

# Finding the Weather and Climate RSE Community

## RSECon24 Birds of a Feather Session

Marion Weinzierl<sup>1</sup>, Jack Atkinson<sup>1</sup>, David Wilby<sup>2</sup>, Emma Hogan<sup>3</sup>, Kirsty Pringle<sup>4,5</sup>, Mark Richardson<sup>6</sup>, Helen Burns<sup>6</sup>, Sadie Bartholomew<sup>7,8</sup>, Colin Sauze<sup>9</sup>

<sup>1</sup> Institute of Computing for Climate Science, University of Cambridge, United Kingdom. <sup>2</sup> British Antarctic Survey, United Kingdom. <sup>3</sup> The Met Office in the UK, United Kingdom. <sup>4</sup> University of Edinburgh, United Kingdom. <sup>5</sup> Software Sustainability Institute, United Kingdom. <sup>6</sup> Centre for Environmental Modelling and Computation, School of Earth and Environment, University of Leeds, United Kingdom. <sup>7</sup> National Centre for Atmospheric Science, United Kingdom. <sup>8</sup> University of Reading, United Kingdom. <sup>9</sup> National Oceanography Centre, United Kingdom



UK Centre for  
Ecology & Hydrology



British  
Geological  
Survey



Met Office



British  
Antarctic Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

PML



National Centre for  
Atmospheric Science

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Institute of  
Computing for  
Climate Science

ECMWF



National  
Oceanography  
Centre

# Collaborative HackPad – Please sign in!

<http://bit.ly/WeatherClimateRSEBoF2024>



# Overview

Welcome

Intro from Orgs

Panel Discussion

Lunch

Breakout Groups

Next Steps and Close

# Why are we here?

- Large number of organizations working in the field weather and climate science
- A lot of research software engineers!
- Want to scope the field and the community
  - Is there already a Weather & Climate RSE community?
  - Do we want/need one? What is the benefit?
  - What do we need?
- Knowledge exchange
  - Learn from each other
  - Help each other



# Organisations in Weather and Climate Research

- Examples of who is in the field
  - Who is part of our community?
  - What might be common questions and approaches?
  - Where can we learn from each other?
- 
- Note an exhaustive list

# Name of Institute

Name of presenter

## **What do we do?**

Insert here a description of the work the institute does as a whole.

Add any pictures or flagship projects from the institute that set it apart, particularly if they involve RSE support.

# Name of Institute

Name of presenter

## **How do our RSEs work?**

Insert here a description of how the RSEs operate in the institute as part of this work.

## **What tools and approaches do we use?**

Insert here information about the structure of the team, backgrounds, tooling etc.

## **What do we need/want from a Climate & Weather RSE community?**

Insert here the top 1-3 things you and your colleagues would like to see from a domain-specific RSE community.



# Met Office

Emma Hogan

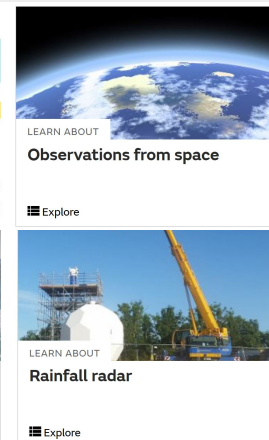
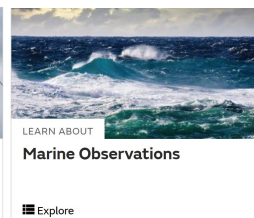
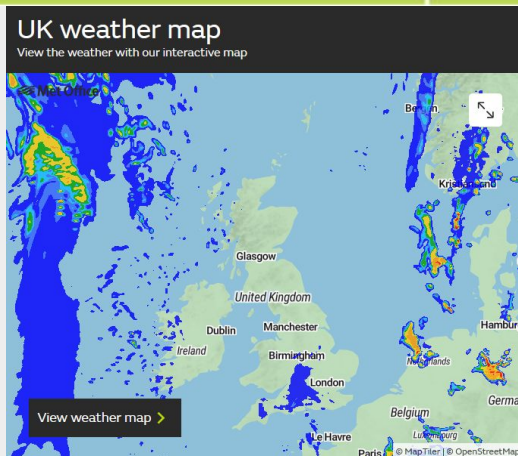
## What do we do?

The Met Office is the national meteorological service for the UK

We provide critical weather services and world-leading climate science

### OUR PURPOSE

Helping you make better decisions **to stay safe and thrive**

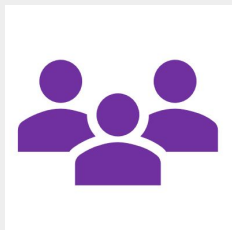


# Met Office

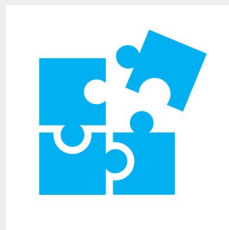
Emma Hogan

## How do our RSEs work?

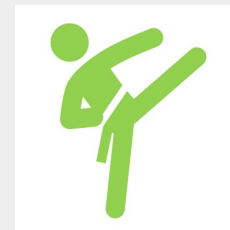
There are around 130 Scientific Software Engineers (SSEs) at the Met Office



Dedicated  
SSE teams

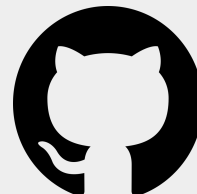


Embedded  
SSEs



Deployable  
SSEs

## What tools and approaches do we use?



# Met Office Academic Partnership

Emma Hogan

## What do we need/want from a Climate & Weather RSE community?

- Share knowledge in a safe, supportive environment
- Support the career development of RSEs and SSEs
- Strengthen collaborations between RSEs, SSEs and scientists
- Increase awareness of RSEs and SSEs

## RSE-SSE MOAP CoP

### What is MOAP?



The Met Office Academic Partnership (MOAP) is a formal collaboration between the Met Office and leading UK universities to advance weather and climate science.

### Who are RSEs and SSEs?



Research Software Engineers (RSEs) and Scientific Software Engineers (SSEs) develop software that enables the science.

### What is a CoP?



A Community of Practice (CoP) is a group of people who share a common interest and interact regularly to improve their understanding and skills related to that interest.

### What are the benefits of forming an RSE-SSE MOAP CoP?



To allow the professional development of RSEs and SSEs, enabling them to do their jobs more productively.



To facilitate technical partnership by focusing on key technical areas of common interest to members of MOAP and where alignment of technical efforts brings substantial benefits to the advancement of the science.



To identify RSEs and SSEs able to provide expertise on specific challenges and topics.

### We need RSEs and SSEs to lead the formation of an RSE-SSE MOAP CoP!



Do you enthusiastically develop and share knowledge, skills, and good working practice?



Are you eager to work collaboratively, share lessons learned and raise the profile of RSE-related work across MOAP?



Would you like to enhance your network, advance your external reputation and evolve your communication and leadership skills?

### Volunteer to be part of the RSE-SSE MOAP CoP core team!



RSEs and SSEs at any point in their career are welcome to volunteer.



Initial expectations involve participating in a workshop to discuss and agree on the purpose and vision of the CoP.



Contact Emma, Glenn, and Verity by June 16, 2023 (emails below)  
emma.hogan@metoffice.gov.uk | glenn@metoffice.gov.uk  
verity.parker@metoffice.gov.uk

# National Centre for Atmospheric Science

Sadie Bartholomew (NCAS-CMS)



**National Centre for  
Atmospheric Science**

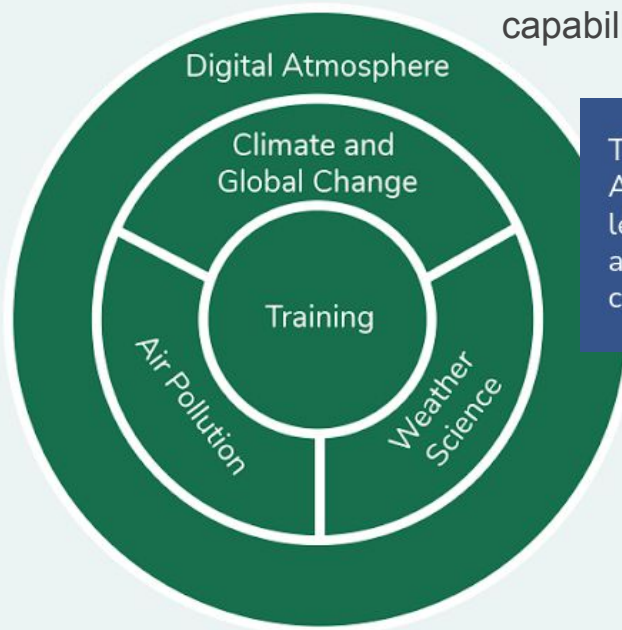
NATURAL ENVIRONMENT RESEARCH COUNCIL

See: [ncas.ac.uk](https://ncas.ac.uk)

## What do we do?

Our *science* - three research areas:

- Underpinned by digital atmosphere capability



The National Centre for Atmospheric Science is a world-leader in atmospheric research and innovation, committed to changing lives.

## Our Mission

is to understand our atmosphere, how it is changing, and how it impacts life on Earth.\*

*\* our work spans much more than just the atmosphere though*

Services we provide to the scientific community:

- FAAM Airborne Laboratory (research aircraft, pictured!)
  - Atmospheric Measurement and Observation Facility
  - Centre for Environmental Data Analysis (CEDA)
  - Computational Modelling Services (CMS)



# National Centre for Atmospheric Science

Sadie Bartholomew (NCAS-CMS)



**National Centre for  
Atmospheric Science**

NATURAL ENVIRONMENT RESEARCH COUNCIL

See: [ncas.ac.uk](https://ncas.ac.uk)

## How do our RSEs work?

Our staff are *embedded* at one of 12 universities and research institutes across the UK (joint affiliation with NCAS and e.g. University of Reading) and *the majority of our RSEs work for one of these two (of four) services:*

- [Computational Modelling Services](#) (NCAS-CMS): provides HPC resource management and software engineering support for the UK atmospheric and polar science community, and delivers key underpinning infrastructure to allow users to run complex modelling workflows on national platforms (**~15 RSE/managers**).
- [Centre for Environmental Data Analysis](#) (CEDA): serves the environmental science community by the provision of data centres, data analysis & access, and research project participation (**~30 RSE/managers**). For example, CEDA co-manage, along with STFC, the **JASMIN** data-intensive supercomputer.

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### What tools and approaches do we use?

- Our own tools are generally open source and under modern version control (i.e. git) e.g. a lot of our codebases are under [github.com/NCAS-CMS](https://github.com/NCAS-CMS) (CMS) or [github.com/cedadev](https://github.com/cedadev) (CEDA).
- Our work involves HPC, infrastructure, model development/support, user support and training, workflow and tool development, and more.

### What do we need/want from a Climate & Weather RSE community?

1. More collaboration and knowledge sharing, ultimately with the aim of *less reinvention of the wheel* (we are aware of a lot of this in the domain)!
2. Helping each other stay on top of new tools, best practice, and progress in the domain.
3. Making our data more standardised & interoperable.



# National Oceanography Centre

Colin Sauze

**National  
Oceanography  
Centre**

## What do we do?

“By gaining a deeper knowledge of the ocean, we help every living thing on our planet flourish”

### Science areas:

- Marine Physics and Ocean Climate
- Marine Systems Modelling
- Ocean Biogeosciences

### Engineering:

- Sensor design
- Autonomous Vehicles

### Data Management:

- Live data from autonomous platforms
- Non-live data from surveys, cameras etc

### Marine Facilities

- Survey ships James Cook and Discovery
- Marine equipment pool



# National Oceanography Centre

## How do our RSEs work?

- Centralised team with 3x RSEs, 1x senior RSE.
- 1 more senior RSEs + 2x AI RSEs starting soon.
- Split between Southampton and Liverpool sites.
- Work with scientists and software devs in other teams.

## What tools and approaches do we use?



## What do we need/want from a Climate & Weather RSE community?

- Knowledge Sharing
- Collaborating on training
- Working with cloud optimised file formats (e.g. Zarr, Cloud Optimised GeoTIFF, Kerchunk)

# British Antarctic Survey (BAS)

David Wilby, RSE, Digital Innovation Team

## What do we do?

- UK's presence & research capability in Antarctica (+ Arctic)
- Research + logistical operations + long-term dataset maintenance
- Based in Cambridge + numerous bases in polar regions
- Research covering: polar & ocean science, biodiversity & ecosystems, space weather, climate, geology & geophysics.



**British  
Antarctic Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL



Credit: Adam Bradley, BAS



Credit: Andreas Czifersky, BAS



# British Antarctic Survey (BAS)

David Wilby, RSE, Digital Innovation Team

## How do our RSEs work?

Digital Innovation Team (5 RSEs) + many more incl. Technical Dev. Community, Polar Data Centre etc.

## What tools and approaches do we use?

Collaboration w/ science & ops teams; AI/ML, collaborative VCS, open research practices.

## What do we need/want from a Climate & Weather RSE community?

Communication; Common Approaches



**British  
Antarctic Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL



Credit: Steve Gibbs, BAS



Credit: Dave Wattam, BAS



# UK Centre for Ecology & Hydrology

Joe Marsh Rossney

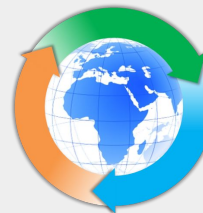
## What do we do?

UKCEH is a significant consumer of, and contributor to, weather & climate research & data.

## Science Areas

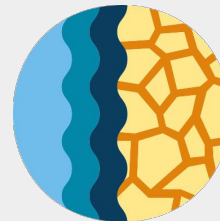
Atmospheric chemistry	Biodiversity
Hydro-climate risks	<u>Pollution</u>
Soils & land use	Water resources

## Highlights...



# JULES

Joint UK Land  
Environment Simulator



# FDRI

FLOODS & DROUGHTS  
RESEARCH INFRASTRUCTURE



# UKECN



UKCEH

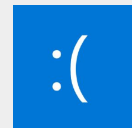
Environmental  
Information  
Data Centre



# UK Centre for Ecology & Hydrology

Joe Marsh Rossney

Tools & approaches - the usual suspects!



## How do our RSEs work?

- We are a brand new group of 6 RSEs from a range of backgrounds, spread over 3 UK sites.
- Open bidding process for O(months) of 2x 0.5FTE RSE time.
- Ambitious aims to catalyse a shift in culture, foster a community of practice around environmental research software & data.

## What do we need from the Climate & Weather RSE community?

- To be part of a community of practice that spans the spaces between disciplines, scientific interests, experience levels, old and new approaches, ... 19



Institute of  
Computing for  
Climate Science

Jack Atkinson

## What do we do?

Provide software support for several international climate science projects funded philanthropically under the VESRI umbrella

VESRI: Virtual Earth System Research Institute

*“improving the accuracy and credibility of major climate models by addressing some of the hardest challenges.”*

Improving software sustainability, advancing modelling techniques, tackling computational and software challenges, often with an AI/ML component.

Highlights: [FTorch library](#), ICCS Summer School,



Institute of  
Computing for  
Climate Science

Jack Atkinson

## How do our RSEs work?

10 RSEs split across Lead-Senior-RSE working on two projects at a time 40:40:20.  
Hybrid team between Cambridge and fully remote.

## What tools and approaches do we use?

There is a diverse background to the team to tackle diverse problems:



## What do we need/want from a Climate & Weather RSE community?

We would like to see a space to share resources and approaches relevant to our community, opportunities for specific training, and space to learn more domain science.

# Centre for Environmental Modelling and Computation

Mark Richardson, University of Leeds

## What do we do?

As a domain specific RSE group (earth and environment) we know the earth simulation models and tools used by our scientists. We know how to configure those simulations.

We use python to acquire, transform, display, explore, disseminate and archive environmental data. The data can be from various sources: satellite feed, field sensor, simulation output or archived historic records.

We create WebUI (data portals) to enable collaborations for our researchers

# Centre for Environmental Modelling and Computation

Mark Richardson, University of Leeds

## How do our RSEs work?

I liaise with researchers when they are preparing their research grant proposal and provide them with guidance on effort required. Eventually we find out the grant is awarded and when the work packages are scheduled, I allocate work to each of the 6 group members. CEMAC staff can be assigned as many as 7 projects each, but the work packages can be as soon as “tomorrow” or as far away as “in 3 years time”. The work packages can be as small as 10 days effort or as much as 24 months over 48 months.

## What tools and approaches do we use?

Generic tools include Fortran, C, Python, R. Understanding HPC i.e job schedulers, MPI, OpenMP parallelism. Some data discovery techniques will use Python scripting with bespoke API to the data curators. Occasionally Web UI developed with Flask or JavaScript. Collaboration via github or other repository infrastructures (often particular to the project work). We keep abreast of technical developments of our domain, including understanding machine learning to provide a levelling opinion in the current period of hype.

## What do we need/want from a Climate & Weather RSE community?

- Sharing good working practice, promoting the activity as a worthy career
- Knowledge pool for tool development
- Signposting to new techniques

# Plymouth Marine Laboratory

Benjamin O'Driscoll - Digital Innovation and Marine Autonomy

## What do we do?

‘A world leader in the field of marine research, PML is committed to the delivery of impactful, cutting-edge environmental and social science in support of a healthy and sustainable ocean.’

## Flagship Project

SyncED-Ocean Digital Twin:

Create a virtual coastal ocean ecosystem by combining:

- Autonomous Robots
- Satellite Earth Observation
- Marine System Models

Enhance harmful algal bloom monitoring

PML

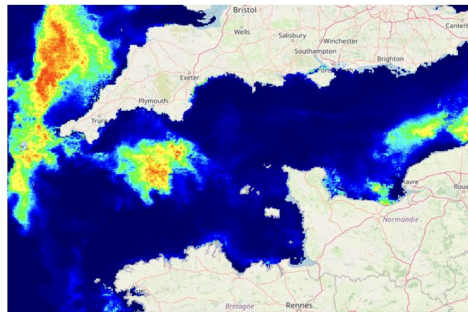
Plymouth Marine  
Laboratory

### STORY

## PML awarded funding to develop state-of-the-art digital twin for harmful algal bloom monitoring

18 January 2024

Through the Twinning Capability for the Natural Environment (TWINE) programme, PML has been successful in a funding bid that aims to significantly improve current predictive capability of harmful algal blooms (HABs).



The project, named Synchronising Earth Observation and Modelling Frameworks Towards a Digital Twin Ocean (SyncED-Ocean), will deliver a digital twin demonstrator, combining data from satellite Earth Observation and marine autonomous robots with marine system models to create an optimised virtual coastal ocean ecosystem.

### What is a digital twin?

A digital twin is a dynamic virtual copy of a physical asset, process, system or environment that looks like and behaves in real time identically to its real-world partner. Actions and events can be modelled with unprecedented accuracy, offering the ability to experiment in a non-live environment of the real world.



# Plymouth Marine Laboratory

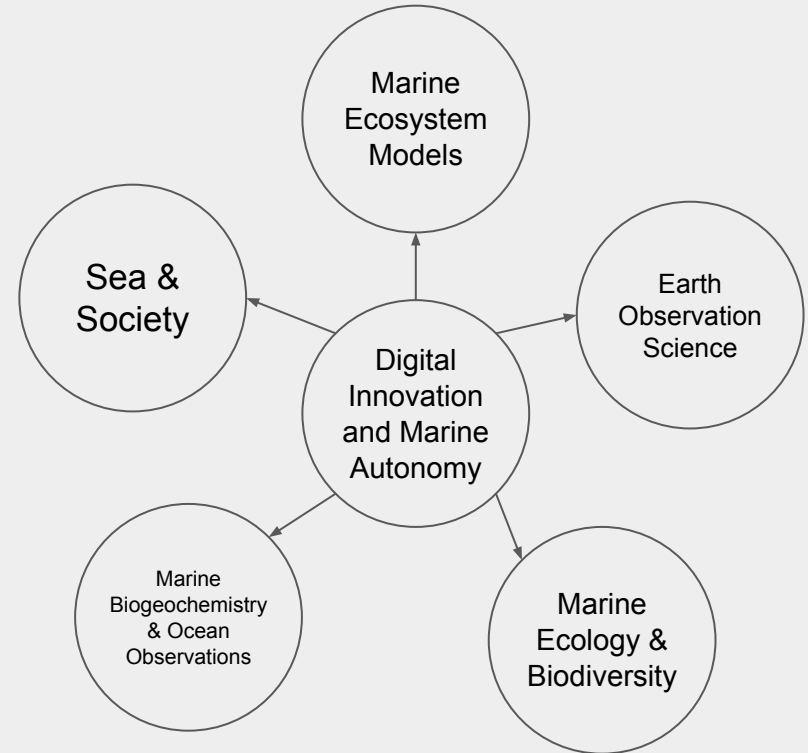
Benjamin O'Driscoll - Digital Innovation and Marine Autonomy

## How do our RSEs work?

All of the formal RSEs are based within the Digital Innovation and Marine Autonomy (DIMA) group.

## Research Technology Guild

- New internal network
- Encourage knowledge sharing
- Discuss new trends and technologies



# Plymouth Marine Laboratory

Benjamin O'Driscoll - Digital Innovation and Marine Autonomy

**PML**

Plymouth Marine  
Laboratory

## What tools and approaches do we use?

- Mainly Python across the Lab.
- Diverse Range of Work:
  - Scientific Analysis
  - AI/ML
  - Operational Processing
  - Web Development
- Computing Resources:
  - MAGEO (MASSive GPU cluster for Earth Observation), Provided by the NEODAAS service
  - CETO / Scylla (Traditional HPC)
  - SLURM Grid (Heterogeneous High Throughput System)

## What do we need/want from a Climate & Weather RSE community?

- Knowledge Sharing between Organisations
- External Opportunities (Training, Collaborations...)
- Career Development Frameworks

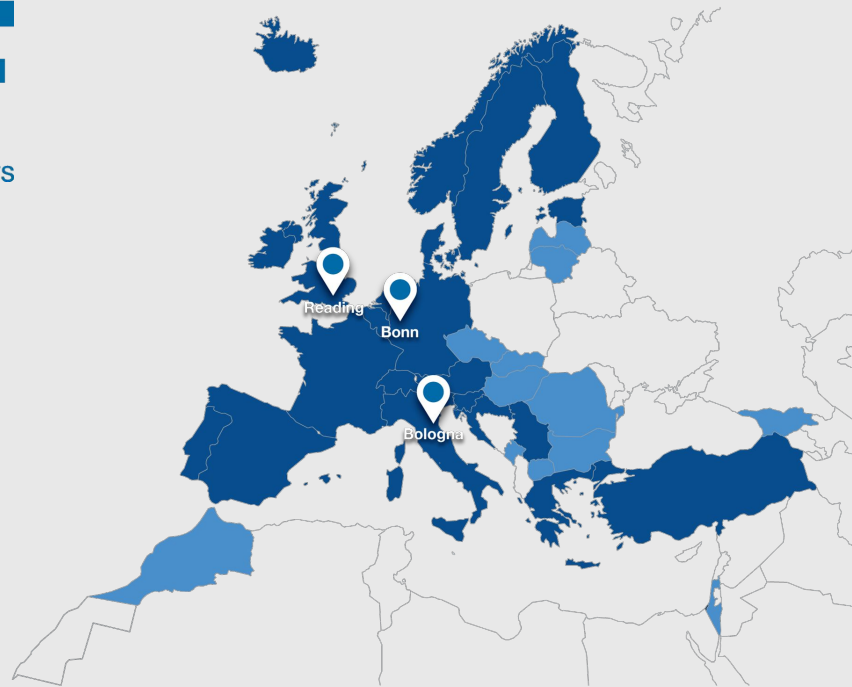
Zbigniew  
Piotrowski

## What do we do?

**ECMWF's** role as an international organisation is to address the critical and most difficult research problems in medium-range NWP that no one country could tackle on its own. It develops advanced technical solutions to bring weather and climate datasets (i.e. ERA5) to the society.

We are a 24/7 operational service, producing global numerical weather predictions and other data for our Member and Co-operating States and the broader community.

Through the EU's Destination Earth initiative, we are developing prototype digital twins of the Earth. We are a key player in Copernicus, the Earth Observation component of the European Union's Space programme, offering quality-assured information on climate change, atmospheric composition, flooding and fire danger.



Funded by  
the European Union

**Destination Earth**

implemented by



## How do our RSEs work?

**IFS model & workflow maintenance/evolution**

**Data services for weather operations and climate research**

**AIFS data-driven forecast framework**

**GT4Py: separation of concerns with DSLs**

## What tools and approaches do we use?

**Blend: from cutting-edge to legacy software.**

**Mixed F90/OO Fortran**

**C++ frameworks**

**ML forecast tool stack**

**SOTA scientific, computational and utility libraries.**

**Community and in-house (e.g. Loki) Python libraries.**

**Shell, CMake, CI workflows**

## What do we need/ want from a Climate & Weather RSE community?

- Weather community assisted the advent of HPC but **no longer drives its development** to the extent it had in the past.
- Constantly **increasing complexity** of hardware and scientific framework calls for specialization, domain scientist are usually no longer capable to design effective HPC implementations and workflows.
- RSE community is called to mentor – on the technical side - the **paradigm shift towards portable and scalable HPC implementations**.

### On the more down-to-earth side, RSE could:

- **advocate for reliable software stacks** that could handle both: legacy Fortran code parts and their modern surrounding, e.g. Fortran tooling and compilers with accelerator-offloading capabilities;
- supply hardware-vendors with mini-applications realizing typical weather/climate computational and communication patterns, aiming at minimization of the early-stage hiccups of newly delivered HPC hardware and accompanying software stack;
- Aid the **convergence of portable programming models** and paradigms for diverse HPC hardware and promote their use among early career domain scientists.



# Panel Discussion

Chairs - Colin Sauze & Helen Burns



**Slido: Scan QR code or**

**go to [slido.com](https://slido.com) and join via code: 1066762**

Sadie Bartholomew - Computational Scientist - NCAS

Benjamin O'Driscoll - Research Software Engineer - PML

John Stevenson - Senior Software Developer - BGS

Emma Hogan - Senior Scientific Software Engineer - Met Office

Zbigniew Piotrowski - Computational Scientist - ECMWF





# Breakout Discussions - Group Formation

Topic A

Led by: Person A

Location: Room A

Topic B

Led by: Person B

Location: Room B

Topic C

Led by: Person C

Location: Room C

# Breakout Discussions - Feedback

Topic A

Topic B

Topic C

Topic D



# Next steps and Closing - What will we do now?

- Blog Post
- Mailing list – see sign-up form link in hackpad
  - You can also indicate if you would like to join the orga team
- Slack channel
  - Existing ones on UK RSE Slack, like #geoscience, #geo
  - New one for SIG #weather-climate
- RSE SIG Formation - Yes!
  - Regular meetings?
- Annual [RSECon] BoFs?
- Future ideas
  - Any other platform? (Github repository, ...)
  - Outreach to science spaces? Conferences etc
  - Website incl. resources page?
  - Special special interest events?