Discussion: Layered ocean climate models

Requirements for global centennial climate:
  Reasonable circulation & watermass structure
  Conservation of tracers
  Long-term simulation stability
  Realistic physics (e.g., Equation of State (EOS))
  Metrics: SST, AMOC, ENSO, Watermasses
  Confidence among non-oceanographers

Emerging issues:
  Regional climate impacts
  Sea level rise (ice sheets & wetting/drying)
  Long-term marine ecosystem studies

Issues for Layered Ocean-Climate models from today's talks

1) Numerical diapycnal diffusion (non-isopycnic region)
2) Choice of vertical coordinate / vertical grid
3) Pressure Gradient Force / thermobaricity (solved?)
4) Nonlinear EOS issues (solved?)
5) Tracer non-conservation (solved in some models!)
6) GM param. – moving past interface height smoothing to include in non-isopycnal regions
7) Representation of bottom topography (numerical, smoothing, "excavation")
8) Horizontal vs. vertical resolution
9) Is KPP the best mixed layer?
10) Why should non-oceanographers care about using layered ocean climate models?
11) Common metrics of ocean-climate model quality?

100-Year Mean February Depth to SST - 1°C
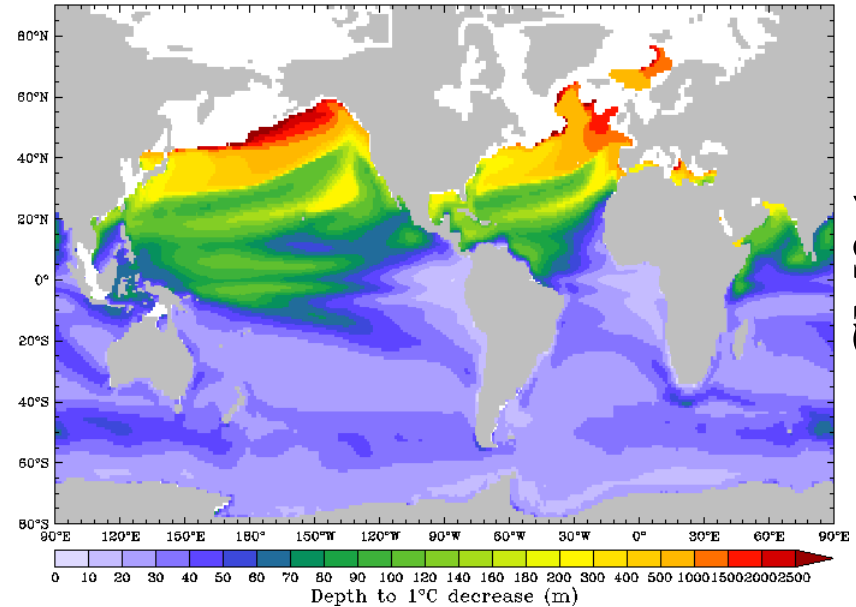

CM2G February Depth of SST − 1°C
Years 101−200

Depth to 1°C decrease (m)
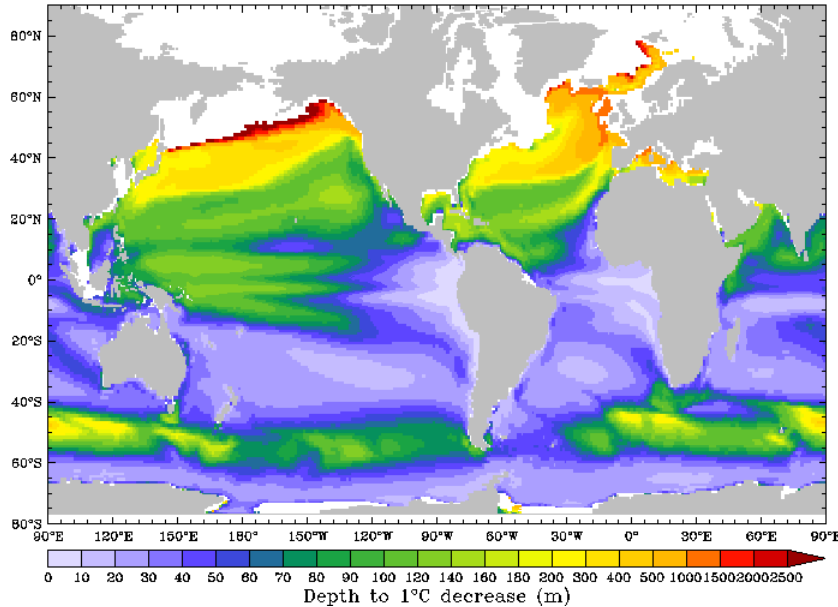
CM2G

CM2p1 February Depth of SST − 1°C
Years 101−200

Depth to 1°C decrease (m)

CM2.1

WOA 2001 Climatology February Depth of SST − 1°C
Climatology

Depth to 1°C decrease (m)

WOA2001 Climatology
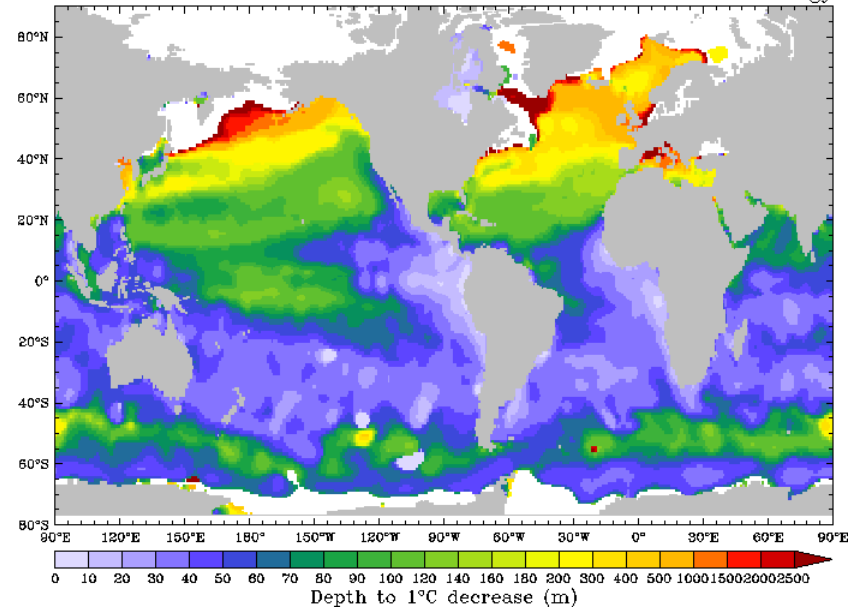
100-Year Mean February SST Errors

CM2G February Sea Surface Temperature Errors
RMS: 1.46°C, 90°S–30°S 1.63°C, 30°S–30°N 1.11°C, 30°N–90°N 1.67°C Years 101–200

Temperature Anomalies (°C)

CM2p1 February Sea Surface Temperature Errors
RMS: 1.84°C, 90°S–30°S 2.75°C, 30°S–30°N 1.09°C, 30°N–90°N 1.67°C Years 101–200

Temperature Anomalies (°C)
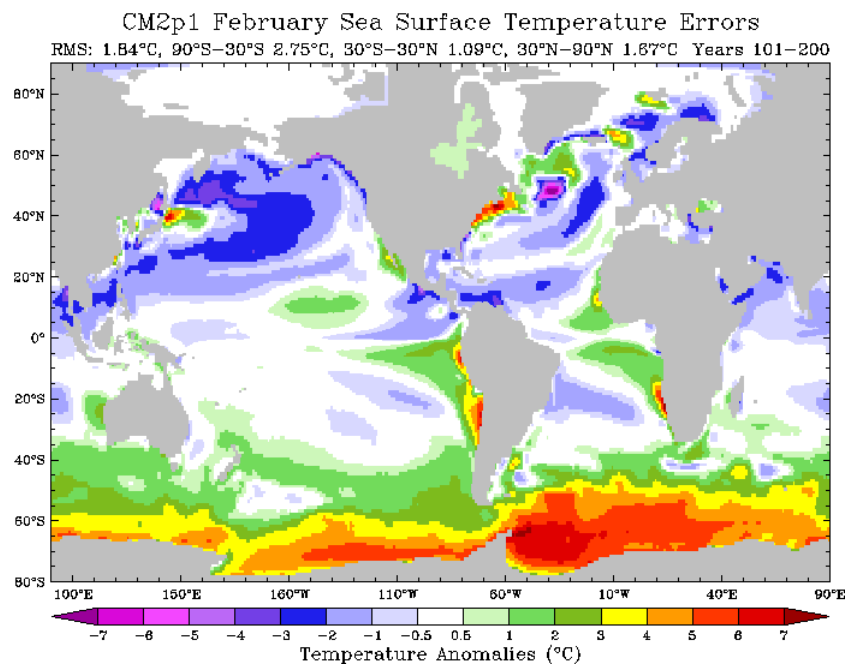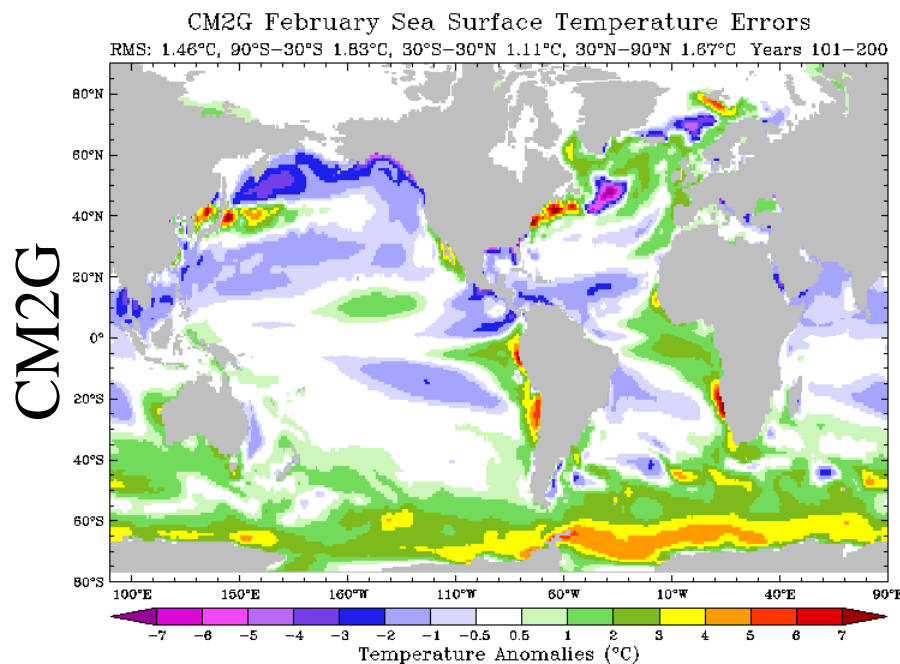
CM2G

CM2.1

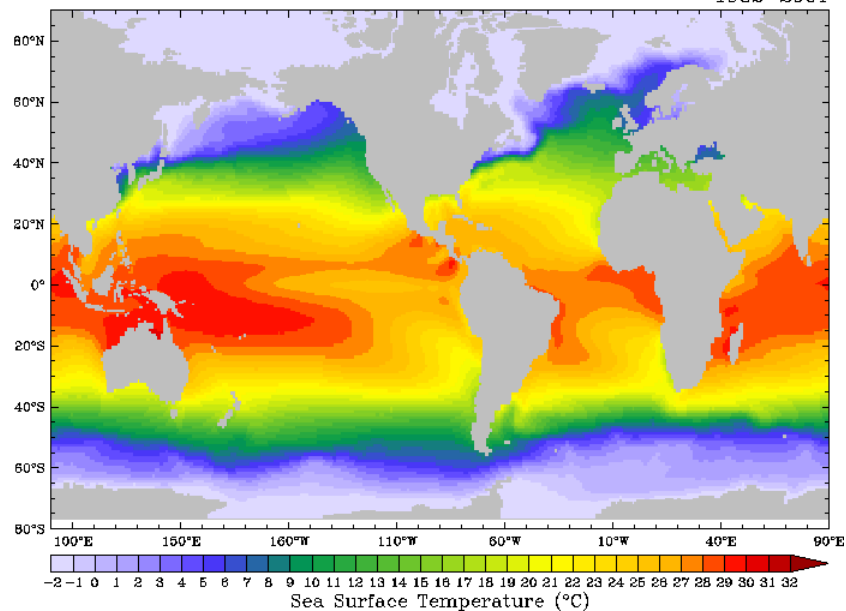## RMS February SST Errors:

- CM2G 1.46°C
- CM2.1 1.84°C
- CM2M 2.00°C

Reynolds 20–Year Mean February Sea Surface Temperatures
1982–2001

Sea Surface Temperature (°C)

Reynolds Climatology

Common Metrics of Coupled Model Quality?

- RMS error in long-term mean SST
- RMS error in mean monthly SST
- RMS error in mean SSS
- Mixed layer depth (depth to SST – 1C)
- RMS temperature/salinity errors vs. depth
- AMOC strength (peak Z-space OTSfn at 45N?)
- AMOC structure (Saunders et al., 2008)
- Transport through passages (Drake, Florida, etc.)
- Sea ice cover (Sept. & March)
- ENSO – Nino34 spectrum