Tropical cyclone seasonal forecast over the SWIO at RSMC La Réunion

Sébastien Langlade
Guillaume Jumaux
François Bonnardot

November 2019

Outline

- What is a TC seasonal forecast – or is not?
- Methodology
- Assessment of the seasonal forecasts
- Conclusive remarks

What is a TC seasonal forecast?

- A forecast of the general characteristics of the forthcoming TC season.

- Our approach focuses on :
  - TC activity (ACE, TS/TC number, TS/TC days ...)
  - Preferred genesis location
  - Track typology

- Required:

  - A better knowledge of what explains TC interannual variability over SWIO

What a TC seasonal forecast is not?

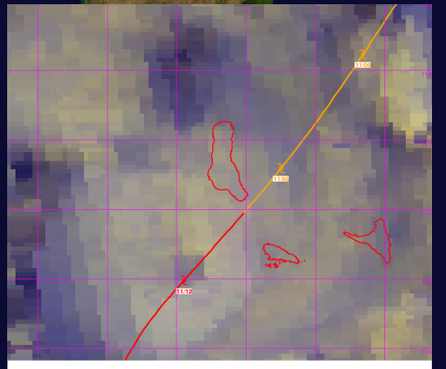
- A forecast of TC impact for a specific region or island

- A way to reduce my preparedness if the season is forecasted to be below normal activity.
  One only can be a disaster! (many examples worlwide of a single dreadful TC during a season with below normal activity)

It only takes one ...

ELINAH
Janv 83

Heavy damage reported at
Anjouan and Moheli :
33 victims, 52 injured
23,1 million USD in damage

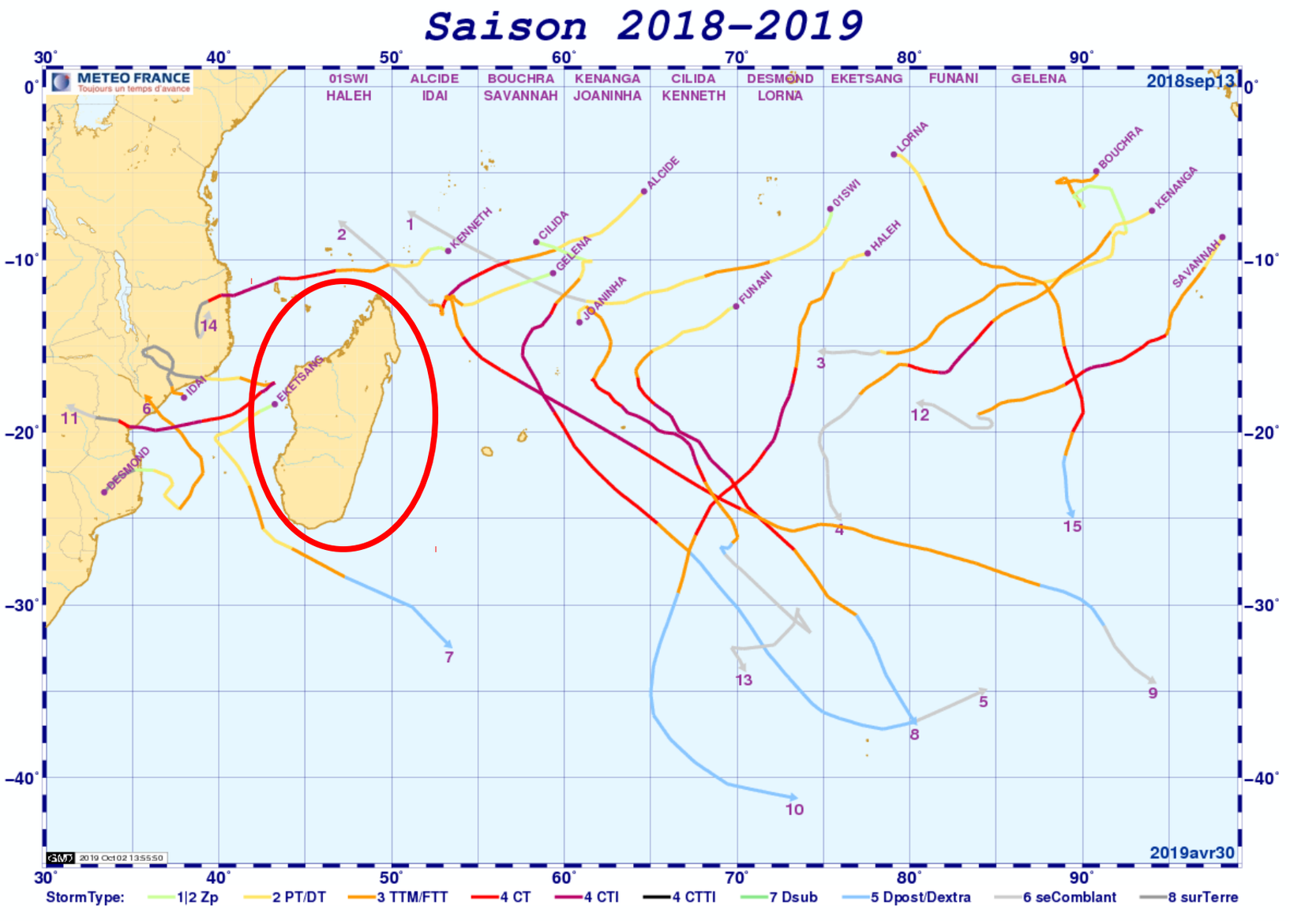


Reanalyzed as a minimal TC as it crossed the Comoros archipelago

1982-1983 SWIO TC season

METEO FRANCE

And sometimes a busy season gives nothing to a usual prone TC area ...

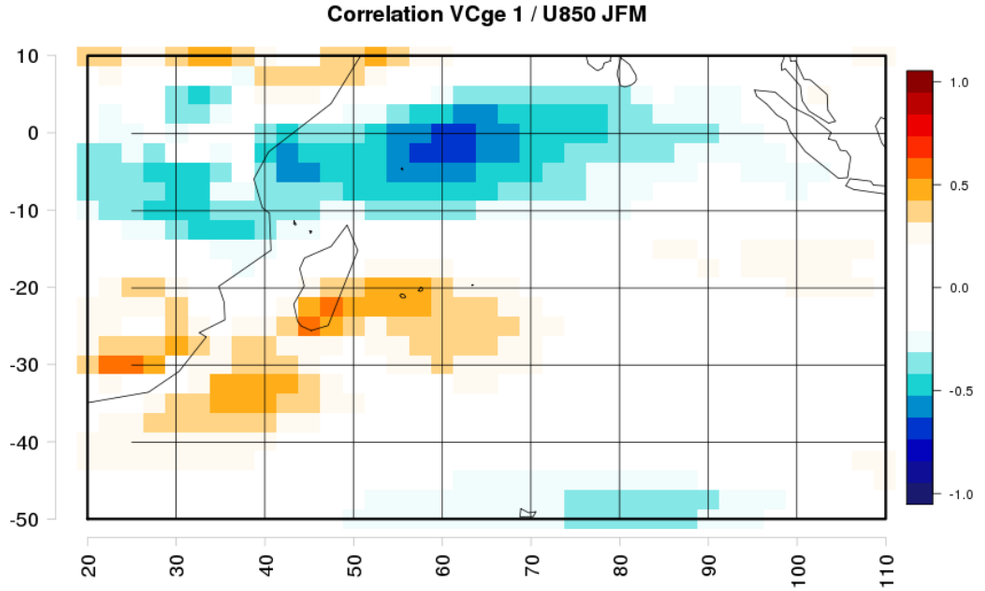


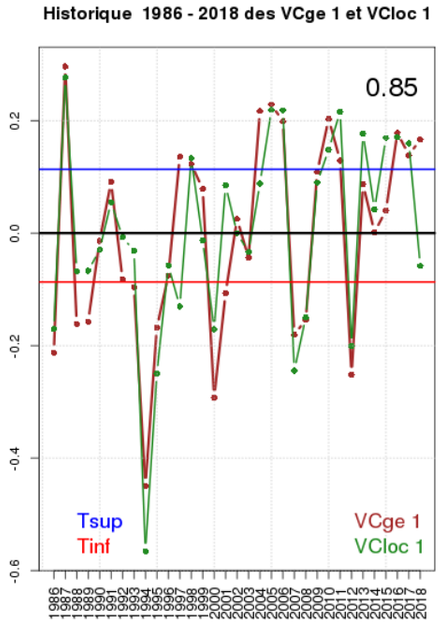
Outline

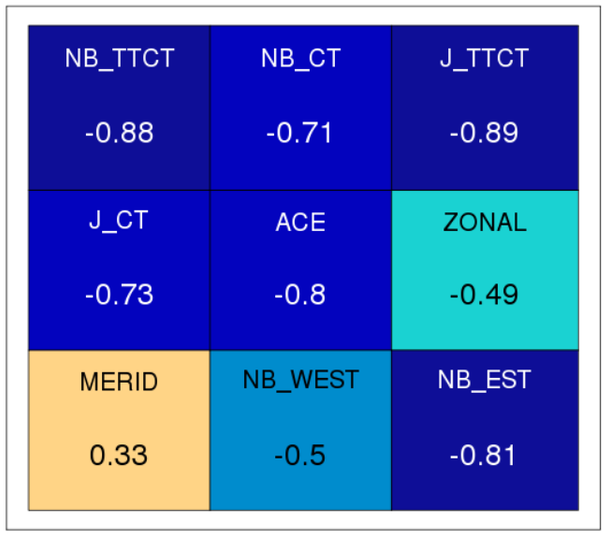
- What is TC seasonal forecast – or is not ?
- **Methodology**
- Assessment of the seasonal forecasts
- Conclusive remarks

Methodology

- Statistical-dynamical approach to link the interannual variability of some of the large scale parameters (SST, U850 etc …) to key features of a TC season.







- Correlation between large scale parameters from ERA-Interim and a set of TC activity parameters is assessed through canonical correlation analysis over a period starting in 85-86 (more than 30 years)

METEO FRANCE

Methodology

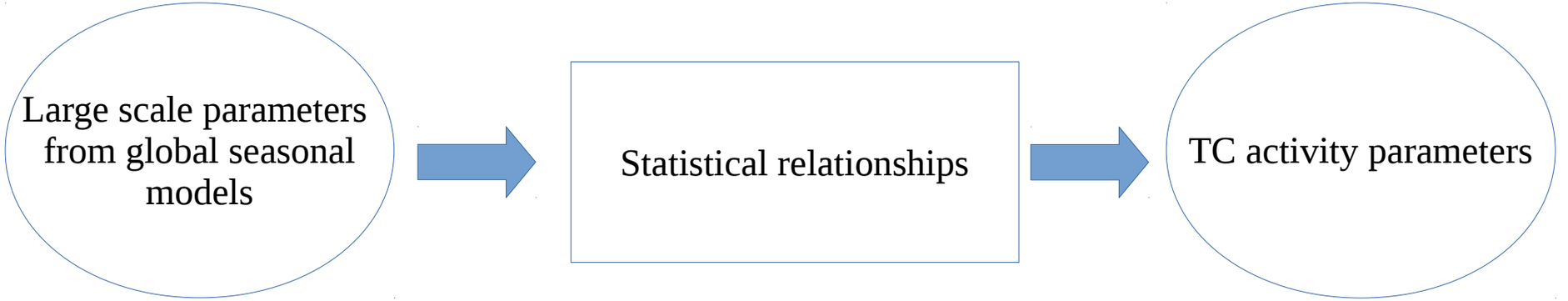
	TC activity	Track typology	Genesis repartition
SST	Good skill	Good skill	Good skill western area
U850	Good skill	Good skill	Low skill
V850	Low skill	Neutral skill	Good skill central and eastern area
U200	Neutral skill	Low skill	Neutral skill western area
Velocity potential 200 hPa*	Good skill	Good skill	
Total water vapor content			Good skill central and eastern area
MSLP	Low skill	Good skill	

- The skill of each parameter is assessed through a « **leave-one-out-cross-validation » method** associated with **correlation and Tercile Heidke skill scores**

METEO FRANCE

Methodology

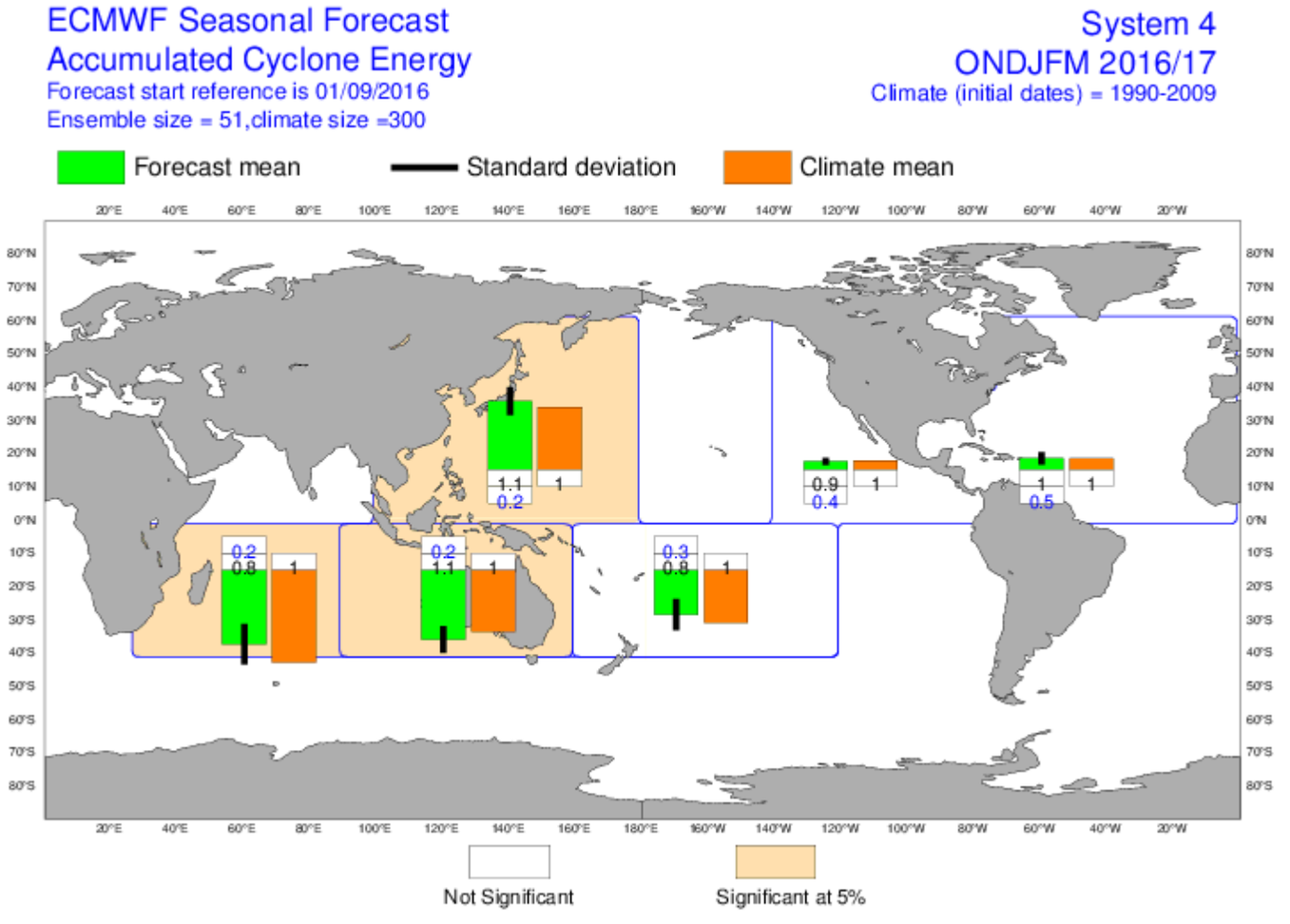
- Statistical relationships found previously are applied to large scale parameters forecasted from numerical seasonal models (ECMWF and ARPEGE-Climat) to get the expected TC activity parameters.



Probabilistic forecast
(51 members for each model)

Probabilistic forecast

Methodology



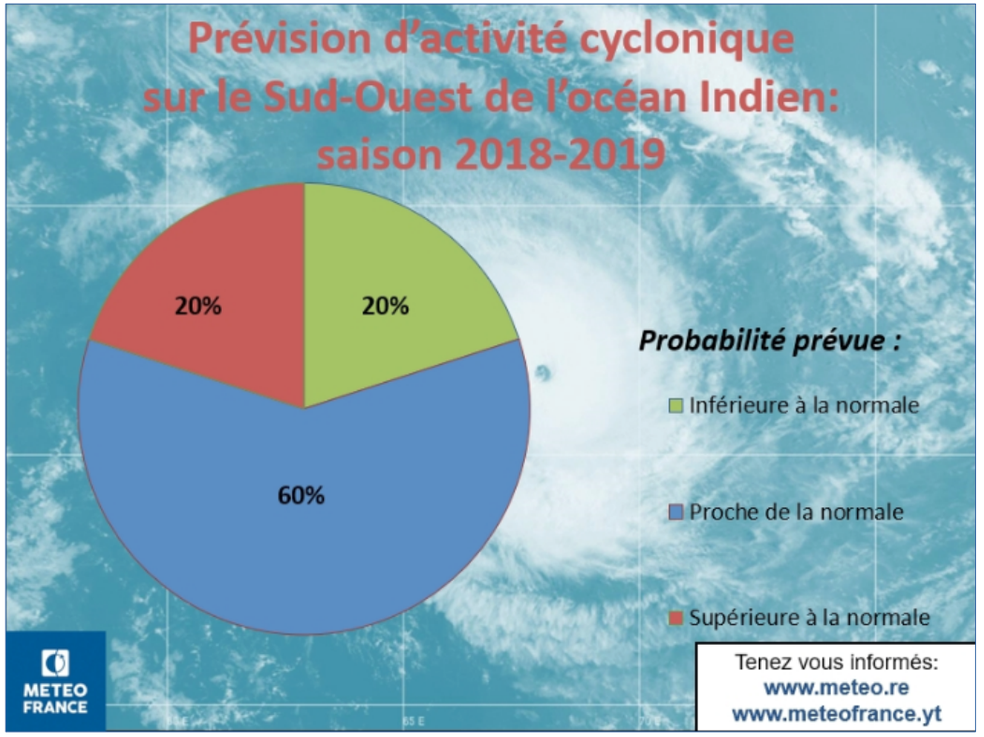
- Also a look at the TC seasonal forecast products from ECMWF
- Based on a tracking of TC in the predicted meteorological fields

- Final forecasts are based on blending. They are issued shortly around 15 November.

Outline

- What is a TC seasonal forecast – or is not?
- Methodology
- **Assessment of the seasonal forecasts**
- Conclusive remarks

Assessment of the seasonal forecast
TC activity

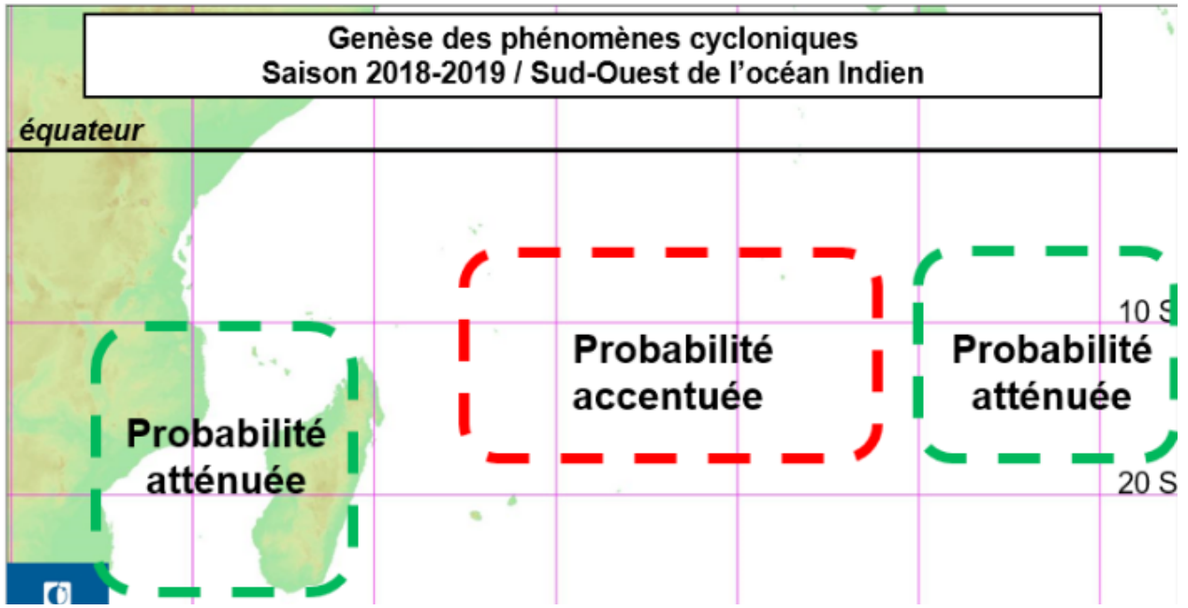


TC seasons	Forecast	Observed
2015-2016	Below to normal	Below
2016-2017	Below	Below
2017-2018	Below to normal	Normal
2018-2019	*Normal*	*Above*

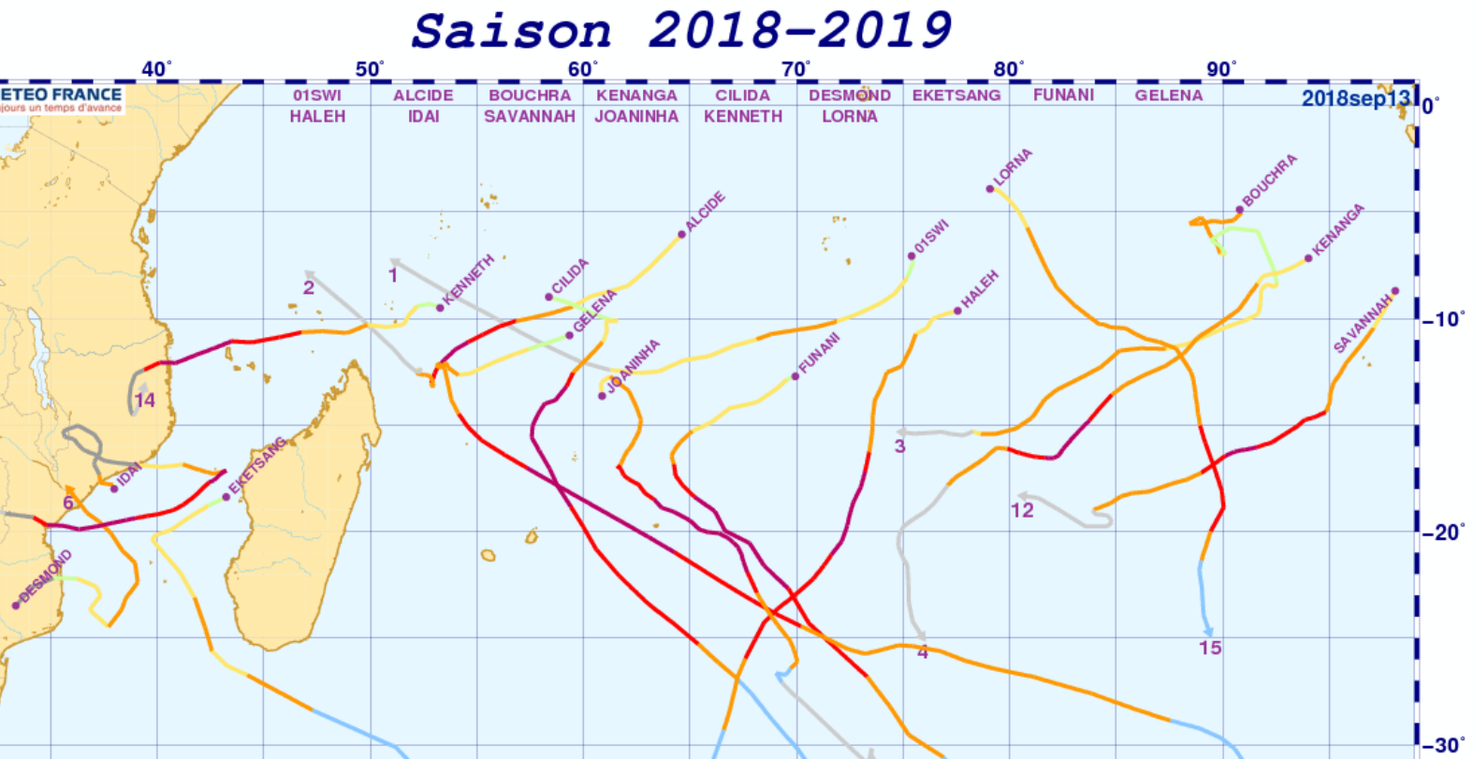
	ACE	TS/TC days	TC days	Total TS/TC	Total TC	Overall qualification
20152016	-0,1	-0,6	-0,2	-0,8	-0,9	inf.
20162017	-1,4	-1,3	-1,7	-1,6	-0,9	inf.
20172018	-0,3	-0,3	-0,2	-0,8	0,5	
20182019	2,1	1,5	2,3	2,1	2,8	sup.

Normalized anomalies

Assessment of the seasonal forecast
Genesis repartition and track typologie



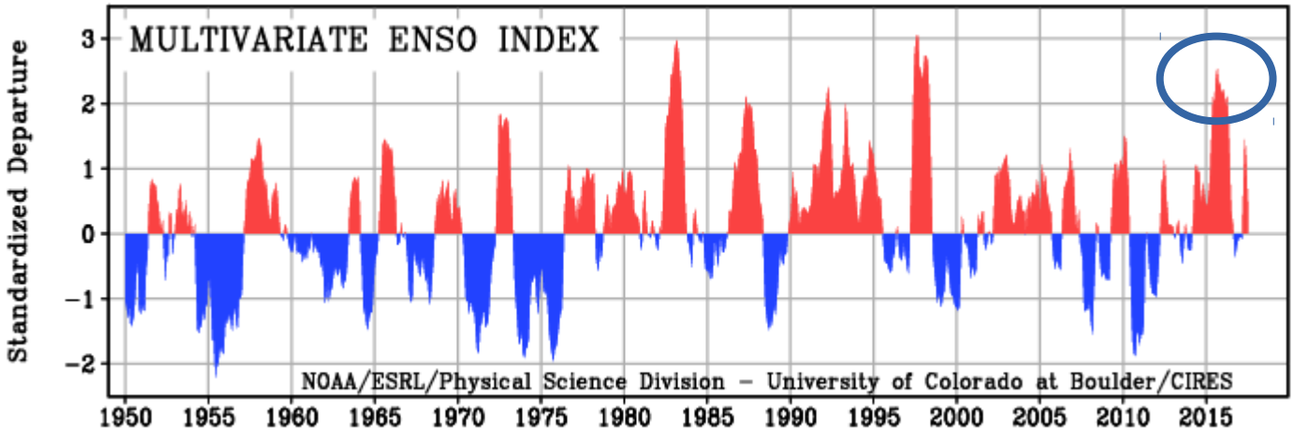
- Good anticipation for Indian ocean area
- Failed to predict enhanced TC activity over the Mozambique channel

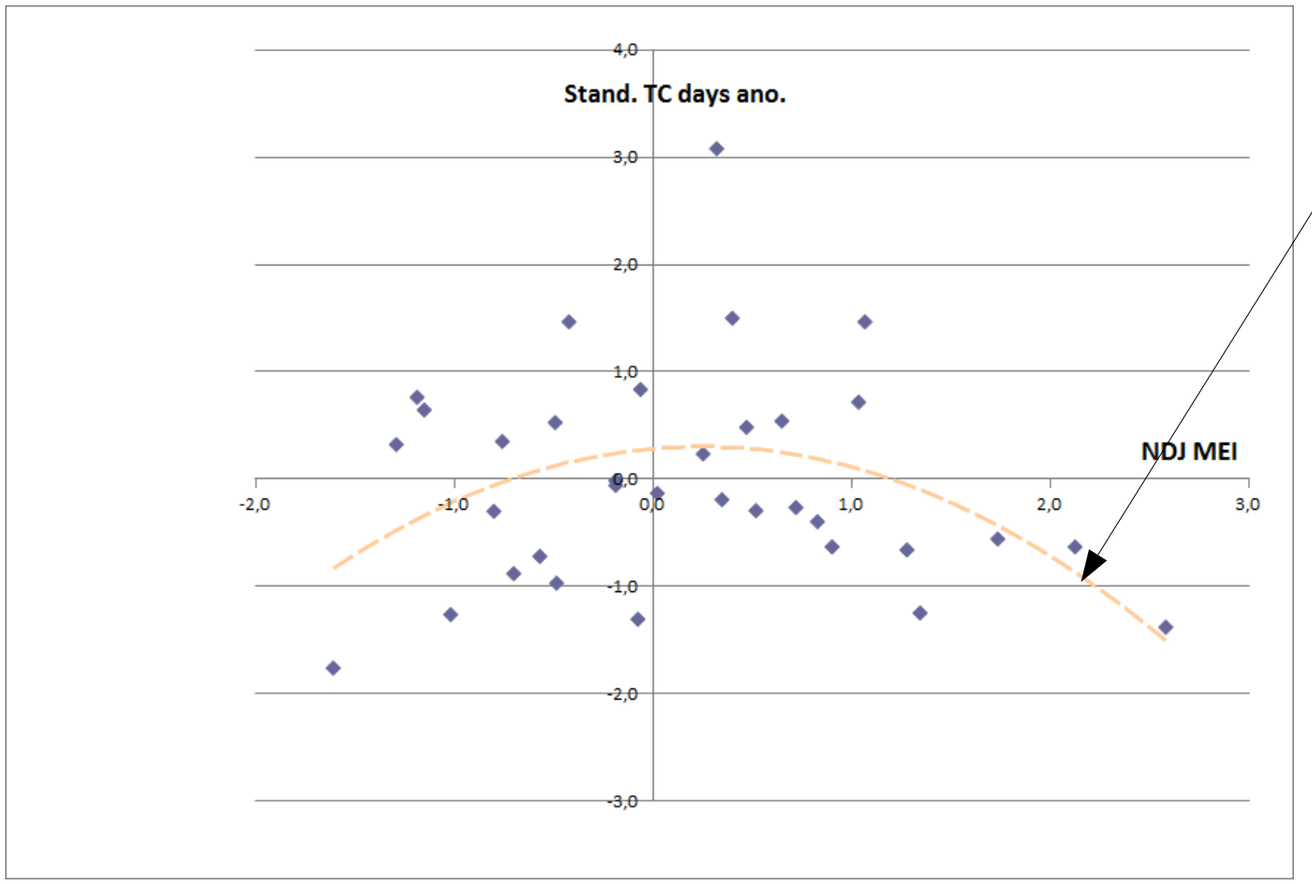


- Track typology prediction: mainly polewards
- Observed: mainly polewards over the Indian ocean – zonal over the Mozambique channel

METEO FRANCE

2015-2016 : Strong El Nino

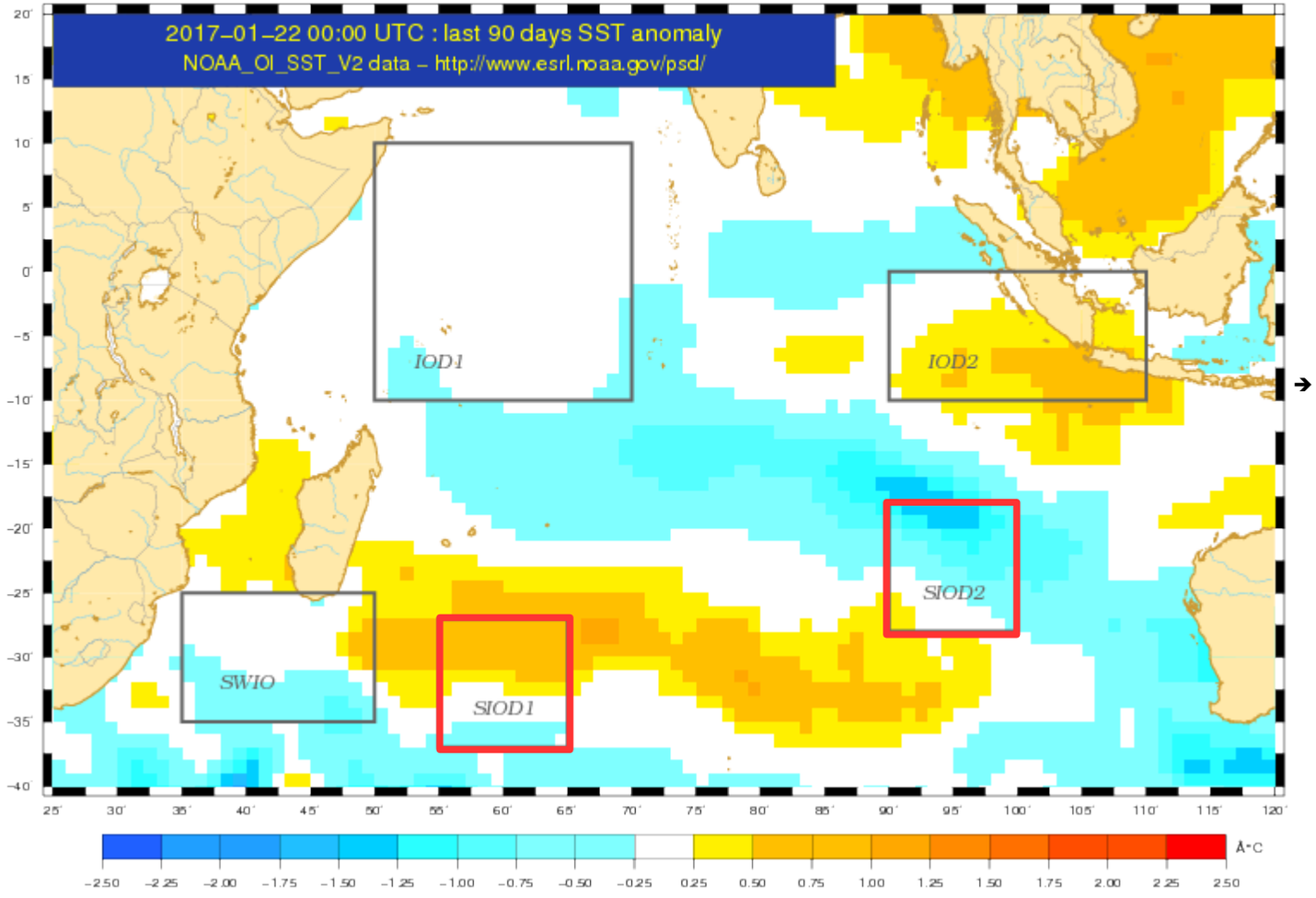




- One of the **three strongest El-Nino events** on record
- Below normal activity during strong El-Nino is consistent with what has been observed in the past … but only a few cases …
- Warmer SST and low level moisture on average over SWIO during El Nino, but increase of the windshear and lack of low level convergence

METEO FRANCE

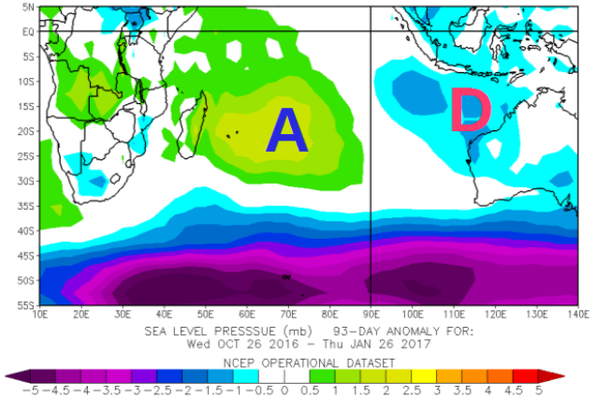
2016-2017 : Strong positive Subtropical Indian Ocean Dipole



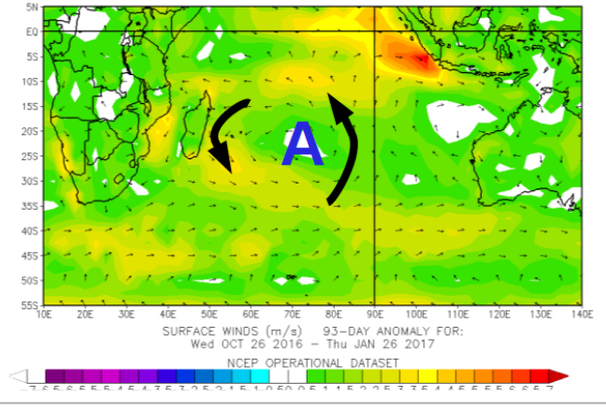
- Strong dipole in the subtropical South Indian Ocean ...

2016-2017 : Strong positive Subtropical Indian Ocean Dipole

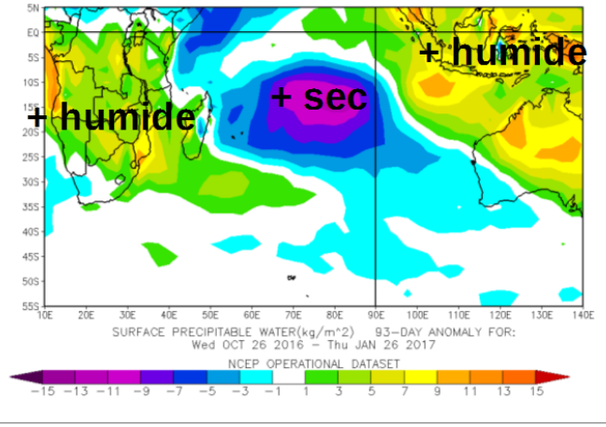
MSLP anomalies



Surface winds anomalies



Precipitable water anomalies

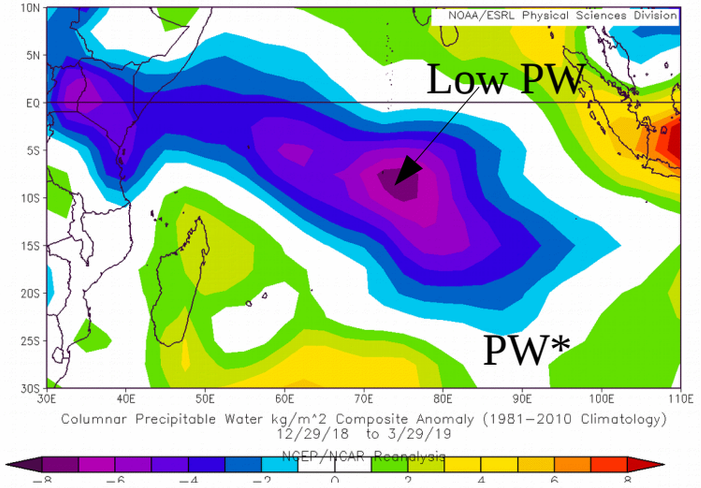


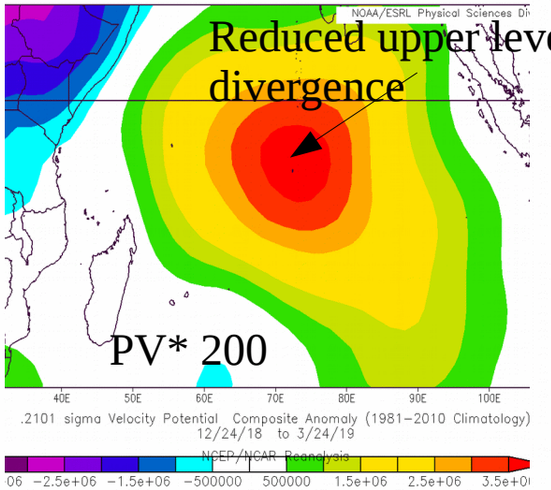
NOV 2016→ JANV 2017
***26/10 → 26/01**

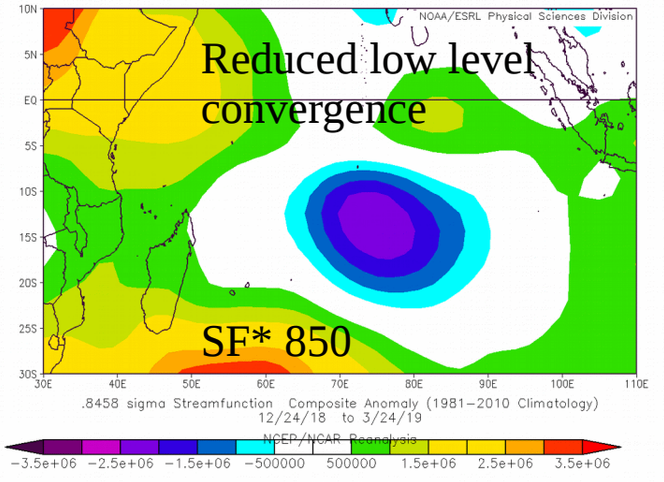
Source : NOAA/ESRL

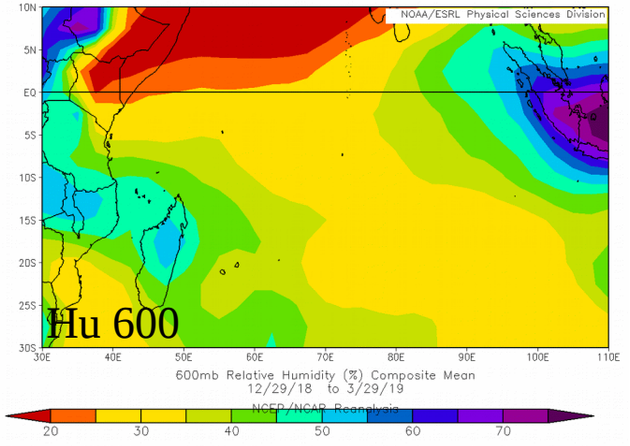
- … strongly related to the atmospheric anomalies of the strength of the Mascarenes High and of the large scale subsidence over the tropical Central Indian Ocean.

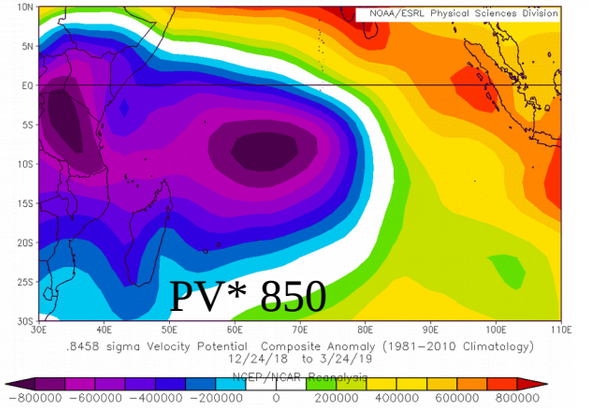
2018-2019 : the forecast that failed ...



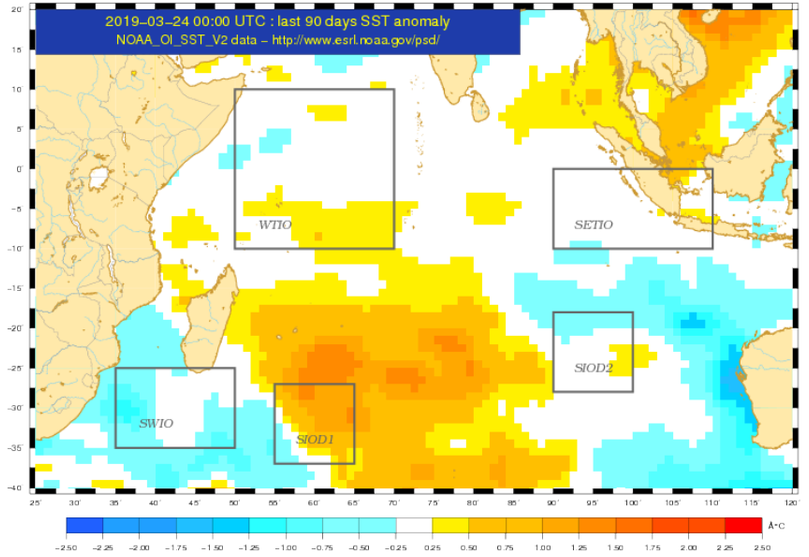




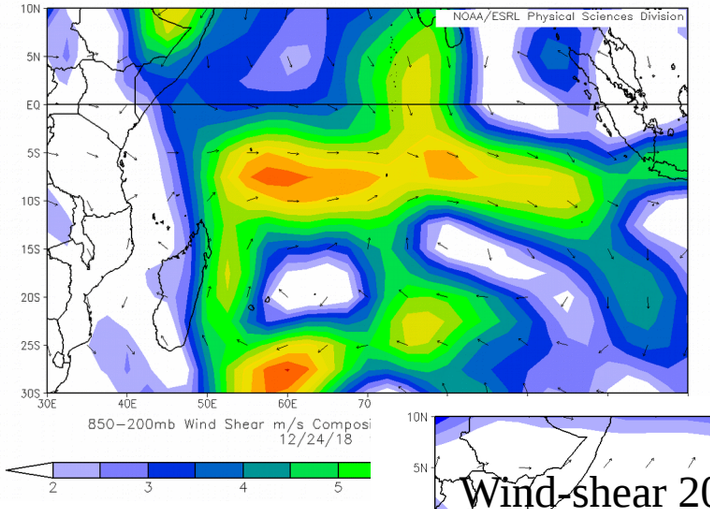


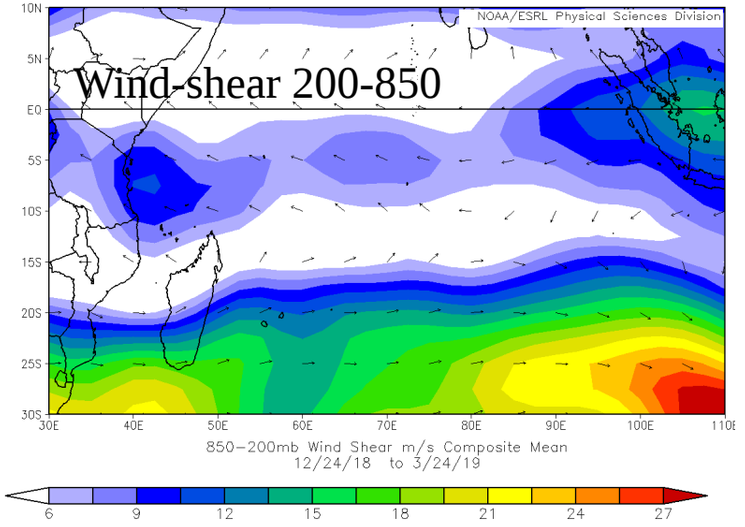


2018-2019 : the forecast that failed ...



Wind-shear anomalies200-850





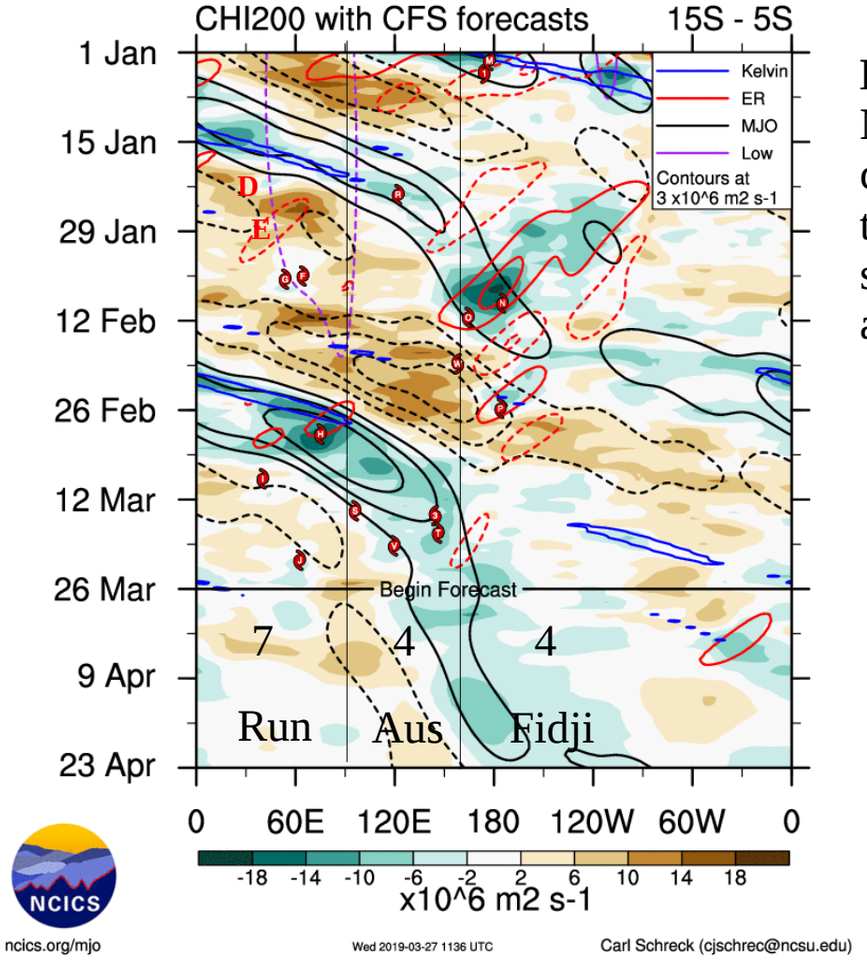
The low frequency favourable environment :

→ Warmer SST

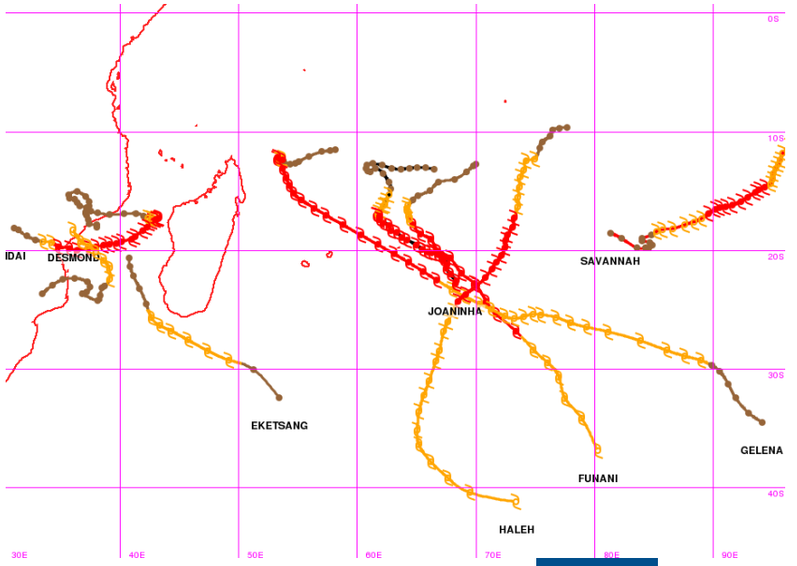
→ Lower wind-shear

2018-2019 : the forecast that failed ...

JFM genesis



Hypothesis :
Most of the energy for cyclogenesis was driven at the intra-seasonal scale with strong equatorial waves activity



METEO FRANCE

Outline

- What is a TC seasonal forecast - or is not?
- Methodology
- Assessment of the seasonal forecasts
- **Conclusive remarks**

Conclusion

- A statistical-dynamical model is used for seasonal TC forecasting at RSMC La Reunion to provide probabilistic predictions of various expected features for the forthcoming TC season.

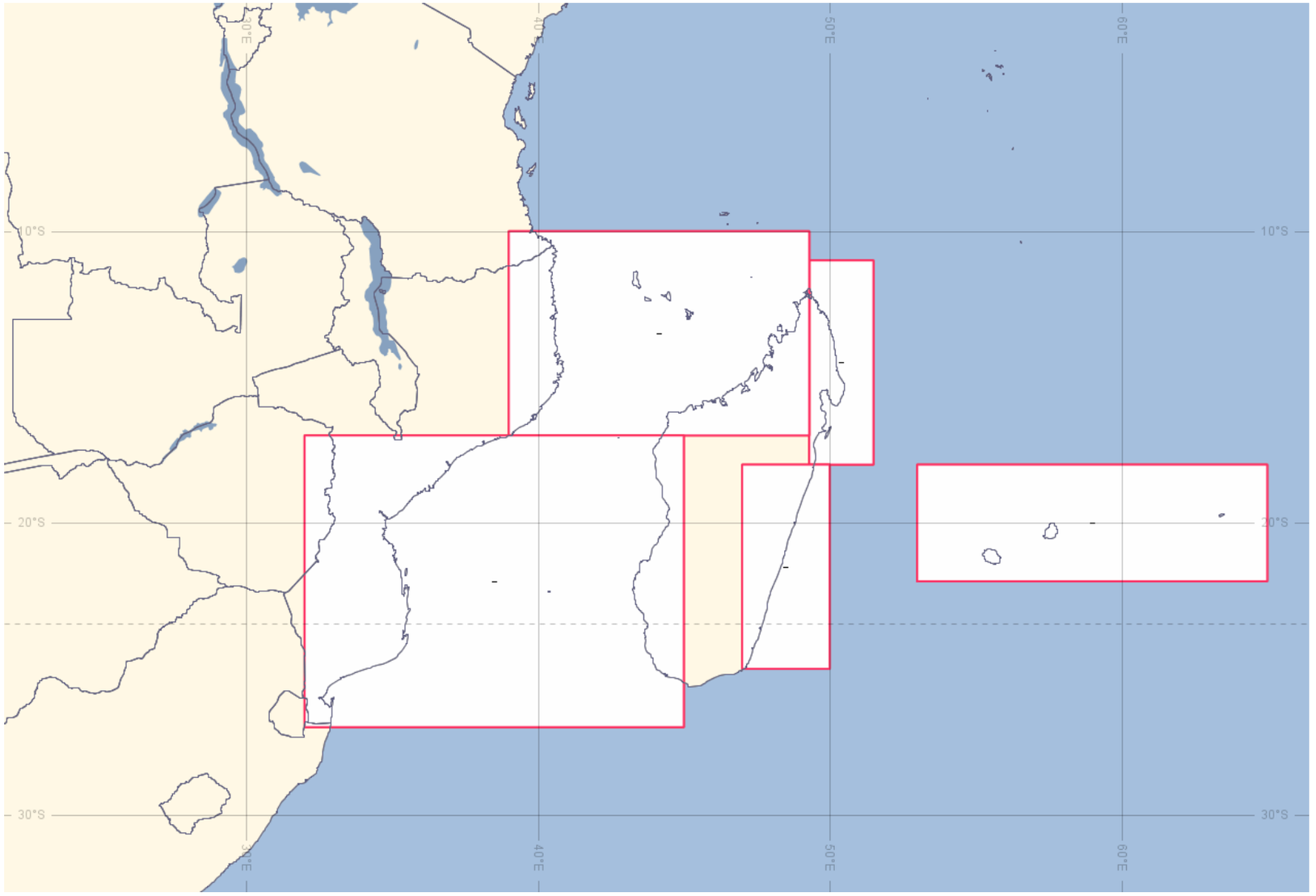
- Assessment of the predictions shows rather good skill to anticipate the overall TC activity, including TS/TC frequency and main track typology (3 of 4 good forecast – 1 fail)

- Strong global or regional large scale phenomena were involved (El Nino for 2015-2016 and SIOD+ for 2016-2017) and have likely contributed to this successful prediction.

- A limiting factor : the intraseasonal scale ...

METEO FRANCE

Future plan ?



Targetting inhabited areas ...