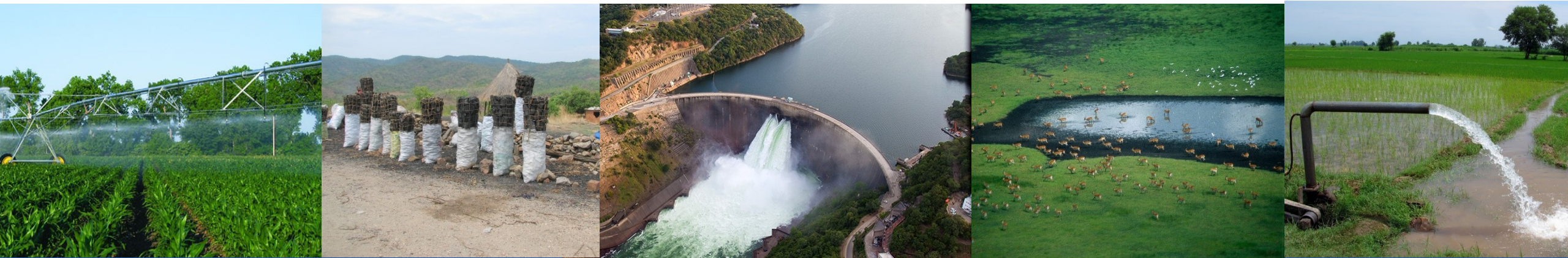


Exercise 4: Select a basin

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Select a basin

0. What you need – downloading data from FTP
1. Lumped vs. distributed modelling
2. The world at 30 arcsec
3. From elevation to flow accumulation
4. Example for Lake Tana, Blue Nile, Ethiopia



Select a basin

0. What you need

- You downloaded already all global static data for 30 arcmin e.g. global soil data on 30 arcmin from:

[from CWATM_data\cwatm_input30min.zip](#)

- You need a global climate dataset (precipitation, temperature, radiation etc.) please download from our ftp server

[climate_2011_2012 .zip](#) from

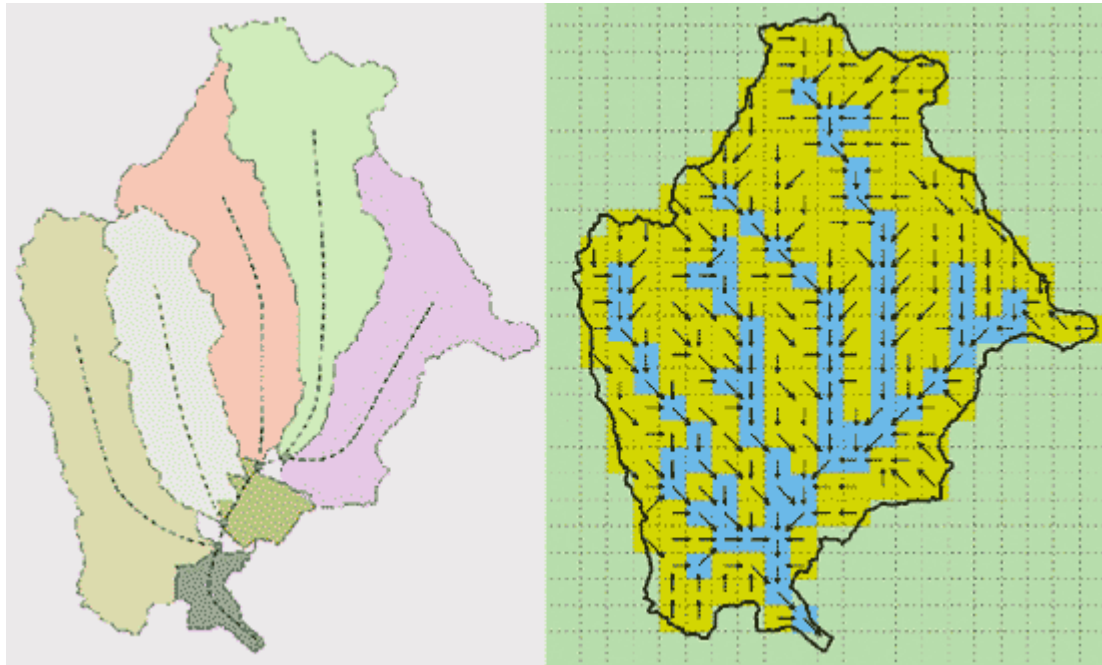
please copy to the folder [CWATM_data/climate/global](#) and unzip (extract here)



Select a basin

1. Lumped and distributed modeling

- CWatM is a distributed model which can be used at different resolutions e.g. 30 arcmin, 5 arcmin, 1km
- Other hydrological models use a lumped model approach (e.g. SWAT)



Lumped model

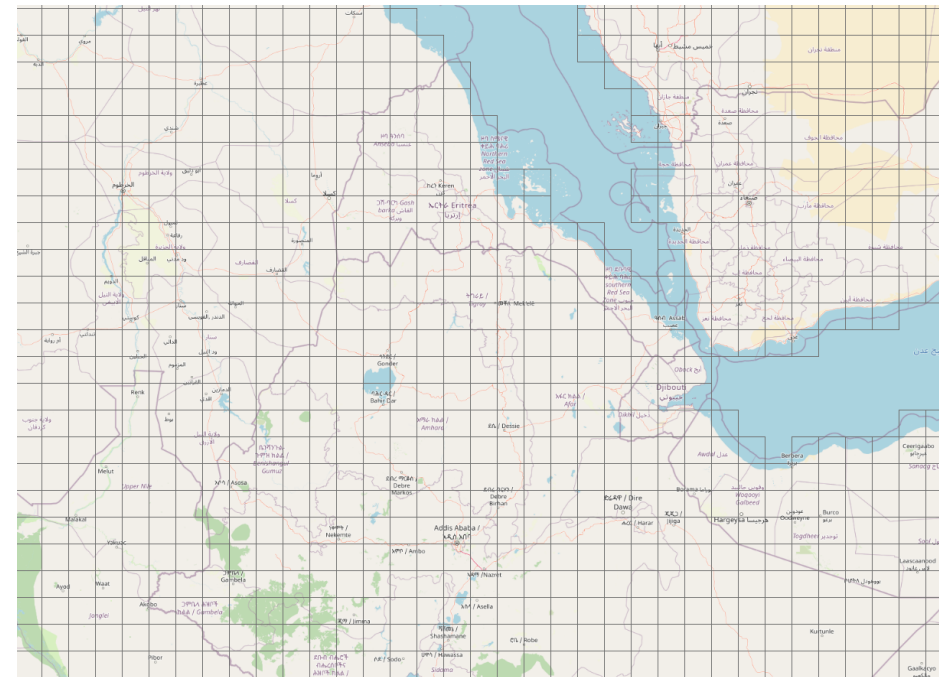
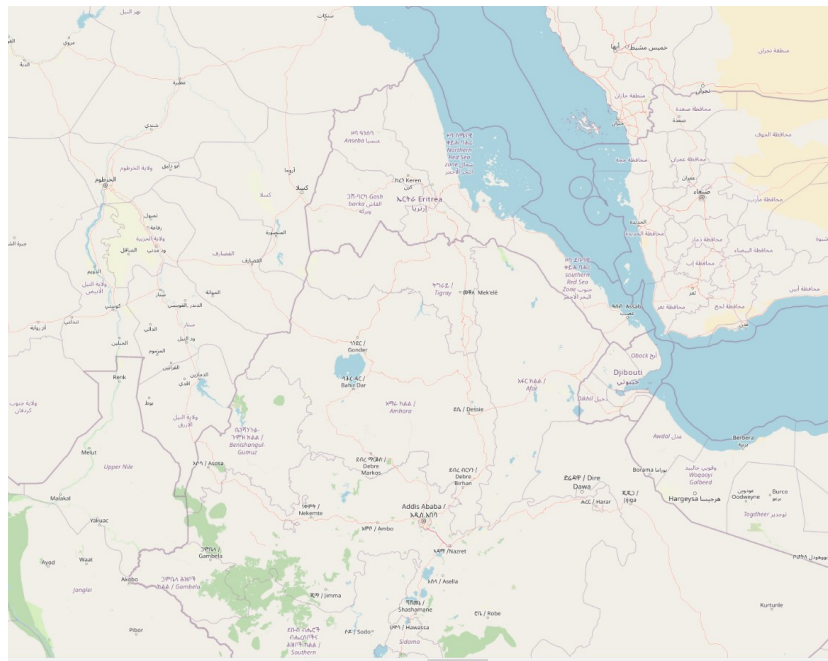
vs. distributed model

(source: <http://crahi.upc.edu>)

Select a basin

2. The world in 30 arcmin raster

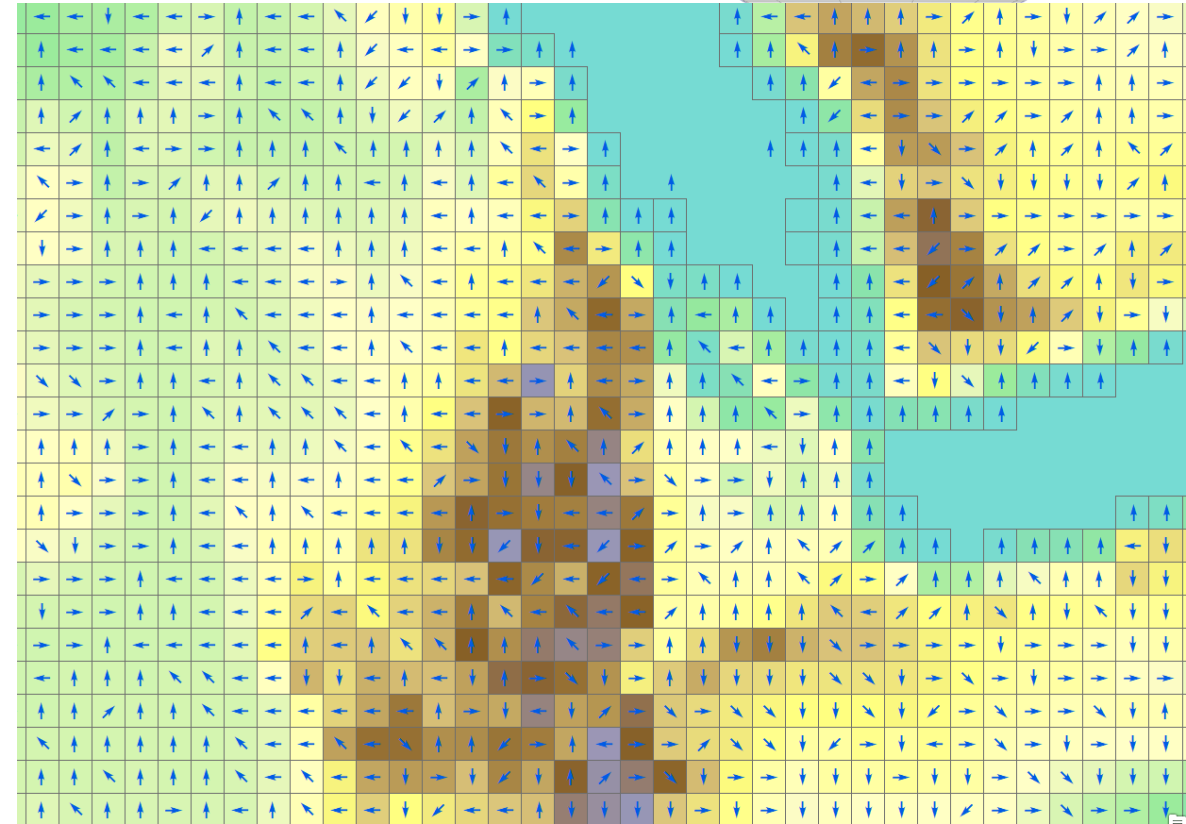
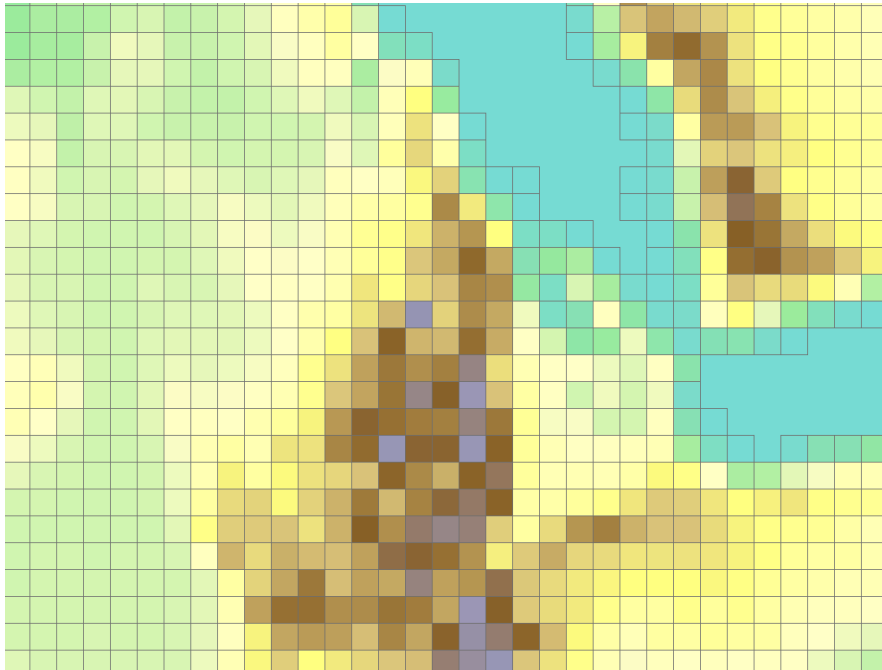
- CWatM is a distributed model which can be used at different resolutions e.g. 30 arcmin, 5 arcmin, 1km
- This is a part of the World (Ethiopia) split into 30 arcmin cells (around 50 km x 50 km)



Select a basin

3. DEM to flow direction

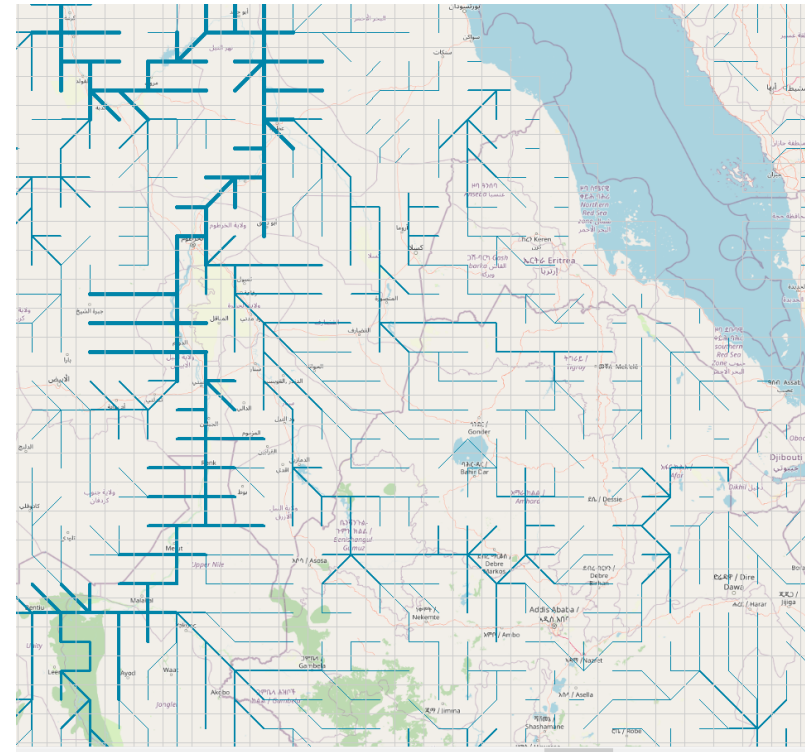
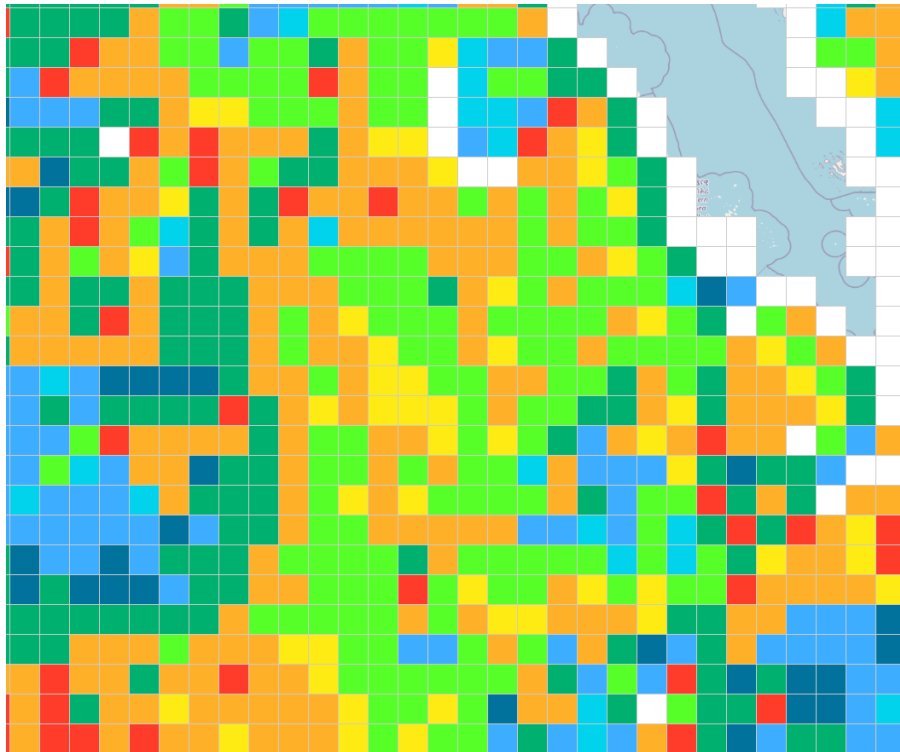
- Based on a digital elevation model for each cell a flow direction is calculated
- This flow direction is from:
DDM30 River-routing network data
(Lehner et al., 2008)



Select a basin

4. Flow direction to stream network

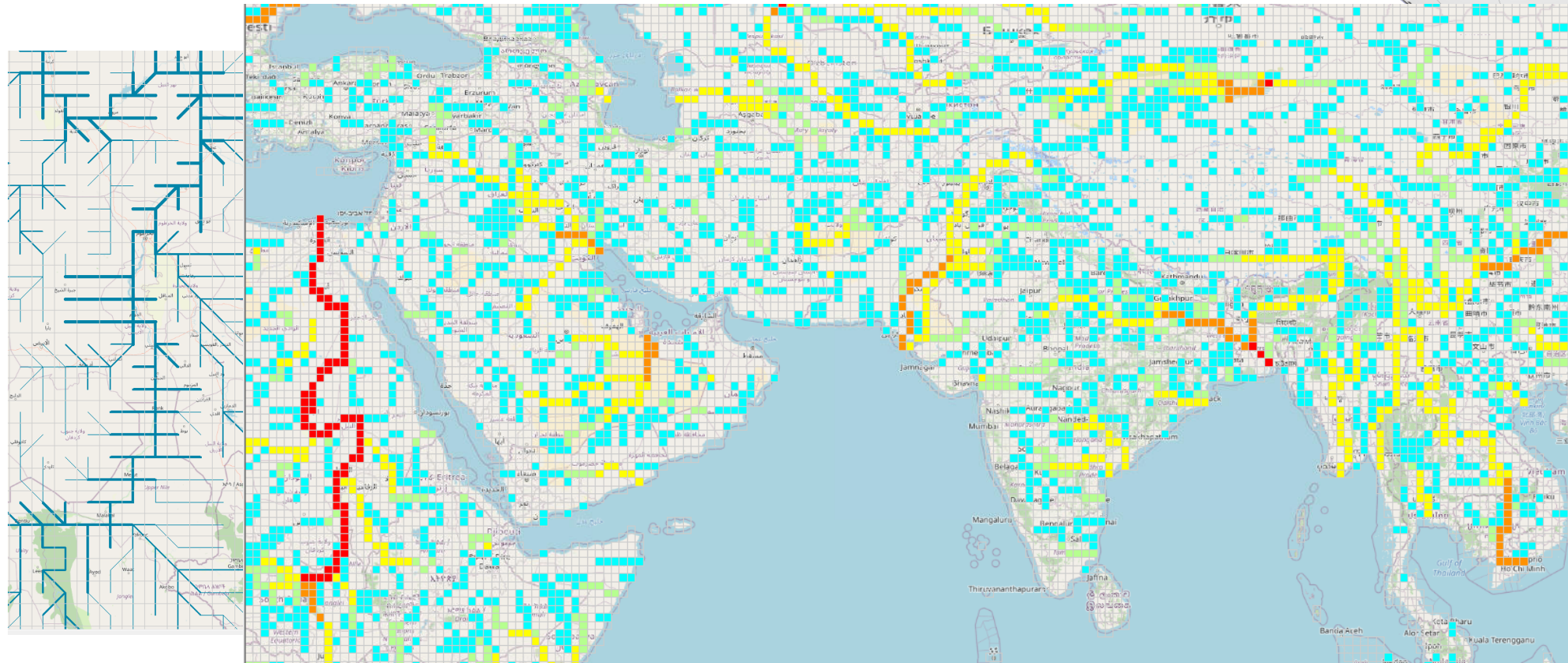
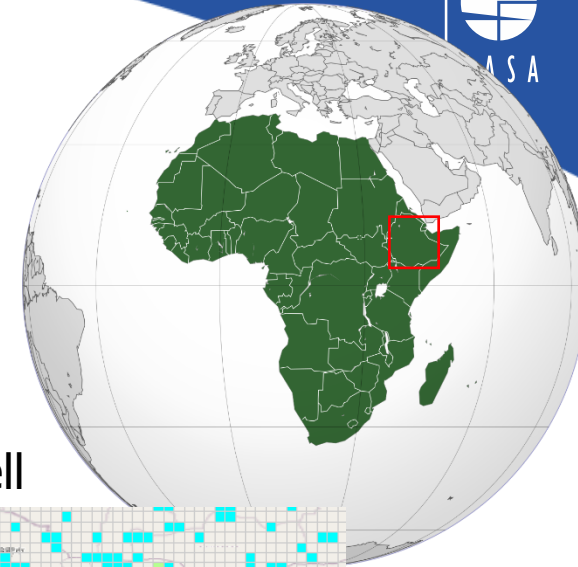
- Each flow direction gets a number (like the number keyboard)
- If you connect the flow direction you get to an upstream – downstream connection – the stream network



Select a basin

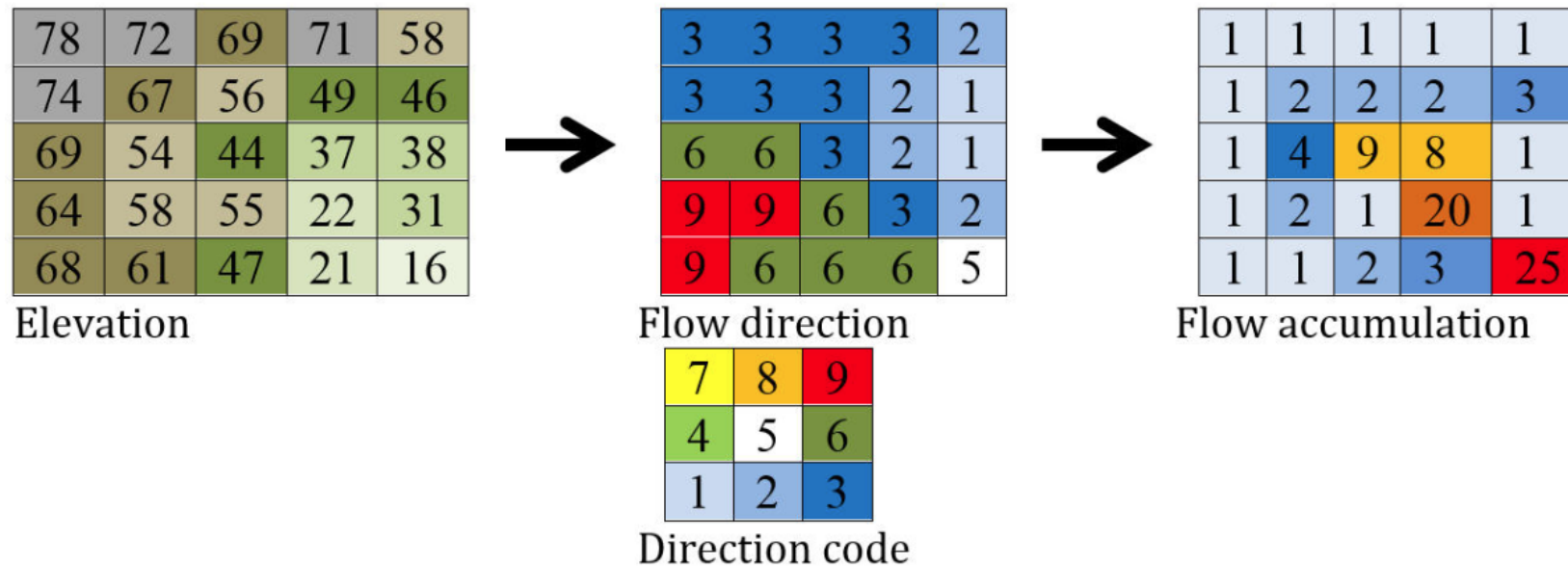
5. Stream network to flow accumulation map

- Each cell has an area (e.g. 30arcmin x 30 arcmin)
- If you sum up all upstream areas for each cell you get to the upstream area. The value is representation the upstream catchment area of this cell



Select a basin

6. In short: from elevation to flow accumulation

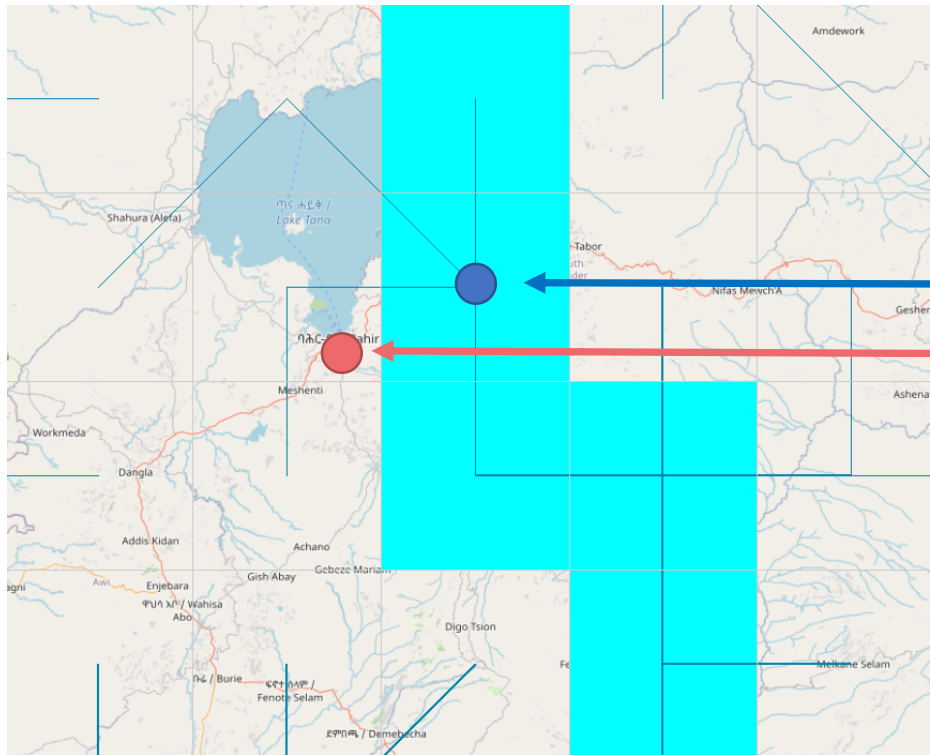


See also: <https://cwatm.iiasa.ac.at/data.html#river-drainage-maps>

Select a basin

7. Why is this important?

- You have to find the right location for your basin and your discharge station as the network, data, an reality sometimes does not fit.



30 arcmin network outlet

Real location of outlet of lake Tana

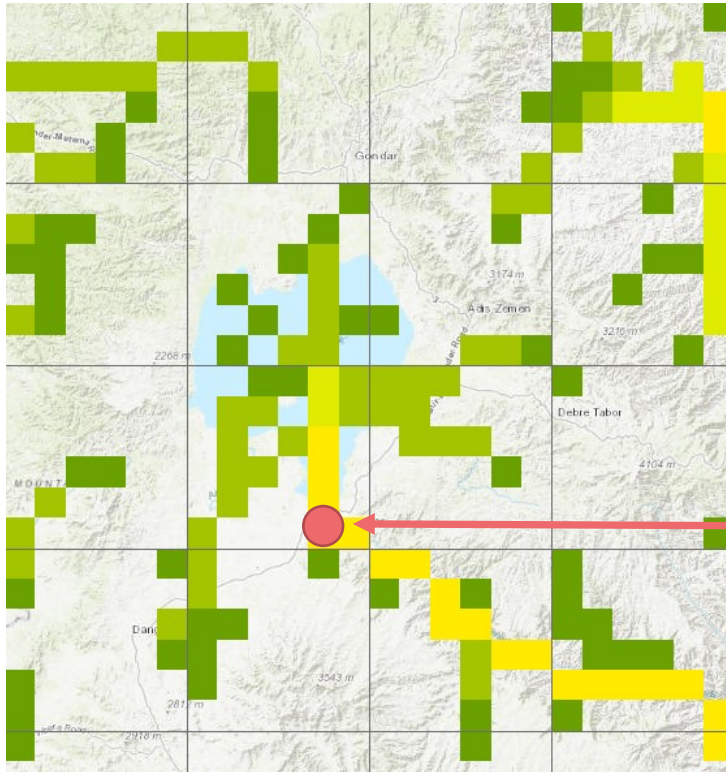
Lake Tana, Ethiopia

Select a basin

8. Why is this important?

- Good news:

This is getting better if you reduce resolution!



Lake Tana, Ethiopia



Exercise: Select a basin

1. Select an outlet of a basin

Folder: CWATM_exercise4

Based on the Rhine basin:

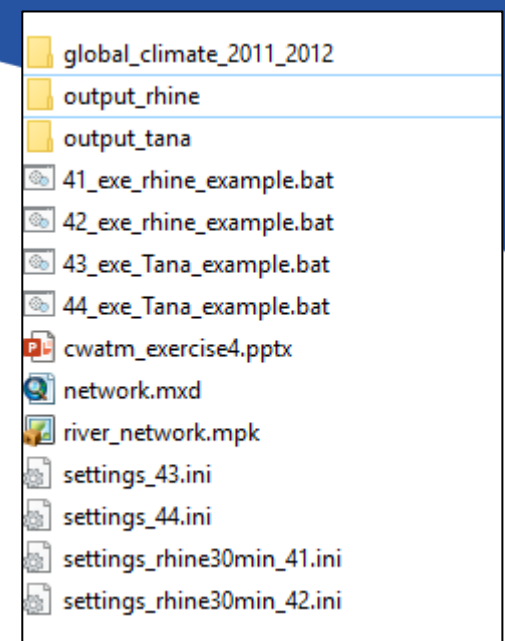
At the moment the Rhine basin is using
a limited set of climatic data, cut to the basin extend.

Run:

..\CWATM_model\CWatMexe\cwatm.exe settings_rhine30min_41.ini

Or: 41_exe_rhine_example.bat

For: original Rhine basin with cut climatic data



Folder structure CWATM_exercise4

Important!

We are in folder CWATM_exercise4

but we using the model stored in CWATM_model

Exercise: Select a basin

1. Select an outlet of a basin

Based on the Rhine basin:

At the moment the Rhine basin is using a limited set of climatic data, cut to the basin extend.

To use the global climate data

Change a few line in the setting: [settings_rhine30min_41.ini](#)

And save it with the same name.

```
calc_evaporation = True
```

```
PathOut = ./output_rhine
```

```
PathMeteo = $(PathRoot)/climate/global
```

```
#StepEnd = 31/12/2010
```

```
StepEnd = 10
```

```
PrecipitationMaps = $(FILE_PATHS:PathMeteo)/pr*
```

```
TavgMaps = $(FILE_PATHS:PathMeteo)/tavg*
```

Calculate potential Evaporation

Change output destination

Change to folder with global climatic data

Change to 100 time steps

Change precipitation input file

Change average temperature input file



You can use the '#' to out comment a line and to keep in mind the original version!

Exercise: Select a basin

1. Select an outlet of a basin

Based on the Rhine basin:

After your changes it should run with global climatic data

Run again:

..\CWATM_model\CWatMexe\cwatm.exe settings_rhine30min_41.ini

Or: 41_exe_rhine_example.bat

For: original Rhine basin with cut climatic data

(in case you did not manage, we prepared a settings file with the changes

..\CWATM_model\CWatMexe\cwatm.exe settings_rhine30min_42.ini

For: original Rhine basin with global climatic data)



Exercise: Select a basin

2. Select an outlet of a basin

Lake Tana, Blue Nile, Ethiopia (thank you Meron)

Station name	Drainage area (km ²)	Latitude	Longitude
Abbay at Bahir Dar	15321	11.6	37.39

Change a few line in the setting: settings_rhine30min_41.ini

```
PathOut = ./output_tana  
MaskMap = 37.39 11.6  
Gauges = 37.39 11.6
```

This will change the basin from Rhine to Lake Tana

```
StepEnd = 10
```



Exercise: Select a basin

2. Select an outlet of a basin

Tana basin

Run again:

..\CWATM_model\CWatMexe\cwatm.exe settings_rhine30min_41.ini For: original
Tana outlet coordinates



```
F:\CWATM.ECHO\CWATM_exercise4>..\CWATM_exercise1\CWatMexe\cwatm.exe settings_43.ini -l
CWATM - Community Water Model 1.04 Date: version 1.04
International Institute of Applied Systems Analysis (IIASA)
Running under platform: Windows
-----
Create catchment from point and river network
Number of cells in catchment: 2 = 6072 km2
CWATM Simulation Information and Setting
The simulation output as specified in the settings file: ./output_tana can be found in settings_43.in

Step    Date      Discharge
1       01/01/2011  167.34
2       02/01/2011  165.03
3       03/01/2011  163.19
4       04/01/2011  161.03
5       05/01/2011  158.27
16:30:43.268411
16:30:43.798132
```

Basin area too small

Station name	Drainage area (km ²)		
Abbay at Bahir Dar	15321		

(in case you did not manage, we prepared a settings file with the changes
..\CWATM_model\CWatMexe\cwatm.exe settings_43.ini

Exercise: Select a basin

3. Select an outlet of a basin

Lake Tana, Blue Nile, Ethiopia

Station name	Drainage area (km ²)	Latitude	Longitude
Abbay at Bahir Dar	15321	11.6	37.39



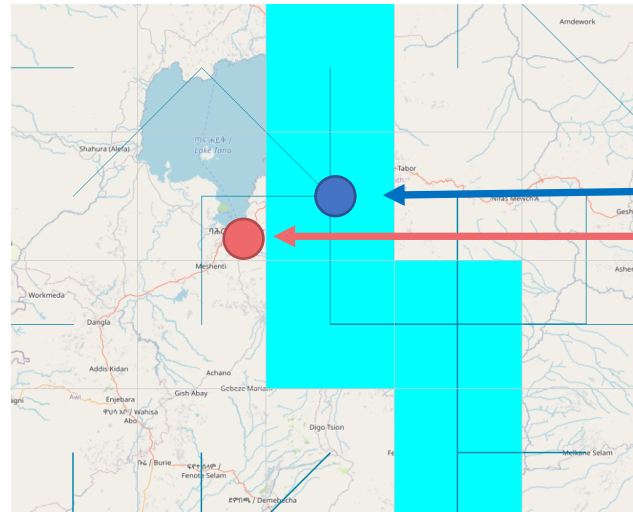
Because the 30arcmin network does not fit completely, we shift the outlet one cell to the east

Change a few line in the setting:

MaskMap = 37.6 11.6

Gauges = 37.6 11.6

This is a bit different then before!



Lake Tana, Ethiopia

30 arcmin network outlet
Real location of outlet of lake Tana

Exercise: Select a basin

3. Select an outlet of a basin

Tana basin

Run:

..\CWATM_exercise4\CWatMexe\cwatmexe\cwatm.exe settings_rhine30min_41.ini

For: changed Tana outlet coordinates

C:\WINDOWS\system32\cmd.exe

```
F:\CWATM.ECHO\CWATM_exercise4>..\CWATM_exercise1\CWatMexe\cwatm.exe
CWATM - Community Water Model 1.04 Date: version 1.04
International Institute of Applied Systems Analysis (IIASA)
Running under platform: Windows

-----
Create catchment from point and river network
Number of cells in catchment:      6 = 18195 km2

CWATM Simulation Information and Setting
The simulation output as specified in the settings file: ./output

Step      Date      Discharge
1         01/01/2011    167.56
2         02/01/2011    165.29
3         03/01/2011    163.22
```

(in case you did not manage, we prepared a settings file with the changes
..\CWATM_exercise1\CWatMexe\cwatmexe\cwatm.exe settings_44.ini



Basin area fits better

Station name	Drainage area (km ²)		
Abbay at Bahir Dar	15321		

Exercise: Select a basin

4. Select an outlet of a basin

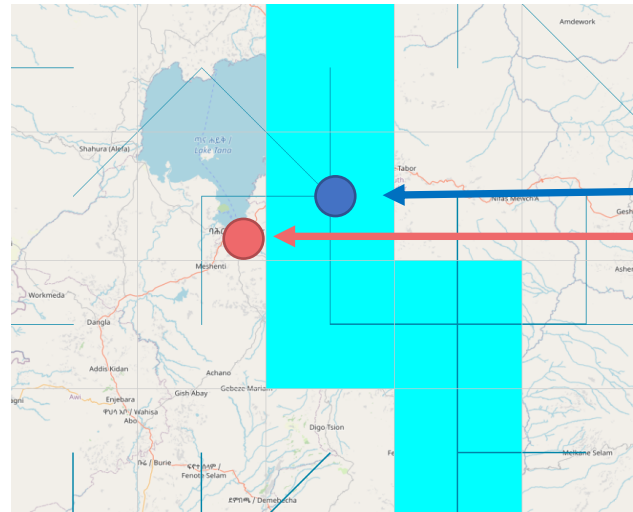
Lake Tana, Blue Nile, Ethiopia

Station name	Drainage area (km ²)	Latitude	Longitude
Abbay at Bahir Dar	15321	11.6	37.39



Change a few line in the setting:

StepEnd = 31/12/2012



30 arcmin network outlet
Real location of outlet of Lake Tana

Lake Tana, Ethiopia

Exercise: Select a basin

4. Select an outlet of a basin

Based on the Rhine basin:

At the moment the Rhine basin is using
a limited set of climatic data, cut to the basin extend.

Run:

..\CWATM_model\CWatMexe\cwatm.exe settings_rhine30min_41.ini

For a longer times serie



Problems

Most problems come from different file systems, folder structures

We try to set up everything with relative path.

1. Please make sure that your folders have a similar structure like in slide 3 in cwatm_exercise1.ppt

2. The settings file has a part:

[FILE_PATHS]

PathRoot = ../cwatm_data

PathOut = ./output

PathMaps = \$(PathRoot)/cwatm_input30min

PathMeteo = \$(PathRoot)/climate/rhine

../ jumps back to the previous folder

./ uses the folder output in the same folder as the settings file or the directory you are in

3. If this is not working you can use also absolute path (also with white space)

PathRoot = C:/root directory/second.root/cwatm/cwatm_data

4. If you execute cwatm you can also use absolute path

instead

../CWATM_model/CWatMexe/cwatm.exe settings_rhine30min.ini -l

"C:/root directory/second.root/cwatm/CWATM_model/CWatMexe/cwatm.exe" settings_rhine30min.ini -l (mind the " if there are white spaces)

5. Some other errors we address in:

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