RÉPUBLIQUE FRANÇAISE
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METEO FRANCE

MONTHLY FORECAST OF TC ACTIVITY

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WMO RA-I Training course 2023

Outline

- **What is monthy forecast**
  - Time scale issues
  - What for ?
  - Main drivers
- **Modeling systems for monthly forecast**
- **Available tools and products**
  - MISVA platform
  - PISSARO project

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Time-scale

- Monthly forecast <-> Subseasonal forecast
- Covers leadtimes beyond 10 days up to 40 days
- Fills the gap between weather forecast (daily values) and seasonal forecast or outlook (seasonal averages)
- Monthly forecast brings relevant information on a weekly time-scales

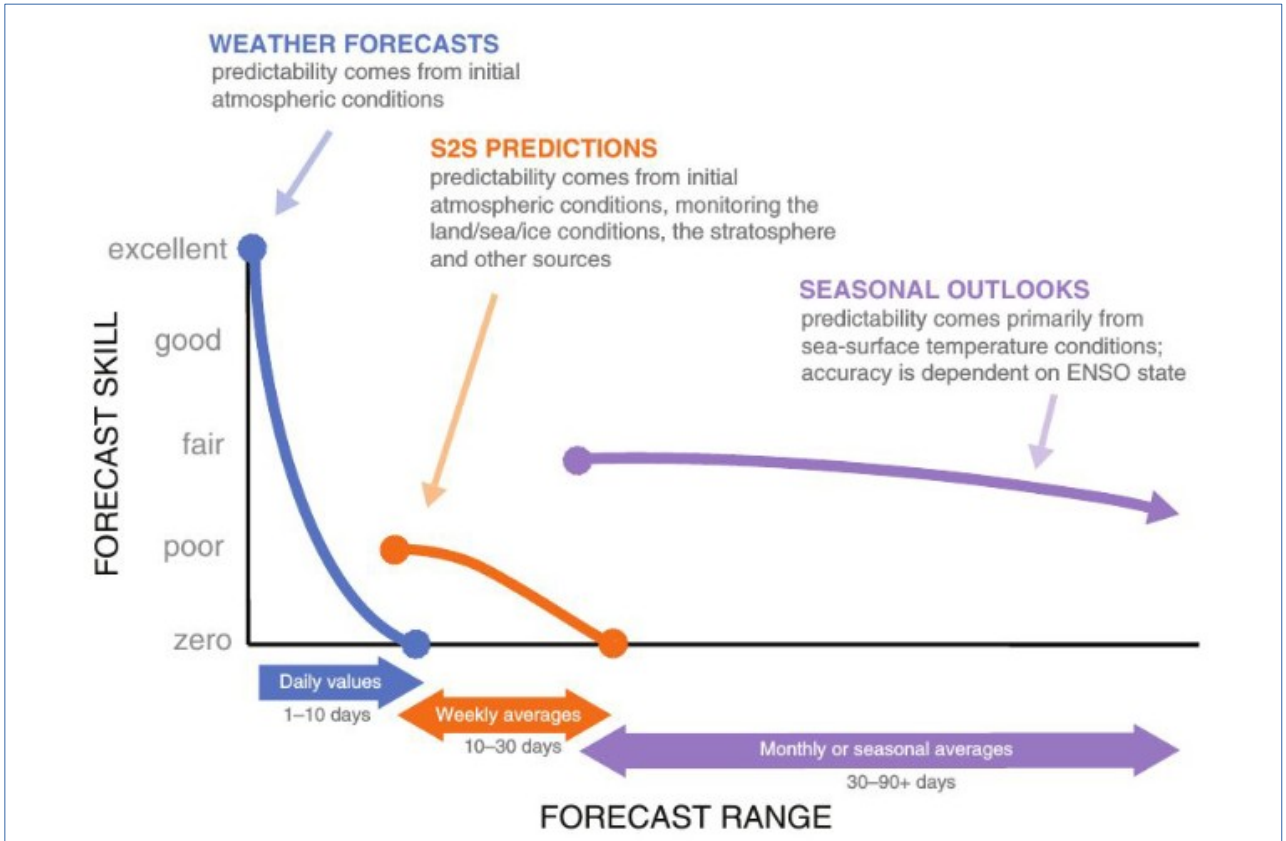


Figure 1. Qualitative estimate of forecast skill based on forecast range. Source : White et al. (2017).

What for ?

- Better anticipation of extreme events (tropical cyclones, heavy rainfall events, heat waves, dry spells…).
- Development of « earling-warning » application/products for better anticipation and decision making from actors of the Disaster Risk Manager sector, Humanitarian sector (red cross...)

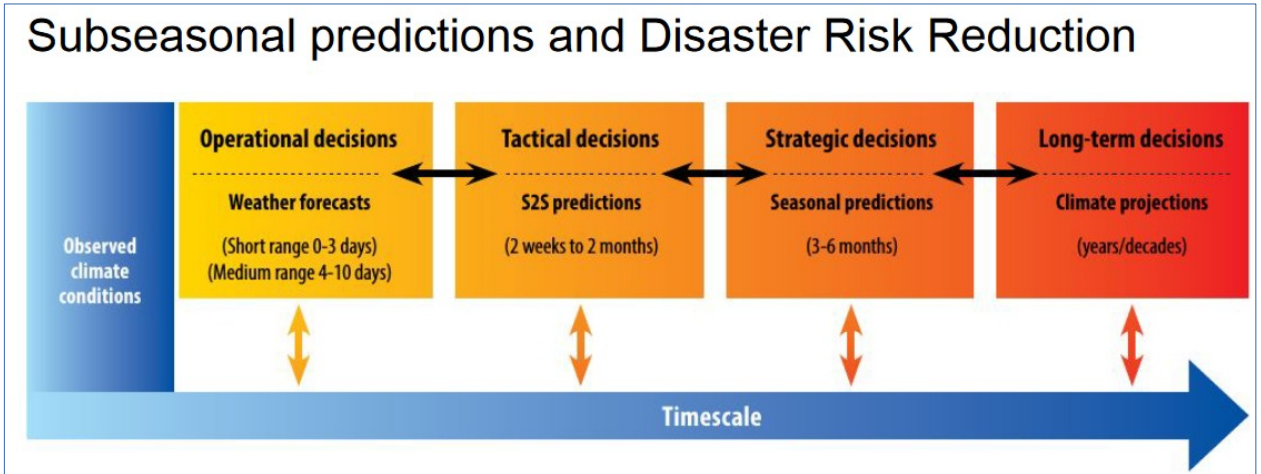
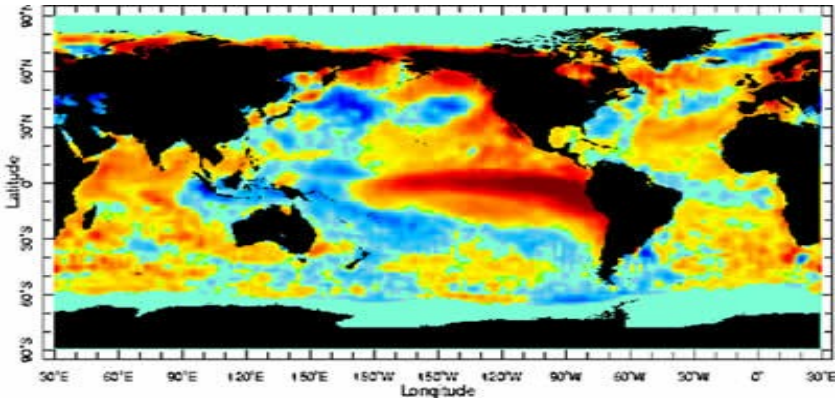


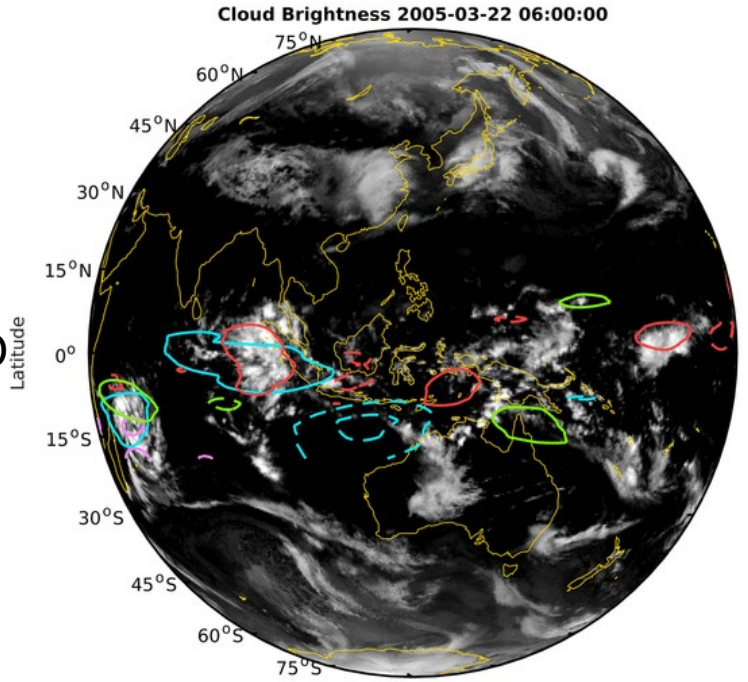
Figure 2. Disaster risk management interventions across the continuum of timescales of climate information.
Source : UN report (2019), modified from ESCAP (2017).

Figure. Le concept "Ready!", "Set!", "Go!" pour l'aide à la prise de décision développé par le Centre climatique de la Croix-Rouge et l'IRI. Extrait du rapport 2019 des Nations Unies (ST/ESCAP/2867), source : Goddard et al., 2014.

Predictability and main drivers

- The time-scale of subseasonal forecast has long been considered as a « predictability desert »
- Recent progress in terms of predictability comes from :
  - A better understanding and representation of atmospheric conditions especially through the conceptual scheme of **atmospheric waves**
  - Improved coupling with, and initialization of, the land-ocean-cryosphere and stratosphere
  - Understanding how these subseasonal predictability sources affect the occurrence (in terms of probability) of extreme events

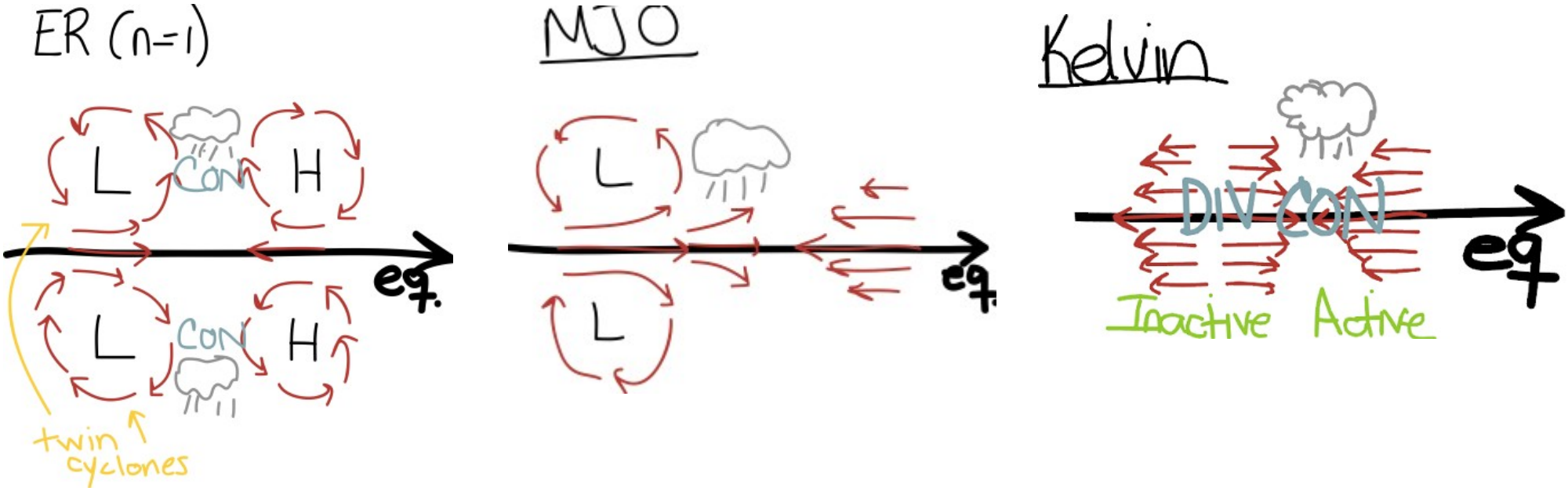




- **Main sources of predictability for tropical regions :**
  - Oceanic « low frequency » oscillations : ENSO, IOD, SIO → defines the background climate conditions, bring information at a monthly to seasonal time-scale
  - Tropical atmospheric waves : Madden Julian Oscillation (MJO), Equatorial Rossby (ER), Kelvin waves (subseasonal) → predictability sources relevant for explaining variations on weekly to monthly time-scale

Atmospheric drivers

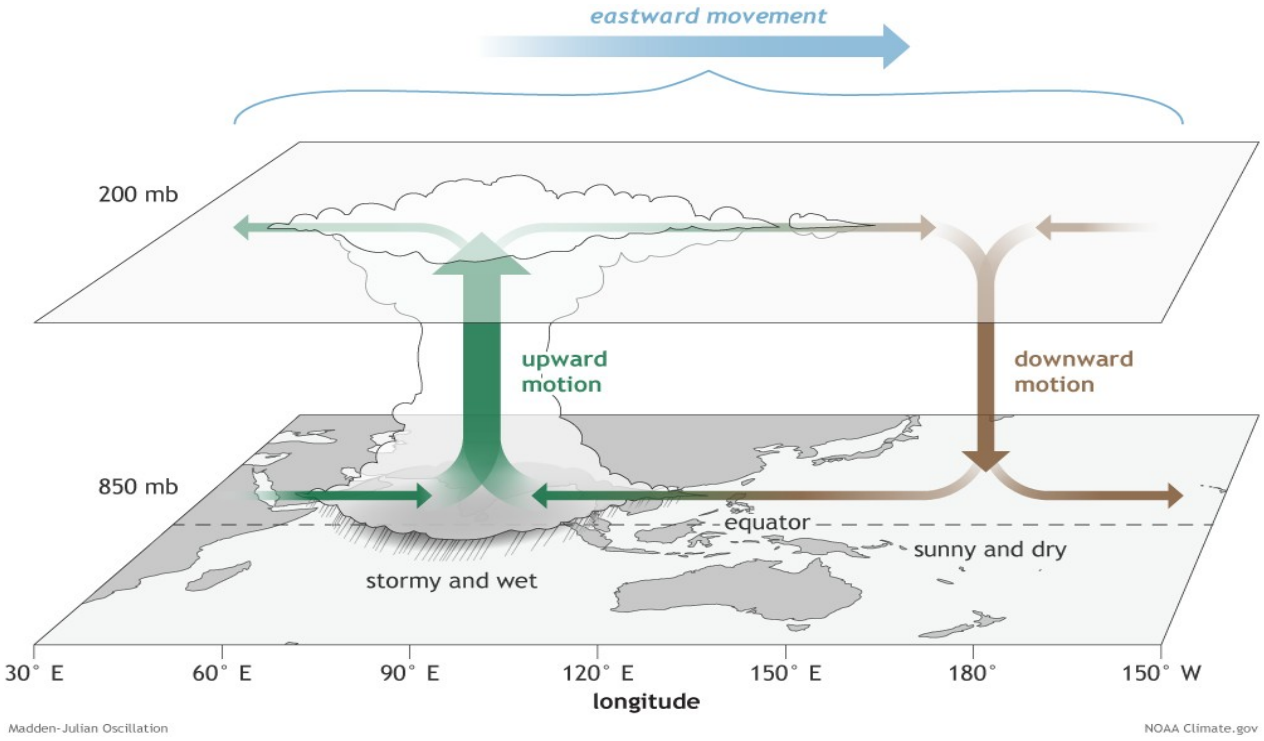
Definition : An equatorial wave materializes the **propagation of an atmospheric disturbance** on a planetary scale. It is **coupled to convection**: strong convective burst give rise to it and the propagation of the wave favors in turn convection.
It remains channeled in the near equatorial zone (± 15°) by the equatorial waveguide but also by the seasonal shift of the ITCZ.

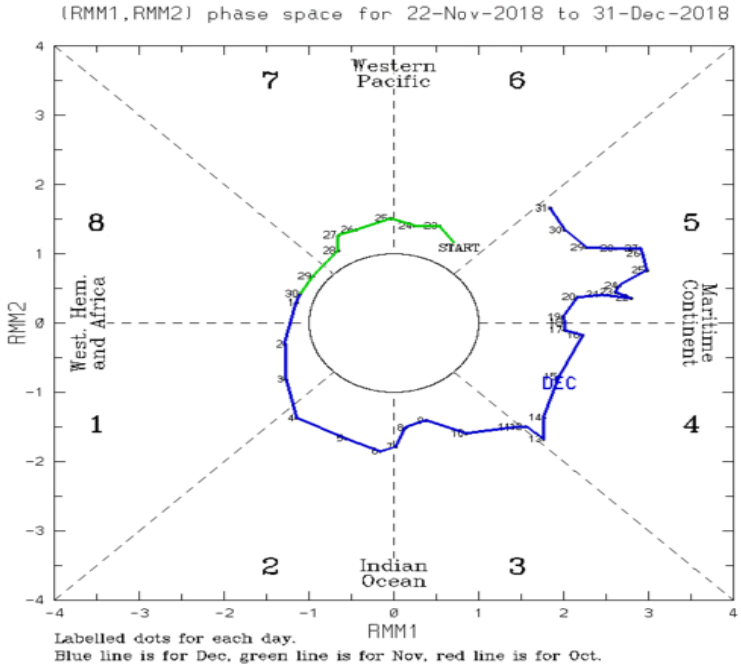


Equatorial waves bring predictability on an intra-seasonal (monthly) scale.

Madden-Julian Oscillation (MJO)

Propagation : Eastwards
Period > 30 jours
Consequences : Succession of enhanced / suppressed large scale deep convection over the Indo-Pacific area within slow moving Walker cells. Modulating influence on tropical cyclogenesis at intra-seasonal time-scale for this region.

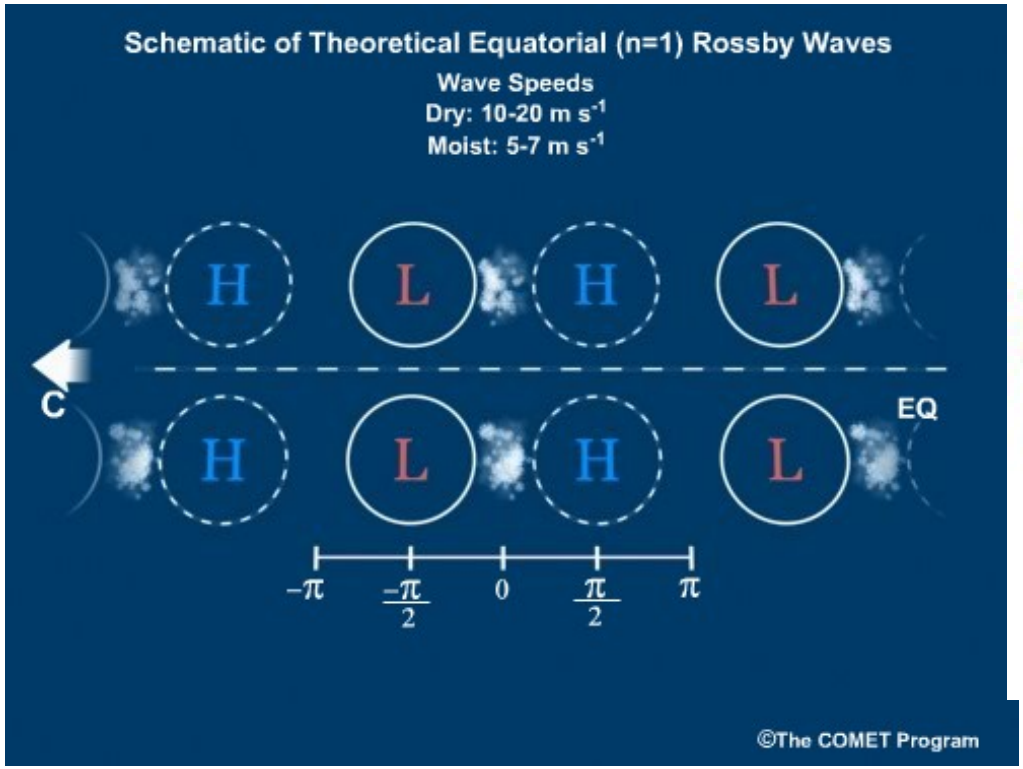


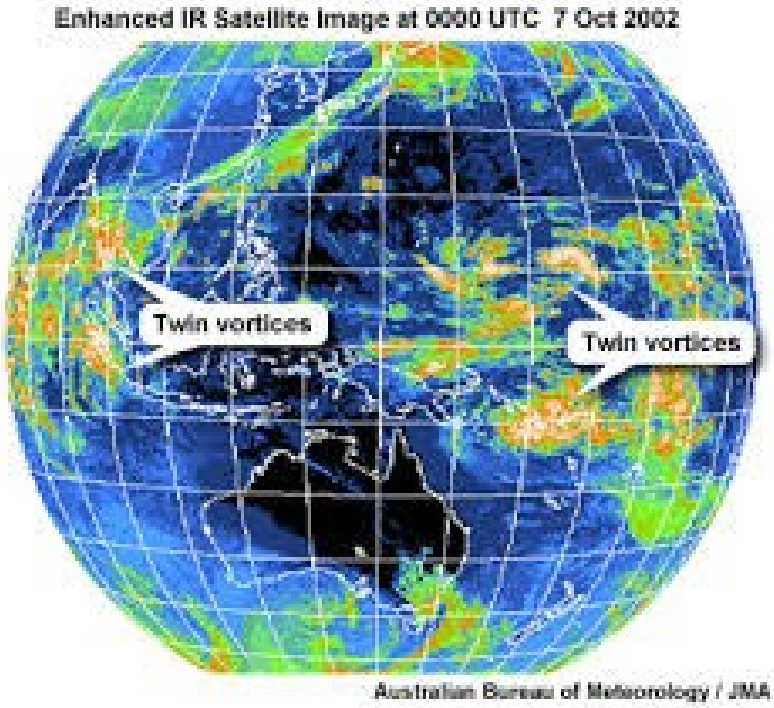


Src : NOAA Climate

Equatorial Rossby (ER)

Propagation : Westwards
Period ≈ 10/20 days
Consequences : Symmetrical cyclonic vortexes on both sides of the meteorological equator (varies with the season)

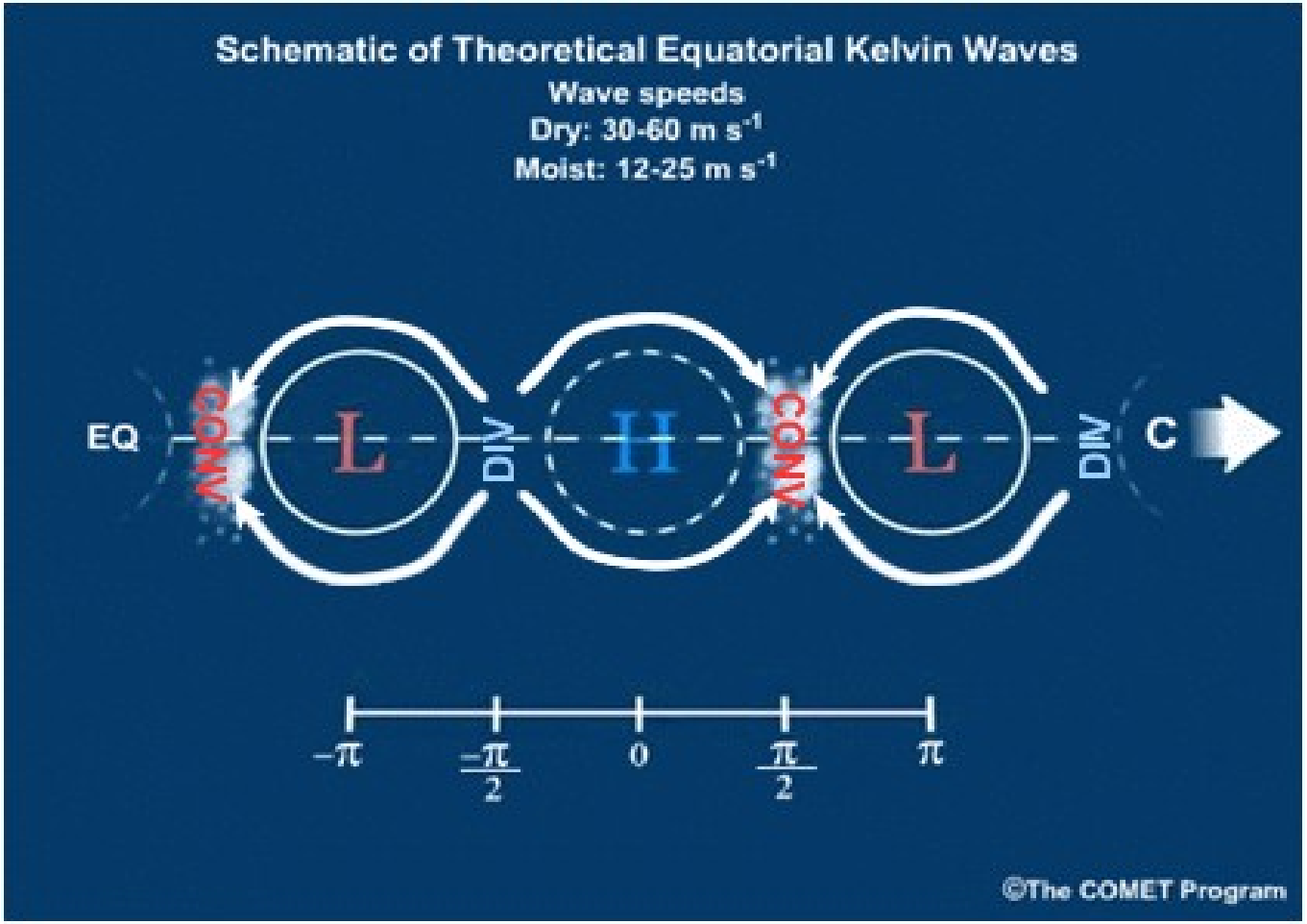




Src : COMET Program

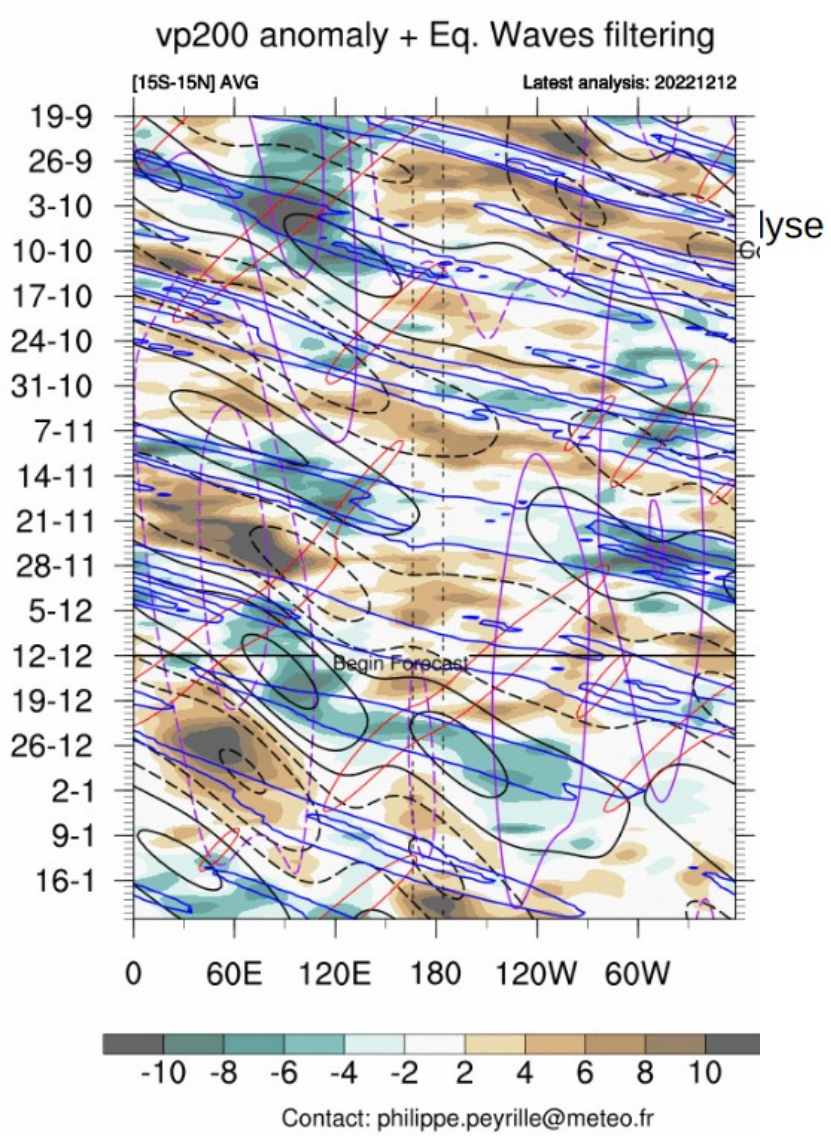
Kelvin waves

Propagation : Eastwards
Period ≈ 3/7 days
Consequences : enhanced convection ahead of a westerly wind surge

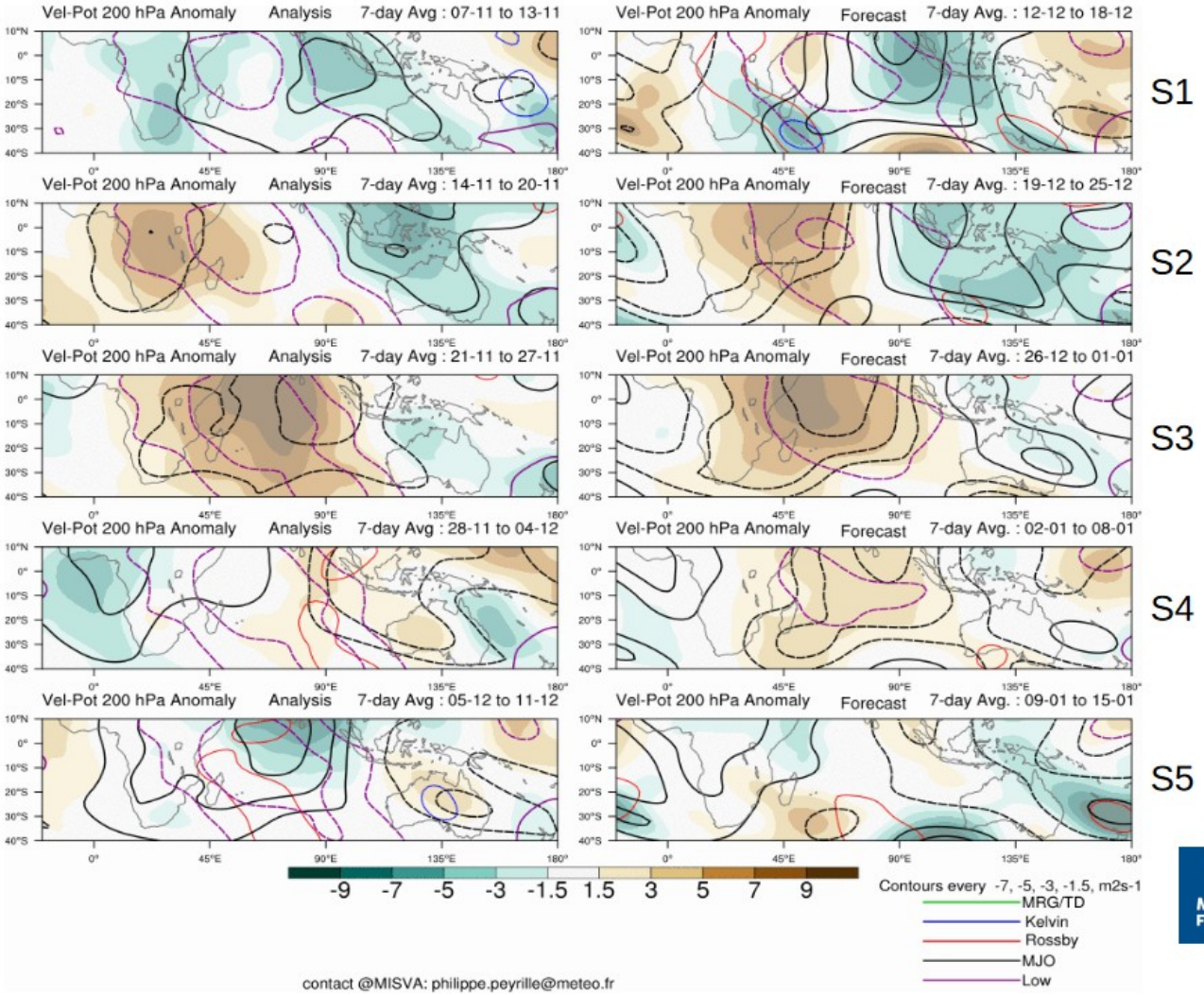


Src : COMET Program

Visualisation of atmospheric waves objects



- Hovmollers diagrams
- 7 days averaged maps
- Eq. Waves filtering



Low freq.
MJO
Kelvin
Rossby

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Modeling systems for monthly forecast

➢ Ensemble Prediction Systems

✗ **S2S project** : intercomparaison of systems for subseasonal to seasonal forecast (12 modeling group participating)

12 modeling group participating : **https://confluence.ecmwf.int/display/S2S/Models**

- Lead-time : 30 to 60 days depending on systems
- From 4 to 100 members depending on systems
- From 30 km to 100 km horizontal resolution depending on systems
- Most of them are ocean-coupled, some are coupled with sea-ice, wave modules
- Run daily to weekly

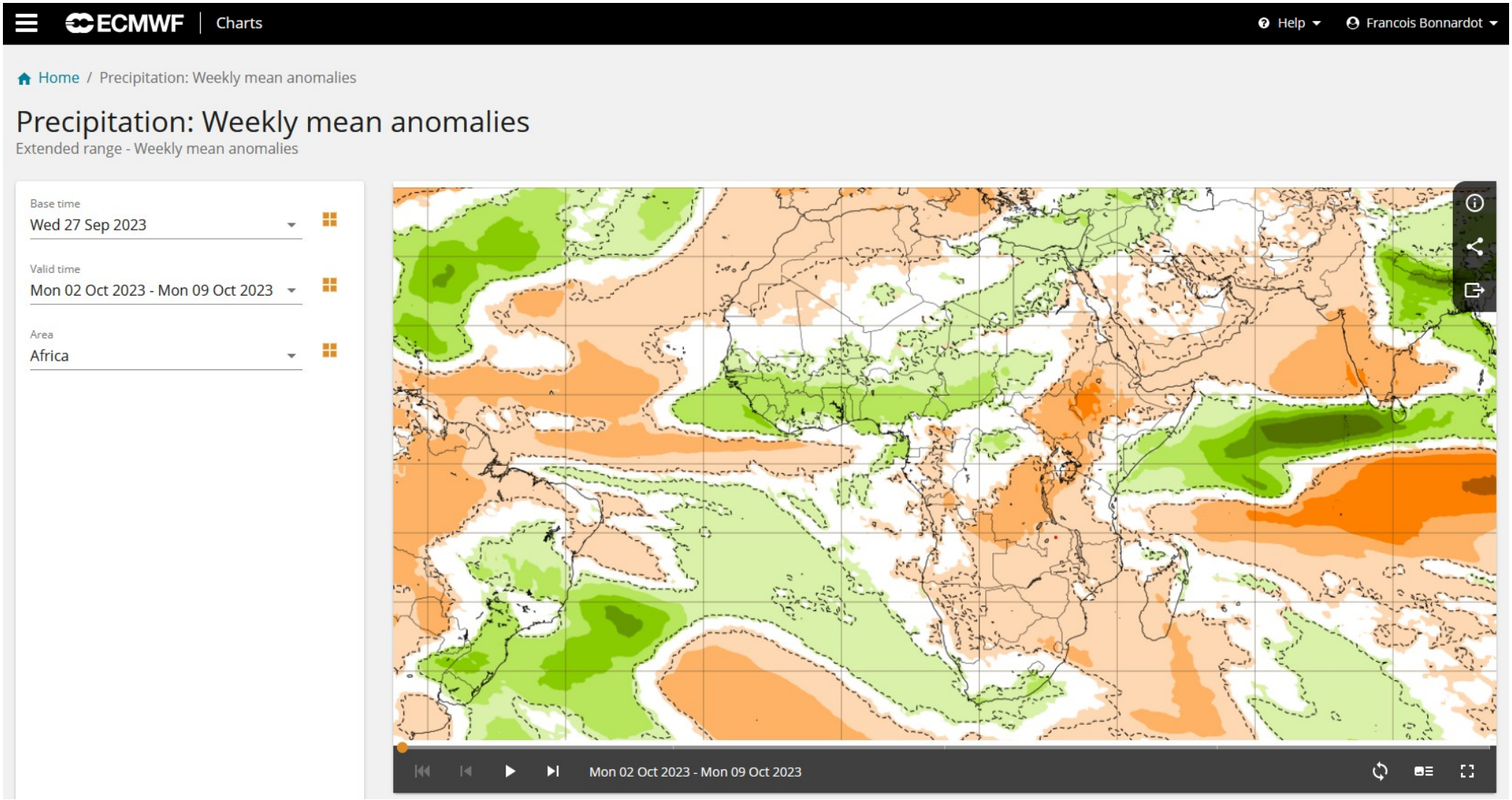
✗ **ECMWF system for operational applications (but not the only one)**

- 46 days leadtime
- 100 members
- 35km horizontal resolution, 137 vertical levels
- Run frequency : daily
- Ocean model : NEMO 0.25° resolution
- Sea Ice model LIM2
- ECMWF Wave model plugged

More details on https://confluence.ecmwf.int/display/S2S/ECMWF+model+description

Modeling systems for monthly forecast

https://charts.ecmwf.int/



Modeling systems for monthly forecast

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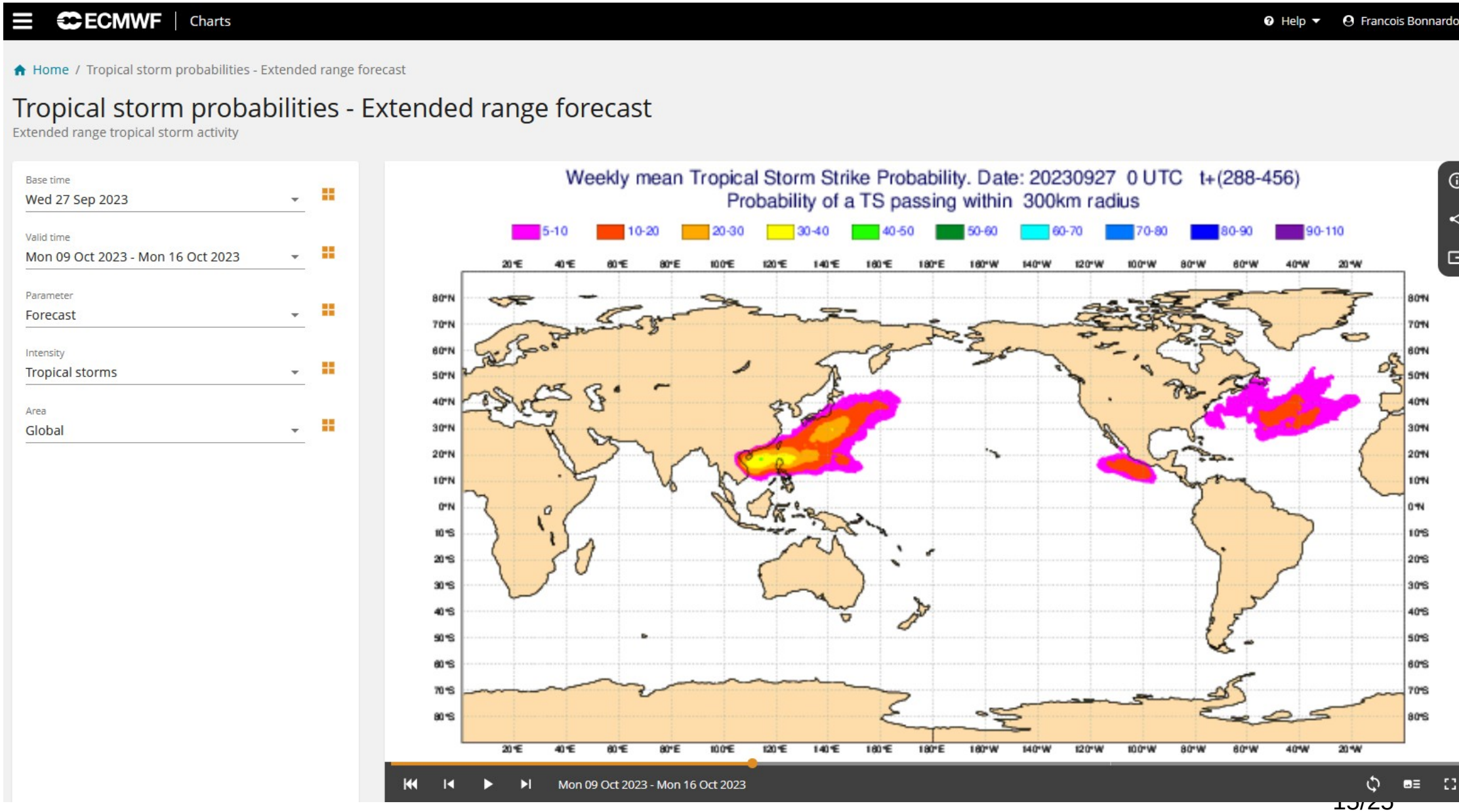

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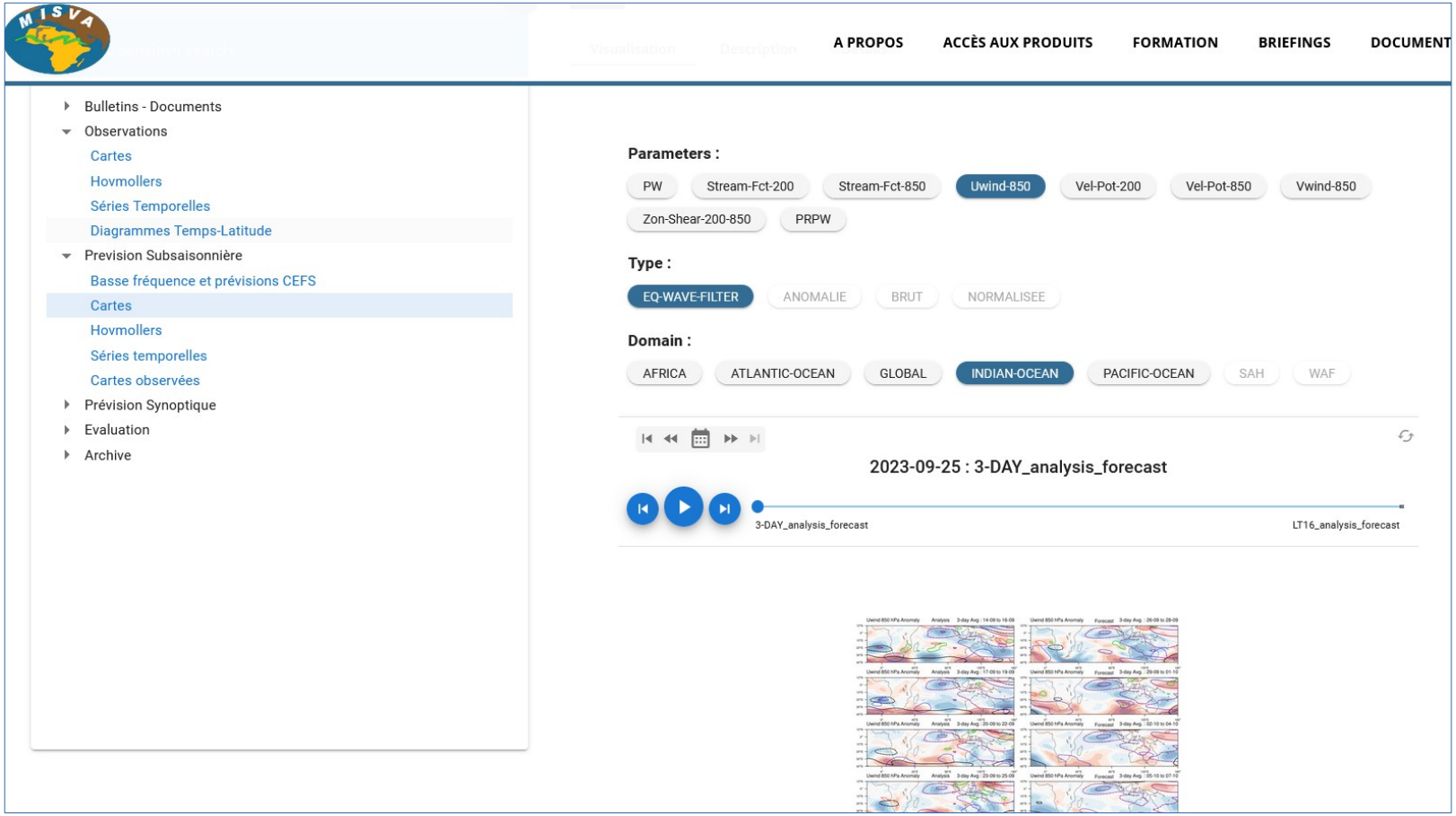
MISVA platform

https://misva.aeris-data.fr/en/products/series_prevues/

- **MISVA** : **M**onitoring and forecast of **I**ntra**S**easonal **V**ariability over **A**frica
- Collaboration between Météo-France and Western African météorological services
- Aims at a better understanding and better forecast of rains, especially extreme rains, in West Africa at synoptic to sub-seasonal scales
- Extension to other basins like south-West Indian Ocean basin for some products



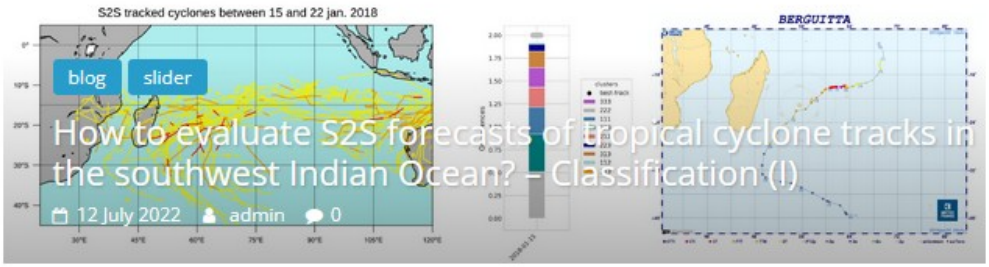
PISSARO project

http://en.pissaro.re/ or http://fr.pissaro.re/

PISSARO

Next event: PISSARO Workshop on June 1 and 2, 2022

ABOUT PISSARO | PRODUCTS | DOCUMENTATION | BLOG



The PISSARO project aims to facilitate the integration of monthly forecast data into the decision-making and management processes of atmospheric hazards in the Indian ocean. It will provide you – via this platform – with information on advances in the field of intra-seasonal forecasting. You will also find all the project news.

Exchanges between researchers, developers and users will enable us to develop products dedicated to reducing the risks associated with tropical cyclones and heavy rainfall in the Indian ocean.

Partners

Under the supervision of:

In partnership with:

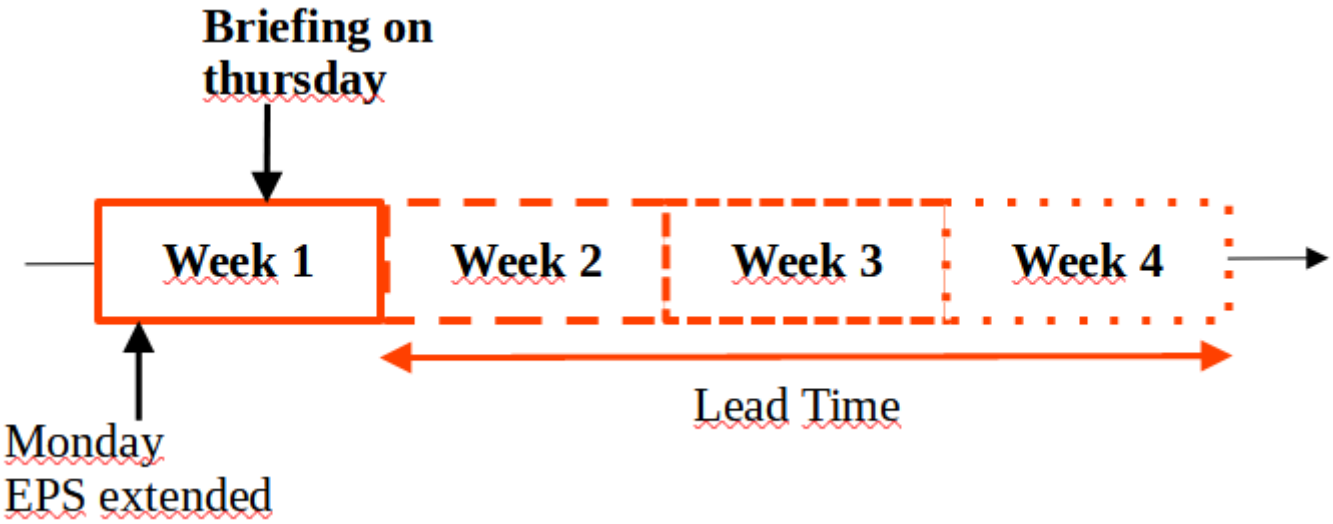
Funded by:

- Better understanding of the subseasonal variability and identification of relevant drivers for a better anticipation of atmospheric hazards in the Indian Ocean
- Provide new products for a better integration of monthly forecast data into decision-making and manangement processes for disaster risk reduction

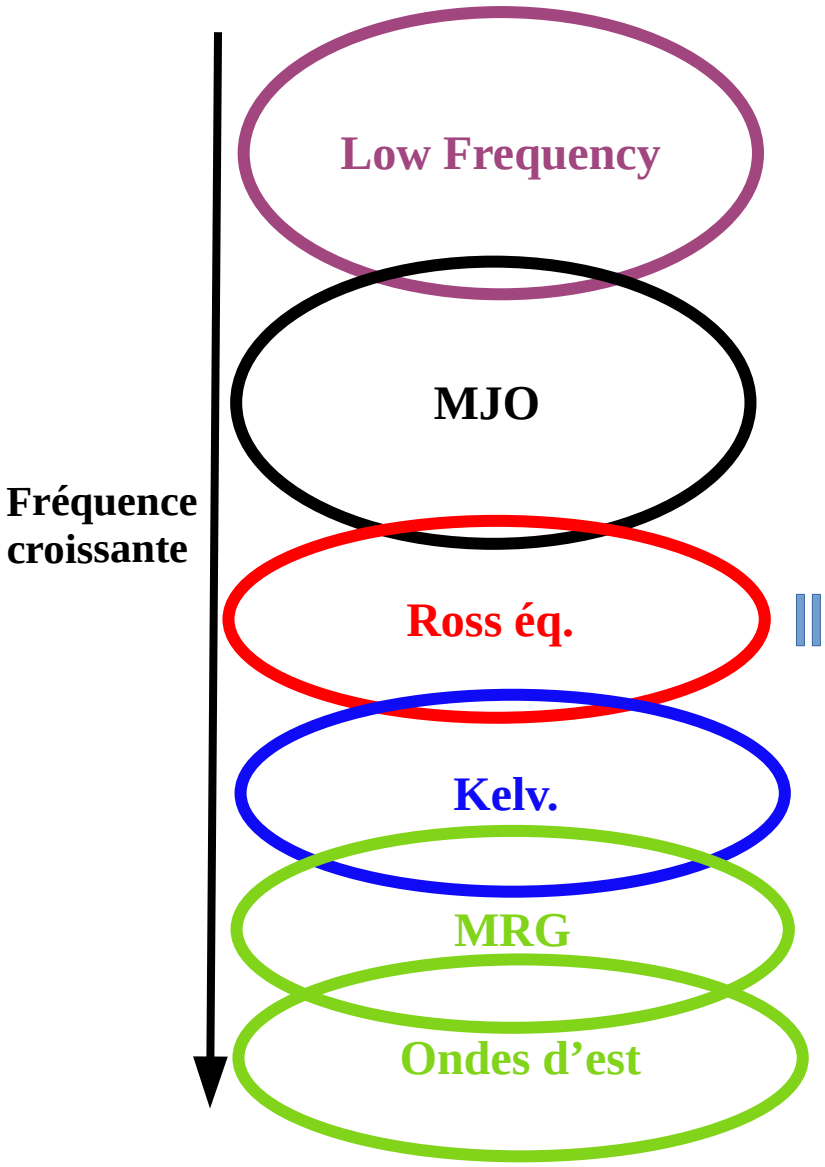
PISSARO project : monthly briefing activity

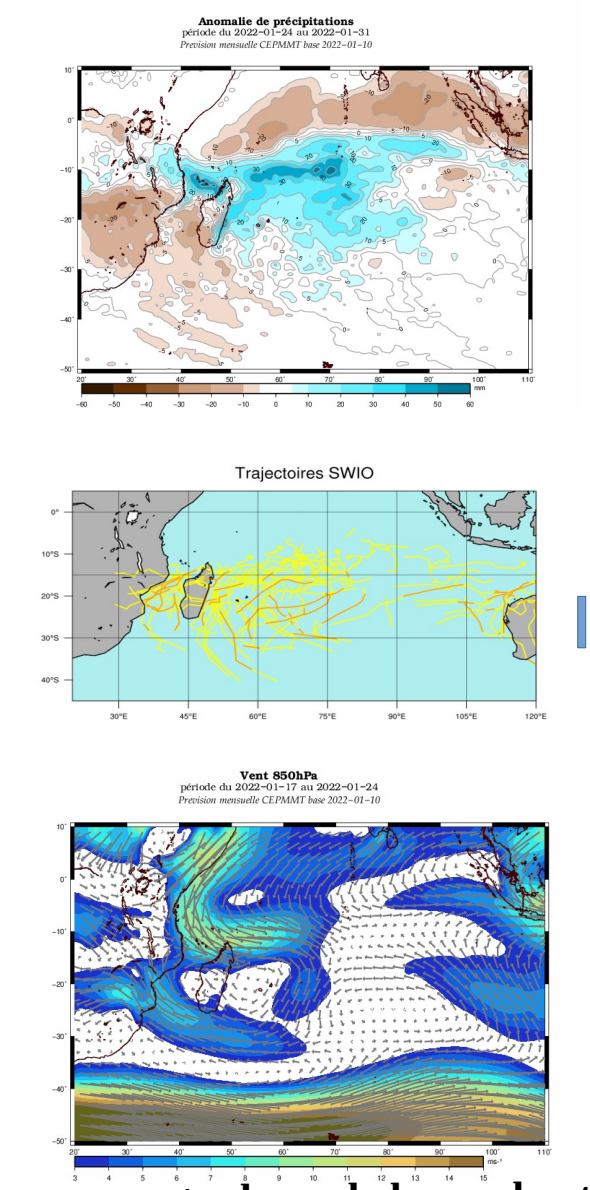
- For better understanding of the subseasonal variability and identification of relevant drivers for a better anticipation of atmospheric hazards in the Indian Ocean, a methodology was developped to better structure the exploitation of monthly forecast data

  - Semi-automatic production of the technical briefing material on tuesday
  - Preparation session with 2 or 3 experts on wednesday
  - Briefing on thursday with participation of researches, developers, operationnal forecasters
  - Provide a comprehensive message on the basin configuration, tropical cyclone activity, weather regimes for W2/W3/W4



PISSARO project : monthly briefing activity





Outlooks on weekly time scale :
- Cyclone activity over SWIO region (early warning of potentially impacting events)

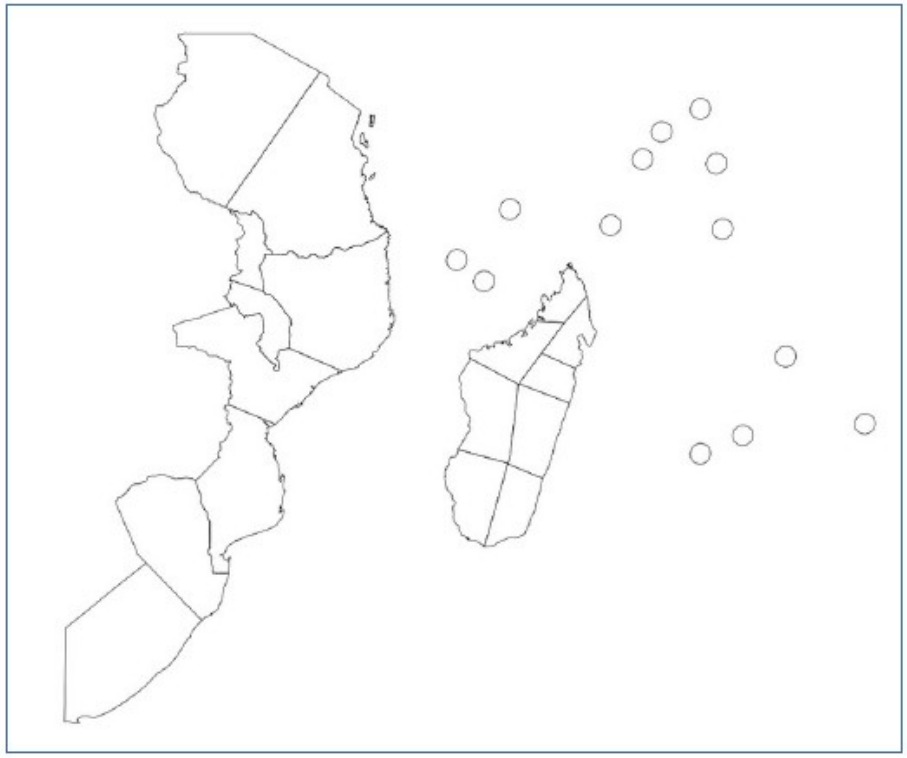
- Dominant Weather regimes for specific locations (La Réunion, Mayotte, Seychelles...)

Analysing the conditions through the atmospheric wave concept scheme helps understanding and interpreting model outputs

PISSARO project : specific products for cyclone hazard anticipation

Cyclone hazard anticipation product for inhabited areas of the southwest Indian Ocean

Produit d'Anticipation de l'aléa Cyclonique pour les Territoires habités du Sud-Ouest de l'Océan Indien (PACT-SOOI)



Zoning of SWIO for TC risk assessment conjointly built with PIROI considering access issues

Colour levels express an increasing degree of reliability of the cyclone signal

Niveaux de couleur expriment un degré de fiabilité croissant du signal cyclonique

Time ranges:

Week 1 (W1) = D+7 to D+13

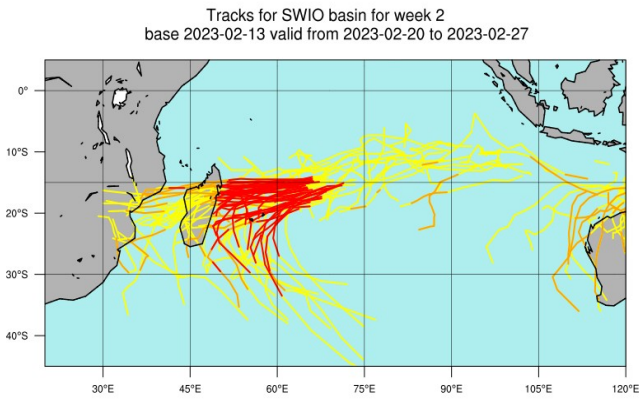
Week 2 (W2) = D+14 to D+20

Week 3 (W3) = D+21 to D+27

	WEEK1	WEEK2	WEEK3
Lev. 0	< 10 %	< 10 %	< 5 %
Lev. 1	10 – 25 %	10 – 15 %	5 – 15 %
Lev. 2	25 – 45 %	15 – 25 %	15 – 20 %
Lev. 3	≥ 45 %	≥ 25 %	≥ 20 % (?)

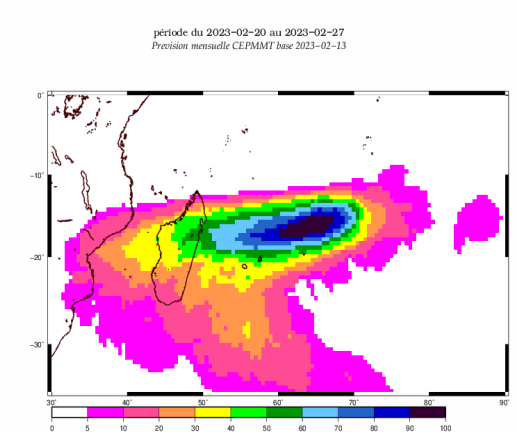
PISSARO project : specific products for cyclone hazard anticipation

Ensemble prediction of tracks within ECMWF EPS system

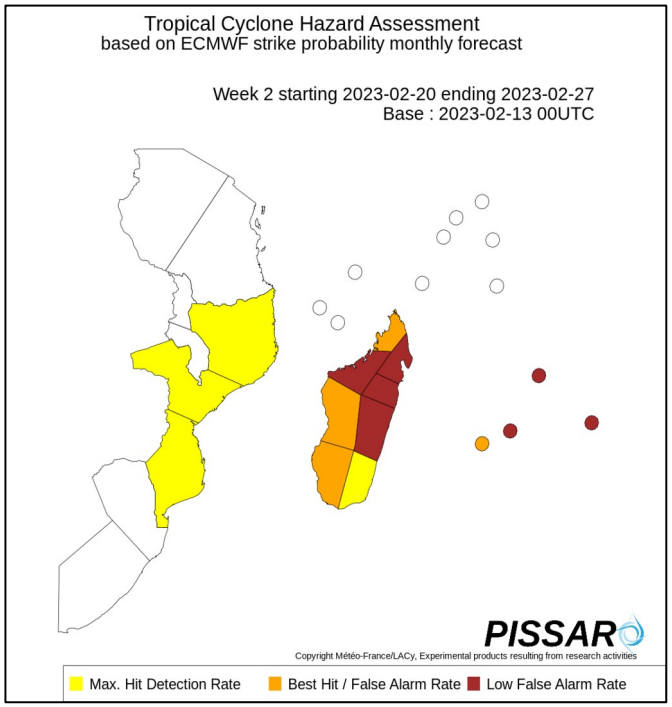


Ensemble des scénarios de trajectoires possibles de système dépressionnaires pour une semaine donnée (en orange : stade tempête et en rouge stade cyclones)

Strike probabilities



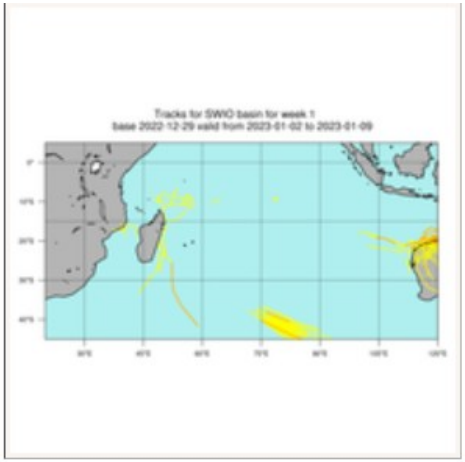
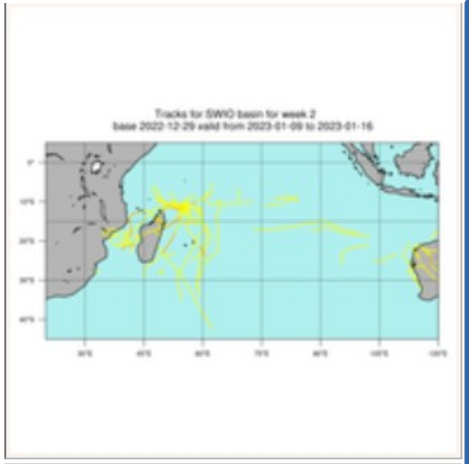
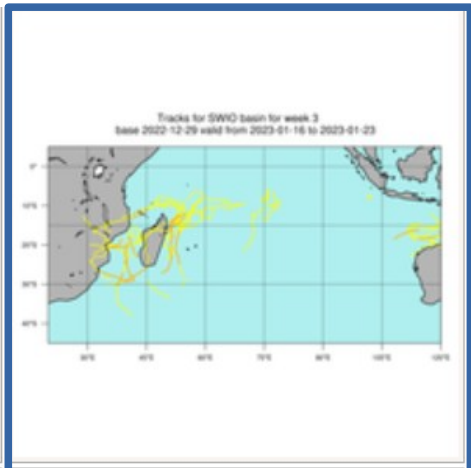
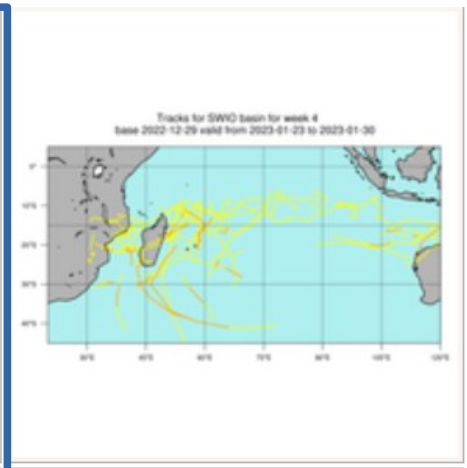
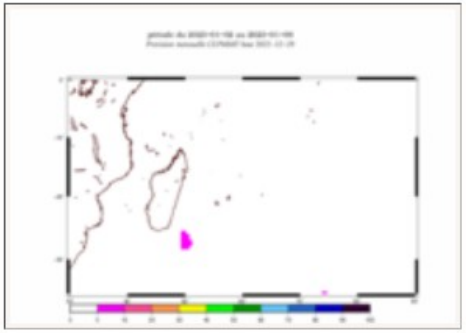
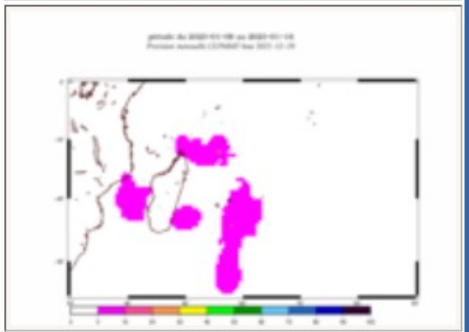
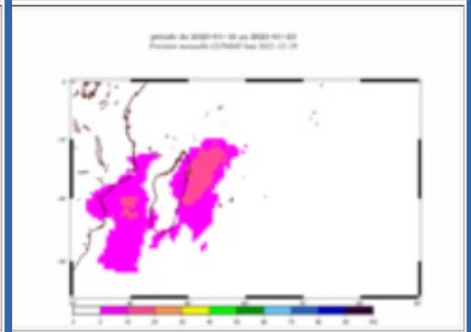
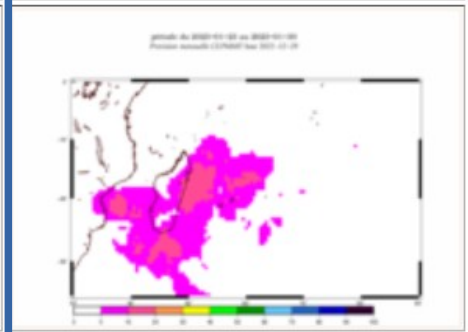
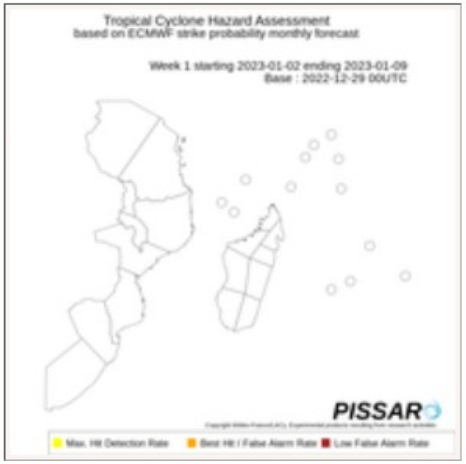
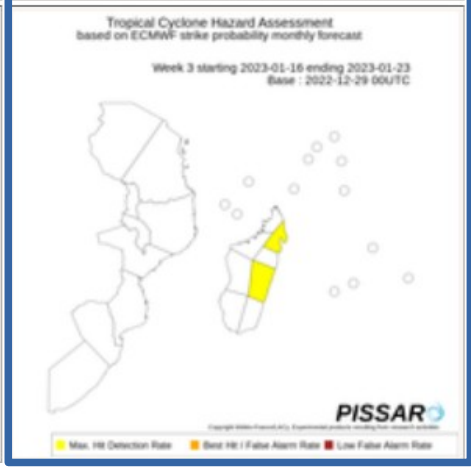
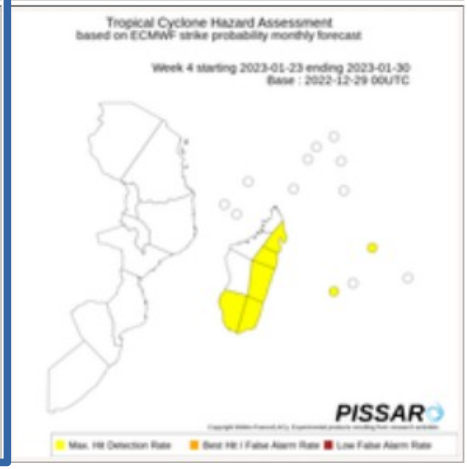
Probabilité d'occurrence de un (ou plusieurs) système (a minima au stade de tempête) dans un rayon de 300 km



Signaux d'activité cyclonique (présence d'une zone colorée) et degré de fiabilité associée à ces signaux (échelle de couleurs).

A noter : niveaux de fiabilité calibrés en fonction des bonnes détections et des fausses alertes associées à différentes probabilités d'occurrence

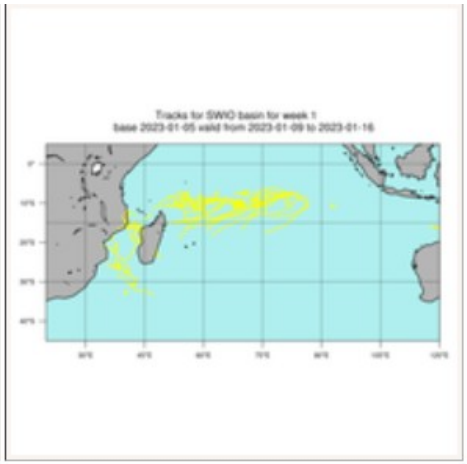
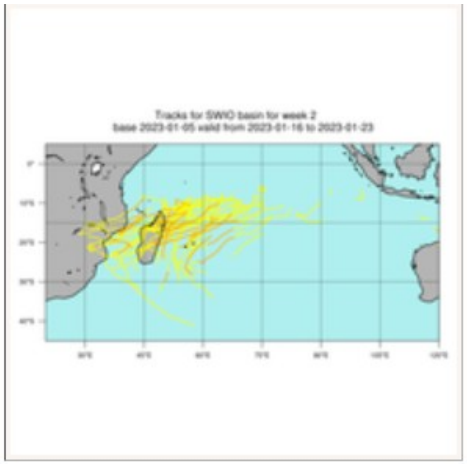
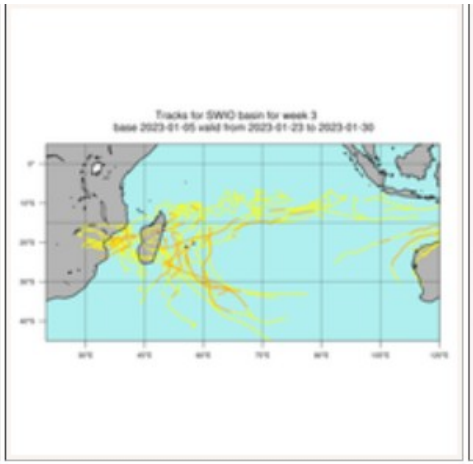
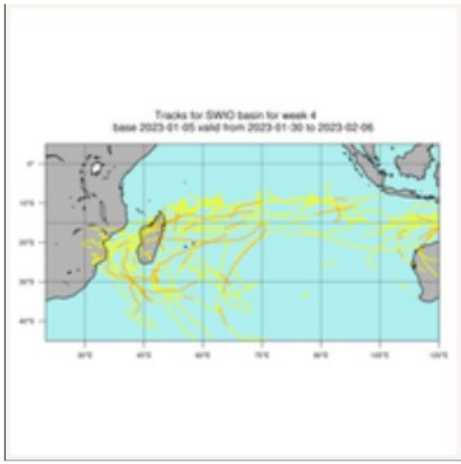
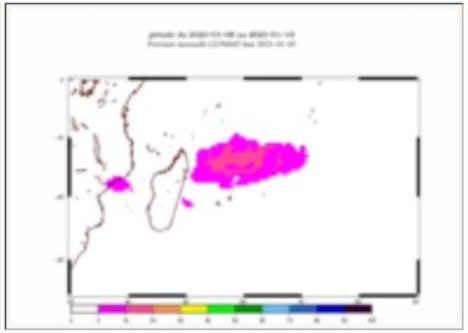
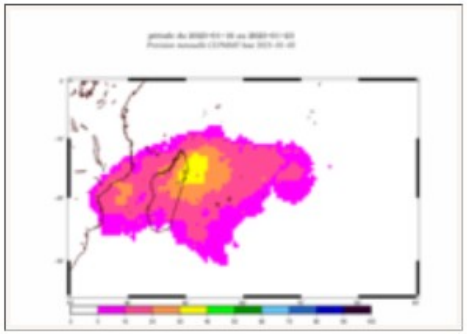
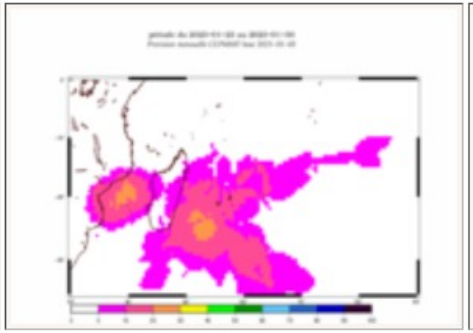
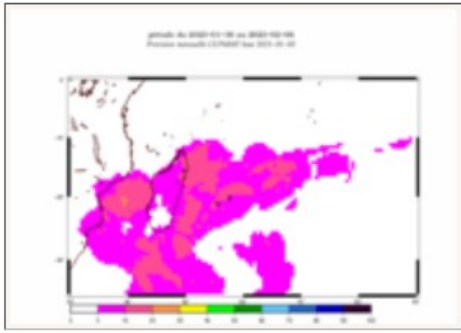
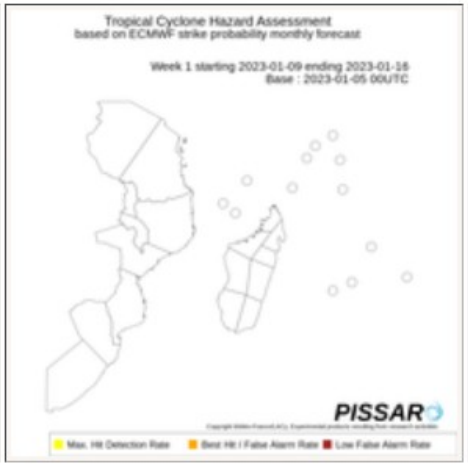
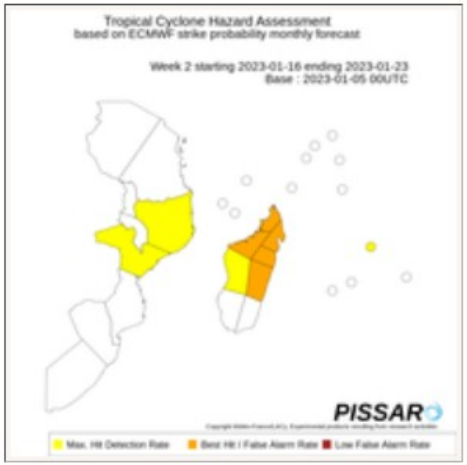
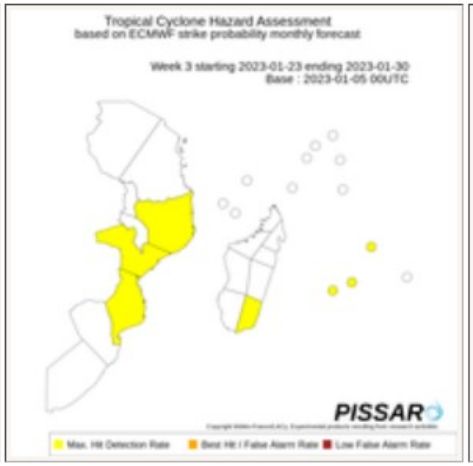
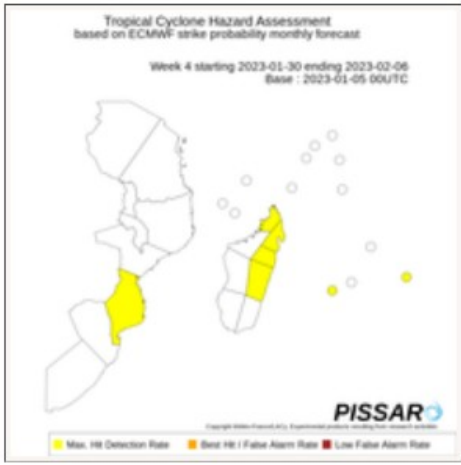
PISSARO project : specific products for cyclone hazard anticipation

TRAJECTOIRES				
STRIKE PROBABILITY 0.5				
STRIKE PROBABILITY STATS ZONALES				

Base : 29 dec 2022

Week 3 : 16-23 jan 2023
Cheneso

PISSARO project : specific products for cyclone hazard anticipation

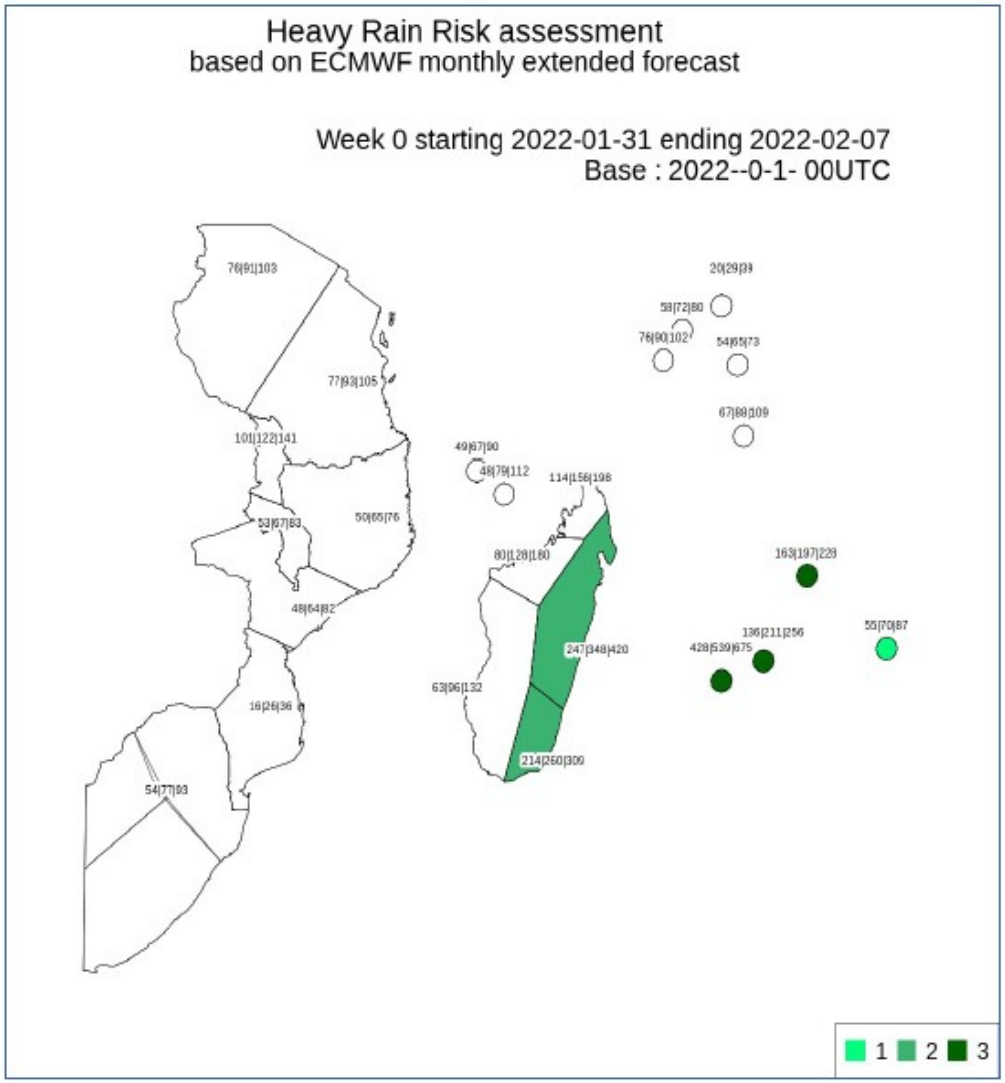
TRAJECTOIRES				
STRIKE PROBABILITY 0.5				
STRIKE PROBABILITY STATS ZONALES				

Base : 5 jan 2023

Week 2 : 16-23 jan 2023

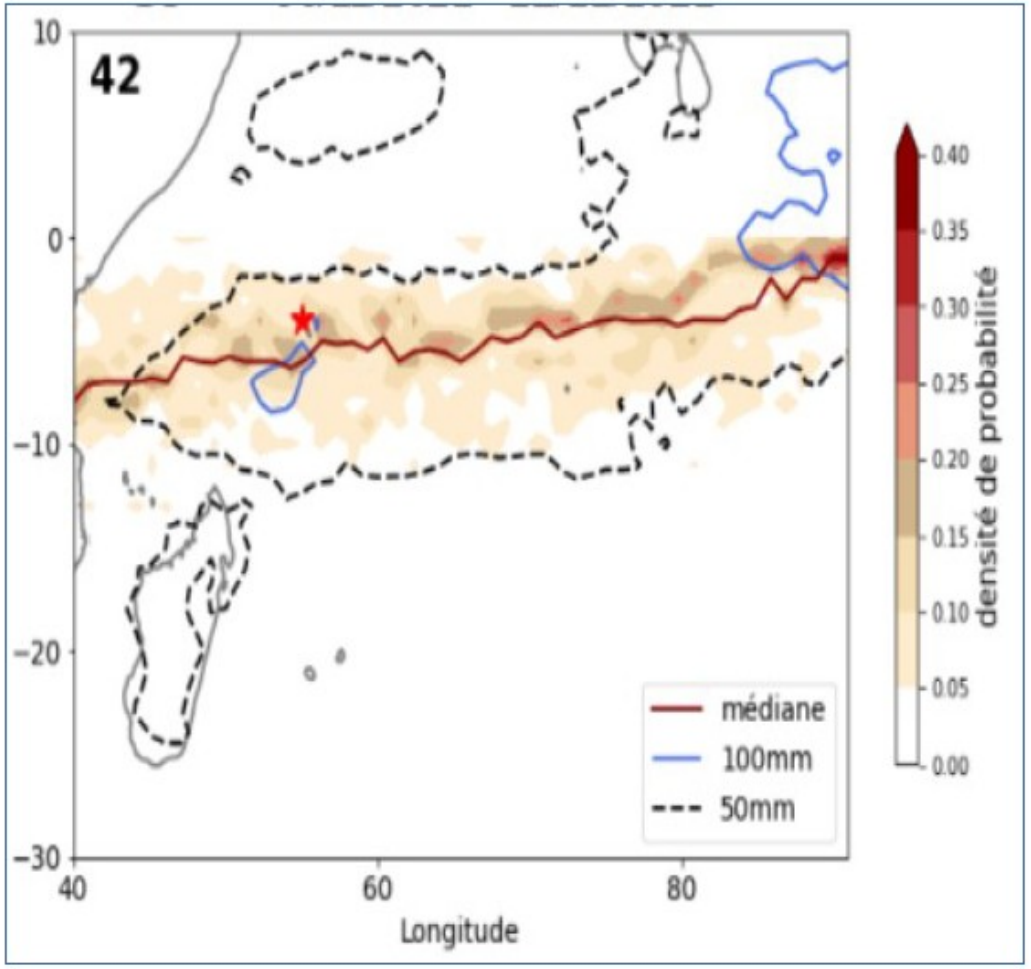
Cheneso

Other products under construction



Heavy Rainfall risk assessment

→ ongoing work to calibrate the risks level...



ITCZ forecast for W2 leadtime (2021-12-06 to 2021-12-12)

ITCZ probabilistic product

- predictability of the ITCZ in terms of location and associated rainfall activity
- better anticipation of the onset of the rainy season and/or heavy rainfall systems during the rainy season (partnership with SMA)