UXarray: An extensible and scalable Python package with support for MPAS and several other unstructured grids

Authors: Orhan Eroglu[1], John Clyne[1], Brian Medeiros[2], Colin Zarzycki[3], Robert Jacob[4], Paul Ullrich[5], Rajeev Jain[4], Philip Chmielowiec[1], Hongyu Chen[5], Cecile Hannay[2], Lantao Sun[6], Richard Loft[7]

[1] NSF NCAR, CISL (Computational and Informations Systems Laboratory)
[2] NSF NCAR, CGD (Climate & Global Dynamics Laboratory)
[3] The Pennsylvania State University
[4] Argonne National Laboratory
[5] UC Davis
[6] Colorado State University
[7] AreandDee LLC

Kilometer-scale climate and global weather models are being more commonly explored and used among the scientific community lately because of their impact in improving modeling and simulation efforts and reducing uncertainties and thanks to increased computational power in recent years. However, the analysis and visualization of such models' output data present significant challenges because of their very large size and use of unstructured grids upon which the governing equations of state are solved. Existence of several unstructured grid formats with technical and conventional differences and without much standardization between them along with presence of only a few Open Science analysis and visualization tools that can operate directly on unstructured grid data (without regridding) are further challenges. Those that exist seem to have a number of incapabilities such as lack of vital functionality, not being able to scale effectively, and/or being dedicated to only one grid format. In order to address those much-needed capabilities, Project Raijin, funded by an NSF EarthCube award, and the DOE SEATS project have been collaborating on developing the UXarray package in the scientific Python ecosystem. UXarray is an extensible and scalable software tool that extends Xarray, one of the commonly used cornerstone Python packages of the Pangeo community, to (1) recognize several unstructured grid formats including MPAS, and (2) to provide support for analysis and visualization functionality to be operated on the native unstructured grid model outputs used in the Earth System Sciences. UXarray encourages and facilitates community contributions to all aspects of the project, following an Open Development model. In this talk, we will provide an overview of UXarray's current capabilities, our future development roadmap, and our efforts to build a community of user contributors around it.