

# Dynamically Downscaled Regional Projections of Ocean Acidification in the Main Hawaiian Islands

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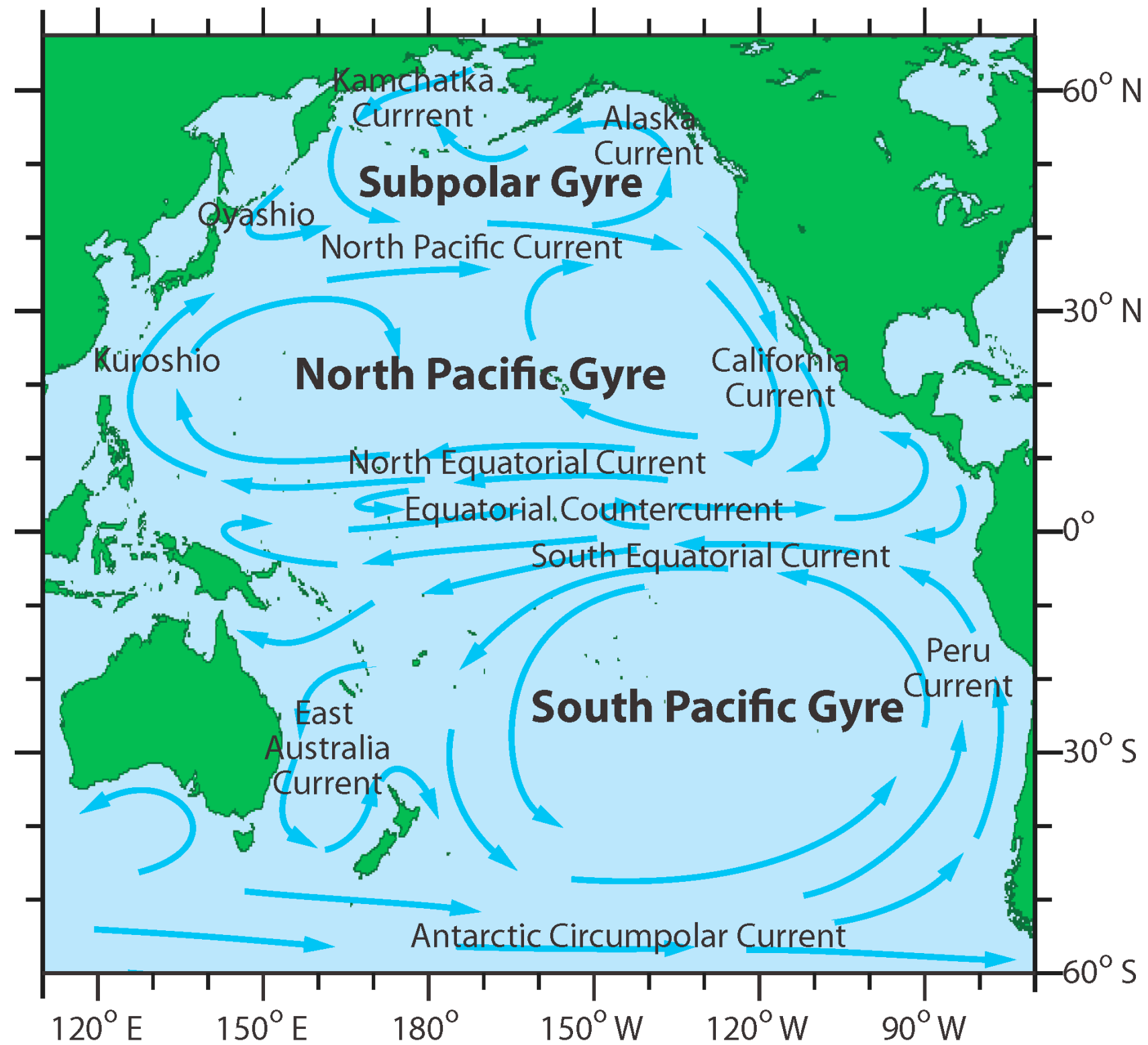
UNIVERSITY of HAWAI'I® at MĀNOA

Ke Kulanui o Hawai'i ma Mānoa





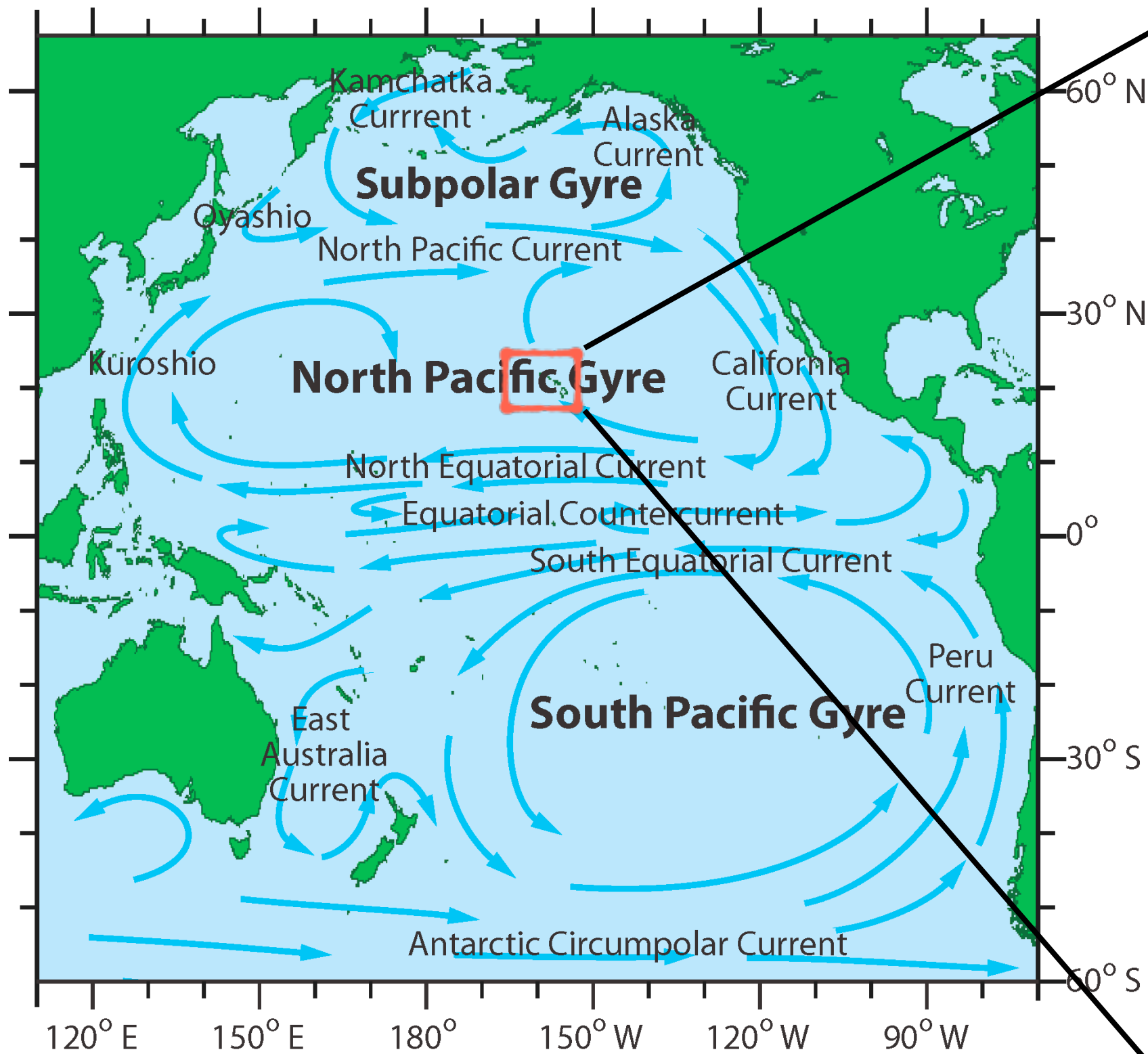
# Main Hawaiian Islands



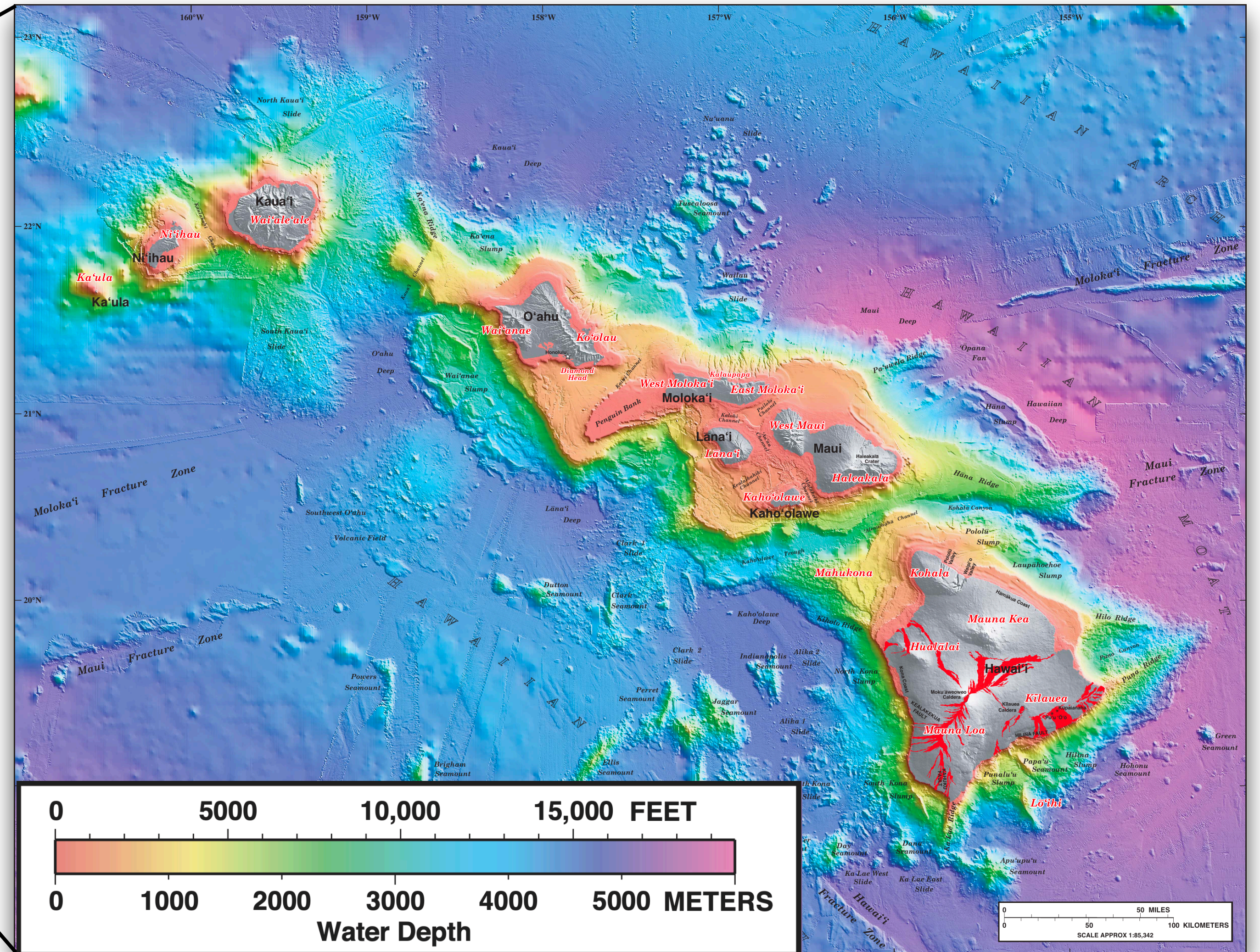
Oceans of Data Institute, <https://oceantracks.org>



# Main Hawaiian Islands



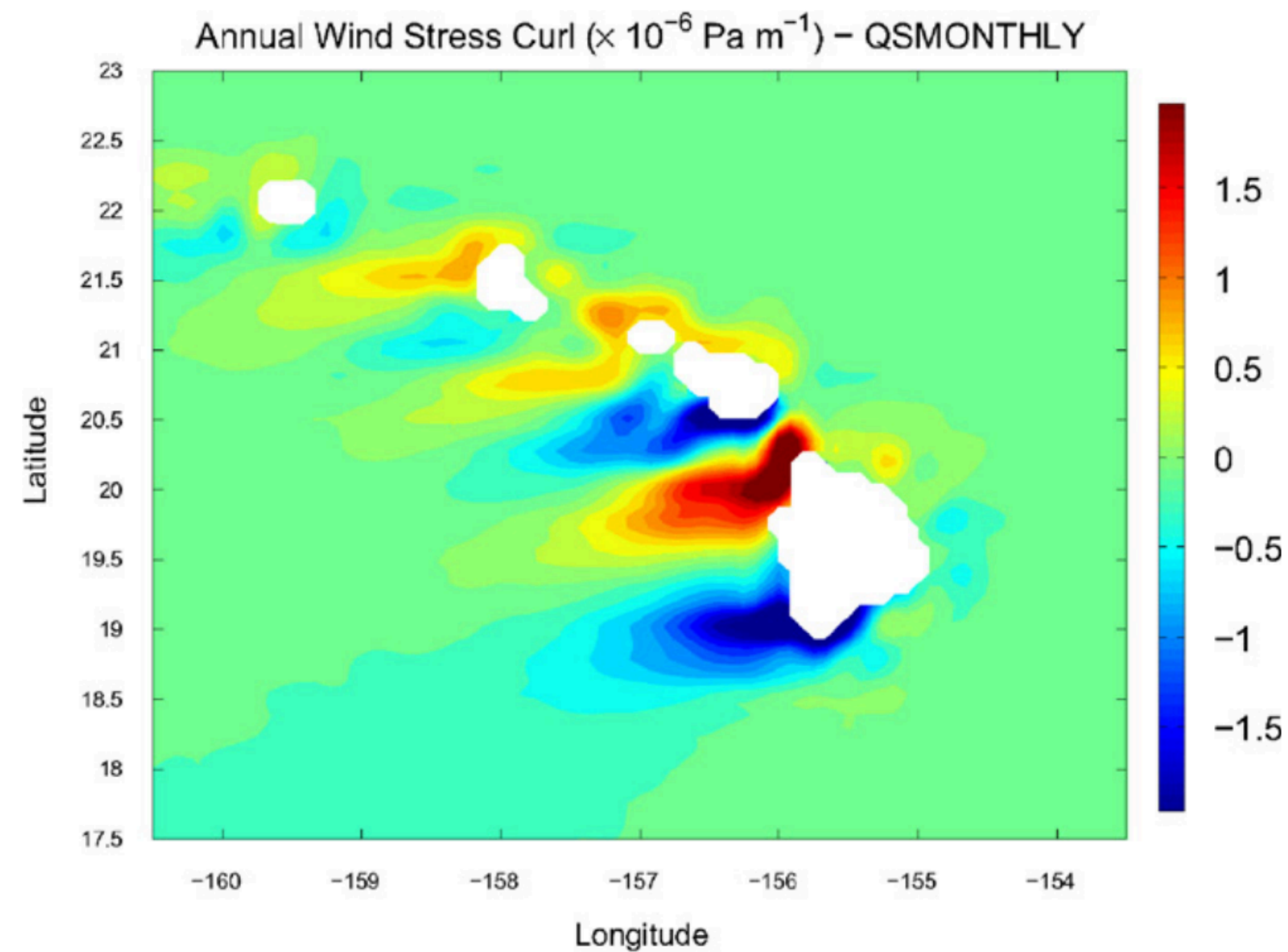
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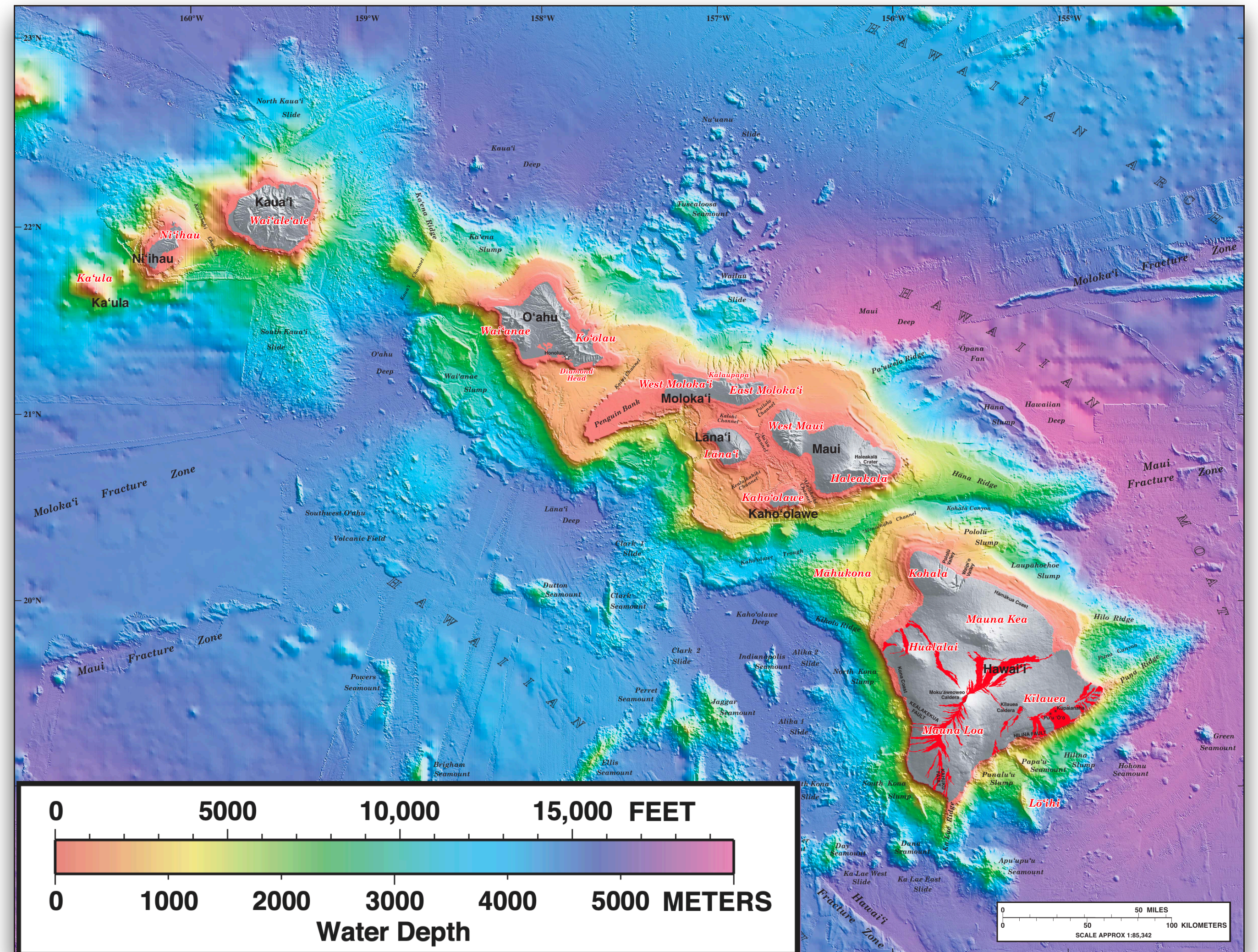
Eakins et al, <https://pubs.usgs.gov/imap/2809/>



# Main Hawaiian Islands



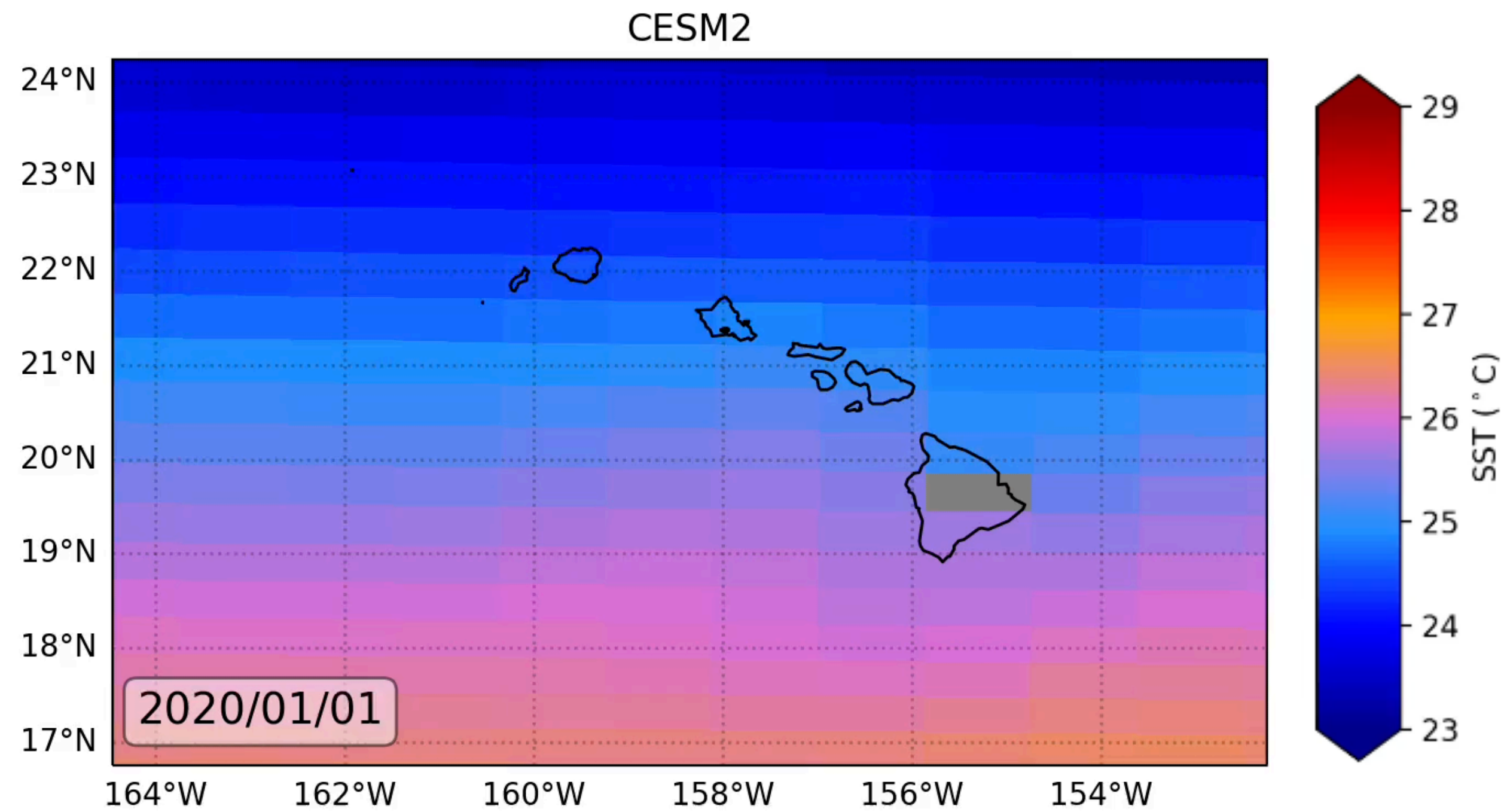
*Calil et al. 2008, Deep Sea Research II*



*Eakins et al, <https://pubs.usgs.gov/imap/2809/>*

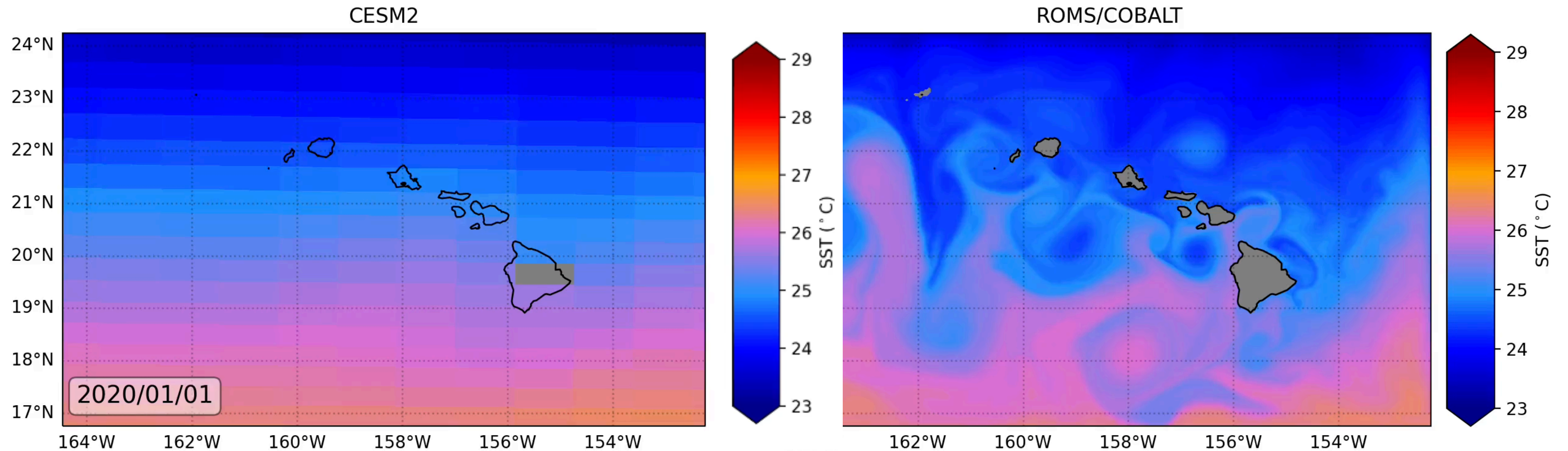


# Dynamical downscaling of MHI domain





# Dynamical downscaling of MHI domain



*Friedrich et al. 2024: Submesoscale-permitting physical/biogeochemical future simulations for the main Hawaiian Islands, accepted*

*Liu et al. 2023: Climate downscaling for regional models with a neural network: A Hawaiian example*



# Ocean acidification indices

pH

$\Omega_A$

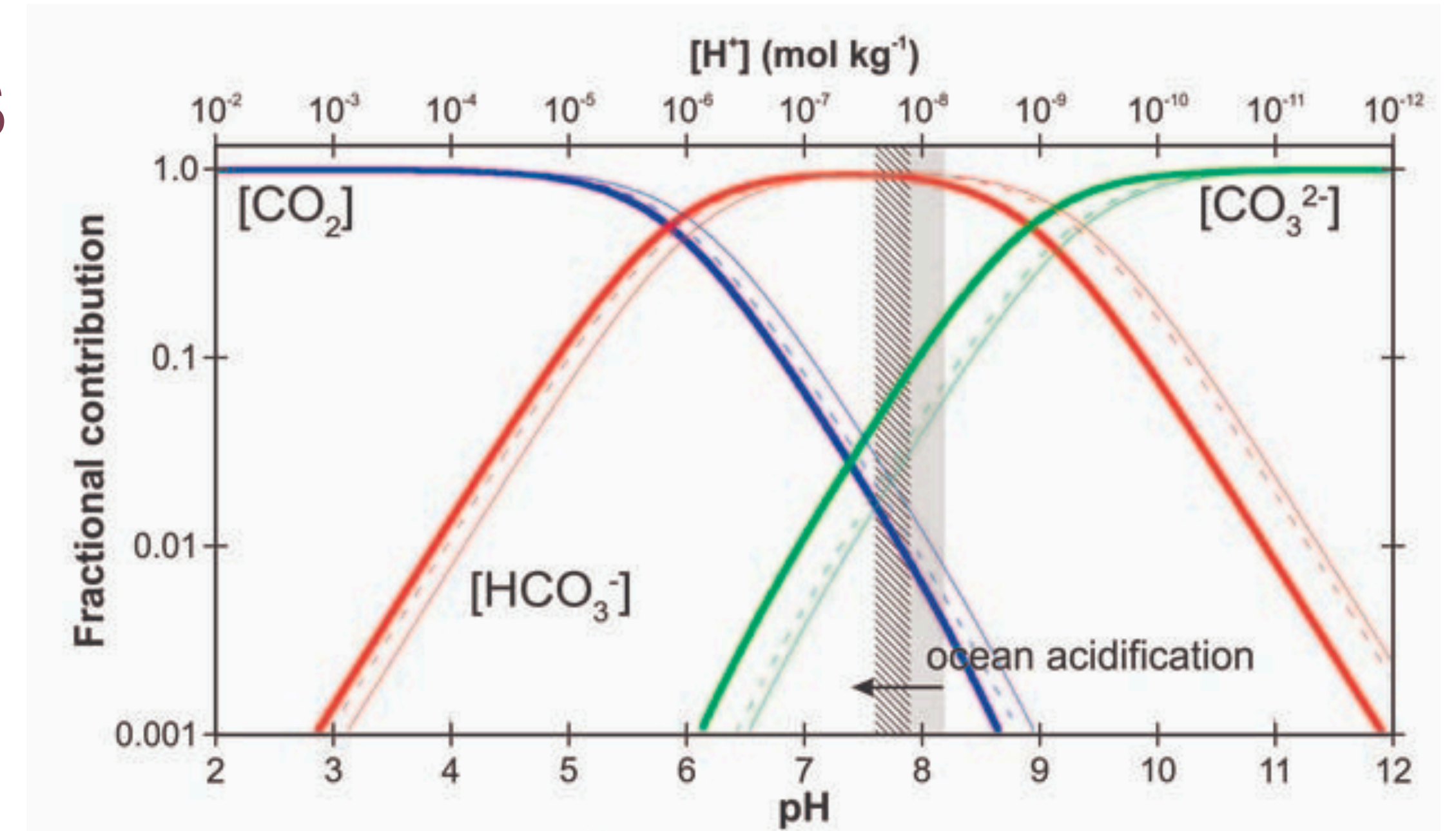
SIR

1. pH ( $\sim[H^+]$ )

2. Aragonite saturation ( $\Omega_A$ ) ( $\sim[CO_3^{2-}]$ )

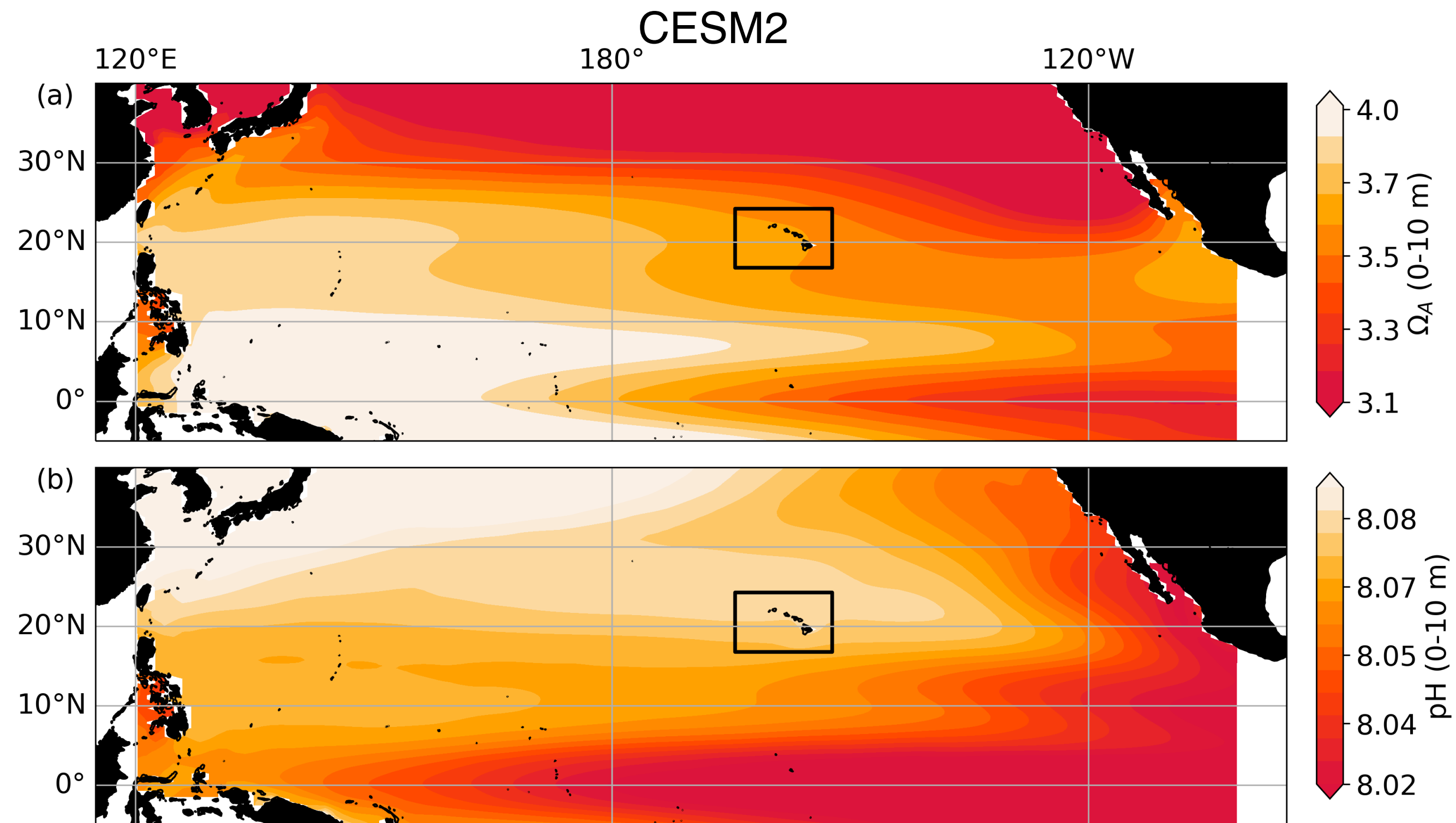
3. Substrate-to-inhibitor ratio (SIR) ( $\sim[HCO_3^-]/[H^+]$ )

Ingredients: T, ALK, DIC, S

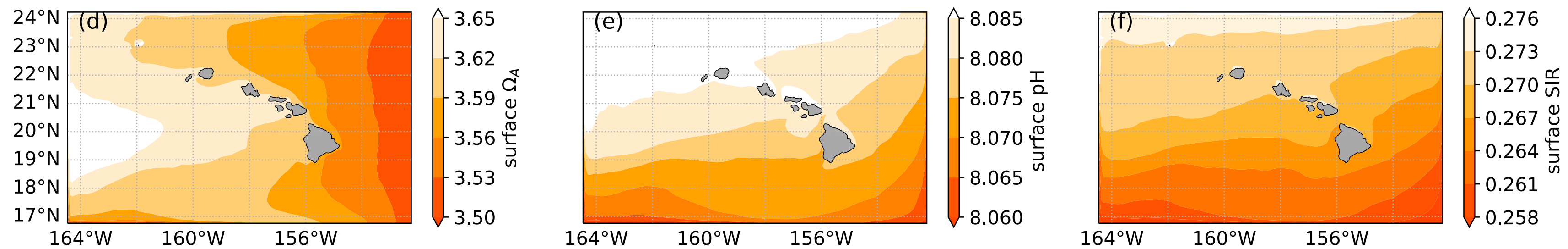




# OA indices 2005-2020

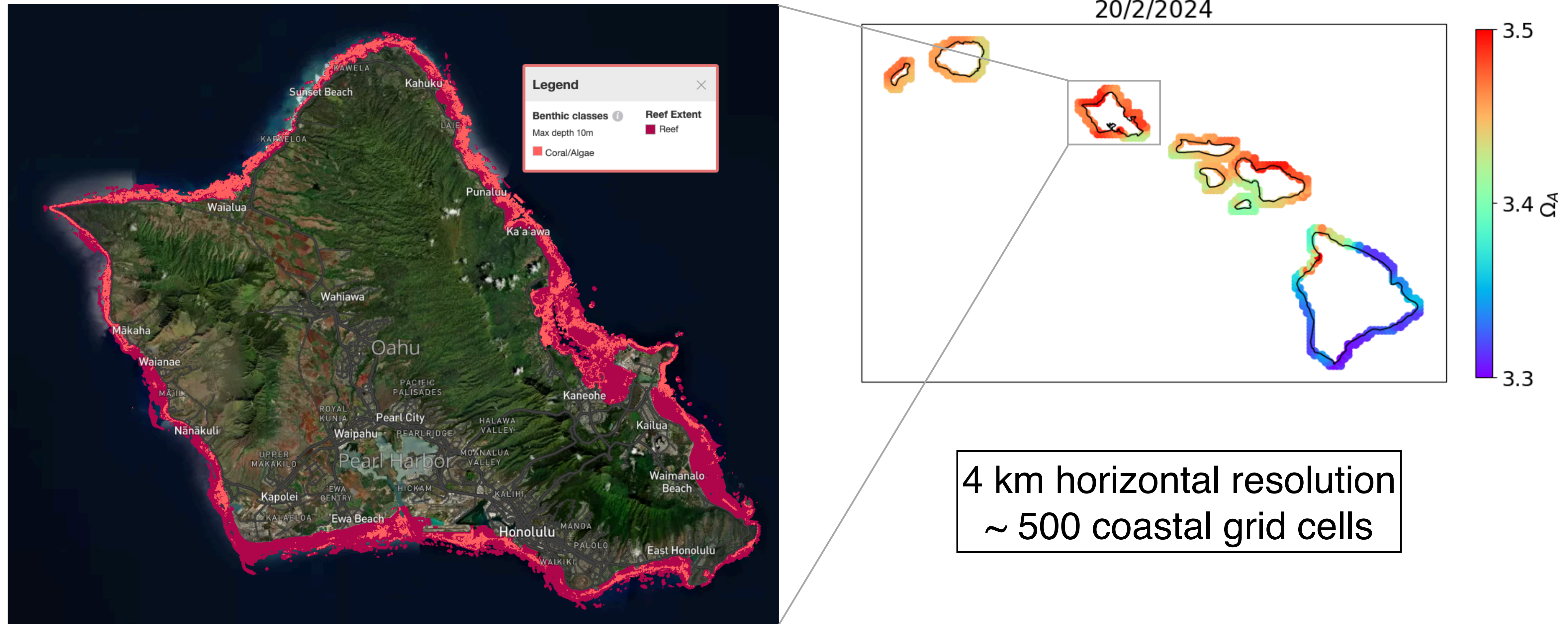


## ROMS/COBALT





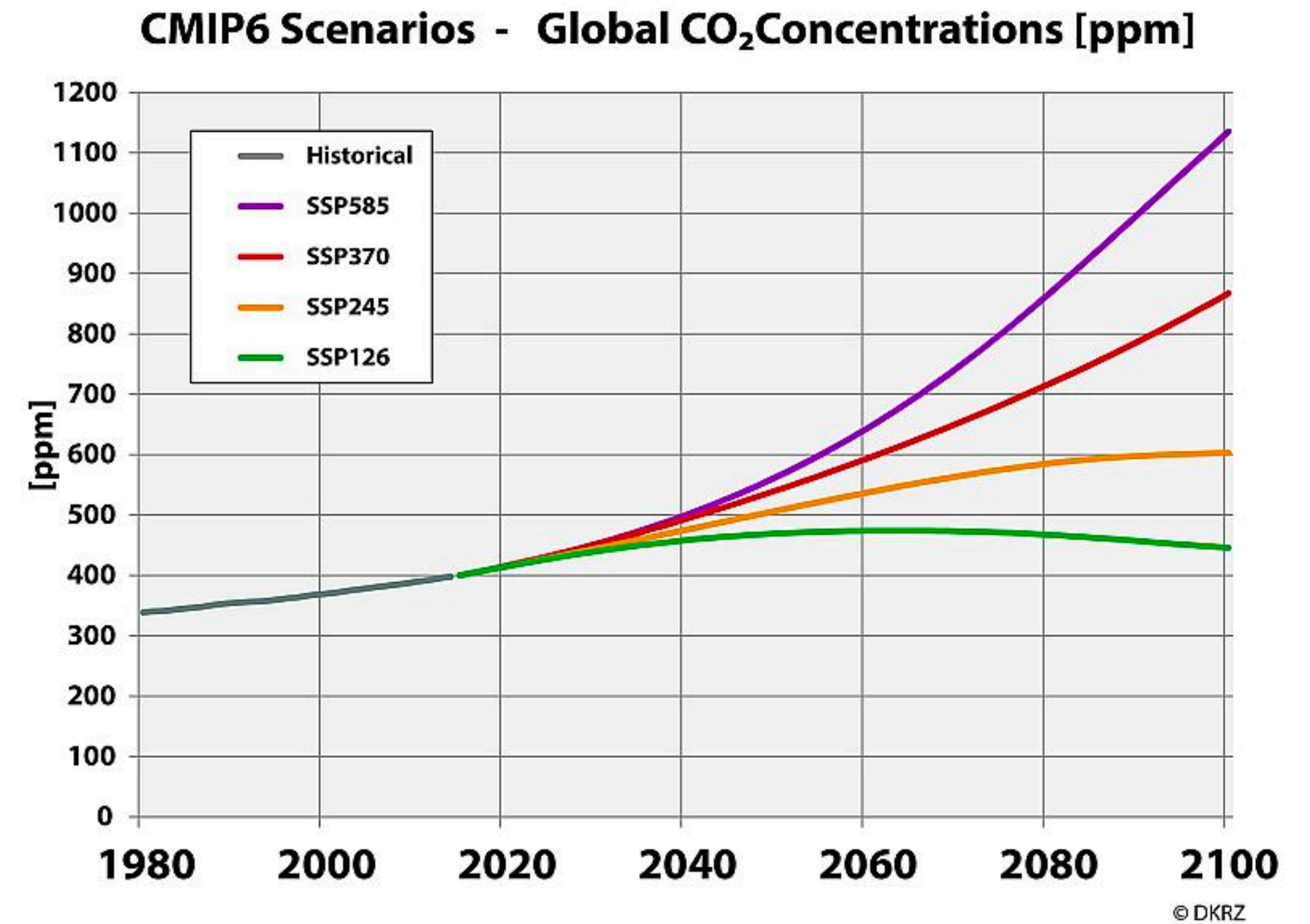
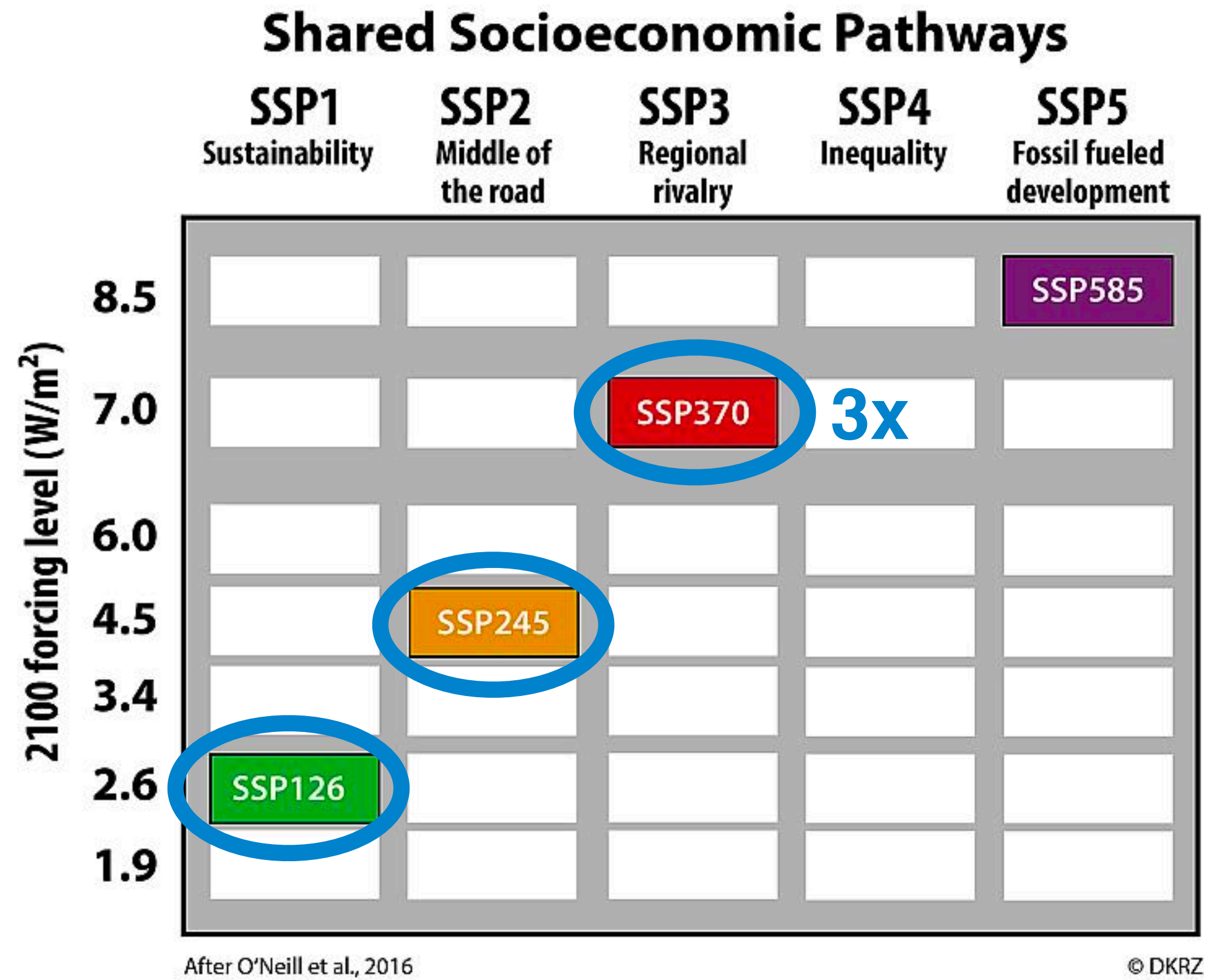
# Fringing coral reefs



Source: <https://allencoralatlas.org/>



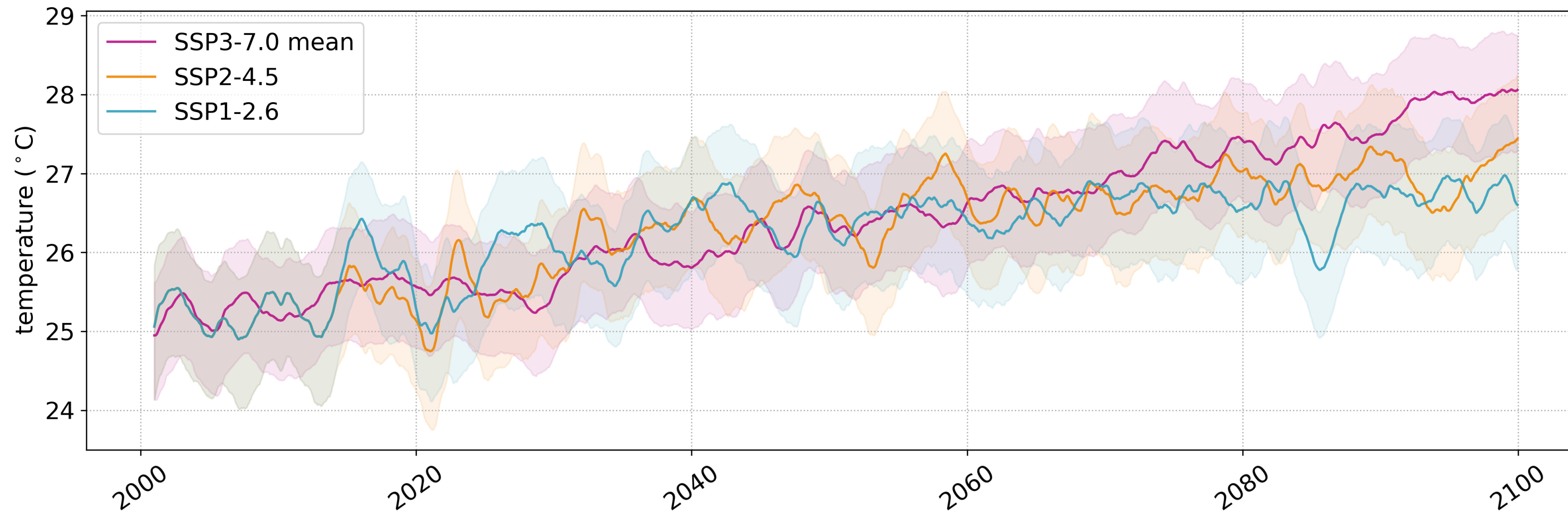
# CMIP6 combined scenarios



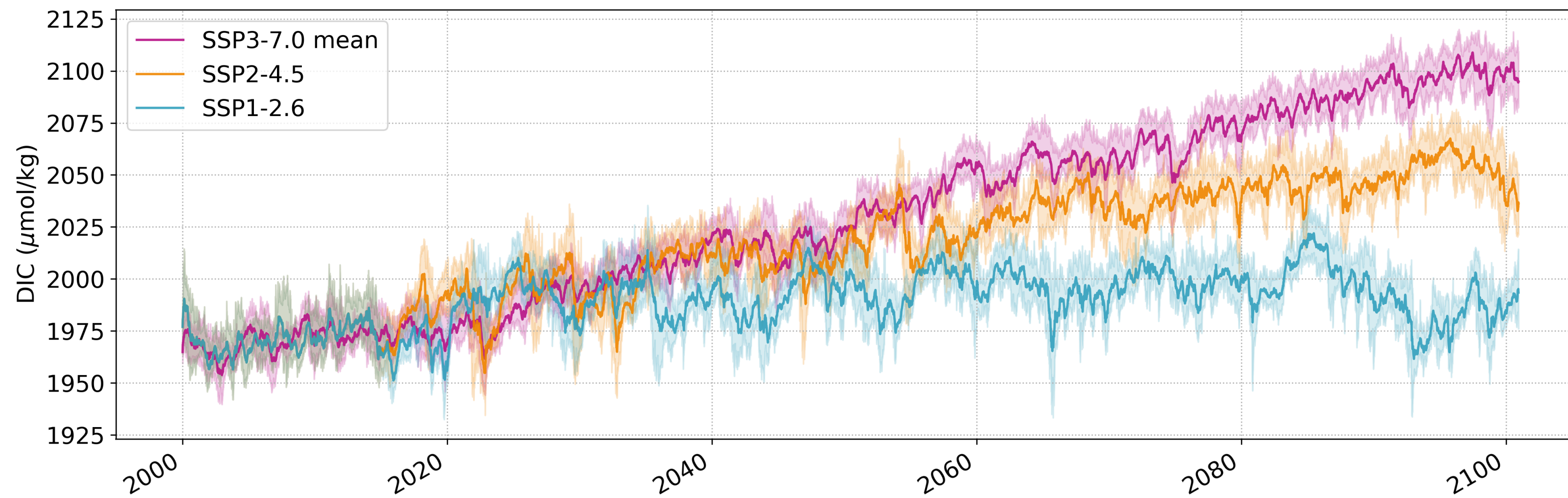


# Temperature and DIC trends

(a)

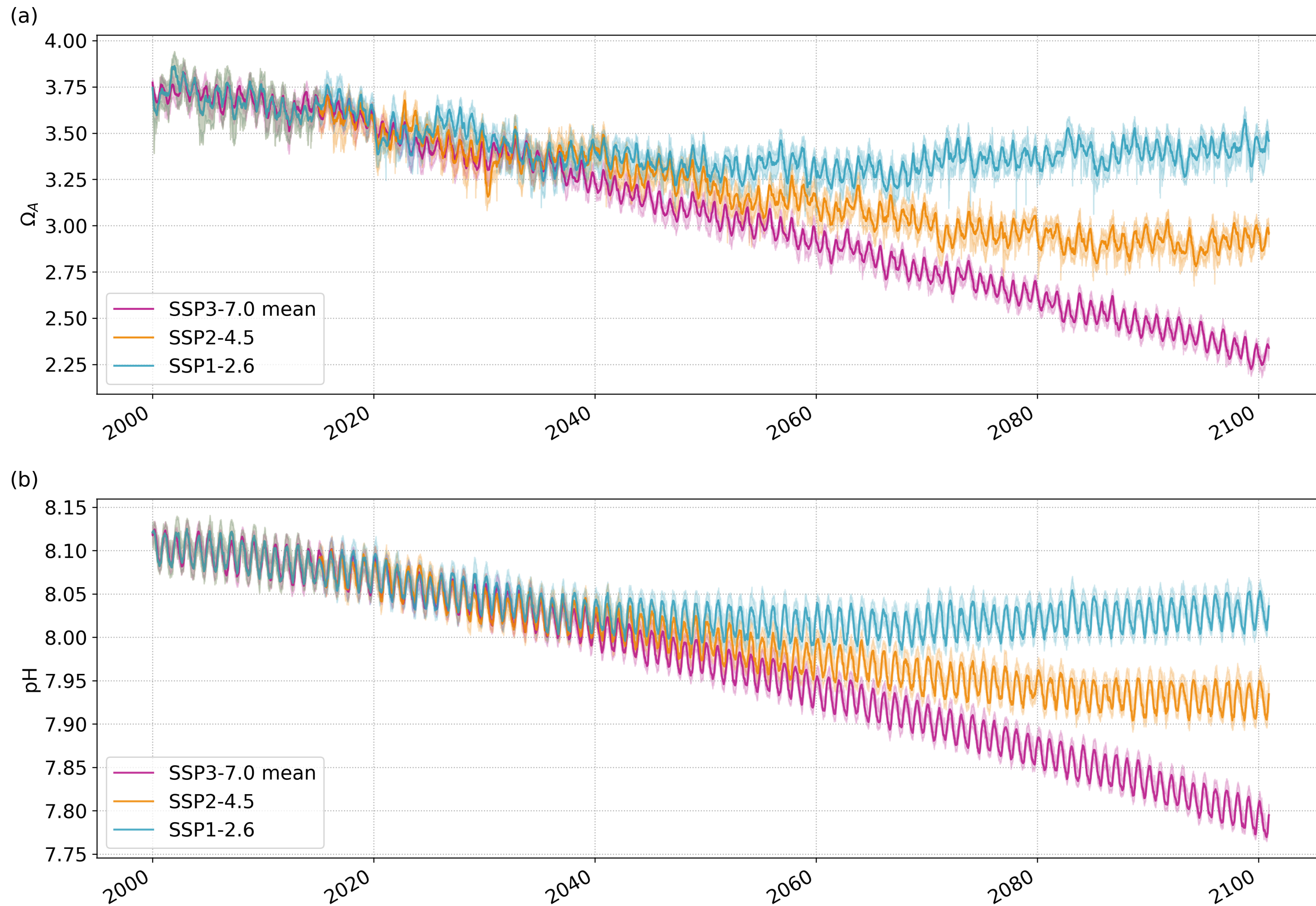


(b)



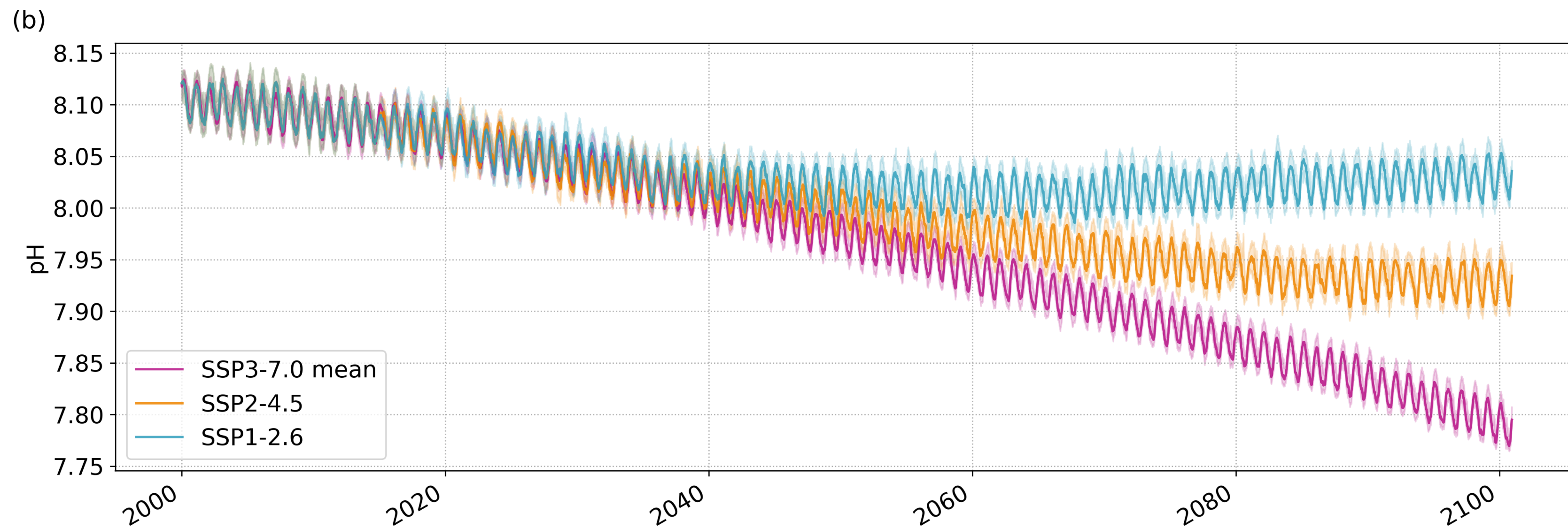
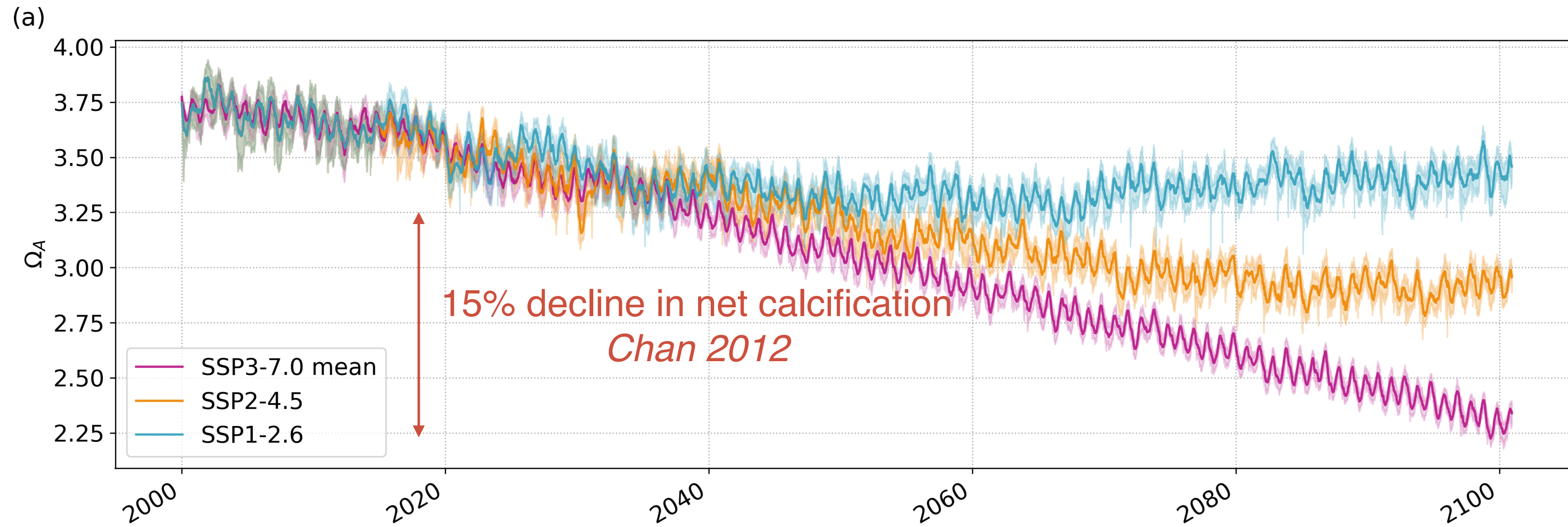


# CMIP6 coastal trends for ocean acidification



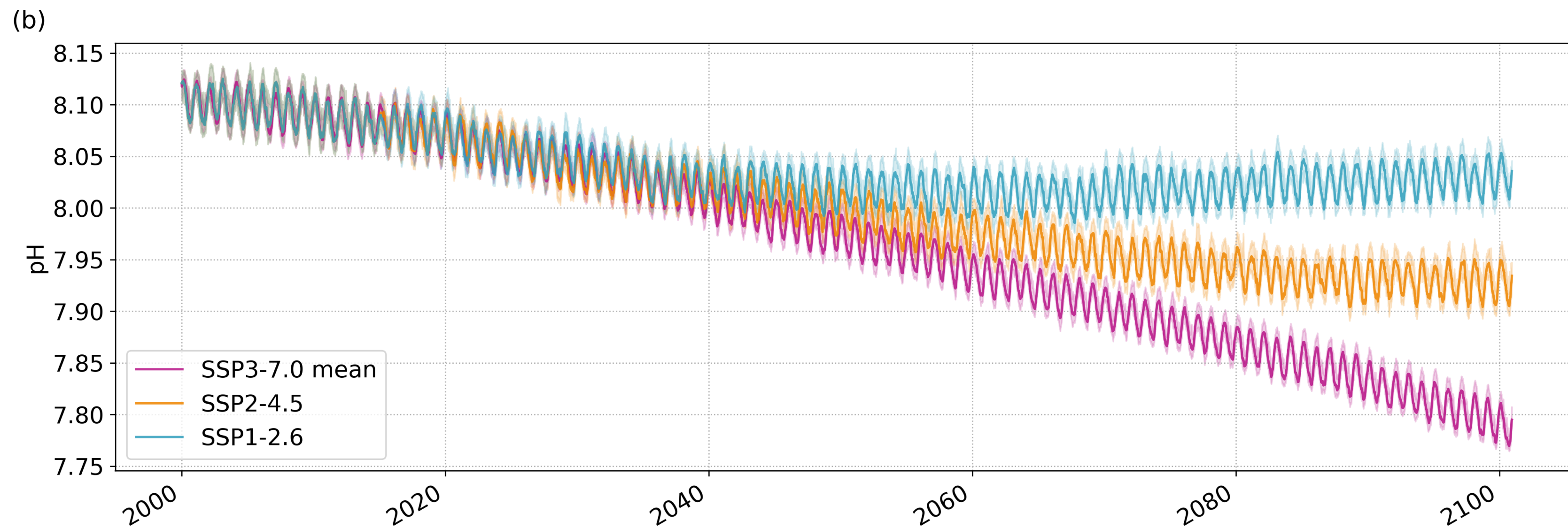
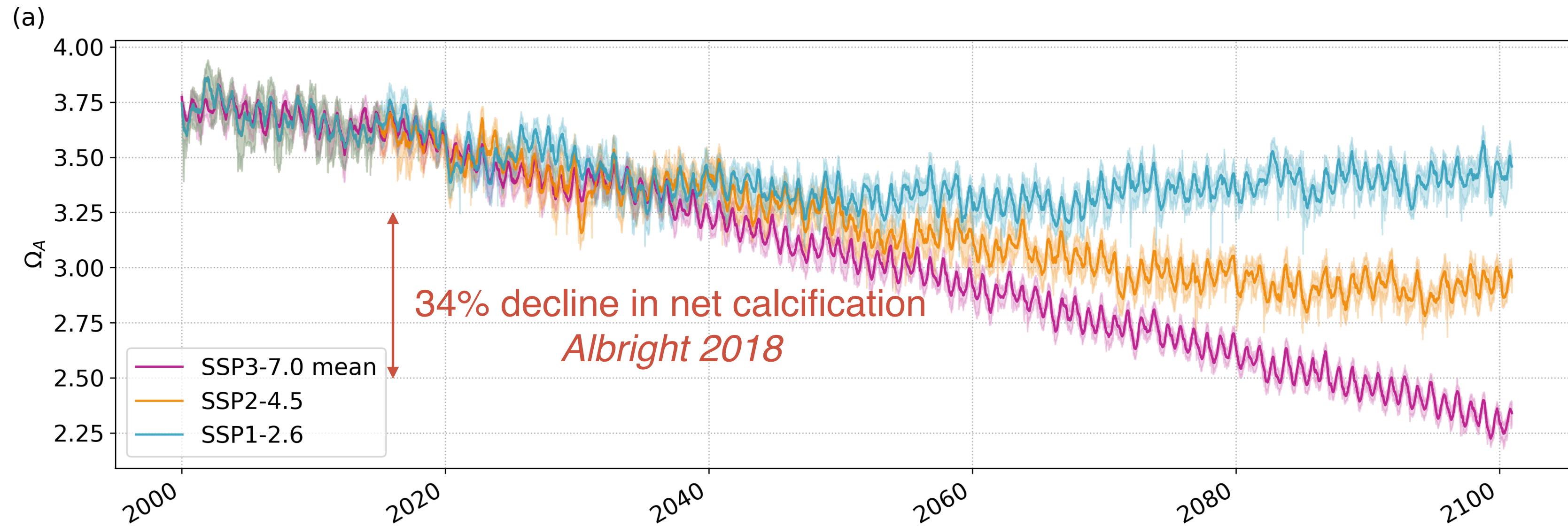


# CMIP6 coastal trends for ocean acidification



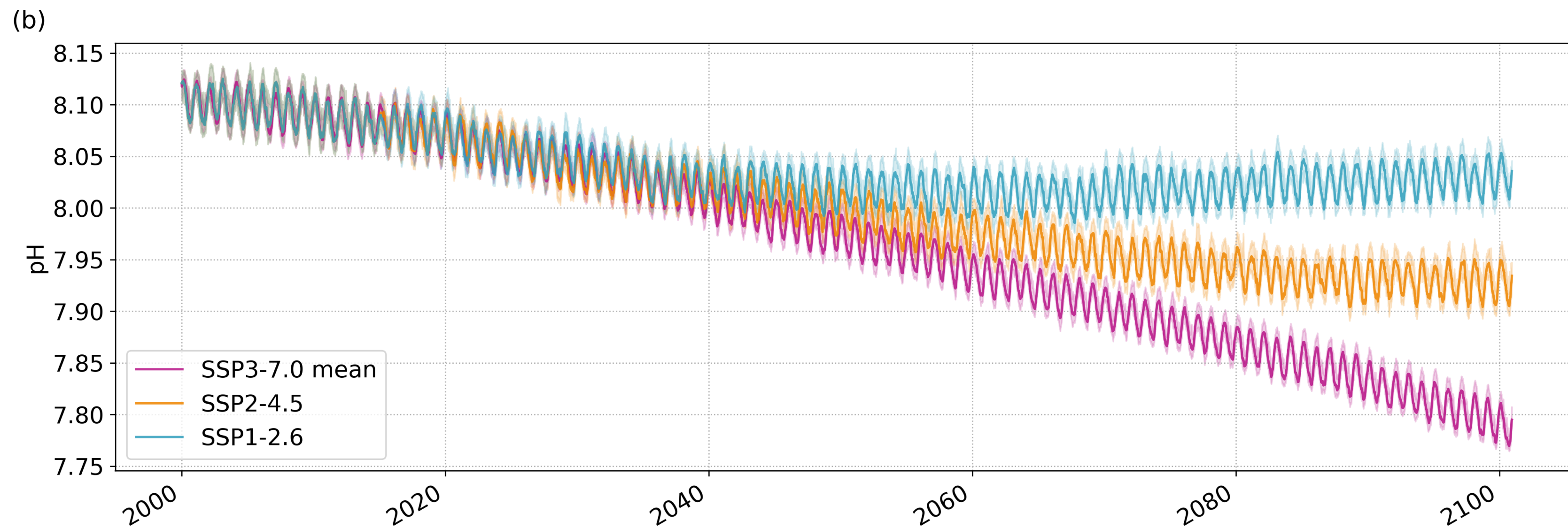
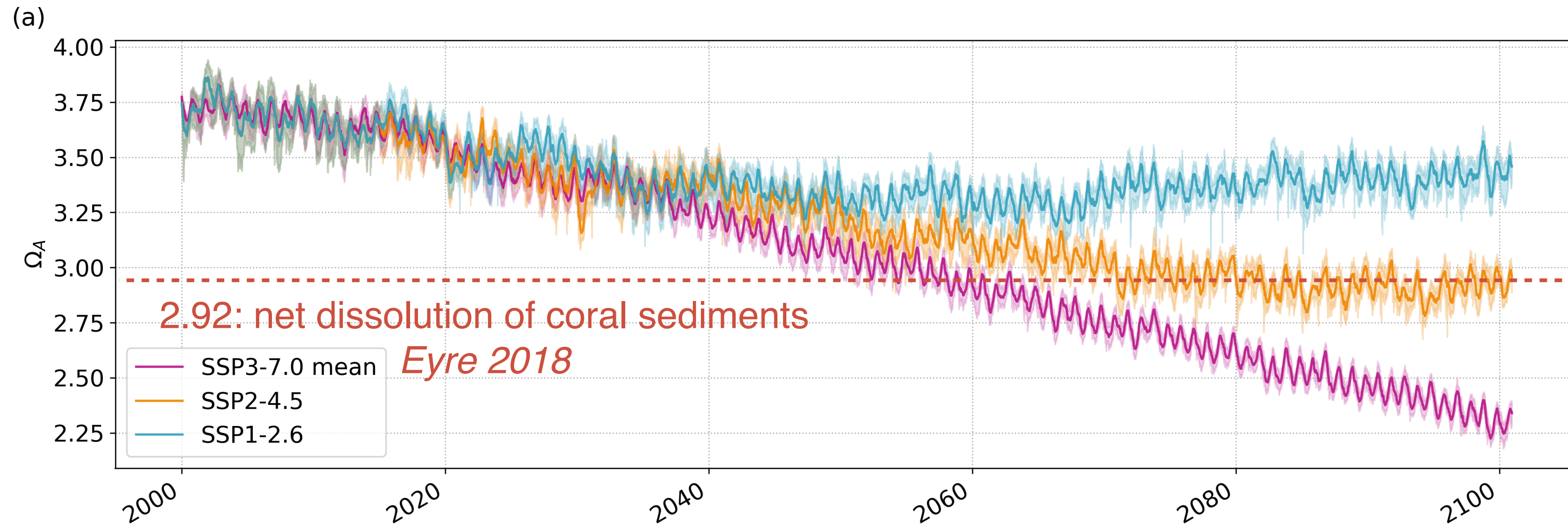


# CMIP6 coastal trends for ocean acidification



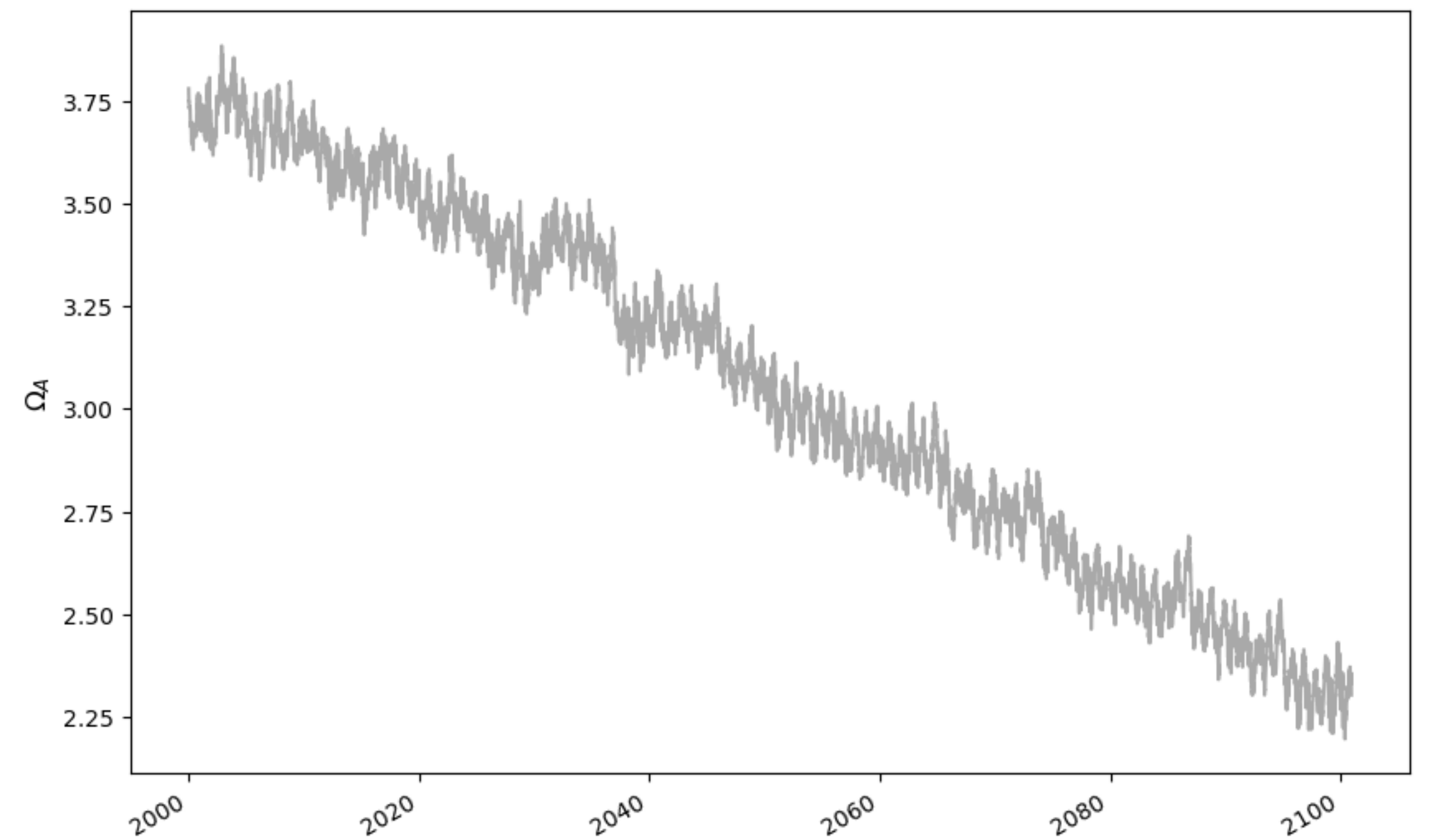


# CMIP6 coastal trends for ocean acidification



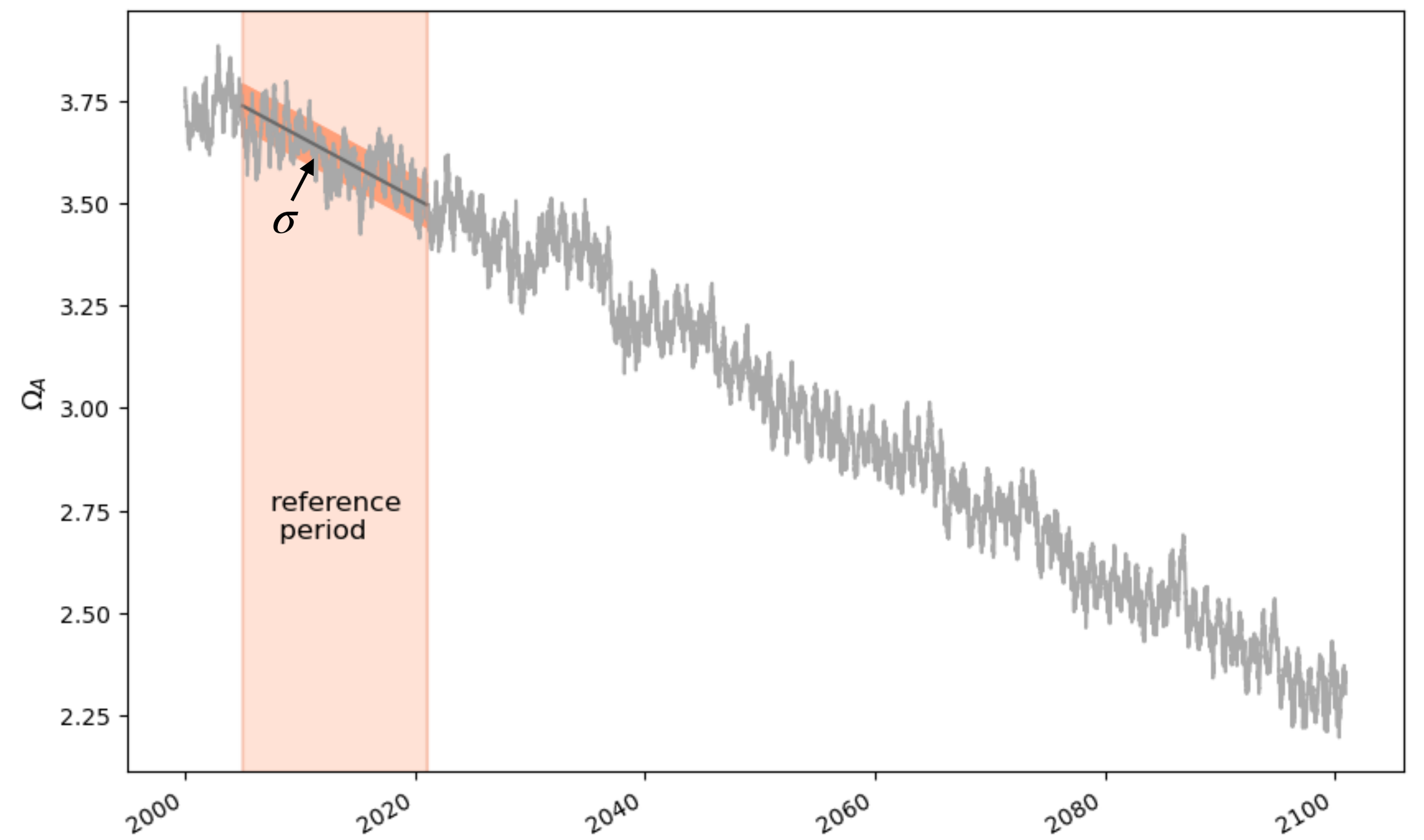


# Novelty: departure from historical variability



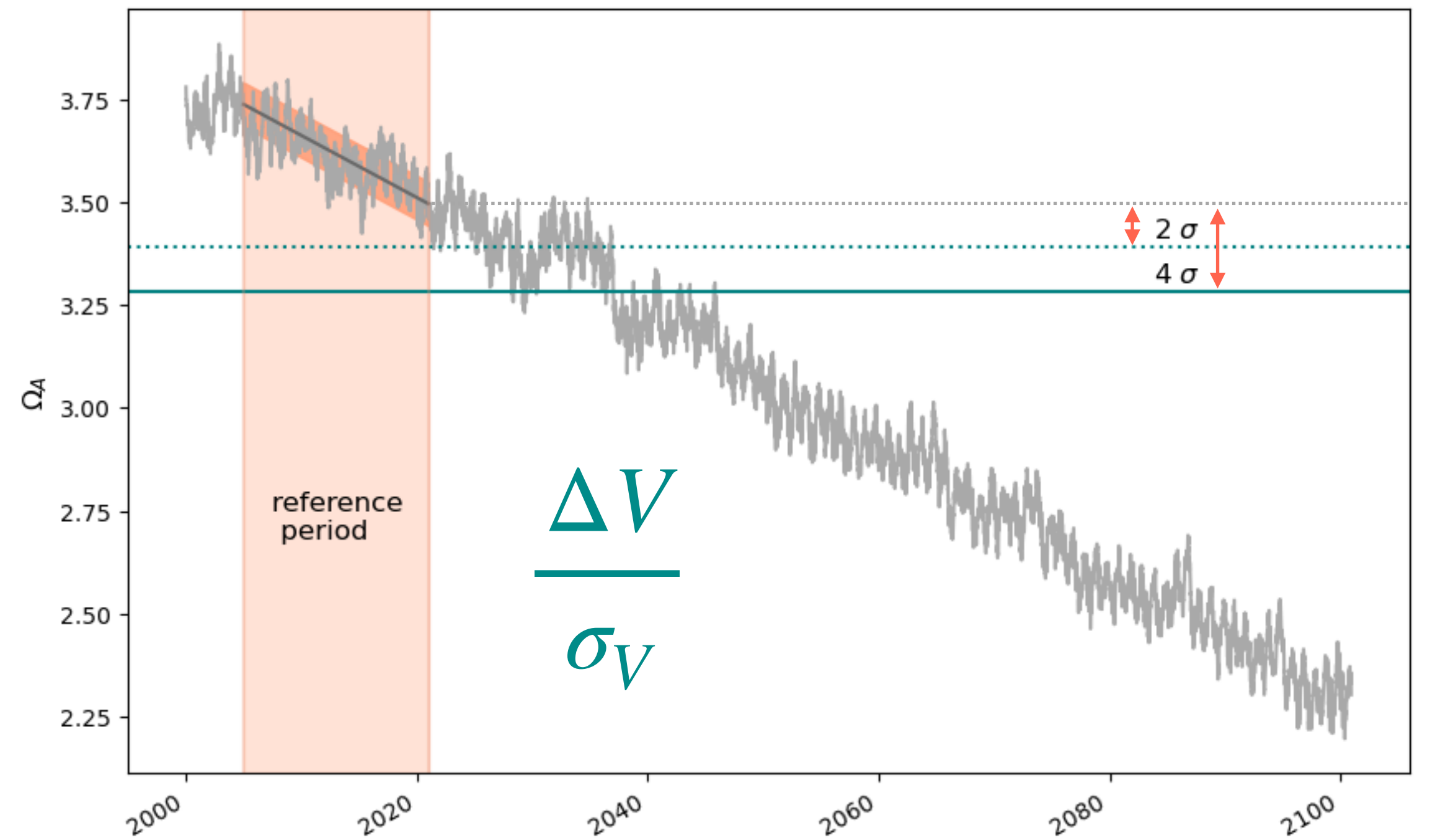


# Novelty: departure from historical variability



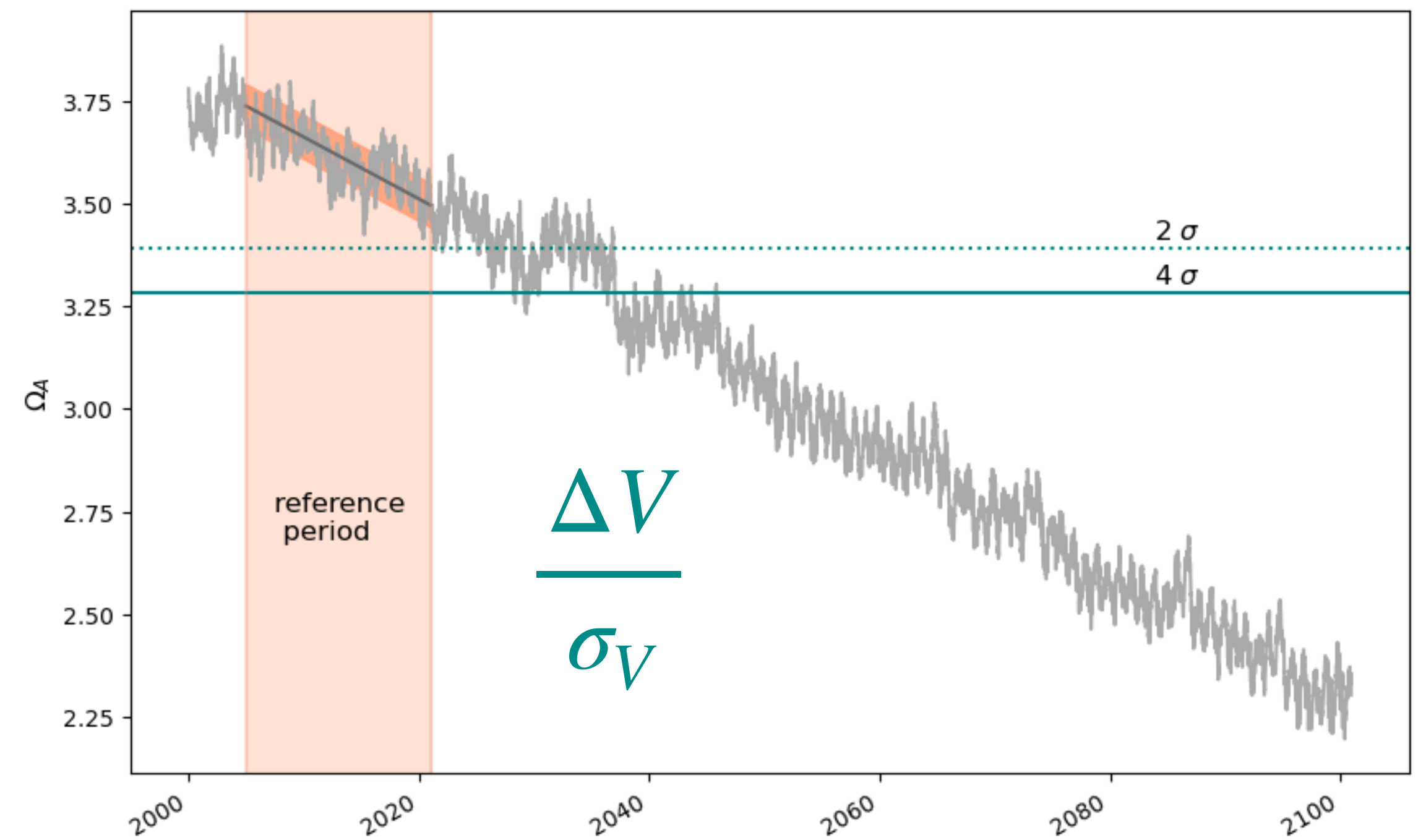
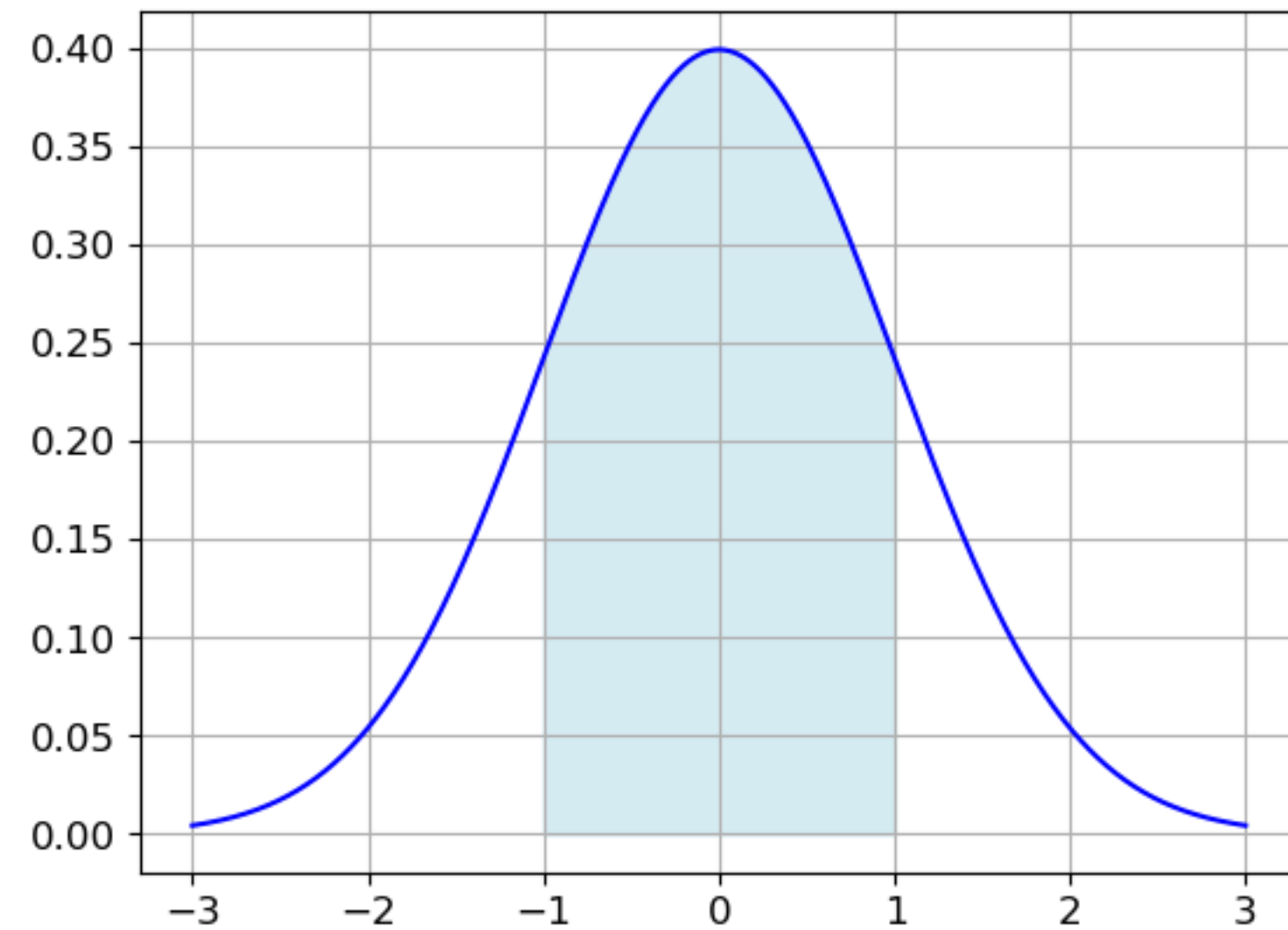


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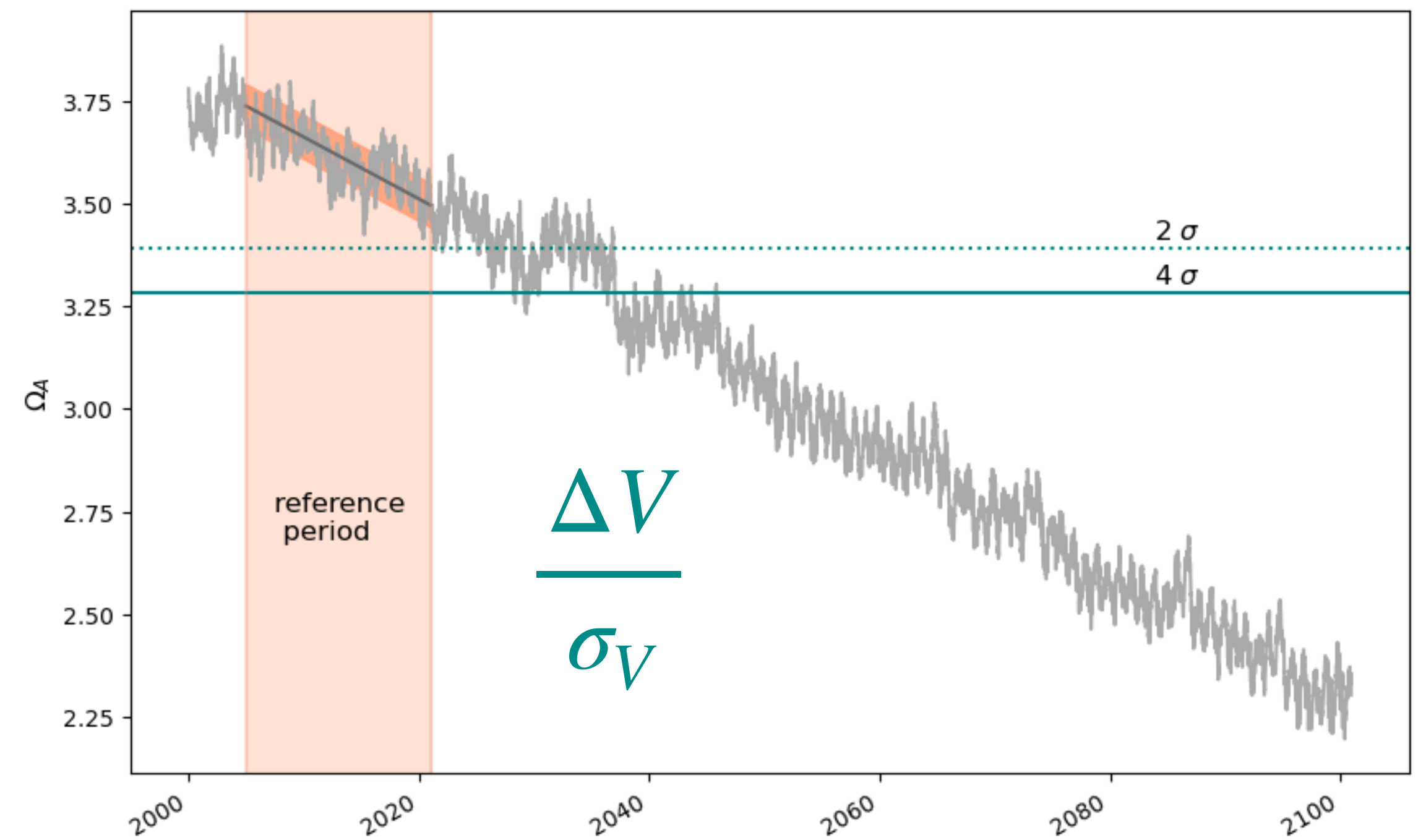
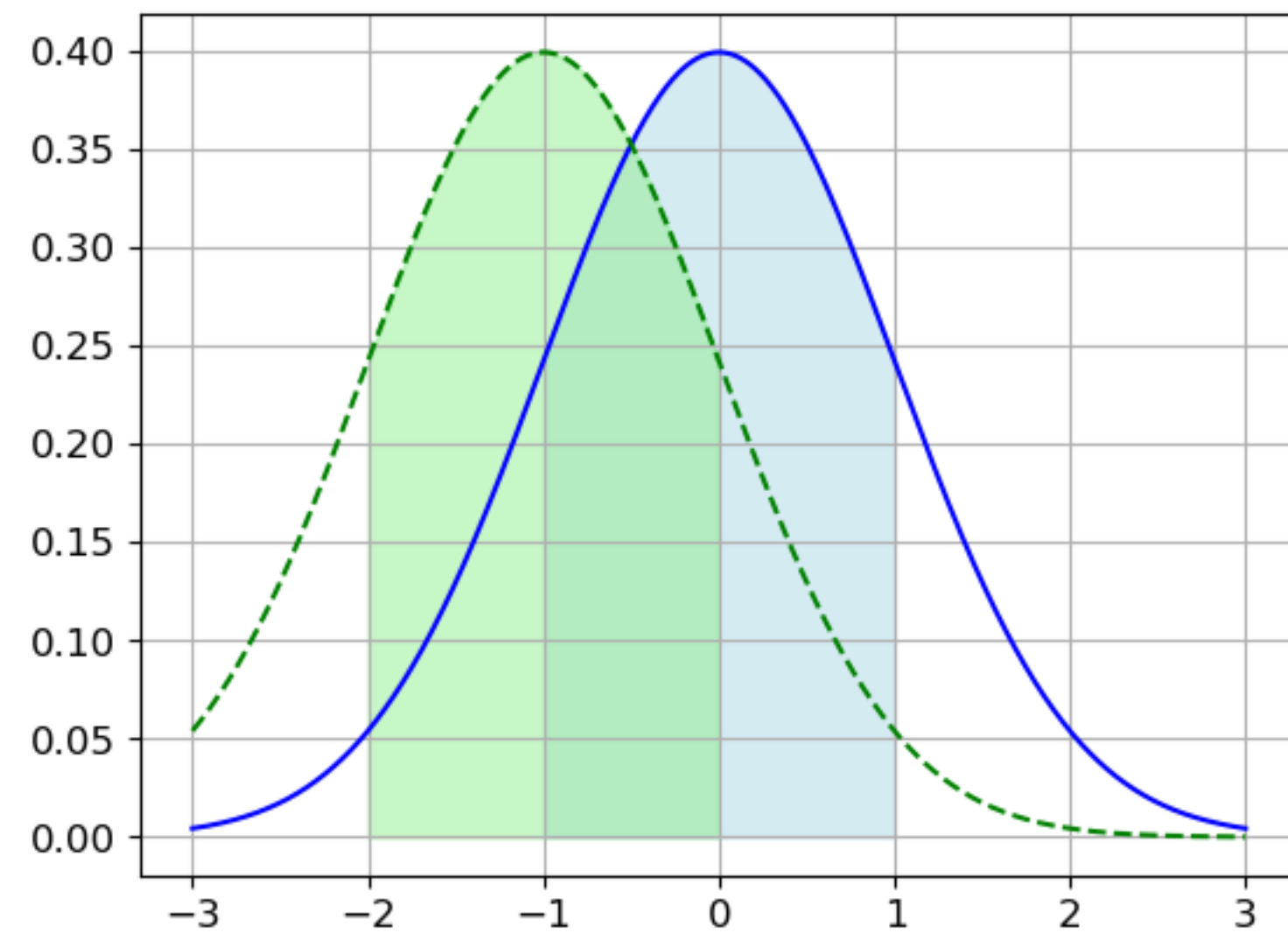


# Novelty: departure from historical variability



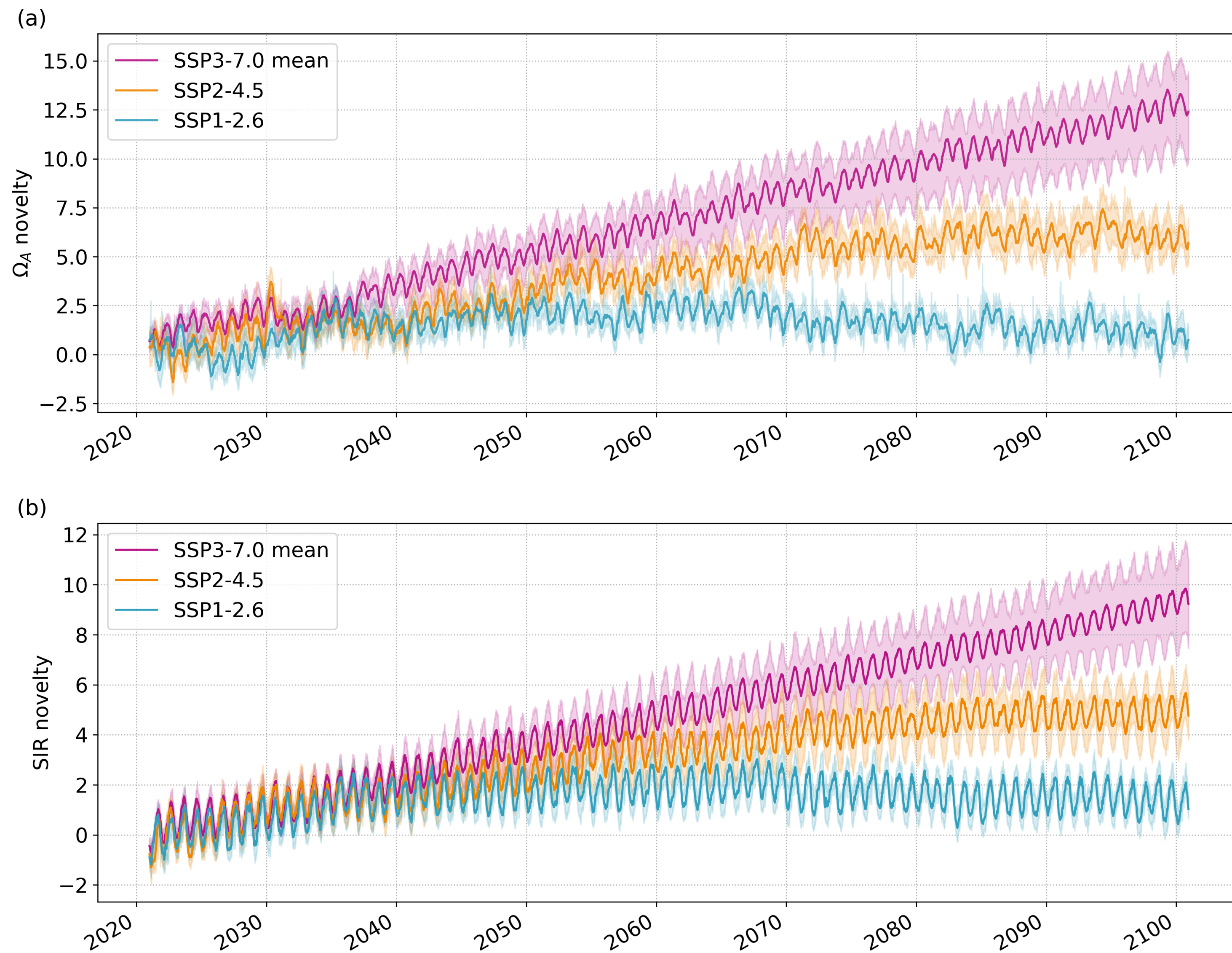


# Novelty: departure from historical variability



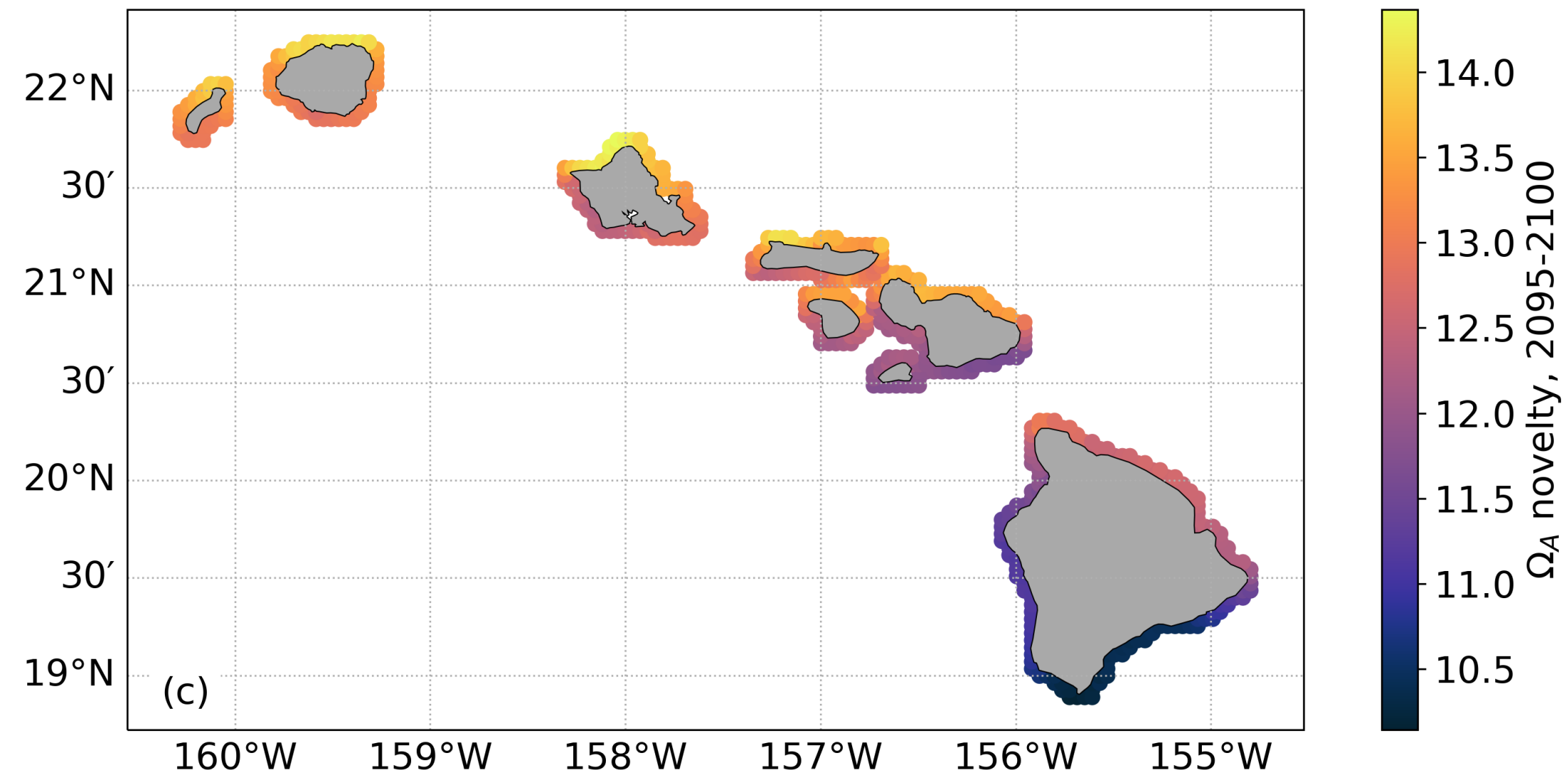


# CMIP6 novelty estimates for MHI coast

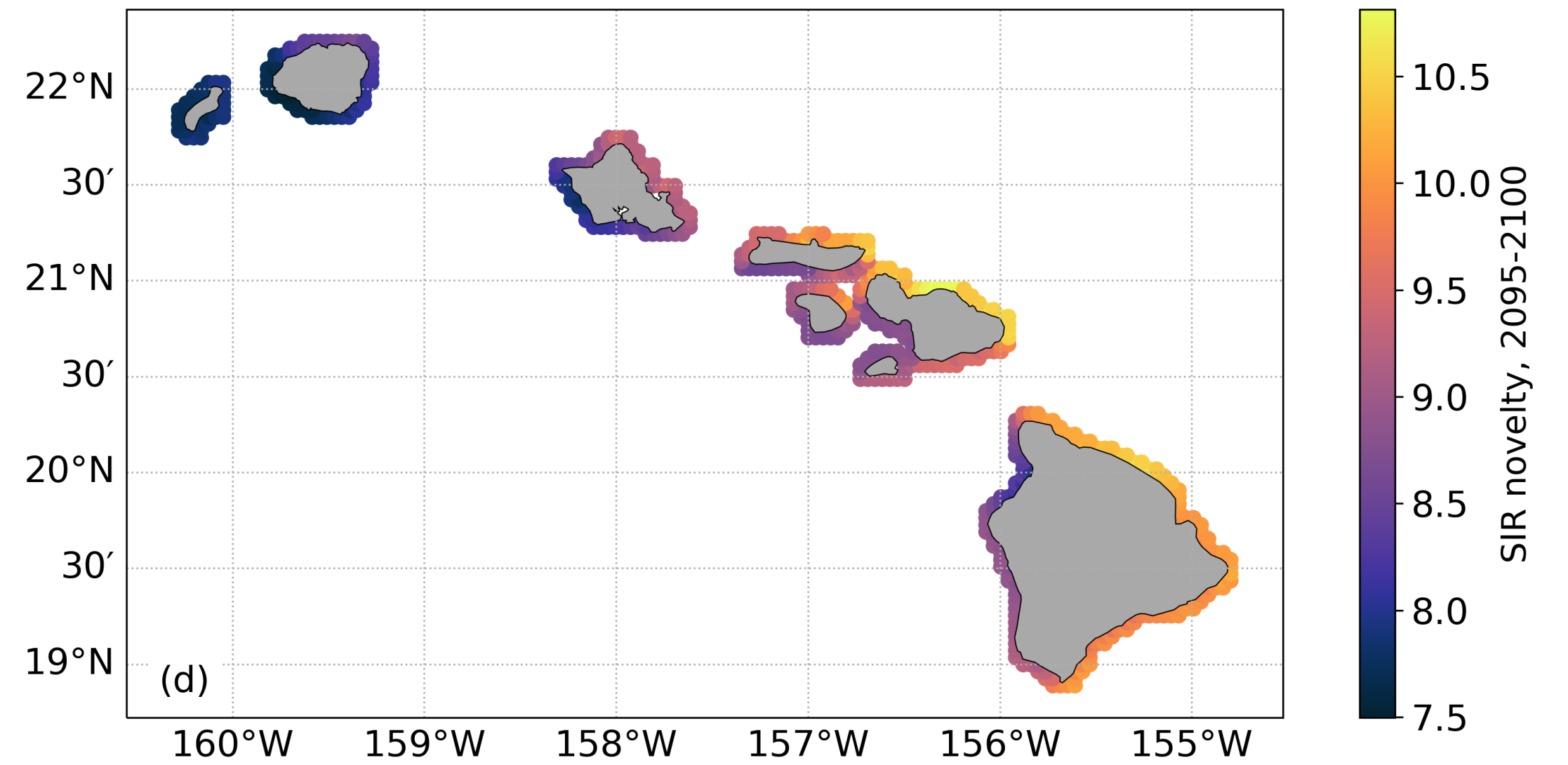




# Climate novelty along the coast in SSP3-7.0



driven by variability in DIC/alkalinity

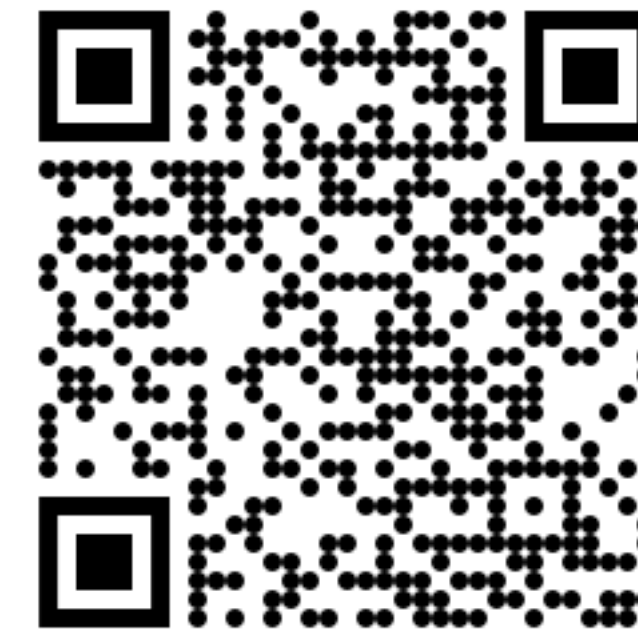


driven by variability in temperature



# Conclusions

- First dynamically downscaled ROMS/COBALT CMIP6 projections for the main Hawaiian Islands
- Unprecedented levels of ocean acidification expected in the next 30 years
- CMIP6 scenarios lead to qualitatively distinct implications for the end of century
- OA anomalies exceeding historical variability by factor 12 in 2100 in SSP3
- Temperature sensitivity of OA indices leads to contrasting spatial patterns of climate novelty
- Contact: [hosekova@hawaii.edu](mailto:hosekova@hawaii.edu)



Hošeková et al. 2025,  
*Journal of Geophysical Research*,  
<https://doi.org/10.1029/2024JC021903>