



The Caribbean Sea, modeling and opportunities in CESM

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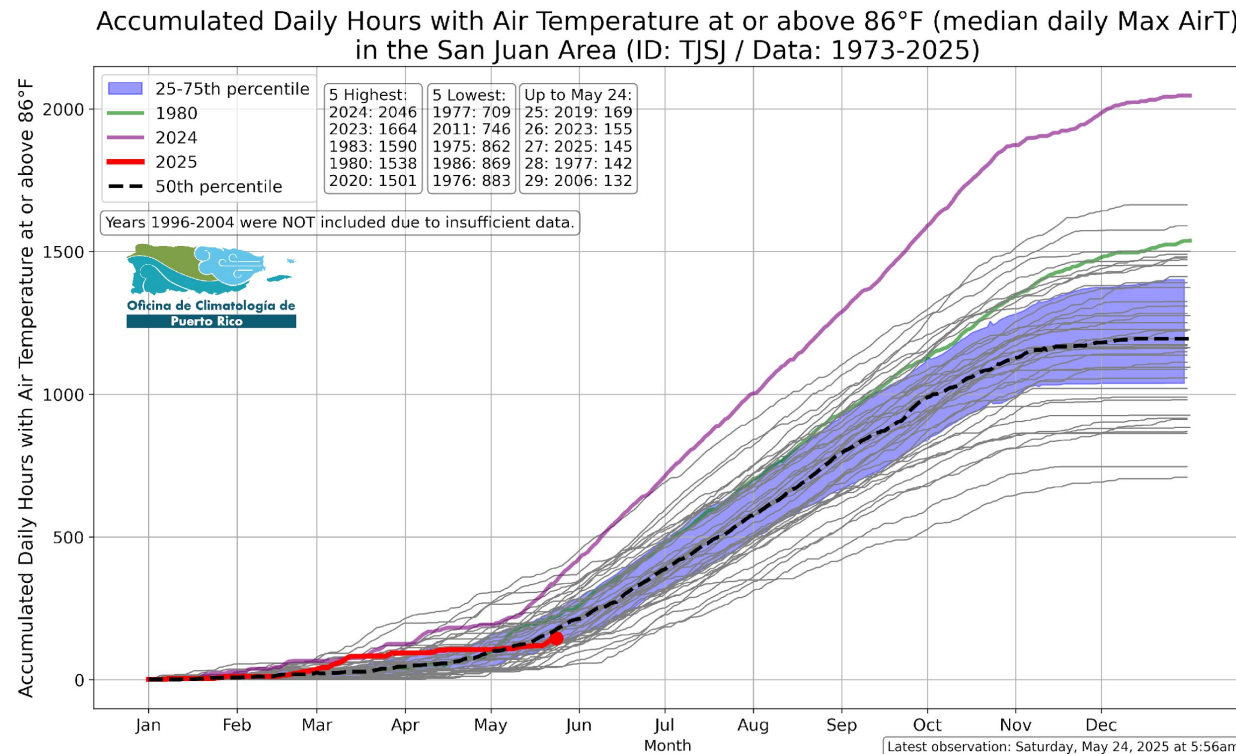
June 10th, 2025

Image: Dr. Ed Hawkins (<https://showyourstripes.info/>)

A satellite image of a large hurricane system over the Caribbean Sea. The hurricane's eye is visible in the center, surrounded by dense, swirling cloud bands. The landmasses of Central America, the Caribbean islands, and northern South America are visible, with some areas highlighted in green. The text "A \$91.6 billion disaster" is overlaid in white, bold, sans-serif font.

A \$91.6 billion
disaster

- The 1991–2024 **period shows the highest temperature trend** ($\sim 0.2\text{ }^{\circ}\text{C}$ or higher per decade according to the WMO)
- Sea-level rise above global average (2004-2019): **$6.15 \pm 0.5\text{ mm/year}$** (Maitland et al. 2024)
- The percentage of live coral covering a reef, has **declined by over 50%** from 1970 to 2012 in the Caribbean (UNEP, 2014)



The Caribbean Sea

- **13 island nations and 14 territories**
- **GDP:** \$151.78 billions
- **Global ocean economy:** 15%-27%.
- **Population:** ~45 million
- Home to 10% of the world's coral reefs
- Unique coastal mangrove ecosystems
- 1,400 species of fish and marine mammals

Source: NOAA Marine Ecosystems, International Monetary Fund, Inter-American Development Bank

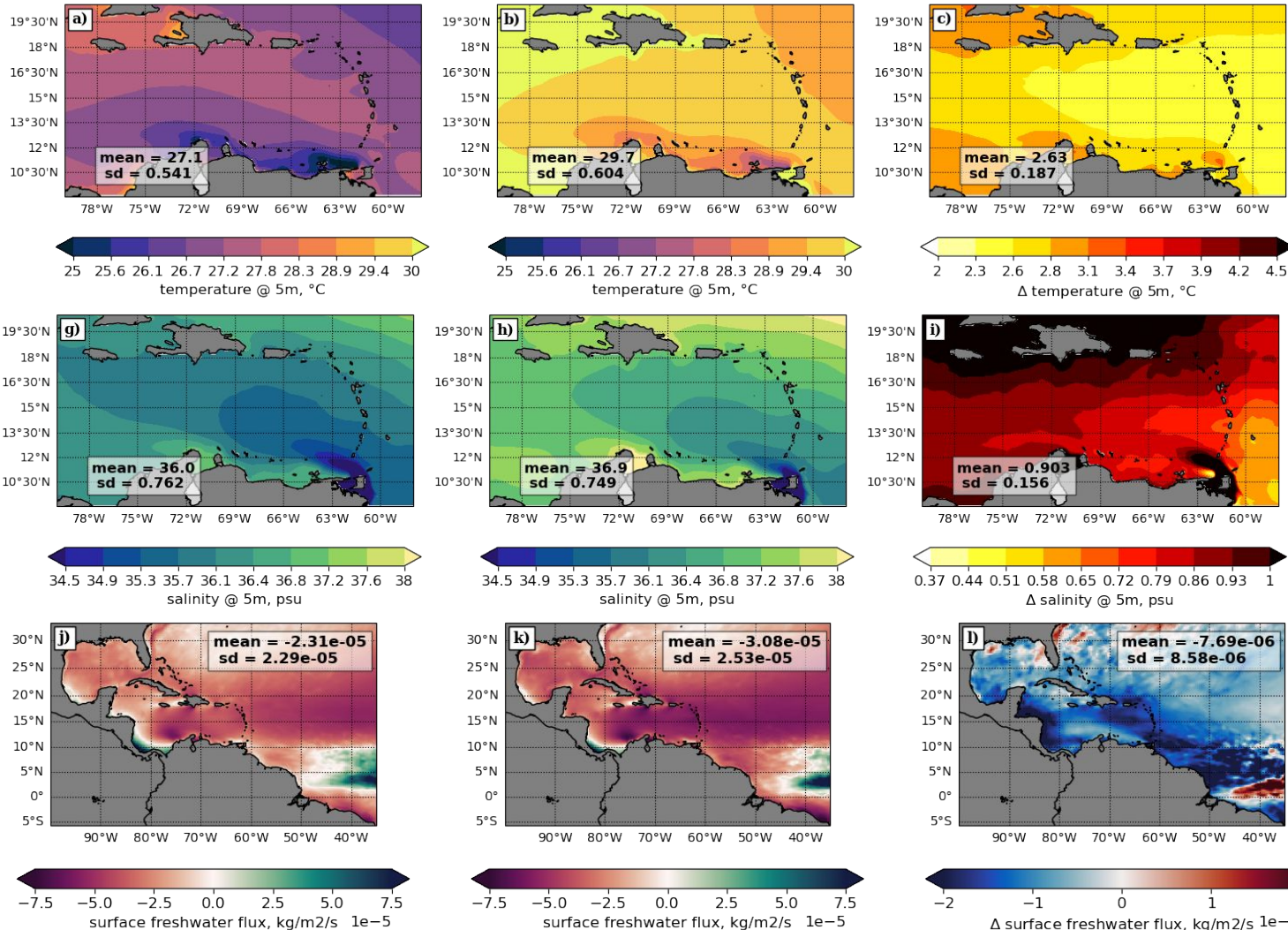


What do CESM projections tell us about the future of the Caribbean Sea?

Reference (1986-2005)

Future (2080-2099)

Difference



□ Near-surface: $\sim 0.2^{\circ}\text{C}/\text{decade}$

□ Near-surface: ~ 0.07 psu/decade

□ Changes in freshwater fluxes contribute to a drier and more saline Caribbean

Development of regional ocean modeling capabilities within CESM

Geosci. Model Dev., 17, 8989–9021, 2024
<https://doi.org/10.5194/gmd-17-8989-2024>
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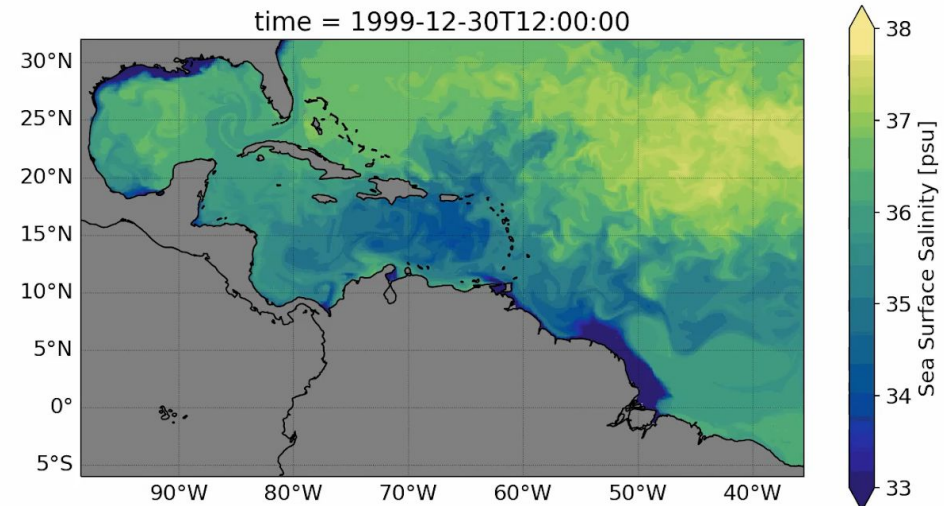
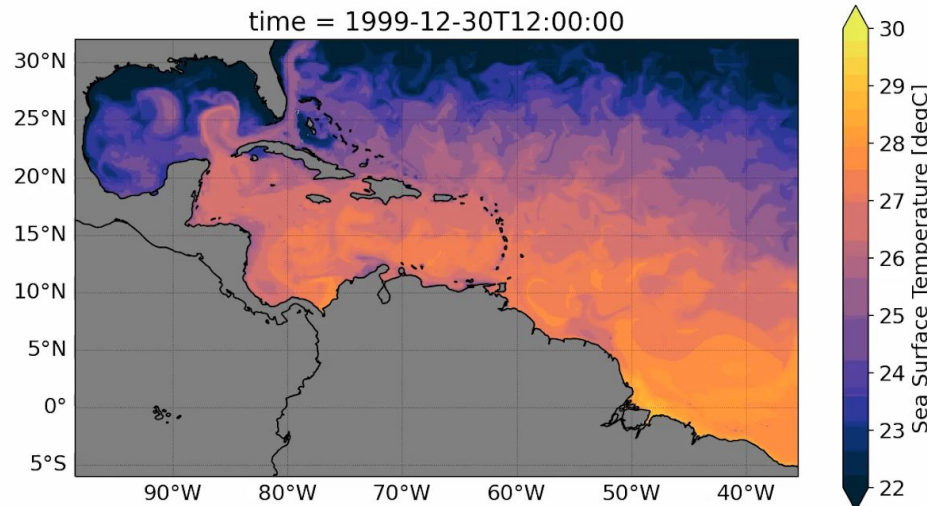


CARIB12: a regional Community Earth System Model/Modular Ocean Model 6 configuration of the Caribbean Sea

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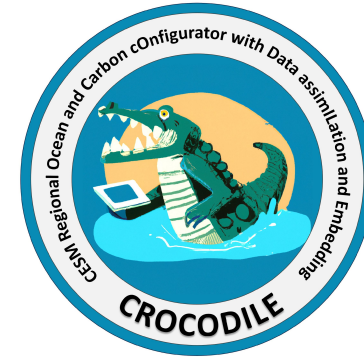
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How can CESM advance regional climate science?

- Continued support to develop and facilitate high-resolution modeling capabilities across scales.
 - CROCODILE, ESPAT, SAAG, INFORM
- Collaborative frameworks and co-production.
 - Regional climate science and solutions **tailored to local needs**





The question is not “what can we model?”,
but “what **must** we model?”