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GBON National Contribution Plan of Kiribati

Systematic Observations Financing Facility

Weather and climate data for resilience

GBON National Contribution Plan

Kiribati

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Introduction

The Global Basic Observing Network (GBON) was agreed at the World Meteorological Congress in 2019 and came into force in January 2023. The GBON is a surface-based weather observing network designed at a global scale to support Numerical Weather Prediction. It aims to address global variability in network density and reporting frequency to improve global weather forecasting and resilience.

In recognition of the challenges for WMO members from Small Island Developing States (SIDS) and Least Developed Countries (LDCs) in meeting GBON requirements, the Systematic Observations Financing Facility (SOFF) was established alongside GBON. SOFF is a United Nations Multi-Partner Trust Fund established by the WMO, the United Nations Environment Programme and the United Nations Development Programme. SOFF provides funding to uplift weather observations in SIDS and LDCs to meet GBON requirements.

The SOFF model is to partner each beneficiary country with a peer advisor country to provide peer support, and with an implementing entity to implement and oversee the SOFF investment. Kiribati has chosen the Australian Bureau of Meteorology (Bureau) as peer advisor and the United Nations Environment Programme (UNEP) as implementing entity.

In the first phase of the SOFF project, the Readiness phase, the beneficiary and peer advisor work together to assess the existing weather networks against GBON requirements, identify gaps, and develop plans for filling these gaps. The peer advisor and beneficiary country then document these plans together in a GBON National Contribution Plan, which supports an investment proposal for the next SOFF Investment Phase.

This document provides the GBON National Contribution Plan (NCP) for Kiribati. It has been developed together by the Kiribati Meteorological Service (KMS) with the Australian Bureau of Meteorology (Bureau) as peer advisor, and the United Nations Environment Programme (UNEP) as implementing entity. It draws on a review of existing documentation and engagement with KMS and other Kiribati weather stakeholders during a visit to the capital in Tarawa between 2-7 July 2023. This visit was supplemented by information from co-incident visits to Kanton and Kiritimati islands performed by other officers from the Bureau, and other site information provided by KMS.

The document:

- outlines the current state of weather observations in Kiribati, highlighting the gaps between the existing network and capabilities and the GBON requirements;
- proposes the planned future state for Kiribati weather networks to become GBON-compliant; and
- details the recommended activities needed to reach this future state.

Module 1. National Target toward GBON compliance

Table 1 GBON National Contribution Target

Type of station	Baseline (Results of the GBON National Gap Analysis)				GBON National Contribution Target	
	Target (# of stations)[1]	GBON-compliant stations (#)	Gap		To improve	New
			New	To improve		
Surface	14	0	0	14	14	0
Upper air	4	0	3	1	1	2

1.1 Summary of Current State

Kiribati's national meteorological service (KMS) comprises skilled teams of observing, technical and forecasting personnel. These teams maintain:

- 7 staffed weather stations;
- 8 automatic weather stations (AWS);
- one upper air station (with support from UK Met Office).

However, KMS faces major challenges in skilled and sufficient personnel, logistics, sourcing of equipment and spares, maintenance and data communications, leading to quality and reliability issues. As a result, Kiribati currently has no GBON-compliant surface stations and most of its AWS are not providing data.

UK Met Office funding and support from the NZ MetService have enabled KMS to maintain the upper air station in Tarawa; although during the SOFF review it was experiencing outages due to power unreliability. The station only provides one flight per day and is therefore not GBON compliant.

There is substantial opportunity for SOFF to support Kiribati to address these challenges, as outlined in the description of GBON targets below.

1.2 Principles for GBON Targets

Kiribati is a country of many islands with a very large marine exclusive economic zone (EEZ), In its global GBON gap analysis, the WMO applied the GBON marine surface and upper air

[1] For SIDS, for the WMO GBON Global Gap Analysis in January 2022, the EEZ area has been added to the total surface area which is the basis for the target number of stations. The standard density requirements for SIDS have been calculated with 500 km for surface stations and 1000 km for upper-air stations.

station density requirements to the land and EEZ area to develop its land-based targets for Kiribati. This resulted in targets of 14 surface stations and 4 upper air stations.

In developing targets for this Kiribati GBON National Contribution Plan, the following attributes of the country were taken into account:

- Kiribati is a sparsely populated country with small land area and few populated islands. The vast majority of the country's territory consists of marine EEZ. Therefore the marine GBON requirements, as used in the global gap analysis, are considered more relevant than the land requirements.
- Kiribati consists of three island groups with non-contiguous EEZ associated with each group, and one isolated coral island, with very different population profiles:
    - The Gilbert Islands contain a series of atolls hosting the vast majority of the Kiribati population.
    - Banaba is a solitary raised Coral Island with a small population of about 300 people to the west of the Gilbert Island group.
    - The Phoenix Islands have almost no population. Only Kanton is inhabited with a population of about 20.
    - The Line Islands represent about 50% of the Kiribati EEZ but are mostly uninhabited. Only three islands in the north part of the island group host about 6% of the Kiribati population.
- Weather observations are most practical in populated areas. Improvements in Numerical Weather Prediction (NWP) will also have the most benefit in populated locations.
- The Tropical Atmosphere Ocean (TAO) moored buoy network, supported by the USA and Japan, provides an excellent supplementary source of data for NWP in both the Phoenix and Line Island group EEZ.
- Maintaining isolated, unstaffed AWS has historically been less successful in terms of data quality and reliability in Kiribati and other SIDS of similar resources. Staffed stations have historically proven to be significantly more reliable, highest quality and most resilient.

1.3 GBON Targets

Based on the above factors, the following GBON targets for Kiribati are proposed:

- **Surface stations**:
    - Nine stations, comprising staffed stations with co-located AWS will be improved to GBON standard, including:
        - Five existing staffed stations in the Gilbert Islands (Bonriki, Betio, Arorae, Beru, Butaritari).
        - One closed staffed station on Banaba Island
        - One existing staffed station on Kanton Island in the Phoenix Island group

        - Two stations in the northern Line Islands, including one existing staffed station on Kiritimati Island and one closed staffed station on Fanning Island.
    - Five existing AWS in the Gilbert Island group will be improved to report internationally and a higher level of maintenance, calibration and quality control implemented with SOFF support, with the aim of meeting GBON requirements.
- **Upper air stations**
    - Three upper air stations will be established as GBON stations, one in each island group as follows:
        - The existing Tarawa upper air station will be improved to two flights per day.
        - A new upper air station will be established immediately in the SOFF Investment Phase on Kiritimati Island in the Line Islands.
        - Subject to future upgrade of the aerodrome and power supply, a new upper air station will be established around year 3 of the SOFF project on Kanton Island in the Phoenix Islands.

1.4 Exemptions

Kiribati will seek an exemption from the GBON requirement for a fourth upper air station, associated with the large EEZ in the southern Line Islands, on the grounds of impracticality in this extremely remote, uninhabited marine zone.

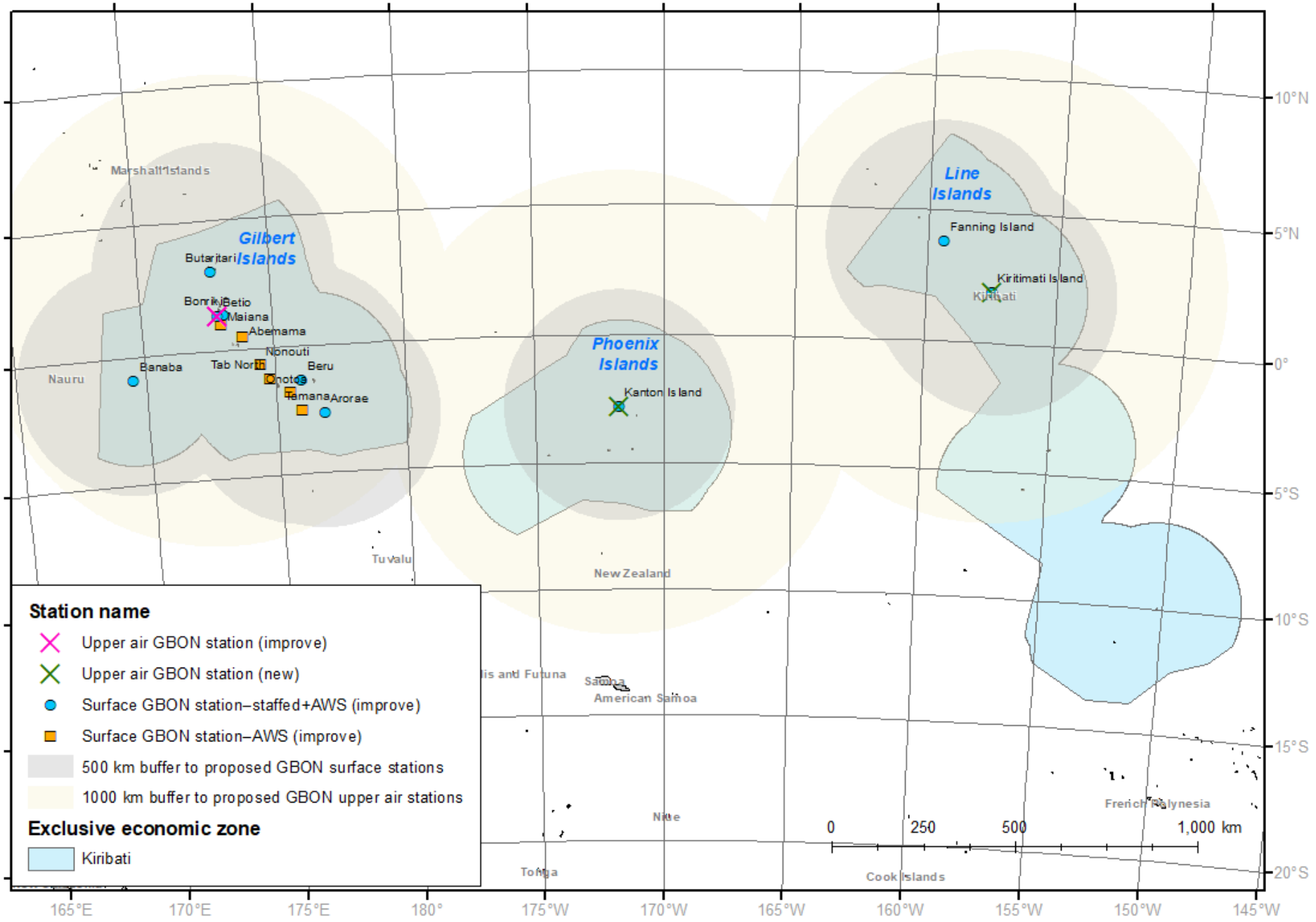

Figure 1 Map of existing and proposed surface and upper-air stations for GBON

Module 2. GBON Business Model and Institutional Development

2.1. Assessment of national governmental and private organizations of relevance for the operation and maintenance of GBON

The Kiribati Meteorological Service (KMS) is the primary organisation of relevance to the operation and maintenance of GBON in Kiribati. As detailed below, it maintains almost all the weather stations in Kiribati, manages almost all the weather data, and has a legislated mandate to do this.

The UK Met Office via the South Pacific Regional Environment Programme (SPREP) supports KMS to operate one upper air station at the Betio head office in Tarawa. Maintenance is undertaken by the New Zealand MetService on behalf of SPREP.

The only other organisation presently operating weather stations in Kiribati is the Civil Aviation Authority of Kiribati. It maintains two automatic weather observing systems (AWOS), one at Cassidy Airport on Kiritmati Island and one at Bonriki Airport in the capital Tarawa (Figure 2). Neither were operational at the date of the country visit for the SOFF program due to maintenance challenges. However, they are planned to be repaired and upgraded in the coming year with investment from an Australian government Pacific aviation initiative.

The aviation AWOS do not provide data to KMS systems. As these AWOS use a different technology to the KMS weather stations, and, as KMS does not have operational control nor ownership of these stations, it is difficult for KMS to ensure the reliability and quality of these data. Consequently, this plan assumes that the GBON requirements will be met with alternative infrastructure owned and operated by KMS.

Figure 2 Automatic weather observing system (AWOS) at Bonriki airport

2.2. Assessment of potential GBON sub-regional collaboration

Coordination was undertaken with peer advisors for neighbouring countries during development of the National Contribution Plan. The proposed station layout, especially for upper air, takes into account other regional SOFF activities. The proposed stations will contribute to a broader well-distributed multi-country network across a critical region for Numerical Weather Prediction (NWP) encompassing other SOFF-funded stations in nearby countries including Tuvalu, Nauru, Fiji and Samoa.

The National Contribution Plan has also been structured to be flexible to accommodate future regional coordination initiatives such as regionally-focused equipment calibration services, training, procurement of common equipment types, and maintenance services. These will be pursued through several forums in which KMS is an active participant (**Activity 2.1**) including:

- Regional SOFF coordination workshop in March 2024
- WMO RA V committee
- Pacific Meteorological Council and its committees
- South Pacific Regional Environmental Programme (SPREP)
- Pacific Community (SPC).

During the Investment Phase, KMS and UNEP will also pursue opportunities for regional synergies for maintenance services that can be implemented during the Compliance Phase, such as coordinated procurement of spare parts and calibration services.

2.3. Assessment of a business model to operate and maintain the network

KMS's annual core budget has been rising (AUD $ 618,458 in 2019, rising to $766,958 in 2023), although it is still low by world standards. Although it may cover staff salaries (with AUD $441,182 allocated in 2019), it does not allow KMS to completely cover equipment or consumables such as radiosondes, or to support significant staff training or operational funds.

KMS has a proven process for improving resourcing, as demonstrated recently through a cabinet paper process. In recent years, this has resulted in the recruitment of a senior forecaster, quality assurance officer, ICT specialist, and oceanographer.

In order to meet requirements of the NCP, substantial additional funding resources will be required. Given the reliability of existing government processes, the existing skill level in the NHMS, its legislated mandate (see 2.5 below), and the remoteness and lack of existing private sector operators in Kiribati, the preferred business model is the *Public model – Full State/NMHS owned and operated*. However, there is opportunity for a substantial private sector role in supporting the NHMS by including ongoing operational support in the procurement contracts for weather stations and ICT equipment (e.g. maintenance, training, calibration, advice, spare part supply, etc.).

This critical ongoing private sector role will require structuring the procurement in a manner than the supplier relationship can continue over the life span of the equipment. This could include procurement being done through UNEP with provisions to transfer support and maintenance contracts to KMS, or alternatively procurement for both supply and support could be done via KMS as the Executing Entity. The Kiribati government 'number 4 accounts' would allow for this option (see 2.5 below). Prior to procurement, KMS and UNEP will engage with prospective suppliers and the Kiribati National Economic Planning Office to undertake a review

of possible procurement approaches and develop a procurement plan (**Activity 2.2**). This plan will designate the 'Executing Entity' for each element of procurement and ensure the procurement model can include supplier support for the life of the equipment.

2.4. Assessment of existing national strategies and projects related to observing networks

Kiribati has recently developed and published its Strategic Plan & Framework for Weather, Climate and Oceans Services 2021-2025, with assistance from WMO, CREWS, and Environment Canada. It sets four long-term goals, two of which are highly relevant to the GBON network:

- Strategic goal 2: Strengthen the Kiribati Meteorological Service's infrastructure capacity for delivery of effective weather and climate services;
- Strategic goal 4: Strengthen the Kiribati Meteorological Service's human capacity, performance management, and operational efficiency.

The activities outlined in this National Contribution Plan thus align strongly with KMS's planned strategic direction.

Existing or planned hydrometeorological development activities related to GBON in Kiribati include:

- UNDP Disaster Resilience for Pacific Small Island Development States (RESPAC) program. This program was to install 5 AWS in Kiribati. Three have been installed so far and two are in storage pending resources for installation. The program covers installation and commissioning after which the stations are handed over the KMS for ongoing maintenance and operation.

- Australian government Pacific aviation initiative. The Australian government is assisting Kiribati to upgrade aviation weather services. This includes, among other activities, repairing the two existing AWOS (noted in 2.1 above), aviation weather training activities, and installing back-up power at the KMS head office in Betio.

- Climate and Oceans Support Program in the Pacific (COSPPac). This Australian government program is, among other activities, assisting Kiribati to maintain its CliDE Climate Data Management System.

- Weather Ready Pacific. This is a broader planned regional multi-donor initiative to comprehensively strengthen the full hydro-meteorological system across the whole value chain in the Pacific region. Weather Ready Pacific can leverage the improved observations from SOFF investment as part of its broader focus on hydro-meteorological services. Weather Ready Pacific currently only has seed funding and full funding is not guaranteed.

Opportunities to leverage these initiatives have been considered in the Module 3 Infrastructure Development below. As development programs in the region are dynamic, it is also recommended that at the start of the Investment phase, UNEP and KMS undertake a comprehensive environment scan of planned development activities related to GBON to identify any other opportunities for leverage and to ensure the planned works will be complementary (**Activity 2.3**).

2.5. Review of the national legislation of relevance for GBON

A new Meteorological Act (2021) in Kiribati provides a mandate and outlines the functional responsibilities for KMS. The Act is strongly worded and clearly outlines the functions and accountability of KMS which include, among others, the following responsibilities relevant to GBON:

- the taking and recording of meteorological observations and other observations required for the purposes of meteorology;
- establishing and maintaining meteorology stations and other observation and research stations, and all other necessary technical installations and equipment;
- collecting, collating, archiving, and making available meteorological data and information required under this Act including archiving of such data and information;
- co-operating with the authorities administering the meteorological services of other countries. and with the World Meteorological Organization, the International Civil Aviation Organization, and any other relevant international organisations in relation to any of the functions and powers stated in this Part, and in particular, supporting the principle of free and unrestricted exchange of meteorological data between national meteorological services;

The Act therefore provides clear authority and responsibility for KMS to establish and operate the GBON stations and share the data internationally

In 2018 the Kiribati Government established a central Procurement Unit (CPU) to coordinate and manage national public procurement transactions. In 2019 the Public Procurement Act was enacted and in 2020 Public Procurement Regulations were introduced.

Under sub regulation 3.1 of the Regulations, 'Projects financed by International Donors, where money and financial assets are not part of Kiribati Public Funds ' are granted an exception and shall not be subject to the procedures of the Public Procurement Act and Regulations. However, procurement under this sub regulation must 'still respect the Principles of Public Procurement defined in Section 4 of the Act unless clearly unsuitable'.[2]

The Kiribati Government Development Fund, known as the number 4 account, is a government bank account managed by the National Economic Planning Office used to receive and acquit donor funds. Funds are remitted to the account by donors and expenditure is then warranted to implementing ministries. The number 4 account provides a mechanism whereby KMS can receive and use funding from agencies such as UNEP, and is a suitable mechanism for KMS to receive SOFF funding both during Investment and Compliance phases to support the proposed the GBON uplift activities.

In general, national legislation therefore does not present any major constraint and in fact will facilitate implementation of GBON.

[2] Public-Procurement-Regulations.pdf (president.gov.ki). - Part 1 – General Principles, 3.1 & 3.2 Exceptions

Module 3. GBON Infrastructure Development

For each section of this module, the existing state of weather observations infrastructure in Kiribati is outlined, followed by the target state and planned activities to achieve the target.

3.1. Surface and upper-air observing network and observational practices

Existing state

Existing weather stations in Kiribati are shown in Figure 3. These included staffed weather stations, automatic weather stations (AWS), automatic weather observing stations (AWOS) at airports, and third-party sea level stations and buoys. Currently, none of the stations are fully GBON-compliant. Details of each station type are provided in the following sections.

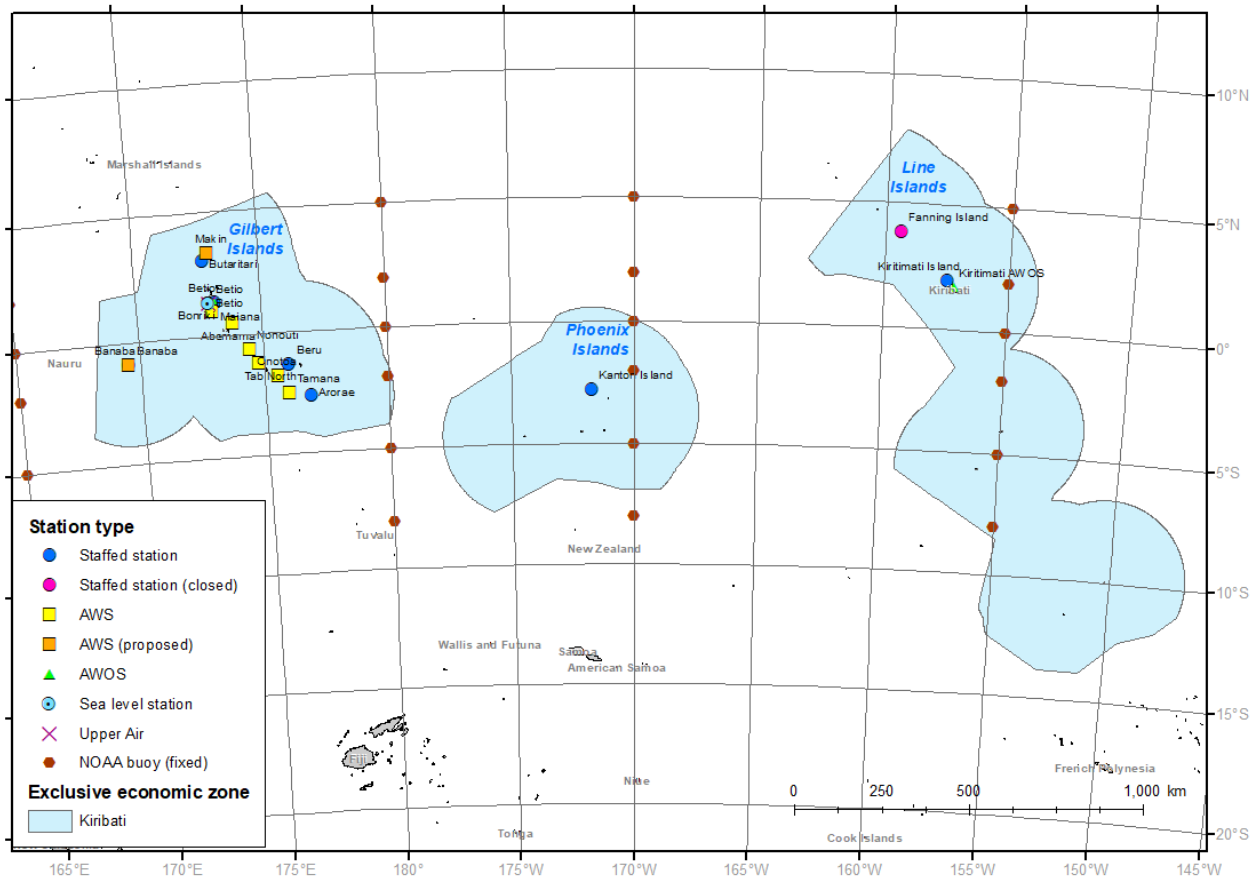

Figure 3 Weather stations in Kiribati.

Staffed Surface Stations

KMS maintains 7 staffed weather stations, with the majority in the Gilbert Islands group. This includes two in South Tarawa (Bonriki Airport and the KMS Betio office), as well as Butaritari, Beru and Arorae. There is one station in each of the Phoenix and Line Island groups, being Kanton and Kiritimati Island respectively.

There are currently two closed staffed stations, one on Banaba, which closed in the 2010s and one on Fanning Island in the Line Islands which closed in the 1990s. KMS retains the land and buildings at these locations, although the condition could not be verified.

The staffed stations have a complement of manually-read monitoring equipment, generally including some or all: thermometers in Stevenson Screen (wet bulb, dry bulb, max, min); barometer; rain gauge; wind vane; anemometer; evaporation pan; and sunshine recorder.

Stations at international airports (Bonriki and Kiritimati Island) have five and four observing staff respectively, while all other stations have a single observer. International airport offices operate 24 hours a day and target hourly observations (hourly Metar/Speci, 3 hourly Synops). The others target 6 hourly reporting. Due to maintenance challenges, some of the instruments are unserviceable, requiring the observers to estimate parameters. In some cases, due to staffing, equipment or communications issues, observations are less frequent than the target.

Figure 4 Manual weather station at Arorae

Automatic Weather Stations

There are at least 8 AWS or AWOS systems in Kiribati that have been installed under development projects for two government agencies for a range of customer purposes. These include:

- Automatic Weather Observing Stations (AWOS) at Bonriki (Tarawa Island) and Cassidy (Kiritimati Island) airports installed for the Kiribati Civil Aviation Authority to provide weather data to the control towers;
- 3 (of 5) AWS recently installed by UNDP in 2021 under the Disaster Resilience for Pacific Small Island Development States (RESPAC) program, with two currently in storage, pending resources for installation;

- 3 AWS installed by New Zealand Institute of Water and Atmospheric Research (NIWA) in 2019 under the Global Environment Facility's Least Developed Countries Fund (LDCF) for climate adaptation.

Three of these AWS were Vaisala models installed by NIWA. Five are OTT/Sutron-Hydromet models recently procured by UNDP, three of which have been installed and two of which are pending resources for installation. Both AWOS are All Weather Inc models, installed by GECI Group (aviation supplier).

The condition of the AWS was variable at the date of the country visit. The two AWOS systems and the 3 UNDP AWS were identified as not operational due to maintenance/software challenges. There are no records of when their performance and instruments were checked.

Figure 5 Automatic weather station at Onotao (from UNDP RESPAC project)

Upper Air Stations

There is one existing upper air station in Kiribati at the KMS Betio meteorology offices in Tarawa Island. The station and its consumables are funded by the United Kingdom Met Office (UKMO) via the South Pacific Regional Environment Programme (SPREP). Maintenance is undertaken by the New Zealand MetService on behalf of SPREP.

The station had been releasing one balloon per day up to June 2023. However as of the July country visit, it had recently experienced an issue with higher than normal electrical mains voltage causing a critical component to trip out, and had been offline for several weeks.

The UKMO plans to upgrade the frequency of balloon flights to twice per day in the near future. There is some uncertainty over long-term funding but the UKMO has ambitions for this to be a long-term ongoing arrangement.

Figure 6 Betio upper air station (building to left) and manual weather station.

Marine stations

One sea level monitoring station is maintained in Kiribati by the Australian Bureau of Meteorology (Bureau) under the Pacific Sea Level and Geodetic Monitoring project. It is located on a wharf at Betio Port and monitors atmospheric pressure as well as sea level, humidity, temperature and wind. Only sea level is currently transmitted internationally from the Bureau to the WMO Information System (WIS).

The United Stations National Oceanic and Atmospheric Administration (NOAA) also maintains sea level stations at Kanton and Kiritimati Islands. These stations record sea level only and report this information internationally.

NOAA and Japanese Agency for Marine-Earth Science and Technology (JAMSTEC) also maintains a large network of moored buoys in the Pacific region as part of the Tropical Atmosphere Ocean (TAO) array. Seven of these buoys are located in Kiribati's marine exclusive economic zone (EEZ) (refer Figure 3). These buoys record and transmit to the WIS air temperature, humidity and sea surface temperatures. NOAA advised there are plans to upgrade a number of these buoys to also record sea level air pressure.

Maintenance

The KMS technical team at the main office in Betio has no access to calibration travelling standards equipment. The team aims to proactively visit staffed stations and AWS at least once per year to inspect and maintain equipment and record some metadata, such as site photos. They also aim to reactively visit stations following critical equipment failure to make repairs.

However, travel and logistics are very expensive and complex in Kiribati, with lengthy and costly air and boat travel required to reach most sites. Budget constraints within the KMS have meant that the technical team has not generally been able to visit sites as frequently as the goals described above. For example, most AWS have not been visited since they were installed in 2019 and 2021.

Sourcing of parts and materials is also a major challenge in Kiribati. With no local supplier, all parts must be procured from overseas with lengthy delivery times and costly freight. These issues combined with budgetary constraints within KMS, have meant that KMS rarely has a sufficient stock of spare parts and tools, and often is unable to make repairs or replacements to unserviceable equipment.

KMS personnel advise that at least five of the existing AWS are currently not fully operational due to communication or equipment problems, lack of spare parts, and/or lack of travel budget to finalise installation or make repairs. Due to budget constraints, the serviceability of the remaining AWSs is difficult to determine as many sites have not been visited in a number of years.

General security and maintenance of vegetation at weather stations is undertaken by the observers at staffed stations and the site surrounds and vegetation tend to be well-maintained at these stations. At AWS, site maintenance is generally ad hoc and is sometimes undertaken on request by island councils. The condition of these stations is variable and often they can be overgrown, or prone to theft or vandalism.

Target state and recommended activities

Surface Stations

The primary planned approach for GBON surface stations in Kiribati is for staffed weather stations with co-located AWS. This approach was chosen for the following reasons:

- Co-locating the AWS with the staffed stations will enable the stations to provide 24 hours observations.
- Maintenance of unattended AWS to GBON reliability standards is challenging in Kiribati due to major logistical challenges (lack of roads, requirement for boat access, harsh environmental conditions, etc.). Having staff on-hand to maintain as required is essential to ensure sufficient up-time to meet GBON standards.
- Having both manual and automatic observations will provide redundancy for down-time of the AWS equipment (e.g. due to delays in shipping parts). When the AWS is down, the frequency of manual observations can be temporarily increased to hourly.
- The presence of skilled staff on-site will provide quality control and allow for quick, reactive maintenance in the event of equipment problems.
- Staff on-site will be able to provide security and grounds maintenance (e.g. vegetation mowing) to ensure the site complies with WMO siting requirements.

KMS currently maintains seven staffed stations. Two additional staffed stations at Banaba and Fanning Islands were closed during recent decades but will be reopened with SOFF funding. These stations will cover the main population centres in the three island groups in Kiribati.

In addition, KMS will aim to upgrade five existing standalone AWS stations to meet GBON requirements. This will require addressing existing maintenance, logistics, communications and security issues.

While Kiribati is upgrading mobile internet coverage across the country and remote islands, internet services are currently variable. To ensure continuity and reliability of data communication from GBON stations, all AWS and all staffed stations will be equipped with robust cellular or satellite (preferred) communications to ensure regular, timely message transmission.

The surface stations to be upgraded as part of this plan are listed in Table 2. The proposed instruments, facilities and observing systems for these stations are summarised in Table 3. Selection and installation of instruments will be compliant with *WMO-No. 8 Guide to Instruments and Methods of Observation*.

Table 2 – Planned GBON surface stations

Station name	Island chain	Existing station status	Planned GBON configuration
Bonriki, Tarawa	Gilbert	Existing staffed station	Co-located staffed and AWS
Betio, Tarawa	Gilbert	Existing staffed station	Co-located staffed and AWS
Butaritari	Gilbert	Existing staffed station	Co-located staffed and AWS
Beru	Gilbert	Existing staffed station	Co-located staffed and AWS
Arorae	Gilbert	Existing staffed station	Co-located staffed and AWS
Kanton	Phoenix	Existing staffed station	Co-located staffed and AWS
Kiritimati	Line	Existing staffed station	Co-located staffed and AWS
Fanning Island	Line	Former staffed station	Co-located staffed and AWS
Banaba	n/a	Former staffed station	Co-located staffed and AWS
Maiana	Gilbert	Existing AWS	Upgraded standalone AWS
Abemama	Gilbert	Existing AWS	Upgraded standalone AWS
Nonouti	Gilbert	Existing AWS	Upgraded standalone AWS
Onotoa	Gilbert	Existing AWS	Upgraded standalone AWS
Tamana	Gilbert	Existing AWS	Upgraded standalone AWS

Table 3 – Instruments and observing systems for planned GBON surface stations

Manual synoptic sites:	Automated synoptic sites:
Instruments	Instruments
• Electronic temperature and humidity sensors @1.25 – 2m with digital readout. • Wind vane (estimated values) or wind sensors (measured value) @10m. • Standard 8 inch (203mm) or 5 inch (127mm) manual rain-gauge. • Other manual instruments (evaporation, sunshine, soil temperatures) as required. • Any electronic instruments required to supplement manual observations (digital barometer)	• Resistance Temperature Device (RTD) dry bulb probe and relative humidity probe @1.25m – 2m. • Wind speed and direction sensors @10m. • Standard 8 inch (203mm) tipping bucket rain-gauge. • Other automated instruments (barometer, evaporation, solar radiation, soil temperatures) as required. • AWS processor to collate data (preferably with a 7-30 day buffer) and send messages at the required intervals.
Structures	Structures
• Instrument shelter (Stevenson style), gloss white and double louvered, with stand to achieve bulb/sensor height of 1.25-2m. • Tilting counterweighted 10m mast. • Post to 0.7m to support raingauge as required. • Fencing, adequate for the required security of the site.	• Instrument shelter (Stevenson style), gloss white and double louvered, with stand to achieve sensor height of 1.25-2m. • Tilting counterweighted 10m mast. • Post to 0.7m to support raingauge as required. • Fencing, adequate for the required security of the site.

	• Housing for the AWS processor, barometer and power supply separate from other sensors.
Facilities	Facilities
• An observations enclosure sufficient to ensure exclusion of obstacles impacting on readings (WMO 25 x 25m, BOM 18 x 18m). • A nearby building to house observing consumables, cleaning materials, station records and stationary, and a work station (with PC and monitor/s) for the manual observer. • A local display for any electronic data (T/RH/WS/WD) recorded on site. • A power supply to enable communication of coded messages. • An uninterruptable power supply to ensure message transmission. • Supply of clean water for cleaning and wet bulb readings.	• An observations enclosure sufficient to ensure exclusion of obstacles impacting on readings (WMO 25 x 25m, BOM 18 x 18m). • Mains and/or solar power supply to site. • Batteries to support solar, and/or to act as UPS for message transmission. • Signage to inform or deter the public.
Communications	Communications
• Robust cellular or satellite communications to ensure regular, timely message transmission. • Backup HF or other common communication method.	• Robust cellular or satellite (preferred) communications to ensure regular, timely message transmission. • Redundant communications system where feasible.

To improve these stations to meet GBON requirements, the following activities will be undertaken:

- **Activity 3.1**: Secure land access for reopening staffed stations at Banaba and Fanning Island.
- **Activity 3.2:** Undertake audit of existing manual equipment and facilities at staffed stations to identify all items that require procurement.
- **Activity 3.3:** Procure 9 x uplifted manual observing equipment and 9 x new AWS at for the staffed sites under 'build and support' contracts, including site works, structures, facilities, power and communications infrastructure.
- **Activity 3.4:** Procure an independent expert site inspection and audit of existing AWS equipment at the five target GBON standalone AWS sites to identify technical and communication faults and gaps.
- **Activity 3.5**: Procure a 'supply and support' contract to uplift 5 x AWS, as per the audit, to ensure they communicate reliably in real-time to GBON standards.
- **Activity 3.6:** Engage with island councils and establish caretaker contracts for the existing AWS for grounds maintenance and security.

Upper air stations

The nominally operational upper air station at the Betio office is a good candidate for upgrading to two flights per day due to its proximity to the KMS office which is staffed almost around the clock.

A second upper air station will be co-located with the staffed surface station at Cassidy International airports on Kiritimati Island in the far east Line Islands. This station currently has mains power and a complement of five observers providing a good opportunity for adding upper air observations.

Kanton Island, in the Phoenix Islands, currently has a staffed weather station but very sparse population, no mains power supply and no regular flights. However the Kiribati government plans to upgrade the aerodrome in the next two years. This upgrade will bring with it a power supply, and semi-regular flights, and will provide the opportunity to develop a third upper air station in this critical remote location using SOFF support. Installation of this station will be subject to the aerodrome upgrade, and associated infrastructure, and will likely occur around year 3 of the SOFF program.

Upper air stations will be manual and operated by the KMS observing staff rostered on shift at each of the stations. A hydrogen generator will be required due to the logistical challenges of sourcing and delivering hydrogen in the remote island environments.

Access to reliable 24/7 power and communications will need to be a major consideration for both existing and proposed upper air locations.

The upper air stations to be upgraded as part of this plan are listed in Table 2. The proposed instruments and observing systems for these stations are summarised in Table 5. Selection and installation of instruments will be compliant with *WMO-No. 8 Guide to Instruments and Methods of Observation*.

Table 4 – Planned GBON upper air stations

Station name	Island chain	Existing station status	Planned GBON configuration
Betio, Tarawa	Gilbert	Existing manual upper air station	Upgraded frequency at existing manual upper air station
Kanton	Phoenix	None	New manual upper air station
Kiritimati	Line	None	New manual upper air station

Table 5 – Instruments and observing systems for planned GBON upper air stations

Manual balloon release system
Instruments/consumables
• Radiosondes (environmental sustainable model) • Balloons (environmental sustainable model) • 'Met' string (environmental sustainable model) • Parachutes (as required) • Personal Protective Equipment (PPE) suitable for dealing with explosive environments.
Structures
• Balloon shed or remote balloon launcher where manually constructed balloon trains can be safely inflated and released.

• Separate (or partitioned) Hydrogen generation shed (or storage shed if bottled H2 is available). • Fencing, adequate for the required security of the site. • Exclusion zones (painted lines), beacons/lighting and paths within the site.
Facilities
• An enclosure sufficient to ensure exclusion of the public and obstacles that may impact or be impacted by balloon releases. • A nearby building to house upper air consumables, cleaning materials, various computer and communications systems supporting the upper air observations, and a workstation for the manual observer to assemble balloon trains. • A local display for the radiosonde profile and access to sensors for ground check data (T/RH/WS/WD/press). • A power supply to enable H2 generation and monitoring, constant communication with the radiosonde and the transmission of coded messages. • A hydrogen generation system (HOGEN) and H2 storage facility to ensure adequate supply for the anticipated upper air program. • An uninterruptable power supply to ensure the above. • Supply of clean water for hydrogen generation.
Communications
• Communications systems integral to the upper air program (to receive sonde data, normally supplied with the Upper Air system). • Robust cellular or satellite communications to ensure regular, timely message transmission.

To improve these stations to meet GBON requirements, the following activities will be undertaken:

- **Activity 3.7**: Secure land access for upper air stations at Kiritmati and Kanton Islands
- **Activity 3.8**: Engage with UK Met Office to develop plan to upgrade flight frequency at existing upper air station at Tarawa (funded by UK Met Office)
- **Activity 3.9:** Procure 2 x upper air station equipment under 'build and support' contract, including site works and all ancillary infrastructure

Marine Stations

Although not part of SOFF, the Readiness Phase investigations have identified an "easy win" for NWP. The Bureau will upgrade the data transmission specifications for its existing sea level station at Betio such that it reports internationally to the WMO Information System (WIS) (**Activity 3.10**). This station can then be designated as a marine GBON station for the variable sea level pressure.

Maintenance

The ongoing operation of the observing equipment requires both preventative and corrective maintenance. This is important to maintain routine operations, address faults as they arise and ensure the safety of the staff. Examples of maintenance tasks are shown in Table 6.

The SOFF investigation highlighted that maintenance is the number one challenge for meeting GBON requirements. Maintenance is therefore a critical focus of the contribution plan. The planned approach is for the procurement contracts for upper air, AWS and manual weather station equipment to be "Supply & Support" contracts for the lifespan of the equipment (refer Section 2.3 and **Activity 2.2**). The contracts will include:

- Supply and installation (where relevant) of all required equipment, including all required calibration equipment (e.g. transfer standards).
- Training, including
    - Ongoing, regular training in detailed maintenance and calibration methods for the KMS technical team.
    - Ongoing training in basic equipment maintenance for the KMS field observers so they can make basic repairs on-site without needing a costly trip by a technician.
    - Ongoing training for field staff in operation of upper air equipment.
- Ongoing on-demand advice service via phone or teleconference to support KMS staff when problems arise ('call-a-friend').
- Continuous supply of spares to be held in-country. Supply to be proactive based on estimated replacement frequencies.
- All other required calibration and maintenance services that are not done by KMS personnel.
- Opportunity for contract renewal when equipment reaches end-of-life.

Funding for ongoing essential services such as logistics, travel and communications is also a key limitation on maintenance of station reliability. During the Investment Phase, and continuing into the Compliance Phase, a logistics fund will also be established in-country with SOFF funding, using a Kiribati government 'number 4 account' (**Activity 3.11**). A Kiribati government 'number 4 account' is a sequestered fund where development funding is held for a specific purpose, within the Kiribati national government accounts.

This fund will be used to fund freight and travel costs to ensure KMS technicians can visit sites for the regular proactive maintenance and for reactive repairs when required. It will also fund costs to maintain communications systems for the GBON stations (e.g. satellite and cellular provider), and all other ongoing costs required to ensure GBON compliance including, but not limited to, travel (air, boat and road) costs, communications costs and logistics costs.

It is proposed that a Pacific regional solution be identified for (i) level 3 maintenance and repair (see Table 6), (ii) instrument calibration and (iii) train-the-trainer services. Due to the small number of staff at most Pacific Island NMHS, regionally based teams that can support multiple Pacific Island Countries will be both effective and sustainable.

Table 6 – Example maintenance tasks for GBON stations

Level	Description	Surface tasks (examples)	Upper Air tasks (examples)
1	Basic tasks requiring few consumables or parts carried out by local personnel Local staff or contractors Basic instruction *And at sites with an upper air program:* In-country observations staff Moderately complex tasks carried out by staff following standard operating procedures (SOPs). Tools, parts and consumables will be required. Specific instruction on hydrogen safety.	• Clean Stevenson screen • Change wet-bulb wick • Cut grass/ vegetation	• Attach sondes and launch balloons • Change over hydrogen cylinders

2	Technical tasks carried out by staff following SOPs. Tools, parts and consumables may be required. In-country observations staff Basic meteorological technician training	• Collect station metadata • Replace sensors • Verify performance of sensors	•
3	Specialised maintenance actions carried out by trained staff. Procedures are complex and fault-finding is a required skill. Pacific Region maintenance resources Advanced meteorological technician training	• Replace infrastructure • Set up and configure new equipment and sensors • Advanced fault-finding	• Annual maintenance of UA system • Advanced fault-finding • Set up and configure new equipment and sensors • Install data communications system
4	Specialised repair or replacement by manufacturer or agent	• Return to agent/ manufacturer of component	• Return to agent/manufacturer of component

3.2. ICT infrastructure and services & 3.3. Data management system

Existing state

Data collection and transmission

Observations from the staffed stations are currently recorded by the observers in logbooks and transcribed into METAR/SPECI and SYNOP messages on a desktop computer. These messages are then sent to the KMS Betio office via e-mail, Facebook messenger or phone call, depending on the available communications technology at the site. 'Chatty beetle' satellite messaging devices have also been used in the past but are not currently operational. The messages are also passed via the same methods to the airport tower where the site is co-located with an airport.

The messages are forwarded by the KMS Betio main office to the Bureau's Central Messaging Switching Service (CMSS) in Australia via e-mail. The CMSS then converts the messages to BUFR format and sends them internationally to the WMO Global Telecommunications System (GTS).

Transmission of AWS data depends on the AWS type:

- NIWA AWS send data at 10-minute intervals via BGAN satellite to NIWA servers in New Zealand. NIWA servers then forward to the data on to the KMS CliDE database hosted on a server in the Betio offices.
- UNDP OTT-Hydromet AWS theoretically send data at 10-minute intervals via Iridium satellite to Iridium servers. The data are then intended to be polled by a server in the KMS Betio office. There are currently issues with software systems associated with this network, and KMS has been unable to procure funding to pay the satellite telemetry account. As a result, at present, no data are received from any OTT-Hydromet AWS.

None of the AWS data are currently transmitted to the GTS/WIS.

Power failures and load shedding are a regular occurrence at the KMS Betio head office in Tarawa and cause significant delays in the receipt and transmission of data from field stations and from AWS.

Climate Data Management System

KMS maintains a local version of the Climate Data for the Environment (CliDE) database (Figure 7). CliDE is a climate database management system developed by the Bureau under the International Climate Change Adaptation Initiative. It provides data entry, storage, basic visualisation and extraction tools for weather and climate data. It can process data in near-real-time.

The KMS version is hosted on KMS servers at their Betio head office. Data from the staffed stations are manually entered by KMS climate staff into CliDE from the SYNOP messages emailed by field observers. Data from the NIWA AWS are transmitted hourly from NIWA servers in NZ to the CliDE database. No data is received from the OTT-Hydromet AWS. The database is backed up daily to Bureau servers in Australia.

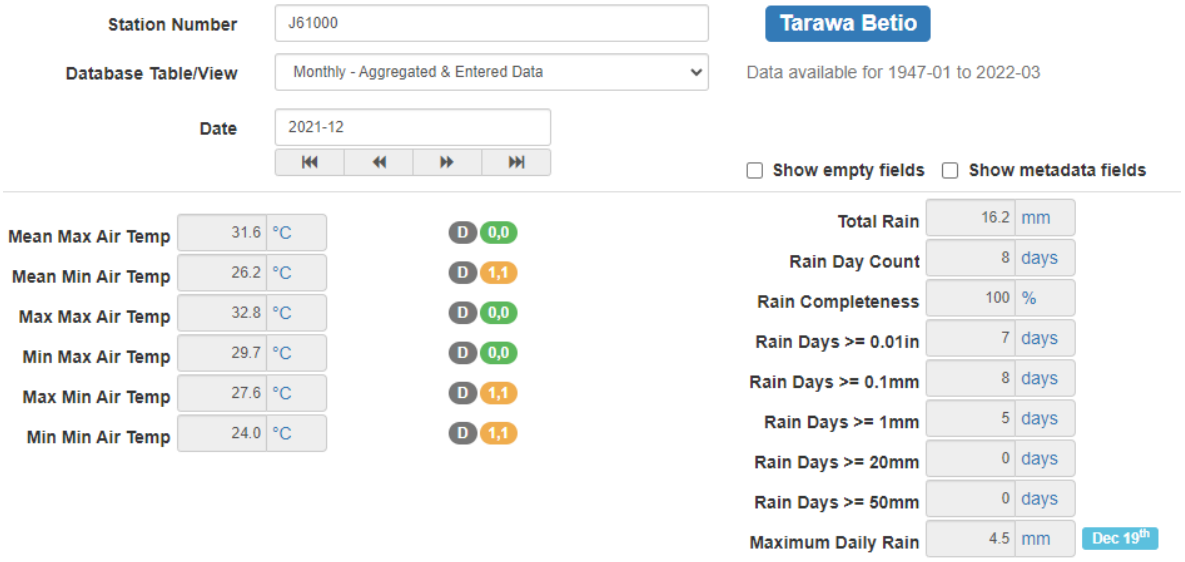

Figure 7 CliDE climate data management system interface

The CliDE database can only be accessed by KMS forecast, climate and oceanographic staff based at the KMS head office in Betio where the server is located. However, most data are not real-time due to the delay to manually input data.

Realtime data from the NIWA AWS can also be accessed from NIWA's NZ servers via NIWA's Neon web tool. Although not intended by NIWA to be a weather data visualization tool, this tool is used by the forecasters to see view recent observations as part of their forecast preparation. Forecasters also have access to the raw coded e-mail messages from the staffed field stations and access the data reported to the WIS via the third-party Ogimet website.

Other than the limited data reported internationally and available via third-party sites like Ogimet, the observations from KMS AWS or field stations are not accessible to other stakeholders or the public.

Target state and activities

Achieving sustainable, reliable reporting to WIS at hourly frequencies from all 14 proposed GBON surface stations will require a significant upgrade to KMS's ICT and data management systems including implementing a new Meteorological Data Management System (MDMS). Given the lack of reliable power supply, it is likely that a cloud-based solution will be most suitable. However if, prior to the start of the investment phase, the Australian aviation services initiative has installed a reliable backup power source at the KMS Betio head office, an on-site option may be possible.

At the start of the investment phase, an audit of existing power supply, ICT equipment and data flows will be undertaken to establish the detailed architecture of a Meteorological Data Management System (MDMS) compliant with WIS 2.0.

The MDMS must not be a single point of failure. This must be avoided with redundancy of the MDMS hardware, network connections and processing workflows or by deploying the MDMS on cloud-based services with the required level of resilience.

Key anticipated elements of the data system are described at conceptual level below.

- ***Observing station data collection***
  As part of the upgrade of manual and automatic weather stations, all stations will be equipped with robust cellular or satellite (preferred) communications to ensure regular, timely message transmission. Redundant data communications (satellite & cellular) communications from all sites is recommended.

  AWS will be configured to send data to the MDMS via a suitable data transfer protocol (e.g. MQTT or SFTP). The MDMS should have the ability for observers to supply manual observations via e-mail in the existing SYNOP or METAR/SPEC format, as well as through more modern methods such as a web or mobile-accessible interface.

- ***Data transmission to WIS 2.0***
  The MDMS will have the capability to undertake basic automated QC, then convert the data received from both automatic and manual stations to BUFR format before making the data available to WIS 2.0 through an HTTP service.

- ***Data services***
  The MDMS will also provide data services (e.g. APIs, shared filesystem, publication/ subscription service) to enable KMS to access the data, use it operationally and make it available to stakeholders.

- ***Climate data management***
  A Climate Data Management System (CDMS) will access data from the MDMS. The CDMS could be an updated and potentially cloud-based version of CliDE, or another suitable system selected in the procurement process. The CDMS should be compliant with *WMO No. 1131 Climate Data Management Systems*. The CDMS will be used to store, view and extract all climate data and metadata collected by KMS. Appropriate processing to produce quality-controlled data and statistics for climate purposes will be performed in the CDMS.

- **Webpage**
  A public-facing webpage will also be developed to disseminate key meteorological and climate data to other Kiribati stakeholders and the public. Consultation with stakeholders such as the Civil Aviation Authority, the Climate Change Unit and the Natural Disaster Management Office, highlighted a demand for weather observations

for situational awareness. Given the maritime nature of the country, there will also likely be strong public interest for marine safety. Disseminating the data widely under the KMS banner will increase public and government support for the important work done by KMS to collect and steward these data, supported by SOFF.

Through the entire value chain of data collection, transmission, processing, storage and distribution, KMS will retain total control and custodianship over their data.

Activities to uplift data systems as described above are:

- **Activity 3.12**: Procure expert audit of power supply, ICT equipment and data flows at start of Investment Phase, to develop detailed architecture for the Meteorological Data Management System and WIS 2.0 implementation
- **Activity 3.13**: Procure, install and commission a Meteorological Data Management System (including WIS 2.0 capability) through a 'supply and support' contracting approach, including ongoing training and maintenance support.
- **Activity 3.14**: Procure, install and commission a suitable upgraded Climate Data Management System through a 'supply and support' contracting approach.
- **Activity 3.15**: Develop a webpage to provide weather data products to stakeholders and the public.

3.4. Environmental and sustainability considerations

Environmental and sustainability considerations will be included in the procurement process, as a selection criterion for suppliers. This will enable UNEP and KMS to consider opportunities for reusable instruments or biodegradable materials such as:

- Biodegradable string (e.g. biotwine) for radiosondes;
- biodegradable balloons and parachutes (coloured blue or green to reduce ingestion by turtles and marine birds);
- reduction in size of radiosondes, incorporating biodegradable materials where feasible;
- environmentally sustainable packaging such as cardboard and paper;
- ensuring instruments do not contain mercury;
- careful use of batteries to reduce toxic waste.

In addition, prior to site works for upgrading stations or installing new stations, an environmental management plan will be prepared (**Activity 3.16**) considering local conditions and approaches to minimise the environmental impact of construction activities such as:

- use of solar or wind power at sites;
- sustainable materials used for construction, including reduction in site footprint;
- sites should be maintainable with basic tools (i.e. use of ladders and climbing harnesses should be avoided);
- plan for safe removal of waste at end of construction.

Module 4. GBON Human Capacity Development

4.1. Assessment of human capacity gaps

The staffing education profile of KMS reported as part of the Weather Ready Pacific assessment is shown in Table 7. The total number of staff positions is 33.

Several teams are critical to the sustainability and quality of observations at KMS:

- The technical and engineering team, headed by the Senior Technical Officer (STO) includes 5 technicians.
- The observing team, headed by the Senior Meteorological Observer (SMO), currently has 13 personnel based at 7 field stations across the country.
- KMS has one IT specialist.

Only a small number of staff have undertaken advanced meteorological training (BIP/M(T)). The main limitation on external training for KMS staff is lack of available of funds and scholarships. KMS does not currently have a budget for external training.

KMS has a better gender balance than many Pacific meteorological services at about 70% male, 30% female. It has high female representation in scientific professional roles such as climate, forecasting and oceanography. However, its gender balance overall is still skewed to males, particularly in technical and observing roles.

Table 7 Staffing profile of KMS. Source: Weather Ready Pacific Proposal, Pacific Meteorological Council 2021

Branch	Doctorate/ MSc/BIP-M	BIP-MT	Bachelor/ Diploma	Other	Total
Administration	1		1	2	4
Forecast and warning	1	2	2		5
Climate			1	1	2
Hydrology, Oceanography			1		1
Observations			1	12	13
Engineering			4	1	5
ICT			1		1
General services				2	2
Total	2	2	11	18	**33**

Figure 8 Key members of the Kiribati Meteorological Service team with Bureau peer advisors

Key gaps in human capacity necessary to ensure GBON compliance of observations are:

- None of the engineering, technical or observing personnel currently have BIP-MT qualifications which are considered essential to ensuring the sustainability and quality of observations.
- The technical personnel have no formal training in cellular and satellite communications which are critical to transmission of real-time data for GBON compliance.
- Additional observers will be required for the reopened Banaba and Fanning Island staffed stations and for the new upper air stations at Kanton and Kiritimati Islands.
- Observers require basic automatic and manual observing equipment maintenance skills to address equipment problems at remote stations in a timely manner to ensure reliability of observations. Given the costly and complex logistics of travel, this is much more efficient for basic maintenance than requiring reactive visits by technicians based on the head office in Tarawa.
- KMS relies on only one trained ICT technician at the head office in Tarawa. In order to successfully implement a new Meteorological Data Management System (MDMS) compliant with WIS2.0, further ICT expertise will be required in data and communications systems including HTTP, MQTT, APIs and WIS2.0 data exchange systems.
- Enhanced program and project management capability is required within KMS to oversee the roll-out and maintenance of the GBON equipment across 14 stations.

4.2. Capacity development activities for technical staff

The following capacity development activities are proposed to address the gaps identified above:

- **Activity 4.1**: Provide training in basic automatic and manual weather station verification and maintenance at the start of the Investment Phase for all KMS observers, with ongoing training through the Compliance Phase. The training should be specific to the equipment types that will be installed. This would ideally be included in a 'supply and support' contract as part of the equipment procurement.
- **Activity 4.2:** Provide comprehensive training in weather station maintenance for all KMS technical staff both at the start of Investment Phase and ongoing through Compliance Phase. This would ideally similarly be structured into 'supply and support' contract.
- **Activity 4.3**: Provide training in cellular and satellite communications and router configuration during the Investment Phase to all KMS technical and engineering personnel. Similarly, this training could be included in a 'supply and support' contract as part of equipment procurement.
- **Activity 4.4**: Offer training leading to BIP-MT qualifications to all of KMS's observing personnel. This could be organised through the Bureau of Meteorology, NZ Met Service or Fiji Met Service.
- **Activity 4.5**: Provide training in OSCAR/Surface and WDQMS operation to selected members of the Observations and Technical teams.
- **Activity 4.6**: KMS to be supported by SOFF to recruit new observers and technical staff to operate the reopened Banaba and Fanning Island staffed surface stations and the new Kanton and Kiritimati upper air stations. Support will be required both during Investment and Compliance phase.
- **Activity 4.7**: KMS to be supported by SOFF to recruit at least one new ICT professional, skilled in network, database and communications technology critical to WIS2.0, MDMS and CDMS. Support will be required both during Investment and Compliance phase. Training in WIS2.0, MDMS and CDMS may also be required.

4.3. Capacity development activities for senior management

The following capacity development activities are recommended to address the gaps identified above:

- **Activity 4.8**: Provide a SOFF-funded program/project manager to oversee equipment procurement, installation and commissioning during the Investment phase, with the position to ideally continue for the life of the equipment during the Compliance phase funded with SOFF compliance funding.

4.4. Gender and CSOs considerations

The following capacity development activities are recommended to address the gaps identified above:

- **Activity 4.9**: Organise stakeholder engagement consultations with civil society organisations (CSOs) focused on women's empowerment. This could include:
    - Direct contact with NGOs working with women and girls in Kiribati to promote employment opportunities in KMS (e.g. Kiribati National Women's Federation – Aia Maea Ainen Kiribati)
    - Presentations at Community meetings
    - Presentations to school groups
- **Activity 4.10:** Develop a Gender Gap Analysis and Gender Action Plan during the Investment Phase to guide the mainstreaming of gender and social inclusion initiatives into SOFF investments. The Gender Action plan could include the following:
    - Targets for female participation in the role areas associated with SOFF Investment and Compliance phases in Kiribati.
    - Inclusion of gender targets in procurement documents where human resources are part of the procurement,
    - Annual reporting of achievement of the above targets.
    - Development of ongoing campaign in schools and communities to promote female participation in roles linked to KMS.

Module 5. Risk Management Framework

5.1 Assess the risks of the observing network and propose mitigation measures

As part of the development of the National Contribution Plan, a high-level risk assessment has been undertaken, focusing on risks that were identified during the Readiness phase, with planned mitigation measures. The mitigation measures will be implemented during the Investment Phase (**Activity 5.1**).

Table 8 Risk analysis

Identified Risk	Mitigation Measures	Responsibility	Monitoring and Evaluation
Lack of equipment maintenance due to lack of spare parts leads to equipment malfunction	Procurement of equipment under 'supply and support' contract including continuous supply of spare parts	UNEP	Monthly spare parts inventory reporting
Lack of equipment maintenance due to lack of funding for travel and logistics	Establishment of logistics trust fund managed under a Kiribati 'number 4 account' for life of equipment	UNEP	Monthly reporting on logistics needs and activities. Regular quality audits
Loss of data due to long lead-times for repairs due to travel distance, complicated logistics	Co-locate the majority of automatic weather stations with manual weather stations. Manual observers to provide basic maintenance and redundancy	KMS and UNEP	Monthly review of WDQMS and GBON compliance
Poor data quality or lack of data from standalone AWS due to degradation of site conditions, vandalism or theft	Organise local caretakers for all AWS Proactive maintenance by KMS staff funded through establishment of 'logistics fund' Review of data that fails automated quality checks	KMS KMS and UNEP KMS	Monthly review of WDQMS and GBON compliance Weekly review of quality flagged data
Poor internet connections lead to data transmission delays	Equip all stations with redundant cellular and/or satellite communications	UNEP	Monthly review of WDQMS and GBON compliance

Unreliable power leads to communications outage and data delay	Equip all stations with batteries, uninterruptible power supply and solar/wind power generators	UNEP	Monthly review of WDQMS and GBON compliance
Unsuitable accommodation for equipment leads to degradation of condition	Include building accommodation audit and upgrade if required in procurement for staffed station uplift	UNEP	Annual quality audit by KMS quality manager
Insufficient human resources or technical skills to install or maintain stations and ICT system	SOFF to provide support for training of technical and observing staff during Investment and Compliance phase SOFF to fund recruitment of additional skilled staff during both Investment and Compliance Phase as outlined in Module 4 Build public and government support for KMS to ensure its budget is supported by: • Improved visibility of observations through stakeholder dissemination via uplifted data management systems and webpage • Improved weather services through access to modelling centre products during compliance phase Workforce planning to address attrition	UNEP UNEP UNEP and KMS KMS	Annual human resources audit by KMS

Module 6. Transition to SOFF investment phase

The activities outlined in this National Contribution Plan will provide the basis for developing the Investment Proposal for Kiribati's National GBON Network. The Investment Proposal will be developed by UNEP and KMS, with input from the Bureau (**Activity 6.1**).

Summary of GBON National Contribution Plan

Components	Recommended activities
Module 2. GBON business model and institutional development	1. Engage in regional forums to pursue opportunities for regional coordination in Investment Phase and Compliance Phase elements such as calibration, training, common equipment types.
	2. Develop procurement plan that allows for procurement of equipment to include private sector ongoing support (e.g. maintenance, training, advice, spare parts, etc.) for the life of the equipment during both Investment and Compliance phases.
	3. Undertake a comprehensive environment scan at start of Investment Phase of planned development activities related to GBON to identify opportunities for leverage and to ensure works are complementary.
Module 3. GBON infrastructure development	1. Secure land access for reopening staffed stations at Banaba and Fanning Island.
	2. Undertake audit of existing equipment and facilities at staffed stations to identify all items that require procurement.
	3. Procure 9 x uplifted manual observing equipment and 9 x new AWS at for the staffed sites under 'build and support' contracts, including site works, structures, facilities, power and communications infrastructure.
	4. Procure an independent expert site inspection and audit of existing AWS equipment to identify technical and communication faults and gaps.
	5. Procure a 'supply and support' contract to uplift at least 5 x AWS, as per the audit, to ensure they communicate reliably in real-time to GBON standards.
	6. Engage with island councils and establish caretaker contracts for the existing AWS for grounds maintenance and security.
	7. Secure land access for upper air stations at Kiritimati and Kanton Islands.
	8. Engage with UK Met Office to develop plan to upgrade flight frequency at existing upper air station at Tarawa (funded by UK Met Office).
	9. Procure 2 x upper air station equipment under 'build and support' contract, including site works and all ancillary structures, facilities and infrastructure.

	10. Update data transmission systems for existing sea level station at Betio to report to WIS (Bureau).
	11. Establish a logistics fund for freight, travel, communications (inc. satellite) and logistics costs for KMS personnel to undertake proactive and reactive maintenance.
	12. Procure expert audit of power supply, ICT equipment and data flows at start of Investment Phase, to develop detailed architecture for the Meteorological Data Management System and WIS 2.0 implementation.
	13. Procure, install and commission a Meteorological Data Management System through a 'supply and support' contracting approach, including ongoing training and maintenance support.
	14. Procure, install and commission a suitable upgraded Climate Data Management System (CDMS).
	15. Develop a webpage to provide weather data to stakeholders and the public.
	16. Develop environmental management plan for investment activities prior to site works.
Module 4. GBON human capacity development	1. Provide training in basic automatic and manual weather station verification and maintenance at the start of the Investment Phase for all KMS observers, with ongoing training through the Compliance phase, ideally included in a 'supply and support' contract.
	2. Provide comprehensive training in weather station maintenance for all KMS technical staff both at the start of Investment Phase and ongoing through Compliance Phase.
	3. Provide training in cellular and satellite communications and router configuration during the Investment Phase for all KMS technical and engineering personnel. Similarly this training could be included in a 'supply and support' contract as part of equipment procurement.
	4. Offer training leading to BIP-MT qualifications to all of KMS's observing personnel. This could be organised through the Bureau of Meteorology, NZ Met Service or Fiji Met Service
	5. Provide training in OSCAR/Surface and WDQMS operation to selected members of the Observations and Technical teams.
	6. KMS to be supported by SOFF to recruit new observers and technical staff to operate the reopened Banaba and Fanning island staffed surface stations and the new Kanton and Kiritimati upper air stations. Support will be required both during Investment and Compliance phase.
	7. KMS to be supported by SOFF to recruit at least one new ICT professional, skilled in network, database and communications

	technology critical to WIS2.0 and CDMS. Support will be required both during Investment and Compliance phase.
	8. Provide a SOFF-funded program/project manager to oversee equipment procurement, installation and commissioning during the Investment phase, with the position to ideally continue for the life of the equipment during the Compliance phase funded with SOFF compliance funding.
	9. Organise stakeholder engagement consultations with civil society organisations (CSOs) focused on women's empowerment.
	10. Develop a Gender Gap Analysis and Gender Action Plan during the Investment Phase to guide the mainstreaming of gender and social inclusion initiatives into SOFF investments.
Module 5. Risk Management	1. Implement measures outlined in the NCP risk management framework
Module 6. Transition to SOFF investment phase	1. Develop investment proposal, incorporating activities from this GBON National Contribution Plan (UNEP, KMS, with support from Bureau)

Report completion signatures

Peer Advisor signature 
Beneficiary Country Signature  **Ueneta Toorua (Mr.)** **Director Kiribati Meteorological Service (KMS)**
WMO Technical Authority Signature