Summary report: SAGES ESM-AI Workshop (October 2025)

William Harcourt & Massimo Bollasina

Introduction

The SAGES Earth System Modelling & Artificial Intelligence (ESM-AI) forum held a workshop in Autumn 2025. The aim of this workshop was to discuss the use of AI for Earth system observations and modelling, with a focus on practical applications and the use of new tools to undertake such analysis.

Topics that were covered:

- Invited Presentations on key topics related to AI and Earth system monitoring and modelling.
- Cloud-based service for applying AI to environmental research.
- Fundamentals of AI

The practical details were as follows:

- Date: Thursday 20th November 2025
- Time: 12:30 to 17:00 GMT
- Location: Room 1.55, Edinburgh Futures Institute, University of Edinburgh, Edinburgh, EH3 9EF

A detailed agenda can be found below.

Time	Title	Speaker
12:00-13:00	Arrival & Networking & Lunch	n/a
13:00-13:15	Introduction to workshop and SAGES ESM-AI	Will Harcourt & Massimo Bollasina
13:15-14:15	Lessons Learned from AI + EO for Monitoring and Modelling Coastal Change	Freya Muir
14:15-14:30	Break	n/a
14:30-14:45	AI meets The Highlands: capturing snow in Scotland's harsh terrain	Leam Howe
14:45-15:00	Downscaling and Prediction of Rainfall Extremes from Climate Model Output (RainX)	Doris Akoto
15:00-15:15	Assessing the Shortfall Risk in Great Britain’s Power System using Shifts in Winter Weather Conditions	Aninda Bhattacharya
15:15-15:30	AI-driven street litter detection in digital imagery	Bipin Babu

15:30-16:00	Break	n/a
16:00-16:45	Discussion	All
16:45-17:00	Summary and future	Will Harcourt & Massimo Bollasina

Photos from the event can be found below.

Forum co-leaders introducing the workshop.

Freya Muir presents her keynote presentation

Networking during lunch and the coffee breaks.

Workshop Discussion
Below, we summarise the discussions across five key strategic areas for the SAGES ESM-AI forum to develop and facilitate research and training for SAGES members.

1. Expanding the Scotland/SAGES Pool of Expertise in ESM-AI
Participants consistently identified a need to broaden and coordinate expertise through **targeted training, knowledge-sharing, and mapping existing capabilities**.

Key Opportunities:
- **Training workshops and tutorials** on:
  - Introductory AI / machine learning for ESM researchers.
  - Choosing suitable ML methods for specific research problems.
  - Hybrid modelling (physics-based + AI).
  - Big data handling for climate/environmental datasets.
  - Parallel computing, GPUs, cloud computing, and cluster setup.
  - Practical coding sessions using Jupyter notebooks and shared repositories.
- **Skills mapping across Scotland/SAGES**:
  - Survey members to identify expertise, interests, teaching resources, and needs.
  - Create a directory of contacts and technical strengths.
- **Specialised themed events**:
  - Sessions on foundation models, downscaling, forecasting, uncertainty, or specific sectors such as water or energy.
- **Seed grants / mini-project funding**:
  - Support early-stage collaborative ideas and experimentation.

2. External Engagement Opportunities and Benefits
All meeting participants strongly support building links beyond universities, particularly with public agencies, industry, and other research communities.

Suggested External Partners:
- Scottish Water
- SEPA
- British Geological Survey
- British Antarctic Survey
- Remote Sensing and Photogrammetry Society
- British Machine Vision Conference
- Energy and environmental sectors.
- International academic visitors and collaborators.

Benefits of External Engagement:
- Access to **real-world problems** (water resources, flooding, snowmelt, energy demand, forecasting).
- Stronger pathways to **impact and societal relevance**.
- New funding opportunities.
- Industry partnerships often required for grants.
- Better visibility of Scottish capability in ESM-AI.
- Shared innovation pipelines where organisations bring problems and researchers co-develop solutions.

3. Improving Collaboration, Networking, and Upskilling

There was repeated emphasis on creating a more active and connected community through regular interaction.

Recommended Actions:

- **Regular seminars/webinars** (virtual and hybrid) to showcase ongoing work.
- **Twice-yearly meetings**, for example:
  - Methods / tools / technical advances
  - Applications / prediction / sector engagement
- **Hackathons and collaborative workshops**:
  - Identify real problems and prepare data/resources.
  - Collaborative initiatives to accelerate interdisciplinary papers, tools, or proposals.
- **Poster and rapid-pitch sessions**:
  - Short presentations on ongoing work, including challenges and failures, not only finished results.
- **Mentorship and community support**:
  - Mentorship between junior and senior researchers.
  - Open forum for asking technical questions.
- **Cross-university networking**, especially for PhD students and early-career researchers.

4. Challenges Identified

Several barriers were repeatedly noted:

- ESMs are technically complex and difficult to set up.
- Handling large climate/environmental datasets is resource-intensive.
- AI talks can be difficult for ESM specialists to follow, and vice versa.
- The field is broad, so meetings need clearer focus.
- Practical training events require substantial preparation.

5. Shared Vision for the Forum Going Forward

The overall vision is for the forum to become a **sustained Scottish community of practice** linking climate/environmental science with AI.

Core Functions of the Forum:

- Build national expertise.
- Connect universities, agencies, and industry.
- Share tools, data, and methods.
- Train the next generation.
- Develop collaborative proposals.
- Demonstrate societal value through applications.

The meeting closed with recommendations for the next ESM-AI workshop.

Strategic Summary

“Create a Scotland-wide ESM-AI network that combines scientific excellence, practical training, external partnerships, and collaborative problem-solving for environmental and climate challenges.”

There is strong agreement that the SAGES ESM-AI forum should develop into a national point of contact that connects Earth System Modelling and Artificial Intelligence expertise through coordinated training, collaboration, and external engagement. Key priorities include workshops on AI for environmental scientists, big-data handling, hybrid modelling, HPC/GPU computing, and practical coding sessions, alongside mapping expertise across Scotland and creating shared learning resources. Participants also emphasised the need for stronger links with organisations such as Scottish Water, SEPA, and British Geological Survey to address real-world challenges in water, energy, forecasting, and environmental management while opening potential avenues for funding and impact. To strengthen the community, regular webinars, hybrid meetings, themed workshops, hackathons, poster sessions, and mentorship schemes were suggested, particularly for early-career researchers and PhD students. Overall, the shared vision is for the forum to become a sustained collaborative network that accelerates innovation, skills development, and practical solutions for climate and environmental challenges.