MPAS-O mesh characteristics, generation, and regional refinement

Phillip J. Wolfram, Steven Brus and the MPAS-O Team Darren Engwirda (NASA/GISS) March 19, 2019





E3SM Spring Meeting Westminster, CO

Global and regionally refined resolution example

Delaware Bay 40 Are LANL LDRD-DR 2017

S. Brus

D. Engwirda





MPAS-O flow discretization (T. Ringler et al)

Grid generation via JIGSAW (D. Engwirda) in COMPASS (S. Brus) (Coastline-following meshes coming)



Current meshing approach (v1/v2)

Variable and mesh properties

Variable definition

- Scalars (water surface, temperature, salinity) at hex cell centers (black dots)
- Velocity face-normals at cell edge mid-points (red arrows)
- Vorticity at hex cell edges (blue dots)

Triangular mesh

- Delanay triangulation
- Dual to Hexagon mesh (orthogonal)
- Connectivity between MPAS-O scalars on triangle vertices



D. Engwirda

High-level COMPASS coastal mesh resolution workflow (S. Brus)

1. Extract coastlines 2. Calculate coast distance -12 477.4 -594 417.8 39.9°N 39.9°N 39.9°N -1175 358.1 38.8°I -1756 E 38.8°N 38.8°N - _{298.4} Ê -2338 - 238.8 นี่ 37.7°N 37.7°N 37.7°N -2919 2 179.1 -3500 36.6°N 36.6°N 36.6°N - 119.4 -4082 - 59.8 35.5°N -4663 75.6°W 74.1°W 72.7°W 71.2°W 74.1°W 72.7°W 71.2°W 75.6°W 75.6°W 74.1°W 72.7°W 71.2°W

3. Apply transition functions and composite

15.38

13 79

12.19

- 10.59 (j

- 8.99 - 8.99 -Gell width - 7.39 - 7.39

5.79

4.20

2.60

Input provided to JIGSAW produces MPAS-O compatible mesh and initial conditions can be provided in COMPASS.

CONUS coastal North America regionally refined mesh

- Built off RRS60to30 mesh
- US Coastal water resolution 8km
- Resolves mid-latitude Rossby Radius of Deformation to resolve mixing (Wolfram et al, 2015)
- Additional mesh resolution:
 - Compatibility with MPAS-Seaice
 - Ensures straits open (e.g., Nares)
 - Ensures under-resolved cells that are land aren't removed



D. Engwirda's new unified land-river-ocean hexagonal meshes via prototype JIGSAW (v3/v4)



D. Engwirda's new unified land-river-ocean hexagonal meshes via prototype JIGSAW (v3/v4)



Note: Coarse mesh used to illustrate downscaling cleanly on single mesh.