

Tropical Cyclone Genesis forecast at RSMC La Reunion

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RA I WMO - Training course on tropical cyclones 2023

Tropical Cyclone Genesis forecast at RSMC La Reunion



I) Operational TCG forecasting

- 1) Large scale analysis
- 2) Synoptic scale analysis
- 3) Examination of deterministic NWP outputs
- 4) Examination of ensemble forecast outputs

II) RSMC products about TCG

- 1) ITCZ Bulletin
- 2) Cyclogenesis map
- 3) Verification

III) Useful resources for TCG

Tropical Cyclone Genesis forecast at RSMC La Reunion



I) Operational TCG forecasting

Operational TCG forecasting

→ TCG forecast at RSMC La Reunion = Likelihood of **Moderate Tropical Storm** formation (ie warm core clockwise circulation with winds at or greater than 34 kt) within the next 5 days

→ The likelihood is expressed with probabilities as below :

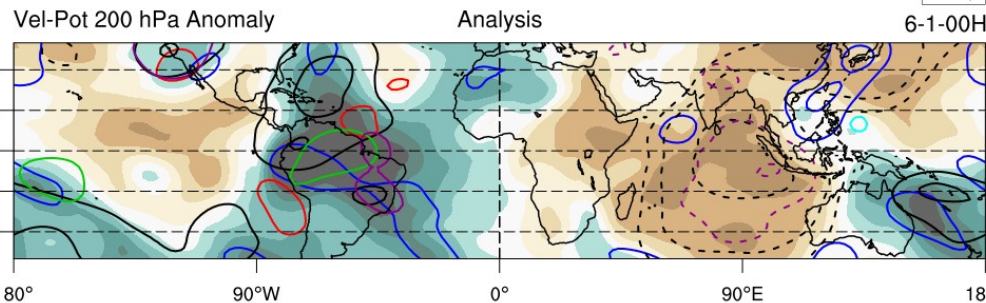
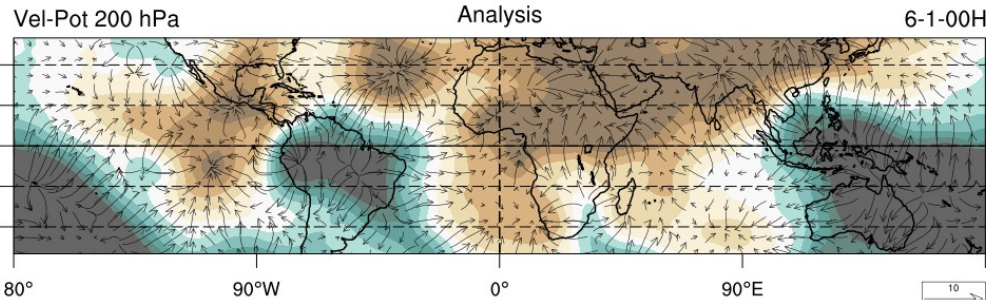
<i>Very low:</i>	<i>less than 10%</i>	<i>Moderate:</i>	<i>30% to 60%</i>	<i>Very high:</i>	<i>over 90%</i>
<i>Low:</i>	<i>10% to 30%</i>	<i>High:</i>	<i>60% to 90%</i>		

→ Issued daily all year around with 2 associated products (ITCZ bulletin, cyclogenesis map)

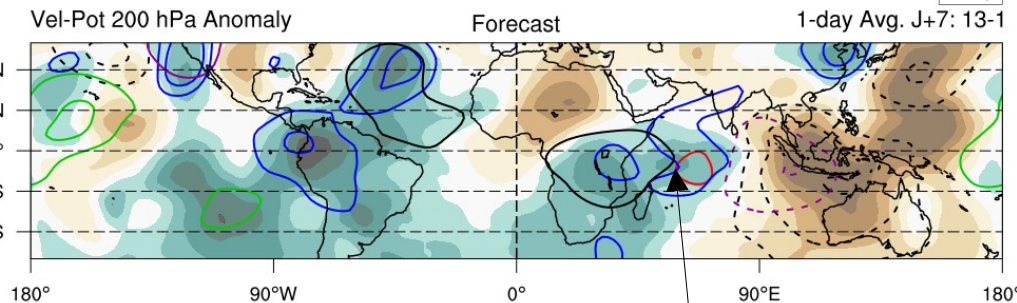
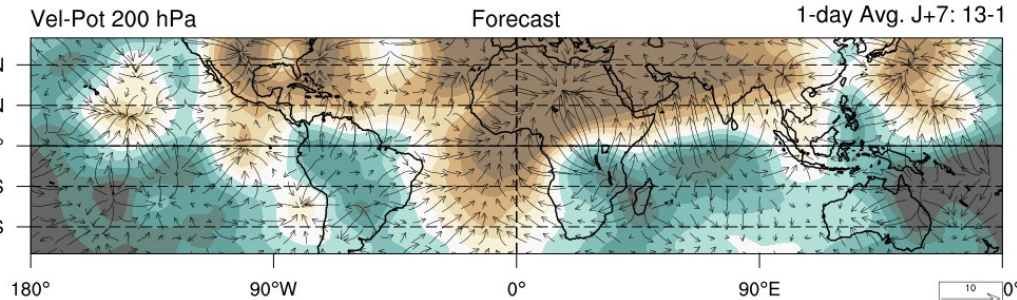
Step 1 : Large scale analysis

→ a : Equatorial waves

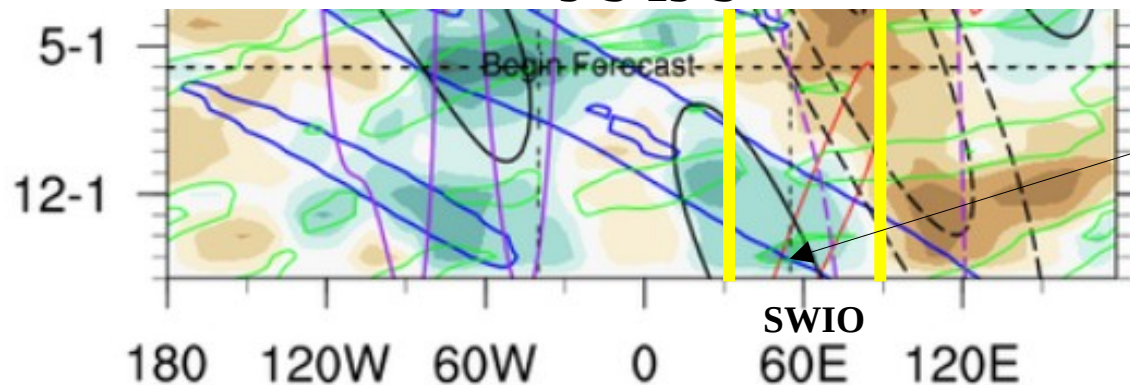
1-day AVG. ECMWF Model, Init. 6-1-00H



1-day AVG. ECMWF Model, Init. 6-1-00H



5°S-15°S



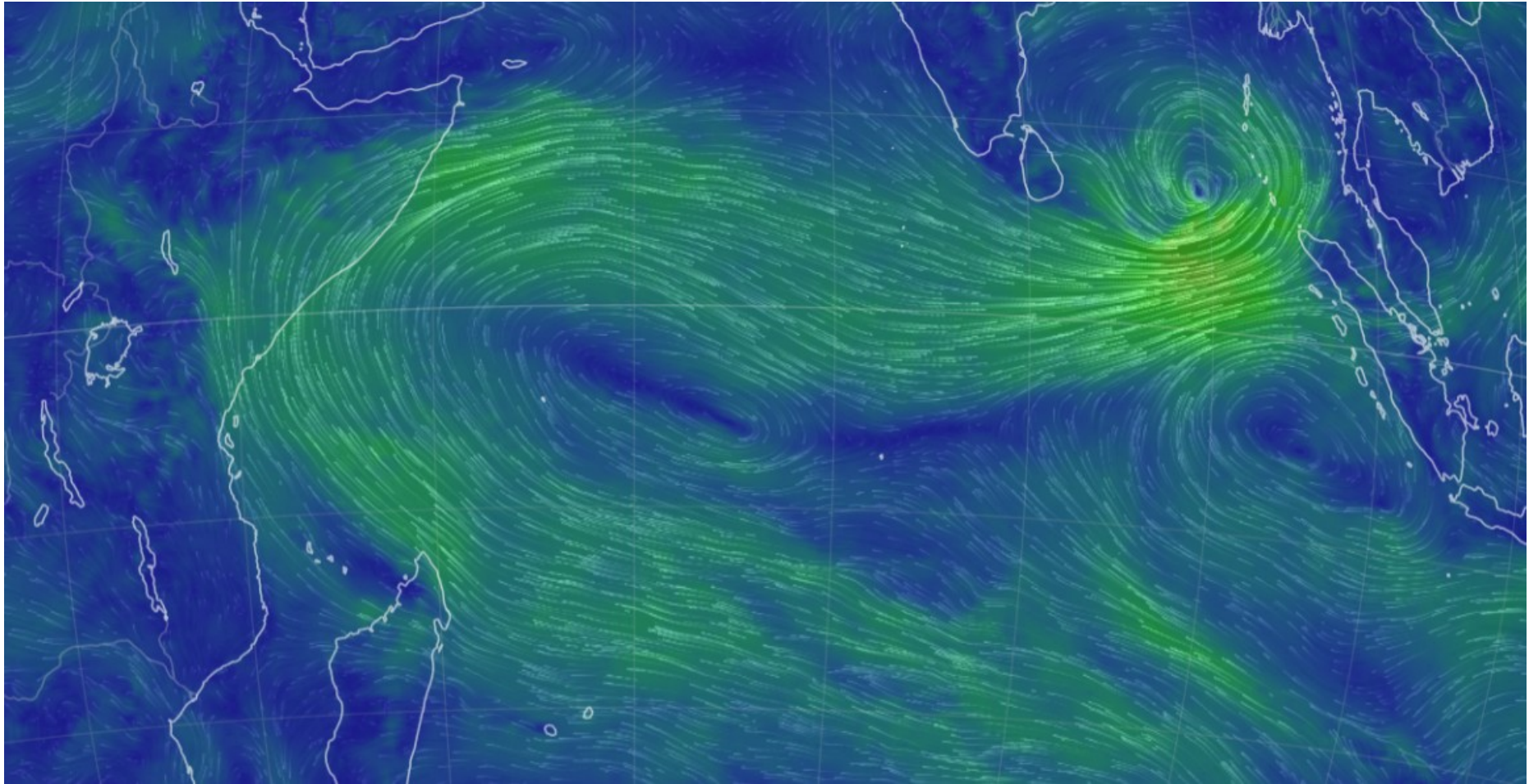
Pre-Genesis CHENESO



Source : <https://misva.aeris-data.fr/>

Step 1 : Large scale analysis

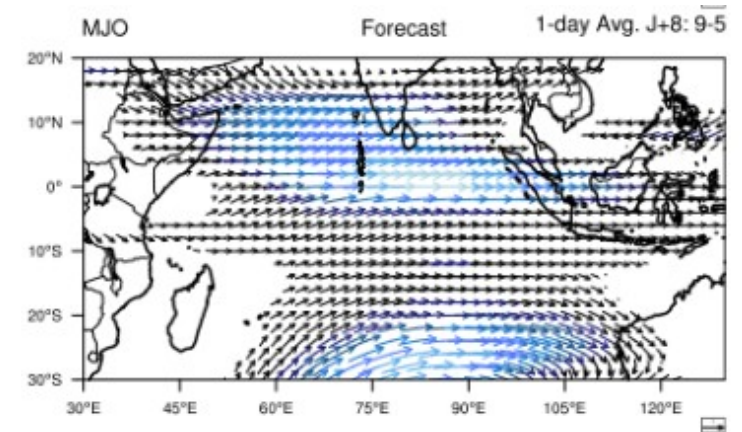
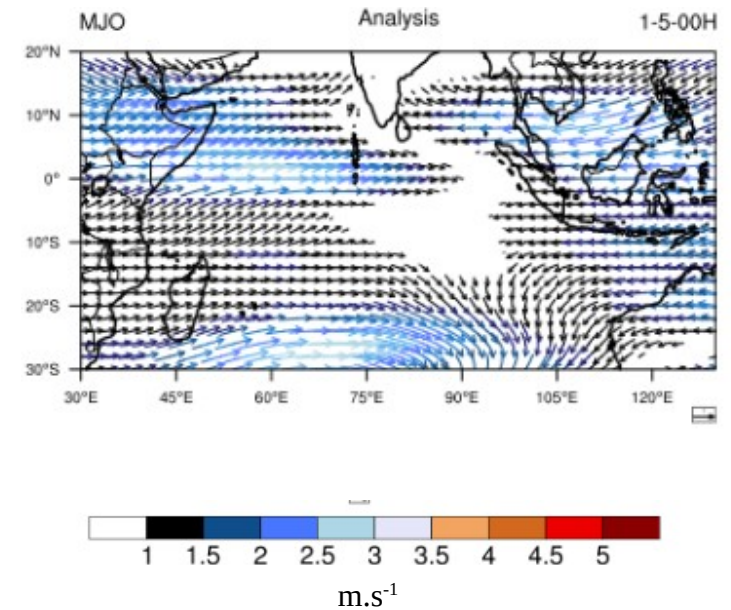
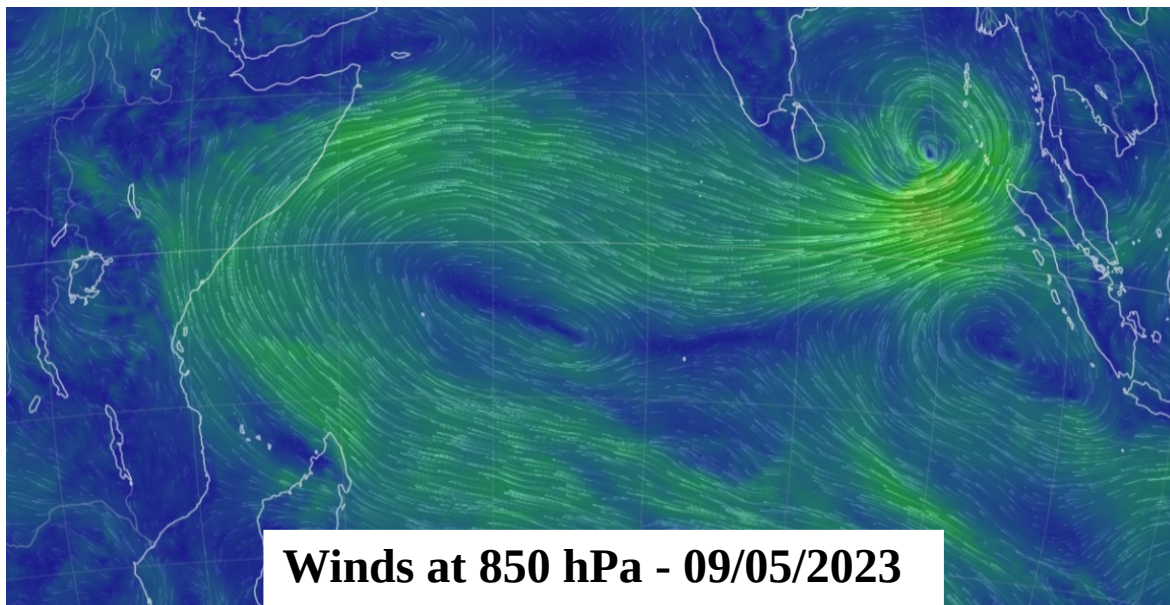
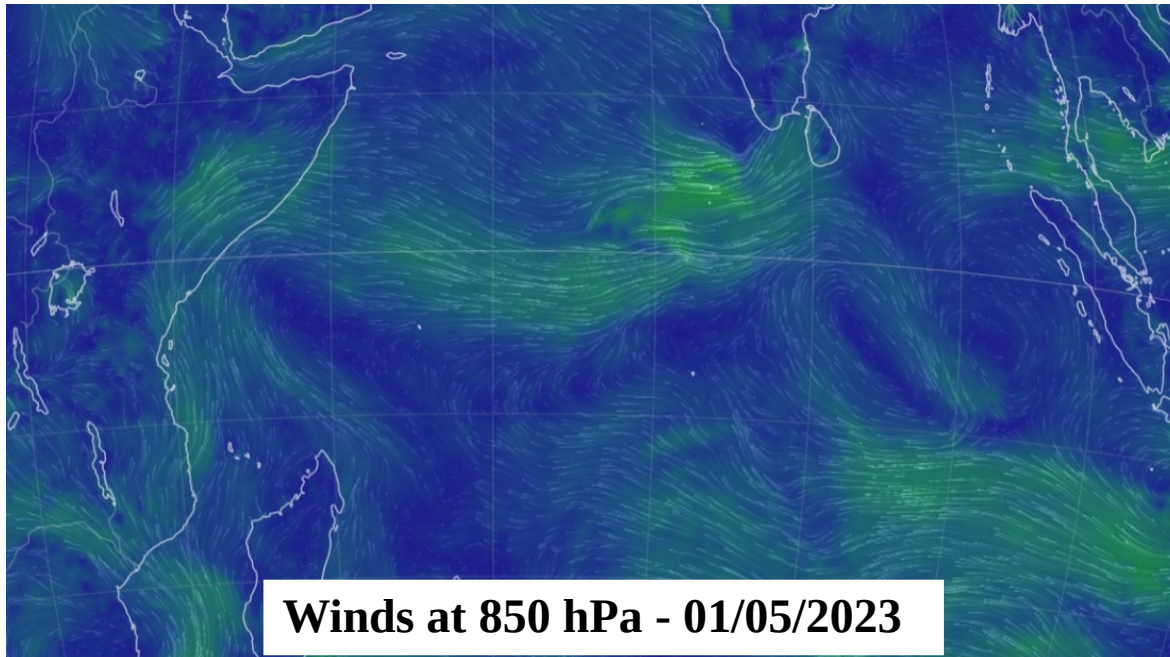
→ b : Bassin low levels wind pattern



Winds at 850 hPa - 09/05/2023

Step 1 : Large scale analysis

→ b : Bassin low levels wind pattern

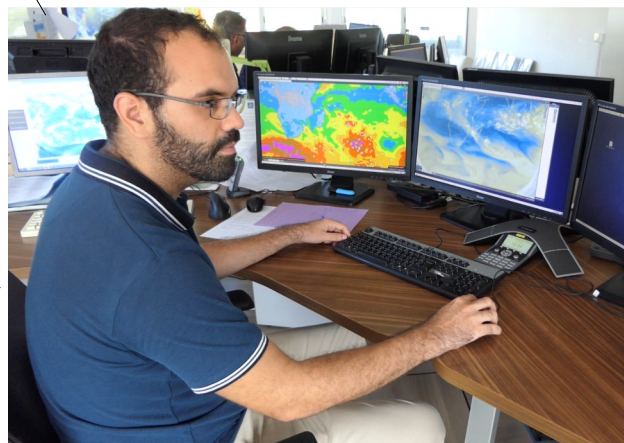
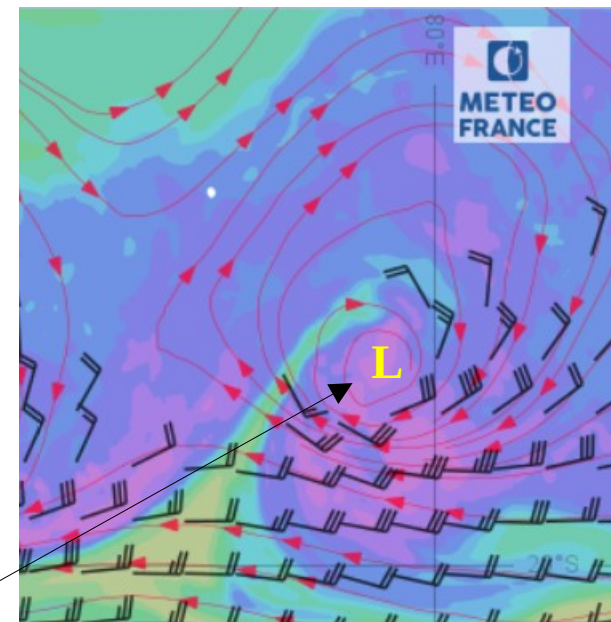
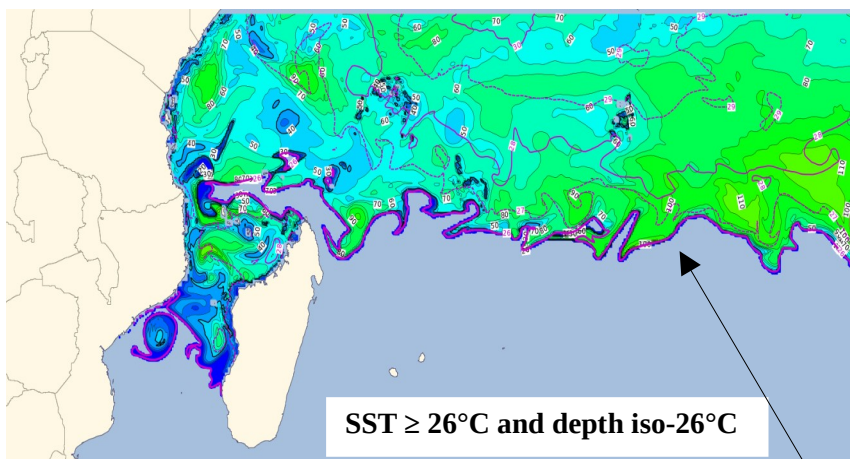


Step 2 :Synoptique scale analysis

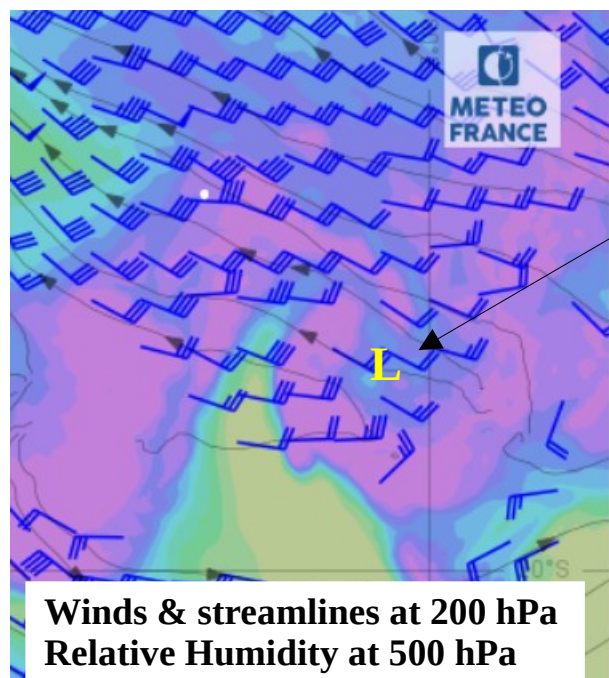
Necessary conditions for cyclogenesis (Gray, 1968) :

- ✓ Sufficient **ocean energy** [Sea Temp. > **26°C** over at least 60 m depth] } **Fuel**
- ✓ Generalized instability allowing deep convection } **Conductive**
- ✓ Mid-tropospheric humidity (700/400 hPa layer) } **atmospheric environment**
- ✓ Latitude > **5°** } **Conductive dynamical environment**
- ✓ Low vertical wind shear (**less than 15kt**) }
- ✓ Vorticity of low layers (precursor) } **Spark !**

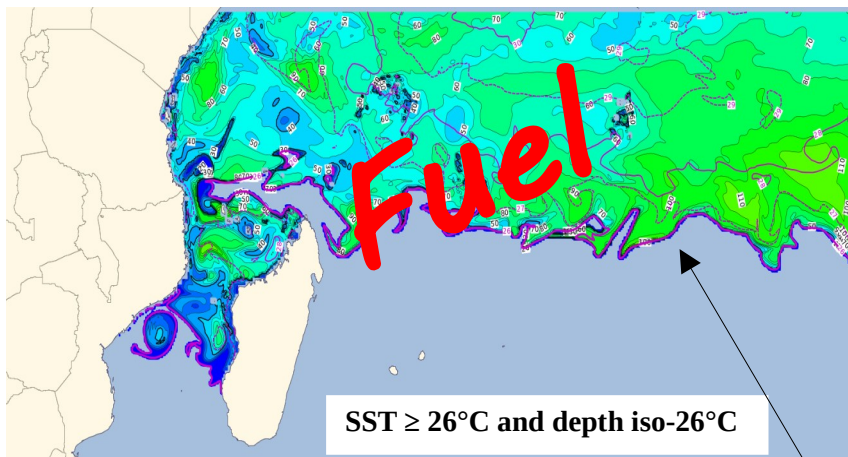
Step 2 :Synoptique scale analysis



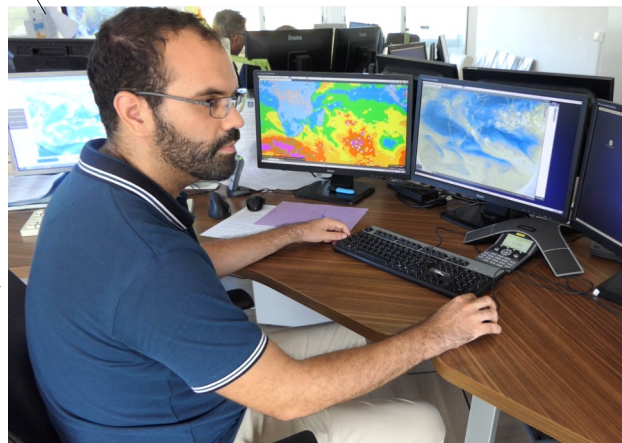
TC forecaster monitoring a suspect area



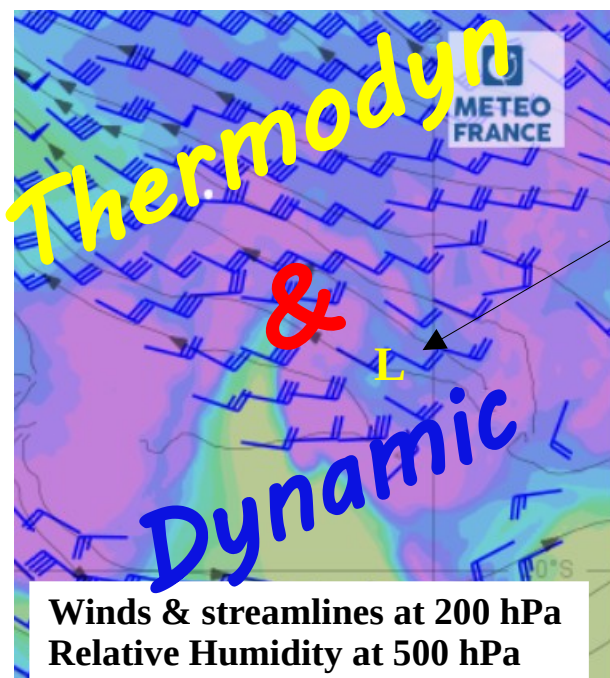
Step 2 :Synoptique scale analysis



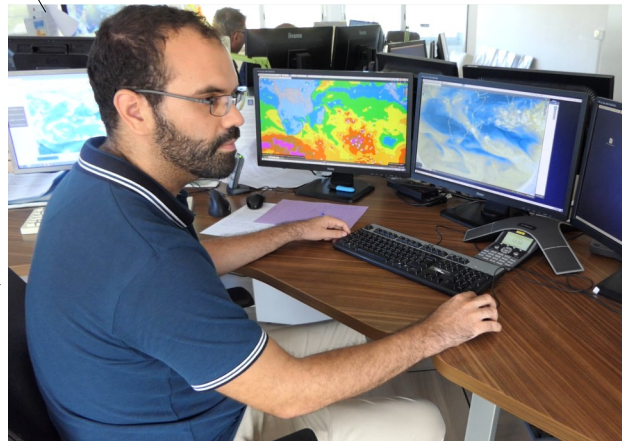
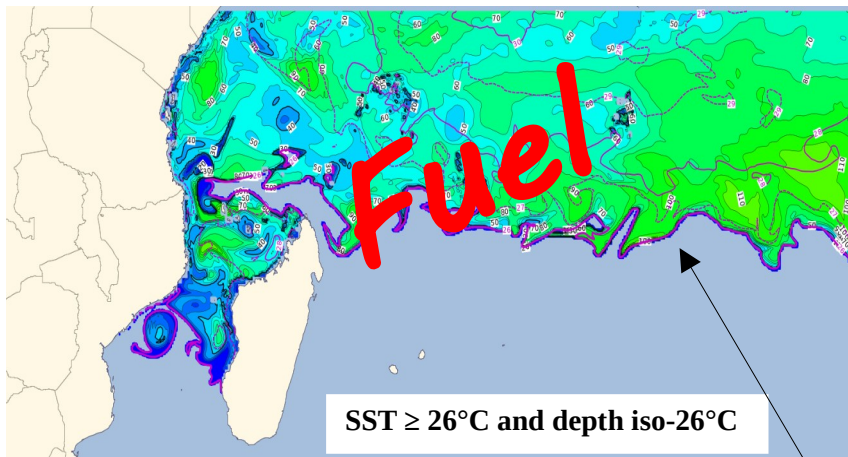
Winds & streamlines at 925 hPa
Relative Humidity at 700 hPa



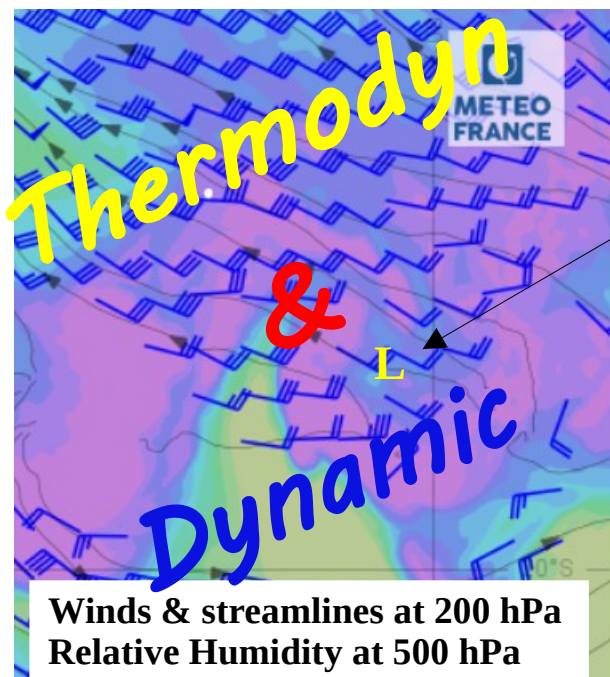
TC forecaster monitoring a suspect area



Step 2 :Synoptique scale analysis

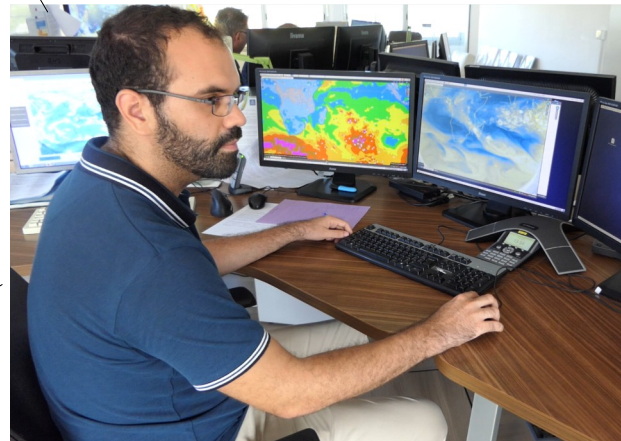
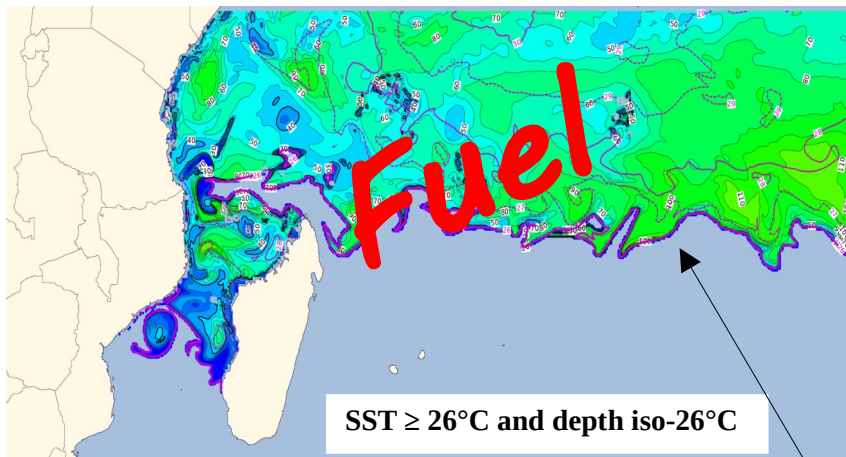


TC forecaster monitoring a suspect area

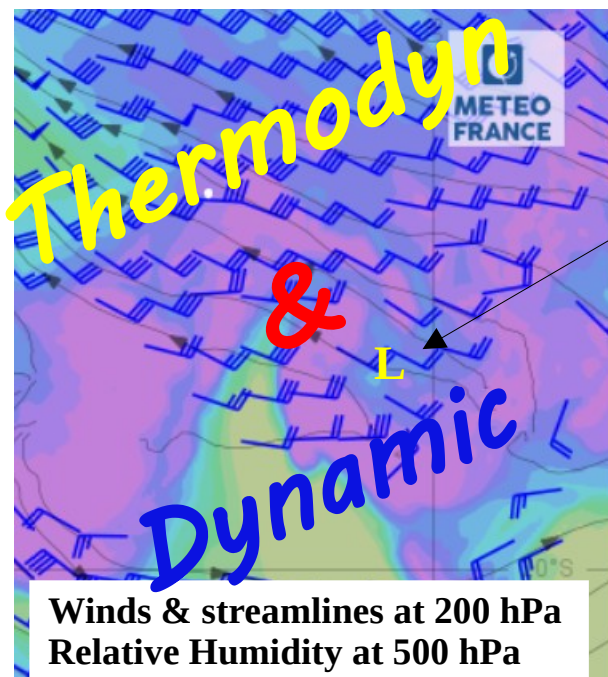


→ At this point, we **ONLY** look at environmental conditions whether or not the model develops the suspect area !

Step 2 :Synoptique scale analysis



TC forecaster monitoring a suspect area

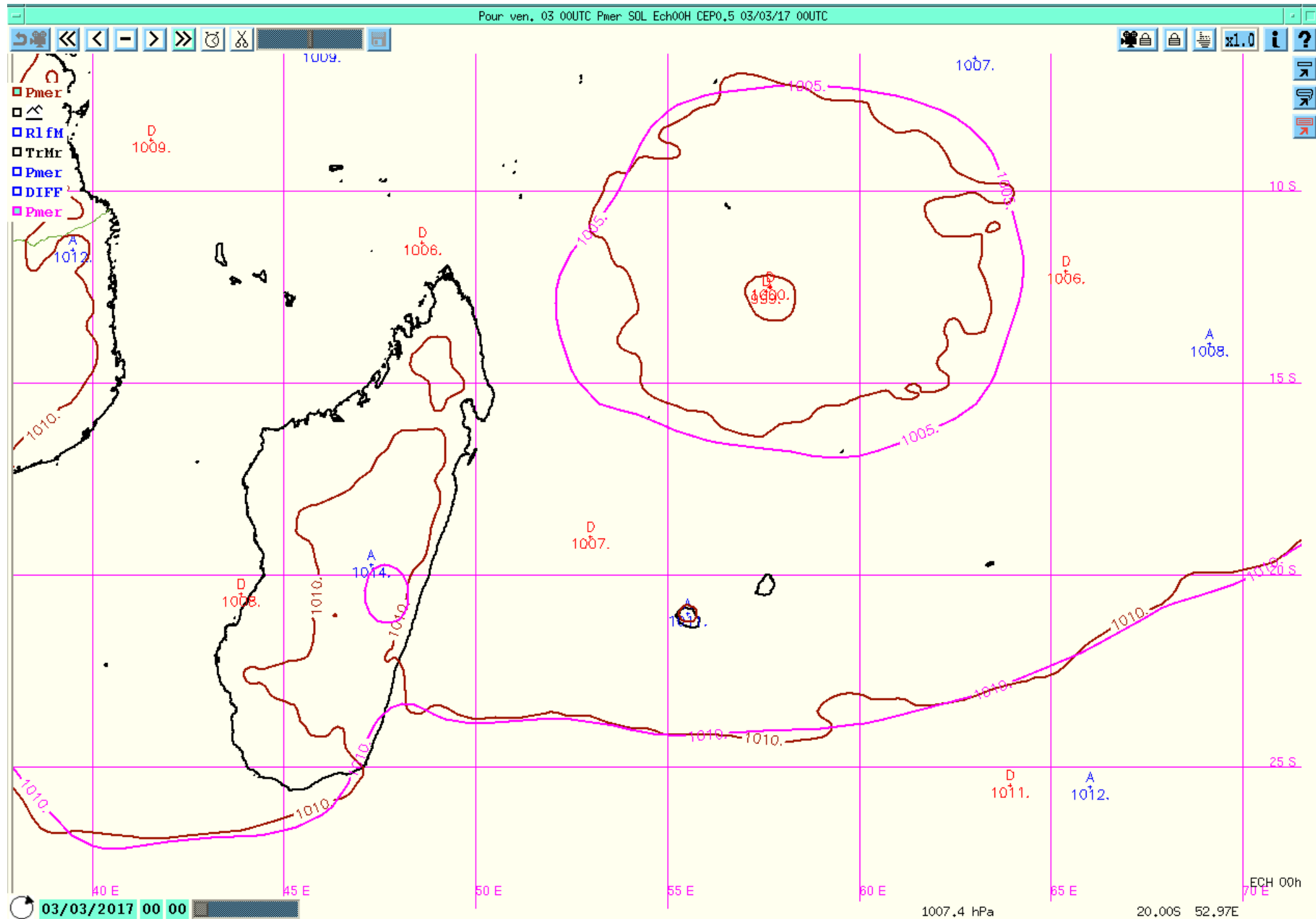


→ This analysis can be done with different available NWP models to assess the predictability of the Gray parameters



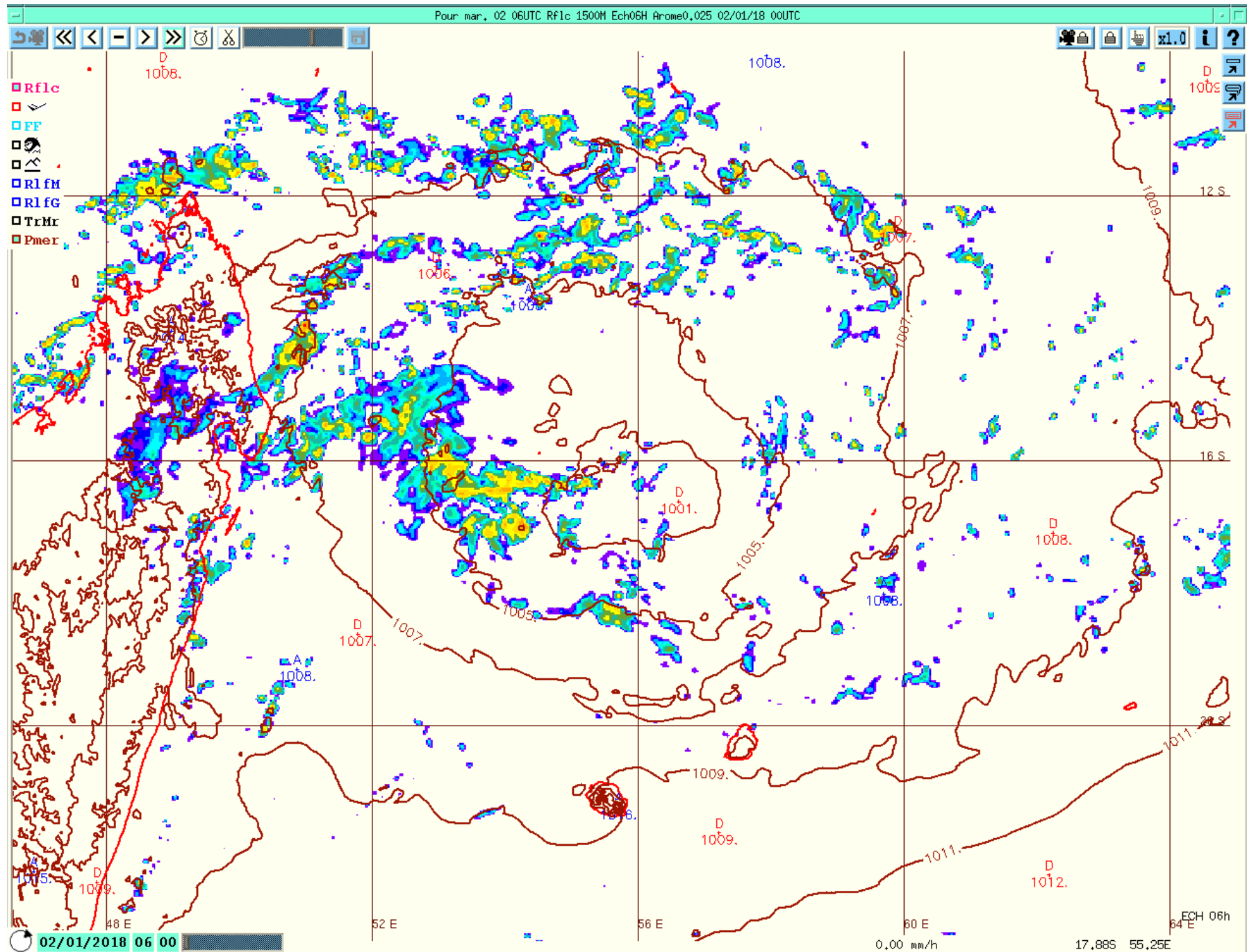
Global models used (fields received) : ECMWF, GFS, ARP, (UK)

Step 3 :Examination of available NWP models

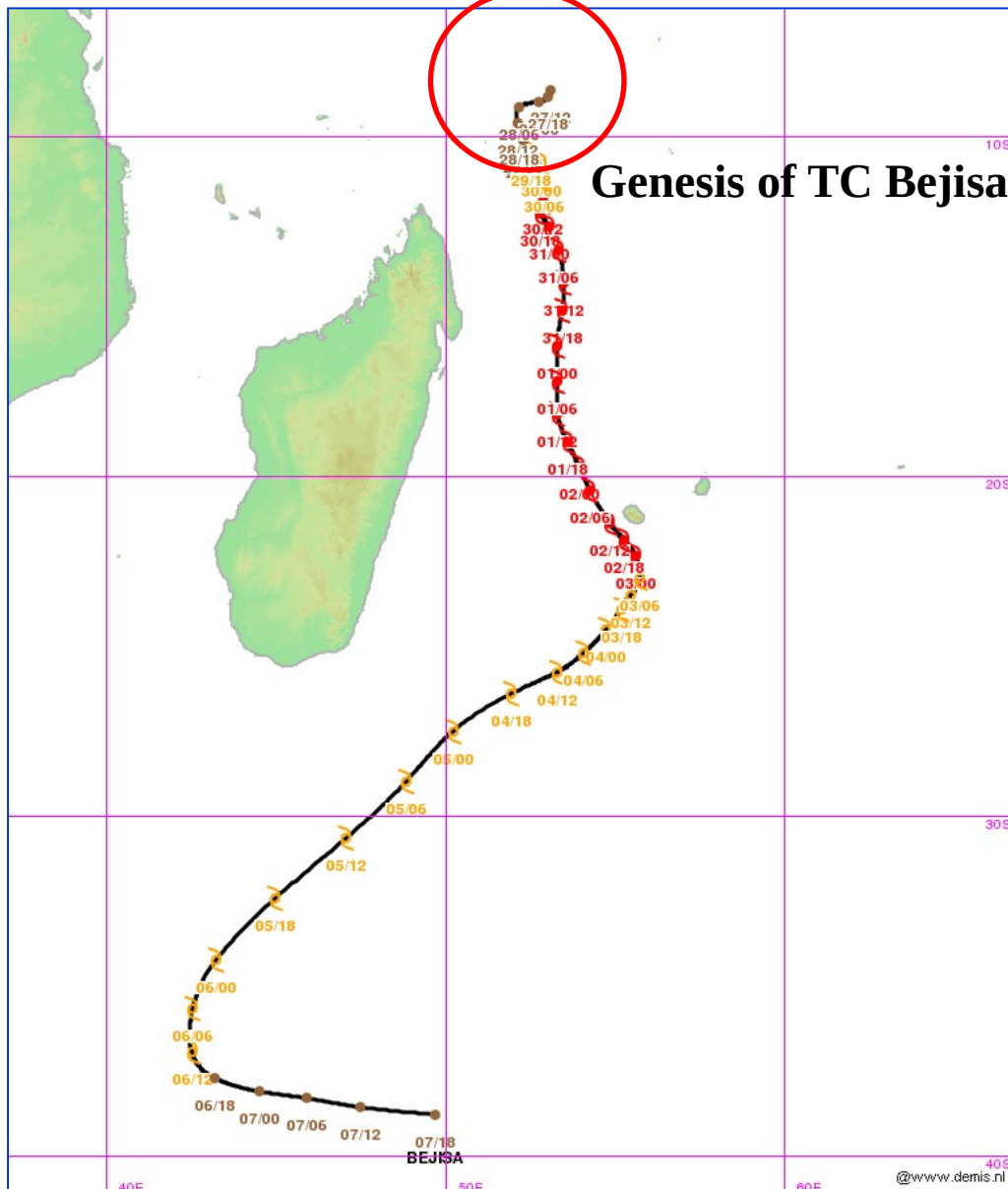


Step 3 :Examination of available NWP models

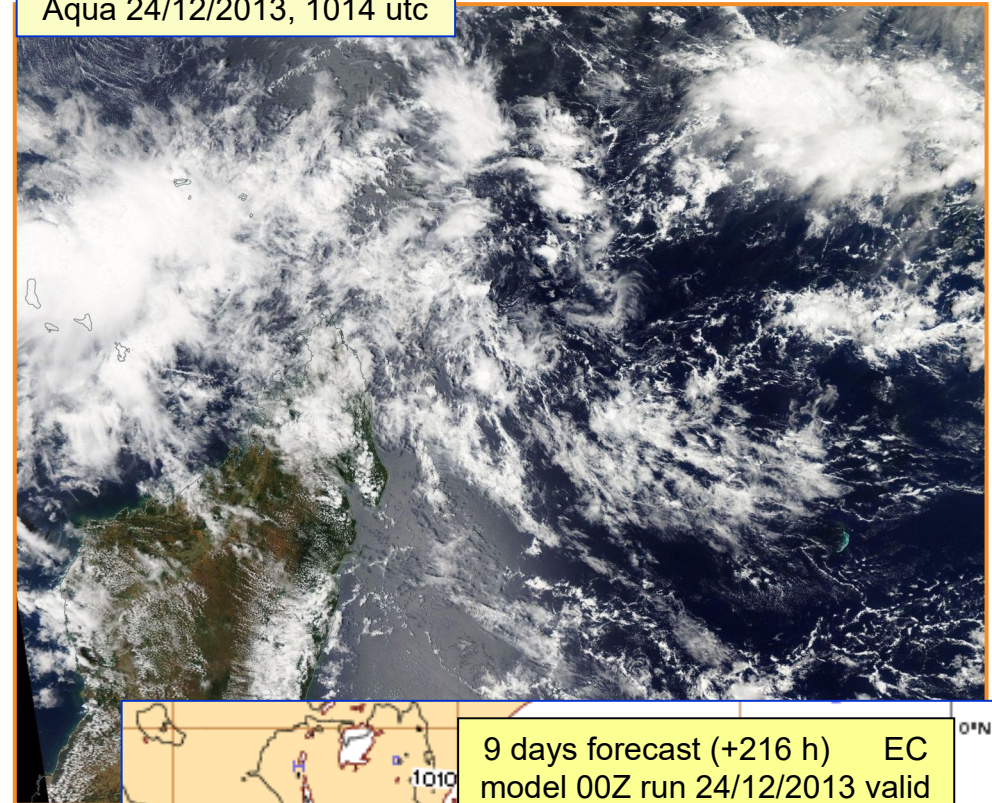
Regional model AROME IO



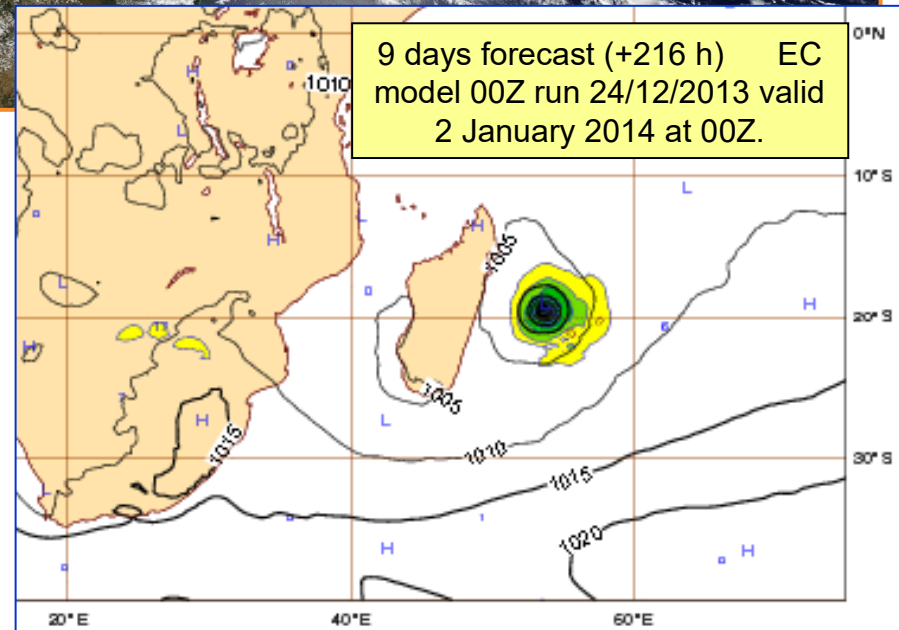
Performances of GFS and EC models : cyclogeneses forecasts over SWIO Previous success in the early 2010's



Aqua 24/12/2013, 1014 utc



9 days forecast (+216 h) EC
model 00Z run 24/12/2013 valid
2 January 2014 at 00Z.



Performances of GFS and EC models : cyclogenesis forecasts over SWIO

➤ Mitigated performances

✓ **Virtually no misses**

(some occasions of no detection for short lived and small size storms - ex : TS 09-20222023)

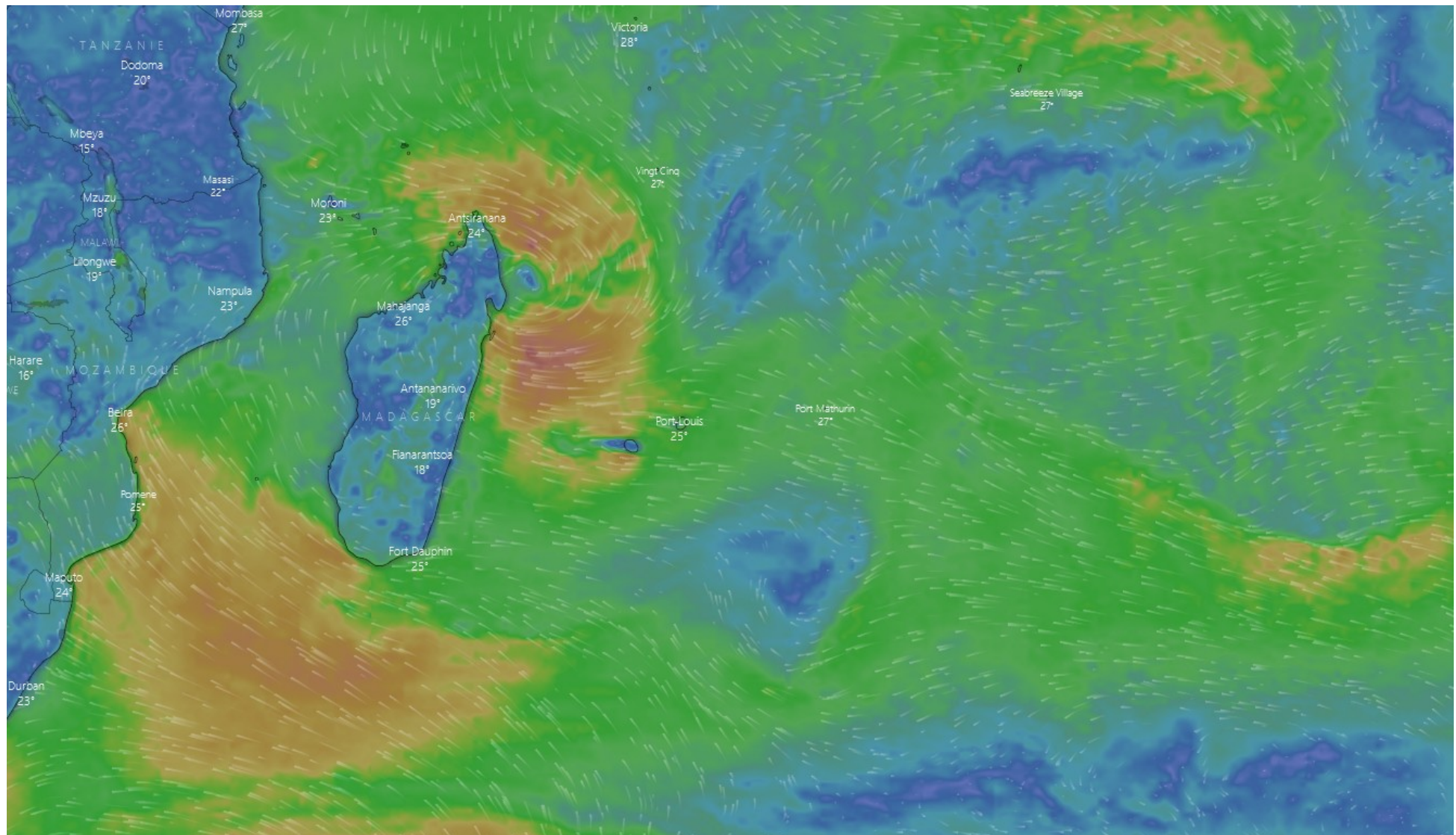
✓ **But quite a significant number of false alarms** (spurious vortices developed)

✓ **Especially so for the GFS model which is far too aggressive in developing and deepening lows beyond 4/5 days**

✓ **Opposite bias for the EC model : too mild and often labouring to spin up or deepen low circulations specially at short range (2021-2022 version of the EC model)**

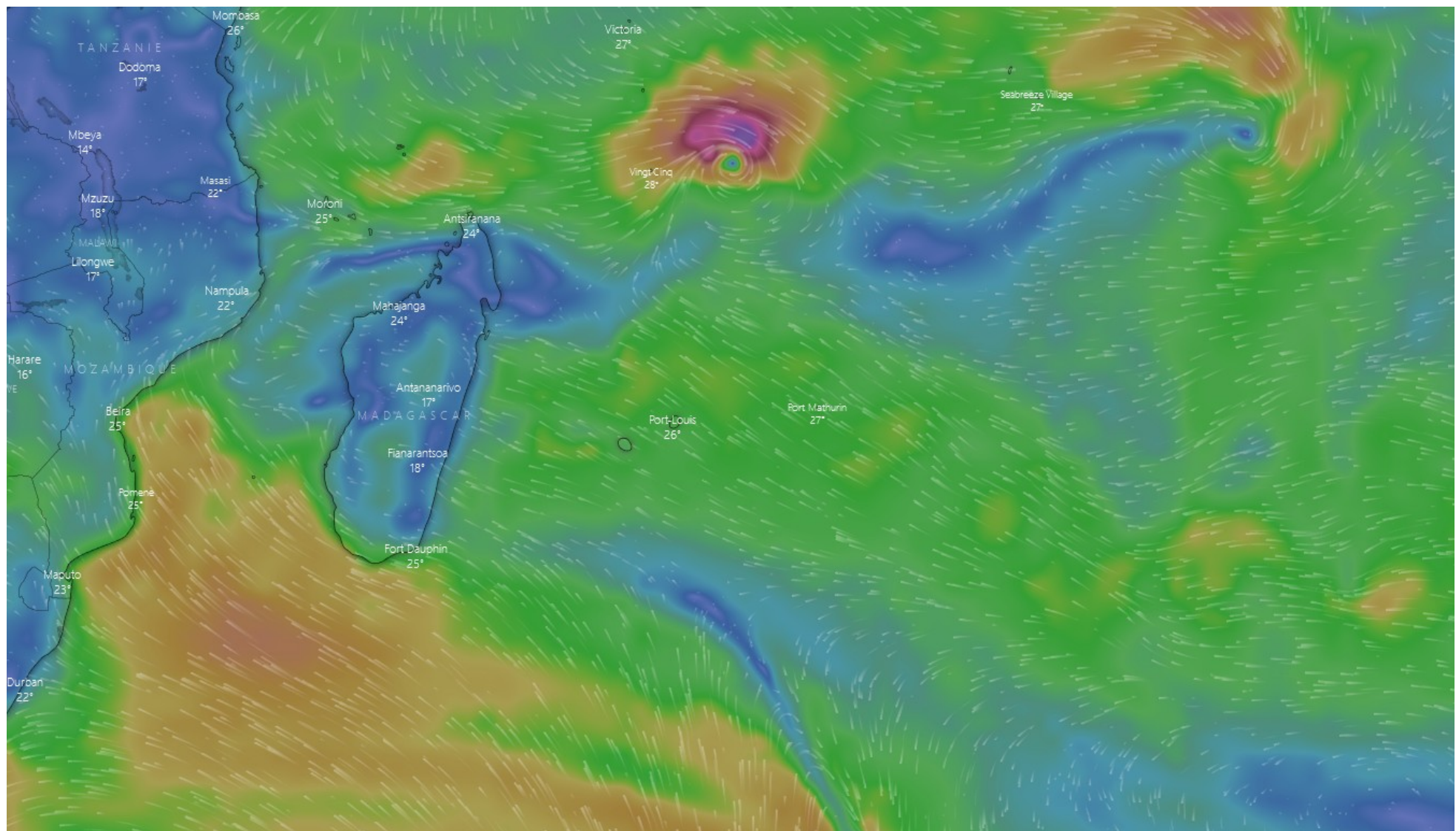
✓ **Consistency from run to run not always there**

Performances of the models : cyclogeneses forecasts



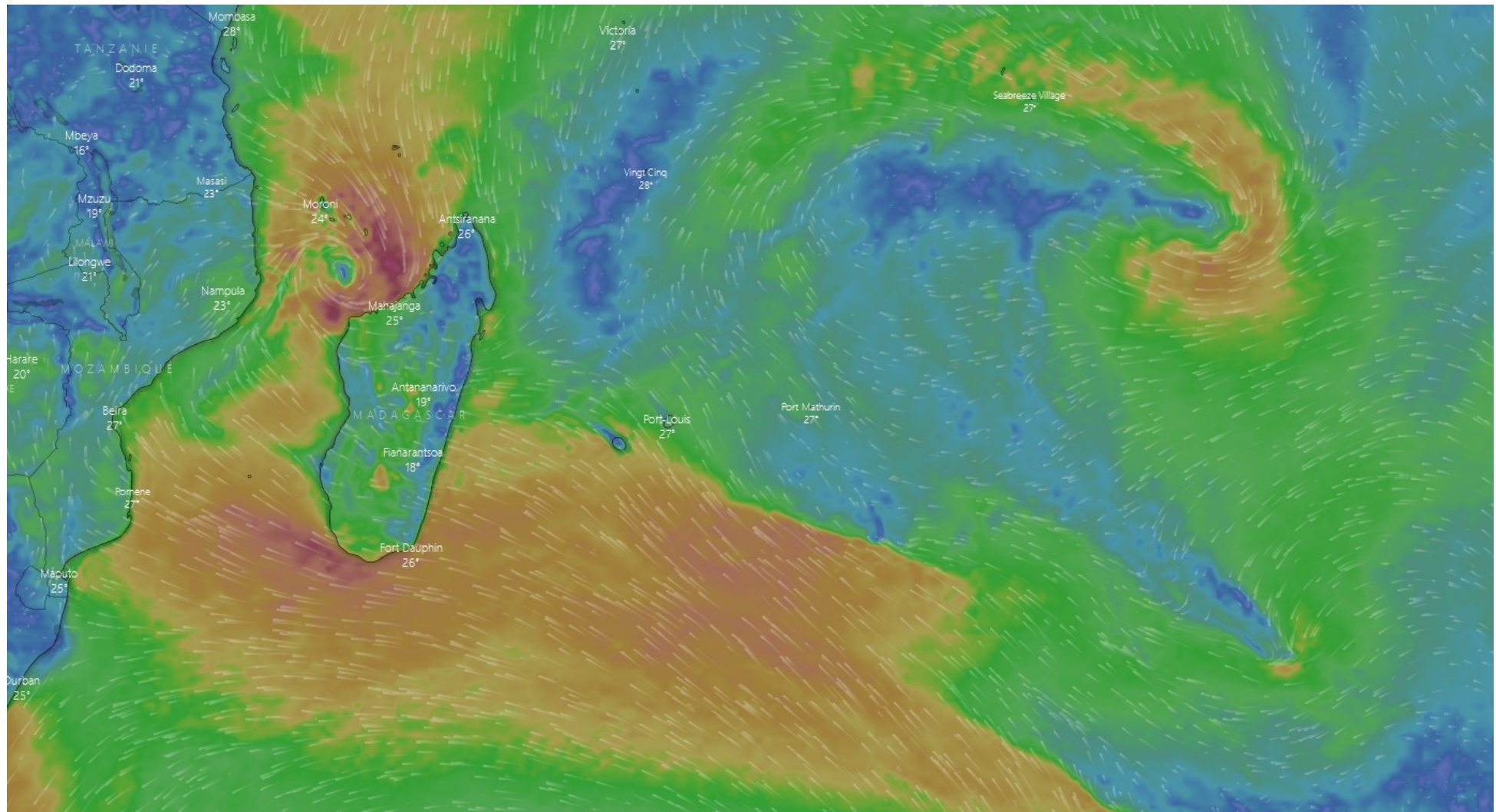
IFS 18/01/2022 at 00Z
valid 23/01/2022 at 00Z
(+120h)

Performances of the models : cyclogeneses forecasts



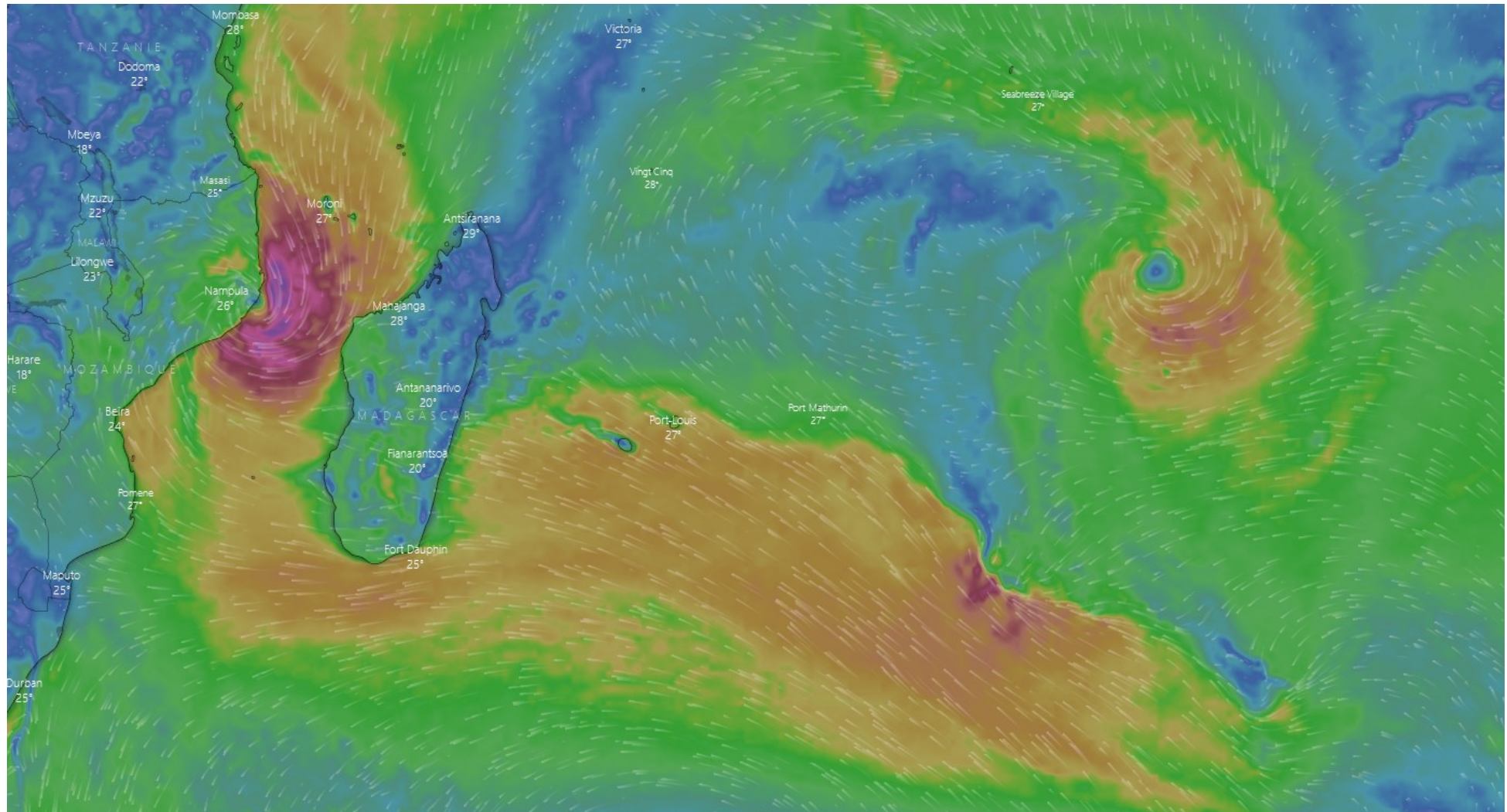
GFS 18/01/2022 at 00Z
valid 23/01/2022 at 00Z
(+120h)

Performances of the models : cyclogeneses forecasts



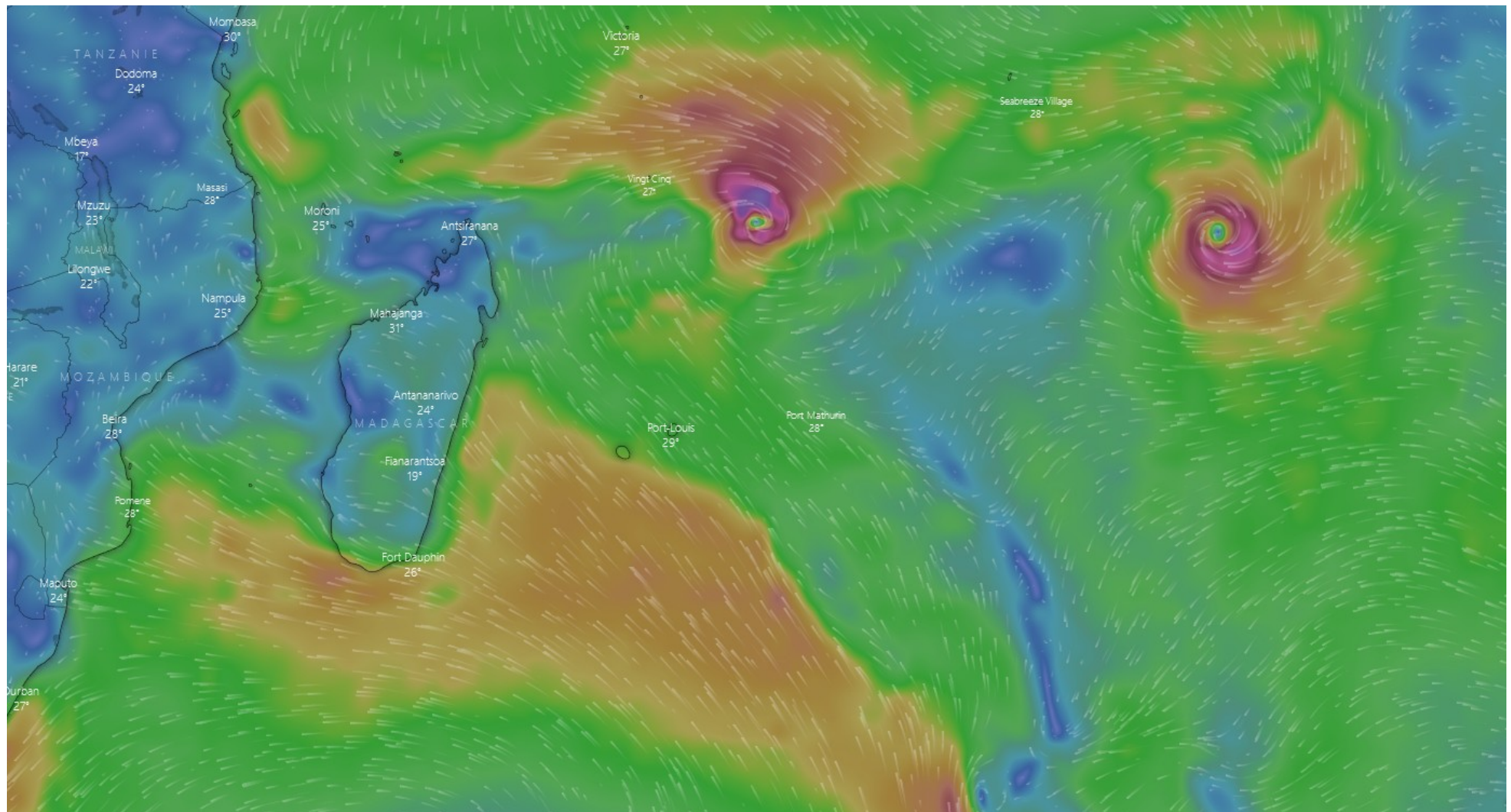
IFS 18/01/2022 at 00Z
valid 24/01/2022 at 12Z
(+156h)

Performances of the models : cyclogeneses forecasts



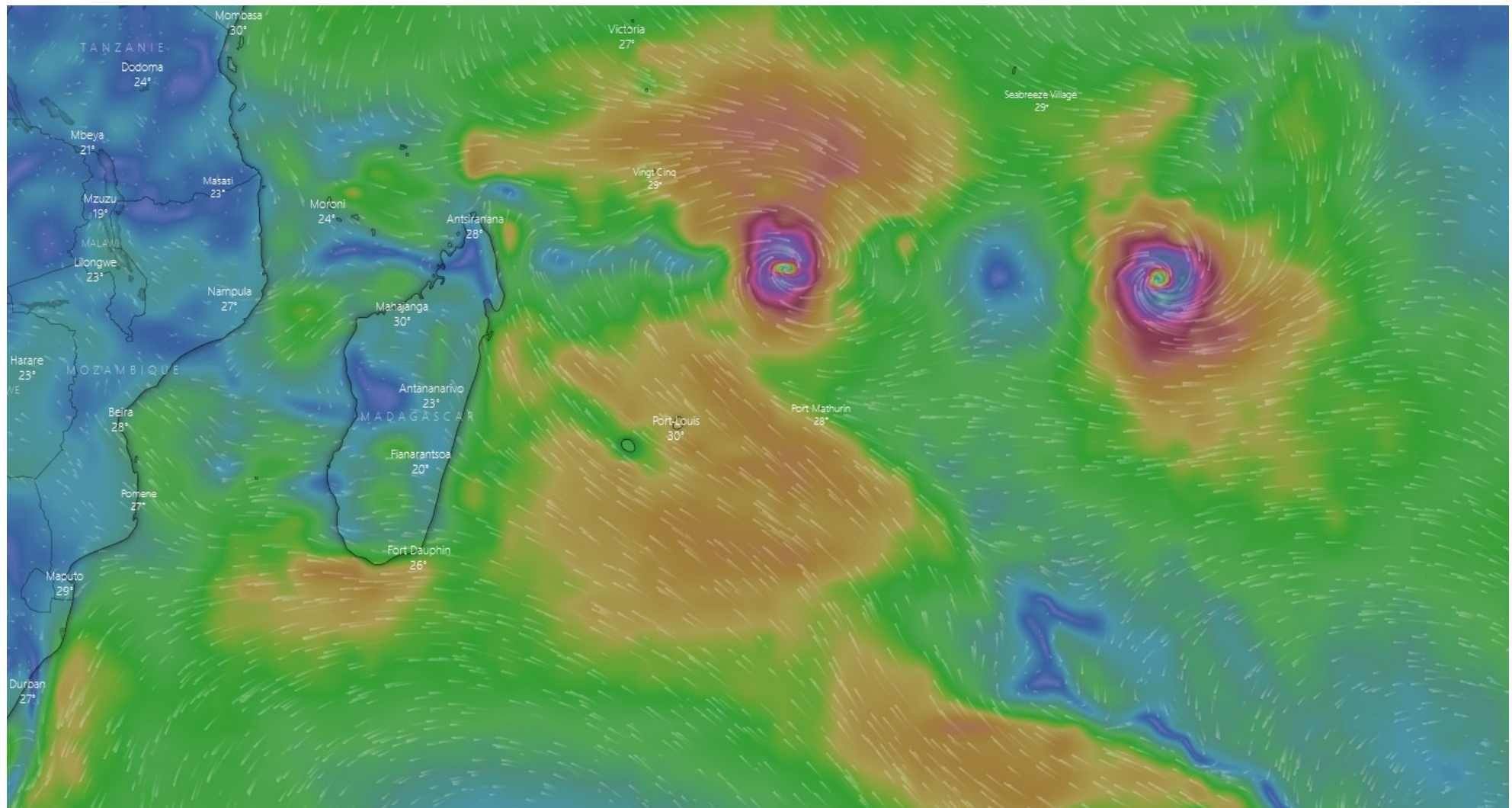
IFS 18/01/2022 at 00Z
valid 25/01/2022 at 12Z
(+180h)

Performances of the models : cyclogeneses forecasts



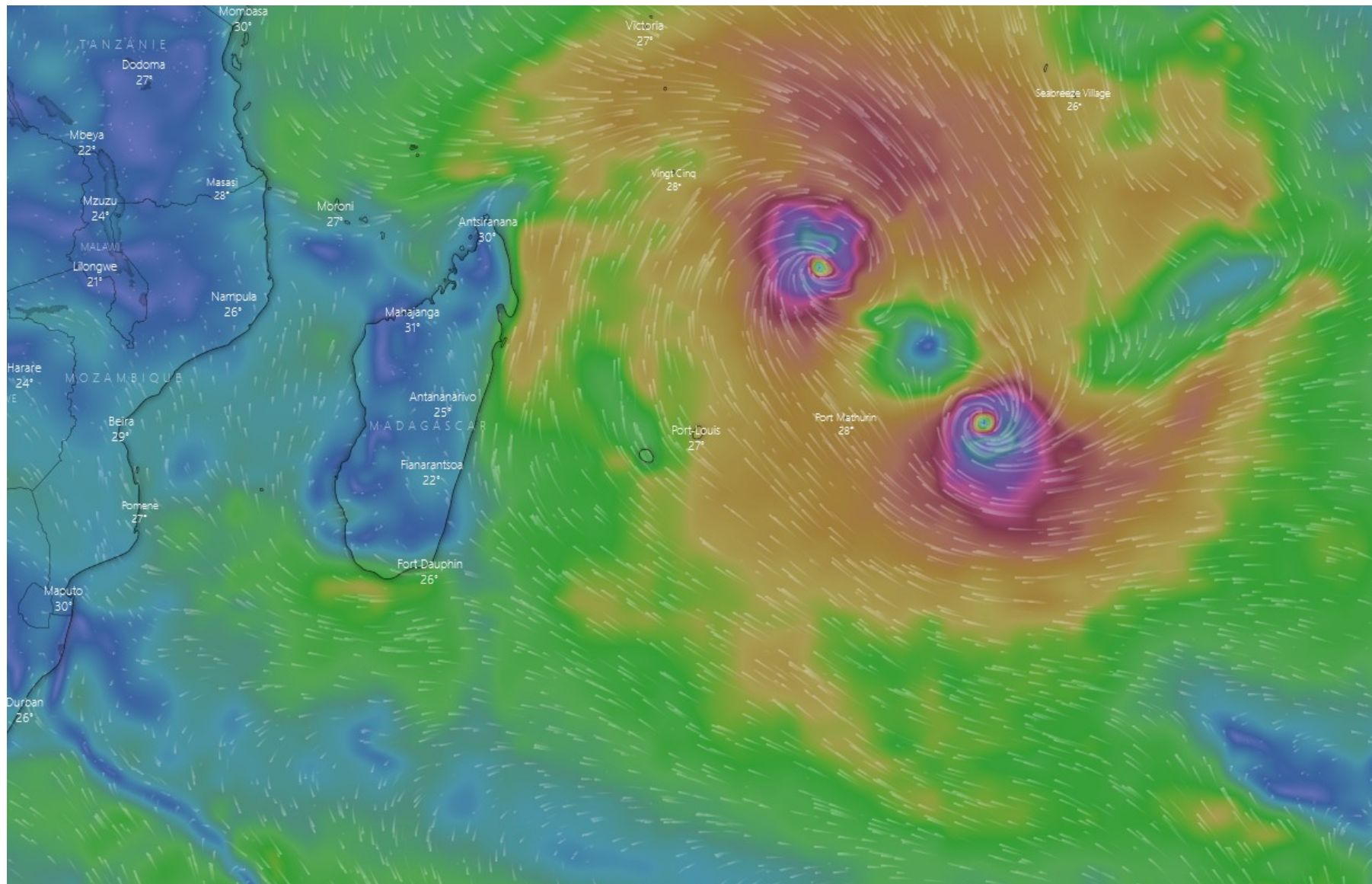
GFS 18/01/2022 at 00Z
valid 24/01/2022 at 12Z
(+156h)

Performances of the models : cyclogeneses forecasts



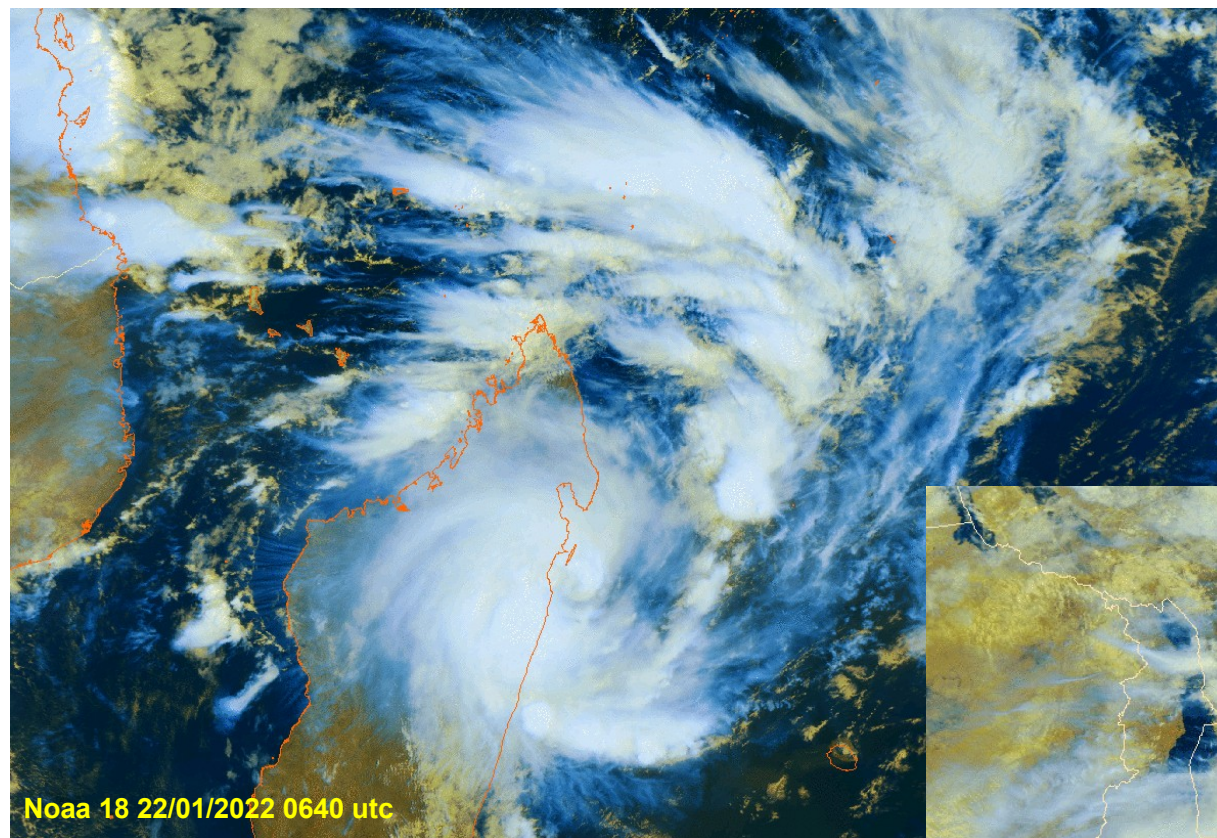
GFS 18/01/2022 at 00Z
valid 25/01/2022 at 12Z
(+180h)

Performances of the models : cyclogeneses forecasts

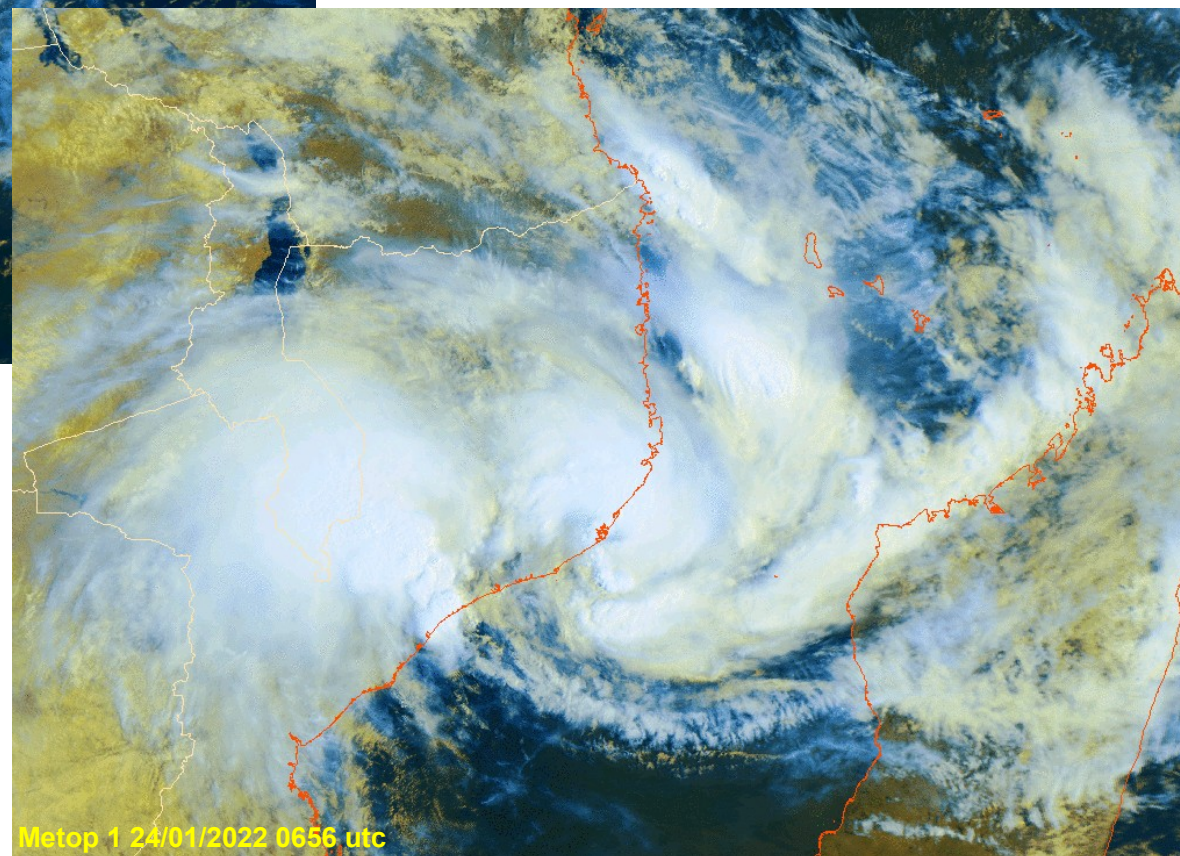


GFS 18/01/2022 at 00Z
valid 27/01/2022 at 12Z
(+228h)

Performances of the models : cyclogeneses forecasts

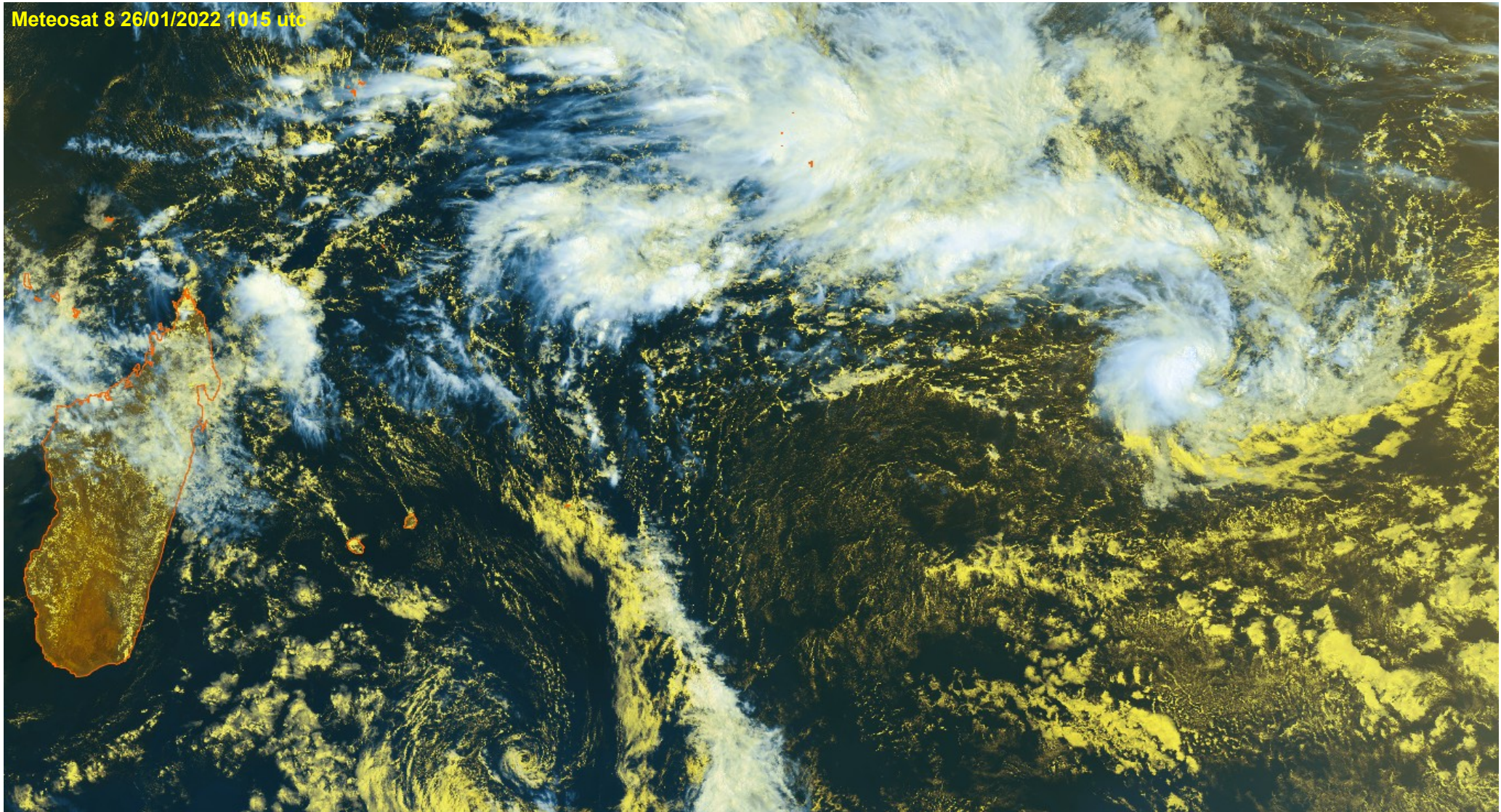


**Tropical Storm
ANA**



Performances of the models : cyclogeneses forecasts

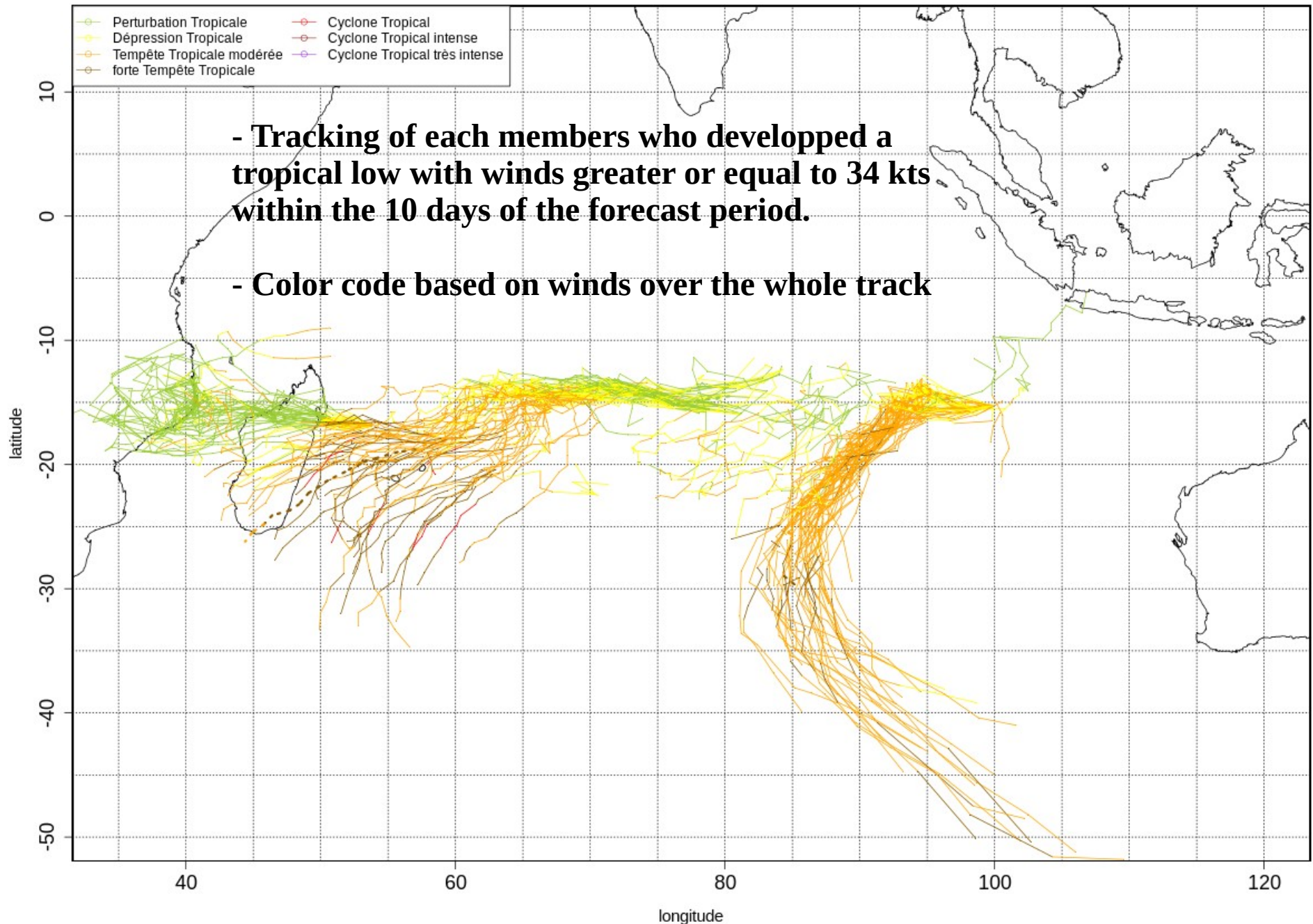
Meteosat 8 26/01/2022 1015 utc



**Cyclogenesis of
BATSIRAI**

Step 4 :Examination of available ensemble forecast

réseau EPS du 2022-02-14 12:00:00 système(s) d'intensité ≥ 34 kt



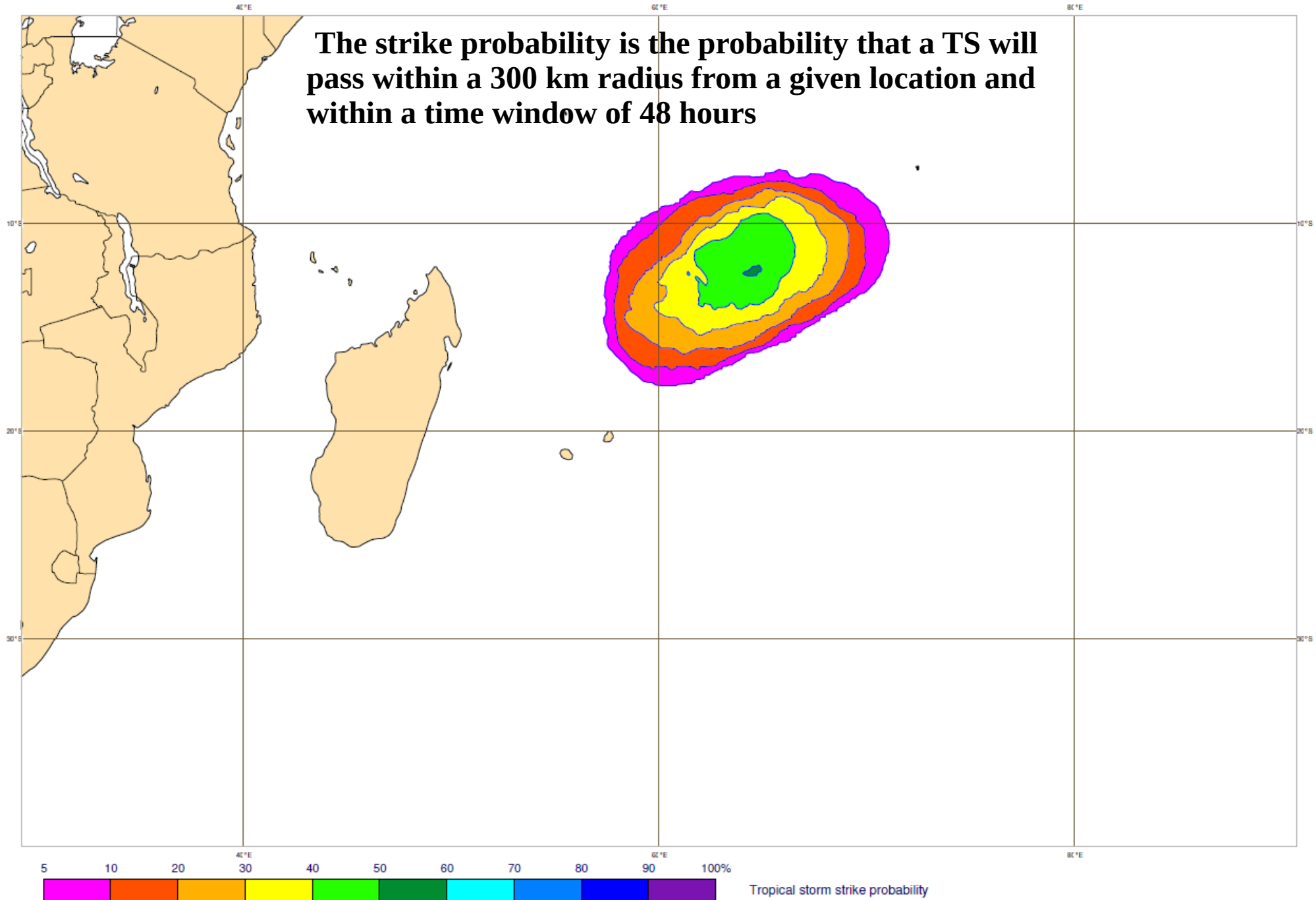
Source : internal MF

Step 4 :Examination of available ensemble forecast

Tropical cyclone activity (Including genesis) - Tuesday 26 Dec 2017, 00 UTC VT Monday 1 Jan 2018, 00 UTC Step 144

© ECMWF 2017

The strike probability is the probability that a TS will pass within a 300 km radius from a given location and within a time window of 48 hours

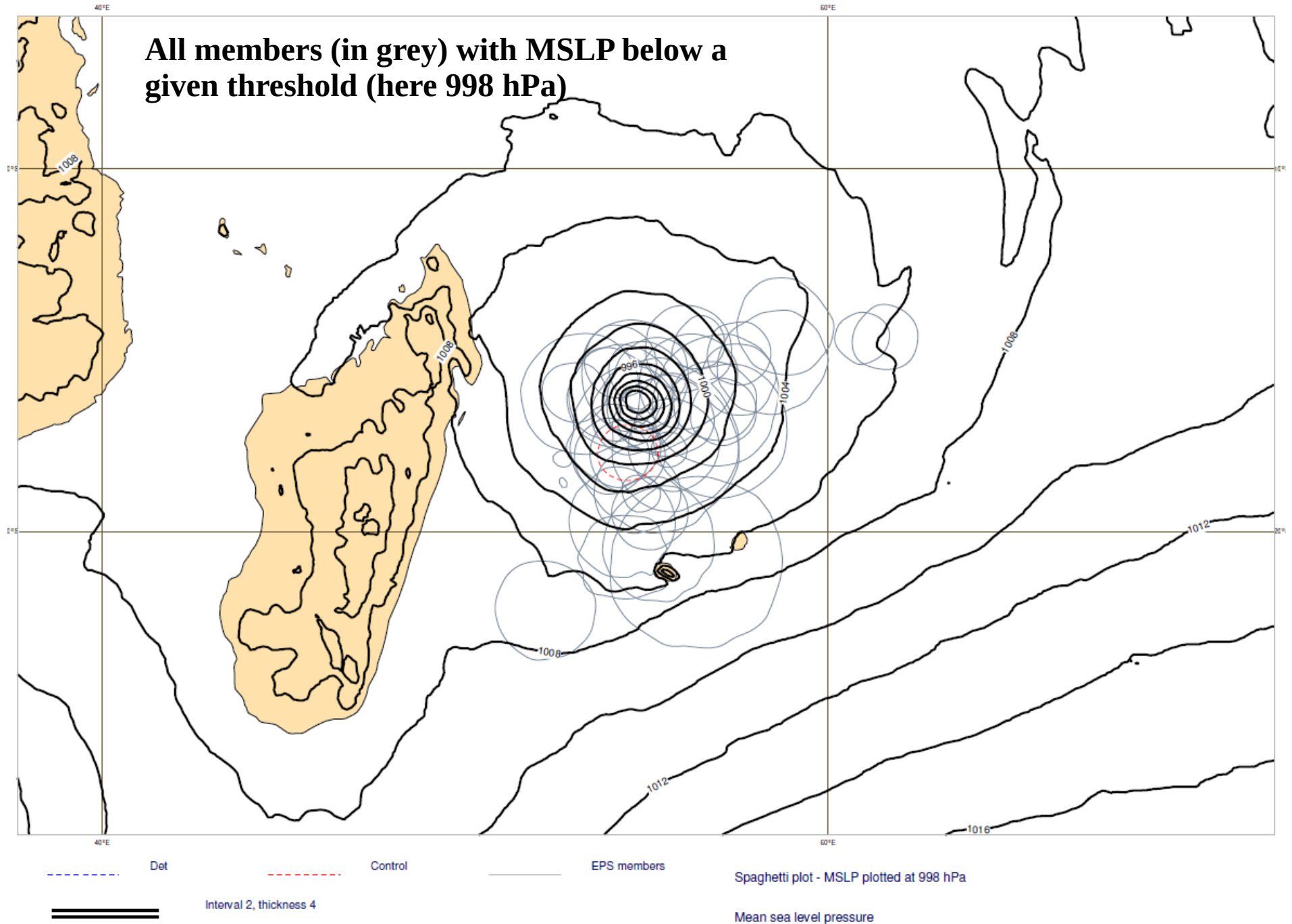


Source : ECMWF

Step 4 : Examination of available ensemble forecast

Thursday 28 Dec 2017, 00 UTC VT Wednesday 3 Jan 2018, 00 UTC Step 144

© ECMWF 2017



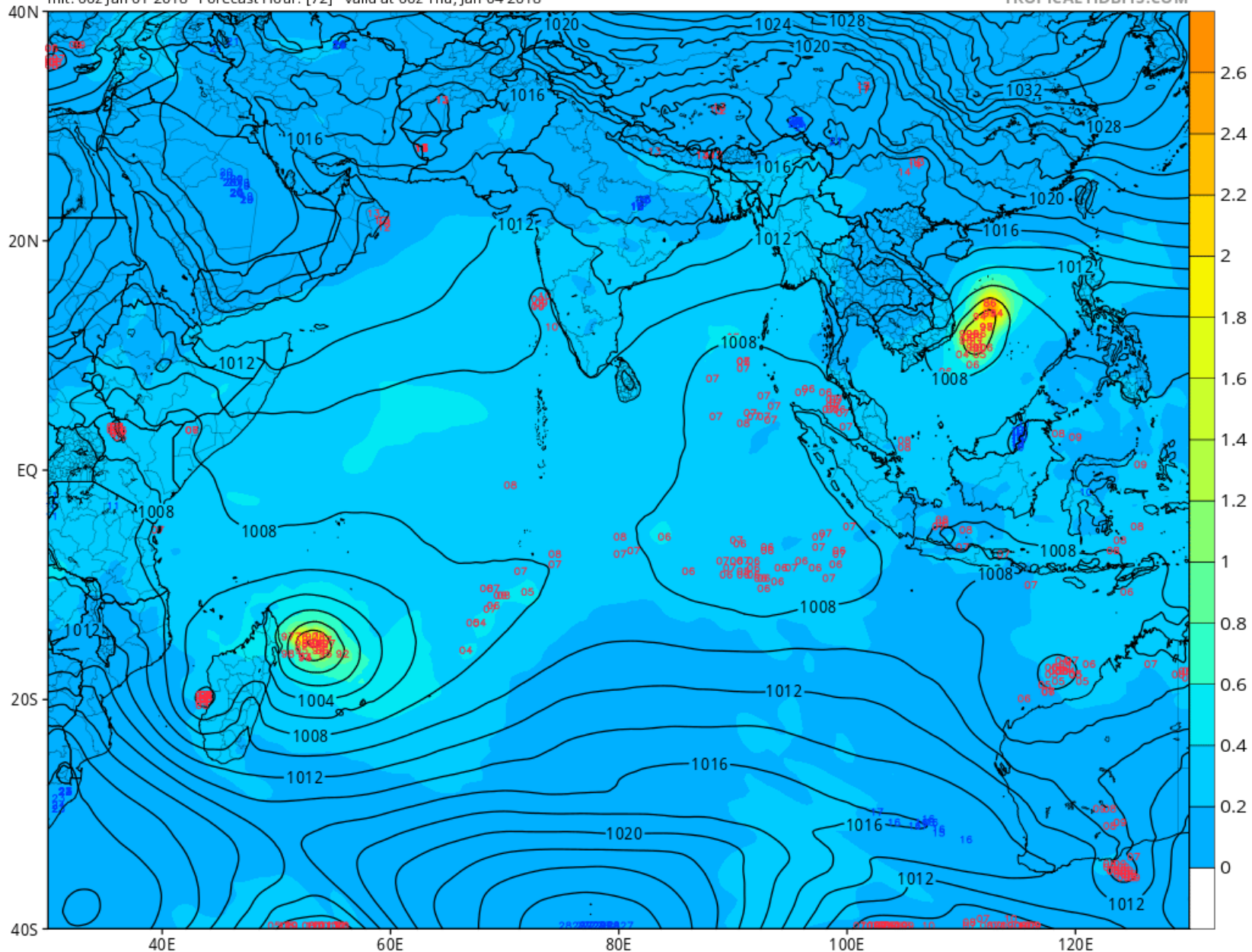
Source : ECMWF

Step 4 :Examination of available ensemble forecast

GEFS Mean MSLP (mb), Ensemble Member Pressure Centers (Lows: red | Highs: blue), & Normalized Spread (σ)

Init: 00z Jan 01 2018 Forecast Hour: [72] valid at 00z Thu, Jan 04 2018

TROPICALTIDBITS.COM



Tropical Cyclone Genesis forecast at RSMC La Reunion



II) RSMC's products regards TCG

Daily ITCZ bulletin issued at 12Z

AWIO20 FMEE (english) or AWIO21 FMEE (french)

DATE: 2023/05/11 AT 1200 UTC

PART 1:
WARNING SUMMARY:

Nil.

PART 2 :
TROPICAL WEATHER DISCUSSION:

The basin is in a Near-Equatorial Trough (NET) configuration that extends over most of the basin, between 2 and 6°S. Convective activity is moderate to strong in the eastern part of the NET, around a low-pressure system currently in the Indonesian zone, east of 90E. In a favorable large-scale context (humid MJO phase, presence of MRG/Rossby wave and the arrival of a westerly surge linked to a Kelvin wave), a cyclogenesis is possible.

East of the basin :

A large elongated circulation is currently present around 4S 92E in the Indonesian area as shown by the latest observations (notably, the 2356Z HY-2B pass and 0735Z AMSR2) but no well-defined center is currently present.

Over the next few days, this circulation should enter our area of responsibility. Environmental conditions will also improve with the strengthening of the convergence on the equatorial side as MOCHA moves northward in the other hemisphere from Saturday. To a lesser extent, the polar trade winds should also strengthen over the weekend. Although currently experiencing northeasterly upper shear, this system could be in a weakly sheared area between 5 and 10S by early next week, thus favoring a development of this minimum.

Among the deterministic models, as is often the case, GFS is the most reactive, proposing a storm as early as Sunday, while CEP suggests a slower development accelerating early next week. Their ensemble models reflect the same trends. However, other models such as Arpege or UKMO are not significantly developing this system at the moment, probably due to a weaker equatorial convergence.

The probability for the formation of a tropical storm over the east of the basin becomes very low on Saturday, low on Sunday and moderate from Monday.

Large scale discussion related to basin configuration with occasionally some details on the equatorial waves context (ref. step 1)

Discussion on a specific suspect area (on going or forecast to develop within the next 5 days)

Several suspect areas imply several discussion

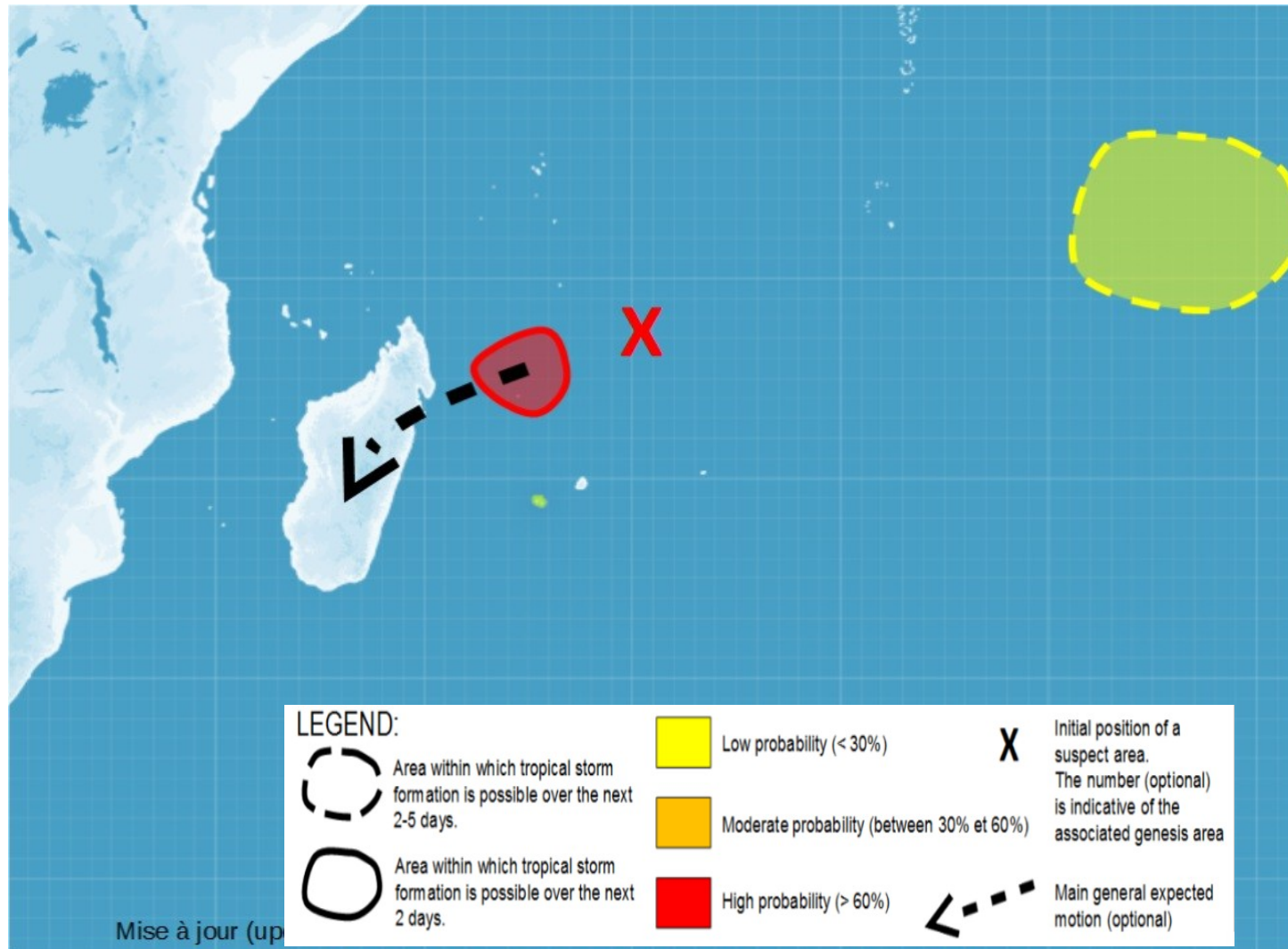
Probabilities of formation of a MTS within the next 5 days associated with the given suspect area

NOTA BENE: The likelihood is an estimate of the chance of the genesis of a moderate tropical storm over the basin and within the next five days:

Very low:	less than 10%	Moderate:	30% to 60%	Very high:	over 90%
Low:	10% to 30%	High:	60% to 90%		



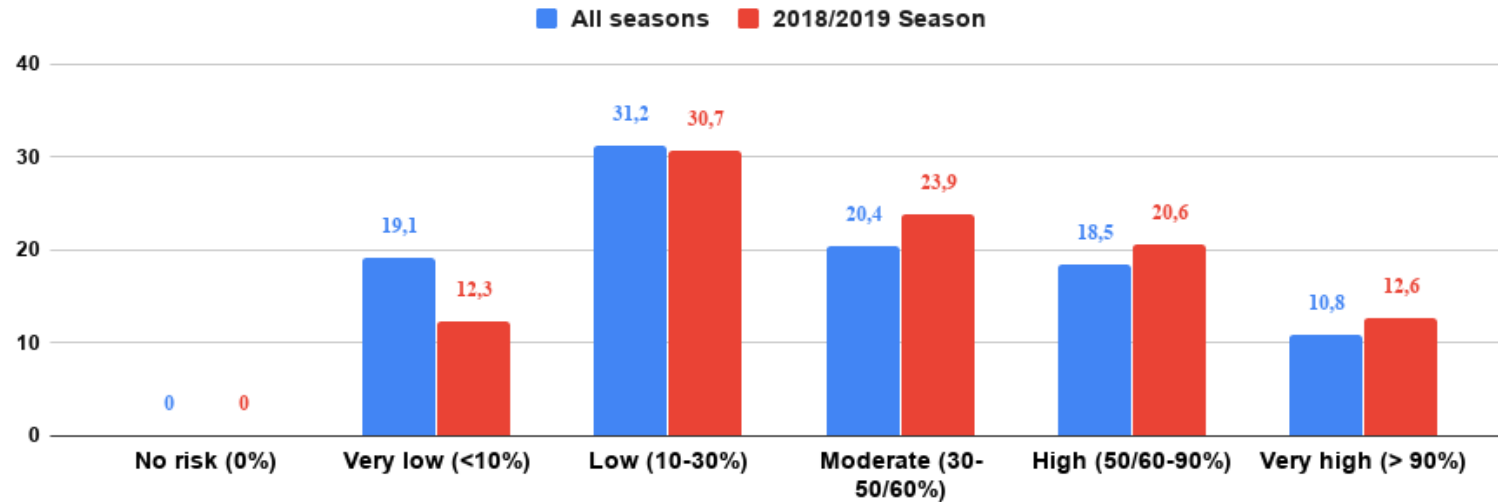
Cyclogenesis map



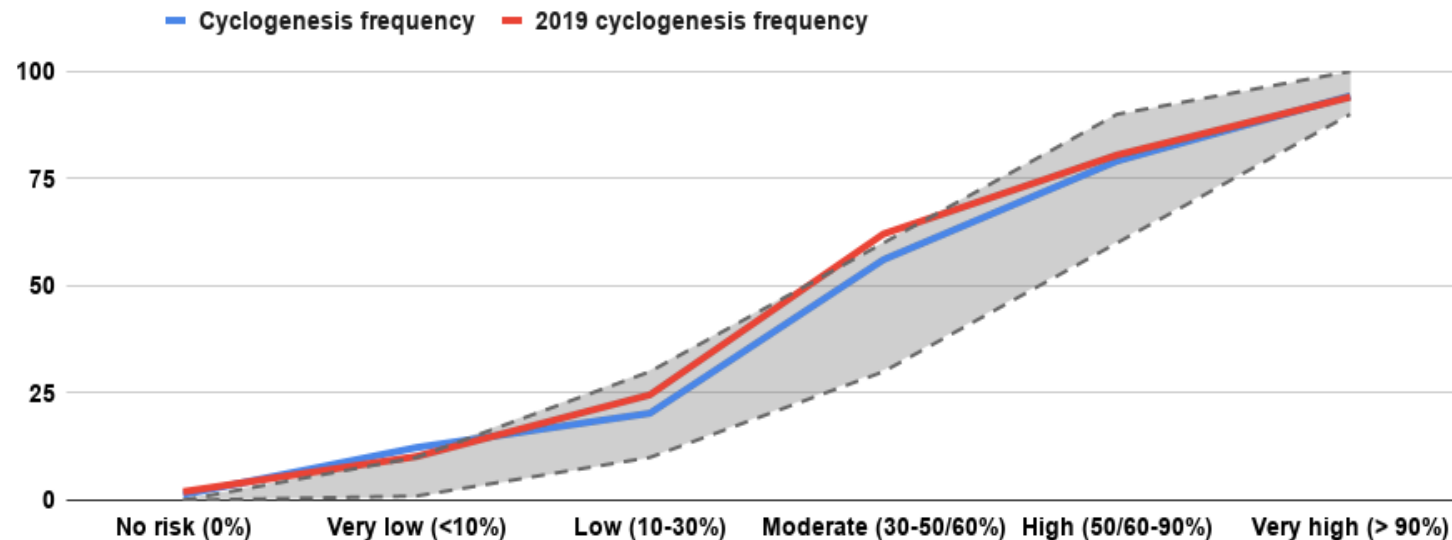
Cyclogenesis map
(human expertise)

Forecast verification

Class usage rates (%)



Fiability of Cyclogenesis Forecasts



In the shaded envelope: good risk estimation

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II) Useful resources in TCG

RSMC websites resources

RSMC's website (public access) → access to cyclogenesis map and ITCZ bulletin:

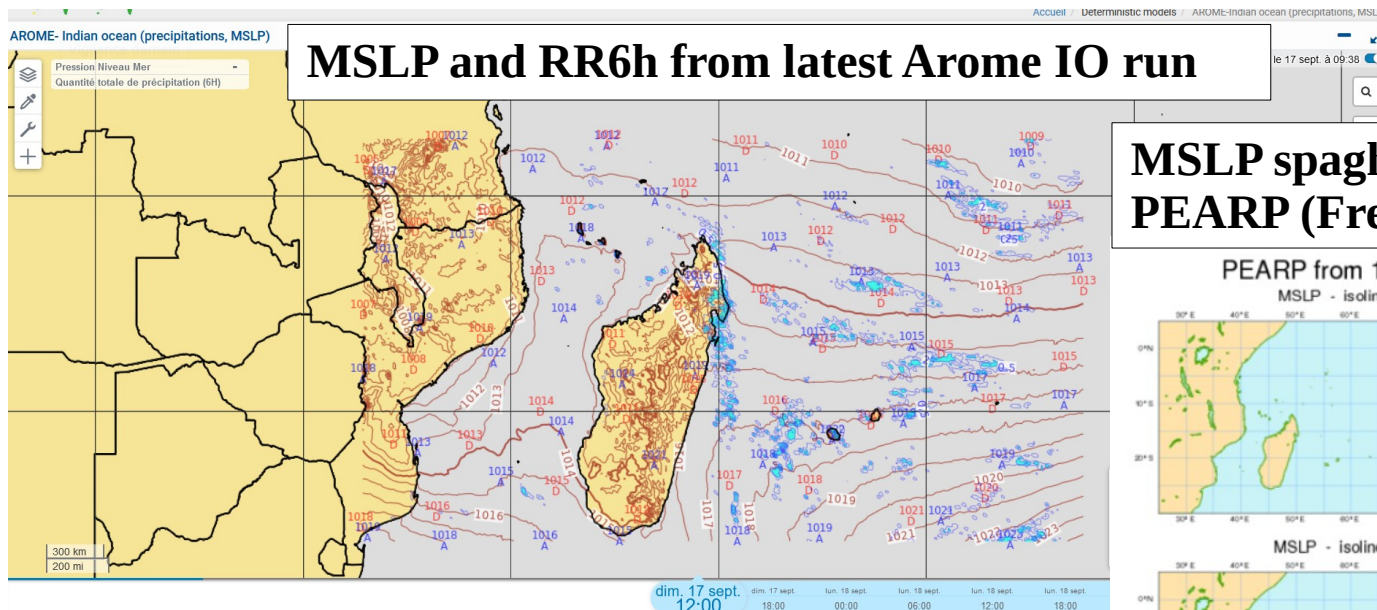
- http://www.meteo.fr/temps/domtom/La_Reunion/webcmrs9.0/

(we are working on an updated version for the 2024-2025 TC season)

- RSMC Extranet for TCC country members :

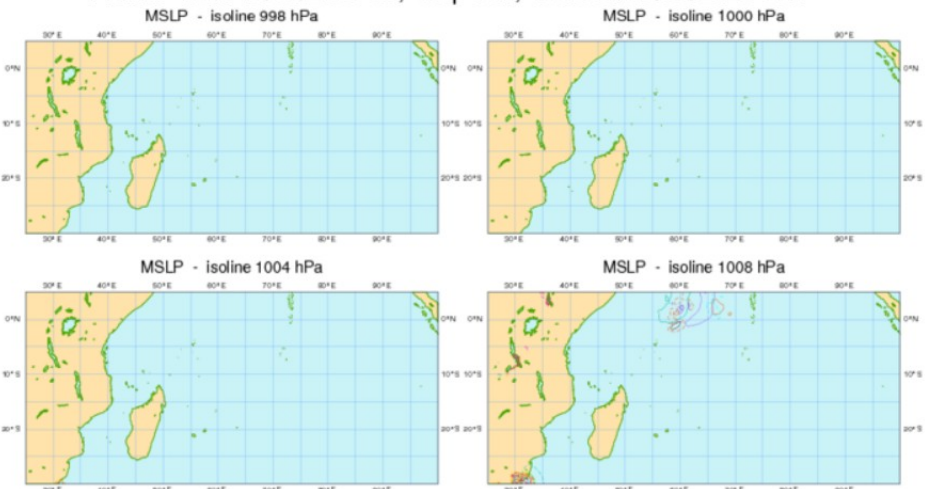
<https://pro.meteofrance.com> (reserved access – user/pwd provided to all NMS of RAI TCC – reminder of the user/pwd possible on request)

→ Near realtime access to NWP models from Meteo France (**AROME IO**) along with ensemble forecast products from various NWP centers (ECMWF, FRANCE, NCEP, CMC)



MSLP spagh (various thresholds) with PEARP (French ensemble forecast)

PEARP from 16/09/2023 6h, step 90h, valid on 20/09/2023 00h



External resources

MISVA websites (public access) -french/english websites

- <https://misva.aeris-data.fr/>

→ Inter-annual / Intra-seasonal / Synoptic scales products (real-time and archives)

Products shown in this presentation come from here :

https://misva.aeris-data.fr/products/synopt_cartes_prevues_ondes/

https://misva.aeris-data.fr/products/synopt_cartes_prevues/

Tropical tidbits (crowdsourced funded websites of Levi Cowan)

<https://www.tropicaltidbits.com/>

Access to real-time NWP products (deter. and ensemble) in all basins
based on state of the art models -some of them shown
in this presentation.

Weathernerds :

https://www.weathernerds.org/tc_guidance/

TC products based on various Ensemble forecast guidance (ECMWF EPS and GEFS mainly)

