COUNTRY HYDROMET DIAGNOSTICS

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

November 2024

Ecuador Peer Review Report

Reviewing Agency:
Federal Office of Meteorology and Climatology MeteoSwiss

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Authorization for release of this report has been received from the Peer Reviewing Agency and the Country NMHS as of 12 December 2024.

Digital unterschrieben von Appenzeller Christof LZNDCC Datum: 2024.12.13 15:47:39 +01'00' Prof. Dr. Christof Appenzeller Director MeteoSwiss Operation Center 1 CH-8058 Zurich-Airport Switzerland	Firmado electrónicamente por: BOLIVAR ANDRES ERAZO MALDONADO PhD, Bolívar Andrés Erazo Maldonado Director Ejecutivo del Instituto Nacional de Meteorología e Hidrología Nuñez de Vala N36-15 y Corea Quito, Ecuador

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Acknowledgements

The successful completion of this report would not have been possible without the invaluable support of INAMHI personnel and the expert contributors from SMN. Furthermore, we would like to express our gratitude to the Swiss Embassy in Quito for its pragmatic and flexible support.

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List of Abbreviations

ACTO	Amazon Cooperation Treaty Organization
CAP	Common Alerting Protocol
CELEC	Corporación Eléctrica del Ecuador (Ecuadorian Electric Corporation)
CHD	Country Hydromet Diagnostics
CPT	Climate Predictability Tool
DGAC	Dirección General de Aviación Civil (Directorate-General for Civil Aviation)
EPMAPS	Empresa Pública Metropolitana de Agua Potable y Saneamiento (Metropolitan Public Water and Sanitation Company)
ERFEN	Estudio Regional del Fenómeno El Niño
EW4All	Early Warnings for All
FEWS	Flood Early Warning System
GBON	Global Basic Observing Network
GFS	Global Forecast System
GOES	Geostationary Operational Environmental Satellites
IBF	Impact-Based Forecasting
IDB/BID	Inter-American Development Bank (Banco Interamericano de Desarrollo)
INAMHI	Instituto Nacional de Meteorología e Hidrología (National Institute of Meteorology and Hydrology)
IRD	Institut de Recherche pour le Développement (Institute of Research for Development)
ISO	International Organization for Standardization
MAATE	Ministerio de Ambiente, Agua y Transición Ecológica (Ministry of Environment, Water and Ecological Transition)
MOS	Model Output Statistics
NCEP	National Centers for Environmental Prediction
NMHS	National Meteorological and Hydrological Service
NOAA	National Oceanic and Atmospheric Administration
NWP	Numerical Weather Prediction
OSCAR	Observing Systems Capabilities Analysis and Review
QMS	Quality Management System
RSMC	Regional Specialized Meteorological Centre
SGR	Secretaría de Gestión de Riesgos (National Secretariat of Risk Management)
SOFF	Systematic Observations Financing Facility
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
WFP	World Food Programme
WIGOS	WMO Integrated Global Observing System
WIS	WMO Information System
WMO	World Meteorological Organization
WRF	Weather Research and Forecasting

Executive Summary

The "Country Hydromet Diagnostics (CHD) Ecuador Report" is an assessment by MeteoSwiss, in collaboration with Ecuador's INAMHI, to enhance hydrometeorological services in Ecuador. It focuses on infrastructure, policy, and service improvements to elevate weather forecasting, climate information, and early warning systems.

In fulfilling its mandate, INAMHI is confronted with a distinctive set of challenges, largely due to Ecuador's geographical diversity, encompassing the Amazon Basin, the Andean Highlands, the effects of the Pacific Ocean and the El Niño Southern Oscillation on the coastal region and the Galapagos Islands.

This summary highlights key achievements and areas for growth across ten critical elements of hydrometeorological services in Ecuador, supporting policy and investment decisions.

Key findings include (bold, to be prioritized):

1. **Governance and Institutional Setting**: Despite operating within a structured legal framework, INAMHI encounters challenges due to insufficient funding and staffing. It is recommended that a risk management plan be established and that funding consistency be enhanced. A socio-economic benefit study may serve as a good starting point.
2. Effective Partnerships: INAMHI benefits from diverse collaborations with national and international entities, including WMO and UNDP, but requires more sustainable, long-term agreements.
3. **Observational Infrastructure**: Ecuador's observational network is moderately developed. Efforts to meet GBON standards and implement essential upper-air observation stations are recommended.
4. **Data and Product Sharing**: A formal data-sharing policy aligned with international standards is necessary to enhance accessibility and usability.
5. Forecasting Tools: INAMHI's modeling and forecasting capabilities are robust, though enhancements in post-processing and probabilistic forecasting are needed for better accuracy.
6. **Warning Systems**: Ecuador's early warning system operates seasonally but needs expansion to offer 24/7, multi-hazard alerts year-round.
7. Climate Services: Existing climate services are beneficial; however, integrating hydrological and climate data will strengthen long-term resource management.
8. Hydrological Contribution: Hydrological forecasting, crucial for flood management, is developing but requires further integration with meteorological forecasts and expanded infrastructure.
9. Outreach and Dissemination: INAMHI communicates effectively via social media, but more targeted outreach to marginalized communities and educational programs would enhance impact.
10. User Engagement: Formal user feedback mechanisms and a quality management system would support continuous service improvement.

This report highlights Ecuador's significant advancements in hydrometeorological services while delineating recommendations for further growth. An emphasis on sustainable

partnerships, infrastructure development, and comprehensive warning systems will empower Ecuador to more effectively manage climate risks, thereby enhancing public safety, environmental protection, and socio-economic resilience.

Element	**Maturity level score**
1. Governance and institutional setting	2
2. Effective partnerships to improve service delivery	3
3. Observational infrastructure	3
4. Data and product sharing and policies	1
5. Numerical weather prediction model and forecasting tool application	3
6. Warning and advisory services	3
7. Contribution to climate services	3
8. Contribution to hydrology	3
9. Product dissemination and outreach	3
10. Use and national value of products and services	3

Chapter 1: General information

Introduction

The Country Hydromet Diagnostics (CHD) provides a structured assessment of INAMHI's capacity, identifying areas of priority for investments and operational improvements. This report is part of the Systematic Observations Financing Facility (SOFF) initiative, aimed at enhancing INAMHI's operational capabilities, particularly in achieving compliance with the Global Basic Observing Network technical regulations (GBON). Ecuador was included in the first "batch" of SOFF recipient countries as the only non-Small Island Developing State or non-Least Developed Country. It is, however, an Official Development Assistance-recipient country (upper middle income). Ecuador is the only country in South America to be selected for this initiative thus far, largely due to the region's overall low GBON compliance.

Country Status

Ecuador is a country at the equator with a total area of 283'561 km^2 including the Galapagos Islands and 6'720 km^2 of water. Its population as of 2022 is about 16.9 million[1].

The country's climate in the tropical zone plays a key role in the world's climate system. Ecuador's diverse topography makes it highly susceptible to climate risks, such as floods, droughts, and tropical storms. Its diverse landscape includes the Amazon Basin, the Andean Highlands and the unique location in the Pacific, the Galapagos Islands. The country's diverse climate zones exhibit a range of characteristics, from equatorial climates with high humidity and minimal winter precipitation to arid conditions, warm-temperate climates, and even polar climates influenced by tropical glaciers in the Andes (Köppen-Geiger Climate Classification).

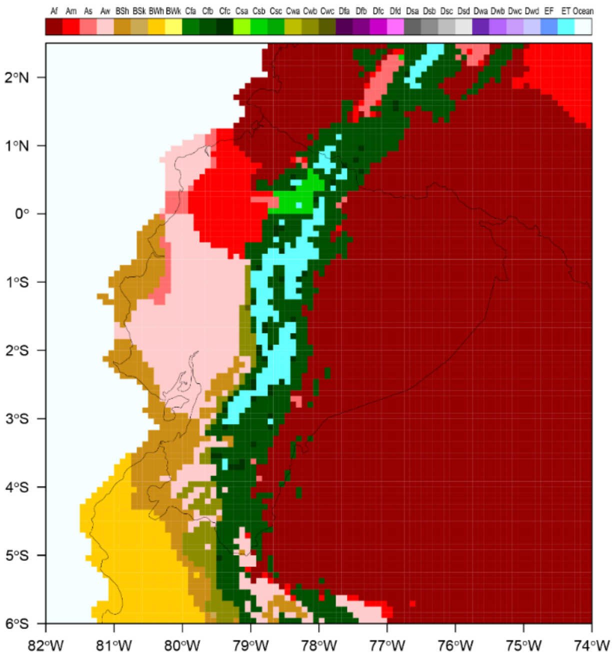

Figure 1: Ecuador with its many different climate zones (Köppen-Geiger Climate Classification, 1986-2010)

[1] Source: https://www.censoecuador.gob.ec/wp-content/uploads/2023/09/InfoNacionalDatos.pdf

This diversity also creates challenges in building a nationwide hydromet network. INAMHI's operational challenges are compounded by budgetary constraints, outdated infrastructure, and the need for more skilled personnel.

The Instituto Nacional de Meteorología e Hidrología (INAMHI) is the agency for hydrometeorology under the Ministerio de Ambiente, Agua y Transición Ecológica "MAATE" (Ministry of Environment, Water and Ecological Transition).

The mandate given to INAMHI as described in the Law of the Institute of Meteorology and Hydrology, INAMHI (Supreme Decree 2438, Official Register 839 of 25 May 1979) is as follows:

- Overseeing meteorological and hydrological activities across the country, in alignment with national socio-economic development programs.
- Setting Standards and Systems: Developing regulations for meteorology and hydrology programs to meet national needs.
- Operating and Maintaining Infrastructure: Establishing and managing the essential hydrometeorological infrastructure for national programs.
- Data Collection and Dissemination: Collecting, analyzing, publishing, and sharing meteorological, climatic, and hydrological data to understand Ecuador's conditions.
- Research and Studies: Conducting general and specific hydrometeorological studies upon request from state or private entities.
- Training and Capacity Building: Providing mid-level training and promoting specialization in meteorology and hydrology.
- Promoting Scientific Research: Encouraging scientific research in the fields of meteorology and hydrology.

INAMHI coordinates the National Network of Meteorological and Hydrological Stations, partnering with state and private institutions to operate weather stations under INAMHI's standards. INAMHI is also responsible for issuing warnings and developing hydrometeorological products based on data from stations, models and satellite-based products.

The following report summarizes the main findings and assigns the levels of maturity defined for the different elements of the CHD within the framework of INAMHI. These results are also used for the Gap Analysis Report and the Contribution Plan for the SOFF Peer Review of INAMHI.

CHD methodology

The CHD process involved collaboration between INAMHI, experts from Servicio Meteorológico Nacional, Argentina (SMN) and MeteoSwiss. It included self-assessment questionnaires (including Early Warnings for All), interviews with national stakeholders, and reviews of different documents. To carry out the CHD, MeteoSwiss used additional information available in the EUROCLIMA+ Diagnostic Report[2]. The WMO data and the information obtained from the questionnaire helped prepare the interviews between experts.

[2] Euroclima+ Climate Governance Project Ecuador, 26.6.2019: Diagnostic Report from the National Institute of Meteorology and Hydrology of Ecuador

Chapter 2: Country Hydromet Diagnostics

Element 1: Governance and institutional setting

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

Ecuador is a member of WMO since 6 July 1951. INAMHI (Instituto Nacional de Meteorología e Hidrología) is a governmental institution that is part of the Ministry of Environment, Water and Ecological Transition "MAATE" and provides Public Weather Services based on the national law of the National Institute of Meteorology and Hydrology (Registro Oficial No. 839, May 25, 1979). The law outlines the responsibilities for measuring and providing meteorological and hydrological observations in Ecuador. INAMHI is the main agency responsible for planning, directing, and supervising meteorological and hydrological activities nationwide and coordinates with other institutions and sets regulations to ensure the effectiveness of meteorological and hydrological programs. INAMHI is tasked with establishing, operating, and maintaining the necessary infrastructure for meteorological and hydrological observations and collects, processes, publishes, and disseminates data related to weather, climate, and hydrology across Ecuador.

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

The Institutional Strategic Plan 2021-2025, published by INAMHI in November 2021, represents the organization's current strategic direction.

In summary, the reduction in annual budgetary allocation has resulted in significant challenges for the Institution in carrying out its activities. This has led to difficulties in maintaining the operational capacity of the network of hydrometeorological stations, renewing technical infrastructure and human resources, and hiring new staff. Furthermore, the absence of documentation of INAMHI processes and knowledge transfer from departing staff to remaining staff has resulted in a loss of institutional knowledge. This has been partially addressed through training funded by the WMO and international cooperation.

On 16 February 2024, the government of Ecuador approved the 'Development Plan for the New Ecuador 2024-2025'. The INAMHI strategic plan is currently aligned with this national plan. The services provided by INAMHI aim to contribute to the preservation of ecosystems, the ability to adapt to climate change, and the mitigation of the impact of extreme weather events, including droughts, floods, and other disasters. The objective of the National Development Plan is to establish sustainable food production systems and resilient agricultural practices that will enhance productivity and production by 2030.

It is imperative that INAMHI establishes long-term strategic and sustainable objectives that extend beyond the year 2030. The implementation of the aforementioned development plan is contingent upon the conclusion of the ongoing organizational restructuring process of INAMHI, as initiated by the current administration. Nevertheless, the success of this plan will also depend on the allocation of funding from the central government.

A comprehensive risk management plan is currently unavailable. A quality management system (QMS) is not currently in place for the entire organization, with the exception of the management of the Water Quality and Sediment Laboratory. The objective is to enhance the efficiency of the processes utilized in the analysis of water and sediment quality samples by maintaining the quality management system in accordance with ISO 17025 standards. Moreover, the metrology laboratory is pursuing ISO 17025 certification.

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 regular annual operating budget of INAMHI is approximately USD 2 Mio, which is consistent with the budgetary allocations of the previous four years. Furthermore, INAMHI has been promised an additional USD 1.2 Mio for investment projects in 2024 and 2025. It is not yet clear when and in what amounts this will be paid out, which presents a significant challenge to the planning and implementation of projects. Moreover, the transition of the substantial research and development work into sustainable operations represents a challenge in the absence of sufficient dedicated funding. The temporary nature of project staffing can result in the loss of knowledge and experience. It is evident that additional resources are required to fulfill the obligations set forth in the National Contribution Plan and outlined in the national development plan, "New Ecuador." INAMHI is confronted with the challenge of accurately identifying the financing gaps associated with key measures and initiatives and of devising strategies to bridge these gaps. The current administration, in collaboration with the IDB, has developed an alternative financing plan based on public-private partnerships and a trust fund. However, its implementation will also require complementary studies for definitive feasibility and political support.

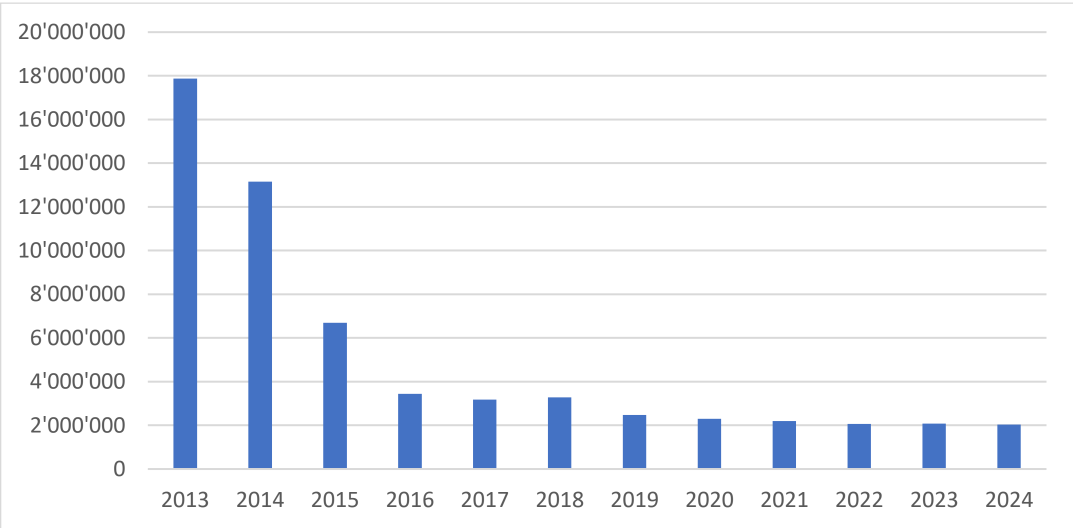

Figure 2: Development of INAMHI's yearly total budget in USD from 2013.

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.

In 2023, INAMHI employed 109 individuals, with a gender ratio of 64% male and 36% female. In the 10 management positions at INAMHI, only three are held by women.

Branch	Doctorate/ MSc	Bachelor	Diploma (technique or technology)	High School Diploma	Total
Administration/ Management	7	16	2	4	29
Climate	2	4			6
Hydrological Technician	2	5		1	8
Hydrologist	1	1			2
Meteorological Technician		1		1	2
Meteorologist		7		2	9
Observations		9	2	4	15
Researcher	2				2
General Technician	2	12		1	15
ICT	1	1			2
General services		3	2	14	19
Total	17	59	6	27	**109**

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

A number of international and national initiatives aimed at enhancing environmental monitoring capabilities and fostering community resilience in Ecuador are outlined in 2.3.

These initiatives collectively demonstrate a comprehensive approach to climate adaptation, disaster risk reduction, and sustainable development in Ecuador. Nevertheless, sustaining operational capacity beyond the conclusion of the projects will prove challenging due to the scarcity of resources (human resources and budget).

Summary score and recommendations for Element 1

INAMHI operates within a well-defined legal framework under the Ministry of Environment, Water and Ecological Transition (MAATE), based on its 1979 foundational law. However, budget reductions and inconsistent funding streams limit its operational capacity. The current Institutional Strategic Plan 2021-2025 sets out some goals, but execution is hindered by the insufficient financial and human resources. Moreover, the need to update this strategic plan has also been identified, and it is currently in progress through the planning department.

The situation highlights the need for better alignment between INAMHI's objectives and Ecuador's National Development Plan 2024-2025, which focuses on sustainable ecosystem management and climate adaptability. As recommended in the GBON National Contribution Plan, long-term sustainability will require aligning GBON compliance strategies with broader national policies, as well as securing additional financial and human resources.

Key Challenges:

- Maintaining and updating the employment of staff qualified in relevant scientific, technical and ICT disciplines.

- Budgetary constraints affect the renewal of technical infrastructure and hiring of new staff.
- No risk management plan.
- No quality management system in place for hydrometeorological services.

Recommendations:

- Take action to secure long-term budget allocations to ensure stable operations. Demonstrate the socio-economic benefit of a national weather service (NMHS) like INAMHI and provide a robust basis for budget negotiations with the government.
- Establish a risk management plan that is capable of anticipating and mitigating the various challenges that may arise at the institutional level. A SWOT analysis can serve as an invaluable tool for assessing the institutional, socio-economic, and technical aspects involved.
- Develop of a robust quality management system to ensure consistency in the provision of services and knowledge transfer. This will also mitigate staff turnover.
- It is essential to implement the new organizational structure in order to ensure that all key positions are filled with the appropriate personnel, thereby maintaining effective and functioning leadership.

Maturity Score: 2 (Introduce enhanced governance and management processes, and address resource challenges. Although adequately mandated, the organization is insufficiently equipped to fulfill its mandate.)

Element 2: Effective partnerships to improve service delivery

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

Collaborative arrangements have been established with other government institutions for the delivery of services. A multitude of agreements have been concluded with Decentralized Autonomous Governments and with academic institutions (Corporación Eléctrica del Ecuador CELEC; Dirección General de Aviación Civil, DGAC) for the provision of services and exchange of information. INAMHI also receives data from other government agencies that have their own observation infrastructure, such as data from hydrometeorological stations. It is evident that some of the existing agreements are no longer valid and require renegotiation.

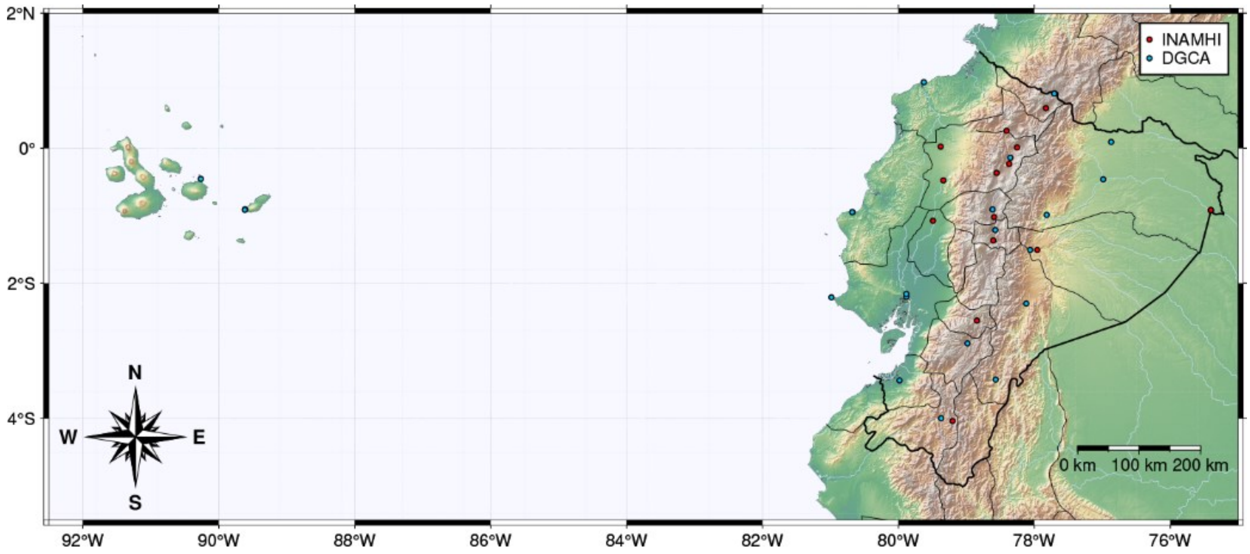

Figure 3: Network of stations operated by INAMHI and Directorate-General for Civil Aviation

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

INAMHI has established a number of collaborative agreements with public and private sector organizations, including the United Nations Development Program (UNDP), the Directorate-General for Civil Aviation (DGCA/DGAC), CELEC, Dundee Precious Metals Inc., among others. Additionally, it engages in joint endeavors with academic and research institutions. Some of the agreements are out of date and need to be renegotiated. CELEC appears to be the most promising potential partner for closer, mutually beneficial cooperation.

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

A list of current partnerships:

- USAID, NASA, Servir Amazonía (INAMHI-GEOGLOS project)
- United States Forest Service (Servicio Forestal de los Estados Unidos -Programa Fuego Regional)
- World Meteorological Organization (WMO)
- Euroclima+

- ENANDES+
- Early Warnings for All (EW4All)

A list of current and past projects:

- Strengthening the National Multi-Hazard Early Warning System: This project seeks to mitigate the potential impact of natural disasters such as floods, landslides, tsunamis, and volcanic eruptions by providing accurate early warning information and fostering community resilience. The budget is USD 1’320’000 plus VAT and is currently ongoing. Funding institution is the Inter-American Development Bank (IDB/BID).
- Projects for the *"Integrated management of water resources in the binational basins Mira, Mataje and Carchi -Guáitara, Colombia-Ecuador"* and *"Reducing climate vulnerability and flood risk in urban and semi-urban coastal areas in Latin American cities – AdaptaClima”*, financed by UNDP. The budget is USD 250’000 and 419’500 respectively. Both end in 2025.
- Sky Quality Project Astrotourism: Focused on collecting meteorological data in the upper atmosphere through radiosondes in Cantón Salcedo, this initiative supports high-level academic and scientific research in astrotourism. It monitors daily variations in atmospheric conditions. The initiative is in progress with an annual budget of USD 15’000. The funding institution is the Universidad técnica de Cotopaxi.
- Hydrology and Current Geodynamics of the Amazon Basin (HyBAm): This project monitors river levels and flows in the Amazon as they exit the Andes, studying water and sediment transfer mechanisms and generating reliable climate data to assess the impacts of climate variability. The project is ongoing with an annual budget of USD 8’000. Funding institution is the Institut de Recherche pour le Développement (IRD).
- Hydrology and Geodynamics of the Amazon Basin: Aims to support sustainable development by providing timely hydro-meteorological information and conducting research to enhance community safety and promote economic growth. The budget is USD 750’000 for three years, starting in 2025. The funding institution is the Amazon Cooperation Treaty Organization (ACTO)
- Improving Adaptive Capacity of Andean Communities through Climate Services (ENANDES+): This project enhances the resilience of Andean communities against hydroclimatic hazards by improving access to weather, water, and climate services. The budget is USD 726’540 for four years and is ongoing. Funding institution is the Swiss Agency for Development and Cooperation SDC, Implementing Entity is WMO.
- Glacioclim Project: Focuses on the glaciological monitoring of Antisana Glacier 15, including mass balance measurements and management of the precipitation network in associated hydrological basins. The budget is USD 5’000 annually and the project is ongoing. The funding institution is the Institut de Recherche pour le Développement (IRD).
- Hydro-Meteorological Data Exchange Project: Aims to integrate data from various hydro-meteorological monitoring networks (EPMAPS-INAMHI-FONAG) in Quito to improve short-term meteorological products. This project is currently utilizing its own resources (EPMAPS-INAMHI-FONAG).
- Binational Adaptation Project, implemented by the World Food Program (WFP) with a budget of USD 100’000, until 2024.

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.

Some examples with successful results:

- “Electronic notebook” developed with the PMA binational basins project: Quality control algorithms developed with the UNDP binational project.
- Through the cooperation of the SERVIR Amazonia Program, the INAMHI GeoGlows Platform has been upgraded with various apps that use geospatial information. This platform provides access to information from INAMHI's local numerical model, access to hourly and daily WRF forecasts, GOES 16 satellite images, 15-day hydrological forecasts through the global GeoGlows model, forest fire detection and more.
- National Drought Monitor Developed in cooperation with CIIFEN
- Sustainability Model Study developed by the IDB
- Flash Flood Guidance System (FFGS) jointly developed with the WMO
- Through the project with UNDP (Adaptaclima), the surface hydrometeorological monitoring network has been strengthened, contributing to improving the provision of information services for local authorities. Additionally, an application was developed to maintain continuous diagnostics of the operability of the country's hydrometeorological station network, allowing real-time monitoring of received information.
- Through the project with WFP, technological infrastructure in the area of numerical weather modeling has been strengthened. This activity is essential for enhancing the capacity for assimilation and development of the country's numerical model.

Summary score, recommendations, and comments for Element 2

INAMHI has established a range of partnerships with national and international stakeholders, such as the World Meteorological Organization (WMO), United Nations Development Program (UNDP), and National Autonomous Governments. While these collaborations contribute to service improvements, most partnerships are project-based and lack long-term sustainability.

Key Challenges:

- Limited capacity to maintain outcomes from collaborative projects after they end.
- Need for formal agreements with private sector and research institutions for data sharing and service provision.
- Implement the organizational restructuring in order to ensure the availability of essential personnel, without whom the launch and ongoing operation of these activities would be unfeasible.

Recommendations:

- Prioritize partnerships with a focus on promoting and formalizing the most significant ones. Renew and update agreements (as part of a QMS).
- Secure long-term agreements with key partners to ensure continuity beyond project lifecycles.
- Expand engagement with regional bodies for cross-border hydromet data sharing, e.g. within the currently running project ENANDES+.

Maturity Score: 3 (Effective but unsustainable partnerships)

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.

The current observation network of INAMHI in Ecuador is comprised of the following:

- There are 62 operational automatic weather stations with a horizontal resolution of approximately 68 km.
- There are 23 operational automatic hydrological stations with a horizontal resolution of approximately 110 km.
- Upper-air observations: There are no stations.

Type of station		# of stations	Operational or partly operational	Not operational, silent or unknown
Meteorological	Automatic	109	62	47
Hydrological	Automatic	38	23	15
Total		**147**	**85**	**62**

With the proposed 8 GBON compliant surface observations stations (National Gap Analysis Ecuador, WMO, 2024; see also Annex 5) a horizontal resolution on mainland Ecuador of 193.7 km is achieved and a land coverage of 86.6%.

The automatic stations transmit data at five-minute intervals when connected to the cellular network or via Ethernet. In the case of stations that lack this capability, data transmission is accomplished via the GOES satellite, with an hourly frequency.

Surface observation stations using satellite transmission systems are typically located in remote areas such as jungles, mountains, rivers, or glaciers, and a portion of these stations are operational. Additionally, GPRS cellular transmission and direct internet connections (Ethernet) are used. Some stations, however, lack real-time transmission systems, requiring manual data downloads. This means an operator must connect to the datalogger and follow the appropriate data retrieval protocols.

Of the 39 conventional weather stations, only 14 are managed entirely by INAMHI and are only required to submit reports at 12:00, 18:00, and 00:00 UTC. However, these stations are only staffed by a single observer, and thus operate from Monday to Friday. At the present time, a synoptic message is transmitted via WhatsApp. Information from conventional DGAC and INAMHI stations reaches the WMO through the regional centre in Brazil. INAMHI is currently in the process of developing an electronic notebook with the objective of automating the aforementioned process.

3.2. Additional observations used for nowcasting and specialized purposes.

CELEC provides daily data to the national network of hydro-meteorological stations, including rainfall data and flow behavior in the Paute River basin.

With regard to surface hydrology (levels, flow rates, gauging [liquid and solid flow]), no supplementary data is presently accessible.

In order to run the monthly climatological forecast with the Climate Predictability Tool (CPT), the data must first be downloaded from the IRI (International Research Institute for Climate and Society) library.

Manual weather observations at airports are carried out by DGAC. The data is available to INAMHI.

INAMHI receives data from government agencies that have their own observation infrastructure, including surface hydrometeorological stations and local numerical models, among other resources. The specific agencies from which INAMHI receives data are: CELEC CCS, CELEC MANDURIACU, EMOV CUENCA, ESPOCH, FONAG, GADP PICHINCHA, UNIVERSIDAD POLITECNICA SALESIANA, EPMAPS and EMAPAG-EP.

A network of conventional and automatic stations operated by INAMHI has yet to be integrated into the international transmission process.

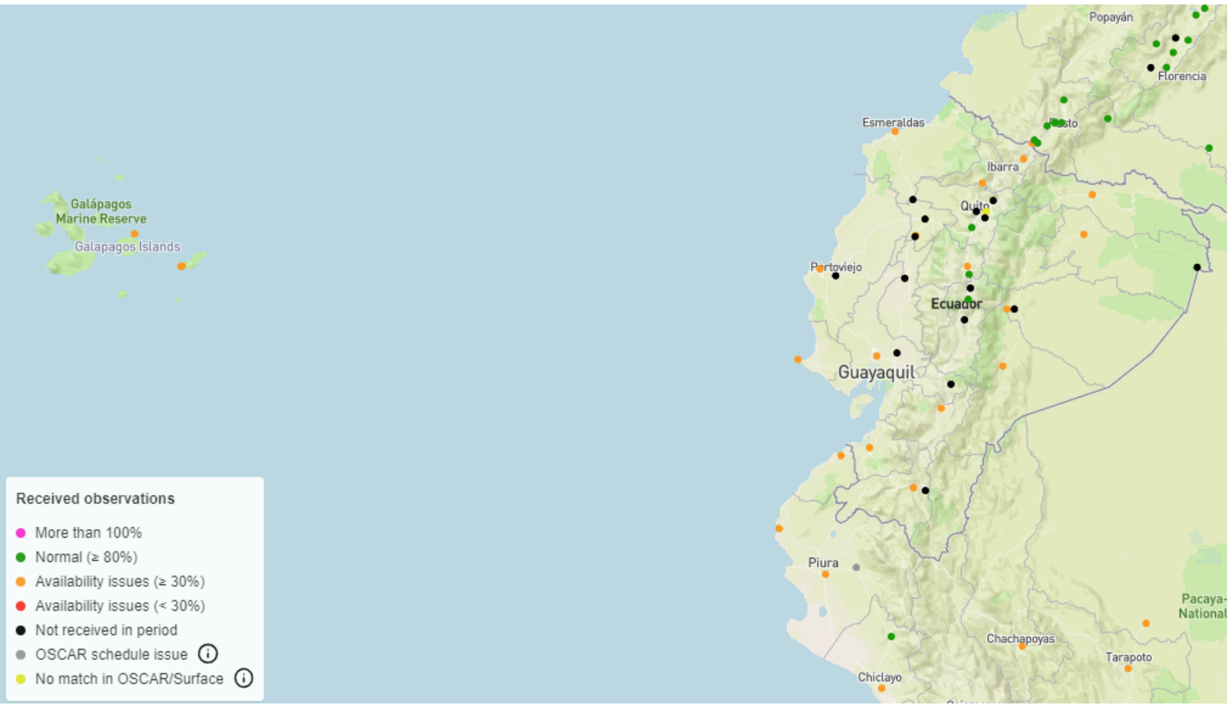

Figure 4: Availability of surface and land observation (global NWP).
(Source: https://wdqms.wmo.int/nwp/land_surface/six_hour/availability/pressure/all/2023-11-08/18)

The storage of historical datasets presents a significant challenge, as not all data is available in digital form. The digitization of the data has commenced and is currently underway, with the integration of the data into Climsoft by SBDAH (Basic Hydrometric Height Data System). This process is also intended to establish an automatic backup, thereby reducing the risk of irrecoverable loss in the event of hardware-related incidents.

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

Most meteorological variables are quality controlled, except for volumetric water content and flow rate.

A key advantage of INAMHI is its own metrological laboratory, which is in the process of implementing a quality management system (ISO 17025). This positions INAMHI to become a regional center for metrological calibration, serving other institutions in Ecuador and the broader Andean region (ENANDES+). While the laboratory has the potential to be a valuable asset, it faces currently the challenge to allocate the necessary resources to ensure proper maintenance and operation. Additionally, the shortage of personnel and financial means needed for both preventive and corrective maintenance on the network's equipment prevents compliance with the Global Basic Observing Network (GBON) standards.

3.4 Implementation of sustainable newer approaches to observations.

The WIGOS initiative has been developed with the objective of enhancing the coordination and integration of global weather, climate, and environmental monitoring systems. It facilitates the sharing of observation data and supports the provision of high-quality information for a range of sectors, including weather forecasting, disaster risk reduction, climate monitoring, and environmental protection. To date, no national WIGOS implementation plan has been developed for INAMHI.

It is, however, highlighted that in order to enhance forecasts and make early warning systems more effective, the following data need to be measured and made available, which are currently not available to INAMHI:

- Tropical cyclones Radar data and lightning data;
- Drought/dry spell: high-resolution rainfall data and soil moisture data;
- Riverine floods: temperature and solar radiation data;
- Wildland fire/forest fire: soil moisture data; high-resolution satellite data;
- Hail: lightning data.

Nevertheless, due to a lack of available resources, INAMHI is unable to maintain an adequate number of surface observation stations, upper atmosphere observation stations, and hydrological stations. Operational meteorological radars and lightning observation stations are not available for use. Moreover, the institution is lacking the necessary materials, trained personnel, and training to fulfill its operational requirements.

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

The number of surface observations that employ automated techniques includes 57 operational automatic weather stations and 20 operational automatic hydrological stations. At least 66% of observations depend on automatic techniques.

Summary score, recommendations, and comments for Element 3

INAMHI's observational network is composed of 57 automatic weather stations and 39 conventional stations. However, the dissemination of data does not align with the standards set forth by the Global Basic Observing Network (GBON). The GBON National Contribution Plan proposes the establishment of eight surface stations and three upper-air stations in Ecuador, including one on the Galapagos Islands. The absence of upper-air observations limits the precision of the forecasts. In particular, upper-air data from the Galapagos Islands would be of significant value.

Key Challenges:

- INAMHI currently does not exchange GBON data for technical reasons.
- There are no operational upper-air stations, especially valuable for high-impact weather forecasting.
- Inadequate maintenance of existing infrastructure due to limited funding and human resources.

Recommendations:

- As a first step, install the required 8 GBON compliant surface stations and 3 upper-air stations. Upper-air data from the Galapagos Islands would be of significant value.
- Develop an infrastructure maintenance plan, including regular calibration and monitoring of stations.
- Explore opportunities for sub-regional collaboration to share observational data.
- Implement the organizational restructuring to have essential personnel that will enable the operation and maintenance of the existing national network and manage data from external networks.

Maturity Score: 3 (Moderate infrastructure with significant gaps)

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 centers.

WIS2.0 has yet to become operational. The installation of the WIS2 box is a relatively straightforward process, typically completed within a single day. However, the configuration stage may necessitate a more substantial investment of time, contingent upon the specific requirements of the user. In particular, the transmission of data to the WIS2 box may necessitate the configuration of additional software or the loggers of the stations, should the intention be to send the data directly from the stations. The registration of a WIS2 node in the WIS2 Global Services system is estimated to require approximately one week.

According to the OSCAR (Observing Systems Capabilities Analysis and Review) website, there are 47 stations in Ecuador listed.

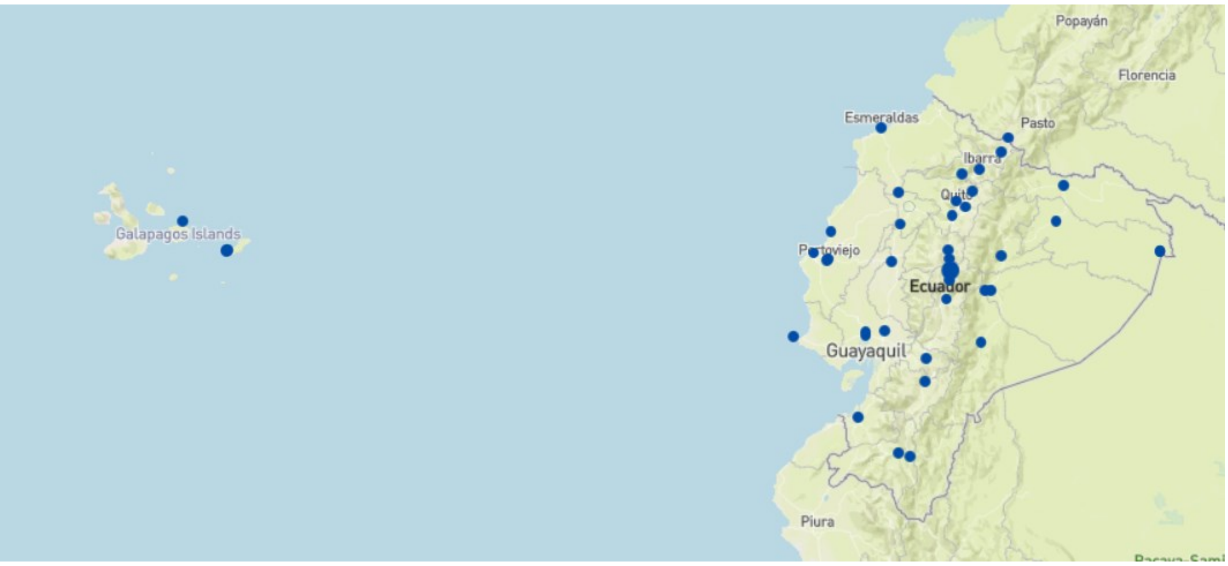

Figure 5: Stations of Ecuador as listed in OSCAR
(Source: https://oscar.wmo.int/surface/#/search/station#map1_div)

At the time of writing, the percentage of GBON compliance is currently at zero. However, the process of transmitting to WIS is nearing completion, with an anticipated date of December 2024 (according to INAMHI). Based on the existing network, INAMHI has identified seven promising sites for the upgrading of stations to meet future GBON requirements, as well as one suitable site for the installation of a new station. It is conceivable that there will be more than 10 compliant surface stations, but currently, there are no secured resources for sustainability.

At present, there are no upper-air stations. Three sites have been selected for future GBON-compliant stations.

Figure 6: Availability of surface land observations (GBON), no available data for Ecuador. (Source: https://wdqms.wmo.int/gbon/land_surface/six_hour/availability/pressure/all/2024-10-17/18)

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

There is a formal policy regarding the sharing of observational data, but it includes a resolution that assigns costs to hourly and more frequent data, suggesting that not all data is freely shared. INAMHI authorities have mentioned that a resolution is being prepared to release all the data and make it easily accessible to the general public.

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

Key data and products are obtained from external sources at national, regional, and global levels, including model and satellite data:

Rain/Wet Spell (Periodos lluviosos): Full disk and mesoscale imagery from GOES 16 is used for monitoring heavy rainfall events, managed by NOAA. Extreme weather indices from the ECMWF model are available on free-access websites. Satellite-based precipitation data is sourced from GPM and IMERG products.

Drought/Dry Spell (Periodos secos): Long-term forecasts for temperature and rainfall anomalies are obtained from the Global Wildfire Information System (GWIS).

Training in remote sensing has been provided over the last two years, although not on a regular basis. INAMHI does not possess a ground station to directly receive satellite data; instead, satellite information is accessed online.

Summary score, recommendations, and comments for Element 4

INAMHI would benefit from enhanced and robust data-sharing systems that meet international standards, such as the WMO Information System (WIS 2.0). At present, there is no upper-air data available, and Ecuador has yet to demonstrate compliance with GBON standards. The GBON National Contribution Plan identifies this as a priority area for improvement, including the establishment and improvement of stations and the implementation of enhanced data transmission systems.

Key Challenges:

- No formal policy for the open sharing of observational data.
- Lack of technical capacity to transmit real-time data to global systems.

Recommendations:

- Implement GBON-compliant data-sharing systems, starting with the integration of existing surface stations. Manage resources or apply for funding to implement high-altitude stations.
- Establish formal data-sharing agreements with international partners.
- Ensure the country's data collection and transmission infrastructure aligns with WIS 2.0 requirements. We encourage INAMHI to get support from SMN in the framework of the ENANDES+ project.

Maturity Score: 1 (No current data sharing)

It should be noted that the installation of WIS2.0 (e.g., the freely available WIS2.0 Box) and the dissemination of data have the potential to elevate the maturity level to a score of 3 or even 4.

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.

The institution uses a range of forecast products from World Meteorological Centres (WMCs) and Regional Specialised Meteorological Centres (RSMCs), including models such as NCEP, ECMWF, and DWD, which are accessible as free, open-source code. The WRF model assimilates gridded data from NCEP/NOAA (GFS) as the initial condition. However, not all personnel have received the required training to fully access and use these products, which may result in the potential lack of capabilities. A number of institutions use the WRF model at resolutions of 1 and 3 km, including the Metropolitan Public Water and Sanitation Company, the Civil Aviation Directorate, and others.

At present, only precipitation, temperature, humidity, and wind forecasts are bias-corrected; plans are in place to implement MOS and Kalman filter post-processing next year. In this case, the bias-corrected method we are using means correcting the forecast output using historical data at a point with observational data, that is, using an approach to fix the WRF output using the differences in the mean and variability between the model and observations in a reference period. MOS and Kalman Filter will be implemented next year to post-process extreme temperatures for agrometeorological purposes. The model data is obtained from a variety of sources, including Meteologix and Windy, and the forecasts are subsequently released on the INAMHI website.

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

The NWP system includes two configurations, each designed for a different length of forecast: 84 forecast hours and 15 forecast days. The initial configuration comprises three domains (9km-3km-3km) for the Continental area and Galapagos Island, with a single domain for each, operated using the GFS - 00UTC model for an 84-hour forecast period.

The second configuration comprises two domains (12km - 4km) for the continental area and Galapagos Island, run using the GFS - 12UTC model for a 15-day forecast. The server configuration is equipped with 80 cores, 512 megabytes of random-access memory (RAM), and 10 terabytes (TB) of storage. The WRF model is executed on a twice-daily basis, at 00:10 am (local time) and 11:30 am (local time), to produce an 84-hour forecast and a 15-day forecast, respectively. The principal forecast graphs are accessible via the INAMHI cloud and can be visualised on the Geoglows platform.

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

At this time, the WRF model is only capable of producing deterministic data; there are no probabilistic data outputs for the NWP.

Summary score, recommendations, and comments for Element 5

INAMHI operates the Weather Research and Forecasting (WRF) model utilising data from the NCEP/NOAA and other sources. Despite the generation of short- to medium-range forecasts, there are deficiencies in post-processing and probabilistic forecasting. The absence of ensemble prediction systems (EPS) diminishes the usefulness of forecasts during extreme events.

Key Challenges:

- Lack of probabilistic forecasting and ensemble prediction systems.
- Limited post-processing capabilities, especially for hydrological forecasting.

Recommendations:

- Implement post-processing tools such as Model Output Statistics (MOS) to improve forecast accuracy. ENANDES + is conducting an investigation to assess the efficacy of the ECMWF model when calibrated with local data.
- Train staff on advanced forecasting techniques and model integration and interpretation.
- If feasible, expand NWP capabilities to include ensemble predictions and probabilistic forecasting. Please be aware that this needs some significant resources.
- Explore the possibility to complement the current INAMHI NWP capabilities with the ECMWF deterministic and ensemble forecasts. Please note that the ECMWF forecast products can be licensed for INAMHI free of information charge, probably free of service charge.

Maturity Score: 3 (Moderate NWP capacity with gaps in advanced forecasting)

Element 6: Warning and advisory services

6.1. Warning and alert service cover 24/7.

Ecuador's Hydrometeorological Forecast and Alerts Directorate operates 24/7 only during the rainy season, with some automated alert services via channels like Telegram, WhatsApp and mass SMS messages when weather warnings are activated in collaboration with the National Secretariat for Risk Management. It is important to note that the current administration has already implemented the reporting of its meteorological warnings through the Common Alerting Protocol (CAP). Despite what has been achieved, the country lacks a Multihazard Early Warning System. The Directorate typically runs from 06:30 am to 10:00 pm with three shifts, supported by 7 rotating staff and two additional members during intermediate hours. Another shift is added during the rainy season for night operations.

The department issues warnings for significant weather conditions 24 hours in advance, valid for 3 to 5 days, which are also reported through the CAP, and uses nowcasting for immediate threats, covering 3 to 12 hours. Warnings are also distributed in PDF and other graphic formats files to authorities, shared via WhatsApp, email and posted on social media to inform the public.

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

INAMHI is responsible for issuing warnings pertaining to a range of meteorological and hydrological hazards, including wildfires, heat waves, frost, droughts, winds, rain, riverine floods, and cold waves. Verification of warnings performance is generally carried out by assessing the accuracy of forecasts using data collected from surface meteorological stations, both conventional and automatic. Additionally, in recent months, the validation of warnings has been enhanced by utilizing satellite information, specifically through estimators. In addition, impact reports provided by the National Secretariat of Risk Management are used.

The NMHS uses a flash flood guidance system to issue warnings of flash floods, which are then provided to the aforementioned secretariat. A system for the archiving of forecasts and warnings is in place for all priority hazards, with both digital and paper formats employed. A portion of the monitoring data and associated metadata is accessible for verification and research purposes. Redundancy systems are in place at four stations for transmission; however, only two are fully operational due to the limited availability of funding for maintenance.

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.

INAMHI disseminates alerts in accordance with the Common Alerting Protocol (CAP) format. Standard operating procedures have been established with the relevant authorities and stakeholders. Nevertheless, only a limited number of forecasters have undergone training in the principles, methods, and applications of impact-based forecasting (IBF), with the majority of personnel still lacking this training.

Summary score, recommendations, and comments for Element 6

INAMHI provides early warnings for significant meteorological events. However, the services are not available on a 24/7 basis throughout the year. The current system is reliant on manual inputs and communication via WhatsApp and Telegram groups, which constrains its scope and reach. A comprehensive multi-hazard early warning system (EWS) is currently lacking in Ecuador.

Key Challenges:

- Lack of year-round, fully operational early warning systems (only during rainy season).
- Limited use of impact-based forecasting and real-time hazard monitoring.

Recommendations:

- Ensure sufficient staff to develop and operate a 24/7 Multi-Hazard Early Warning System (EWS) integrated with real-time data from observational networks and latest model forecasts.
- Strengthen the implementation Common Alerting Protocol (CAP) further to improve communication with stakeholders.
- Expand the use of nowcasting techniques for extreme weather warnings.
- Expand the automatic gauge network and secure funding, including for remote sensing systems, to improve hydroclimatic forecasting and services for decision-making.
- Establish an organizational structure and secure funding to ensure essential staff for continuous monitoring and the implementation of new technological tools, especially for nowcasting purposes.
- Establish a continuous training and skills development program for technical staff, ensuring they have the competencies needed to use advanced modeling tools and real-time observation systems.

Maturity Score: 3 (Weather-related warning service with modest public reach and informal engagement with relevant institutions, including disaster management agencies.)

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.

The Climate Predictability Tool (CPT) is employed by INAMHI to generate monthly climate forecasts, thereby providing indispensable projections for Ecuador's regions that inform governmental decision-making. This comprises three maps which illustrate precipitation and temperature patterns across the country. Furthermore, the PREERFEN committee is responsible for conducting situation analyses and climate perspectives, which are then compiled into a quarterly Climate Situation and Climate Outlook Report.

A larger gauge's network could be used for climate forecasts once the integration of conventional and automatic databases, along with their quality controls, is resolved. Additionally, this will be possible when networks of external stations from operators of hydroelectric centrals, airports, and the main cities and provinces are integrated.

Meteorological and hydrological yearbooks are available for download free of charge from the INAMHI website. Furthermore, the INAMHI portal provides access to hydrometeorological data from 1985 to 2015, in conjunction with climatological temperature normals. The service provides climate certifications and a Fire Forecasting System for Ecuador, with the support of the US Forest Service and USAID. Hydrological data, including levels and flows, is generated from a limited number of automatic and conventional stations, with some discharge curves available. The longest time series dates back to 1964.

Summary score, recommendations, and comments for Element 7

INAMHI offers a range of fundamental climate services, including seasonal forecasts and historical climate data. Nevertheless, concerns persist regarding the quality and accessibility of the data. The integration of hydrological and climate data has the potential for further expansion, which could lead to improvements in water resource management and disaster risk reduction.

Key Challenges:

- Limited integration of meteorological and hydrological data.
- Lack of a comprehensive climate data management system.

Recommendations:

- Invest in a robust Climate Data Management System (CDMS) that integrates real-time and historical data from meteorological and hydrological stations.
- Ensure the secure allocation of resources in order to facilitate the systematic advancement of the recovery of historical data. Resources available through the currently running ENANDES+ project.
- Expand services to include more specialized climate products tailored to key sectors like agriculture and water management.
- Consider the development and sustainability of climate products in the institutional restructuring process.
- Take external station networks into account to generate national and local-scale climate products.

Maturity Score: 3 (Services with potential for expansion)

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.

INAMHI regularly produces quantitative precipitation estimates and forecasts, which are designed to meet the needs of the hydrological community. Although INAMHI has demonstrated proficiency in meteorological forecasting, its capabilities in hydrological forecasting are still evolving. The development of hydrological modelling for specific areas has commenced. However, national hydrological forecasts continue to rely on global models. The observation network is limited, mainly due to the lack of human resources and permanent funding. Furthermore, the INAMHI-GEOGLOWS platform has been implemented with the cooperation of USAID and Servir Amazonía, which allows for hydrological forecasting up to 15 days ahead based on a global model and meteorological forecasts.

INAMHI participates in two virtual meetings per year with ARIII[3] hydrological advisors and at least three virtual meetings with the WMO ARIII regional hydrology working group, which are coordinated by WMO regional representatives.

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

It should be noted that in the case of Ecuador, INAMHI manages both meteorology and hydrology. There is no national agency solely dedicated to hydrological monitoring. Some units of the Ecuadorian Electric Corporation (CELEC) generate hydrological data for their reservoirs. Standard Operating Procedures (SOPs) are in place in Ecuador. Disaster risk reduction activities are coordinated by the National Secretariat of Risk Management, which oversees the implementation of disaster risk management policies and plans. This ensures that the entire value chain is addressed.

There is an intrinsic coordination between meteorology and hydrology within INAMHI, particularly in the issuance of alert bulletins. INAMHI adheres to a standard operating procedure for the issuance of alerts, whereby a warning is issued and disseminated through established channels to both the risk management secretariat and other pertinent agencies, such as the Red Cross and local governments. Furthermore, the bulletins are published on all communication networks managed by INAMHI.

8.3. Data sharing agreements (between local and national agencies, and across international borders as required) on hydrological data in place or under development.

A number of agreements have been established for the exchange of hydrological data with a variety of institutions, including UNDP, CELEC, the National Secretariat of Risk Management, and others. Some progress in sharing information is underway with IDEAM of Colombia.

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

Several joint projects and initiatives aim to enhance hydrometeorological cooperation within the hydrological community, including the Binational Mira-Mataje & Carchi-Guáitara Project, the BID SAT Multihazard Project, and AdaptaClima.

[3] WMO Regional Association III: South America

Several projects and joint initiatives aim to improve hydrometeorological cooperation within the hydrological community, such as:

- Project with CELEC Manduriacu, the following results were obtained:
    - Daily flow forecast with weekly frequency for the Manduriacu power plant
    - Development of a viewer with hydrometeorological information for the Manduriacu hydroelectric power plant.
- Integrated management of water resources project for the Mira, Mataje and Carchi-Guáitara national basins Colombia - Ecuador, the following results were obtained:
    - Integration of the binational hydrometeorological information system (FEWS) Ecuador Colombia.
- Multi-risk BID SAT project, it is expected to obtain:
    - Increased coverage of exposed population with access to SAT due to flooding and river overflow
- AdaptaClima project:
    - Implementation of a viewer for monitoring hydrometeorological information.

Summary score, recommendations, and comments for Element 8

INAMHI's hydrological services play a crucial role in flood forecasting and water resource management. However, the hydrological observation network is limited, and existing infrastructure requires expansion. Expanding the hydrological observation network and integrating these services with meteorological forecasts will strengthen the institution's capacity.

Key Challenges:

- The current hydrological observation network is insufficient and lacks the capacity for real-time data transmission. This is particularly important for flood warning.
- Civil infrastructure for hydrological observations (including flow measurements) is reaching the end of lifecycle and requires renovation and/or replacement with the construction of new stations.
- Lack of integration between meteorological forecasts and hydrological models.
- Integrate global hydrology developments from the WMO into regional and local hydrological tools.

Recommendations:

- Expand and fund the hydrological and meteorological observation network, particularly in river basins prone to flooding.
- Integrate hydrological forecasting with meteorological models to improve flood risk management.

Maturity Score: 3 (Well-developed but requires further integration)

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?).

INAMHI uses social media, its website, and TV for user-centered communication. However, there is no mention of dedicated television, video, or audio production facilities or the use of cutting-edge techniques for communication.

9.2. Education and awareness initiatives in place.

Education and awareness initiatives are limited to basic efforts, with no annual community education plan in place. However, projects like VOLUNCLIMA and partnerships with the Ecuadorian Red Cross have helped promote voluntary observation networks.

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

In collaboration with the World Food Program, a series of products have been developed for the indigenous communities and peoples of the provinces of Carchi and Esmeraldas. This is a development of specific forecasts for the areas of influence of the communities, in addition to the electronic notebook developed for this purpose, which provides the meteorological information provided by the community.

Summary score, recommendations, and comments for Element 9

INAMHI makes use of social media, television, and radio to disseminate weather and climate forecasts; however, the scope of its outreach to marginalized communities is limited. The provision of educational and awareness programs is inadequate, and there is a lack of provision of products tailored to the needs of indigenous or rural populations.

Key Challenges:

- Limited outreach to vulnerable and marginalized communities.
- Lack of formal education and awareness programs.

Recommendations:

- Develop community-specific outreach programs in coordination with local governments. Consider to follow the ENANDES+ project plans to develop agriculture round tables.
- Implement formal education campaigns to increase public awareness of weather risks.

Maturity Score: 3 (Moderate outreach with room for improvement)

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.

A formal general platform for engaging with users to co-design improved services doesn’t exist.

However, INAMHI in collaboration with the Ecociencia Foundation, has developed the INAMHI-GeoGlows platform, whose main objective is to facilitate access to hydrometeorological information generated by the institution. This tool integrates specialized services, such as satellite information data, global numerical models and INAMHI's own model, with a bias correction based on data from surface stations. The potential users of this platform are mainly from the energy, agriculture, risk management and local government sectors, who provide feedback on the services via email, thus allowing for continuous improvement of the tool.

In addition, there is a committee composed of several institutions, which study the El Niño phenomenon (ERFEN - Estudio Regional del Fenómeno El Niño). The lead of this platform is with the National Secretariat of Risk Management (SGR) and is composed of following stakeholders:

- Instituto Oceanográfico y Antártico de la Armada - INOCAR
- Secretaría de Gestión de Riegsos - SGRE
- Dirección General de Aviación Civil - Ecuador
- Instituto Nacional de Meteorología e Hidrología - INAMHI
- Instituto Público de Investigación de Acuicultura y Pesca - IPIAP
- Escuela Superior Politécnica del Litoral - ESPOL
- Universidad Estatal Península de Santa Elena - UPSE

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

The results of user satisfaction surveys, which are done after the service delivery, are used to inform improvements to the service. Other than that, INAMHI does not currently conduct regular independent customer surveys.

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

A quality management system for meteorological, hydrological, and climate warning services has not been implemented. However, hydrometeorological instrument calibration services are offered, with partial quality management systems in place for this specific service (ISO 17025 planned).

On a monthly basis, evaluations are conducted to ascertain the accuracy and timeliness of weather forecasts, with a particular focus on 24-hour forecasts for precipitation and temperature (maximum, minimum, and mean).

Summary score, recommendations, and comments for Element 10

INAMHI offers essential meteorological and climatological services to a range of stakeholders. However, there is currently no formalised platform in place for the repeated and regular collection of user feedback or the administration of satisfaction surveys. The expansion of stakeholder engagement will facilitate the refinement and improvement of INAMHI services.

Key Challenges:

- Lack of user engagement and feedback mechanisms.
- Absence of a quality management system to monitor service effectiveness.

Recommendations:

- Establish a formal platform for regular user consultations and feedback.
- Develop and implement a quality management system to continuously improve services.
- It is recommended that projects and project resources be used to develop and test such platforms, as an example of which can be seen in the current project, ENANDES+.

Maturity Score: 3 (Valuable services but lacks formal feedback mechanisms)

Key Recommendations

The principal recommendations presented in the "Country Hydromet Diagnostics (CHD) Ecuador Report" identify practical strategies for the enhancement of Ecuador's hydrometeorological services. The objective of these recommendations is to reinforce infrastructure, partnerships, and service quality in order to enhance Ecuador's resilience to climate risks.

A summary of the recommendations is provided below.

It is essential to ensure long-term funding stability. It is recommended that budget allocations for INAMHI be increased in order to support continuous operations, renew technical infrastructure, and secure human resources. A stable financial foundation will facilitate the effective maintenance and expansion of INAMHI's critical services.

It is recommended that observation infrastructure be expanded. It is recommended that the GBON National Contribution Plan be implemented in order to establish additional surface and upper-air observation stations, thereby improving data coverage and quality for weather forecasting.

It is imperative to reinforce data-sharing policies. It is recommended that data-sharing policies be developed and aligned with WIS 2.0 standards. This would promote open access to reliable climate information and foster international collaboration.

It is recommended that the Early Warning Systems be enhanced. A comprehensive multi-hazard early warning system should be established to operate on a 24/7 basis, with the objective of extending seasonal capabilities and ensuring that warnings are disseminated to all regions in a prompt manner.

The objective of advance training and quality management is to provide employees with the skills and knowledge required to perform their roles effectively and efficiently. It is recommended that investment be made in the development of the workforce, including training in advanced forecasting techniques and data management. It is recommended that a quality management system be established in order to ensure the reliability of the service provided and to facilitate continuous improvement.

It is recommended that efforts be made to reinforce existing partnerships and to extend the reach of the organization through community outreach. It is recommended that partnerships with the private sector and research institutions be reinforced and that key agreements be renewed. It is recommended that outreach initiatives for marginalized and indigenous communities be enhanced, with the objective of ensuring inclusive access to critical climate information.

It is recommended that the focus be placed on the integration of hydrological services. It is recommended that the hydrological observation network be expanded and that hydrological and meteorological models be integrated for the purpose of providing comprehensive flood forecasting and water resource management.

It is essential to enhance stakeholder engagement and facilitate feedback mechanisms. A formal platform for user engagement and feedback should be developed in order to refine services and better meet community needs. It is recommended that regular user satisfaction surveys be conducted in order to inform improvements to the service.

These recommendations present a constructive pathway for the advancement of Ecuador's INAMHI, which is committed to the protection of communities and ecosystems through the provision of enhanced weather, water and climate services.

Conclusion

The Country Hydromet Diagnostics (CHD) report on Ecuador illustrates the noteworthy advancements achieved by INAMHI in enhancing Ecuador's meteorological and hydrological services. By addressing key challenges related to infrastructure, funding stability, data accessibility, and community outreach, Ecuador is well-positioned to make the weather, water and climate service more resilient and responsive to the needs of the population.

The implementation of these recommendations will enable INAMHI to assume a more prominent role in the protection of communities and ecosystems against the adverse effects of climate change. The implementation of enhanced early warning systems, modernized observational networks, and strengthened partnerships will enable Ecuador to navigate future climate challenges with greater accuracy and agility. By pursuing these objectives, INAMHI will maintain its substantial contribution to sustainable development, climate adaptation, and disaster risk reduction in Ecuador, thereby fostering a safer and more informed society.

Annex 1 Consultations (including experts and stake-holder consultations)

19.11.2023 – 2.12.2023: Visit of INAMHI in Quito, Ecuador:

- 20.11.2023 – 23.11.2024: Visit of INAMHI Headquarter, Quito
- 23.11.2023 – 24.11.2024: Visit of several observation stations
- 26.11.2023 – 29.11.2023: Visit to Galapagos Santa Cruz and San Cristobal
- 30.11.2023: Final day visit to INAMHI Headquarter

Annex 2 Urgent needs reported

The following recommendations address possible urgent needs identified in INAMHI's operations:

- Governance and Institutional Setting: Despite operating within a structured legal framework, INAMHI encounters challenges due to insufficient funding and staffing. It is recommended that a risk management plan be established and that funding consistency be enhanced. A socio-economic benefit study may serve as a good starting point. A budget increase would be optimal, so that sufficient funds are available for the operation of the network of hydrometeorological stations, renewal of technical infrastructure and human resources.
- Observational Infrastructure: Ecuador's observational network is moderately developed. Efforts to meet GBON standards and implement essential upper-air observation stations are recommended. Implement the GBON National Contribution Plan to establish 8 surface stations and 3 upper-air stations.
- Data and Product Sharing: A formal data-sharing policy aligned with international standards is necessary to enhance accessibility and usability. Install WIS2.0!
- Warning Systems: Ecuador's early warning system operates seasonally but needs expansion to offer 24/7, multi-hazard alerts year-round.

The subject of the installation and, in particular, the operation of upper-air stations was discussed at length. While the necessary infrastructure can be financed, the operational costs of an upper-air station are often prohibitively expensive, rendering its maintenance and operation unfeasible. In many countries in South America, the launch of radiosondes is limited to once a day, if at all, in order to be able to cover the costs. The number of upper-air stations proposed by the GAP analysis exceeds the financial capabilities of the organizations in question.

Annex 3 Information supplied through WMO

- WIGOS Data Quality Monitoring System website: https://wdqms.wmo.int/
- OSCAR Observing Systems Capability Analysis and Review Tool website: https://space.oscar.wmo.int/
- CHD EW4All Data Inventory and Review Sheet Ecuador

Annex 4 List of materials used

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Annex 5 Copy of the SOFF National Gap Analysis for Ecuador

9 September 2024

GBON National Gap Analysis

Systematic Observations Financing Facility

Weather and climate data for resilience

Screening of the National Gap Analysis (NGA) of Ecuador

WMO Technical Authority screens the GBON National Gap Analysis to ensure consistency with the GBON regulations and provides feedback for revisions as needed. *The screening of the NGA is conducted according to the SOFF Operational Guidance Handbook, version: 04.07.2023 and the provisions in Decision 5.7 of the SOFF Steering Committee.*

Following iterations with peer advisor and beneficiary country, WMO Technical Authority confirms that the National Gap Analysis is consistent with GBON regulations. While the WMO GBON Global Gap Analysis identified the need for 7 surface stations and 2 upper air station over land to meet the GBON horizontal requirement, the **WMO Technical Authority confirms the NGA results which indicate the need for 8 surface land stations and 3 upper station based on specific national circumstances.**

Date: 18 November 2024

Signature:

Albert Fischer

Director, WIGOS Branch, Infrastructure Department, WMO

GBON National Gap Analysis Report
Ecuador

Beneficiary Country Focal Point and Institute	Bolivar Erazo, Executive Director Instituto Nacional de Meteorología e Hidrología "INAMHI", Ecuador
Peer Advisor Focal Point and Institute	Leading Peer Advisor: Marcel Haefliger, Federal Office of Meteorology and Climatology MeteoSwiss, Switzerland (hereafter MeteoSwiss) Supporting Peer Advisor: Servicio Meteorológico Nacional Argentina (hereafter SMN)

Executive summary

This preliminary gap analysis was carried out prior to the visit to INAMHI, taking into account various sources of information, mainly obtained through the OSCAR platform, the WQDMS, the regional WIGOS center, and a series of discussions with INAMHI staff.

According to the existing Global Gap Analysis, Ecuador would need 7 surface and 2 upper-air GBON-compliant stations to meet the station density requirements at the lowest resolution (200 km grid). Considering the location of the Galapagos Islands, an additional surface station as well as an additional upper-air observing station are justified from our point of view. This was acknowledged by WMO Technical Authority (WMO TA), which has approved an additional Surface and one Upper Air Station. The number increases to 26 surface and 3 upper-air for the highest density (100 km grid). It is important to keep in mind that SOFF at this stage is concerned with helping countries to be compliant at least at the lower resolution.

As of today, Ecuador has 45 surface stations registered in OSCAR, of which 11 are closed or silent. All 45 are manned stations, with some belonging to INAMHI and others to the Dirección General de Aviación Civil (DGAC). The 34 that are active provide 3 hourly data in some periods of the day and only some of the required variables. In addition to the manned stations, there are 117 automatic stations also belonging to both institutions (103 of INAMHI – 65 in working conditions – and 14 of third parties – 10 in working conditions), which do not appear in OSCAR but provide information to local authorities.

Concerning upper-air soundings there are 3 registered sites, but no information has been exchanged through WIGOS during the last 3 years. We believe that a very positive effect of SOFF would be to recover the 3 soundings, particularly re-establishing the one from Galapagos Island.

For surface stations the situation deserves further analysis. Raw numbers say that Ecuador counts nearly 100 stations that are operational, a much larger number than the minimum proposed by GBON. Nevertheless, none of these stations are as of today GBON compliant: the manned stations do not operate in 24/7 basis and do not transmit hourly values, and the automatic stations are not linked to WIGOS.

After the on-site visit in Ecuador and the information, which was collected, and the WMO TA decision 7 surface stations in continental Ecuador were identified and an additional station on the Galapagos Island. One of these 8 stations will be a new station in the Amazon region.

Next step will be to develop a sustainable implementation plan, based on the information, that are available after the on-site visit.

1. Country information from the GBON Global Gap Analysis

According to the results of the Global Core Observation Network Global Gap Analysis for Ecuador (ref. 18876/2022/I/WIGOS/ONM/GBON), and considering a land area of 256’370 km^2, Ecuador should have at least 7 surface stations (in a 200 km grid density scenario). In a high-density scenario (100 km grid), 26 surface stations are needed to meet the GBON requirements. In terms of upper-air observing stations, there should be at least two in operation in Ecuador.

Using circles with a 100 km radius around the station instead of a 200 km grid, the number of stations would increase to 8 surface stations instead of 7, as proposed by the Global Gap Analysis.

Considering the location of the Galapagos Islands, an additional surface station as well as an additional upper-air observing station are justified from our point of view. This was acknowledged by WMO Technical Authority (WMO TA), which has approved an additional Surface and one Upper Air Station. The Global Gap Analysis didn’t consider the geographical separation of the Galapagos Islands from the mainland.

According to the records of the WMO Secretariat, none of the stations in Ecuador reports according to the GBON requirement.

Given the potential of the installed capacity, it is important to consider the inclusion of additional surface stations in the GBON network as a possible scenario.

Table I. WMO GBON Global Gap Analysis (June 2023). Illustration of the information that the WMO Secretariat provides to each country (Galapagos wasn’t considered in this report)

A. GBON horizontal resolution requirements	B. Target	C. Reporting (GBON compliant)[1]	D. Gap to improve	E. Gap new	F. Gap total
	[# of stations]				
Surface stations Standard density[2] 200 km	7	0	7	0	7
Upper-air stations over land Standard density[2] 500km	2	0	2	0	2

2. Analysis of existing GBON stations and their status against GBON requirements

The total number of stations declared in OSCAR for Ecuador is 45, all of them manual. Within this list of stations, 34 are partially operational; the rest (10 stations) are silent or closed[3]. These 34 stations

[1] The rationale for classifying surface and upper-air stations as reporting is based on the WIGOS Data Quality Monitoring System (WDQMS) for the chosen time period (WMO GBON Global Gap analysis, June 2023). Stations with data availability more than 80% on at least 80% of days, are considered as reporting. Other listed stations are counted as having the possibility to be improved.

[2] For SIDS, for the WMO GBON Global Gap Analysis in June 2023, 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.

[3] The stations that are currently non-operational have the following characteristics:

- 3 sea profiling stations (silenced)

report with some interruptions according to the WDQMS tool of the WMO, classifying them as "partially operational". During the last 3 years, no upper-air observation data have been available from the 3 stations declared in OSCAR.

The stations are owned and operated by Instituto Nacional de Meteorología e Hidrología INAMHI and Dirección General de Aviación Civil DGAC:

INAMHI	DGAC
• 14 partially operational surface stations[4] • 3 surface stations closed	• 22 partially operational airport stations • 2 Airport stations closed

Between the two institutions (INAMHI and DGAC) there are a total of 37 observing stations, of which 34 are surface stations and 3 are upper-air observation stations (see Table 2 and Figure 1 to 3).

Table II. Assessment of existent stations per their operational status and network ownership

GBON Requirements	Existing observation stations (# of stations)			
	NMHS network		Third-party network	
	Reporting (GBON compliant) [5]	To improve	Reporting (GBON compliant) [3]	To improve
Surface land stations Standard density [6] 200km Variables: SLP, T, H, W, P, SD	14	14	20	20
Upper-air stations operated from land Horizontal resolution[4]: 500km Vertical resolution: 100m, up to 30 hPa Variables: T, H, W	**0**	**2**	**0**	**1**
Surface marine stations in Exclusive Economic Zones:[7] 500 km Variables: SLP, SST	-	-	-	-

- 1 GAW (ozonesonde, closed)
- 4 airports closed
- 3 closed conventional stations

[4] In addition to the 22 stations located at airports reported in OSCAR, there are two stations located at airports that were recently incorporated to the DGAC network and are not yet reporting to OSCAR.

[5] The rationale for classifying surface and upper-air stations as reporting is based on the WIGOS Data Quality Monitoring System (WDQMS) for the chosen time period during the development of National Gap Analysis Stations with data availability more than 80% on at least 80% of days, are considered as reporting. Other listed stations are counted as having the possibility to be improved.

[6] For SIDS, for the WMO GBON Global Gap Analysis in June 2023, 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.

Upper-air stations operated in Exclusive Economic Zones:[7] 1000 km Vertical resolution: 100m, up to 30 hPa Variables: T, H, W	-	-	-	-

Table III. Assessment of existing GBON stations per station characteristics. Station type: S: Surface, UA: Upper-Air; M: Marine; Owner of the station: NMHS or name of third-party; GBON variables: SLP: Atmospheric pressure; T: Temperature; H: Humidity; W: wind; P: Precipitation; SD: Snow depth; SST: Sea surface temperature; Reporting cycle: Number of observation reports exchanged internationally per day (0-24); GBON compliance: whether the station is GBON compliant or not (see GBON guide on compliance criteria).

Station name	Station type (S/UA/M)	Owner (NMHS/3rd party)	Funding source	GBON variable measured						Reporting cycle (obs/day)	GBON Compliant (Y/N)
				SLP	T	H	W	P	SD		
INGUINCHO	S	INAMHI	INAMHI	X	X	X	X	X	-	5	N
IZOBAMBA	S	INAMHI	INAMHI	X	X	X	X	X	-	5	N
RUMIPAMBA SALCEDO	S	INAMHI	INAMHI	X	X	X	X	X	-	5	N
NUEVO ROCAFUERTE	UA	INAMHI	INAMHI	-	-	-	-	-	-	0	N
PICHILINGUE	S	INAMHI	INAMHI	X	X	X	X	X	-	5	N
PUERTO ILA	S	INAMHI	INAMHI	X	X	X	X	X	-	5	N
SAN GABRIEL	S	INAMHI	INAMHI	X	X	X	X	X	-	5	N
SAN CRISTOBAL - GALAPAGOS	UA	INAMHI	INAMHI	-	-	-	-	-	--	0	N
QUEROCHACA	S	INAMHI	INAMHI	X	X	X	X	X	-	5	N
BALTRA AEROPUERTO-GALAPAGOS	S	DGAC	DGAC	X	X	X	X	X	-	5	N
CUENCA AEROPUERTO	S	DGAC	DGAC	X	X	X	X	X	-	5	N
EL COCA AEROPUERTO	S	DGAC	DGAC	X	X	X	X	X	-	5	N
ESMERALDAS AEROPUERTOS	S	DGAC	DGAC	X	X	X	X	X	-	5	N
AEROPUERTO DE GUAYAQUIL	S	DGAC	DGAC	X	X	X	X	X	-	5	N
AEROPUERTO DE GUAYAQUIL	UA	DGAC	DGAC	-	-	-	-	-	-	0	N
AEROPUERTO LATACUNGA	S	DGAC	DGAC	X	X	X	X	X	-	5	N
AEROPUERTO MACAS	S	DGAC	DGAC	X	X	X	X	X	-	5	N
MANTA AEROPUERTO	S	DGAC	DGAC	X	X	X	X	X	-	5	N
NUEVA LOJA AEROPUERTO	S	DGAC	DGAC	X	X	X	X	X	-	5	N

[7]Although GBON marine stations and stations in EEZ are not part of initial SOFF scope, peer advisors are encouraged to analyze in this step when considered relevant e.g. SIDS, the status of current marine stations for future GBON marine observations investments.

Station name	Station type (S/UA/M)	Owner (NMHS/3rd party)	Funding source	GBON variable measured						Reporting cycle (obs/day)	GBON Compliant (Y/N)
				SLP	T	H	W	P	SD		
SALINAS AEROPUERTO	S	DGAC	DGAC	X	X	X	X	X	-	5	N
AEROPUERTO DE SAN CRISTÓBAL - GALAPAGOS	S	DGAC	DGAC	X	X	X	X	X	-	5	N
AEROPUERTO SANTA ROSA	S	DGAC	DGAC	X	X	X	X	X	-	5	N
SHELL MERA AEROPUERTO	S	DGAC	DGAC	X	X	X	X	X	-	5	N
TOMO CATAMAYO AEROPUERTO	S	DGAC	DGAC	X	X	X	X	X	-	5	N
TULCAM AEROPUERTO	S	DGAC	DGAC	X	X	X	X	X	-	5	N
AEROPUERTO SUCRE	S	DGAC	DGAC	X	X	X	X	X	-	5	N
LA TOLA	S	INAMHI	INAMHI		X	X	X		-	5	N
NUEVO ROCAFUERTE	S	INAMHI	INAMHI		X	X	X		-	5	N
PUYO	S	INAMHI	INAMHI		X	X	X		-	5	N
LA CONCORDIA	S	INAMHI	INAMHI		X	X	X		-	5	N
CAÑAR	S	INAMHI	INAMHI		X	X	X		-	5	N
LOJA - LA ARGELIA	S	INAMHI	INAMHI		X	X	X		-	5	N
SAN CRISTOBAL - GALAPAGOS	S	INAMHI	INAMHI		X	X	X		-	5	N
TOMALON TABACUNDO	S	INAMHI	INAMHI		X	X	X		-	5	N
AMBATO AEROPUERTO	S	DGAC	DGAC		X	X	X		-	5	N
TENA AEROPUERTO	S	DGAC	DGAC		X	X	X		-	5	N
AEROPUERTO DE GUALAQUIZA	S	DGAC	DGAC		X	X	X		-	5	N

3. Results of the GBON National Gap Analysis

According to the information gathered so far, Ecuador does not have any stations compatible with the GBON criteria. After the on-site visit end of November 2023, 6 surface stations were identified from the existing network, which should be improved in order to be GBON compliant. One additional station is recommended to be built in the Amazon region. This station will also be an upper-air station. As mentioned in Section 1, one surface station and one upper-air station have been added, each located on the Galapagos Islands. So, there are a total of 8 surface stations and 3 upper-air stations.

Considering the climatic zones of Ecuador, it is recommended to establish additional stations in the future that comply with GBON standards in order to ensure adequate coverage and high-quality data. This will be presented to and discussed with the Inter American Development Bank.

Table IV. Results of the GBON national gap analysis. SLP: Atmospheric pressure; T: Temperature; H: Humidity; W: wind; P: Precipitation; SD: Snow depth; SST: Sea surface temperature**.**

GBON requirements	Global GBON target	Approved national target	Reporting	Gap	
				To improve	New
	[# of stations]				
Surface land stations	7	8	0	**7**	**1**
Upper-air stations operated from land	2	3	0	**2**	**1**
Surface marine stations in Exclusive Economic Zones:[8] Density 500 km Variables: SLP, SST Observing cycle: 1h	-	-	-	**-**	**-**
Upper-air stations operated in Exclusive Economic Zones:[9] Density 1000 km Vertical resolution: 100 m, up to 30 hPa Variables: T, H, W Observing cycle: twice a day	-	-	-	**-**	**-**

3.1 Recommended existing surface, upper-air and marine[11] stations to be designated to GBON

After the on-site visit to Ecuador following 7 surface stations and an additional station on Galapagos are recommended to be designated to GBON. For the Amazon region it is proposed to establish a new Station, which will also be an Upper-air station.

[8] Although GBON marine stations are not part of initial SOFF scope, peer advisors are encouraged to analyze in this step when considered relevant e.g. SIDS, the need for future GBON marine observations investments according to the GBON requirements.
[9] Although GBON marine stations are not part of initial SOFF scope, peer advisors are encouraged to analyze in this step when considered relevant e.g. SIDS, the need for future GBON marine observations investments according to the GBON requirements.
[10] Although GBON marine stations are not part of initial SOFF scope, peer advisors are encouraged to analyze in this step when considered relevant e.g., SIDS, the need for future GBON marine observations investments according to the GBON requirements.
[11] Although GBON marine stations are not part of initial SOFF scope, peer advisors are encouraged to analyze in this step when considered relevant e.g., SIDS, the need for future GBON marine observations investments according to the GBON requirements.

Table V. Recommended existing surface, upper-air and marine stations to be designated to GBON.

Station name	Station type (S/UA/M[12])
Guyaquil (relocated)	S/UA
Izobamba	S
Sacha INIAP (New Station)	S/UA
La Concordia	S
La Teodomira	S
Loja – La Argelia	S
Puyo	S
San Cristobal - Galapagos	S/UA

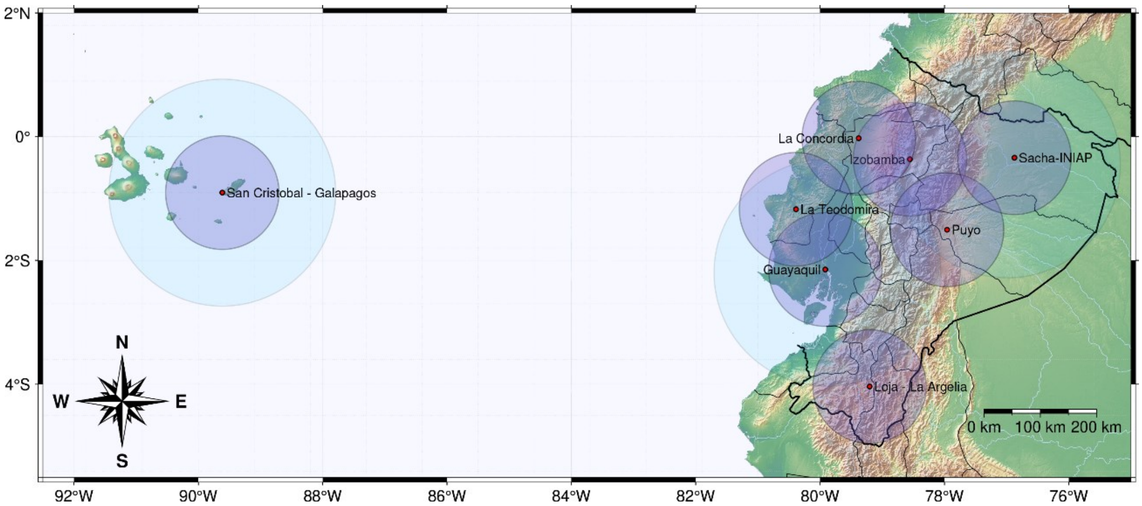

Figure 1: Map with the proposed 8 GBON Stations and 3 UA Stations.
Sacha-INIAP is the planned new surface and UA station.

[12] Please see guidance on marine stations in Section 2 on Scope.

4. Report completion signatures

Peer Advisor signature 16.9.2024
Beneficiary Country signature
WMO Technical Authority screening signature

ANNEX

Additional observations not shared internationally

According to the information provided by INAMHI, there is a significant number of automatic weather stations (AWS) in continental Ecuador. This is additional information collected as part of the Gap Analysis, and we believe it may be useful to survey the country's observing capabilities, although none of the automatic stations surveyed are reported in OSCAR nor are they shared internationally.

A total of 117 AWS were counted, of which 103 are owned by INAMHI, and 14 are owned by third parties.

According to the information provided by INAMHI staff, their operation can be categorized as follows:

	INAMHI	Third Party
Operational	65	10
Semi-Operational or Non-Operational	38	4
Total	103	14

IMPORTANT: There are no automatic stations declared in OSCAR. The details of these stations are shown in the following table.

Code	Database name	Network	Transmitting (June)	Status	Owner	Type of transmission
H0011	MIRA EN LITA	Hydrological	YES	Operational	INAMHI	GOES
H0012	LITA AJ MIRA	Hydrological	NO	Non-Operational	INAMHI	GOES
H0017	APAQUI D GRUTA LA PAZ #3	Hydrological	YES	Operational	INAMHI	GOES
H0064	EL ANGEL EN PTE.AYORA	Hydrological	NO	Non-Operational	INAMHI	
H0136	ALAMBI EN CHURUPAMBA	Hydrological	YES	Operational	CELEC	GPRS
H0148	GUAYLLABAMBA DJ PISQUE	Hydrological	YES	Operational	INAMHI	GOES
H0149	GUAYLLABAMBA EN PTE.CHACAPATA	Hydrological	YES	Operational	INAMHI	GOES
H0150	INTAG D.J. PAMPLONA	Hydrological	YES	Operational	CELEC	GOES
H0158	PITA AJ SALTO	Hydrological	YES	Operational	INAMHI	GOES
H0168	ESMERALDAS DJ SADE	Hydrological	YES	Non-Operational	PNUD/INAMHI	GOES
H0170	GUAYLLABAMBA AJ BLANCO	Hydrological	NO	Operational	PNUD/INAMHI	GOES
H0173	TEAONE AJ ESMERALDAS	Hydrological	YES	Non-Operational	PNUD/INAMHI	GPRS
H0229	CARRIZAL EN CALCETA	Hydrological	YES	Operational	INAMHI	GOES
H0235	CHONE EN CHONE	Hydrological	YES	Operational	INAMHI	GOES
H0266	PORTOVIEJO EN H. VASQUEZ (GUARUMO)	Hydrological	NO	Non-Operational	INAMHI	GOES
H0343	ECHEANDIA EN ECHEANDIA	Hydrological	NO	Non-Operational	INAMHI	GOES
H0346	ZAPOTAL EN LECHUGAL	Hydrological	YES	Operational	INAMHI	GOES
H0347	QUEVEDO EN QUEVEDO	Hydrological	NO	Non-Operational	INAMHI	GOES
H0371	SAN PABLO EN PALMAR	Hydrological	YES	Operational	INAMHI	GOES

Code	Database name	Network	Transmitting (June)	Status	Owner	Type of transmission
H0448	PAYO AJ BULUBULU	Hydrological	YES	Operational	INAMHI	GOES
H0471	CAÑAR DJ RAURA	Hydrological	NO	Non-Operational	INAMHI	GOES
H0587	PINDO AJ AMARILLO	Hydrological	YES	Operational	INAMHI	GOES
H0589	PUYANGO AJ MARCABELI	Hydrological	YES	Operational	INAMHI	GOES
H0591	PUYANGO EN CPTO.MILITAR (PTE.CARRETERA)	Hydrological	YES	Operational	INAMHI	GOES
H0620	CATAMAYO EN PTE.SANTA ROSA	Hydrological	YES	Operational	INAMHI	GOES
H0719	QUIJOS DJ OYACACHI	Hydrological	YES	Operational	INAMHI	GOES
H0790	CEBADAS AJ GUAMOTE	Hydrological	NO	Non-Operational	INAMHI	GOES
H0797	PANSACHI EN HDA.BAÑOS	Hydrological	NO	Non-Operational	INAMHI	GOES
H0854	CUTUCHI EN CASPI	Hydrological	YES	Operational	INAMHI	GOES
H0884	ZAMORA AJ BOMBOIZA	Hydrological	NO	Non-Operational	INAMHI	GOES
H0890	ZAMORA DJ NANGARITZA	Hydrological	NO	Non-Operational	INAMHI	GOES
H0894	PAUTE EN PAUTE (DJ GUALACEO)	Hydrological	YES	Operational	INAMHI	GOES
H1133	AGUARICO EN NUEVA LOJA (LA GABARRA)	Hydrological	YES	Operational	INAMHI	GOES
H1134	COCA EN SAN SEBASTIAN	Hydrological	YES	Operational	INAMHI	GPRS
H1136	NAPO EN NUEVO ROCAFUERTE	Hydrological	YES	Operational	INAMHI	GOES
H1149	SANTIAGO EN BATALLON SANTIAGO	Hydrological	YES	Operational	INAMHI	GOES
H1153	NAPO AJ PAYAMINO	Hydrological	NO	Non-Operational	INAMHI	GOES
H5007	ZARUMILLA EN CARCABON	Hydrological	NO	Non-Operational	INAMHI	GOES
H5011	PAYAMINO AJ NAPO	Hydrological	NO	Non-Operational	INAMHI	GPRS
M0001	INGUINCHO	Meteorological	YES	Operational	INAMHI	GOES
M0002	LA TOLA	Meteorological	YES	Semi-Operational	INAMHI	GPRS
M0003	IZOBAMBA	Meteorological	YES	Semi-Operational	INAMHI	GPRS
M0004	RUMIPAMBA SALCEDO	Meteorological	YES	Operational	INAMHI	GPRS
M0006	PICHILINGUE	Meteorological	NO	Non-Operational	INAMHI	GPRS
M0007	NUEVO ROCAFUERTE	Meteorological	YES	Non-Operational. Valores atípicos	INAMHI	GOES
M0008	PUYO	Meteorological	YES	Operational	INAMHI	GPRS
M0012	LA CUCA	Meteorological	NO	Non-Operational	INAMHI	GPRS
M0024	IÑAQUITO	Meteorological	YES	Semi-Operational	INAMHI	ETHERNET
M0025	LA CONCORDIA	Meteorological	YES	Operational	PNUD/INAMHI	GPRS
M0026	PUERTO ILA	Meteorological	NO	Non-Operational	INAMHI	GPRS
M0031	CAÑAR	Meteorological	YES	Operational	INAMHI	GPRS
M0033	LOJA - LA ARGELIA	Meteorological	YES	Operational	INAMHI	GPRS
M0037	MILAGRO (INGENIO VALDEZ)	Meteorological	YES	Semi-Operational	INAMHI	GPRS

Code	Database name	Network	Transmitting (June)	Status	Owner	Type of transmission
M0055	QUITO AEROPUERTO-PARQUE BICENTENARIO	Meteorological	YES	Operational	INAMHI	GPRS
M0102	EL ANGEL	Meteorological	YES	Operational	INAMHI	GPRS
M0103	SAN GABRIEL	Meteorological	YES	Operational	INAMHI	GPRS
M0105	OTAVALO	Meteorological	YES	Operational	INAMHI	GPRS
M0117	MACHACHI	Meteorological	YES	Operational	GAD MUNICIPAL CANTÓN MEJÍA	
M0124	SAN JUAN LA MANA	Meteorological	YES	Operational	INAMHI	GPRS
M0130	CHILLANES	Meteorological	NO	Non-Operational	INAMHI	GPRS
M0136	CHUNCHI	Meteorological	NO	Non-Operational	ESPOCH (MODEM Y CHIP propuesto por INAMHI)	
M0139	GUALACEO	Meteorological	NO	Non-Operational	INAMHI	GPRS
M0146	CARIAMANGA	Meteorological	NO	Non-Operational	INAMHI	GPRS
M0150	AMALUZA 1	Meteorological	NO	Non-Operational	INAMHI	GOES
M0156	QUININDE	Meteorological	YES	Operational	PNUD/INAMHI	GPRS
M0160	EL CARMEN	Meteorological	YES	Operational	PNUD/INAMHI	GPRS
M0162	CHONE-U. CATOLICA	Meteorological	YES	Operational	INAMHI	GPRS
M0168	PEDERNALES	Meteorological	YES	Operational	INAMHI	GPRS
M0188	PAPALLACTA	Meteorological	YES	Operational	INAMHI	GPRS
M0189	GUALAQUIZA	Meteorological	NO	Non-Operational	INAMHI	
M0221	SAN CRISTOBAL-GALAPAGOS	Meteorological	YES	Semi-Operational	INAMHI	GPRS
M0258	QUEROCHACA	Meteorological	YES	Operational	INAMHI	GPRS
M0427	SAYAUSI (MATADERO DJ)	Meteorological	NO	Non-Operational	INAMHI	
M0444	TEAONE-TABIAZO	Meteorological	YES	Operational	PNUD/INAMHI	GPRS
M1036	RIOBAMBA POLITECNICA	Meteorological	YES	Operational	INAMHI	GPRS
M1040	MACAS SAN ISIDRO-PNS	Meteorological	YES	Semi-Operational	INAMHI	GPRS
M1094	TOMALON-TABACUNDO	Meteorological	YES	Operational	INAMHI	GPRS
M1107	LAGUACOTO	Meteorological	YES	Operational	INAMHI	GPRS
M1124	SIERRAZUL	Meteorological	YES	Operational	INAMHI	GOES
M1128	EL INGENIO	Meteorological	NO	Non-Operational	INAMHI	GPRS
M1170	SANTA ELENA	Meteorological	NO	Non-Operational	INAMHI	GPRS
M1171	HUATICOCHA	Meteorological	NO	Non-Operational	INAMHI	
M1190	SAN BERNABE	Meteorological	YES	Operational	PNUD/INAMHI	ETHERNET y GOES
M1203	LUMBAQUI	Meteorological	NO	Non-Operational	INAMHI	GPRS
M1207	NOBOL	Meteorological	YES	Operational	INAMHI	GPRS
M1208	LA TEODOMIRA	Meteorological	YES	Operational	INAMHI	GPRS
M1217	BAHIA DE CARAQUEZ-PUCE	Meteorological	NO	Non-Operational	INAMHI	GPRS
M1219	TENA HDA. CHAUPISHUNGO	Meteorological	YES	Operational	INAMHI	GPRS
M1220	ATASCOSO (VIA PICHINCHA)	Meteorological	NO	Non-Operational	GADP Pichincha	
M1221	SAN JOSE DE PAYAMINO	Meteorological	NO	Non-Operational	INAMHI	GOES
M1233	CANTAGALLO-GRANJA UNESUM	Meteorological	YES	Operational	INAMHI	GPRS
M1240	IBARRA - 1	Meteorological	YES	Operational	INAMHI	GPRS

Code	Database name	Network	Transmitting (June)	Status	Owner	Type of transmission
M1242	EL ALMENDRAL - GRANJA ALMENDRAL	Meteorological	NO	Non-Operational	INAMHI	GPRS
M1244	PALMALES	Meteorological	NO	Non-Operational	INAMHI	GPRS
M1246	LAS LAJAS	Meteorological	YES	Operational	INAMHI	GPRS
M1247	CHUQUIRIBAMBA	Meteorological	YES	Operational	INAMHI	GPRS
M1249	PALESEMA	Meteorological	NO	Non-Operational	INAMHI	GPRS
M1253	PUERTO HONDO	Meteorological	YES	Operational	SENESCYT	GPRS
M1256	RANCHEROS DEL NORTE-EL CARMELO	Meteorological	YES	Operational	INAMHI	GOES
M1259	MACARA - 1	Meteorological	NO	Non-Operational	INAMHI	GOES
M1262	LA PALMA	Meteorological	YES	Operational	PNUD/INAMHI	GPRS
M1266	SAN MARCOS -LA CELICA	Meteorological	YES	Operational	PNUD/INAMHI	GPRS
M1271	GUAYAQUIL (FACULTAD CCNN)	Meteorological	YES	Operational	INAMHI	GPRS
M1273	LLOA	Meteorological	YES	Operational	INAMHI	GPRS
M1274	POLITECNICA SALESIANA-CAMPUS SUR	Meteorological	YES	Operational	UPS Quito - Universidad Politécnica Salesiana	GPRS
M5090	LA LAMPADA	Meteorological	YES	Operational	INAMHI	GPRS
M5091	TANZARAY	Meteorological	NO	Non-Operational	INAMHI	GOES
M5092	GUALLETURO	Meteorological	NO	Non-Operational	INAMHI	GPRS
M5131	CAMARONERA-SONGA	Meteorological	NO	Non-Operational	SENESCYT	GPRS
M5132	COE-MONTE BELLO	Meteorological	YES	Operational	SENESCYT	GPRS
M5133	CUERPO DE BOMBEROS DIVINO NIÑO-DURAN	Meteorological	YES	Operational	SENESCYT	GPRS
M5134	MINISTERIO DE SALUD MACHALA-SNEM	Meteorological	YES	Operational	SENESCYT	GPRS
M5135	HOSPITAL PUBLICO-HUAQUILLAS	Meteorological	YES	Operational	SENESCYT	GPRS
M5136	COLEGIO 13 DE MAYO-PORTOVELO	Meteorological	YES	Operational	SENESCYT	GPRS
M5137	ZARUMA	Meteorological	NO	Non-Operational	SENESCYT	GPRS
M5151	GLACIAR 11 CHIMBORAZO	Meteorological	NO	Non-Operational	INAMHI	GOES
M5192	EL CHONTAL	Meteorological	YES	Operational	PNUD/INAMHI	GOES