

Streamlining erosion and sediment transport modelling: the pywatemsedem package

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Interreg



Co-funded by
the European Union

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ClimASed

WaTEM-SEDEM: intro

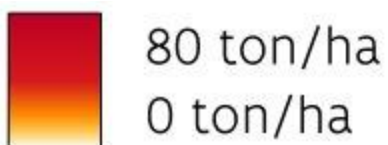
- **WaTEM: Water and Tillage Erosion Model - SEDEM: Sediment Delivery Model**
- **Spatially distributed model to simulate soil erosion and sediment transport in agricultural catchments**
- **Developed at KULeuven (Verstraeten et al., 2002)**
- **Based on RUSLE with additional transport component (Transporting sediment through landscape), simulating erosion and deposition**

WaTEM-SEDEM : intro

Sediment Delivery



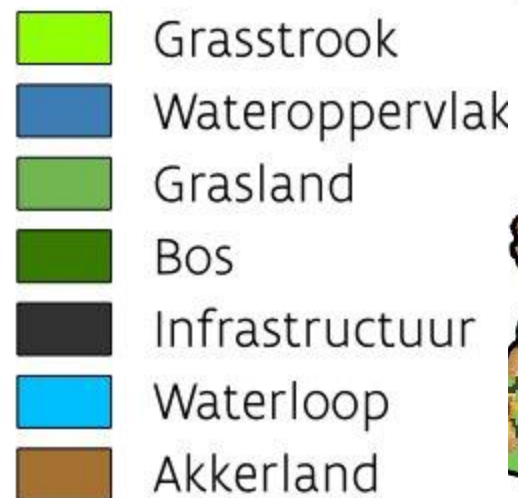
Sediment Transport



Priority



Land Use



WaTEM-SEDEM: intro

- Since 2017 code maintenance by Fluves (funded by Departement Omgeving and VMM)
 - Debugging
 - Increasing performance
 - Documenting
- Since 2024: open-source
 - LGPL-3.0 license
 - published on Github: <https://github.com/watem-sedem/watem-sedem>
 - Fully documented: <https://watem-sedem.github.io/watem-sedem/>
 - DOI available: [10.5281/zenodo.10997287](https://doi.org/10.5281/zenodo.10997287)

WaTEM-SEDEM: Github

github.com/watem-sedem/watem-sedem

☰

GitHub

watem-sedem / watem-sedem

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<> Code

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👤 12 Branches

🏷️ 18 Tags

🔍 Go to file

📄 Add file

<> Code

👤 daarende

Merge pull request #187 from watem-sedem/cleanup

267fa11 · last month

🕒 1,637 Commits

📁 .github	Remove some unused files/vars from ci	2 months ago
📁 ci	Add fpc to build requirements	11 months ago
📁 common	Check if latlong is enabled	5 months ago
📁 debian	Fix d/control syntax	last year
📁 docs	Update documenation total_sediment.txt	7 months ago
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📁 tests	Support reading integer 32 sgrds	4 years ago
📁 watem_sedem	Update Makefile	last year
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📄 AUTHORS.rst	Small corrections and additions of references	last year
📄 CHANGELOG.rst	Update CHANGELOG.rst	5 months ago
📄 CITATION.cff	Update CITATION.cff	5 months ago
📄 CONDUCT.md	Adding all documentation pages	5 years ago

About

⚙️

WaTEM/SEDEM

🔗 watem-sedem.github.io/watem-sedem/

modeling

water

erosion

soil

rusle

watem-sedem

📖 Readme

📄 LGPL-3.0 license

👤 Contributing

🔗 Cite this repository

📊 Activity

📁 Custom properties

★ 3 stars

👁️ 2 watching

🍴 3 forks

Report repository

Releases 18

📦 5.0.3 Latest

on May 26

+ 17 releases

Contributors 7

👤

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5

WaTEM-SEDEM: Github

The screenshot shows the GitHub repository page for **watem-sedem**. The repository is public and has 12 branches and 18 tags. The file list is circled in red, and the text "Source code" is written in red next to it. The file list includes:

File/Folder	Description	Time
.github	Remove some unused files/vars from ci	2 months ago
ci	Add fpc to build requirements	11 months ago
common	Check if latlong is enabled	5 months ago
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docs	Update documenation total_sediment.txt	7 months ago
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The right sidebar shows the repository's metadata:

- About**: WaTEM/SEDEM, watem-sedem.github.io/watem-sedem/, tags: modeling, water, erosion, soil, rusle, watem-sedem.
- Readme**: LGPL-3.0 license, Contributing, Cite this repository, Activity, Custom properties.
- Stars**: 3 stars, 2 watching, 3 forks.
- Releases**: 18 releases, latest 5.0.3 on May 26, + 17 releases.
- Contributors**: 7 contributors.

WaTEM-SEDEM: Github

github.com/watem-sedem/watem-sedem

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modeling water erosion soil

rusle watem-sedem

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Cite this repository

Activity

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Report repository

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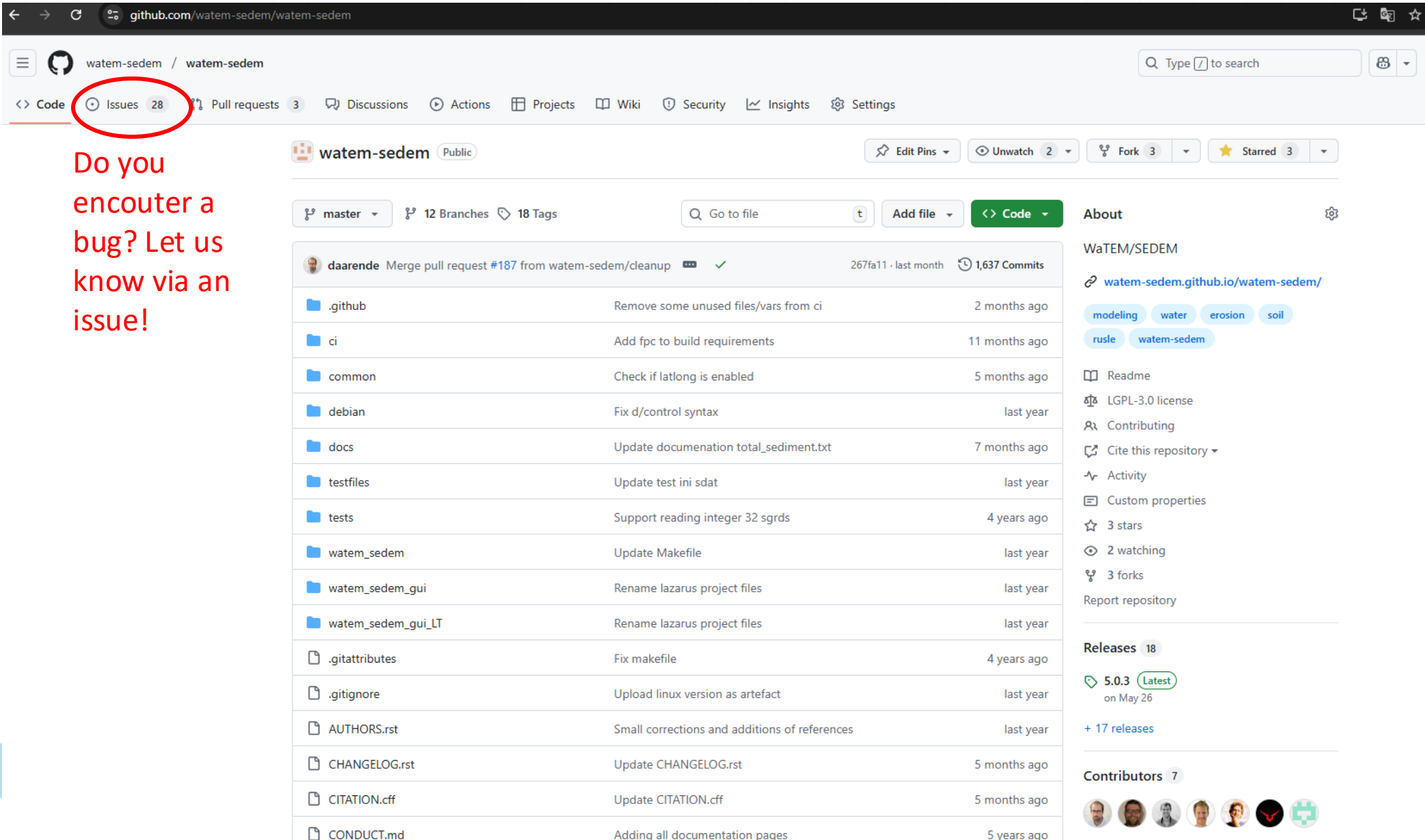
5.0.3 Latest on May 26

+ 17 releases

Contributors 7

Download latest version of binaries – no compilation of code needed!

WaTEM-SEDEM: Github



github.com/watem-sedem/watem-sedem

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Do you encounter a bug? Let us know via an issue!

watem-sedem Public

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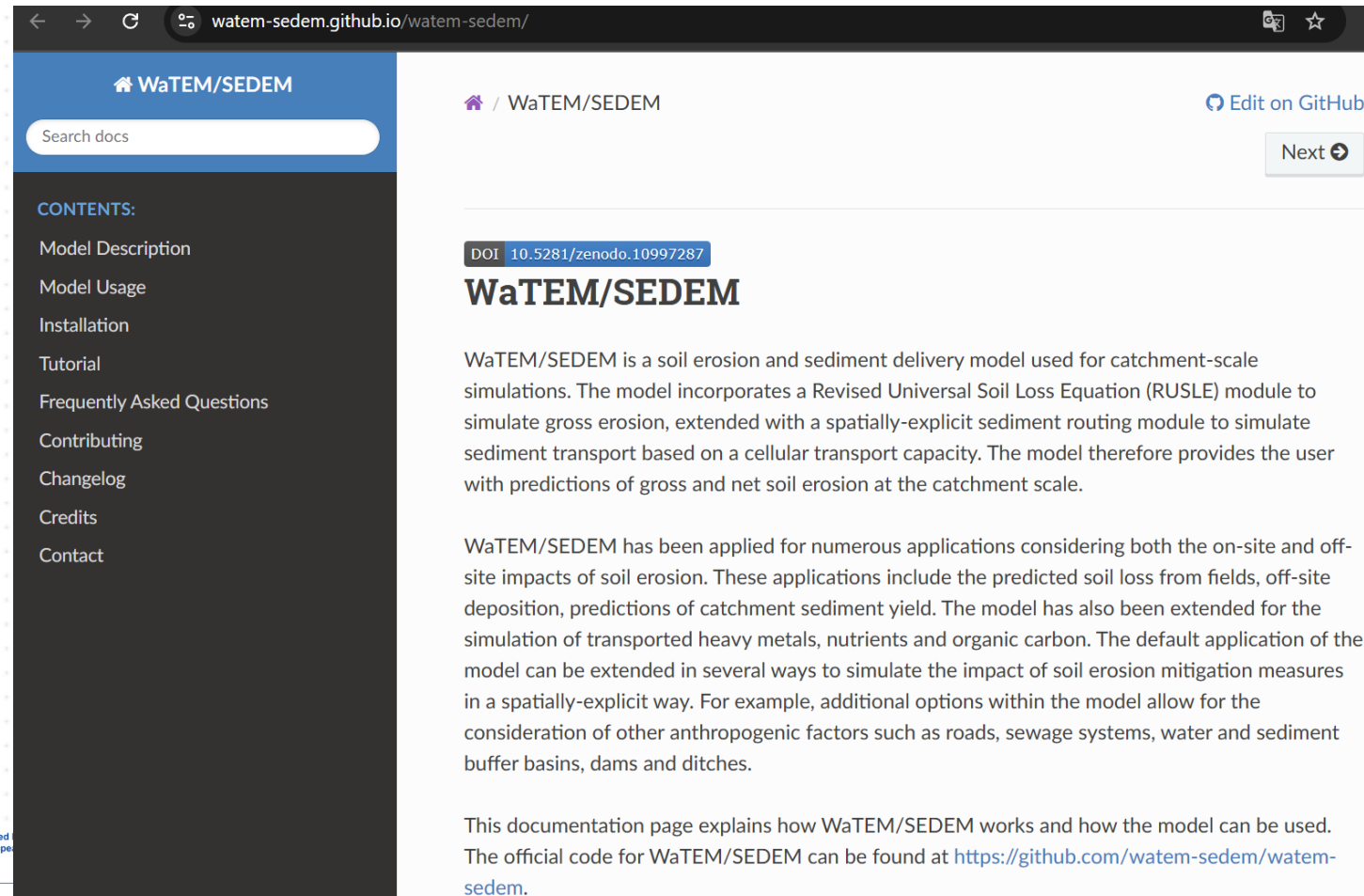
+ 17 releases

Contributors 7

Link to documentation website

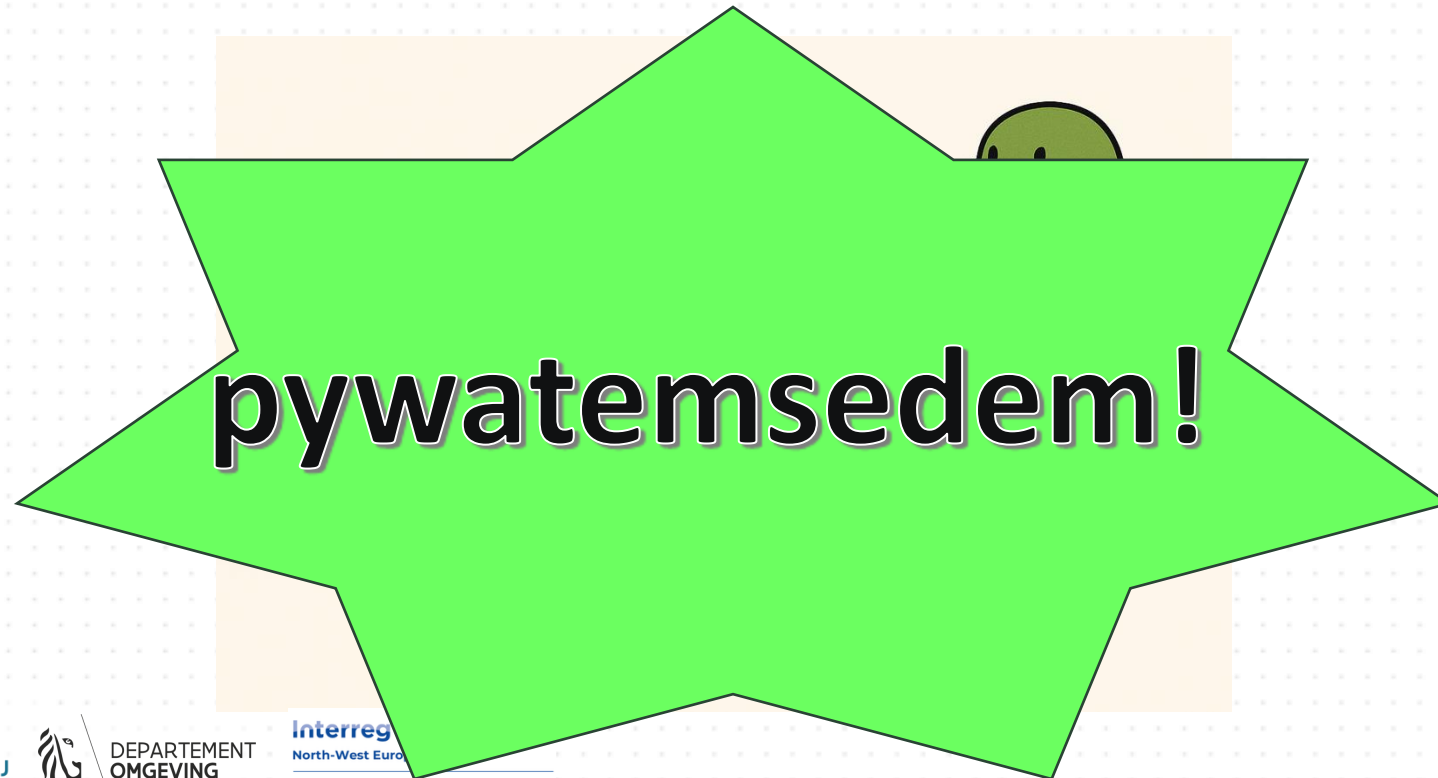
WaTEM-SEDEM: documentation

- Documentation website with
 - Model description (theory)
 - Model usage
 - what input needed?
 - how to install?
 - how to use the output?
 - Tutorials



pywatemsedem

- Despite (excellent 😊) documentation, it is not easy to prepare inputdata for WaTEM-SEDEM



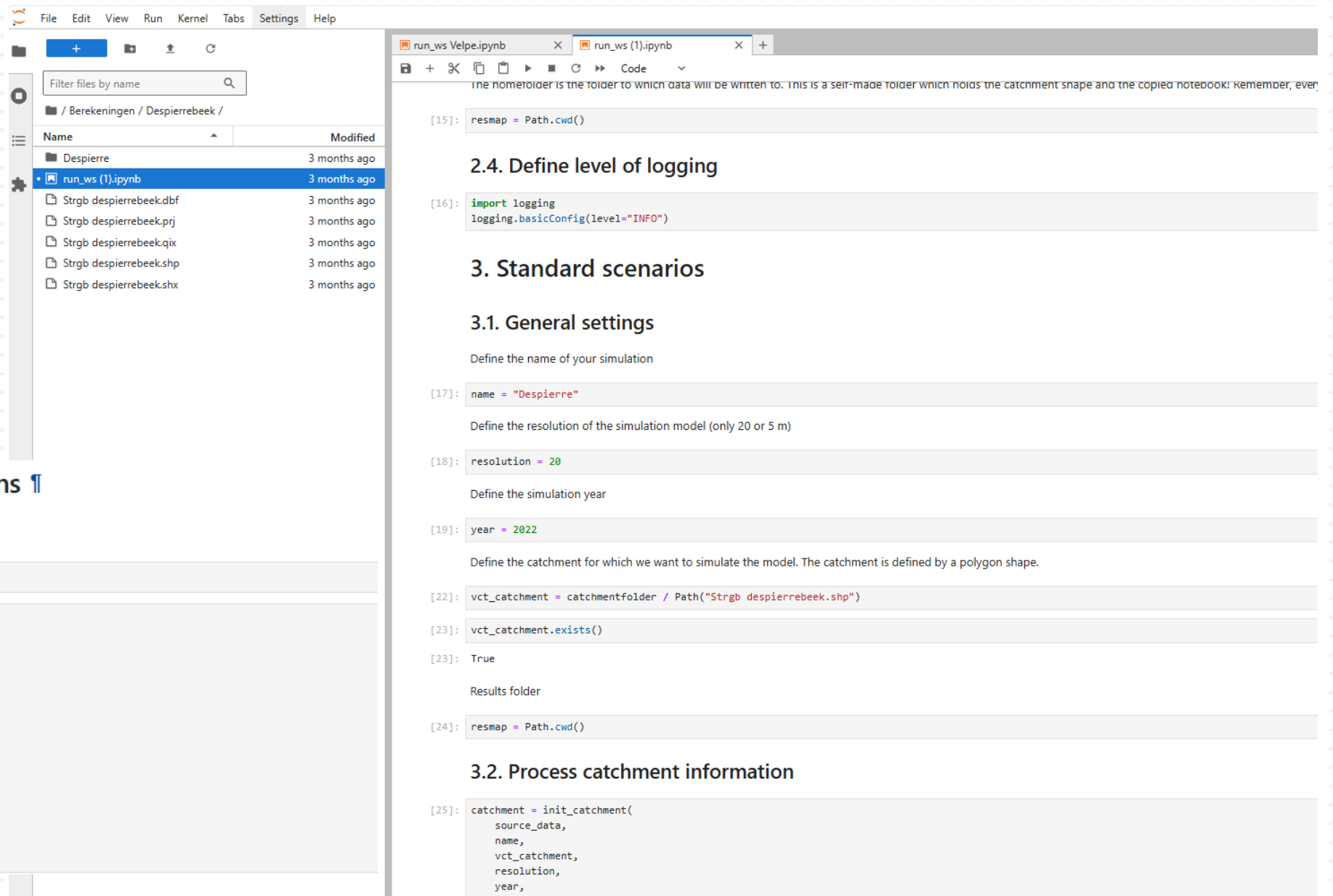
Pywatemsedem

- Python package that can be used as a data wrapper:
 - Generating general input data (e.g. shapefiles of rivers, parcels, roads,...)
 - Running watem-sedem
 - Postprocessing of output data of WaTEM-SEDEM
- Applicable worldwide!
- open source (MIT license)
 - <https://github.com/watem-sedem/pywatemsedem>

Pywatemsedem

- Easy to use API via jupyter notebooks
 - Easy to reproduce results
 - Fully documented on <https://watemsedem.github.io/pywatemsedem/index.html>
- First (official) version will be released soon!

Pywatemsedem: jupyter notebook



The screenshot displays a Jupyter Notebook environment. On the left, a file explorer shows the directory structure, including a file named 'run_ws (1).ipynb'. The main area shows the notebook content, which includes a code cell for defining simulation parameters and a code cell for defining catchment information.

3.4. Generate and check model options

Get default ini to define default user choices

```
defaultini = source_data.get_default_inifile(resolution)
```

```
choices = set_settings(
    'WS',
    resolution,
    year,
    defaultini,
    cn_ws_binary,
    dict_output={},
    dict_options=options,
    dict_ecm_options=ecm_options,
    dict_ecm_sources=ecm_sources,
    dict_flanders_options=flanders_options,
    dict_variables={}
)
```

2.4. Define level of logging

```
[15]: resmap = Path.cwd()
```

3. Standard scenarios

3.1. General settings

Define the name of your simulation

```
[17]: name = "Despierre"
```

Define the resolution of the simulation model (only 20 or 5 m)

```
[18]: resolution = 20
```

Define the simulation year

```
[19]: year = 2022
```

Define the catchment for which we want to simulate the model. The catchment is defined by a polygon shape.

```
[22]: vct_catchment = catchmentfolder / Path("Strgb despierrebeek.shp")
[23]: vct_catchment.exists()
[23]: True
```

Results folder

```
[24]: resmap = Path.cwd()
```

3.2. Process catchment information

```
[25]: catchment = init_catchment(
    source_data,
    name,
    vct_catchment,
    resolution,
    year,
```

Pywatemsedem: jupyter notebook

3.6. Run model

```
scenario.run_model(cn_ws_binary)
write_run_file(name, scenario.scenario_nr, choices, cn_ws_binary)
```

```
INFO:pycnws.core.scenario:Modeling scenario 1
INFO:pycnws.core.scenario:CN_WS model version: 4.2.3
INFO:pycnws.core.scenario:
INFO:pycnws.core.scenario:Inifile : /var/lib/private/d1c36dc0d337c645349ed186969e
INFO:pycnws.core.scenario:19793e78580-ovo000092/Berekeningen/Despierrebeek/Despie
INFO:pycnws.core.scenario:/inifile.ini
INFO:pycnws.core.scenario:
INFO:pycnws.core.scenario:Calculations completed. Program Execution Time: 2.82 se
INFO:pycnws.core.scenario:Modelrun finished!
```

4. Erosion control measures: buffers and grass strips

In this section, it is explained how the effect of extra erosion control measures can be estimated with the help of pycnws. In order to estimate this, we will run the same erosion control measure input data. For this, we work file-based, in which we define input shapes/vectors that can be used as input files to the pycnws model. The files use the given templates below to get started. In the next lines, we present template shape files, and how they should be used in pycnws.

Note Each type of measure has its own vector file!

4.1. Buffers and grass strips

```
vct_buffers = catchmentfolder / "extra_buffer_Blankaart3_s2.shp"
#vct_crop_technical = Path("data") / "extra_nt_kerende_template.shp"
#vct_grass = Path("data") / "Extragras2025.shp"
vct_grass_strips = catchmentfolder / Path("extra_gras_Blankaart3_s2.shp")
#vct_grass_strips = Path("data") / "extra_grass_strips_template.shp"
```

The format of the example buffers template file can be used (load with geopandas):

```
gdf_buffers = gpd.read_file(vct_buffers)
```

For the buffers, a number of parameters can be defined, yet only the *buffer efficiency* `eff(%)` is considered for WaTEM/SEDEM (others are only considered for CN).

`gdf_buffers`

	id	hdam	hknijp	dknijp	qcoeff	boverl	eff		opm	qcoef	area	buffercap	Type	
0	38	1.0	0.0	0.03	None	7.0	75.0		None	0.6	None	449.487304	default	POLYGON ((47734.103 186
1	1	1.0	0.0	0.03	None	7.0	75.0		None	0.6	None	1008.735127	default	POLYGON ((52144.072 186
2	3	1.0	0.0	0.03	None	7.0	75.0		None	0.6	None	1363.016739	default	POLYGON ((52567.176 186
3	5	1.0	0.0	0.03	None	7.0	75.0	bufferende gracht		0.6	None	865.941463	default	POLYGON ((52784.141 186



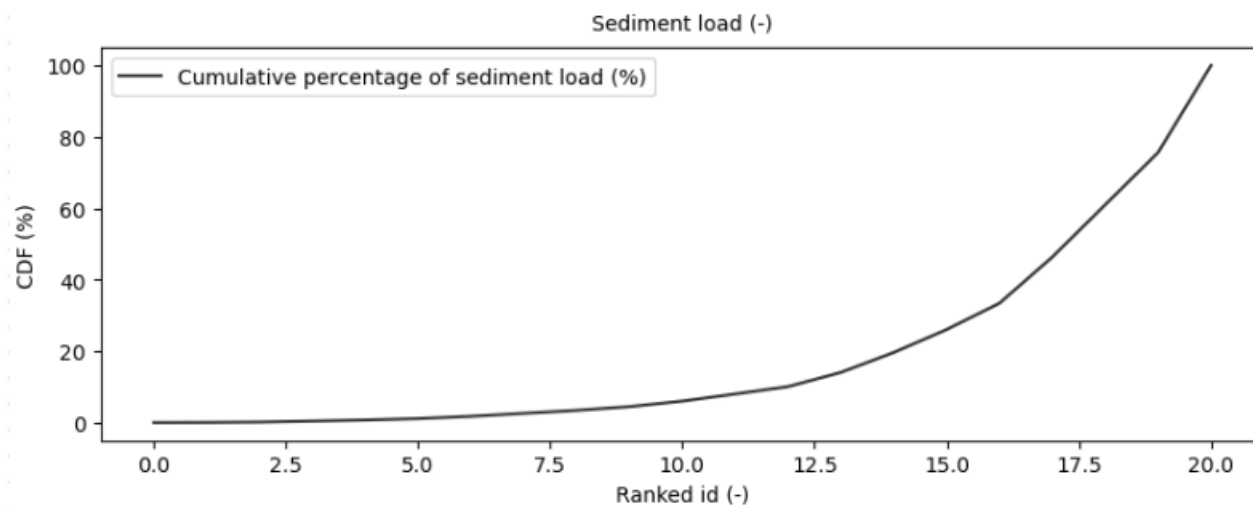
Pywatemsedem: jupyter notebook

3.7. Postprocess results

Run the postprocessing module to get a more detailed insight in the output (results in `molenbeek/scenario_1/postprocessing`)

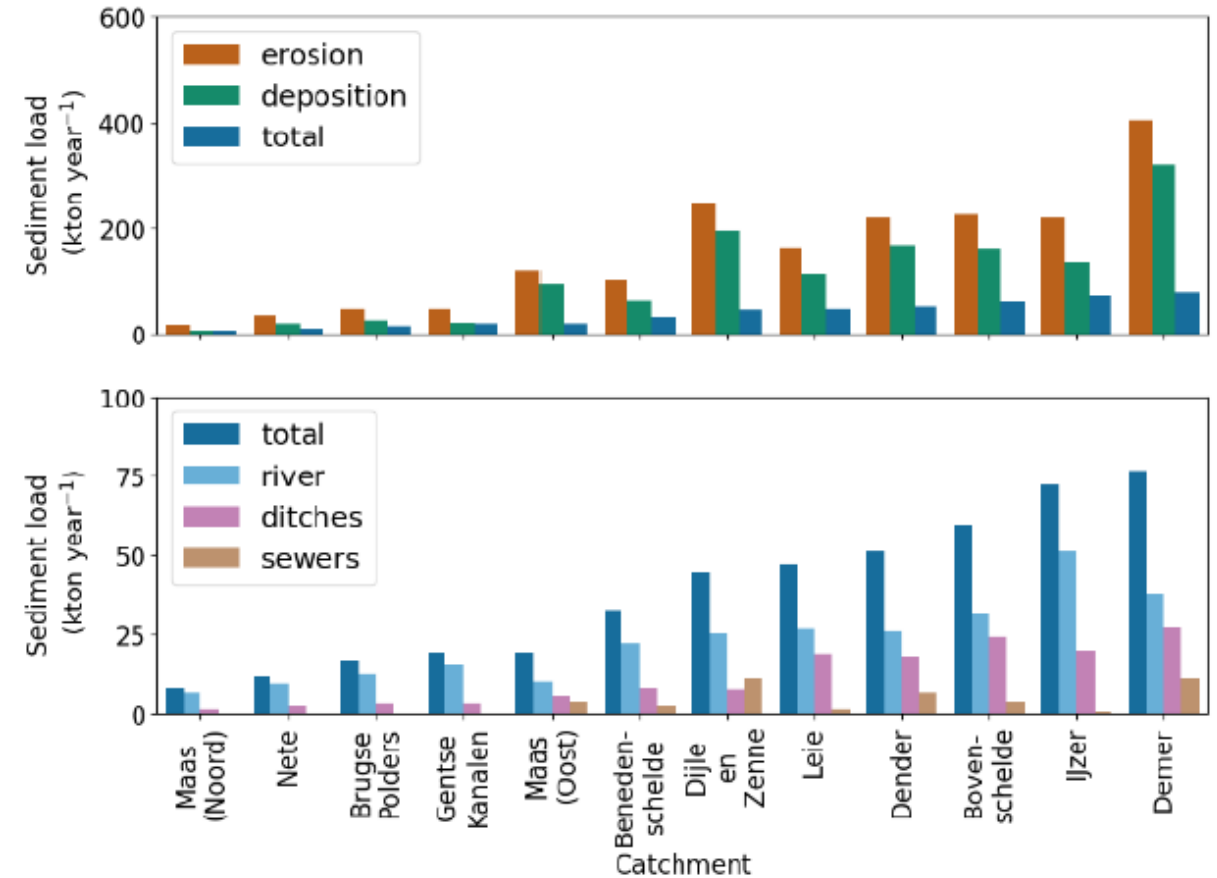
```
pp = PostProcessFlanders("Despierre", vct_catchment, resolution, 1, year)
```

```
Totale erosie -4675.570730
Totale sedimentatie 3459.472680
Totale sedimentaanvoer VHA 357.537930
Buiten domein 18.958200
Totale sedimentaanvoer in grachten en riolering 729.113090
Totale sedimentaanvoer in grachten 714.973206
Totale sedimentaanvoer in riolering 14.139917
Name: waarde (ton), dtype: float64
```



Pywatemsedem: example Flanders

- All of Flanders has been calculated with the model
- Results (maps) available on <https://www.dov.vlaanderen.be/portaal/?module=sedimentverkenner>
- Fig.: different catchments in Flanders: illustrating the differences in erosion and deposition rates, and subsequent loads transported to the river



Thank you, so now let's model!

Nele Van Ransbeeck

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