



THE UNIVERSITY
of EDINBURGH



Scottish
Government
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Hydro Nation Scholars Programme

Global Shocks and disruptions to Scotland's Surface Waters: A systems-based scenario analysis of emerging pressures.

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Supervision:

Prof Mathew Williams, Prof Roxane Andersen (UHI), and Dr Luke Smallman

About me

Education

B.S., Physics

Graduated May 2018

Physics Department, Department of Natural Sciences
Universidad de Sonora, Hermosillo, Sonora, Mexico

M.N.S., Natural Science (Geological Sciences)

Graduated Aug 2022

School of Earth and Space Exploration, Graduate
College

Arizona State University, Tempe, Arizona, USA

Interests

Eco-hydrology, atmospheric and environmental sciences,
meteorology, climate change, water resources, land cover
changes.



UNIVERSIDAD DE SONORA
"El Saber de mis Hijos hará mi Grandeza"



About me

Reader, baker and
former desert rat.



Motivation and Background

- Scotland the Hydro Nation:
 - Connect research and policy to ensure Scotland's water environment is managed to the best advantage
 - Peatland Action
 - Net zero goals
 - Climate change mitigation
- Scenario analysis exploration by applying earth system models.
 - Use of new datasets
 - Reduce computational costs
 - Better description of organic soils



Key Research Questions

How soil moisture and carbon dynamics change under a range of scenarios of future climate and land use?

How these changes impact Scotland's surface water resources across mineral and organic soils?

Scales of Study

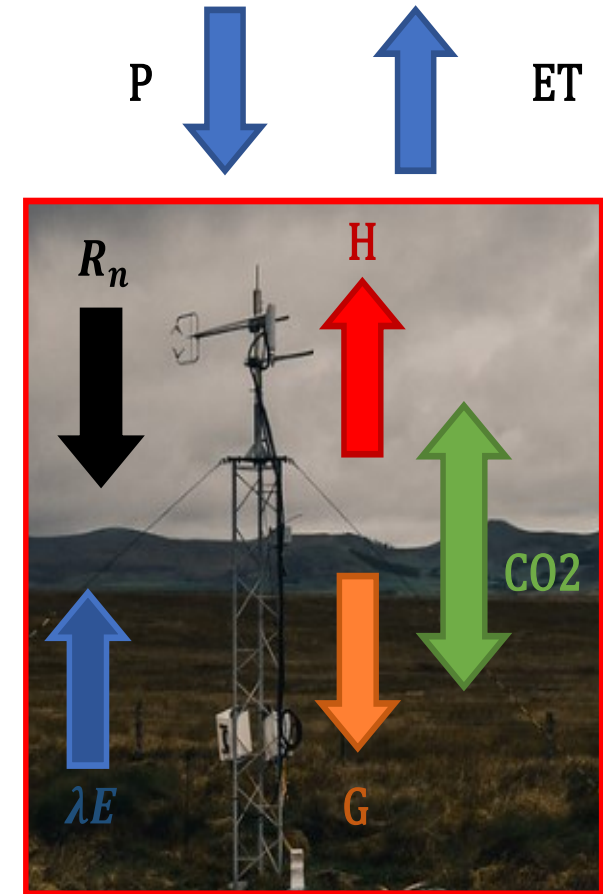
- We will utilize site-specific Eddy covariance data at **local scale**, while incorporating satellite and remote sensing data at a **regional scale**.
- **Figure (A)** shows a map of Scotland with relevant **Eddy Covariance tower** locations represented by star symbols.



High Resolution Imagery Map of Scotland created by Dr. David Milodowski (UoE).

Eddy Covariance Method

- The EC method estimate exchanges between the surface and atmospheric boundary layer:
 - Heat (H , G),
 - Water vapor (λE , ET)
 - CO_2 (NEE)
- This information can inform ecosystem function, calibrate and evaluate process-models

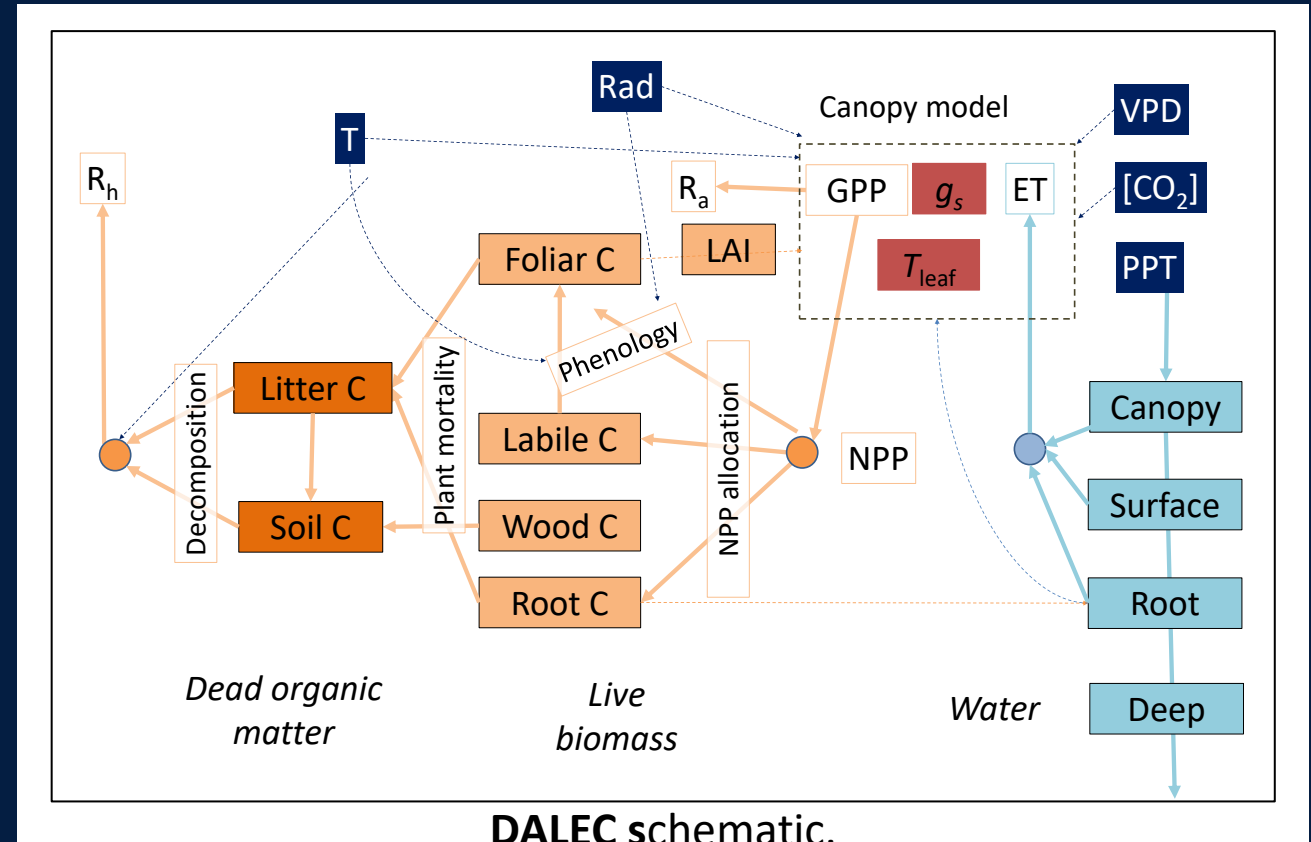


EC Tower picture from ICOS
Station Auchencorth Moss.

Data Assimilation Linked Ecosystem Carbon Model (DALEC)

Simulates:

Ecosystem carbon (red) and water (blue) pools including key processes such as photosynthesis (**GPP**) and evapotranspiration (**ET**).

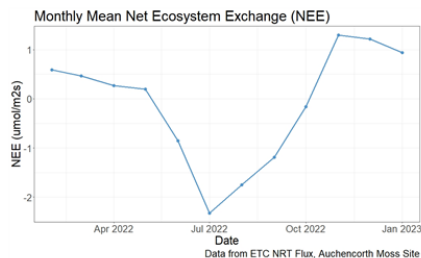


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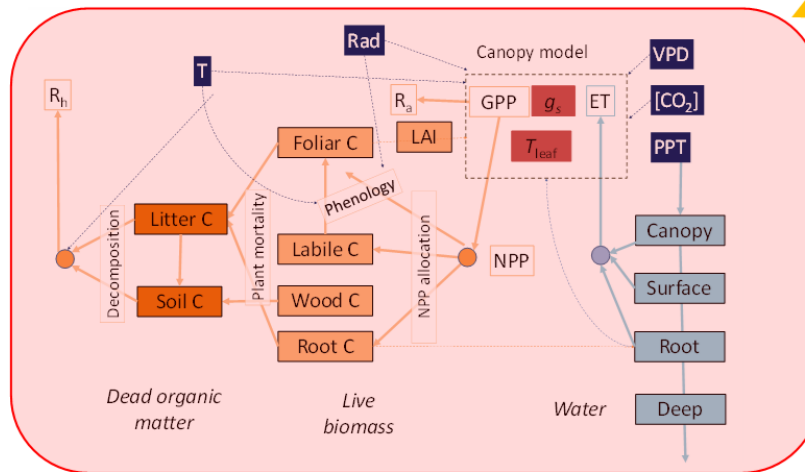
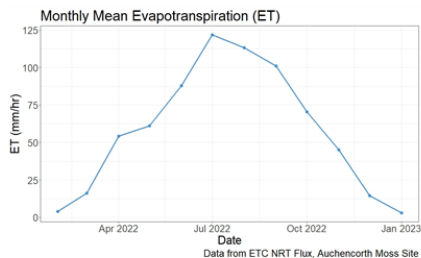
CARDAMOM

Observations

Net Ecosystem Exchange

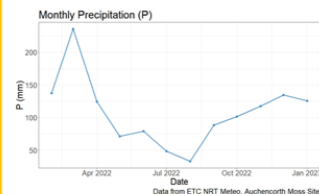


Evapotranspiration

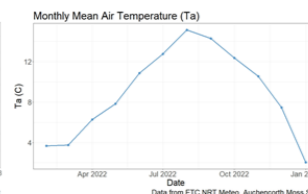


Forcings

Precipitation



Air Temp



MDF algorithm

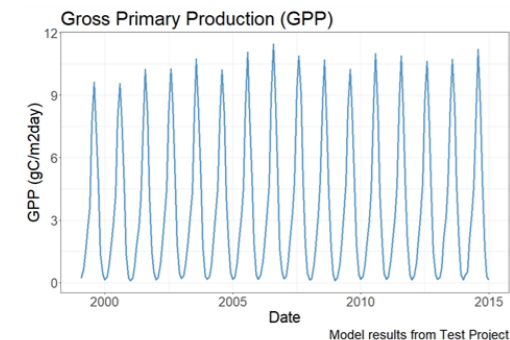
Update Parameters

Parameter priors

Likelihood

Outputs

Gross Primary Production



Next Steps

1. EC Data processing of Drivers and Observations.
2. Calibration and validation of the model at site level using time series data.
3. Model evaluation and development for peatlands.
4. Calibration and validation of the model at national scale using earth observation data and soil maps.
5. Exploration and development of different future scenarios for land use and climate forecast.

A scenic landscape featuring a body of water in the foreground, surrounded by green and brown vegetation. In the background, there are several large, rugged mountains under a sky with white and grey clouds. The word "Questions?" is overlaid in the center of the image in a bold, dark blue font.

Questions?