

Projections of future coral bleaching conditions

Gabriel Grimsditch, Coral Reef Unit, United Nations Environment Programme Monaco Ocean Week, March 25th 2021

Photo credit: The Ocean Agency

Coral bleaching – The great threat

"Mass coral bleaching and mortality are projected to increase because of interactions between rising ocean temperatures, ocean acidification, and destructive waves from intensifying storms. At 1.5°C, approximately 70–90% of global coral reefs are projected to be at risk of long-term degradation due to coral bleaching, with these values increasing to 99% at 2°C."

- IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels



Photo credit: The Ocean Agency



Two landmark studies

UN environment 2017

Coral Bleaching Futures

Downscaled projections of bleaching conditions for the world's coral reefs, implications of climate policy and management responses



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Climate policy implications, management applications, and Regional Seas summaries





Collaboration with NOAA, Symbioseas, University of Miami

Funded by US Department of State and the Principality of Monaco

Available for download: https://www.unep.org/resour ces/report/projectionsfuture-coral-bleachingconditions-using-ipcc-cmip6models-climate

Purpose of the report

1. To present projections of coral bleaching conditions that support decisions regarding coral reef management and conservation planning

2. To evaluate the implications of the Paris Agreement for coral bleaching as well as failure to achieve its goal, by comparing different IPCC Shared Socioeconomic Pathways SSP5-8.5 and SSP2-4.5

3. To provide public access to the projections data



Photo credit: The Ocean Agency



IPCC shared socioeconomic pathways & climate data

Projections made using World Climate Research Programme's Working Group on Coupled Modelling (WGCM) Coupled Model Intercomparison Project Phase 6 (CMIP6) generation of climate models

SSP5-8.5 is the pathway that represents current rates of emissions and emissions growth; it is also considered a "worst-case scenario".

SSP2-4.5 is an ambitious but plausible scenario. It's a "middle of the road" pathway in which emissions continue to increase through the end of the century. It could represent future conditions if greater levels of emissions reduction (~150% of pledges) are achieved than would result from all Nationally Determined Contributions in the Paris Agreement combined.



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Main findings – climate refugia

Under the worst-case scenario, annual severe bleaching (ASB) is projected to occur this century for 100% of the world's coral reefs. The average projected year of ASB is **2034**, 9 years *earlier* than earlier projected. Previous projections of future bleaching conditions potentially underestimated the future threat of bleaching.

The average year for the projected timing of ASB under SSP2-4.5 is 2045, *11 years later*.

Projected exposure to annual severe bleaching conditions varies greatly among and within countries. Coral reefs with relatively early and late exposure to bleaching occur in all regions. Some countries have more temporary refugia than others.

Six of the 20 countries with the greatest reef area having >25% temporary refugia (i.e., projected ASB after 2044) are: Indonesia, western Australia, The Bahamas, Madagascar, India and Malaysia.



Main findings – coral adaptation

- 1. Each quarter degree Celsius of assumed coral adaptation adds ~7 years to the global average timing of projected annual severe bleaching .
- 2. The great majority of coral reefs (>80%) are expected to experience ASB this century even if 2°C of adaptation is assumed
- 3. The extent to which corals will adapt to increasing sea temperatures is unknown, but some level of adaptation is expected. If we assume 1°C of adaptation, the global average ASB timing is ~30 years later than if no adaptation is assumed.





Practical uses

Marine Spatial Planning for Marine Protected Areas – Examples from Malaysia and Hawaii

Identification of climate refugia for investments by the Global Fund for Coral Reefs

Informing IPCC reports



2020 2025 2030 2035 2040 2045 2050 2055 2060



Thank you!



Photo credit: Kimberly Jeffries

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