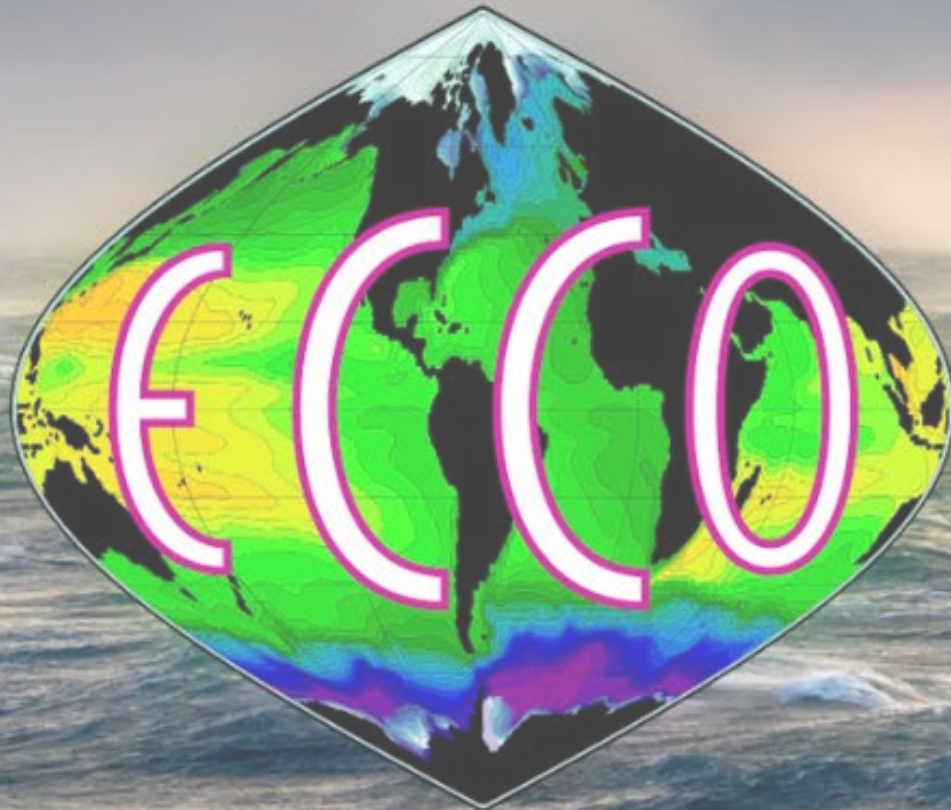


PO.DAAC and ECCO

Celia Ou - PO.DAAC Data
Publication Team

January 25, 2023

ECCO Annual Meeting



Estimating the Circulation and Climate of the Ocean (ECCO)

PO.DAAC — Physical Oceanography Distributed Active Archive Center

NASA Jet Propulsion Laboratory
California Institute of Technology

PO.DAAC
Physical Oceanography Distributed Active Archive Center

HOME FIND DATA ACCESS DATA RESOURCES ABOUT HELP CLOUD DATA

Data Search

Follow Us

Surface Water and Ocean Topography (SWOT) Expected to Launch

Mark your calendars! Thursday, December 15th is the targeted date for launch of the SWOT satellite from Vandenberg Space Force Base at 3:46 AM PST

scroll for more

Science Disciplines

- Ocean
- Cryosphere
- Terrestrial Hydrosphere

Announcements

- Tapes > CD > FTP > drive
- Now migrating to Earthdata Cloud
- Workshops and webinars – cloud early adopters, project-specific (SWOT, S-MODE)

ECCO Version 4 Release 4 (V4r4)

- Published April 2021
- PO.DAAC's first cloud-native publication!
- 79 datasets

The screenshot shows the PO.DAAC website interface. At the top, there is a navigation bar with the NASA logo, Jet Propulsion Laboratory California Institute of Technology, and the PO.DAAC logo (Physical Oceanography Distributed Active Archive Center). The navigation menu includes HOME, FIND DATA, ACCESS DATA, RESOURCES, ABOUT, HELP, and CLOUD DATA. A search bar is located on the right side of the navigation bar.

The main content area features a "Find Data" section with a notification: "Datasets are being migrated to Earthdata Cloud. Learn More" with an AWS logo. Below this, there is a "Select Filter" section with the following categories:

- Processing Levels:** 4 - Gridded Model Output (90)
- Keywords:** Atmosphere (10), Climate Indicators (2), Cryosphere (12), Oceans (72), Terrestrial Hydrosphere (4)
- Instruments:** ALT (TOPEX) (85), AIRKa Altimeter (85), AMI (85), Aquarius_Radiometer (85), Aquarius_Scatterometer (85), ATSR (85), ATSR-2 (85), AVHRR (85), [Show More](#)
- Platforms:** Space-based Platforms (85), Water-based Platforms (85), Other (90)
- Projects:** ECCO (90)
- Horizontal Data Resolution:** 50 to 100 km (38), 100 to 250 km (52)
- Additional Filters:** Earthdata Cloud Enabled (90)

The search results section shows "Found 90 matching dataset(s)". A "Need help selecting a dataset? Visit the PO.DAAC Forum" link is provided. Below the search results, there is an "Advanced search" section with a "Free Text Search" field containing "ecco v4r4" and a "Temporal Search" section with "Start Date" and "Stop Date" fields. "Perform Search" and "Reset" buttons are located below the search fields.

The search results are displayed in a list view. The first result is "ECCO Atmosphere Surface Temperature, Humidity, Wind, and Pressure - Daily Mean 0.5 Degree (Version 4 Release 4)". The result includes a globe icon with a "CLOUD ENABLED" badge. The description for this dataset is:

ECCO Atmosphere Surface Temperature, Humidity, Wind, and Pressure - Daily Mean 0.5 Degree (Version 4 Release 4)
(ECCO_L4_ATM_STATE_05DEG_DAILY_V4R4)
ATMOSPHERIC WINDS, OCEAN WINDS, OCEAN PRESSURE, ATMOSPHERIC WATER VAPOR, EARTH SCIENCE REANALYSES/ASSIMILATION MODELS, ATMOSPHERIC TEMPERATURE
Platform/Sensor: ERS-1/RADAR ALTIMETERS , ERS-1/ERS-1 ALTIMETER , ERS-1/AMI , ERS-1/ATSR , ERS-1/PRARE , ERS-2/RADAR ALTIMETERS , ERS-2/ERS-2 Altimeter , ERS-2/ATSR-2 , ERS-2/SAR , TOPEX/POSEIDON/ALT (TOPEX) , TOPEX/POSEIDON/TMR , TOPEX/POSEIDON/SSALT ... [more](#)
Processing Level: 4
Coverage: South: -90, West: -180, North: 90, East: 180
Start/End Date: 1992-Jan-1 to 2018-Jan-1
Description: This dataset contains daily-averaged atmosphere surface temperature, humidity, wind, and pressure interpolated to a regular 0.5-degree grid from the ECCO Version 4 revision 4 (V4r4) ... [more](#)

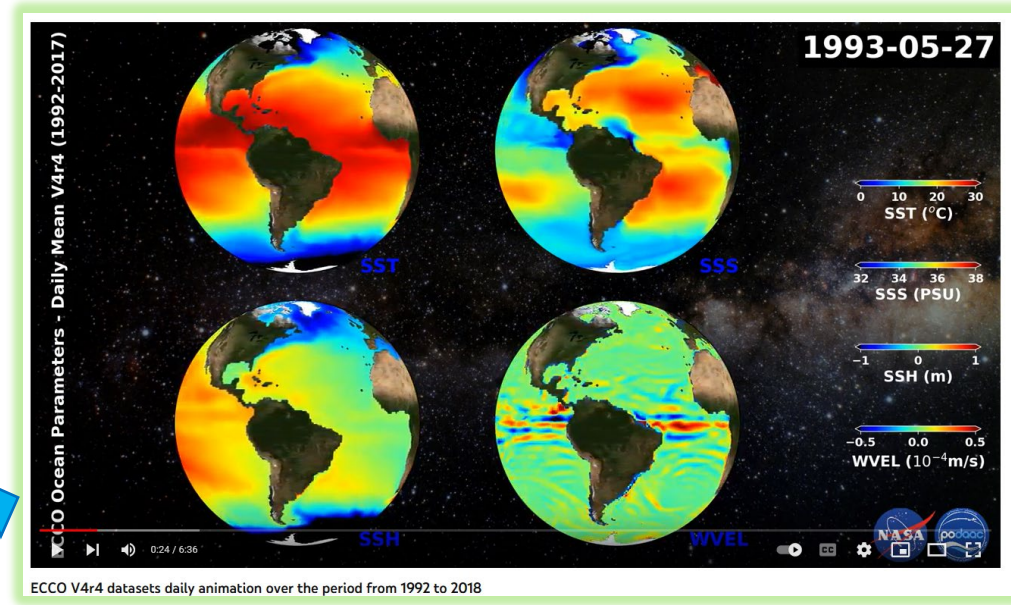
We also publish animations, Data in Action stories

NASA JPL PODAAC
@NASAJPLPODAAC
652 subscribers

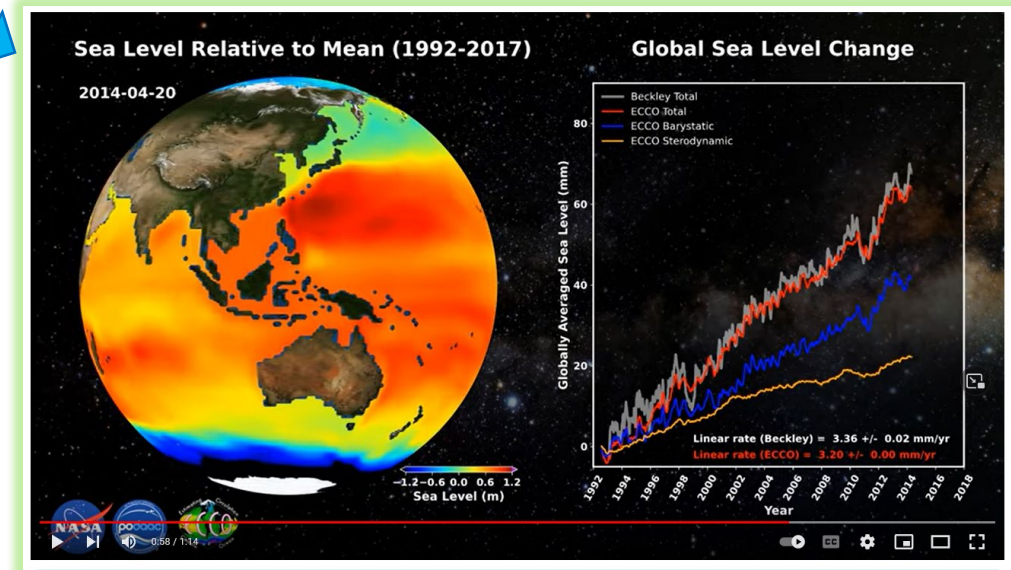
HOME VIDEOS SHORTS PLAYLISTS COMMUNITY CHANNELS ABOUT

Recently uploaded Popular

- 2018-12-08: Sea Surface Salinity from SMAP RSS Level 3 V5 (2015-2022) - 293 views • 2 months ago
- 2018-12-08: Sea Surface Height grids with different spatial resolutions - 265 views • 2 months ago
- 2020-06-16: Ocean Surface Wind Speed Animation for the CYGNSS Level 3 Climate Data Record... - 59 views • 3 months ago
- 2020-06-16: Saildrome 2021 Arctic field campaign for the Multi-Sensor Improved SST (MISST) project - 68 views • 3 months ago
- 2021-01-30: CYGNSS Level 2 Ocean Surface Heat Flux Science Data Record Version 2.0 - 85 views • 5 months ago
- 2019-08-16: Global Sea Surface Foundation Temperature v5.1 produced by the Remote Sensing... - 196 views • 6 months ago
- 2022-08-21: Simulated SWOT L2 River and Lake Vectors for Consecutive Passes over North America - 95 views • 6 months ago
- 2008-04-19: MEASUREs Gridded Sea Surface Height Anomalies Version 2205 - 172 views • 7 months ago



ECCO V4r4 datasets daily animation over the period from 1992 to 2018

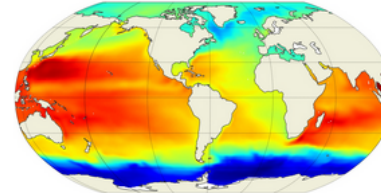


Dataset Landing Pages

ECCO Sea Surface Height - Monthly Mean 0.5 Degree (Version 4 Release 4)

(ECCO_L4_SSH_05DEG_MONTHLY_V4R4)

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CLOUD ENABLED

Status: COMPLETE

Short Name:

ECCO_L4_SSH_05DEG_MONTHLY_V4R4

Collection Concept ID:

C1990404799-POCLOUD

Spatial Coverage:

N: 90° S: -90°

E: 180° W: -180°

Access:

- [Search Granules](#)
- [Browse Granule Listing](#)

Capabilities:



Data Recipes:

- [Generic data readers](#)

[Information](#) [Coverage](#) [Data Access](#) [Documentation](#) [Citation](#)

Version	V4r4
Processing Level	4
Start/Stop Date	1992-Jan-01 to 2018-Jan-01
Short Name	ECCO_L4_SSH_05DEG_MONTHLY_V4R4
Description	<p>This dataset contains monthly-averaged dynamic sea surface height interpolated to a regular 0.5-degree grid from the ECCO Version 4 revision 4 (V4r4) ocean and sea-ice state estimate. Estimating the Circulation and Climate of the Ocean (ECCO) ocean and sea-ice state estimates are dynamically and kinematically-consistent reconstructions of the three-dimensional, time-evolving ocean, sea-ice, and surface atmospheric states. ECCO V4r4 is a free-running solution of the 1-degree global configuration of the MIT general circulation model (MITgcm) that has been fit to observations in a least-squares sense. Observational data constraints used in V4r4 include sea surface height (SSH) from satellite altimeters [ERS-1/2, TOPEX/Poseidon, GFO, ENVISAT, Jason-1,2,3, CryoSat-2, and SARAL/AltiKa]; sea surface temperature (SST) from satellite radiometers [AVHRR], sea surface salinity (SSS) from the Aquarius satellite radiometer/scatterometer, ocean bottom pressure (OBP) from the GRACE satellite gravimeter; sea ice concentration from satellite radiometers [SSM/I and SSMIS], and in-situ ocean temperature and salinity measured with conductivity-temperature-depth (CTD) sensors and expendable bathythermographs (XBTs) from several programs [e.g., WOCE, GO-SHIP, Argo, and others] and platforms [e.g., research vessels, gliders, moorings, ice-tethered profilers, and instrumented pinnipeds]. V4r4 covers the period 1992-01-01T12:00:00 to 2018-01-01T00:00:00.</p>
DOI	10.5067/ECG5M-SSH44
Measurement	OCEANS > SEA SURFACE TOPOGRAPHY > SEA SURFACE HEIGHT MODELS > EARTH SCIENCE REANALYSES/ASSIMILATION MODELS

- Lists coverage
- Access links and names
- Documentation
- DOI and Citation

Dataset Landing Pages

ECCO Sea Surface Height - Monthly Mean 0.5 Degree (Version 4 Release 4)

(ECCO_L4_SSH_05DEG_MONTHLY_V4R4)

Information Coverage Data Access Documentation Citation

Version	V4r4
Processing Level	4
Start/Stop Date	1992-Jan-01 to 2018-Jan-01
Short Name	ECCO_L4_SSH_05DEG_MONTHLY_V4R4
Description	<p>This dataset contains monthly-averaged dynamic sea surface height interpolated to a regular 0.5-degree grid from the ECCO Version 4 revision 4 (V4r4) ocean and sea-ice state estimate. Estimating the Circulation and Climate of the Ocean (ECCO) ocean and sea-ice state estimates are dynamically and kinematically-consistent reconstructions of the three-dimensional, time-evolving ocean, sea-ice, and surface atmospheric states. ECCO V4r4 is a free-running solution of the 1-degree global configuration of the MIT general circulation model (MITgcm) that has been fit to observations in a least-squares sense. Observational data constraints used in V4r4 include sea surface height (SSH) from satellite altimeters [ERS-1/2, TOPEX/Poseidon, GFO, ENVISAT, Jason-1,2,3, CryoSat-2, and SARAL/AltiKa]; sea surface temperature (SST) from satellite radiometers [AVHRR], sea surface salinity (SSS) from the Aquarius satellite radiometer/scatterometer, ocean bottom pressure (OBP) from the GRACE satellite gravimeter; sea ice concentration from satellite radiometers [SSM/I and SSMIS], and in-situ ocean temperature and salinity measured with conductivity-temperature-depth (CTD) sensors and expendable bathythermographs (XBTs) from several programs [e.g., WOCE, GO-SHIP, Argo, and others] and platforms [e.g., research vessels, gliders, moorings, ice-tethered profilers, and instrumented pinnipeds]. V4r4 covers the period 1992-01-01T12:00:00 to 2018-01-01T00:00:00.</p>
DOI	10.5067/ECG5M-SSH44
Measurement	OCEANS > SEA SURFACE TOPOGRAPHY > SEA SURFACE HEIGHT MODELS > EARTH SCIENCE REANALYSES/ASSIMILATION MODELS

Download ECCO Sea Surface Height - Monthly Mean 0.5 Degree (Version 4 Release 4) Close

Short Name: ECCO_L4_SSH_05DEG_MONTHLY_V4R4
Collection Concept ID: C1990404799-POCLOUD

Tools

PO.DAAC Data Subscriber | [Information](#)

```
podaac-data-subscriber -c ECCO_L4_SSH_05DEG_MONTHLY_V4R4 -d ./data/ECCO_L4_SSH_05DEG_MONTHLY_V4R4 --start-date 1992-01-01T00:00:00Z
```

Services

PO.DAAC harmony-netcdf-to-zarr | [Information](#)

```
https://harmony.earthdata.nasa.gov/C1990404799-POCLOUD/ogc-api-coverages/1.0.0/collections/all/coverage/rangeset?format=application%2Fzarr
```

Direct S3-Access

- Available for access in-region with AWS Cloud
 - Region:**
 - us-west-2
 - Bucket/Object Prefix** [Information](#)
 - podaac-ops-cumulus-protected/ECCO_L4_SSH_05DEG_MONTHLY_V4R4/
 - podaac-ops-cumulus-public/ECCO_L4_SSH_05DEG_MONTHLY_V4R4/


Download Service Subset

Data Recipes:

- Generic data readers

Tools, services, and S3 Prefixes exposed through the Download button

- Lets you know a certain service (ex: Zarr) is supported
- Gives a basic command for PO.DAAC Data Subscriber
- Displays S3 bucket prefix, Short Name, Collection concept-id
- Increase cloud accessibility

 Download Close

ECCO Sea Surface Height - Monthly Mean 0.5 Degree (Version 4 Release 4)

Short Name: ECCO_L4_SSH_05DEG_MONTHLY_V4R4
Collection Concept ID: C1990404799-POCLOUD

Tools

PO.DAAC Data Subscriber | [Information](#)

```
podaac-data-subscriber -c ECCO_L4_SSH_05DEG_MONTHLY_V4R4 -d ./data/ECCO_L4_SSH_05DEG_MONTHLY_V4R4 --start-date 1992-01-01T00:00:00Z
```

Services

PO.DAAC harmony-netcdf-to-zarr | [Information](#)

```
https://harmony.earthdata.nasa.gov/C1990404799-POCLOUD/ogc-api-coverages/1.0.0/collections/all/coverage/rangeset?format=application%2Fzarr
```

Direct S3-Access

- Available for access in-region with AWS Cloud
 - **Region:**
 - us-west-2
 - **Bucket/Object Prefix** [Information](#)
 - podaac-ops-cumulus-protected/ECCO_L4_SSH_05DEG_MONTHLY_V4R4/
 - podaac-ops-cumulus-public/ECCO_L4_SSH_05DEG_MONTHLY_V4R4/

Dataset Landing Pages

ECCO Sea Surface Height - Monthly Mean 0.5 Degree (Version 4 Release 4)

(ECCO_L4_SSH_05DEG_MONTHLY_V4R4)

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Information Coverage Data Access Document

Version	V4r4
Processing Level	4
Start/Stop Date	1992-Jan-01 to 2018-Jan-01
Short Name	ECCO_L4_SSH_05DEG_MONTHLY_V4R4
Description	This dataset contains monthly-average sea surface height (SSH) on a regular 0.5-degree grid from the ECCO sea-ice state estimate. Estimating the ocean and sea-ice state estimates are reconstructions of the three-dimensional atmospheric states. ECCO V4r4 is a free-running simulation configuration of the MIT general circulation model (MITgcm) that has been constrained by observations in a least-squares sense. Observational data constraints used in V4r4 include sea surface height (SSH) from satellite altimeters [ERS-1/2, TOPEX/Poseidon, GFO, ENVISAT, Jason-1,2,3, CryoSat-2, and SARAL/AltiKa]; sea surface temperature (SST) from satellite radiometers [AVHRR], sea surface salinity (SSS) from the Aquarius satellite radiometer/scatterometer, ocean bottom pressure (OBP) from the GRACE satellite gravimeter; sea ice concentration from satellite radiometers [SSM/I and SSMIS], and in-situ ocean temperature and salinity measured with conductivity-temperature-depth (CTD) sensors and expendable bathythermographs (XBTs) from several programs [e.g., WOCE, GO-SHIP, Argo, and others] and platforms [e.g., research vessels, gliders, moorings, ice-tethered profilers, and instrumented pinnipeds]. V4r4 covers the period 1992-01-01T12:00:00 to 2018-01-01T00:00:00.
DOI	10.5067/ECG5M-SSH44
Measurement	OCEANS > SEA SURFACE TOPOGRAPHY > SEA SURFACE HEIGHT MODELS > EARTH SCIENCE REANALYSES/ASSIMILATION MODELS

Service

ECCO Sea Surface Height - Monthly Mean 0.5 Degree (Version 4 Release 4)

Short Name: ECCO_L4_SSH_05DEG_MONTHLY_V4R4
Collection Concept ID: C1990404799-POCLOUD

Services

PO.DAAC harmony-netcdf-to-zarr | Information

```
https://harmony.earthdata.nasa.gov/C1990404799-POCLOUD/ogc-api-coverages/1.0.0/collections/all/coverage/rangeset?format=application%2Fzarr
```

Capabilities

Download Service Subset

Data Recipes:

- Generic data readers

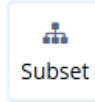
Dataset Landing Pages

ECCO Sea Surface Height - Monthly Mean 0.5 Degree (Version 4 Release 4)

(ECCO_L4_SSH_05DEG_MONTHLY_V4R4)

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Subset

ECCO Sea Surface Height - Monthly Mean 0.5 Degree (Version 4 Release 4)

Short Name: ECCO_L4_SSH_05DEG_MONTHLY_V4R4

Collection Concept ID: C1990404799-POCLOUD

Services

OPeNDAP in the Cloud | Information

<https://opendap.earthdata.nasa.gov>

Information Coverage Data Access Documents

Version	V4r4
Processing Level	4
Start/Stop Date	1992-Jan-01 to 2018-Jan-01
Short Name	ECCO_L4_SSH_05DEG_MONTHLY_V4R4
Description	<p>This dataset contains monthly-averaged sea surface height (SSH) on a regular 0.5-degree grid from the ECCO V4r4 reanalysis. The ECCO V4r4 reanalysis is a free-running solution of the 1-degree grid configuration of the MIT general circulation model (MITgcm) that has been fit to observations in a least-squares sense. Observational data constraints used in V4r4 include sea surface height (SSH) from satellite altimeters [ERS-1/2, TOPEX/Poseidon, GFO, ENVISAT, Jason-1,2,3, CryoSat-2, and SARAL/AltiKa]; sea surface temperature (SST) from satellite radiometers [AVHRR], sea surface salinity (SSS) from the Aquarius satellite radiometer/scatterometer, ocean bottom pressure (OBP) from the GRACE satellite gravimeter; sea ice concentration from satellite radiometers [SSM/I and SSMIS], and in-situ ocean temperature and salinity measured with conductivity-temperature-depth (CTD) sensors and expendable bathythermographs (XBTs) from several programs [e.g., WOCE, GO-SHIP, Argo, and others] and platforms [e.g., research vessels, gliders, moorings, ice-tethered profilers, and instrumented pinnipeds]. V4r4 covers the period 1992-01-01T12:00:00 to 2018-01-01T00:00:00.</p>
DOI	10.5067/ECG5M-SSH44
Measurement	OCEANS > SEA SURFACE TOPOGRAPHY > SEA SURFACE HEIGHT MODELS > EARTH SCIENCE REANALYSES/ASSIMILATION MODELS

• Browse UI

Capabilities:



Data Recipes:

• Generic data readers

Download via your browser – Earthdata Search

The screenshot displays the Earthdata Search web application. The main content area shows search results for 'ECCO Sea Surface Height - Monthly Mean 0.5 Degree (Version 4 Release 4)'. It lists 312 matching granules, with 20 shown in a grid. Each granule card includes the granule ID, start and end dates, and a download icon. A sidebar on the left allows filtering granules by temporal and data access criteria. On the right, a map of the Indian Ocean is displayed with a green bounding box around the search area. The interface also includes a search bar at the top, a 'Find a DAAC' dropdown, and a user profile 'Celia'.

Granule ID	START	END
SEA_SURFACE_HEIGHT_mon_mean_1992-01_ECCO_V4r4_latlon_0p50deg	1992-01-01 12:00:00	1992-02-01 00:00:00
SEA_SURFACE_HEIGHT_mon_mean_1992-02_ECCO_V4r4_latlon_0p50deg	1992-02-01 00:00:00	1992-03-01 00:00:00
SEA_SURFACE_HEIGHT_mon_mean_1992-03_ECCO_V4r4_latlon_0p50deg	1992-03-01 00:00:00	1992-04-01 00:00:00
SEA_SURFACE_HEIGHT_mon_mean_1992-04_ECCO_V4r4_latlon_0p50deg	1992-04-01 00:00:00	1992-05-01 00:00:00
SEA_SURFACE_HEIGHT_mon_mean_1992-05_ECCO_V4r4_latlon_0p50deg	1992-05-01 00:00:00	1992-06-01 00:00:00
SEA_SURFACE_HEIGHT_mon_mean_1992-06_ECCO_V4r4_latlon_0p50deg	1992-06-01 00:00:00	1992-07-01 00:00:00
SEA_SURFACE_HEIGHT_mon_mean_1992-07_ECCO_V4r4_latlon_0p50deg	1992-07-01 00:00:00	1992-08-01 00:00:00
SEA_SURFACE_HEIGHT_mon_mean_1992-08_ECCO_V4r4_latlon_0p50deg	1992-08-01 00:00:00	1992-09-01 00:00:00
SEA_SURFACE_HEIGHT_mon_mean_1992-09_ECCO_V4r4_latlon_0p50deg	1992-09-01 00:00:00	1992-10-01 00:00:00
SEA_SURFACE_HEIGHT_mon_mean_1992-10_ECCO_V4r4_latlon_0p50deg	1992-10-01 00:00:00	1992-11-01 00:00:00
SEA_SURFACE_HEIGHT_mon_mean_1992-11_ECCO_V4r4_latlon_0p50deg	1992-11-01 00:00:00	1992-12-01 00:00:00
SEA_SURFACE_HEIGHT_mon_mean_1992-12_ECCO_V4r4_latlon_0p50deg	1992-12-01 00:00:00	

- Many links and information are also repeated here

OPeNDAP – subset and download



dataset: SEA_SURFACE_HEIGHT_mon_mean_1992-01_ECCO_V4r4_latlon_0p50deg.nc

Actions Download Encoding:

Data URL [https://opendap.earthdata.nasa.gov/providers/POCLOUD/collections/ECCO%20Sea%20Surface%20Height%20-%20Monthly%20Mean%200.5%20Degree%20\(V%20Version%20Release%20\)/granules/SEA_SURFACE_HEIGHT_mon_mean_1992-01_ECCO_V4r4_latlon_0p50deg?dap4.ce=/SE](https://opendap.earthdata.nasa.gov/providers/POCLOUD/collections/ECCO%20Sea%20Surface%20Height%20-%20Monthly%20Mean%200.5%20Degree%20(V%20Version%20Release%20)/granules/SEA_SURFACE_HEIGHT_mon_mean_1992-01_ECCO_V4r4_latlon_0p50deg?dap4.ce=/SE)

Global Attributes

Global Dimensions [/time = 0..0] [/latitude = 0..359] [/longitude = 0..719] [/nv = 0..1]

Variables SSH [/time = 0..0] [/latitude = 0..359] [/longitude = 0..719]

SSHIBC [/time = 0..0] [/latitude = 0..359] [/longitude = 0..719]

SSHNOIBC [/time = 0..0] [/latitude = 0..359] [/longitude = 0..719]

latitude_bnds [/latitude = 0..359] [/nv = 0..1]

time_bnds [/time = 0..0] [/nv = 0..1]

longitude_bnds [/longitude = 0..719] [/nv = 0..1]

latitude [/latitude = 0..359]

longitude [/longitude = 0..719]

nv [/nv = 0..1]

no attributes

time [/time = 0..0]

-Visit OPeNDAP page for each granule
-Construct OPeNDAP url programmatically and download with command line interface

Download via command-line tool

- <https://github.com/podaac/data-subscriber>
- Update periodically for new and improved usages
- `podaac-data-downloader -c ECCO_L4_SSH_05DEG_DAILY_V4R4B -d ./data/ECCO_L4_SSH_05DEG_DAILY_V4R4B --start-date 1992-01-01T00:00:00Z --end-date 1992-01-10T23:59:59Z`

```
Anaconda Prompt (Anaconda3)
(base) C:\Projects>podaac-data-downloader -c ECCO_L4_SSH_05DEG_DAILY_V4R4B -d ./data/ECCO_L4_SSH_05DEG_DAILY_V4R4B --start-date 1992-01-01T00:00:00Z --end-date 1992-01-10T23:59:59Z
[2023-01-23 18:18:53,720] {podaac_data_downloader.py:163} INFO - NOTE: Making new data directory at ./data/ECCO_L4_SSH_05DEG_DAILY_V4R4B(This is the first run.)
[2023-01-23 18:18:55,657] {podaac_data_downloader.py:264} INFO - Found 10 total files to download
[2023-01-23 18:19:00,320] {podaac_data_downloader.py:297} INFO - 2023-01-23 18:19:00.320501 SUCCESS: https://archive.podaac.earthdata.nasa.gov/podaac-ops-cumulus-protected/ECCO_L4_SSH_05DEG_DAILY_V4R4B/SEA_SURFACE_HEIGHT_day_mean_1992-01-10_ECCO_V4r4b_latlon_0p50deg.nc
[2023-01-23 18:19:01,595] {podaac_data_downloader.py:297} INFO - 2023-01-23 18:19:01.595050 SUCCESS: https://archive.podaac.earthdata.nasa.gov/podaac-ops-cumulus-protected/ECCO_L4_SSH_05DEG_DAILY_V4R4B/SEA_SURFACE_HEIGHT_day_mean_1992-01-09_ECCO_V4r4b_latlon_0p50deg.nc
[2023-01-23 18:19:03,576] {podaac_data_downloader.py:297} INFO - 2023-01-23 18:19:03.575759 SUCCESS: https://archive.podaac.earthdata.nasa.gov/podaac-ops-cumulus-protected/ECCO_L4_SSH_05DEG_DAILY_V4R4B/SEA_SURFACE_HEIGHT_day_mean_1992-01-08_ECCO_V4r4b_latlon_0p50deg.nc
[2023-01-23 18:19:05,103] {podaac_data_downloader.py:297} INFO - 2023-01-23 18:19:05.103999 SUCCESS: https://archive.podaac.earthdata.nasa.gov/podaac-ops-cumulus-protected/ECCO_L4_SSH_05DEG_DAILY_V4R4B/SEA_SURFACE_HEIGHT_day_mean_1992-01-07_ECCO_V4r4b_latlon_0p50deg.nc
[2023-01-23 18:19:06,476] {podaac_data_downloader.py:297} INFO - 2023-01-23 18:19:06.476515 SUCCESS: https://archive.podaac.earthdata.nasa.gov/podaac-ops-cumulus-protected/ECCO_L4_SSH_05DEG_DAILY_V4R4B/SEA_SURFACE_HEIGHT_day_mean_1992-01-06_ECCO_V4r4b_latlon_0p50deg.nc
[2023-01-23 18:19:07,757] {podaac_data_downloader.py:297} INFO - 2023-01-23 18:19:07.757305 SUCCESS: https://archive.podaac.earthdata.nasa.gov/podaac-ops-cumulus-protected/ECCO_L4_SSH_05DEG_DAILY_V4R4B/SEA_SURFACE_HEIGHT_day_mean_1992-01-05_ECCO_V4r4b_latlon_0p50deg.nc
[2023-01-23 18:19:09,093] {podaac_data_downloader.py:297} INFO - 2023-01-23 18:19:09.093012 SUCCESS: https://archive.podaac.earthdata.nasa.gov/podaac-ops-cumulus-protected/ECCO_L4_SSH_05DEG_DAILY_V4R4B/SEA_SURFACE_HEIGHT_day_mean_1992-01-04_ECCO_V4r4b_latlon_0p50deg.nc
[2023-01-23 18:19:10,334] {podaac_data_downloader.py:297} INFO - 2023-01-23 18:19:10.334263 SUCCESS: https://archive.podaac.earthdata.nasa.gov/podaac-ops-cumulus-protected/ECCO_L4_SSH_05DEG_DAILY_V4R4B/SEA_SURFACE_HEIGHT_day_mean_1992-01-03_ECCO_V4r4b_latlon_0p50deg.nc
[2023-01-23 18:19:11,474] {podaac_data_downloader.py:297} INFO - 2023-01-23 18:19:11.474533 SUCCESS: https://archive.podaac.earthdata.nasa.gov/podaac-ops-cumulus-protected/ECCO_L4_SSH_05DEG_DAILY_V4R4B/SEA_SURFACE_HEIGHT_day_mean_1992-01-02_ECCO_V4r4b_latlon_0p50deg.nc
[2023-01-23 18:19:12,860] {podaac_data_downloader.py:297} INFO - 2023-01-23 18:19:12.860775 SUCCESS: https://archive.podaac.earthdata.nasa.gov/podaac-ops-cumulus-protected/ECCO_L4_SSH_05DEG_DAILY_V4R4B/SEA_SURFACE_HEIGHT_day_mean_1992-01-01_ECCO_V4r4b_latlon_0p50deg.nc
[2023-01-23 18:19:12,860] {podaac_data_downloader.py:308} INFO - Downloaded Files: 10
[2023-01-23 18:19:12,861] {podaac_data_downloader.py:309} INFO - Failed Files: 0
[2023-01-23 18:19:12,861] {podaac_data_downloader.py:310} INFO - Skipped Files: 0
[2023-01-23 18:19:13,087] {podaac_data_downloader.py:318} INFO - END
```

Access the data in AWS S3

- https://podaac.github.io/tutorials/quarto_text/ECCO.html

- [https://github.com/podaac/ECCO/blob/main/Data Access/cloud direct access s3.ipynb](https://github.com/podaac/ECCO/blob/main/Data%20Access/cloud_direct_access_s3.ipynb)

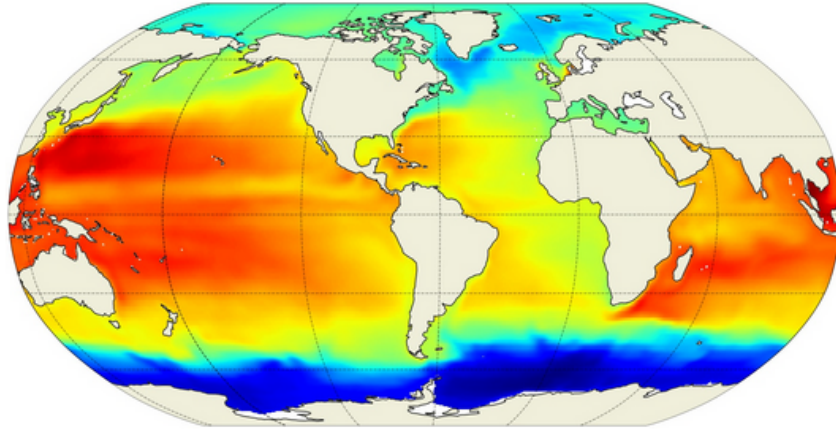
- Github URLs may change during re-organization, but our goal is to display tutorials in an easily discoverable way on the Cookbook

Direct access to ECCO data in S3 (from *us-west-2*)

Getting Started

In this notebook, we will access monthly sea surface height from ECCO V4r4 ([10.5067/ECG5D-SSH44](https://doi.org/10.5067/ECG5D-SSH44)). The data are provided as a time series of monthly netCDFs on a 0.5-degree latitude/longitude grid.

We will access the data from inside the AWS cloud (*us-west-2* region, specifically) and load a time series made of multiple netCDF datasets into a single xarray dataset. This approach leverages S3 native protocols for efficient access to the data.



Requirements

AWS

This notebook should be running in an EC2 instance in AWS region *us-west-2*, as previously mentioned. We recommend using an EC2 with at least 8GB of memory available.

The notebook was developed and tested using a *t2.large* instance (2 cpus; 8GB memory).

Python 3

Most of these imports are from the Python standard library. However, you will need to install these packages into your Python 3 environment if you have not already done so:

- s3fs
- requests
- pandas
- xarray
- matplotlib
- cartopy

Inputs

Configure one input: the *ShortName* of the desired dataset from ECCO V4r4. In this case it's the following string that unique identifies the collection of monthly, 0.5-degree sea surface height data.

```
ShortName = "ECCO_L4_SSH_05DEG_MONTHLY_V4R4"
```

Earthdata Login

You should have a *.netrc* file set up like:

```
machine urs.earthdata.nasa.gov login <username> password <password>
```

Direct access from S3

Set up an s3fs session for authenticated access to ECCO netCDF files in s3:

```
def begin_s3_direct_access(url: str="https://archive.podaac.earthdata.nasa.gov/s3credentials"):
    response = requests.get(url).json()
    return s3fs.S3FileSystem(key=response['accessKeyId'],
                           secret=response['secretAccessKey'],
                           token=response['sessionToken'],
                           client_kwargs={'region_name': 'us-west-2'})

fs = begin_s3_direct_access()

type(fs)
```

```
s3fs.core.S3FileSystem
```

Datasets

sea surface height (0.5-degree gridded, monthly)

[ECCO_L4_SSH_05DEG_MONTHLY_V4R4](#)

Get a list of netCDF files located at the S3 path corresponding to the ECCO V4r4 monthly sea surface height dataset on the 0.5-degree latitude/longitude grid.

```
ssh_files = fs.glob(join("podaac-ops-cumulus-protected/", ShortName, "**2015*.nc"))

len(ssh_files)
```

Datasets

sea surface height (0.5-degree gridded, monthly)

[ECCO_L4_SSH_05DEG_MONTHLY_V4R4](#)

Get a list of netCDF files located at the S3 path corresponding to the ECCO V4r4 monthly sea surface height dataset on the 0.5-degree latitude/longitude grid.

```
ssh_files = fs.glob(join("podaac-ops-cumulus-protected/", ShortName, "*2015*.nc"))

len(ssh_files)
```

12

Open with the netCDF files using the `s3fs` package, then load them all at once into a concatenated `xarray` dataset.

```
ssh_dataset = xr.open_mfdataset(
    paths=[fs.open(f) for f in ssh_files],
    combine='by_coords',
    mask_and_scale=True,
    decode_cf=True,
    chunks={'latitude': 60, # These were chosen arbitrarily. You must specify
            'longitude': 120, # chunking that is suitable to the data and target
            'time': 100}    # analysis.
)

ssh = ssh_dataset.SSH

print(ssh)
```

```
<xarray.DataArray 'SSH' (time: 12, latitude: 360, longitude: 720)>
dask.array<concatenate, shape=(12, 360, 720), dtype=float32, chunksize=(1, 60, 120), chunktype=numpy.ndarray>
Coordinates:
  * time      (time) datetime64[ns] 2015-01-16T12:00:00 ... 2015-12-16T12:00:00
  * latitude  (latitude) float32 -89.75 -89.25 -88.75 ... 88.75 89.25 89.75
  * longitude (longitude) float32 -179.8 -179.2 -178.8 ... 178.8 179.2 179.8
Attributes:
  coverage_content_type:  modelResult
  long_name:              Dynamic sea surface height anomaly
  standard_name:          sea_surface_height_above_geoid
  units:                  m
  comment:                Dynamic sea surface height anomaly above the geoi...
  valid_min:              [-1.88057721]
  valid_max:              [1.42077196]
```


Plot the gridded *sea surface height* time series

But only the timesteps beginning in 2015:

```
ssh_after_201x = ssh[ssh['time.year']>=2015,:,:]

print(ssh_after_201x)

<xarray.DataArray 'SSH' (time: 12, latitude: 360, longitude: 720)>
dask.array<concatenate, shape=(12, 360, 720), dtype=float32, chunksize=(1, 60, 120), chunktype=numpy.ndarray>
Coordinates:
  * time      (time) datetime64[ns] 2015-01-16T12:00:00 ... 2015-12-16T12:00:00
  * latitude  (latitude) float32 -89.75 -89.25 -88.75 ... 88.75 89.25 89.75
  * longitude (longitude) float32 -179.8 -179.2 -178.8 ... 178.8 179.2 179.8
Attributes:
  coverage_content_type:  modelResult
  long_name:              Dynamic sea surface height anomaly
  standard_name:         sea_surface_height_above_geoid
  units:                 m
  comment:               Dynamic sea surface height anomaly above the geoi...
  valid_min:             [-1.88057721]
  valid_max:             [1.42077196]
```

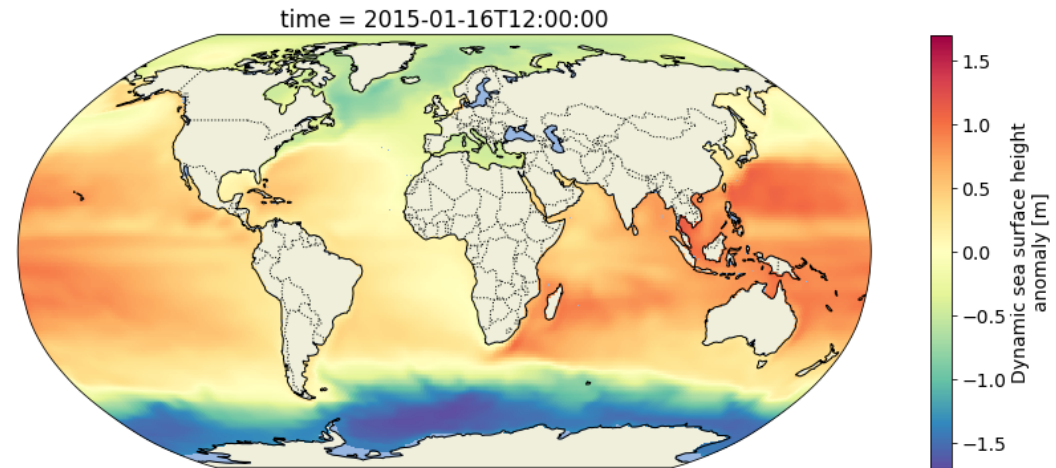
Plot the grid for the first time step using a Robinson projection. Define a helper function for consistency throughout the notebook:

```
def make_figure(proj):
    fig = plt.figure(figsize=(16,6))
    ax = fig.add_subplot(1, 1, 1, projection=proj)
    ax.add_feature(cfeat.LAND)
    ax.add_feature(cfeat.OCEAN)
    ax.add_feature(cfeat.COASTLINE)
    ax.add_feature(cfeat.BORDERS, linestyle='dotted')
    return fig, ax

fig, ax = make_figure(proj=ccrs.Robinson())

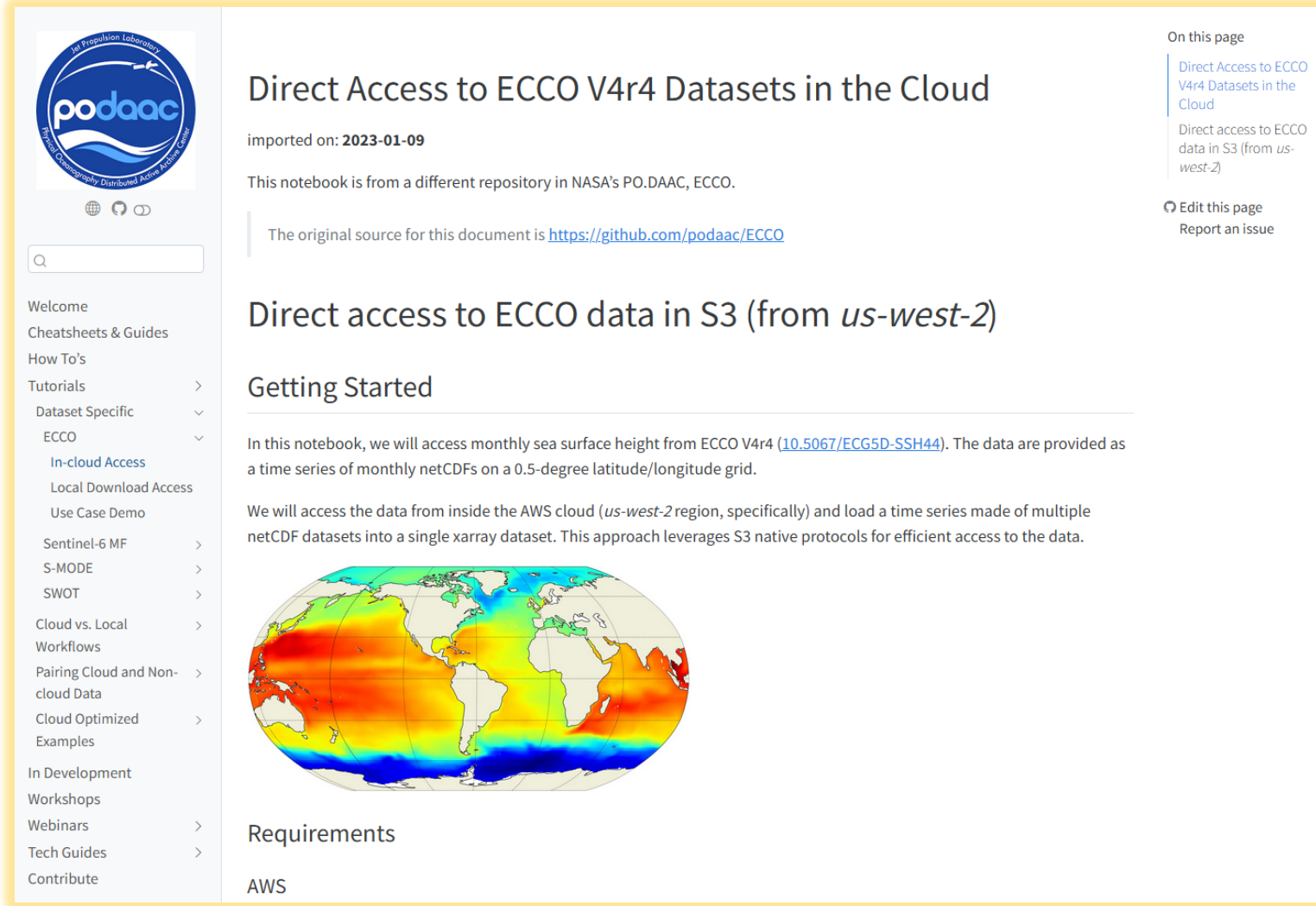
ssh_after_201x.isel(time=0).plot(ax=ax, transform=ccrs.PlateCarree(), cmap='Spectral_r')
```

```
<matplotlib.collections.QuadMesh at 0x7fae2533d730>
```



Resources at the new PO.DAAC Cookbook

- <https://podaac.github.io/tutorials/>
- New one-stop-shop for tutorials
- Work-in-progress
- Cloud and local workflows
- Examples with specific datasets
- Increase cloud dataset accessibility and ease of workflow adoption



The screenshot displays the PO.DAAC Cookbook interface. On the left is a navigation sidebar with the PO.DAAC logo (a circular emblem with 'podaac' in the center and 'Sea Surface Topography Distributed Active Archive Center' around the perimeter) and a search bar. The sidebar menu includes: Welcome, Cheatsheets & Guides, How To's, Tutorials (with a right-pointing arrow), Dataset Specific (with a downward arrow), ECCO (with a downward arrow), In-cloud Access (highlighted in blue), Local Download Access, Use Case Demo, Sentinel-6 MF (with a right-pointing arrow), S-MODE (with a right-pointing arrow), SWOT (with a right-pointing arrow), Cloud vs. Local Workflows (with a right-pointing arrow), Pairing Cloud and Non-cloud Data (with a right-pointing arrow), Cloud Optimized Examples (with a right-pointing arrow), In Development, Workshops, Webinars (with a right-pointing arrow), Tech Guides (with a right-pointing arrow), and Contribute.

The main content area features the title 'Direct Access to ECCO V4r4 Datasets in the Cloud' and the import date 'imported on: 2023-01-09'. Below this, it states 'This notebook is from a different repository in NASA's PO.DAAC, ECCO.' and provides the original source link: 'The original source for this document is <https://github.com/podaac/ECCO>'. The page title is repeated as a section header: 'Direct access to ECCO data in S3 (from *us-west-2*)'. The 'Getting Started' section explains: 'In this notebook, we will access monthly sea surface height from ECCO V4r4 ([10.5067/ECG5D-SSH44](#)). The data are provided as a time series of monthly netCDFs on a 0.5-degree latitude/longitude grid. We will access the data from inside the AWS cloud (*us-west-2* region, specifically) and load a time series made of multiple netCDF datasets into a single xarray dataset. This approach leverages S3 native protocols for efficient access to the data.' Below the text is a global map showing sea surface height anomalies with a color scale from blue (low) to red (high). The 'Requirements' section lists 'AWS'.

On the right side of the page, there is a 'On this page' section with links: 'Direct Access to ECCO V4r4 Datasets in the Cloud' (highlighted), 'Direct access to ECCO data in S3 (from *us-west-2*)', 'Edit this page', and 'Report an issue'.

Next up!
Version 4
Release 5
and more!

EARTHDATA Other DAACs - **podaac** Physical Oceanography Distributed Active Archive Center
NASA Jet Propulsion Laboratory California Institute of Technology

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ECCO Sea Surface Height - Daily Mean 0.5 Degree Lat-Lon Grid (Version 4 Release 5) (ECCO_L4_SSH_05DEG_DAILY_V4R5)

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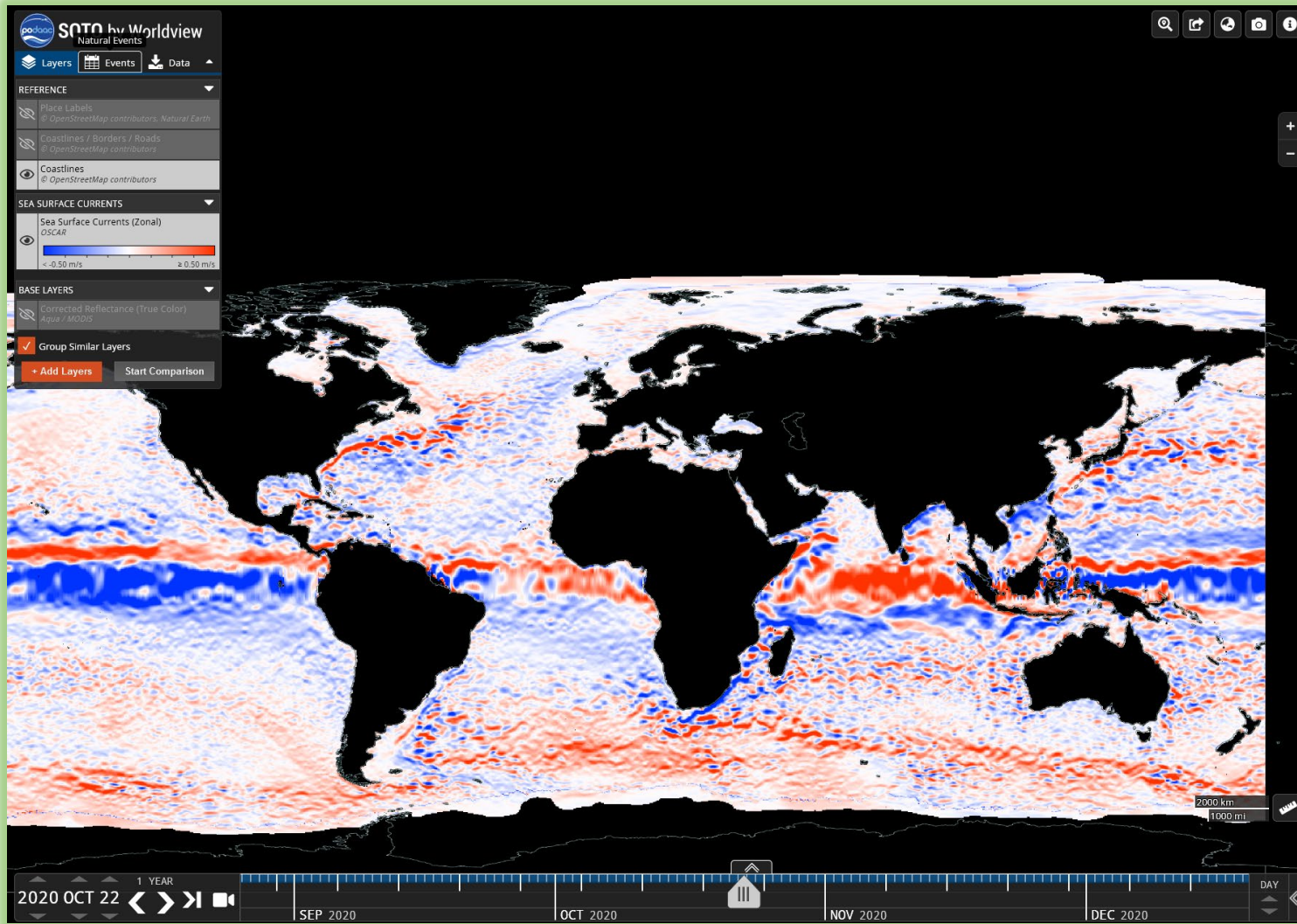


CLOUD ENABLED

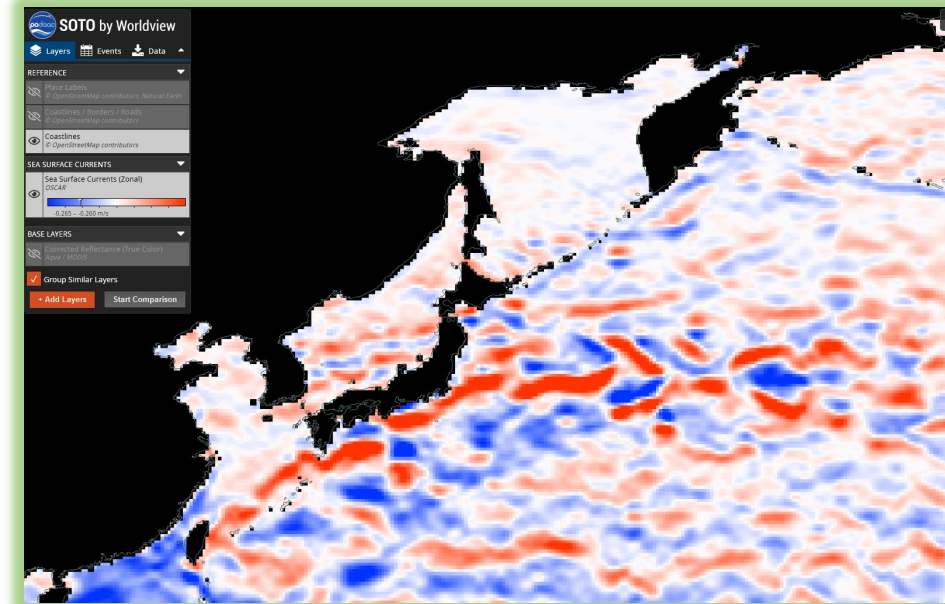
Status: COMPLETE
Short Name: ECCO_L4_SSH_05DEG_DAILY_V4R5
Collection Concept ID: C2301137280-POCLOUD
Spatial Coverage: N: 90° S: -90° E: 180° W: -180°
Access: Search Granules, Browse Granule Listing
Capabilities: Download, Service, Subset
Data Recipes: Generic data readers

Information	Coverage	Data Access	Documentation	Citation
Version	V4r5			
Processing Level	4			
Start/Stop Date	1992-Jan-01 to 2020-Jan-01			
Short Name	ECCO_L4_SSH_05DEG_DAILY_V4R5			
Description	<p>This dataset contains monthly-averaged dynamic sea surface height interpolated to a regular 0.5-degree grid from the ECCO Version 4 Release 5 (V4r5) ocean and sea-ice state estimate. Estimating the Circulation and Climate of the Ocean (ECCO) ocean and sea-ice state estimates are dynamically and kinematically-consistent reconstructions of the three-dimensional, time-evolving ocean, sea-ice, and surface atmospheric states. ECCO V4r5 is a free-running solution of the 1-degree global configuration of the MIT general circulation model (MITgcm) that has been fit to observations in a least-squares sense. Observational data constraints used in V4r5 include sea surface height (SSH) from satellite altimeters [ERS-1/2, TOPEX/Poseidon, GFO, ENVISAT, Jason-1,2,3, CryoSat-2, and SARAL/AltiKa]; sea surface temperature (SST) from satellite radiometers [AVHRR], sea surface salinity (SSS) from satellite radiometers/scatterometers [Aquarius, SMOS, and SMAP], ocean bottom pressure (OBP) from the GRACE and GRACE-FO satellite gravimeters; sea ice concentration from satellite radiometers [SSM/I and SSMIS], observation-based ice shelf melt rate around Antarctica, and in-situ ocean temperature and salinity measured with conductivity-temperature-depth (CTD) sensors and expendable bathythermographs (XBTs) from several programs [e.g., WOCE, GO-SHIP, Argo, and others] and platforms [e.g., research vessels, gliders, moorings, ice-tethered profilers, and instrumented pinnipeds]. V4r5 covers the period 1992-01-01T12:00:00 to 2020-01-01T00:00:00.</p>			
DOI	10.5067/ECG5D-SSH45			
Measurement	OCEANS > SEA SURFACE TOPOGRAPHY > SEA SURFACE HEIGHT			
Platform/Sensor	ERS-1 / RADAR ALTIMETERS ERS-1 / ERS-1 ALTIMETER ERS-1 / AMI ERS-1 / ATSR ERS-1 / PRARE			

Next: ECCO in SOTO by Worldview



- Lowers barrier to access
- Scroll through time
- Zoom in on region
- Add other layers



- <https://soto.podaac.earthdatacloud.nasa.gov/>

Any requests, comments, or suggestions?

- Ease of access
- Discoverability of data, resources
- Gaps in tools/services
- Community events
- Help Desk – where do you turn to?
- What are we doing well?