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A global dataset of Holocene reef morphometrics to improve numerical modelling of coral reef development

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Coral reef construction results from interactions between the biosphere, hydrosphere and lithosphere. Reefs constructed during Quaternary sea-level variations and displaced by rock uplift produce stair-cased morphologies called reefal sequences. The stratigraphy and morphology of these sequences is often used to infer eustatic variations and vertical deformation.

Because few coral terraces have been precisely dated and high resolution topo-bathymetry is scarce along most coastlines, morphostratigraphic interpretations of reefal sequences usually seek to constrain only the elevation and age of relative sea level highstands and average rate of vertical deformation. Numerical modelling of reef development can help elucidate the continuous evolution of coral reefs through glacio-eustatic cycles.

However, controls on coral reef growth and morphology are still strongly debated. Eustatic variations, vertical deformation of the lithosphere, geometry of the accommodation space, ecology of the reef, temperature, wave regime, turbidity and other factors may all affect reef type (e.g., barrier or fringing), volume and geometry.

In order to quantify controls on coral reef development, we compiled a global dataset of coral reef morphometrics from satellite imagery and measurements of potential controlling factors (e.g., slope of the bedrock, rate of vertical deformation, wave power, sea-surface temperature, reef growth rate).

Our first results highlight a strong control of the geometry of the accommodation space on

modern reefs morphology, especially on the reef type and the location of the reef crest. This geometry results from the combination of the initial topography and antecedent constructions, which result from the interactions between eustatic variations, rate of vertical deformation and reef growth. A vast majority of barrier reefs, as well as the widest reef complexes, are located on antecedent reef platforms reoccupied during periods of sea-level rise.

Conclusions arising from this study will help validate our reef growth modelling, as well as its temporal and spatial resolution. This model could then not only improve the interpretation of the morphostratigraphic record, but also clarify the ability of coral reefs to keep-up with the future sea-level rise and protect coastlines from wave erosion.