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Regridding Satellite and Model Data to DGGS (HEALPix) Using the Pangeo Ecosystem

Justus Magin[1], Jean-Marc Delouis[1], Lionel Zawadski[2], Julien Petiton[2], Max Jones[3], and Tina Odaka[1]
[1]LOPS - Laboratoire d'Oceanographie Physique et Spatiale, UMR 6523 CNRS-IFREMER-IRD-Univ.Brest-IUEM
[2]CNES - Centre National d'Études Spatiales
[3]Development Seed

Regridding data from diverse sources, such as satellite observations and numerical models, is a critical task in Earth system sciences. Proper interpolation methods are essential to ensure data fidelity when combining or comparing datasets on different grids. This becomes especially relevant in the context of emerging grid systems like Discrete Global Grid Systems (DGGS), specifically HEALPix.

DGGS are spatial reference systems designed to partition the Earth's surface into a hierarchy of equal-area cells. Unlike traditional latitude-longitude grids, DGGS uses tessellations, such as hexagons, to represent the Earth's curved surface with minimal distortion. This grid system is particularly suited for handling global-scale geospatial data by providing uniform coverage and resolution, enabling efficient storage, processing, and analysis.

HEALPix (Hierarchical Equal Area isoLatitude Pixelation) is a specific implementation of DGGS widely used in astronomy and Earth sciences. HEALPix divides the sphere into equal-area cells following an iso-latitude structure, making it computationally efficient for operations such as spherical harmonics and multi-resolution analysis. Originally developed for astrophysical applications, it has become increasingly popular in the Earth sciences for representing satellite data, model outputs, and other geospatial datasets in a way that preserves area integrity and facilitates seamless multi-resolution data integration.

By leveraging these grid systems, particularly HEALPix, we can achieve a more accurate and efficient representation of geospatial data.

The Pangeo ecosystem includes an array of powerful regridding tools, each tailored to specific grid types and applications. However, navigating this ecosystem to identify the most suitable tool and workflow can be challenging.

In this presentation, we will show an overview of regridding solutions within Pangeo, highlighting their capabilities and limitations, as well as their application. We will also demonstrate a practical regridding workflow using model outputs or simulated satellite data such as the Odysea dataset (Aviso+ Altimetry. (n.d.). *Simulated Level-2 Odysea Dataset*. Retrieved from https://www.aviso.alt

imetry.fr/en/data/products/value-added-products/simulated-level-2-odysea-dataset.html on January 14, 2025), to the HEALPix grid. This workflow will make use of recent advances in technology to make it reproducible to make it efficient and reproducible, such as virtualizarr for fast metadata access and dask for scalable operations, with the output saved as chunked zarr files for seamless integration with downstream analysis.