

# Surface water for drinking with minor or no treatments - Supply

## General description

The surface water supply is displayed as annual average available water runoff. Using the INVEST water yield model, the annual average quantity of water runoff from each subcatchment of the Alpine space is calculated. The model estimates the water runoff based on gridded information on climatic, soil, topographic and landcover characteristics.

## Input Data

- Annual average precipitation sum
- Annual average evapotranspiration
- Root restricting layer depth
- Plant available water content
- Landcover
- Root depth
- Evapotranspiration coefficient table
- DEM
- Annual average runoff

## Calculation processes

**(1) Run INVEST water yield model**

**Download and Install INVEST water yield model**

The Invest model toolbox can be downloaded at <https://www.naturalcapitalproject.org/invest/> and installed on windows and mac's. Furthermore, a very detailed User's guide explaining the model's configuration can be found on the mentioned homepage.

**Prepare Input data for INVEST water yield model**

The InVEST Reservoir Hydropower model estimates the relative contributions of water from different parts of a landscape, offering insight into how land use patterns affect annual surface water yield. As the model runs on a gridded map, the majority of input data needs to be provided on a gridded map (see raster). Furthermore, due to the annual reference of the model, input data need to be provided as annual averages. As such, annual average rainfall, average annual reference evapotranspiration, root restricting layer depth, plant available water content, root depth and land use datasets need to be raster files and annually averaged where applicable. A number of base data-sets can be found in the MESH tool under <https://www.naturalcapitalproject.org/mesh/>. For all raster inputs, the projection used should be defined, and the projection's linear units should be in meters. It is advisable that datasets were collected in the same year, e.g. rainfall and land use. Furthermore, polygons delineating the watershed area on large and medium scale are needed.

In a next step, the evaporation coefficient table should be calculated following the guidelines provided in the INVEST User's guide.

### Run the model

When the input datasets are all clipped, projected in a consistent way, they can be defined in the user's interface of the model, which can be found as a standalone application accessible from the Windows start menu. For Windows 7 or earlier, this can be found under All Programs → INVEST [version] → Water Yield. Windows 8 users can find the application by pressing the windows start key and typing "water" to refine the list of applications. The standalone can also be found directly in the INVEST install directory under the subdirectory invest-3\_x86/invest\_hydropower\_water\_yield.exe.

### Interpreting the results

Once done with the number crunching, the results need to be interpreted. The following short description of the outputs is extracted from the INVEST water yield model's user's guide, which can be found under

<http://data.naturalcapitalproject.org/nightly-build/invest-users-guide/html/reservoirhydropowerproduction.html#interpreting-results>

Outputs in the *per\_pixel* folder within the *output* folder can be useful for intermediate calculations but should **NOT** be interpreted at the pixel level, as model assumptions are based on processes understood at the subwatershed scale.

output\per\_pixel\fracp(fraction): Estimated actual evapotranspiration fraction of precipitation per pixel (Actual Evapotranspiration / Precipitation). It is the mean fraction of precipitation that actually evapotranspires at the pixel level.

output\per\_pixel\aet(mm): Estimated actual evapotranspiration per pixel.

output\per\_pixel\wyield(mm): Estimated water yield per pixel.

output\watershed\_results\_wyield.shp and output\watershed\_results\_wyield.csv: Shapefile and table containing output values per watershed: When the water yield model is run, the following biophysical outputs result:

precip\_mn(mm): Mean precipitation per pixel on the watershed.

PET\_mn(mm): Mean potential evapotranspiration per pixel on the watershed.

AET\_mn(mm): Mean actual evapotranspiration per pixel on the watershed.

wyield\_mn(mm): Mean water yield per pixel on the watershed.

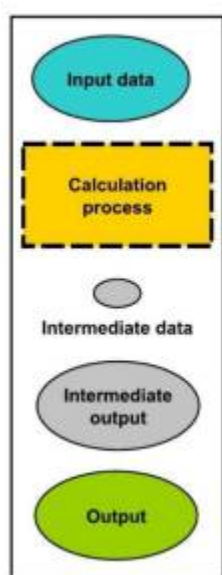
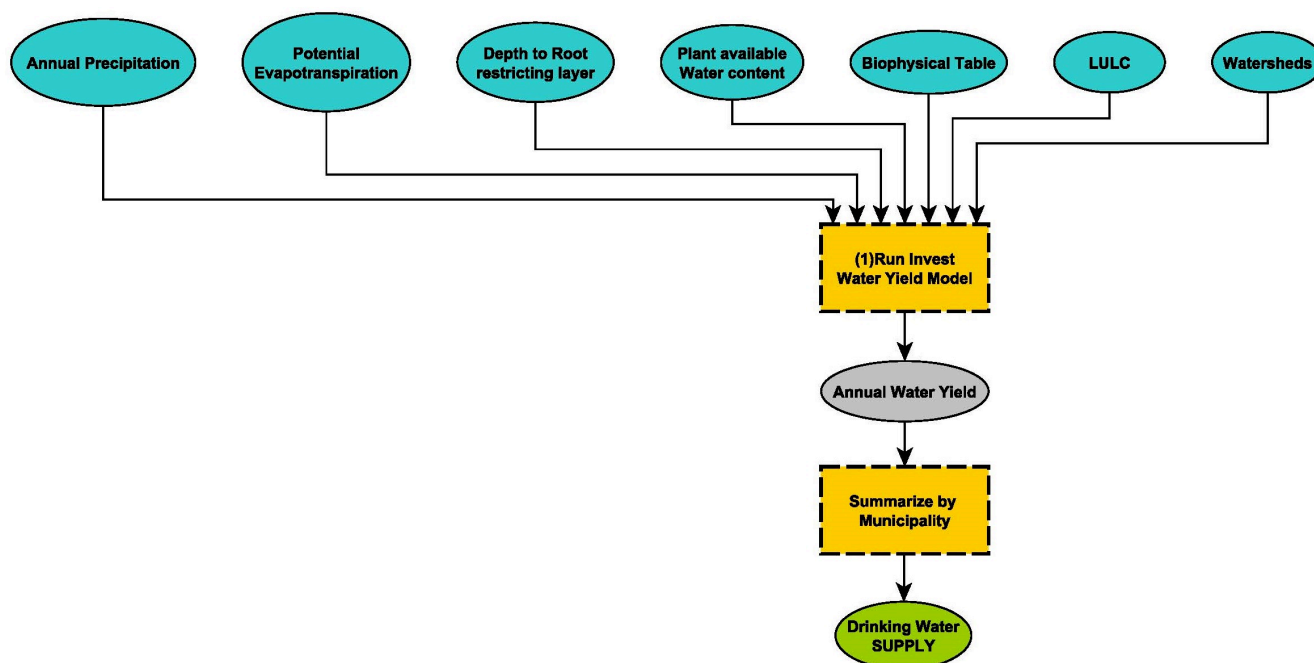
num\_pixels: Number of pixels per watershed.

$wyield\_vol(m^3)$ : Volume of water yield in the watershed.

$wyield\_ha(m^3)$ : Volume of water yield in the watershed per hectare.

### Calibration

As most input data, were physically determined values, and hence are not to be changed. The calibration, after assessing the sensitivity was done with the annually average evapotranspiration coefficient. Therefore, comparing the dataset with the observation-based map of mean annual runoff from Beck (2012), step-wise adjustments of the KC- (Evapotranspiration coefficient table) values are made towards minimising the error to reach a threshold of max 10-15 % error rate. This was done in a semi-automatic calibration scheme in python and R environment.



**Input data** → elements that hold a value or a reference to data stored on disk. It is usually a spatial explicit information coming from official sources.

**Calculation process** → the actual operation performed on the data. The number preceding the item refers to the number in the model description.

**Intermediate data** → for each calculation process intermediate data is generated. This data, however, is usually not significant itself, but is used as an input for the next calculation step.

**Intermediate output** → is intermediate data that has a significance for the ES evaluation.

**Output** → is the result of the calculation process. It is typically one of the ES indicators, either Supply, Demand or Flow.

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