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Africa – EU Space Partnership Programme Strengthening Early Warning in Africa (AESPP – SEWA)

Co-designed impact-based forecast tools and trainings to advise on early warning

Results of the Scoping Study

On behalf of ECMWF’s SEWA team:

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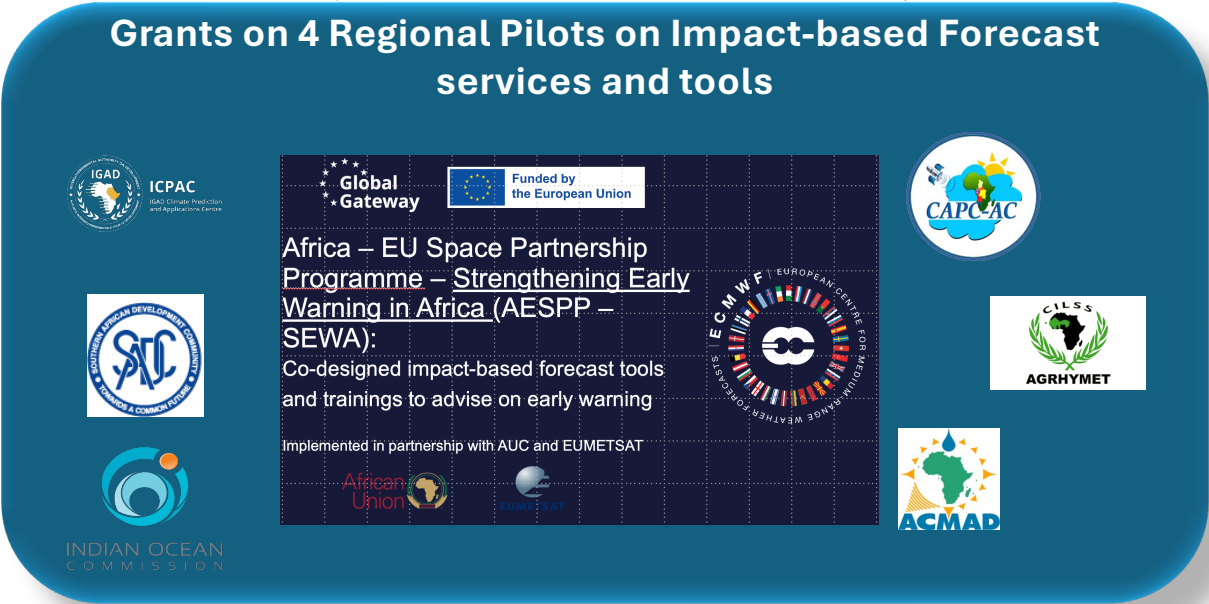
Want to get in touch? SEWA@ecmwf.int



Scoping Study:
Assessing the current landscape of
early warning and Impact-based
forecasts across Africa

Call for Expression of
Interest

Grants on 4 Regional Pilots on Impact-based Forecast services and tools



Grant on
Training and
Capacity
Building

Grant on
Digital Tools

Timeline of the launch of the grants

SEWA Scoping Study



WP1:
LITERATURE
REVIEW AND
MAPPING OF
EXISTING
INITIATIVES, DATA
AND INTERFACES



WP2: STAKEHOLDER
ENGAGEMENT AND
USER REQUIREMENTS
(4 REGIONAL
WORKSHOPS &
PARTNERS & NMHS
INTERVIEWED)



WP3: HAZARD
AND IMPACT
LANDSCAPE
ASSESSMENT



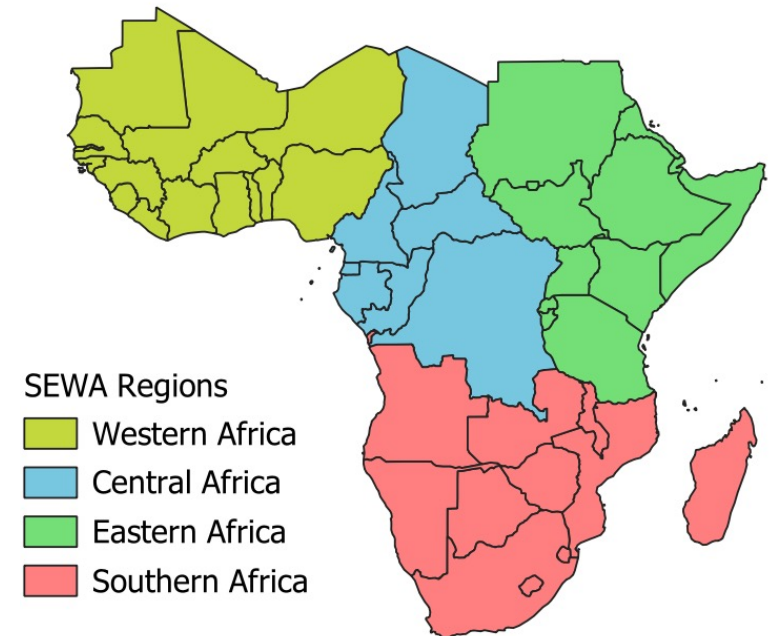
WP4:
REFLECTION ON
SUSTAINABILITY,
OWNERSHIP,
AND LESSONS
FROM PAST
INITIATIVES



WP5: ACTION
PLAN FOR
REGIONAL
PILOTS

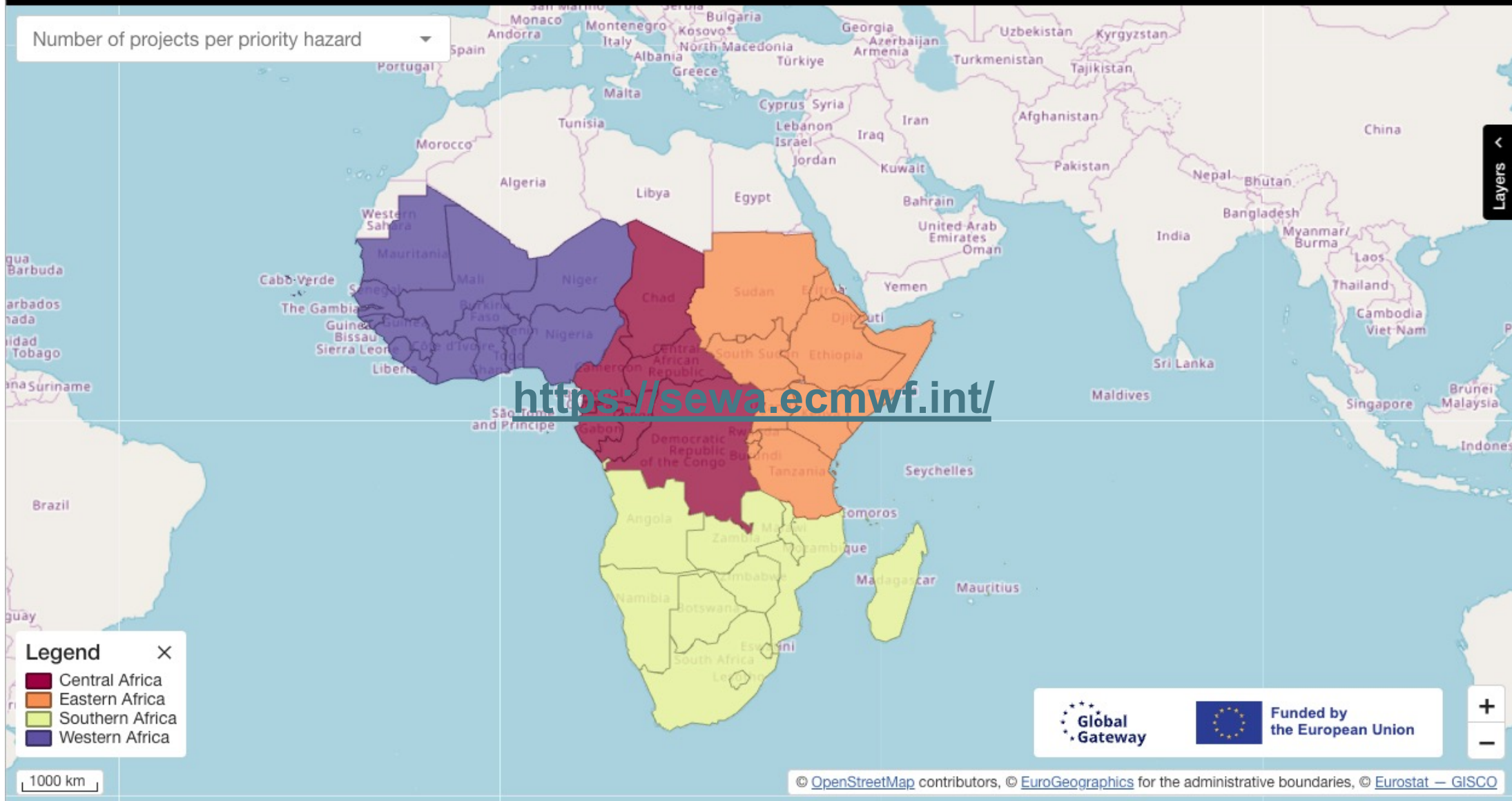
General indications

- Regional boundaries are not always well defined
- Terrain and climatic zones are complex even within one region
- Data gathered in the Scoping Study can't be considered as complete and has related uncertainties
- Scoping Study assessed initiatives, gaps, requirements, etc. related to SEWA
- Focus hazards: Drought, Floods (riverine and flash), Heatwave, Thunderstorms, Tropical Cyclones, Dust, Wildfires
- Exposure and vulnerability data, available through global products (e.g. WorldPop, JRC), appear most often in project-based risk mapping and resilience studies than as maintained layers embedded in routinely updated operational workflows.
- Several NMHSs do issue (impact-based) CAP alerts: WMO's ClimWeb provides a good overview





Number of projects per priority hazard



<https://sewa.ecmwf.int/>

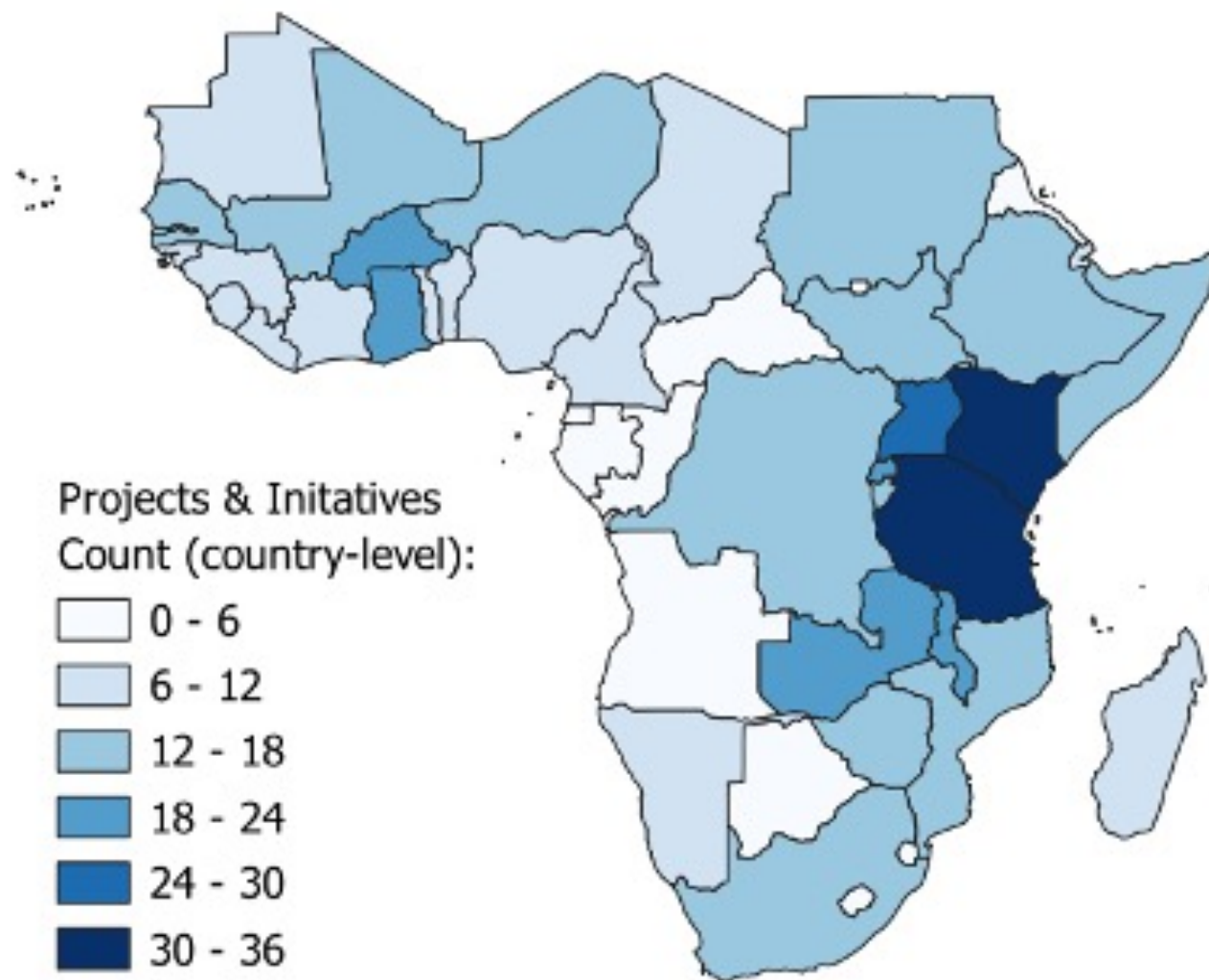
Legend

- Central Africa
- Eastern Africa
- Southern Africa
- Western Africa



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Projects (relevant
to SEWA)
-
All hazards



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Projects (relevant to SEWA) per hazard and country

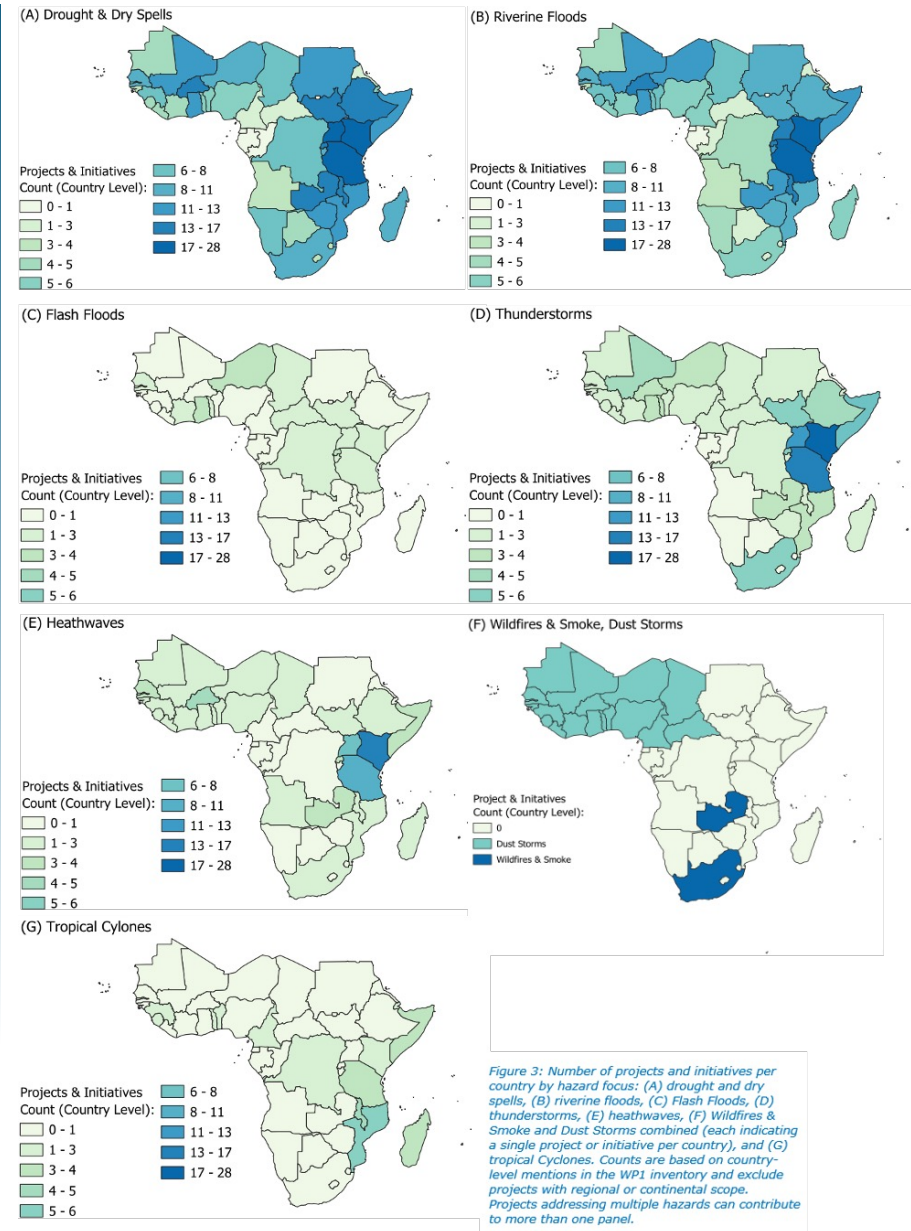
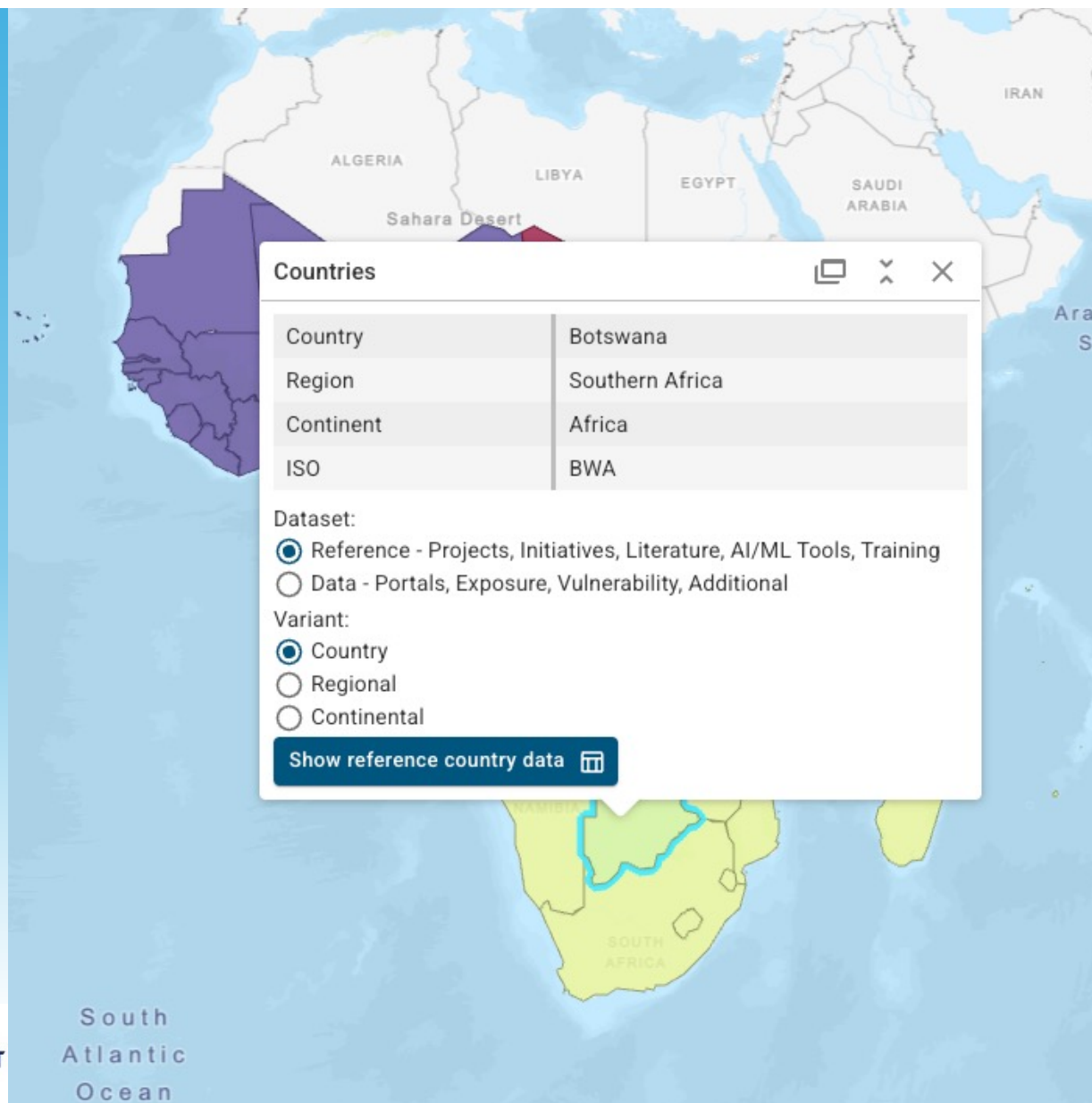


Figure 3: Number of projects and initiatives per country by hazard focus: (A) drought and dry spells, (B) riverine floods, (C) Flash Floods, (D) thunderstorms, (E) heathwaves, (F) Wildfires & Smoke and Dust Storms combined (each indicating a single project or initiative per country), and (G) tropical Cyclones. Counts are based on country-level mentions in the WPI inventory and exclude projects with regional or continental scope. Projects addressing multiple hazards can contribute to more than one panel.

Data, projects, etc.
can be accessed
through a
dashboard



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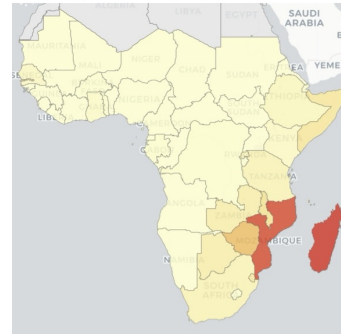


Title name	Source	Short description
CREWS Niger	CREWS	A CREWS project that strengthened Niger's multi-hazard early warning system through improved forecasting, institutional coordination, and community-based warning dissemination.
NORCAP Climate Action Program: Strengthening Climate services in Africa	Norad / NORCAP	A capacity-building programme that deploys climate and meteorological experts to support African national and regional institutions in strengthening climate services delivery, forecasting capabilities, and early warning systems.
Danish Contribution to EW4All - Niger	Danish Development Cooperation / WMO	Danish government support to the UN Early Warnings for All initiative in Niger, helping strengthen multi-hazard early warning systems as part of the global EW4All framework.
WMO's Danish Support to EW4All	Ministry of Foreign Affairs of Denmark	Danish government support to the UN Early Warnings for All initiative, helping ensure everyone on Earth is protected by early warning systems by 2027 through funding for EWS development in priority countries.
AfriCultuReS - Enhancing Food Security in Africa	European Union (Horizon 2020)	A Horizon 2020 project using Earth Observation to enhance food security monitoring in Africa, including drought monitoring and agricultural early warning.
African SWIFT - GCRF African Science for Weather Information and Forecasting Technol...	GCRF / Met Office UK	A research programme developing improved weather forecasting techniques for Africa, with focus on high-impact weather events and capacity building for African...

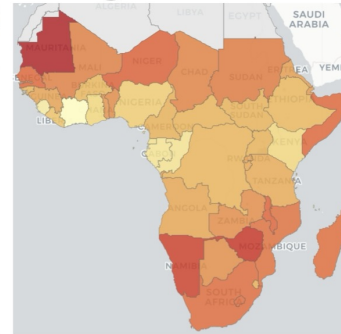


Ranking score for each hazard at national scale, with darker shading indicating higher relative risk per hazard

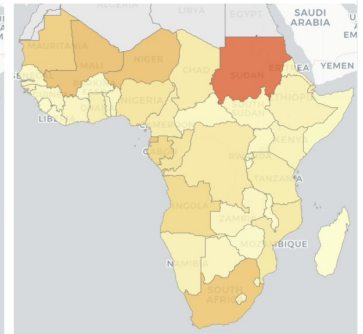
Tropical Cyclones



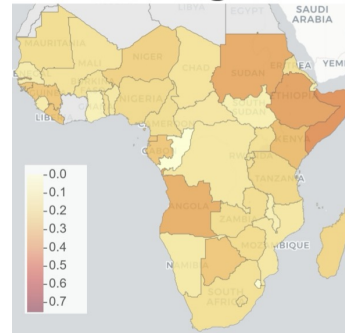
Drought



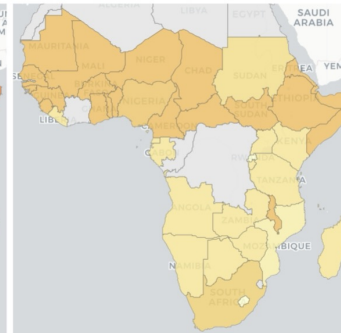
Dust storm



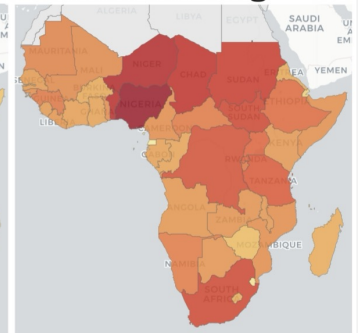
Flash Flooding



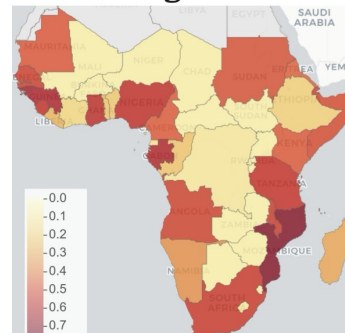
Heatwaves



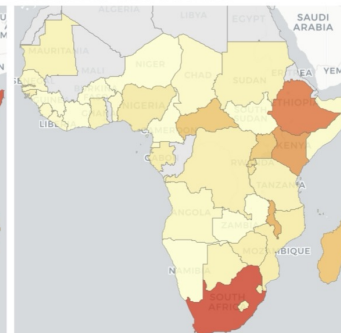
Riverine flooding



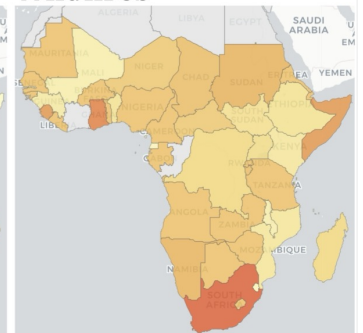
Storm Surge



Thunderstorm



Wildfires



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Databases and criteria

- **Prevalence** — how frequently the hazard occurs (using EM-DAT, ThinkHazard, DesInventar)
- **Impact** — severity for people: deaths, affected populations, displacements (EM-DAT, DesInventar, IDMC)
- **Scale** — geographic extent and size of exposed populations/assets
- **Cascading & compounding hazards** — likelihood of one hazard triggering or amplifying another (assessed qualitatively using MYRIAD-HES datasets)
- **Future relevance** — how climate change is expected to alter hazard frequency or intensity (INFORM Climate Change projections)



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Select data source(s)

- DesInventar (selected)
- EM-DAT (selected)
- IDMC (GIDD disasters)
- IHME-GBD PM2.5 Proxy
- INFORM Climate Change
- INFORM Risk
- SYNOP Dust Proxy
- ThinkHazard!
- WorldRiskIndex

Uncertainties

Source coverage

Number of distinct data sources

	Prevalence	Scale	Impact	Future relevance
Riverine Flooding	3	4	3	1
Drought	3	4	3	1
Storm Surge	3	4	3	1
Tropical cyclone	3	4	3	0
Flash Flooding	3	2	3	0
Thunderstorm	2	2	3	0
Wildfires	3	2	3	0
Duststorm	1	0	1	0
Heatwave	3	2	2	0

Country coverage

Number of countries with at least one indicator

	Prevalence	Scale	Impact	Future relevance
Riverine Flooding	47	48	49	48
Drought	44	48	38	48
Storm Surge	28	48	11	48
Tropical cyclone	42	49	32	0
Flash Flooding	45	34	36	0
Thunderstorm	30	30	42	0
Wildfires	45	21	28	0
Duststorm	44	0	46	0
Heatwave	42	4	4	0

Uncertainties



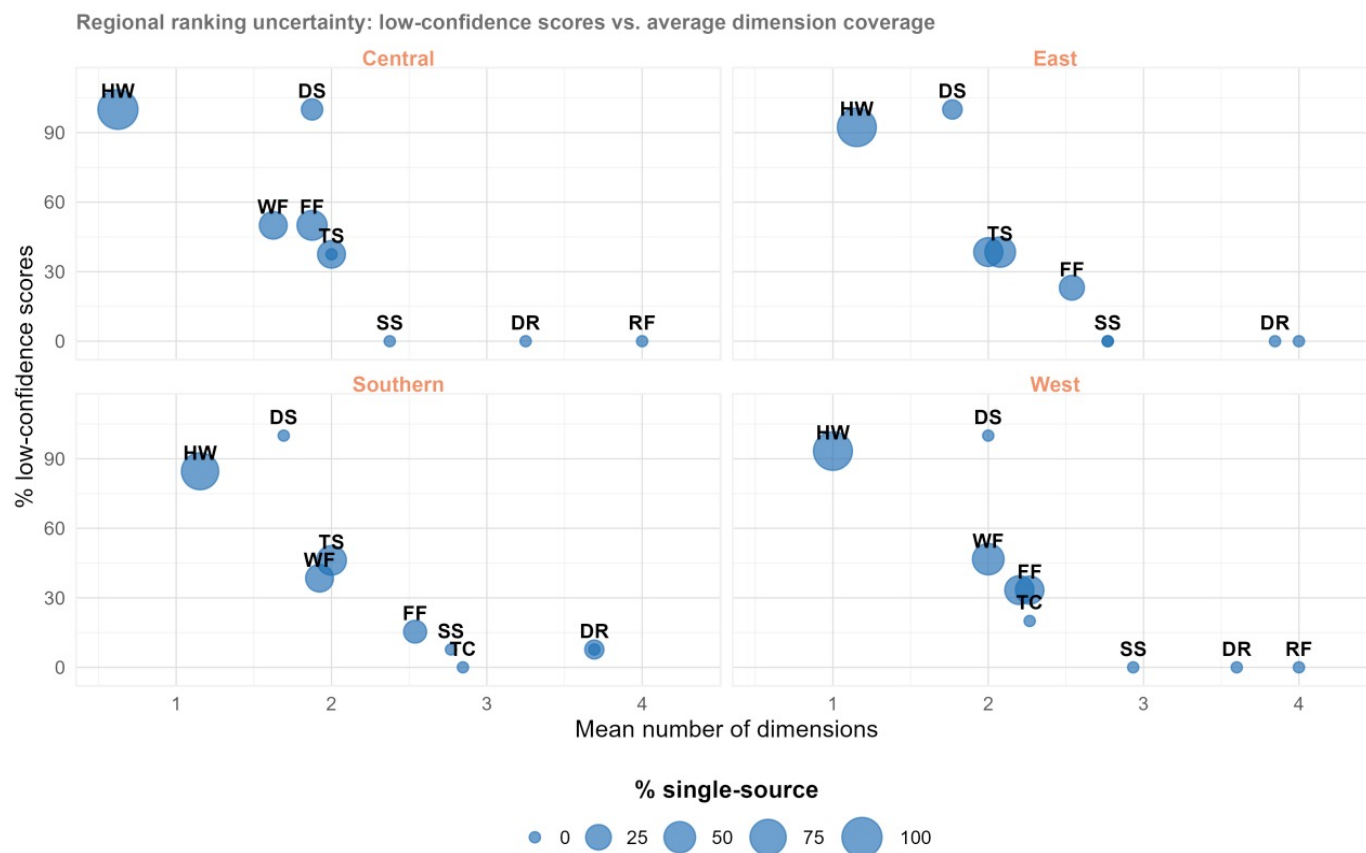
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- Heatwaves and dust storms usually lack strong evidence, while thunderstorms, wildfires, and flash floods often depend on one dimension or source.
- Drought and riverine flooding, however, benefit from broader coverage and more consistent evidence.
- Overall, the hazard rankings should be interpreted with caution, as their robustness depends on the strength of the underlying evidence base.
- At the same time, better coverage for some hazards may also reflect their greater prominence in existing monitoring and data systems, rather than only their underlying risk.



Results of the Scoping Study (combined assessment)

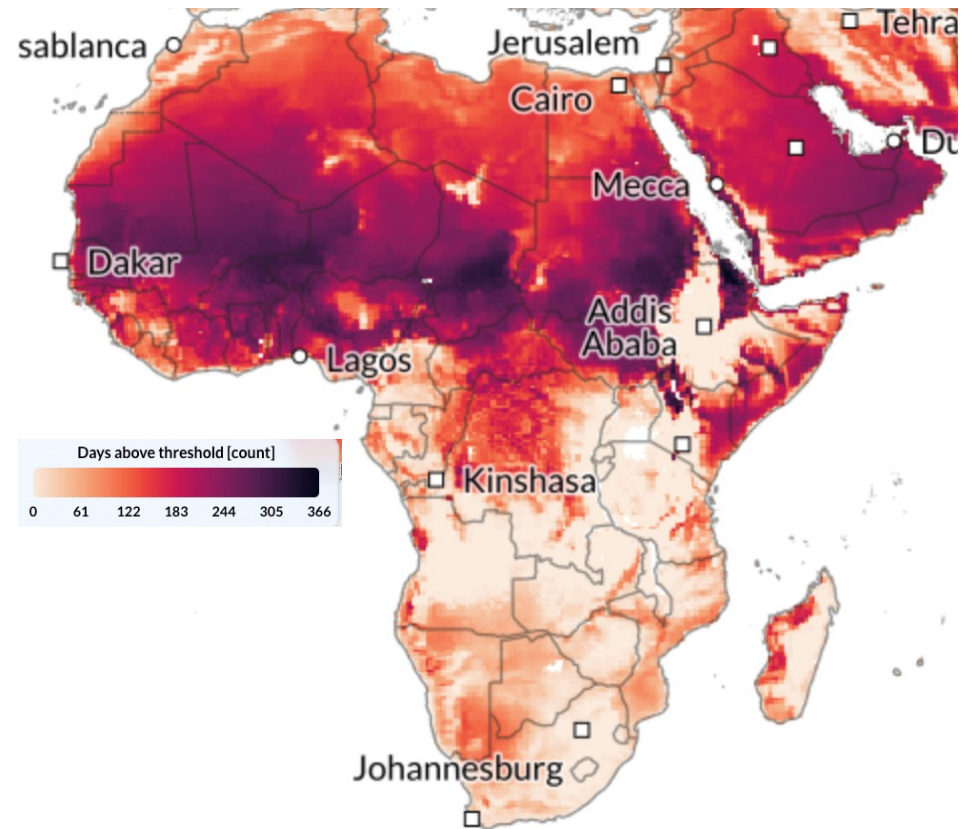
Region	Rank	Unweighted hazard	Population-weighted hazard	Stakholder consultation
Central Africa	1	Riverine Flooding	Riverine Flooding	Flash Flooding
Central Africa	2	Drought	Wildfires	Riverine Flooding
Central Africa	3	Flash Flooding	Drought	Thunderstorm
East Africa	1	Riverine Flooding	Riverine Flooding	Flash flooding
East Africa	2	Drought	Flash Flooding	Drought and dry spell
East Africa	3	Flash Flooding	Drought	Riverine flooding
Southern Africa	1	Drought	Drought	Tropical cyclones
Southern Africa	2	Tropical Cyclone	Riverine Flooding	Flash floods
Southern Africa	3	Riverine Flooding	Tropical Cyclone	Thunderstorm
West Africa	1	Riverine Flooding	Riverine Flooding	Flash flooding
West Africa	2	Drought	Drought	Riverine Flooding
West Africa	3	Wildfires	Heatwave	Thunderstorm

Forecasting challenges

- **Convective systems, related to thunderstorms and flash floods.**
 - Produce short-lived, highly localised extremes that are fundamentally difficult to predict accurately in space and time, even with the best global models.
 - In multiple regions, the most damaging floods are driven by convection and mesoscale storm systems that remain difficult to predict.
 - Sparse observation networks and a lack of data assimilation in numerical weather prediction models.
- **Seasonal-to-trigger translation for drought.** Seasonal outlooks are inherently probabilistic, which is hard to convert into binary yes/no anticipatory-action triggers.
- **Wildfires & smoke.** Skill is limited because these depend on non-meteorological drivers such as vegetation dryness and ignition conditions.
- **Heatwaves.** Forecast skill is generally higher than for rainfall, but operational warning remains constrained by limited use of heat-health thresholds, suggesting the gap for heat lies on the operational side rather than in forecasting skill itself.
- **Dust forecasting.** Constrained by uncertainty in emissions and atmospheric transport processes.
- **Tropical cyclones.**
 - Track and intensity prediction remain physical skill gaps.
 - Cyclone-related rainfall extremes interacting with mountainous inland areas are difficult to predict accurately.

Other Hazard-related Challenges

- Drought and flood dominate operational early warning investment across all regions, reflecting recent crises and high societal exposure.
- Heat is rising rapidly and is increasingly recognized as an extreme hazard, yet dedicated heat–health early warning capacity remains limited.
- Dust storms represent an unevenly operationalised hazard, particularly across the Sahel, with impacts on health, transport, aviation, and agriculture. Dust is often treated as a secondary hazard or only incorporated through sector-specific applications.
- Hazards, such as wildfire and smoke, compound floods, and thunderstorms, are addressed in selected settings but are not consistently integrated into multi-hazard operational practice.
- Landslides were highlighted as cascading hazard in East and Central Africa



Average annual number of days with experiencing very strong heat stress (daily max UTCI $\geq 38^{\circ}\text{C}$.)

<https://thermaltrace.climate.copernicus.eu/>

Crosscutting gaps in all regions

- Power and connectivity issues
- Insufficient observations at all levels
- Computing and IT capacity
- LAM availability
- Experiences with (IT) clouds are very mixed
- Data availability, sharing, storage and archiving
- Redundancy
- Staffing shortages and staff retention
- Lack of government commitment and funding (project-based)
- Mandates
- AI promising but does not always delivering

- Imbalance between hazard monitoring and impact-oriented decision support.
 - Operational systems tend to be strongest in climate monitoring, seasonal forecasting, and hazard detection, while the translation of hazard information into decision-relevant warnings remains less developed.
 - Not only a lack of data, but also lack of standardised methods, institutional ownership, data discoverability and exchange between institutions, and operational routines.
- Sustainability and operational consolidation.
 - EW activity is frequently project-driven, with parallel platforms, short-lived pilots, and fragmented tools that are difficult to maintain once external support ends.
 - Creates discontinuity in staffing, system maintenance, institutional learning, and it reduces the return on investment from training and technology upgrades.
 - National services often carry multiple tools with inconsistent governance, limited resources for maintenance, and unclear sustainability pathways.
- Interoperability and shared standards.
 - Platforms and workflows vary widely in data formats, metadata quality, and the way warning thresholds, verification, and uncertainty are communicated.
 - Limits cross-border comparability, makes replication expensive, and prevents regional institutions from scaling successful approaches across member states.
 - It complicates the integration of emerging methods such as AI/ML.

Western Africa

- WP1 identifies 72 projects and initiatives for Western Africa
 - Highest concentration in Ghana (22 projects), Burkina Faso (20), Mali (17), and Niger (17).
 - Countries with more restrained investment are Liberia (10), Sierra Leone (10), and Guinea-Bissau (7).
- Projects on riverine flood and flash flood (sometimes both) dominate followed by droughts and dry spells, thunderstorms, heatwaves...
- Several NMHSs in the region do issue impact-based or CAP-based alerts
- Combines regional institutions, a substantial project inventory and advanced technical capacity for drought and flood monitoring, forecasting, and warning.
- Lacks consolidation and operational embedding. Several systems address similar hazards in overlapping geographies without clear integration into sustained national workflows or full EWS-chain implementation.
- AGRHYMET is still in demonstration status, has high technical influence at regional scale but limited uptake at national level (products sometimes hard to adapt to regional level, language barriers, lacking cross-regional and cross-sectorial collaboration)

Need

- Translate forecasts into impacts
- Operationalise IbF
- Define warning trigger thresholds

Limitations

- Limited access to structured impact data and severity thresholds,
- Weak integration of hazard information into operational decision-making,
- Shortage of IbF-specific skills such as vulnerability and exposure mapping, risk analysis and risk communication
- Absence of a permanent regional training

Eastern Africa

- WP1 identifies 88 projects and initiatives in Eastern Africa
 - Most projects reference riverine floods, followed by drought and dry spell, thunderstorms, heatwaves, and tropical cyclones.
 - Heatwaves and tropical cyclones are typically referenced within multi-hazard frameworks rather than as dedicated operational systems.
 - Despite the high relevance, only 4 projects explicitly reference flash floods (3 also address riverine floods)
 - The most balanced hazard profile of any SEWA region.
- Combines strong regional coordination through ICPAC, the highest number of projects in the inventory, and a balanced drought–flood profile.
- Lacks no initiatives but faces coordination complexity and uneven national operational embedding.
- Training continuity is comparatively strong: ICPAC's Training Academy for Early Warning Experts provides a strong regional anchor
- A specific challenge in forecasting for East Africa, additional to the continental challenges, is its complex topography and lake effects.

High level of readiness to move from EWS to IbF, underpinned by ICPAC's coordination role and by the East Africa Drought Watch and East Africa Hazard Watch platforms.

Needs

- Run more forecasting models inhouse (more frequent).
- Tailor and calibrate a LAM for East African topography and lake/highland environments using in-situ data and existing global forcings;
- Operationalise the impact layer on top of the improved hazard forecasts, defining and verifying impact thresholds, embedding verification in routine workflows, and strengthening the link to anticipatory action.

Central Africa

- Flood-related hazards are most prominent in the inventory for Central Africa.
 - Thunderstorms and severe weather are addressed largely through SWFP Central Africa.
 - Drought risk is relevant in multiple Central African contexts, but it is weakly reflected outside multi-hazard programmes.
 - Urban resilience projects show the highest share of any region. This reflects rapid urbanisation in flood-prone capital cities.
 - Heatwaves are referenced, but dedicated heat–health early warning is still absent in most countries.
- Is characterised by weaker regional operational coordination, a dominant focus on flood hazards, limited transboundary early warning despite the presence of major river systems.
- Central Africa has the narrowest training footprint of any SEWA region
- Weak operational NWP capacity and limited computing, connectivity and power more than other regions
- The exception on IbF is CAPC-AC producing impact-based outputs and disseminates a malaria hazard bulletin combining meteorological forecasts with land use, population density and vegetation.
- Cameroon is uprising.

Central Africa is still in a foundational build phase, characterised by fewer initiatives, lower operational embedding, and narrower hazard coverage.

It is flood-dominant, urban-focused, and constrained by foundational observation and operational service capacity.

Needs

- Strengthen these foundations.
- Expanding observation networks.
- Focus on developing systems suitable for data-scarce environments, while integrating the real-time and historic data that is available to showcase the relevance of this data to decision makers.
- Consider new tools as well as existing platforms for pilots.

Southern Africa

- Characterised by both drought and flood risks followed by tropical cyclones, heatwaves and wildfires
- The Indian Ocean Commission (IOC) Hydromet Programme provides a dedicated regional framework for the Indian Ocean island states.
- Relatively strong operational foundation, but continued reliance on targeted investments to extend operational methods and standards beyond South Africa.
- Benefits from established coordination through SADC-CSC and SARCOF, with concentrated operational capacity in South Africa and regional support through the RSMCs and SARFFGS.
- Southern Africa's training structure is “distinctive” (university-based degree programmes alongside specialised meteorological training). However, training is concentrated in South Africa and does not extend evenly across the region
- South Africa operates a National Geo-Spatial Information Portal. Outside South Africa, integration of exposure and vulnerability data and the operationalisation of IbF emerges as a widespread need
- SAWS is also a WMO-designated GPC for Long-Range Forecasts (GPC-LRF), the only one in Sub-Saharan Africa.

In-situ observation networks vary considerably in density, automation, and integration into operational forecasting workflows.

Data sharing between countries and between institutions is often constrained by the absence of formal governance arrangements.

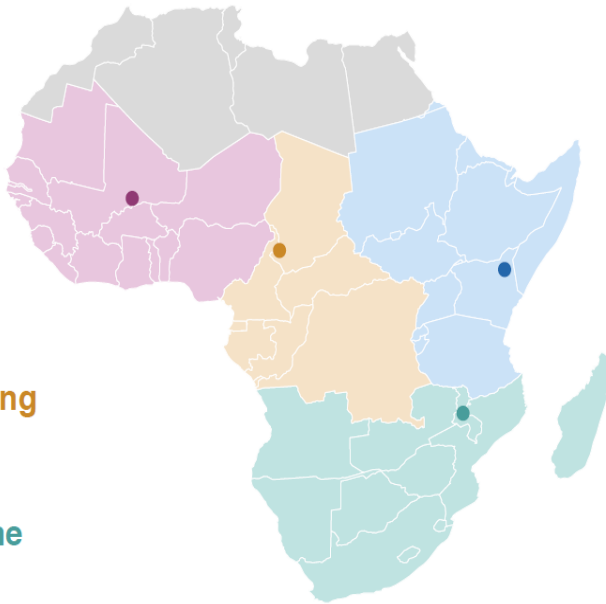
IbF in the region remains underdeveloped relative to hazard monitoring and forecasting, with exposure and vulnerability datasets largely available but not embedded in routine operational workflows.

Needs

- Automating data assimilation, verification and validation,
- Integrating exposure and vulnerability data, defining and verifying impact thresholds
- Embedding intra-regional data governance and sharing arrangements
- Built on top of existing regional platforms.

Storylines

-  *Western Africa*
Heatwave
-  *Eastern Africa*
Heavy Rains and Flooding
-  *Central Africa*
Riverine Flooding
-  *Southern Africa*
Tropical Cyclone



- **What happened?**
- **The role of forecasting**
- **Moving forward**

Western Africa, The Sahel Heatwave, Sahel region, 2024 (coincided with Ramadan)

Eastern Africa, Heavy Rains and Flooding, Burundi, Ethiopia, Kenya, Somalia, Tanzania, and Uganda, 2024

Central Africa, West and Central Africa Flooding, West and Central Africa, 2024

Southern Africa, Tropical Cyclone Freddy, Malawi, 2023

Resources

- Results: <https://www.ecmwf.int/en/about/what-we-do/environmental-services-and-future-vision/strengthening-early-warning-africa-scoping-study>
- ECMWF News Article: <https://www.ecmwf.int/en/about/media-centre/2026/sewa-scoping-study-early-warning-sub-saharan-africa>
- Direct link Dashboard: <https://sewa.ecmwf.int/>

