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Exercise 6: Water cycles and signatures

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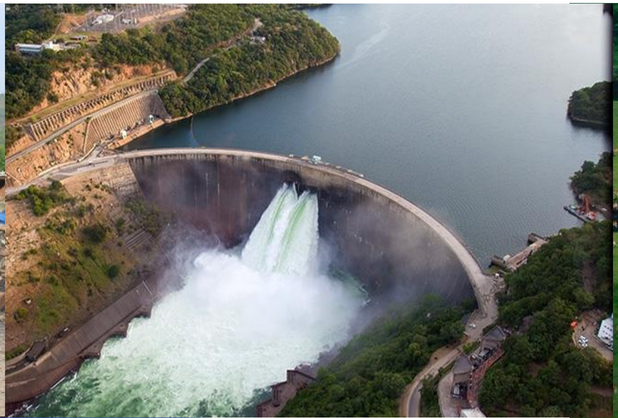


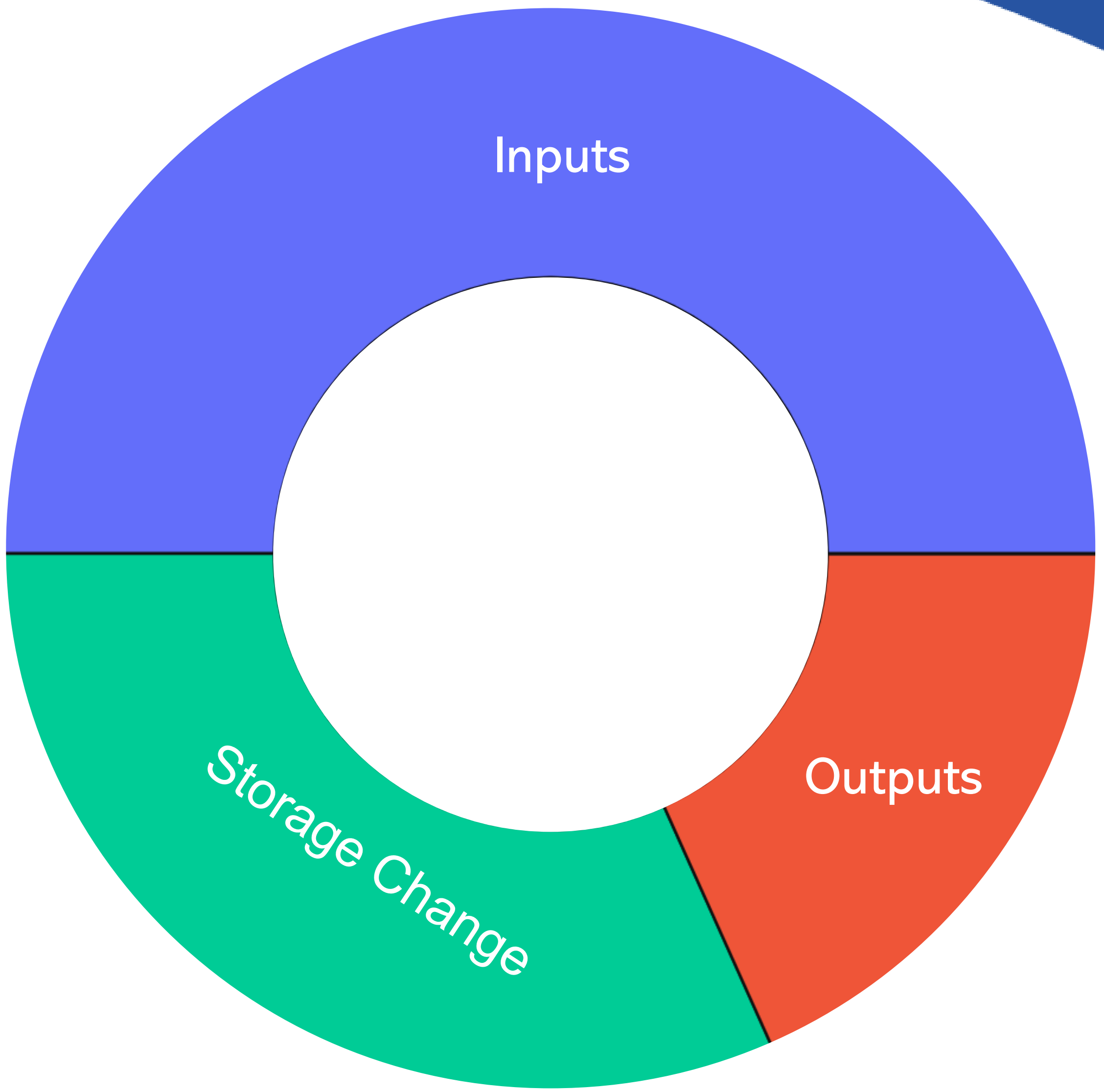
Water cycle

A water balance is used to understand the flows through a system.

A water cycle/wheel/circle summarises the flows through a system over a certain period.

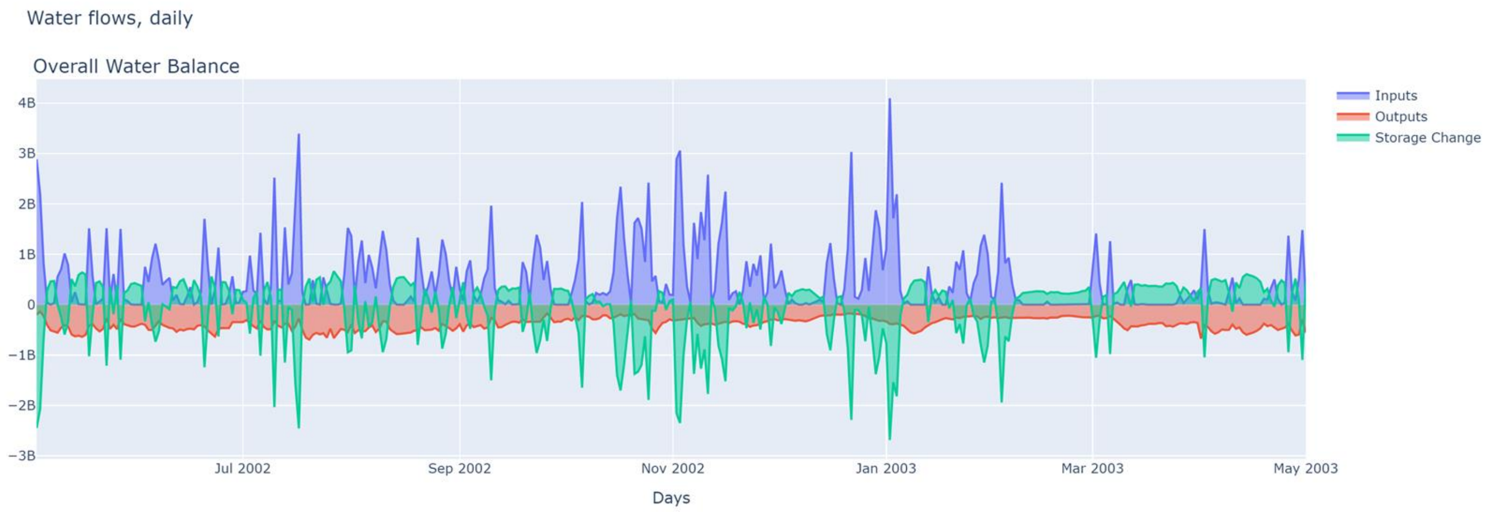
The inputs to the system equal the outputs from the system plus whatever changed in the system.

Inputs = Outputs + Storage change



Water cycle and signature example

The Rhine basin for an example year



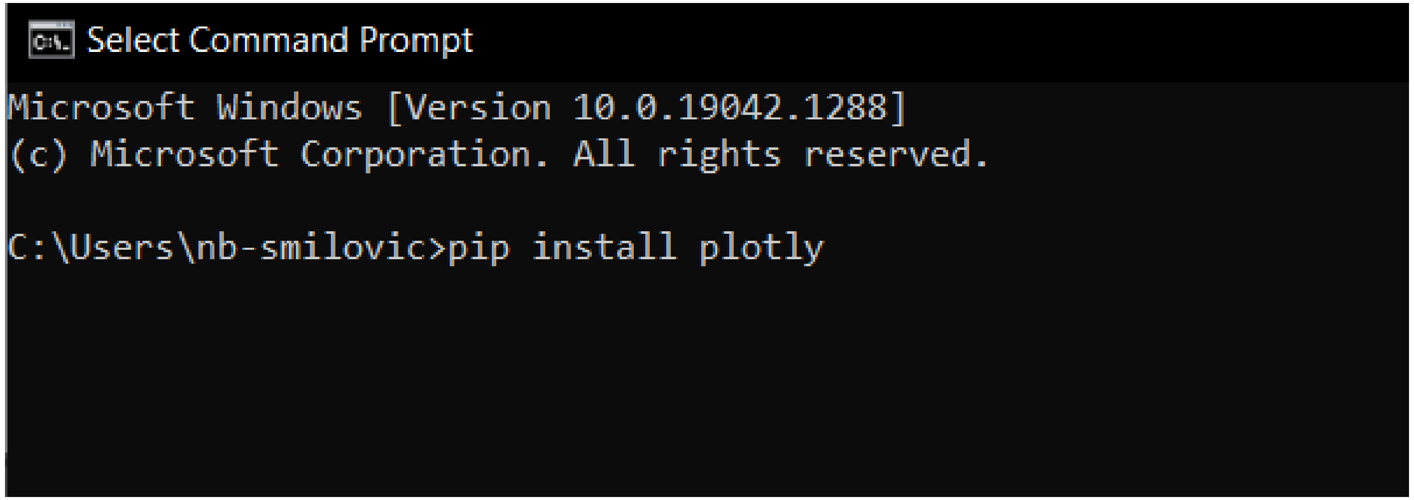
Water cycles and signatures

1. Install Jupyter notebooks and some python packages
2. Open and execute WaterCycles.ipynb using Jupyter notebook
3. Play CWatM with specific outputs and for your coordinates
4. Execute WaterCycles.ipynb, updating the outputs path and basin outlet coordiantes

1. Install four python packages

In a command prompt terminal, type the following commands followed by the enter button (or however you may be familiar with installing packages)

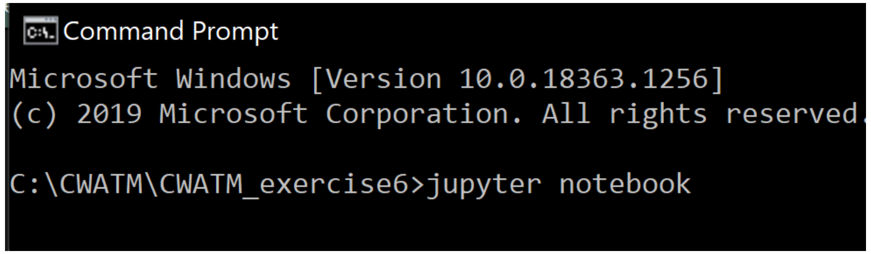
- pip install plotly [enter]
- pip install pandas [enter]
- pip install matplotlib [enter]
- pip install notebook [enter]



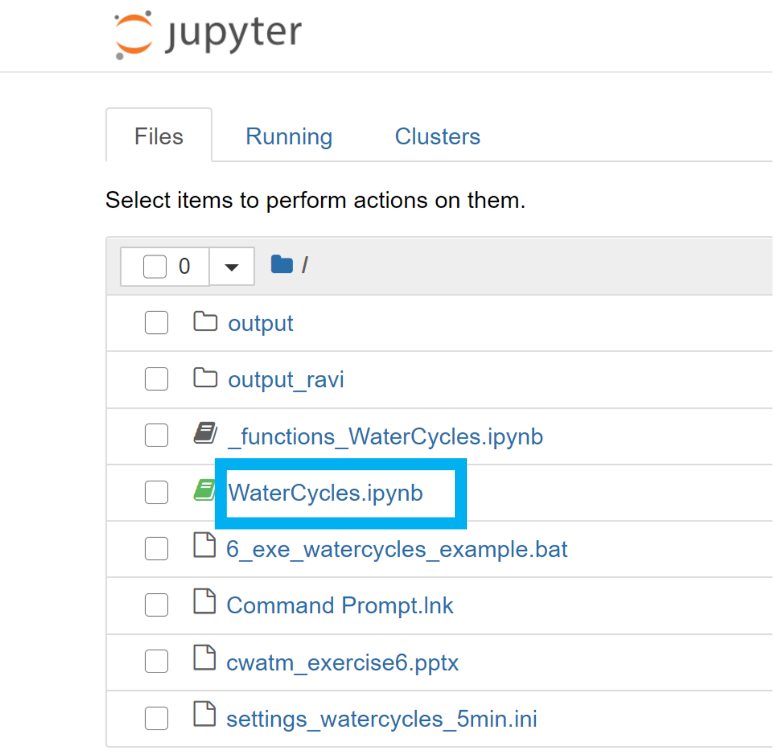
2. WaterCycles.ipynb

1. Open up the terminal within the Exercise 6 folder and type

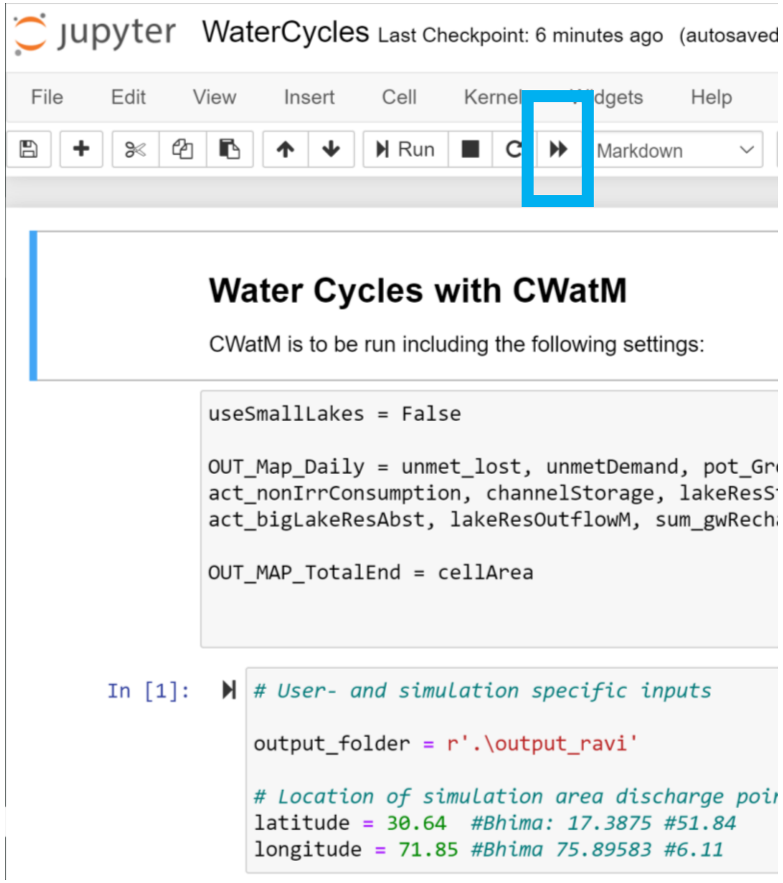
```
jupyter notebook
```



2. Click WaterCycles.ipynb

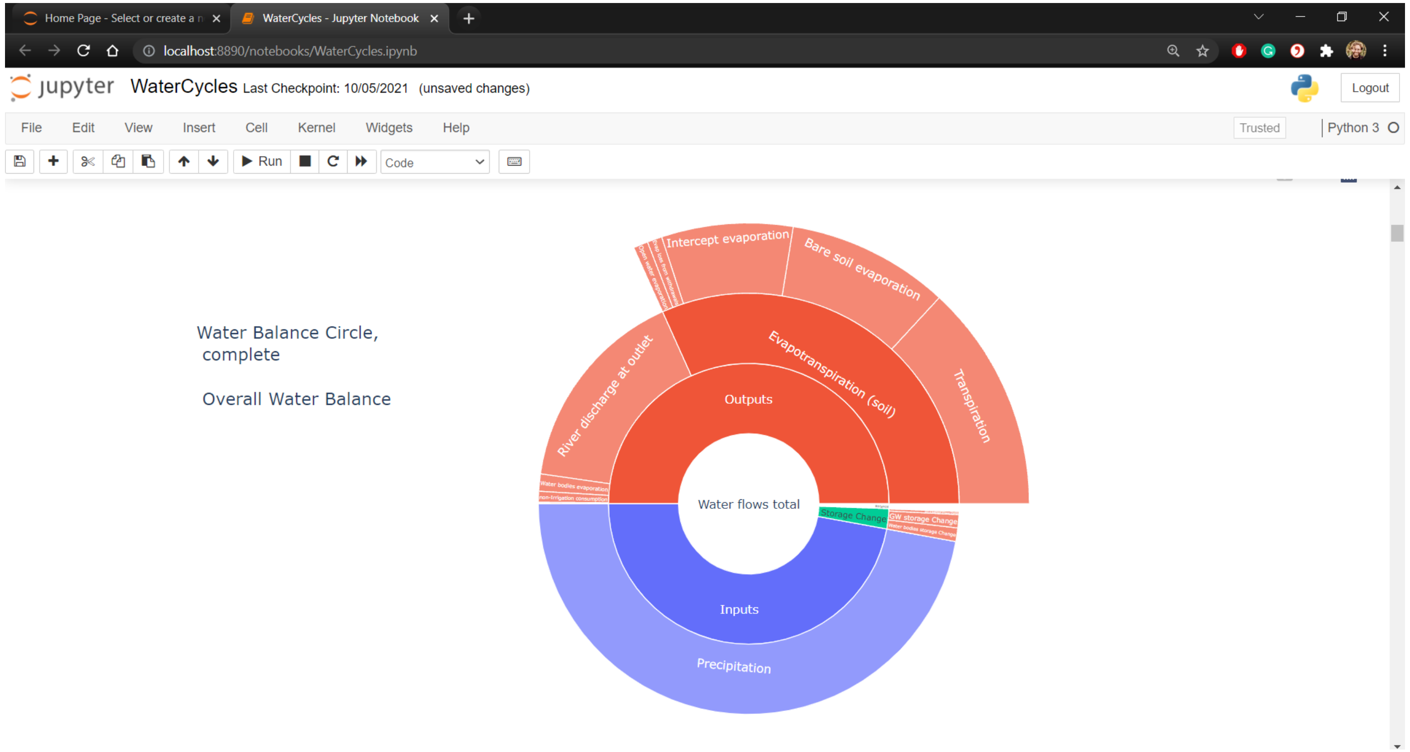


3. Execute the notebook



If the notebook has executed successfully, scroll down to see the collection of water cycles and signatures for an example basin.

Now to create these with your simulation data.



3. Play CWatM with these settings

Play CWatM with a familiar settings file, updated with the following settings:

```
MaskMap = Longitude Latitude (basin outlet)

Gauges = Longitude Latitude (basin outlet)

PathOut = ./output

useSmallLakes = False

limitAbstraction = False

OUT_Map_Daily = snowEvap, Rain, Snow, actTransTotal_forest,
actTransTotal_grasslands, actTransTotal_paddy,
actTransTotal_nonpaddy, unmet_lost, unmetDemand,
pot_GroundwaterAbstract, discharge, storGroundwater,
nonFossilGroundwaterAbs, Precipitation, totalET, EvapoChannel,
EvapWaterBodyM, act_nonIrrConsumption, channelStorage,
lakeResStorage, totalSto, sum_actTransTotal,
sum_actBareSoilEvap, sum_interceptEvap, sum_openWaterEvap,
addtoevapotrans, lakeResInflowM, act_bigLakeResAbst,
lakeResOutflowM, sum_gwRecharge, sum_capRiseFromGW, baseflow,
act_totalIrrConsumption, sum_runoff, returnFlow,
act_SurfaceWaterAbstract

OUT_MAP_TotalEnd = cellArea
```

Alternatively, the settings file *settings_WaterCycles.ini* already has the correct settings. Simply change `MaskMap` and `Gauges` to the coordinates of the outlet of any basin of interest.

For example, for the Nile basin

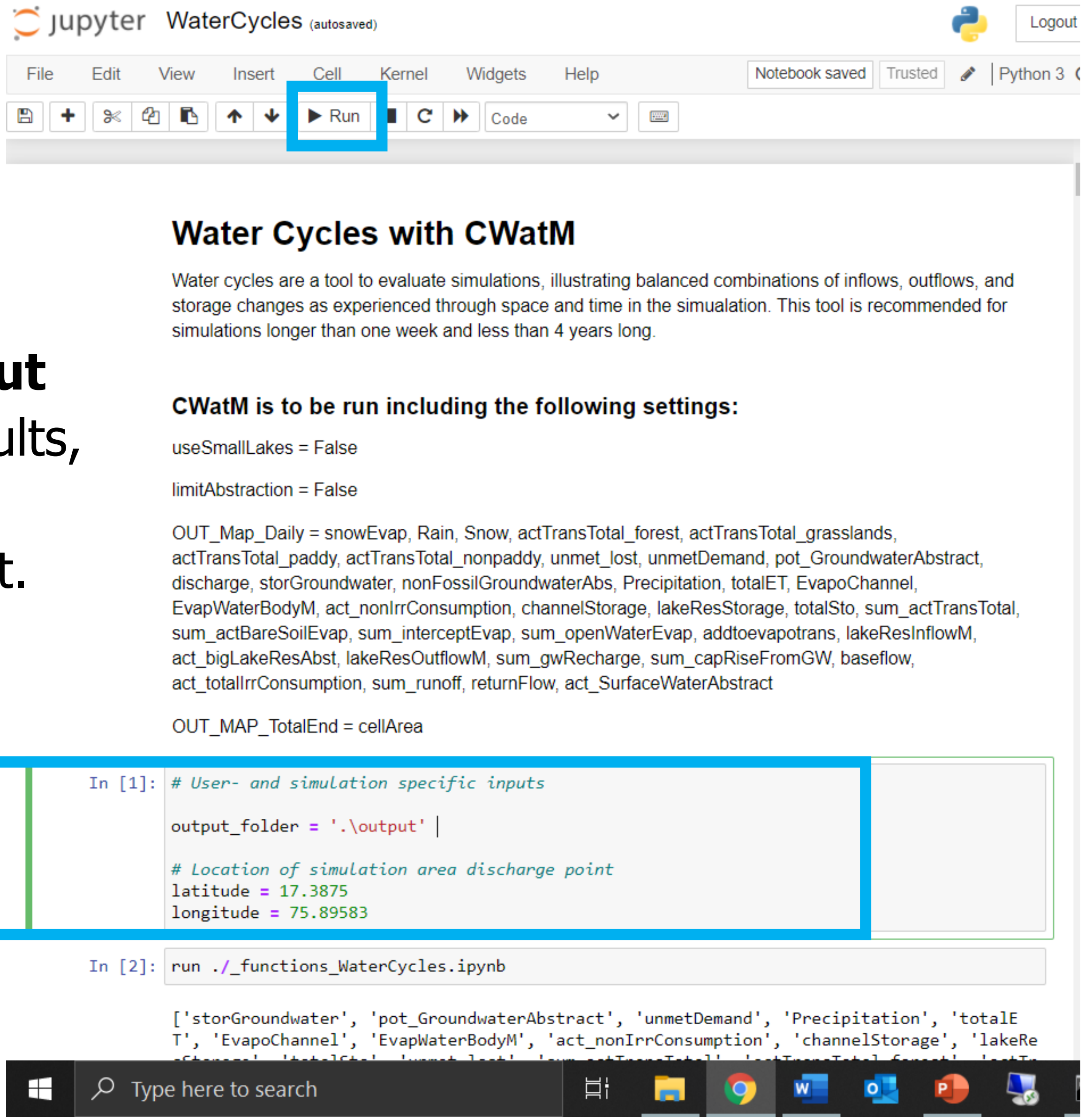
MaskMap = 30.45 31.4

Gauges = 30.45 31.4

4. WaterCycles, new basin

In the Jupyter Notebook, update the **output folder** to the folder holding simulation results, and update the latitude and longitude **coordinates** to the associated basin outlet. Then, execute the Notebook.

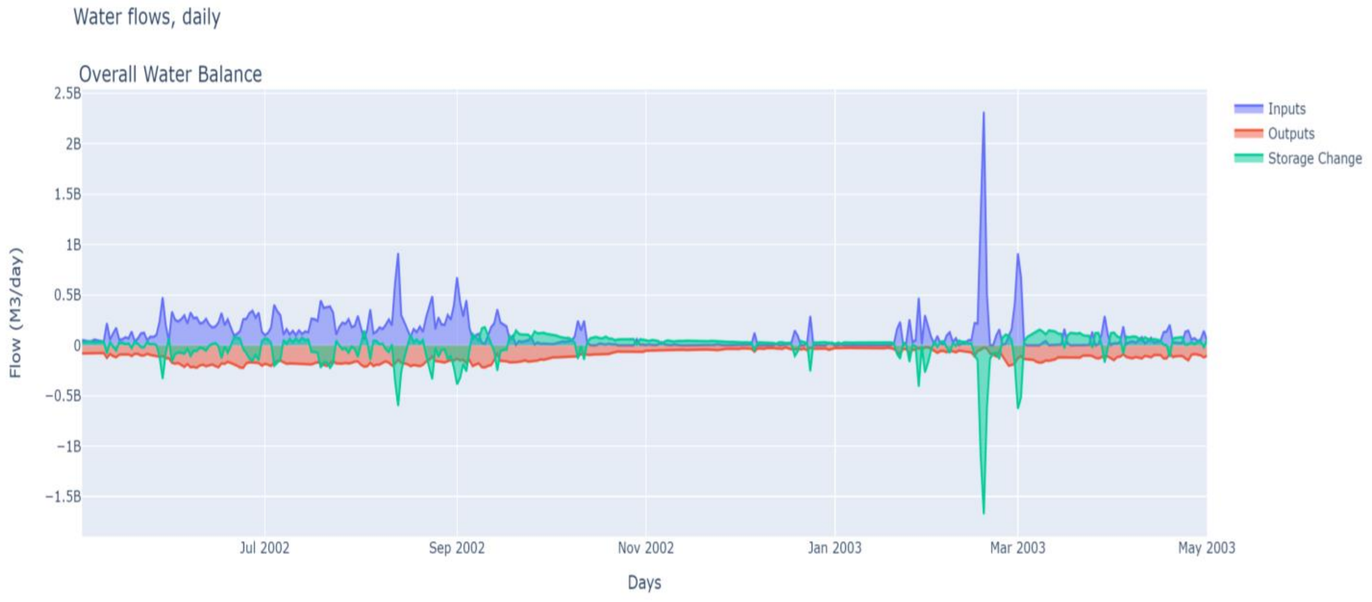
Update output folder and coordinates

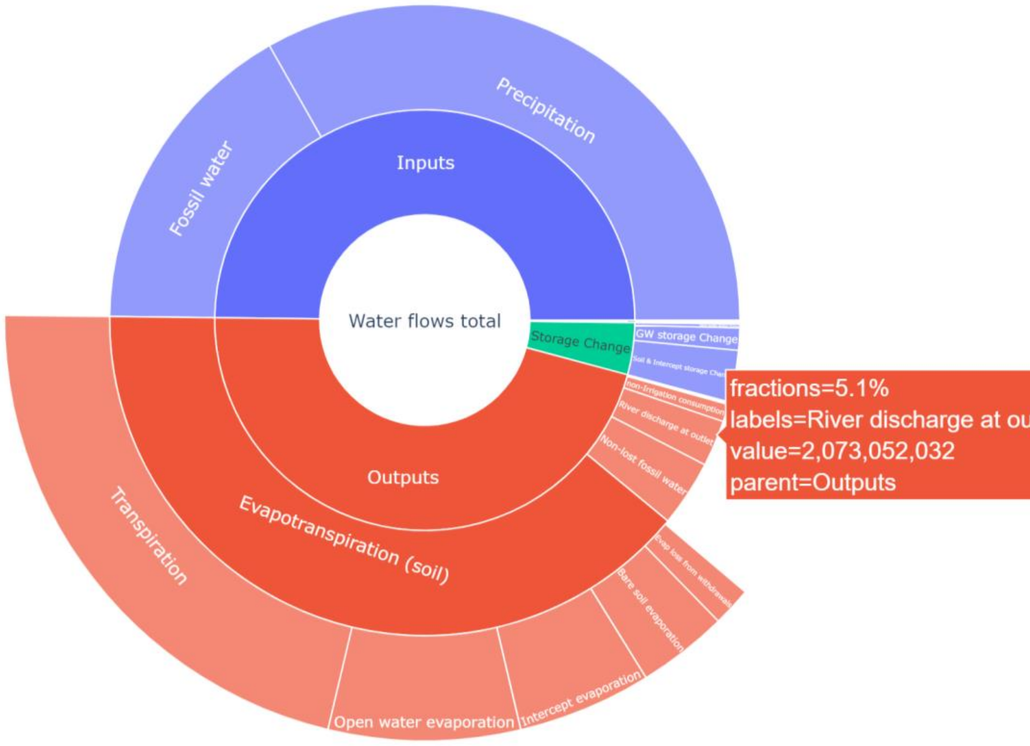


Ravi subbasin

MaskMap = 71.85 30.64 (long lat)

Gauges = 71.85 30.64 (long lat)



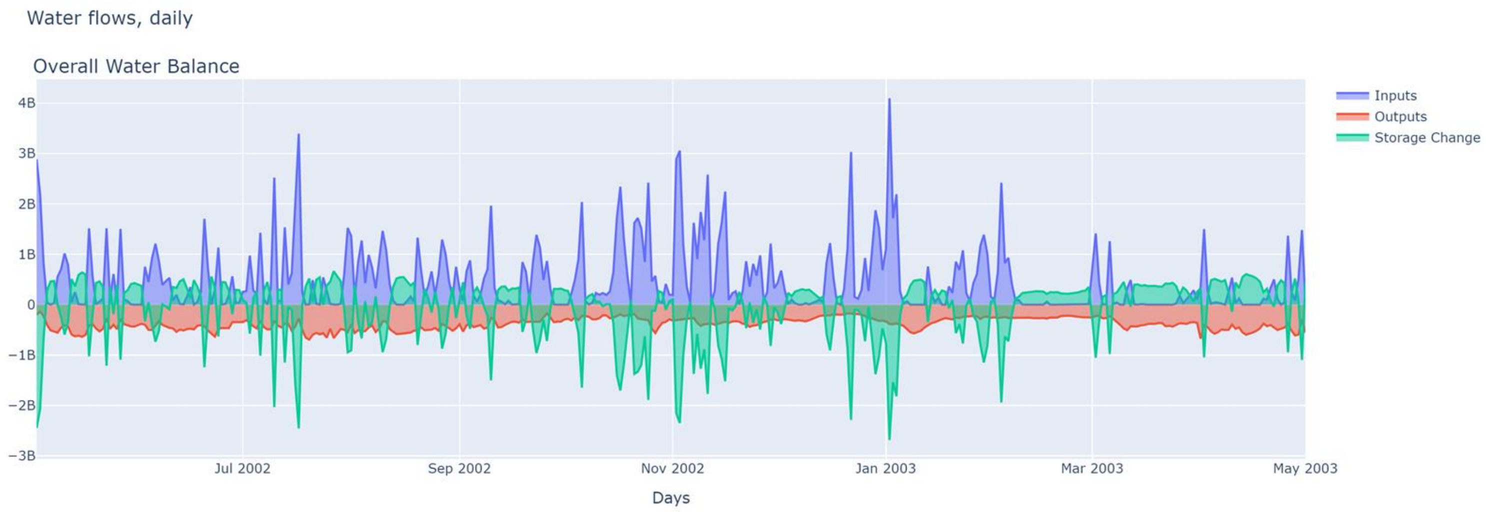


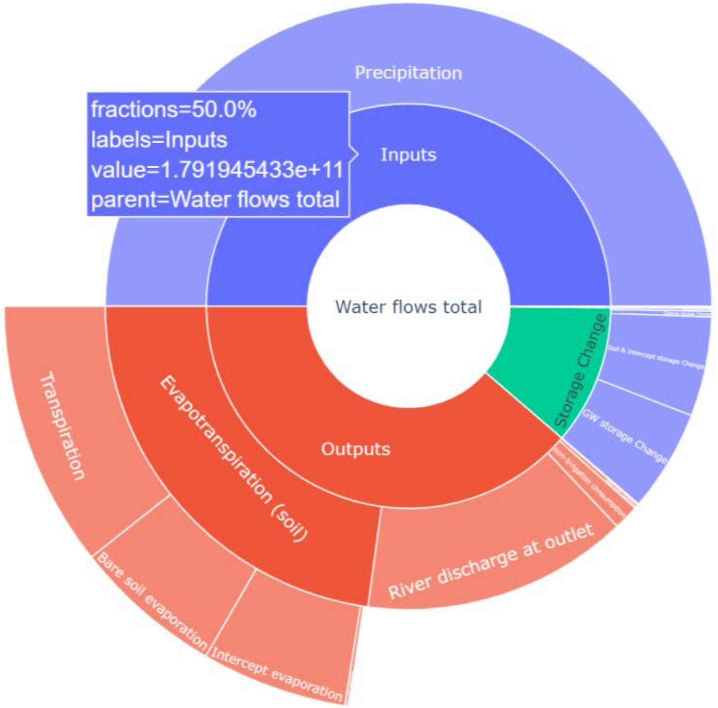
StepStart = 01/04/2002
SpinUp = 01/05/2002
StepEnd = 01/05/2003

Rhine basin

MaskMap = 6.11 51.84

Gauges = 6.11 51.84



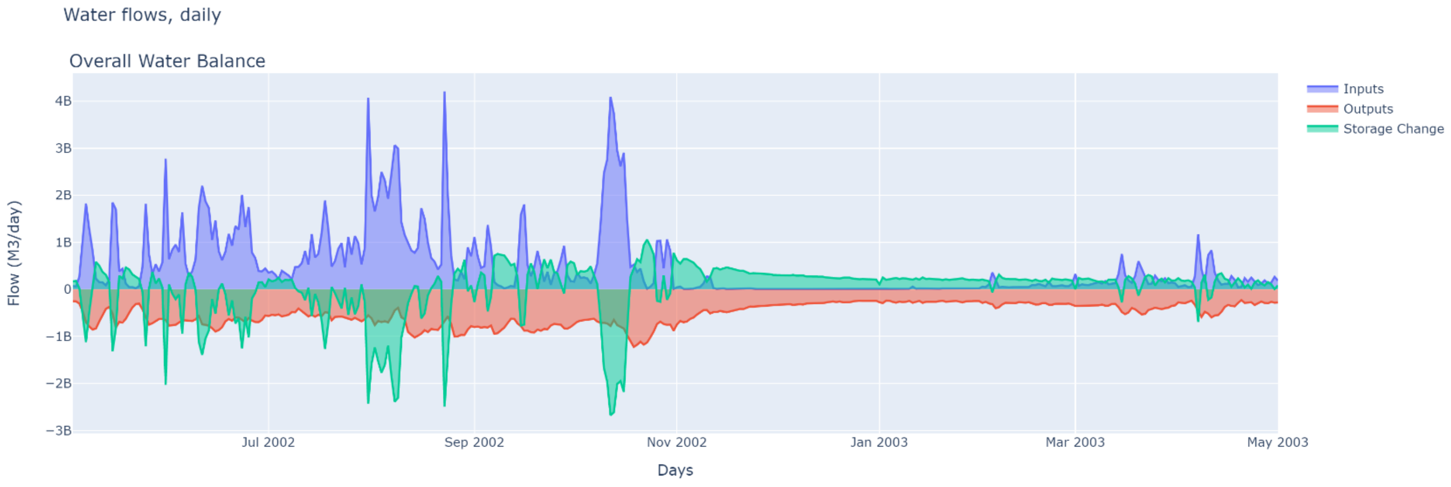


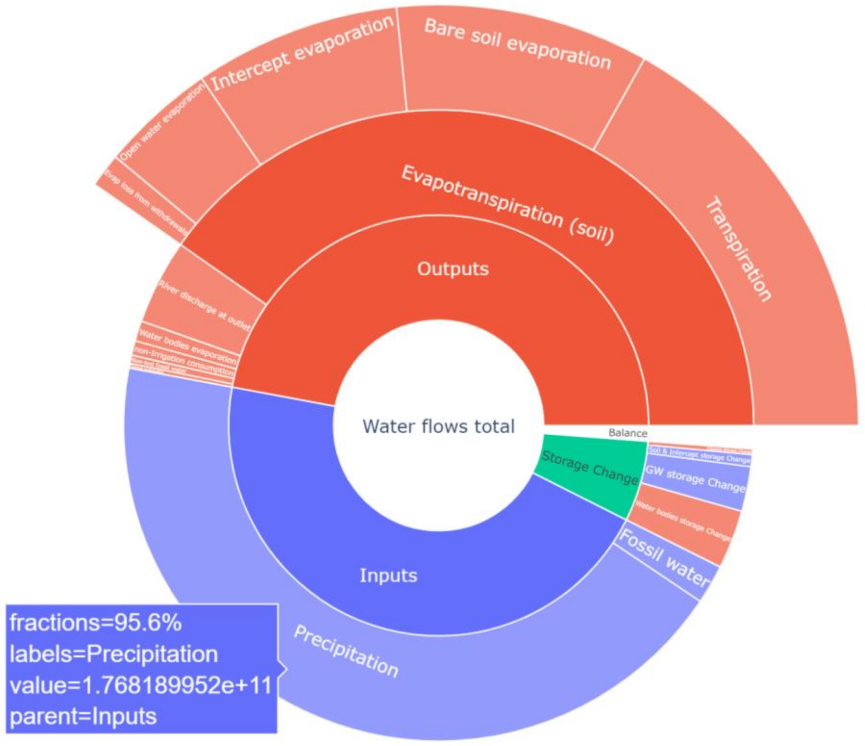
StepStart = 01/04/2002
SpinUp = 01/05/2002
StepEnd = 01/05/2003

Krishna basin

MaskMap = 80.875 15.875

Gauges = 80.875 15.875



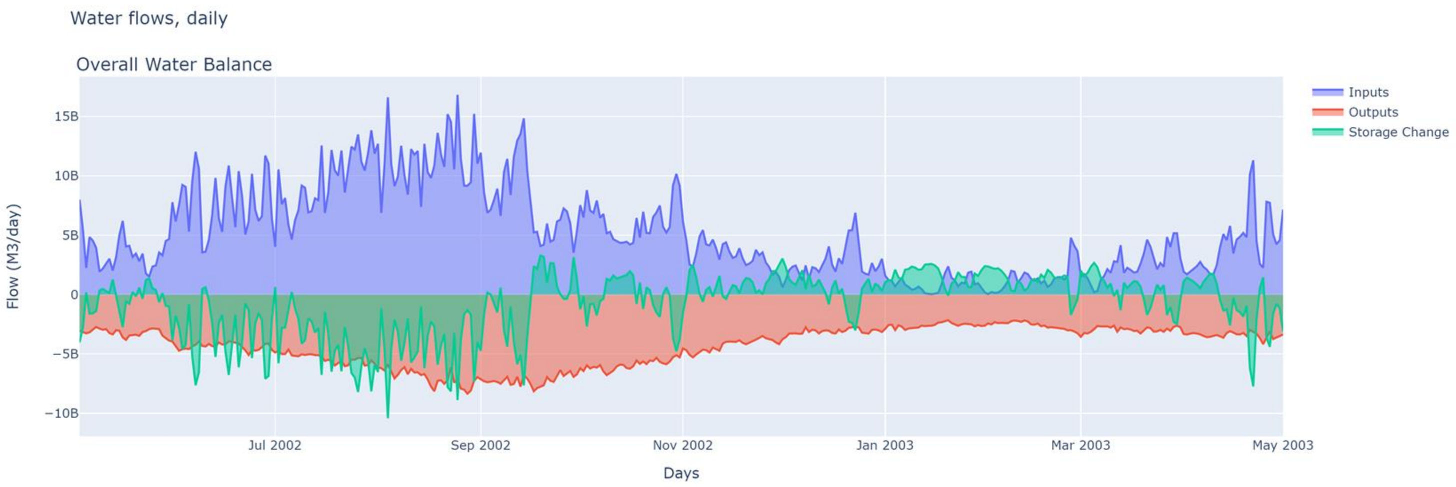


StepStart = 01/04/2002
SpinUp = 01/05/2002
StepEnd = 01/05/2003

Nile basin

MaskMap = 30.45 31.4

Gauges = 30.45 31.4



StepStart = 01/04/2002
SpinUp = 01/05/2002
StepEnd = 01/05/2003