COUNTRY HYDROMET DIAGNOSTICS

Informing policy and investment decisions for high-quality weather forecasts, early warning systems, and climate information in developing countries.

May, 2024

São Tomé and Príncipe NMS Peer Review Report

Reviewing Agency: KNMI, The Netherlands

INM
INSTITUTO NACIONAL DE METEOROLOGIA
República Democrática de São Tomé e Príncipe

Royal Netherlands Meteorological Institute
Ministry of Infrastructure and the Environment

UNDP

SOFF
Systematic Observations Financing Facility
Weather and climate data for resilience

WORLD METEOROLOGICAL ORGANIZATION

Alliance for Hydromet Development

Disclaimer

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Acknowledgements

information gathering by the KNMI peer-advisor team Janet Wijngaard, Carolina Pereira Marghidan and Chris Mannaerts (consultant).

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Executive Summary

In this hydrometeorological diagnostic report of the Democratic Republic of São Tomé and Príncipe (STP), the ten elements suggested according to the scoring criteria, defined in the CHD guidelines provided by WMO[1], were used to assess the maturity levels jointly by the peer advisor and beneficiary. The assessment was carried out through face-to-face meetings with officials of the National Institute of Meteorology (INM) of STP, its main stakeholders, and through a workshop held in São Tomé with the main partner organizations and users of meteorological services. This process allowed the reviewers to get a good overview of INM's institutional capacity and governance environment, as well as the main challenges INM faces in delivering its services. The INM and others provided sufficient information to suggest and propose specific recommendations.

INM is the designated Government authority for delivering meteorological services in STP. Its meteorological observations and forecasts are crucial for all socio-economic sectors, supporting short- and long-term planning and decision-making. The maturity scores, all 1 (one), indicate an institution currently in a non-progressive state of development, but with a desire to improve its services and reach higher maturity levels. The maturity levels of various elements require serious investments in human resource capacity as well as organizational and technical infrastructures. A number of relative quick wins were also identified which can permit the institution to acquire a fast institutional development track in the coming years (see further by key recommendations).

Table 1. Maturity levels for São Tomé and Príncipe

Element	Maturity Level Score
1. Governance and institutional environment	1
2. Effective partnerships to improve service delivery	1
3. Observational Infrastructure	1
4. Data & Product Sharing & Policies	1
5. Numerical Weather Forecast Model and Forecast Tool Applications	1
6. Warning and counseling services	1
7. Contribution to climate services	1
8. Contribution to hydrology	1
9. Promotion and dissemination of the product	1
10. Use and national value of products and services	1

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[1] WMO, 2022. Country Hydromet Diagnostic: Introduction ppt and video. https://alliancehydromet.org. (May, 2023).

There are still unresolved issues in the governance structure, such as implementation of legislation for the meteorological sector. However, most notably are the serious financial challenges and constraints of the institute. This leads to lack of operational funds to maintain its observation infrastructure and sustain the continuation of measurements. This includes a lack of trained and qualified human resources to fully oversee the entire "observation to information dissemination chain". It prevents the INM from effectively fulfilling its various functions at national, regional and international levels.

The INM lacks essential elements such as a sustained observation network, data processing, quality control and sharing mechanisms. There are no standard operational procedures nor service contracts for network maintenance and quality control. Efforts should be maximized to ensure continued and sustained operation and maintenance of the station network, and dissemination of information, warnings and forecasts to the society, ranging from government stakeholders to end-users in rural and urban areas. In summary, the ten critical elements assessed in this peer review are currently at the level one of maturity.

A bar chart summarizing the peer review scores for STP is presented in Figure 1. The country currently achieves Maturity Level 1 scores for all ten elements of the value chain.
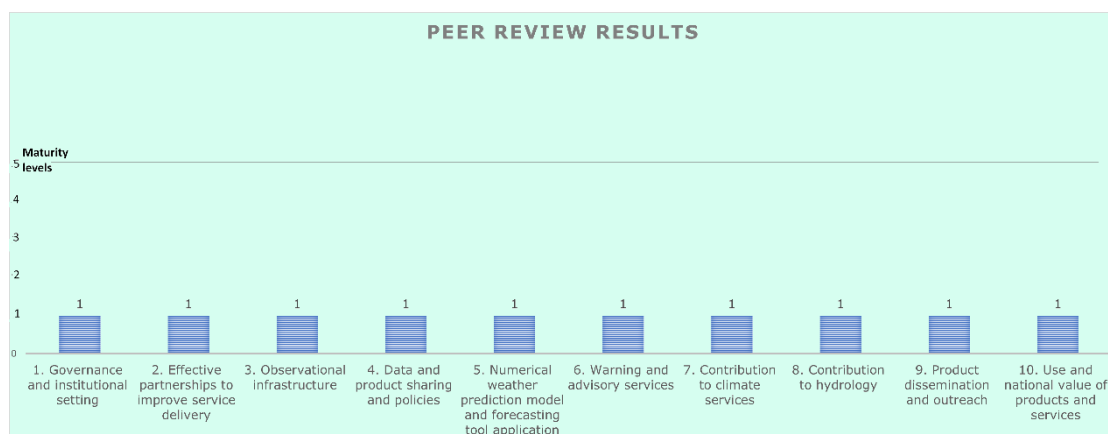
Figure 1: Maturity levels for the Hydrometeorological sector of São Tomé and Príncipe

The low maturity levels of all elements, from element 1 to 10, constitute serious challenges for the country. Problems detected in the national governance structure, implementation of legal frameworks, serious financial challenges and staff capacity are currently preventing the INM from effectively fulfilling all its functions at national, regional and international levels.

In the short- and medium- term, these levels can be raised with efforts to implement the main recommendations suggested in this diagnosis.

Gaps, urgent needs and key recommendations

Below we present an overview of the urgent needs and key recommendations for the different gaps, identified for the ten elements of the Hydromet value chain of São Tomé & Príncipe. The recommendations are ordered according to the 10 elements.

Table 2: Urgent needs and Key recommendations for the different elements

Element of Value Cycle	Key recommendations
Element 1: Governance and Institutional Settings	- Develop strategic plans to support and monitor the work processes and targets of the institute, i.e., 4-yr plans; - further work towards implementing legal Gvt. decrees; - diversify financial resources to reduce dependency on a single client & funding source; - develop a financial strategy for collection & delivering meteorological information to the agricultural, water, maritime, civil protection and health sectors (next to aeronautical weather services);
Element 2: Effective Partnerships to Improve Service delivery	- when building partnerships (e.g., int'l projects and investments), prioritize on securing sustainability of observations i.e., appropriate funding for O&M[2] and ICT[2]; - develop more active links and knowledge exchange with regional (e.g. Atlantic SIDS) and other partners;
Element 3: Observation Infrastructure	- Prioritize on the O&M component to sustain the observation infrastructure and invest in human resources for instrument & ICT expertise (currently only 1 person); ; - Expand the Observations Infrastructure unit (department);
Element 4: Data and Product Sharing and Policies	- Develop ICT and data quality control protocols; - Develop a digital Climate Data Management System and on-line mechanisms for data dissemination;
Element 5: Numerical Model and Forecasting applications	- seek partnerships with int'l institutions a/o countries, for developing joint initiatives in NWP; e.g., CPTEC, Brazil and other expertise centers, incl. academia;
Element 6: Early warning and advisory services	- Explore and develop a direct INM dissemination service; - Further strengthen coop. with CONPREC for joint public dissemination of extreme weather warnings;
Element 7: Contribution to Climate Services	- Set-up a Data Rescue project to save valuable historical meteorological data (from paper to digital climate data); - build human expertise in digital data management;

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[2] O&M: Operation and Maintenance and ICT: Information and Communication Technology

	- cooperate with DAAC in joint CS building;	
Element 8: Contribution to Hydrology	- Develop a cooperation agreement (with DGNRE - INA) for weather information provision and alert warnings for water-related hazards (e.g., flash floods); - Engage with int'l a/o regional hydrometeorological expertise partners;	
Element 9: Product dissemination and outreach	- Invest in human capacity for building and operating an on-line data access and dissemination system; - Design outreach efforts to e.g., the education sector, local communities to increase awareness of the societal value of meteorological observations e.g., for health;	
Element 10: Use of National Products and Values	- Engage in pro-active government awareness building to show the vital importance of meteorological observations and data for agricultural, water, maritime, civil protection and health purposes, beyond aeronautical safety;	

Chapter 1: General information

Introduction

São Tomé and Príncipe (STP) is an archipelago formed by two islands and several islets. It is located in the Gulf of Guinea between latitude 0-2°North and longitude 6-7°East, about 300 kilometers from the West African coast. The closest neighboring country is Gabon[3].

The country is of volcanic origin and has a hot humid tropical climate. Located on the equator, we observe one long rainy season occurring from September to June, but containing a small less wet period i.e., Dec-Jan.

Figure 2: Location of STP in Gulf of Guinea – Central West Africa

A more expressed drier season called "gravana"[4], occurs from June to August. These wet and drier spells arise from the seasonal migration of the Intertropical Convergence Zone (ITCZ) across the equator. The average annual rainfall in the country is around 2,200 mm[4], reaching more than 5,000 mm[4] at higher elevations in the south-west of the island of São Tomé. Lower rainfall (1,000 to 2000 mm) is prevalent in the northern coastal area of São Tomé Island[5]. Rainfall varies greatly from the coast to the interior upland areas and from the north to the south[6]. The local climate is strongly influenced by topography and elevation. The relief is very rugged, with the highest points: Pico de São Tomé with 2,024. m.a.s.l. and Pico do Príncipe with 948 m.a.s.l. The usually dense tropical vegetation varies according to the relief, altitude and microclimate characteristic of each region. The average annual temperature is around 25°C, while the relative humidity averages between 75% and 85% throughout the year[7]. The winds are predominantly from S/SE and the average speed does not exceed 12km/hr[8].

Figure 3: Satellite image of São Tomé Island, illustrating mountainous relief and dense tropical vegetation. Image: ESA Sentinel-2 date: 2024/Jan-Feb - minimal cloudcover temporal composite, 10-m spatial resolution, RGB pseudo colour (by CM)

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[3] Neves, A. M. (2019). Models for the Location of Sanitary Landfills in São Tomé and Principe. Lisbon, Portugal

[4] https://climateknowledgeportal.worldbank.org/country/sao-tome-and-principe/climate-data-historical

[5] Lains and Silva, H., (1958). Current Status of the Ecological Charter of São Tomé and Príncipe. Draft of the Natural Vegetation Charter. Lisbon, Portugal.

[6] Third National Communication on Climate Change: Vulnerability and Adaptation Report, São Tomé and Príncipe (2019)

[7] Second National Communication on Climate Change, Sao Tome and Principe (2014)

[8] Communication from the National Institute of Meteorology of São Tomé and Príncipe (Feb, 2024).

In 2012 the population of São Tomé and Príncipe was 178,739 inhabitants[9]. In 2017 the population of São Tomé grew to 197,700 inhabitants, of which 97,988 are men and 99,712 are women. Current population estimates (year 2023) range from 201,000[10] to 227,000[10] inhabitants. The Human Development Index (HDI) rose from 0.56 to 0.62 between 2010 and 2019, placing the country close to the average of countries in the average human development group (0.63).[11] These improvements are also reflected in the increase in average life expectancy from 67.4 years in 2010 to 70.4 years in 2019.[12]
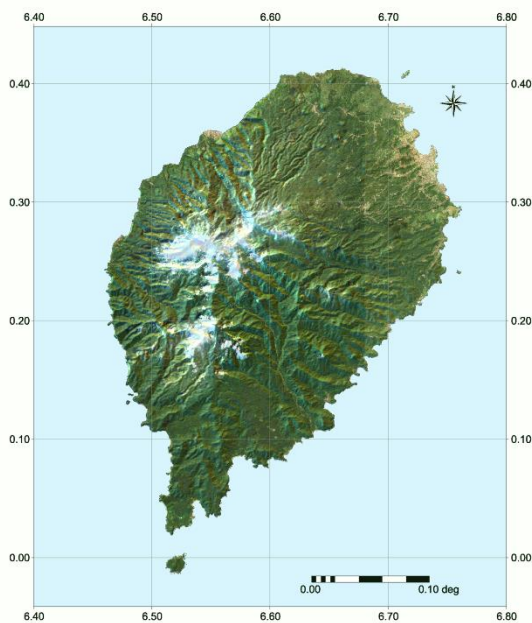

Figure 4: Satellite image of Principe Island, illustrating relief and dense tropical vegetation. Image: ESA Sentinel-2 MSI, date: 2024/Jan-Feb minimal cloudcover temporal composite, 10-m spatial resolution, RGB pseudo colour (by CM)
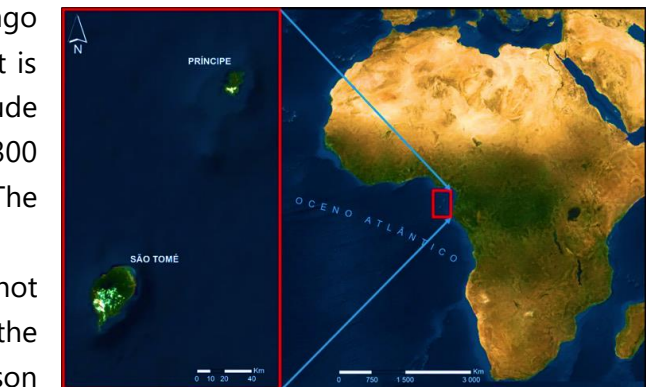
CHD Methodology

The Hydrometeorological Diagnostic (CHD) report responds to the need for a standardized, integrated and operational tool and approach to diagnose the National Meteorological Services, their operational environment and their contribution to high-quality meteorological, climatic, hydrological and environmental services and warnings. The CHD is a comprehensive tool that builds on and adds value to WMO's existing evaluation material by synthesizing existing approaches and data in an easily interpretable format. Thus, validating information provided by WMO members through a peer review process, and identifying missing information. The diagnosis aims to inform policy and investment decision-making, in particular to guide the investments of the members of the Alliance for Hydrometeorological Development. The Alliance brings together key development and climate finance partners behind a joint commitment to strengthen the hydrometeorological capacity of developing countries. Through this diagnosis, it is hoped that developing countries will benefit from better targeted and aligned financial and technical support. The Hydrometeorological Diagnosis of the Country is based on the ten most critical elements of the Hydrometeorological value cycle, grouped into four categories – enablers, observation and data processing system, production and dissemination of services and products, and interaction between users and stakeholders. The country information available in the WMO database and the responses provided by the NMHS focal points to a questionnaire developed on the basis of the CHD indicators were used as the first source of information to prepare this report. Several reports related to the meteorological and hydrometeorological capacities of STP were also used to obtain information of interest in this peer review process. However, it should be mentioned that the
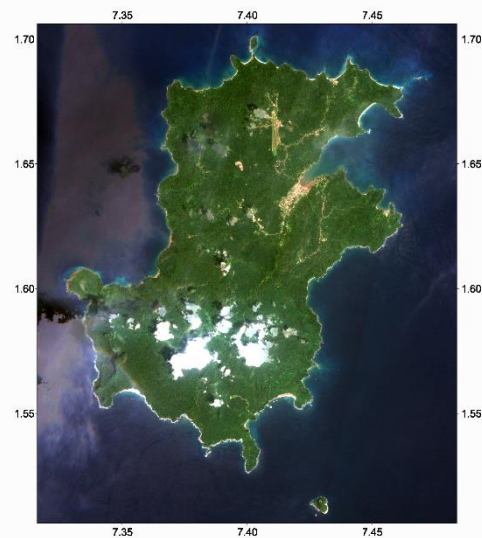
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[9] INE (2012). 2012 Population census conducted in São Tomé and Principe. Instituto Nacional de Estadística (INE)
[10] Data sources: UN World Population Prospects https://population.un.org/wpp/ (Jan, 2024) and https://dadosmundiais.com (visited: Mar, 2024)
[11] National Institute of Statistics, 2018.
[12] UN Common Country Analysis, 2022

main focus of this report is on the INM. This report presents a review of each of the ten most critical elements of the hydrometeorological value chain based on the information mentioned above and ranks each of them with a maturity level score (based on the evaluation of the indicators). At the end, the reviewers listed recommendations to help improve the maturity level rating in relation to these critical elements

Chapter 2: Country Hydromet Diagnostics

Element 1: Governance and institutional setting

In São Tomé and Príncipe, national meteorological services are provided by the National Institute of Meteorology (INM), currently under the Ministry of Infrastructure and Natural Resources (MIRNA). Until recently, the institute resided under the Ministry of Environment and Natural Resources. Hydrological Services are provided by the National Water Institute (INA). The National Council for the Prevention of Risks and Catastrophes (CONPREC) was created through Law – Decree No. 17/2011[13], in collaboration with the National Civil Protection and Fire Service (SNPCB) and has an important role in hydrometeorological early warning and disaster risk management.

The INM is the body through which the State coordinates work, actions and research, with the goal of delivering meteorological information and all other geophysical and astrological information, which are indispensable for air and maritime navigation, agriculture, livestock, fishing, the use of water resources, and other economic and scientific activities.

1.1   Existence of Act or Policy describing the NMHS legal mandate and its scope

The INM, in the past known as the Meteorological Service of São Tomé and Príncipe, was created in 1950 and transformed into the INM in 1979. The INM is now under the supervision of the Ministry of Infrastructure and Natural Resources (MIRNA). INM's legal statute was approved by Law Decree No. 10/2012[14], and its main attributions are: to maintain and develop the national meteorological, seismological and air quality information and surveillance systems, issuing severe weather warnings to public and private entities; ensure the provision of services in the fields of meteorology, seismology and air quality to the different national and international socio-economic agents, promote and ensure study and training at national and international level in the fields of meteorology, seismology and air quality. INM has currently the unique mandate for the above-mentioned monitoring services. In terms of air quality, the INM currently does not do any monitoring, although it is mentioned being their

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[13] "Diário da República", 24 May, 2011. Governmental Decree #17. Creation of CONPREC. See also https://www.fao.org/faolex/results/details/en/c/LEX-FAOC121605/ (in Portuguese).
[14] "Diário da República", 21 May, 2012. Gvt. Decree #10. Approval of legal statute of INM https://faolex.fao.org/docs/pdf/sao118129.pdf (in Portuguese).

mandate. A new Law - Decree No. 35/2018[15] has created a private regime for INM staff, but this has not been implemented yet.

INM does not operate a National Early Warning System for weather-related risks. Instead, INM provides daily weather forecasts to CONPREC, who disseminates weather information and early warnings to the general public and local communities. The country has already adopted a Disaster Risk Management (DRM) governance system for prevention, preparedness, emergency response and recovery (ref. Law Decree 17/2011 on Natural Disasters[16]). The system is based on collaboration and partnerships between institutions to facilitate the effective implementation of disaster risk-relevant measures through CONPREC.

1.2 Existence of Strategic, Operational and Risk Management plans and their reporting as part of oversight and management.

Currently, INM does not develop or use Strategic Plans (e.g., 4-yr), and also does not use Operational & Risk Management Planning, to guide and implement its work activities and delivery of services.

1.3 Government budget allocation consistently covers the needs of the NMHS in terms of its national, regional, and global responsibilities and based, among others, on cost-benefit analysis of the service. Evidence of sufficient staffing to cover core functions.

The annual budget is 1,346.131.72 (STN Dobra) and is equivalent to EUR 54. 944,15.0€. Nearly all (approximately 95%) of the budget is used for staff payroll. INM does not receive nor relies on the aid of international donors and/or projects for its main annual operating budget. Aviation and aeronautical meteorological services cover 83.4% of the annual budget through ENASA. Budget is therefore consequently mainly used for aeronautical forecasting purposes (staff salaries). Direct funding from the government is only 16.6%. About 5.3% of private revenues are allocated to small maintenance of equipment. The significant deployment of new equipment and instruments at the stations is all funded through international development assistance projects such as the regional WACA[17] program and national Early Warning e.g., SAP[17] project and others. Except the minimal private revenues resource (sale of meteorological data to third parties), INM has no budget for operation and maintenance (O&M) of its observation infrastructure.

1.4 Proportion of staff (availability of in-house, seconded, contracted- out) with adequate training in relevant disciplines, including scientific, technical, and information and communication technologies (ICT). Institutional and policy arrangements in-country to support training needs of NMHS.

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[15] "Diário da República", 10 Nov, 2018. Gvt. Decree #35. INM employee legal status (in Portuguese).
[16] "Diário da República", 24 May, 2011. Gvt. Decree #17. Creation of CONPREC.
https://www.fao.org/faolex/results/details/en/c/LEX-FAOC121605/ (in Portuguese).
[17] WACA or regional "Western Africa Coastal Area Management" Program, World Bank / GFDRR, under the Directorate of Environment & Climate Action (DAAC); SAP or "Sistema de Alerte Prévio" project, IE/UNDP under the Directorate General of Natural Resources and Energy (DGRNE) and INA (Institute of Water).

INM's human resources base consists of a total of 28 employees[18] (January 2024). The gender ratio of staff is 8 women to 20 men (see small Table below).

	# of Staff	Category	Training
	4	Meteorologist	Higher level in Meteorology
	16	Meteorological Technician / Observer	Various levels (classes) of meteorological training
	1	ICT Technician – Station Operation & Maintenance	Average level of meteorology and informatics
	2	Administrative assistant*	---
	1	Driver	---
	4	Cleaning**	---
	Total: 28		

(*) one in São Tomé main office and one in Príncipe Island (Autonomous Region); (**) 2 in ST; 2 in RAP

INM meteorologists are trained in general meteorology and over the years have participated in training and capacity building courses, mainly those offered by or through WMO. Most of the INM's staff are meteorological technicians and weather observers trained locally in São Tomé and Príncipe and do not have a formal higher education degree in one of the different scientific areas of meteorology, climatology, agrometeorology, oceanography or hydrometeorology. It is important to note that the INM has a deficit when it comes to the issue of human resources capacity, ranging from degree-trained higher-level staff, data communication (ICT) and instrument operation & maintenance technicians, to administrative and support staff.

The Government of STP has no official training policy for employees in the field of meteorology and climate.

1.5 Experience and track record in implementing internationally funded "Hydromet" projects as well as research and development projects in general.

INM, as main meteorological entity in STP, cooperates in international Hydromet-type projects with financing or project implementation partners e.g., UNDP, World Bank and others. Almost the entire AWS network is financed by external cooperation projects. We refer to the current station network in Figure 5, illustrating the AWS supplied (during 2022-23) through the WACA[17] program, and another Hydrometry & AWS network, installed (~2015) under the UNDP implemented SAP[17] project. We observed that most of these int'l funded observation network improvement projects lack the required financial component and resources for guaranteeing operation & maintenance of the new stations. This impedes INM from assuring continuity in observations. We diagnosed also that these modernization or network rehabilitation projects seldom foresee in adequate financial support for mobilization of human resources (e.g., 5-yr or more) for O&M[19], data collection and management (e.g., ICT). This is one of the root causes of failure of hydrometeorological observation infrastructure in many developing countries[20], and also the case in STP.

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[18] Source: National Institute of Meteorology (INM), Jan, 2024.
[19] O&M: AWS station Operation and Maintenance (incl ICT data communication)
[20] World Bank, 2022. Charting a Course for Sustainable Hydrological and Meteorological Networks in Developing Countries. Washington, DC: World Bank.
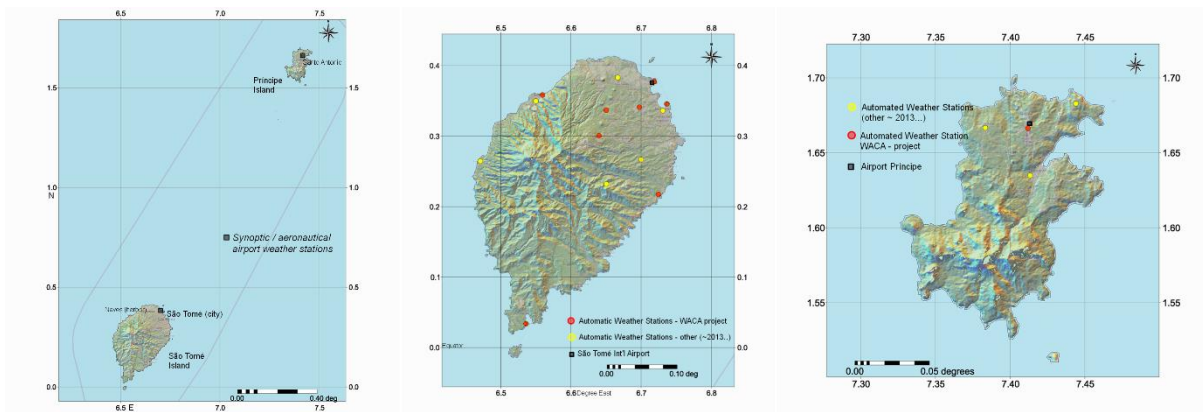
Figure 5: Weather observation network of STP

Due to the limited human resource base, no research cooperation and build-up of research capacity and/or project experience and track record has been achieved.

Summary score and recommendations for Element 1

Based on the analysis above, the **Maturity Level of One (1) was given to the Governance and Institutional Settings** of the Hydromet value chain for INM.

INM has a defined (but not fully implemented) legal mandate, but faces serious financial challenges to fully execute the work processes, required to maintain a national meteorological service. The limited human resource base also resorts in a lack of essential key competences. The governance structure is not well formalized and future planning is also poorly visible. The low score is also due to a significant budgetary dependence (83.4%) on one aeronautical (airports and air safety) company ENASA. This financing model does not support and permit development of other operational activities by INM, such as sound operation and maintenance a/o expansion of weather observation networks for maritime, agrometeorological, climate and other purposes, and also meteorological and climate research. The maturity level can be improved if INM can develop new (financial and capacity development) strategies[21], endorsed by higher government authorities, and can create services with various partners that support the entire chain of meteorological and climate observation. Strategic multi-year planning, including prioritizing operation and maintenance of its observation network, data communication, storage and dissemination, and also including staff development, training and capacity building also are an entire part of the strategy.

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[21] An example of a possible strategy here, can be the consideration (or request by INM) to include station operation & maintenance cost-based funding incl. human capacity, in station network expansion or rehabilitation projects, usually internationally funded by grants or soft loans (ref. WACA and SAF projects).

Element 2: Effective partnerships to improve service delivery

2.1. Effective partnerships for service delivery in place with other government institutions.

INM provides services to the general public, although service delivery is mostly informal (e.g., without a formal contract a/o Memorandum of Understanding). INM sends (tailored) warnings and forecasts for weather alerts to CONPREC who further disseminates them. There is an official partnership between INM and ENASA for the provision of aeronautical observation and forecasting services. Currently, there is no official collaboration or service delivery in place with national education and academic institutions.

2.2. Effective partnerships in place at the national and international level with the private sector, research centres and academia, including joint research and innovation projects.

Currently, there are no formal agreements between INM and the private sector for meteorological observation data collection initiatives or dissemination processes. There is a project-based partnership with AMBIMETRIC C° (Portugal) for the installation of automated weather stations under the WACA project, including an agreement for the use of cloud-based data storage and exchange (©Ambi DS). The INM does not receive government or other funding for research activities or projects. INM possesses a legal provision for eventual participation of private parties in the transmission of meteorological information. However, no private partner is currently involved with the institute.

2.3. Effective partnerships in place with international climate and development finance partners.

The INM does not have formal partnerships with the international climate and development community, except for being Focal Point for WMO and the UN-IPCC. In the framework of the WACA Project, with financial support from the World Bank, it has a project-based cooperation with international partners and private companies (equipment providers) to install new AWS and/or recover weather stations that have ceased to function (e.g., the SAP hydrometric station network; see further in Figure 7). New AWS were recently (2023) installed, such as the maritime station at the Port of Ana Chaves and Port of Neves, and in the future a maritime AWS will also be installed in the Autonomous Region of Príncipe.

2.4. New or enhanced products, services or dissemination techniques or new uses or applications of existing products and services that culminated from these relationships.

The new AWS networks have introduced new instruments and data communication protocols and data storage technologies (e.g. cloud-based services). Lack of human resource capacity however does not permit to take full advantage of the new technologies, introduced by external projects. This will require staff development and recruitment of new personnel, with appropriate training and capacity.

Summary score, recommendations, and comments for Element 2

On the basis of the above, **the Maturity Level 1 was given to Element 2: Effective Partnerships** of the Hydromet value chain for INM.

INM relies much on itself and does not have the human resources to promote and engage in partnerships. To increase this score, the INM should aim to develop weather and climate partnerships, and urgently develop the human capacity to implement more service delivery agreements and protocols with financing initiatives to empower and train its staff. INM should engage more with national and international stakeholders, and could be more proactive in implementing its partnership activities.

Element 3: Observational infrastructure

3.1. Average horizontal resolution in km of both synoptic surface and upper-air observations, including compliance with the Global Basic Observing Network (GBON) regulations.

INM's main observational infrastructure, with global real-time data communication, currently consists of only 2 aeronautical/synoptic AWS (Automated Weather Station), located at São Tomé int'l airport and Príncipe (domestic) airport. They are both listed in WMO OSCAR/Surface database.

These two synoptic stations lie ~170-km apart from each other. This distribution of stations has historically been derived from aviation and maritime transport needs and coastal zone activities. The current distribution of the stations approximates the GBON resolution requirement. Figure 6 shows the proposed GBON Surface and Upper Air stations of STP.
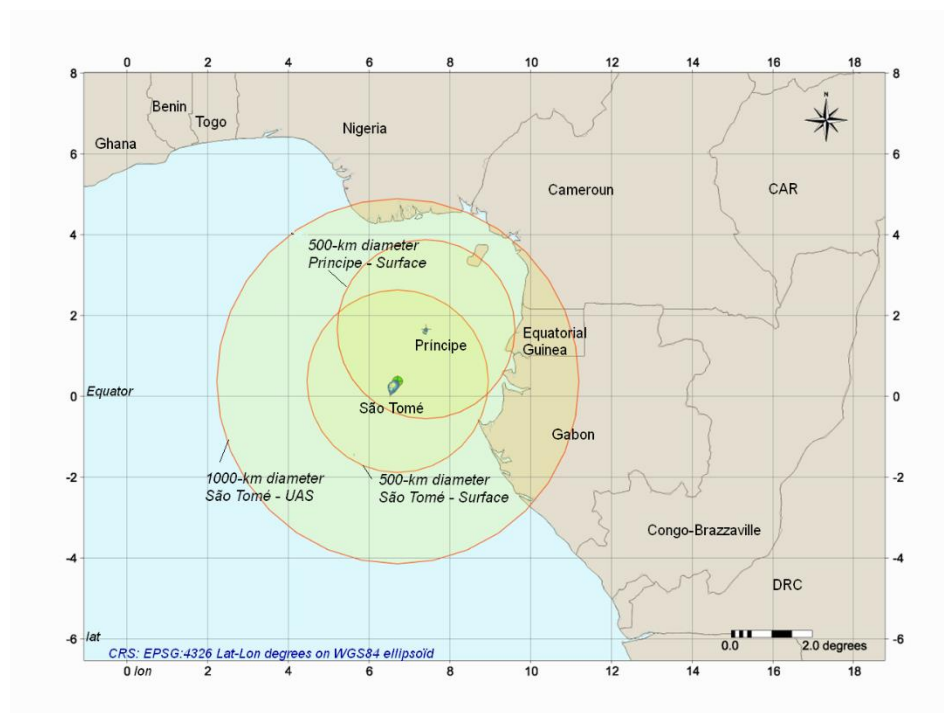

Figure 6: Proposed GBON meteorological station infrastructure of STP: two (2) Surface AWS (at airports of São Tomé int'l and Príncipe Islands and 1 Upper Air Sounding (UAS) station at ST Int'l airport

As shown in Figure 5 (see Paragraph 1.5), the INM operates currently (Jan, 2024) in total 13 AWS and 2 MWS. Two (2) AWS are classified as Synoptic aeronautical (and located at the airports of São Tomé and Príncipe Islands), two (2) newer maritime purpose AWS stations are located in the main harbours (Ana Chaves and Neves) and equipped with marine tidal gauges. The other weather stations are classified as "climatological" stations.

3.2. Additional observations used for nowcasting and specialized purposes.

The INM does not use additional surface station data for short-term early warning purposes. Its weather forecast unit (based at the ENASA offices at São Tomé int'l airport) uses EUMETSAT satellite observations (1 operational Synergie - Puma v.2015 system) in near real-time with a resolution of 3 km and time frequency of 15 minutes. The results of global weather forecast models, obtained from internet sources (e.g., the ECMWF 9-km NWP model; UK/0.3 and UK/Africa/0.04 and UK/Africa/0.2 and ARPEGE-AFR/0.5 models), are also routinely used in forecasting. There are no Doppler weather radar systems deployed by INM.

3.3. Standard Operating Practices in place for the deployment, maintenance, calibrations and quality assurance of the observational network.

INM staff applies some quality criteria for the deployment and maintenance of instruments. Regarding the overall quality assurance of the observational network however (e.g., incl. data quality control), there are no formal Standard Operating Procedures (SOPs) in place. There is also still no national WIGOS governance mechanism in place. Only one staff is currently being trained in OSCAR (by WMO). There is not a national process in place yet for quality questions and information received from WIGOS.

3.4 Implementation of sustainable newer approaches to observations.

The INM has not implemented new sustainable approaches to observations, except the use of renewable energy solar power panels for its newer AWS. INM currently is not developing or using multi-year strategic plans. We refer to the GBON National Contribution Plan for more information (establishment of national targets).

3.5. Percentage of the surface observations that depend on automatic techniques.

More than 90% of the Surface meteorological observations of São Tomé & Principe rely on AWS techniques and automated data communication protocols. Only two (2) manual weather stations are still in operation. The METAR/TAF and SYNOP reports from the aeronautical station (international airport) are transmitted using ICAO's AMHS (Aeronautic Message Handling System) and manually transferred to WMO RTH (Congo - Brazzaville) using WIS2.0 with a Messir-NET/COM software system.

Summary score, recommendations, and comments for Element 3

On the basis of the above, **the Maturity Level 1 was given to Element 3: Observational Infrastructure.**

STP has currently a limited basic surface observation infrastructure (1 globally communicating station) and no Upper Air observations. INM has a limited AWS network, and most AWS have a very short operational lifetime (estimated at 1-3 years), due to lack of O&M (budget and staff resources). The AWS network shows gaps with respect to WMO regulations and guidelines, due to operation and maintenance, data quality and reporting issues. The maturity level could be increased when operation and maintenance strategies and protocols are introduced, and sufficient (financial) resources and qualified personnel can be mobilized for the purpose. It is also necessary to further develop the newly introduced integrated ICT system for data reception, monitoring, storing, quality control and archiving meteorological and climate data. The INM should continue to put effort in meeting its SOP requirements in line with WMO standards[22].

Element 4: Data and product sharing and policies

4.1. Percentage of GBON compliance – for how many prescribed surface and upper-air stations are observations exchanged internationally. Usage of regional WIGOS centres.

Currently, one airport station is reporting (partially GBON-compliant) to the global community i.e., WMO and ICAO. There is no Upper Air observation facility. Aeronautical SYNOP data are now reported to the WMO Regional Telecommunication Hub (RTH) in Congo – Brazzaville using WIS2.0 (NEO – Supervision MESSIR-COM) and a manual message transfer protocol.

4.2. A formal policy and practice for the free and open sharing of observational data.

There is currently no formal data sharing policy by the INM for sharing weather station data generated by the service. The data is provided upon formal request to interested parties. The data is provided free of charge to the public through CONPREC. There is no WIGOS National Partnership Agreement for integration and open sharing of observations from INM, other institutions a/o private partners. There are currently no formal data policies and practices for sharing observation data.

4.3. Main data and products received from external sources in a national, regional and global context, such as model and satellite data.

Near real-time access to WMO data and products, as well as weather and satellite model data from other international sources, is reliable. INM uses EUMETSAT data reception and analysis products provided by one Synergie – PUMA v.2015 station and MESA software system. Access to global weather forecast models is used by the forecasting team, using reliable sources from the internet (see section 5.2).

Summary score, recommendations, and comments for Element 4

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[22] WMO, 2022. GBON Implementation and Compliance Monitoring.
https://community.wmo.int/en/activity-areas/wigos/gbon

A Maturity Level of 1 was assessed for Element 4: Policies and Data and Product Sharing. Currently, only a very limited amount of station data is shared through WMO-WIS and the global community. Only one station (São Tomé int'l airport) releases Synoptic data. We note that also METAR/TAF data (hourly airport weather reports) are issued and can be tracked on global aviation weather data servers. The maturity level can be increased if an appropriate data sharing policy is established by the INM, including technical aspects of AWS data storage and communication. The creation of a web-based platform for dissemination of data and information to stakeholders and the public is considered essential, as it will improve public awareness and interest in the service and also increase meteorological and climate data use. INM is currently making advances in using cloud-based data storage solutions (AmbiDS) and GPRS-based station data communication (for its new e.g., WACA program stations).

Element 5: Numerical model and forecasting tool application

5.1. Model and remote sensed products form the primary source for products across the different forecasting timescales.

INM utilizes near real-time internet access to various global weather forecast model results along with satellite data products and information generated by one MESSIR-SAT and one MESA system for forecasting. The types of data used range from textual information, to weather charts and gridded data. Satellite image products generated by the EUMETSAT and post-processed by the Synergie – PUMA station and MESA software systems are also interpreted.

5.2. a) Models run internally (and sustainably), b) Data assimilation and verification performed, c) appropriateness of horizontal and vertical resolution.

Currently there are no models run internally by INM. INM's weather forecasting unit uses and analyzes real-time information from regional and global NWP, climate prediction centers, and WMO WIS data. These are internet-based near real-time and forecast data and information. The most used NWP tool is the ECWMF 9-km NWP model output, derived from open access int'l servers (e.g., windy.com and/or others). We also refer back to section 3.2.

5.3. Probabilistic forecasts produced and, if so, based on ensemble predictions.

Currently, there are no probabilistic forecasts, derived, for example, from set forecasts generated by the INM. This requires, first and foremost, the development of sufficient human resources and skills.

Summary score, recommendations, and comments for Element 5

The Maturity Level for Element 5: Numerical model and application of forecasting tool is rated as one (1). The forecasts are based on classic forecasting techniques and NWP information from global models, and cover only a limited forecast time range. No regional models are used, except the Africa regional NWP models from the UK MET Office and Meteo France. The further increase in the maturity level requires, first of all, capacity building and

long-term international cooperation and engagement with NWP specialized centers, as staff is not trained in numerical weather forecasting models.

Element 6: Warning and advisory services

6.1. Warning and alert service cover 24/7.

INM produces daily weather forecast bulletins at 10.00 am local time, and shares this information with CONPREC. Detectable extreme weather alerts are included in the bulletin. If an extreme weather event rapidly develops after the bulletin is published, the bulletin is amended and/or an additional emergency is sent out. The CONPREC council is the responsible authority for Early Warning and coordination of Disaster Risk Reduction Services at national and local level. The National Civil Protection and Fire Service (SNPCB) is also part of the council. The INM has the obligation to send weather reports (including early warnings) to CONPREC. The INM has a 24/7/365 weather information service, covering the following weather-related hazards: extreme rainfall, strong winds, air turbulence and heavy tropical storms. Lead times are 48-hours up to a 3-hours in advance.

6.2. Hydrometeorological hazards for which forecasting and warning capacity is available and whether feedback and lessons learned are included to improve warnings.

Hydrometeorological risks monitored by INM include: thunderstorms/squall lines, extreme rainfall and strong winds; fog; dry haze and smoke; prolonged rainfall and wet spells. The INM does not issue early warnings through the standard national communication channels, but sends this information to CONPREC, which disseminates the messages to the public.

There is currently no flash flood early warning system, due to technical O&M issues with the Hydrometric station network (Fig.7). These are managed by the National Water Institute (INA). This diagnosis highlights that the legal basis and framework for hydrological risks has not yet been resolved and requires urgent attention from government stakeholders.

6.3. Common alerting procedures in place based on impact-based services and scenarios taking hazard, exposure and vulnerability information into account and with registered alerting authorities.

The INM does not have an established mechanism for the co-design and/or co-production of customized EW products and services[23]. Currently, there is no common format of alert procedures in place with partner governmental or non-governmental organizations. CONPREC develops National Contingency Plans[24] for Disaster Risk Management.

Summary score, recommendations, and comments for Element 6

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[23] WMO, 2019. Multi Hazard Early Warning Systems (MHEWS): a checklist
https://library.wmo.int/viewer/55893?medianame=MHEW_030918-08_#page=1&viewer=picture&o=bookmarks&n=0&q=
[24] CONPREC, 2018. "Plano de Contigençia Nacional" (in portuguese). National Council for Disaster Preparedness and Emergency Response, STP.

Element 6: Warning and Advisory Services has been assigned Maturity Level 1.

INM issues weather-related alerts with a lead time of 24-hr. INM does not directly disseminate its early warnings to the public. CONPREC receives the early warning information from INM and decides to further disseminate to the public.

The INA, mandated for hydrological hazards and early warning does currently not have a fully operational hydrometric network. An important physical hydrometric station network was built (ref. SAP[25] project ~ 2015-2016; see Figure 7), but essential rehabilitation and repairs are already needed and projected.

The full EW chain for Hydrometeorological hazards [26] [27]is still not entirely operational in STP.

To increase its weather alert and early warning services, INM should increase its reporting on more specific weather hazards and provide alerts for the passage of squall lines, development of massive convection, with thunderstorms, accompanied with lighting, high rainfall and strong winds; prolonged wet spells and increased flooding and inundation risks, visibility related to dry haze periods; prolonged heat periods. It could also directly disseminate its messages through standard national communication channels such as national TV and radio. Informal engagement with relevant institutions, including disaster management agencies, is still common practice, but progress on creating more formal cooperation agreements is being made. There is a legal basis for Disaster Risk Management with CONPREC[28], but no multi-hazard early warning system (MHEWS) is currently operational[26].

Element 7: Contribution to Climate Services

7.1. Where relevant, contribution to climate services according to the established capacity for the provision of climate services.

INM has a limited basic capacity to contribute to climate services, yet it is involved in national governance mechanisms for Climate Services. The Directorate for the Environment and Climate Action (DAAC) coordinates all activities related to climate change and adaptation in STP. DAAC works together with multiple national and international stakeholders, including financial institutions. The INM has the basic system capacity (networks and observation data) that allows it to contribute by providing data to authorities and stakeholders for research and development around climate services. The development of human resources capacity is considered an important issue for the development of climate services in the country.

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[25] SAP or "Sistema de Alerte Prévio" Hydromet project, implemented by UNDP and under the Directorate General of Natural Resources and Energy (DGRNE) – INA: National Institute for Water
[26] WMO EW4All Rapid Assessment for Pillar-2 (2023)
https://wmo.int/site/wmo-and-early-warnings-all-initiative
[27] WMO Hydrology Survey & Dashboard (2023)
https://hydrohub.wmo.int/en/hydrology-dashboard
[28] Diário da República", 24 May, 2011. Gvt. Decree #17. Creation of CONPREC.
https://www.fao.org/faolex/results/details/en/c/LEX-FAOC121605/ (in portuguese).

Important historical data rescue efforts are required in order to create appropriate time series of meteorological data for climate change analysis purposes.

Summary score, recommendations, and comments for Element 7

The Maturity score for this Element 7: Contribution to Climate Services has been rated at Level 1 (one).

INM has a very limited basic data infrastructure and human resources to respond to requests for climate data products and climate services. The INM has long historical series of meteorological data that can lead to very valuable contributions to climate change research and the development of climate services. A lot of historical data, however, is still on old paper files and needs to be transformed to digital format. To provide better meteorological and climate services, the INM should develop more human capacity to rapidly initiate historical analogue data rescue efforts and generate a digital climate database. From this database, appropriate statistical analysis can be made in order to generate sector-specific products. These valuable in-situ observation data can be compared and used together with freely available global climate data, products and models from various regional and global climate research and operational centers.

Element 8: Contribution to hydrology

8.1. Where relevant, standard products such as quantitative precipitation estimation and forecasts are produced on a routine basis according to the requirements of the hydrological community.

The National Water Institute (INA) is the main "Water Policy Manager" entity in São Tomé and Príncipe. Law Decree No. 17/2020[29] approves the organic statute of the INA. It is the authority whose mission is to propose, monitor, and ensure the implementation of national policy in the field of water resources including its sustainable management. It also is mandated to ensure the effective application of the Framework Law on Water Resources (Law Decree No. 07/2018)[30].

One of the main tasks of the INA is to organize, implement and manage the national water information system. It also has a close relation and cooperation with the National Fire Service and Civil Protection and other entities concerning local flash flood monitoring and alert warnings. INA together with CONPREC and SNPCB are involved in the dissemination of water-related early warnings to safeguard people and property. Currently, most hydrological and/or hydrometeorological observations are halted, because most automated hydrometry stations

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[29] "Diário da República", 17 June, 2020. Gvt. Decree #40. Approval legal statute of National Water Institute (INA); (in Portuguese).
[30] "Diário da República", Gvt. Decree 07/2018. Framework Law on Water Resources.

are out of order (due to lack of operation and maintenance and financial means for the technical maintenance and servicing of the stations).

Figure 7: Hydrometric stations

8.2. SOPs in place to formalize the relation between Met Service and Hydrology Agency, showing evidence that the whole value chain is addressed.

Currently, there is no formal agreement or a Standard Operating Procedure (SOP) to formalize the relationship between INM and INA. In São Tomé and Príncipe there is currently almost no surface water or flow monitoring infrastructure in operation. The sharing of information is made upon request by the institutions responsible for the services. INA has an important hydrological database of the country, which has been created in the past years.
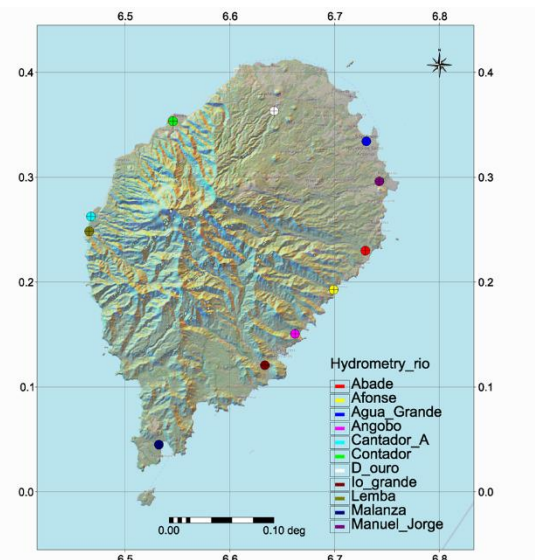
8.3. Data sharing agreements (between local and national agencies, and across international borders as required) on hydrological data in place or under development.

Upon formal request, the INA provides hydro-meteorological data and information to interested parties. There is currently no real-time operational and data-sharing mechanism. Hydrometeorological data products are neither generated nor disclosed.

8.4 Joint projects/initiatives with hydrological community designed to build hydrometeorological cooperation.

INA has national and international cooperation projects, such as the Network of Directors of Water Resources of the CPLP[31] to share information and knowledge of water resources; partnership with Brazil to exchange experiences; and a project with the African Water Resources Network for the recovery and operationalization of hydrometeorological stations in the country (project approved).

Summary score, recommendations, and comments for Element 8

For Element 8: Contribution to hydrology, a Level One (1) Maturity Score was attributed. INM has currently very little meteorological contribution to hydrology and water resources management in STP. The INM provides (on request) meteorological precipitation information that is used for hydrology and water resources management. This information is currently not sent to the hydrology services in the country on a regular exchange basis.

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[31] CPLP: Community of Portuguese Speaking Countries

There is still no formalized protocol between the INM and the INA for the operation of a hydrometric early warning network in the country. INM would be responsible for timely weather alert information and INA for subsequent water hazard alerts (i.e., flooding).

The current hydro-meteorological network in São Tomé and Príncipe requires rehabilitation, including more trained O&M and ICT technicians to work on improving and delivering hydrological information services to stakeholders and the public.

Element 9: Product dissemination and outreach

9.1. Channels used for user-centred communication and ability to support those channels (for example, does the NMHS operate its own television, video or audio production facilities? Does it effectively use cutting-edge techniques?).

INM disseminates the weather information only through CONPREC and sends daily weather reports (bulletins) by email to a number of Government parties and other stakeholders. CONPREC communicates via radio communication channels to the local communities (urban, peri-urban, rural). Currently, the INM does not have a website, social media (i.e., Facebook page), or uses any other means to disseminate its weather information.

9.2. Education and awareness initiatives in place.

There are no initiatives for education and awareness building for meteorological information in STP, led by the INM. The INM should show more interest in dissemination of meteorological practice and climate information to a variety of social groups including schoolchildren, young people and adults, in schools, churches, municipalities and other locations and CSOs of interest. This would increase climate literacy. In relation to AWS station safety and protection, awareness building of local populations for weather observations and meteorology is also considered important.

9.3. Special measures in place to reach marginalized communities and indigenous people.

Meteorological weather and forecast information sent to CONPREC by INM does reach isolated communities through the CONPREC communication channels. There are no specific measures in place to reach elderly populations, as they are mostly entire part of local communities.

Summary score, recommendations, and comments for Element 9

For **Element 9: Product dissemination and outreach, the maturity level is 1 (one).** Dissemination and Outreach of meteorological information is mostly done through CONPREC, with little control over messaging and/or format. Due to financial constraints, INM is not issuing weather bulletins via the standard communication channels (e.g. national TV and Radio). Social media are also not used to disseminate weather information. To improve the level of maturity it is necessary to create means such as telecommunication, a proper website and other media on social networks to reach larger parts of the population, increase climate

literacy and build institutional trust. Product dissemination and outreach has a high potential to develop services to more sectors.

Element 10: Use and national value of products and services

10.1. Formalized platform to engage with users in order to co-design improved services.

INM does not have a formalized platform to interact with users or co-design enhanced services. INM does not use a regular consultation mechanism to exchange and interact with other Government institutions, ministries and public stakeholders to interact about the importance and value of its weather products and services to the society and the economy. The DAAC is the main organizer and convener of the cross-sector dialogue, especially in the multisectoral debate on climate change.

10.2. Independent user satisfaction surveys are conducted, and the results used to inform service improvement.

The INM does not conduct surveys of various users and stakeholders, because it does not have a strategic plan and also lacks the human and financial resources to organize these activities.

10.3. Quality management processes that satisfy key user needs and support continuous improvement.

INM does currently not use a Quality Management System (QMS) for meteorological services, and is also not involved in international or regional project-based initiative on QMS.

Summary score, recommendations, and comments for Element 10

Element 10: Use and national value of products and services is assessed as level one.

Weather services (aeronautical, weather bulletins, alert warnings) provided by INM are used by the national stakeholders i.e., ENASA, CONPREC and others. However, INM does not engage with end-users in stakeholder feedback for e.g., improving and developing new services. Notwithstanding all stakeholders have emphasized the great importance and value of meteorological information and their sector (ref. Annex 2 recent stakeholder consultation meeting), there is currently no regular interaction with national stakeholders. Informal consultations only arise when extreme weather conditions occur across the country. The level of maturity can be increased by creating a mechanism for more regular interaction and joint development of products and services for the various stakeholders in society.

Annex 1 List of abbreviations

AMN-CP	National Maritime Agency and Port Authorities
ANP-STP	National Petroleum Agency of STP
AWOS	Automated Weather Observing Systems
AWS	Automated Weather Station
STP	São Tomé and Príncipe
CONPREC	National Council for Disaster Preparedness and Emergency Response
CSO	Civil Society Organization
DGA	Directorate General of Environment
DGAAC	Directorate General of Environment and Climate Action
DGNRE	Directorate General of Natural Resources & Energy
DPA	Directorate of Fisheries & Aquaculture
DRM	Disaster Risk Management a/o Risk Reduction (DRR)
ENASA	National Enterprise for Airports & Air traffic Safety
ECMWF	European Centre for Midterm Weather Forecasting
EU	European Union
EUMETSAT	European Meteorological Satellite Agency
FAO	Food & Agricultural Organization (UN)
FOSS	Free and Open-Source Software
GBON	Global Basic Observation Network – WMO
GFS	Global Forecasting System (US/NOAA)
GSOD	Global Summary of Day meteorological database (WMO Res.41)
ICAO	International Civil Aviation Organization
IMAP	Maritime and Harbor Institute
INAC	National Institute of Civil Aviation
INA	National Water Institute
INM	National Institute of Meteorology
INSP	National Institute for Public Health
KNMI	Royal Netherlands Meteorological Institute
MAPDR	Ministry of Agriculture, Fisheries and Rural Development
METAR	Meteorological Airport Reports (used for aviation)
MHEWS	Multi Hazard Early Warning Systems
NHS	National Hydrological Service
NMS	National Meteorological Service
NOAA	National Oceanic and Atmospheric Administration (USA)
NWP	Numerical Weather Prediction
NGO	Non-Governmental Organization
OSCAR	Observing Systems Capability Analysis Reviewing Tool - WMO
SIDS	Small Island Development States
SNPCB	National Service for Civil Protection and Fire Brigades
SOFF	Systematic Observations Financing Facility
SYNOP	Synoptic coded weather station messages
UN	United Nations
UNDP/PNUD	United Nations Development Program
UNICEF	United Nations Children's Fund
WIGOS	WMO Integrated Global Observing System
WIS2.0	WMO Information System 2.0
WMO	World Meteorological Organization
WHO	World Health Organization

Annex 2: Consultations (expert and stakeholder consultations)[32]

#	Organization (English)	Organization (in Portuguese)	Socio-economic sector	Main role & responsibility	Link a/o interests in INM (services, agreements, cooperation, opportunities)[33]
1	Directorate for the Environment and Climate Action	Direção do Ambiente e Ação Climática (DAAC)	Environment	DAAC leads (Gvt. Environmental Policy) and coordinates multiple national actions & projects related to environmental management, protection of ecosystems & rare species, natural resources, climate; see also https://dga.st Ref. Gvt. Law Decree #2/2007 art.24	*Cooperation* in the UNFCCC framework with INM (Nat.Focal Point); DGA in projects (e.g., WACA program weather monitoring infrastructure in coastal zones, etc.; climate data resources, reporting;
2	National Disaster Preparedness and Response Council	Conselho Nacional para a Preparação e Resposta a Catástrofes (CONPREC)	Disaster Risk Management (DRM)	CONPREC disseminates information about extreme weather and disaster alerts to entities, communities, and through radio and TV. Ref. Gvt. Law Decrees #17/2011; revised #3/2020 https://disasterlaw.ifrc.org/dmi/dmi-country/23	*Cooperation agreement*: CONPREC issues bulletins and early warnings derived from INM daily weather forecasts; allows to alert and trigger reaction mechanisms and responses for disasters; coordination DRM actions (with SNPCB);
3	National Civil Protection and Fire Service	Serviço Nacional de Proteção Civil e Bombeiros (SNPCB)	Civil Protection	SNPCB: gvt. entity on disaster risk prevention; coordination of emergency actions; execution "socorro e assistencia"; Ref. Facebook Page available	No direct cooperation agreement; through CONPREC: weather alerts and information; *Opportunities*: would require improved hydrometrical information (flash flood early warnings, etc.); see also DGNRE-INA;
4	National Company for Airports and Aviation Security	Empresa Nacional de Aeroportos e Segurança Aérea (ENASA)	Transport / Civil aviation	Airport infrastructure management; air traffic control and aeronautical navigation security; See also: https://www.enasa.st Ref. Gvt. Law decrees #34/1987; revised #4/2016	*Cooperation agreement* and direct 24/7 link with INM weather forecaster staff; airport AWOS for near real time weather information (e.g., Synop, Metar, Taf reports) for pilots and air traffic;
5	Maritime and Port Institute	Instituto Marítimo e Portuário (IMAP)	Transport / Maritime	Gvt. Entity; regulatory; maritime transport security (incl. ferries), vessel pollution monitoring, security and navigation, etc. See also https://imapst.com Gvt. Law Decree #13/2007 IMAP-STP	*Opportunities*: weather data i.e., maritime station data, e.g. tidal monitoring, local weather information for harbors; coastal winds and wave heights info in EEZ, etc.

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[32] Results of a joint Stakeholder consultation meeting with beneficiary, various stakeholders and peer-advisor team, held on Feb, 01 2024 in São Tomé city (offices of DGA); and further contacts of peer-advisor consultants with a number of parties;

[33] This column indicates: existing *formal cooperation agreements*, other links, and also some *opportunities* for future cooperation (e.g., information provision, data sharing and exchange, etc.) discussed during the workshop or during further contacts;

6	Directorate of Fisheries and Aquaculture	Direção das Pescas e Aquacultura (DPA)	Agriculture & Fisheries / Marine resources	Promote sustainable management, coordination, monitoring of fisheries in EEZ; from pelagic, artisanal to large vessel; coordination actions; project development, int'l cooperation;	*Opportunities:* Enabling local fishermen better access to near real time local weather and sea state information; use of SHIP weather data (int'l vessel-based weather stations); marine weather stations;
7	Ministry of Agriculture, Fisheries & Rural Development	Ministério de Agricultura, Pescas & Desenvolvimento Rural / MAPDR	Agriculture, Fisheries, Food & natural resources; Rural space	Management of the agricultural resource base, incl. marine (food) resources, rural populations, rural area management; food security; www.mapdr.gov.st	*Opportunities*: meteorological forecasts for agriculture; agrometeorological stations data sharing and exchange / use; weather alert warnings in rural areas;
8	National Water Institute	(Instituto Nacional da Água) INA	Water & Sanitation, Water resources	National water management; water use authority, licensing; sanitation; water resources monitoring; Part of Dir.Gen. of Energy, Water, Geology & Mining; more info on: https://dgnre.org Gvt. Law Decree #17/2020	*Opportunities:* design cooperation agreement in hydrometeorological monitoring e.g., coupling hydrometric and AWS weather station network data; for flash flood alert warnings, and more;
9	National Petroleum Agency	Agência Nacional de Petroleos (ANP)	Energy & Industry; natural resources	Public entity, regulation petroleum, gas industries and use; https://www.anp-stp.gov.st Gvt. Law Decrees #5/2004; revised #7/2014	*Opportunities*: Weather bulletins; weather alert warning; information for safety of storage utilities, petrol transport;..
10	National Institute of Civil Aviation	Instituto Nacional de Aviação Civil (INAC)	Transport / Civil aviation	Civil aeronautical authority; coordination civil aviation; ICAO link; More info on: https://www.inac.st Gvt. Law decree #44/1998	Weather bulletins and meteorological information for civil aviation safety;
11	National Maritime Authority – Port Authority	Autoridade Marítima Nacional – Capitania dos Portos (AMN CP)	Transport / Maritime	Maritime port authority; harbor monitoring, security and navigation, etc. Facebook page available	*Cooperation agreement* on sharing maritime station data, e.g., harbor tidal monitoring, local weather information for harbors (vessel docking);.
12	Airlines	- STP Airways - TAAG - TAP	Transport / Civil aviation Airlines	National domestic airline; main connection Sao Tome – Principe International airline (Angola); int'l connections International airline (Portugal); int'l connections	*Opportunities*: ensuring improved aeronautical and airport weather information, required for pilots and aviation safety; alert warnings e.g. for large convection, lightings, heavy thunderstorms; wind shear; etc.
13	United Nations Development Programme	UNDP / PNUD Programa das Nações Unidas para o Desenvolvimento	Development & Int'l Cooperation sector	United Nations Development Program – STP offices. For national program and actions, ref. https://www.undp.org/pt/sao-tome-principe	*Cooperation* in UN ("PNUD") projects; Implementation Entity (IE) for WMO – SOFF Systematic Observation Financing Facility; Interests in digital access to weather and climate information and data of STP for development;

Annex 3 Information supplied through WMO and other references

The data inventory and review sheet supplied by WMO was used as a peer-review assistance tool developed to standardize the review process by providing WMO Monitoring System data in an organized way. A digital copy of the sheet was provided to the peer advisor (Nov, 2023) with beneficiary country data organized across the CHD elements, indicators, WMO Data, Suggested Additional Data, Peer-Advisory Score.

For this CHD production, multiple WMO webpages, related to observation infrastructure, data streams and the SOFF process were reviewed. The https://alliancehydromet.org pages and information were also used to disseminate the purpose of the CHD country diagnostic to the INM service staff and stakeholders. This included also the PowerPoints. We refer further to the list of references below, shown as numbered references in the report text.

WMO information and consulted documents (in period Oct, 2023 – Mar, 2024)

[1]   WMO, 2022. Implementation of GBON & GBON Network Status
        https://community.wmo.int/en/activity-areas/wigos/gbon/implementation-global-basic-observing-network-gbon

[2]   WMO, 2022. Country Hydromet Diagnostic: Introduction ppt and video.
        https://alliancehydromet.org. (May, 2023)

[3]   WMO, 2022. SOFF Operation Manual (version Nov, 2022)
        https://un-soff.org/document-library/

[4]   WMO, 2022. GBON Implementation and Compliance Monitoring.
        https://community.wmo.int/en/activity-areas/wigos/gbon

[5]   WMO, 2019. Multi Hazard Early Warning Systems (MHEWS): a checklist
        https://library.wmo.int/viewer/55893?mediiname=MHEW_030918-08_#page=1&viewer=picture&o=bookmarks&n=0&q=

[6]   WMO, 2023. Various webpages consulted on WIGOS, SOFF, GBON, OSCAR, GDQMS, WIS2.0 https://community.wmo.int/en/activity-areas/wigos/gbon

[7]   WMO Monitoring System Data (2023)
        https://community.wmo.int/en/planning-and-monitoring/monitoring-and-evaluation

[8]   WMO EW4All Rapid Assessment for Pillar-2 (2023)
        https://wmo.int/site/wmo-and-early-warnings-all-initiative

[9]   WMO Hydrology Survey & Dashboard (2023)
        https://hydrohub.wmo.int/en/hydrology-dashboard

Other references (also embedded as footnotes)

[10]   "Diário da República", 24 May, 2011. Gvt. Decree #17. Creation of CONPREC.
        https://www.fao.org/faolex/results/details/en/c/LEX-FAOC121605/ (in portuguese).

[11]   "Diário da República", 21 May, 2012. Gvt. Decree #10. Approval of legal statute of INM
         https://faolex.fao.org/docs/pdf/sao118129.pdf . (in portuguese).

[12]   "Diário da República", 10 Nov, 2018. Gvt. Decree #35. INM employee legal status (in
         portuguese).

[13]   World Bank, 2022. Charting a Course for Sustainable Hydrological and Meteorological
         Networks in Developing Countries. Washington, DC: World Bank.

[14]   "Diário da República", 17 June, 2020. Gvt. Decree #40. Approval legal statute of National
         Water Institute (INA); (in portuguese).

[15]   "Diário da República", 11 Sep, 2007. Gvt. Decree #44, Lei de Base da Segurança Marítima
         (AMN-CP).

[16]   UNDP-STP, 2023. UNSDCF 2023-2027. UN Sustainable Development Cooperation
         Framework for STP. Commitment Declaration.

[17]   CONPREC, 2018. "Plano de Contigência Nacional" (in portuguese). National Council for
         Disaster Preparedness and Emergency Response, STP.

[18]   DGP/DPA, 2017. Multisector Investment Plan for Coastal Zone Management. Directorate
         General for Planning (DGP) & Directorate General of Environment (DGA) of STP, with World
         Bank - GFDRR support.

[19]   UNEP, 2022. São Tomé and Príncipe National Adaptation Planning NAP project: "Reduce
         São Tomé and Príncipe's vulnerability to climate change impacts by strengthening the
         Country's capacity to implement an integrated approach to adaptation planning". Interim
         Progress Report of Readiness and Preparatory Support Phase. GCP - Green Climate Fund,
         grant STP-RS-002.