

Towards a Pacific model

Charles Seaton, David Graves, Denise Kelsey,

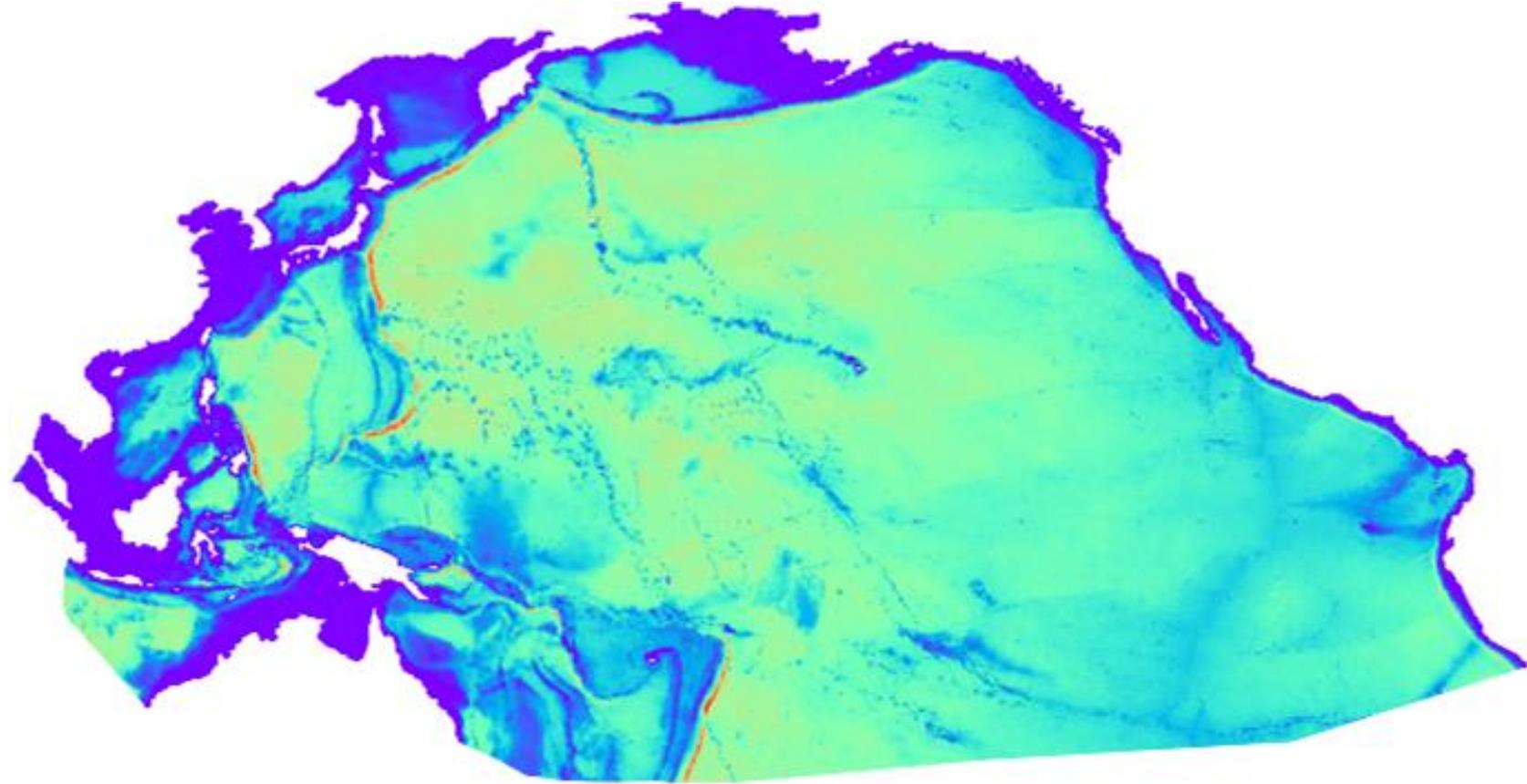
Y. Joseph Zhang, Antonio Baptista

CRITFC



Outline

- Context
- Current status
- Grid development
- 2D and 3D results





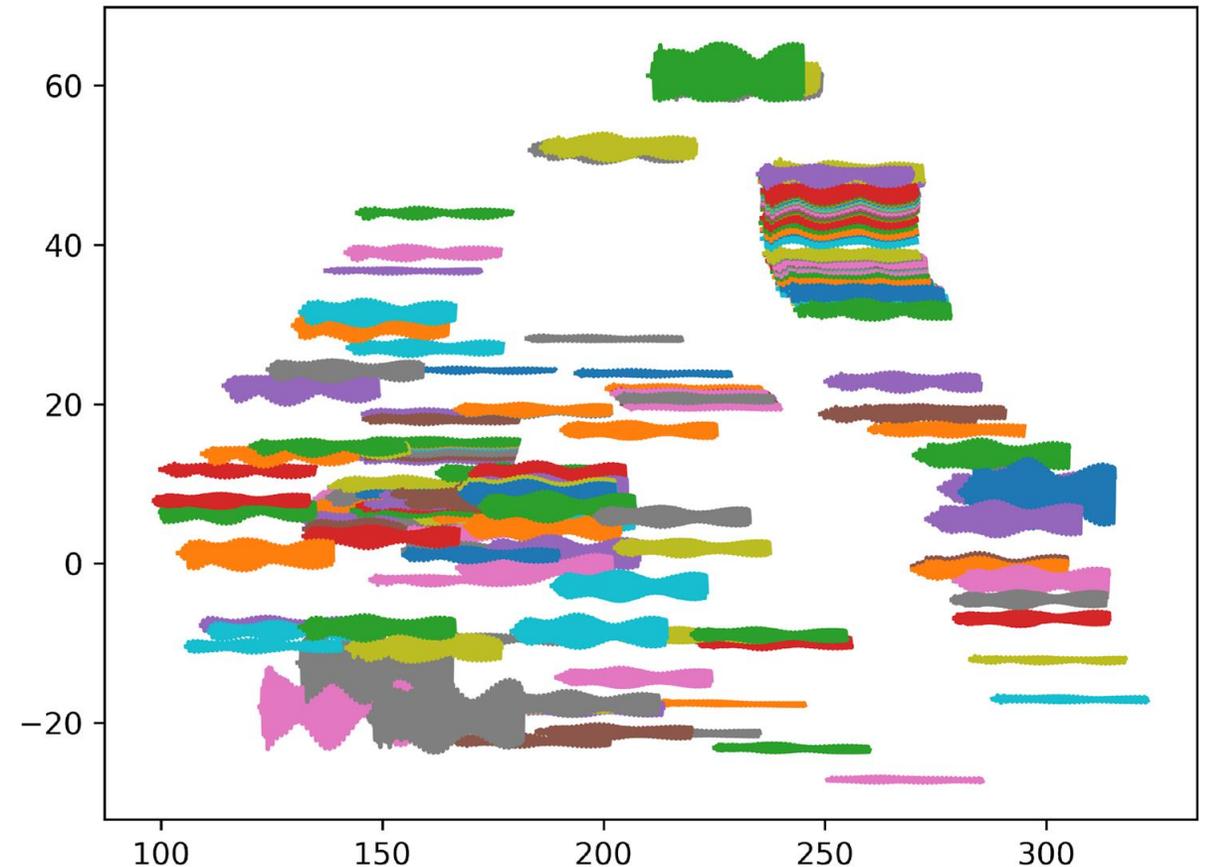
Context

- The Center for Coastal Margin Observation and Prediction (CMOP) has moved from OHSU to the Columbia River Inter-Tribal Fish Commission (CRITFC)
 - Charles Seaton leads the CRITFC-CMOP team, which continues (SCHISM-based) modeling and observational activities
 - Former CMOP Director Antonio Baptista has retired, and is now an OHSU Emeritus Professor. He advises CRITFC-CMOP as needed
- CRITFC-CMOP is developing a Pacific basin-scale model supported by NOAA-NOS-OCS through the Coastal Marine Modeling Branch. Goals:
 - Support improvements to definitions of vertical datums in Oceania
 - Develop storm surge model
 - Develop 3-D surface current modeling for navigation support



Current Status of Pacific Model

- Processed bathymetry and coastline to generate SMS map
- Completed early 2D runs
- Currently conducting sensitivity tests for 2D model
- Collaborating with Joseph on 3D model and grid design





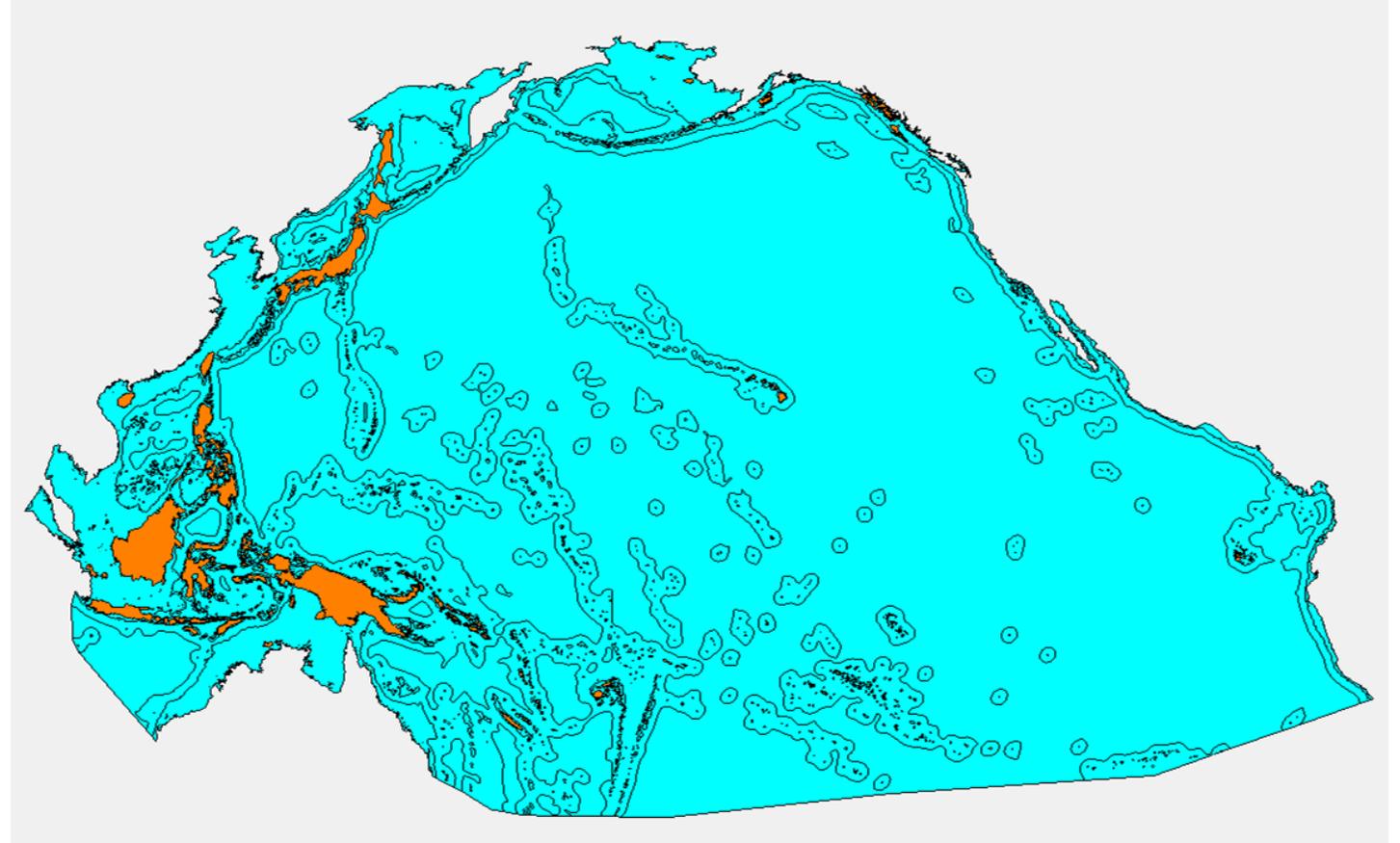
Initial 2D model run - setup

- Bathymetry is GEBCO
- Tidal model is TPX09 or FES2014a
 - bctides.in generated using Jaime Calzada's psychism module and standard matlab method
- Forcing included: Harmonic boundary conditions and tidal potential
- Not yet included: Atmospheric forcing, Self-Attraction and Loading (SAL), and Non-tidal elevations
- Current focus is on assessing results via co-tidal charts

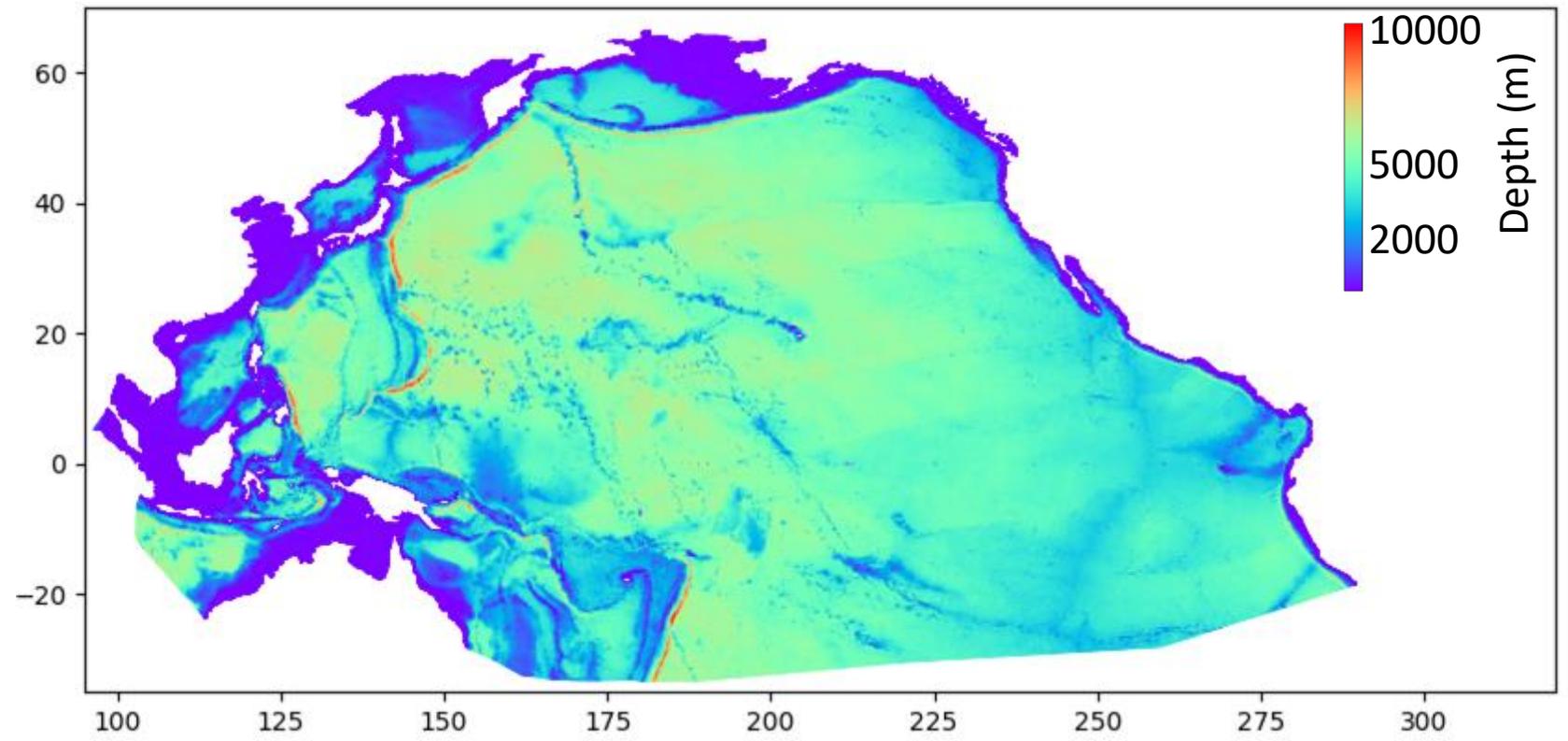


Grid design – basin scale

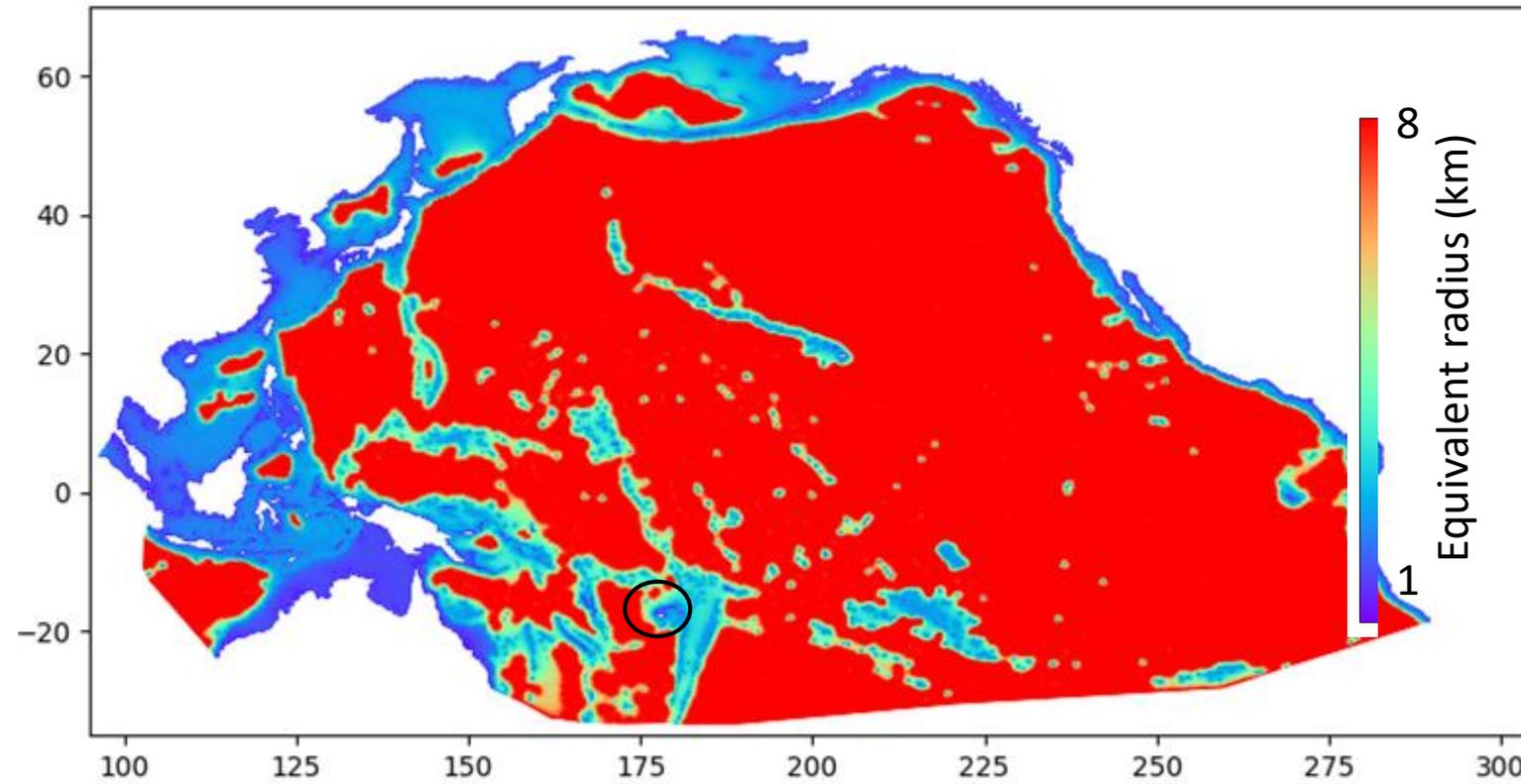
- Retained islands down to 2km coast length
- Using :
 - 500m resolution for islands < 8 km,
 - 2km resolution for coastlines > 8 km
- Retained seamounts (<500m depth) without islands (4km resolution)



Grid bathymetry – Basin scale



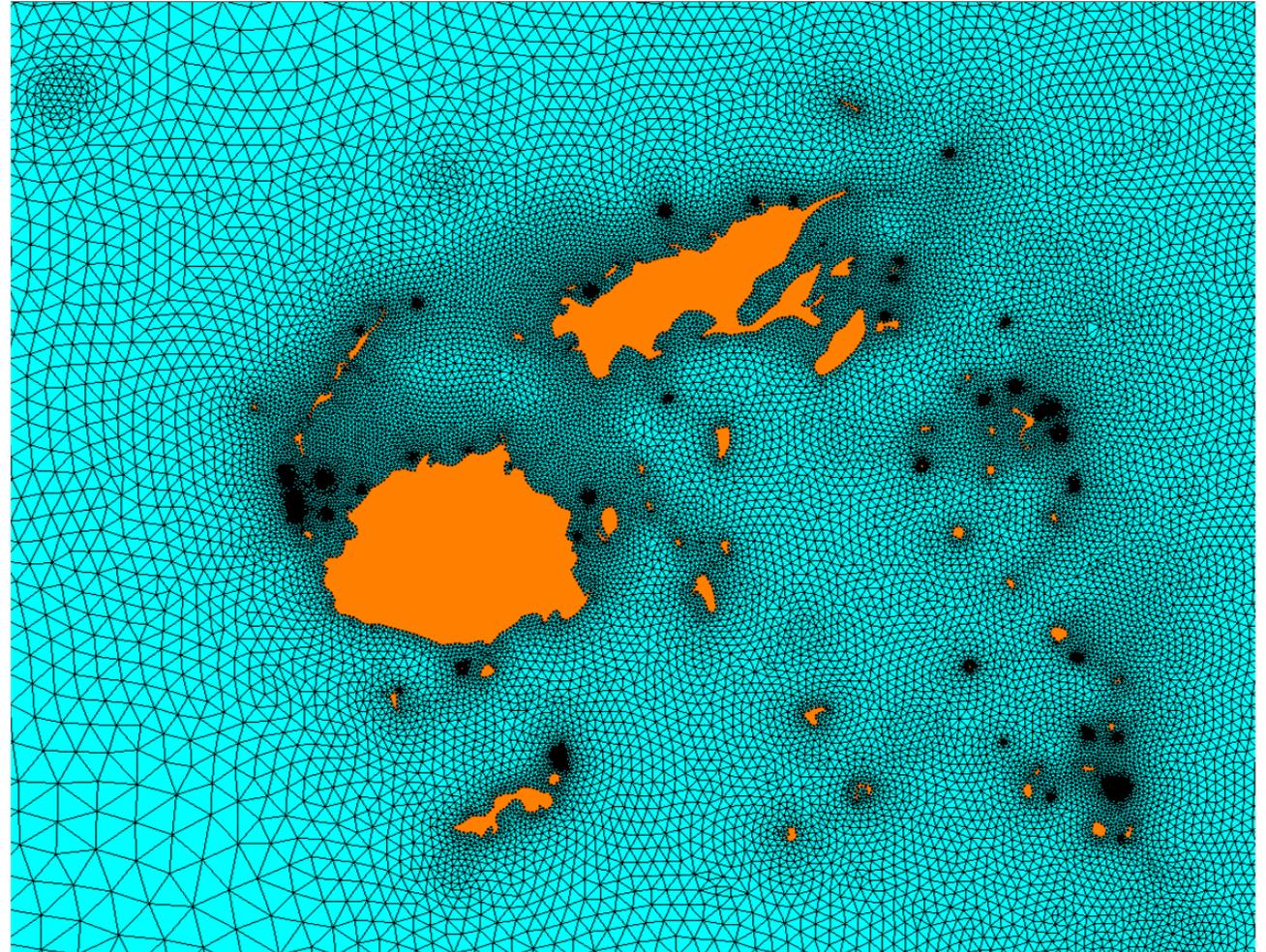
Grid resolution – Basin scale





Grid design – Islands (Fiji)

- Incorporation of islands down to small atolls
- Coastline currently at 2km resolution
- Planned resolution of <100m in areas of interest

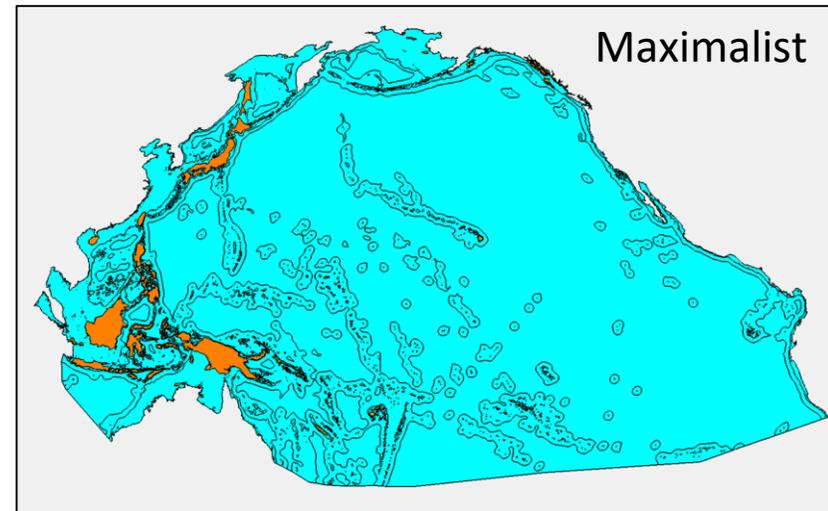
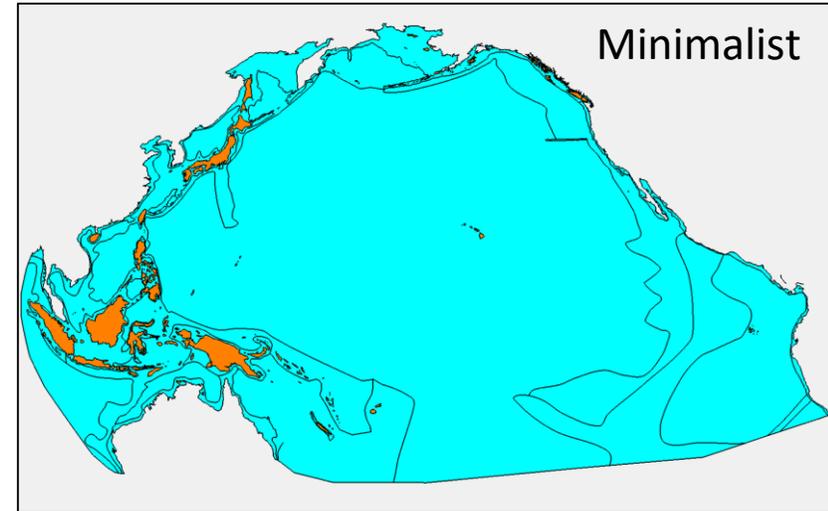




Island inclusion – basin scale

Two versions of grid:

- VIMS developed minimalist inclusion of islands – targeted at 3D runs
- CRITFC developed maximalist inclusion of islands – targeted at 2D runs





Simulations to date

2D simulations:

- Maximalist and minimalist grids
- Testing sensitivity to timestep and friction (constant Manning's n)

3D simulations

- Collaboration with Joseph on a proof-of-concept 3D simulation
- Harmonic constituent co-tidal charts for 3D results show substantial improvement over 2D results



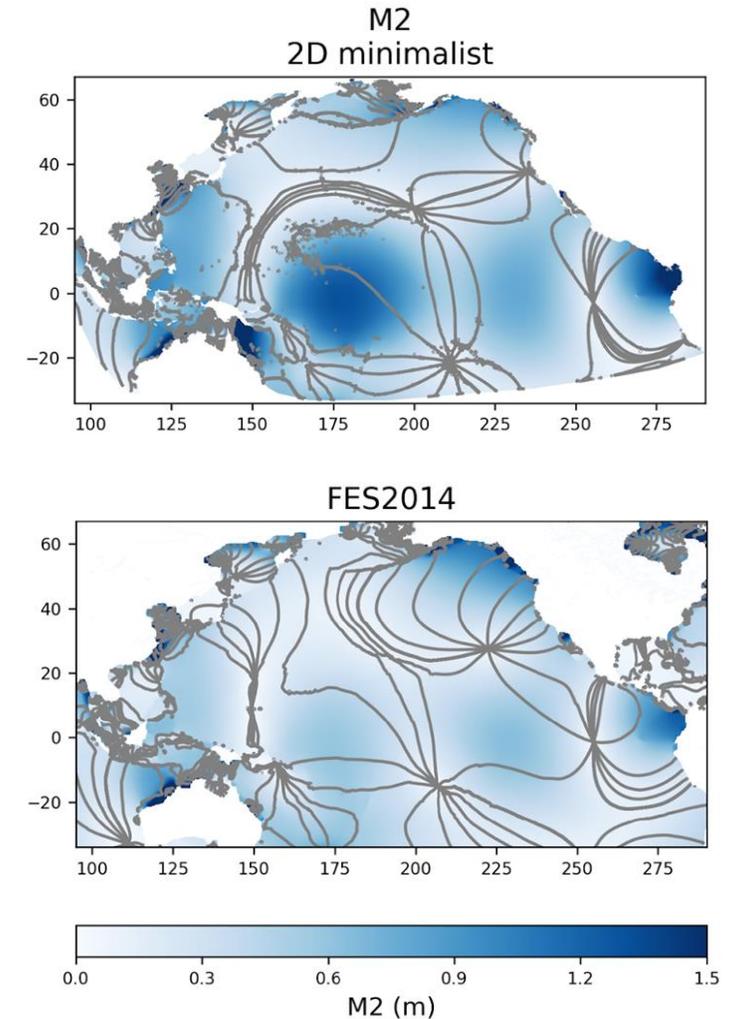
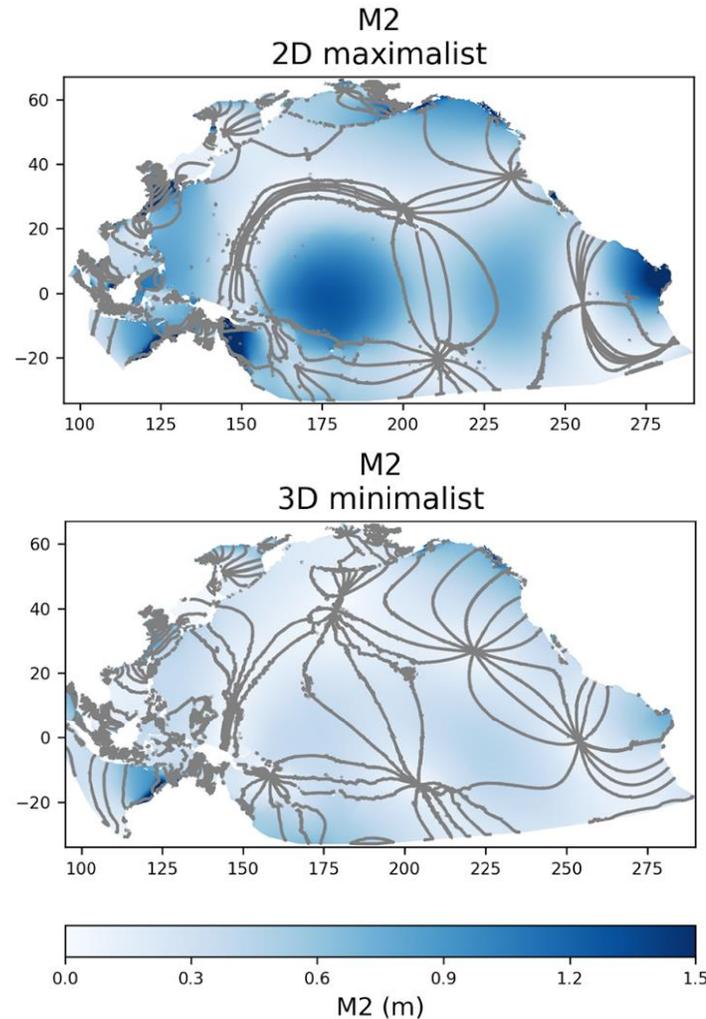
Pacific model: Harmonic analysis

Dimensions	dt	Friction	Comment
2D	150	$n = 0.025$	Maximalist grid
2D	150	$n = 0.025$	Minimalist grid
3D	120	$cD = 0.0025$	Minimalist grid

- Previous runs tested:
 - sensitivity to friction (Manning's n) and timestep
 - boundary conditions and parameterization
- Amphidromic points roughly represented in 2D, but issues remain
- Incorporation of Self Attraction and Loading in 2D run explored, results not shown
- **Next step for 2D: spatially variable Manning's n**

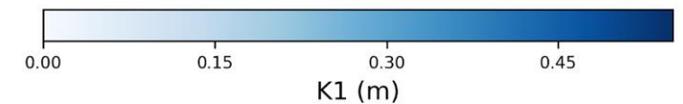
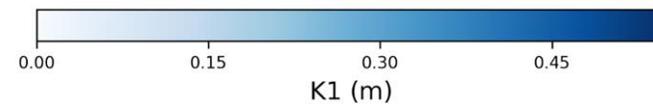
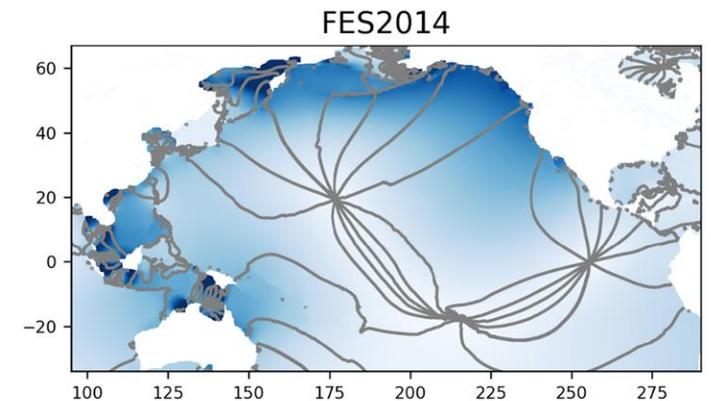
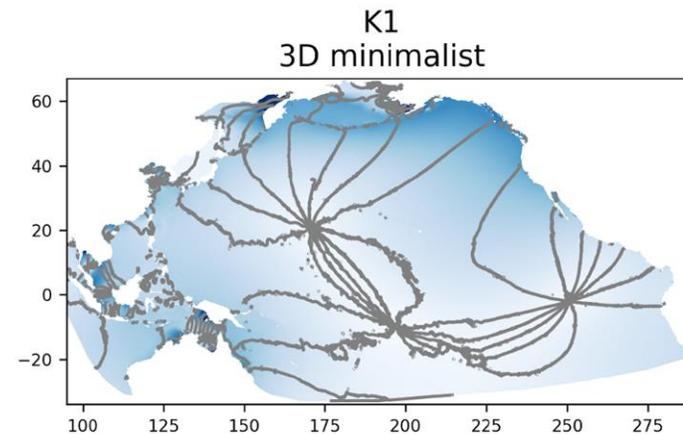
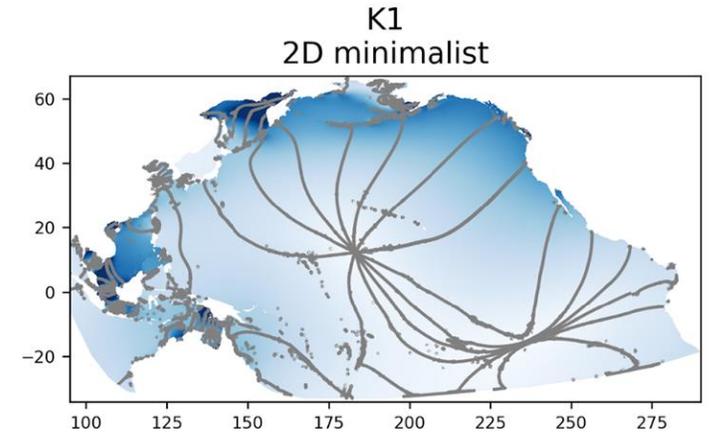
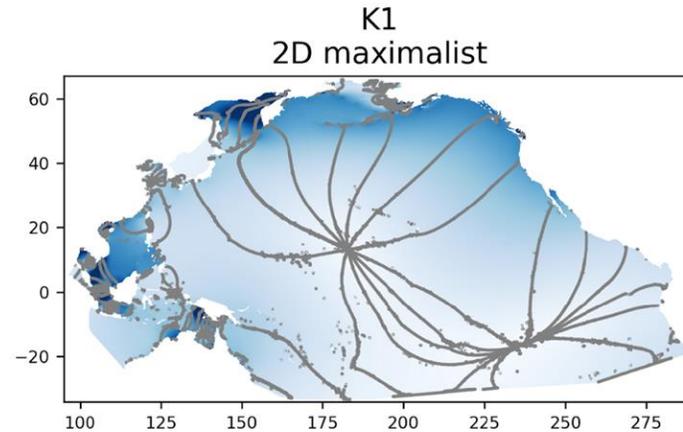
M2: Co-tidal charts

- Behavior is similar across different grid complexities
- 3D has substantially better amphidromic point locations
- 2D severely overpredicts amplitude in Micronesia
- 3D underpredicts amplitude in high amplitude regions



K1: Co-tidal charts

- More similar across runs than M2
- Amphidromes in tropical Pacific better represented in 3D run





Conclusions

- Significant progress towards 2D and 3D simulations of the northern and equatorial Pacific basin
- Primary advantage of 2D over 3D is computational cost
- Elevation performs better in 3D simulation than in 2D simulation with little calibration
- Spatially varying Manning's n required for accurate elevations in 2D
- Self-Attraction and Loading may be relevant for Pacific basin scale