International Institute for Applied Systems Analysis
IIASA www.iiasa.ac.at

Hands on CWatM

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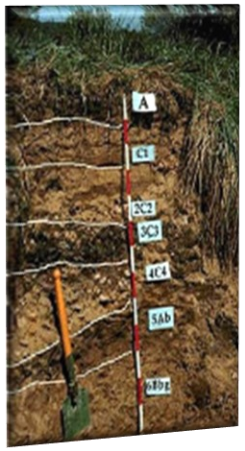
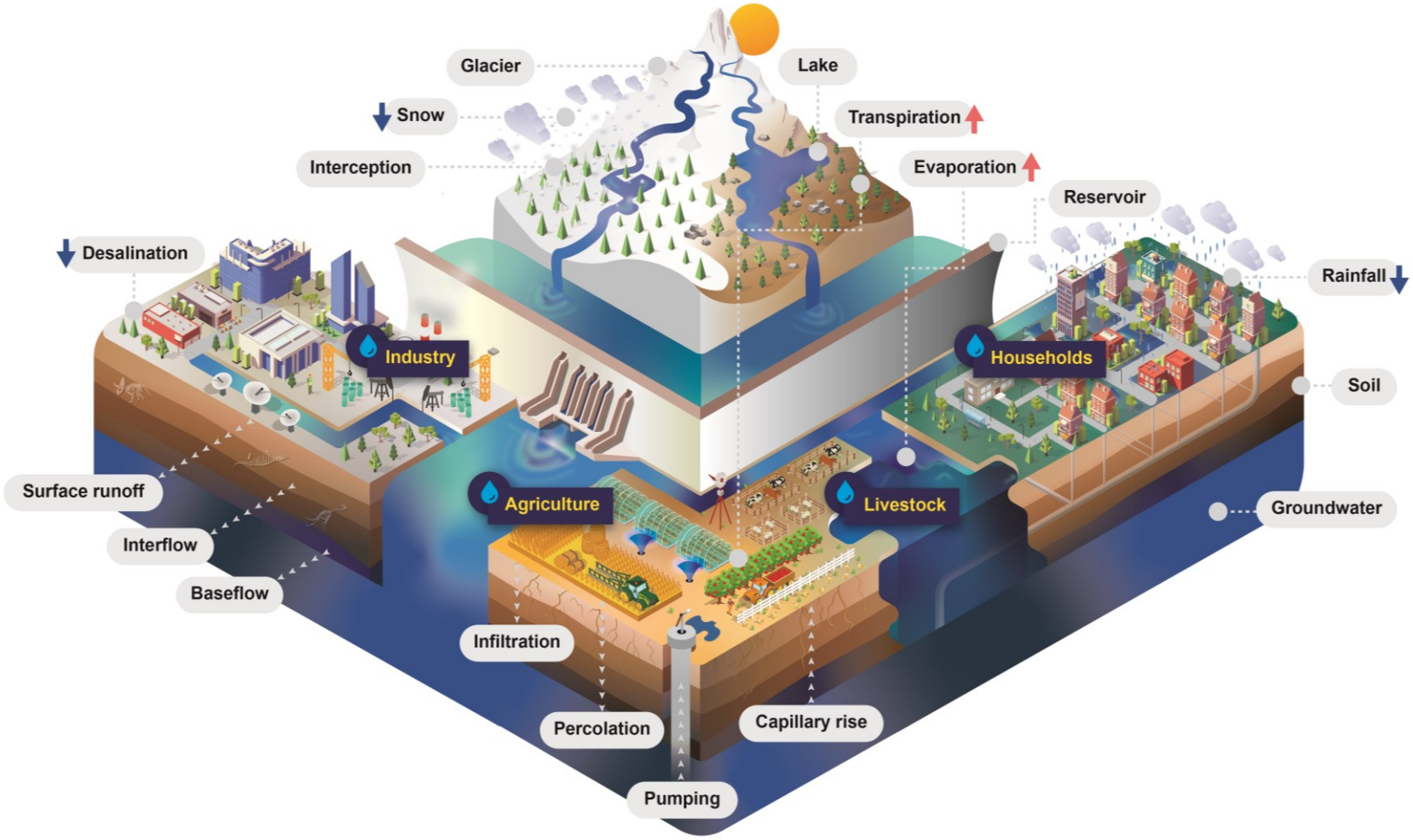
Research Scholars at
Water Program
15th Oct 2020





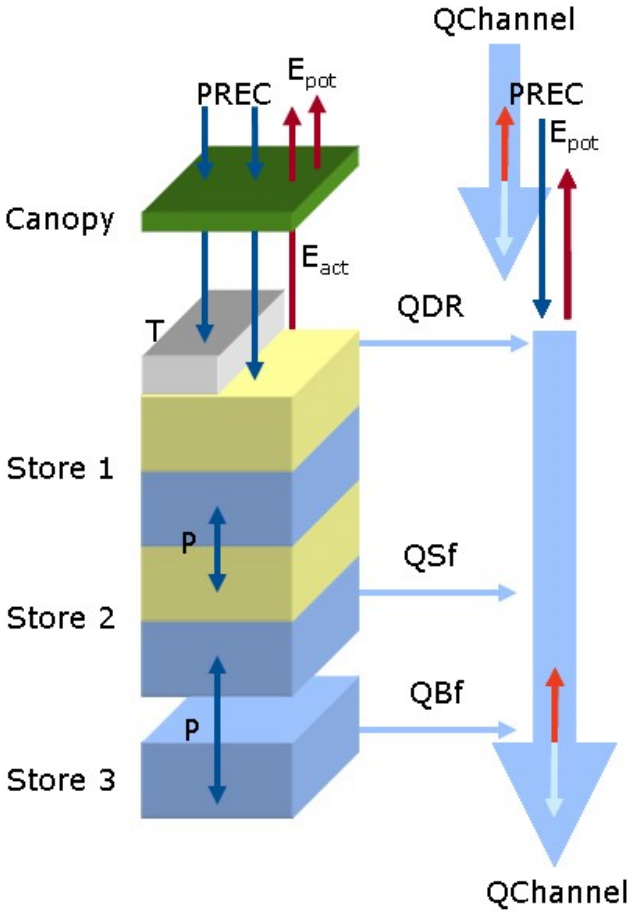
Community Water Model (CWatM)



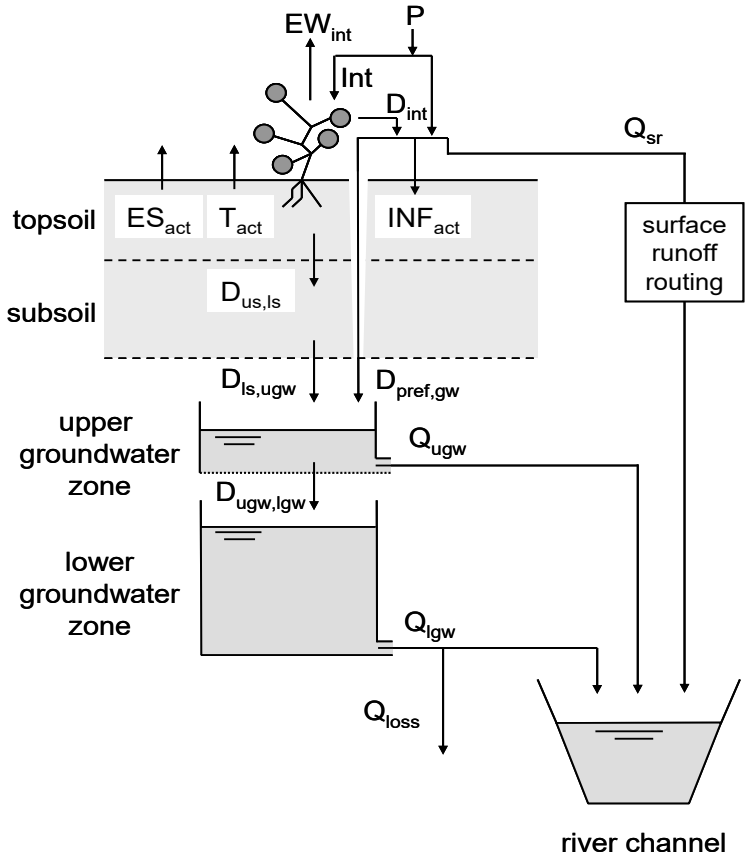


http://www.iiasa.ac.at/cwatm
https://cwatm.iiasa.ac.at/

IIASA Community Water Model



PCR-GLOBWB

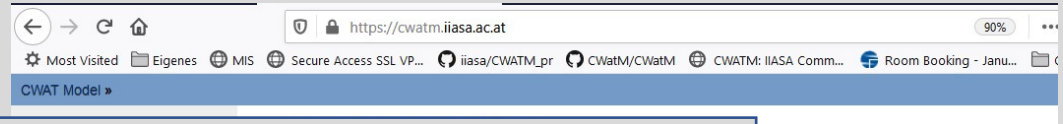


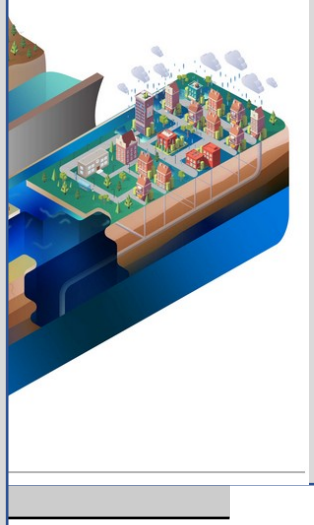
LISFLOOD

Commu

Community Model on the web

https://cwatm.iiasa.ac.at/





Open source on Github

https://github.com/CWatM/CWatM

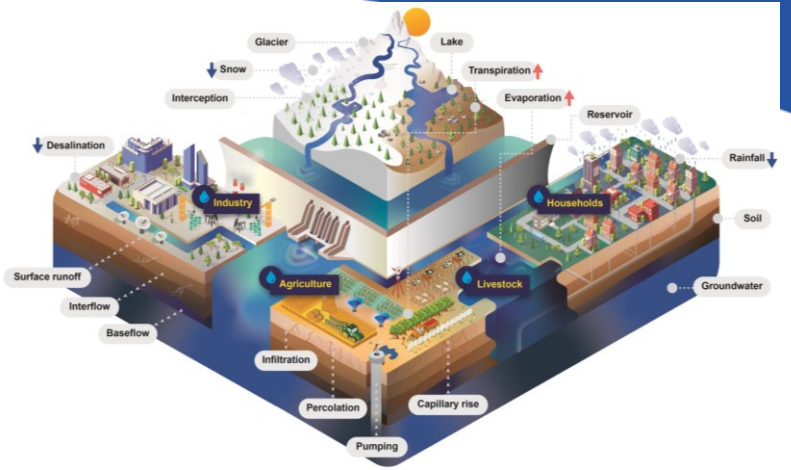
Community Water Model

Feature	Description
Flexible	different resolution, different processes for different needs, links to other models, across sectors and across scales
Adjustable	to be tailored to the needs at IIASA i.e. collaboration with other programs/models, including solutions and option as part of the model
Multi-disciplinary	including economics, environmental needs, social science perspectives etc.
Sensitive	Sensitive to the option / solution
Fast	Global to regional modeling – a mixture between conceptional and physical modeling – as complex as necessary but not more
Comparable and exchangeable	Planned to be part of the ISI-MIP community, part of capacity development

Modules in CwatM

Cwatm_init

...



Cwatm_dynamic

readmeteo_module
↓
evaporatePot_module
↓
inflow_module
↓
lakes_reservoirs_module
↓
snowfrost_module

→ **landcoverType**_module

evaporation_module
interception_module
waterdemand_module
soil_module
- actTrans
- dirctRunoff
- interflow
- gwRecharge

sealed_water_module

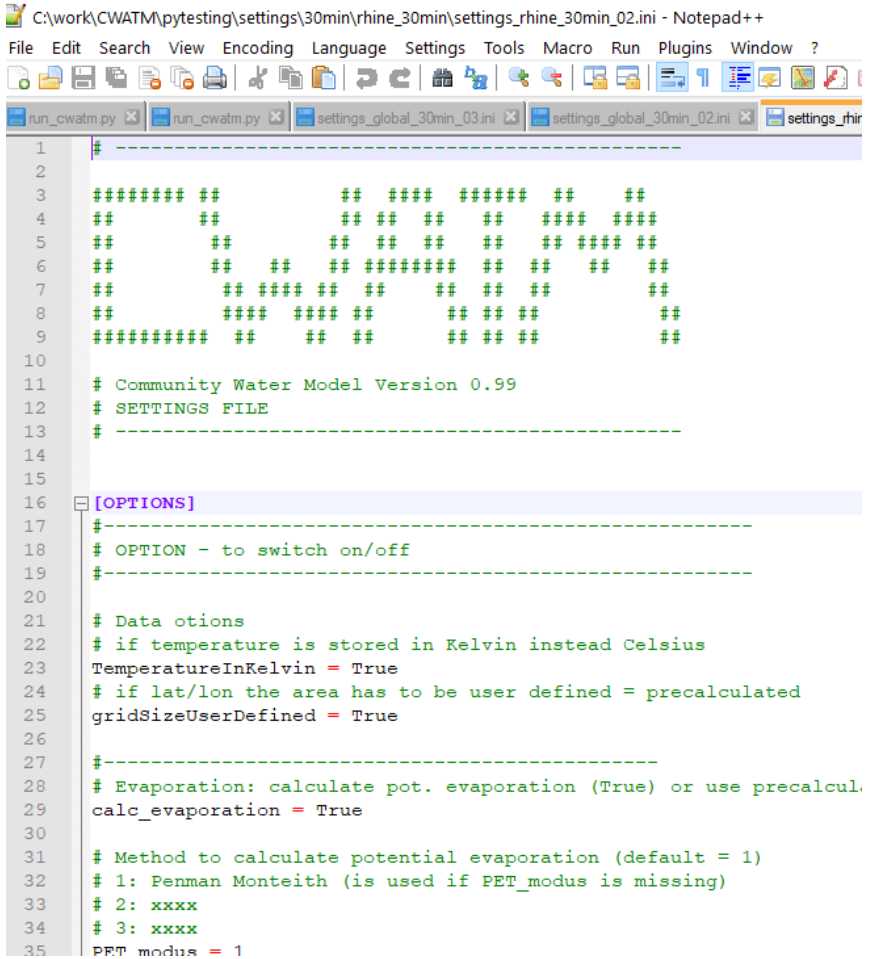
→ **groundwater**_module
↓
runoff_concentration
↓
lakes_res_small_module
↓
routing_kinematic_module
↓
environmentalflow
↓
output_module

Installation of software 1

Texteditor

CWatM information (settingsfile) is stored in a text file, which can be read by Windows notepad.
But we strongly recommend a better text editor!
You can use any text editor you are familar with.

In case you do not have a texteditor
Install notepad++ in the Dropbox folder cwatm_exercise1/tools
or from
https://notepad-plus-plus.org

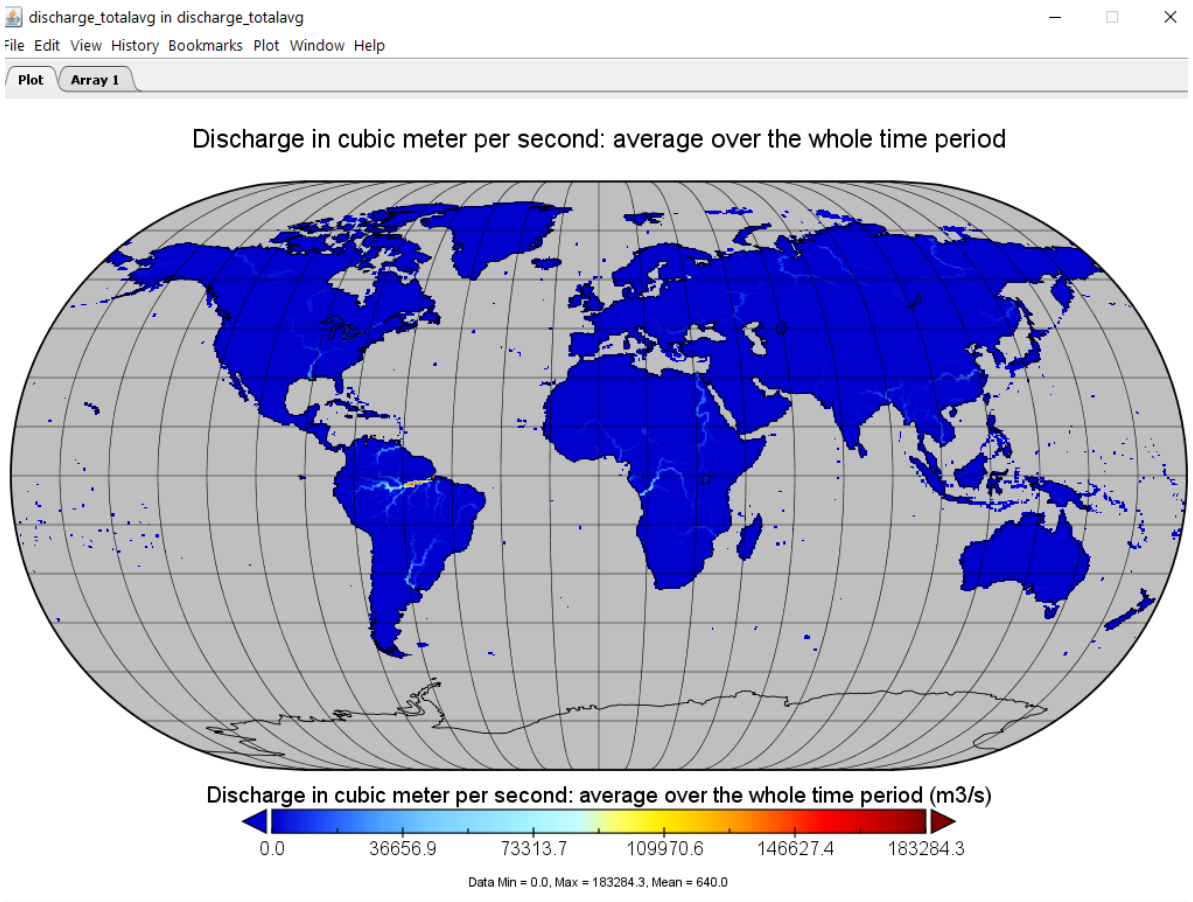


Installation of software 2

Texteditor
CWatM data and output can be quite large
Therefore we store our data as compressed as possible as netCDF files
NetCDF is a nice format but not so easy to handle as this is mostly used by meteorologist on there Linux systems

To view input and output data on Windows you can use the Panoply netCDF viewer

Install panoply from the Dropbox
in the folder cwatm_exercise1/tools
or from:
https://www.giss.nasa.gov/tools/panoply/



Installation of software 3

CWatM GitHub

Our software is open source.
We use a public repository to store our software – Github
https://github.com/CWatM/
As CWatM is a living software, we add thing, change things, remove bugs
And we put our changes alive on GitHub

This workshop gives a short introduction into GitHub
Therefore it would be good if you:
- subscribed to a GitHub account
- install GitHub Desktop (https://desktop.github.com/)

https://github.com/
https://docs.github.com/en/free-pro-team@latest/github/getting-started-with-g
https://www.wikihow.com/Create-an-Account-on-GitHub

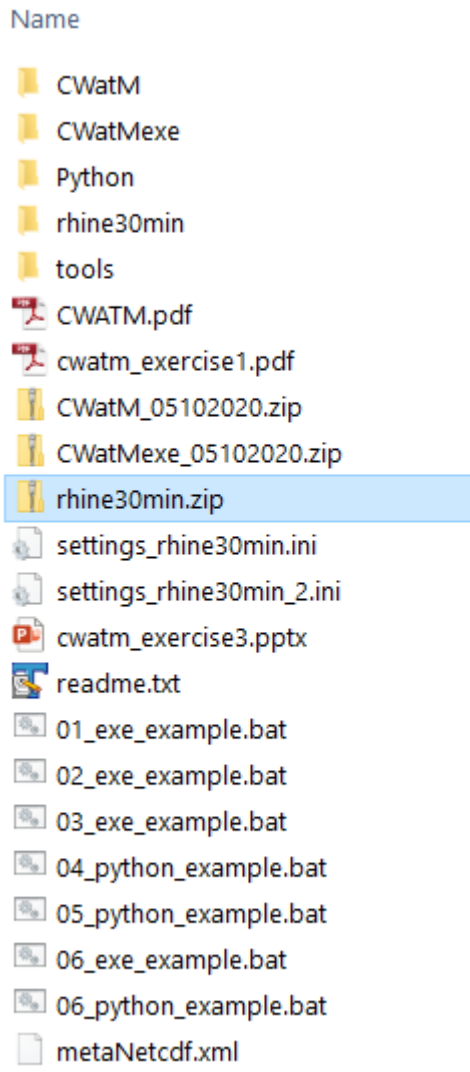
Installation of software 5

CWatM + Exercises

Please download all the files in:
https://www.dropbox.com/sh/gvzg2ucbybkf0q1/AAANxK-JfH6IrWqh2FsM33UTa?dl=0

And unzip the three zipped folders:
- CWatM_05102020.zip (CWatM Python version)
- CWatMexe_05102020.zip (CWatM executable version)
- rhine30min.zip (test catchment and data)

With:
Extract here
The folder structure should look likes this
(You need some diskspace – the whole folder structure needs around 2GB)



Hands on CWatM

1. Running CWatM for the first time
2. Run CWatM with a settings file
3. Test the options –l , -t
4. Take a look at the settings file
5. Take a look at the dataset
6. Have a look at the documentation https://cwatm.iiasa.ac.at/
7. Have a look at github https://github.com/CWatM/CWatM
8. Installing Python, libraries and CWatM

Hands on CWatM

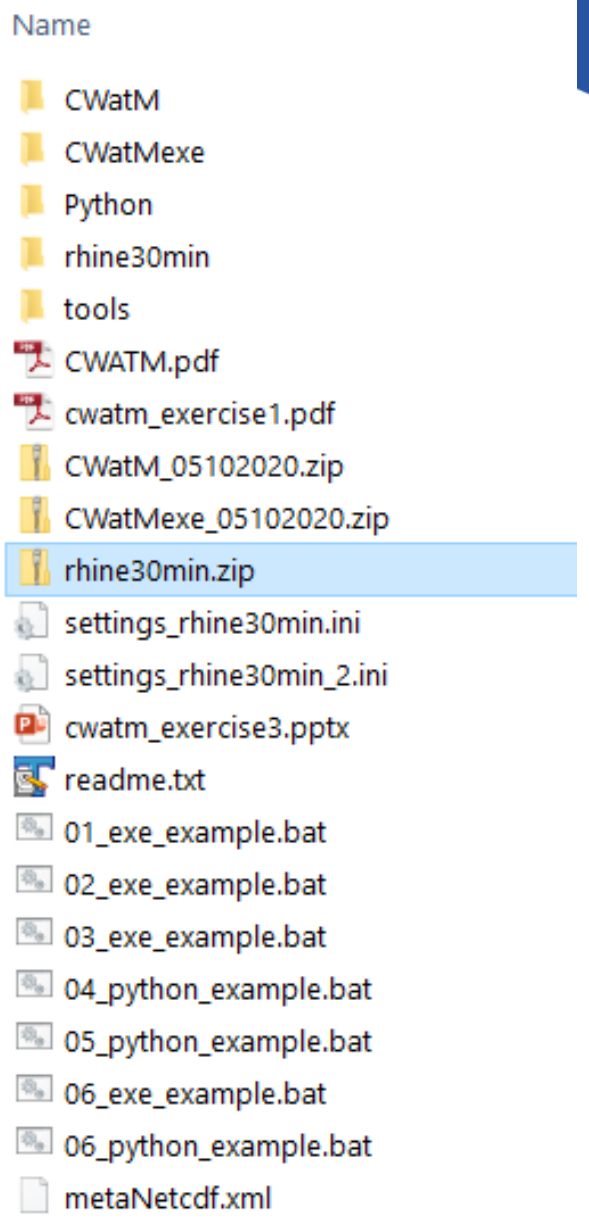
1. Running CWatM for the first time

- Go to folder CWATM_exercise1
- Look into directory rhine30min
- Start: 01_exe_example.bat

```
F:\CWATM_exercise2\rhine30min>..\CWatMexe\cwatmexe\cwatm.exe
CWatM - Community Water Model
Authors:  WATER Program, IIASA
Version:  Version: 1.04
Date:  06/08/2019
Status:  Development

       Arguments list:
       settings.ini     settings file

       -q --quiet       output progression given as .
       -v --veryquiet   no output progression is given
       -l --loud        output progression given as time step, date and discharge
       -c --check       input maps and stack maps are checked, output for each input map BUT no model run
       -h --noheader    .tss file have no header and start immediately with the time series
       -t --printtime   the computation time for hydrological modules are printed
       -w --warranty    copyright and warranty information
```



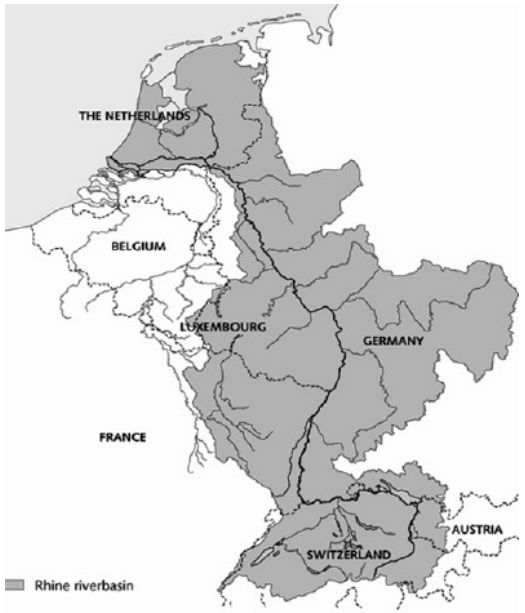
Hands on CWatM

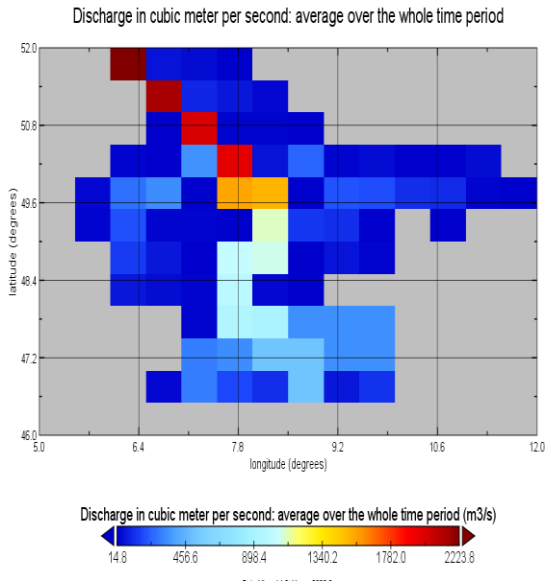
2. Run CWatM with a settings file

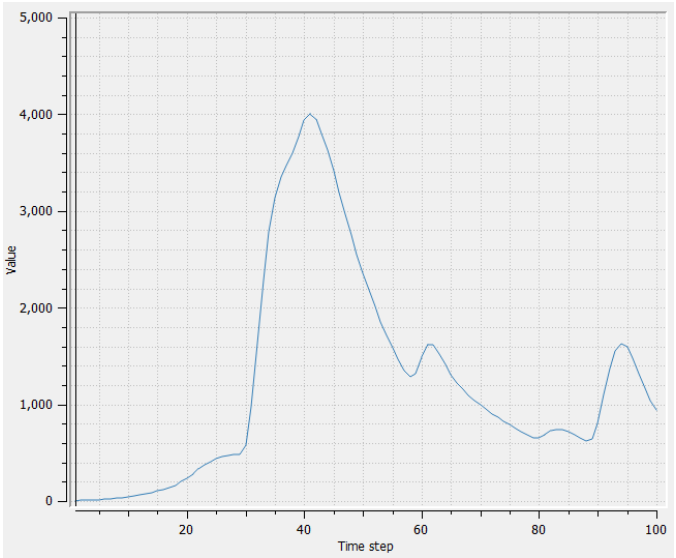
- Start 02_exercise.bat

  ..\CWatMexe\cwatmexe\cwatm.exe settings_rhine30min.ini –l

- Use a text editor e.g. notepad, textpad, notepad++
- Look at rhine30min\output\discharge_daily.tss







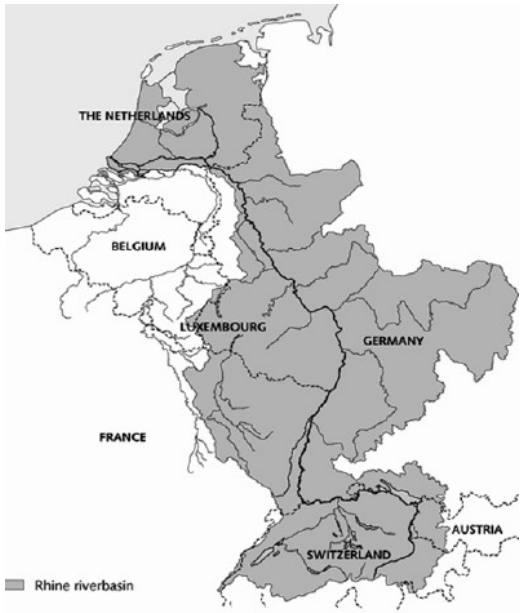
Hands on CWatM

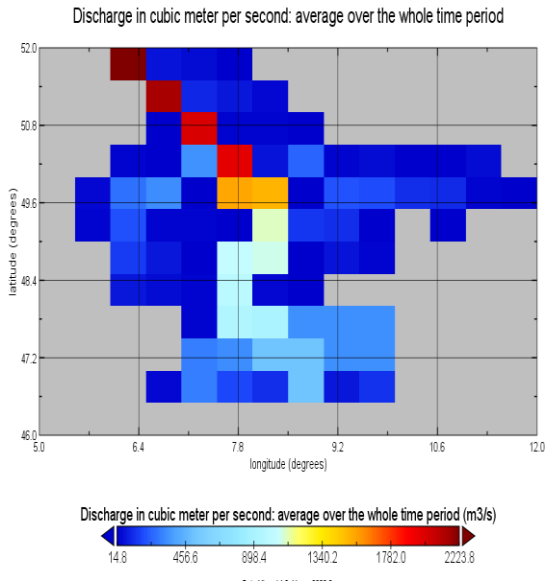
3. Run CWatM with a settings file

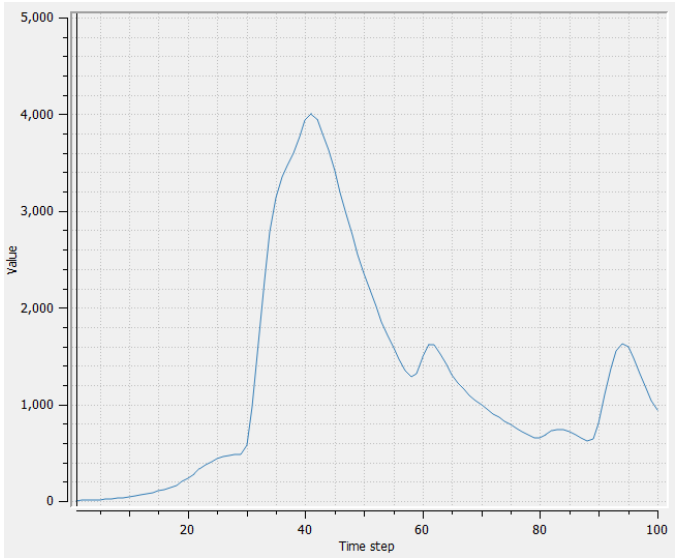
- Start 03_exercise.bat

  ..\CWatMexe\cwatmexe\cwatm.exe settings_rhine30min.ini –l -t

- Use a text editor e.g. notepad, textpad, notepad++ to change 03_exercise.bat



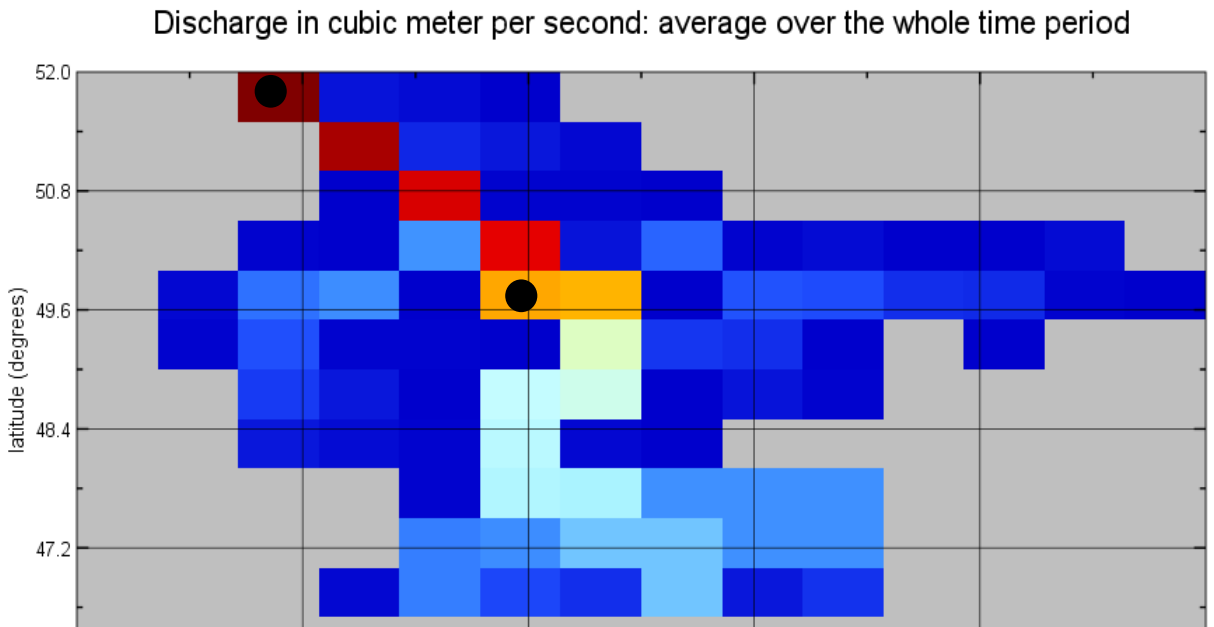


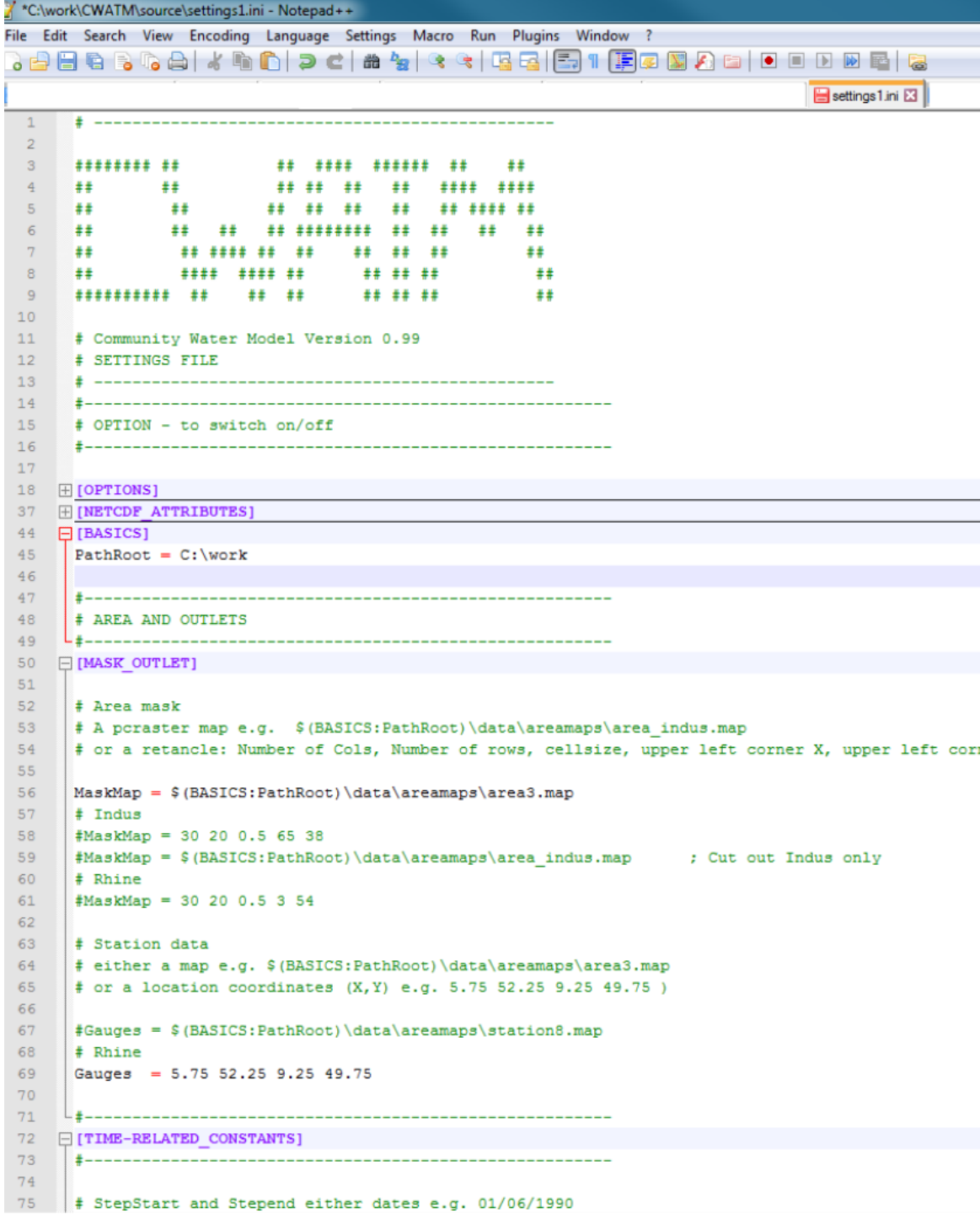


Exercise 3: Hands on CWatM

4. Take a look at the settings file

- Change settings_rhine30min.ini with a text editor
- Look for gauges in settings_rhine30min.ini
- Change it to Gauges = 6.25 51.75 7.75 49.75
- Change StepEnd = 100
- Start 02_exercise.bat



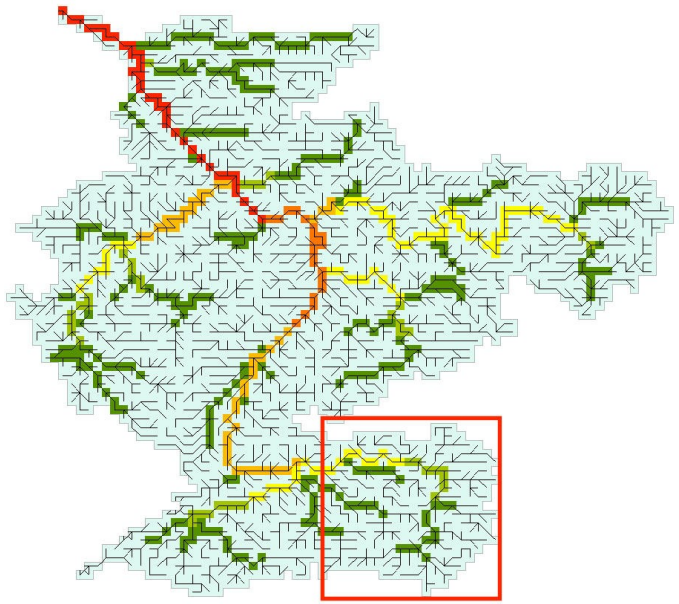


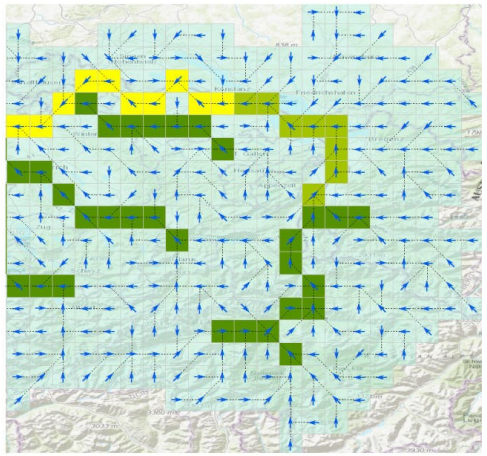
Exercise 3: Hands on CWatM

5. Take a look at dataset

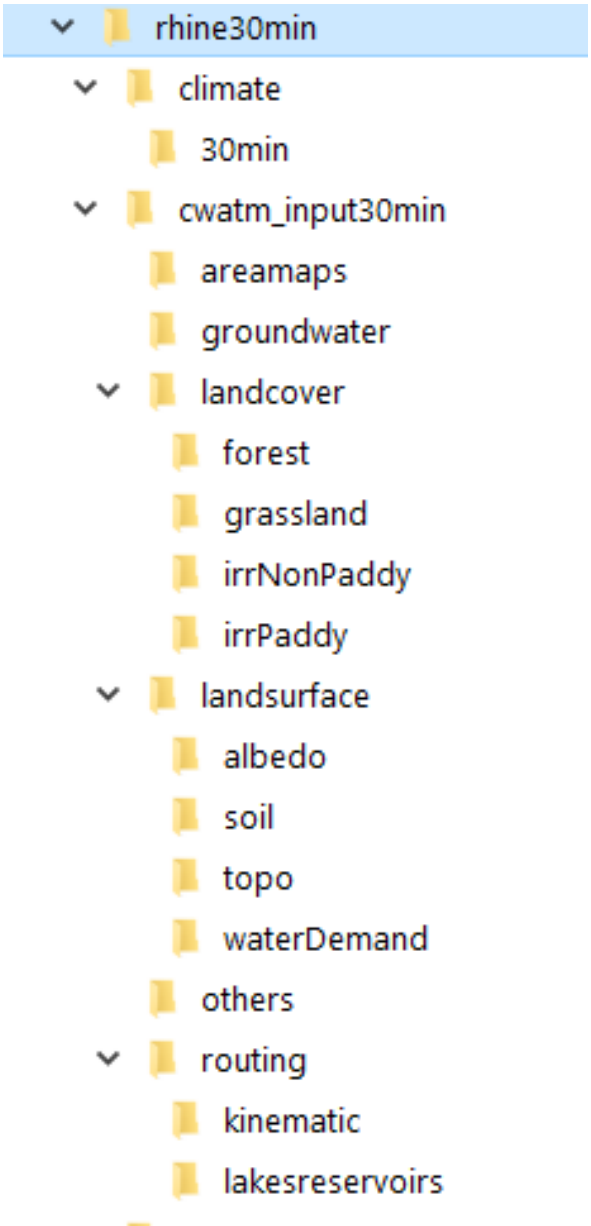
- Take a look at folder rhine30min
- Take a look at:

  https://cwatm.iiasa.ac.at/data.html





River network at 5 arcmin for the Rhine basin



Exercise 3: Hands on CWatM

6. Have a look at the documentation

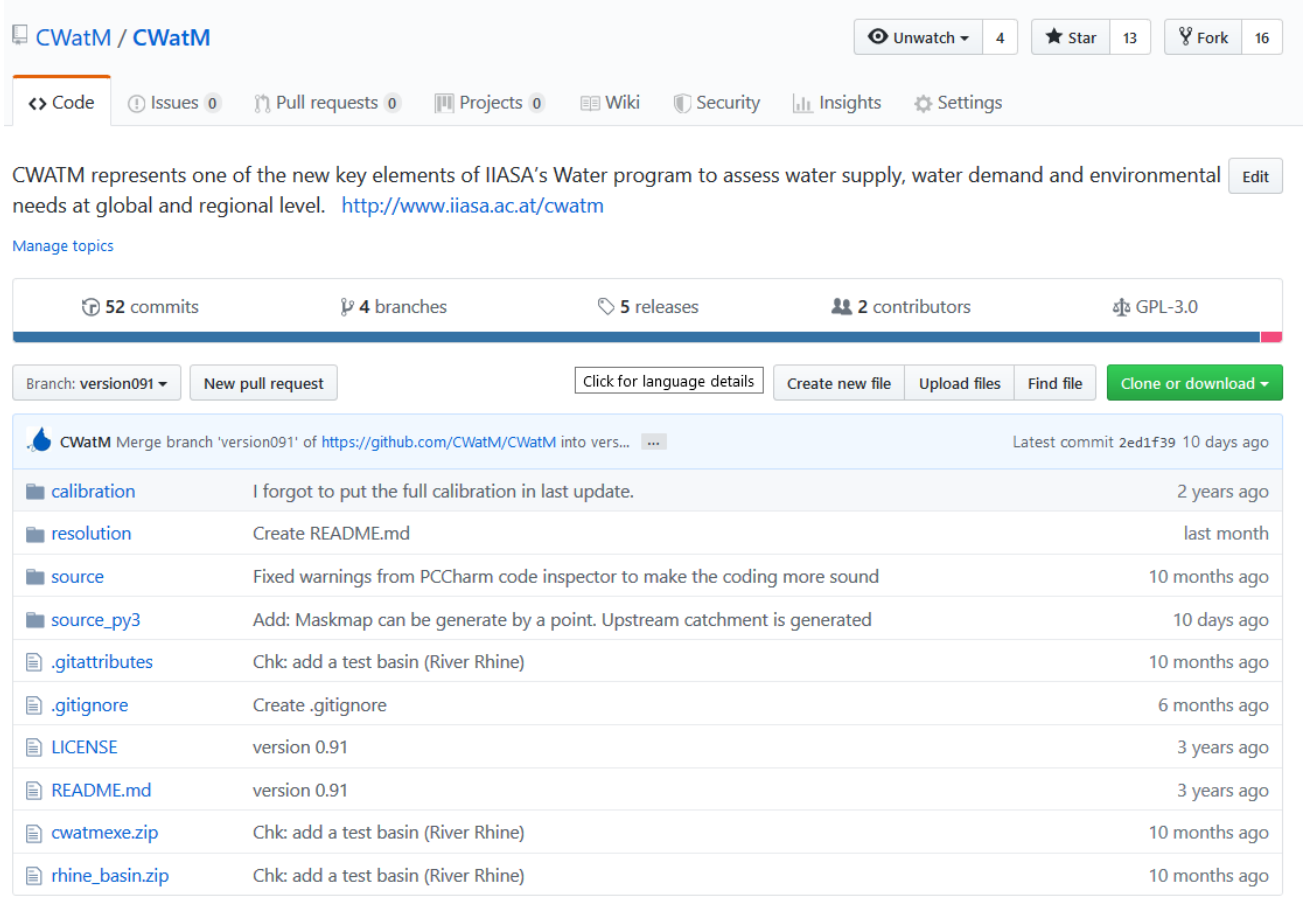
   https://cwatm.iiasa.ac.at/

Hands on CWatM

7. Have a look at github

https://github.com/CWatM/CWatM

- Modular structure of CWatM
- Subversion system



Installation of software 4a

CWatM Python

Our software is mainly programed as Python3.x source code

- One of the easiest programming language
- The source code is freely available: https://cwatm.iiasa.ac.at/sourcecode.html
- The way to contribute to CWatM is to get familar with Python

Here we give NO Python course, as CWatM also runs without any programming skills!

But we strongly recommend to install Python (Version 3.7 or 3.8 as 64 bit) and the necessary libraries to be up to date with our newest versions on GitHub

In case you are not able to install Python + libraries we also provide a Windows executable

Installation of software 4b

CWatM Python

Python 3.8 64 bit you can find:
On our Dropbox: CWATM_exercise1/Python/python-3.8.6-amd64.exe
Or on:
https://www.python.org/downloads/release/python-386/
(we know that Python 3.9 is out now, but we did not test it!)

You can use also Anaconda Python.

To run CWatM you need also some libraries
We have limited the use of libraries to a minimum but those one you need:

- Numpy
- Scipy
- netCDF4
- GDAL

Please read: https://cwatm.iiasa.ac.at/setup.htm

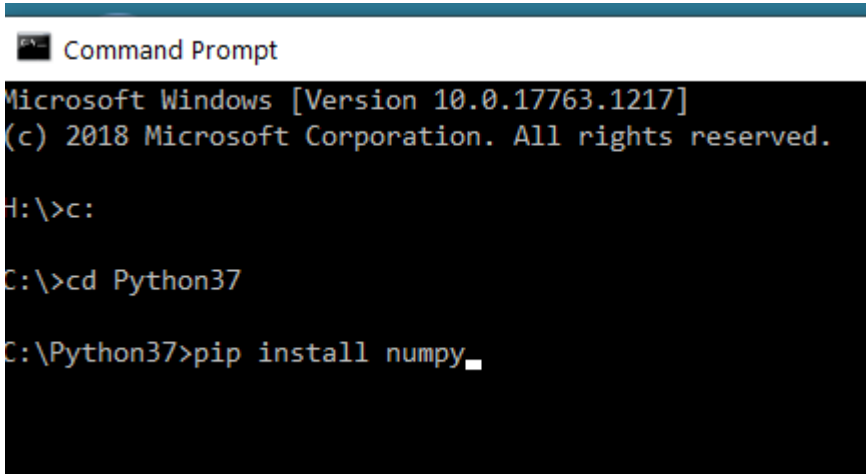
Installation of software 4c

CWatM Python libraries

Please read: https://cwatm.iiasa.ac.at/setup.htm
We provide some libraries on (not numpy because it is to big):
CWATM_exercise1/Python/

But in most cased you can install them with pip (or conda if you use anaconda)
pip install numpy
pip install scipy
pip install netCDF4

In case you see some errors you can also try:
pip install your_pathto/ netCDF4-1.5.4-cp38-cp38-win_amd64.whl



Installation of software 4d

CWatM Python libraries

Troublemaker GDAL library

In most cases
Pip install GDAL will not work!

We provide the GDAL library for Python 3.8 in CWATM_exercise1/Python/
GDAL-3.1.3-cp38-cp38-win_amd64.whl
If you use another version you can download the library:
https://www.lfd.uci.edu/~gohlke/pythonlibs/#gdal

Please install

pip install your_path_to/GDAL-3.1.3-cp38-cp38-win_amd64.whl

Exercise 3: Hands on CWatM

8. Installing Python, libraries and CWatM

- Install python 3.8.5 (in folder CWATM_exercise1/python)
- Install libraries with pip (you may have to change to the python directory)
  - pip install numpy-1.17.3+mkl-cp38-cp38m-win_amd64.whl
  - Pip install scipy-1.3.1-cp38-cp38m-win_amd64.whl
  - …
- Test python 3.8 (you may have to change to the python directory)
  - Type python

```
F:\CWATM_exercise2\rhine30min>python
Python 3.7.0 (v3.7.0:1bf9cc5093, Jun 27 2018, 04:59:51) [MSC v.1914 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> import numpy
>>> import netCDF4
>>> import scipy
>>> import gdal
>>>
```

- If an error occurs it might be handled on https://cwatm.iiasa.ac.at/tutorial.html#test-the-python-model-version

Hands on CWatM

8. Installing Python, libraries and CWatM

- Start 04_python_example.bat

  python ./CWatM/run_cwatm.py settings_rhine30min.ini –l

- Start 05_python_example.bat

  python ./CWatM/run_cwatm.py settings_rhine30min.ini –l

```
F:\CWATM_ECHO\CWATM_exercise1>python ./CWatM/run_cwatm.py
CWatM - Community Water Model
Authors:  Peter Burek, Yusuke Satoh, Peter Greve, Mikhail Smilovic, Jens de Bruijn
Version:  1.4
Date:  19/02/2020
Status:  Development

    Arguments list:
    settings.ini     settings file

    -q --quiet       output progression given as .
    -v --veryquiet   no output progression is given
    -l --loud        output progression given as time step, date and discharge
    -c --check       input maps and stack maps are checked, output for each input map BUT no model run
    -h --noheader    .tss file have no header and start immediately with the time series
    -t --printtime   the computation time for hydrological modules are printed
    -w --warranty    copyright and warranty information
```

- If an error occurs it might be handled on

  https://cwatm.iiasa.ac.at/tutorial.html#test-the-python-model-version

9. Homework

- Play around with the Rhine catchment

  change the settings file: settings_rhine30min.ini
  - Run for different times
  - Produce different outputs

- What catchment are you interested?
  - Find out the coordinates (lat/lon) of the outlet point
  - Find out coordinates of gauges
  - Send me the coordinates for next lesson

10. Outlook for next session

- Dive deeper into the settings file
- Compare simulated with observed discharge
- Set up your own catchment

“Water is a precious resource, crucial to realizing the sustainable development goals, which at their heart aim to eradicate poverty.”
UN Secretary-General Ban Ki-moon
21th January 2016, Davos

Thank you