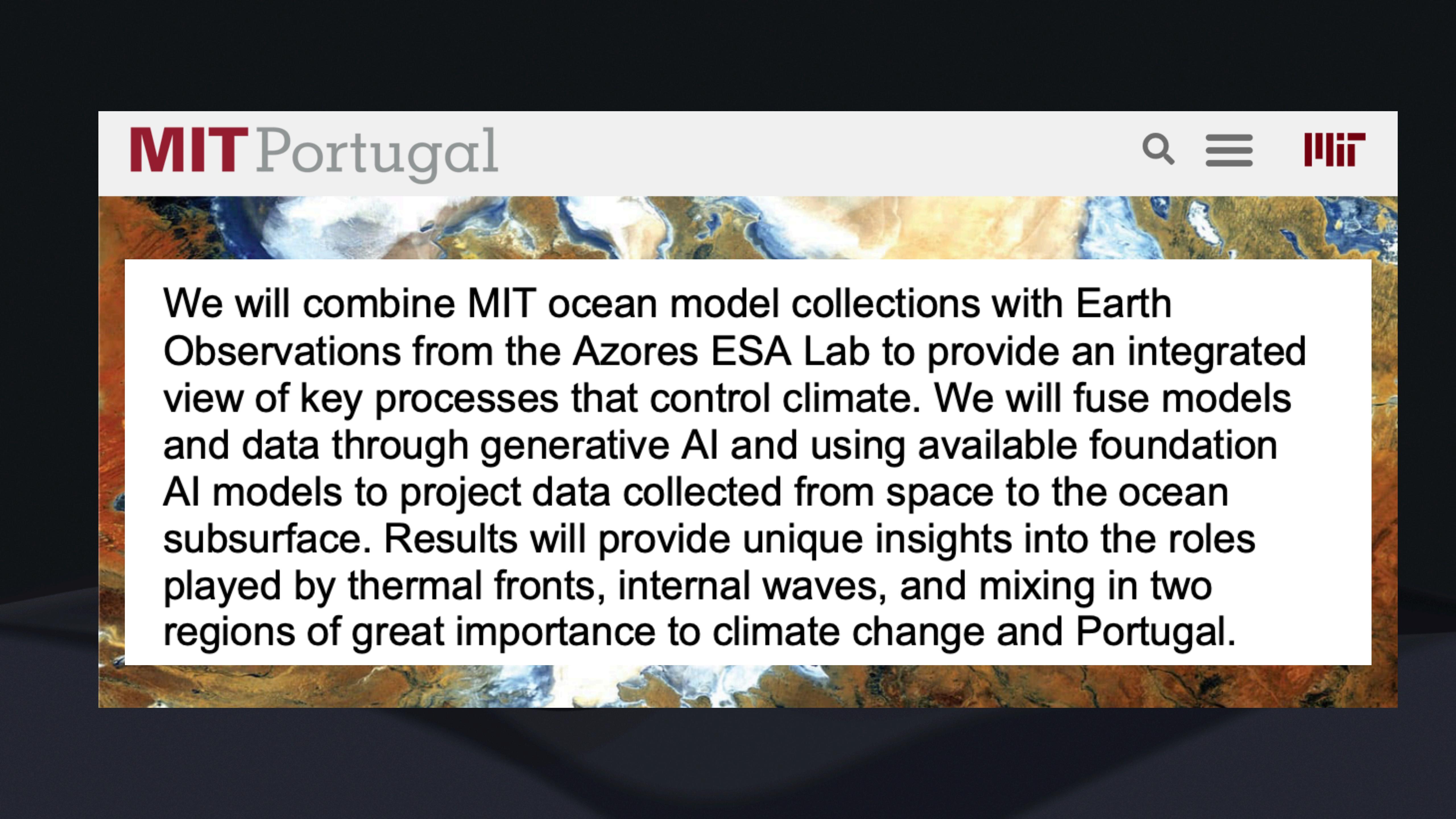


# Model-Data Fusion for the Azores and the Tropical Pacific

*Gaël Forget, Adriana Ferreira, Jorge Magalhães, João Pinelo, José Silva*



We will combine MIT ocean model collections with Earth Observations from the Azores ESA Lab to provide an integrated view of key processes that control climate. We will fuse models and data through generative AI and using available foundation AI models to project data collected from space to the ocean subsurface. Results will provide unique insights into the roles played by thermal fronts, internal waves, and mixing in two regions of great importance to climate change and Portugal.

# Julia Island ... the Origin Story

## 2022 Symposium on Advances in Ocean Observations

The goal :

“Bring together a small yet highly motivated group of experts focusing on smarter methods in ocean observation. The aim is to generate ideas across science and technology, to advance ocean observation in novel ways.”

My contribution :

👉 Here is a framework to demonstrate and evaluate new observational concepts in Julia!



Figure reproduced from ***Digital Twins for Ocean Robots***. G Forget 2024. Proceedings of the JuliaCon Conferences 6 (65), 164. Depiction of thermal fronts in MIT general circulation model.

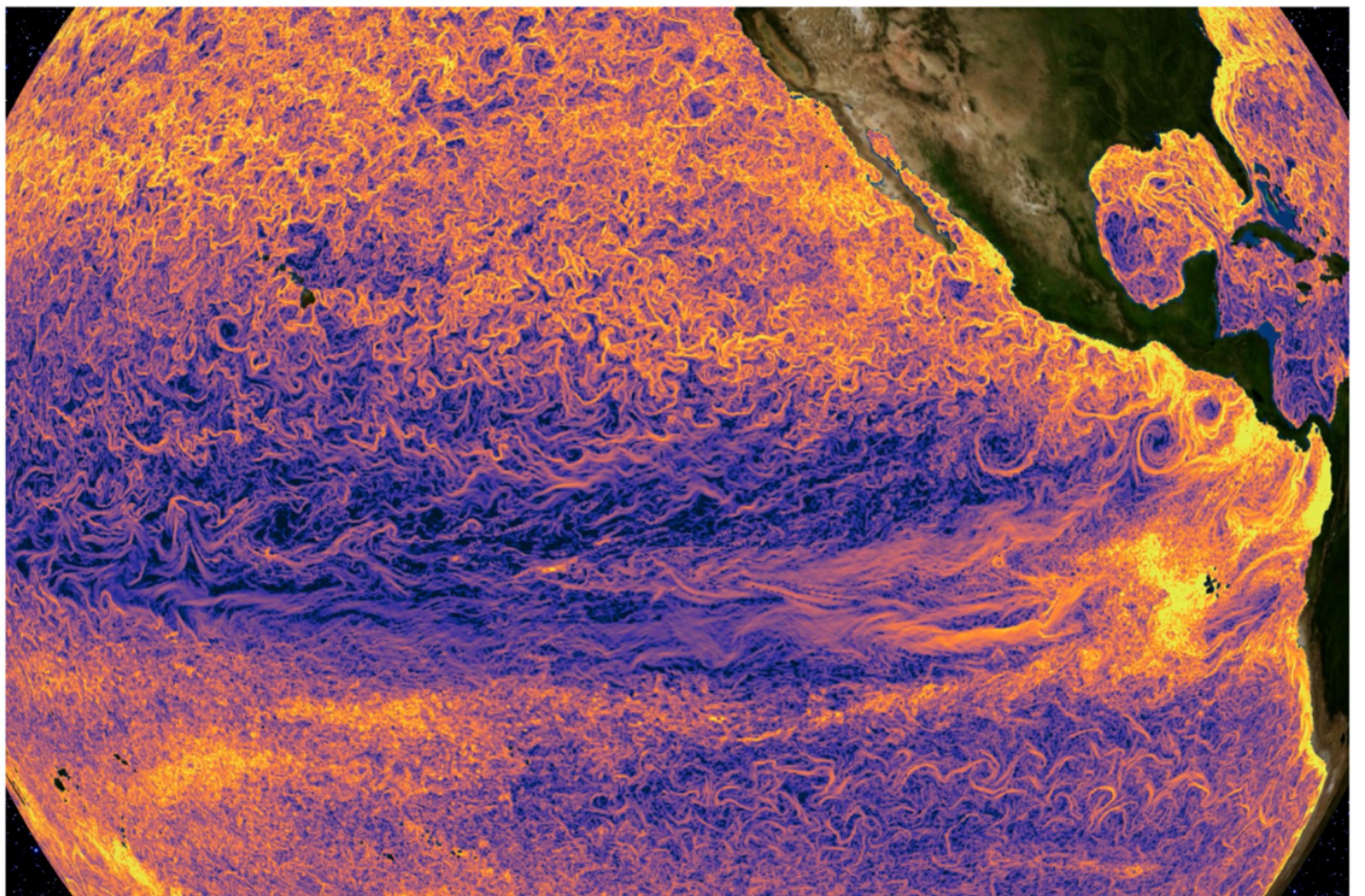


Fig. 8: Temperature fronts in a global km-scale MITgcm simulation. Plotted is the logarithm of the spatial gradient of a temperature snapshot.

<https://proceedings.juliaco.n.org/papers/10.21105/jcon.00164.pdf>

→ ComplexOcean1.mov

<https://www.gaelforget.net/artwork/>

# ClimateModels.jl

[documentation](#)

ClimateModels.jl provides a uniform interface to climate models of varying complexity and completeness. Models that range from low dimensional to whole Earth System models can be run and analyzed in this framework.

ClimateModels.jl supports standard model runs as well as workflows that replay model output from storage. The framework is compatible with the various computer languages and file formats commonly used in climate science.

ClimateModels.jl uses *git* to enable documentation and reproducibility of your workflows by default.

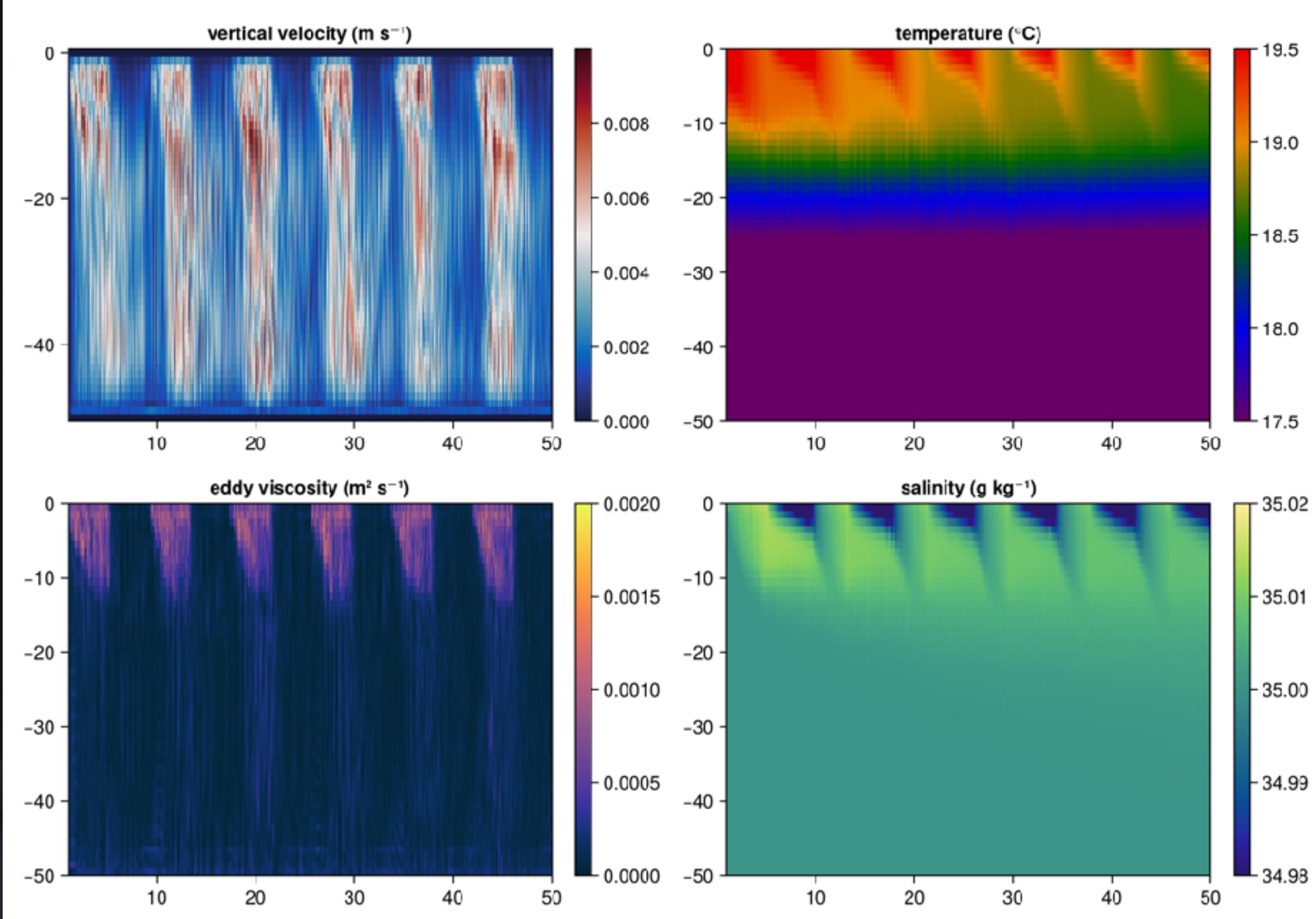
## Workflows That Run Models

- Random Walk model (Julia) [» code link](#)
- ShallowWaters.jl model (Julia) [» code link](#)
- Oceananigans.jl model (Julia) [» code link](#)
- Hector global climate model (C++) [» code link](#)
- FaIR global climate model (Python) [» code link](#)
- SPEEDY atmosphere model (Fortran90) [» code link](#)
- MITgcm general circulation model (Fortran) [» code link](#)

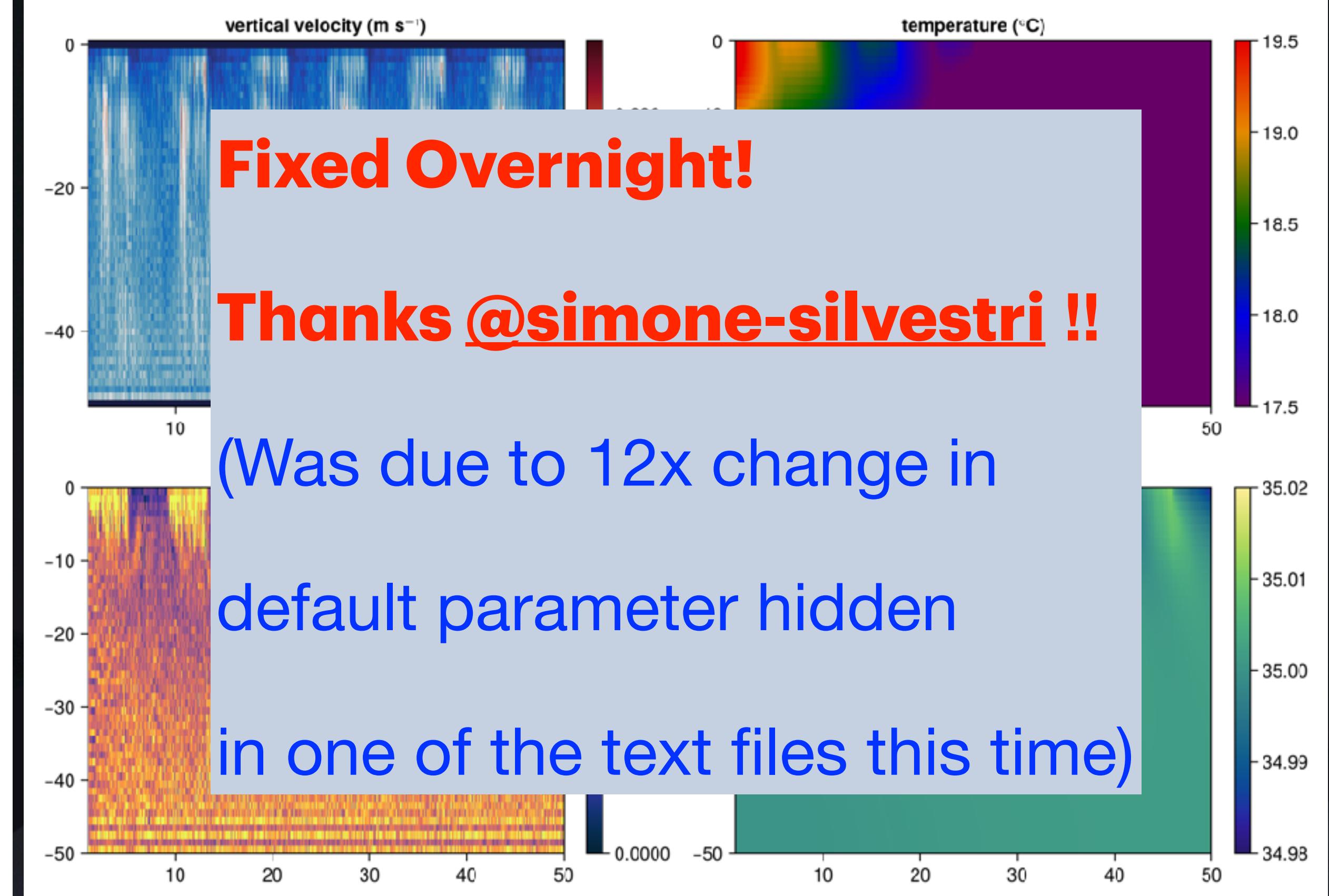
## Workflows That Replay Models

- IPCC report 2021 (NetCDF, CSV) [» code link](#)
- CMIP6 model output (Zarr) [» code link](#)
- ECMWF IFS 1km (NetCDF) [» code link](#)
- ECCO version 4 (NetCDF) [» code link](#)
- Pathway Simulations (binary, jld2) [» code link](#)

# We have been Ready to Use Oceananigans for years but it keeps on breaking ...



Oceananigans.jl v0.95.5 (one year ago)



**Fixed Overnight!**

**Thanks @simone-silvestri !!**

(Was due to 12x change in

default parameter hidden

in one of the text files this time)

Oceananigans.jl v0.103.1 (now)