2021 2030 United Nations Decade of Ocean Science for Sustainable Development

GOOS | Ocean Observing Co-Design
by The Global Ocean Observing System

TROPICAL CYCLONE EXEMPLAR

– Co-Designing Ocean Observing Systems for Improving Tropical Cyclone Forecasts and Warnings –

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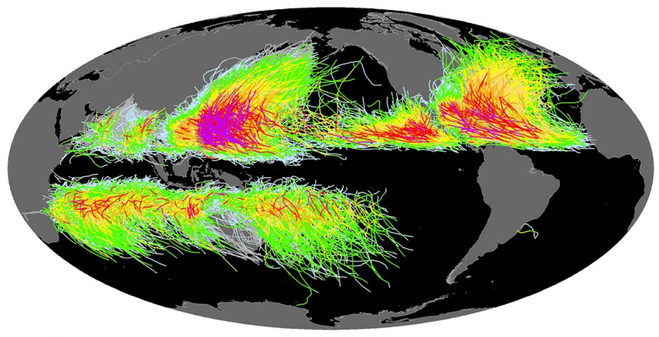
- **Tropical Cyclones** (TCs) are among the most dangerous and destructive weather events worldwide, annually impacting >20M people with >$50B in losses[1,2]
- TC impacts are amplified by **rising sea levels, warming oceans,** and **heavier rainfall**, disportionately affecting small **developing states**
- Improved TC **forecasts and warnings** will save lives & property, and promote equity & resiliency, across the globe
- Modern **Earth System** forecast models require more **ocean data**, especially subsurface, to help improve forecast accuracy and extend forecast lead times



Deliverables:

1. **Co-designed**, regionally distributed ocean observing **pilot studies** - *to develop collaborative capacity and demonstrate mutual value*
2. **Increased coverage and delivery** of ocean data to forecasting centers and scientists - *to expand critical observations across international borders*[3]
3. **More accurate characterization & understanding** of essential ocean features & air-sea processes - *to improve Earth System Models & tropical cyclone forecast*

Involvement:

- International **Steering Committee**
- **GOOS** Observing Systems & Regional Alliances
- **WMO** Tropical Cyclone Programme & Regions
- Initial **Government & Foundation** support

Stakeholder Benefits:

- Improved representation of the **Essential Ocean Features** impacting TC track, intensity, size and storm surge forecasts in Earth System Models
- Improved understanding of **Essential Ocean Processes** impacting TC evolution in Earth System Models
- Improved TC **forecasts & warnings**
- Improved **lead times** for emergency managers to coordinate response.

Emergency Managers

- Require accurate forecasts with longer lead times to make successful decisions such as evacuate vs. shelter in place.

Forecast Centers

- Require improved numerical model guidance to issue the most effective forecasts and warnings.

Modeling Centers

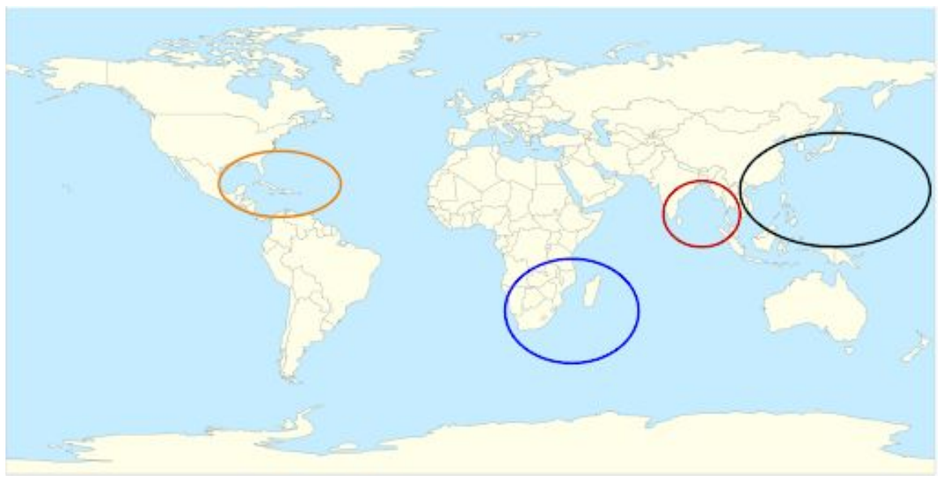
- Require atmospheric and ocean data for assimilation in Earth system models. Ocean data limited.

Observing Systems Operators

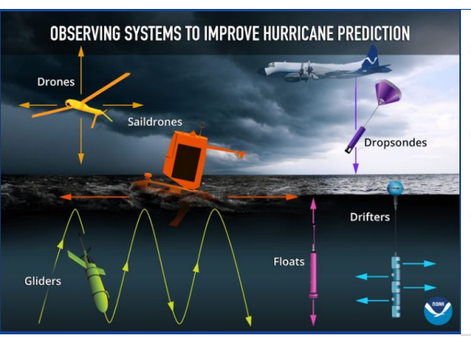
- Require permissions to collect data in regions that cross national jurisdictions[3].

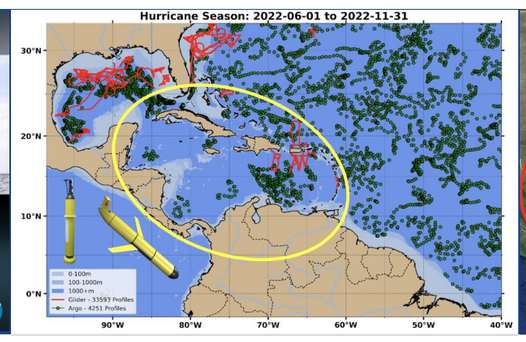
Next Steps:

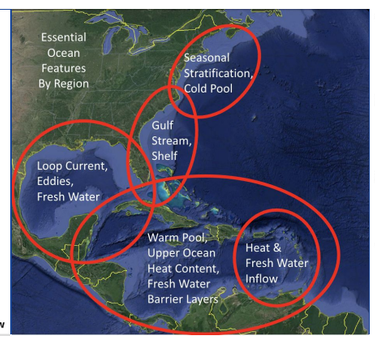
- **Coordinate** with regional **GOOS** Alliances & **WMO** Regions
- **Fundraising** for pilot study demonstration projects
  - TAC: Ocean Observing capacity building for most damaging TCs
  - SWIO: Observing network design for TC, BC, MHW triple threat
  - Bay of Bengal: Network expansion for the most deadly TCs
  - NPOMS: Coupled air-sea science for the most intense TCs
- **Implementation** of regional plans; results shared globally

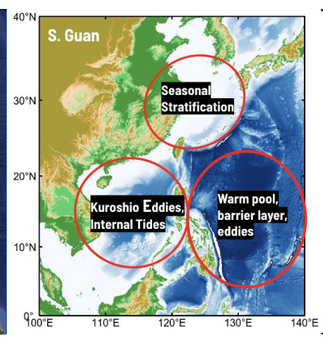


Four Pilot Study Regions identified:
Tropical Americas and Caribbean (TAC), South West Indian Ocean (SWIO), Indian Ocean - Bay of Bengal, North Pacific Ocean and Marginal Seas (NPOMS)










The New York Times

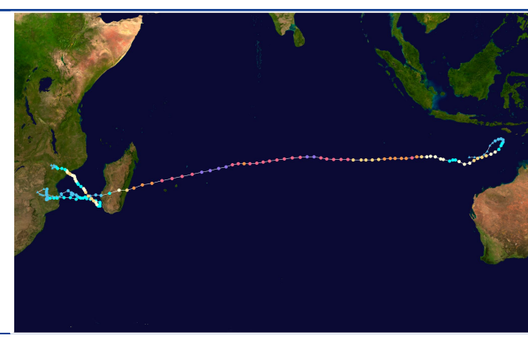
How Do You Save a Million People From a Cyclone? Ask a Poor State in India

By Hari Kumar, Jeffrey Gettleman and Sameer Yasir
May 3, 2019

BHUBANESWAR, India — Flights were canceled.

Train service was out.

And one of the biggest storms in years was bearing down on Odisha, one of India's poorest states, where millions of people live cheek by jowl in a low-lying coastal area in mud-and-stick shacks.



References:

[1]Krichene, H., Vogt, T., Piontek, F. *et al.* The social costs of tropical cyclones. *Nat Commun* 14, 7294 (2023). https://doi.org/10.1038/s41467-023-43114-4 | [2]WMO Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (1970-2019), WMO-No. 1267 | [3]Ocean Observations in areas under National Jurisdiction (OONJ) GOOS Expert Meeting Report (2020), GOOS-246