

# Coupling MOM6 into CESM: progress, challenges and next steps

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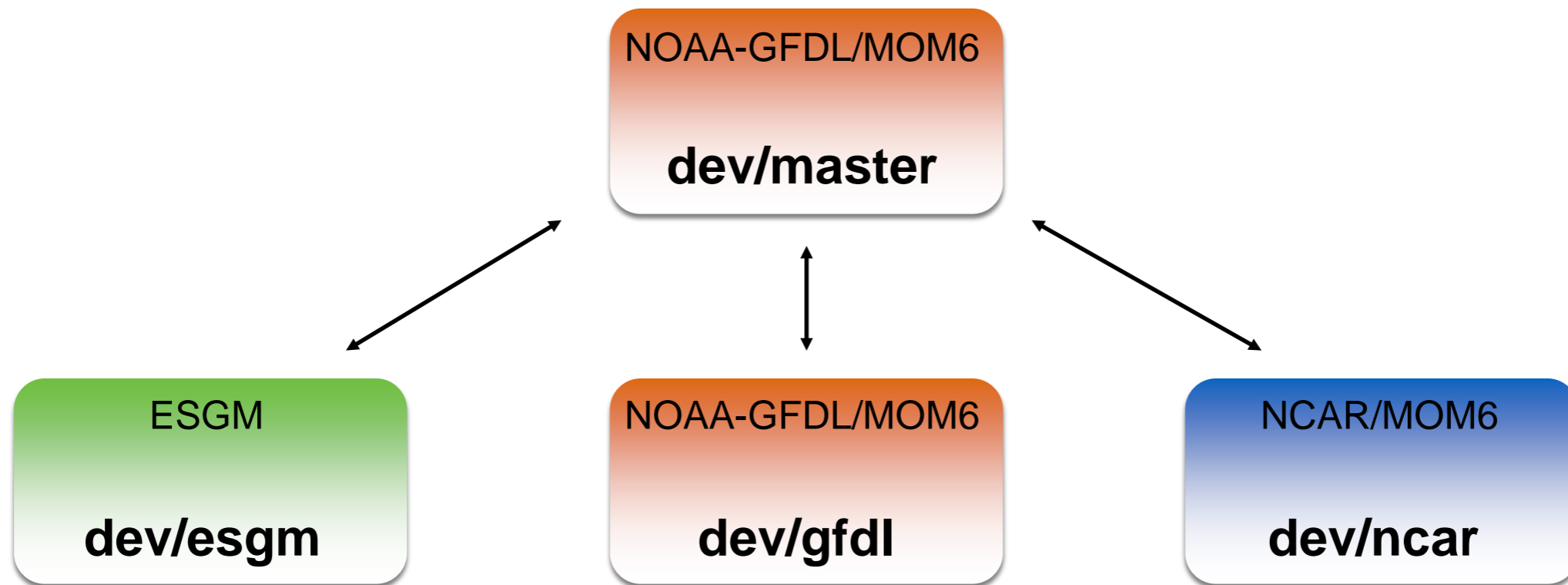
CESM Ocean Model Working Group



# The NCAR/MOM6 repository

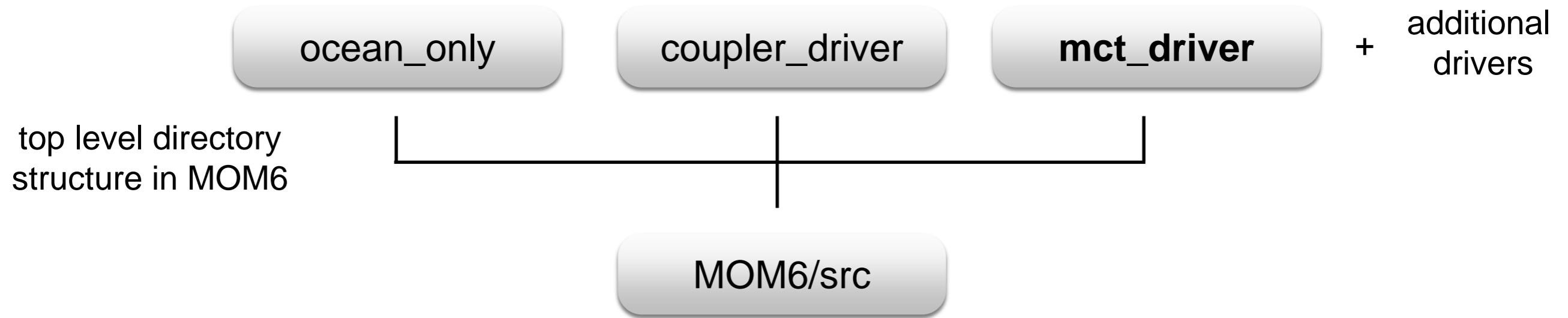
<https://github.com/NCAR/MOM6>

- Initial goal: couple MOM6 to the Common Infrastructure for Modeling the Earth (CIME) and test the model using a configuration based on POP's 1° grid
- NCAR/MOM6 is a fork from NOAA-GFDL/MOM6



- Branches are synced to dev/master every ~1-3 months
- Testing:
  - Continuous integration using Travis (only for small tests)
  - MOM6 regression answers (55 tests)
  - Regression answers for 1 test using MOM6/CESM

# The Model Coupling Toolkit (MCT) driver



- **mct\_driver/ocn\_comp\_mct.F90** is the main driver for MOM6 in CESM
- Relies on CIME and the Flexible Modeling System (FMS/GFDL) infrastructures
- Public member functions: `ocn_init_mct`, `ocn_run_mct` and `ocn_final_mct`
- Fully Doxygenized
- TODO: Langmuir related fields, Biogeochemistry etc

# The NCAR/MOM6-Cases repository

<https://github.com/NCAR/MOM6-cases>

📖 README.md

## MOM6-cases

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Example configurations for NCAR/MOM6.

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MOM6 is the provisional ocean component of CESM3, a future version of NCAR's global climate model. This repository houses experimental test cases to be developed and used during the process of transitioning from POP2, the current ocean component of CESM, to MOM6.

### Getting Started

1. [Downloading NCAR/MOM6-cases](#)
2. [Setting up the compiler environment](#)
3. [Compiling cases](#)
4. [Running cases](#)

### MOM6 & CIME:

- [Quick Start](#)

### Developers Guide

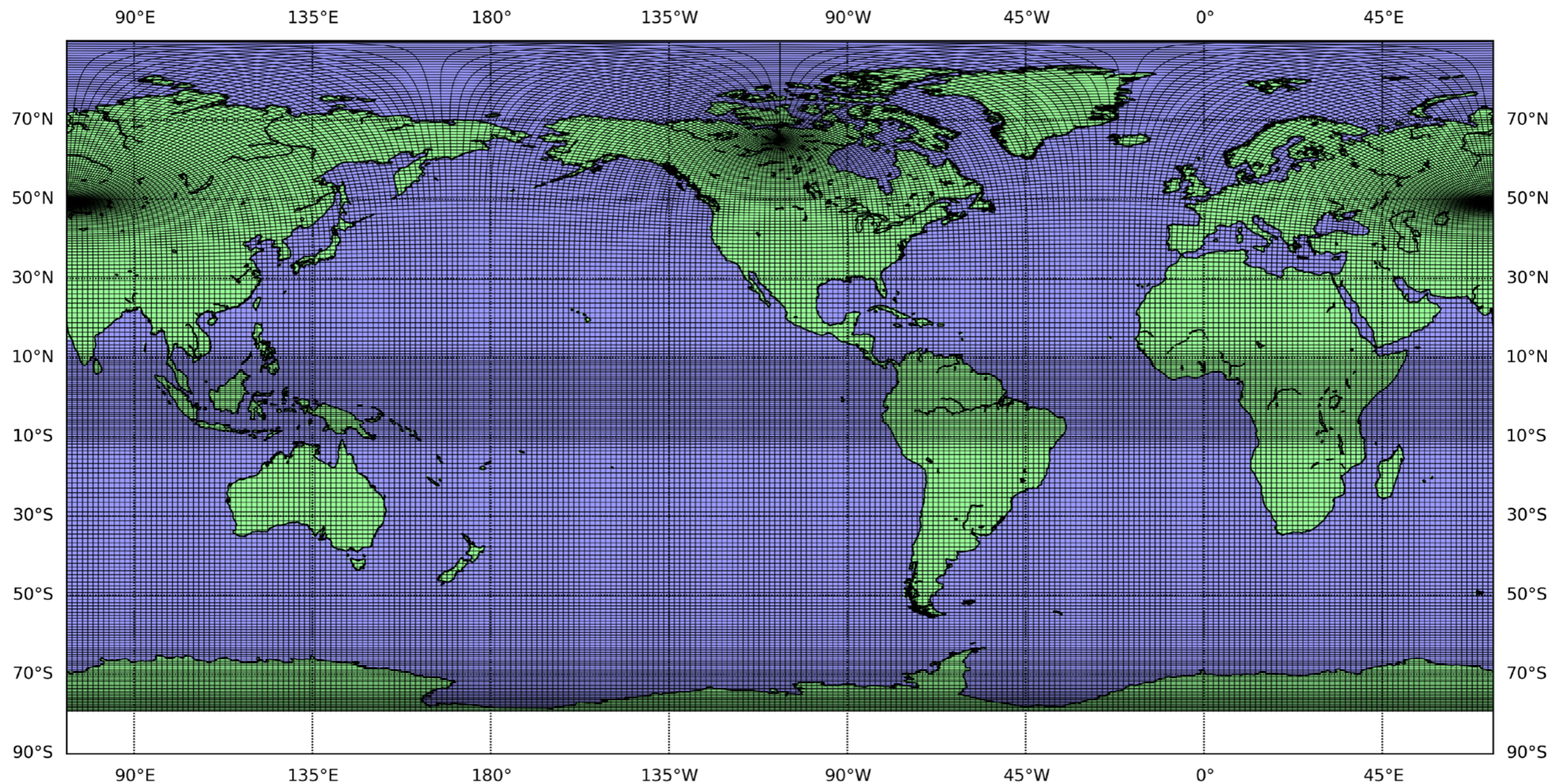
- [Contributing to this repo](#)



# A new global configuration

## Contribution from Fred Castruccio

- Nominal  $2/3^\circ$  horizontal resolution grid ( $n_x = 540$ ;  $n_y = 458 \sim 1.4 \times$  POP's  $1^\circ$  grid in each direction)





# Control experiment

- Run using the CESM framework (`mct_driver/ocn_comp_mct.F90`)
- MOM6 parameters follow, as close as possible, the GFDL OM\_05 configuration
- $Z^*$  vertical coordinate with 60 layers ( $\Delta z$  varies from 10 to 250 m)
- G-case (only ocean and sea ice are active), run for 100 years using normal year forcing
- Baroclinic  $\Delta t$  = coupling  $\Delta t$  = 0.5 hours
- SSS restoring (0.16 m/day)
- With submeso but without Gent-McWilliams (GM) eddy parameterization
- Energetic Planetary Boundary Layer (ePBL)

# Control experiment

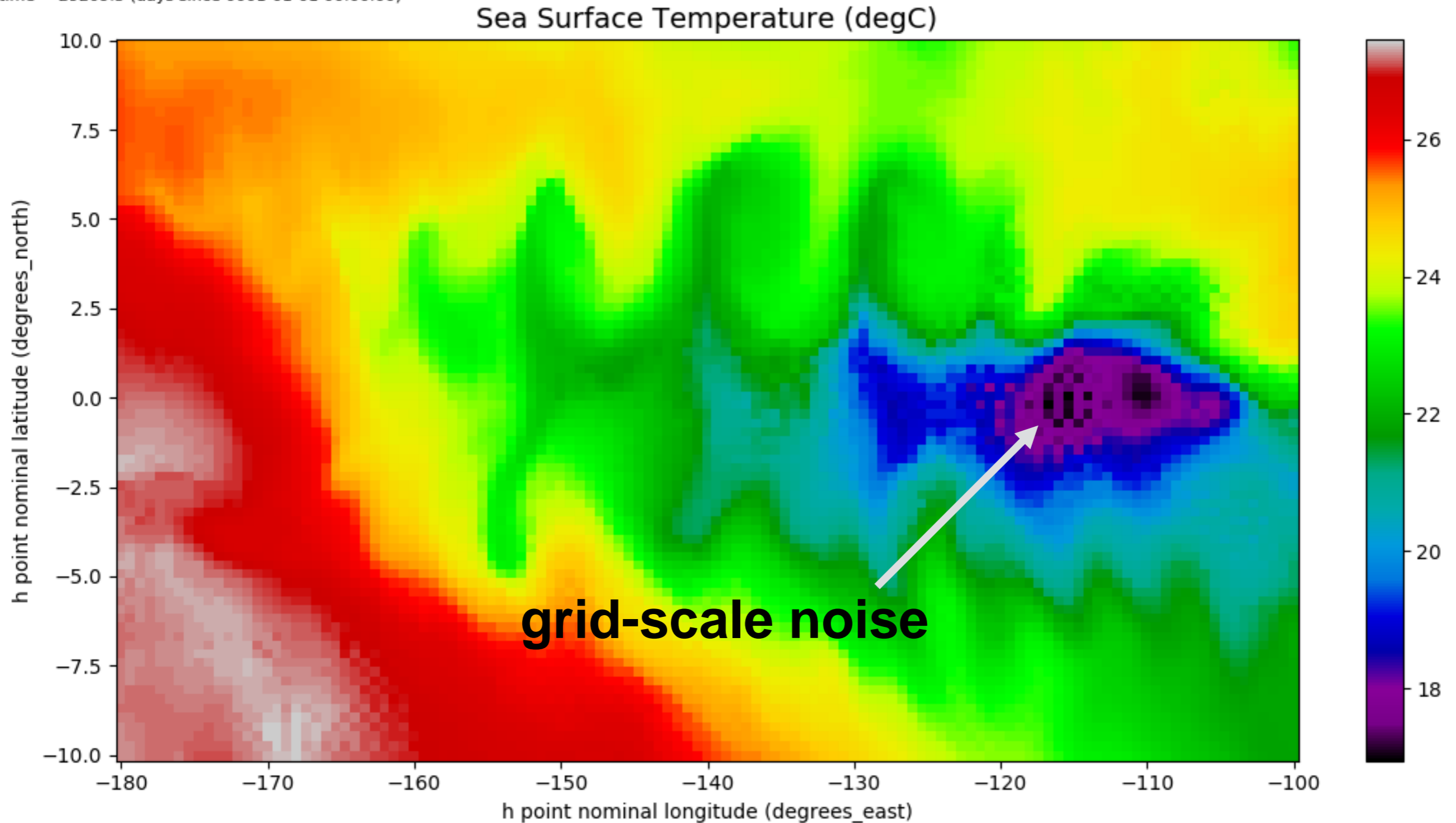
Sea surface temperature (°C)



# Control experiment

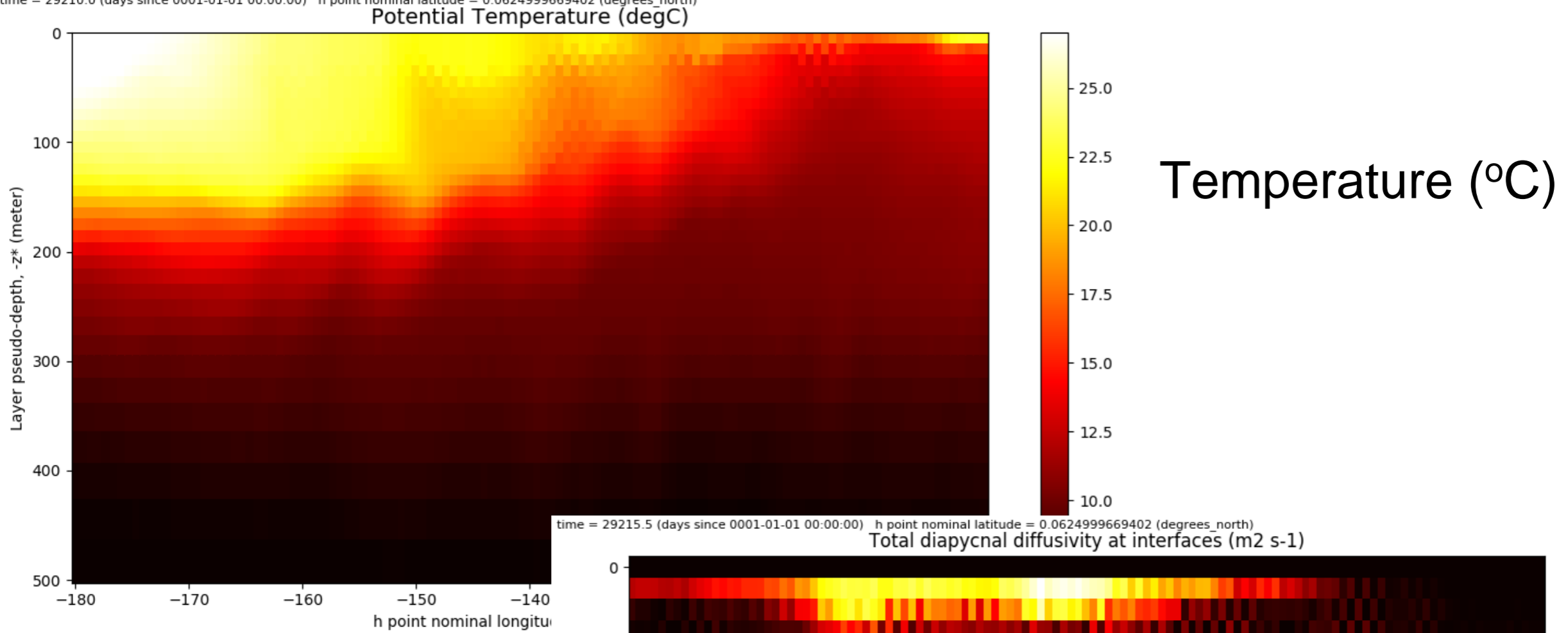
## Sea surface temperature (°C)

time = 29209.5 (days since 0001-01-01 00:00:00)

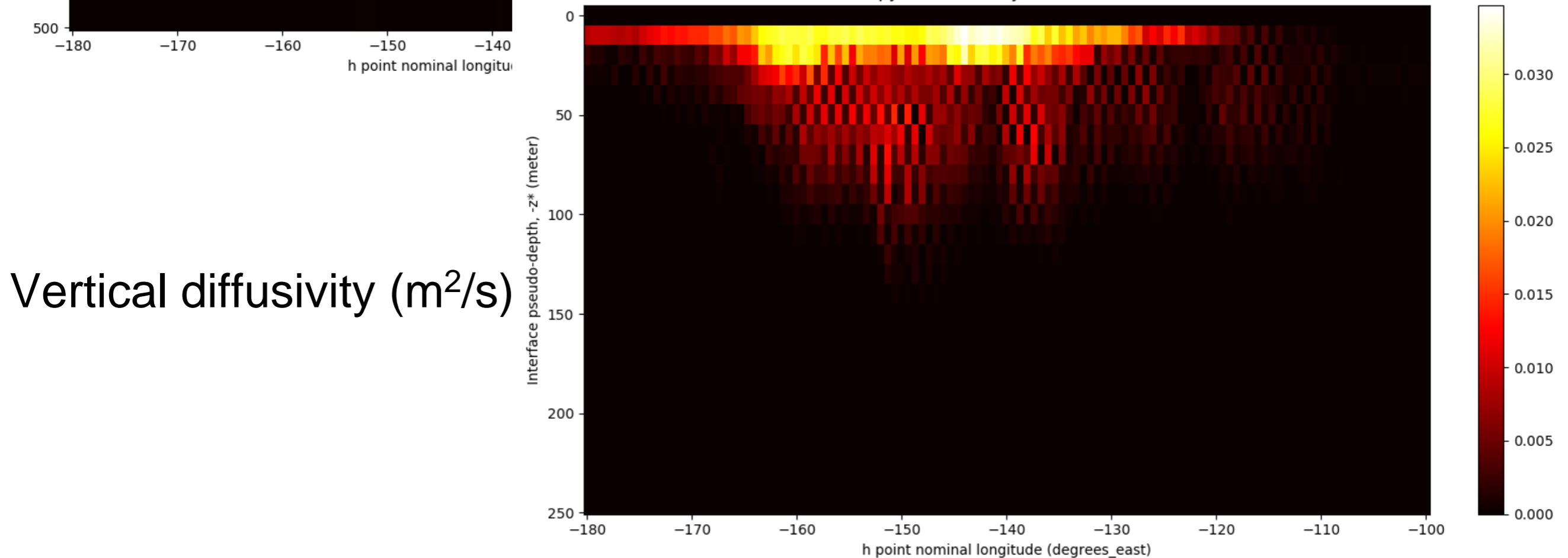


# Control experiment

time = 29210.0 (days since 0001-01-01 00:00:00) h point nominal latitude = 0.0624999669402 (degrees\_north)



time = 29215.5 (days since 0001-01-01 00:00:00) h point nominal latitude = 0.0624999669402 (degrees\_north)



# KPP experiment

Sea surface height (m)



# Next steps

- Build an ocean only test case using the 2/3 global grid (Gustavo and Alper)

## Add new parameterizations:

- Anisotropic lateral mixing (Gustavo, Alper and Scott)
- Anisotropic/lateral mixing in GM (Scott, Gustavo and Alper)
- Add all components in CVMix (Gustavo and Alper)
- Estuary Box Model (Frank, Gustavo and Alper)

## Explore existing capabilities:

- GM
- QG Leith
- Sub-mesoscale
- Internal tides dissipation
- River/Calving heat content (involves changes in the coupler)
- Add opacity to determine e-folding depth of incoming shortwave radiation
- Geothermal heating

# Summary

## Accomplishments:

- ✓ Initial goal —→ couple MOM6 to CIME and test the model using a configuration based on POP's 1° grid
- ✓ Build our own configurations from scratch —→ reproducible
- ✓ Run experiments: control, KPP etc —→ issues (numerical instability in the equatorial Pacific; ice/ocean coupled instabilities)

## What we would like to accomplish in 2018:

- Diagnostic package (Matt Long)
- Start adding our own parameterizations and explore existing capabilities
- Release a MOM6/CESM branch by Summer 2018 —→ tutorial MOM6/CESM
- Weekly meetings with GFDL + other groups using MOM6