Eighth Meeting of the Pacific Meteorological Council (PMC-8)

Weather Ready for a Secured and Sustainable Pacific

10, 11, 14 September 2026 | Nuku'alofa, Tonga

Agenda Item 13.2: Expansion of the Systematic Observations Financing Facility (SOFF) for Global Basic Observing Network (GBON) Marine Surface Observations

Purpose:

1. Request Meeting's recommendation to the Systematic Observations Financing Facility (SOFF) to explore funding opportunities and further extend its scope to cover GBON marine surface observations.
2. Seek Meeting's endorsement of regionally-supported, regional-and-national implementation as region's preferred approach for the design, financing and delivery of GBON marine surface observations in the SOFF-eligible Pacific Islands.

Objectives:

1. Recognise the critical and persistent gap in Global Basic Observing Network (GBON) surface marine observations across the Pacific Islands.
2. Fill the identified GBON surface marine observations gap in the Pacific Islands by requesting SOFF, in cooperation with the WMO Secretariat as SOFF Technical Authority, to explore funding opportunities and extend SOFF's scope to cover GBON marine surface observations.
3. Propose regionally-supported, regional-and-national implementation as region's preferred approach for the design, financing and delivery of GBON marine surface observations in the SOFF-eligible Pacific Islands.

Background:

1. The Global Basic Observing Network (GBON), established by World Meteorological Organisation (WMO) Congress Resolution 2 (Cg-Ext(2021)), requires Members to measure sea surface temperature and sea level pressure within their Exclusive Economic Zones (EEZs) at a horizontal resolution of 500 km with hourly reporting.
2. The Pacific Islands region is overwhelmingly ocean, with ~98% of the region comprised of ocean space. Marine surface observations are therefore core to the region's GBON compliance and hydrometeorological capability as it relate directly to the environment in which Pacific Island Countries and Territories (PICTs) operate, underpinning the cyclone, storm surge and marine hazard warnings, and the fisheries, shipping and tourism activity, on which Pacific communities and economies depend.
3. The 2023 WMO gap analysis, and the updated 2026 analysis, show extremely low levels of compliance among Pacific Small Island Developing States (SIDS), even when counting observations contributed by foreign ships and drifting platforms.

4. The Systematic Observations Financing Facility (SOFF) supports Least Developed Countries (LDCs) and SIDS, through a three-phased Readiness, Investment and Compliance model, to close land-based and upper-air GBON observation gaps, but does not currently finance surface marine observations.
5. WMO governing bodies have on multiple occasions since 2022, most recently through a September 2025 decision by Regional Association V, called for SOFF's scope to be widened, resources permitting, to cover marine GBON stations in Exclusive Economic Zones (EEZs).
6. SOFF is establishing a Financing Platform to mobilize additional capital for systematic observations. By combining catalytic grants with private investment, the Platform will enable resources to be frontloaded through tailored Systematic Observation Impact Bonds. This will accelerate progress, reduce the costs of inaction, and bring forward the benefits of improved observations. Subject to sufficient funder interest, SOFF is considering a dedicated Pacific Ocean Observation Bond to help close the GBON marine observation gap in the Pacific.
7. SOFF has traditionally supported LDCs and SIDS on a national basis, with each Member individually receiving Readiness, Investment and Compliance support. For GBON marine surface observations in the Pacific Islands, a new, a regionally supported, regional-and-national implementation approach is proposed. This proposed approach could be modular with greater national implementation where capacity allows.
8. A regionally supported, regional-and-national implementation approach offers significant advantages over the traditional national delivery model in both cost efficiency and likelihood of success. A preliminary analysis suggests that a purely national approach could cost more than twice as much as the regionally supported, regional-and-national implementation approach. Regional coordination enables the use of voluntary observing ships and low-cost drifting platforms that pass through multiple Member EEZs, while allowing the pooling of technical resources and helping to address the limited capacity and small size of some national organisations responsible for marine observations. A purely national approach, by contrast, would preclude the use of such transboundary platforms and would instead lean towards costlier technology (e.g. more moored buoys) to sustain compliance.
9. While SOFF's scope is limited to GBON requirements, SOFF investment could be complemented by additional funding from other sources to extend observing platforms to other high-priority variables of national and regional interests, such as waves. Since the platform itself accounts for the largest share of cost in the marine environment, a relatively small cost increment could substantially expand its capability to serve a wider range of national and regional applications.
10. While the Meeting is invited to endorse the regionally-supported, regional-and-national implementation approach as the Pacific's preferred model, the detailed design of the implementation arrangements would be developed during the SOFF Readiness Phase.
11. The proposal has been reviewed by SOFF and the WMO Secretariat for technical validation.

Recommendations:

The Meeting is invited to:

i) **Note** the critical and persistent gap in the GBON for surface marine observations within EEZs of Pacific Islands.
ii) **Recommend** that SOFF, supported by the WMO Secretariat as SOFF Technical Authority, considers expanding its support to GBON marine observations, starting with the Pacific and under Pacific leadership, funded potentially through a dedicated Pacific Ocean Observation Impact

Bond, with funding ring-fenced for this purpose, without affecting national Investment Funding Requests for GBON-compliant surface observations.

iii) **Endorse** the regionally-supported, regional-and-national implementation approach as the Pacific's preferred model for the design, financing and delivery of GBON marine surface observations.

iv) **Request** that the SOFF Readiness Phase includes consultations with Pacific countries to inform the development of a consolidated regional GBON Contribution Plan for ocean observations.

ANNEX A

Why should GBON Marine Surface Observations matter to the Pacific Islands?

This annex makes the case, for the Pacific Meteorological Council and for every Pacific NMHSs individually, that closing this gap is a direct national interest. It draws on the ECMWF SOFF Impact Experiments (ECMWF, 2025), commissioned by the SOFF Steering Committee and conducted using the Ensemble of Data Assimilations (EDA) technique, which provide the first quantitative, model-based evidence of how additional surface, upper-air and marine observations affect global forecast uncertainty.

Direct Benefits to Individual Pacific Island Countries and Territories

Marine surface observations are not solely a global public good, they feed directly into services that PICTs already rely on:

- Tropical cyclone forecasting: In-situ pressure and SST observations near cyclone tracks materially improve intensity and track forecasts issued by Regional Specialized Meteorological Centres (e.g. RSMC Nadi) and NMHSs, directly affecting the lead time communities have to prepare.
- Marine heatwave and coral bleaching early warning: Continuous SST monitoring underpins bleaching alert products that matter to reef-dependent tourism and subsistence/artisanal fisheries across virtually every PICTs.
- Storm surge and coastal inundation modelling: Marine pressure and sea-state data improve the boundary conditions for surge models.
- Fisheries management: SST and related ocean-state data support tuna stock and migration modelling that underlies revenue from fisheries access agreements, which is for several PICTs, the single largest source of Government revenue.
- Maritime safety and shipping: Real-time marine observations feed the marine weather and navigational warning services PICTs are obligated to provide under SOLAS and WMO Technical Regulations for inter-island and international shipping lanes.

This Matters Even More for the Region's Smallest and Most Vulnerable Members

The case above applies to every PICTs, but it applies with particular force to the smallest island states and territories, including Tuvalu, Kiribati, Marshall Islands, Naoero, Niue and Tokelau, whose entire inhabited land area can sit only a few metres above sea level and NMHSs are often only a handful of staff. Three points matter specifically for these Members:

- Risk is inversely related to size. The smaller the landmass, the larger the share of national territory and population exposed to a single cyclone track, storm surge or marine heatwave. A modest improvement in surge or cyclone-track forecasting that would be marginal for a larger, higher-elevation state can be the difference between a manageable warning and a national-scale emergency for an atoll nation.
- Capacity, not willingness, has been the barrier and the regional approach solves exactly that. A national, station-by-station approach could cost more than twice as much as a regionally-supported, regional-and-national implementation model, precisely because it does not require every small NMHSs to independently build, deploy and maintain equipment. Regional coordination pools technical capacity, procurement and maintenance across Members, so no single small PICTs are asked to carry the technical or financial burden alone.

- This is not being asked as an unfunded mandate. SOFF operates through a three-phased Readiness, Investment and Compliance model in which the SOFF, not national treasuries, finance the Readiness assessments and Investment-phase infrastructure, with Compliance-phase support helping sustain operations while national capacity is built up. Extending this same financing model to marine GBON means small PICs would gain compliant, life-saving observation infrastructure without that cost falling on already-stretched national budgets. Regional financing and implementation model is specifically designed so that participation does not require any PICT to have a large NMHS, a large budget, or a large landmass.

The Economic and Risk-Reduction Case

Pacific SIDS are among the most disaster-exposed economies in the world relative to GDP, and early warning systems are consistently found to be a high-return investment. The Global Commission on Adaptation and related WMO/World Bank analyses have cited benefit-cost ratios for early warning investment commonly in the range of several times to an order of magnitude, driven by avoided loss of life, assets and productivity. Marine surface observations are foundational inputs to the cyclone, surge and marine hazard warnings on which that return depends. At the same time, the "blue economy" - fisheries, shipping, tourism represents a growing share of Pacific SIDS GDP and government revenue, and each of these sectors depends on the ocean-state information that GBON marine stations would support.

Reducing Forecast Uncertainty Across the Pacific Region

Numerical weather prediction (NWP) skill depends on the density and quality of observations assimilated into forecast models, and the marginal value of an additional observation is highest precisely where data is scarcest. Few parts of the world are as persistently short of in-situ marine data as the tropical Pacific - the region where tropical cyclones form and where El Niño–Southern Oscillation (ENSO) signals originate before spreading weather and climate impacts across the wider Pacific and, via atmospheric teleconnections, well beyond it. Observing System Experiments conducted by global NWP centres have repeatedly shown that withholding marine surface pressure and SST observations in data-sparse ocean basins degrades short- and medium-range forecast skill measurably more than the same withdrawal in data-dense regions, because there is little redundant information for the assimilation system to fall back on. In-situ surface observations also serve functions satellite coverage cannot replace. They are used to verify forecast performance and to constrain the bias corrections applied to satellite radiance measurements, a role that remains essential even in ocean areas with extensive satellite coverage.

Commissioned by the SOFF Steering Committee, the ECMWF SOFF Impact Experiments (ECMWF, 2025) provide the first quantitative, model-based test of this reasoning. The study found that adding the Pacific land-based observations reduced short-range forecast uncertainty by up to 20% in the region.

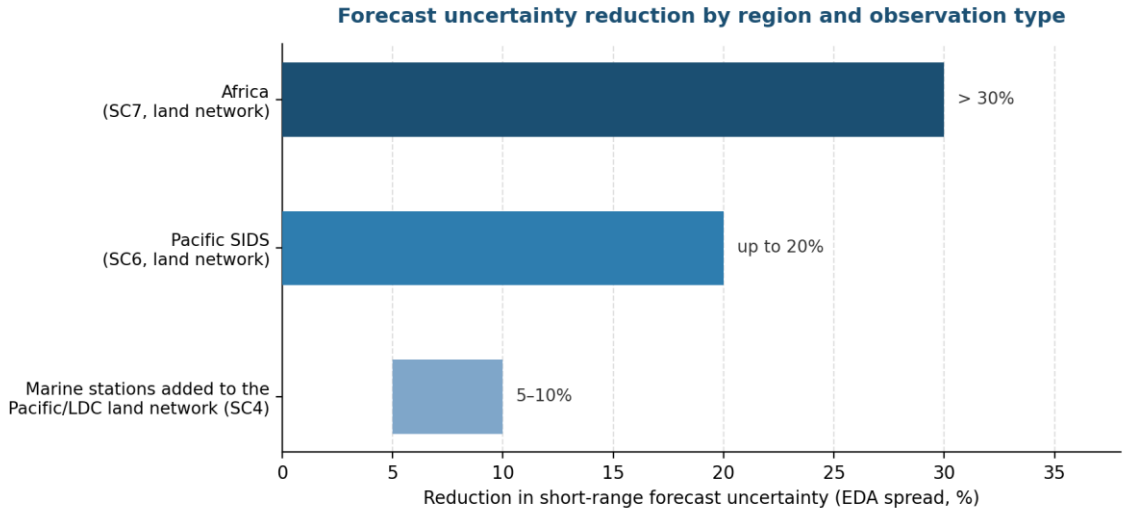

Figure A1. Reduction in short-range (12-hour) forecast uncertainty by scenario, as reported in ECMWF (2025, Executive Summary; Sections 3.1 and 3.2.3). Ranges reflect EDA spread reductions relative to the June 2023 baseline.

For the marine observations specifically, one of the ECMWF experiments added 145 simulated marine stations on top of the land network (LDCs and SIDS), at an incremental annual cost of only around USD 0.5 million. This reduced surface pressure analysis uncertainty by roughly 5–10% in the immediate vicinity of the new marine observations, a smaller signal than the land-based scenarios, but one the study attributes explicitly to the low density of the marine network tested rather than to marine data being inherently less valuable. This is precisely the case for a regionally coordinated Pacific network dense enough, through pooled voluntary observing ships, drifting buoys and moored stations, to move beyond this sparse-network minimum requirement.

Obligations as WMO Members

Beyond the direct service benefits, closing the marine GBON gap responds to a clear, escalating set of governance decisions that Pacific Members have themselves been party to. Table A1 summarises the key instruments.

Instrument	What it requires	Why it matters for PICTs
Resolution 2, Cg-Ext(2021)	Establishes GBON, including the requirement to observe sea surface temperature and atmospheric pressure within national EEZs at ≥500 km horizontal resolution with hourly reporting.	Legally establishes the marine surface requirement as part of every Member's basic observing obligation, not an optional extra.
Resolution 1, Cg-Ext(2021) – WMO Unified Data Policy	Requires real-time, free and unrestricted international exchange of GBON data.	Pacific SIDS are expected to both close the observing gap and share the

Instrument	What it requires	Why it matters for PICTs
		resulting data globally, in return for reciprocal access to the global observing system.
WIGOS Regulations (WMO-No. 49, Vol. I) and WIGOS Data Quality Monitoring System (WDQMS)	Places GBON compliance under continuous, publicly visible international monitoring.	Persistent non-compliance is visible to the whole WMO membership and donor community, with reputational and negotiating consequences for the region.
RA V (Nineteenth Session, Sept. 2025) decision	Regional Association V formally requested that SOFF's scope be widened, resource permitting, to cover marine GBON stations in EEZs.	Provides the direct regional mandate that PMC-8's recommendation would reinforce and operationalise for the Pacific sub-region.

Table A1. Key WMO governance instruments underpinning the marine GBON obligation.

ANNEX B

Comparison of a Regionally-Supported, Regional-and-National Implementation Approach and a Purely National Implementation Approach for GBON Marine Surface Observations in the Pacific

The table below sets out the principal advantages and disadvantages of the two implementation approaches considered for delivering GBON marine surface observations across the Pacific.

Implementation Approach	Advantages	Disadvantages
Regionally-Supported, Regional-and-National Implementation Approach	• Enables effective use of voluntary observing ships and low-cost drifting buoys, which cross multiple EEZs and can be credited towards the compliance of several Members over time. • Preliminary analysis indicates significant cost efficiency: a purely national approach could cost more than twice as much as a regional one. • Pools technical resources and addresses the limited capacity and small size of many national organizations responsible for marine observations. • Economies of scale in procurement, spares management, training and maintenance through a single regional technical team. • Consistent technical standards, quality control and data exchange (WIS 2.0) across the region. • Efficient, shared use of scarce peer advisory and technical expertise (e.g. Australia, New Zealand) across all participating countries. • Stronger collective visibility and negotiating position for donor engagement. • Streamlined fiduciary oversight and safeguards through a single Implementing Entity/Beneficiary, reducing duplication of institutional arrangements.	• Reduced direct national control over the day-to-day management of specific regional assets, although national data stewardship is maintained. • Some national decision-making is exercised collectively through the regional coordinating body rather than solely at the national level. • Long-term success depends on sustained regional institutional capacity and continued regional political will. • Possible perception of uneven benefit-sharing, where a Member may benefit from another Member's contribution to shared compliance (e.g. a drifting buoy transiting multiple EEZs). • Introduces a degree of dependency on the performance and funding stability of the regional coordinating mechanism itself.

	• Facilitates region-wide knowledge sharing, joint training and career development for national technicians.	
Purely national implementation	• Full national ownership, control and visibility of assets and observational data. • Direct, unambiguous accountability between each NMHSs and SOFF/donors. • May align more easily with existing national planning, budgeting and procurement systems. • No dependency on the performance or capacity of a regional coordinating body.	• Substantially higher cost: preliminary analysis suggests a purely national approach could cost more than twice as much as a regional one. • Loses the principal cost advantage of drifting buoys, which cross EEZ boundaries; a national approach would need a different, generally costlier, technology mix (e.g. more moored buoys) to sustain compliance. • Duplicates technical capacity, training, spares management and data systems across many small Pacific NMHSs, most of which have limited capacity for marine observations. • Marine observing technology is often peripheral to core NMHS mandates in Pacific countries; building this capability nationally in every SOFF-eligible country is a substantially heavier lift. • Weaker collective bargaining position with donors. • Slower and less resilient scale-up, given human and technical resource constraints typical of small island states. • Fragmented compliance monitoring, quality control standards and data exchange practices across countries.

Note: cost and technology comparisons are indicative and based on preliminary analysis; they will be refined through country and regional readiness assessments.