



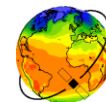
Universität  
Bremen



# Intake, Zarr, Healpix

ESMValTool Workshop

Oberpfaffenhofen, 13.05.2025



**ESMValTool**  
Earth System Model Evaluation Tool

# New data sources

<https://github.com/ESMValGroup/ESMValCore/issues/2584>

The plan for what the configuration should look like is in [#2371](#). Example `dkrz-intake.yml` configuration file:

```
projects:
  CMIP6:
    data:
      CMIP6-intake-esm:
        type: esmvalcore.intake.IntakeDataSource
        file: '/pool/data/Catalogs/levante-cmip6.json'
        facets:
          # mapping from recipe facets to intake-esm catalog facets
          activity: activity_id
          dataset: source_id
          ensemble: member_id
          exp: experiment_id
          grid: grid_label
          institute: institution_id
          mip: table_id
          short_name: variable_id
          version: version
```

# Intake

<https://github.com/ESMValGroup/ESMValCore/pull/2690>

Charles working on their local intake catalogue

Many different facets of intake: intake-esm, intake-stac, etc

# Zarr

Probably access through xarray?

Jan has a working prototype for reading it with xarray, but not in the structure we're aiming for

# HEALPix

Goal: Just to read  
or also to use the grid  
natively for plotting/  
using the zoom function?  
People at km-scale  
hackathon will work  
with HEALPix this week  
and give us some insight  
Timeline?

## Regridding Satellite and Model Data to DGGS (Healpix) Using The Pangeo Ecosystem

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### Outline

We explore how to regrid diverse Earth observation and model data onto the HEALPix grid—a DGGS offering equal-area, multi-resolution tiling ideal for global-scale analysis—using tools from the Pangeo ecosystem. This poster highlights key methods, challenges, and ready-to-use examples for efficient, reproducible regridding.

### What Is Regridding?

(and why is it important for geospatial data analysis?)

- Also called "resampling" or "remapping"
- Interpolation of data on one grid to another
- Necessary step when comparing data on different grids
- Different algorithms for continuous and categorical data

### Grid Types

Rectilinear

DGGS

ISEA7H ISEA4T

Curvilinear

Unstructured

### HEALPix

- Designed for use in astronomy
- Increasing popularity in geosciences
- Cells arranged on isolatitude rings
- In nested or ring order
- Equal-area (→ high accuracy for most applications)
- Defined on a sphere (but can be extended to an ellipsoid)

### Interpolation Algorithms

#### Online

- Fitting of functions into the data (polynomials, spline)
- Evaluation in the target grid
- Repeated for every variable and every non-spatial dimension (costly)

AI methods are also online interpolation

#### Offline

- Depends only on the grid geometry
- Can be expressed as a weighted sum of source cells
- Weights can be precomputed and cached to disk
- Can be reused for other variables / dimensions

Steps:

- Find cells to aggregate
- Compute weights
- Apply weights (sparse matrix multiplication)

#### Area-based

Binning

Conservative

#### Point-based

Nearest neighbor

Bilinear

Inverse distance weighting

- Source grid
- Target grid
- Weight proportional to

### Evaluation Of Regridding Libraries In The Pangeo Ecosystem

(when regridding to / from DGGS)

Library	Grid types	Algorithms	Distributed computation?	
			Weights	Regridding
xesmf	rectilinear, curvilinear DGGS <sup>1</sup> , unstructured <sup>1</sup>	nearest, bilinear, IDW binning	?	yes
uxarray	rectilinear <sup>2</sup> , curvilinear <sup>2</sup> DGGS <sup>2</sup> , unstructured	nearest, IDW	no	no
grid-weights	rectilinear <sup>3</sup> , curvilinear <sup>3</sup> DGGS <sup>3</sup> , unstructured <sup>3</sup>	conservative	yes	yes

<sup>1</sup>as unordered list of points  
<sup>2</sup>as unstructured mesh  
<sup>3</sup>as cartesian boundary polygons

Digital version with more details and code:

<https://iaocsa.github.io/regridding-ecosystem-overview>

Sharing is encouraged

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<https://github.com/IAOCEA/regridding-ecosystem-overview>