The Model for Prediction Across Scales (MPAS) is a climate model framework that supports unstructured, variable resolution grids. Since a primary issue in ocean modeling is the treatment of the vertical coordinate, MPAS-Ocean has been developed to allow for a variety of options in the vertical coordinate choice. The representation of overflows has been shown to be difficult at horizontal resolutions coarser than a few kilometers. Therefore, the combination of the unstructured horizontal grid and the variety of vertical grid choices available with MPAS-Ocean provides a unique approach. MPAS-Ocean is used to simulate an idealized density driven overflow using the dynamics of overflow mixing and entrainment (DOME) setup. Numerical simulations are carried out at a variety of horizontal and vertical resolutions, with several different vertical grid types, and for a range of physical parameters. Entrainment and mixing statistics are calculated and analyzed in order to compare the results from the various grid setups.

**Overflows**

Dense water forms as a result of cooling, evaporation, or freezing in marginal seas & coastal shelves which drives the following overflows:
- DSOW-Denmark Strait Overflow Water
- FBOW – Faroe Bank Channel Overflow Water
- DW - Iceland-Scotland Ridge Overflow Water
- RSW - Red Sea Overflow Water
- MSOW - Mediterranean Sea Overflow Water
- WSOW - Weddell Sea Overflow Water
- RSW/ - Ross Sea Overflow/Water

**Metrics**

**Total Transport** — a measure of the total amount of dense overflow water that is transported along the slope at each downstream location,

\[ T(x) = \int_{y>0} U \, dy \, dz \]

**Entrainment Coefficient** — a measure of entrainment, the mixing of ambient water into the descending dense flow,

\[ \alpha_E(x) = \frac{1}{L U} \int_{y>0} T(x) \, dy \, dz \]

**Summary of Test Cases**

<table>
<thead>
<tr>
<th>Case</th>
<th>Horizontal Resolution</th>
<th>Vertical Resolution</th>
<th>( v_\theta ) (m s(^{-1}))</th>
<th>( v_\alpha ) (m s(^{-1}))</th>
<th>Partial Bottom Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50 km</td>
<td>120 m</td>
<td>5.0 x 10(^{-8})</td>
<td>5.0 x 10(^{-8})</td>
<td>Off</td>
</tr>
<tr>
<td>2</td>
<td>50 km</td>
<td>120 m</td>
<td>5.0 x 10(^{-8})</td>
<td>5.0 x 10(^{-8})</td>
<td>Off</td>
</tr>
<tr>
<td>3</td>
<td>10 km</td>
<td>120 m</td>
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<td>5.0 x 10(^{-8})</td>
<td>Off</td>
</tr>
<tr>
<td>4</td>
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<td>120 m</td>
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<td>5.0 x 10(^{-8})</td>
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</tr>
<tr>
<td>5</td>
<td>2.5 km</td>
<td>60 m</td>
<td>5.0 x 10(^{-8})</td>
<td>5.0 x 10(^{-8})</td>
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</tr>
<tr>
<td>6</td>
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</tr>
<tr>
<td>7</td>
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<td>30 m</td>
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<td>5.0 x 10(^{-8})</td>
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</tr>
<tr>
<td>8</td>
<td>500 m</td>
<td>30 m</td>
<td>5.0 x 10(^{-8})</td>
<td>5.0 x 10(^{-8})</td>
<td>Off</td>
</tr>
</tbody>
</table>

*Cases in blue are in progress*

**Results**

Passive Tracer Concentration, above bottom cells

- **Case 1:** 50 km x 120 m
- **Case 2:** 50 km x 120 m w/PBC
- **Case 3:** 10 km x 120 m
- **Case 4:** 10 km x 120 m w/PBC
- **Case 5:** 2.5 km x 60 m
- **Case 6:** 2.5 km x 60 m w/PBC

**Passive Tracer Concentration Along the Bottom Slope at t=13 days after initiation of dense flow.**

**Total Transport and Entrainment Coefficient**

- **Case 1:** Total Transport 50 km x 120 m
- **Case 2:** Total Transport 50 km x 120 m w/PBC
- **Case 3:** Total Transport 10 km x 120 m
- **Case 4:** Total Transport 10 km x 120 m w/PBC
- **Case 5:** Total Transport 2.5 km x 60 m
- **Case 6:** Total Transport 2.5 km x 60 m w/PBC