

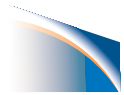


A high-resolution regional model for the Coral Triangle



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National Science Foundation



Regional Ocean Modeling System

Coral Triangle Implementation

Motivation:

Conservation efforts within the Coral Triangle Initiative require understanding of:

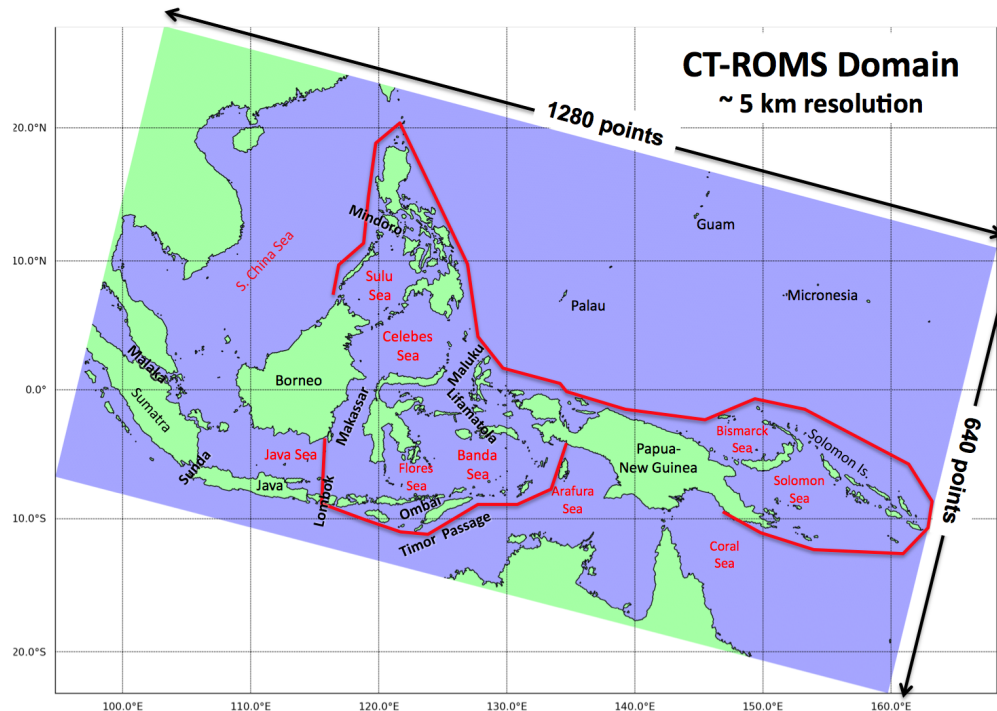
- 1. How oceanographic circulation influences the susceptibility of coral reefs to bleaching*
- 2. Ability of reefs to recolonize via larval-dispersal following a bleaching event*

Outline:

- 1. Description of a circulation model to achieve this understanding**
- 2. Comparison of model simulations with observations**
 - Flows through major passages
 - Tidal characteristics
 - Sea surface temperature
- 3. Preliminary look at larval dispersal simulations**

Regional Ocean Modeling System

Coral Triangle Implementation



Bathymetry: global SRTM30_PLUS product with 30-sec resolution [Becker et al., 2009]

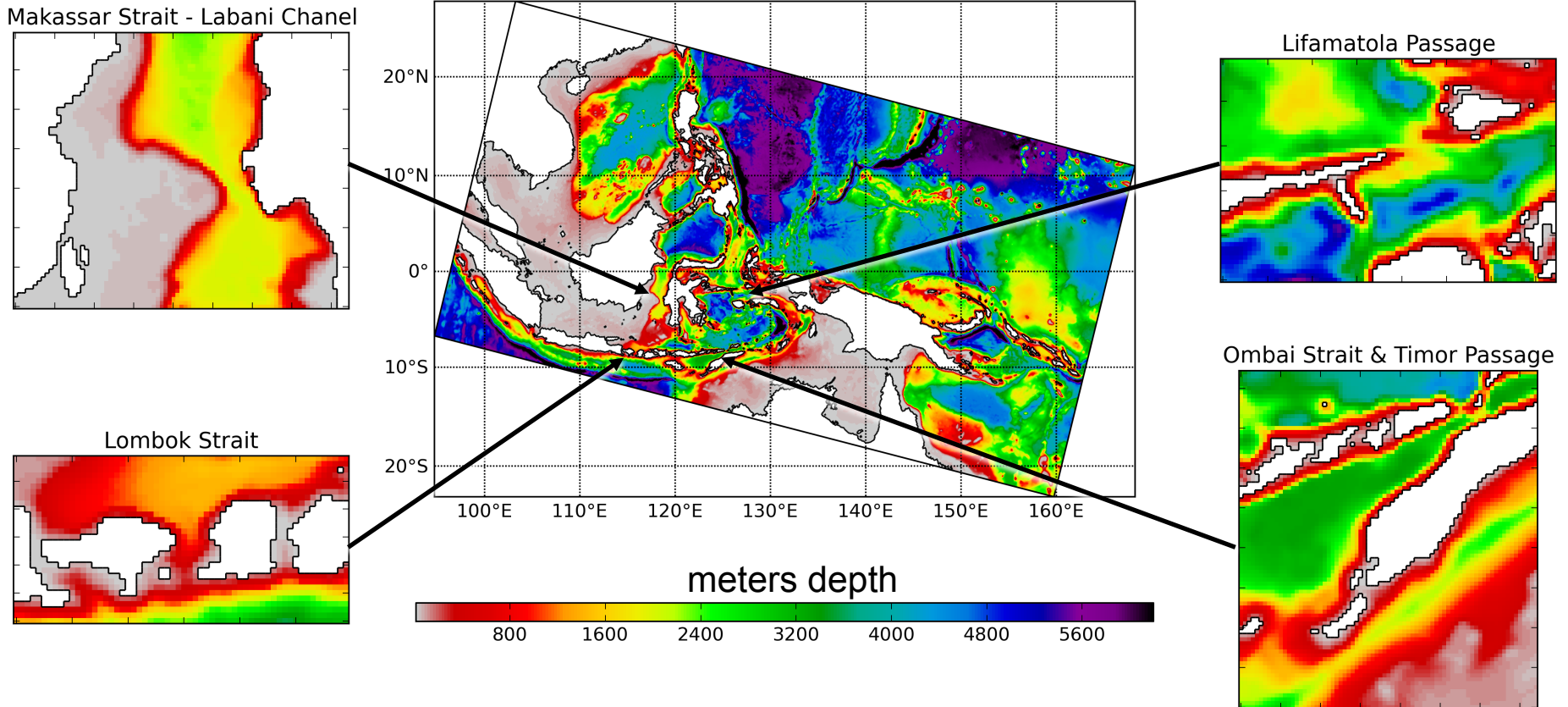
Vertical resolution: 50 terrain-following levels

Atmospheric forcing: Modern Era-Retrospective Analysis for Research and Applications (MERRA, Rienecker et al., 2011)

Boundaries and initial conditions: Simple Ocean Data Assimilation (SODA, Carton et al., 2000)

Tidal boundary conditions: global model of ocean tides TPXO 7.2 (Egbert and Erofeeva, 2002)

CT-ROMS Bathymetry

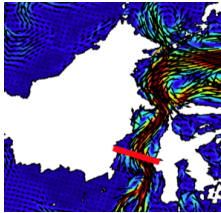


5 km resolution allows:

- representation of complex bathymetry
- coastlines
- dynamical features of circulation

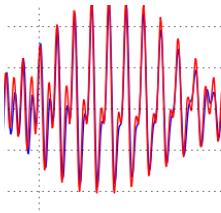
CT-ROMS

Evaluation against observations



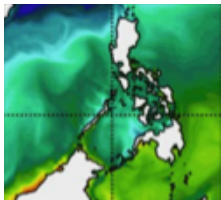
Transports through major passages

- INSTANT (International Nusantara Stratification and Transport Program) [Gordon et al., 2010]



Tidal constituents

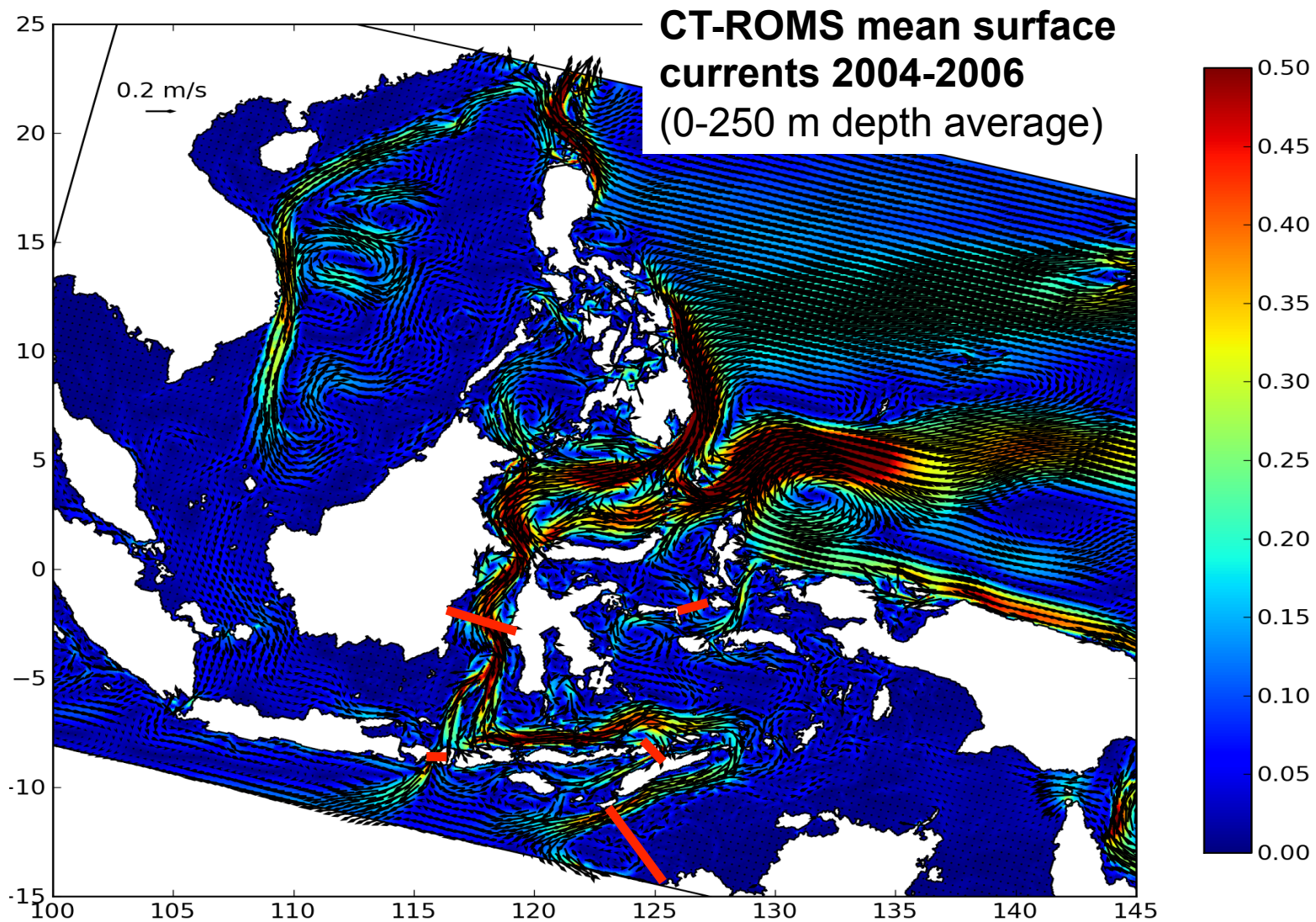
- Local tide gauges



Sea surface temperature

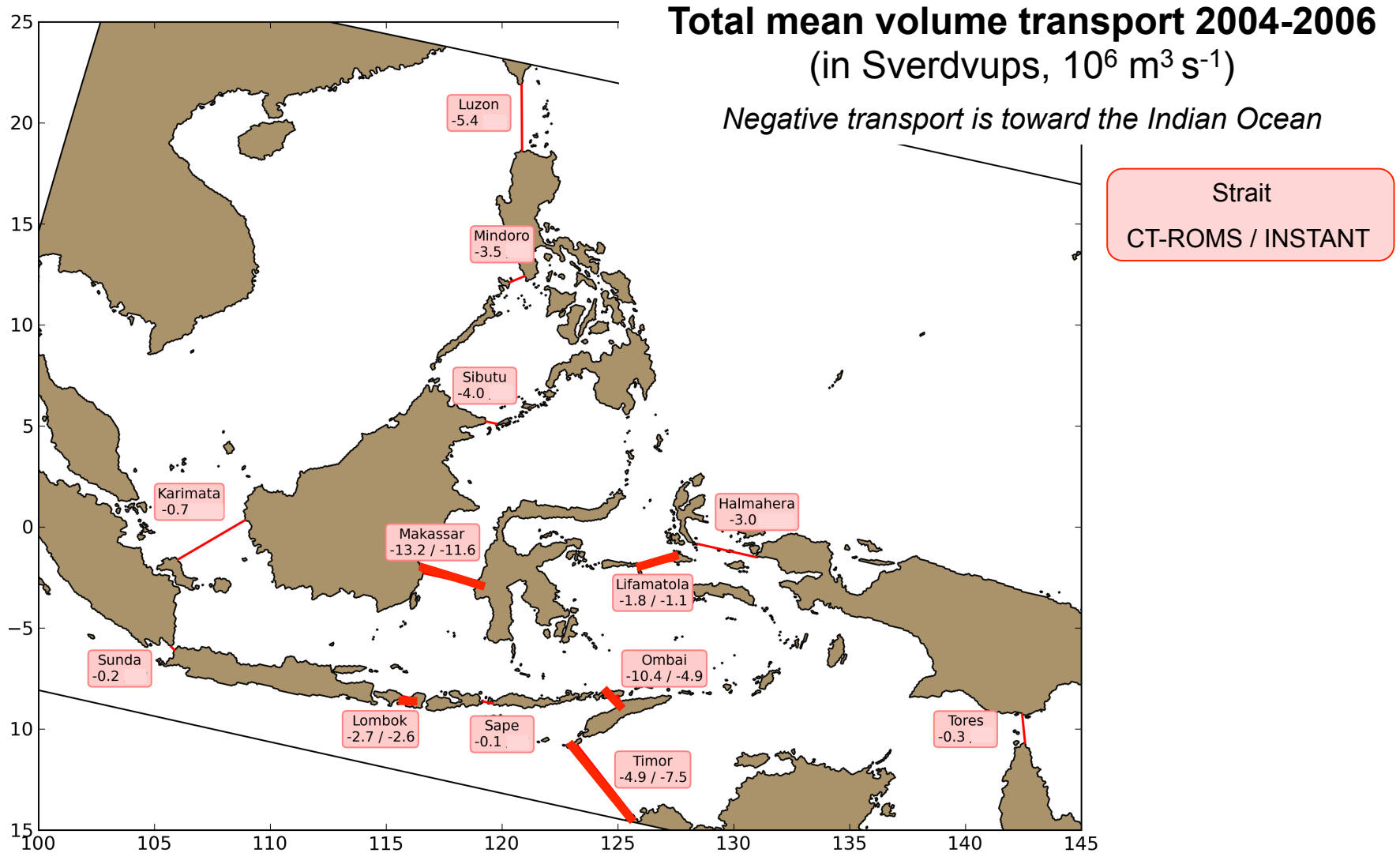
- CoRTAD (Coral Reef Temperature Anomaly Database) [Selig et al., 2010]
- TAO moorings

Surface Currents and ITF Transports



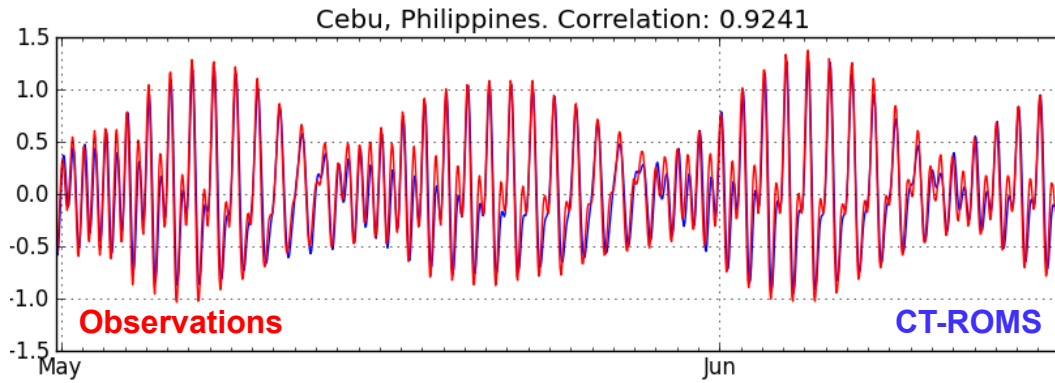
Red bars = straits with INSTANT observations

Surface Currents and ITF Transports

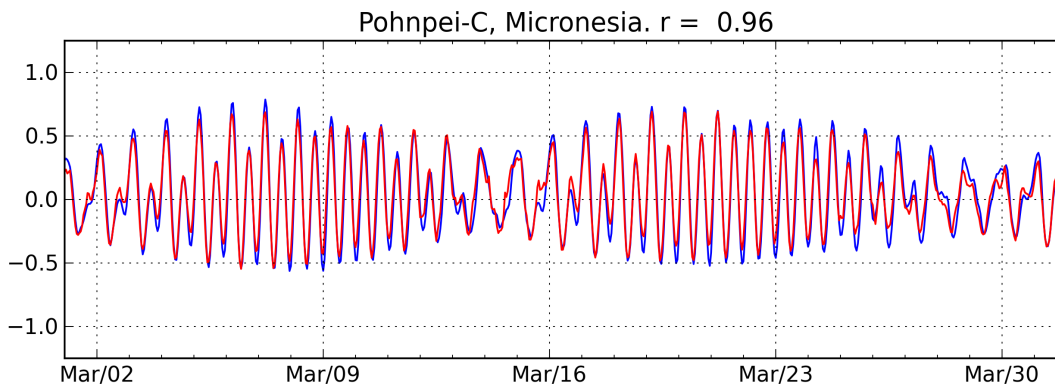


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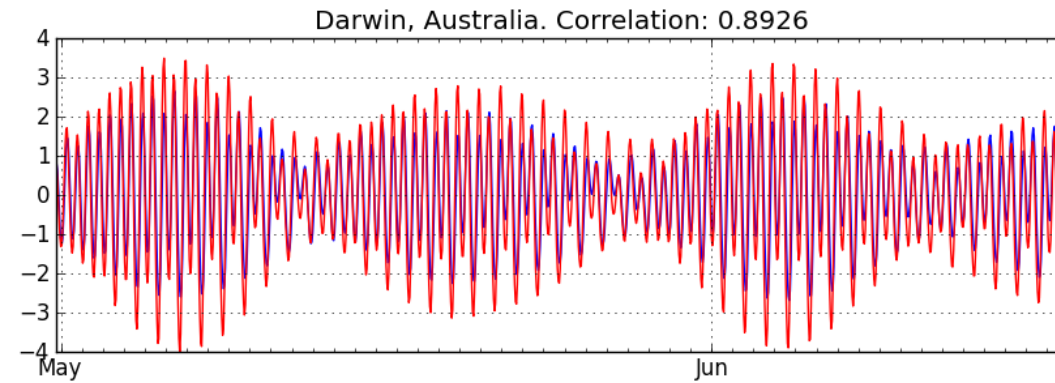
Water Levels at Tide Stations



Cebu, Philippines



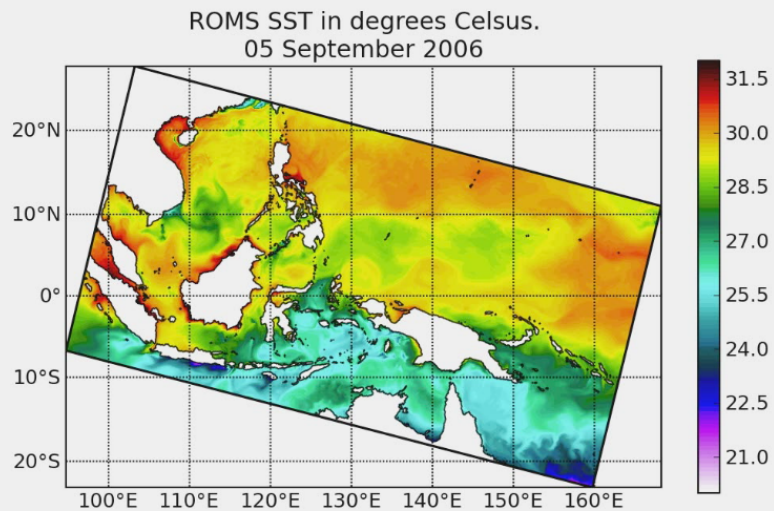
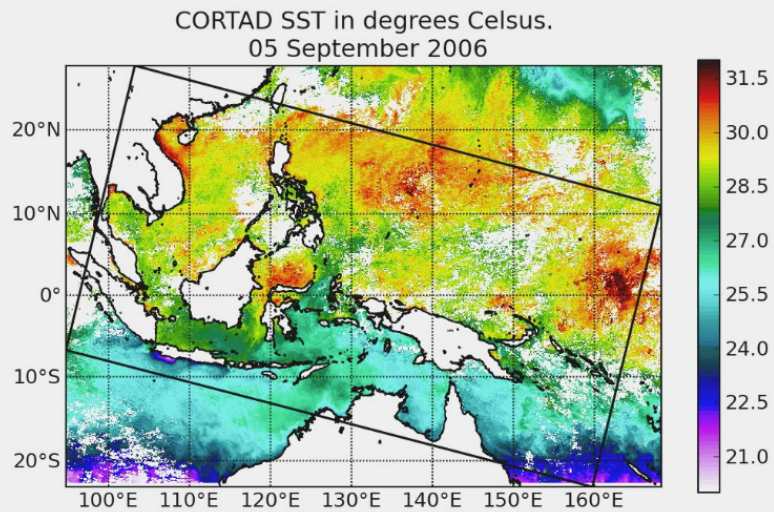
Pohnpei-C, Micronesia



Darwin, Australia

Sea Surface Temperature

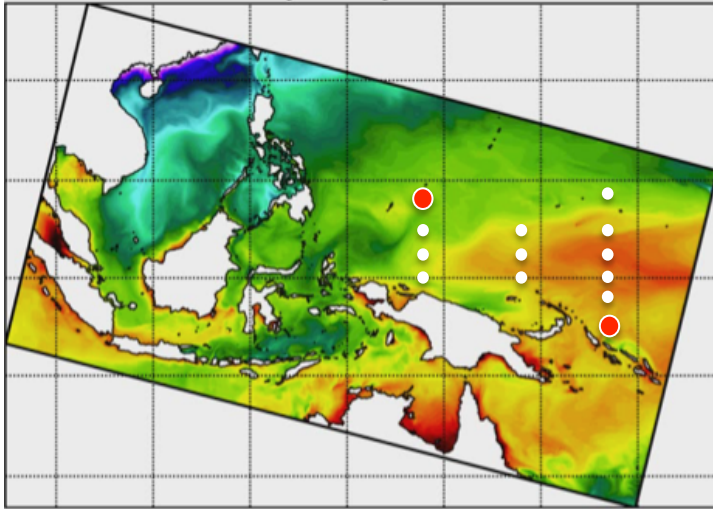
**CoRTAD weekly average SST
05 September 2006**



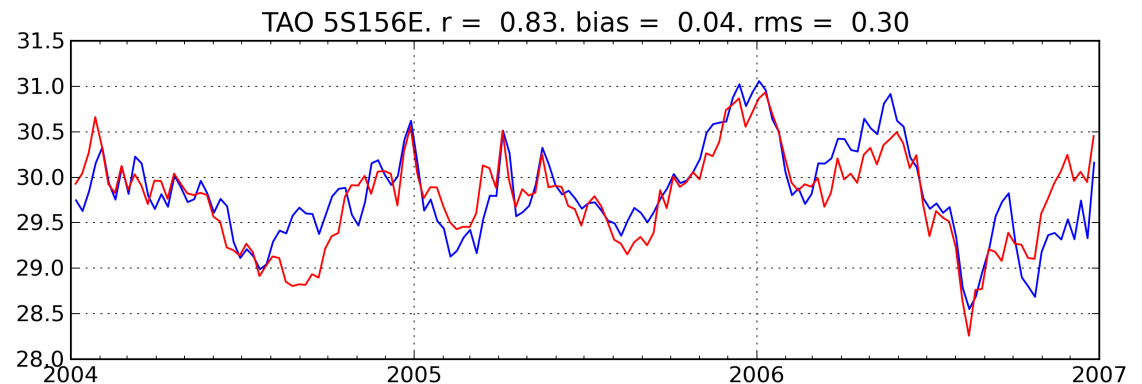
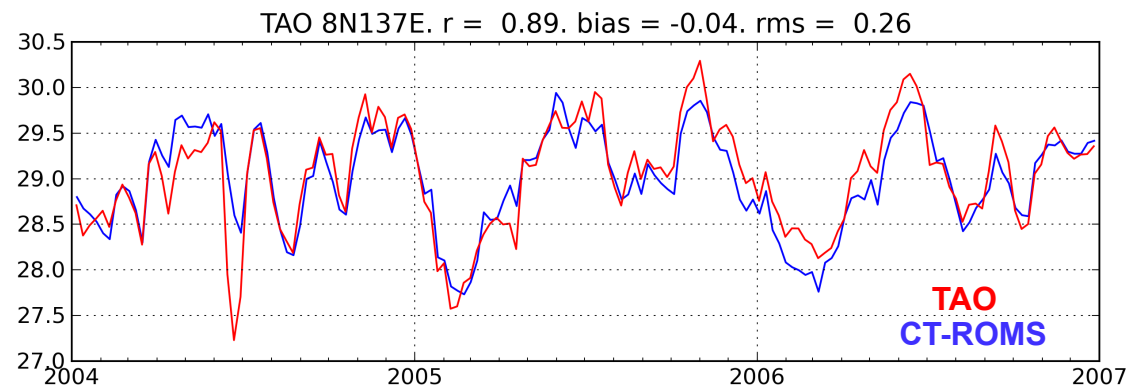
**CT-ROMS weekly average SST
05 September 2006**

Sea Surface Temperature

Average weekly SST CT-ROMS versus TAO moorings

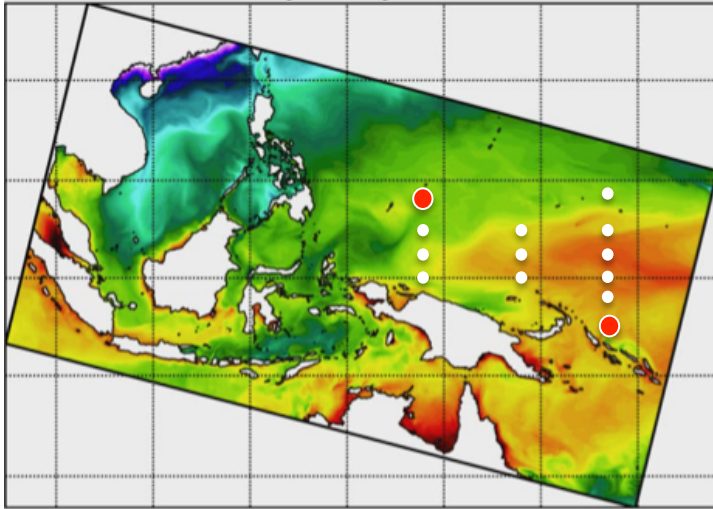


<u>CoRTAD</u>	<u>r</u>	<u>bias</u>	<u>RMS error</u>
CT-ROMS domain		0.40	0.8
TAO moorings	r	bias	RMS error
➔ 8N 137E	0.89	-0.04	0.26
8N 156E	0.72	0.04	0.35
5N 137E	0.74	-0.29	0.47
5N 147E	0.73	0.01	0.25
5N 156E	0.72	0.18	0.28
2N 137E	0.73	-0.30	0.46
2N 147E	0.81	0.05	0.23
2N 156E	0.82	0.21	0.30
0N 137E	0.69	-0.16	0.35
0N 147E	0.81	-0.06	0.28
0N 156E	0.80	0.14	0.26
2S 156E	0.78	0.10	0.24
➔ 5S 156E	0.83	0.04	0.30

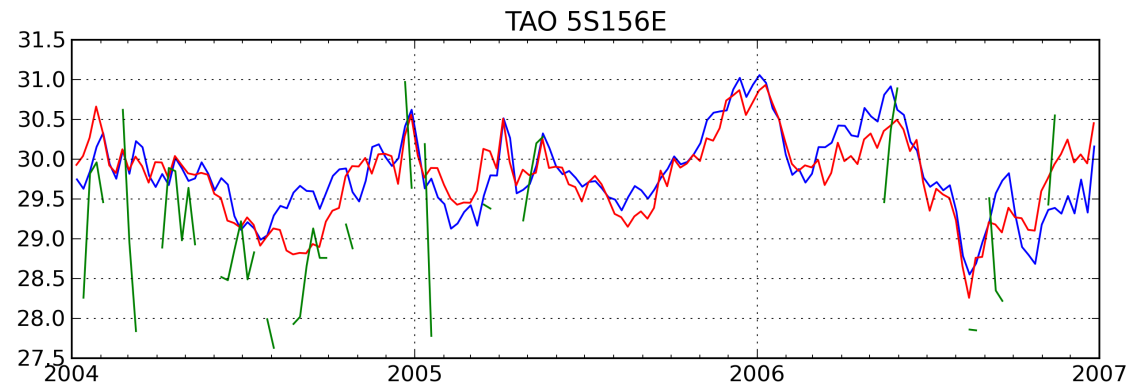
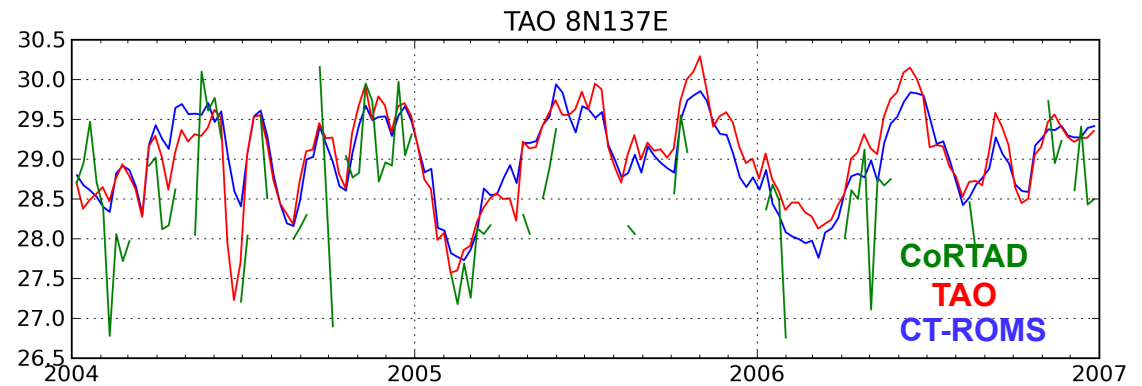


Sea Surface Temperature

Average weekly SST
CT-ROMS versus TAO moorings



<u>CoRTAD</u>	<u>r</u>	<u>bias</u>	<u>RMS error</u>
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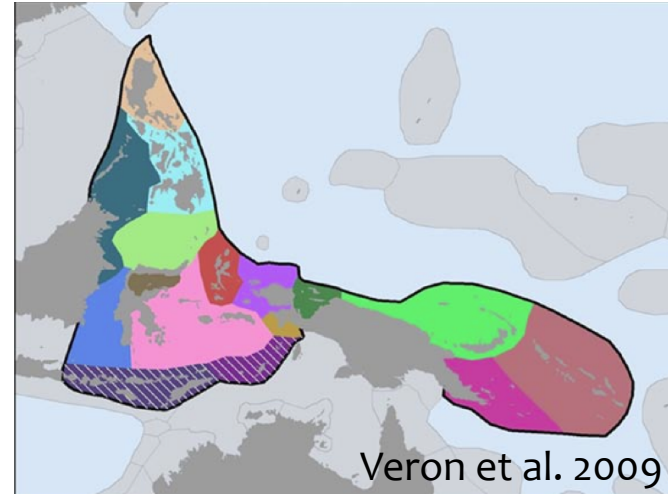


CT-ROMS: Quick look at larval dispersal



Acropora millepora

- Widespread in the Coral Triangle
- Broadcast spawner
- April 1 spawning
- Precompetency
 - 3-4 days
 - T-dependent
- Mortality rate
- Settlement occurs once within a reef cell

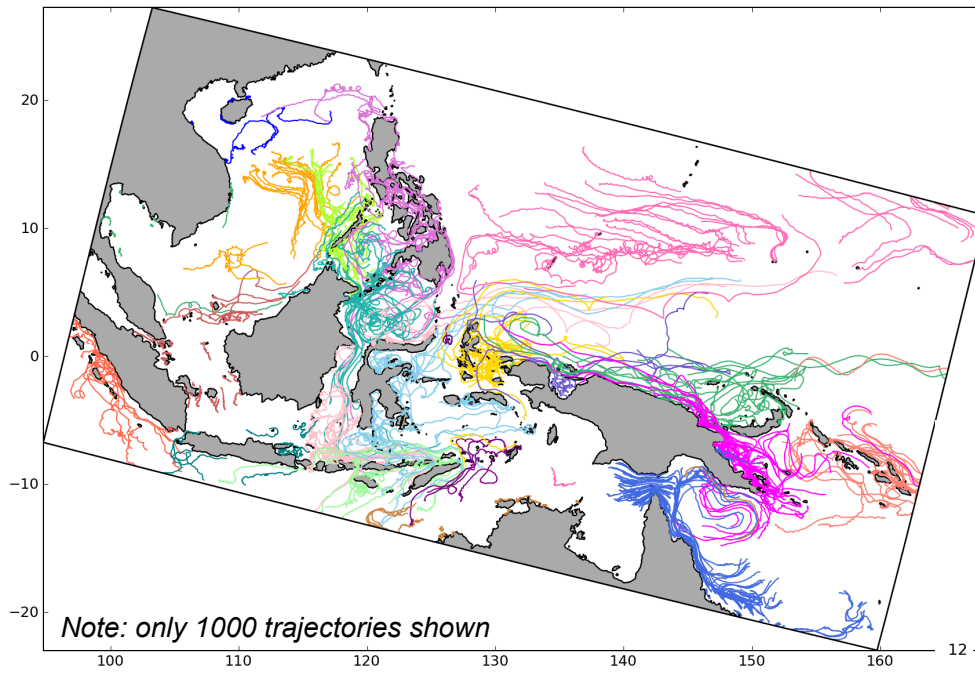


Coral Triangle Ecoregions

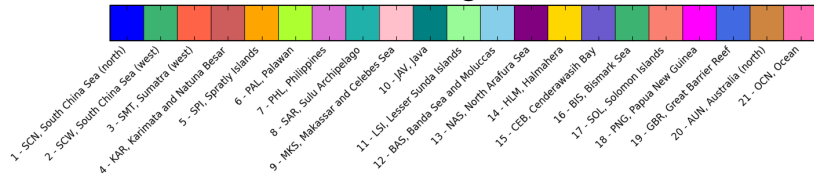
- Based on ecoregions of Veron et al. [2009] + additional regions outside the Coral Triangle
- 50,000 larvae labeled according to ecoregion
- Larvae tracked for 45 days
- Connectivity matrix calculated

CT-ROMS: Quick look at larval dispersal

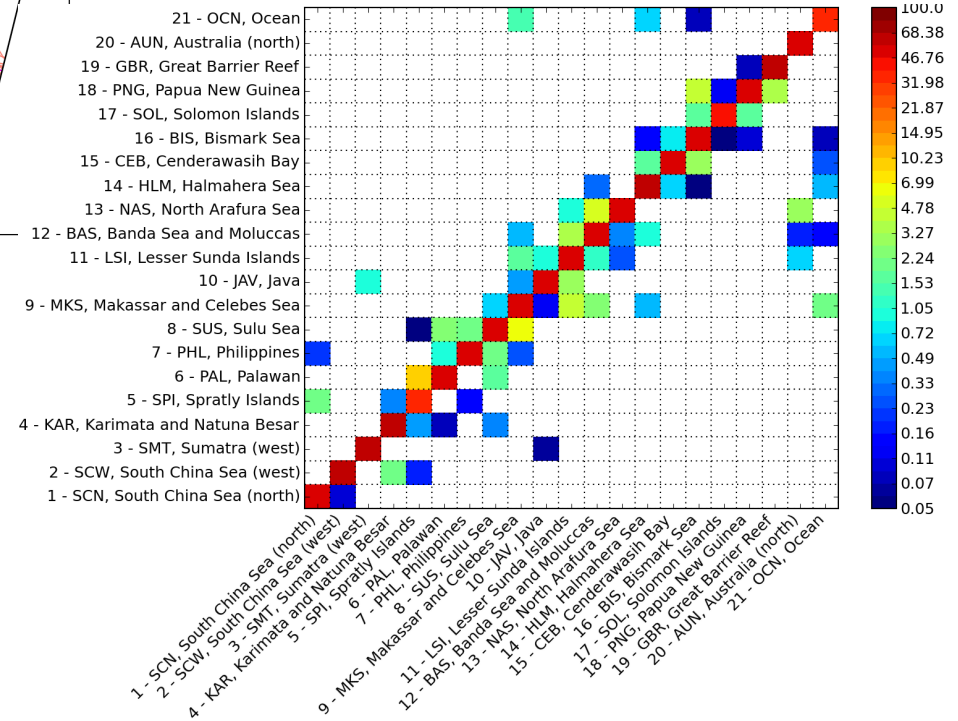
45-day trajectories of *A. millepora* larvae



Ecoregions



Connectivity matrix



Most larvae are retained within the same ecoregion, but there is some long-distance connectivity



A high-resolution regional model for the Coral Triangle

Advantages of CT-ROMS

- Captures entire ITF region with significant skill
- Explicitly modeled tides (important to getting dynamics right)
- Suitable for climate-scale studies (e.g., coupling to global climate models)
- Ability to nest at higher resolution in targeted regions
- CT-ROMS improves our capacity to understand regional differences in vulnerability of coral reefs to climate change

A horizontal banner image showing a map of the Coral Triangle region. The map uses a color scale from green to yellow to orange, representing different data values. The text "A high-resolution regional model for the Coral Triangle" is overlaid in white, bold font.

**A high-resolution regional model
for the Coral Triangle**

Thank You