Advancing Water Resources Research: Use of JASMIN in Hydrological Innovation

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JASMIN

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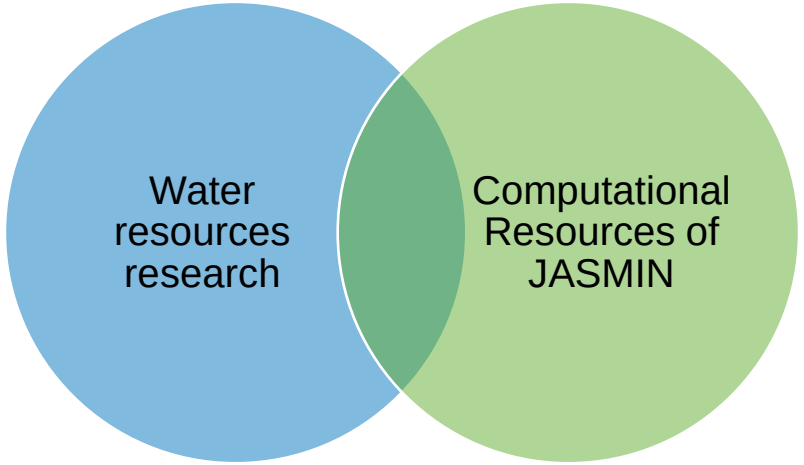
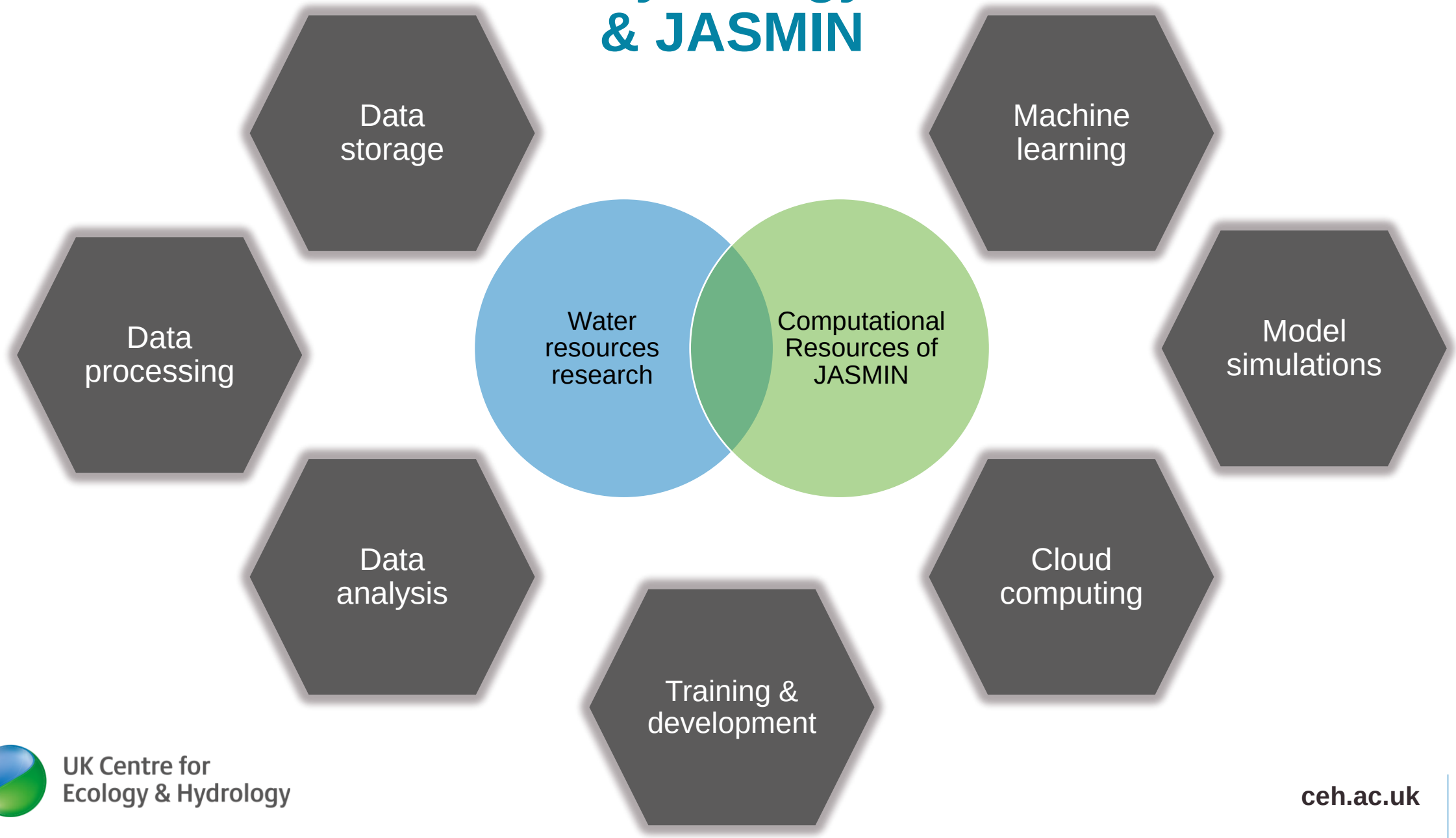
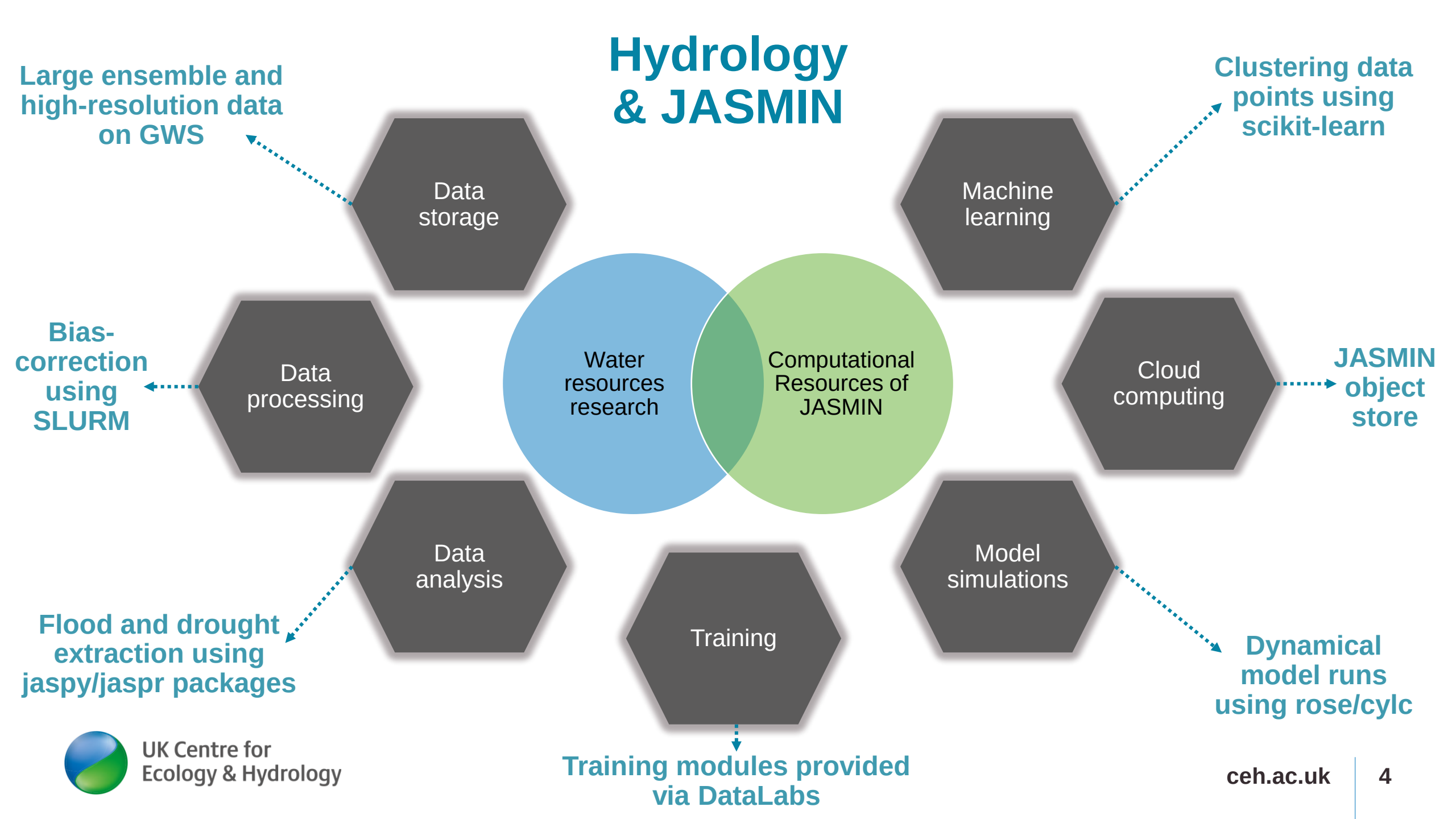
Hydrology & JASMIN



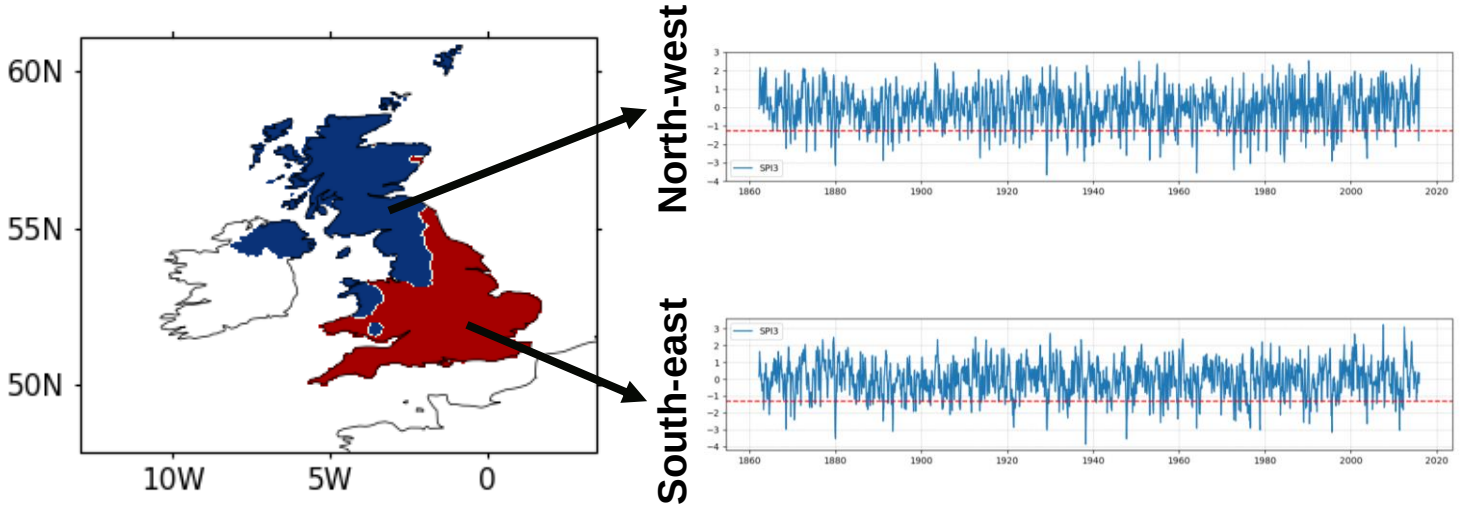
Hydrology & JASMIN



Hydrology & JASMIN



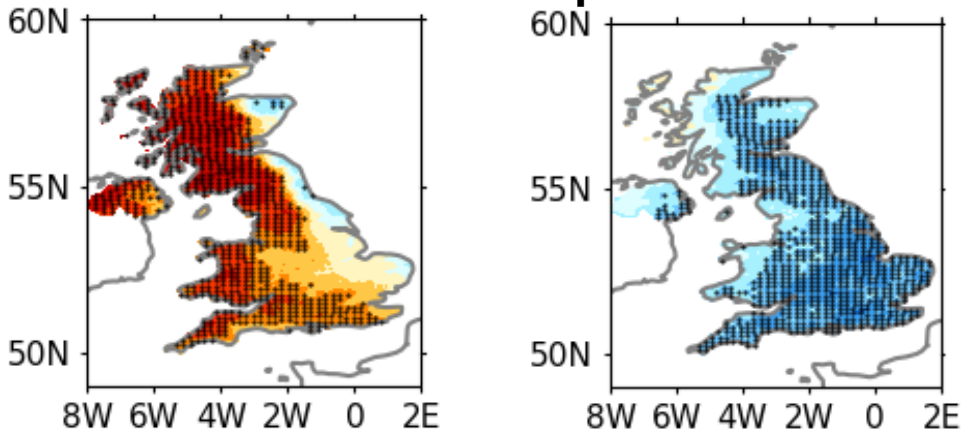
Homogenous rainfall regions: Regional clustering



SPI3 regional clusters identified using k-means clustering

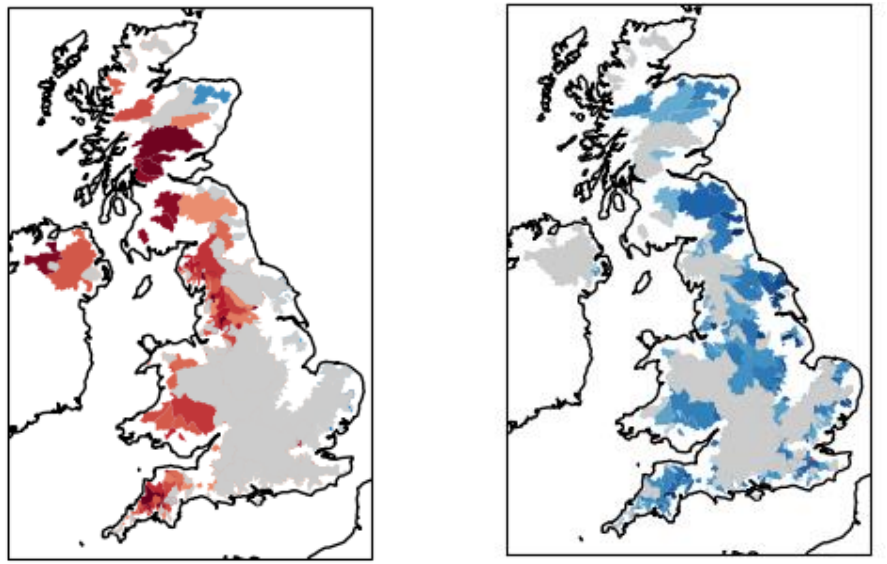
Regional area-averaged standardized SPI3 time series and the 10th percentile threshold

Standardised Precipitation Index



Regional homogeneity of Rainfall has impacts over streamflow too

Standardised Streamflow Index



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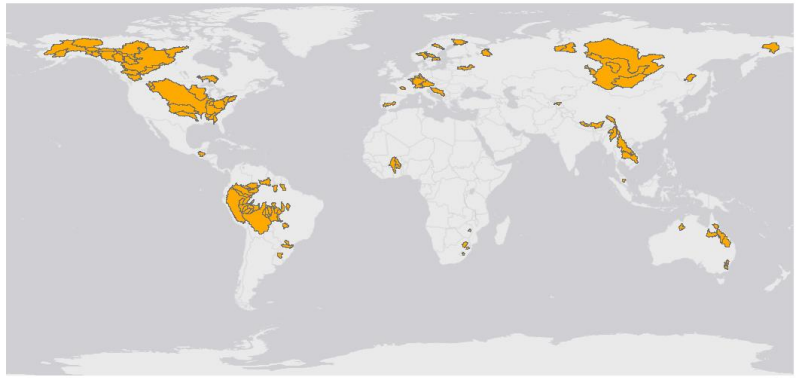
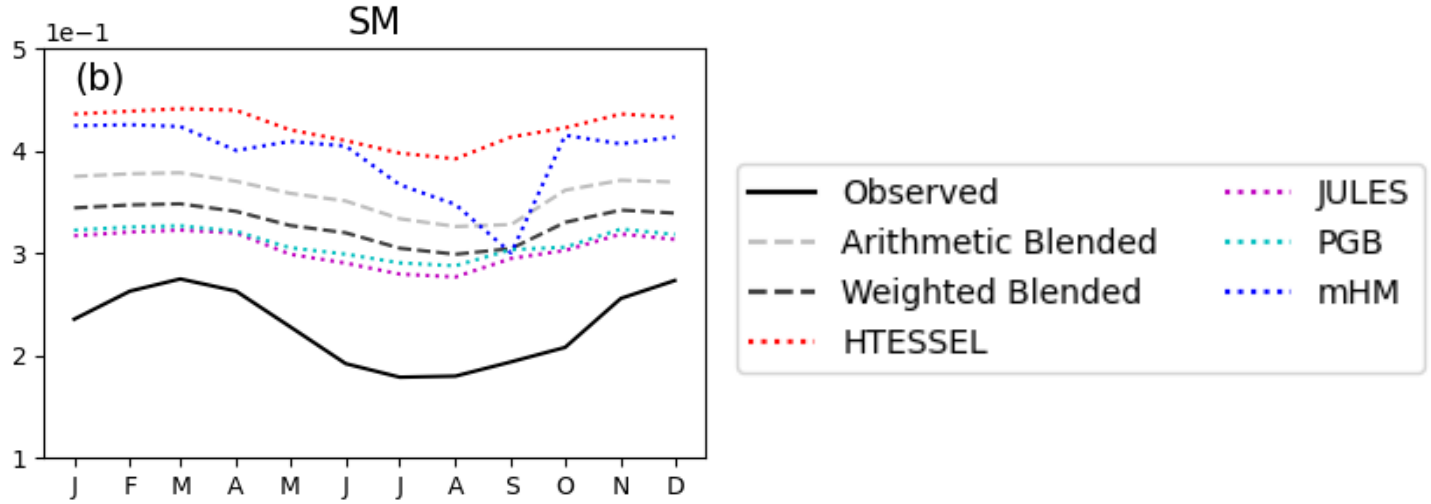
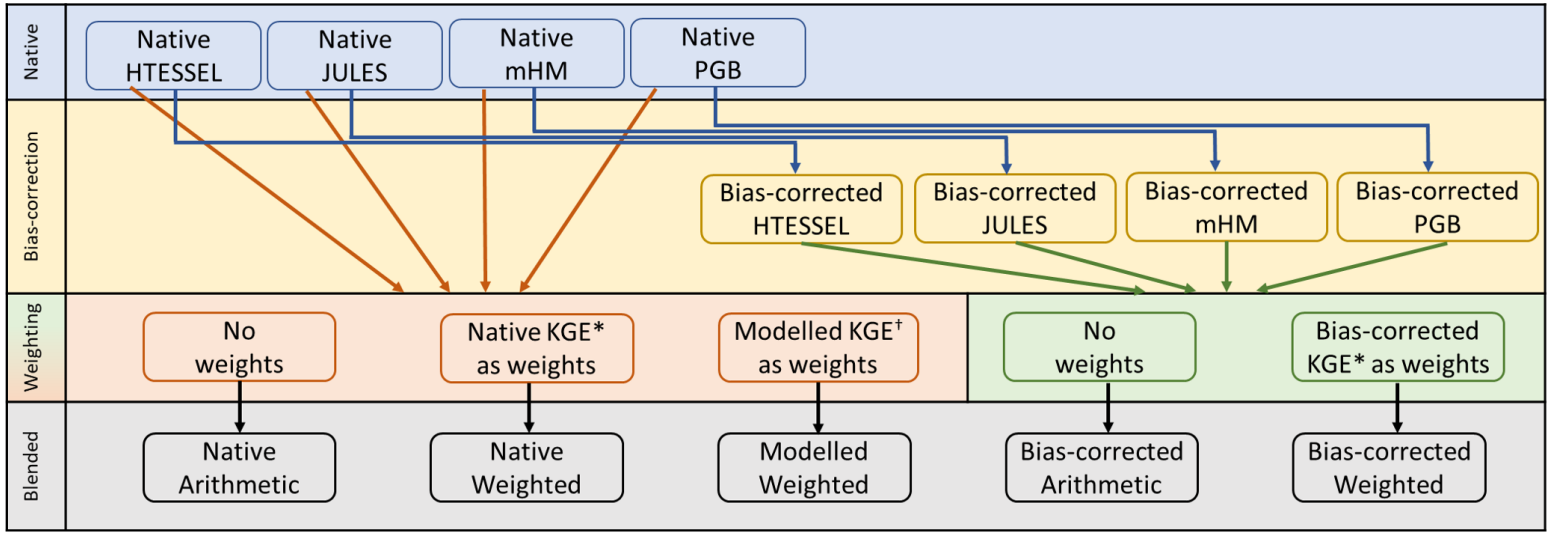
Chevuturi A, Tanguy M, Svensson C, Hannaford J and NOC; NCAS

Forecasts for ungauged catchments: Multi-model blending & Bias-correction





Bias-correction & Blending



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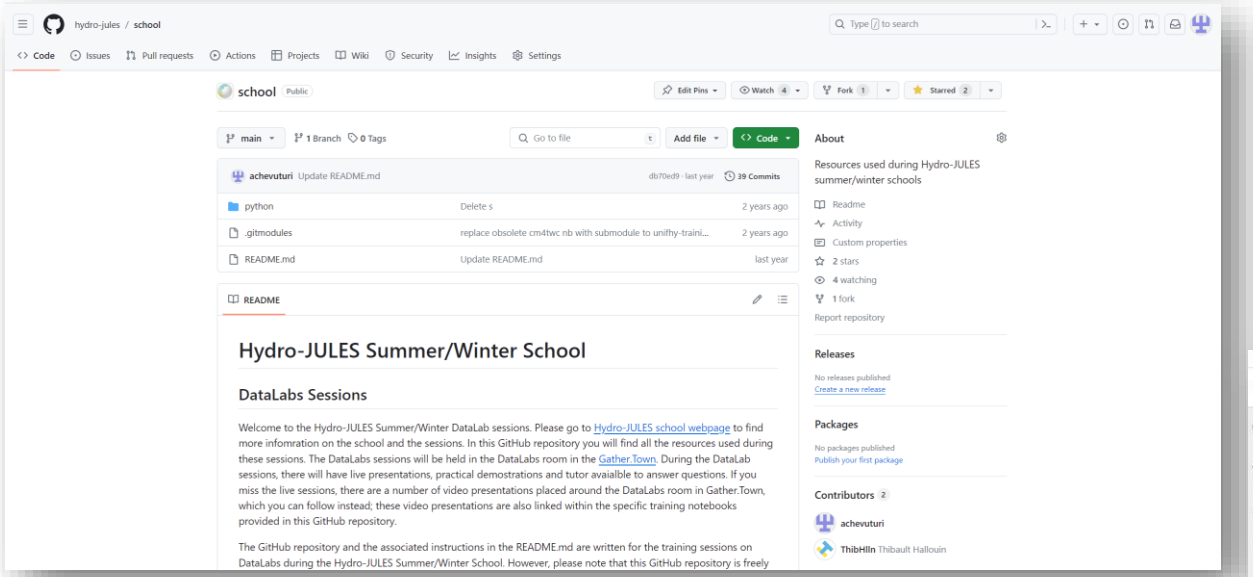
Chevuturi A, Tanguy M, Facer-Childs K, Sarkar S, Blyth E and UFZ; UU

Training & development: Hydro-JULES summer/winter school

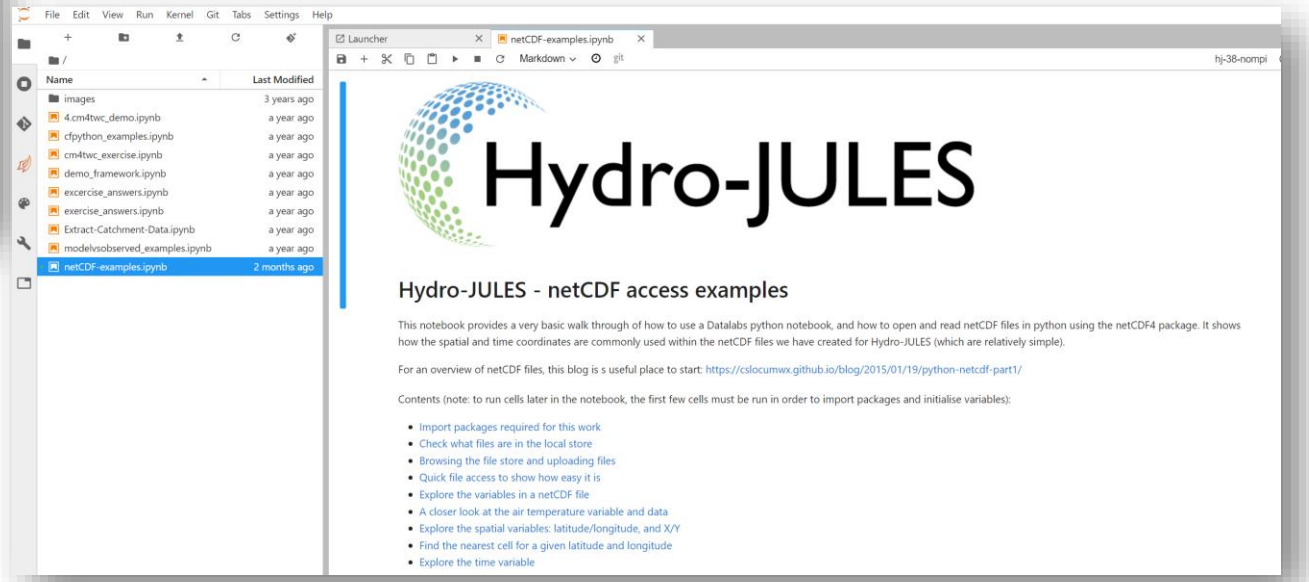
GitHub repository



DataLabs Sessions:

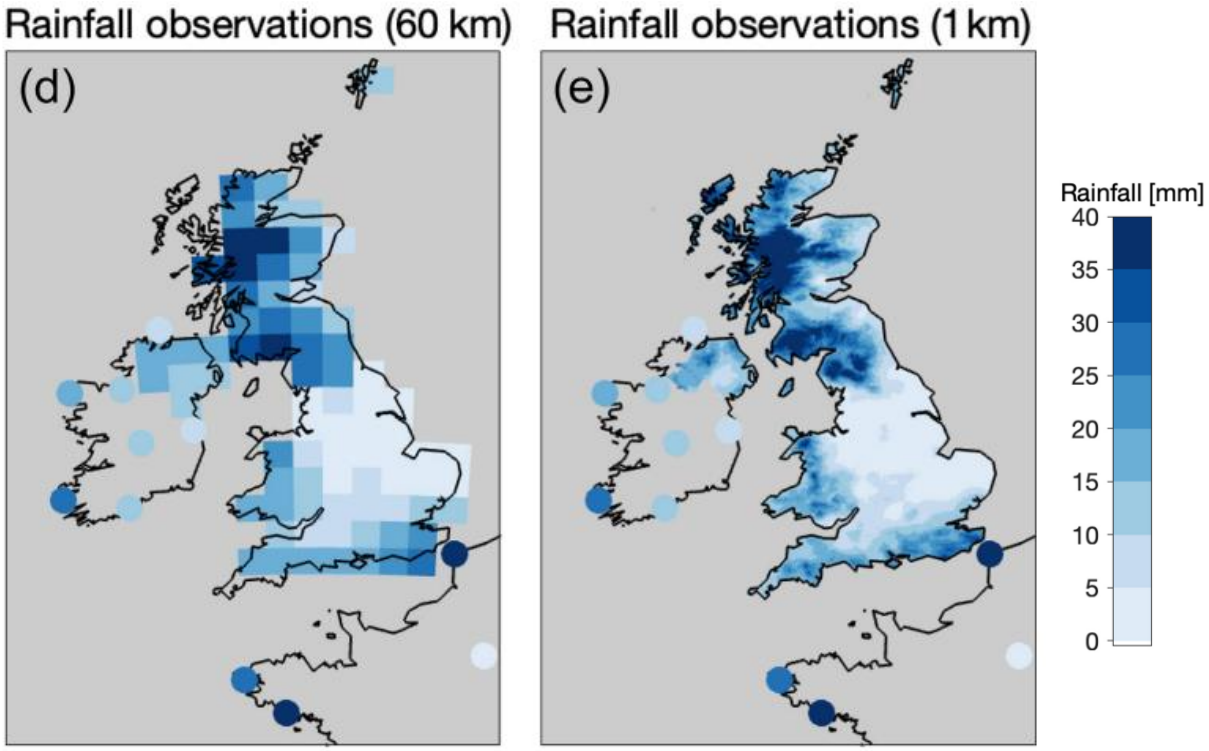
- HydroJULES model simulation
- NetCDF output analysis & visualisation

Training provided through DataLabs

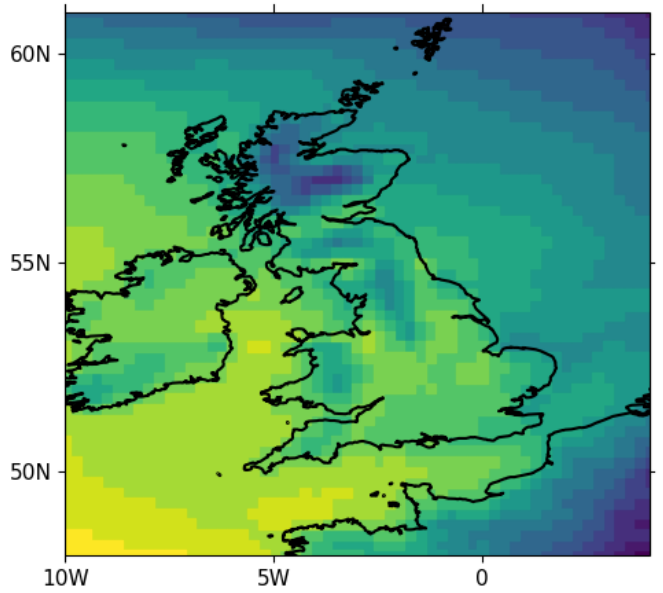


High resolution reanalysis: Downscaling

Weather Rescue Citizen Science Project

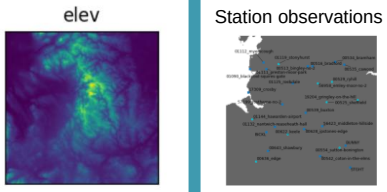


Hawkins et al., 2023

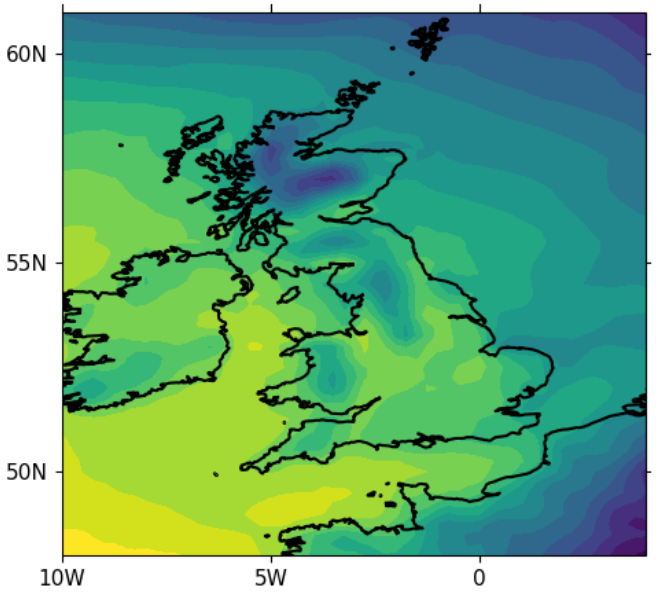


~25km horizontal resolution

Downscaling



ERA5 Daily 2m Temperature



1km horizontal resolution

Infrastructure for near-real-time (NRT) modelling

NRT 1km UK based JULES model workflow

1km driving data

ERA5 downscaling

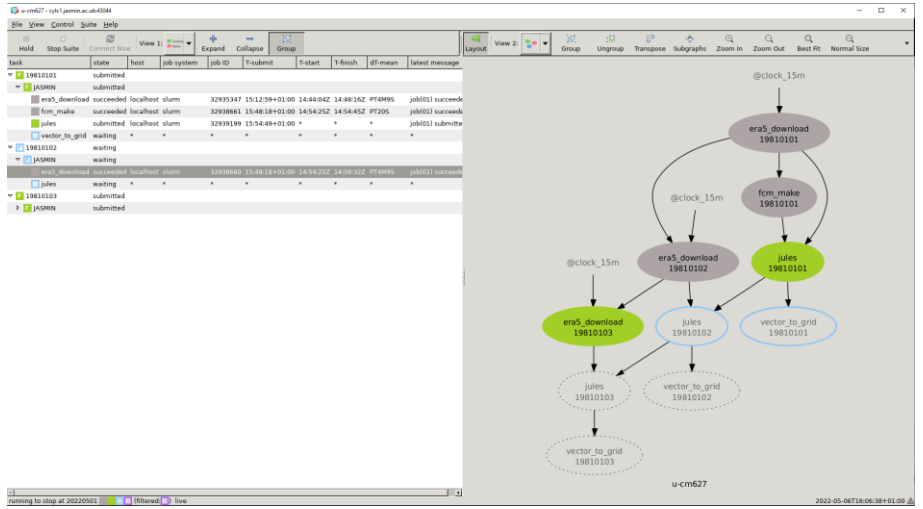
JULES model

JULES
Joint UK Land Environment Simulator

Model outputs

- Make data available to community
- JASMIN object store
- Datalabs

DataLabs



- Implementing these processes within a workflow engine on JASMIN (Cylc)

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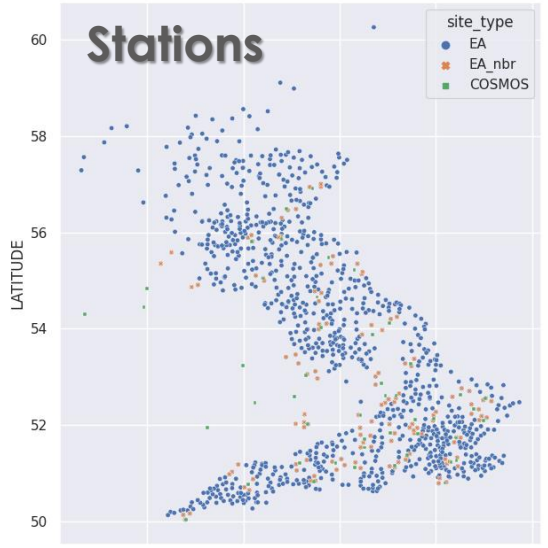
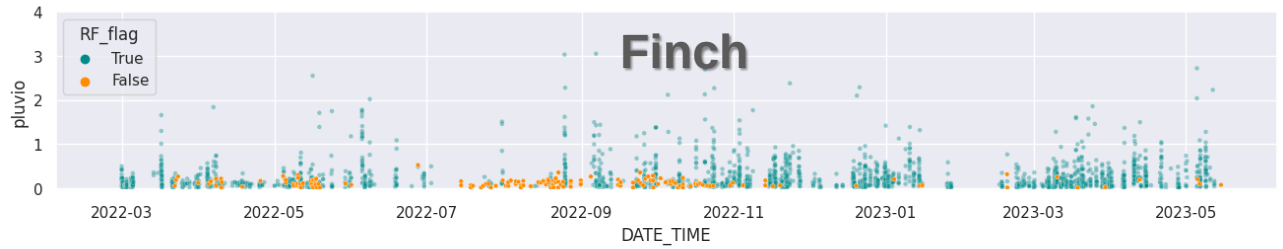
Quality control of observations: Rainfall and Soil Moisture

Cosmic-ray soil moisture monitoring (COSMOS) network





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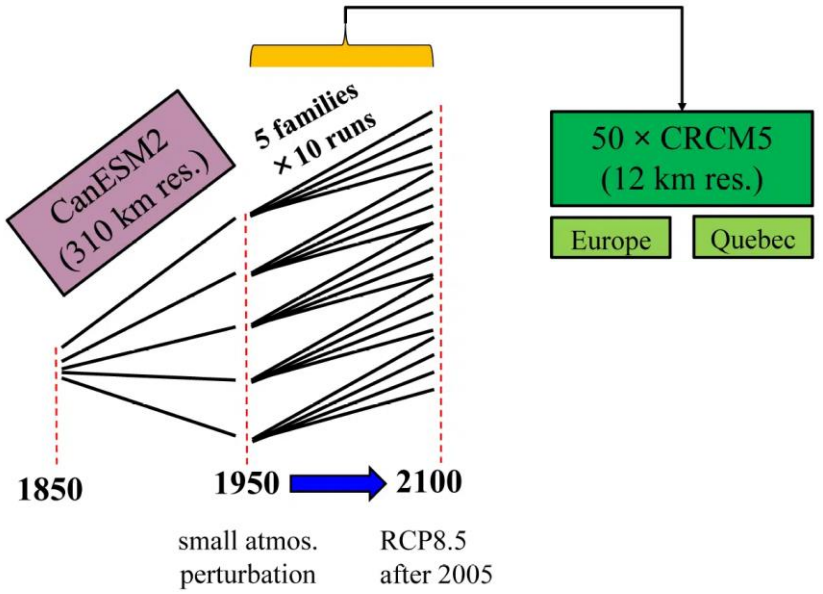
Khamis D, Stanley S, Smith R, Fry M and the rest of the COSMOS team

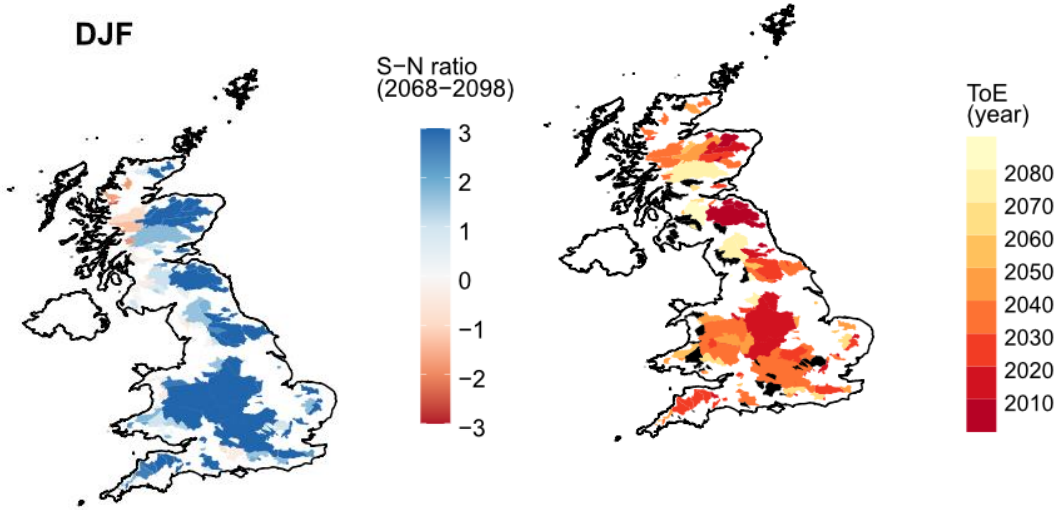
Use of JASMIN in CANARI

- Data access of observations to obtain the input data and ancillary information needed for hydrological modelling via **CEDA**
- Processing climate model data (MSLP, wind speed, pr, tas) using **LOTUS** (50 ensemble members)
- Hydrological model simulations of 200 UK catchments initiated through R to simulate river flows at catchments across Great Britain using **LOTUS**



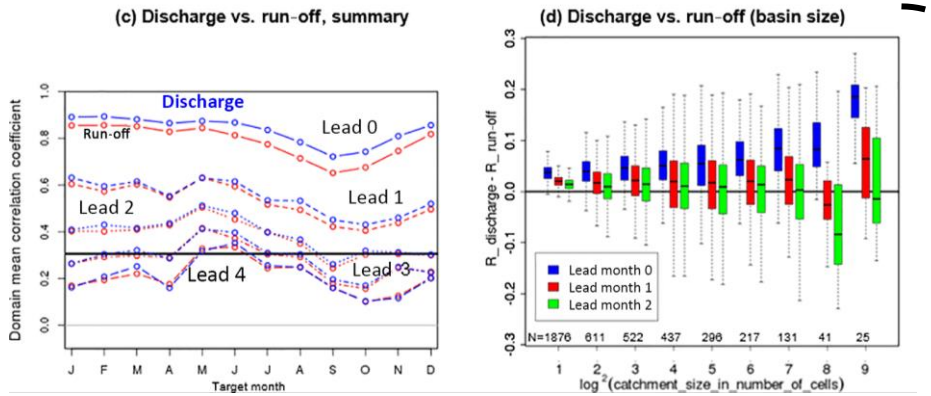
Plans in 2024

- Climate data processing of CANARI LE (calculation of PE, bias correction, downscaling)
- Hydrological simulations using historical runs of the CANARI LE



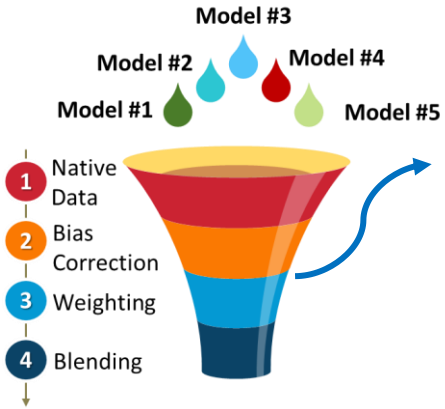
Hydrology

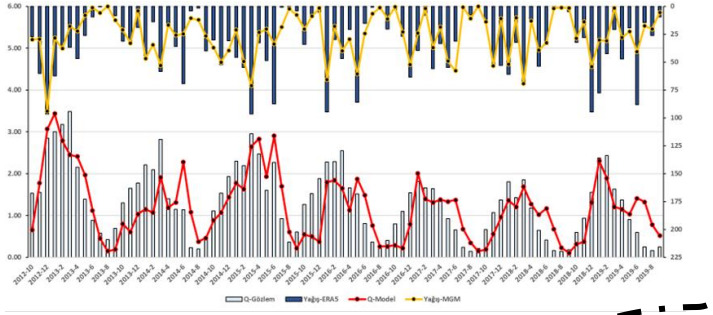
- **Seasonal Streamflow Forecast Verification Workbench**



https://doi.org/10.5194/hess-22-3453-2018

- **Model Blending and Bias-Correction for Forecasts**

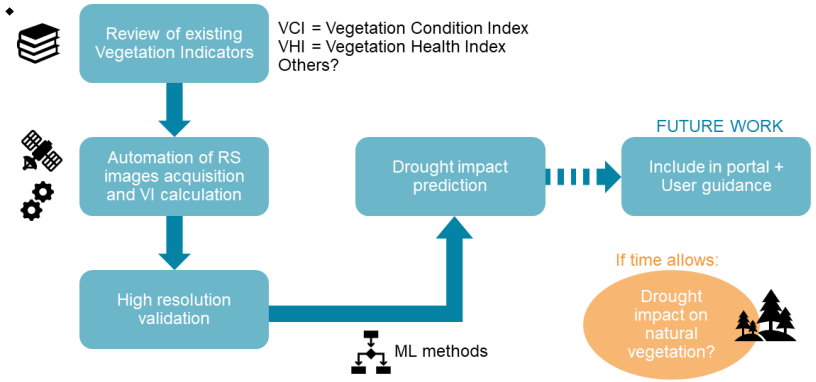




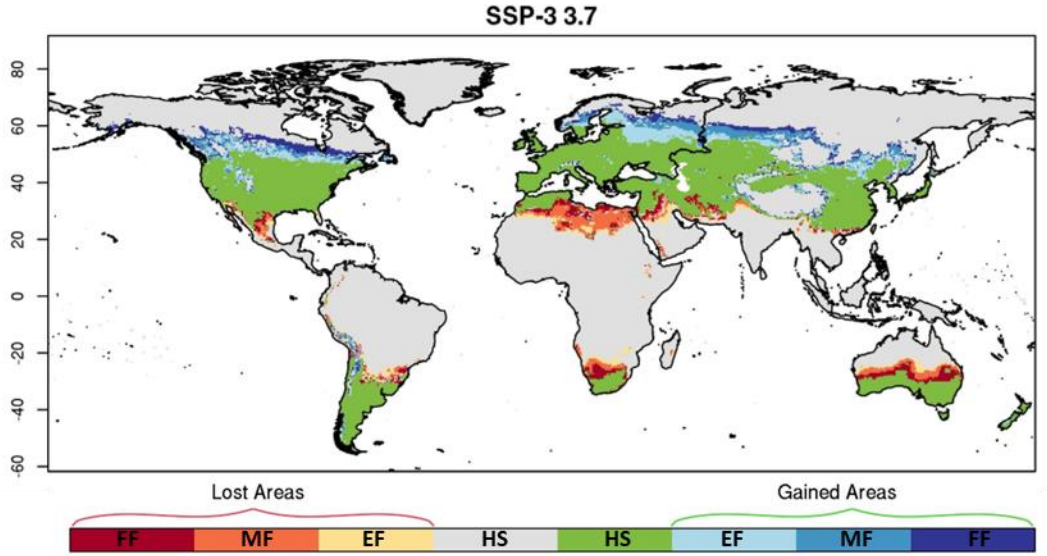
JASMIN

Agriculture

- **Drought Impact Estimation**



- **Global Scale Multi-Model & Scenario Drought Analysis**



Burak Bulut, PhD
Hydrological & Crop Modelling
Climate Change Impacts on **Hyd.&Agr.**
Spatio-Temporal Analysis of Large Datasets

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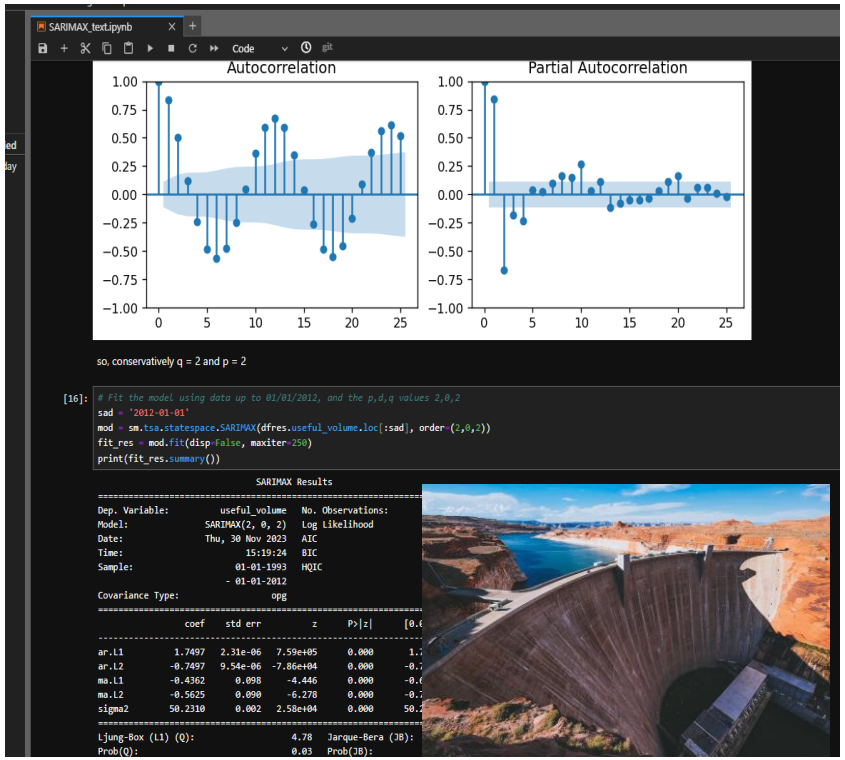
Bulut B, Facer-Childs K, Hannaford J

Hydrological modelling with anthropogenic influences

- Limited use of Jasmin up until now – attended training course in Nov 2022
- Jasmin notebooks used for machine learning task on reservoirs
- Jasmin will be used to develop and run JULES in ‘Big Thaw’. Collaboration with U. Edinburgh, U. Birmingham and BAS
- Water resources model runs using ensemble climate input and JULES outputs, as part of NERC NC International



Benefits around a shared workspace and data

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JULES
Joint UK Land Environment Simulator

Final points…

Open dialogue between JASMIN team and researchers

Examples for discussion topics for the future:

- GPU computing
- Cloud storage changes
- Kubernetes
- Group workspace migration
- FORTRAN compilers

Thank you

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JASMIN

Computing for Climate: JASMIN's Impact on Hydroclimatic Risk Science

Matt Brown
Mark Rhodes-Smith
Nathan Missault

6th Feb 2024

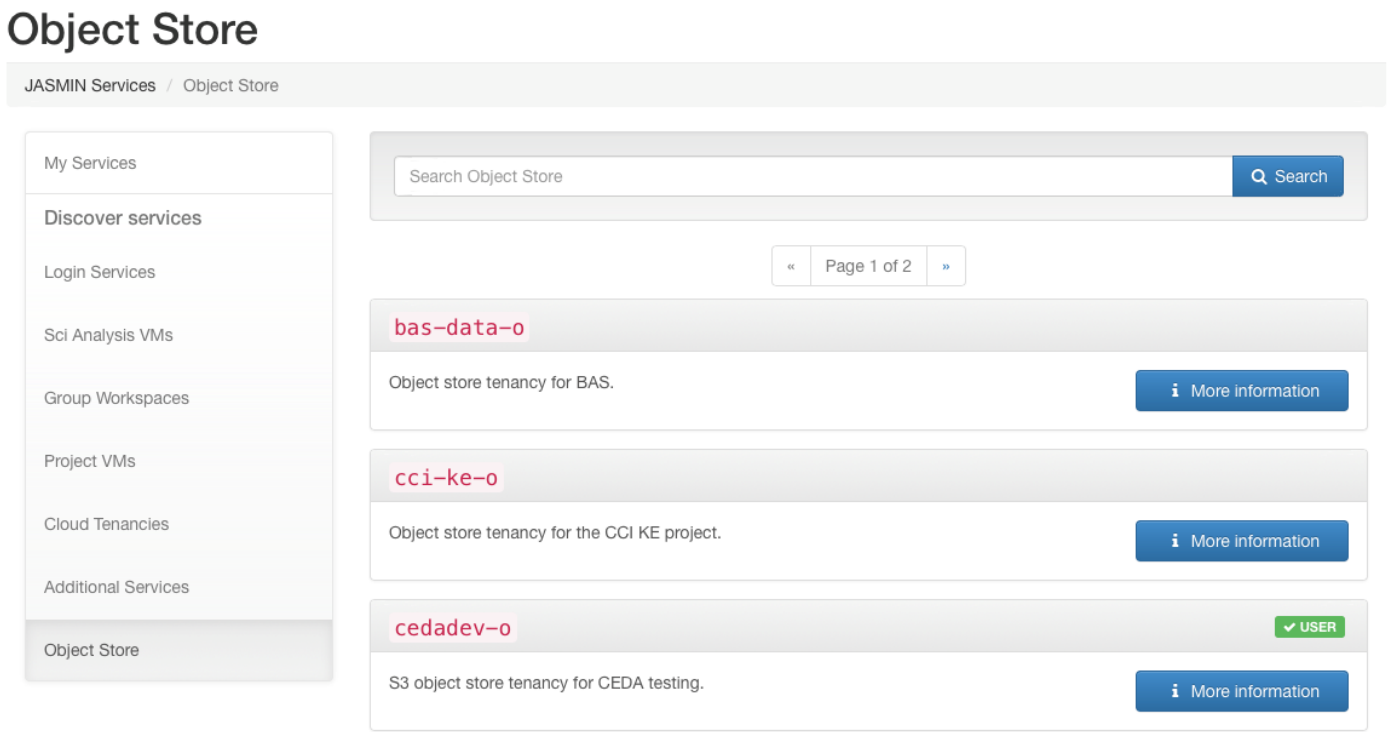
UK Centre for Ecology & Hydrology

JASMIN Object Storage

Storing and accessing big data is a major concern with large amounts of climate data being produced

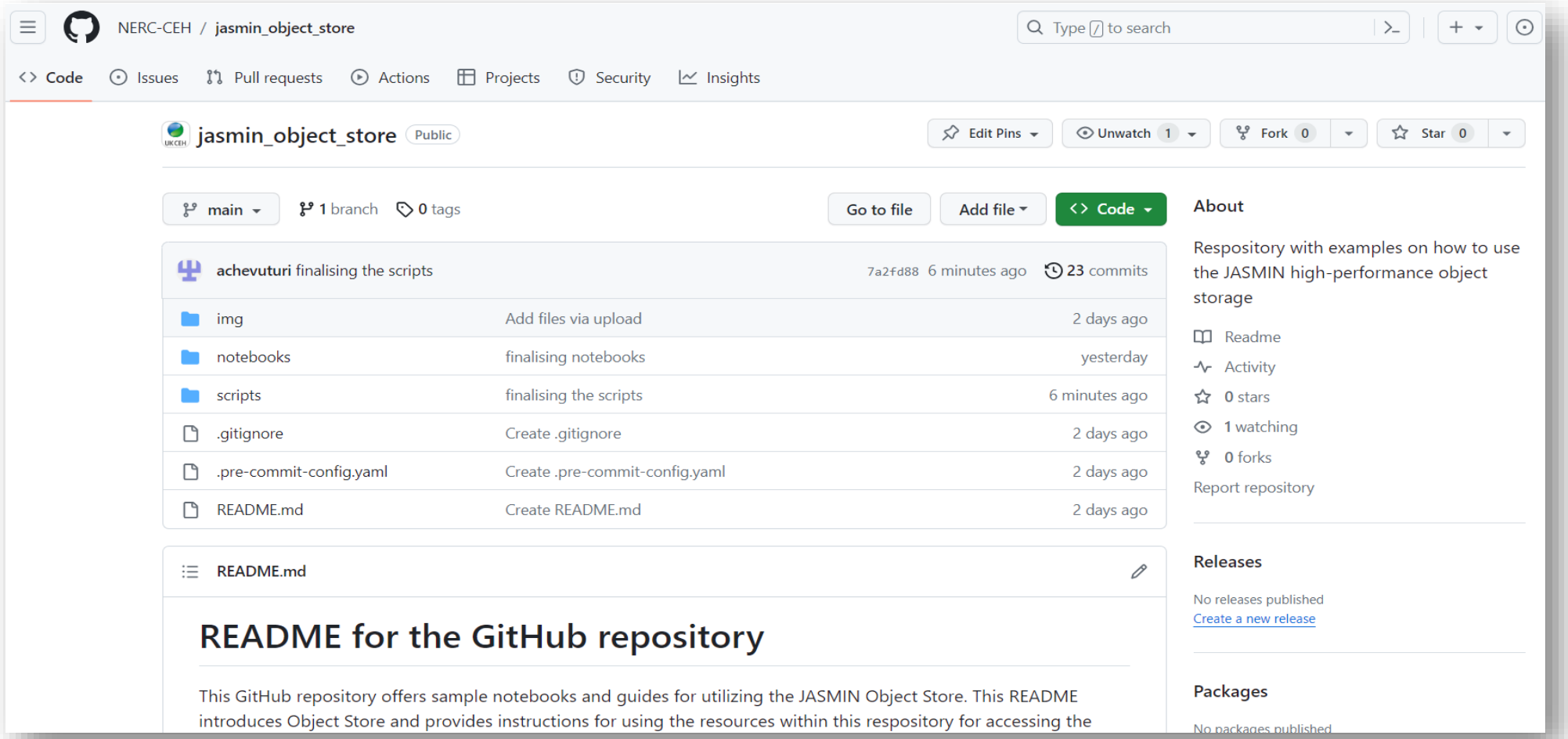
One of the newest solutions we are exploring is the *JASMIN Object Store*

Aim: **To produce materials helping scientists make use of this new technology**



JASMIN Object Store

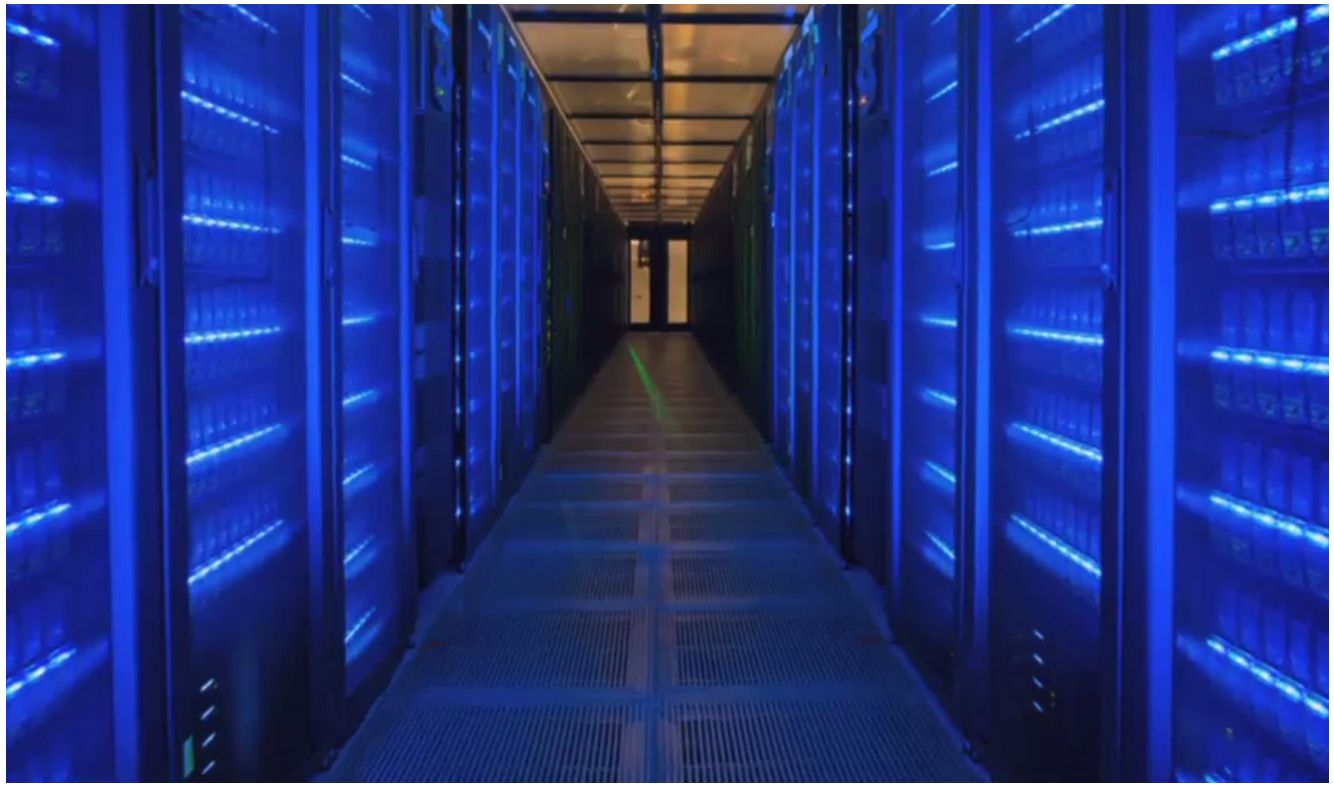
JASMIN Object Storage - GitHub Repository



https://github.com/NERC-CEH/jasmin_object_store

JASMIN Object Storage – Future Work?

- Develop training module/labs (e.g. HJ winter and summer school)
- Connect Object Store to API type interfaces??
- Use apache-beam on JASMIN for more robust processing of input data?
- Integrate with DataLabs?



https://www.scd.stfc.ac.uk/Gallery/JASMIN.PNG

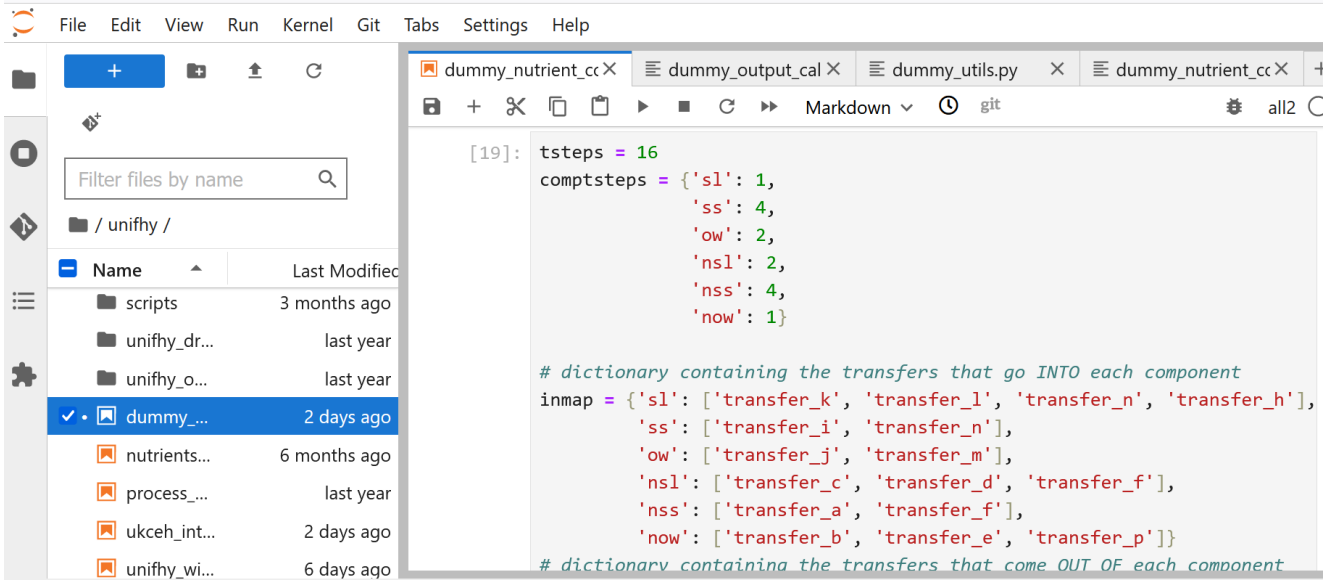
JASMIN Notebook Service and Dask Gateway

- Recent addition of write access to GWS has meant I now use these for data visualisation and testing
- Unclear how sharing of notebooks works?

- Dask-gateway service makes using dask on LOTUS **much** easier!

Hydro-JULES

unifhy

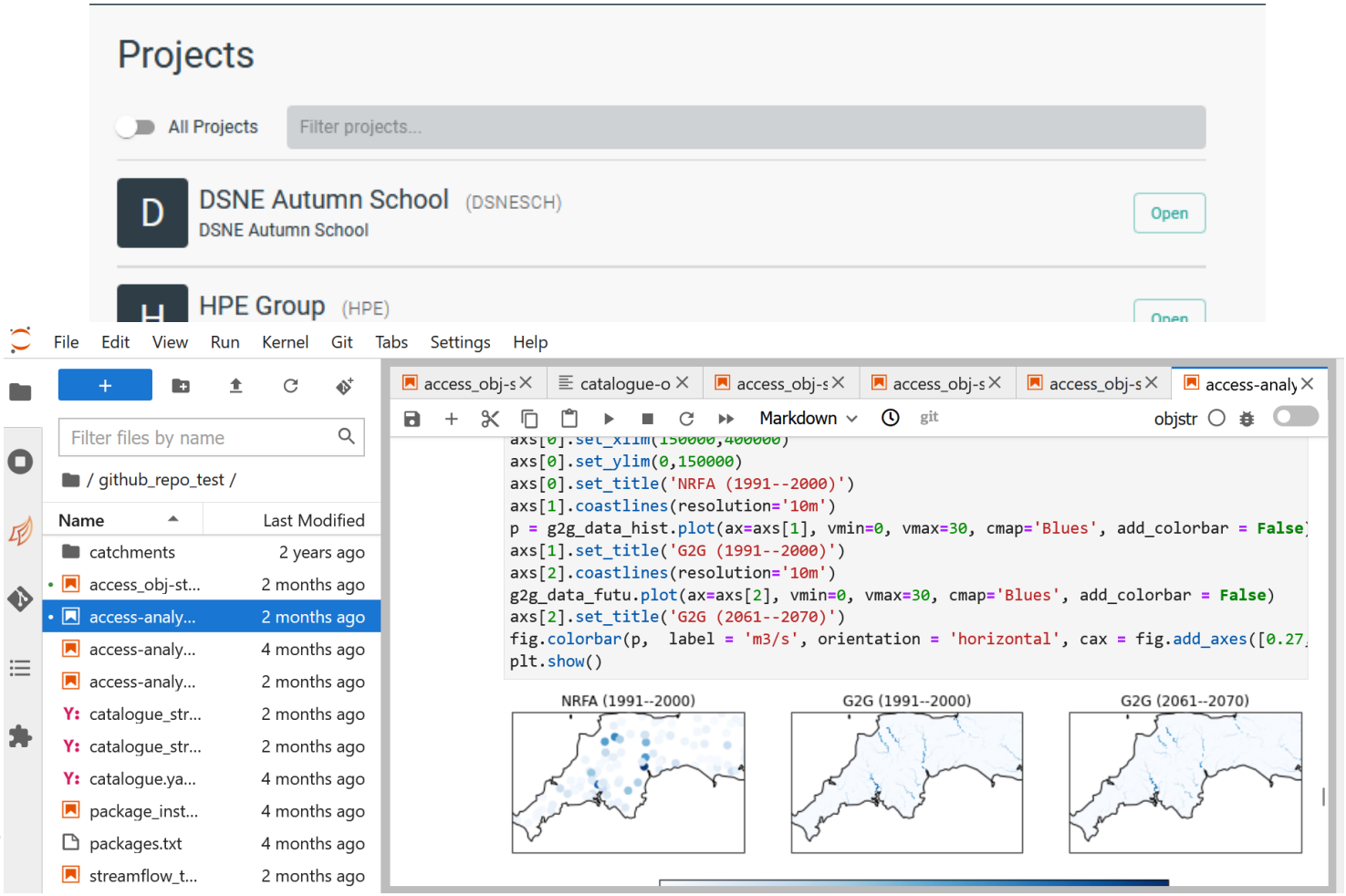


DataLabs

- Built on JASMIN unmanaged cloud?
- Great for training, collaborative working

- But…

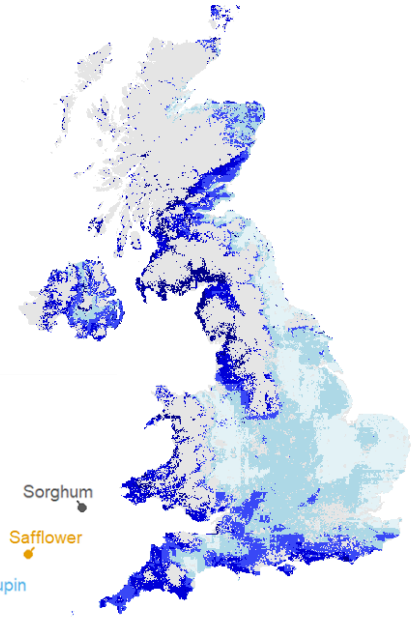
- Difficult to use for those unfamiliar with jupyter
- Unclear resource limits
- Storage (disk & obj) is fiddly to access/use

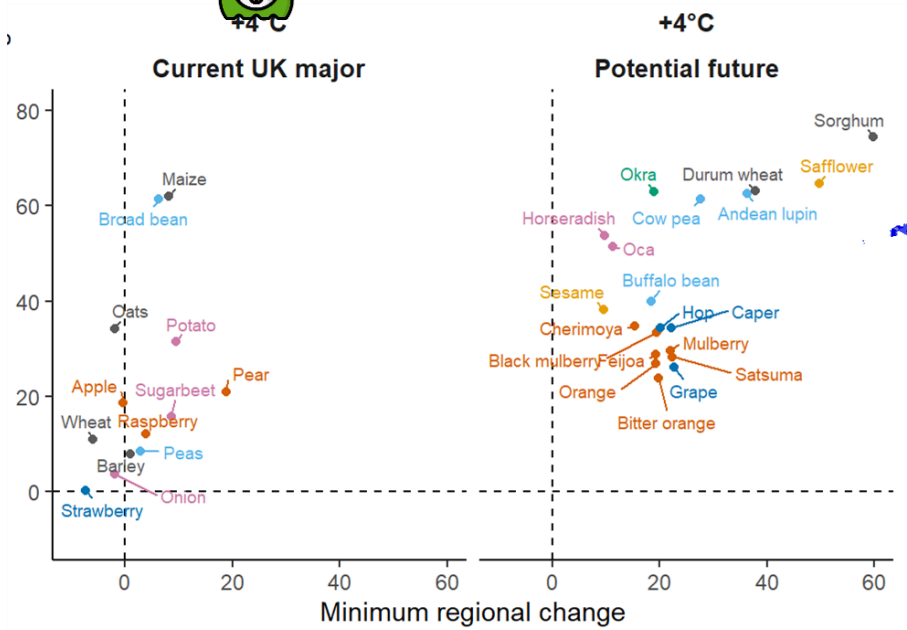


LOTUS

- In particular the high-memory queue has been super useful
- Used for high-RAM demand model runs when there is no option to run anywhere else
- Facilitated work on many projects, e.g. OpenCLIM

OPEN CLIMATE IMPACT FRAMEWORK



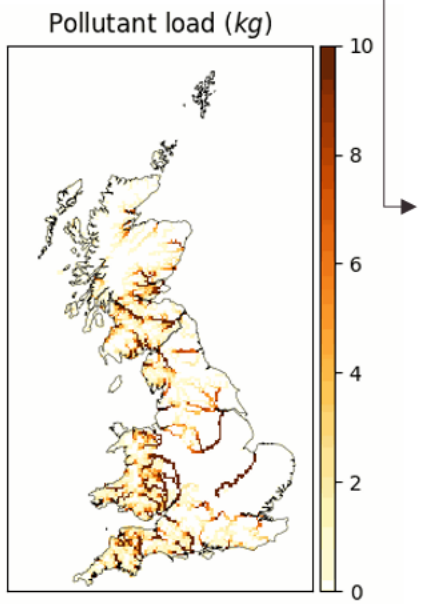


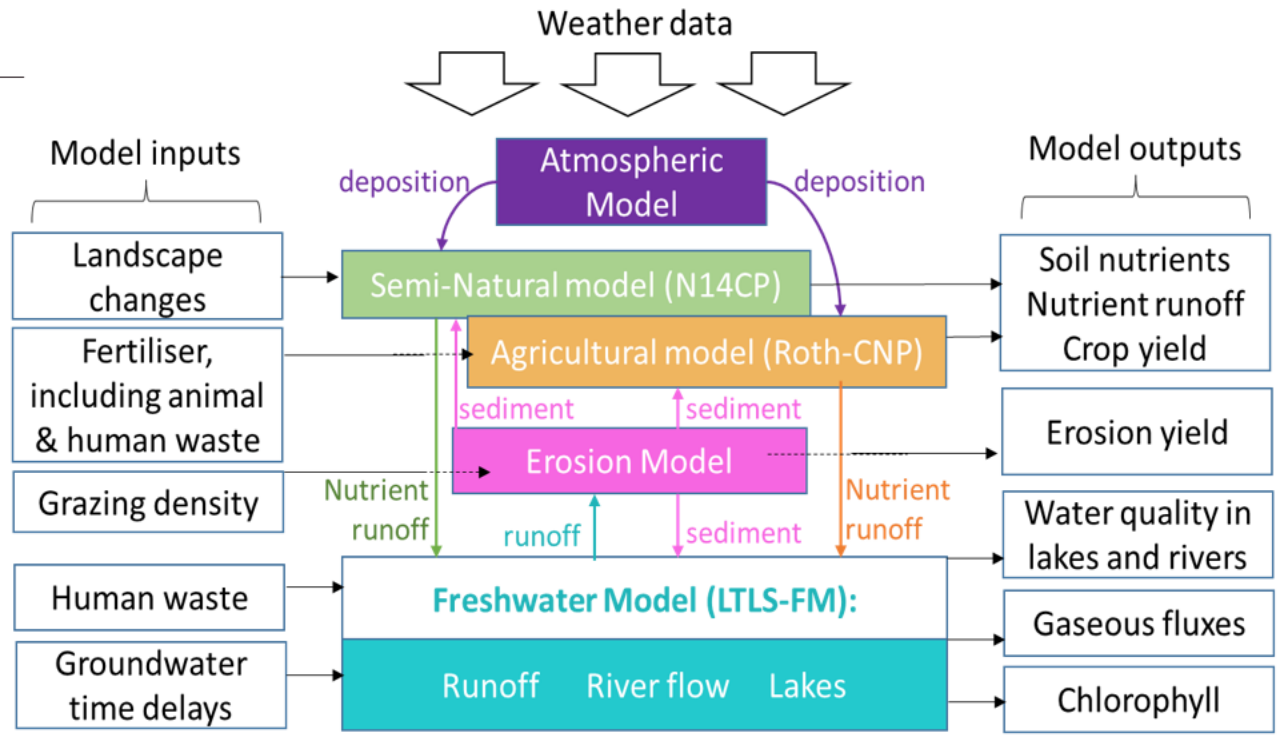
LTLS-FE Freshwater model

- Modelling **transport, transformation and fate of chemicals** in rivers, accounting for **projected hydrological changes under future scenarios;**
- Modelling **100-year** period at **2-hour** intervals across a **5 km** grid of the **UK.**

JASMIN

- High performance computing using the **LOTUS** cluster, which enables **parallel processing** of different scenarios
- Direct access to the **CEDA archive** for climate data
- Group workspace (**GWS**) facilitates collaboration





LTLS FRESHWATER ECOSYSTEMS

UK Centre for Ecology & Hydrology

ROTHAMSTED RESEARCH

BGS British Geological Survey

CARDIFF UNIVERSITY PRIFYSGOL CAERDYDD

Bowburn Consultancy

Thank you

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