Automating Hydrological Model Preprocessing: GIS Tools for CATFLOW in V-FOR-WaTer

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Motivation: From DEM to Decision

Hydrological models like CATFLOW rely on high-resolution spatial inputs, typically derived from Digital Elevation Models (DEMs). However, traditional preprocessing of these datasets is often manual, time-consuming, and prone to inconsistency.

To overcome these challenges, we present **DEM2CAT**— a containerized, automated tool that transforms raw DEMs into model-ready inputs. This approach accelerates preprocessing, enhances reproducibility, and aligns with FAIR data principles, enabling more efficient and transparent hydrological modeling.

Ultimately, it supports faster, more reliable scenario analysis and decision-making in water resource management.
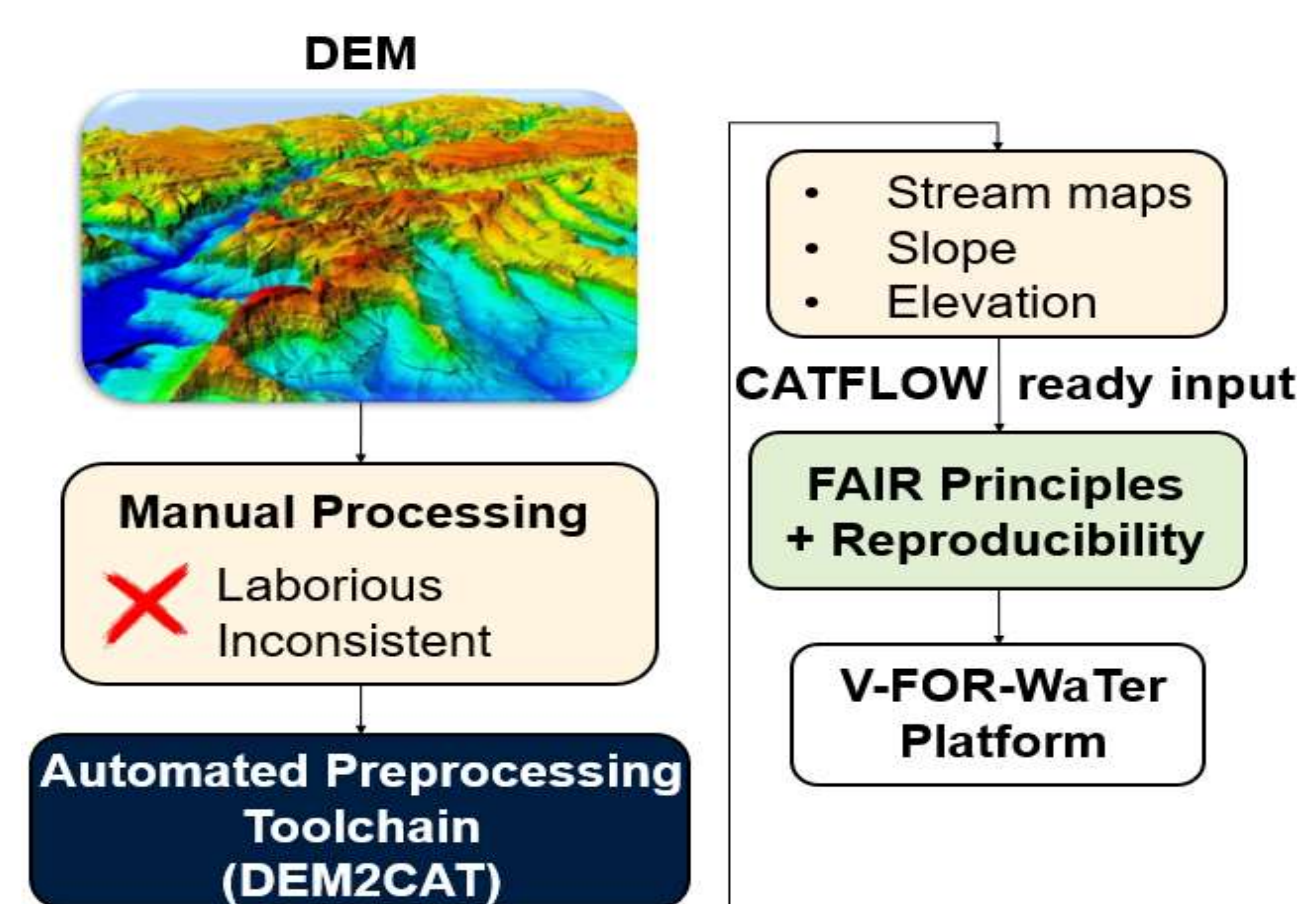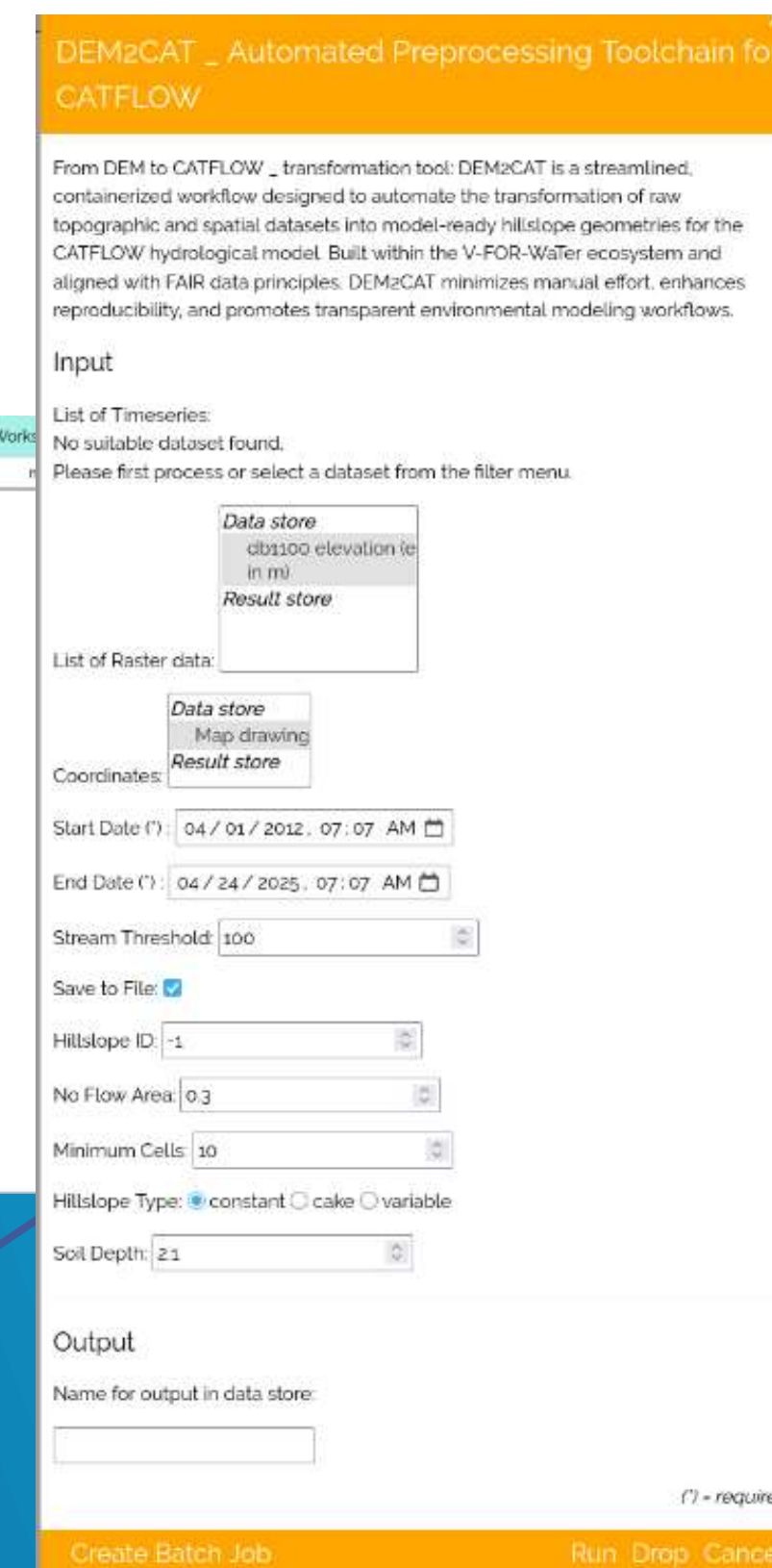

Find data
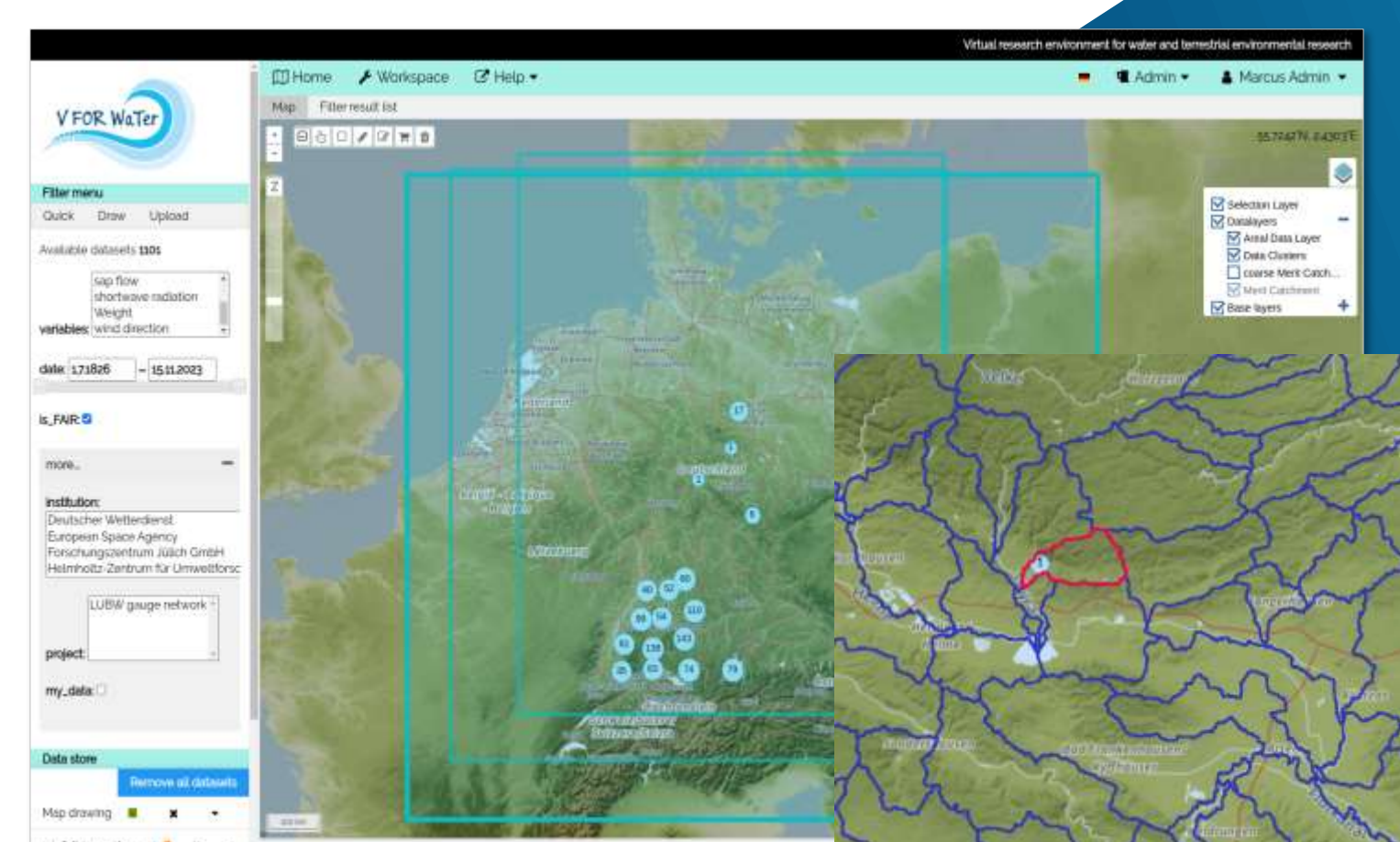
- Catchments can be selected directly within the portal, enabling automated filtering and clipping of raster and timeseries data to the chosen hydrological region.

Process data within portal

DEM2CAT is a containerized PyGeoAPI tool that integrates dataset loading, raster clipping, terrain analysis, and hillslope extraction.

Extendable Toolbox

The tools operate within **independent Podman[1] containers** and are accessed via **GeoAPI Processes of OGC standard**, enabling:

- **Seamless expansion** of the toolbox with new functionalities
- **Efficient creation** of automated workflow chains
- **Enhanced reproducibility**, ensuring consistent and reliable results

Preview results

DEM2CAT applies terrain preprocessing using WhiteboxGIS tools to generate the following rasters:
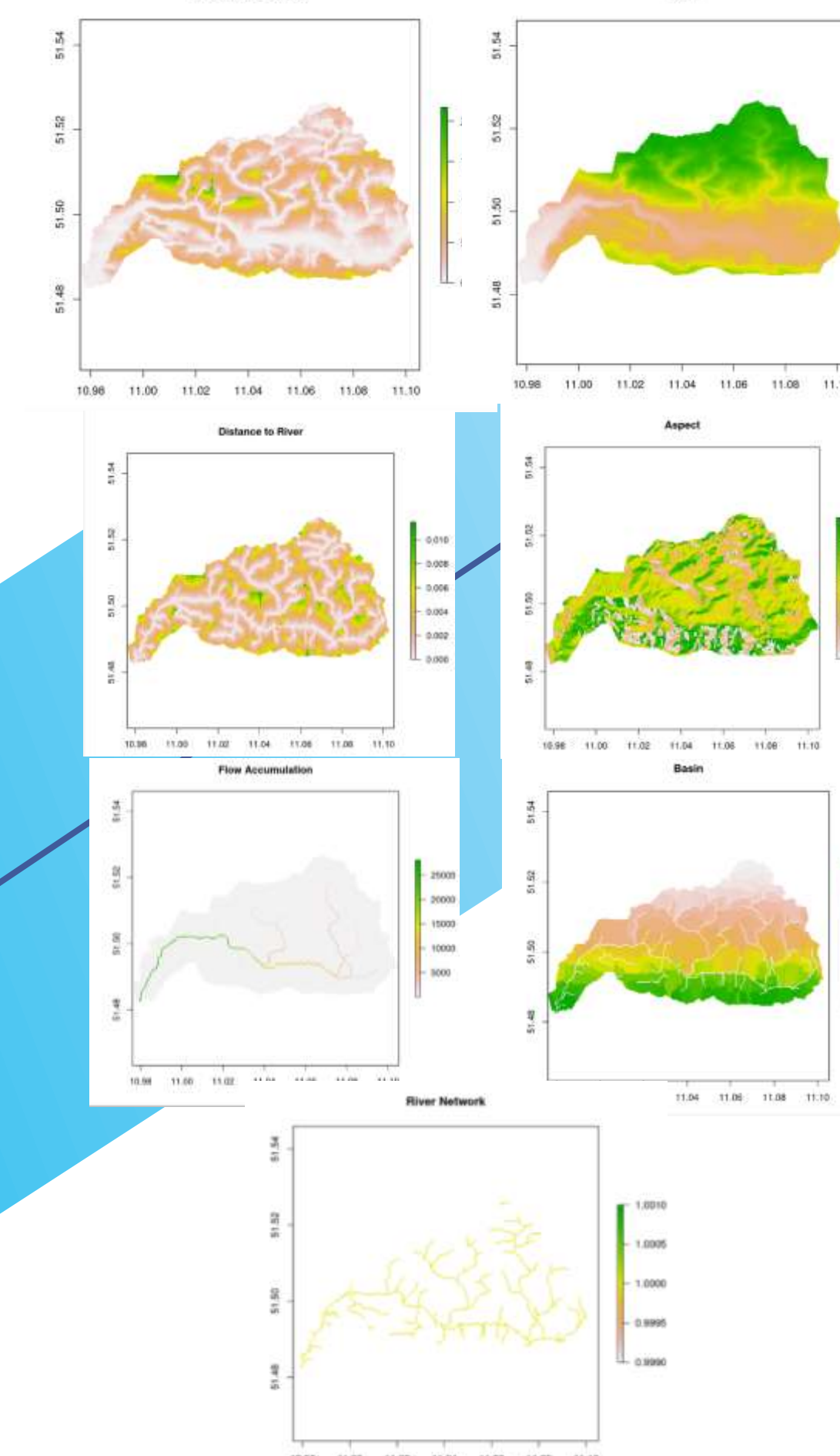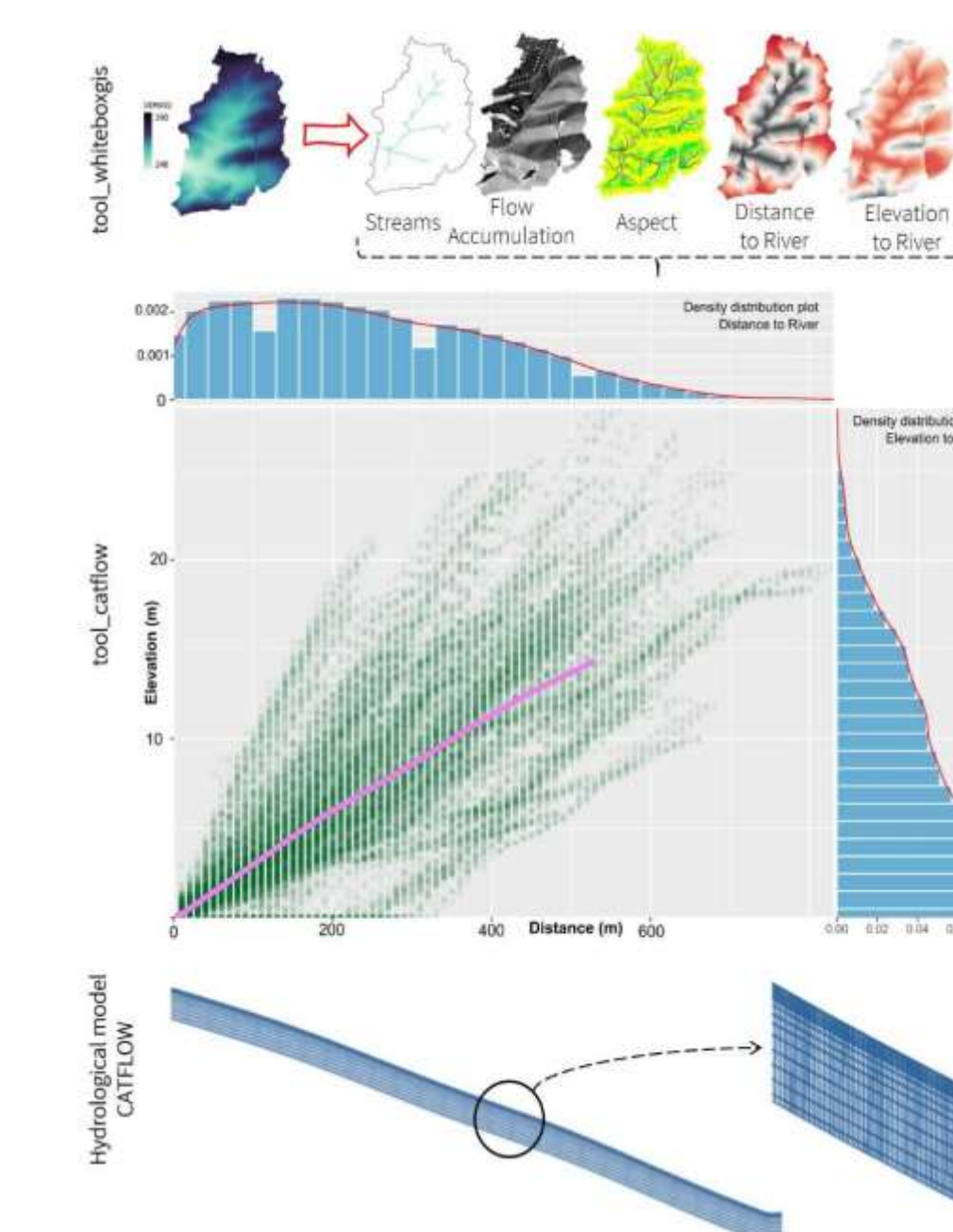

Download and Analyze
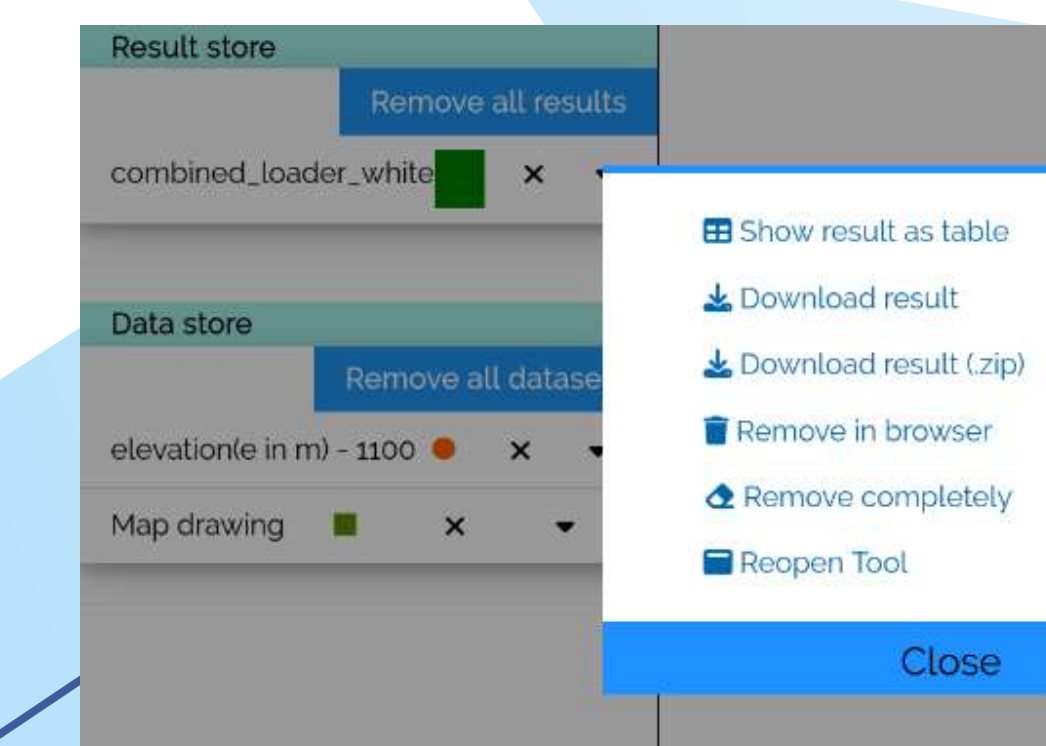
Downloadable Results

The obtained results from the tools can be downloaded as a Zip file, PDF files or used for further analysis
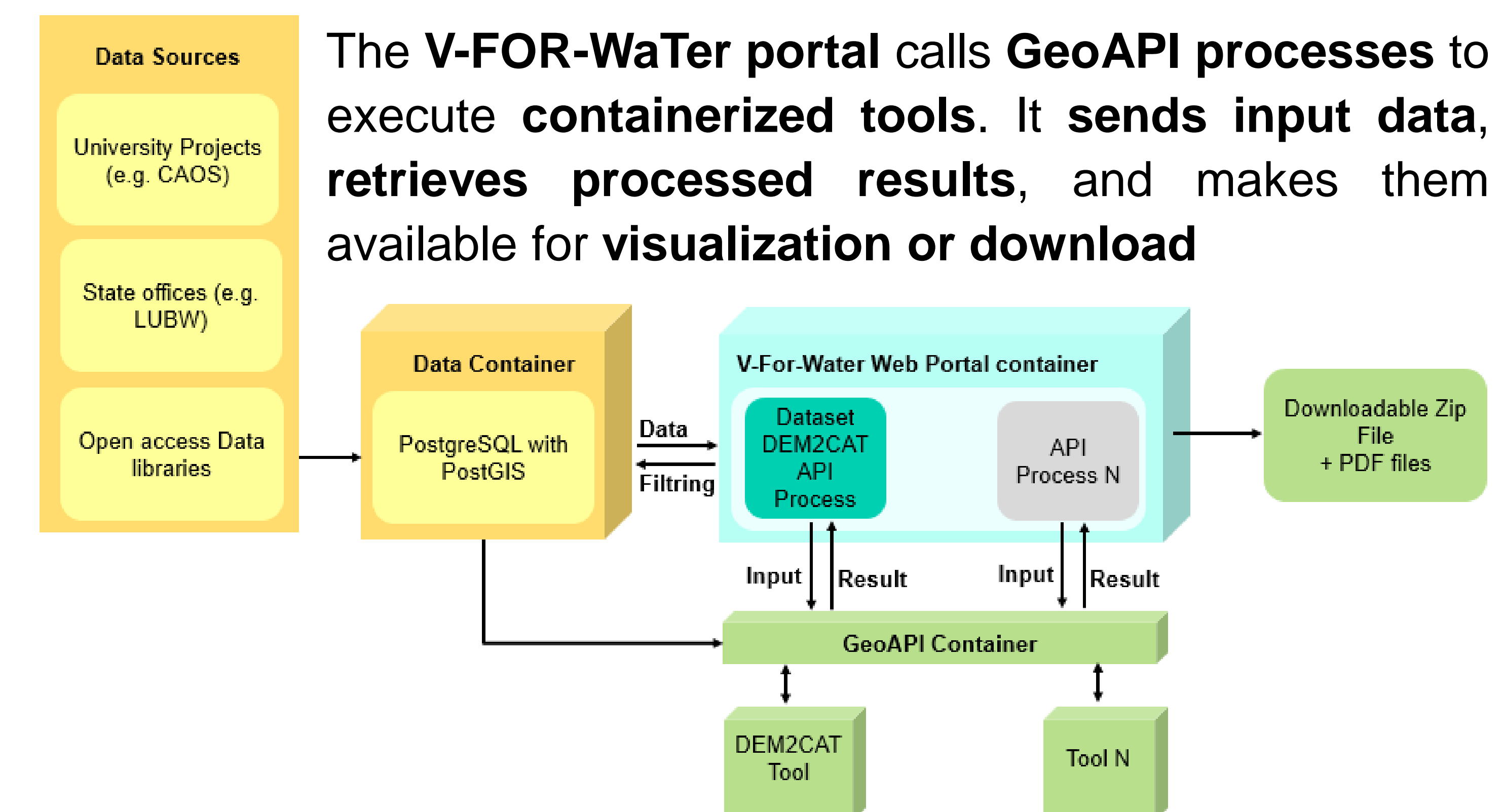

Using **DEM2CAT,** it is possible to reproduce the methodology from **Manoj et al. (2024)** [2] to extract representative hillslope catenas based on elevation and distance-to-river distributions. This aids in setting up process-based models to characterize flash floods in small headwater catchments.

The workflow supports setup of **process-based models in other data-scarce regions, as demonstrated in Manoj et al. (2024)** [2]

The **V-FOR-WaTer portal** calls **GeoAPI processes** to execute **containerized tools**. It **sends input data**, **retrieves processed results**, and makes them available for **visualization or download**

[1]Mälicke, M. et al.: Using Docker for reproducible workflows, EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-15382

[2]Manoj J, Ashish et al. "Toward flash flood modeling using gradient resolving representative hillslopes", Water Resources Research, 60, e2023WR036420

More info at
https://www.vforwater.de/

Code available at
https://github.com/VForWaTer