



The Caribbean Sea, modeling and opportunities in CESM

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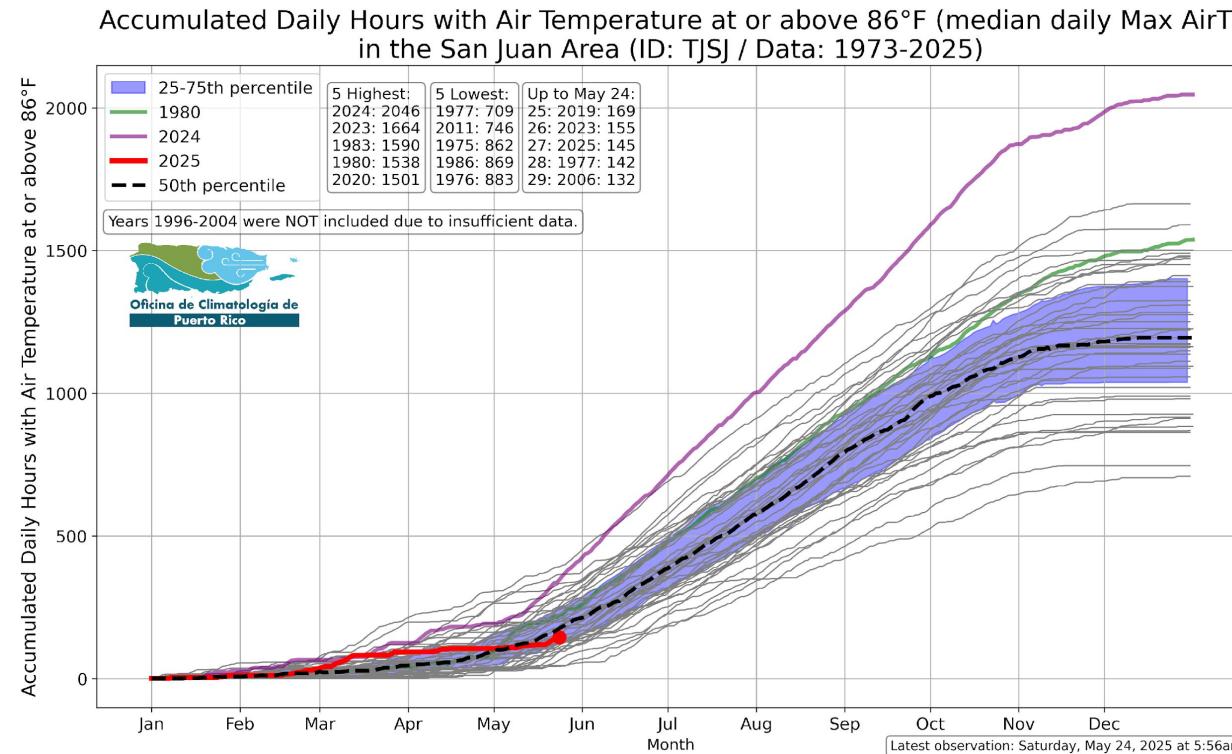
2025 CESM Workshop, Boulder, CO
June 10th, 2025

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



A \$91.6 billion
disaster

- The 1991–2024 **period shows the highest temperature trend** ($\sim 0.2^{\circ}\text{C}$ 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

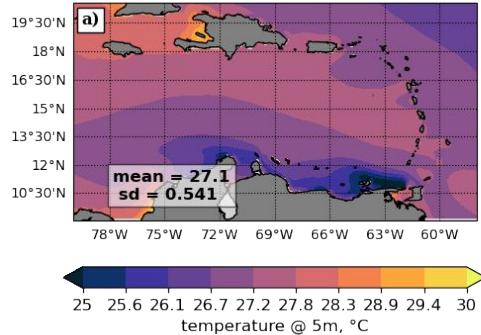
- **13 island nations and 14 territories**
- **GDP:** \$151.78 billions
- **Global ocean economy:** 15%-27%.
- **Population:** ~45 million
- Home to 10% of the world's coral reefs
- Unique coastal mangrove ecosystems
- 1,400 species of fish and marine mammals



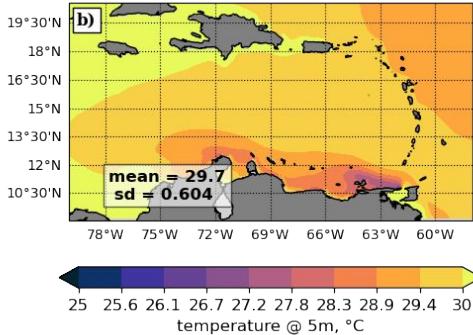
Source: NOAA Marine Ecosystems, International Monetary Fund, Inter-American Development Bank

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

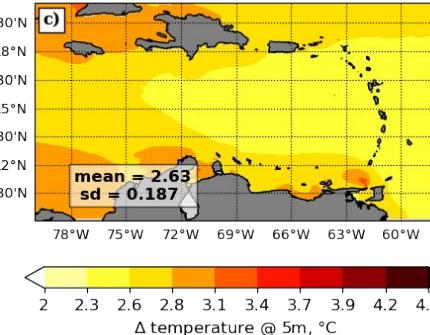
Reference (1986-2005)



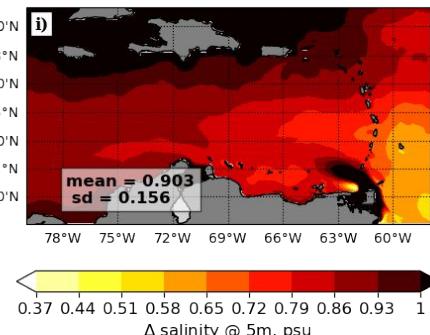
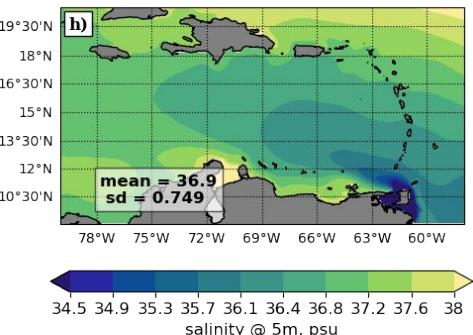
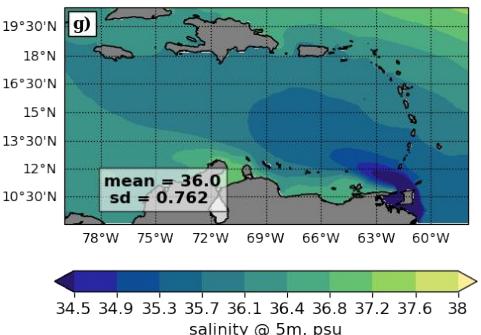
Future (2080-2099)



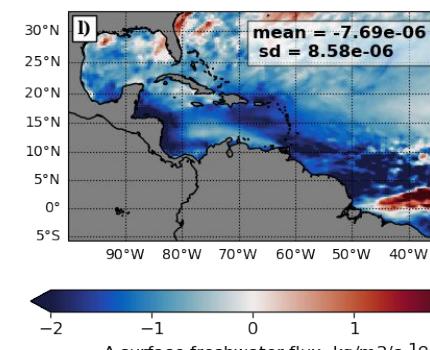
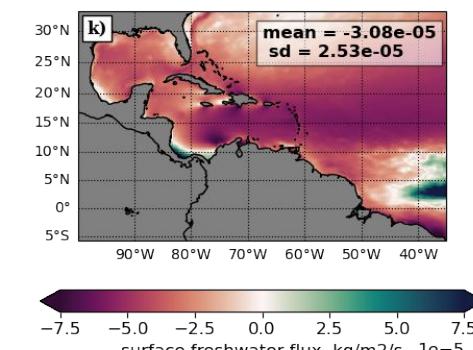
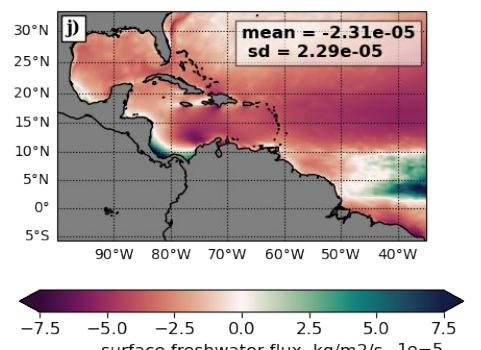
Difference



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



- Near-surface: $\sim 0.07 \text{ psu}/\text{decade}$



- 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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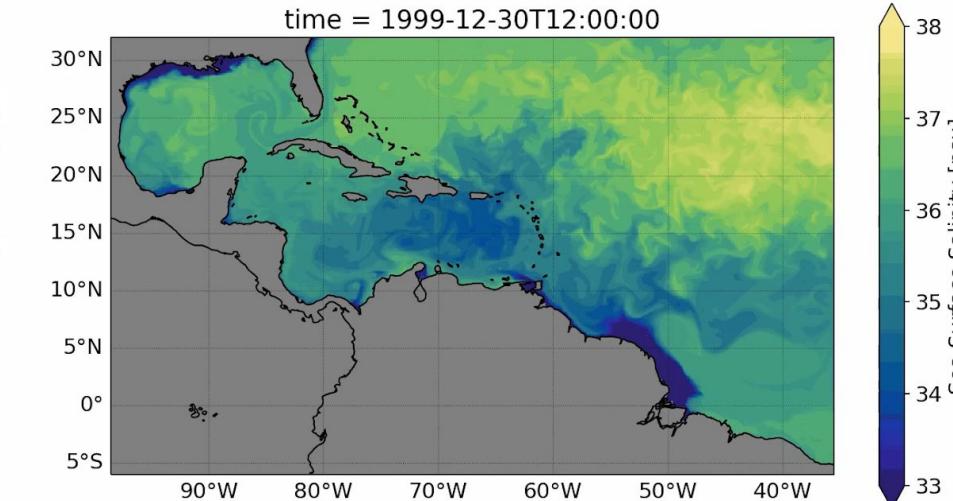
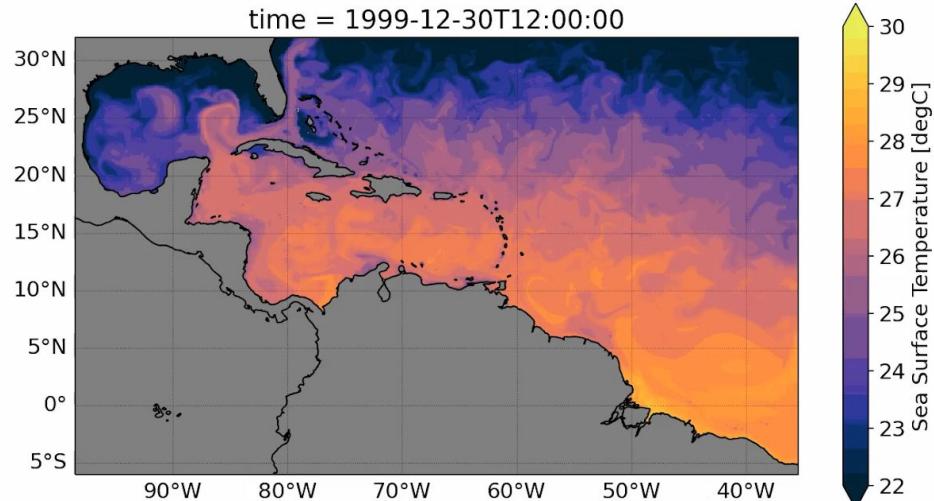


CARIB12: a regional Community Earth System Model/Modular Ocean Model 6 configuration of the Caribbean Sea

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How can CESM advance regional climate science?

- Continued support to develop and facilitate high-resolution modeling capabilities across scales.
 - CROCODYLE, 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?”