USE-CASES – Coastal Resilience to Climate Change

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This document outlines the use cases for the "Coastal Resilience to Climate Change" thematic call for proposals. It is intended to develop sustainable services using space assets and technology together to address key challenges and opportunities for developing operational solutions. The use cases presented are the result of a collaboration between the European Space Agency (ESA) and entities such as Aon, ESA's Maritime Sustainability Task Force, and ESA's Task Force for Smart and Green Cities. The use cases are categorised by the agency that provided them. When writing the initial proposal (APQ/APQ+ proposal), the applicant should specify which use case(s) their solution will address, if selected from those listed here.

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Aon

Aon plc (NYSE: AON) – a global professional services firm specialising in risk management, reinsurance, retirement, and health solutions – is supporting this call with use cases. Aon's areas of interest include understanding the impacts of tropical cyclone storm surges on coastal communities, enhancing the modelling of natural and man-made coastal resilience measures, and assessing the implications of climate change on port functionalities, particularly in terms of business interruptions due to severe weather or sea level changes.

Use case #1: Understanding the Impacts of Tropical Cyclone Storm Surges on Coastal Communities

Objective: To assess and mitigate the effects of tropical cyclone storm surges on coastal communities.

The goal is to develop comprehensive models that predict the impact of tropical cyclone storm surges on coastal areas. This includes analysing historical data, current weather patterns, and geographical features to forecast potential damage. The models will help identify vulnerable areas.

Expected Outcomes:

- Enhanced predictive capabilities for storm surge impacts, leading to more accurate risk assessments and insurance pricing.
- Improved emergency preparedness and response strategies, reducing potential losses and claims.
- Strengthened community resilience, minimising disruptions to local economies and enhancing recovery efforts.

Use case # 2: Enhancing the Modelling of Natural and Man-Made Coastal Resilience Measures

Objective: To improve the effectiveness of coastal resilience measures through advanced modelling techniques.

The focus is on enhancing the modelling of both natural and man-made resilience measures, such as mangrove forests, seawalls, and flood barriers, by integrating various data sources and employing sophisticated simulation tools.

Expected Outcomes:

- Optimised design and implementation of resilience measures, leading to reduced risk exposure and lower insurance premiums.
- Increased protection for coastal areas, enhancing the stability and sustainability of local economies.
- Greater adaptability of coastal infrastructure, ensuring long-term resilience and reducing the need for costly repairs and replacements.

Use case #3: Assessing the Implications of Climate Change on Port Functionalities

Objective: To evaluate the impact of climate change on port operations and business continuity.

The goal is to assess how climate change, particularly severe weather events and sea level rise, affects port functionalities. This involves analysing the potential for business interruptions, damage to infrastructure, and changes in operational efficiency.

Expected Outcomes:

- Comprehensive understanding of climate change impacts on ports, leading to more accurate risk assessments and insurance solutions.
- Effective mitigation strategies to ensure business continuity, reducing potential financial losses and claims.
- Enhanced resilience of port infrastructure and operations, supporting global trade and economic stability.

ESA's Maritime Sustainability Task Force

In 2024, The European Space Agency (ESA) launched the Maritime Sustainability Task Force to focus on short- and long-term priorities for the maritime sector. This initiative aims to leverage space-based solutions for maximum impact. The Task Force includes experts from various maritime fields working together to develop projects that support decarbonisation, protect marine ecosystems, and strengthen the maritime economy in Europe and beyond.

Members of the Maritime Task Force include:

- **Damens Shipyard Group** – owners of 35 shipyards worldwide
- **DNV** – Norwegian-based independent experts in assurance and risk management
- **European Maritime Safety Agency (EMSA)** – maritime authority serving EU maritime interests
- **Grimaldi Euromed SPA** – ro-ro ship owners and operators
- **International Windship Association** – industry association
- **Maersk Mc-Kinney Moller Center for Zero Carbon Shipping** – not-for-profit R&D centre
- **MSC - Mediterranean Shipping Company** – container shipping line
- **Ocean Autonomy Cluster** – maritime cluster
- **One Sea Association** – industry association
- **TMA Blue Tech** – maritime cluster
- **Wallenius Wilhelmsen** – ro-ro ship owners and operators

Use case #1: Mitigating Increased Flooding Risks

Objective: To reduce the disruption of port operations and damage to infrastructure caused by increased flooding risks.

Develop and implement flood management strategies that include the construction of flood barriers, improved drainage systems, and the elevation of critical infrastructure. Utilise space-based monitoring to predict and respond to flooding events in real-time.

Expected Outcomes:

- Enhanced flood resilience of port infrastructure.
- Reduced operational downtime and financial losses due to flooding.
- Improved safety for port workers and surrounding communities.

Use case # 2: Protecting Against Higher Storm Surges

Objective: To safeguard port terminals, warehouses, and surrounding areas from the threats posed by higher storm surges.

Design and deploy storm surge barriers and reinforcement measures for port terminals and warehouses. Use satellite data to monitor storm surge patterns and provide early warnings to port authorities.

Expected Outcomes:

- Increased protection for port infrastructure and assets.
- Timely response to storm surge threats, minimising damage.
- Enhanced preparedness and resilience of port operations.

Use case #3: Addressing Coastal Erosion

Objective: To prevent the weakening of port foundations and the disruption of nearby transport networks due to coastal erosion.

Implement coastal protection measures such as seawalls, breakwaters, and beach nourishment projects. Use space-based imagery to monitor coastal erosion and assess the effectiveness of protection measures.

Expected Outcomes:

- Stabilised port foundations and transport networks.
- Reduced risk of structural damage and operational disruptions.
- Long-term sustainability of coastal infrastructure.

Use case #4: Strengthening Port Infrastructure Against Stronger Storms

Objective: To minimise structural damage to docks, cranes, and container storage areas caused by stronger storms.

Description: Reinforce port infrastructure and use satellite data to track storm intensity and provide real-time updates to port operators.

Expected Outcomes:

- Enhanced durability and resilience of port infrastructure.
- Reduced repair and replacement costs due to storm damage.
- Improved operational continuity during and after storms.

Use case #5: Managing High Winds and Navigation Safety

Objective: To reduce downtime and ensure safe navigation for vessels during high wind conditions.

Description: Develop wind management protocols and install wind-resistant infrastructure. Use space-based wind monitoring to provide accurate forecasts and guidance for vessel navigation.

Expected Outcomes:

- Reduced operational downtime due to high winds.
- Increased safety for vessels and port workers.
- Improved efficiency of port operations during adverse weather conditions.

Use case #6: Adapting to Changes in Current Patterns, Sea Level, and Precipitation

Objective: To address the impact of changes in current patterns, sea level, and precipitation on dredging requirements.

Description: Conduct regular assessments of dredging needs using satellite data and predictive models. Implement adaptive dredging strategies to ensure optimal port functionality.

Expected Outcomes:

- Efficient and cost-effective dredging operations.
- Maintained navigability and operational efficiency of ports.
- Enhanced resilience to changing environmental conditions.

ESA's Task Force for Smart and Green Cities

The Space for Smart and Green Cities Task Force was launched in Rome in September 2023. This initiative focuses on innovative projects, technology trials, and user-driven solutions in smart cities, emphasising implementation. It aims to highlight the socio-economic and environmental benefits of smart and green cities for users and industry.

The Task Force's objectives include using space applications to advance sustainable services in the smart cities ecosystem and support a green economy. By working with city stakeholders, it seeks to generate green and economic impacts for urban areas and provides a platform to share ESA-backed initiatives with cities.

The Task Force examines urban needs to agree on short- and long-term priorities and defines funding opportunities to develop innovative and sustainable projects for smarter and greener cities.

Use case #1: Planning Coastal Nature-Based Solutions for Climate Change Adaptation

Objective: To assist coastal cities in planning effective nature-based solutions for climate change adaptation.

Description: Expertise and resources are needed to help coastal cities identify and design nature-based solutions such as mangrove restoration, dune stabilisation, and coastal wetlands. This includes conducting feasibility studies, environmental impact assessments, and community consultations to ensure the solutions are tailored to local coastal conditions. Satellite data and remote sensing technologies could be leveraged to monitor coastal environmental conditions and provide accurate information for planning.

Expected Outcomes:

- Comprehensive plans for nature-based solutions that address coastal climate change adaptation.
- Increased awareness and engagement among coastal communities.
- Enhanced resilience of coastal areas to climate-related impacts.

Use case # 2: Implementing Coastal Nature-Based Solutions

Objective: To support coastal cities in the implementation of nature-based solutions for climate change adaptation.

Description: Successful implementation of nature-based solutions involves coordinating with local authorities, stakeholders, and experts to oversee the construction and integration of green coastal infrastructure. Space-based monitoring could be used to track the progress and effectiveness of the implemented solutions.

Expected Outcomes:

- Successful implementation of nature-based solutions in coastal areas.
- Improved coastal biodiversity and ecosystem services.
- Reduced vulnerability of coastal cities to climate-related risks.

Use case #3: Maintaining Coastal Nature-Based Solutions

Objective: To ensure the long-term maintenance and sustainability of coastal nature-based solutions.

Description: Guidelines and best practices for the maintenance of coastal nature-based solutions are needed, which include training local personnel, establishing monitoring systems, and providing ongoing support to address any challenges that arise. Satellite data can be used to continuously monitor the condition of the nature-based solutions and assess their long-term impact.

Expected Outcomes:

- Long-term sustainability and effectiveness of coastal nature-based solutions.
- Enhanced capacity of local authorities to manage and maintain green coastal infrastructure.
- Continuous improvement of coastal resilience to climate change.