "MWR" ;
      rad_wet_tropo_corr_reaper:_dimensions_ = "(u\'time\',)" ;
      rad_wet_tropo_corr_reaper:coordinates = "lon lat" ;
      rad_wet_tropo_corr_reaper:long_name = "radiometer wet tropospheric
correction" ;
      rad_wet_tropo_corr_reaper:standard_name =
"altimeter_range_correction_due_to_wet_troposphere" ;
      rad_wet_tropo_corr_reaper:_nb_cycles_ = "1" ;
      rad_wet_tropo_corr_reaper:_nc_data_type_ = "<i2" ;
      rad_wet_tropo_corr_reaper:units = "m" ;
      rad_wet_tropo_corr_reaper:institution = "CLS" ;
      rad_wet_tropo_corr_reaper:comment = "Data interpolated from product
ers2.r by CTOH. A wet tropospheric correction must be added (negative
value) to the instrument range to correct this range meas
urement for wet tropospheric range delays of the radar pulse. See REAPER
User Handbook." ;
      rad_wet_tropo_corr_reaper:_nb_hf_per_record_ = "1" ;
      rad_wet_tropo_corr_reaper:ctoh_edit_date = "2015-05-20 22:29" ;
```

model_wet_tropo_corr_reaper

```
short model_wet_tropo_corr_reaper(time) ;
      model_wet_tropo_corr_reaper:_FillValue = 32767s ;
      model_wet_tropo_corr_reaper:comment = "Data interpolated from product
ers2.r by CTOH. Computed at the altimeter time-tag from the interpolation
of 2 meteorological fields that surround the altime
ter time-tag. A wet tropospheric correction must be added (negative value)
to the instrument range to correct this range measurement for wet
tropospheric range delays of the radar pulse. See REAPER User Handbook
." ;
      model_wet_tropo_corr_reaper:scale_factor = 0.001 ;
```

```
	model_wet_tropo_corr_reaper:source = "European Center for Medium 
Range Weather Forecasting" ;
	model_wet_tropo_corr_reaper:_dimensions_ = "(u\'time\',)" ;
	model_wet_tropo_corr_reaper:coordinates = "lon lat" ;
	model_wet_tropo_corr_reaper:long_name = "model wet tropospheric 
correction" ;
	model_wet_tropo_corr_reaper:standard_name = 
"altimeter_range_correction_due_to_wet_troposphere" ;
	model_wet_tropo_corr_reaper:_nb_cycles_ = "1" ;
	model_wet_tropo_corr_reaper:_nc_data_type_ = "<i2" ;
	model_wet_tropo_corr_reaper:units = "m" ;
	model_wet_tropo_corr_reaper:institution = "ECMWF" ;
	model_wet_tropo_corr_reaper:_nb_hf_per_record_ = "1" ;
	model_wet_tropo_corr_reaper:ctoh_edit_date = "2015-05-20 22:29" ;
```

tb_238_reaper

```
short tb_238_reaper(time) ;
	tb_238_reaper:_FillValue = 32767s ;
	tb_238_reaper:quality_flag = "interp_flag_tb rad_state_" ;
	tb_238_reaper:scale_factor = 0.01 ;
	tb_238_reaper:long_name = "23.8 GHz main beam brightness temperature" 
;
	tb_238_reaper:_dimensions_ = "(u\'time\',)" ;
	tb_238_reaper:coordinates = "lon lat" ;
	tb_238_reaper:_nb_cycles_ = "1" ;
	tb_238_reaper:standard_name = "surface_brightness_temperature" ;
	tb_238_reaper:_nc_data_type_ = "<i2" ;
	tb_238_reaper:units = "K" ;
	tb_238_reaper:comment = "Data interpolated from product ers2.r by 
CTOH. Brightness temperature measured by the microwave radiometer at 23.8 
GHz and cross-calibrated with ENVISAT. This is an avera
ged, 1 Hz value computed from the valid 20 Hz measurements." ;
	tb_238_reaper:_nb_hf_per_record_ = "1" ;
	tb_238_reaper:ctoh_edit_date = "2015-05-20 22:29" ;
```

ocean_tide_equil_reaper

```
short ocean_tide_equil_reaper(time) ;
	ocean_tide_equil_reaper:_FillValue = 32767s ;
	ocean_tide_equil_reaper:comment = "Data interpolated from product 
ers2.r by CTOH. This value can be added to the two geocentric ocean tide 
height values recorded in the product (ocean_tide_sol1 a
nd ocean_tide_sol2)." ;
	ocean_tide_equil_reaper:scale_factor = 0.001 ;
	ocean_tide_equil_reaper:source = "Cartwright tidal potential" ;
	ocean_tide_equil_reaper:_dimensions_ = "(u\'time\',)" ;
	ocean_tide_equil_reaper:coordinates = "lon lat" ;
	ocean_tide_equil_reaper:long_name = "equilibrium long-period ocean 
tide height" ;
	ocean_tide_equil_reaper:standard_name = 
"sea_surface_height_amplitude_due_to_equilibrium_ocean_tide" ;
	ocean_tide_equil_reaper:_nb_cycles_ = "1" ;
	ocean_tide_equil_reaper:_nc_data_type_ = "<i2" ;
	ocean_tide_equil_reaper:units = "m" ;
	ocean_tide_equil_reaper:institution = "CLS" ;
	ocean_tide_equil_reaper:_nb_hf_per_record_ = "1" ;
	ocean_tide_equil_reaper:ctoh_edit_date = "2015-05-20 22:29" ;
```

load_tide_sol1_reaper

```
short load_tide_sol1_reaper(time) ;
      load_tide_sol1_reaper:_FillValue = 32767s ;
      load_tide_sol1_reaper:comment = "Data interpolated from product
ers2.r by CTOH. This value can be added to the corresponding ocean tide
height value recorded in the product (ocean_tide_sol1). See
 REAPER User Handbook." ;
      load_tide_sol1_reaper:scale_factor = 0.001 ;
      load_tide_sol1_reaper:source = "GOT4.7" ;
      load_tide_sol1_reaper:_dimensions_ = "(u\'time\',)" ;
      load_tide_sol1_reaper:coordinates = "lon lat" ;
      load_tide_sol1_reaper:long_name = "load tide height for geocentric
ocean tide (solution 1)" ;
      load_tide_sol1_reaper:_nb_cycles_ = "1" ;
      load_tide_sol1_reaper:_nc_data_type_ = "<i2" ;
      load_tide_sol1_reaper:units = "m" ;
      load_tide_sol1_reaper:institution = "CLS" ;
      load_tide_sol1_reaper:_nb_hf_per_record_ = "1" ;
      load_tide_sol1_reaper:ctoh_edit_date = "2015-05-20 22:29" ;
```

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