EStreams: An Integrated Dataset of Streamflow, Hydro-Climatic Variables and Landscape Attributes for Catchments in Europe

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Summary

Motivation
- Lacking a European large-sample dataset focusing on daily streamflow
- Daily streamflow data exists but, is limited to what is available from national providers
- Accessing this “available” data is a challenging process

Key findings
- 15 047 European river catchments
- Covering +100 years and +200 variables:
  - Streamflow indices and signatures
  - Climatic time-series
  - Landscape attributes
  - Catchment boundaries

- Due to licence restrictions, we are not able to provide the daily streamflow data, but we offer:
  - Gauges metadata
  - Streamflow catalogue: where to find and download daily data
  - Python scripts for data retrieval, aggregation and processing

EStreams: daily streamflow data download for Germany: Niedersachsen

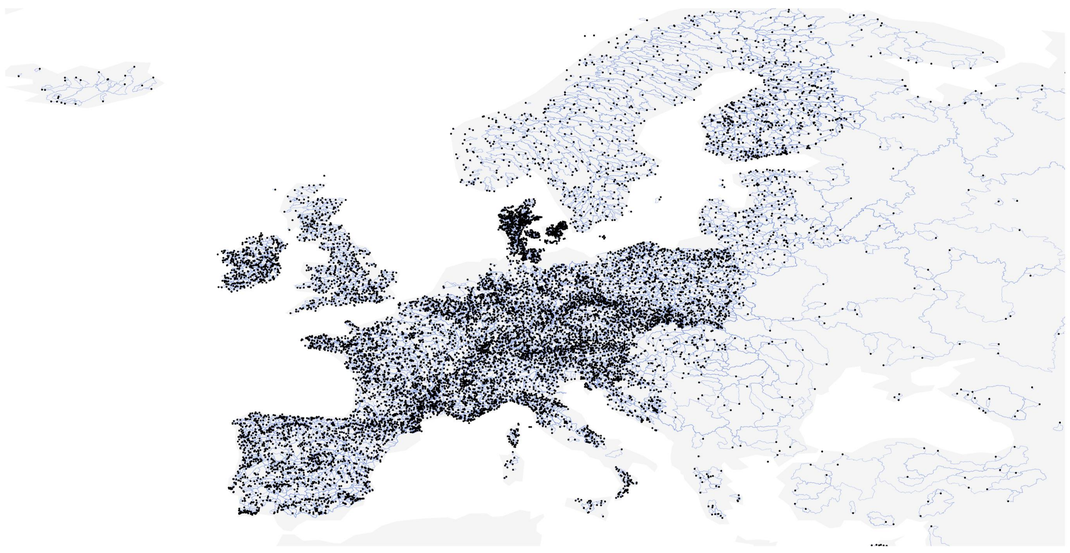
```
driver_path = r'C:\Users\jullarudlang\OneDrive - Delft University of Technology\Scripts\API\chromedriver.exe'
driver = webdriver.Chrome(executable_path=driver_path)

# Navigate to the website
driver.get("http://www.wasserdaten.niedersachsen.de/cadenza/pages/selector/index.xhtml;jsessionid=D98BADD048D937F25ACF8B748567A21C")

s = np.arange(0, 253, 1) # Total amount of stations
a = np.arange(0, 80, 1)  # The available years

## Start Loop
for n in s:
    for i in a:
        #driver.find_element_by_xpath('//*[@id="s21d_j_idt1324:tableCondition"]').click()
        time.sleep(5)

        driver.find_element_by_xpath('//*[@id="j_idt183"]').click() # deleting any previous data

        time.sleep(8)

        # choosing the station
        driver.find_element_by_xpath('/html/body/div[1]/div[2]/div/div/div[1]/form[1]/div[1]/div/div[1]/div[2]/div[1]/div/div[1]/div[3]/div/div[2]').click()

        time.sleep(8)

        driver.find_element_by_xpath(f'//*[@id="j_idt618:conditionTable:{n}:n"]/td[1]/div').click()
        driver.find_element_by_xpath('//*[@id="selectorDialogPanel"]/div[2]').click()

        time.sleep(5)

        # choosing year
        driver.find_element_by_xpath('//*[@id="j_idt237:zeit_cnd_Panel"]/div/div[2]').click() # this is opening the pop up where you choose the year

        time.sleep(5)

        try:
            time.sleep(5)
            driver.find_element_by_xpath(f'//*[@id="j_idt618:conditionTable:{i}:n"]/td[1]/div/div').click() # this is choosing the first year in the table
        except:
            driver.find_element_by_xpath('/html/body/div[3]/div[1]/a').click()
            break  # exit the inner loop and move on to the next station

        driver.find_element_by_xpath('//*[@id="selectorDialogPanel"]/div[2]').click() # click OK to close the pop up

        time.sleep(5)
        # choosing the parameter
        driver.find_element_by_xpath('//*[@id="j_idt275:parameter_cnd_Panel"]/div/div[2]').click() # choose parameter pop up

        time.sleep(7)
        driver.find_element_by_xpath('//*[@id="j_idt618:conditionTable:1:n"]/td[1]/div/div').click() # choose discharge
        driver.find_element_by_xpath('//*[@id="selectorDialogPanel"]/div[2]').click() # click ok

        # Download
        time.sleep(5)
        driver.find_element_by_xpath('//*[@id="topToolbarForm:saveAsMenu"]/div').click()
        driver.find_element_by_xpath('//*[@id="topToolbarForm:saveAsMenu"]/div/ul/li/a/div').click()
```

Do you want to know more?

Preprint Dataset GitHub

Method

- Data collection from national providers
- Integration with already existing large datasets
- Catchment boundaries delineation with the Global Watersheds web app



The resulting distribution of catchment boundaries in blue and streamflow gauges as black dots

What is next for this research?

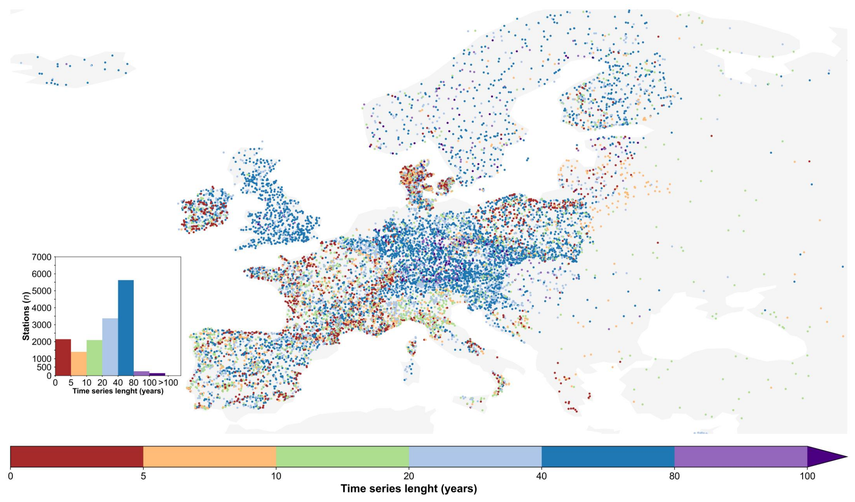
EStreams is the foundation of my PhD research titled: Why is the hydrological response in some river catchments more sensitive to environmental change than in others?

The first step to answer this question is to understand the major controls of the hydrological response in Europe.

Our current hypothesis is that climate is the dominant control at the continental scale. However, the density of data in the EStreams dataset allows for detailed analysis at the regional scale, where we hypothesise that landscape characteristics play a major role in controlling the hydrological response.

Dataset and Catalogue

EStreams dataset: 15 047 river catchments
- Streamflow data available as indices at the resolutions: weekly, monthly, seasonal and annual
- Time-series records up to 120 years (between 1900 – 2023)
- Derived catchment boundaries

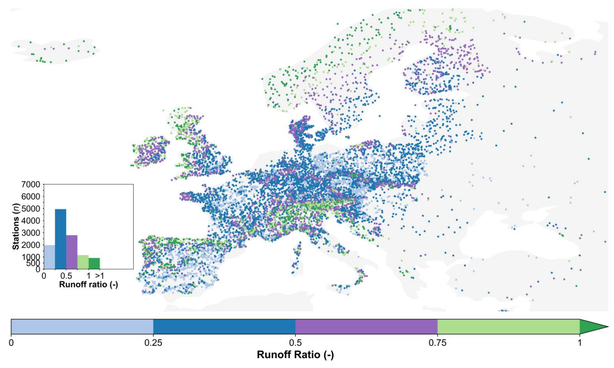


Streamflow data catalogue
- Information on data providers, such as name and country
- Information on license redistribution
- Weblinks for retrieval of data at daily resolution

We also provide Python scripts for data retrieval, aggregation and processing per catchment

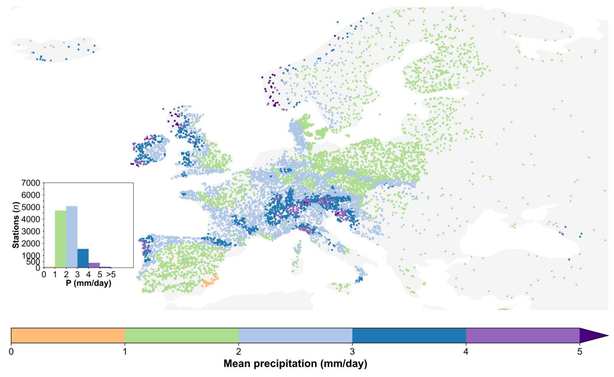
Hydro-Climatic Signatures

Several hydrological and climatic signatures are included, for the dataset to be “ready to use” for various analyses by anyone



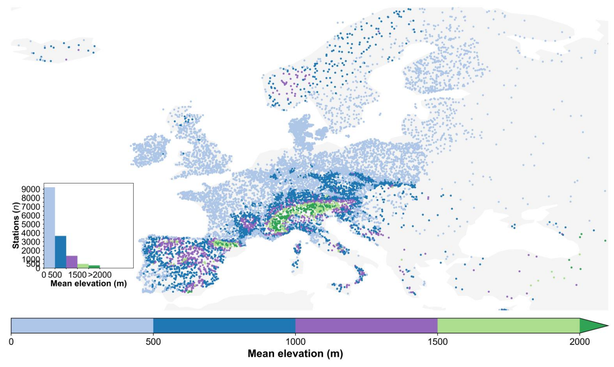
Temporal Attributes

- Meteorological (E-OBS): precipitation, temperature and potential evapotranspiration at a daily timestep
- Vegetation (MODIS): LAI, NDVI and snow cover at monthly/annual timestep
- Landcover (CORINE): landcover type



Static Attributes

The static attributes included in the dataset cover various landscape descriptors such as elevation, soil type, root depth, lithology, dams and reservoirs



References
Thiago V.M. do Nascimento, Julia M. Rudlang, Marvin Höge, Ruud van der Ent, Máté Chappon, Jan Seibert, Markus Hrachowitz, Fabrizio Fenicia. (2024). *Estreams: An Integrated Dataset and Catalogue of Streamflow, Hydro-Climatic Variables and Landscape Descriptors for Europe.* Earth ArXiv. https://doi.org/10.31223/X5M39F

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