CLIMATE CHANGE INITIATIVE

Visualisation and Analysis of Climate Data in the ESA CCI Toolbox

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CCI

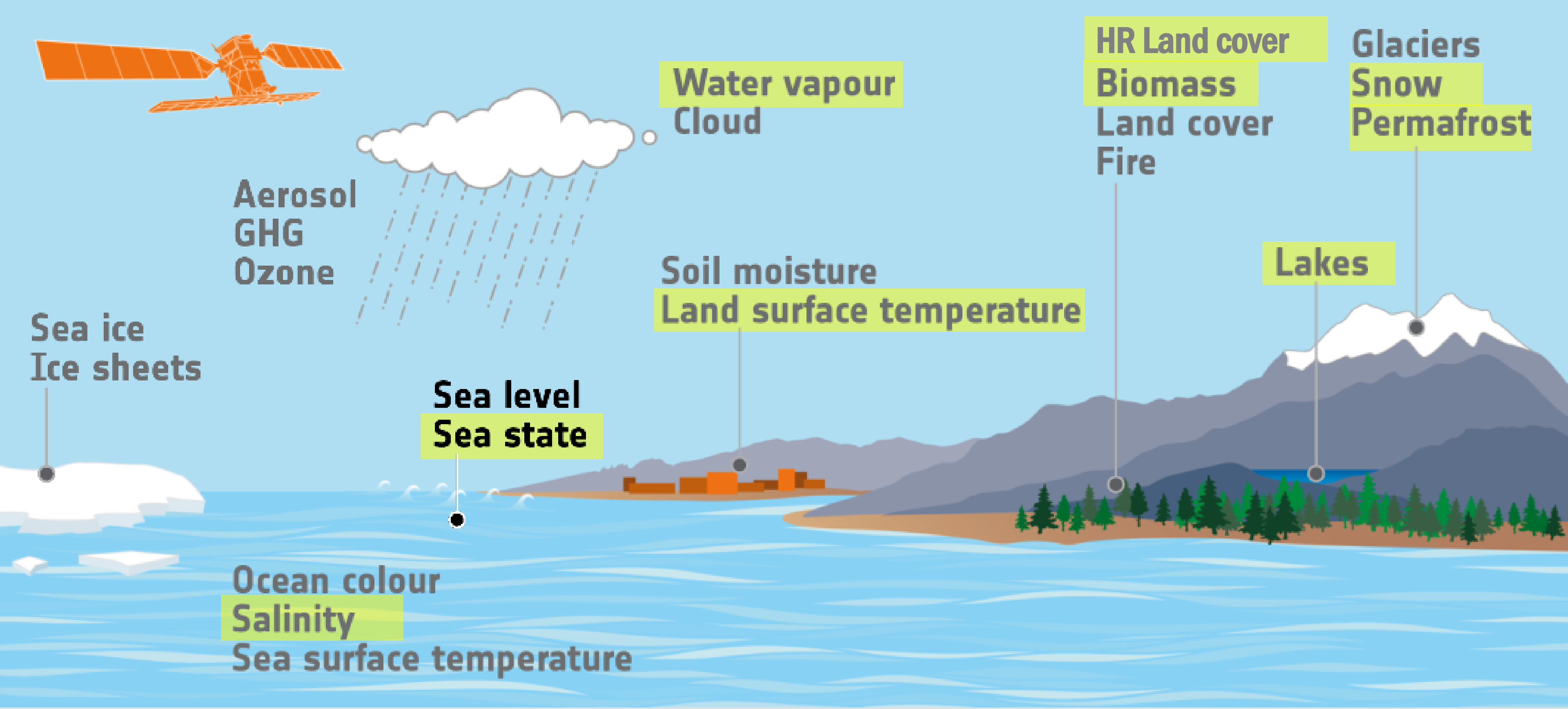
Climate Change Initiative

ESA's 140 MEuro R&D Programme (2010-2024)
to exploit the **full potential of Earth Observation**
in support of **Climate Research and Assessment**

Produces long time series of **Essential Climate Variables** (ECVs)

Existing and new ECVs in the CCI

CLIMATE CHANGE INITIATIVE esa



European Space Agency

CCI achievements to date

CLIMATE CHANGE INITIATIVE esa

European scientists

178 Institutions

22 ECVs

13 ECVs transferred to Copernicus

Copernicus Europe's eyes on Earth

Open data

100+ datasets

2.6 million files

571 Peer-reviewed articles

15 Papers, cited 60 times

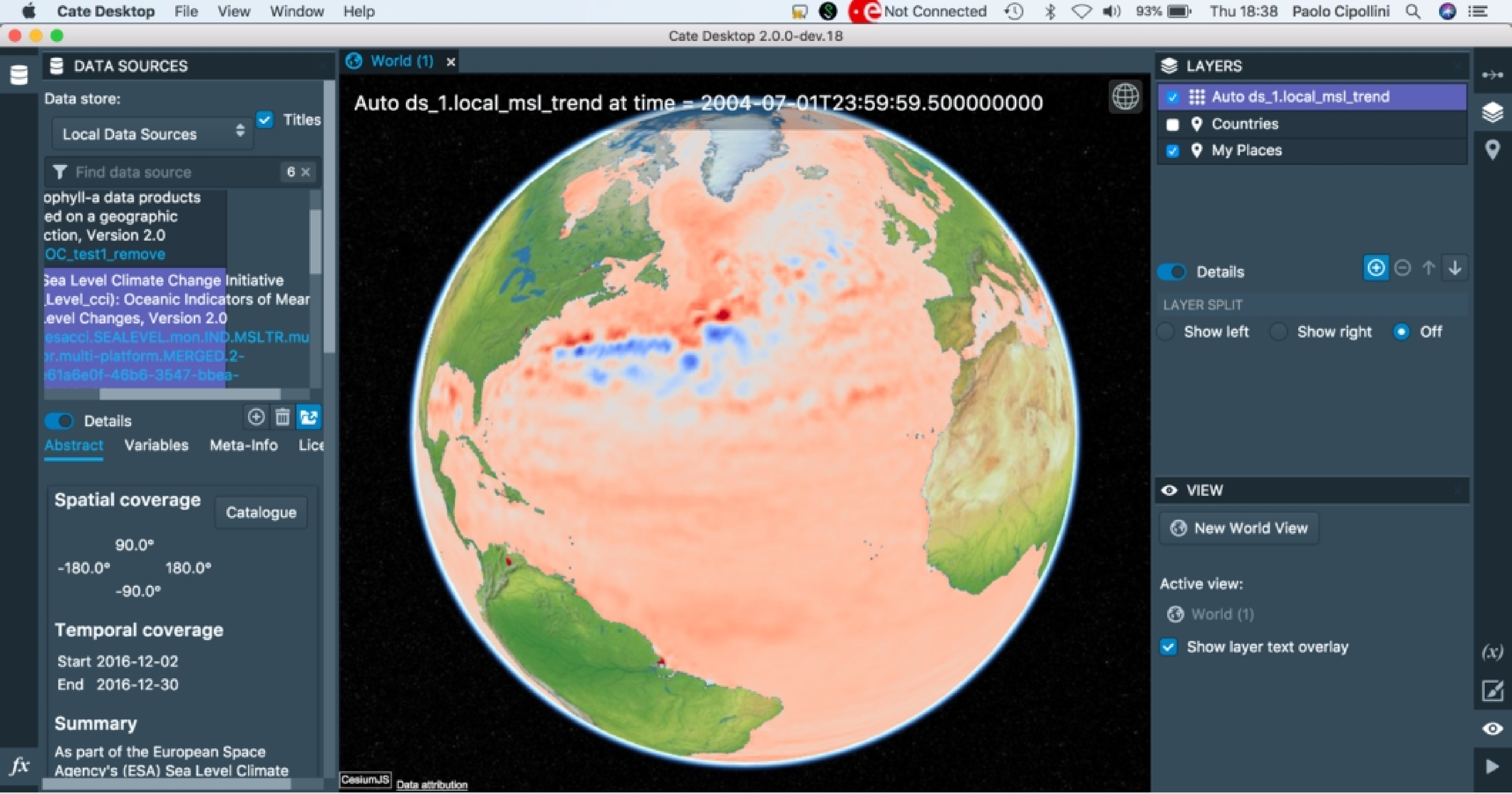
..and a toolbox!

toolbox cci

Cate: the CCI Toolbox

a software environment for scientific analysis of all ESA CCI datasets

…as well as other climate data from various sources


Cate Desktop File View Window Help
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Catalogue
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Temporal coverage
Start 2016-12-02
End 2016-12-30
Summary
As part of the European Space
Agency's (ESA) Sea Level Climate
World (1)
Auto ds_1.local_msl_trend at time = 2004-07-01T23:59:59.500000000
CesiumJS
Data attribution
LAYERS
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Countries
My Places
Details
LAYER SPLIT
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VIEW
New World View
Active view:
World (1)
Show layer text overlay

Cate main features

Open source

Ingests and mashes data into a common data model

Its backend operating on the data is **fully implemented in Python** to allow users to modify and extend it.

Three interfaces:

- A **Graphical User Interface (GUI)** with powerful visualisation capabilities, designed as a native desktop application
- A **Command Line Interface (CLI)**
- An **Application Programming Interface (API)**

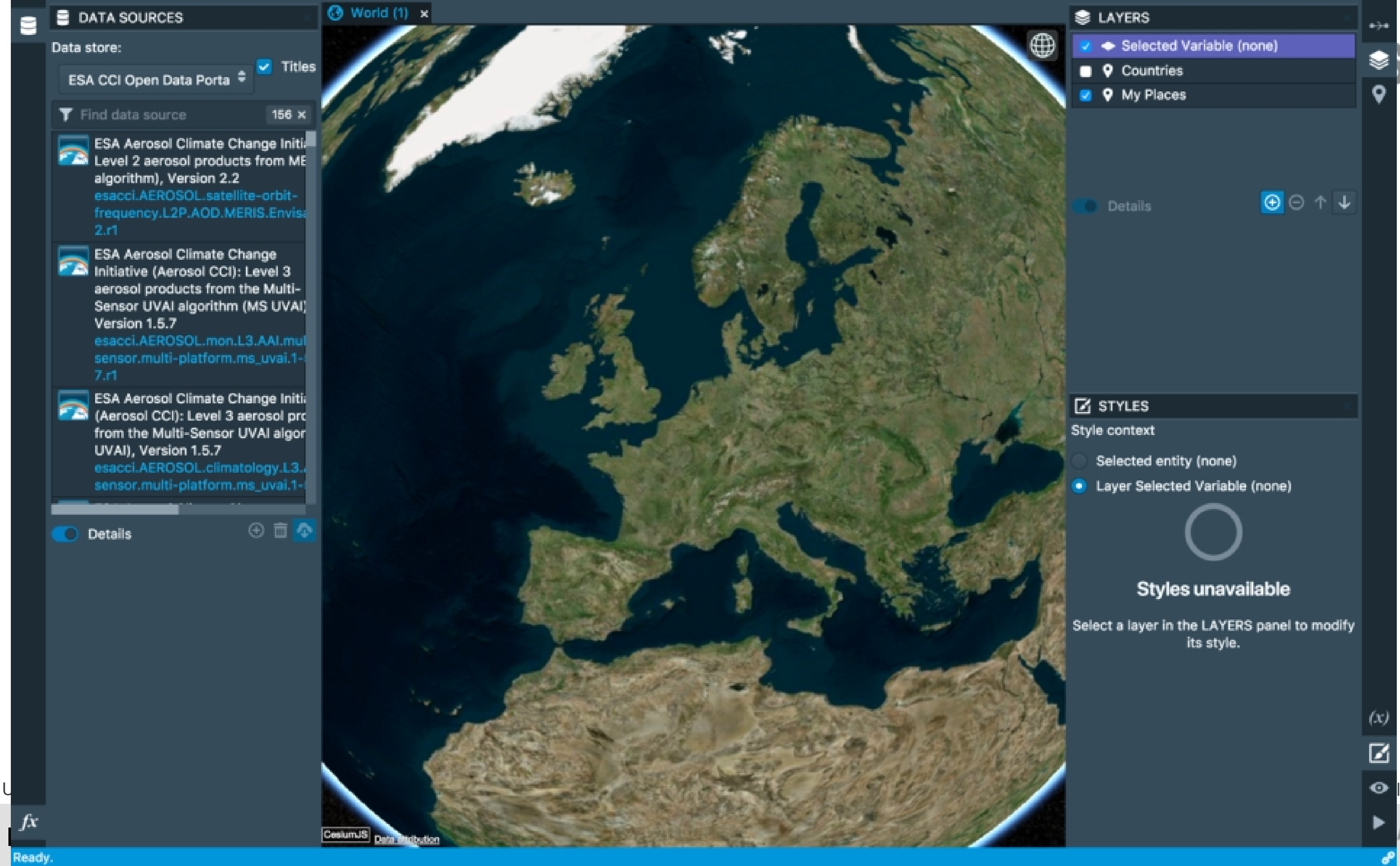
Backend and frontend communicate via Web services (CCI Toolbox' WebAPI service) - this makes CATE ready for deployment on the Cloud and allows for later extensions towards a web application with multiple remote WebAPI services.

Altimetry in Cate

The ESA CCI Open Data Portal – directly accessible from Cate – already contains the Climate indicators from the ESA SL CCI project

- The monthly L4 ECV data are also easy to ingest

Let’s see a **hands-on example using the Sea Level CCI data>**


DATA SOURCES
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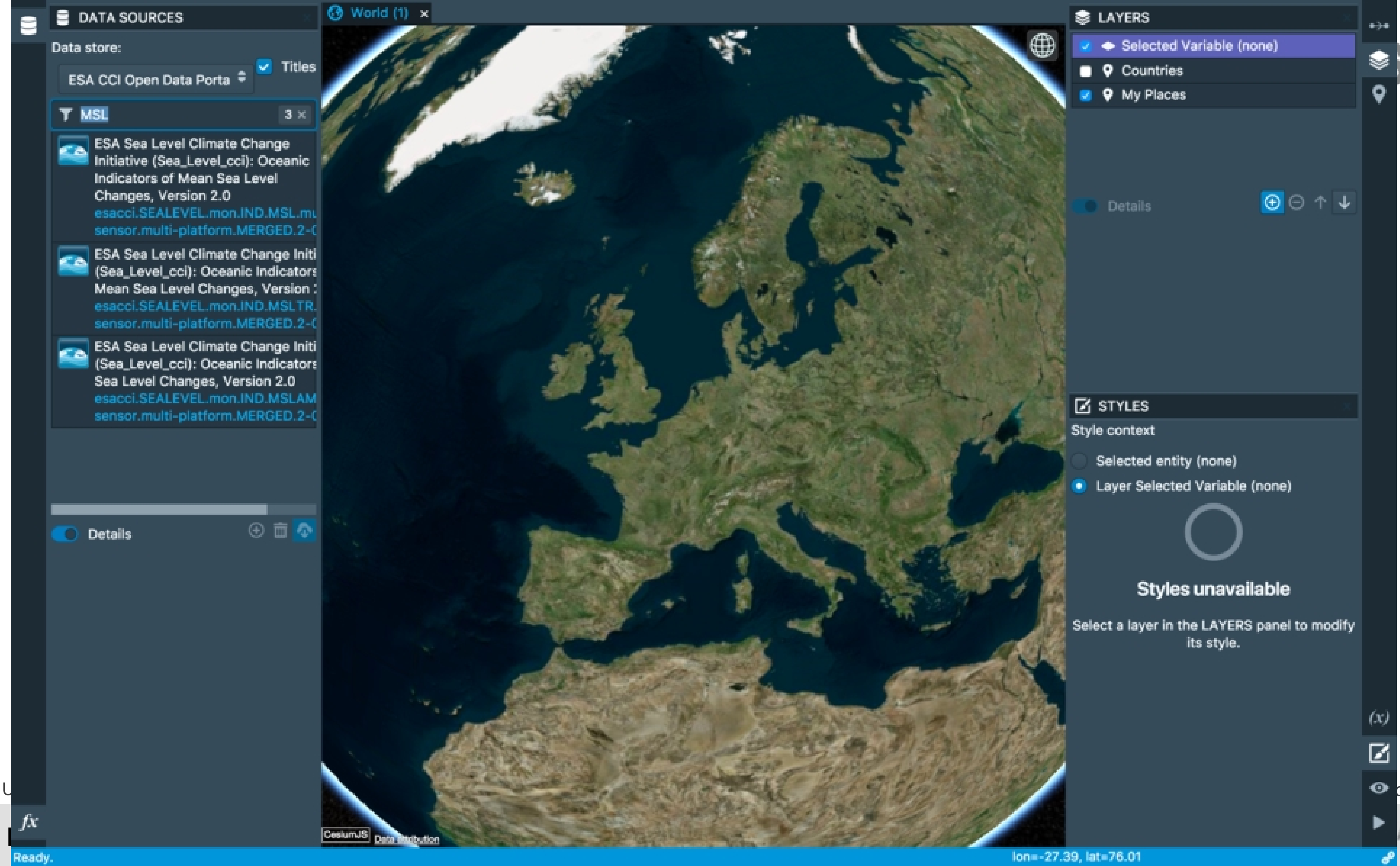
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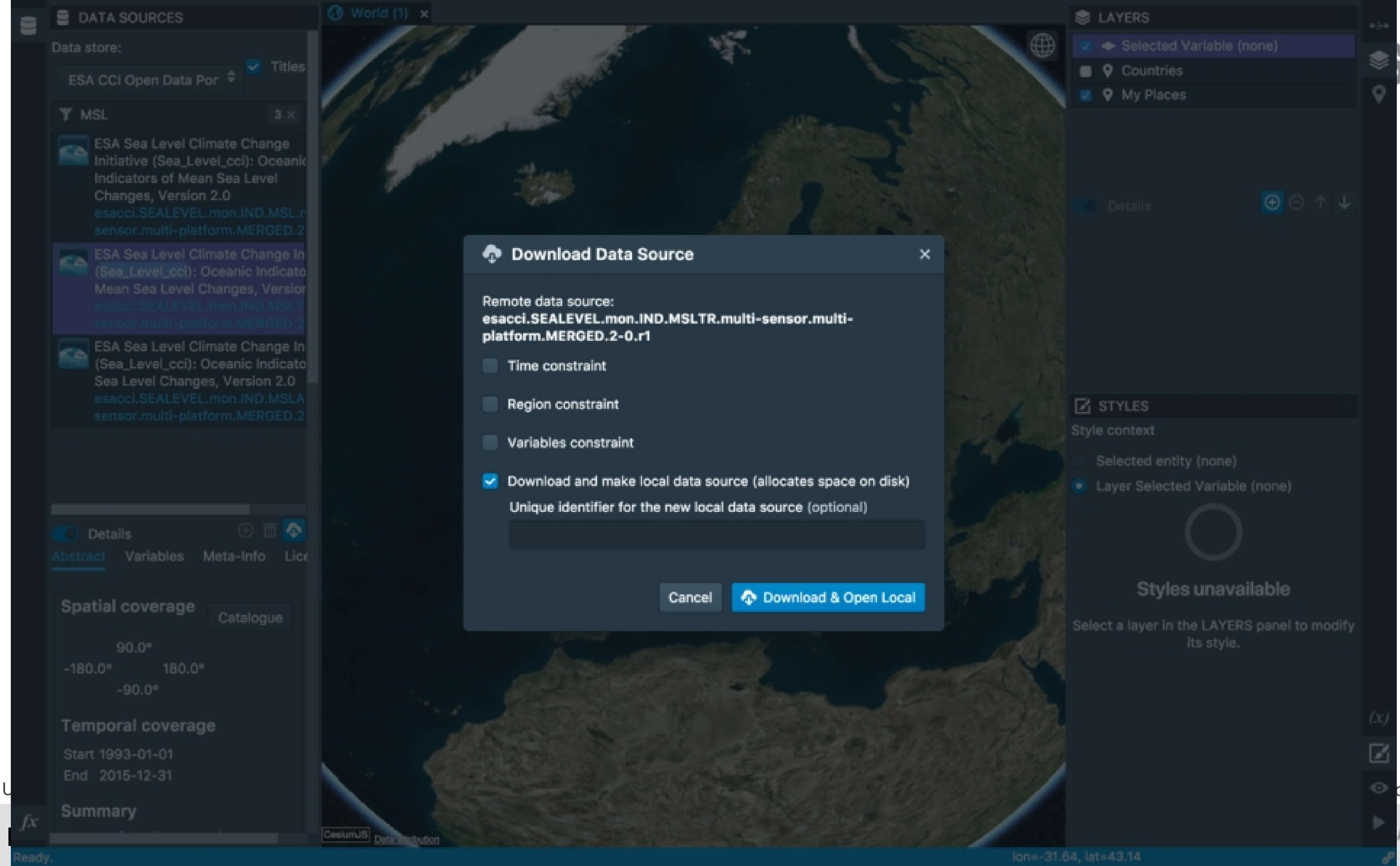
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Temporal coverage
Start 1993-01-01
End 2015-12-31
Summary
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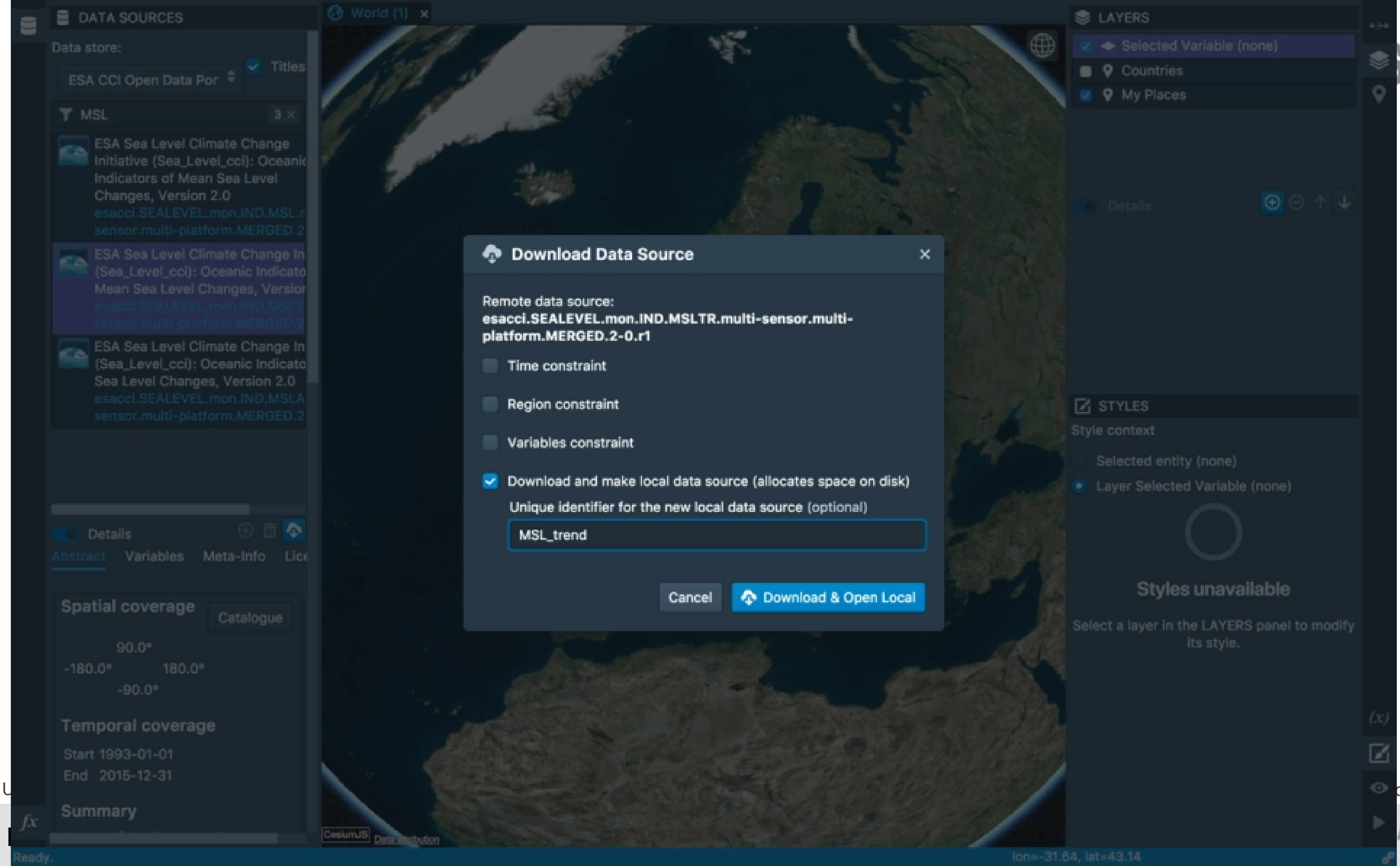
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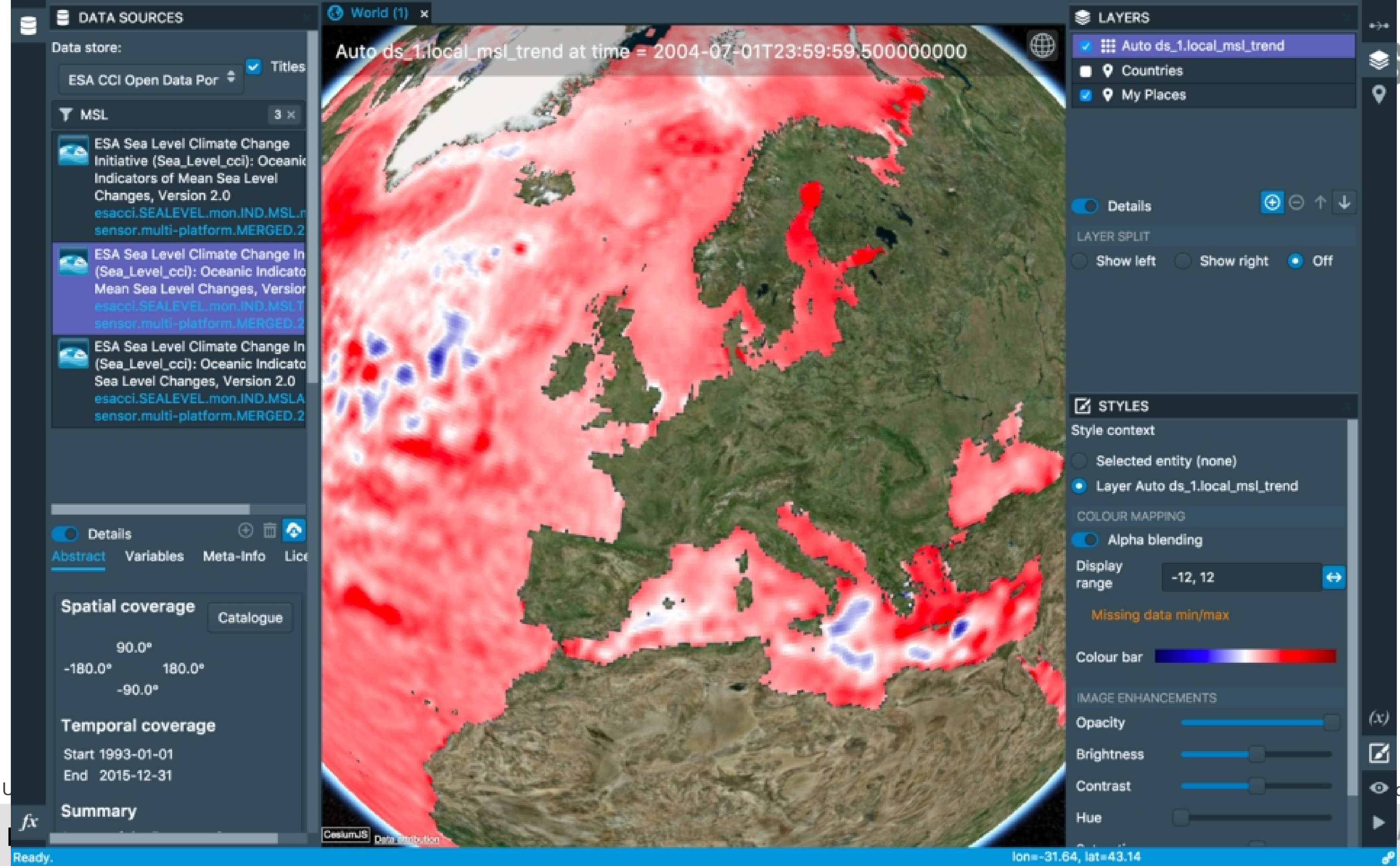
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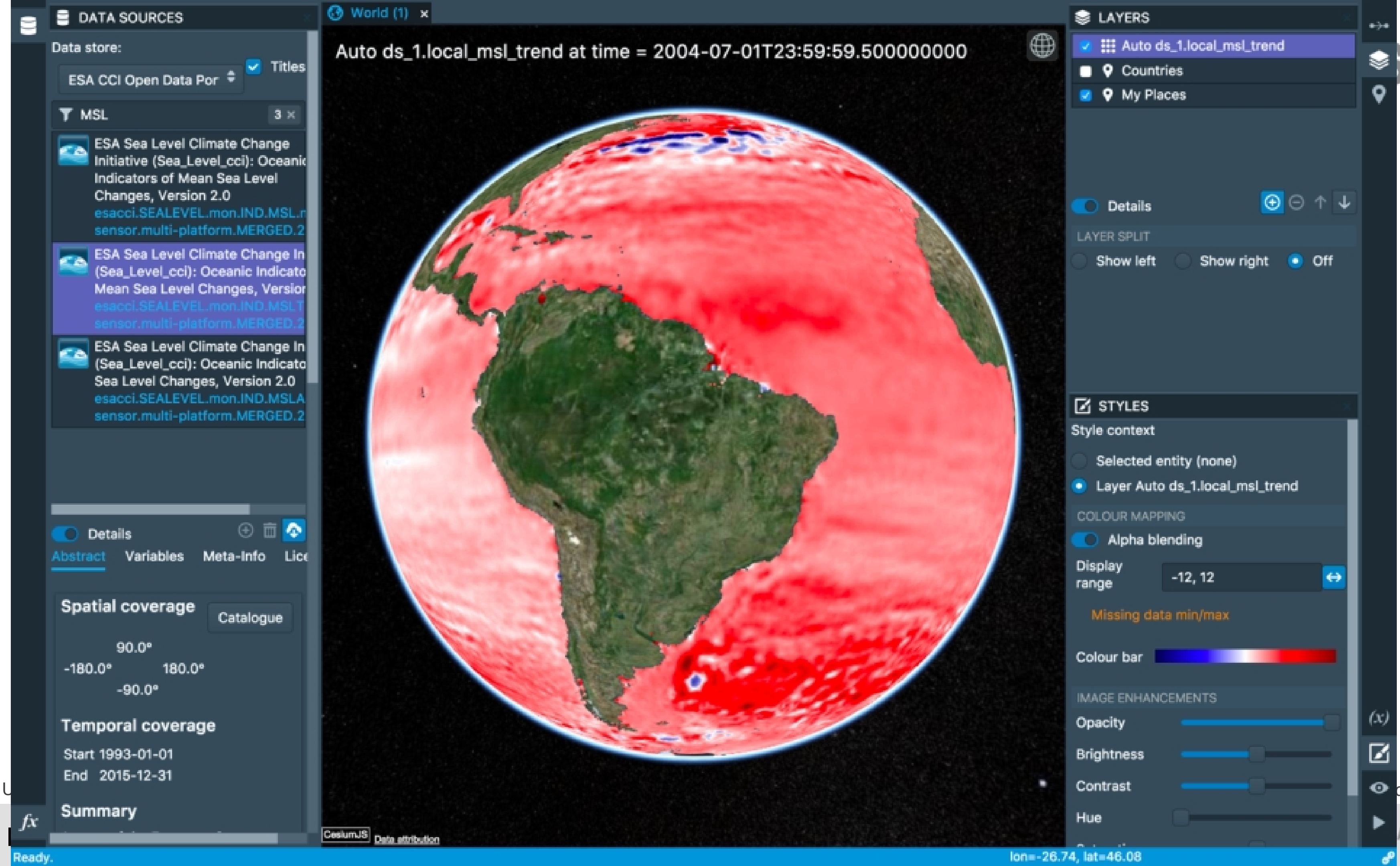
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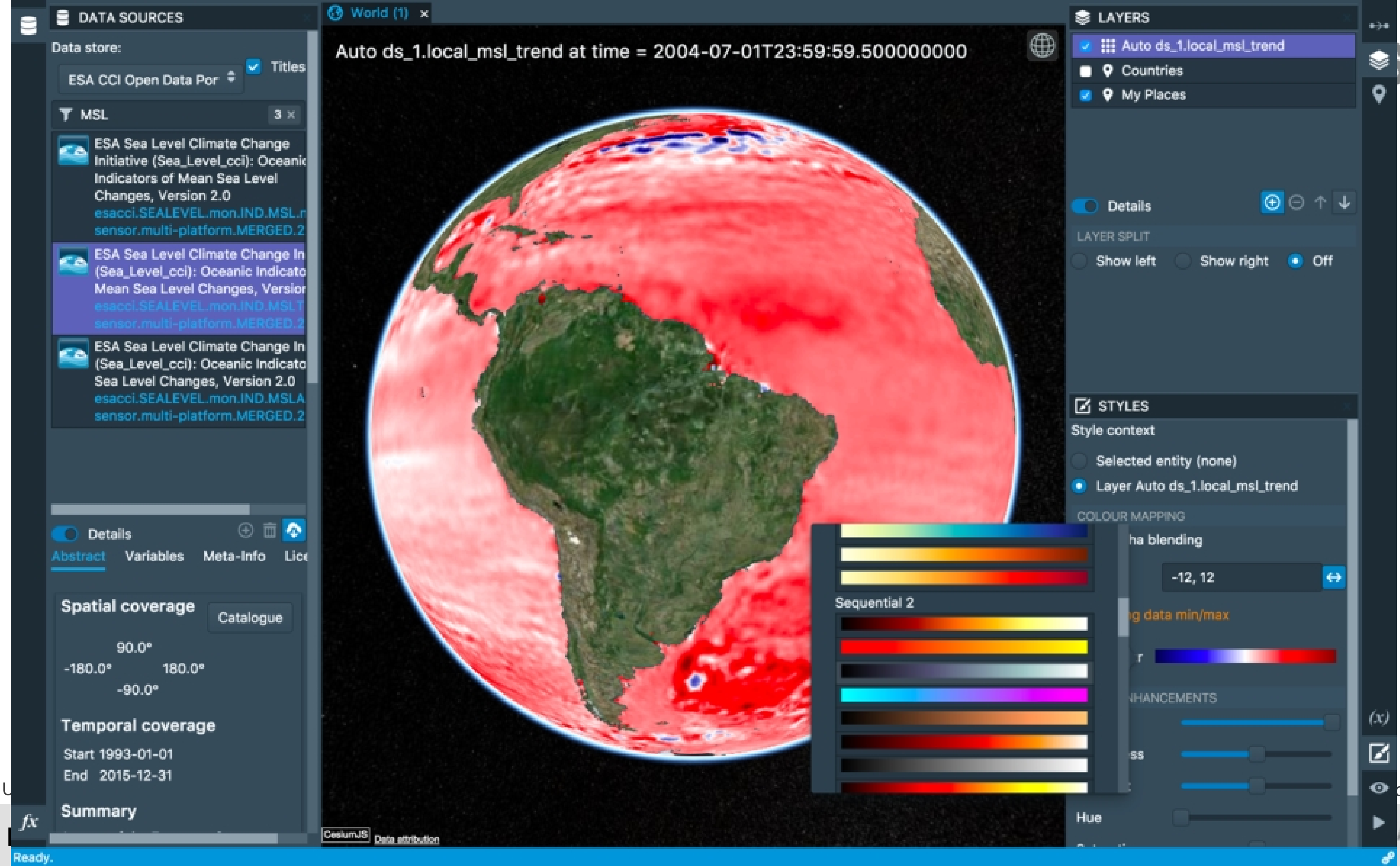
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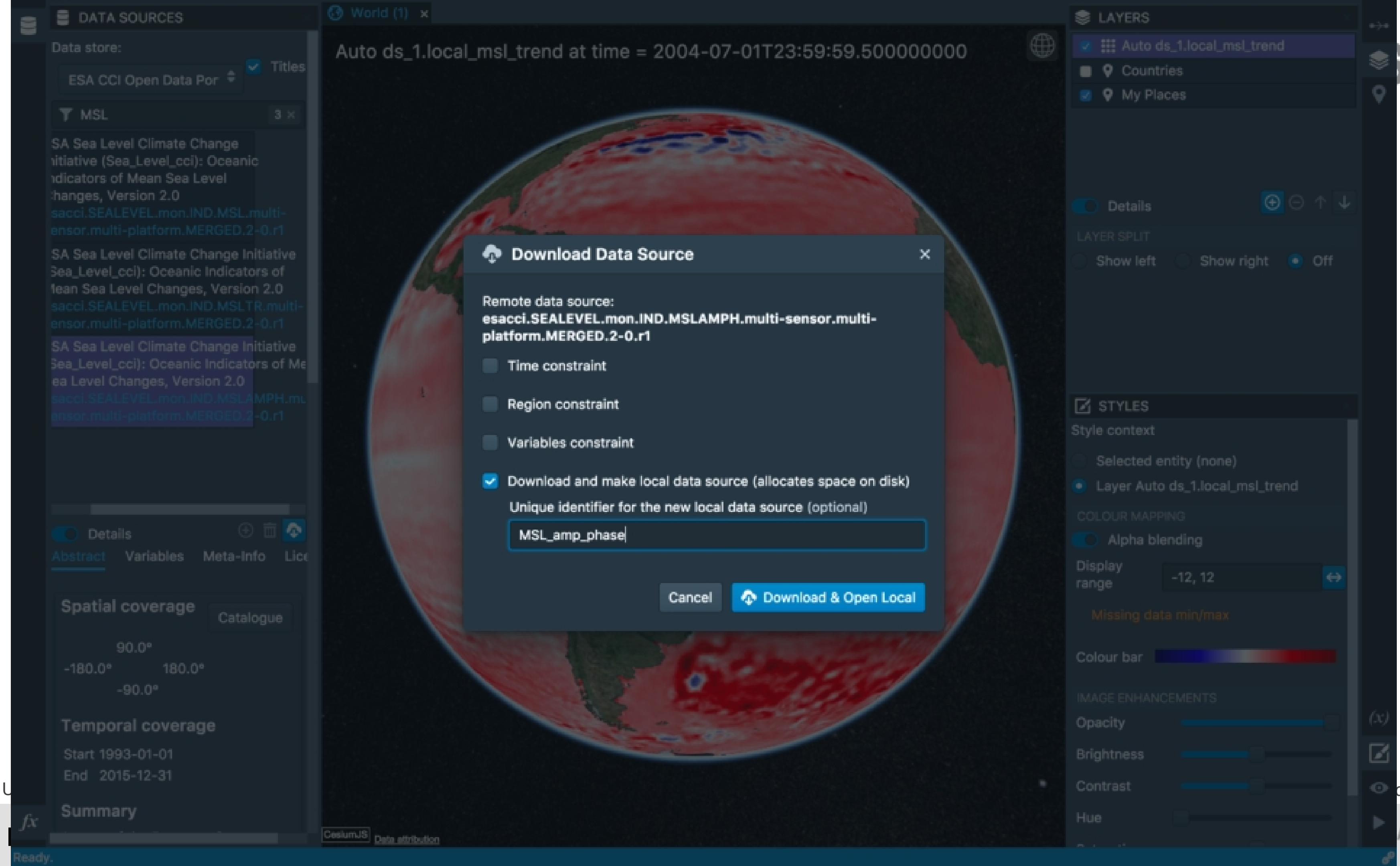
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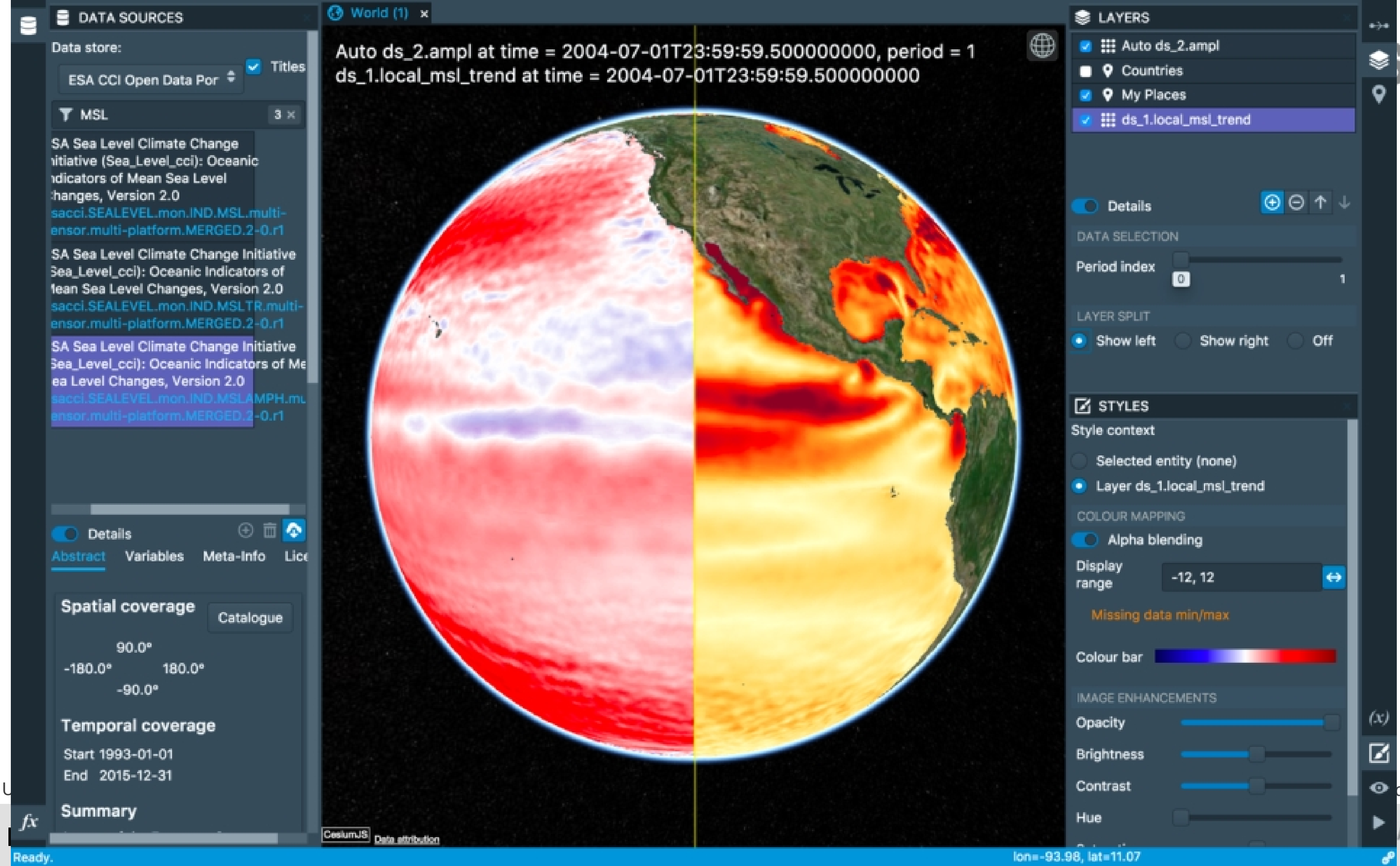
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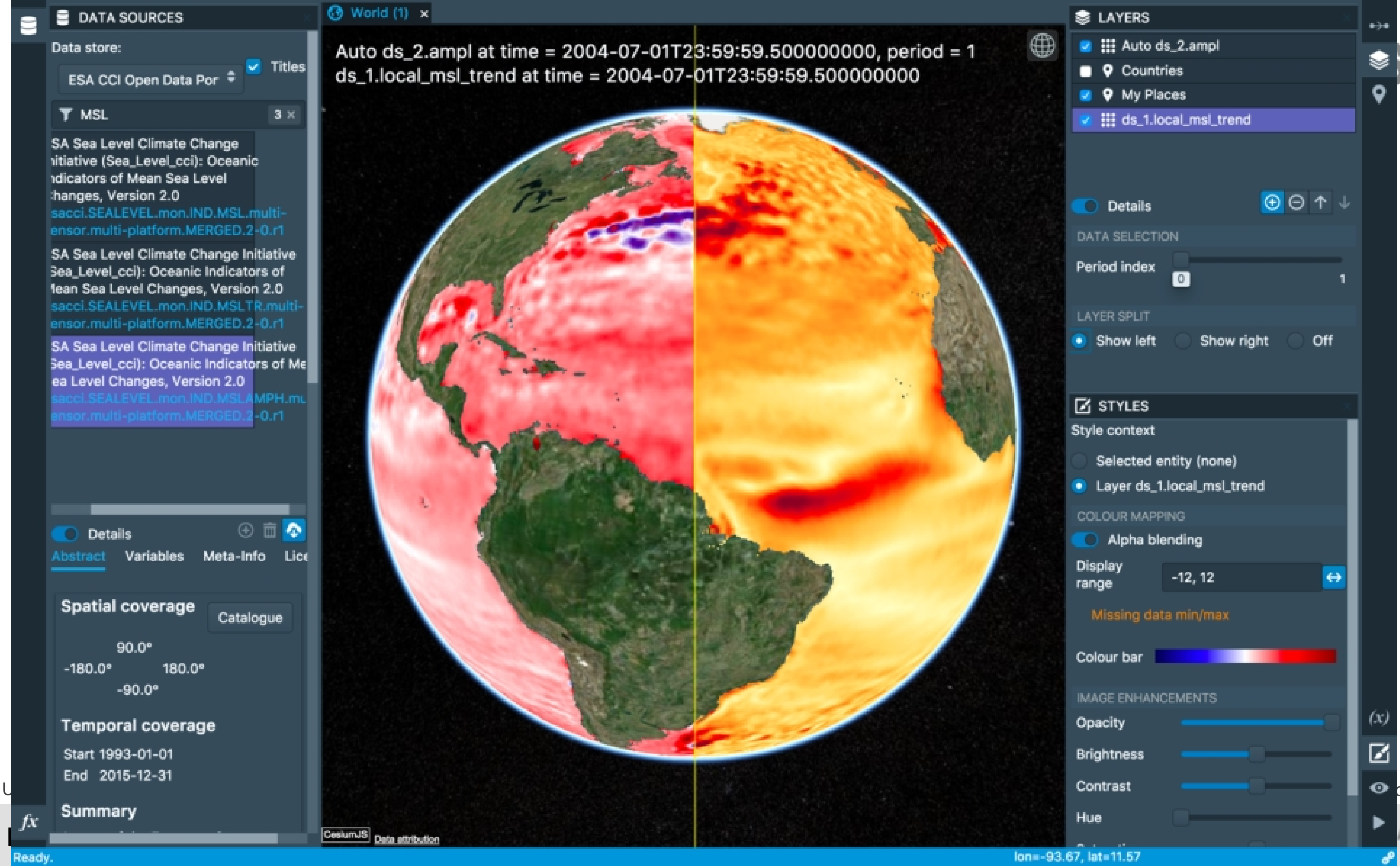
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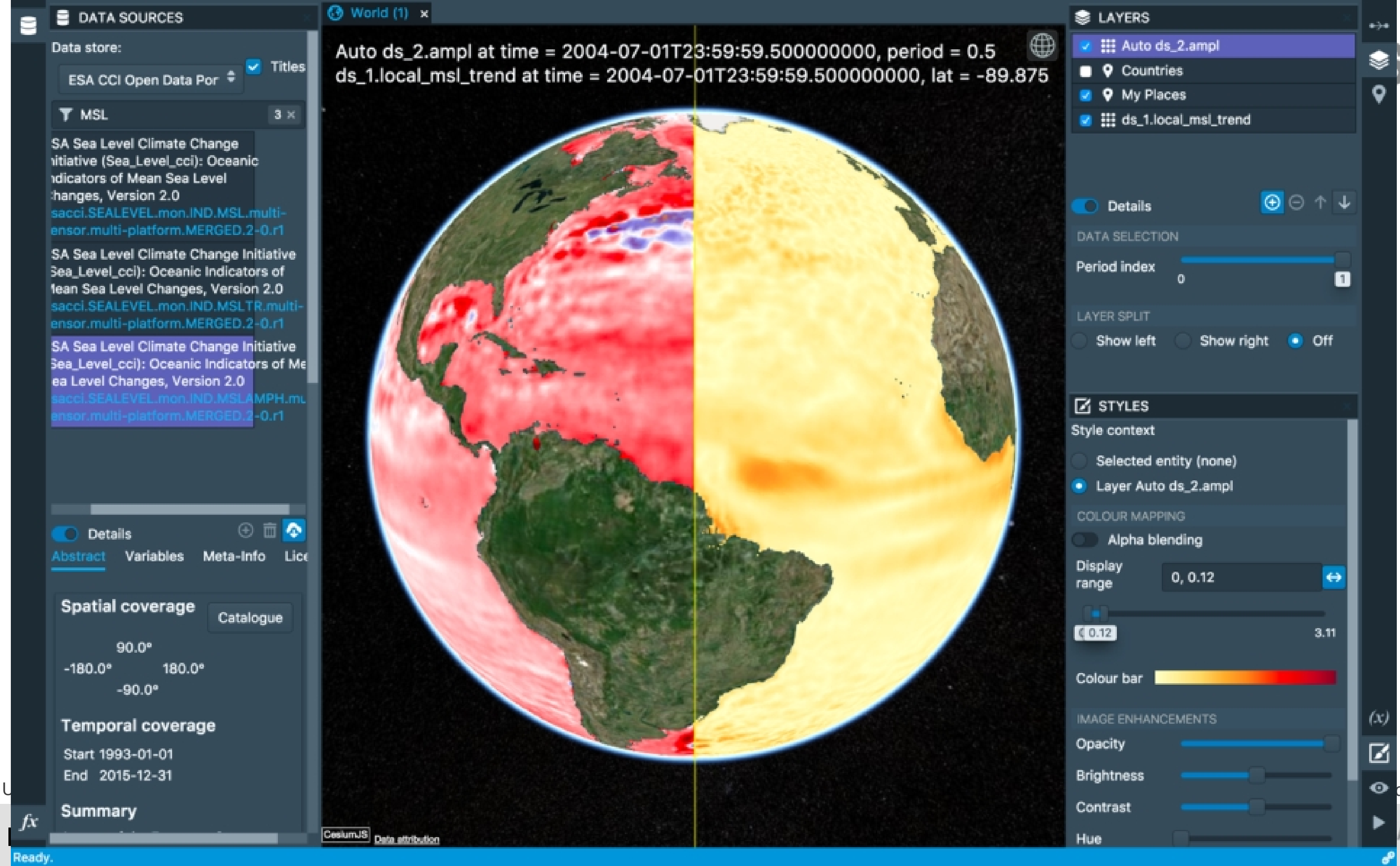
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Temporal coverage
Start 1993-01-01
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CesiumJS
Data attribution
LAYERS
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Countries
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DATA SELECTION
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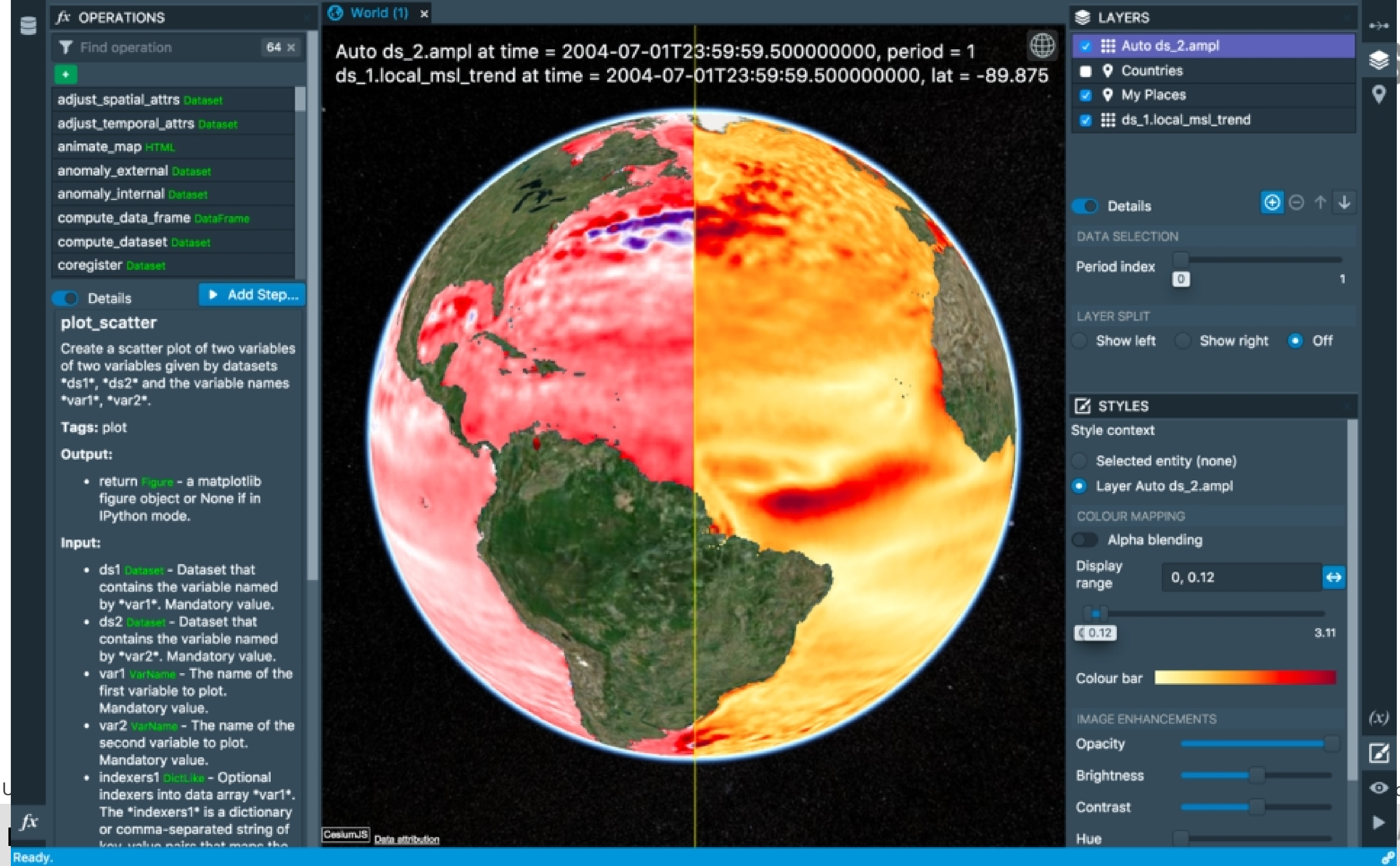
OPERATIONS
Find operation
64
adjust_spatial_attrs Dataset
adjust_temporal_attrs Dataset
animate_map HTML
anomaly_external Dataset
anomaly_internal Dataset
compute_data_frame DataFrame
compute_dataset Dataset
coregister Dataset
Details
Add Step...
plot_scatter
Create a scatter plot of two variables of two variables given by datasets *ds1*, *ds2* and the variable names *var1*, *var2*.
Tags: plot
Output:
return Figure - a matplotlib figure object or None if in IPython mode.
Input:
ds1 Dataset - Dataset that contains the variable named by *var1*. Mandatory value.
ds2 Dataset - Dataset that contains the variable named by *var2*. Mandatory value.
var1 VarName - The name of the first variable to plot. Mandatory value.
var2 VarName - The name of the second variable to plot. Mandatory value.
indexers1 DictLike - Optional indexers into data array *var1*. The *indexers1* is a dictionary or comma-separated string of
World (1)
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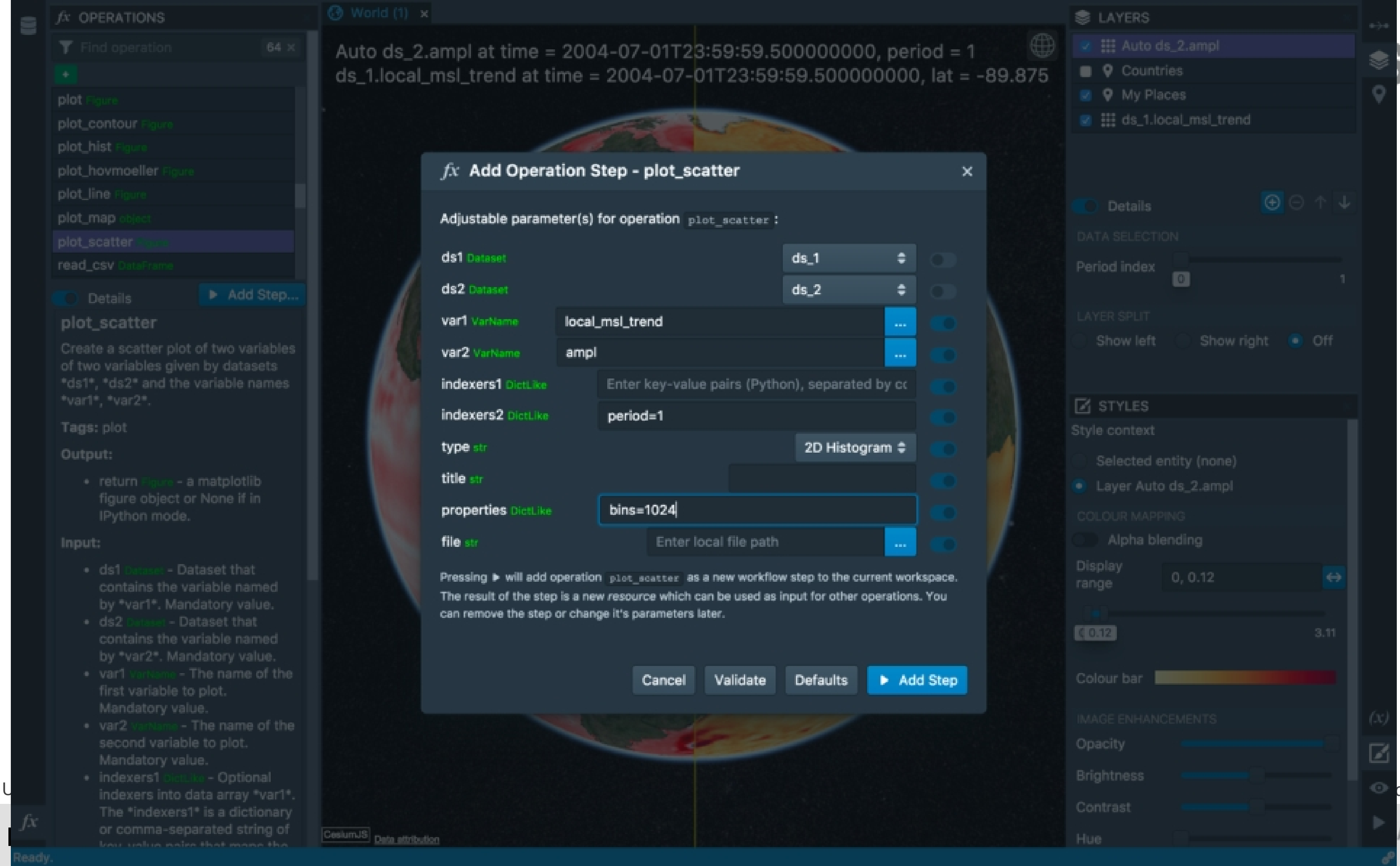
OPERATIONS
Find operation
64
plot Figure
plot_contour Figure
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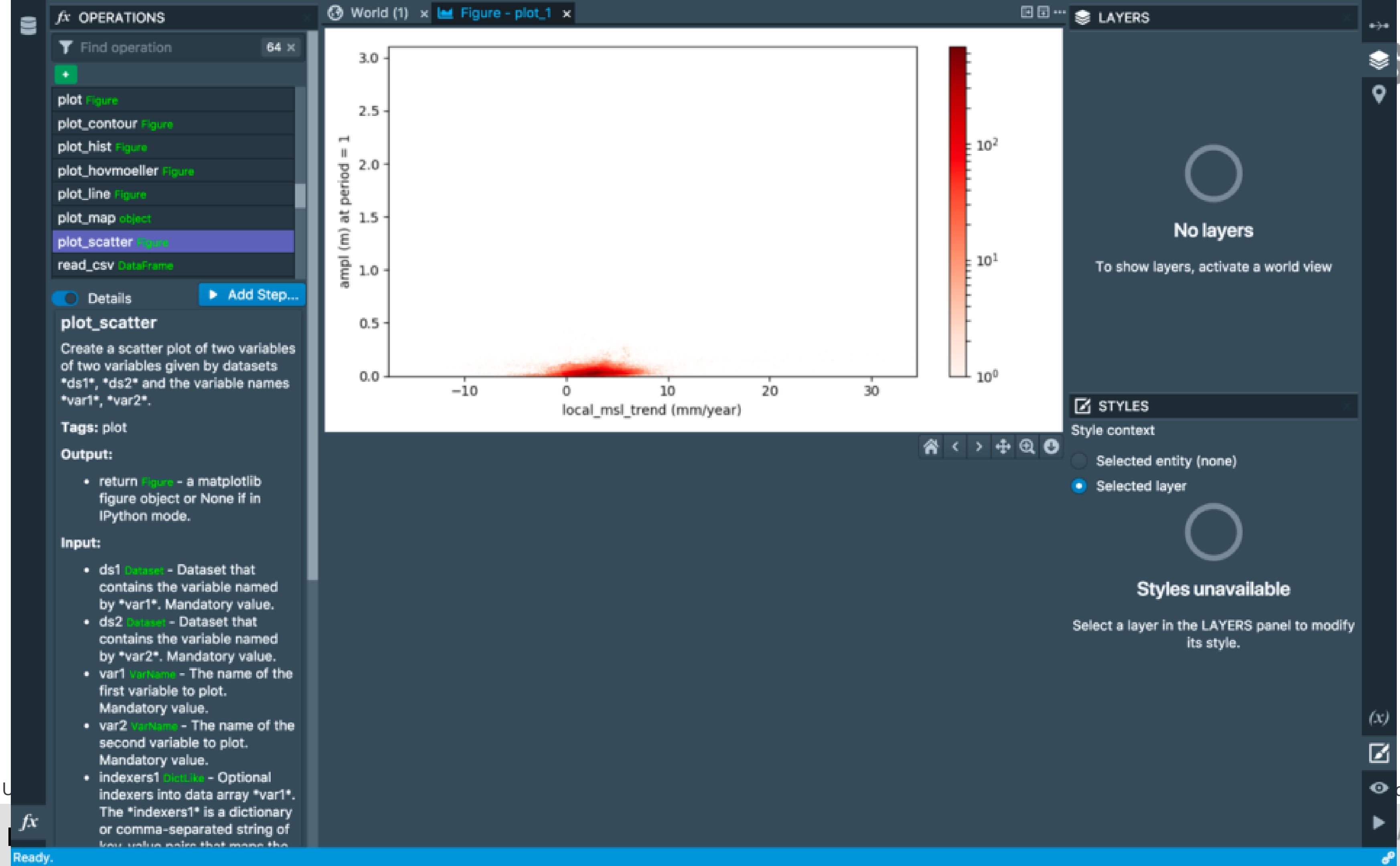
read_csv DataFrame
Details
Add Step...
plot_scatter
Create a scatter plot of two variables of two variables given by datasets *ds1*, *ds2* and the variable names *var1*, *var2*.
Tags: plot
Output:
return Figure - a matplotlib figure object or None if in IPython mode.
Input:
ds1 Dataset - Dataset that contains the variable named by *var1*. Mandatory value.
ds2 Dataset - Dataset that contains the variable named by *var2*. Mandatory value.
var1 VarName - The name of the first variable to plot. Mandatory value.
var2 VarName - The name of the second variable to plot. Mandatory value.
indexers1 DictLike - Optional indexers into data array *var1*. The *indexers1* is a dictionary or comma-separated string of
World (1)
Auto ds_2.ampl at time = 2004-07-01T23:59:59.500000000, period = 1
ds_1.local_msl_trend at time = 2004-07-01T23:59:59.500000000, lat = -89.875
Add Operation Step - plot_scatter
Adjustable parameter(s) for operation plot_scatter :
ds1 Dataset
ds_1
ds2 Dataset
ds_2
var1 VarName
local_msl_trend
var2 VarName
ampl
indexers1 DictLike
Enter key-value pairs (Python), separated by cc
indexers2 DictLike
period=1
type str
2D Histogram
title str
properties DictLike
bins=1024
file str
Enter local file path
Pressing ▶ will add operation plot_scatter as a new workflow step to the current workspace.
The result of the step is a new resource which can be used as input for other operations. You can remove the step or change it's parameters later.
Cancel
Validate
Defaults
Add Step
CesiumJS
Data attribution
LAYERS
Auto ds_2.ampl
Countries
My Places
ds_1.local_msl_trend
Details
DATA SELECTION
Period index
LAYER SPLIT
Show left
Show right
Off
STYLES
Style context
Selected entity (none)
Layer Auto ds_2.ampl
COLOUR MAPPING
Alpha blending
Display range
0, 0.12
3.11
Colour bar
IMAGE ENHANCEMENTS
Opacity
Brightness
Contrast
Hue
Ready.


OPERATIONS
Find operation
64
plot Figure
plot_contour Figure
plot_hist Figure
plot_hovmoeller Figure
plot_line Figure
plot_map object
plot_scatter Figure
read_csv DataFrame
Details
Add Step...
plot_scatter
Create a scatter plot of two variables of two variables given by datasets *ds1*, *ds2* and the variable names *var1*, *var2*.
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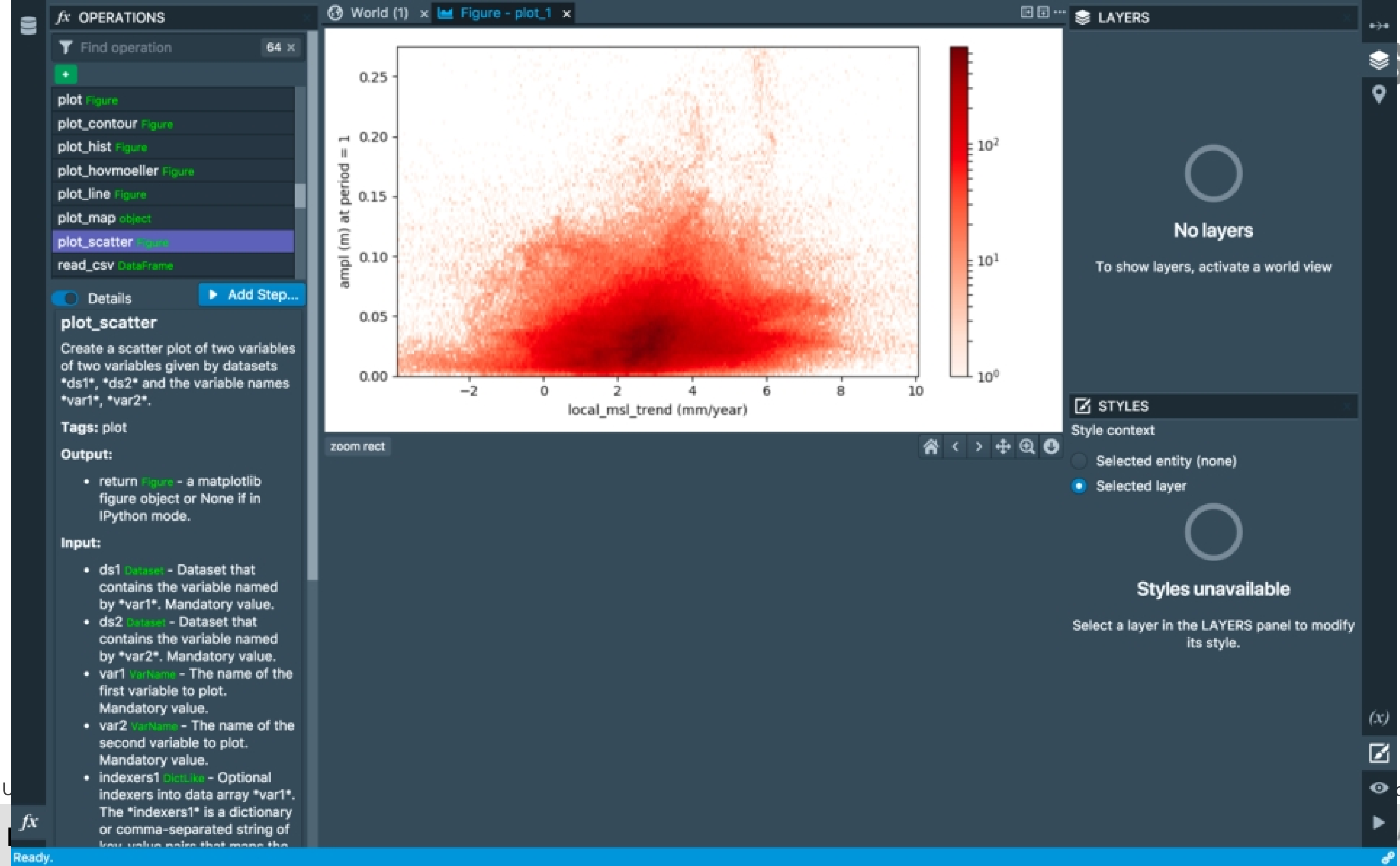
var2 VarName - The name of the second variable to plot. Mandatory value.
indexers1 DictLike - Optional indexers into data array *var1*. The *indexers1* is a dictionary or comma-separated string of
World (1)
Figure - plot_1
ampl (m) at period = 1
local_msl_trend (mm/year)
LAYERS
No layers
To show layers, activate a world view
STYLES
Style context
Selected entity (none)
Selected layer
Styles unavailable
Select a layer in the LAYERS panel to modify its style.
Ready.


OPERATIONS
Find operation
64
plot Figure
plot_contour Figure
plot_hist Figure
plot_hovmoeller Figure
plot_line Figure
plot_map object
plot_scatter Figure
read_csv DataFrame
Details
Add Step...
plot_scatter
Create a scatter plot of two variables of two variables given by datasets *ds1*, *ds2* and the variable names *var1*, *var2*.
Tags: plot
Output:
return Figure - a matplotlib figure object or None if in IPython mode.
Input:
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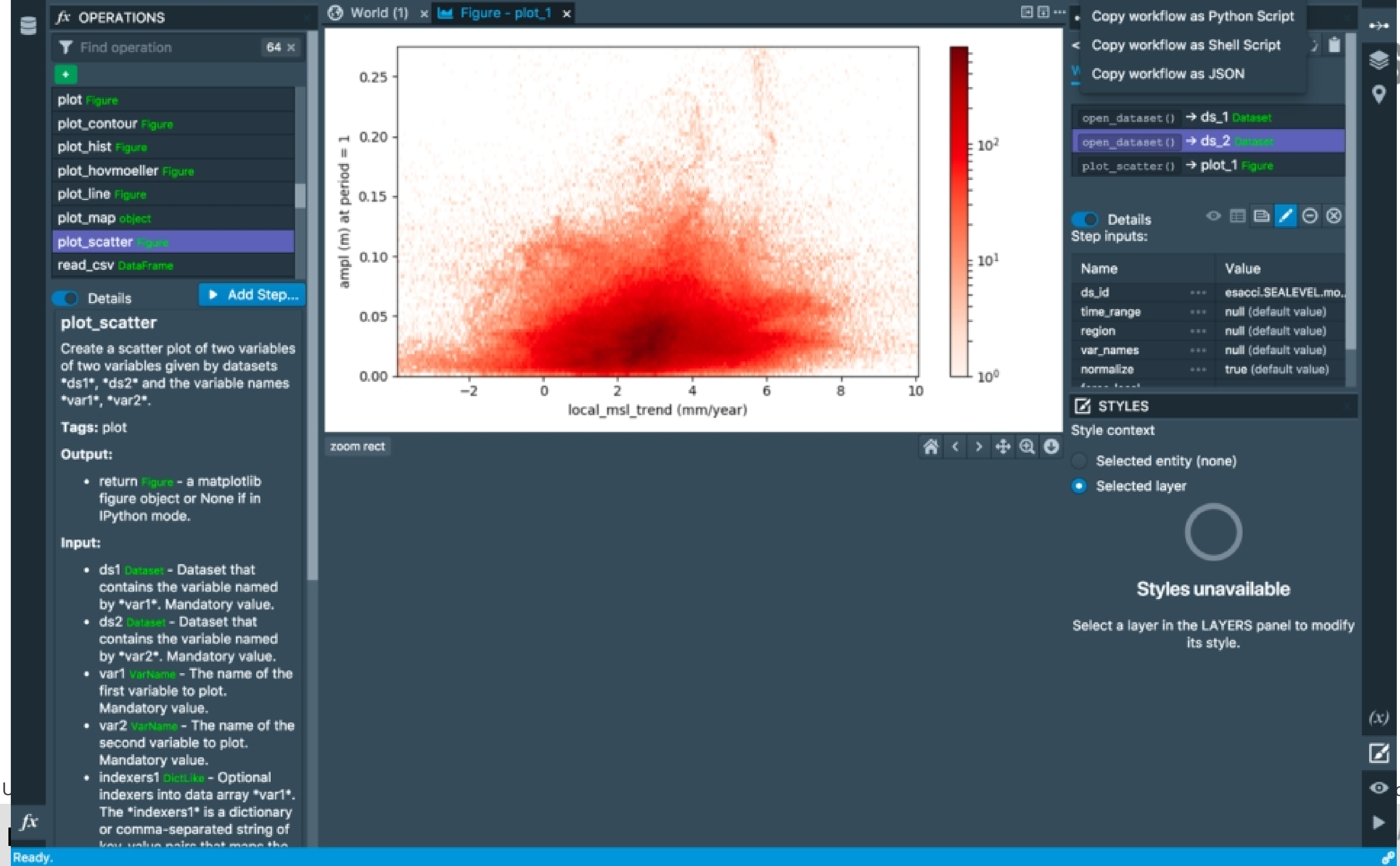
var2 VarName - The name of the second variable to plot. Mandatory value.
indexers1 DictLike - Optional indexers into data array *var1*. The *indexers1* is a dictionary or comma-separated string of
World (1)
Figure - plot_1
ampl (m) at period = 1
0.25
0.20
0.15
0.10
0.05
0.00
−2
0
2
4
6
8
10
local_msl_trend (mm/year)
10^2
10^1
10^0
zoom rect
LAYERS
No layers
To show layers, activate a world view
STYLES
Style context
Selected entity (none)
Selected layer
Styles unavailable
Select a layer in the LAYERS panel to modify its style.
Ready.


OPERATIONS
Find operation
64
plot Figure
plot_contour Figure
plot_hist Figure
plot_hovmoeller Figure
plot_line Figure
plot_map object
plot_scatter Figure
read_csv DataFrame
Details
Add Step...
plot_scatter
Create a scatter plot of two variables of two variables given by datasets *ds1*, *ds2* and the variable names *var1*, *var2*.
Tags: plot
Output:
return Figure - a matplotlib figure object or None if in IPython mode.
Input:
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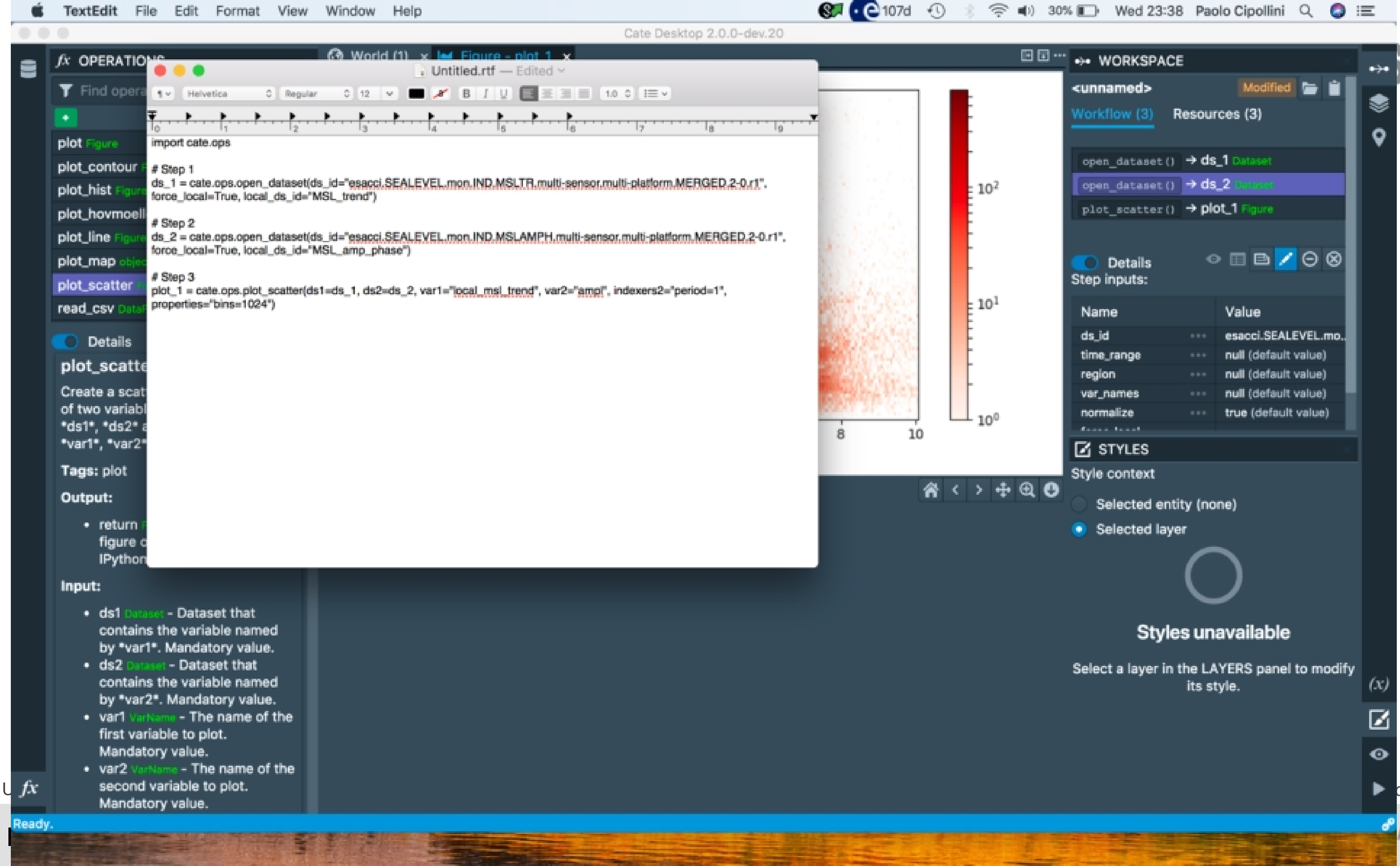
ds2 Dataset - Dataset that contains the variable named by *var2*. Mandatory value.
var1 VarName - The name of the first variable to plot. Mandatory value.
var2 VarName - The name of the second variable to plot. Mandatory value.
indexers1 DictLike - Optional indexers into data array *var1*. The *indexers1* is a dictionary or comma-separated string of
World (1)
Figure - plot_1
ampl (m) at period = 1
local_msl_trend (mm/year)
zoom rect
Copy workflow as Python Script
Copy workflow as Shell Script
Copy workflow as JSON
open_dataset() → ds_1 Dataset
open_dataset() → ds_2 Dataset
plot_scatter() → plot_1 Figure
Details
Step inputs:
Name
Value
ds_id
esacci.SEALEVEL.mo..
time_range
null (default value)
region
null (default value)
var_names
null (default value)
normalize
true (default value)
STYLES
Style context
Selected entity (none)
Selected layer
Styles unavailable
Select a layer in the LAYERS panel to modify its style.
Ready.


TextEdit File Edit Format View Window Help
Wed 23:38 Paolo Cipollini
Cate Desktop 2.0.0-dev.20
OPERATIONS
Untitled.rtf — Edited
import cate.ops
# Step 1
ds_1 = cate.ops.open_dataset(ds_id="esacci.SEALEVEL.mon.IND.MSLTR.multi-sensor.multi-platform.MERGED.2-0.r1", force_local=True, local_ds_id="MSL_trend")
# Step 2
ds_2 = cate.ops.open_dataset(ds_id="esacci.SEALEVEL.mon.IND.MSLAMPH.multi-sensor.multi-platform.MERGED.2-0.r1", force_local=True, local_ds_id="MSL_amp_phase")
# Step 3
plot_1 = cate.ops.plot_scatter(ds1=ds_1, ds2=ds_2, var1="local_msl_trend", var2="ampl", indexers2="period=1", properties="bins=1024")
plot Figure
plot_contour
plot_hist
plot_hovmoell
plot_line
plot_map
plot_scatter
read_csv
Details
Tags: plot
Output:
Input:
ds1 Dataset - Dataset that contains the variable named by *var1*. Mandatory value.
ds2 Dataset - Dataset that contains the variable named by *var2*. Mandatory value.
var1 VarName - The name of the first variable to plot. Mandatory value.
var2 VarName - The name of the second variable to plot. Mandatory value.
WORKSPACE
<unnamed>
Modified
Workflow (3)
Resources (3)
open_dataset() → ds_1 Dataset
open_dataset() → ds_2 Dataset
plot_scatter() → plot_1 Figure
Details
Step inputs:
Name
Value
ds_id
esacci.SEALEVEL.mo...
time_range
null (default value)
region
null (default value)
var_names
null (default value)
normalize
true (default value)
STYLES
Style context
Selected entity (none)
Selected layer
Styles unavailable
Select a layer in the LAYERS panel to modify its style.
Ready.

The latest version of **Cate, the CCI Toolbox** is available on

climatetoolbox.io