

# Computational Green Ocean Sustainability

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Algorithmic Optimal Control – CO<sub>2</sub>-Uptake of the Ocean  
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**PAL  
MOD**

GERMAN  
CLIMATE  
MODELING  
INITIATIVE

# Sustainable Software Development

- ▶ Origin: Future Ocean, Sustainable Ocean
- ▶ Idea: Make research in ocean sustainability sustainable as well
- ▶ In the field of numerical experiments, make software sustainable
- ▶ How? Make software development sustainable
  
- ▶ However, scientific software is special
  - ▶ either it's result-oriented, one-time usage for publication
  - ▶ or it's a huge monolithic block with decades of development

For instance,

- ▶ Investigation of the CO<sub>2</sub>-uptake of the ocean requires
- ▶ High-resolution simulation of marine ecosystem models
- ▶ Within the Paleo Modelling (PalMod) project we use the
  - ▶ Max Planck Institute for Meteorology Earth System Model (MPIESM)
  - ▶ Including the HAMburg Ocean Carbon Cycle (HAMOCC)
  - ▶ Consists of 887,496 lines of code
- ▶ Strategies for transition to sustainable software needed

## Proof of concept for the biogeochemical component of earth system models

- ▶ We introduced an application programming interface (API) for biogeochemical (BGC) models:

```
subroutine bgc(ny, nx, m, nb, nd, dt, q, t, y, u, b, d)
  integer :: ny, nx, m, nb, nd
  real(8) :: dt, q(nx, ny), t, y(nx, ny), u(m), b(nb), d(nx, nd)
end subroutine
```

- ▶ We extracted HAMOCC from the MPIESM, coupled it to an off-line transport and gained a speedup factor of 30
- ▶ More, during the poster session