Introducing Project Raijin
Community Geoscience Analysis Tools for Unstructured Mesh Data

Deepak Cherian[1], John Clyne[1], Orhan Eroglu[1], Brian Medeiros[1], Colin Zarzycki[2]

[1] National Center for Atmospheric Research
[2] Pennsylvania State University

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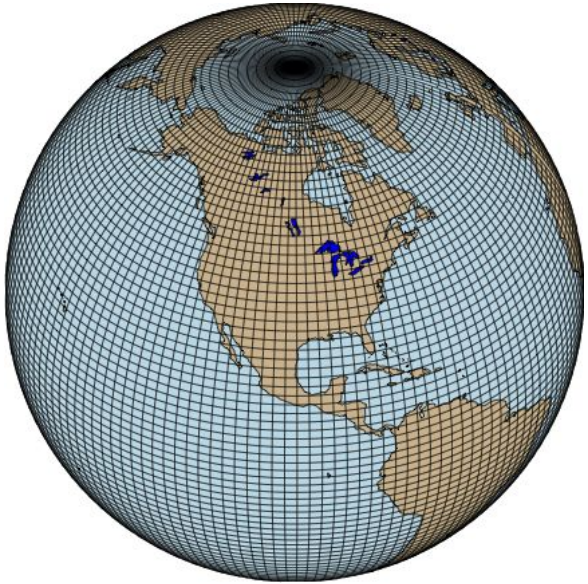
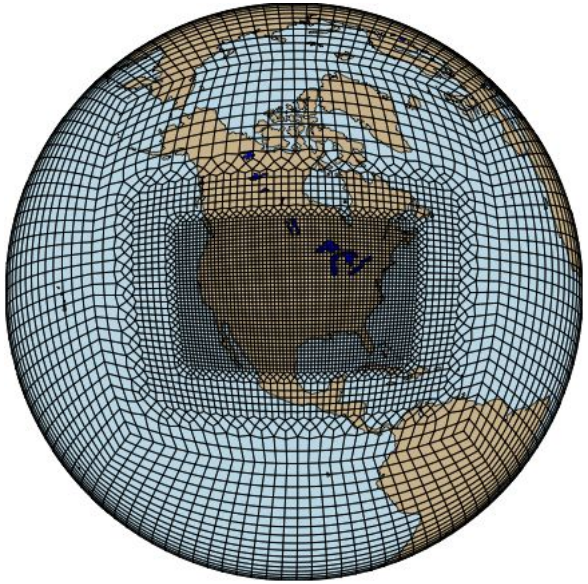


“Lat-lon” structured grid

Icosahedral grid
(MPAS-A)



Variable resolution, cube sphere grid
(CAM-SE)

After nearly two decades of development and evaluation, the climate and global weather modeling communities are transitioning from more simple structured grids to more complex, but scalable unstructured grids upon which governing equations of state are solved.

Problem?

1. No widely used convention for the storage of unstructured grid data
    - UGRID conventions: https://ugrid-conventions.github.io

2. Few analysis tools capable of working directly with unstructured data
    - Resampling to structured grids has numerous pitfalls

3. Global storm resolving resolution models are capable of generating LOTS of data
    - Further exacerbating problems with limited set of tools that operate directly on unstructured meshes

Project Raijin Goals

1. Develop extensible, scalable, open source tools supporting fundamental analysis and visualization methods capable of operating directly (without resampling) on unstructured grid model outputs at global storm resolving resolutions, and

2. Establish a vibrant community of user-contributors, committed to extending our work beyond the scope of this proposal, and helping ensure the long term sustainability of the project.

Driving use cases

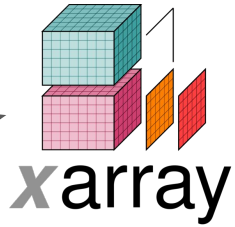
1. **Dynamical core evaluation**
   - Comparison and determination of suitability of new dynamical cores

2. **Atmospheric blocking frequency**
   - An important atmospheric phenomenon that emerges within chaotic atmospheric flow

3. **Cyclonic storm analysis**
   - Lagrangian evaluation of extreme weather features

Core technologies

Data ingest, internal representation, compatibility



Scalability

Versioning, continuous integration & deployment, collaboration

Documentation and examples

Packaging, distribution, testing

User APIs

A notional component diagram

IKON

MPAS

CAM-SE

FV3

Supported models

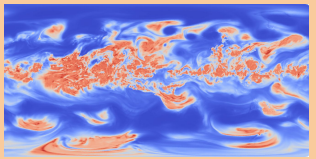
UXarray

Xarray

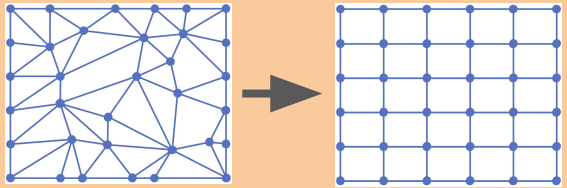
Computational operators

$\mathcal{F}(x)$ $\iint$ $\frac{\partial x}{\partial y}$ $\mathcal{L}(x)$

Plotting



Regridding



Current status

PoP started Oct. 1, 2021

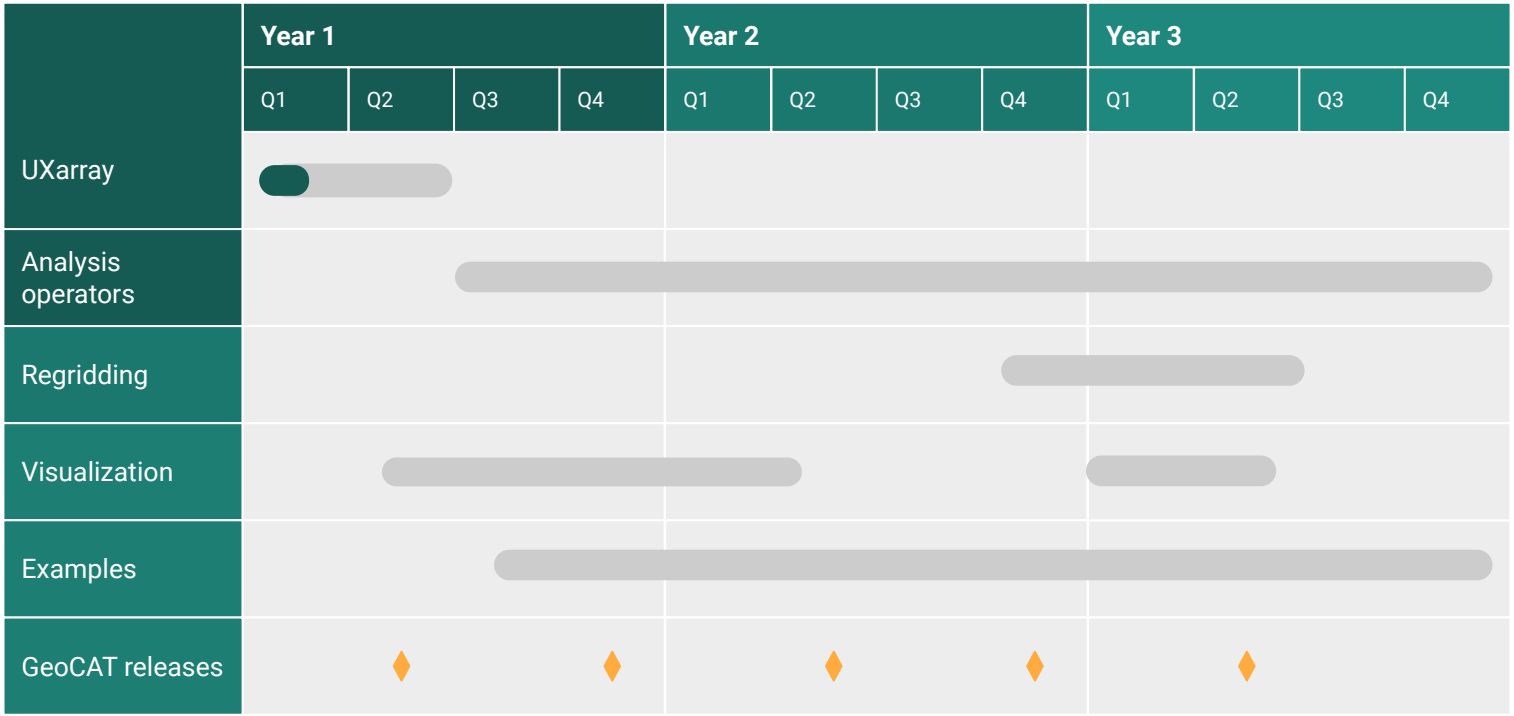
New partnership with DOE's SEATS Project (Argonne National Laboratory, UC Davis, and Lawrence Livermore National Laboratory)

- SEATS: Adding UGRID output support to E3SM
- Collaborative development of UXarray

UXarray repo: https://github.com/UXARRAY/uxarray

Project Raijin web site: https://raijin.ucar.edu

Development roadmap



Summer Internships in Parallel Computational Science (SIParCS)

...significant hands-on experience in high-performance computing and related fields that use HPC for scientific discovery and modeling.

10-week, paid summer internship supported by NCAR

Open to undergraduate and graduate students enrolled in a U.S. university

Application deadline: January ?? (https://www2.cisl.ucar.edu/siparcs)

Project #8: *Python data analysis & visualization and Jupyter notebook development for unstructured grids data*

Get involved!!!

Send us email

projectraijin@googlegroups.com

Start a discussion

https://github.com/NCAR/projectraijin.github.io/discussions

Students: apply to SIParCS

https://www2.cisl.ucar.edu/siparcs

Find out more

https://raijin.ucar.edu

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Pangeo community

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