Remote Streaming & Visualization of ECCO Data with Jupyter Notebook and IDX

Nina McCurdy/NASA Ames

but first!...

https://data.nas.nasa.gov/viz/vizdata/llc4320/

Visualizations of the ECCO Pro ×

data.nas.nasa.gov/viz/vizdata/llc4320/index.html

Visualizations of the ECCO Project's 1/48° MITgcm Simulation (aka llc4320)

This page provides access to precomputed visualizations of the Estimating the Circulation and Climate of the Ocean (ECCO, https://ecco-group.org) Project's 1/48° Massachusetts Institute of Technology general circulation model (MITgcm, https://mitgcm.org) simulation, a 14-month global simulation of the ocean (September 2011 to November 2012) that resolves internal tides and admits submesoscale and internal-gravity-wave variability.

The visualizations make accessible nearly all of the output from the simulation: all scalars, all levels, and all regions. A number of different resolutions are available, from single animations that show a global view to regional closeups that are nearly the same resolution as the simulation.

The different resolutions are organized into five series of animations. Three series show most of the globe, and two show the Arctic. The highest resolution series showing the globe has 128 different views organized into 8 rows and 16 columns. The medium resolution global series has 8 views that roughly divide the domain into eighths, and is organized into two rows each having 4 columns. The lowest resolution global series has a single global view. The high resolution Arctic series has 26 views organized into 6 rows and 5 columns (four views are blank), and the low resolution Arctic series has a single view.

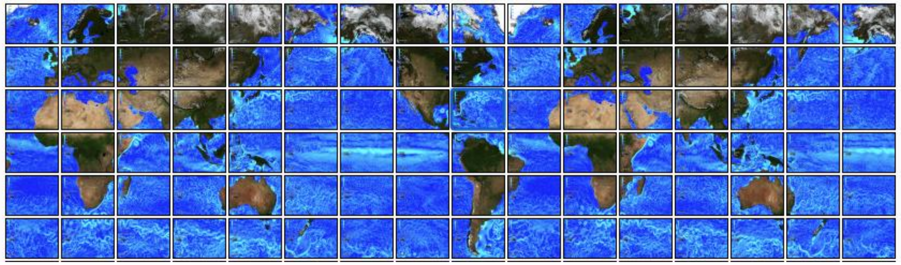
Each series of views has visualizations available in two or three different animation resolution sizes, ranging from about 800 by 600 to sizes that only fit on a 4K monitor. Finally, the animations are available with different time steps, ranging from one hour time steps to one day time steps.

For more information about using this page, the ECCO group has a web page with detailed instructions.

Use the menus below to select the animation series, scalar value, and simulation level (depth). A scalar must be selected before the Level menu is populated as the number of available levels vary by scalar. Selecting a 2D scalar automatically selects the single available level. Once the three selections are made, an image map appears below that shows thumbnails of each available view. Clicking on a thumbnail will open a new tab with a page that has links to animations for the available resolutions and time steps.

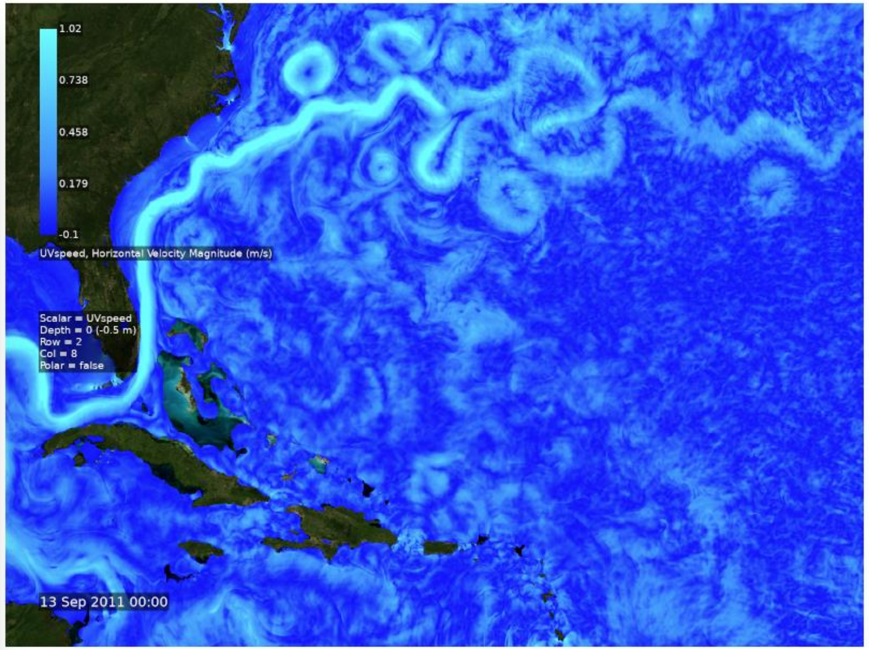
Series	Scalar	Level
128 regions (2-5km)	UVspeed (horizontal speed)	Level 0 (-0.5 m)

Click on one of the 128 images below to see the available animations for UVspeed level 0 at that geographic location in a new tab.



ECCO UVspeed level 0 Row 2 ×

data.nas.nasa.gov/viz/vizdata/llc4320/html/UVspeed/level_00/F_UVspeed_l00_2_08.html



ill select a visualization of UVspeed (horizontal speed) level 0 (depth -0.5 m) located at row 2 column 8 in the 128-region series of animations. The for either a MP4 animation or a full size image. Animations are available for different resolutions and image sizes, and for a range of time steps. The sizes l.

Timestep	Animation Pixel Resolution and File Size	
	5.4 km / 800x600	2.7 km / 1600x1200
1 hour	587 MB Play MP4 Download MP4 Image	1.5 GB Play MP4 Download MP4 Image
3 hours	251 MB Play MP4 Download MP4 Image	716 MB Play MP4 Download MP4 Image
6 hours	132 MB Play MP4 Download MP4 Image	367 MB Play MP4 Download MP4 Image
12 hours	64 MB Play MP4 Download MP4 Image	183 MB Play MP4 Download MP4 Image
24 hours	34 MB Play MP4 Download MP4 Image	96 MB Play MP4 Download MP4 Image

Play MP4

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Series	**Scalar**	**Level**
Series	Scalar	Select scalar first

Note: The menus are sometimes unresponsive when using Safari and returning to this page using the browser Back function. The work-around is to reload the page or to reselect a different value in one of the working menus.

Model output from the 1/48° MITgcm simulation is available at https://data.nas.nasa.gov/ecco/. Technical aspects of the visualization are described in Ellsworth et al. (2017). The MITgcm is described in Marshall et al. (1997 a, b). The 1/48° simulation has resulted in more than 80 science publications (see References).

References

Arbic, B. K., Alford, M. H., Ansong, J. K., Buijsman, M. C., Ciotti, R. B., Farrar, J. T., Hallberg, R. W., Henze, C. E., Hill, C. N., Luecke, C. A., Menemenlis, D., Metzger, E. J., Müeller, M., Nelson, A. D., Nelson, B. C., Ngodock, H. E., Ponte, R. M., Richman, J. G., Savage, A. C., … Zhao, Z. (2018). A Primer on Global Internal Tide and Internal Gravity Wave Continuum Modeling in HYCOM and MITgcm. In E. P. Chassignet, A. Pascual, J. Tintoré, & J. Verron (Eds.), *New Frontiers in Operational Oceanography* (pp. 30–392). GODAE OceanView https://doi.org/10.17125/gov2018.ch13

Ardhuin, F., Aksenov, Y., Benetazzo, A., Bertino, L., Brandt, P., Caubet, E., Chapron, B., Collard, F., Cravatte, S., Delouis, J. M., Dias, F., Dibarboure, G., Gaultier, L., Johannessen, J., Korosov, A., Manucharyan, G., Menemenlis, D., Menendez, M., Monnier, G., … Xie, J. (2018). Measuring currents, ice drift, and waves from space: The Sea surface KInematics Multiscale monitoring (SKIM) concept. *Ocean Sci.*, 14(3), 337–354. https://doi.org/10.5194/os-14-337-2018

Ardhuin, F., Brandt, P., Gaultier, L., Donlon, C., Battaglia, A., Boy, F., Casal, T., Chapron, B., Collard, F., Cravatte, S., Delouis, J.-M., De Witte, E., Dibarboure, G., Engen, G., Johnsen, H., Lique, C.,

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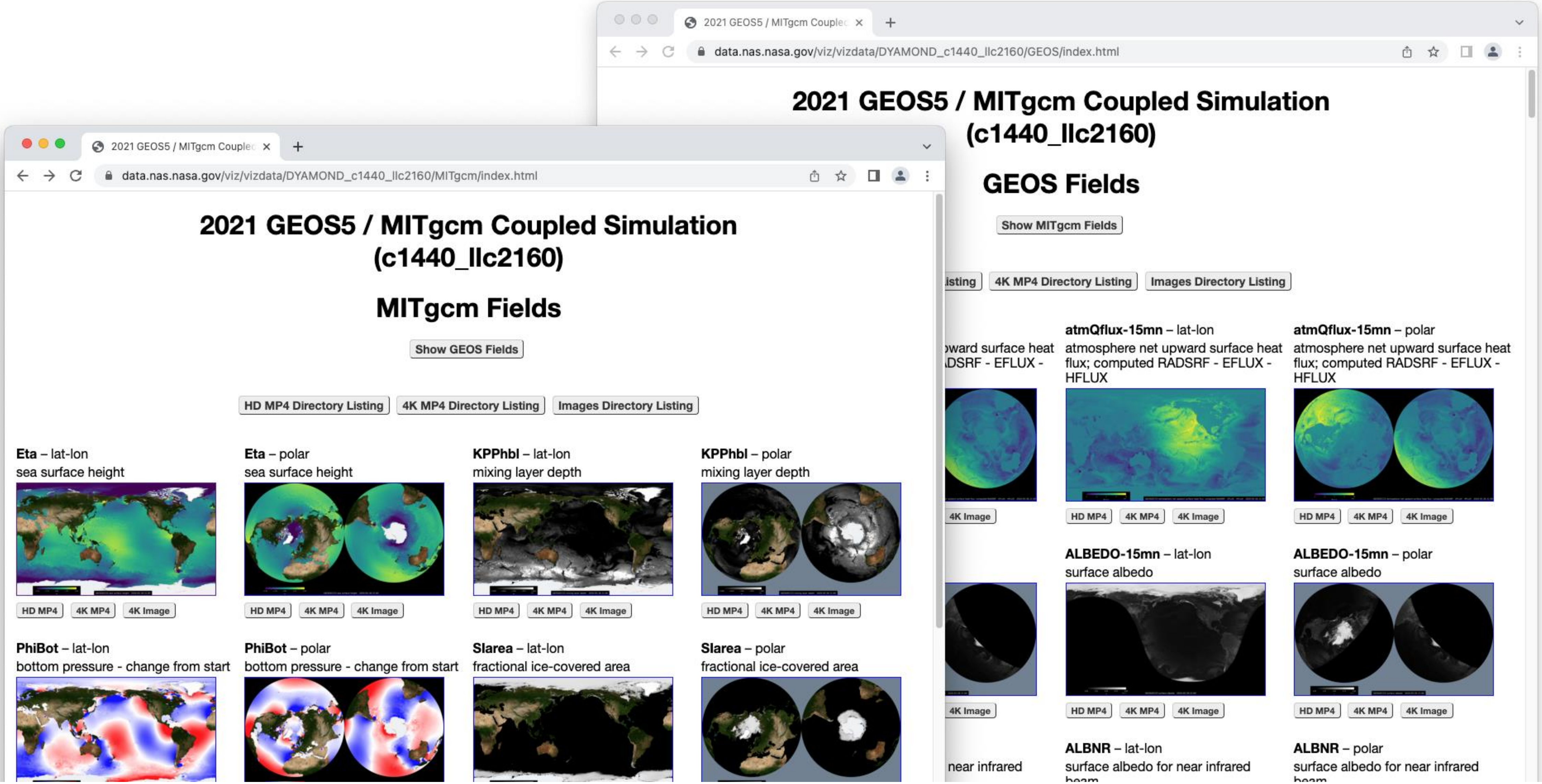
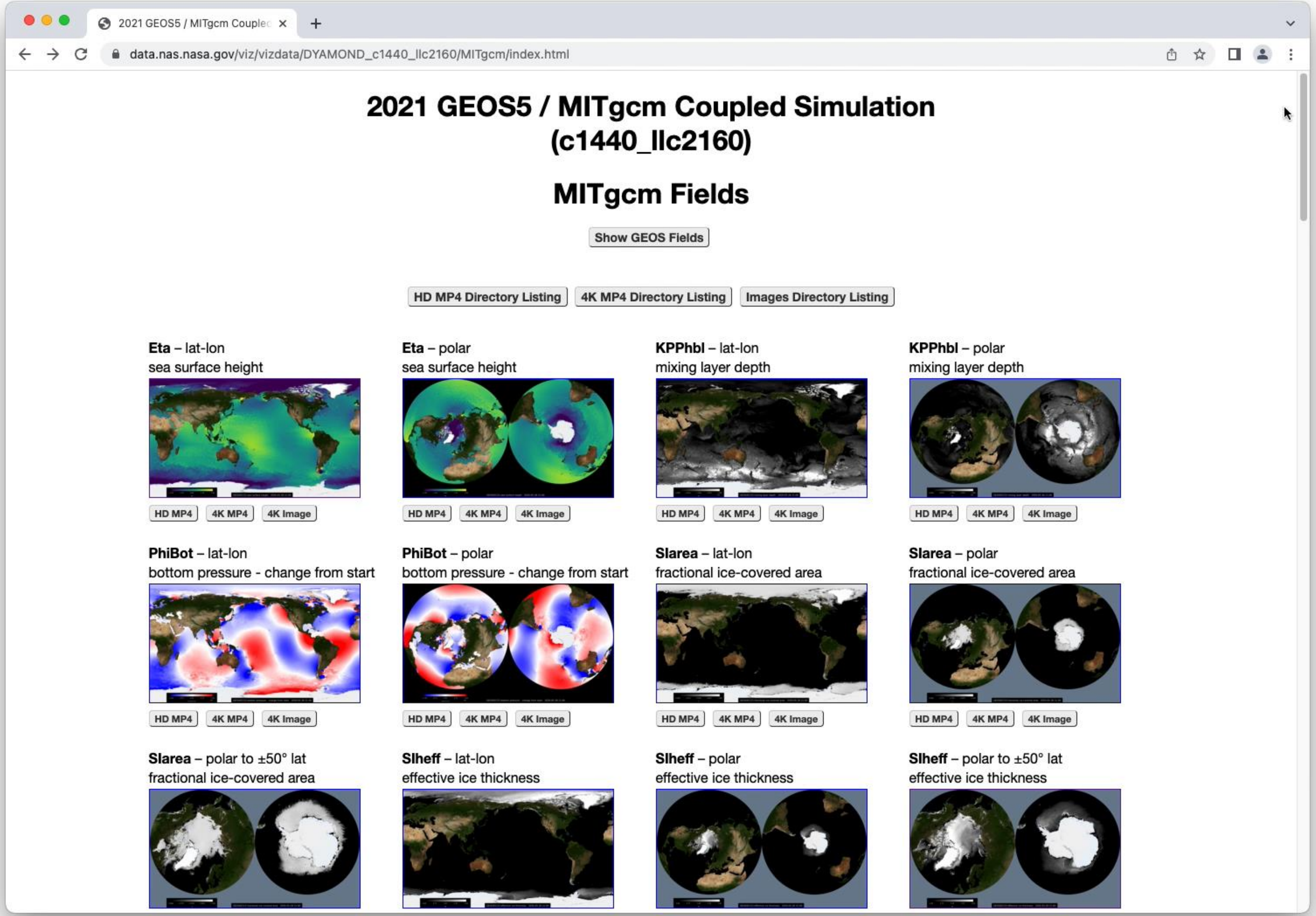
https://data.nas.nasa.gov/viz/vizdata/DYAMOND_c1440_llc2160/MITgcm/



https://data.nas.nasa.gov/viz/vizdata/DYAMOND_c1440_llc2160/MITgcm/



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MITgcm compressed data extraction tool

usage: extract[4320,2160] [options] timesteps fieldNames 3DstartPoint 3Dextent

MITgcm "uncompress" tool

usage: uncompress[4320,2160] [options] timesteps fieldNames

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Remote streaming and Visualization with Jupyter Notebook and IDX(2)

- IDX(2) : wavelet compression + octree data structure to support progressive decompression of data at different levels of precision and resolution.

- Jupyter Notebooks at NAS : to support remote streaming and interactive visualization of IDX(2)-formatted data.

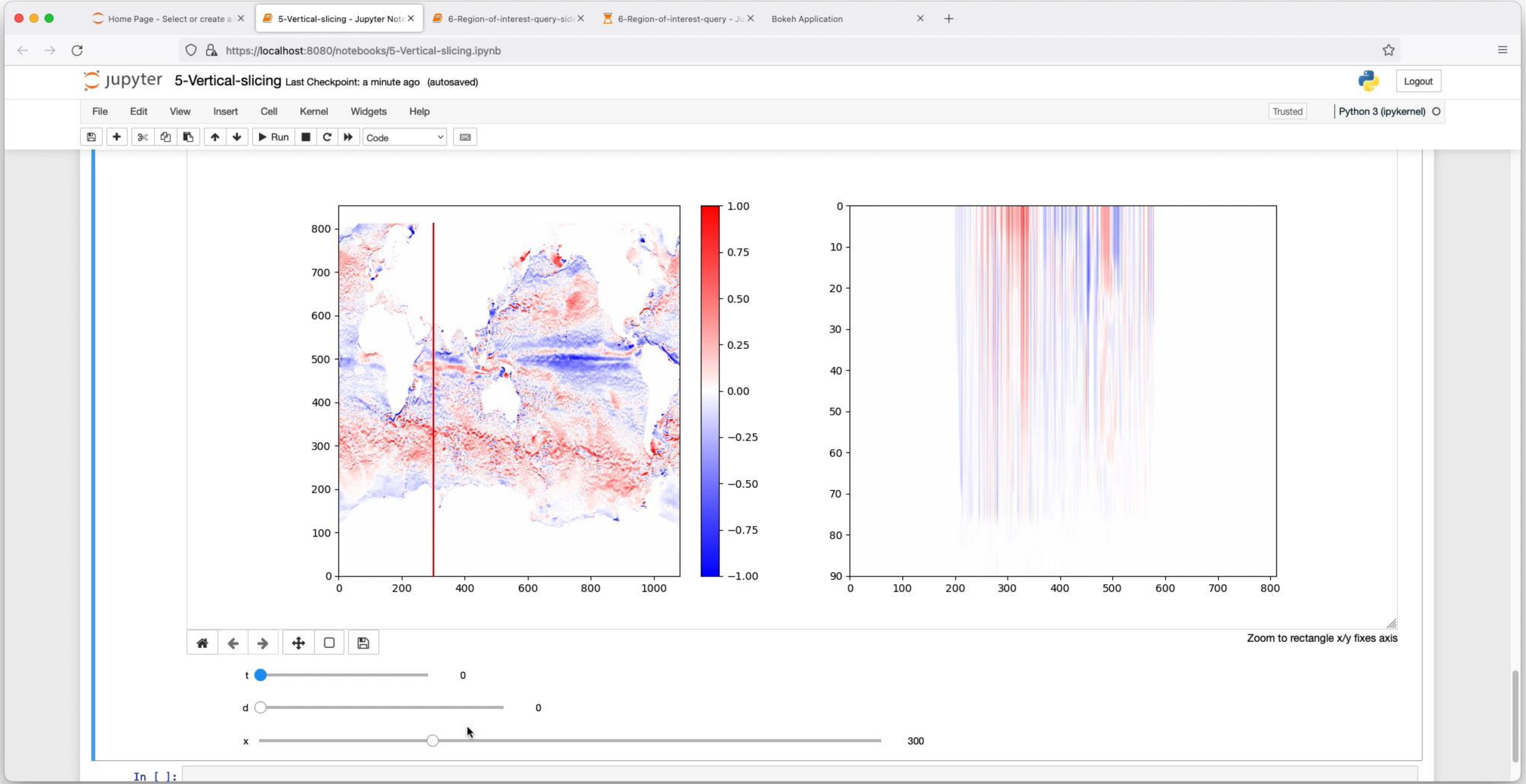
6-Region-of-interest-query-side-by-side Last Checkpoint: 09/19/2022 (unsaved changes)

In [1]:
```
import sys
sys.path.insert(0, 'F:/Workspace/idx2/build/Source/Python/Release')
sys.path.insert(0, 'D:/pascucci/ppt/2022/6_NASA/idx2/build/Source/Python/RelWithDebInfo')
sys.path.insert(0, '/nobackupp19/vpascucc/converted_files/')
import os
import idx2Py as i2p
import numpy as np
import matplotlib
from matplotlib import pyplot as plt
import matplotlib.image as mpimg
from matplotlib.animation import FuncAnimation
from ipywidgets import *
import concurrent.futures
import threading

path_prefix = 'J:/nasa/'
if not os.path.exists (path_prefix):
  path_prefix = "W:/cedmav/hello/"
if not os.path.exists (path_prefix):
  path_prefix = "/nobackupp19/vpascucc/converted_files/"

%matplotlib notebook
from IPython.core.display import display, HTML
display(HTML("<style>.container { width:90% !important; }</style>"))

vmin = -1
vmax = 1
```

```
/var/tmp/pbs.88098.pbspl4.nas.nasa.gov/ipykernel_47993/1123367501.py:23: DeprecationWarning: Importing display from IPython.core.display is deprecated since IPython 7.14, please import from IP
ython display
  from IPython.core.display import display, HTML
```

Set up color map

In [2]:
```
import colorsys

Points = [
  -10,
  -2.18552,
  -0.260014,
  0.00702716,
  0.372452,
  0.709768,
  10
```


Home Page - Select or create a
5-Vertical-slicing - Jupyter Note
6-Region-of-interest-query-side
6-Region-of-interest-query - Ju
Bokeh Application
https://localhost:8080/notebooks/5-Vertical-slicing.ipynb
jupyter 5-Vertical-slicing Last Checkpoint: a minute ago (autosaved)
Logout
File Edit View Insert Cell Kernel Widgets Help
Trusted
Python 3 (ipykernel)
Run
Code
Zoom to rectangle x/y fixes axis
t 0
d 0
x 300
In [ ]:

OpenVisus Streaming Analysis of LLC4320 datasets directly from NAS server (Field:U)

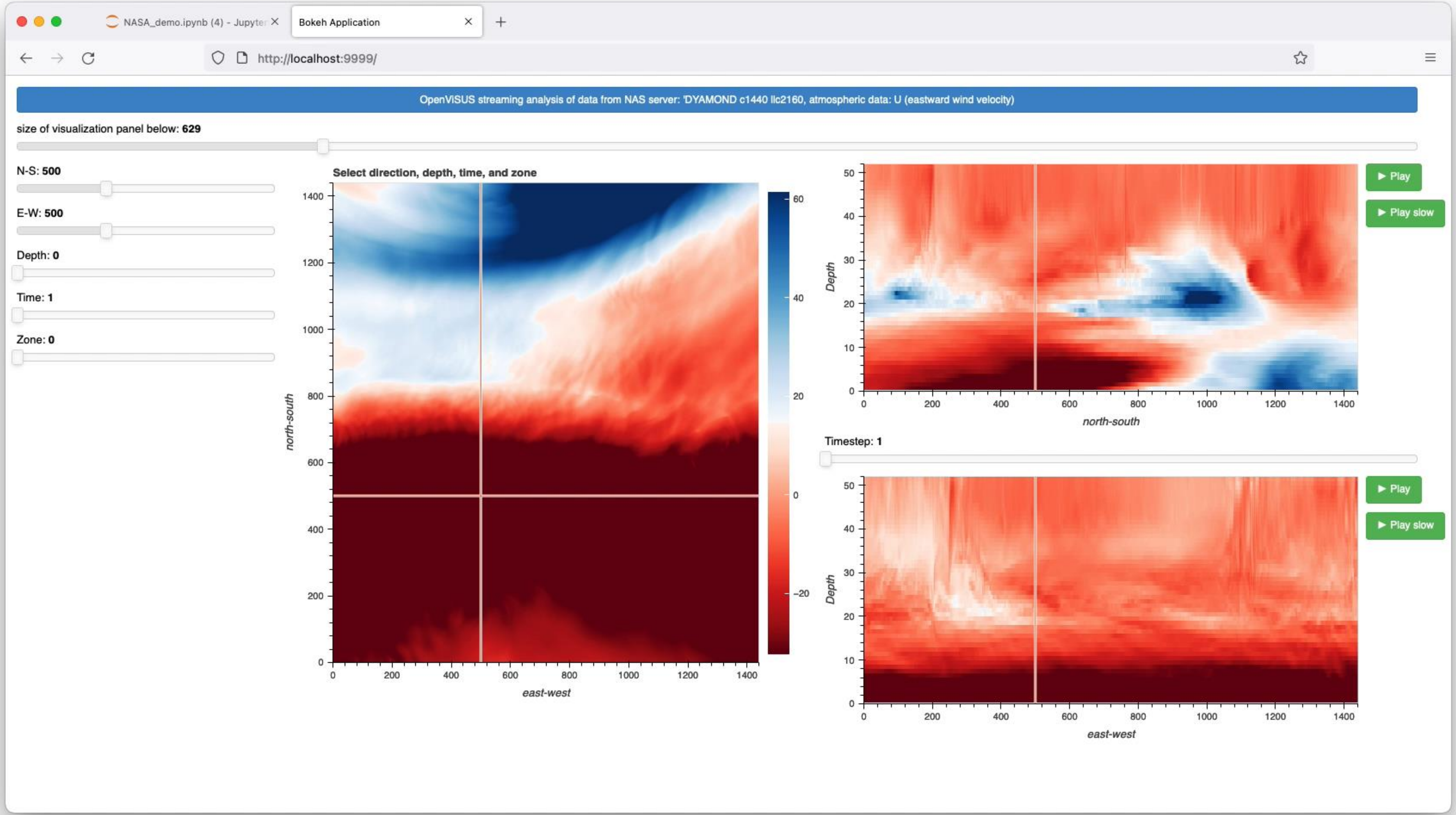
[1]:

```python
import sys
sys.path.insert(0, '/nobackupp19/vpascucc/llc4320_raw/')
import os
from OpenVisus import *
import numpy as np
import matplotlib
from matplotlib import pyplot as plt
import matplotlib.image as mpimg
from matplotlib.animation import FuncAnimation
from ipywidgets import *
import concurrent.futures
import threading
path_prefix = "/nobackupp19/vpascucc/converted_files/"

# %matplotlib notebook
from IPython.core.display import display, HTML
display(HTML("<style>.container { width:90% !important; }</style>"))

vmin = -1
vmax = 1
```

```
Starting OpenVisus /nobackupp1/nmccurdy/collab/pascucci/nasa-encoding-framework/OpenVisusenv/lib/python3.9/site-packages/OpenVisus/__init__.py 3.9.5 (default, Aug 19 2021, 22:47:29)
[GCC 7.5.0] sys.version_info(major=3, minor=9, micro=5, releaselevel='final', serial=0) ...
/var/tmp/pbs.88098.pbspl4.nas.nasa.gov/ipykernel_74495/3176252284.py:16: DeprecationWarning: Importing display from IPython.core.display is deprecated since IPython 7.14, please import from IPython display
  from IPython.core.display import display, HTML
```

[2]:

```python
def blockPrinting(func):
    def func_wrapper(*args, **kwargs):
        # block all printing to the console
        sys.stdout = open(os.devnull, 'w')
        # call the method in question
        value = func(*args, **kwargs)
        # enable all printing to the console
        sys.stdout = sys.__stdout__
        # pass the return value of the method back
        return value
```



NASA_demo.ipynb (4) - Jupyter
Bokeh Application
http://localhost:9999/
OpenViSUS streaming analysis of data from NAS server: 'DYAMOND c1440 llc2160, atmospheric data: U (eastward wind velocity)
size of visualization panel below: 629
N-S: 500
E-W: 500
Depth: 0
Time: 1
Zone: 0
Select direction, depth, time, and zone
north-south
east-west
Depth
north-south
Timestep: 1
Depth
east-west
▶ Play
▶ Play slow
▶ Play
▶ Play slow

Thank you!

Questions?

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https://data.nas.nasa.gov/viz/vizdata/DYAMOND_c1440_llc2160/MITgcm/

https://data.nas.nasa.gov/viz/vizdata/llc4320/