

IV ESA EARSEL CNR School Remote Sensing for Forest Fires: Correlating Burned Area and Soil Moisture with CCI Toolbox

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<http://climatetoolbox.io/>

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CCI Toolbox

The Climate Analysis Toolbox of the
ESA Climate Change Initiative.

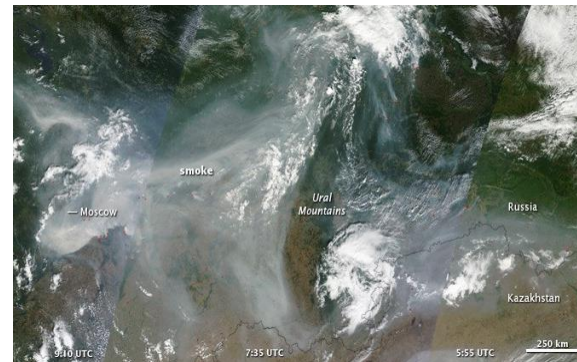
Summary



1. Wildfire event in Russia (summer 2010)
2. CCI Toolbox Exercise
 1. Opening global datasets (soil moisture, fire product and aerosols)
 2. Make spatial subsets
 3. Calculate and plot mean over time
 4. Calculate and plot correlation between datasets

3- Wildfires in Russia (summer 2010)

- Spring & Summer: intense heatwave (40 degrees Celsius)
- Hundreds of forest fires & peat fires
- Around 300 000 ha of forest destroyed
- Over 13.3 million hectares of crop were affected by fires, drought and heat
- Economic losses of more than 15 billion dollars



Sources: (1) <https://www.climatechangepost.com/russia/forest-fires/>, (2) http://gfmcconline/gfmcnew/2010-gfmcnew/08-08-2010-gfmcnew/04-08-08-2010-gfmcnew/20100804_ru.html
(3) <https://www.nature.com/news/2010/100812/full/news.2010.404.html>

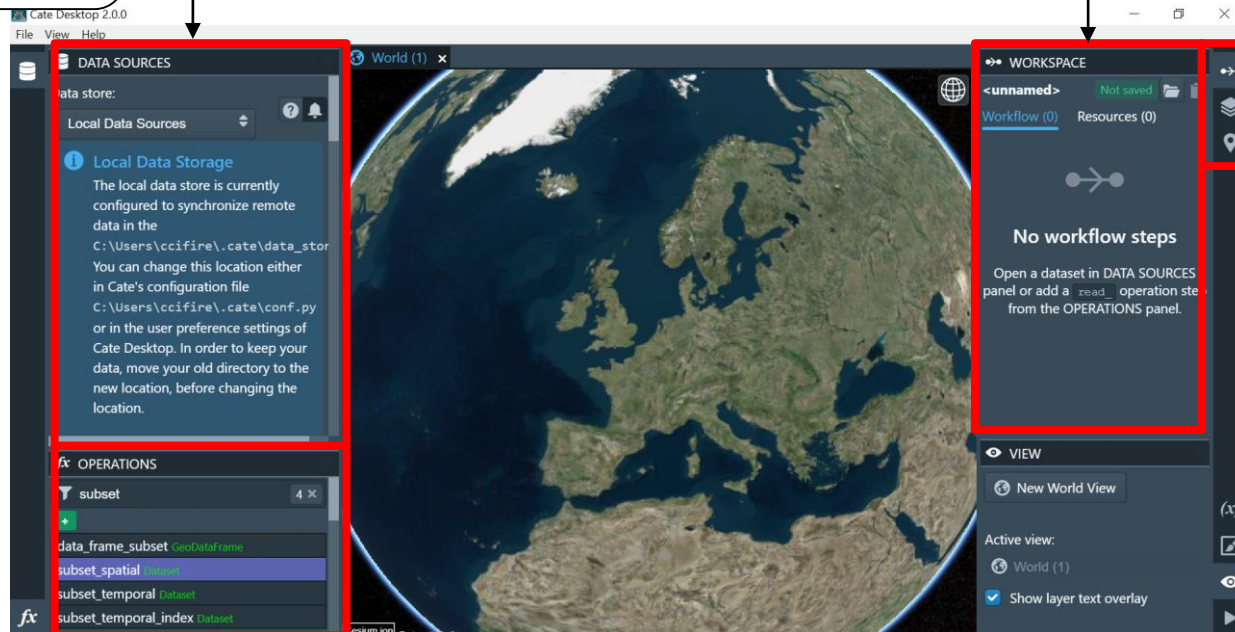
4- CCI Toolbox exercise



- 1. Opening global datasets (soil moisture, fire product and aerosols)**
2. Make spatial subsets
3. Calculate and plot mean over time
4. Calculate and plot correlation between datasets

Data sources panel: browse, download and open both local and remote data sources

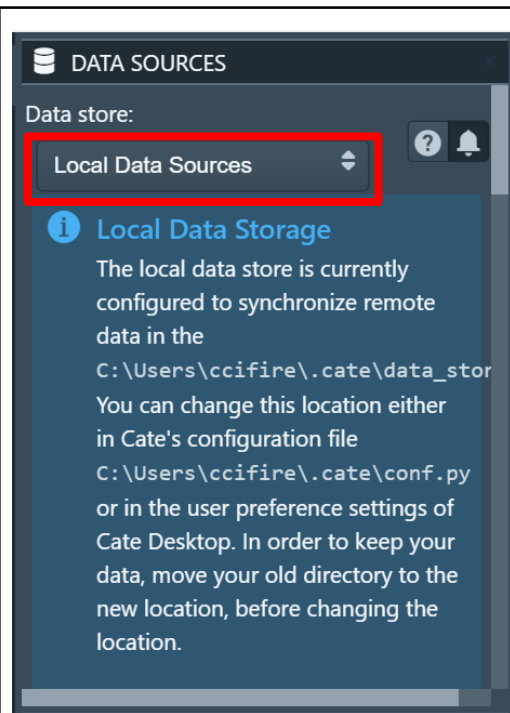
Workspace: see and browse your data, applied operations and results



Operations panel: browse and apply available operations

Switch between workspace and layers

1



DATA SOURCES

Data store:

Local Data Sources

Local Data Storage

The local data store is currently configured to synchronize remote data in the

C:\Users\ccifire\.cate\data_store

You can change this location either in Cate's configuration file

C:\Users\ccifire\.cate\conf.py

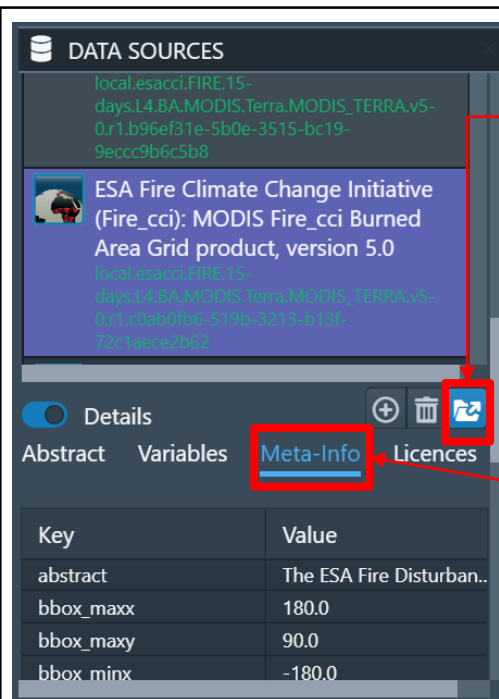
or in the user preference settings of Cate Desktop. In order to keep your data, move your old directory to the new location, before changing the location.

In the Data Sources panel, select Local Data Sources from the dropdown menu. This will show you only the datasets which are saved locally on your computer.

Select and open, one after another, the following datasets:

- Aerosols
- Fire product
- Soil moisture

2



DATA SOURCES

local.esacci.FIRE.15-days.L4.BA.MODIS.Terra.MODIS_TERRA.v5-0.r1.b96ef31e-5b0e-3515-bc19-9eccc9b6c5b8

ESA Fire Climate Change Initiative (Fire_cci): MODIS Fire_cci Burned Area Grid product, version 5.0

local.esacci.FIRE.15-days.L4.BA.MODIS.Terra.MODIS_TERRA.v5-0.r1.b96ef31e-5b0e-3515-bc19-9eccc9b6c5b8

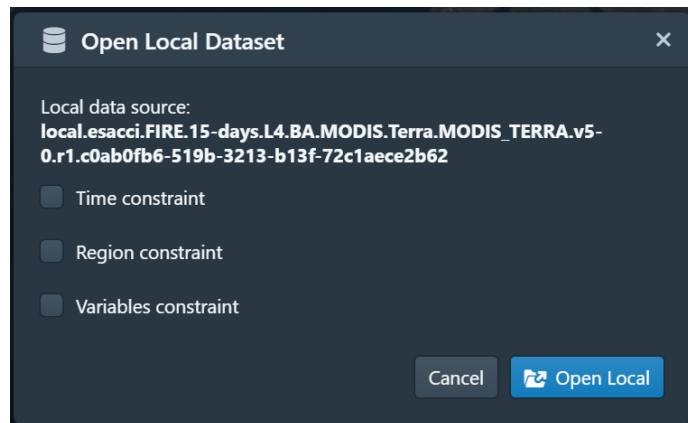
Details

Abstract Variables **Meta-Info** Licences

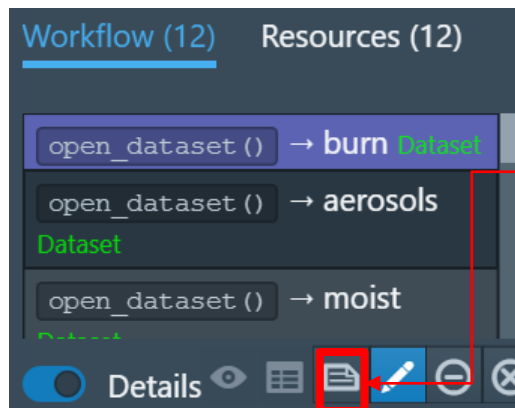
Key	Value
abstract	The ESA Fire Disturban..
bbox_maxx	180.0
bbox_maxy	90.0
bbox_minx	-180.0

You can open the dataset by clicking on the blue folder symbol.

When you select a dataset in the dropdown menu, you can find additional information like time period covered, temporal and spatial resolution etc. from the Meta-Info tab.



When opening a dataset, you can apply certain constraints or filters. Leave these fields empty and import the 3 datasets as are. The datasets that you are importing cover the period from May to October 2010.



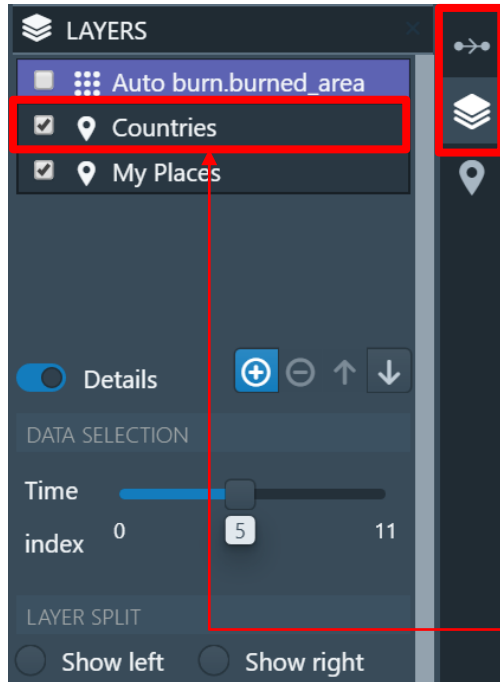
You can change the name of imported datasets (or resources) by clicking on the Resource/step properties button in the Workspace panel.

4- CCI Toolbox exercise



1. Opening global datasets (soil moisture, fire product and aerosols)
2. **Make spatial subsets**
3. Calculate and plot mean over time
4. Calculate and plot correlation between datasets

1

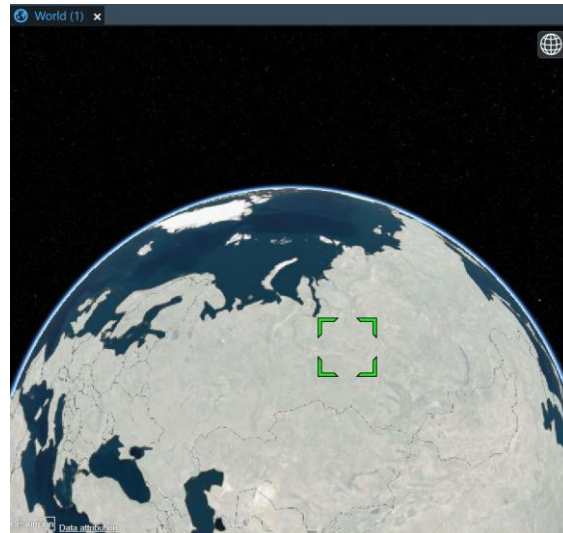


Switch from the Workspace panel to the Layers panel.

Here you can activate/deactivate different layers of your current map visualisation simply by ticking the box next to the layer name.

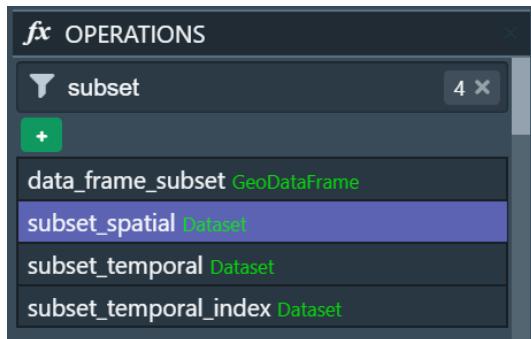
Activate the Countries layer.

2



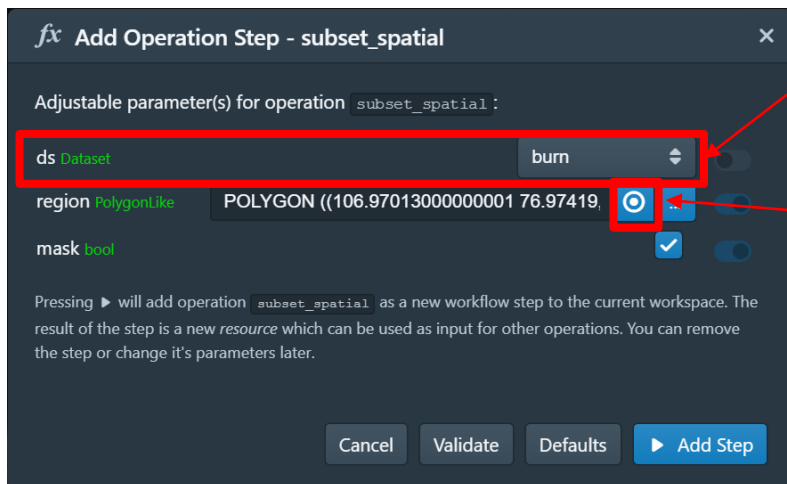
In the World view, you should now be able to see the country borders. Find Russia in the map and activate it by double clicking on the country shape. You have activated the shape when you see a green rectangle above it.

1



In 2010 there were large-scale wildfires in Russia. To analyse the impact of these fires on soil moisture and aerosol content in the atmosphere, the three global datasets we imported have to be subsetting. In the Operations panel, search for the operation subset_spatial and activate it by double-clicking.

2



Under ds Dataset, you can select the dataset you want to apply the operation to from a dropdown menu.

By clicking on the circle next to the region field, you can use the activated country border polygon of Russia as the spatial extent of this operation.

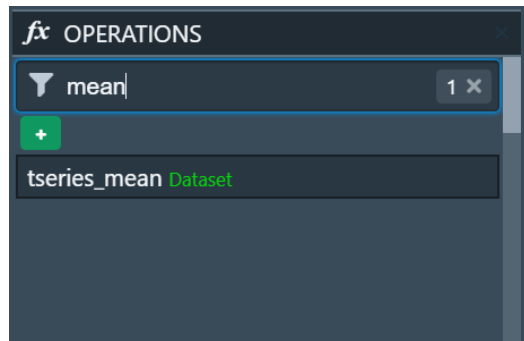
Run the operation by clicking on Add Step, then repeat it three times for the fire, aerosol and soil moisture products. Each time you run the operation, a new dataset is created in your workspace which you can use as input for further operations.

4- CCI Toolbox exercise



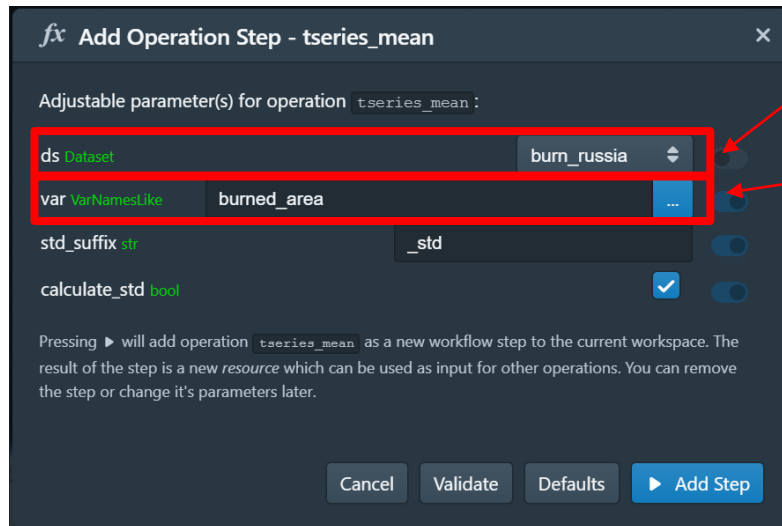
1. Opening global datasets (soil moisture, fire product and aerosols)
2. Make spatial subsets
- 3. Calculate and plot mean over time**
4. Calculate and plot correlation between datasets

1



For each of the 3 subsets (soil moisture, fire product and aerosols) we want to calculate the mean over time. To do that, use the `tseries_mean` tool from the Operations panel.

2

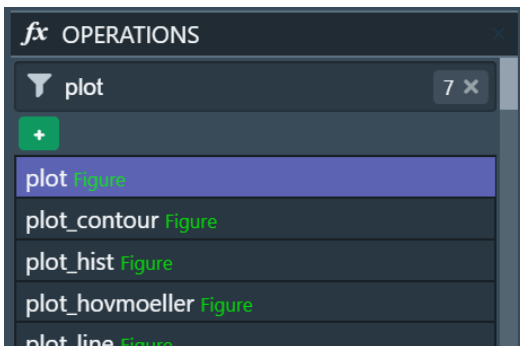


Under `ds Dataset`, you can select the dataset to which you want to apply the operation from a dropdown menu.

Under `var VarNamesLike`, you can select the dataset variable for which you want to calculate the mean.

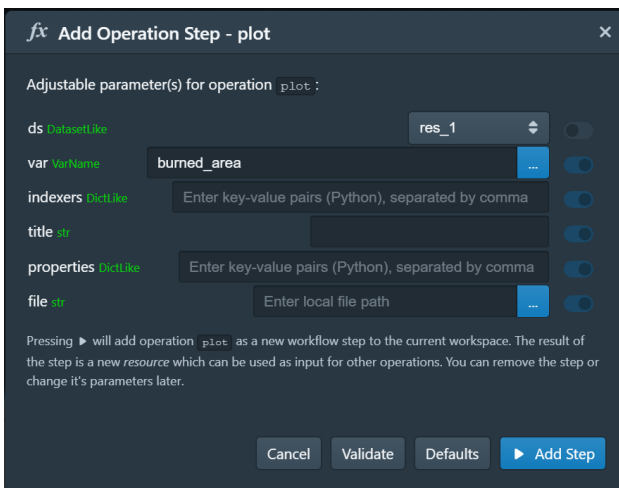
Run the operation by clicking on Add Step, then repeat it three times for the fire, aerosol and soil moisture products. The respective variables are: `burned_area` (m2) for the fire product, `absorbing_aerosol_index` for the aerosol dataset, and `sm` (m3) for the soil moisture dataset.

1



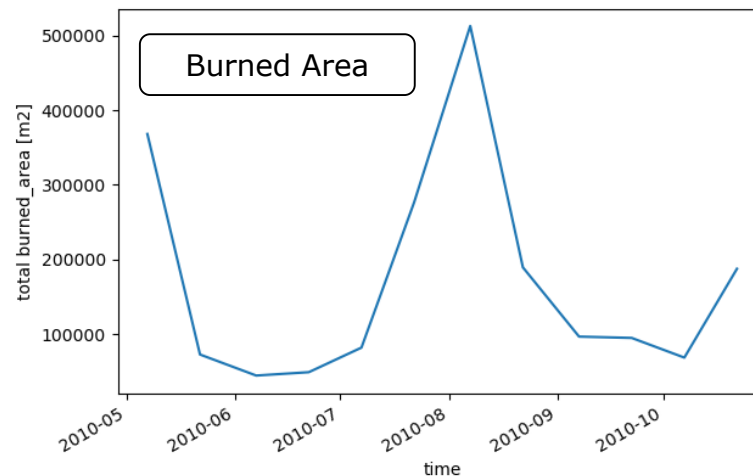
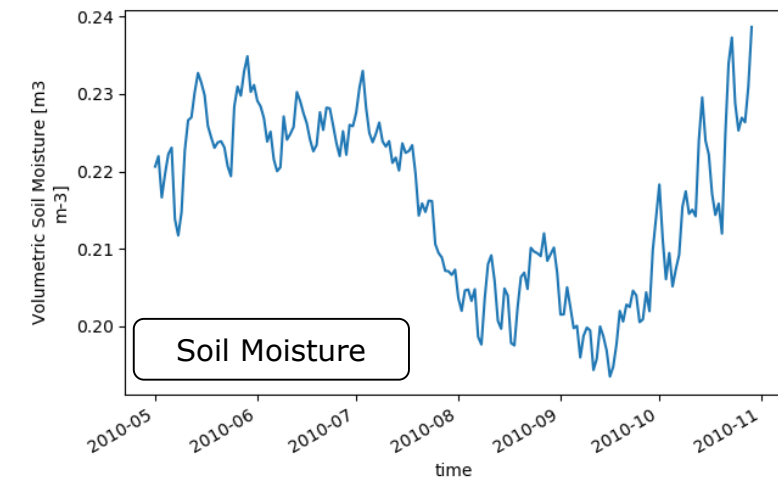
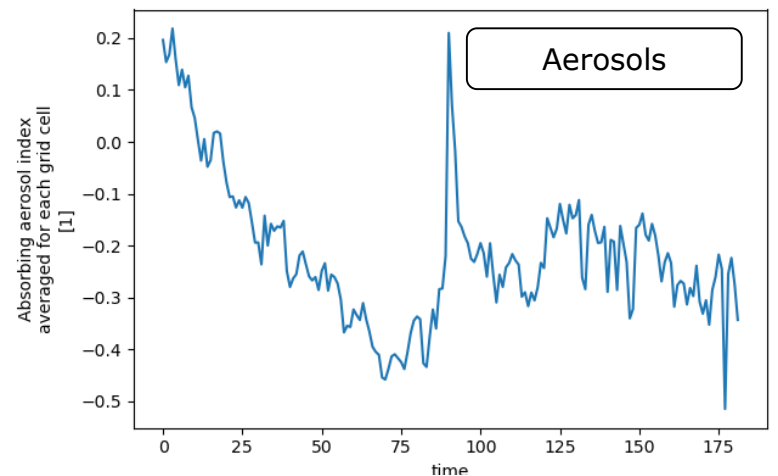
Now let's plot the mean values for the three datasets. Search for the plot function in the Operations panel.

2



Run the operation, one after another, for the three datasets and the variables to plot. The respective variables are:
burned_area (m2) for the fire product
absorbing_aerosol_index for the aerosol dataset
sm (m3) for the soil moisture dataset

Each time you run the operation, a new window opens showing the mean over time plot. You can save that window as an image file.



As can be seen, there seems to be a positive correlation between the total burned area and the aerosol index. This could be due to aerosols released by the wildfires.

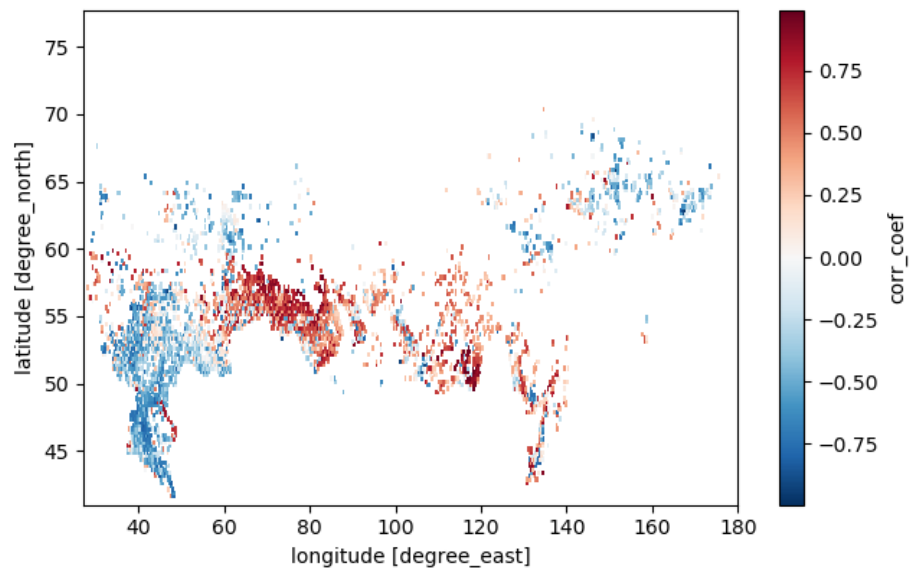
On the other hand, there seems to be a negative correlation between burned area and soil moisture. We can see the soil moisture going down while the burned area increases.

4- CCI Toolbox exercise

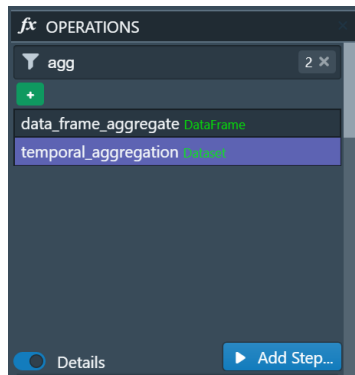


1. Opening global datasets (soil moisture, fire product and aerosols)
2. Make spatial subsets
3. Calculate and plot mean over time
- 4. Calculate and plot correlation between datasets**

We can also look at the correlation between burned area and soil moisture and plot it in a map.



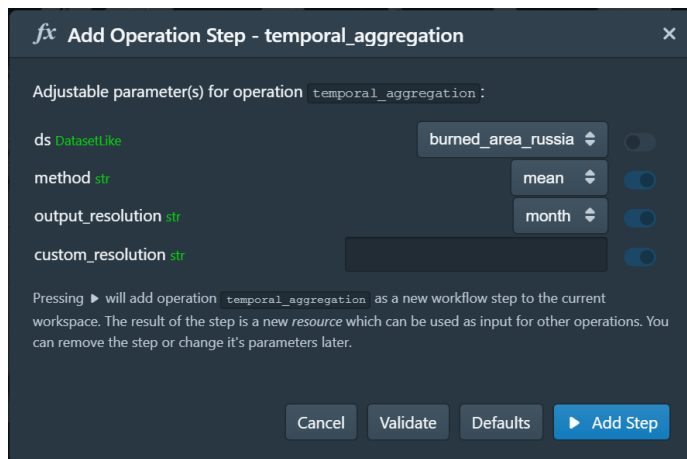
1



The burned area product has a temporal resolution of 15 days, the soil moisture product has a temporal resolution of 1 day. In order to correlate the two datasets, we need to ensure that they have the same temporal dimension. We will therefore aggregate the data on a monthly basis.

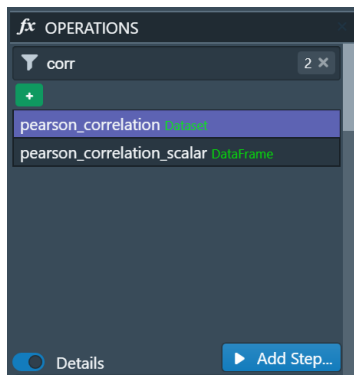
In the Operations panel search for the temporal_aggregation function.

2



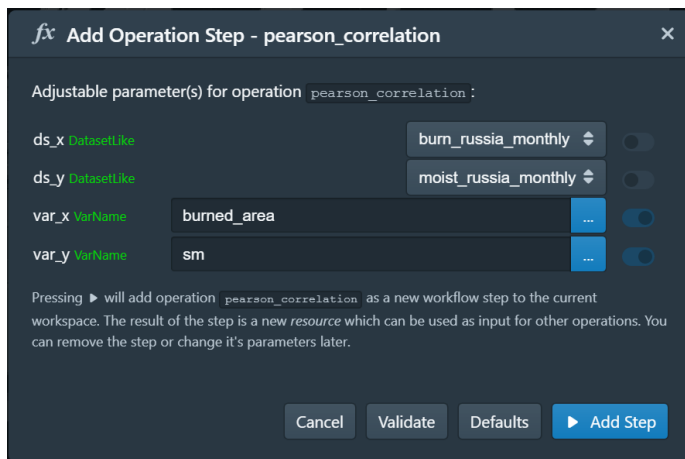
Select as input datasets the burned area subset for Russia and the soil moisture subset for Russia. Choose mean as method and month as output resolution.

1



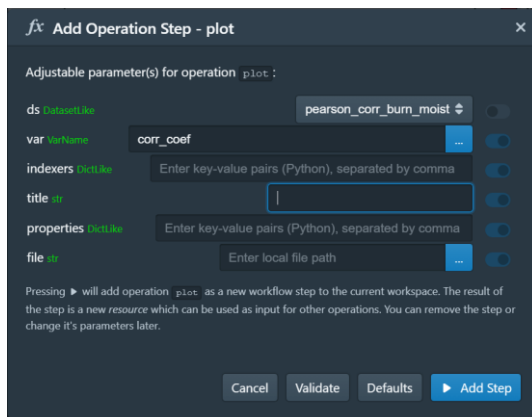
To do a pixel-by-pixel correlation of the two aggregated datasets, use the `pearson_correlation` function.

2



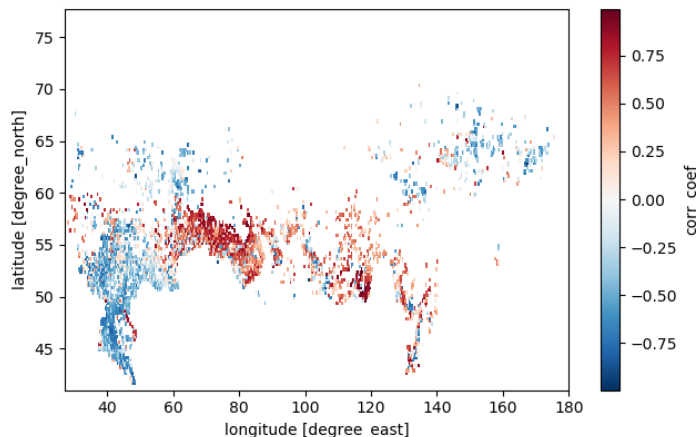
`ds_x` and `ds_y` refer to the two datasets to be correlated. Select here the aggregated and subsetting fire and soil moisture products. The respective variables `var_x` and `var_y` are the burned area (`burned_area`) and soil moisture (`sm`). The output of this operation is a dataset containing the pixel-wise correlation coefficients.

1



Finally, plot the resulting correlation map.

2



The output map should look like this. It is a bit hard to interpret the result since many pixels are empty. However, it seems that in the Western part of Russia where most of the wildfires took place in the summer of 2010, there is a negative correlation between soil moisture and burned area.