

SLBC_cci+

SEA LEVEL BUDGET CLOSURE - CLIMATE CHANGE INITIATIVE +

SYSTEM VERIFICATION REPORT (SVR)

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Contents

1. Introduction	5
1.1. Scope and objective	5
1.2. Document structure	5
1.3. Related documents	5
1.3.1. Applicable documents	5
1.3.2. Bibliography	6
1.4. Acronyms	6
2. System verification tools	7
3. System verification tests	7
3.1. Tests on input data	7
3.2. Tests on output data	8
4. System verification results	8

1. Introduction

1.1. Scope and objective

This document is the System Verification Report (SVR) for the ESA SLBC_cci+ project ([AD-1] and [AD-2]). This SVR is dedicated to the description of the verification that is made on the SLBC system. It covers an introduction of the tools used for the verification, a concise description of the tests applied to the data and the results of the complete verification task on the product.

1.2. Document structure

In addition to this introduction, the document is organised as follows:

- System verification tools description
- System verification tests
- System verification results

1.3. Related documents

1.3.1. Applicable documents

Table 1 *List of applicable documents.*

Id.	Name	Description
[AD 1]	ESA AO/1-11340/22/I-NB	Call to tender "SEA LEVEL BUDGET CLOSURE_CCI+ (SLBC_CCI+)"
[AD 2]	MAG-22-PTF-060_DetailedProposal_V2	Detailed proposal in response to ESA/ESRIN Request for Quotation "SEA LEVEL BUDGET CLOSURE_CCI+ (SLBC_CCI+)" ESA AO/1-11340/22/I-NB [AD-1]
[AD 3]	SLBC_CCI-DT-074-MAG_PUG_D3-3	SLBC_CCI+ Product User Guide

[AD 4]	SLBC_CCI-DT-072-MAG_SDD_ D3-1	SLBC_CCI+ System Description Document
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1.3.2. Bibliography

- Horwath, M., Gutknecht, B. D., Cazenave, A., Palanisamy, H. K., Marti, F., Marzeion, B., Paul, F., Le Bris, R., Hogg, A. E., Otosaka, I., Shepherd, A., Döll, P., Cáceres, D., Müller Schmied, H., Johannessen, J. A., Nilsen, J. E. Ø., Raj, R. P., Forsberg, R., Sandberg Sørensen, L., Barletta, V. R., Simonsen, S., Knudsen, P., Andersen, O. B., Rannadal, H., Rose, S. K., Merchant, C. J., Macintosh, C. R., Von Schuckmann, K., Novotny, K., Groh, A., Restano, M., and Benveniste, J.: ESA Sea Level Budget Closure Climate Change Initiative (SLBC_cci): Time series of global mean sea level budget and ocean mass budget elements (1993-2016, at monthly resolution), version 2.2, <https://doi.org/10.5285/17C2CE31784048DE93996275EE976FFF>, 2021.

1.4. Acronyms

Table 2 *List of abbreviations and acronyms.*

Acronyms	Description
CCI	The ESA Climate Change Initiative
ESA	European Space Agency
RSL	Relative Sea Level
SLBC_cci	Sea Level Budget Closure of the ESA Climate Change Initiative (first phase)
SLBC_cci+	Sea Level Budget Closure of the ESA Climate Change Initiative (second phase, this activity)
w.r.t	With respect to

2. System verification tools

The verifications made on the system consists of simple material production to verify the input and outputs of the system (the SLB product, see System Description Document [\[AD4\]](#)). Since there are no complex algorithms on the system production itself (sum of components) there are no particular verifications that have been implemented to verify its behavior.

As a result, the tools that are used consist of common Python libraries available freely to produce graphs (e.g. matplotlib) to verify the input and output of the system.

3. System verification tests

The system verification tests are divided into 2 categories and are realised at 2 separate times of the system production:

- Tests on input data (sea level components) to verify their consistency
- Tests on output data (sea level budget) to verify the results

3.1. Tests on input data

The system realise different tests on the components input before computing the budget such as:

- verification that the resolutions of the input data are consistent (temporally and spatially)
- verification that none of the input data specified in the configuration file is missing
- no data verification

If one of these tests fails, an error message is raised to the user console and the system is stopped.

3.2. Tests on output data

Tests are also applied automatically once the system has finished producing the SLB product and generates multiple graphs and metrics that are analysed manually to verify that no issues have been raised during the processing.

The following metrics are produced:

- Comparison of the components sum of sea level with Relative Sea Level (RSL) measured from altimetry
- Display of the SLB residuals
- Comparisons of SLB residuals with residuals from phase-I
- Comparisons of individual components with the those from phase-I

4. System verification results

The test results on the output are produced and analysed manually. It consists of figures that represent the different sea level components and their sum compared to the RSL measured by altimetry. Also the residuals are plotted to have a better visualisation and verification. The [Figure 1](#) shows one of these test results.

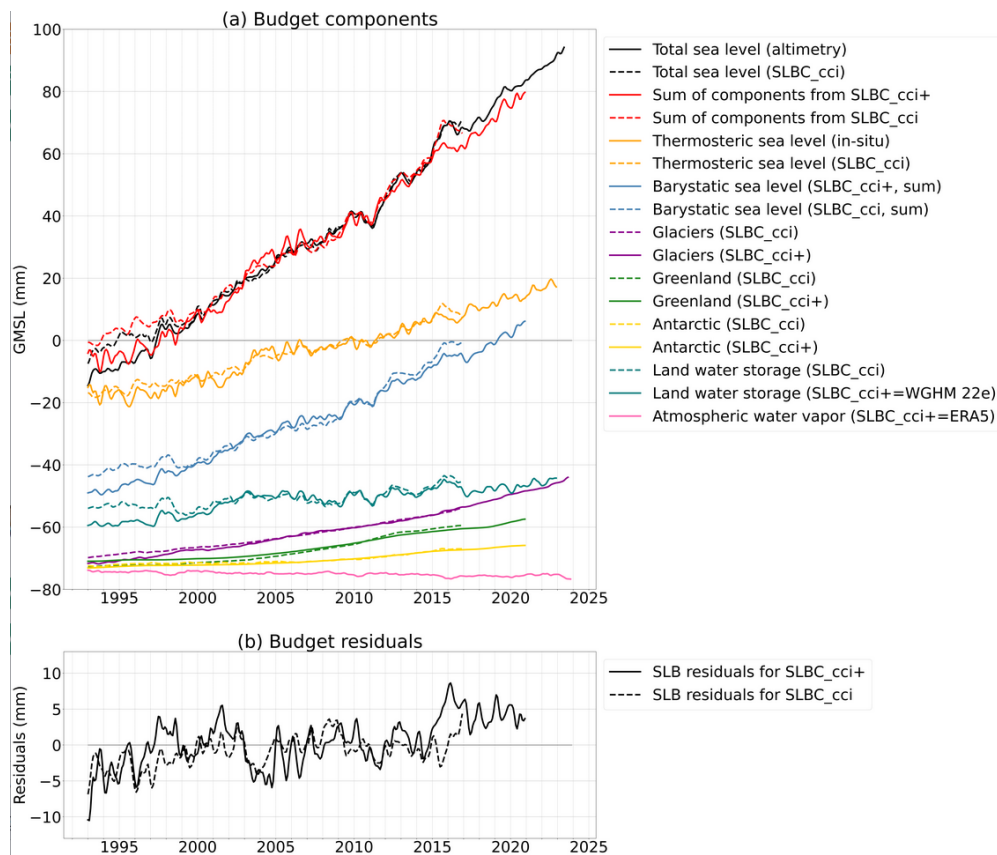


Figure 1: *Comparison of system product output (solid lines) with product issued from phase-I (dashed lines) (Horwath et al., 2021)*

To verify that the product is respecting the Climate Forecast convention, the online tool CFChecker is used (<https://cfchecker.ncas.ac.uk/>) manually to indicate if all the variables and their descriptions are respecting the convention. The output of this verification is provided below.

```
CHECKING NetCDF FILE: SLBC_ccip_data.nc
=====
Using CF Checker Version 4.1.0
Checking against CF Version CF-1.8
Using Standard Name Table Version 89 (2025-01-21T13:26:50Z)
Using Area Type Table Version 12 (21 January 2025)
Using Standardized Region Name Table Version 5 (12 November 2024)
```

Checking variable: latitude

Checking variable: time

Checking variable: longitude

Checking variable: SL

Checking variable: OM

Checking variable: TSL

Checking variable: HSL

Checking variable: ICE_AIS

Checking variable: ICE_GIC

Checking variable: ICE_GIS

Checking variable: TWS

Checking variable: TCWV

Checking variable: CGRDF_ASL_AIS

.....

Checking variable: CGRDF_VLM_GIS

Checking variable: GIA_ASL

Checking variable: GIA_GHC

Checking variable: GIA_RSL

Checking variable: GIA_VLM

ERRORS detected: 0
WARNINGS given: 0
INFORMATION messages: 0

End of the document