Gridlook

ESM data viewer on a 3D sphere using WebGL

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https://pad.gwdg.de/s/mP3yfY2tW

🌍 Motivation

Build an easy-to-use **visualisation tool** to:

- 👀 show plotting without HPC
- 🔎 *Simply and Interactively explore* **native grid** Earth System Model (ESM) output
- 🔗 Share *any dataset view* via URL
- 🚄💨 no installation or compute server required

🌍 Motivation

for developers: interesting technology!

🎨 *client-side* rendering and color mapping

no image pregeneration

☁️ Set-up

Support and leverage **any Zarr dataset** stored in cloud environments.

📌 **Recipe**:

`https://gridlook.pages.dev/#` + `ZARR_URI`

Where `ZARR_URI`:

- ✅ Is **openly accessible**
- 🌐 Allows **Cross-Origin Requests (CORS)**

Gridlook is *Not*

- ❌ A competitor to high-end visualization suites
- ❌ A tool for generating publication-quality graphics

👉 It’s built for intuitive, efficient, interoperable **exploration**.

🛠️ Technical Details

- 🧠 Built with **TypeScript**
- 🌱 Frontend: **Vue.js** + **Bulma**
- 🔺 Rendering: **Three.js (WebGL)**
- 📦 Zarr handling via **Zarrita**

Supported Grids

- 🌐 Regular Grids
- 🧭 Rotated Regular Grids
- 💠 HEALPix
- 🔺 Triangular (ICON)
- 🧬 * Irregular Grids
- 🌐 * Gaussian Reduced (e.g., ERA5)

- Not upstreamed yet

Limitations (yet)

- 🕳️ No multi-dimensional arrays
  No Model-levels enabled
- 🔒 No scale shown
- 🕳️ Python example does not work
- 🌱 Code is not consolidated yet

📊 Examples

💠 Healpix

Support for all datasets in the WCRP Global Hackathon HK25 catalog.
Get to know the gridtype *healpix*
with this ICON amip Dyamond3 simulation PT6h_inst dataset:

- Level 0
- Level 4
- Level 7
- Level 11 (downloads much data!)

👀 Many of the following datasets have large chunks (~100MB).

Mind that when you are on mobile network or using a mobile device.

2. 🔺 Triangular

   Dataset: EERIE ICON hist-1950 tas on R2B8 (10km)

3. 🌐 Regular (lat x lon)

   Dataset: CMIP6 EC-Earth3P-HR highresSST-present pr, 30km.

   -> Support for CMIP

4. 🧭 Rotated lat x lon

   Dataset: CORDEX REMO2015 historical tas on EUR11(11km)

   -> Support for CORDEX

5. 🌐 Gaussian reduced (decreasing no of longitudes towards poles)

   Dataset: EERIE IFS hist 10fg on TCO1279 (10km)

   --> Support for ERA5

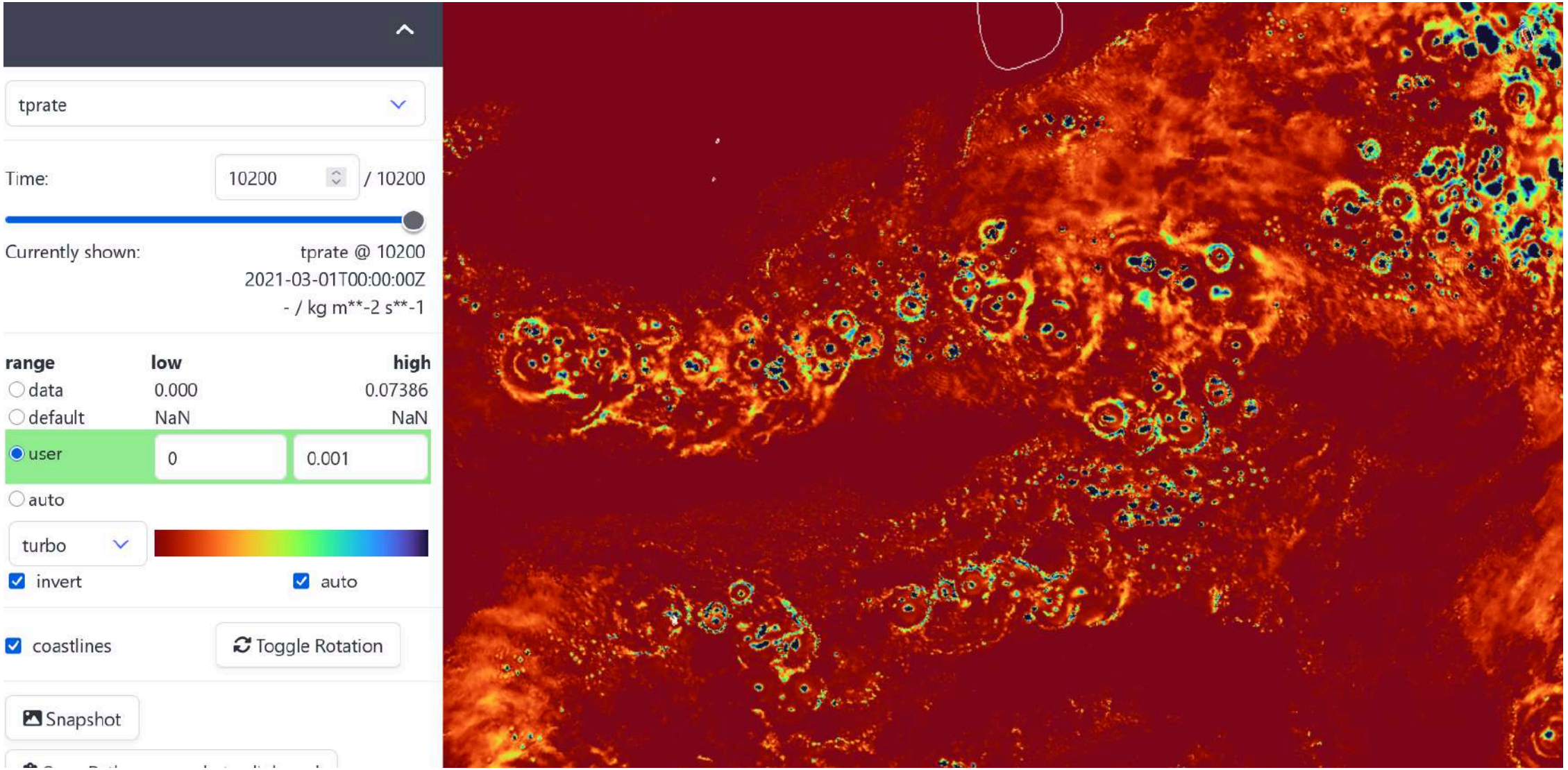
6. 🪢 Irregular

   Dataset: CMIP6 AWI-CM-1-1-MR historical tos, 25km.

💡 Use Cases

- 📱 Embed in web apps — even works on mobile
- 🧬 Understand model internals
  (e.g., ring-shaped precipitation in IFS)
- 🐛 Find bugs or diagnose outputs
  (e.g., Amazon River temperature anomaly in CMIP6 MPI-ESM1-2)

Precipitation rate in IFS Dyamond3 over the indian ocean



Cloud coverage in IFS Dyamond3 over the Pacific

☁️ Gridlook collections

🧊 DKRZ support for S3 and Swift datasets

STAC Integration as a DM test service:
Buttons as Assets in STAC Items

- Dyamond3 Healpix

🧊 **DKRZ support for S3 and Swift datasets**

works well for the HK25 data stored at DKRZ because of

1.

a performant institutional s3 cloud storage

🧊 DKRZ test support for S3 and Swift datasets

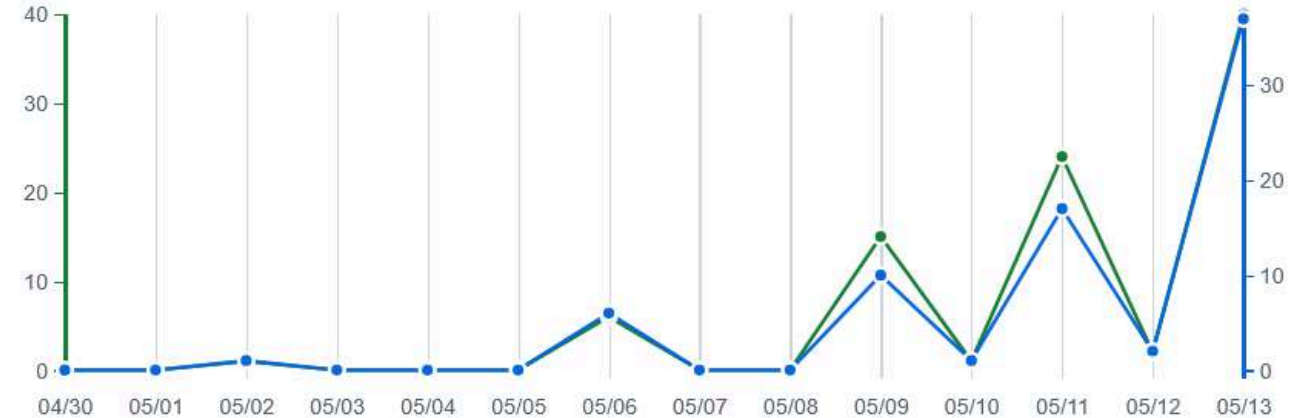
works well for the HK25 data stored at DKRZ because we

2.

prepared datasets

- rechunked datasets
- enriched datasets (`crs`, attributes)
- brought it to cloud
- embedded links in catalogs

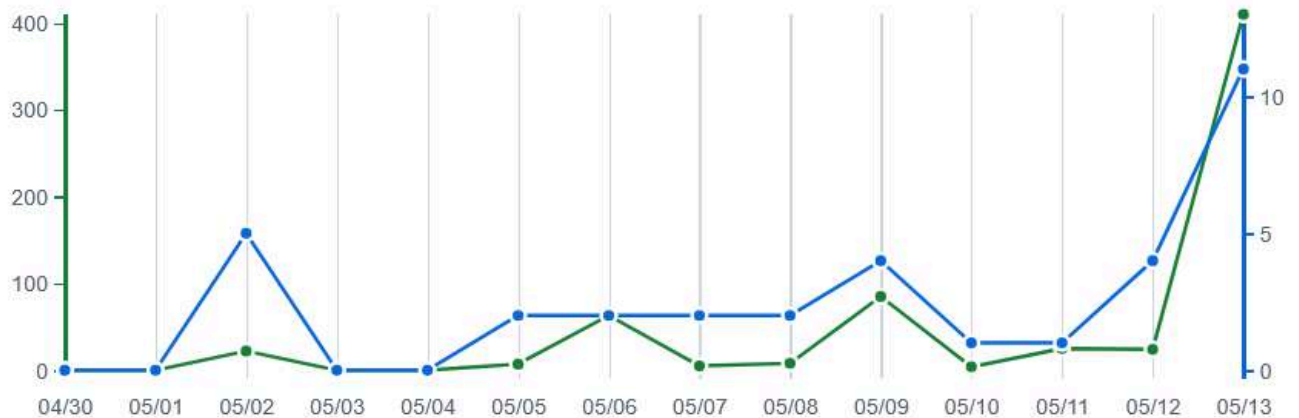
Git clones



89 Clones

71 Unique cloners

Visitors



653 Views

18 Unique visitors

☁️ Other Cloud Providers

For CORS-enabled locations:

💡 Right-click `.zmetadata` to get the URL
→ append to Gridlook URL and remove `.zmetadata`
→ submit

- **Google Cloud**
  CMIP6 Dataset
- **AWS**
  EURO-CORDEX Dataset
- (**Azure**
  ❌ Not supported (e.g., Planetary Computer))

BYODataset

A minimal guide:

1. Make your dataset CF conform for gridtype identification. Add
    - `grid_mapping` attribute used for *"rotated_lat_lon"* and *"healpix"*
    - coordinates: `lat` and `lon` values
    - better not encode `time` as *"INT64"*
    - (`long_name` attribute to variables)

2. Store zarr datasets in DKRZ cloud storage: swift (until 2026) and s3 soon.

```
cdo -f nc4c copy INPUT OUTPUT #reformat to zarr
module load swift #login
swift upload BUCKET OUTPUT
```

Without temporary output in Python with swiftspec

```
import xarray as xr
ds = xr.open_dataset(YOUR_DS_URI)
ds.to_zarr("swift://BUCKET/DS_NAME")
```

Example: Fsspec intro(EERIE Hackathon 2023)

3. Bucket setting: Publish and allow CORS

```
swift post BUCKET -r .r:* #publish
swift post BUCKET -m \
  "X-Container-Meta-Access-Control-Allow-Origin:*" #set CORS
```

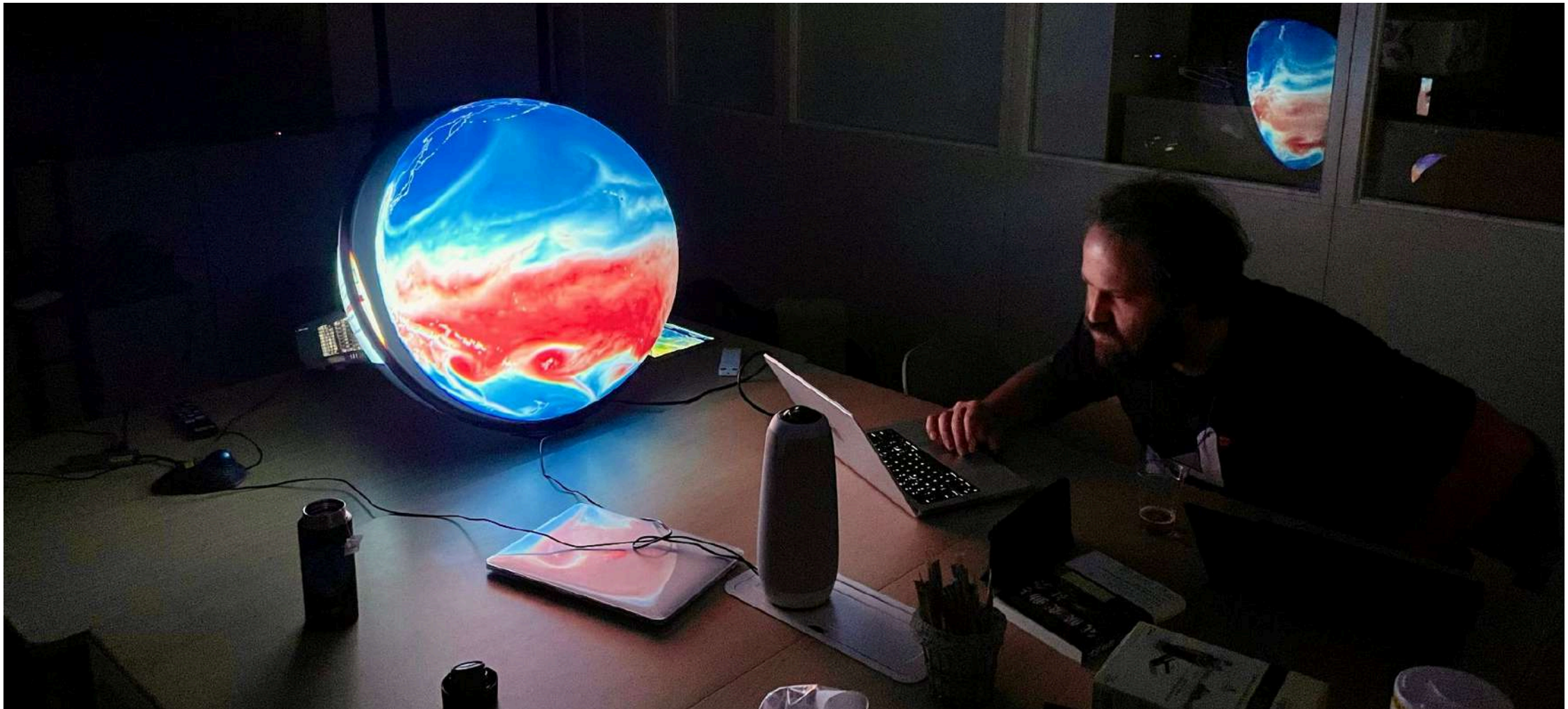
Optimal Zarr-datasets for Web-Apps:

Reduce the amount of transferred data.

- Chunks!
  - aim for 1-5 MB
  - are loaded in parallel (it's ok to load a few)
  - are *cached* (on client-side usually only if smaller than 50MB)
- Compress it!
  - zarrita supports common algorithms

🔭 Outlook

We have ideas...



🎯 **Low-hanging fruits**:

- Sliders for additional dimensions
- URL-based config: default variable, color map, etc.

🚨 NEED SUPPORT — NEED SUPPORT 🚨

✨ Wouldn’t it be cool if Gridlook, the afternoon hack, …

- 🌍 could generate snapshots in python for reproducability?
- ▶️ had a play button for animation of time series for small datasets?
- 🌍 could plot not just data stored in cloud, but also your grid and data, too?
  - Make it a tool including data serving mechanism
  - Support for more complex grid types

🚨 NEED SUPPORT — NEED SUPPORT 🚨

✨ Wouldn’t it be cool if Gridlook, the afternoon hack, …

- 🧵 could be even more efficient?
  - Dynamic level-of-detail rendering depending on scale
  - Improve caching mechanism to load data faster and smarter
  - Parallelize with web-worker

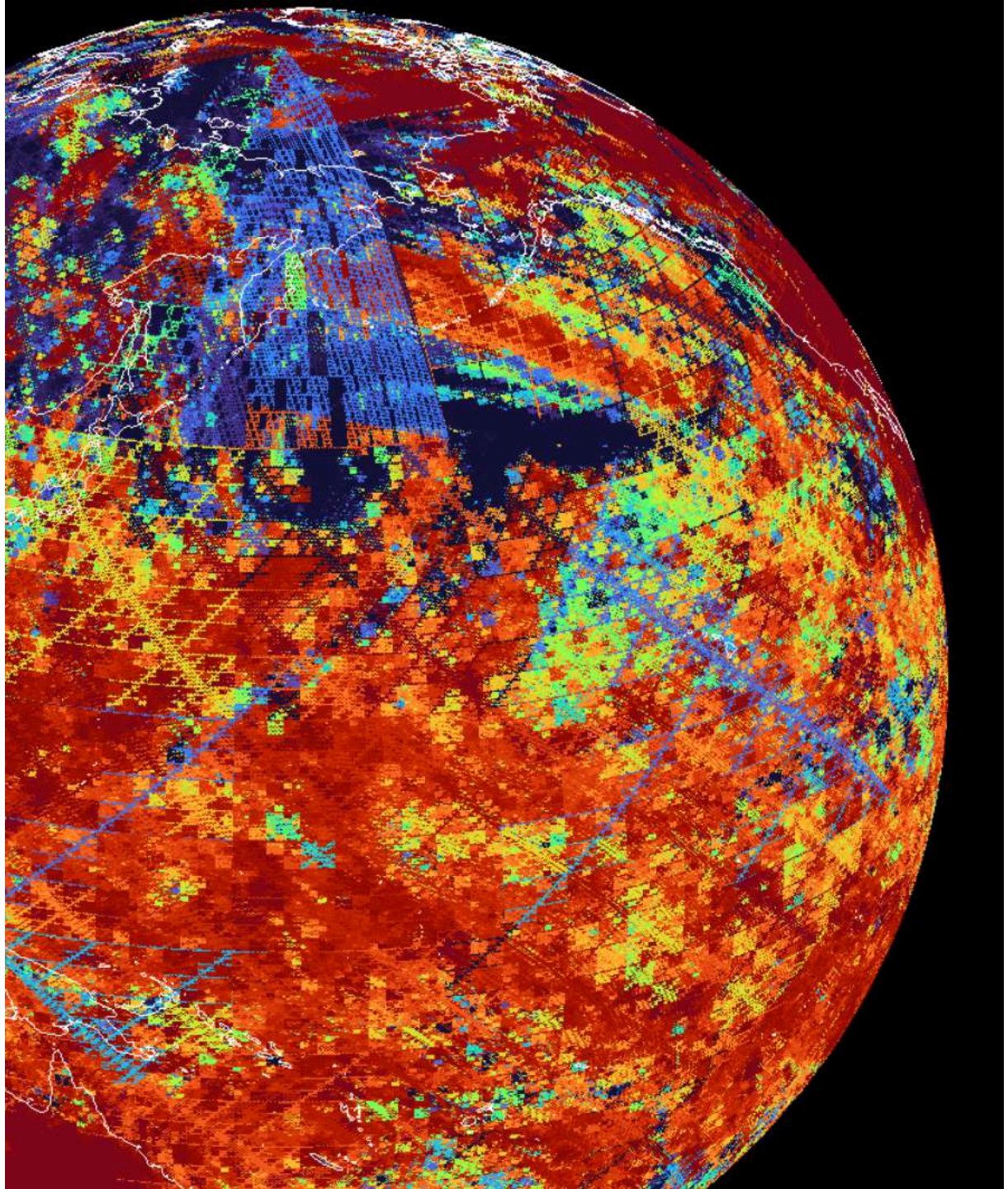
Thank you

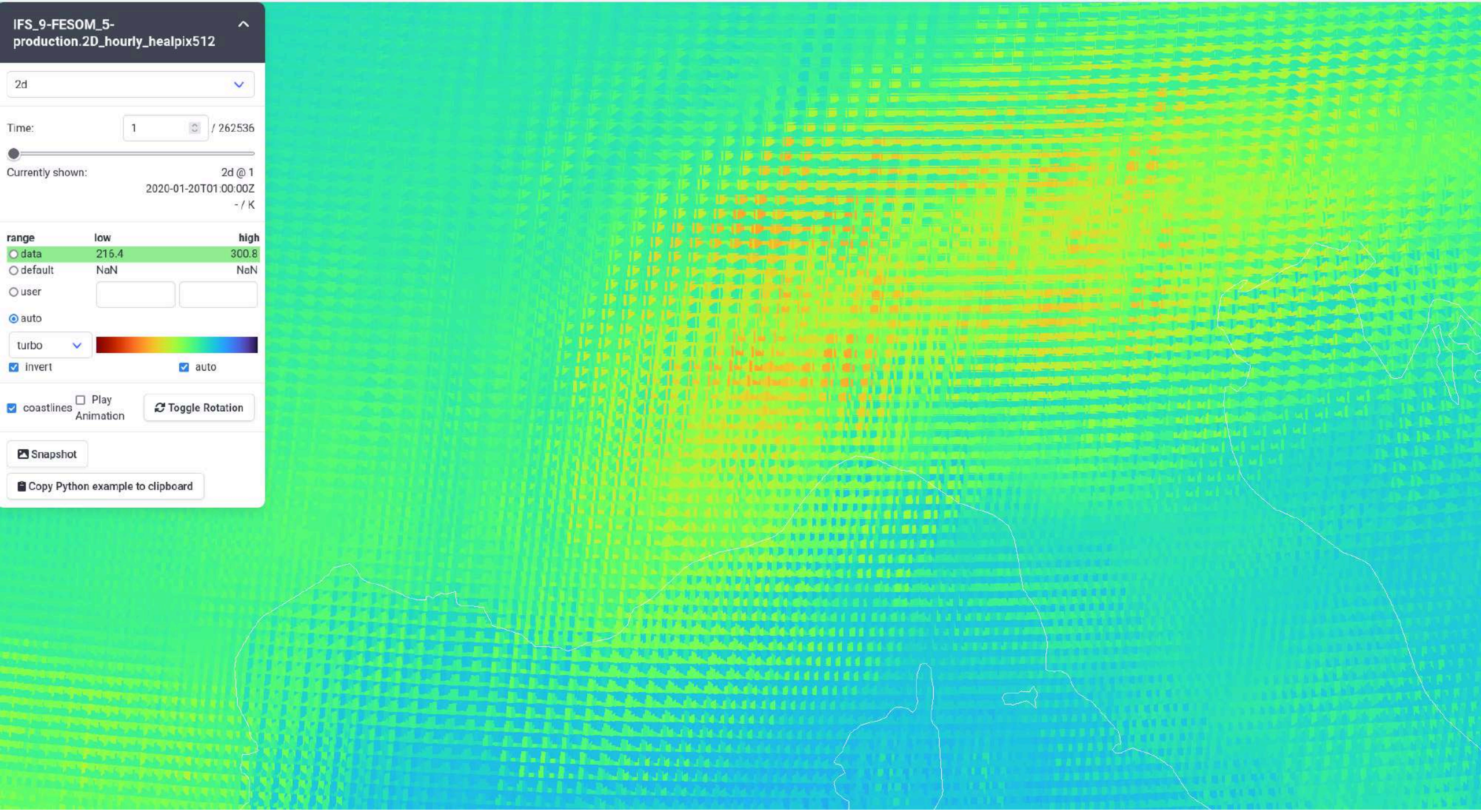
Contribute, leave issues or discuss in:

🔗 https://github.com/d70-t/gridlook

🎯 makes **climate science more explorable and tangible**.

Outtakes




IFS_9-FESOM_5-production.2D_hourly_healpix512
2d
Time:
1
/ 262536
Currently shown:
2d @ 1
2020-01-20T01:00:00Z
- / K
range
low
high
data
216.4
300.8
default
NaN
NaN
user
auto
turbo
invert
auto
coastlines
Play Animation
Toggle Rotation
Snapshot
Copy Python example to clipboard

ifs-fesom2-sr.eerie-spinup-1950.v20240304.ocean.native.daily

sst

Time: 1 / 11322

Currently shown: sst @ 1
1950-01-02T23:50:00Z
sea surface temperature / C

range	low	high
data	-2.093	32.05
default	NaN	NaN
user		

auto

turbo

invert

auto

coastlines

Toggle Rotation

Snapshot

Copy Python example to clipboard