Executive Summary

2026

Climate information and early warning systems

Independent evaluation of the GCF's approach to and Portfolio of Climate Information and Early Warning System Interventions (CIEWS2025)

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© 2026 Green Climate Fund Independent Evaluation Unit
175, Art center-daero
Yeonsu-gu, Incheon 22004
Republic of Korea
Tel. (+82) 032-458-6450
Email: ieu@gcfund.org
https://ieu.greenclimate.fund

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Head of the GCF Independent Evaluation Unit: Andreas Reumann
Task manager: Aiko Ward, Principal Evaluation Officer, Independent Evaluation Unit
Editing: Toby Pearce
Layout: Giang Pham
Cover photo: ©Evelyn Vargas Carmona, *Especialista en comunicación* (Communication Specialist), IUCN Guatemala Office
Cover design: Therese Gonzaga

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ABBREVIATIONS

B.43	The fortieth third meeting of the Board
CIEWS	Climate information and early warning systems
CIS	Climate information services
EWS	Early warning systems
FP	Funding proposal
GCF	Green Climate Fund
IRMF	Integrated results management framework
MHEWS	Multi-hazard early warning systems
NMHS	National meteorological and hydrological services
USP	Updated Strategic Plan for the GCF
WMO	World Meteorological Organization

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INTRODUCTION

Climate information and early warning systems (CIEWS) play a critical role in reducing climate risks and building resilience. Evidence shows that well-designed CIEWS can prevent and reduce loss and damage, saving millions of lives. When aligned with the Global Goal on Adaptation's aim to enhance adaptive capacity, strengthen resilience and reduce vulnerability to climate change, CIEWS are likely to remain a central priority within climate finance.

With its mandate to support developing countries in addressing climate change mitigation and adaptation, the Green Climate Fund (GCF) has made significant investments in CIEWS over the past decade. Despite the large investments, however, there has been no evaluation of GCF's approach to and portfolio of CIEWS projects and programmes. Hence, this evaluation sought to answer the following key questions:

- How can the GCF be strategic in promoting and supporting CIEWS in developing countries with a view to strengthening resilience, preparedness and response while ensuring sustainability of the systems?
- How can the GCF as a global climate finance mechanism build stronger coalitions with other international actors to identify and collectively fill investment gaps in the CIEWS value chain, and/or bring in and blend private sector resources to effect paradigm shifts faster?

To answer these questions, this evaluation examined the GCF's approach to and portfolio of CIEWS. Specifically, the evaluation focused on assessing the GCF's collaboration with other CIEWS actors as well as how the GCF has leveraged its programmatic approaches and funding windows to support CIEWS. These programmatic approaches include working with direct access entities versus international accredited entities, engaging with the public versus private sectors, and single-country versus multi-country programming to attain CIEWS results. For funding windows, the evaluation assessed the extent to which and how the GCF has leveraged the Readiness and Preparatory Support Programme and Project Preparation Facility for supporting CIEWS interventions. The evaluation also assessed the GCF's portfolio of CIEWS projects and programmes by evaluating the extent to which GCF-funded interventions have made CIEWS available, accessible, and responsive, with the aims of protecting lives and livelihoods and strengthening resilience in developing countries.

By tracing GCF's evolution over the past 10 years, this evaluation presents a story of the GCF emerging as the leading global financier in CIEWS through a process of learning and adaptation. While multilateral banks like the World Bank previously led funding in this area, with the World Meteorological Organization's (WMO) technical support, the landscape has gradually shifted as the GCF has expanded its commitment to CIEWS. GCF's investments began in 2015 with its first project in Malawi (FP002), which upgraded weather infrastructure and early warning systems (EWS) and benefited over 1.2 million people. The portfolio had grown to 141 CIEWS-tagged projects by the forty-third meeting of the Board (B.43).

CONCLUSIONS AND RECOMMENDATIONS

Conclusion 1: The GCF is highly relevant to CIEWS and holds a privileged position in the space. However, GCF-funded CIEWS projects lack coherence and a systematic approach at portfolio level.

By 2024, the GCF had surpassed the World Bank as the leading financier in EWS, accounting for 34 per cent of the global share and supporting 44 per cent of EWS investments in least developed countries and small island developing States. The evaluation team estimates that GCF's cumulative investments in CIEWS reached USD 1.997 billion as of B.43, representing 10 per cent of the total GCF portfolio. Investments in CIEWS include projects that focus primarily on CIEWS and those that integrate CIEWS into broader adaptation efforts.

The release of a sectoral funding approach by the GCF Secretariat in 2022 marked a new phase, introducing three distinct paradigm-shifting pathways for CIEWS investments: (i) strengthening climate information services (CIS), (ii) promoting impact-based multi-hazard early warning systems (MHEWS), and (iii) improving CIEWS for investment and financial decisions. In the same year, the launch of the Early Warning for All initiative by the United Nations Secretary-General António Guterres, which aims at achieving universal early warning coverage by 2027, generated renewed momentum and contributed to the inclusion of CIEWS as a programmatic priority in the Strategic Plan for the Green Climate Fund 2024–2027 (USP-2).

Following the launch of the Early Warning for All initiative, CIEWS-related projects increased substantially within the GCF portfolio. However, while the CIEWS project portfolio continues to feature across all eight results areas, investments remain fragmented and are not guided by a unified portfolio-level CIEWS approach. This lack can lead to a fragmented portfolio, where results are provided in isolation and without further consideration of the paradigm shift potential in this sector.

Recommendation 1: The GCF Board and Secretariat should capitalize on the Fund's position as the leading financier in CIEWS and prepare to assume a leadership role beyond 2027. The GCF Board should offer strategic guidance on GCF's intended role and designate CIEWS as a strategic priority under the Strategic Plan for the Green Climate Fund 2028–2031 (USP-3). In turn, the Secretariat should operationalize this guidance aligned with the USP-3.

Conclusion 2: Limited knowledge-sharing and knowledge brokering represent missed opportunities in the CIEWS investments.

The Governing Instrument states that "the Fund will be scalable and flexible and will be a continuously learning institution guided by processes for monitoring and evaluation. The Fund will strive to maximize the impact of its funding for adaptation and mitigation" (paragraph 3). The GCF is in the early stages of its knowledge management practices, which is broadly consistent with its organizational maturity but not yet sufficient to facilitate a larger knowledge brokering role and leadership. The GCF has a knowledge management strategy and action plan that is not yet fully implemented and institutionalized, but efforts are under way. This shortcoming is also apparent in the portfolio of CIEWS projects.

The discontinuation of the CIEWS sectoral guide in 2025 has heightened uncertainty regarding the GCF's technical and knowledge role in CIEWS projects. At present, the Fund does not provide a comprehensive or visible articulation of its experience or strategic approach in this area, resulting in missed opportunities for broader learning, engagement and influence. Existing GCF documents, including the SAPCREWS Scaling-up Framework, USP-2, and the WMO–GCF "Developing the

Climate Science Information for Climate Action" offer only limited context. They function primarily as frameworks or toolkits rather than as dedicated CIEWS knowledge resources. Furthermore, the inclusion of a CIEWS target in USP-2, on its own, is insufficient to enable meaningful cross-learning, representing a missed opportunity given GCF's extensive experience in CIEWS investments over the past decade.

Within the organization, respondents expressed differing views on GCF's knowledge-sharing role in CIEWS, likely reflecting the Fund's primary function as a secondary due diligence entity rather than as a dedicated knowledge broker. In practice, GCF largely adopts a passive approach to knowledge dissemination, primarily contributing to resources developed by other CIEWS stakeholders, including WMO, United Nations Office for Disaster Risk Reduction, the Alliance for Hydromet Development, and the Risk-informed Early Action Partnership.

Findings from this evaluation highlight several areas of practice where the GCF approach to CIEWS investments could benefit from greater clarity, knowledge-sharing, mutual learning and strengthening. These include, among others, operationalizing blended finance mechanisms for CIEWS, streamlining regional approaches to managing cross-boundary hazards, and strengthening partnerships with local actors to improve last-mile reach. Sharing these insights in accessible formats would facilitate broader knowledge exchange, promote complementarity and enhance coherence across the diverse CIEWS landscape.

Recommendation 2: As a continuously learning institution, the GCF Secretariat should continue to shift towards a structure and operations that ensure learning and feedback loops across projects, countries and entities clearly and systematically. The Fund should share its CIEWS expertise with relevant CIEWS stakeholders to strengthen the GCF's role as a knowledge broker, besides its position as the leading financier in the CIEWS space.

Conclusion 3: GCF has succeeded in directing CIEWS investments towards countries most in need. Although GCF's CIEWS investments have achieved notable results at the project level, a full paradigm shift of climate information and early warning capabilities has yet to occur across the diverse contexts of participating countries.

The evaluation finds that GCF demonstrates strong alignment with its mandate to serve those developing countries particularly vulnerable to the adverse effects of climate change, as set out in the Governing Instrument. A comparative analysis of GCF investments by country and disaster risk data from the World Risk Index 2025 shows that the Fund's investments have largely targeted countries experiencing the highest levels of disaster risk, exposure and vulnerability. This highlights GCF's important role in strengthening countries' resilience as they pursue broader adaptation measures, including CIEWS.

However, the evaluation found that while GCF's CIEWS investments have achieved notable results at the project level, persistent challenges remain at the portfolio level, and a full paradigm shift in climate information and early warning capabilities has yet to occur across the diverse contexts of participating countries.

The three pathway assessments show that gaps or weaknesses at any point along the value chain can compromise the overall effectiveness of the CIEWS portfolio, resulting in inconsistent delivery of climate services and warnings.

For example, the assessment of pathway 1, CIS, revealed that although GCF investments have improved meteorological infrastructure, including in fragile settings, persistent gaps exist in advanced climate modelling, user engagement and co-production of climate services, and long-term

institutional capacity-building. Weak user engagement, in particular, highlights the need to build trust and co-develop a timely, reliable and usable climate information service tailored to end user needs and decision contexts.

Pathway 2, MHEWS, has improved the technical sophistication of EWS, but gaps remain between system design and operational delivery. These gaps are most evident in last-mile connectivity and cross-border coordination. The pathway 2 assessment also found a mismatch between stated objectives and actual conditions, as most projects continue to focus on single hazards rather than addressing multiple hazards.

Pathway 3, CIEWS for investments and financial decisions, performed relatively well despite being the youngest portfolio. However, a notable disconnect remains between financial mechanisms and the real-time usability of CIEWS, limiting the full potential of risk-informed finance.

The pathway assessments also revealed limitations in the current framing of the three paradigm-shifting pathways. Because the pathways often overlap and are not sufficiently granular to identify investment gaps by value chain, the evaluation disaggregated each pathway using value chain analysis to better assess portfolio-level performance. Without the ability to review CIEWS by value chain, the Fund cannot assess the maturity of each value chain and prioritize investments accordingly.

Recommendation 3: The Fund should revise how it presents the paradigm-shifting pathways in the CIEWS operational guidance, as outlined in Recommendation 1. A clearer, more structured approach is needed to identify investment gaps across each country's CIEWS value chain. The revised pathways should align with global standards, including the six value chains of the Global Framework for Climate Services and the MHEWS pillars.

Conclusion 4: The long-term sustainability of GCF CIEWS investments remains an ongoing concern. In some cases, project design and review processes do not adequately address long-term outcomes or account for the practical realities encountered during implementation in local contexts.

The evaluation found that GCF funding proposals (FPs) have at times exceeded national capacities, leading to implementation challenges and sustainability risks. Developing countries, especially least developed countries and small island developing States, often struggle to manage large GCF grants because of limited human and technical resources.

Mismatches between GCF investments and national capacity in national meteorological and hydrological services (NMHS) or related agencies often stem from limited stakeholder consultations, insufficient gap analyses and feasibility studies during project design, and assumptions that newer or more advanced equipment and technology will automatically deliver greater effectiveness.

Many CIEWS proposals emphasize equipment-related investments, including basic observation networks, automated weather stations, weather radars and sea buoys. However, project designs often fail to account for the full cost of ownership, particularly long-term operational and maintenance requirements, leading to recurring sustainability issues. While organizations such as the Systematic Observations Financing Facility provide long-term, results-based financing to support the operation and maintenance of basic observation networks in developing countries, a collaboration framework between the Observations Financing Facility and climate funds, including the GCF, has not been fully utilized, resulting in missed opportunities.

Moreover, projects with a primary focus on CIEWS are often designed at the national level with NMHS and national disaster management agencies. As a result, local end users' needs, which are critical to the success of end-to-end impact-based EWS, are often overlooked. At the same time, evidence indicates that participatory and inclusive approaches introduced from the start of the project design consistently emerge as key success factors in driving sustained institutional and behavioural change at both national and local levels.

The evaluation also highlighted ongoing difficulties in engaging with the private sector and in establishing sustainable, revenue-generating CIEWS service models, exposing a gap between stated goals and practical realities. Although many CIEWS FPs include well-articulated exit strategies – such as securing public funding, generating revenue from commercial weather services, or cutting inefficient operating costs – these ambitions often remain unrealized by the end of project implementation, leading to continued reliance on grant-based financing from development partners.

In response to ongoing sustainability challenges, the evaluation found that CIEWS actors have increasingly applied the concept of operations in observation-related infrastructure projects. This helps ensure the proposed system is fit for purpose and affordable beyond project lifespan.

Recommendation 4: Across all stages of the project cycle, particularly during project design, the GCF Secretariat should strengthen considerations of the sustainability of CIEWS investments. Such measures should consider including participatory needs assessments that engage both providers and end users of CIS, including women, Indigenous Peoples and other vulnerable groups, as well as comprehensive feasibility studies for revenue-generating activities undertaken by NMHS or related agencies.

In addition, the Secretariat should strengthen its appraisals of CIEWS FPs to ensure that GCF-funded equipment serves its intended use aligns with local institutional and technical capacity, and that post-project operation and maintenance are properly considered in the project design.

Conclusion 5: The Fund faces difficulties in assessing portfolio-wide impacts and accurately identifying and estimating investment volumes for CIEWS projects.

Analysis of reported results against the GCF's mitigation and adaptation performance measurement frameworks and the integrated results management framework (IRMF) reveals systematic measurement challenges across CIEWS investments.

Data reported by accredited entities against CIEWS-related indicators of the performance measurement frameworks, including A1.1 on expected losses, A6.2 on the use of climate information, A7.1 on usage by vulnerable groups, and A7.2 on people reached by warnings, continue to have quality issues. These issues include the reporting of intended (ex-ante) results rather than achieved (ex-post) results, inconsistent units of measurement and calculation, or transcriptions.

While GCF indicators for CIEWS represent a positive step towards tracking and reporting progress, they remain limited in their ability to capture the full breadth and quality of impacts, especially regarding last-mile interventions. For example, the indicators offer limited insight into whether beneficiaries are receiving timely warnings or information, understand the alerts, know appropriate responses, or have the resources to act on them.

The absence of more granular data means that existing indicators do not adequately capture the potential impact of EWS on those receiving alerts. Moreover, the limited and inconsistent application of standard CIEWS indicators across early warning initiatives hinders meaningful

comparisons between projects and prevents the measurement of portfolio-wide impact using these corporate indicators.

The adoption of the Belém Adaptation Indicators at the seventh session of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement, followed by the two-year Belém-Addis Vision on Adaptation process to develop guidance on their operationalization, presents an opportunity for the Fund to engage and contribute to refining these indicators. This timeline also aligns with the scheduled 2026 review of the IRMF.

This evaluation also found that identifying CIEWS projects and estimating CIEWS investment amounts at the portfolio level continue to pose a challenge for CIEWS actors and climate funds, including the GCF. In response, the United Nations Office for Disaster Risk Reduction developed the *Early warning systems taxonomy: Guide for tagging and tracking components of early warning systems* to improve the consistency and comparability of EWS data reported by multilateral actors, including the GCF.

With specific reference to GCF tagging practices, the evaluation team identified inconsistencies in the Secretariat's CIEWS-tagging exercise. Some projects were tagged as CIEWS even though they did not meet the criteria. In contrast, other qualifying projects were not tagged, undermining the accuracy and reliability of the GCF CIEWS portfolio.

Furthermore, while the GCF routinely uses the term CIEWS in its documentation, including in USP-2, it lacks a formal definition, leading to inconsistent application across investments and identification of CIEWS projects. While the previous sectoral guide offered some conceptual clarity, its discontinuation has left the Fund without clear guidance on how to apply the term.

Recommendation 5: The GCF Secretariat should leverage the 2026 review of the IRMF to align indicators with global best practices, including the Belém Adaptation Indicators. In doing so, the Secretariat should also consider additional measurement approaches capable of capturing the operational progress of CIEWS interventions and their outcomes at the community level. The primary objective should be to improve the monitoring of progress across CIEWS projects, thereby ensuring that the reported results are both reliable and suitable for comparison and impact measurement.

The GCF Secretariat should formally define CIEWS as part of its operational guidance, as outlined in Recommendation 1, to ensure its consistent application across the portfolio. It should also establish a clear CIEWS taxonomy, aligned with the revised framing of paradigm-shifting pathways set out in Recommendation 3, to address existing challenges in CIEWS-tagging and investment identification.