

Leveraging the ESA Network of Resources (NoR) for Ultra High-Resolution Monitoring of Coastal Morphodynamics: Praia d'el Rey Case Study

S. Nave, P. Gonçalves, L. Albardeiro, S. Soares

silvia.nave@lneg.pt pedro.goncalves@lneg.pt

The study of coastal cliffs is essential for territorial management, public safety, and environmental preservation, given their inherently dynamic and geomechanically unstable nature. Monitoring these landforms requires decimeter-scale spatial resolution to capture subtle geomorphological changes such as clifftop retreat, block detachment, and the development of structural discontinuities. The multi-sensor analysis enabled the precise identification of clifftop retreat and structurally significant discontinuities along the Praia d'El Rey sector.

Multi-temporal differencing of Vexcel Elevate DTMs (2020–2024) revealed spatially coherent zones of material loss along the cliff face and beach interface (Figure 4E). However, these results remain preliminary: uncertainty persists due to (i) tidal stage differences between acquisitions affecting intertidal elevations, (ii) co-registration offsets between epochs, and (iii) unvalidated vertical accuracy of the DTM products at this site.

This work demonstrates that initiatives such as the ESA Network of Resources, supported by the European Union Space Programme, play a critical role in enabling high-precision coastal research by removing barriers to accessing commercial UHR satellite data. Without such institutional support, sub-metre imagery would remain largely inaccessible to public research institutions, reinforcing the strategic importance of European Earth Observation programmes for evidence-based coastal hazard management.

Terra em Foco
Conferência Nacional de Observação da Terra



Figure 1 - Praia d'el Rey Marriott Golf & Beach Resort. Image source: <https://www.1golf.eu/en/hotel/prai-d-el-rey-marriott-golf-beach-resort>



Figure 2 - Pléiades Neo 4 pansharpenerd multispectral ortho composite (30 October 2024; GSD 0.30 m). Standard PMS Full-Scene product, orthorectified by Airbus.



Figure 3 - Beijing-3A pansharpenerd multispectral composite (6 March 2022) over the Praia d'El Rey coastal sector, Baleal-Lagoa de Óbidos. Original L2 multispectral product (GSD aprox. 2.0 m) fused with the panchromatic band (~0.50 m) using in-house pansharpenerd.

Table 1 - Summary of remote sensing datasets used in this study. All satellite imagery was acquired through the ESA Network of Resources (NoR) initiative via the UP42 platform

Dataset	Product	Date	GSD	Processing
Pléiades Neo 4	PMS-FS Ortho	30 Oct 2024	0.30 m	Pansharpenerd multispectral, orthorectified
Beijing-3A	MS1 → PANSHARPENERD	6 Mar 2022	~0.50 m	L2 multispectral, pansharpenerd
Vexcel Aerial Ortho	RGB + NIR	2020	0.15 m	Orthorectified true-colour and near-infrared composites
Vexcel Aerial Ortho	RGB + NIR	2024	0.15 m	Orthorectified true-colour and near-infrared composites
Vexcel Elevate DSM	DSM	2020	0.15 m	Digital Surface Model
Vexcel Elevate DSM	DSM	2024	0.15 m	Digital Surface Model
Vexcel Elevate DTM	DTM	2024	0.15 m	Digital Terrain Model

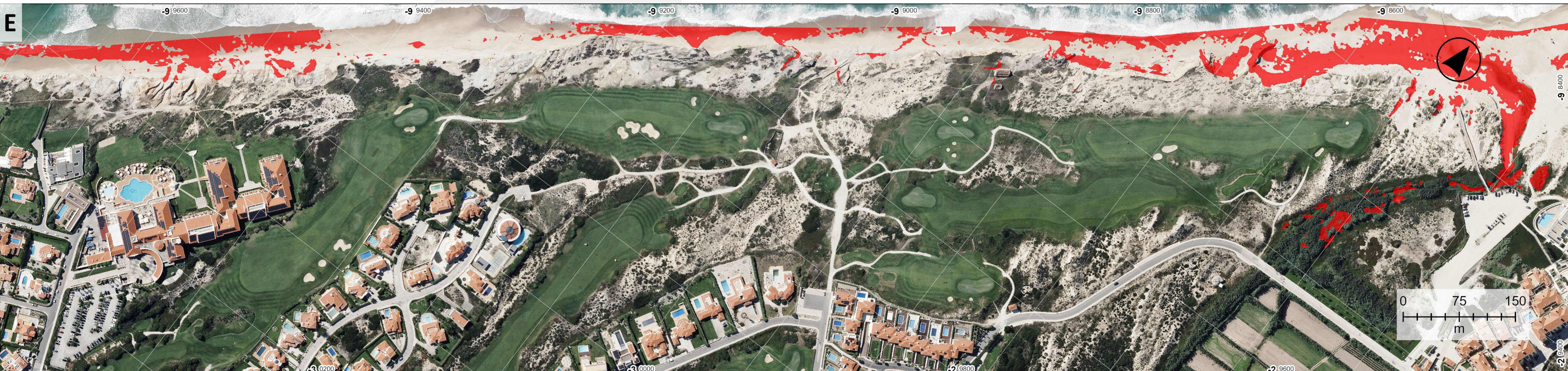
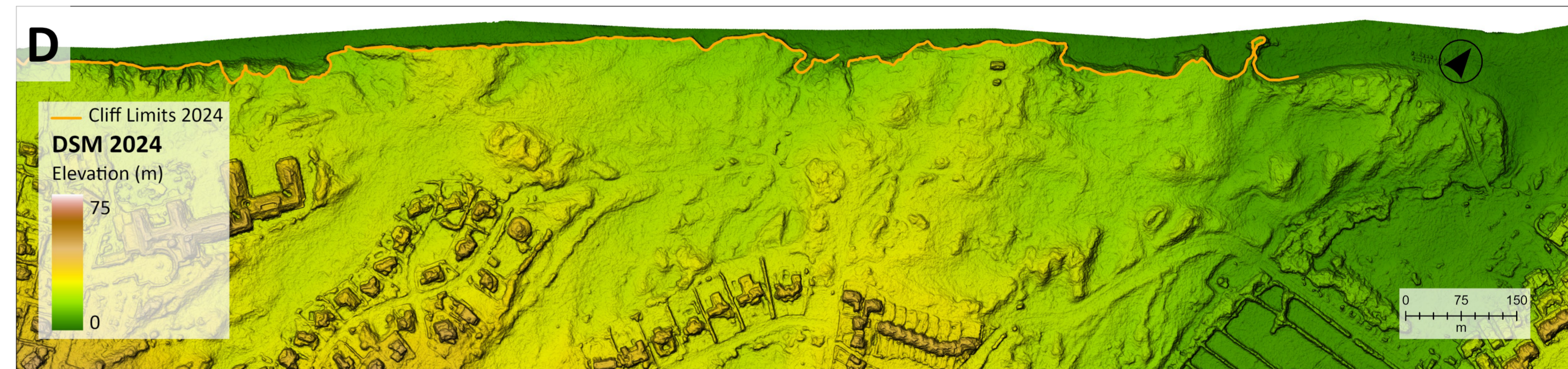
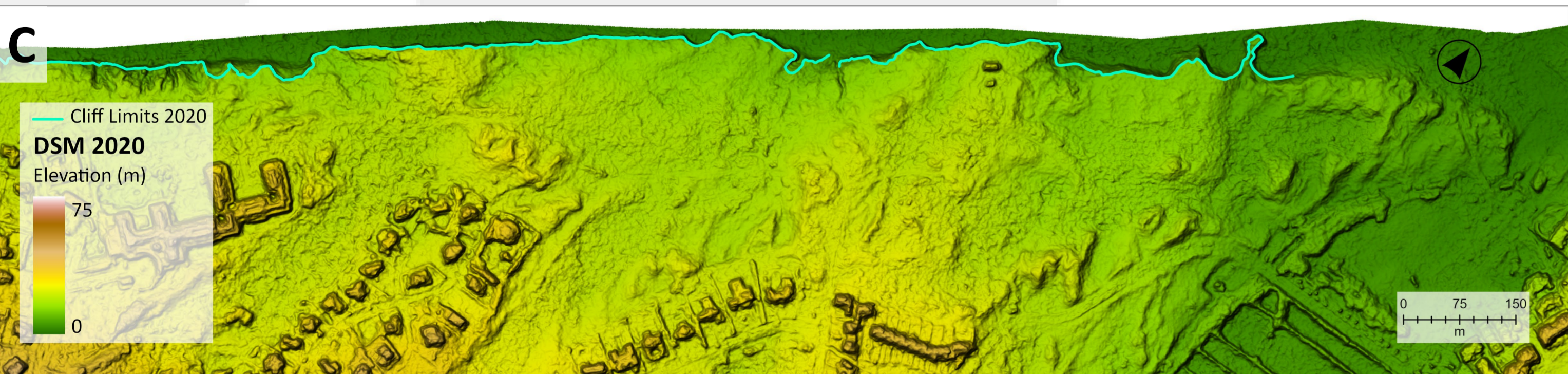
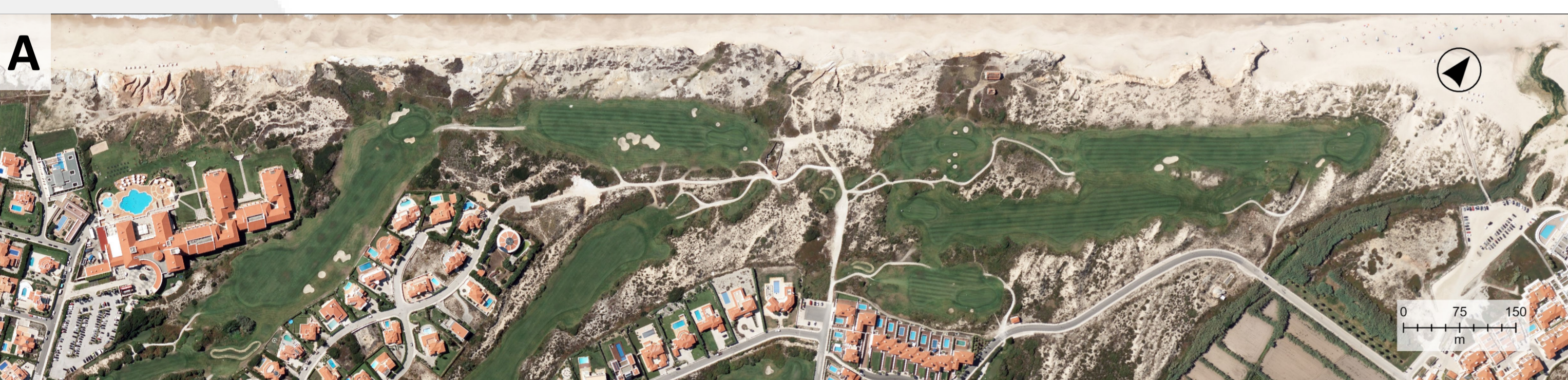


Figure 4 - Multi-temporal analysis of coastal cliff retreat using Vexcel aerial imagery and derived elevation models. (A) Vexcel orthophoto mosaic (2020). (B) Vexcel orthophoto mosaic (2024). (C) Digital Surface Model (DSM) from 2020 with mapped cliff crest (cyan line); (D) DSM from 2024 with mapped cliff crest (orange line). (E) 2024 orthophoto overlaid with areas of negative elevation change (red), derived from the subtraction of $DSM_{2020} - DSM_{2024}$, highlighting zones of potential material loss along the cliff face and beach.

ACKNOWLEDGEMENTS: This work was supported by the European Space Agency (ESA) Network of Resources Initiative (NoR) under request IDs 5403mk and 5320ti. The authors gratefully acknowledge Francesco Cantore and the UP42 team for their valuable support in facilitating access to the NoR platform and associated service providers. Airbus Defence and Space is acknowledged for the provision of Pléiades Neo imagery, and Twenty First Century Aerospace Technology (21AT) for Beijing-3A data. Vexcel Imaging is acknowledged for the supply of UltraCam aerial orthophoto mosaics and Elevate digital elevation products through the NoR ecosystem.