

COASTAL RESILIENCE TO HAZARDS SESSION AT COSPAR2026 – REPORT SUMMARY

46th COSPAR Scientific Assembly | 3 August 2026 | Florence, Italy

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1. Session Overview

Coastal zones support vital ecosystems and growing populations but are increasingly exposed to climate change, sea-level rise and multiple natural and human-driven hazards, including flooding, tsunamis and coastal erosion. Earth Observation (EO) provides an increasingly powerful capacity to monitor these environments, but an important challenge remains: translating observations and scientific advances into information and services that can effectively support coastal users and decision-making.

Session A0.2, *Coastal Resilience to Hazards: Bridging the Gap between Earth Observations and User Needs*, brought together research and operational developments to explore how these capabilities can improve the understanding, monitoring and prediction of coastal processes and hazards, and ultimately better support user needs.

The session built on the complementary activities of CEOS COAST and GEO Blue Planet, which promote collaboration with stakeholders and the co-design of solutions to improve the usability and uptake of coastal EO information. CEOS COAST promotes the integration of satellite and in situ observations for applications including coastal change, flooding and land-to-sea interactions, while GEO Blue Planet connects scientific, operational and user communities to strengthen the use of ocean and coastal observations in decision-making.

In Europe, this collaborative approach is further supported by the EuroGEO Marine and Coastal Action Group, co-led by the European Offices of GEO Blue Planet and GEO AquaWatch. The Action Group connects European marine and coastal EO initiatives across the Data-to-Intelligence value chain, supporting the transition from observations and research outputs to actionable knowledge and sustained impact.

Structured around three Quarter Day Sessions, the programme showcased advances in satellite and in situ observations, numerical modelling, artificial intelligence and forecasting, and explored how these capabilities can contribute to more integrated coastal information systems and better support user needs. Two presentations included in the original programme were withdrawn and were therefore not delivered during the session.

2. Scientific and Technical Highlights

The session was introduced within the broader context of GEO Blue Planet and the EuroGEO Marine and Coastal Action Group, highlighting the importance of strengthening the pathway from EO to actionable information and societal impact.

At the global level, CoastPredict and GlobalCoast highlighted the move towards integrated, multi-hazard coastal observing and prediction systems that combine satellite and in situ observations, modelling and forecasting while engaging coastal stakeholders in their development. CEOS

COAST further demonstrated the value of combining multiple satellite and in situ observations with stakeholder co-design to develop fit-for-purpose coastal information products.

Across the scientific contributions, a strong emphasis was placed on the integration of complementary observations, models and emerging technologies to better characterise complex coastal processes. Coastal Digital Twins illustrated how satellite observations, in situ measurements, numerical models and AI can be combined to move from monitoring towards forecasting and resilience assessment. Other applications demonstrated the value of accounting for interacting processes such as sea-level change and vertical land motion when assessing coastal risk, as well as the potential of satellite observations to complement existing hazard-monitoring and early-warning capabilities.

AI and machine-learning approaches also showed growing potential to overcome observational limitations and extract higher-resolution information from EO data. Examples included improved monitoring of dynamic tidal-flat environments, physics-informed approaches to harmful algal bloom detection, and super-resolution methods for high-resolution precipitation mapping. Together with applications combining satellite imagery and modelling to understand phenomena such as floating Sargassum, these developments illustrated the capacity to derive actionable information from diverse and complex EO datasets.

The transition from research towards operational applications was another theme. Examples included EO- and model-based harmful algal bloom forecasting to support shellfish harvesting and the assimilation of satellite altimetry into high-resolution coastal wave forecasting. These applications demonstrated how advances in observations, modelling and prediction are increasingly being translated into services that can support operational planning, early warning and coastal management.

3. Key Messages

The session reinforced the importance of integration across satellite EO, in situ observations, numerical modelling and emerging digital technologies. AI and Digital Twins are creating new opportunities to extract information from complex coastal environments and improve forecasting capabilities, while validation, uncertainty assessment and physical consistency remain essential to ensure reliable and usable products.

A second key message was the need to accelerate the transition from scientific capability to operational use. This requires not only technological advances but also sustained observing and operational infrastructures, user engagement and international collaboration. Initiatives such as GEO Blue Planet, CoastPredict and CEOS COAST can help connect scientific, operational and user communities, ultimately strengthening the translation of Earth Observation into actionable information for coastal decision-making.