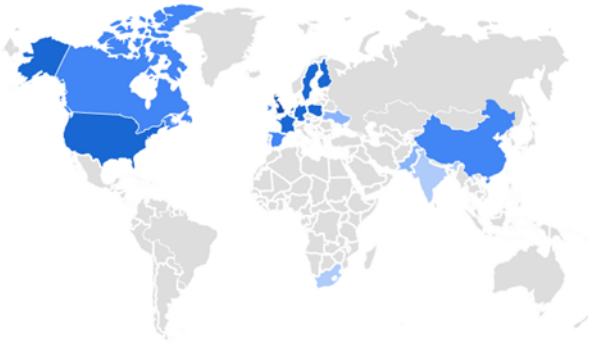
MOTHERSHIP (2022-2027)

Newsletter 2— Year 2 progress—May 2024

MOTHERSHIP is a five-year (April 2022-2027), £3.7m international research project to assess the risk that climate change poses to peatlands. The project is a collaboration between funded partners James Hutton Institute; UKCEH; and the Universities of the Highlands and Islands, Leeds, Nottingham and Exeter and 23 (at project start) project partners providing in-kind support .

Our project has increased its readership on social media on multiple platforms, with increased follower numbers on both X (@PeatMothership, 496 followers), and, to a lesser extent, Mastodon (@peatmothership@fediscience.org, 28 followers). Our project website has had several updates and received interest from a wide variety of audiences (right). In addition to the original project partners, 16 new partners were attracted to the project since its' start in April 2022.



At the end of project year 2, progress was expected for 12 of 15 project objectives and two impact activities. We report some highlights here.

O1) Form a coordinated national observing network based on harmonised measurement protocols and centralised data processing.

The WP1 team has made significant progress towards O1 and have gone beyond the expectations set at the proposal stage. Under MOTHERSHIP, we have formed a coordinated network of peatland flux tower sites, with 31 sites now contributing data streams to the project from across all four nations of the UK. Beyond the UK, the WP1 team have engaged a number of European partners who are actively collaborating on O2 (below), which has included a workshop in Brussels organised by project ECRs from UKCEH and JHI. In addition to flux tower data collection, the WP1 team have sampled the majority of UK flux sites for site-level metadata, including peat depth and condition, and vegetation. (Image: Our Co-I Eddy Graham (UHI) at the Arnol station on the Isle of Lewis).

O2) Synthesise driving variables, below-ground measurements and GHG emissions for JULES-PEAT development.

Building on the harmonised UK network and engagement with European partners, the WP1 team are leading a collaborative analysis of eddy covariance data using inverse modelling approaches based on the 'BigLeaf' approach. These datasets include a variety of peatland types and conditions and were selected to represent gradients spanning natural bogs and fens, as well as grasslands and croplands. The BigLeaf analysis is progressing with further engagement from European partners, and we estimate this will be complete by October. We are on track to publish the results of the site characterisation dataset via the EIDC, and as a data or scientific paper depending on the results of current analyses. (Image left: MOTHERSHIP WP1 data synthesis workshop with project partners, Brussels, March 2024).

The James Hutton Institute · University of the Highlands and Islands / Oilthigh na Gàidhealtachd agus nan Eilean · UNIVERSITY OF LEEDS · UK Centre for Ecology & Hydrology · University of Exeter · The University of Nottingham UNITED KINGDOM · CHINA · MALAYSIA · BioSS · UKRI Natural Environment Research Council

MOTHERSHIP (2022-2027)

Newsletter 2— Year 2 progress—May 2024

O6: Create a drainage classification from estimated water table depth (median and range) of temperate peatlands as input for JULES-PEAT and vegetation classification as JULES-PEAT validation

A statistical model relating EO images and other geographic covariates to ground measurements of WTD has been produced for two test areas. The model permits upscaling of ground measurements to the landscape level, and across the data archive of the Sentinel satellite series inputs (~2017 onwards). The approach will be extended to a much larger area in the next few months.

O7) Understand fine-scale spatial variability in peatland ecohydrological state at landscape scale around exemplar (golden) sites.

Golden sites were defined by Digibog component and surface motion data ordered in March 2024. In the meantime, condition classes, condition probability (2015-19 and 2019-23) and overall change maps (2015 – 2023) and annual change maps have been produced for the Cross Lochs golden site where an existing shorter time series was available (May 2014 – Jan 2023). Mapping of the data at 20 m by 20 m shows success of the processing to show fine scale variability in ecohydrological condition. We are currently awaiting delivery of InSAR data from Terra Motion for all Golden Sites. To align with O8, we have been receiving feedback from DigiBog and JULES modelling progress and assisting in decisions on Digibog transect placements and JULES modelling approaches to help define the scaling methodology. It is planned to use water table outputs and motion characteristics to scale Digibog to InSAR, a decision on a corresponding parameter is yet to be made with JULES. Cross talk with other WPs includes WP1 for scaling between the WP3 models using EC data, and integration with WP2 discussing synergy between EO modelled water table predictions and InSAR condition outputs.

O8) Use DigiBog to simulate the past, present, and future state of the golden sites, the latter for a range of climate change and management scenarios

A new version of DigiBog has been developed and tested. It facilitates the simulation of golden site peatland types without having to modify large parts of the model code for each new type. In the new version a user can also initialise the starting point of a simulation (spin-up) with a peatland type that is not the result of a previous DigiBog simulation. This approach is helpful when past information about the site is not available and allows the simulation to be started and run forward based on present day measurements. Twelve golden sites have been selected from three peatland types - blanket bog, raised bog, and lowland agicultural peats. Initial simulations have been run for the blanket peatland type based on Cross Lochs in Scotland, and for the agricultural peatlands. For Cross Lochs we ran a 'full' simulation, i.e. from peatland initiation to 1950 CE, whereas several agricultural peat simulations have been run from a spin-up that has been tested with different hydrological management approaches. The next stage is to create palaeo and future climate inputs for each site. In addition, we will use the project meeting in June 2024 to begin work on simulating lateral fluxes for use in large-scale JULES-PEAT simulations.

O9) Introduce key missing processes into JULES-PEAT, parameterised with data from WP's 1-3. Soil C dynamics, natural peatland vegetation, sub-grid and between grid-cell hydrology

The soil carbon model in terms of carbon decay, accumulation and the coupling between decomposition and soil physical properties is currently operational (JULES-Peat, Chadburn 2022). However, its behaviour has not been fully explored and there is a high degree of uncertainty in its parameters. We have therefore firstly been examining the behaviour of the coupled soil carbon and accumulation models to better understand how JULES responds to different parameters and the applicability of current processes. Alongside we have been reviewing outputs from the peat modelling workshops WP6 and the wider literature

to compare the current parametrisation to that of other peat models and observations (where available). Initial site runs have taken place, however a key next step is bringing together observations from sites for the purposes of driving the model (checking driving data for bias, and using a prescribed water table at point sites for evaluation of carbon dynamics) and model evaluation (though observations of soil carbon profiles, water table depths, and fluxes) to create a first configuration of JULES for our sites, before new processes are developed. A JULES branch with a moss PFT was developed at UKCEH and it is available in various JULES PEAT branches, the latest branch at JULES vn7.4. The JULES and Digibog teams will use the June 2024 meeting for a discussion on developing lateral scaling rules now that Digibog and JULES are set up at some sites.

O14) Ensure optimal process representation and parameterisation of peatland processes in JULES-PEAT via focussed international model development workshops

For O14, which will run for almost the entire duration of the project, since the successful establishment of a new Peat sector within ISIMIP (https://www.isimip.org/about/#sectors-and-contacts) and the peat protocol for ISIMIP3a, we have had 4 online peat-modelling workshops, with contributions from 9 different models. The focus of these workshops was on exploring and beginning to compile key functions for comparison. We have also been exploring ways of comparing parametrisations where models use different functional forms and structures.

Impact activities:

The three publications to date are contributions to an Open Access review article (Minasny et al 2024) and two "grey literature" reports relating to WPs 1-2. Engagement activities have ranged from (invited) conference presentations to contributions to the e.g. EC Expert Group on Carbon Farming (Technical Focus Group on Peatlands) and ESA WorldPeatlands project alongside several invited seminars. Several online workshops have been run to support the development of the ISMIP3 simulation protocol (see O14). Various media engagement included e.g. BBC Landward, BBC Sunday Live, independent US and French journalists, and contributing a TEDx talk at a London Climate Change event. Influence on policy and practice included several contributions to the development of the UK Peatland Code, as well as direct advice to UK devolved government representatives on matters relating to peatland management, emission factors and potential to avoid emissions. The Exeter PI was a contributing author to the IPCC Sixth Assessment report (2022).

Career Development

The JHI partners hosted 7 online ECR writing retreats throughout Year 2. At each of these retreats, at least one PI has been present to provide support and feedback. The retreats have supported the development of four publications that are currently in early to advanced draft stages (3) or nearing submission (1). As per O1, two of the ECRs have gained knowledge of organising and hosting a workshop to facilitate knowledge exchange with European project partners.

In other news:

The JHI team were awarded the Conservation Science Award for their work to put Scottish peatlands 'on the map' at the Nature of Scotland 2023 Awards.