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|  <b>antarctic<br/>ice sheet<br/>cci</b> | Anterctic_Ice_Sheet_cci+<br>CRDP Release Note | Reference : NU-ESA-AISCCI+-CRDP_RN-001<br>Version : 1.0 page<br>Date : 10 June 2026 1/14 |
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# **ESA Climate Change Initiative (CCI+)** **Essential Climate Variable (ECV)** **Antarctic\_Ice\_Sheet\_cci+ phase 2** **(AIS\_cci+ phase 2)**

## Climate Research Data Package (CRDP) Release Notes

|                       |                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| Technical Officer(s): | Anna Maria Trofaier<br>ESA ECSAT, Didcot, United Kingdom                                                                                                                                                                                                                                                                                                                   |
| Consortium:           | DTU Microwaves and Remote Sensing Group (DTU-N)<br>DTU Geodynamics Group (DTU-S)<br>Environmental Earth Observation IT GmbH (ENVEO)<br>Deutsches Zentrum für Luft- und Raumfahrt (DLR) Remote Sensing Technology<br>Institute (IMF)<br>Northumbria University (NU)<br>S&T Norway AS (S&T)<br>Technische Universität Dresden (TUDr)<br>University College London (UCL/MSSL) |

**Signatures page**

|             |                                              |                                                                                    |
|-------------|----------------------------------------------|------------------------------------------------------------------------------------|
| Prepared by | Andrew Shepherd<br>Science Lead, NU          |  |
| Issued by   | Daniele Fantin,<br>Project Manager, S&T      |                                                                                    |
| Approved by | Anna Maria Trofaier<br>ESA Technical Officer |                                                                                    |



# Table of Contents

|                                                   |          |
|---------------------------------------------------|----------|
| <b>Signatures page</b>                            | <b>2</b> |
| <b>Change Log</b>                                 | <b>3</b> |
| <b>Acronyms and Abbreviations</b>                 | <b>5</b> |
| <b>1 Introduction</b>                             | <b>6</b> |
| 1.2 Document Structure                            | 6        |
| 1.3 Applicable and Reference Documents            | 6        |
| <b>2 CRDP release notes on each ECV released.</b> | <b>7</b> |
| 2.1 Surface Elevation Changes (SEC)               | 7        |
| 2.2 Ice Velocity from SAR                         | 8        |
| 2.3 Grounding Line Location                       | 9        |
| 2.4 Gravimetric Mass Balance                      | 10       |
| 2.5 Ice Shelf CoastLine (ISCL)                    | 12       |
| 2.6 Prototype Uplift product                      | 13       |

## Acronyms and Abbreviations

| Acronym  | Explanation                                   |
|----------|-----------------------------------------------|
| AIS      | Antarctic Ice Sheet                           |
| ADP      | Algorithm Development Plan                    |
| AIS_cci+ | Antarctic Ice Sheets CCI project Extension    |
| API      | Antarctic Peninsula                           |
| ATBD     | Algorithm Theoretical Basis Document          |
| CAR      | Climate Assessment Report                     |
| CCI(+)   | Climate Change Initiative (Extension)         |
| CFL      | Calving Front Location                        |
| CONAE    | Comisión Nacional de Actividades Espaciales   |
| DEM      | Digital Elevation Model                       |
| DLR      | Deutsches Zentrum für Luft- und Raumfahrt     |
| DTU      | Danish Technical University                   |
| EAIS     | East Antarctic Ice Sheet                      |
| ECV      | Essential Climate Variable                    |
| ENVEO    | ENVironmental Earth Observation GmbH          |
| EO       | Earth Observation                             |
| ESA      | European Space Agency                         |
| GLL      | Grounding Line Location                       |
| GLM      | Grounding Line Migration                      |
| GMB      | Gravimetric Mass Balance                      |
| ISCL     | Ice Shelf Coast Line                          |
| IV       | Ice Velocity                                  |
| IV-TDM   | Ice Velocity Tidal Correction Module          |
| IVC      | Ice Velocity Change                           |
| MFID     | Mass Flux Ice Discharge                       |
| MPC      | Mission Performance Cluster                   |
| SEC      | Surface Elevation Change                      |
| SL       | Science Lead                                  |
| SOW      | Statement of Work                             |
| ST       | Science & Technology AS                       |
| TOPS     | Terrain Observation by Progressive Scans      |
| TUD      | Technical University of Dresden               |
| UB       | University of Bristol                         |
| UCL      | University College London                     |
| UL       | University of Leeds                           |
| UN       | University of Northumbria                     |
| WAIS     | West Antarctic Ice Sheet                      |
| NASA     | National Aeronautics and Space Administration |
| SAR      | Synthetic Aperture Radar                      |
| InSAR    | Interferometric SAR                           |
| ML       | Machine Learning                              |

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|--------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------------------------|
|  <b>antarctic<br/>ice sheet<br/>cci</b> | Anterctic_Ice_Sheet_cci+<br>CRDP Release Note | Reference : NU-ESA-AISCCI+-CRDP_RN-001<br>Version : 1.0 page<br>Date : 10 June 2026 6/14 |
|--------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------------------------|

# 1 Introduction

## 1.1 Purpose and Scope

This document is a release note associated with CRDP ECV data products released by the Antarctic\_Ice\_Sheet\_cci (AIS\_cci) project for CCI+ Phase 2, in accordance with the contract and SoW [AD1 and AD2]. The purpose of this note is to give an overview of the products being released:

- Surface Elevation Change (SEC) ECV parameter.
- Ice Velocity (IV) ECV parameter.
- Grounding Line Location (GLL) ECV parameter.
- Gravimetric Mass Balance (GMB) ECV parameter.
- Ice Shelf CoastLine (ISCL) parameter.

## 1.2 Document Structure

This document is structured as follows:

- Chapter 1 provides an introduction to the document.
- Chapter 2 provides a short overview of each ECV released.

## 1.3 Applicable and Reference Documents

**Table 1.1: List of Applicable Documents**

| No  | Doc. Id                                                   | Doc. Title                                                                                                   | Date       | Issue/<br>Revision/<br>Version |
|-----|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|------------|--------------------------------|
| AD1 | ESA/Contract No. 4000143397/23/I-NB<br>CCI+ PHASE 2 - AIS | CCI+ PHASE 2 - NEW R&D ON CCI ECVS for AIS<br>CCI                                                            | 13.02.2024 | NA                             |
| AD2 | ESA-EOP-SC-AMT-2023-12 and its<br>appendix 2              | STATEMENT OF WORK, ESA EXPRESS<br>PROCUREMENT – EXPRO CCI+ Phase 2 – Theme II<br>– Antarctic Ice Sheet (AIS) | 14.07.2023 | 1.2                            |

|                                                                                                                          |                                               |                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------------------------|
|  <b>antarctic<br/>ice sheet<br/>cci</b> | Anterctic_Ice_Sheet_cci+<br>CRDP Release Note | Reference : NU-ESA-AISCCI+-CRDP_RN-001<br>Version : 1.0 page<br>Date : 10 June 2026 7/14 |
|--------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------------------------|

## 2 CRDP release notes on each ECV released.

### 2.1 Surface Elevation Changes (SEC)

CRDP release note on Surface Elevation Change (SEC) for Antarctic\_Ice\_Sheet\_cci+ phase 2.

|                                                                                                         |                                                                                                                                                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Name of data product</b>                                                                             | Surface Elevation Change                                                                                                                                                                                                                                                                                             |
| <b>Unique product version number</b>                                                                    | v2                                                                                                                                                                                                                                                                                                                   |
| <b>Release date</b>                                                                                     | November 2025                                                                                                                                                                                                                                                                                                        |
| <b>Description of the file naming</b>                                                                   | ESACCI-AIS-L3C-SEC-<MISSION>-5KM-<STARTDATE>-<ENDDATE>-fv2.nc<br><MISSION> is MULTIMISSION for multi-mission composites or the sensor code (e.g. S3B, CS2, ENV, ER2, ER1, IS2) for single-mission products.<br><STARTDATE>/<ENDDATE> are YYYYMM for multi-mission products and YYYYMMDD for single-mission products. |
| <b>Assigned DOIs</b>                                                                                    | n/a                                                                                                                                                                                                                                                                                                                  |
| <b>List of satellites used</b>                                                                          | ERS-1, ERS-2, Envisat, CryoSat-2, Sentinel-3A, Sentinel-3B, ICESat-2                                                                                                                                                                                                                                                 |
| <b>Information on processing level and whether the product is a single instrument or harmonised CDR</b> | Level 3C; available as a harmonised multi-mission CDR (cross-calibrated radar altimetry) and as individual single-mission CDRs (radar and laser altimetry). Updated monthly.                                                                                                                                         |
| <b>A list of all resolution and spatiotemporal sampling and time and space coverage</b>                 | 5 km south polar stereographic grid (EPSG:3031); monthly update frequency; temporal coverage 1991–present                                                                                                                                                                                                            |
| <b>Any specific product format attributes</b>                                                           | NetCDF-4; variables include gridded rate of surface elevation change (dH/dt), uncertainty, and associated parameters. Multi-mission 5-year means and cumulative annual dH products also available.                                                                                                                   |
| <b>Public or internal data release</b>                                                                  | Public data release                                                                                                                                                                                                                                                                                                  |
| <b>Version history (i.e. list of major differences compared to earlier releases )</b>                   | v1: radar altimetry missions only (ERS-1, ERS-2, Envisat, CryoSat-2, Sentinel-3A, Sentinel-3B).<br>v2: adds ICESat-2 laser altimetry and cumulative annual height change product.                                                                                                                                    |
| <b>Contact information of the data provider</b>                                                         | a.muir@ucl.ac.uk                                                                                                                                                                                                                                                                                                     |
| <b>Links to where data are available</b>                                                                | <a href="https://www.cpom.ucl.ac.uk/ais_cci_phase2/">https://www.cpom.ucl.ac.uk/ais_cci_phase2/</a>                                                                                                                                                                                                                  |

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|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------------------------|
|  <b>antarctic<br/>ice sheet</b><br>cci | Anterctic_Ice_Sheet_cci+<br>CRDP Release Note | Reference : NU-ESA-AISCCI+-CRDP_RN-001<br>Version : 1.0 page<br>Date : 10 June 2026 8/14 |
|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------------------------|

## 2.2 Ice Velocity from SAR

CRDP release note on Sentinel-1 derived velocity time series for Antarctic\_Ice\_Sheet\_cci+ phase 2:

|                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Name of data product</b>                                                                             | Ice Velocity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Unique product version number</b>                                                                    | v1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Release date</b>                                                                                     | n/a                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Description of the file naming</b>                                                                   | <p>antarctica_iv_&lt;gridspacing&gt;_&lt;sensor&gt;_t&lt;track#&gt;_&lt;date1&gt;_&lt;date2&gt;_&lt;version&gt;_&lt;type&gt;.&lt;filetype&gt;</p> <ul style="list-style-type: none"> <li>• &lt;gridspacing&gt;: 200m</li> <li>• &lt;sensor&gt;: s1 = Sentinel-1</li> <li>• &lt;type&gt;: vx, vy, vz or vv (3 velocity components &amp; horizontal magnitude respectively)</li> <li>• &lt;filetype&gt; : tif (velocity maps), xml (metadata) or ql.png (quiclook)</li> </ul> <p>Example:<br/>antarctica_iv_200m_s1_t169_20210125_20210131_v1_1_vx.tif</p> |
| <b>Assigned DOIs</b>                                                                                    | n/a                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>List of satellites used</b>                                                                          | Sentinel-1 (A,B,C,D)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Information on processing level and whether the product is a single instrument or harmonised CDR</b> | L3C: Observations combined from a single instrument into a space-time grid.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>A list of all resolution and spatiotemporal sampling and time and space coverage</b>                 | <p>resolution: 6/12 day, 200 m</p> <p>coverage: 2015-onwards, Antarctica</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Any specific product format attributes</b>                                                           | See Product User Guide (PUG)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Public or internal data release</b>                                                                  | public data release                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Version history (i.e. list of major differences compared to earlier releases )</b>                   | v1.2: reprocessed using improved tide correction                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Contact information of the data provider</b>                                                         | jan.wuite@enveo.at                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Links to where data are available</b>                                                                | <a href="https://cryoportal.enveo.at/">https://cryoportal.enveo.at/</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

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|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------------------------|
|  <b>antarctic<br/>ice sheet</b><br>cci | Anterctic_Ice_Sheet_cci+<br>CRDP Release Note | Reference : NU-ESA-AISCCI+-CRDP_RN-001<br>Version : 1.0 page<br>Date : 10 June 2026 9/14 |
|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------------------------|

## 2.3 Grounding Line Location

CRDP release note on ERS-1/2 and Sentinel-1A derived grounding line location time series for Antarctic\_Ice\_Sheet\_cci+ phase 2:

|                                                                                                         |                                                                                                                                                                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Name of data product</b>                                                                             | Grounding Line Location                                                                                                                                                                                                                                                                  |
| <b>Unique product version number</b>                                                                    | v3.0                                                                                                                                                                                                                                                                                     |
| <b>Release date</b>                                                                                     | n/a                                                                                                                                                                                                                                                                                      |
| <b>Description of the file naming</b>                                                                   | <release_datetime>_AIS_CCI_<ecv_name>.<version>.<release_date>.<format_suffix><br>release_datetime: YYYYMMDDHHMMSS<br>ecv_name: GLL<br>version: X.X<br>release_date: YYYYMMDD<br>format_suffix: ESRI Shapefile (.shp, .shx, .prj, .dbf, .cpg),<br>GeoJSON (.geojson), GeoPackage (.gpkg) |
| <b>Assigned DOIs</b>                                                                                    | n/a                                                                                                                                                                                                                                                                                      |
| <b>List of satellites used</b>                                                                          | Sentinel-1 (A,B), TerraSAR-X, ERS-1, ERS-2                                                                                                                                                                                                                                               |
| <b>Information on processing level and whether the product is a single instrument or harmonised CDR</b> | L3U: Observations attributed to single instruments provided in time-annotated vector geometries                                                                                                                                                                                          |
| <b>A list of all resolution and spatiotemporal sampling and time and space coverage</b>                 | resolution: 6/12 day, 100 m<br>temporal coverage 1994–present<br>spatial coverage: selected key regions, Antarctica                                                                                                                                                                      |
| <b>Any specific product format attributes</b>                                                           | See Product User Guide (PUG)                                                                                                                                                                                                                                                             |
| <b>Public or internal data release</b>                                                                  | public data release                                                                                                                                                                                                                                                                      |
| <b>Version history (i.e. list of major differences compared to earlier releases )</b>                   | v2.0: inclusion of AI delineated GLLs and related parameters in the product annotation                                                                                                                                                                                                   |
| <b>Contact information of the data provider</b>                                                         | lukas.krieger@dlr.de                                                                                                                                                                                                                                                                     |
| <b>Links to where data are available</b>                                                                | <a href="https://cryoportal.enveo.at/">https://cryoportal.enveo.at/</a>                                                                                                                                                                                                                  |

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|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|-------------------------------------------------------------------------------------------|
|  <b>antarctic<br/>ice sheet</b><br>cci | Anterctic_Ice_Sheet_cci+<br>CRDP Release Note | Reference : NU-ESA-AISCCI+-CRDP_RN-001<br>Version : 1.0 page<br>Date : 10 June 2026 10/14 |
|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|-------------------------------------------------------------------------------------------|

## 2.4 Gravimetric Mass Balance

CRDP release note on GRACE-derived basin and gridded mass changes for Antarctic\_Ice\_Sheet\_cci+ phase 2.

|                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Name of data product</b>                                                                             | Gravimetric Mass Balance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Unique product version number</b>                                                                    | v5.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Release date</b>                                                                                     | May 2026                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Description of the file naming</b>                                                                   | <CCI_project>_<data_type>_<product_type>.nc - <CCI_project>: Antarctic Ice Sheet ('AIS')- <data_type>: Gravimetric Mass Balance ('GMB')- <product_type>: Basin product ('basin') or Gridded product ('grid')                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Assigned DOIs</b>                                                                                    | n/a                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>List of satellites used</b>                                                                          | GRACE, GRACE-FO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Information on processing level and whether the product is a single instrument or harmonised CDR</b> | GRACE and GRACE-FO L2 CSR solutions Release-06.3 in one single CDR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>A list of all resolution and spatiotemporal sampling and time and space coverage</b>                 | <p>Temporal resolution: monthly (single months missing)<br/>Temporal coverage: 2002-04 – 2025-12. The 11-month gap between the mission times of GRACE and GRACE-FO (2017-07 - 2018-05) is interpolated by using modelled surface mass balance to represent the short-term mass variability.</p> <p>Spatial resolution of the basin product: whole AIS, West AIS, East AIS, Antarctic Pensinsula, and 26 drainage basins<br/>Spatial resolution of the gridded product: 50 km formal resolution<br/>Spatial coverage: whole AIS (no peripheral glaciers)</p>                                                                  |
| <b>Any specific product format attributes</b>                                                           | n/a                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Public or internal data release</b>                                                                  | Public release                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Version history (i.e. list of major differences compared to earlier releases )</b>                   | <p>v4.0:<br/>Reprocessing with CSR Release 6.2 GRACE/GRACE-FO L2 monthly solutions<br/>Application of ellipsoidal correction according to the method by Ditmar (2018, 10.1007/s00190-018-1128-0)<br/>Update of temporal coverage to 2002-04 - 2023-11</p> <p>v5.0<br/>Reprocessing with CSR Release 6.3 GRACE/GRACE-FO L2 monthly solutions<br/>Update of temporal coverage to 2002-04 - 2024-12</p> <p>v5.1<br/>Update temporal coverage to 2002-04 - 2025-03</p> <p>v5.2<br/>Gap Filling: Interpolation to the gap between GRACE and GRACE-FO (2017-07 - 2018-05)<br/>Update of temporal coverage to 2002-04 - 2025-12</p> |

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|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|-------------------------------------------------------------------------------------------|
|  <b>antarctic<br/>ice sheet</b><br>cci | Anterctic_Ice_Sheet_cci+<br>CRDP Release Note | Reference : NU-ESA-AISCCI+-CRDP_RN-001<br>Version : 1.0 page<br>Date : 10 June 2026 11/14 |
|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|-------------------------------------------------------------------------------------------|

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|-----------------------------------------------------|-------------------------------------------------------------------------------------------------|
| <b>Contact information of the data<br/>provider</b> | martin.horwath@tu-dresden.de                                                                    |
| <b>Links to where data are available</b>            | <a href="https://data1.geo.tu-dresden.de/ais_gmb/">https://data1.geo.tu-dresden.de/ais_gmb/</a> |

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|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|-------------------------------------------------------------------------------------------|
|  <b>antarctic<br/>ice sheet</b><br>cci | Anterctic_Ice_Sheet_cci+<br>CRDP Release Note | Reference : NU-ESA-AISCCI+-CRDP_RN-001<br>Version : 1.0 page<br>Date : 10 June 2026 12/14 |
|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|-------------------------------------------------------------------------------------------|

## 2.5 Ice Shelf CoastLine (ISCL)

CRDP release note on Sentinel1-derived Ice Shelf CoastLine product for Antarctic\_Ice\_Sheet\_cci+ phase 2.

|                                                                                                         |                                                                                                                                                       |
|---------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Name of data product</b>                                                                             | Antarctic Ice Shelf Coast Lines                                                                                                                       |
| <b>Unique product version number</b>                                                                    | 1.0                                                                                                                                                   |
| <b>Release date</b>                                                                                     | n/a                                                                                                                                                   |
| <b>Description of the file naming</b>                                                                   | ISCL_<ice_shelf_name>_<start_date>_<end_date>.gpkg<br>ice_shelf_name is either: Filchner, Ronne1, Ronne2, LarsenC                                     |
| <b>Assigned DOIs</b>                                                                                    | 10.5281/zenodo.18672278                                                                                                                               |
| <b>List of satellites used</b>                                                                          | Sentinel-1, CryoSat-2                                                                                                                                 |
| <b>Information on processing level and whether the product is a single instrument or harmonised CDR</b> | Sentinel-1 GRD L2 combined with CryoSat-2 L2 tracks as input to a ML model.                                                                           |
| <b>A list of all resolution and spatiotemporal sampling and time and space coverage</b>                 | Monthly 100m resolution<br>Provided on south polar stereographic grid (EPSG:3031), covering Filchner, Ronne1, Ronne2, LarsenC Ice shelves, Antarctica |
| <b>Any specific product format attributes</b>                                                           | See Product User Guide (PUG)                                                                                                                          |
| <b>Public or internal data release</b>                                                                  | Public                                                                                                                                                |
| <b>Version history (i.e. list of major differences compared to earlier releases )</b>                   | N/A                                                                                                                                                   |
| <b>Contact information of the data provider</b>                                                         | <a href="mailto:issa@stcorp.no">issa@stcorp.no</a> , hay@stcorp.no                                                                                    |
| <b>Links to where data are available</b>                                                                | <a href="https://doi.org/10.5281/zenodo.18672278">https://doi.org/10.5281/zenodo.18672278</a>                                                         |

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|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|-------------------------------------------------------------------------------------------|
|  <b>antarctic<br/>ice sheet</b><br>cci | Anterctic_Ice_Sheet_cci+<br>CRDP Release Note | Reference : NU-ESA-AISCCI+-CRDP_RN-001<br>Version : 1.0 page<br>Date : 10 June 2026 13/14 |
|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|-------------------------------------------------------------------------------------------|

## 2.6 Prototype Uplift product

CRDP release note on Sentinel1-derived ice surface uplift/subsidence product for Antarctic\_Ice\_Sheet\_cci+ phase 2.

|                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Name of data product</b>                                                                             | Uplift/Subsidence from InSAR line-of-sight                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Unique product version number</b>                                                                    | 1.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Release date</b>                                                                                     | n/a                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Description of the file naming</b>                                                                   | <p>antarctica_uplift_s1_&lt;region&gt;_t&lt;track&gt;&lt;pass&gt;_&lt;date1&gt;_&lt;date2&gt;.nc</p> <p>where</p> <p>&lt;region&gt; is a descriptive name of the region covered by the data,</p> <p>&lt;track&gt; is the Sentinel-1 track number (i.e. relative orbit) from which the data were acquired,</p> <p>&lt;pass&gt; is a single lowercase 'a' or 'd' indicating whether the S1 data were acquired from an ascending ('a') or descending ('d') pass</p> <p>&lt;date1&gt; and &lt;date2&gt; are the dates of the first and last uplift maps in the timeseries in the format YYYYMMDD</p> |
| <b>Assigned DOIs</b>                                                                                    | 10.11583/DTU.31747927                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>List of satellites used</b>                                                                          | Sentinel-1 A/B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Information on processing level and whether the product is a single instrument or harmonised CDR</b> | L3C: Observations combined from a single instrument into a space-time grid.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>A list of all resolution and spatiotemporal sampling and time and space coverage</b>                 | Resolution 12 days, 50 m. Provided on south polar stereographic grid (EPSG:3031), covering area in Enderby Land, Antarctica<br>Upper left lat/lon: -69.08, 39.35<br>Lower right lat/lon: -69.13, 42.14                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Any specific product format attributes</b>                                                           | See Product User Guide (PUG)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Public or internal data release</b>                                                                  | Public                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Version history (i.e. list of major differences compared to earlier releases )</b>                   | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Contact information of the data provider</b>                                                         | ak@space.dtu.dk                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Links to where data are available</b>                                                                | <a href="https://doi.org/10.11583/DTU.31747927">https://doi.org/10.11583/DTU.31747927</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

