Coastal Forecasting for a Sustainable Fisheries Management System in India

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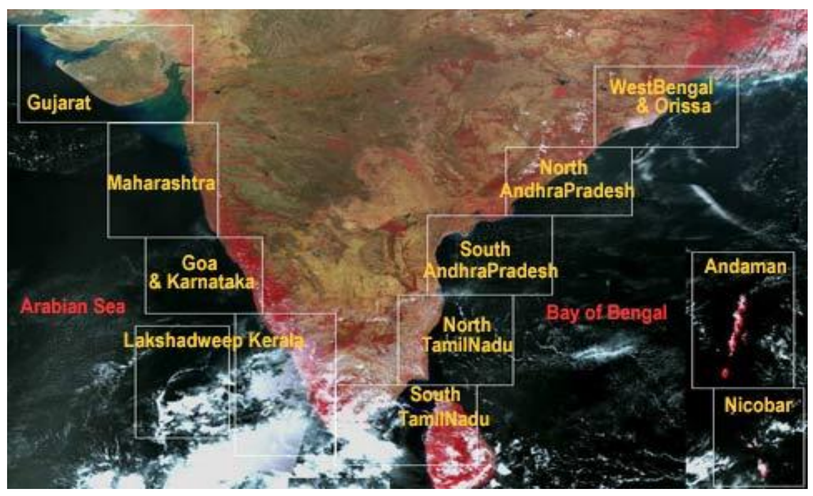
Opportunity

Fisheries: Driver of the Coastal Economy

- Indian Fisheries is the 3rd largest globally
- Employs 14 mn people
- 1.1% of GDP (5.3% of agri. GDP)
- 8129 km of coasts
- 2.02 mn sq. km of Exclusive Economic Zone
- Exports of $1.8 bn to over 90 countries[a,b]

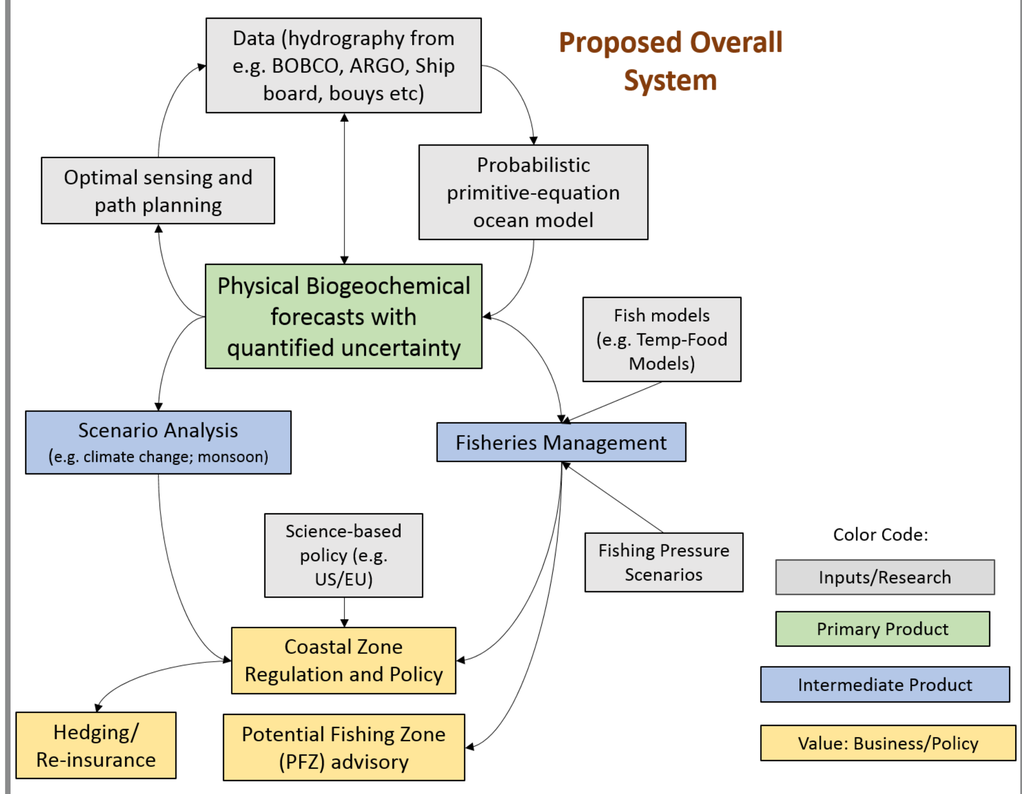


12 Fishing Zones in India [Image Courtesy: INCOIS]

Proposed Solution

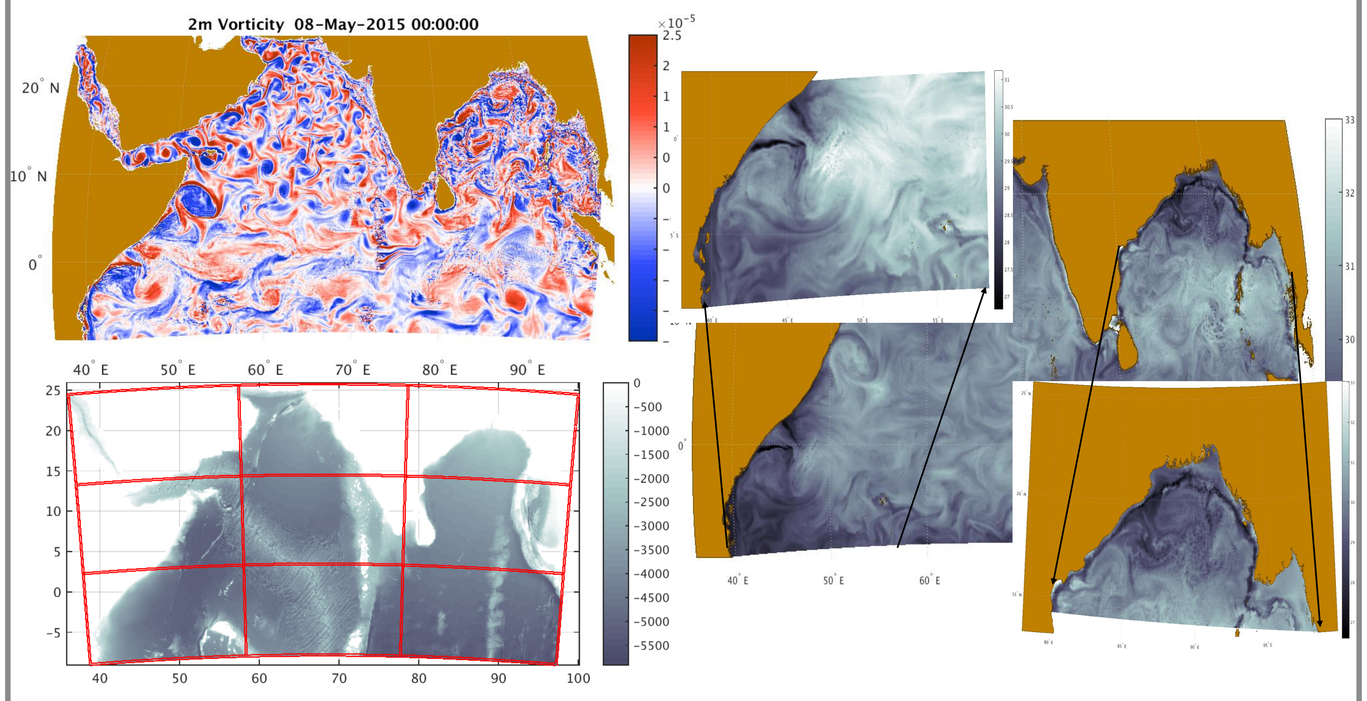
Quantitative Modeling

- Rigorous Uncertainty Quantification (UQ)
- Physical-Bio-Geo-Chemical ocean forecast
- Species-specific fish forecast



Results

- Multiresolution ocean circulation model for the North Indian Ocean – Arabian Sea and Bay of Bengal
- Tiling with conservative Implicit 2-Way Nesting
  - Coarse domain at 1/25º for the basin, 9 tiling domains at 1/75º for specific regions, telescoping domains at 1/225º (i.e., 493 m resolution) for coastal fishing grounds



- Tidal, atmospheric and river inputs (external forcing)
- Novel 3-d Dynamically Orthogonal (DO) Primitive Equations for rigorous UQ and probabilistic prediction

Value Proposition

Sustainable Fisheries Management

- Technical decision aide for policy makers
- Species specific forecast to aid stock assessment

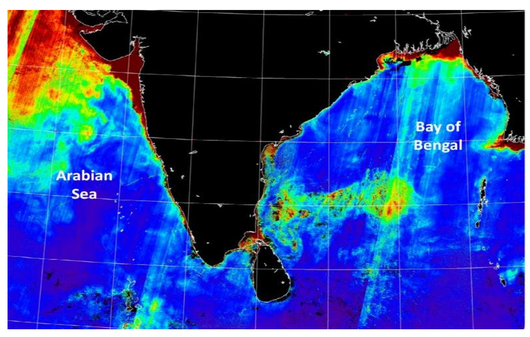
Increased Incomes for Subsistence Fishing

- Improved Potential Fishing Zone advisory for greater catch per unit effort

Coastal Zone Regulation

- Model to predict impact of marine pollution spread

Fishing boats in Kollam
[By Arunvrparavur, CC BY-SA 3.0]



Oceansat-2 Chlorophyll-a Product [ISRO]
[Used for PFZ Advisory by INCOIS]

Next Steps

- Calibration of multiresolution ocean simulations and multiscale dynamical studies
- Biogeochemical ecosystem modeling & fish modeling
- Implement the 3-d DO Primitive Equations
- Verification and Validation (V&V) of our deterministic and probabilistic models

Acknowledgments

Thanks to the members of our MSEAS group, HYCOM team, and colleagues at INCOIS Hyderabad, NIOT Chennai, IIT Bhubaneswar, MSSRF Chennai, AU Vizag, CMLRE Kochi. We also thank ONR for partial research support under grant N00014-15-1-2616 (DRI-NASCAR) to MIT.

References

(a) World Bank Integrated Coastal Zone Management Project in India (2010)
(b) Food and Agriculture Organization of the UN (2006)
Publications: http://mseas.mit.edu/