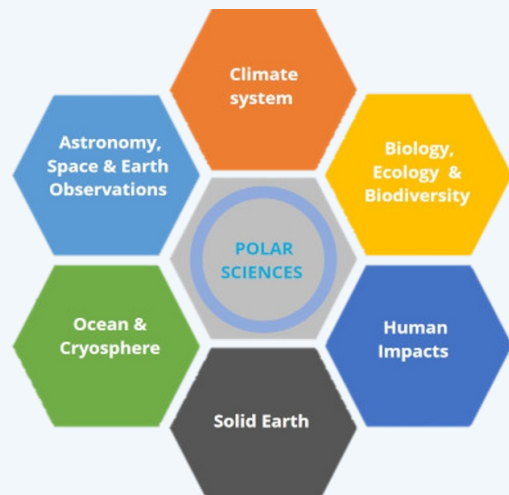


Paleo shorelines of Patagonia preserve record of Southern Ocean wave climate

Jacob Melly¹, Ian D. Goodwin², Tobia Lahbi¹, Nikos Georgiou¹, Sebastián Richiano^{3,4}, Patricio Ruiz⁴, Alejandro Montes^{5,6}, Giovanni Scardino⁷, Deirdre D. Ryan⁸, Evan J. Gowan⁹, Giovanni Scicchitano¹⁰, Alessio Rovere^{1,11}

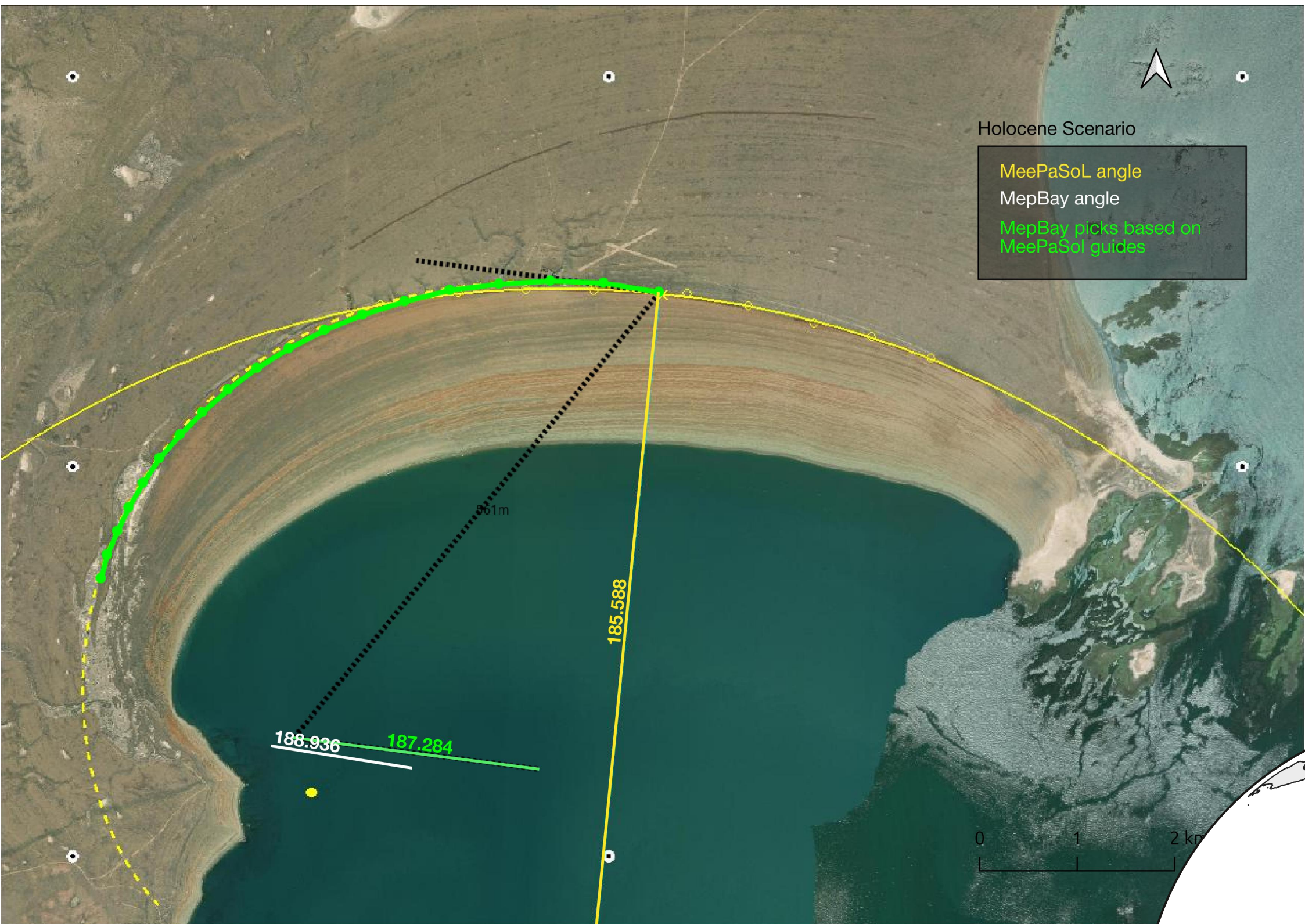


Università
Ca'Foscari
Venezia

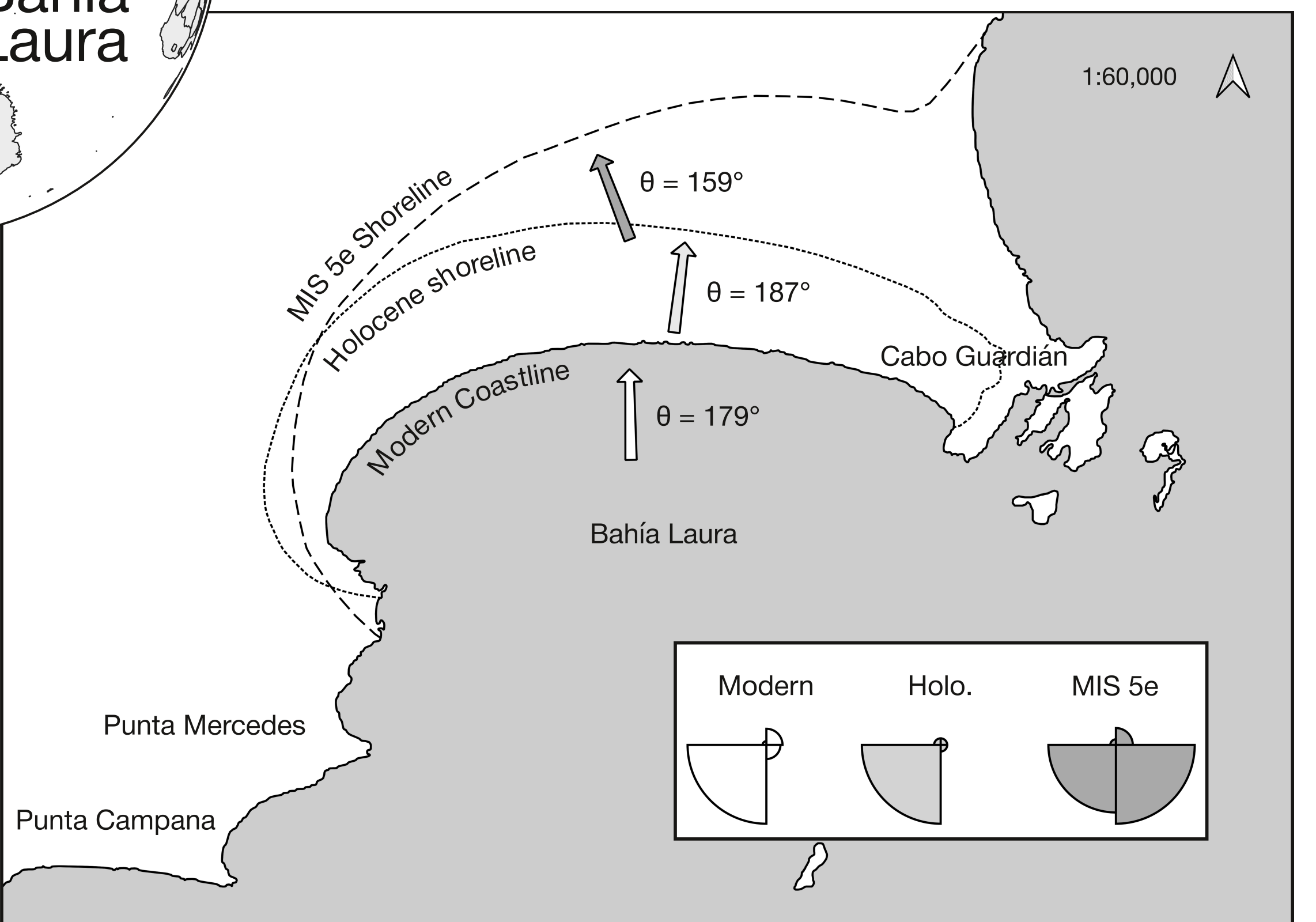
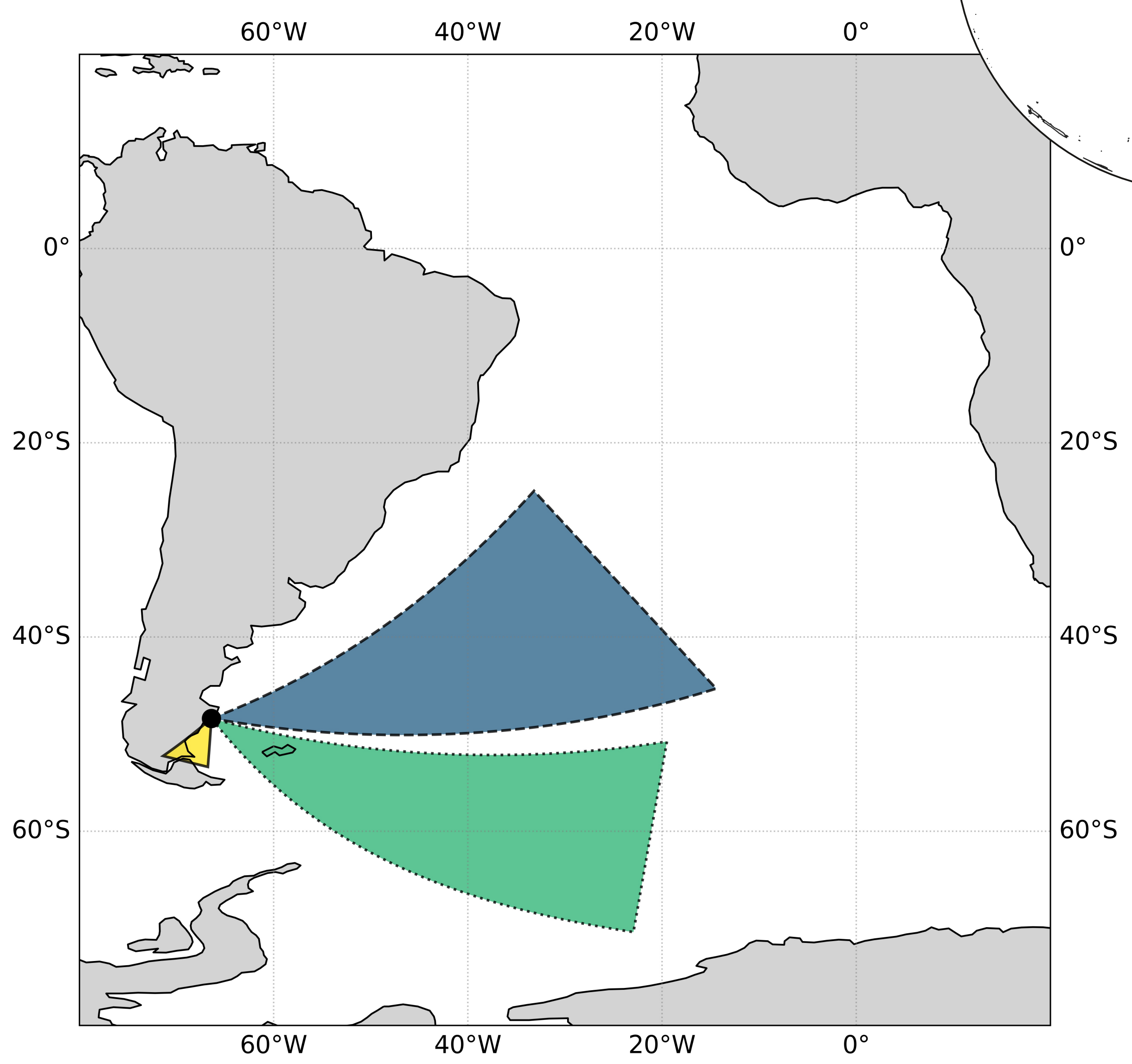
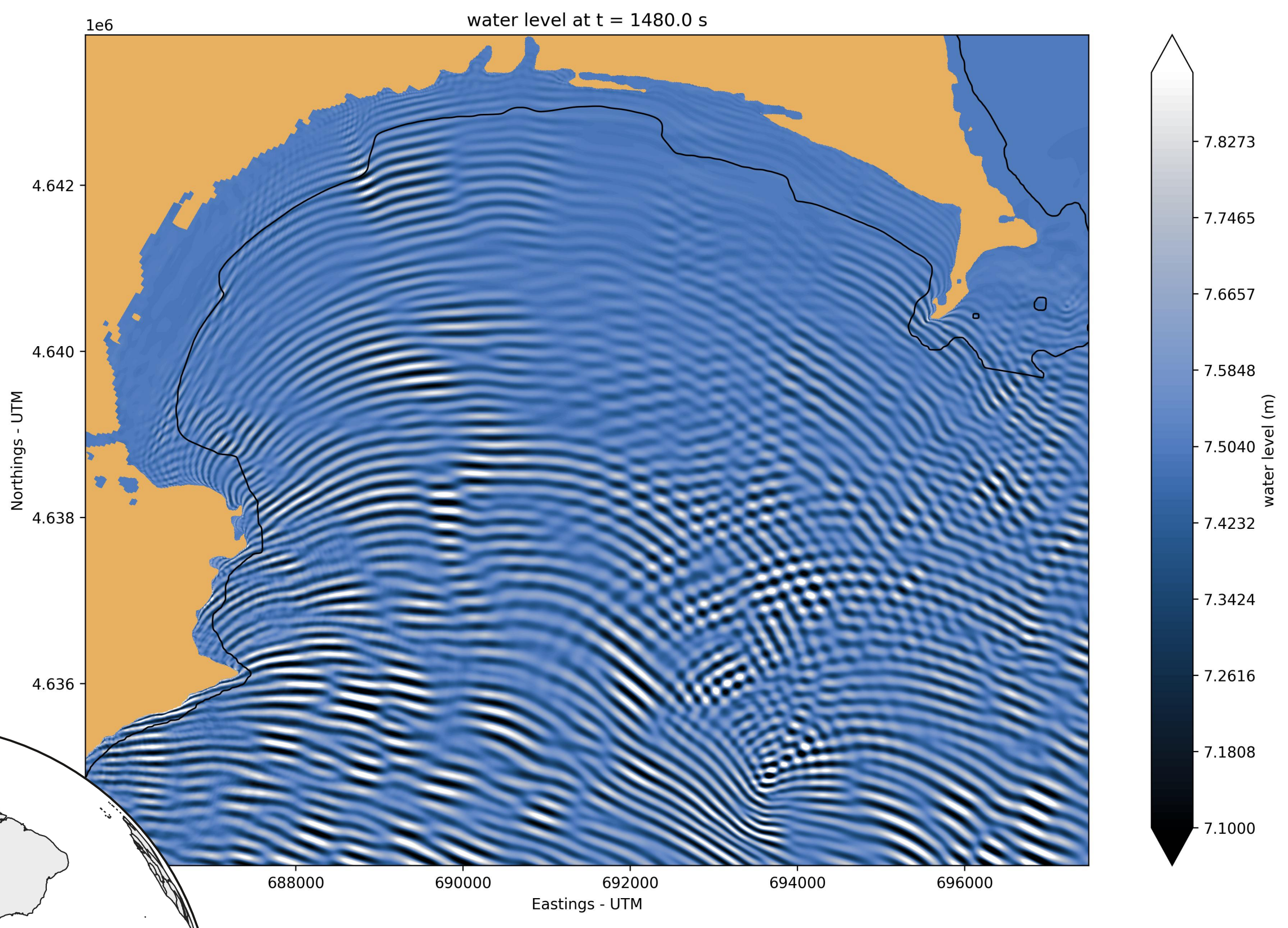


¹ Università Ca' Foscari di Venezia, Italy
² Centre for Marine Science and Innovation, University of New South Wales, Australia
³ Instituto Patagónico de Geología y Paleontología del Consejo Nacional de Investigaciones Científicas y Técnicas (IPGP-CONICET), Argentina
⁴ Universidad Nacional de la Patagonia San Juan Bosco, Argentina
⁵ Centro Austral de Investigaciones Científicas del Consejo Nacional de Investigaciones Científicas y Técnicas (CADIC-CONICET), Argentina
⁶ Universidad Nacional de Tierra del Fuego, Antártida e Islas del Atlántico Sur, Argentina
⁷ Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy
⁸ Università di Pisa, Italy
⁹ KIKAI Institute for Coral Reef Sciences, Kikai Town, Japan
¹⁰ Università degli Studi di Bari Aldo Moro, Italy
¹¹ MARUM Center for Marine Environmental Sciences, University of Bremen, Germany

Shoreline planform geometry of **gravel beach ridges** records the predominant direction of arriving **wave energy** on the order of decades to centuries.



Numerical models help link nearshore **wave approach angles** to the offshore conditions capable of producing them.



Weather regime types produce **swell** through atmosphere-ocean interaction. The **frequency** of individual weather regime occurrence **varies through time**.

Offshore modal wave climate has **rotated up to 45°** clockwise since MIS 5e owing to different ocean regions generating storm waves following synoptic weather pattern changes. Changing nearshore **wave direction** can **place populations and infrastructure at risk**.

Works cited

Goodwin ID. (2025, September). *Synoptic Paleoclimatology: The Weather Regime Approach from the Tropics to the Poles* (1st ed.). Cambridge University Press. <https://doi.org/10.1017/9781108892742>.

Lim C, Hsu JRC, Lee JL. 2022. MeePaSoL: A MATLAB-based GUI software tool for shoreline management. *Computers & Geosciences*. 161:105059. <https://doi.org/10.1016/j.cageo.2022.105059>.

Roelvink D, Reniers A, van Dongeren A, van Thiel de Vries J, McCall R, Lescinski J. 2009. Modelling storm impacts on beaches, dunes and barrier islands. *Coastal Engineering*. 56(11–12):1133–1152. doi:10.1016/j.coastaleng.2009.08.006.

Silva AP, Klein AHF, Fetter-Filho AFH, Hein CJ, Méndez FJ, Broggio MF, Dalinghaus C. 2020. Climate-induced variability in South Atlantic wave direction over the past three millennia. *Scientific Reports*, 10. <https://doi.org/10.1038/s41598-020-75265-5>