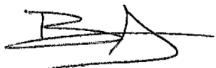



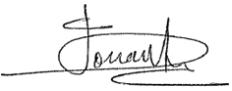


SEA LEVEL BUDGET CLOSURE - CLIMATE CHANGE INITIATIVE +

DATA ACCESS REQUIREMENT DOCUMENT

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Document evolution sheet

Ed.	Rev.	Date	Purpose of evolution	Observations
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1. Introduction

1.1. Purpose of document

This document is the Data Access Requirement Document (DARD) for the ESA SLBC_cci+ project ([AD-1] and [AD-2]) It aims at describing the data available for the product generation of WP2000 ([AD2]). Figure 1 summarises the content and scope of the Product Specification Document (PSD), Data Access Requirement Document (DARD) and Algorithm Theoretical Baseline Document (ATBD).

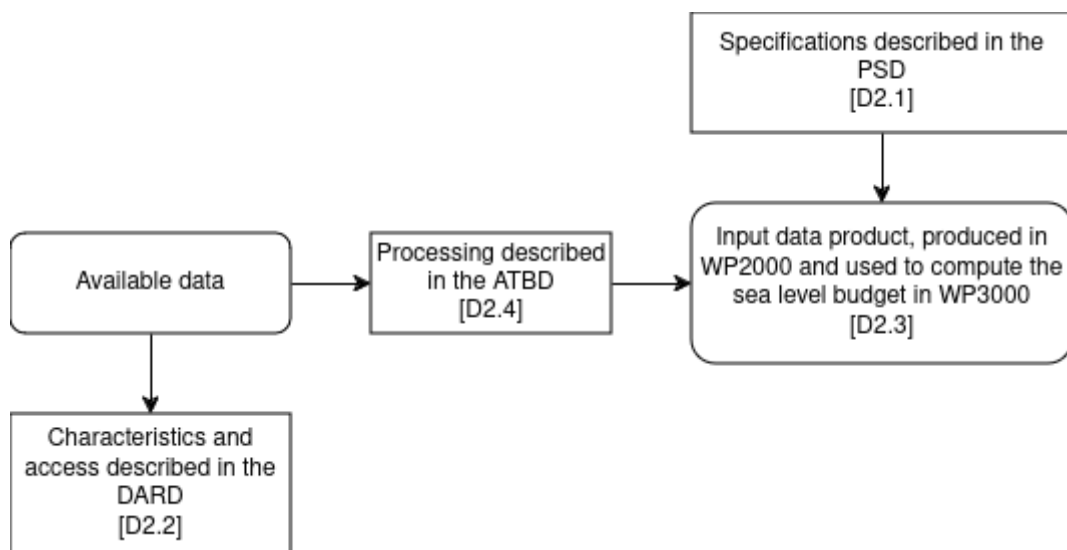


Figure 1: Scope of the Product Specification Document (PSD), Data Access Requirement Document (DARD) and Algorithm Theoretical Baseline Document (ATBD).

1.2. Document structure

In addition to this introduction, this document includes Section 2, which specifies the data to be accessed for every individual element of the sea-level budget as well as for the synthetic datasets.

1.3. Applicable documents

Table 1: List of applicable documents.

Id.	Ref.	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_Detailed Proposal_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-008-MAG_S RD_D1-1	SEA LEVEL BUDGET CLOSURE_CCI+ Science Requirements Document Version 1.2, 07/06/2024
[AD-4]	SLBC_CCI-DT-039-MAG_P SD_D2-1	SEA LEVEL BUDGET CLOSURE_CCI+ Product Specification Document

1.4. Terminology

The list of acronyms that are used in the document is presented in Table 2.

Table 2: List of acronyms.

Acronym	Description
AD	Applicable Documents
AIS	Antarctica Ice Sheet
AP	Antarctica Peninsula
APDRC	Asia-Pacific Data Research Center of the IPRC
APIS	Antarctic Peninsula
C3S	Copernicus Climate Change Service
CCI	The ESA Climate Change Initiative
CDR	Climate Data Record
CDS	Climate Data Store
COST-G	Combination Service for Time-variable Gravity Fields
CRDP	Climate Research Data Package

CRI	Coastline Resolution Filter
CSR	Center for Space Research
DTU	Technical University of Denmark
EAIS	East Antarctic Ice Sheet
ECMWF	European Center for Medium-Range Weather Forecasts
ECV	Essential Climate Variable
ERA5	ECMWF atmosphere reanalysis version 5
ESA	European Space Agency
EWH	Equivalent Water Height
GIA	Glacial Isostatic Adjustment
GIS	Greenland Ice Sheet
GMB	Gravimetric Mass Balance
GRACE	Gravity Recovery and Climate Experiment
GRACE-FO	GRACE Follow-On
GSFC	Goddard Space Flight Center
HOAPS	Hamburg Ocean Atmosphere Parameters and Fluxes
ICDR	Interim Climate Data Record
IGE	Institut des Géosciences de l'Environnement
IMBIE	Ice-sheet Mass Balance Inter-comparison Exercise
IPRC	International Pacific Research Center
ISAS	In Situ Analysis System
JAMSTEC	Japan Agency for Marine-Earth Science and Technology
JPL	Jet Propulsion Laboratory
MOAA GPV	Grid Point Value of the Monthly Objective Analysis using the Argo data

NA	Not Applicable
NCAR	National Center for Atmospheric Research
NCEI	National Centers for Environmental Information
NEMO	Nucleus for European Modelling of the Ocean
OCCUPUT	OceaniC Chaos-ImPacts, strUcture, predicatbiliTy
PROMICE	Programme for Monitoring of the Greenland Ice Sheet
SELEN	Sea lEvel EquatioN solver
SEANOE	Sea Scientific Open Data Publication
SIO	Scripps Institute of Oceanography
SLA	Sea Level Anomaly
SLBC	Sea level budget closure
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)
SL_cci	The Sea Level component of the ESA Climate Change Initiative
STASA	Subsurface Temperature And Salinity Analyses
SWE	Snow Water Equivalent
TCDR	Thematic Climate Data Record
TCWV	Total column water vapour
TU	Technical University
WAIS	West Antarctic Ice Sheet
WaterGAP	Water - Global Assessment and Prognosis
WGHM	WaterGAP Hydrological Model
WOA23	World Ocean Database 23
WP	Work Package

2. Data access and requirements

2.1. For total sea level component

Table 3: Description of the total sea level data.

Data product name	Sea level gridded data from satellite observations for the global ocean from 1993 to present
Version	vDec2021
Variable(s) [units]	sla [m] tpa_correction [m]
Short description	Level 4 product of total sea level anomaly
Spatial resolution	0.25°x0.25°
Spatial coverage	global ocean
Temporal resolution	daily
Temporal coverage	01/01/1993-07/06/2023, no gaps
File format	netCDF-4 [.nc]
File size	312 Mb / year (~850-890 Kb / daily file)
Source	Copernicus Climate Change Service (C3S)
Access point	DOI: 10.24381/cds.4c328c78 https://cds.climate.copernicus.eu/cdsapp#!/dataset/satellite-sea-level-global?tab=form [last access: 09/02/2024]
Access conditions	public (account needed)
Citation/acknowledgments	Copernicus Climate Change Service, Climate Data Store, (2018): Sea level gridded data from satellite observations for the global ocean from 1993 to present. Copernicus Climate Change Service (C3S) Climate Data Store (CDS). DOI: 10.24381/cds.4c328c78 (Accessed on DD-MMM-YYYY)
Comments	The tpa_correction variable is used to correct the sea level anomaly for the TOPEX-A altimeter drift.

Table 4: Description of the correction of the wet troposphere correction data to be applied to the sea level anomaly over the Jason-3 period.

Data product name	Jason-3 wet path delay correction
Variable [units]	Path delay correction [cm]
Version	230925
Short description	Correction due to Jason-3 radiometer wet troposphere correction drift
Spatial resolution	Global time series
Spatial coverage	66°S/66°N
Temporal resolution	Altimetry path (~ 56 minutes)
Temporal coverage	12/02/2016-18/08/2023 (Jason-3 period)
File format	Text file [.txt]
File size	2,4 Mb
Source	JPL
Access point	DOI: 10.5067/J3L2G-PDCOR https://podaac.jpl.nasa.gov/dataset/JASON_3_PD_CORRECTION [last access: 20/03/2024]
Access conditions	public
Citation/acknowledgments	Brown, S., J. Willis, S. Fournier. 2023. Jason-3 Wet Path Delay Correction. Ver. F. PO.DAAC, CA, USA. Dataset accessed [YYYY-MM-DD] at https://doi.org/10.5067/J3L2G-PDCOR
Comments	

2.2. For steric sea level

Table 5: Description of the ISAS steric sea level data.

Data product name	In Situ Analysis System (ISAS)
Version	ISAS20
Variable(s) [units]	TEMP [°C] PSAL [psu]
Short description	Temperature and salinity fields
Spatial resolution	0.5°x0.5° horizontal 187 vertical depth levels between 0-5500m vertical
Spatial coverage	Global ocean
Temporal resolution	Monthly
Temporal coverage	15/01/2002-15/12/2023, no gaps
File format	netCDF-4 [.nc]
File size	285 Mb
Source	Sea Scientific Open Data Publication (SEANOE)
Access point	DOI: 10.17882/52367 [last access : 11/04/2024]
Access conditions	Public
Citation/acknowledgments	Kolodziejczyk Nicolas, Prigent-Mazella Annaig, Gaillard Fabienne (2023). ISAS temperature, salinity, dissolved oxygen gridded fields. SEANOE. https://doi.org/10.17882/52367
Comments	-

Table 6: Description of the Roemmich-Gilson Argo Climatology data product.

Data product name	Roemmich-Gilson Argo Climatology
Version	2019
Variable(s) [units]	ARGO_TEMPERATURE_ANOMALY [°C] ARGO_SALINITY_ANOMALY [psu]
Short description	Temperature and salinity fields
Spatial resolution	1°x1° horizontal 58 vertical depth levels between 0-1975 dbar vertical
Spatial coverage	Global ocean
Temporal resolution	Monthly
Temporal coverage	15/01/2004-15/12/2023, no gaps
File format	netCDF-4 [.nc]
File size	1035 Mb
Source	Scripps Institute of Oceanography (SIO)
Access point	https://sio-argo.ucsd.edu/RG_Climatology.html [last access : 29/04/2024]
Access conditions	Public
Citation/acknowledgments	Roemmich, D. and J. Gilson, 2009: The 2004-2008 mean and annual cycle of temperature, salinity, and steric height in the global ocean from the Argo Program. Progress in Oceanography, 82, 81-100.
Comments	-

Table 7: Description of the IPRC data product.

Data product name	International Pacific Research Center (IPRC)
Version	-
Variable(s) [units]	PTEMP [°C] SALT [psu]
Short description	Temperature and salinity fields
Spatial resolution	1°x1° horizontal 27 vertical depth levels between 0-2000m vertical
Spatial coverage	Global ocean
Temporal resolution	Monthly
Temporal coverage	01/01/2005-01/12/2020, no gaps
File format	netCDF-4 [.nc]
File size	2.3 Gb
Source	Asia-Pacific Data Research Center of the IPRC (APDRC)
Access point	http://apdrc.soest.hawaii.edu/projects/Argo/data/profiles/?F=2 [last access : 29/04/2024]
Access conditions	Public
Citation/acknowledgments	-
Comments	-

Table 8: Description of the EN4.2.2 data product.

Data product name	EN.4.2.2
Version	v1.0
Variable(s) [units]	POTM_CORRECTED [°C] PSAL_CORRECTED [psu]
Short description	Temperature and salinity fields
Spatial resolution	1°x1° horizontal 27 vertical depth levels between 0-5500m vertical
Spatial coverage	Global ocean
Temporal resolution	Monthly
Temporal coverage	01/01/1993-01/12/2023, no gaps
File format	netCDF-4 [.nc]
File size	2.3 Gb
Source	Met Office Hadley Centre
Access point	https://www.metoffice.gov.uk/hadobs/en4/download-en4-2-2.html#g10_analyses [last access : 29/04/2024]
Access conditions	Public
Citation/acknowledgments	Good, S. A., M. J. Martin and N. A. Rayner, 2013. EN4: quality controlled ocean temperature and salinity profiles and monthly objective analyses with uncertainty estimates, Journal of Geophysical Research: Oceans, 118, 6704-6716, doi:10.1002/2013JC009067
Comments	-

Table 9: Description of the MOAA GPV data product.

Data product name	Grid Point Value of the Monthly Objective Analysis using the Argo data (MOAA GPV)
Version	-
Variable(s) [units]	TOI [°C] SOI [psu]
Short description	Temperature and salinity fields
Spatial resolution	1°x1° horizontal 25 vertical depth levels between 10-2000 dbar vertical
Spatial coverage	Global ocean
Temporal resolution	Monthly
Temporal coverage	01/01/2001-01/12/2023, no gaps
File format	netCDF-4 [.nc]
File size	2.3 Gb
Source	Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
Access point	https://pubargo.jamstec.go.jp/argo_product/catalog/MOAA_GPV/Glb_PRS/OI/DM/catalog.html [last access : 29/04/2024]
Access conditions	Public
Citation/acknowledgments	S. Hosoda, T. Ohira, T. Nakamura, 2008: A monthly mean dataset of global oceanic temperature and salinity derived from Argo float observations. JAMSTEC Rep. Res. Dev., Vol. 8, 47-59.
Comments	-

Table 10: Description of the STASA data product.

Data product name	Subsurface Temperature And Salinity Analyses (STASA)
Version	-
Variable(s) [units]	temperature [°C] salinity [psu]
Short description	Temperature and salinity fields
Spatial resolution	1°x1° horizontal 24 vertical depth levels between 0-1500m vertical
Spatial coverage	Global ocean
Temporal resolution	Monthly
Temporal coverage	01/01/1945-01/12/2012, no gaps
File format	netCDF-4 [.nc]
File size	1.0 Gb
Source	National Center for Atmospheric Research (NCAR)
Access point	https://rda.ucar.edu/datasets/ds285.3/dataaccess/# [last access : 29/04/2024]
Access conditions	Public
Citation/acknowledgments	Ishii, M., Fukuda, Y., Hirahara, S., Yasui, S., Suzuki, T., & Sato, K. (2017). Accuracy of global upper ocean heat content estimation expected from present observational data sets. <i>Sola</i> , 13, 163-167.
Comments	-

Table 11: Description of WOA23 data product.

Data product name	World Ocean Database 23 (WOA23)
Version	23
Variable(s) [units]	temperature [°C] salinity [psu]
Short description	Temperature and salinity fields
Spatial resolution	1°x1° horizontal 102 vertical depth levels between 0-5500m vertical
Spatial coverage	Global ocean
Temporal resolution	Monthly
Temporal coverage	01/01/1955-01/12/2022, no gaps
File format	netCDF-4 [.nc]
File size	81.0 Gb
Source	National Centers for Environmental Information (NCEI)
Access point	https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:0270533 [last access : 30/04/2024]
Access conditions	Public
Citation/acknowledgments	Reagan, James R.; Boyer, Tim P.; García, Hernán E.; Locarnini, Ricardo A.; Baranova, Olga K.; Bouchard, Courtney; Cross, Scott L.; Mishonov, Alexey V.; Paver, Christopher R.; Seidov, Dan; Wang, Zhankun; Dukhovskoy, Dmitry. (2024). World Ocean Atlas 2023. NOAA National Centers for Environmental Information. Dataset: NCEI Accession 0270533.
Comments	-

2.3. For ocean mass from space gravimetry missions

Table 12: Description of the GRACE CSR Mascon data.

Data product name	CSR GRACE/GRACE-FO Mascon Solutions
Version	RL06.2
Variable(s) [units]	Equivalent water height [cm]
Short description	Level-3 gridded monthly water height anomalies from GRACE/GRACE-FO gravity fields from processing and regularization by CSR
Spatial resolution	0.25° x 0.25° (based on native 1° x 1° equal area mascons)
Spatial coverage	global, land/ocean mask available
Temporal resolution	monthly
Temporal coverage	2002-04 – 2023-12, 11 month data gap between GRACE and GRACE-FO mission (2017-07 – 2018-05), and additional number of single months
File format	netCDF-4 [.nc]
File size	100 MB
Source	Center for Space Research (CSR)
Access point	DOI: 10.15781/cgq9-nh24 , https://www2.csr.utexas.edu/grace/RL06_mascons.html [last access: 2024-04-11]
Access conditions	public
Citation/acknowledgments	Save, H., S. Bettadpur, and B.D. Tapley (2016), High resolution CSR GRACE RL05 mascons, J. Geophys. Res. Solid Earth, 121, doi:10.1002/2016JB013007. Save, Himanshu, 2020, "CSR GRACE and GRACE-FO RL06 Mascon Solutions v02", doi: 10.15781/cgq9-nh24.
Comments	ICE-6G GIA model removed, GAD added back to ocean pixels only, grids of individual corrections (C20, C30, degree-1, GIA, GAD) available, used water density for conversion to EWH: 1025 kg/m ³

Table 13: Description of the GRACE JPL Mascon data.

Data product name	JPL GRACE/GRACE-FO Mascon Solutions
Version	RL06.1_v03, CRI (Coastline Resolution Improvement) Filtered
Variable(s) [units]	Equivalent water height [cm]
Short description	Level-3 gridded monthly water height anomalies from GRACE/GRACE-FO gravity fields from processing and regularization by JPL
Spatial resolution	0.5° x 0.5° (based on native 3° x 3° equal area mascons)
Spatial coverage	global, land mask available
Temporal resolution	monthly
Temporal coverage	2002-04 – 2023-12, 11 month data gap between GRACE and GRACE-FO mission (2017-07 – 2018-05), and additional number of single months
File format	netCDF-4 [.nc]
File size	85 MB
Source	Jet Propulsion Laboratory (JPL)
Access point	DOI: 10.5067/TEMSC-3JC63 , https://podaac.jpl.nasa.gov/dataset/TELLUS_GRAC-GRFO_MASCON_CRI_GRID_RL06.1_V3 [last access: 2024-04-11]
Access conditions	public (NASA Earthdata account needed)
Citation/acknowledgments	D. N. Wiese, D.-N. Yuan, C. Boening, F. W. Landerer, M. M. Watkins. 2023. JPL GRACE and GRACE-FO Mascon Ocean, Ice, and Hydrology Equivalent Water Height CRI Filtered. Ver. RL06.1Mv03. PO.DAAC, CA, USA.
Comments	ICE-6G GIA model removed, GAD added back to ocean pixels only, used water density for conversion to EWH: 1000 kg/m ³ , Coastline Resolution Filter (CRI) applied to separate land/ocean mass within mascons that span coastlines

Table 14: Description of the GRACE GSFC Mascon data.

Data product name	GSFC GRACE/GRACE-FO Mascon Solutions
Version	RL06v2.0, SLA/OBP
Variable(s) [units]	Equivalent water height [cm]
Short description	Level-3 gridded monthly water height anomalies from GRACE/GRACE-FO gravity fields from processing and regularization by GSFC with different versions for different handling of background models (SLA-version and OBP-version)
Spatial resolution	SLA-version: 1° x 1° equal area, OBP-version: 0.5° x 0.5°
Spatial coverage	global, land mask available
Temporal resolution	monthly
Temporal coverage	2002-04 – 2023-12, 11 month data gap between GRACE and GRACE-FO mission (2017-07 – 2018-05), and additional number of single months
File format	SLA-version: HDF5 [.h5] OBP-version: netCDF-4 [.nc]
File size	SLA-version: 153 MB OBP-version: 469 MB
Source	Goddard Space Flight Center (GSFC)
Access point	https://earth.gsfc.nasa.gov/geo/data/grace-mascons [last access: 2024-04-11]
Access conditions	public
Citation/acknowledgments	Loomis, B.D., Luthcke, S.B. & Sabaka, T.J. (2019) Regularization and error characterization of GRACE mascons. <i>J Geod</i> 93 , 1381–1398. https://doi.org/10.1007/s00190-019-01252-y
Comments	ICE-6G GIA model removed, used water density for conversion to EWH: 1000 kg/m ³ , SLA-version: GAD added back to ocean pixels only and mean GAD over the ocean removed, OBP-version: GAD added back to ocean pixels only (comparable to CSR and JPL mascon products)

Table 15: Description of the CSR GRACE Level-2 SH coefficients data.

Data product name	CSR GRACE/GRACE-FO Level-2 Spherical Harmonics
Version	GRACE: RL06; GRACE-FO: RL06.2
Variable(s) [units]	Spherical Harmonic Stokes coefficients [unitless] as a representation of gravitational potential [m ² / s ²]
Short description	Level-2 sets of SH coefficients of the geopotential of the Earth (GSM) and background models (GAD)
Spatial resolution	GSM: SH d/o 60/96 GAD: SH d/o 180
Spatial coverage	global
Temporal resolution	monthly
Temporal coverage	2002-04 – 2023-12, 11 month data gap between GRACE and GRACE-FO mission (2017-07 – 2018-05), and additional number of single months
File format	ASCII
File size	GRACE GSM: 116 MB (d/o 96) GAD: 478 MB (d/o 180) GRACE-FO: GSM: 35 MB (d/o 96) GAD: 144 MB (d/o 180)
Source	CSR
Access point	GRACE GSM: DOI: 10.5067/GRGSM-20C06 [last access: 2024-04-11] GAD: DOI: 10.5067/GRGAD-20C06 [last access: 2024-04-11] GRACE-FO: GSM and GAD: DOI: 10.5067/GFL20-MC062 [last access: 2024-04-11]
Access conditions	public, (NASA Earthdata account needed)
Citation/acknowledgments	GRACE. 2018. GRACE_GSM_L2_GRAV_CSR_RL06. Ver. 6.0. PO.DAAC, CA, USA. GRACE. 2018. GRACE_GAD_L2_GRAV_CSR_RL06. Ver. 6.0. PO.DAAC, CA, USA. GRACE-FO. 2023. GRACEFO_L2_CSR_MONTHLY_0062. Ver. 6.2. PO.DAAC, CA, USA.
Comments	time series of degree-1 and C20/C30 are provided in Technical Note 13 and Technical Note 14, respectively (both available at the GRACE-FO access point)

Table 16: Description of the ITSG GRACE Level-2 SH coefficients data.

Data product name	ITSG GRACE/GRACE-FO Level-2 Spherical Harmonics
Version	ITSG2018
Variable(s) [units]	Spherical Harmonic Stokes coefficients [unitless] as a representation of gravitational potential [m ² / s ²]
Short description	Level-2 sets of SH coefficients of the geopotential of the Earth and background models
Spatial resolution	GSM: SH d/o 60/96/120 GAD: SH d/o 180
Spatial coverage	global
Temporal resolution	monthly
Temporal coverage	2002-04 – 2023-12, 11 month data gap between GRACE and GRACE-FO mission (2017-07 – 2018-05), and additional number of single months
File format	ASCII
File size	GRACE GSM (naming: ITSG-Grace2018): 70 MB (d/o 96) GAD (naming: model_OceanBottomPressure): 140 MB (d/o 180) GRACE-FO: GSM (naming: ITSG-Grace_operational): 31 MB (d/o 96) GAD (naming: model_OceanBottomPressure): 56 MB (d/o 180)
Source	Institute of Geodesy, Graz University of Technology (TU Graz)
Access point	GRACE: DOI: 10.5880/ICGEM.2018.003 [last access: 2024-04-11] GRACE-FO: http://ftp.tugraz.at/outgoing/ITSG/GRACE/ITSG-Grace_operational/monthly/ [last access: 2024-04-11]
Access conditions	public
Citation/acknowledgments	Kvas, A., Behzadpour, S., Ellmer, M., Klinger, B., Strasser, S., Zehentner, N., & Mayer-Gürr, T. (2019).ITSG-Grace2018: Overview and evaluation of a new GRACE-only gravity field time series. Journal of Geophysical Research: Solid Earth, 124. https://doi.org/10.1029/2019JB017415 Mayer-Gürr, Torsten; Behzadpur, Saniya; Ellmer, Matthias; Kvas, Andreas; Klinger, Beate; Strasser, Sebastian; Zehentner, Norbert (2018): ITSG-Grace2018 - Monthly, Daily and Static Gravity Field Solutions from GRACE. GFZ Data Services. http://doi.org/10.5880/ICGEM.2018.003
Comments	

Table 17: Description of the COST-G GRACE Level-2 SH coefficients data.

Data product name	COST-G GRACE/GRACE-FO Level-2 Spherical Harmonics
Version	GRACE: RL01, GRACE-FO: RL02
Variable(s) [units]	Spherical Harmonic Stokes coefficients [unitless] as a representation of gravitational potential [m ² / s ²]
Short description	Level-2 sets of SH coefficients of the geopotential of the Earth and background models
Spatial resolution	GSM: SH d/o 90 GAC: SH d/o 90
Spatial coverage	global
Temporal resolution	monthly
Temporal coverage	2002-04 – 2023-12, 11 month data gap between GRACE and GRACE-FO mission (2017-07 – 2018-05), and additional number of single months
File format	ASCII
File size	GRACE GSM: 62 MB (d/o 90) GAC: 37 MB (d/o 90) GRACE-FO: GSM: 24 MB (d/o 90)
Source	Combination Service for Time-variable Gravity Fields (COST-G)
Access point	GRACE: DOI: 10.5880/ICGEM.COST-G.001 [last access: 2024-04-11] GRACE-FO: https://icgem.gfz-potsdam.de/sp/02_COST-G/Grace-FO_RL02 [last access: 2024-04-11]
Access conditions	public
Citation/acknowledgments	Meyer, U, Jaeggi, A, Dahle, C, Flechtner, F, Kvas, A, Behzadpour, S, Mayer-Gürr, T, Lemoine, J-M, and Bourgogne, S 2020 International Combination Service for Time-variable Gravity Fields (COST-G) Monthly GRACE Series. DOI: https://doi.org/10.5880/ICGEM.COST-G.001 Meyer, U, Lasser, M, Dahle, C, Förste, C, Behzadpour, S, Koch, I, and Jäggi, A 2023 Combined monthly GRACE-FO gravity fields for a Global Gravity-based Groundwater Product. Geophysical Journal International. DOI: https://doi.org/10.1093/gji/ggad437
Comments	GAC background model provided for GRACE solutions, no background model provided for GRACE-FO solutions

2.4. For ocean mass from land and atmosphere components

2.4.1. Greenland ice sheet

Table 18: Description of IMBIE aggregated dataset for IPCC AR6.

Data product name	IMBIE aggregated dataset for IPCC AR6
Version	1.0
Variable(s) [units]	Mass balance [Gt] and cumulative mass balance [Gt/yr]
Short description	Ice sheet Mass Balance Intercomparison Exercise (IMBIE) dataset aggregated from 50 independent estimates of ice sheet mass balance
Spatial resolution	None. Datasets are available for AIS, EAIS, WAIS, AP, GIS
Spatial coverage	Antarctica Ice Sheet (AIS), East Antarctica Ice Sheet (EAIS), West Antarctica Ice Sheet (WAIS), Antarctica Peninsula (AP), Greenland Ice Sheet (GIS)
Temporal resolution	monthly
Temporal coverage	1992-01 – 2020-12
File format	ASCII (CSV)
File size	< 20 kB
Source	Ice-sheet Mass Balance Inter-comparison Exercise (IMBIE)
Access point	https://doi.org/10.5285/77B64C55-7166-4A06-9DEF-2E400398E452
Access conditions	public
Citation/acknowledgments	IMBIE Team: Antarctic and Greenland Ice Sheet mass balance 1992–2020 for IPCC AR6 (Version 1.0), UK Polar Data Centre, Natural Environment Research Council, UK Research & Innovation [data set], https://doi.org/10.5285/77B64C55-7166-4A06-9DEF-2E400398E452 , 2021
Comments	

Table 19: Description of the Greenland Ice Sheet GMB data.

Data product name	Greenland Ice Sheet CCI GMB product
Version	4.0
Variable(s) [units]	Surface mass density change [kg / m ²]
Short description	Gravimetric Mass Balance (GMB) products generated by TU Dresden based on the monthly GRACE solutions CSR RL06.2
Spatial resolution	50 km x 50 km (polar-stereographic projection)
Spatial coverage	Greenland Ice Sheet
Temporal resolution	monthly
Temporal coverage	2002-04 – 2023-12, 11 month data gap between GRACE and GRACE-FO mission (2017-07 – 2018-05), and additional number of single months
File format	netCDF-4 [.nc]
File size	3.7 MB
Source	ESA Climate Change Initiative (CCI+ Greenland Ice Sheet)
Access point	https://data1.geo.tu-dresden.de/gis_gmb/index.html [last access: 2024-04-11]
Access conditions	public
Citation/acknowledgments	Döhne, T., Horwath, M., Groh, A., & Buchta, E. (2023). The sensitivity kernel perspective on GRACE mass change estimates. <i>Journal of Geodesy</i> , 97(1), 11, https://doi.org/10.1007/s00190-022-01697-8 Groh, A., M. Horwath (2021): Antarctic Ice Mass Change Products from GRACE/GRACE-FO Using Tailored Sensitivity Kernels. <i>Remote Sensing</i> , 13, 1736, https://doi.org/10.3390/rs13091736
Comments	GIA model: Caron2018 (DOI: 10.1002/2017GL076644), Method designed to exclude peripheral glaciers, however residual leakage effects may remain

Table 20: Description of the GIS_cci / SLBC_cci Greenland Ice Sheet mass balance from calibrated radar altimetry.

Data product name	GIS_cci / SLBC_cci Greenland Ice Sheet mass balance from calibrated radar altimetry
Version	1
Variable(s) [units]	(a) Integrated product: Rate of mass balance per basin [Gt/yr] (b) Gridded product : Rate of mass balance per grid cell [kg/m ² /yr]
Short description	Greenland Ice Sheet mass balance (1992-2020) from calibrated radar altimetry
Spatial resolution	(a) none. One time series per basin (b) 5 km x 5km
Spatial coverage	Greenland Ice Sheet
Temporal resolution	annual
Temporal coverage	1992 - 2019
File format	netCDF-4 [.nc]
File size	13 MB
Source	Technical University of Denmark (DTU)
Access point	https://doi.org/10.11583/DTU.13353062
Access conditions	public
Citation/acknowledgments	Simonsen, S. B., Barletta, V. R., Colgan, W. T., & Sørensen, L. S. (2021). Greenland Ice Sheet mass balance (1992–2020) from calibrated radar altimetry. <i>Geophysical Research Letters</i> , 48, e2020GL091216. https://doi.org/10.1029/2020GL091216
Comments	

Table 21: Description of PROMICE Greenland Ice Sheet Mass Balance from 1840 through next week.

Data product name	PROMICE Greenland Ice Sheet Mass Balance from 1840 through next week
Version	1
Variable(s) [units]	Mass balance [Gt/d]
Short description	Mass balance (and components) for Greenland
Spatial resolution	per drainage sector
Spatial coverage	Greenland Ice Sheet
Temporal resolution	weekly
Temporal coverage	1840 – present
File format	NetCDF-4 [.nc]
File size	8 MB
Source	Programme for Monitoring of the Greenland Ice Sheet (PROMICE)
Access point	https://doi.org/10.22008/FK2/OHI23Z
Access conditions	public
Citation/acknowledgments	<p>Mankoff, K. D., Fettweis, X., Langen, P. L., Stendel, M., Kjeldsen, K. K., Karlsson, N. B., Noël, B., van den Broeke, M. R., Solgaard, A., Colgan, W., Box, J. E., Simonsen, S. B., King, M. D., Ahlstrøm, A. P., Andersen, S. B., and Fausto, R. S.: Greenland ice sheet mass balance from 1840 through next week, <i>Earth Syst. Sci. Data</i>, 13, 5001–5025, https://doi.org/10.5194/essd-13-5001-2021, 2021.</p> <p>Mankoff, K., Fettweis, X., Solgaard, A., Langen, P., Stendel, M., Noël, B., van den Broeke, M. R., Karlsson, N., Box, J. E., and Kjeldsen, K.: Greenland ice sheet mass balance from from 1840 through next week, <i>GEUS Dataverse [data set]</i>, https://doi.org/10.22008/FK2/OHI23Z, 2021.</p>
Comments	

2.4.2. Antarctica ice sheet

Table 22: Description of IMBIE aggregated dataset for IPCC AR6.

Data product name	IMBIE aggregated dataset for IPCC AR6
Version	1.0
Variable(s) [units]	Mass balance [Gt] and cumulative mass balance [Gt/yr]
Short description	Ice sheet Mass Balance Intercomparison Exercise (IMBIE) dataset aggregated from 50 independent estimates of ice sheet mass balance
Spatial resolution	None. Datasets are available for AIS, EAIS, WAIS, AP, GIS
Spatial coverage	Antarctica Ice Sheet (AIS), East Antarctica Ice Sheet (EAIS), West Antarctica Ice Sheet (WAIS), Antarctica Peninsula (AP), Greenland Ice Sheet (GIS)
Temporal resolution	monthly
Temporal coverage	1992-01 – 2020-12
File format	ASCII (CSV)
File size	< 20 kB
Source	Ice-sheet Mass Balance Inter-comparison Exercise (IMBIE)
Access point	https://doi.org/10.5285/77B64C55-7166-4A06-9DEF-2E400398E452
Access conditions	public
Citation/acknowledgments	IMBIE Team: Antarctic and Greenland Ice Sheet mass balance 1992–2020 for IPCC AR6 (Version 1.0), UK Polar Data Centre, Natural Environment Research Council, UK Research & Innovation [data set], https://doi.org/10.5285/77B64C55-7166-4A06-9DEF-2E400398E452 , 2021
Comments	Identical to entry for GIS in chapter 2.4.1

Table 23: Description of the Antarctic Ice Sheet GMB data.

Data product name	Antarctic Ice Sheet CCI GMB product
Version	4.1
Variable(s) [units]	Surface mass density change [kg / m ²]
Short description	Gravimetric Mass Balance (GMB) products generated by TU Dresden based on the monthly GRACE solutions CSR RL06.2
Spatial resolution	50 km x 50 km (polar-stereographic projection)
Spatial coverage	Antarctic Ice Sheet
Temporal resolution	monthly
Temporal coverage	2002-04 – 2023-12, 11 month data gap between GRACE and GRACE-FO mission (2017-07 – 2018-05), and additional number of single months
File format	netCDF-4 [.nc]
File size	21 MB
Source	ESA Climate Change Initiative (CCI+ Antarctic Ice Sheet)
Access point	https://data1.geo.tu-dresden.de/ais_gmb/index.html [last access: 2024-04-11]
Access conditions	public
Citation/acknowledgments	Groh, A., M. Horwath (2021): Antarctic Ice Mass Change Products from GRACE/GRACE-FO Using Tailored Sensitivity Kernels. Remote Sensing, 13, 1736, https://doi.org/10.3390/rs13091736 Döhne, T., Horwath, M., Groh, A., & Buchta, E. (2023). The sensitivity kernel perspective on GRACE mass change estimates. Journal of Geodesy, 97(1), 11, https://doi.org/10.1007/s00190-022-01697-8
Comments	GIA model: IJ_RL2 (DOI: 10.1002/jgrb.50208), Method designed to exclude peripheral glaciers, however residual leakage effects may remain

Table 24: Description of the AIS_cci Surface Elevation Change data.

Data product name	AIS_cci Surface Elevation Change
Version	1
Variable(s) [units]	Mean rates of surface elevation change [m/yr]
Short description	Surface Elevation Change of the Antarctic Ice Sheet from Multi-Mission Altimetry (1991-2021), 5-year Gridded Means stepped by 1-year, 5km Resolution.
Spatial resolution	5 km
Spatial coverage	AIS, subject to coverage by satellite tracks. (Grid is partly sparsely sampled)
Temporal resolution	Mean rates for overlapping 5 year-periods, in 1-year steps
Temporal coverage	Central years of the 5-year periods go from 1993 to 2019
File format	NetCDF-4 [.nc]
File size	610 MB (uncompressed)
Source	Centre for Polar Observation and Modeling
Access point	http://www.cpom.ucl.ac.uk/csopr/icesheets2/
Access conditions	Public (with registration)
Citation/acknowledgments	Shepherd, A., Gilbert, L., Muir, A. S., Konrad, H., McMillan, M., Slater, T., Briggs, K. H., Sundahl, A., V., Hogg, A. E., & Engdahl, M. (2019). Trends in Antarctic Ice Sheet Elevation and Mass. <i>Geophysical Research Letters</i> , https://doi.org/10.1029/2019GL082182
Comments	

Table 25: Description of the MEaSURES ITS_LIVE Antarctic Grounded Ice Sheet Elevation Change data.

Data product name	MEaSURES ITS_LIVE Antarctic Grounded Ice Sheet Elevation Change
Version	1
Variable(s) [units]	Change in ice sheet elevation since the nominal center reference date of 2013-12-16 [m]
Short description	Surface Elevation Change of the Antarctic Ice Sheet from Multi-Mission Altimetry
Spatial resolution	1920 m x 1920 m, Polar Stereographic grid
Spatial coverage	AIS, subject to coverage by orbit constellation. Interpolated between satellite tracks
Temporal resolution	1 month
Temporal coverage	17 April 1985 to 16 December 2020
File format	netCDF-4
File size	4 GB
Source	MEaSURES ITS_LIVE
Access point	https://doi.org/10.5067/L3LSVDZS15ZV
Access conditions	public
Citation/acknowledgments	<p>Nilsson, J., Gardner, A. S., and Paolo, F. S.: MEaSURES ITS_LIVE Antarctic Grounded Ice Sheet Elevation Change, Version 1, Data archived at National Snow and Ice Data Center, http://its-live-data.jpl.nasa.gov.s3.amazonaws.com/height_change/Antarctica/Grounded/ANT_G1920V01_GroundedIceHeight.nc</p> <p>Nilsson, J., Gardner, A. S., and Paolo, F. S.: Elevation change of the Antarctic Ice Sheet: 1985 to 2020, Earth Syst. Sci. Data, 14, 3573–3598, https://doi.org/10.5194/essd-14-3573-2022, 2022.</p>
Comments	

2.4.3. Glaciers and ice caps

Table 26: Description of glacier data.

Data product name	Copernicus Climate Services Glacier Mass balance
Version	WGMS-FOG-2022-09
Variable(s) [units]	Glacier Mass Change [Gt / grid point]
Short description	Glacier and Ice Cap Mass Balance
Spatial resolution	0.5x0.5 deg (polar projection)
Spatial coverage	Global
Temporal resolution	monthly
Temporal coverage	1992-01-2021-12
File format	netCDF-4 [.nc]
File size	21 MB
Source	Climate Data Store (CDS)
Access point	https://cds.climate.copernicus.eu/cdsapp#!/dataset/derived-gridded-glacier-mass-change?tab=form
Access conditions	public
Citation/acknowledgments	Dussailant, I., Bannwart, J., Paul, F., Zemp, M. (2023): Glacier mass change global gridded data from 1976 to present derived from the Fluctuations of Glaciers Database. World Glacier Monitoring Service. (Accessed on DD-MMM-YYYY) Copernicus Climate Change Service (C3S) (2023): Glacier mass change global gridded data from 1976 to present derived from the Fluctuations of Glaciers Database. Copernicus Climate Change Service (C3S) Climate Data Store (CDS). (Accessed on DD-MMM-YYYY)
Comments	The data set is identical to the one described except it will have a seasonal cycle included and be at monthly time step

2.4.4. Land water storage

Table 27: Description of the land water storage data from WaterGAP Hydrological Model (WGHM).

Data product name	The global water resources and use model WaterGAP
Version	v2.2e
Variable(s) [units]	tws [kg/m ²]
Short description	Gridded product of land water storage with different climate forcings (W5E5 v2.0 or ERA5), with and without including the anthropogenic contribution
Spatial resolution	0.5°x0.5°
Spatial coverage	global over land
Temporal resolution	monthly
Temporal coverage	01/01/1993-31/12/2022, no gaps (ERA5 climate forcing) 01/01/1993-31/12/2019, no gaps (W5E5 v2.0 climate forcing)
File format	netCDF-4 [.nc]
File size	361 Mb / file over 1901-2022
Source	Water - Global Assessment and Prognosis (WaterGAP)
Access point	<p>ERA5 climate forcing, with anthropogenic contribution DOI: 10.25716/gude.1q7k-2gww https://gude.uni-frankfurt.de/entities/researchdata/c53bb505-a620-4860-b2a2-d5a6de74dbd9/files [last access: 20/03/2024]</p> <p>W5E5 climate forcing, with anthropogenic contribution DOI: 10.25716/gude.0tny-kjpg https://gude.uni-frankfurt.de/entities/researchdata/45867b1e-17f2-4125-a219-ded20bad249e/files [last access: 20/03/2024]</p> <p>ERA5 climate forcing, without anthropogenic contribution DOI: 10.25716/gude.0wkz-74yd https://gude.uni-frankfurt.de/entities/researchdata/1f9dc2f1-23ca-4710-9827-fd93e7d5a692/files [last access: 20/03/2024]</p> <p>W5E5 climate forcing, without anthropogenic contribution DOI: 10.25716/gude.0pzw-2tvk https://gude.uni-frankfurt.de/entities/researchdata/29879d10-3b64-4dce-8fb6-fa6d44b66869/files [last access: 20/03/2024]</p>
Access conditions	public
Citation/acknowledgments	Müller Schmied, H., Trautmann, T., Ackermann, S., Cáceres, D., Flörke, M., Gerdener, H., Kynast, E., Peiris, T. A., Schiebener, L., Schumacher, M., and Döll, P.: The global water resources and use model WaterGAP v2.2e: description and evaluation of modifications and new features, Geosci. Model Dev. Discuss. [preprint], https://doi.org/10.5194/gmd-2023-213 , in review, 2023.
Comments	The four versions described in this table are provided from 1901, with two different climate forcings before 1979 (GSWP3 and 20CRV3). In total, eight versions are therefore available. As these forcings only affect data before the altimetry era, we arbitrarily choose the files using GSWP3 forcing before 1979.

Table 28: Description of the lakes data from ESA CCI.

Data product name	ESA Lakes Climate Change Initiative (Lakes_cci): Lake products
Version	2.0.2
Variable(s) [units]	water_surface_height_above_reference_datum [m] lake_surface_water_extent [km ²]
Short description	Daily gridded product of water height and extent over lakes
Spatial resolution	1/120°x1/120°
Spatial coverage	global
Temporal resolution	daily
Temporal coverage	26/09/1992-31/12/2020
File format	netCDF-4 [.nc]
File size	484 Gb
Source	ESA Climate Change Initiative
Access point	DOI: 10.5285/a07deacaffb8453e93d57ee214676304 https://catalogue.ceda.ac.uk/uuid/a07deacaffb8453e93d57ee214676304 [last access: 11/04/2024]
Access conditions	public
Citation/acknowledgments	Carrea, L.; Crétaux, J.-F.; Liu, X.; Wu, Y.; Bergé-Nguyen, M.; Calmettes, B.; Duguay, C.; Jiang, D.; Merchant, C.J.; Mueller, D.; Selmes, N.; Simis, S.; Spyrakos, E.; Stelzer, K.; Warren, M.; Yesou, H.; Zhang, D. (2022): ESA Lakes Climate Change Initiative (Lakes_cci): Lake products, Version 2.0.2. NERC EDS Centre for Environmental Data Analysis, 06 July 2022. doi:10.5285/a07deacaffb8453e93d57ee214676304. https://dx.doi.org/10.5285/a07deacaffb8453e93d57ee214676304 Carrea, L., Crétaux, JF., Liu, X. et al. Satellite-derived multivariate world-wide lake physical variable timeseries for climate studies. Sci Data 10, 30 (2023). https://doi.org/10.1038/s41597-022-01889-z
Comments	This dataset enables us to compute the lakes part of the LWS component.

Table 29: Description of the snow data from ESA CCI.

Data product name	ESA Snow Climate Change Initiative (Snow_cci): Snow Water Equivalent (SWE) level 3C daily global climate research data package (CRDP)
Version	2.0
Variable(s) [units]	swe [mm]
Short description	Daily gridded product of water height and extent over lakes
Spatial resolution	0.1°x0.1°
Spatial coverage	global
Temporal resolution	daily
Temporal coverage	02/01/1979-24/05/2020
File format	netCDF-4 [.nc]
File size	10.4 Gb
Source	ESA Climate Change Initiative
Access point	DOI: 10.5285/4647cc9ad3c044439d6c643208d3c494 https://catalogue.ceda.ac.uk/uuid/4647cc9ad3c044439d6c643208d3c494 [last access: 11/04/2024]
Access conditions	public
Citation/acknowledgments	Luojus, K.; Moisander, M.; Pulliainen, J.; Takala, M.; Lemmetyinen, J.; Derksen, C.; Mortimer, C.; Schwaizer, G.; Nagler, T.; Venäläinen, P. (2022): ESA Snow Climate Change Initiative (Snow_cci): Snow Water Equivalent (SWE) level 3C daily global climate research data package (CRDP) (1979 – 2020), version 2.0. NERC EDS Centre for Environmental Data Analysis, 17 March 2022. doi:10.5285/4647cc9ad3c044439d6c643208d3c494. https://dx.doi.org/10.5285/4647cc9ad3c044439d6c643208d3c494
Comments	This dataset enables us to compute the snow part of the LWS component.

2.4.5. Atmosphere water vapour content

The ECMWF atmosphere reanalysis ERA5 provides monthly water vapour data globally, over the full study period (Table 30). The ESA Water Vapour Climate Change Initiative provides a Climate Data Record (CDR) of total column water vapour (TCWV), but only over land and over 2002-2017 (Table 31). To enable comparison, we also consider the ECMWF HOAPS thematic and interim CDRs (TCDR and ICDR) version 4, providing data over the ice-free ocean over 1993-2014 and 2015-2020 respectively (Table 32).

Table 30: Description of the atmosphere water vapour data from ERA5.

Data product name	ERA5 monthly averaged data on single levels from 1940 to present
Version	5
Variable(s) [units]	tcwv [kg/m ²]
Short description	Gridded product of total column water vapour
Spatial resolution	0.25°x0.25°
Spatial coverage	global
Temporal resolution	monthly
Temporal coverage	01/01/1993-31/12/2023, no gaps
File format	netCDF-4 [.nc]
File size	1.5 Gb / 31 years
Source	European Center for Medium-Range Weather Forecasts (ECMWF)
Access point	DOI: 10.24381/cds.f17050d7 https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-era5-single-levels-monthly-means?tab=form [last access: 20/03/2024]
Access conditions	public (account needed)
Citation/acknowledgments	Hersbach, H., Bell, B., Berrisford, P., Biavati, G., Horányi, A., Muñoz Sabater, J., Nicolas, J., Peubey, C., Radu, R., Rozum, I., Schepers, D., Simmons, A., Soci, C., Dee, D., Thépaut, J.-N. (2023): ERA5 monthly averaged data on single levels from 1940 to present. Copernicus Climate Change Service (C3S) Climate Data Store (CDS), DOI: 10.24381/cds.f17050d7 (Accessed on DD-MMM-YYYY)
Comments	

Table 31: Description of the atmosphere water vapour data from ESA CCI.

Data product name	ESA Water Vapour Climate Change Initiative (Water_Vapour_cci): Total Column Water Vapour monthly gridded data over land at 0.5 degree resolution
Version	3.2
Variable(s) [units]	tcwv [kg/m ²]
Short description	Monthly gridded averaged total column water vapour data over land, observed from various satellite instruments, part of the TCWV over land Climate Data Record-1 (TCWV-land (CDR-1))
Spatial resolution	0.5°x0.5°
Spatial coverage	global, over land
Temporal resolution	monthly
Temporal coverage	01/07/2002-31/12/2017, no gaps
File format	netCDF-4 [.nc]
File size	~1.2 Mb / monthly file
Source	ESA Climate Change Initiative
Access point	DOI: 10.5285/4a85c0ef880e4f668cd4ec8e846855ef https://catalogue.ceda.ac.uk/uuid/80ad33b237084a8dbfb81ec5414e68dd [last access: 20/03/2024]
Access conditions	public
Citation/acknowledgments	Danne, O.; Falk, U.; Preusker, R.; Brockmann, C.; Fischer, J.; Hegglin, M.I.; Schröder, M. (2022): ESA Water Vapour Climate Change Initiative (Water_Vapour_cci): Total Column Water Vapour monthly gridded data over land at 0.5 degree resolution, version 3.2. NERC EDS Centre for Environmental Data Analysis, <i>date of citation</i> . https://catalogue.ceda.ac.uk/uuid/80ad33b237084a8dbfb81ec5414e68dd
Comments	

Table 32: Description of the Hamburg Ocean Atmosphere Parameters and Fluxes (HOAPS) atmosphere water vapour data from ECMWF.

Data product name	Monthly total column water vapour over ocean from 1988 to 2020 derived from satellite observations
Version	HOAPS algorithm version 4.0
Variable(s) [units]	wvpa [kg/m ²]
Short description	Monthly gridded fields of total column water vapour data
Spatial resolution	0.5°x0.5°
Spatial coverage	global, over ice-free oceans
Temporal resolution	monthly
Temporal coverage	01/01/1993-31/12/2014 (TCDR) 01/01/2015-31/12/2020 (ICDR)
File format	netCDF-4 [.nc]
File size	~7.6 Mb / monthly file
Source	EUMETSAT
Access point	DOI: 10.24381/cds.92db7fef https://cds.climate.copernicus.eu/cdsapp#!/dataset/satellite-total-column-water-vapour-ocean?tab=form [last access: 20/03/2024]
Access conditions	public (account needed)
Citation/acknowledgments	Thematic Climate Data Record (TCDR): Andersson, A., Graw, K., Schröder, M., Fennig, K., Liman, J., Bakan, S., Hollmann, R., Klepp, C., (2017): Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite Data - HOAPS4.0. Satellite Application Facility on Climate Monitoring. DOI: 10.5676/EUM_SAF_CM/HOAPS/V002 (Accessed on DD-MMM-YYYY) Interim Climate Data Record (ICDR): Andersson, A., Graw, K., Schröder, M., Fennig, K., Liman, J., Bakan, S., Raphoe, N., Hollmann, R., Klepp, C., (2021): Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite Data - HOAPS4.0. Copernicus Climate Change Service (C3S) Climate Data Store (CDS). DOI: 10.24381/cds.92db7fef (Accessed on DD-MMM-YYYY) Citing the web catalogue entry: Copernicus Climate Change Service (2022): Monthly and 6-hourly total column water vapour over ocean from 1988 to 2020 derived from satellite observations. Copernicus Climate Change Service (C3S) Climate Data Store (CDS). DOI: 10.24381/cds.92db7fef (Accessed on DD-MMM-YYYY)
Comments	

2.5. For fingerprints and GIA

The fingerprints dataset includes time-series of the monthly elastic response to surface mass redistribution in terms of vertical land motion, geoid height change, sea surface height change and relative sea level change. The dataset includes the cumulated effect of ice sheets and terrestrial water storage as well as individual components associated with major cryospheric sources (GIS, AIS and small glaciers).

Input datasets will hence be the ones described in Sections 2.4.1, 2.4.2, 2.4.3 and 2.4.4. Their description is not repeated here.

Present-day steady-state rates of GIA will use the ICE-7G(VM7) GIA model.

Table 33: ICE-7G(VM7) GIA model.

Data product name	ICE-7G(VM7) GIA model
Version	The ICE-7G_NA (VM7)
Variable(s) [units]	Ice thickness and topography [m]
Short description	Full history of the ice thickness and topography since 26 ka in combination with a radial viscosity profile (VM7)
Spatial resolution	1 degree
Spatial coverage	Global
Temporal resolution	500 years or 1000 years
Temporal coverage	From the Last Glacial Maximum (26 ka) to present time
File format	netCDF
File size	Approx 15 Mb
Source	W. R. Peltier
Access point	https://www.atmosp.physics.utoronto.ca/~peltier/data.php
Access conditions	None
Citation/acknowledgments	The model is validated in: Roy K. and Peltier W. R. (2018). Relative sea level in the Western Mediterranean basin: A regional test of the ICE-7G_NA (VM7) model and a constraint on Late Holocene Antarctic deglaciation. <i>Quaternary Science Reviews</i> , 183, 76-87, doi:10.1016/j.quascirev.2017.12.021.
Comments	The <i>ICE-7G(VM7) GIA model</i> has been implemented in the SELEN ⁴ open source program (Spada G. and Melini D., 2019. SELEN ⁴ (SELEN version 4.0): a Fortran program for solving the gravitationally and topographically self-consistent sea-level equation in glacial isostatic adjustment modeling, <i>Geoscientific Model Development</i> , 12, 5055-5075, https://doi.org/10.5194/gmd-12-5055-2019) to provide predictions of the present-day GIA fingerprints for absolute and relative sea-level variations and geoid height change.

2.6. For synthetic observations: Altimetric synthetic data

Table 34: Description of the gridded fields from the OCCIPUT ocean simulation.

Data product name	OCCIPUT (OceaniC Chaos-ImPacts, strUcture, predicatbiliTy) global ocean simulations with the NEMO (Nucleus for European Modelling of the Ocean) model
Version	v1
Variable(s) [units]	<ul style="list-style-type: none"> • ssh (sea surface height) in meter [x,y] • botpres (ocean bottom pressure) in dbar [x,y] • Temperature in °C [x,y,z] • Salinity in psu [x,y,z]
Short description	<p>These fields are extracted from the OCCIPUT global ocean/sea-ice/iceberg simulation, which uses the NEMO model, and has a horizontal resolution of 1/4°. It was run as an ensemble experiment (50 members) of which we provide here only the outputs from ensemble member #1. It ran over the period 1960-2015. The atmospheric forcing applied at the surface comes from the DFS5.2 dataset (Dussin et al., 2016), based on the ERAi reanalysis. It varies over the full range of time-scales from 6 hours to multi-decadal. The freshwater river runoff and icecap melting forcing applied to the experiment is climatological. The full technical documentation is available here:</p> <p>https://docs.google.com/document/d/1Bs4ov6nkRZUwLe6Vp3TZqXFxdQ8qQy_pObwVKt0wiY/edit?usp=sharing</p>
Spatial resolution	<p>Two types are available:</p> <ul style="list-style-type: none"> • 1/4° ORCA grid (native irregular grid of NEMO model) • 1/4° interpolated regular grid (available only for 2-D fields)
Spatial coverage	Global
Temporal resolution	<p>1-day for 2-D fields 5-day for 3-D fields</p>
Temporal coverage	1993-2015
File format	NetCDF
File size	3 Go per year
Source	DATLAS and Institut des Géosciences de l'Environnement (IGE) Grenoble France
Access point	https://ige-meom-opensap.univ-grenoble-alpes.fr/thredds/catalog/meomopenda/p/extract/MEOM/IMHOTEP/OCCIPUT/SHAREDforESA-CCI/catalog.html
Access conditions	<p>2-D fields: Anyone with the link can access 3-D fields: needs a login on French HPC computer IRENE@TGCC</p>
Citation/acknowledgments	<p>These datasets are derived from numerical ocean simulations produced as part of the OCCIPUT project lead by T. Penduff (IGE) in collaboration with Jean-Marc Molines (IGE) and S. Leroux (Datlas). Reference: Bessières, L., Leroux, S., Brankart, J.-M., Molines, J.-M., Moine, M.-P., Bouttier, P.-A., Penduff, T., Terray, L., Barnier, B., and Sérazin, G.: Development of a probabilistic ocean modelling system based on NEMO 3.5: application at eddying resolution, Geosci. Model Dev., 10, 1091–1106, https://doi.org/10.5194/gmd-10-1091-2017, 2017.</p> <p>These datasets are available upon request for scientific collaboration. Please let us know by email if you download and use them, and/or if you need further information about them (contact: thierry.penduff@univ-grenoble-alpes.fr and stephanie.leroux@datlas.fr).</p>
Comments	The 2-D fields are provided with the global mean at each time step removed (see specific doc for more details). The global mean is also provided.

Table 35: Description of the along-track dataset sampled from the OCCIPUT ocean simulation.

Data product name	Along-track synthetic SLA extracted from OCCIPUT global ocean simulations with the NEMO model
Version	v2 (scale factor corrected, 2024)
Variable(s) [units]	<ul style="list-style-type: none"> • SLA (sea level anomaly) in meter
Short description	<p>Synthetic along-track SLA extracted from OCCIPUT ocean simulation to mimic true along-track JASON2 observations downloaded from AVISO. See full technical documentation here: technical documentation here: https://docs.google.com/document/d/1Bs4ov6nkRZUwLe6Vp3TZgXFxlDQ8qQy_pObwVKt0wjY/edit?usp=sharing</p>
Spatial resolution	Same as Jason-2 along-track observations
Spatial coverage	Same as Jason-2 along-track observations
Temporal resolution	Same as Jason-2 along-track observations (but no interpolation in time between model timesteps, which are every xx minutes)
Temporal coverage	2009-2015
File format	NetCDF (in feedback format from the NEMO obs operator)
File size	1.3 Go per year
Source	DATLAS and Institut des Géosciences de l'Environnement (IGE) Grenoble France
Access point	https://ige-meom-opensap.univ-grenoble-alpes.fr/thredds/catalog/meom_opensap/extract/MEOM/IMHOTEP/OCCIPUT/SHAREDforESA-CCI/SLA_2009-2015_MB001/catalog.html
Access conditions	Anyone with the link can access
Citation/acknowledgments	<p>These datasets are derived from numerical ocean simulations produced as part of the OCCIPUT project led by T. Penduff (IGE) in collaboration with Jean-Marc Molines (IGE) and S. Leroux (Datlas). Reference: Bessières, L., Leroux, S., Brankart, J.-M., Molines, J.-M., Moine, M.-P., Bouttier, P.-A., Penduff, T., Terray, L., Barnier, B., and Sérazin, G.: Development of a probabilistic ocean modelling system based on NEMO 3.5: application at eddy resolution, Geosci. Model Dev., 10, 1091–1106, https://doi.org/10.5194/gmd-10-1091-2017, 2017. These datasets are available upon request for scientific collaboration. Please let us know by email if you download and use them, and/or if you need further information about them (contact: thierry.penduff@univ-grenoble-alpes.fr and stephanie.leroux@datlas.fr).</p>
Comments	<p>Users might need to remove the global mean of the model SSH at each time (see technical documentation here: https://docs.google.com/document/d/1Bs4ov6nkRZUwLe6Vp3TZgXFxlDQ8qQy_pObwVKt0wjY/edit?usp=sharing)</p>

2.7. For synthetic observations: Steric synthetic data

Also see Table 34 in section 2.6 above (Description of the gridded fields from the OCCIPUT ocean simulation).

Table 36: Description of the in-situ T/S profiles sampled from the OCCIPUT ocean simulation.

Data product name	Synthetic in situ Temperature and Salinity profiles extracted from OCCIPUT global ocean simulations with the NEMO model
Version	v1
Variable(s) [units]	<ul style="list-style-type: none"> • temperature • salinity
Short description	<p>Synthetic observations of in-situ Temperature and Salinity profiles as a function of depth extracted online during the production of the global, NEMO-based OCCIPUT experiment at every single time and location (in x,y,z dimensions) where a true in-situ profile exists in the ENACT-3 database (Ingleby, B., and M. Huddleston, 2007) over the simulation period: 1960-2015. See technical documentation here: https://docs.google.com/document/d/1Bs4ov6nkRZUwLe6Vp3TZgXFxldQ8qQy_pObwVKt0wjY/edit?usp=sharing</p>
Spatial resolution	Same as ENACT3
Spatial coverage	Same as ENACT3
Temporal resolution	Same as ENACT3 (but no interpolation in time between model timesteps, which are every xx minutes)
Temporal coverage	1961-2015
File format	NetCDF (in feedback format from the NEMO obs operator)
File size	Up to 800 Mo per month
Source	DATLAS and Institut des Géosciences de l'Environnement (IGE) Grenoble France
Access point	https://ige-meom-opensap.univ-grenoble-alpes.fr/thredds/catalog/meomopensap/extract/MEOM/IMHOTEP/OCCIPUT/SHAREDforESA-CCI/ENACT3_1961-2015_MB001/catalog.html
Access conditions	Anyone with the link can access
Citation/acknowledgments	<p>These datasets are derived from numerical ocean simulations produced as part of the OCCIPUT project lead by T. Penduff (IGE) in collaboration with Jean-Marc Molines (IGE) and S. Leroux (Datlas). Reference: Bessières, L., Leroux, S., Brankart, J.-M., Molines, J.-M., Moine, M.-P., Bouttier, P.-A., Penduff, T., Terray, L., Barnier, B., and Sérazin, G.: Development of a probabilistic ocean modelling system based on NEMO 3.5: application at eddy resolution, Geosci. Model Dev., 10, 1091–1106, https://doi.org/10.5194/gmd-10-1091-2017, 2017. These datasets are available upon request for scientific collaboration. Please let us know by email if you download and use them, and/or if you need further information about them (contact: thierry.penduff@univ-grenoble-alpes.fr and stephanie.leroux@datlas.fr).</p>
Comments	

2.8. For synthetic observations: Gravimetric synthetic data

The input dataset for ocean dynamics water redistribution will be the variable 'botpres' (ocean bottom pressure) in Table 34 in section 2.6 above.

Input datasets for the ocean mass change due to land sources (ice sheets, glaciers, land water storage) will hence be the ones described in Sections 2.3, 2.4.1, 2.4.2, 2.4.3 and 2.4.4. Their description is not repeated here.