

Geophysical Fluid Dynamics Laboratory Review

June 30 - July 2, 2009



Ocean Modeling Innovations

Presented by

Alistair Adcroft

Geophysical Fluid Dynamics Laboratory Review

June 30 - July 2, 2009



Ocean Modeling Innovations

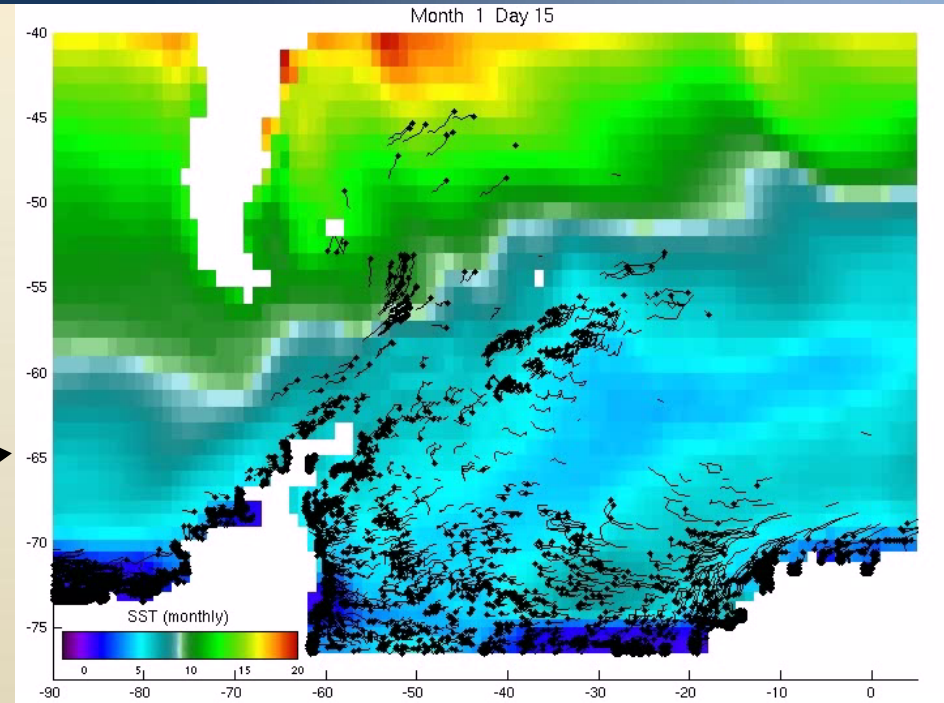
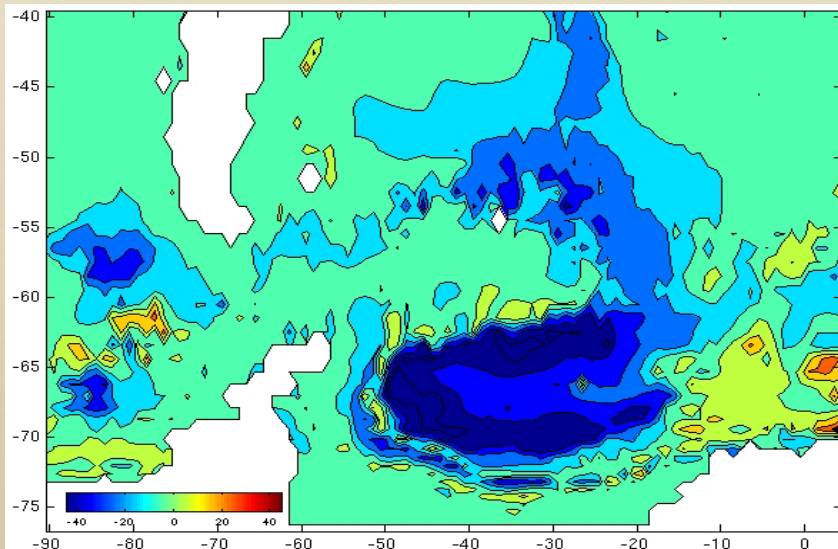
Numerous developments for i) specific models, ii) all models and iii) laying foundation for the future

- Universally applicable
 - Advection schemes
 - **Icebergs**
 - Sub-ice shelf cavities
 - Thin walls/porous barriers
 - **Geometry of straits**
 - Meso-scale Eddy Kinetic Energy framework
 - Resolution dependent scaling
 - Grid specifications (Mosaics)
 - Symmetric arrays for nesting (GOLD)
- Isopycnal specific
 - Finite volume pressure gradient (error free)
- General coordinates
 - **Regridding/remapping**
 - **Continuous isopycnal coordinate**
- Parameterization
 - Shear mixing
 - Internal tides
 - Channel drag

Icebergs

- New iceberg model transports land ice from continent out to open ocean to melt
 - Avoids cold-fresh bias around Antarctica (led to excess sea-ice)
- Lagrangian model of icebergs

**Iceberg positions
with 10 day trails**



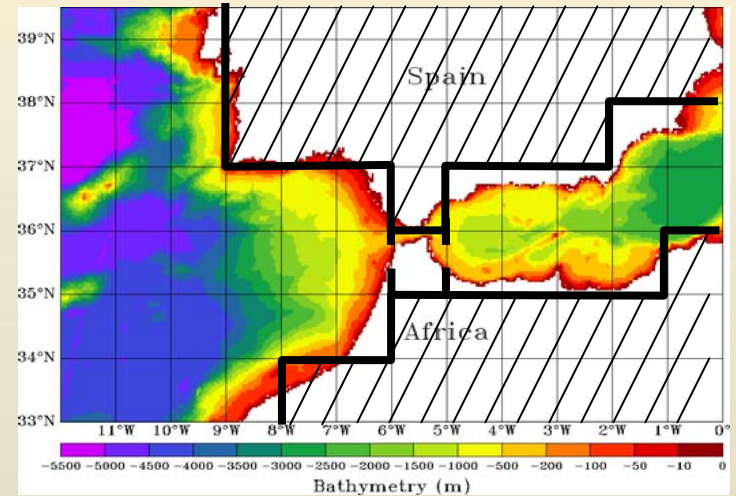
- Exporting fresh cap beyond shelf edge increases ventilation
- Bottom water significantly younger

**Change in ideal age of bottom water
due to inclusion of icebergs**

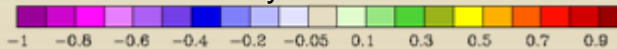
Martin & Adcroft, in prep. for OM

Topographic Restrictions

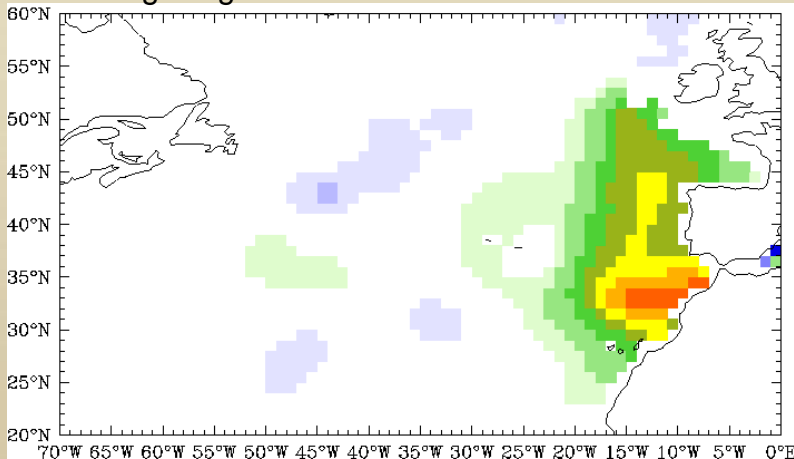
- 1° resolution → 110 km wide Gibraltar Strait
- Modify grid metrics to impose representative width (~12 km)
- Controls transport
- Improves Med. outflow salt bias



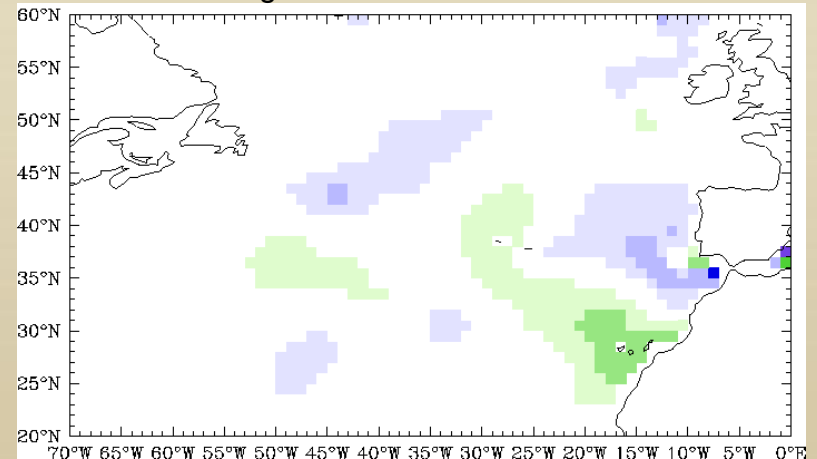
Salinity bias at 1500m



Original grid: Gibraltar strait is 110 km wide



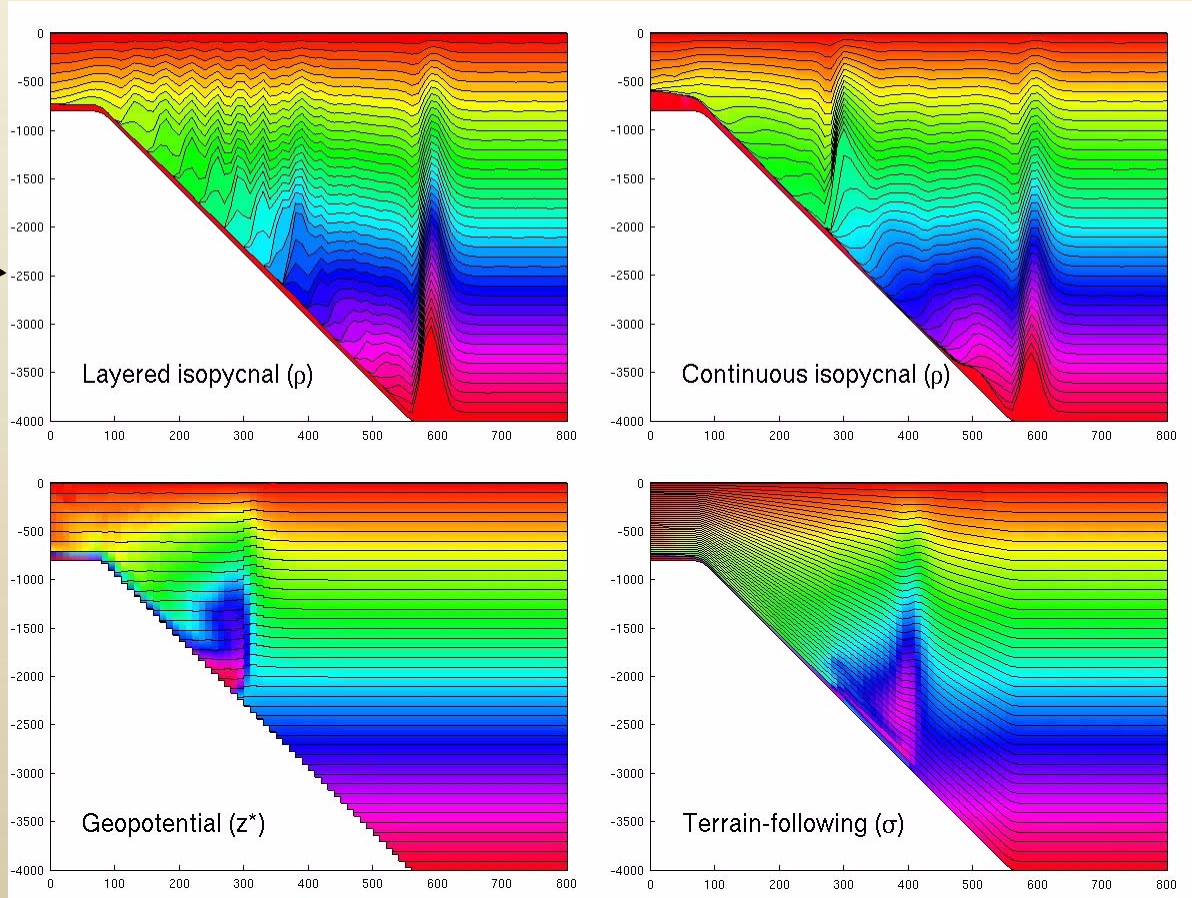
Restricted grid: Gibraltar strait is 12 km wide



One Model, Four Coordinates

Spurious diffusion can significantly dilute gravity currents

“True” solⁿ
(adiabatic)



Z^* and σ
dilute
buoyancy
anomaly

“Hybrid”
approach
remapping to

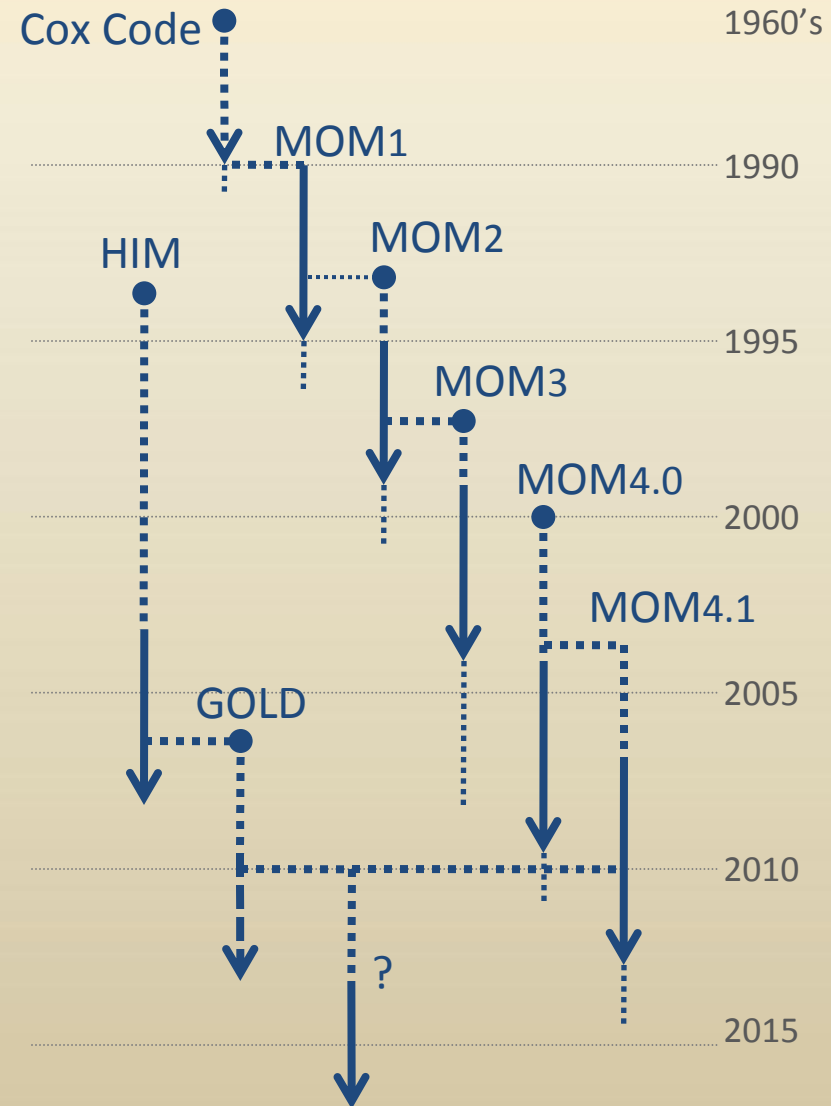
ρ

Same
numerics for
non-layered
models

White & Adcroft, JCP'08
White, Adcroft & Hallberg, JCP'09

MOM-GOLD evolution

- **GOLD lineage is the main focus of our current research effort**
 - GOLD is under development
 - Most likely route to answering the “mixing” and “eddy” questions
- **Generalization of coordinates**
 - Allows exploration of coordinate question.
 - e.g., which hybrid combination is most useful for ocean climate?
 - Some issues affecting z-coords also affect hybrid coords if coordinate is poorly constructed
- **A unified code & a single model will happen when appropriate**
 - Path forward and timing depend on the results of the coordinate research



Geophysical Fluid Dynamics Laboratory Review

June 30 - July 2, 2009

