



CREWS PROJECT PROGRESS REPORT (July-Dec 2022)

1. Project title	Seamless operational forecast systems and technical assistance for capacity building in west Africa (CREWS West Africa)	2. Project reference CREWS/RProj/02/West Africa CREWS/RProj/03/AdditionalFinancing/West Africa
3. Implementing Partners involved in the project	World Meteorological Organization (Lead) World Bank	4. Regional/National Partners involved in the project Agrhymet Regional Center (RTC, future RCC, FFGS regional centre, FANFAR regional centre) ANACIM Senegal (RSMC Severe Weather, FFGS regional centre) AEMET and BSC Spain (RC SDS-WAS) IRI (sub-seasonal forecasting) UoR (TAMSAT) KNMI (WA-CA&D) HRC (WA-FFGS) Sierra Leone Meteorological Service Sierra Leone National Water Resources Management Agency
5. Project Duration/Timeframe (from year – to year)	January 2018 – December 2024	6. Total Funding Approved by Steering Committee (in US dollars), including fees 5,300,000 USD
7. Reporting focal point(s) from Implementing Partners	Jean-Baptiste Migraine – jbmigraine@wmo.int Makoto Suwa - msuwa@worldbank.org	









<p>8. Project overview</p>	<p>Project objective: to strengthen regional entities to engage with national hydrometeorological agencies in the region to improve risk information and early warning services at national level</p> <p>The project develops capacities within existing institutions in line with their mandates : (i) RTC and future RCC Niamey (AGRHYMET) for food security and regional climate services; (ii) RSMC Dakar (ANACIM) for severe weather forecasting and WIGOS coordination; (iii) Casablanca GISC (DGM Morocco) for information and data exchange; (iv) NMHSs for optimal utilization of new regional capacities including flash flood guidance.</p> <p>Beneficiaries are the 19 Members of PRESASS and PRESAGG: Benin, Burkina Faso, Cameroon, Central African Republic, Cap Verde, Chad, Côte d'Ivoire, the Gambia, Ghana, Guinea Bissau, Guinea, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo.</p> <p>The project complements national CREWS projects in Burkina Faso, Chad, Mali, Niger and Togo, and also contributes to demonstrate the feasibility of developing capacities for urban flood forecasting in Sierra Leone. While provision of meteorological, hydrological, climate and early warning services is clearly a national responsibility, a number of support functions can be best performed at regional scale, with economies of scale and enhanced quality of services resulting for specialized regional cooperation, including for cascading approaches for numerical weather prediction (under the leadership of Dakar as regional specialised meteorological center), flash flood guidance (building upon enhanced numerical weather prediction capabilities and AGRHYMET training capabilities), climate watch and climate analysis (building upon ACMAD and later AGRHYMET as regional climate centers), training of meteorological and hydrological staff (with EAMAC and AGRHYMET, both in Niamey), etc.</p> <p>The World Bank is currently supporting the implementation of hydromet and early warning investments in West Africa under the West Africa Food System Resilience Program – FSRP – (P172769 and P178132), through which the project outcomes and impacts will be scaled up in Burkina Faso, Mali, Niger, Togo and with the Agrhymet Regional Center during Phase 1, and Chad, Ghana and Sierra Leone for Phase 2; and under the Resilient Urban Sierra Leone Project (P168608). In addition, the CREWS supported the implementation of hydromet activities under the Freetown Emergency Recovery Project (P166075), which has recently been completed.</p> <p>Overall, the project has leveraged 51 million USD (IDA 41 million (Phase 1 of FSRP) / IDA 2 million (SL) / ACP-EU 8 million).</p>
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9. Progress summary

- **Partnership Agreements:** [DWD](#), [IRI](#), are closed; [UK Reading University](#), [HRC](#), [KNMI](#), [RSMC Dakar](#), [INRAE](#), [SEPIA](#), [IRD](#), [AEMET](#), [BSC](#), [DGM Morocco](#) are progressing well.
- **Trainings:** (i) [SWFP training \(including severe weather forecasting, sand and dust storms, common alerting protocol and impact-based forecasting\)](#) for West and Central Africa took place on 23-27 May 2022, with 29 forecasters from 16 West and Central African countries; (ii) following the completion of the FFGS Step 2 Training late in 2021, trainees have been selected for Step 3; (iii) a [training on strategic planning and quality management systems](#) for francophone NMHSs (West Africa, Central Africa and SWIO together) was organized on 31 May and 1st June 2022, with presentations from Benin, Burkina Faso, Cameroon, Central African Republic, Comoros, Côte d'Ivoire, Djibouti, Guinea, Madagascar, Morocco, Mauritania, Niger, Republic of Congo, Senegal, Chad, Togo, Tunisia.
- **Tools:** (i) AGRHYMET is maintaining the catalog of extreme events and the climate watch service, prepared by DWD (including the CM SAF satellite- and GPCP-based monitoring products for West Africa) on its Linux server; (ii) KNMI is preparing for the migration into the cloud of the climate assessment and database (WA-CAD); (iii) Météo France updated the MISVA website to assist forecasters with anticipation of extreme weather events based upon sub seasonal forecasting; (iv) HRC connected the WAFFGS prototype to the WIS and to the DWD ICON (13 km resolution) numerical weather prediction model; (v) a novel method of deriving spatially and temporally contiguous daily rainfall estimates and associated uncertainty estimates has been finalized by University of Reading (UoR) with TAMSAT and has been operationalized.
- **Investments:** The phase 1 and phase 2 of the regional **Food System Resilience Program** were approved by the WB board in November 2021, and July 2022, respectively, with a substantive hydromet component to support the agriculture and food security sector in West Africa as well as in Burkina Faso, Mali, Niger and Togo.

10. Project Performance

Interpretation of color coding		
High		Good progress; on track in most or all aspects of delivery
Medium		Moderate progress or on track in some aspects of delivery
Low		Less than moderate or poor progress. Not on track in critical areas of its delivery. Requires remedial attention

	Rate of expenditure	Rate of delivery	Alignment of Objectives
Coding			
Narrative	Use of funds as of 31 Dec 2022: WMO – US\$1,785,185 disbursed (44%) US\$806,592 committed (20%) WB – US\$122,749 disbursed (35%) US\$349,940 committed (70%)	The rate of delivery is satisfactory.	Project remains strongly aligned to the initial objectives



11. Risk Management Status

Risk Status	<p>Risks remain moderate, as identified at the proposal stage, and have evolved in relation with:</p> <ul style="list-style-type: none"> - the undergoing enlargement of AGRHYMET mandate to take over the Regional Climate Center function from ACMAD in the near future; - the number of partners involved (HRC, KNMI, AEMET, BSC, DGM Morocco, ANACIM, IRD, SEPIA, INRAE), thus requiring additional coordination efforts among partners; - Chad and Togo joining as CREWS beneficiary countries since July 2019, resulting in a need to expand the coverage of regional services to additional countries, in a situation of uncertainty related to the access of Chad and Togo to investment financing for early warning;
Measures to address	<p>The risks are being addressed with :</p> <ul style="list-style-type: none"> - regular consultations and close communication with stakeholders (see project steering committee meeting 15 June 2022 as an example); - transfer of knowledge to regional centres; - frontloading activities that can be implemented remotely. <p>Due consideration is given not to compromise the quality of outputs in reprioritizing activities.</p>



12. Contributions to CREWS Outputs

(use number for activities and products and % for project component completion)

11.1 National Output(s)

CREWS Output(s) 1: National Meteorological and Hydrological Services service delivery improved, including the development of long-term service delivery strategies and development plans				
State Project Output(s) in this section	Overall Project Target	Progress by June 2022	Target for reporting period	Progress by Dec 2022
New/Enhance weather and early warning information products	System design of integrated system for Multihazard warning system	A consultant has been selected.	A consultant starts the identified tasks.	First mission to SL completed with concept note, technical, operational and training plans developed.
Enhanced weather and climate information products and services	Customised early warning system product design.	Concept of operations (CONOPS) prepared. Draft procurement plan completed and submitted to end users for implementation.	Procurement of critical infrastructure in support of early warning systems.	User needs and technical gap analysis conducted to evaluate technical requirements to supplement customized



				warning services.
<p>Additional information: briefly indicate, with concrete examples, the contributions to CREWS value propositions (gender-responsive, multiplier, people-centered, promote coherence, solution-oriented, unique), as relevant (150 – 200 words). <u>Please list in bullet points.</u></p> <p>SOLUTION-ORIENTED - CREWS West Africa in Sierra Leone has developed a few key analytics to support SLMet and NWRMA to make key strategic decisions on their investment program to develop a flood early warning system for Freetown. The project has developed the Concept of Operations (CONOPS) and based on the CONOPS, a preferred investment option was identified for short-term improvement of weather and flash flood forecasting services. A detailed assessment of observations, data processing, ICT and forecasting, dissemination infrastructure equipment, and staff capacity was also performed to inform the IPF, which this CREWS project is leveraging. TORs have been developed for engagement of the forecasting services provider; Technical Specifications are being developed to procure high priority hardware and software; training plan will be developed for short and long-term capacity building of staff. The consultant to support SLMet and NWRMA to co-develop forecasting and warning services and provide on-the-job training has been selected and they are expected to start the provision of support shortly.</p>				

CREWS Output(s) 2: Risk Information to guide early warning systems and climate and weather service developed and accessible				
State Project Output(s) in this section	Overall Project Target	Progress by June 2022	Target for reporting period	Progress by Dec 2022
Detailed design and establishment of urban flash flood warning services.	Development of capacity of the NDMA, SLMET and NWRMA to forecast, monitor and manage severe events.	SLMET: Equipment delivered to site. Awaiting travel of OEM to site to	Completed installation of SLMET and NWRMA sites	Assessment of existing rainfall information completed to evaluate the



		complete installation NWRMA: 4 stations have been installed, 8 stations are outstanding.		need to an enhanced hydrological forecasting delivery and comminu
<p>Additional information: briefly indicate, with concrete examples, the contributions to CREWS value propositions (gender-responsive, multiplier, people-centered, promote coherence, solution-oriented, unique), as relevant (150 – 200 words). <u>Please list in bullet points.</u></p> <p>UNIQUE - The CREWS project has provided critical technical advisory services to advance the above mentioned tasks. Both SLMet and NWRMA are still in the early stage of expanding observation network, and making these few stations operational would lay the solid foundation for then for the future expansion of their monitoring capability, which will support the development of warning systems envisioned by the beneficiaries.</p>				

11.2 Regional Outputs

CREWS Regional Output(s): Institutional and human capacities at Regional WMO and Intergovernmental organizations to provide regional climate and weather services to LDCs and SIDS increased

State Project Output(s) in this section	Overall Project Target	Progress by June 2022	Target for reporting period	Progress by Dec 2022
1. Proposal for a data and metadata exchange collaboration framework outlining stations to be included in the regional dataset, including recommendations for incorporating missing or new stations into the WMO WIGOS and WIS systems	100%	75%	90%	90%

<p><i>(OSCAR/Surface, WDQMS, GTS and WIS/GISCs) and forward looking plan for establishing a regional WIGOS center – Following the regional workshop on data collection, management, exchange organized in July 2020, an Agreement was signed with DGM Morocco in March 2021 to provide support to all West African NMHSs. NMHSs are receiving support individually.</i></p>				
<p><i>2. West Africa Climate Assessment & Dataset (WACA&D) system open to use for NMHSs and regional institutions, with supporting training at regional level and tools materials in French and English - A local version of the tool is available, hosted in KNMI (see presentation). A cloud-version of the website using DRUPAL was developed in collaboration with the ClimaSA project. The basic system used for WACA&D is now consistent with the implementations in preparation for 6 additional Regional Climate Centres.</i></p>	100%	95%	95%	95%
<p><i>4. West Africa hydro-met and Climate Extreme database (WACE), involving a standard typology of high-impact event types and the assignment of a Universal Unique Identifier (UUID), with supporting training and guidance materials in French and English - The database was created and transferred to AGRHYMET in May 2021. Single events can be reported with an online interface (see progress report).</i></p>	100%	100%	100%	100%
<p><i>5. Climate Watch Service (with automatic update) - Visualized CM products are included in the demonstrator application. Monitoring products are available in the form of climate watch advisory drafts. The user can decide which products to include.</i></p>	100%	100%	100%	100%

Additionally, ERA5T reanalysis data can be included on day 5 for the previous month. TAMSAT and river discharges from GloFAS are also selectable (see progress report).				
6. <i>West Africa Severe Weather Forecasting System online, in line with SWFDP guidebook, with RSMC Dakar Training Desk and supporting training and guidance materials in French and English</i> – Based on the review of forecasters’ use and expectations with regards to SWFP and MISVA , the user manual was finalized and made available online at https://misva.aeris-data.fr/documentation . In addition, RSMC Dakar and WMO jointly delivered a SWFP training on 23-27 May 2022 for West and Central African forecasters. AEMET and BSC are expanding the SDS-WAS system, based on the median value of 12 models, in 6 countries.	100%	95%	95%	95%
7. <i>West Africa Flash Flood Guidance System online, with supporting training and guidance materials in French and English</i> - HRC followed-up upon the Step 2 training delivered during the previous reporting period, and provided AGRHYMET, RSMC Dakar, Burkina Faso, Mali and Niger with a link to the demonstration version of the system (see progress report).	100%	75%	90%	90%
8. <i>Flood forecasting feasibility studies in West Africa.</i> This in order to propose an operational methodology for flash flood forecasting, and options for urban flood at pilot areas. INRAE and IRD analyzed surveys and interviews and explored use of EFAS -GlofaS and CHMI - FFG to deepen knowledge about the operational use of their systems.	100 %	55%	75%	60%

<p>9. <i>Development of CREWS West Africa Community of Practice.</i> The matrix on synergies between CREWS and related projects was further updated to ensure optimal use of funding available for severe weather (CREWS, CDSF), climate (ACP-EU, CREWS), civil protection and food security.</p>	100%	30%	30%	30%
<p>10. <i>Pilot services on early warnings for agricultural severe drought in West Africa.</i> Following the training workshop on “Satellite rainfall estimation and validation for Africa” organized with 5 countries in Nov 2021 (see report), UoR finalized the implementation of the system.</p>	100%	95%	95%	95%
<p>11. <i>Recommendations related to dissemination of seasonal and monthly prediction products and services in West Africa.</i> Python tools for subseasonal forecasting have been developed by IRI and tested for West Africa, based on the S2S and SubX model forecast databases and IRI tools. Guidance has been provided by IRI for the April-May RCOFs (PRESASS and PRESAGG). See report.</p>	100%	100%	100%	100%
<p>12. <i>Service delivery strategy, the concept of operations and business model for AGRHYMET.</i> A consultant has developed a draft.</p>	100%	80%	100%	100%
<p>Additional information: briefly indicate, with concrete examples, the contributions to CREWS value propositions (gender-responsive, multiplier, people-centered, promote coherence, solution-oriented, unique), as relevant (150 – 200 words). Please list in bullet points.</p> <p>Gender Responsive - The project considers gender equality in itself a key development objective, with direct demonstrated impacts in terms of increasing productivity, improving the impact of development for future generations, and making institutions more representative. To this end, the project promotes approaches aimed at eliminating the differences between men and women in</p>				



accessing economic opportunities and in productivity, as well as to help give women a stronger voice within society. In Sierra Leone, the user needs assessment will fully take into account the gender aspect. In addition, the WB investment projects informed by CREWS West Africa are developing a gender action plan to consider the gender aspects in all relevant activities.

Multiplier - The project mobilizes specific expertise to guide investments such as AfDB SAWIDRA, EU Climate Services (8 million EUR) and WB Food System Resilience Program (P172769 and P178132), which covers Burkina Faso, Mali, Niger and Togo in addition to the Agrhymet Regional Center in its first phase, and Chad, Ghana and Sierra Leone in its second phase [Overall program budget for phase 1 and 2: 645 million USD, budget for hydromet activities TBD]. It also supports a component to strengthen emergency management including early warning systems under the Resilient Urban Sierra Leone Project (P168608).

People-centered - The project mobilizes expertise to support AGRHYMET, working directly with countries' multidisciplinary working groups to track food security and nutrition from the community to the regional levels. User engagement is an important aspect of the design of the CREWS West Africa project. While the current global pandemic has made it challenging to conduct on-the-ground consultation, the project incorporates users' perspective through, for example, the development of service delivery strategy.

Promote Coherence - The project integrates expertise from regional and global centers such as Dakar RSMC, Niamey RTCs, Niamey RCCs, Météo-France, DWD, KNMI, ECMWF, UK Reading, HRC, and coordinates frequently with multilateral and bilateral development partners in the sub-region. The major ones are participating in the Steering Committee meetings. Coordination with international partners active in the hydromet domain in West Africa is key to ensuring effective use of funds and sustainability. WMO and WB are actively coordinating with those partners through bi-lateral meetings and workshops to understand their on-going and planned activities and inform them about our plan to seek complementarity and avoid duplication.

Solution-oriented - The project makes available information from global and regional centers to national meteorological and hydrological services. Cascading forecasting is substantially improving the lead time and accuracy of forecasts and warnings. Public private engagement is an integral part of strategic dialogue with governments in the region to ensure innovative business models and solutions are duly considered in considering different options.

Unique - The seamless approach to early warning supported by the project is unique, possible in relation with the multiplier effect and coherence. The project leverages the economies of scale by promoting regional collaboration, and contributes to the development of cost-effective hydromet system regionally. Such an approach will also provide cross-learning opportunities for

countries in the region and facilitate a peer-to-peer support system. On-going work with Agrhymet Regional Center on the development of a business model will directly inform more sustainable operation.

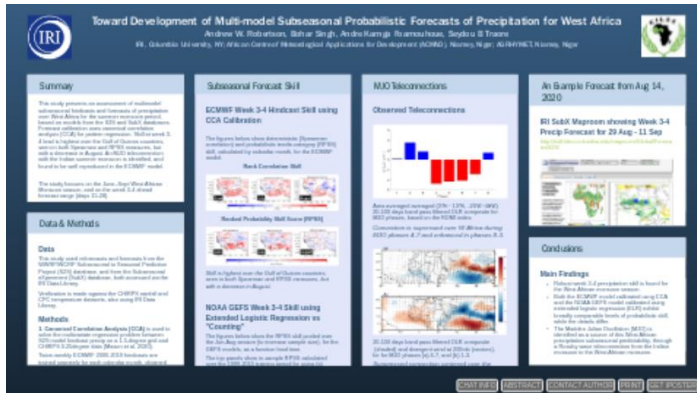
13. Visibility products



[Project presentation](#)



[Video message from RSMC Dakar](#)



Toward Development of Multi-model Subseasonal Probabilistic Forecasts of Precipitation for West Africa
 Andrew W. Robertson, Bahar Singh, Anshu Kamga, Ibrahimu Hassan, Sreyas S Trivedi
 IRI, (Ghana) University, West African Centre of Meteorological Application for Development (WACAM), Niamey, Niger; AGRHYMET Niamey, Niger

Summary
 This study presents an assessment of subseasonal probabilistic forecasts and forecasts of precipitation over West Africa for the summer season (June–August) using a multi-model ensemble (MME) of probabilistic forecasts (PFs) from the European Centre for Medium-Range Weather Forecasts (ECMWF), the National Centers for Environmental Prediction (NCEP), and the National Oceanic and Atmospheric Administration (NOAA). The MME is compared to the skill of the best individual model. The results show that the MME skill is generally higher than that of the best individual model, particularly for the 2–4 week lead time. The skill of the MME is also compared to that of the best individual model for the 2–4 week lead time.

Subseasonal Forecast Skill
ECMWF Week 3–4 Hindcast Skill using CCA Calibration
 The figure below shows the hindcast skill (Pearson correlation) and probabilistic forecast (PF) skill (calculated as the ratio of the MME skill to the best individual model) for the 2–4 week lead time.

Key Findings
 The skill of the MME is generally higher than that of the best individual model, particularly for the 2–4 week lead time. The skill of the MME is also compared to that of the best individual model for the 2–4 week lead time.

MJO Teleconnections
Observed Teleconnections
 The figure below shows the observed teleconnections between the MJO and precipitation over West Africa. The MJO is defined as the leading mode of the interannual variability of the 200-hPa velocity potential over the tropical region (20°S–20°N, 0°–360°). The MJO is shown as a time series of the 200-hPa velocity potential (contours) and precipitation (shaded) over West Africa. The MJO is shown as a time series of the 200-hPa velocity potential (contours) and precipitation (shaded) over West Africa.

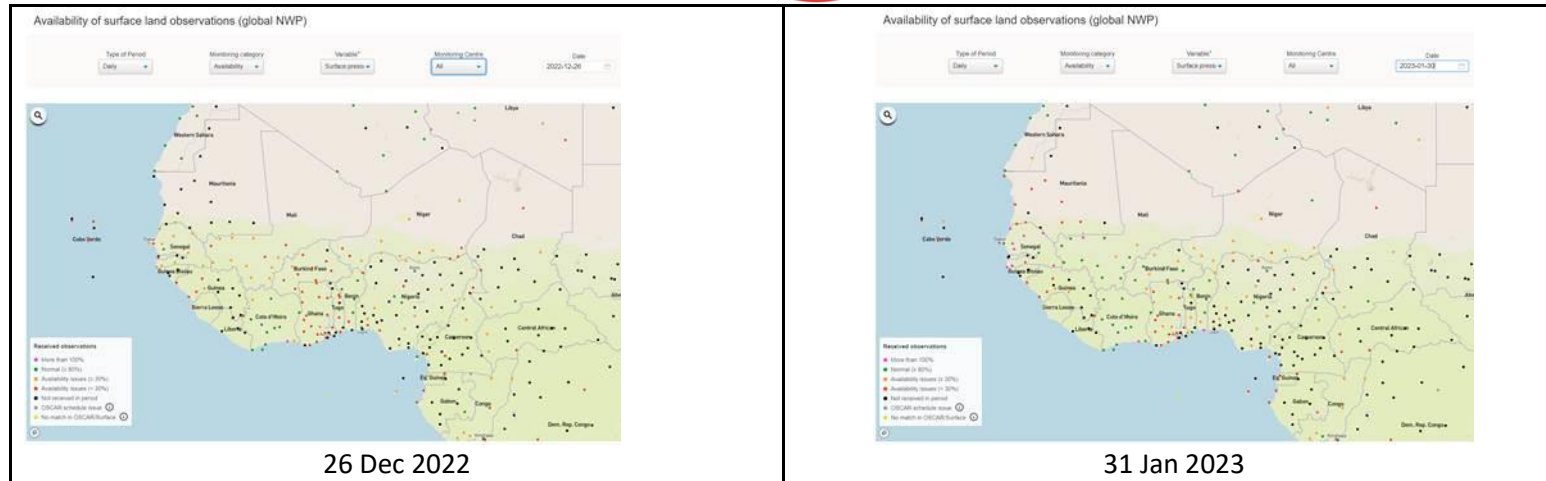
An Example Forecast from Aug 14, 2020
IRI Sub-Maproon showing Week 3–4 Precip Forecast by 29 Aug–11 Sep
 The figure below shows the IRI sub-Maproon showing the Week 3–4 precipitation forecast for West Africa. The sub-Maproon shows the 200-hPa velocity potential (contours) and precipitation (shaded) over West Africa. The sub-Maproon shows the 200-hPa velocity potential (contours) and precipitation (shaded) over West Africa.

Data & Methods
Data
 The study used observations and forecasts from the ECMWF, NCEP, and NOAA. The observations were obtained from the Global Precipitation Climatology Project (GPCP) archive, and the forecasts were obtained from the ECMWF, NCEP, and NOAA. The observations were obtained from the Global Precipitation Climatology Project (GPCP) archive, and the forecasts were obtained from the ECMWF, NCEP, and NOAA.

Methods
 A Generalized Linear Model (GLM) was used to assess the relationship between the MJO and precipitation over West Africa. The GLM was used to assess the relationship between the MJO and precipitation over West Africa. The GLM was used to assess the relationship between the MJO and precipitation over West Africa.

Conclusions
 The study shows that the MME skill is generally higher than that of the best individual model, particularly for the 2–4 week lead time. The skill of the MME is also compared to that of the best individual model for the 2–4 week lead time.

[Poster prepared by IRI, ACMAD and AGRHYMET](#)



[WIGOS Data Quality Monitoring System \(WDQMS\) webtool](#), illustrating improvements in observations and data sharing in relation with GISC/RWC Casablanca (see [Implementation Arrangement](#))

CARTES PRÉVUES

Search product by name

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Visualisation Description Details

Parameters :

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Zon-Shear-200-850

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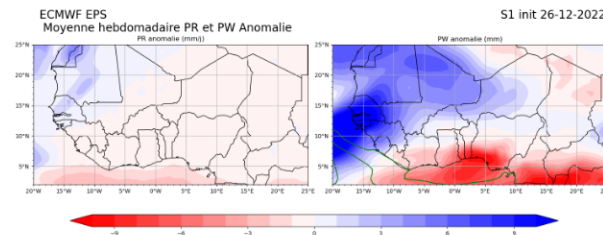
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Domain :

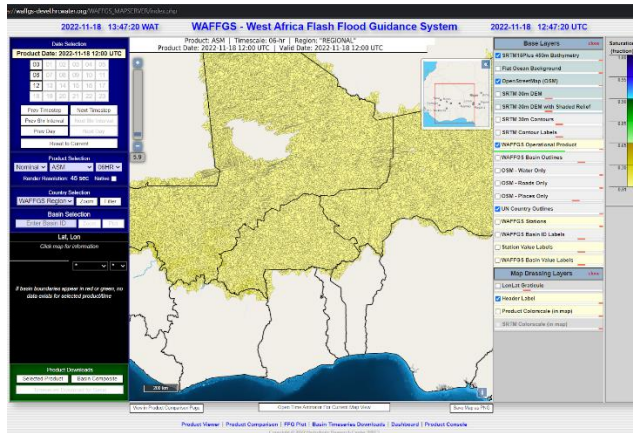
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2022-12-26 : LT1

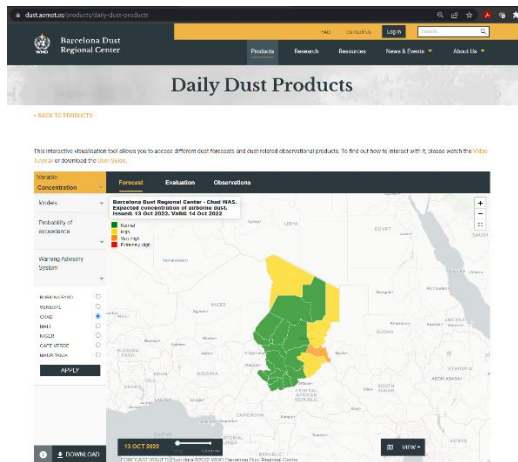
Timeline: LT1, LT2, LT3, LT4, LT5, LT6



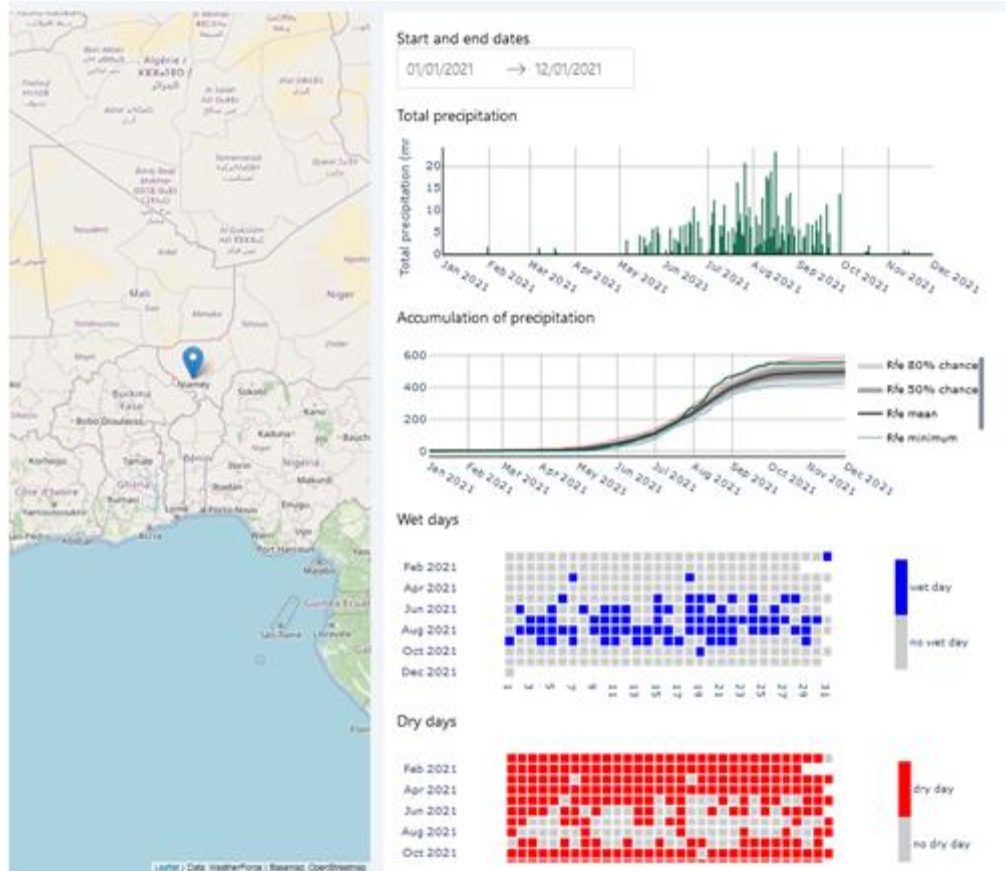
[MISVA website](https://www.misva.org/) providing 6-week advanced sub-seasonal forecasts. Weekly briefings are organized to guide warning issuance by NMHSs.



Flash Flood Guidance System launched in demo mode for training purposes in Dec 2022 (see [article](#))



Sand and Dust Warning Advisory System (<https://dust.aemet.es/products/daily-dust-products>)



Indicators for production of agrometeorological bulletins and warnings in all West Africa (hub.weatherforce.net/service/crews)

14.Supporting documents

- [Project proposal](#) approved by CREWS Steering Committee (Aug 2018)



- [Additional financing](#) approved by CREWS Steering Committee (Feb 2020)
- [1st Steering Committee](#) Meeting Report (Dec 2018)
- [2nd Steering Committee](#) Meeting Report (Nov 2019)
- [3rd Steering Committee](#) Meeting Report (June 2022)
- Mapping of initiatives relevant for Hydromet, urban development and coastal risk management in [Sierra Leone](#)
- Mapping of initiatives relevant for Hydromet and early warning in [West Africa](#)
- Report of the consultation on the [9 elements of the CREWS West Africa project](#) (Sep 2018)
- Setup of a [CREWS West Africa Community of Practice](#) (Sep 2018)
- Training on interpretation of numerical weather prediction products (Lomé Oct 2018, Ouagadougou [May 2019](#))
- Training on [crop modelling with SARRA model](#) (Ouagadougou, Nov 2018)
- Training on [agricultural land data assimilation](#) (LDAS, Niamey, May 2020)
- Training on agricultural statistical risk assessment with [crop calendars](#) (Ouagadougou, Feb 2020)
- [Regional workshop on data collection, management, exchange](#) (July 2020)
- [TAMSAT Training Workshop](#) (July 2020)
- [SWFDP WA](#) Implementation Plan (Sept 2017)
- [FFGS WA](#) - Report of the Technical Planning Meeting (June 2019)
- [CIFI WA](#) - Proposed workplan
- [MISVA](#) - Terms of reference
- [Terms of reference](#) of the CREWS West Africa Steering Committee
- [Report](#) of the first session of the CREWS West Africa Steering Committee (19 Dec 2018)
- [Draft report](#) of the second session of the CREWS West Africa Steering Committee (12 Nov 2019)
- [Report](#) of the joint KNMI-DWD-WMO mission to AGRHYMET (Nov 2019)
- Partnership agreement with [KNMI](#) - sub-regional climate dataset WACA&D (report)
- Partnership agreement with [DWD](#) - cataloguing of extreme events and climate watch service ([report Oct 2020](#))
- Partnership agreement with [Météo France](#) - MISVA ([report Dec 2020](#))
- Partnership agreement with [UoR](#) - improving use of TAMSAT ([report Oct 2020](#))
- Partnership agreement with [IRI](#) - forecasting subseasonal timescales in PRESASS and PRESAGG ([report Oct 2020](#))
- Partnership agreement with [HRC](#) - flash flood guidance system in Burkina Faso, Mali, Niger ([report Dec 2020](#))
- Partnership agreement with [ANACIM \(RSMC Dakar\)](#) - strengthening SWFP

15. Project History

