CoastRI: A National Coastal Research Infrastructure Initiative

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Abstract
Over 85% of Australians live within 50 km of the coastline, relying on coastal ecosystems and associated services for industry, recreation, and cultural identity. Climate change is altering our coastline at unprecedented rates, with sea level rise, erosion, inundation, and weather changes compounding habitat loss from human activity. These changes also impact the built environment, natural resource systems, and infrastructure planning. Despite these pressures, Australia currently lacks a national, cohesive, coordinated approach to observing, modelling, and managing coastal change. CoastRI is a new cross-NCRIS (National Collaborative Research Infrastructure Strategy) initiative, involving 13 NCRIS capabilities, that seeks to address this gap by establishing a nationally coordinated coastal observing and modelling capability to improve predictions of coastal change, support risk assessments, and inform decision-making across research, industry, government, and communities. Stage 1 of CoastRI, funded in the 2023 NCRIS round, focused on national consultation to identify research and stakeholder needs, as well as First Nations co-design partnerships, and initiate targeted investments in key areas of coastal observation and modelling. This paper outlines the achievements and roll-out of the initial investments of Stage 1, including the establishment of the Coastal Ocean Modelling Commons, deployment of infrastructure for wave and estuarine water quality monitoring, expansion of the surface elevation table network for tidal wetland elevation monitoring, aggregation of urban infrastructure datasets, and the expansion of drone and fixed camera monitoring for erosion and habitat assessments. These foundational efforts address clear national gaps and demonstrate the value of coordinated national-scale research infrastructure investments and activities. The capabilities and partnerships established through Stage 1 form the essential groundwork for a future, expanded Stage 2. This next stage, not yet funded, would scale and integrate coastal observations and models to further support national adaptation planning in key focus areas such as erosion, inundation, water quality, habitat condition, biodiversity, community well-being, and the impacts on settlements, infrastructure, and industry.

Keywords: coastal change, national research infrastructure, coastal observations, modelling, data stewardship.

1. Introduction

Our cities, industries, recreation, and cultural identity are deeply interconnected with coastal environments [1]. However, climate change is driving rapid and unprecedented transformations - through sea level rise, erosion, inundation, and increasingly variable weather - exacerbating the impacts of existing human pressures and habitat loss [1]. These shifts not only affect ecosystems but also have significant implications for Australia's built environment, natural resource systems, and infrastructure planning. Despite the growing urgency, Australia lacks a nationally coordinated and cohesive approach to monitor, understand, predict, and adapt to coastal change.

To increase preparedness, inform decision-making, and support the sustainable use of coastal areas, improved and integrated data and modelling capability are essential [1]. In response, a consortium of 13 National Collaborative Research Infrastructure Strategy (NCRIS) capabilities is working to develop the Coastal Research Infrastructure (CoastRI) initiative - a national-scale effort to address the current and future needs of Australian researchers, industry, and government. CoastRI is designed around three interconnected themes:

- observing coastal processes,
- cross-sector modelling and prediction, and
- data identification, integration, and management.

Given the complexity and scale of the challenges facing Australia's coastal regions, this initiative is only possible through synthesis across NCRIS capabilities and close coordination with key national partners such as Geoscience Australia, CSIRO, and the Bureau of Meteorology. CoastRI aims to deliver a transformative step-change in how research infrastructure is operated and connected across coastal systems, providing a step-change for integrated national-scale coastal and climate capabilities currently unavailable in Australia.

CoastRI is being developed through a two-stage process. Stage 1 - funded through the 2023 NCRIS investment round - has completed a national consultation to identify stakeholder priorities and

end-user needs [2]. Initial research infrastructure investments by consortium participants during this Stage 1 phase are now rolling out, addressing key gaps in coastal observation, modelling, and data integration. Efforts to establish co-investment partnerships and First Nations co-design collaborations are ongoing. The outcomes of this Stage are informing a fully scoped and costed Stage 2, which, pending future funding, will implement the fully coordinated CoastRI vision to maximise impact. This paper provides an overview of the current active investments as part of Stage 1 and presents the priority areas identified for Stage 2.

2. Foundational Investments in Observation and Modelling

The CoastRI consortium participants received initial multi-year funding (2023–2027) to collaboratively develop an advance a CoastRI vision, demonstrate the value of a nationally coordinated approach, and build momentum for further co-investment. Foundational investments support joint, pilot-level CoastRI consortium activities across six key areas, targeting priority gaps identified through national consultation. These efforts represent a crucial first step in establishing a coherent collaborative structure for an integrated national coastal research infrastructure capability for Australia. The specific activities and their contributions are discussed in more detail below.

2.1 Coastal Ocean Modelling Commons

Led by ACCESS-NRI (Australian Earth System Simulator - National Research Infrastructure), AuScope, and NCI (National Computational Infrastructure), this two-year pilot program is currently underway to establish a community-accessible Coastal Ocean Modelling Commons and enhance Australia's ice sheet modelling capabilities. These efforts mark an important step in building national capacity to model and understand complex coastal and cryospheric processes.

The Ice Sheet and Sea-level System Model (ISSM) has been selected as the officially supported ice sheet model for the ACCESS-NRI community. In July 2024, a dedicated Ice Sheet Modelling Team was established within ACCESS-NRI to lead the development of open-source tools and workflows for the community. These include an ISSM Python API for model pre-processing, configuration, and output analysis and visualisation; the ISSM Community Cookbook, which offers ready-to-run modelling and analysis recipes; ACCESS-NRI-supported ISSM configurations for the Gadi supercomputer; and an open community Ice Sheet Modelling Data Pool and Intake Catalogue, containing both input and output datasets. Further, a new open-source modelling framework is under development at the Australian National University to model Glacial Isostatic Adjustment (GIA) - the solid earth and gravitational response to changes in surface ice and water distribution. GIA is fundamental in shaping how oceans respond to ice-sheet changes, drives significant regional sea-level variations, and remains a gap in current modelling capabilities.

In parallel, a regional and coastal ocean modelling team was launched in September 2024 to support the Australian National Coastal Ocean Modelling System (ANCOMS) community. This team is focused on developing tools to streamline workflows, improve access to modelling resources, and address known gaps in Australian coastal water modelling. Initial engagement with stakeholders - including CSIRO, university-based modelling groups, the ARC Centre of Excellence for Weather of the 21st Century, the National Centre for Atmospheric Research (NCAR), and the COSIMA community - is helping shape priorities and foster collaboration across the national modelling landscape.

2.2 Coastline Observing

This project, led by AuScope and IMOS (Integrated Marine Observing System), in association with TERN (Terrestrial Ecosystem Research Network) is advancing coastal monitoring through the deployment of drones (UAVs) and fixed imaging infrastructure. These technologies support innovative approaches to detecting and monitoring environmental change at strategically important coastal sites, including validation locations, areas impacted by extreme events or inundation, and regions undergoing significant coastal management interventions.

To inform the development of a nationally coordinated coastal drone and fixed station program, a national workshop was held in March 2025 to identify existing efforts and assess national needs and gaps. Based on these insights, work plans are now being shaped to ensure alignment with both research and management priorities, and integration across capabilities. The program consists of three main components led by facilities based at Deakin University, University of New South Wales (UNSW), and University of Queensland.

- Long range drone and sensor capability. Led by University of Queensland, this capability will coordinate investment in heavy lift and long-range drone platforms and sensor technology. Coastal applications will focus on coordinated efforts to assess habitat condition using a suite of sensors including terrestrial and bathymetric LiDAR, and multispectral and hyperspectral sensors. The facility will also develop Standard Operating Procedures (SOPs) that underpin long term monitoring of coastal change to produce trends for applications such as State of

Environment reporting for the Australian Government.

- Low-cost drone capability. Led by Deakin University this capability will leverage <2kg drone capability to develop a nationally coordinated coastal erosion monitoring program representative across Australia's sediment compartments. The program will leverage existing state and local government efforts and engagement with traditional owners and communities through citizen science opportunities.
- Fixed camera capability**.** Led by UNSW this program will expand fixed camera stations across Australia's coastal monitoring locations using advanced imaging and LiDAR technologies complemented by an expansion of Citizen science efforts through the CoastSnap program.

The full coastline observing program is expected to commence rollout in mid-2025.

2.3 Monitoring Sea Level Impacts on Coastal Ecosystems Resilience

Led by TERN, this project monitors the impacts of sea level change on vegetated coastal habitats. Using a network of over 300 Surface Elevation Tables (SETs) deployed in tidal wetlands across 32 locations, data are systematically collected on sediment elevation changes. TERN's funding builds on past investments in site establishment obtained through grants from the National Environmental Science Program (NESP) and the Australian Research Council (ARC). A future objective is to integrate SET data with drone-based remote sensing and LiDAR to generate a more comprehensive understanding of wetland vegetation dynamics and surface elevation change.

During Stage 1, the network has expanded with 15 new SET installations at Mungalla Station in Queensland (Figure 1), carried out in close collaboration with Traditional Owners and CSIRO. To further guide the development of the project, TERN hosted a workshop at the Australian Mangrove and Saltmarsh Network Conference in 2024 and held a focused workshop in February 2025 to gather expert input for shaping the project's Stage 2.

Figure 1. SET installations at Mungalla Station, Queensland, carried out in close collaboration with Traditional Owners and CSIRO. (Source: Madeline Goddard, image taken on Nywaigi Country).

2.4 Coastal Waves and Estuarine Condition

Led by IMOS, this project is enhancing national capabilities to observe coastal wave dynamics and water properties at estuary entrances to better understand conditions and processes linked to inundation and other coastal risks. These efforts aim to establish critical baseline data in key coastal areas, supporting long-term trend detection and informed management decisions.

As part of this initiative, the IMOS Coastal Wave Buoys Facility was established, with the central hub based at the University of Western Australia (UWA) and regional sub-facilities managed by Deakin University, South Australian Research and Development Institute (SARDI), Flinders University, the New South Wales Department of Climate Change, Energy, the Environment and Water, the University of Newcastle, the Australian Institute of Marine Science (AIMS), and the Queensland Department of Environment, Science and Innovation. The national network, comprising 52 planned and deployed sites equipped with SOFAR wave buoys, is supported through a combination of IMOS funding and co-investment from regional partners (Figure 2). Site prioritisation was informed by local needs and logistics, as well as national wave correlation analyses led by the Australian Climate Service to identify existing gaps in the observation network. Near real-time data from SOFAR wave buoys are already available through the IMOS Australian Ocean Data Network (AODN) via the '*Wave Buoys Observations – Australia – near-real time'* dataset, with spectral data anticipated to be available in near real-time from 2025. All delayed mode data will be incorporated into the AODN's National Wave Archive, encompassing integrated and spectral wave parameters along with raw displacement time series.

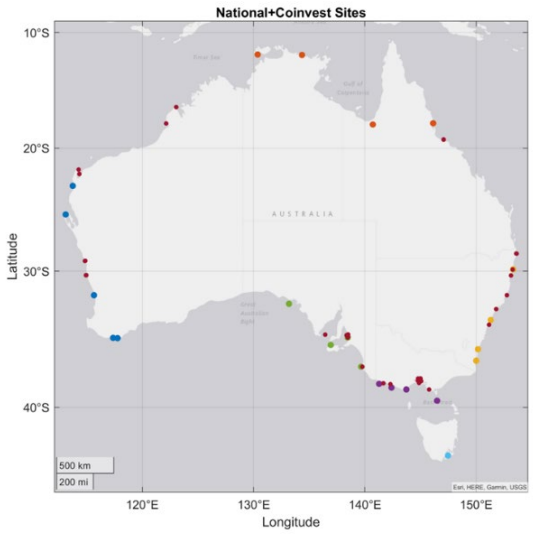

Figure 2. Deployed and planned SOFAR wave buoy sites across Australia.

In parallel, the IMOS Estuarine and Coastal Mooring Facility has been established, led by SARDI. A national horizon scan of existing estuarine and coastal mooring infrastructure is currently underway to inform future planning. To guide this effort, a steering committee will be established to define key water quality parameters, identify priority locations, and determine appropriate mooring configurations to support a coordinated and effective national rollout.

2.5 Planet Research Data Commons

Led by ARDC (Australian Research Data Commons), the Planet Research Data Commons (RDC) provides data and analytics infrastructure to enable environmental monitoring and prediction. An Australian Dataspaces Capability is being developed, which is piloting governance and technical frameworks based on the International Data Spaces Association model. Dataspaces create trusted collaborations between research, government, and industry sectors to streamline data sharing and enable information products such as national tide and water quality monitoring data assets to be developed. The Planet RDC has also developed the Domain Data Portals service to provide researchers a single discovery and access point for data and software that has been developed through a program or initiative, regardless of the creator's discipline or institution. This will be applied to CoastRI data and models in Stage 2.

2.6 Underground infrastructure in critical coastal areas

Led by AURIN (Australian Urban Research Infrastructure Network), this project contributes curated data, training, expertise, and understanding of urban coastal assets to allow modelling of the risk and impact of coastal inundation from storm surge and sea-level rise. This includes access to AURIN's current repository of curated coastal population and demographic data, derived data, and historical data to allow time series analysis. Acquiring access to currently unavailable and hard-to-get urban infrastructure data assets, such as subterranean utilities, is a key priority for AURIN and its users. Data pertaining to the urban environment is critical to understanding the economic and human well-being impacts of coastal inundation and other climate change risks.

3. Full Program - Building a National Initiative for Coastal Resilience

Stage 2 of CoastRI will build on the foundations established during Stage 1 by expanding observation networks, enhancing modelling capabilities, implementing targeted social case studies, and integrating both new and existing data streams to address critical gaps in coastal observation, data collection, modelling, and prediction.

Priority themes identified through extensive stakeholder consultation include coastal erosion, inundation, water quality, habitat condition, biodiversity, community wellbeing, and the impacts on settlements, infrastructure, and industry (Figure 3).

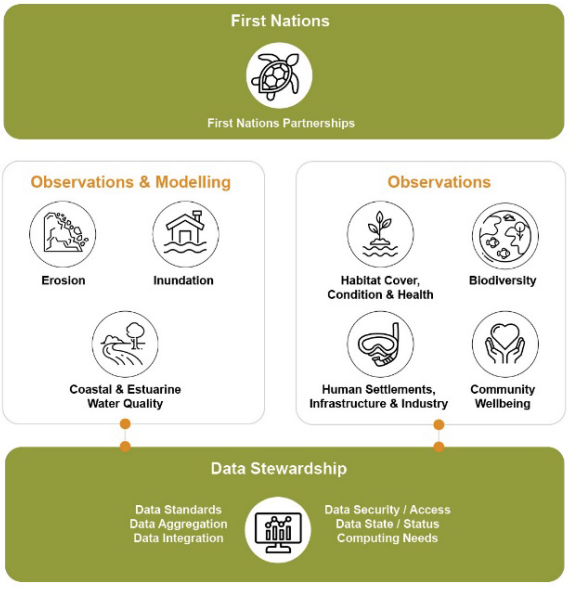

Figure 3. Depiction of the proposed themes of CoastRI's full program.

Observing sites will be strategically selected based on national and state-level priorities, areas of highest importance or risk, and through a co-design process that incorporates stakeholder and end-user input, resourcing levels, and First Nations partnerships. Some locations will serve as "*synergistic sites*," combining land and ocean infrastructure to support integrated and comprehensive data collection.

Targeted case studies will explore health and wellbeing outcomes and assess risks to critical assets - such as homes, infrastructure, and cultural sites - from coastal hazards. These studies will generate valuable insights for policymakers, planners, insurers, and communities. They will also inform the development of digital tools and predictive maps to support cross-disciplinary research, urban planning, and risk assessment, including forecasts of population movement and areas facing health or infrastructure challenges.

First Nations involvement will be embedded through ongoing co-design, ensuring meaningful engagement and leadership throughout the initiative. Likewise, data stewardship is a foundational pillar of CoastRI, with a commitment to adopting FAIR and CARE data principles and promoting best practices to ensure secure, accessible, and integrated data systems. Partnerships with government and industry will expand access to valuable data streams and support the creation of federated data networks.

A shared modelling approach will unite Australia's currently fragmented modelling landscape. Using open-source development practices, CoastRI will deliver robust, accessible models to improve forecasting of sea-level rise and coastal change. These tools will support long-term research and real-time prediction systems, strengthening Australia's resilience to coastal challenges.

4. Summary

Stage 1 of CoastRI demonstrates how coordinated investment in coastal research infrastructure - including observations, modelling, data, and stakeholder engagement frameworks - can build a foundation for national-scale impact. The achievements to date signal a transformation in how Australia prepares for and responds to coastal challenges. Importantly, Stage 1 has also highlighted the strong interest of stakeholders to co-invest in this initiative, underscoring a shared commitment to long-term, collaborative solutions. With continued support through Stage 2, CoastRI can further develop the national-scale research infrastructure needed to deliver the data, models, and partnerships needed to protect coastal communities and ecosystems now and into the future. The CoastRI initiative will generate significant benefits across Australia’s coastal zones, supporting emergency planning, insurance, conservation, community, and industry resilience. By investing in sustained coastal research infrastructure and fostering strong collaboration across research, government, industry, and community partners, CoastRI will provide centralised, accessible data, models, and tools to help the nation adapt to a changing coast.

5. Acknowledgements

The CoastRI initiative is underpinned by a strong collaborative foundation across thirteen NCRIS capabilities. The following individuals lead these key national facilities and have contributed to shaping the CoastRI vision:

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- Australian Urban Research Infrastructure Network (AURIN): Pascal Perez
- Bioplatforms Australia (BPA): Sarah Richmond
- Australian Research Data Commons (ARDC): Hamish Holewa
- Australian Earth System Simulator - National Research Infrastructure (ACCESS-NRI): Andy Hogg
- Australian Access Federation (AAF): Sarah Thomas
- Coastal Research Vessel Fleet (CRVF): Michael Steer
- Heavy Ion Accelerators (HIA): Thomas McGoran
- Population Health Research Network (PHRN): Merran Smith

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6. References

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Relevant UN SDGs (https://sdgs.un.org/goals) - 9, 11, 13, 14, 15