

Version History

Sea ice products are continuously updated to include scientific and technical improvements. We aim for a yearly update cycle for the AWI CryoSat-2 sea-ice data, which is implemented at the start of the Arctic winter season on Oct. 1st. An update of the algorithm includes a re-processing of the full CryoSat-2 data record. Each update contains algorithm evolutions (changes of the processing evolutions) and system evolutions (changes of the code or input data sets).

[[Summary](#)] [[Changelog](#)] [[Fall 2023 \(v2.6\)](#)] [[Fall 2022 Update \(v2.5\)](#)] [[Fall 2021 Update \(v2.4\)](#)] [[Fall 2020 Update \(v2.3\)](#)] [[Fall 2019 Update \(v2.2\)](#)]

Summary

Version	Platform	Coverage	Documentation
v1.2	CryoSat-2	2010-11-01 - 2017-04-30	epic.awi.de
v2.0	CryoSat-2	2010-11-01 - 2018-04-30	
v2.1	CryoSat-2	2010-11-01 - 2019-04-30	epic.awi.de
v2.2	CryoSat-2	2010-11-01 - 2020-04-30	epic.awi.de
v2.3	CryoSat-2	2010-11-01 - 2021-04-30	epic.awi.de
v2.4	CryoSat-2	2010-11-01 - 2022-04-30	epic.awi.de
v2.5	CryoSat-2	2010-11-01 - 2023-04-30	Zenodo
v2.6	CryoSat-2	2010-10-21 - 2024-04-30 (TBD)	

Changelog

Fall 2023 (v2.6)

Input Data

- CryoSat-2 ICE baseline-E L1B data is now used for the full data record. In the previous version baseline-D data was used until April 2020)
- CryoSat-2 ICE baseline-E L1B data from 21. Oct. 2010 to 30. Oct. 2010 added

Auxiliary Data

- New version 3 of OSI-SAF/C3S sea ice concentration and type (interim) climate data record. Notable change is improved sea ice type information in early October (see Known Issues of version 2.5)

Fixed Issues

- Latency of CryoSat-2 near real-time data has been increased from 36h to 48h to avoid missing files on the AWI production system.

Known Issues

- The marginal ice zone flag may include LRM waveforms over open water (carried over from v2.5)

Fall 2022 Update (v2.5)

Input Data

- Open Ocean data from CryoSat-2 pulse-limited radar mode (LRM) is included, but not yet used for estimation of sea surface height

Auxiliary Data

- Update region code to [2021 NSIDC regional mask for Arctic sea ice trends and climatologies](#) (credit J. Scott Stewart and Walter N. Meier, NSIDC)

Algorithm

- New surface type classification (sea ice / lead / open ocean discrimination). The new surface type classification increases the number of waveforms for sea ice freeboard/thickness evaluation.
- New flag indicating surface wave / swell influence in the marginal ice zone. Surface waves that penetrate into the sea ice lead to a roughening of the surface and a freeboard bias. This bias is now detected based on waveform properties and the distance to open water from sea ice concentration data.
- Quality flag (l3c variable `quality_flag`) now also depends on marginal ice zone flag

Product format and content

- Quality flag (l3c variable `quality_flag`) now also depends on marginal ice zone flag
- Added `coverage_content_type` attribute to all netCDF variables

- Minor update of global attributes

Fixed Issues

- Date in L2P files was incorrect in version 2.4 in cases where the first orbit included data from a previous day. In this case the L2P file from the previous file was overwritten resulting in data loss.
- Fixed issue with connecting data from the same orbit that was distributed over different files in Level-1 pre-processor. The issue has caused data loss and degraded sea surface height information (see <https://github.com/pysiral/pysiral/issues/91>)
- Fixed issue with computing pulse peakiness for noisy waveforms in Level-1 pre-processor. This issue has caused incorrect surface type classifications (<https://github.com/pysiral/pysiral/issues/89>)

Known Issues

- Sea ice type auxiliary data set for reprocessed CryoSat-2 (OSI-SAF/C3S sea ice type climate data record only contains ambiguous ice types in the first half of October. This leads to a sudden change of the snow depth and density parametrization and a change in sea ice thickness on October 16). The OSI-SAF operational sea ice type product is not affected.
- The marginal ice zone flag may include LRM waveforms over open water.

Fall 2021 Update (v2.4)

Input Data

- CryoSat-2 ICE baseline E data as primary altimeter data now used for the operational near real-time and reprocessed data generation from October 2021 and later. The previous data record (Nov 2010 till April 2021) is based on the previous L1B version (ICE baseline D).

Auxiliary Data

- Updated C3S sea ice type (interim) climate data record from version 1 to version 2 (reprocessed data only).
- Updated OSI-SAF operational sea ice type to version OSI-403-d.
- Updated mean sea surface from DTU15 to DTU21.

Algorithm

- Surface type classification: Sea ice mask is now based on 15% sea ice concentration threshold. The threshold was 70% in previous versions.
- Used 'uncertainty' field in OSI-403-d sea ice type files instead of parametrization based on 'confidence' flags of previous versions.
- The sea ice thickness quality flag is no longer automatically set to 'intermediate' outside the central Arctic basin.

Product format and content

- Flag values of the status flag (l3c variable 'status_flag') have been changed. Flag value 0 is now 'nominal' and other values have been shifted accordingly.
- Flag values of the quality flag (l3c variable 'quality_flag') have been changed. Flag value 0 is now 'nominal' and the 'no data' has been moved to flag value 3.
- Various changes to the global and variable attributes to improve compliance with newer versions of the Climate & Forecast (CF) and Attribute Convention for Dataset Discovery (ACDD) standards.

Level-1 Pre-Processor

- Added L1 preprocessor for CryoSat-2 L1b for ICE baseline-E.

Fall 2020 Update (v2.3)

Input Data

- CryoSat-2 baseline-D data as primary altimeter data now used for the full reprocessed data record since November 2010.

Auxiliary Data

- Switched C3S sea-ice concentration (interim) climate data record from v1.2 to v2.0
- Reverted mean sea surface from DTU18 to DTU15
- Optimized sea-ice type information near coasts and in the Canadian Archipelago

Algorithm

- Updated computation of wave speed correction in the snow layer following [Mallett et al., 2020](#)
- Used hemisphere-wide snow density values following [Mallett et al., 2020](#)
- Snow depth and density values are updated daily instead of monthly to avoid freeboard and thickness discontinuities at a change of month
- Optimizations in the estimation of along-track sea-level anomaly

Product format and content

- Field sea level anomaly is now named 'sea_level_anomaly' instead of 'sea_surface_height_anomaly'

Level-1 Pre-Processor

- Fixed an issue that resulted in loss of data for the SARin radar mode (most severe in the Canadian Archipelago). Data was rejected based on an incorrect interpretation of the measurement confidence flag for baseline-D SARin data files.

Fall 2019 Update (v2.2)

Input Data

- CryoSat-2 baseline-D data as primary altimeter data since April 28, 2019. NOTE: In v2.2 the reprocessed grid products consist of a mix between baseline-C and baseline-D

Auxiliary Data

- Use C3S (interim) climate data records of sea ice concentration as auxiliary data for the reprocessed data stream. This fixes an issue with evolving land masks in the OSI-SAF operational products, which will not be reprocessed to a consistent standard. The C3S sea ice type is also known to be more precise in the marginal ice zone

Level-1 Pre-Processor

- Added support for the new ESA baseline-D netCDF format
- Increased the regional subset from 50N – 88N in version 2.1 to 45N – 88N

Level-2 Processor

- Split algorithm between near-real time and reprocessed with timeliness dependent choice of validation data
- Removed requirement of having a minimum of 3 leads in each orbit.
- Added sea ice draft and sea ice draft uncertainty as output variables
- Renamed freeboard to sea ice freeboard to be in line with the variables standard name

Level-3 Processor

- Added sea ice draft and sea ice draft uncertainty as output variables
- Renamed freeboard to sea ice freeboard to be in line with the variables standard name
- Removed the average Level-2 orbit-based uncertainty for radar freeboard, sea-ice freeboard and sea-ice thickness
- All statistical variables are now named with a “stat_” prefix in the variable name for clarity
- Added temporal statistics variables (see Temporal Coverage per grid cell5.2)
- Added the fraction of negative thicknesses per grid cell as statistical parameter
- Added geotiff output (variable sea-ice thickness only) for all gridded products