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FROM DATA TO DIGITAL TWIN: MAPPING A MALDIVIAN ATOLL FOR SEA LEVEL RISE AND STORM SURGE MODELLING

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Due to their low-lying nature, atoll islands are widely recognised as some of the most vulnerable environments to the impacts of climate change. Recent studies suggest that overwash during storm events allows for sediment deposition atop these mobile islands, enabling them to potentially keep up with sea-level rise. To better understand and model the hydrodynamic and geomorphological response of atoll islands to climate change, an accurate depiction of the systems topography is needed. Due to the challenges of collecting such data in remote and environmentally challenging conditions, there have been few datasets that comprehensively capture the topography of atoll island and reef systems.

This study integrates multiple remote sensing and hydrographic techniques to construct a digital twin of an uninhabited multi-island reef system in the southern Maldivian atoll of Gaafu Dhaalu. UAV LiDAR with ground point filtering captured the island elevation through dense vegetation. UAV photogrammetry techniques were used across the reef platform, with a refraction coefficient applied to areas of standing water, capturing elevations up to 5 m below mean sea level (MSL). Multibeam bathymetry captured the offshore reef slope to ~130 m below MSL, while singlebeam bathymetry captured the shallow lagoon bathymetry.

The integration of such datasets results in a comprehensive 3D model able to replicate the forereef, reef platform, islands, and lagoon, serving as the foundation for a digital twin. Such approaches are increasingly vital for any modelling studies to support a range of applications, including sea-level rise modelling, storm surge simulations, and assessments of island morphological changes over time.