Understand Risk Forum

Cape Town (4 July 2012)

Meteorological, Hydrological and Climate Services to Support Risk Analysis

Philippe CAROFF Météo-France

Operational Head RSMC La Réunion
(Tropical Cyclone Centre for the South-West Indian Ocean

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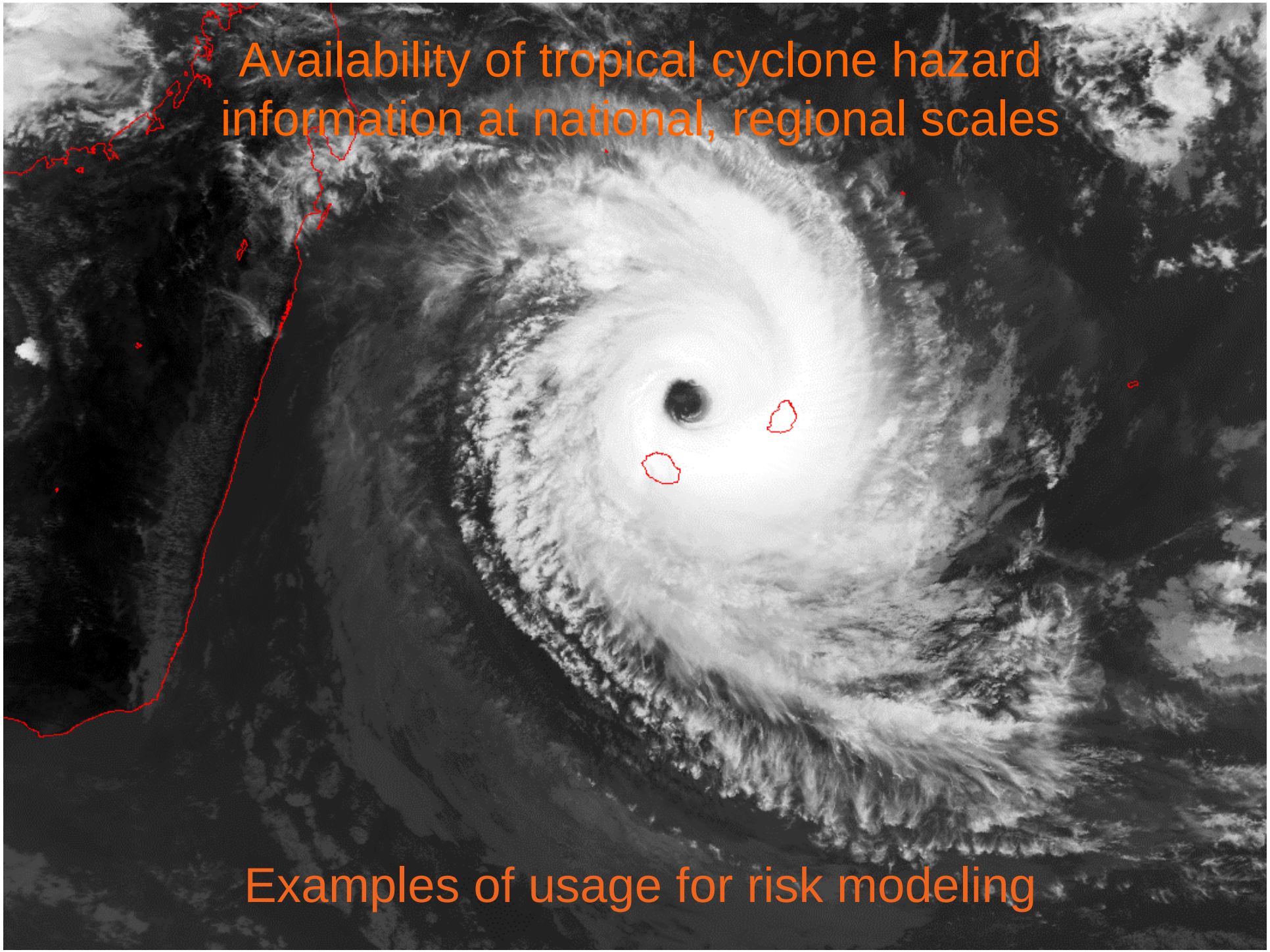

Availability of tropical cyclone hazard information at national, regional scales
Examples of usage for risk modeling

OUTLINE

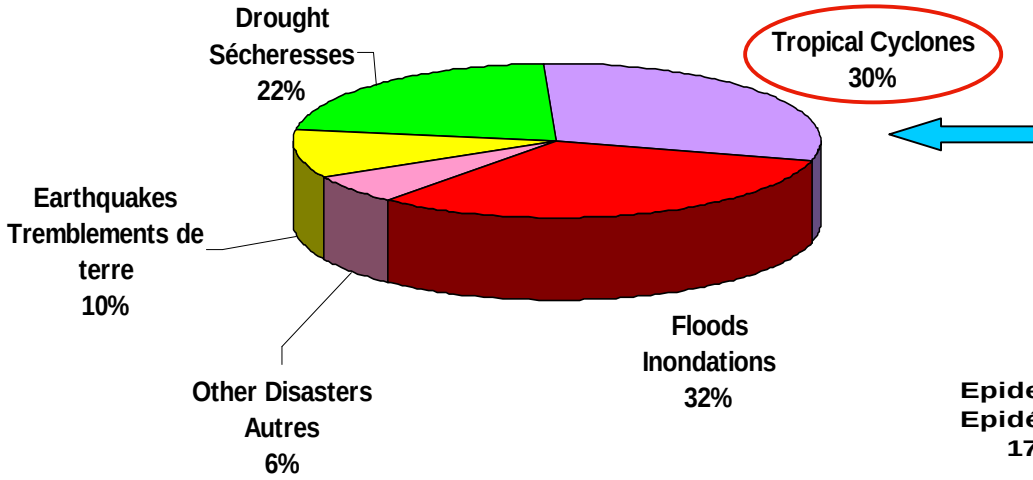
1. RSMCs : dedicated centres of expertise dealing with a major natural hazard : tropical cyclones

2. Availability of tropical cyclone hazard information

3. Using tropical cyclone hazard information for risk modelling

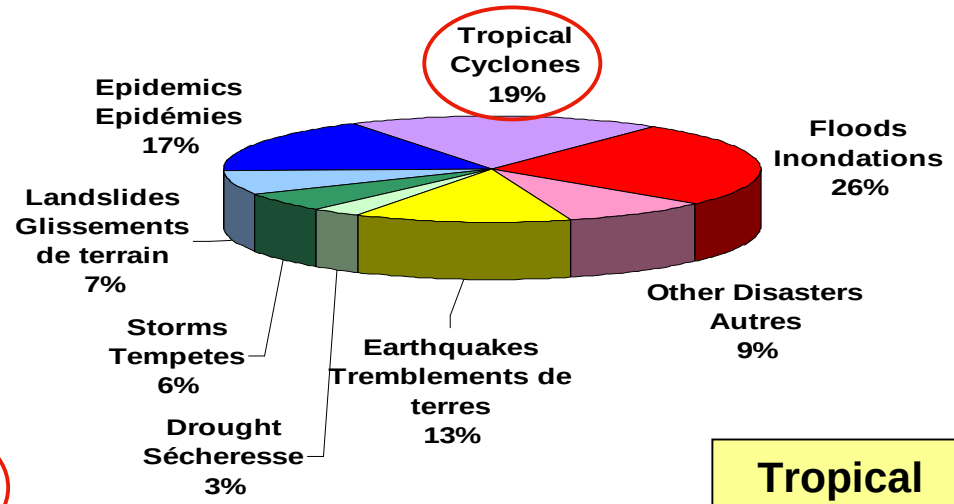
1. RSMCs : dedicated centres of expertise dealing with a major natural hazard : tropical cyclones

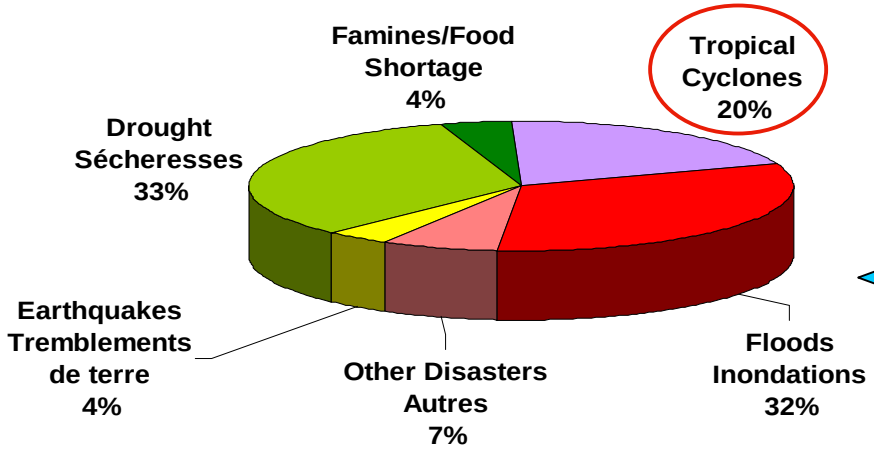
Natural disasters in the world (1963-1992). *Source United Nations.*



DAMAGE

MORTALITY





AFFECTED PEOPLE

Tropical cyclones : a major natural hazard

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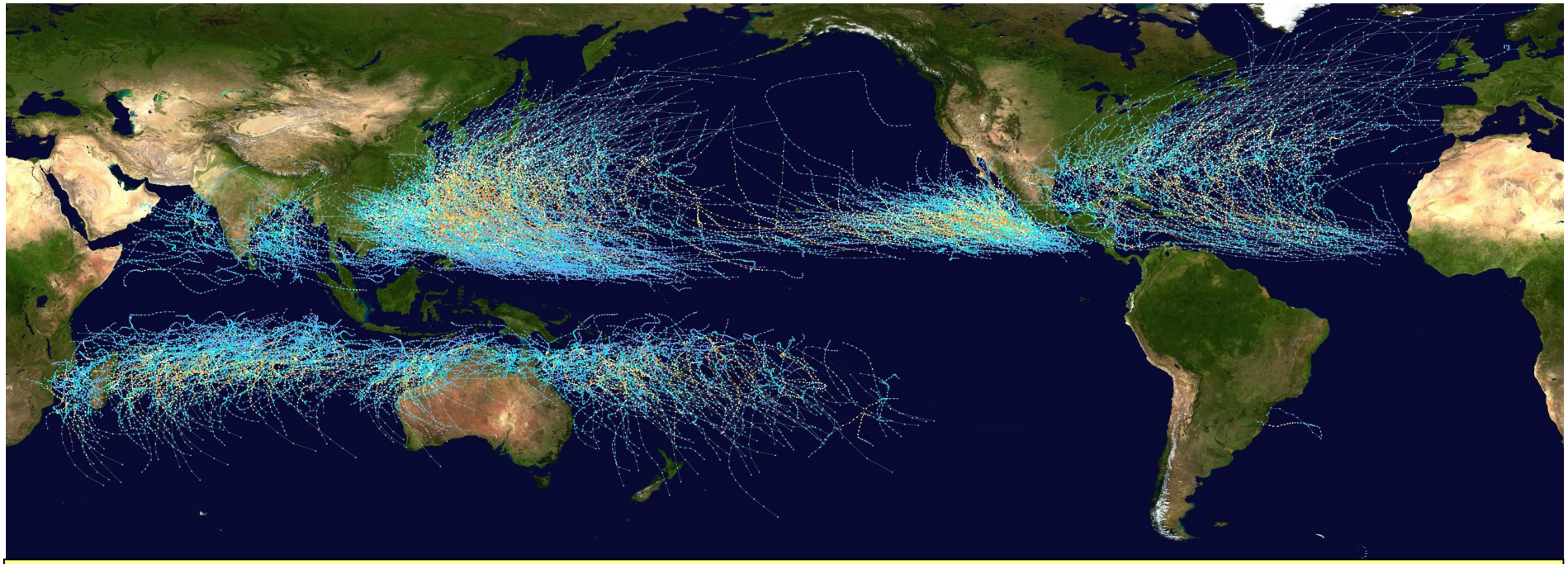
Tropical cyclone activity worldwide



20-years of worldwide tropical cyclone activity as represented by the global TC tracks for the period 1985-2005.

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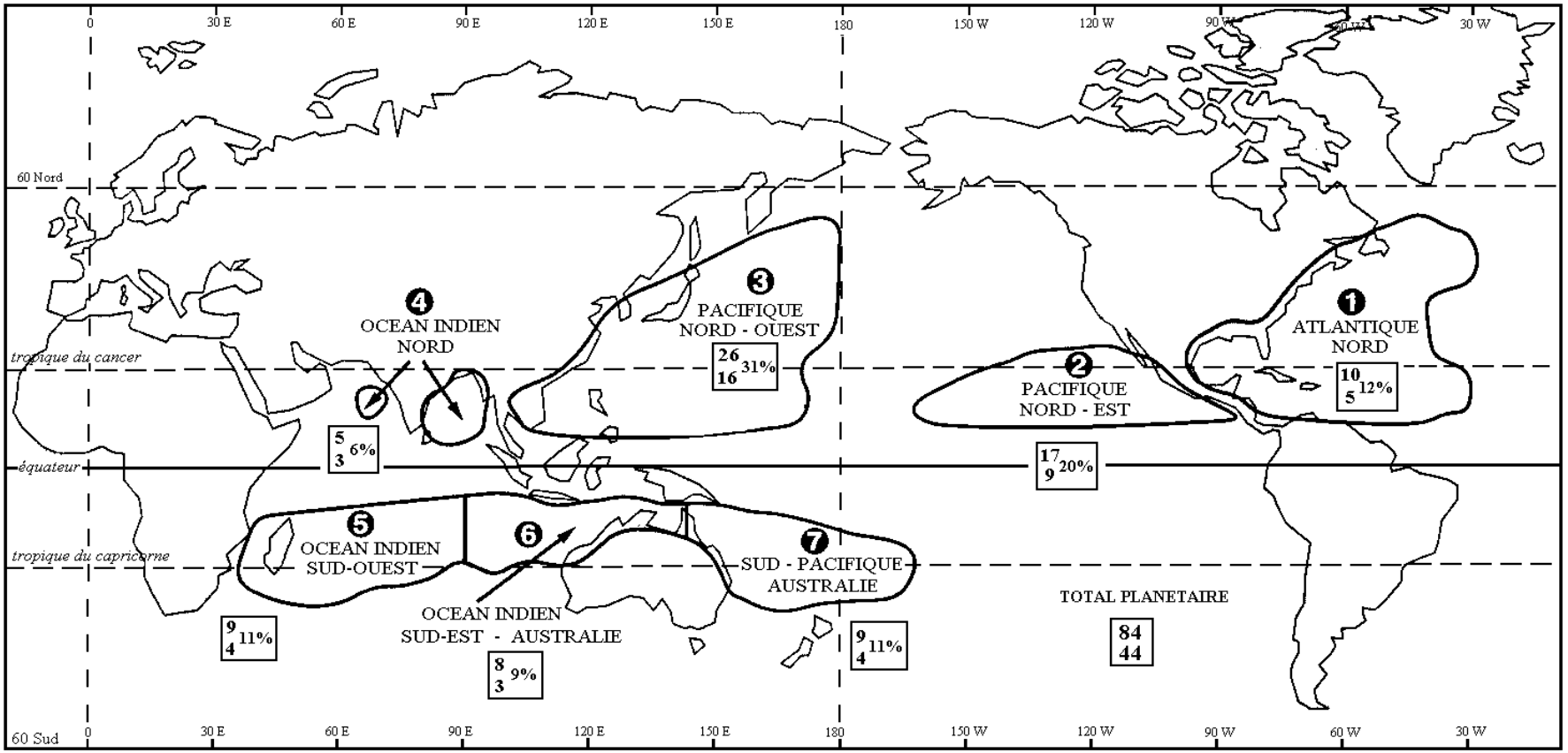
Tropical cyclone basins



A : ***Average annual number of tropical storms and tropical cyclones***

B : ***Average number of tropical cyclones*** *(hurricanes)*

C : ***Relative frequency of TC activity by basins*** *(tropical storms and tropical cyclones)*

A / B C%

Tropical cyclone basins and their compared related TC activity (based on the 1968-1990 period).

From *: Charles J. Neumann, in Global Guide of Tropical Cyclone Forecasting, WMO/TD N°560, 1993.*

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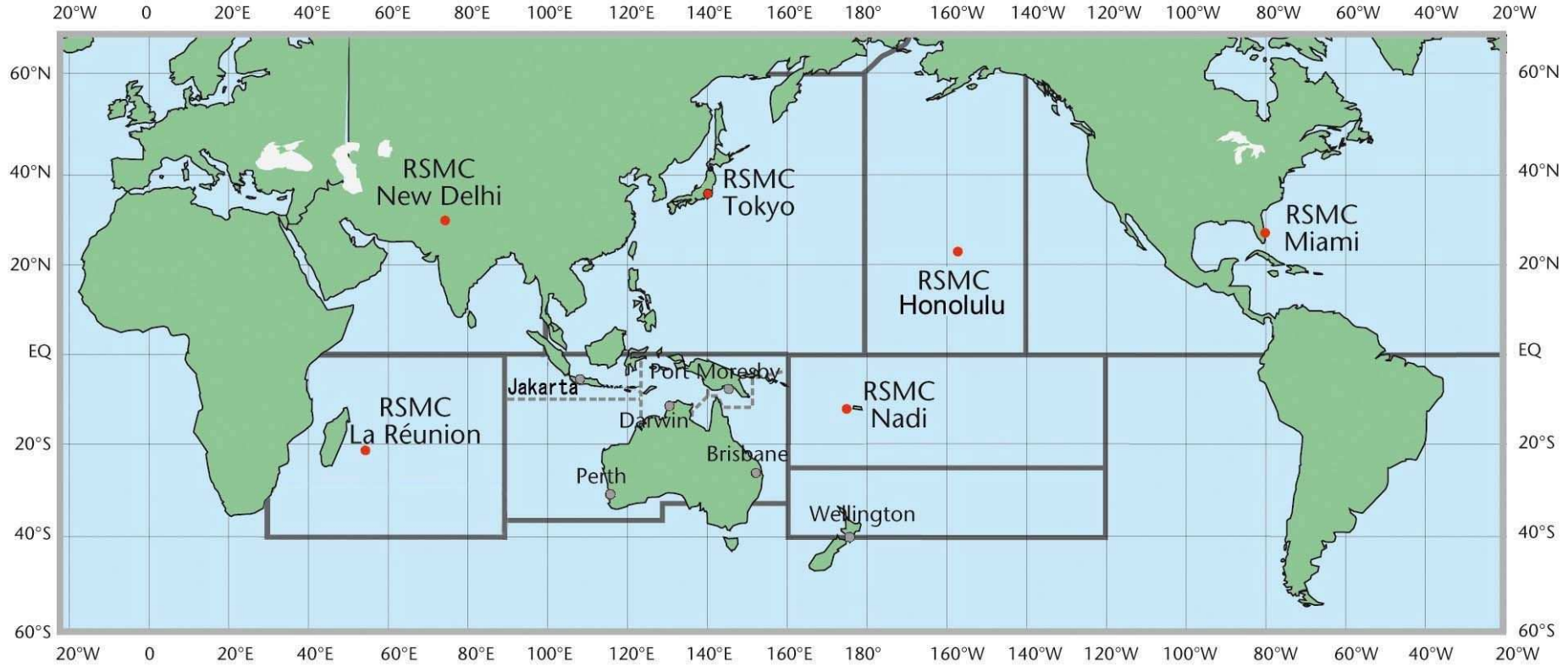
Tropical Cyclone monitoring worldwide



A specific and unique organization, under the framework of the World Meteorological Organization (WMO) to carry on the global watch of a major natural hazard : the RSMCs (Regional Specialized Meteorological Centres).

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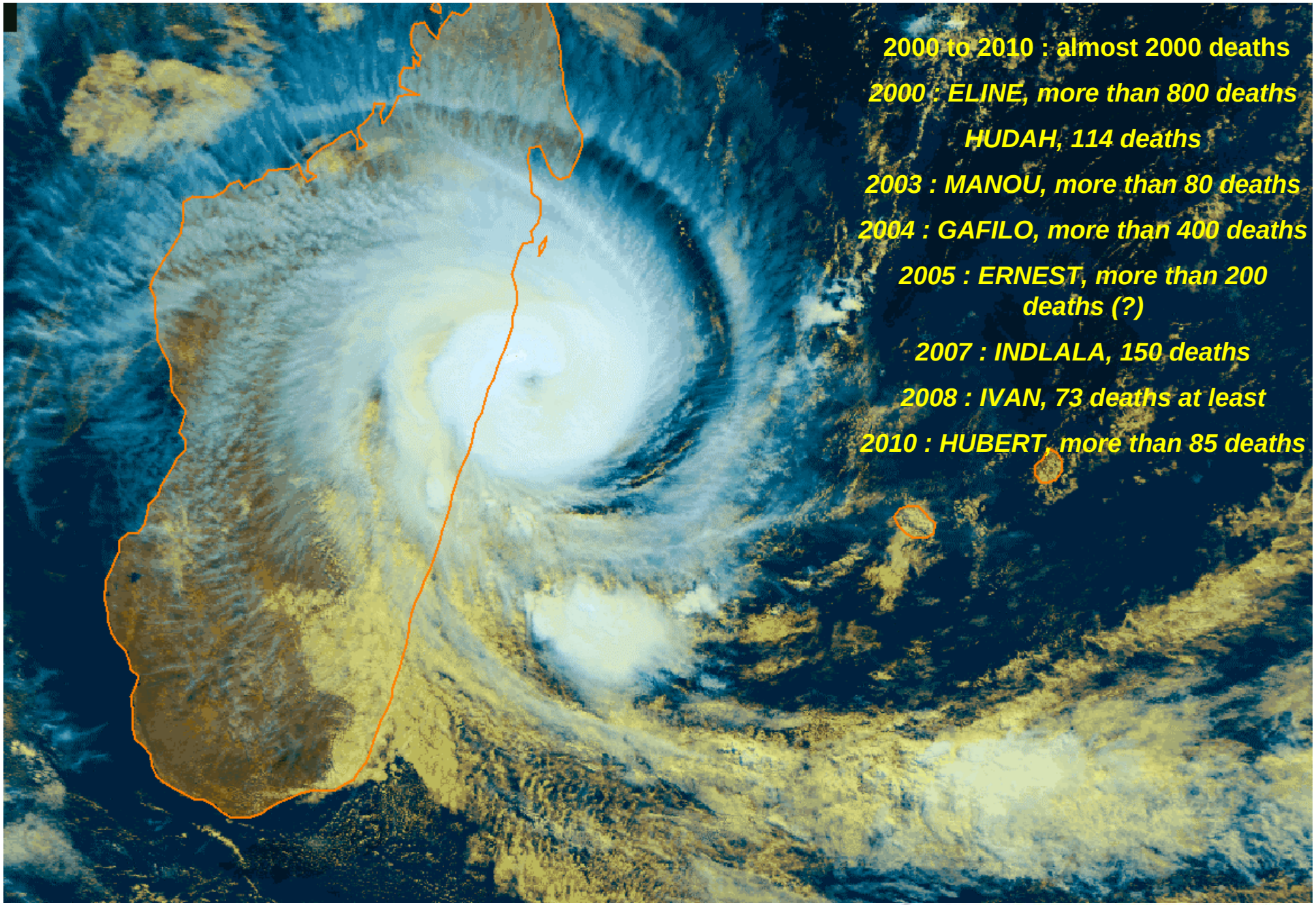

Tropical cyclones : a major natural hazard for the South-West Indian Ocean as well

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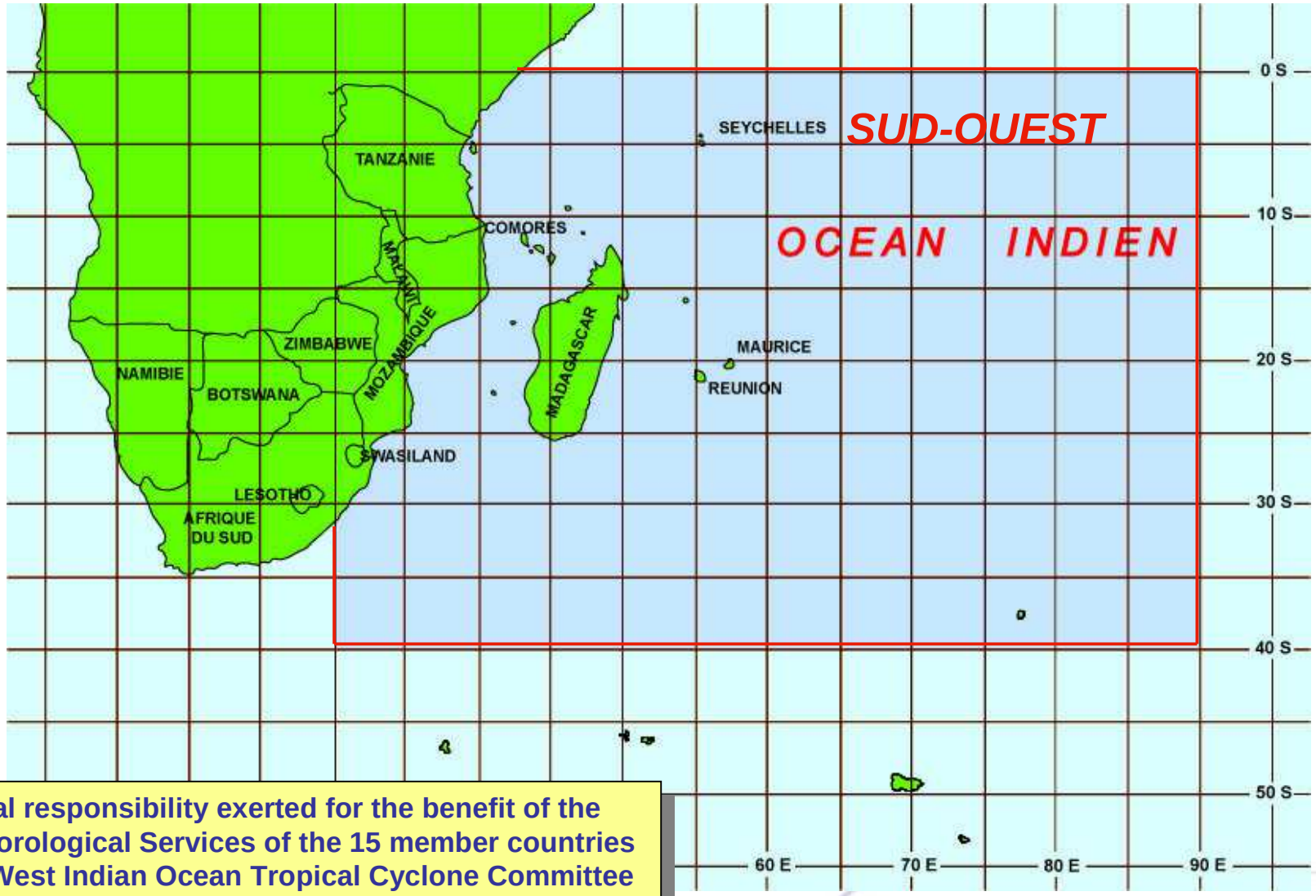
RSMC La Réunion

The Meteo-France regional centre based at La Réunion Island officially started operating as the Tropical Cyclones / Regional Specialised Meteorological Centre (RSMC) for the South-West Indian Ocean in June 1993.

The 3 main missions of RSMC La Réunion :

- **Operational tropical cyclone warning centre for the Southwest Indian Ocean :** to provide the first-level information (analyses, forecasts, guidance and warnings) on all the tropical disturbances forming or evolving within its AoR.
- **Research :** contribute to better knowledge on tropical cyclones and more specifically to improve the handling of tropical cyclones by the numerical models and develop new tools tailored for tropical cyclone forecasting.
- **Formation :** contribute to form the forecasters of the area through training courses or attachment of forecasters.

Area of responsibility of RSMC La Réunion



International responsibility exerted for the benefit of the National Meteorological Services of the 15 member countries of the South-West Indian Ocean Tropical Cyclone Committee in order to reduce the loss of lives and mitigate the socio-economic damages caused by tropical cyclones.

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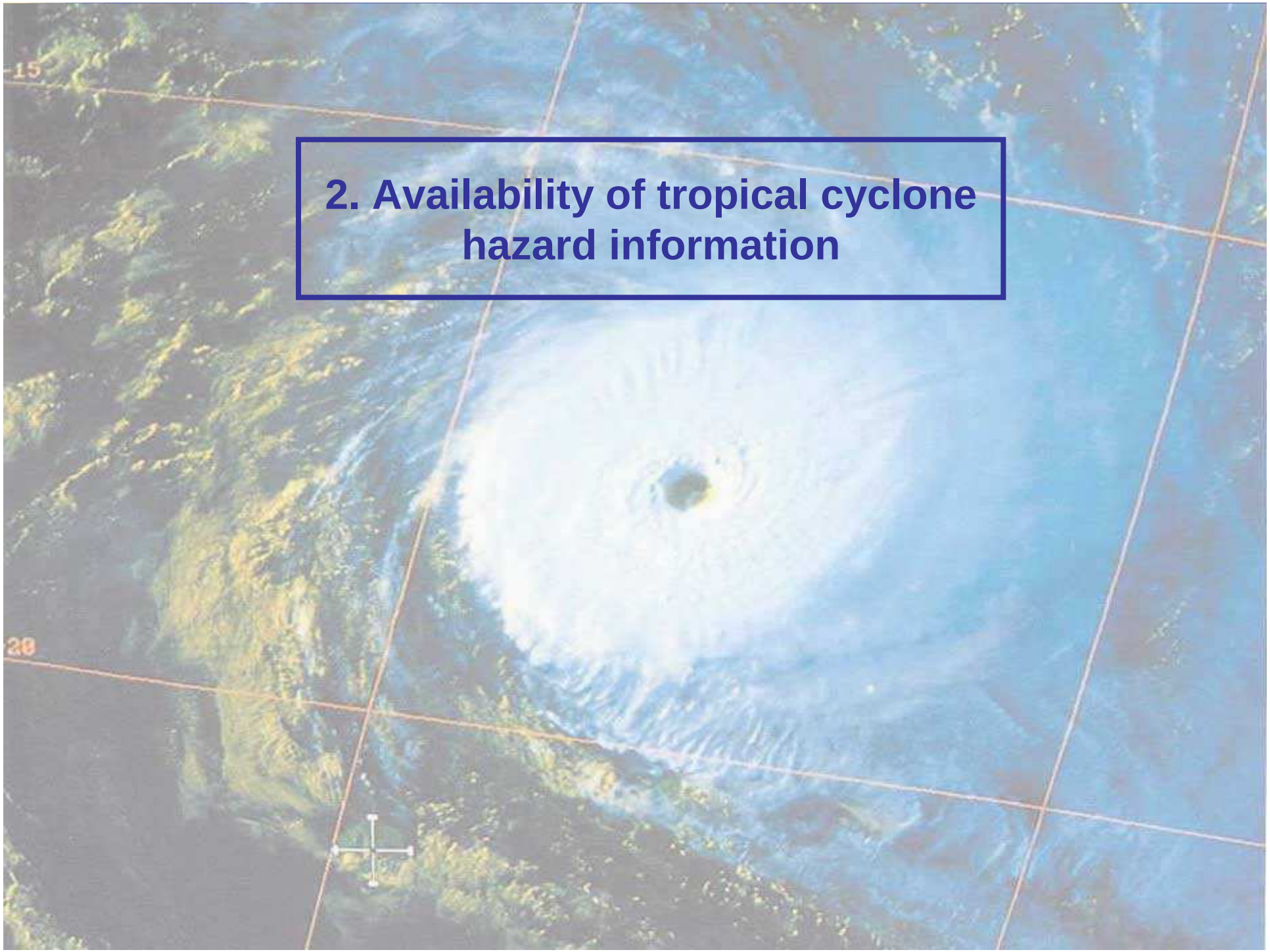
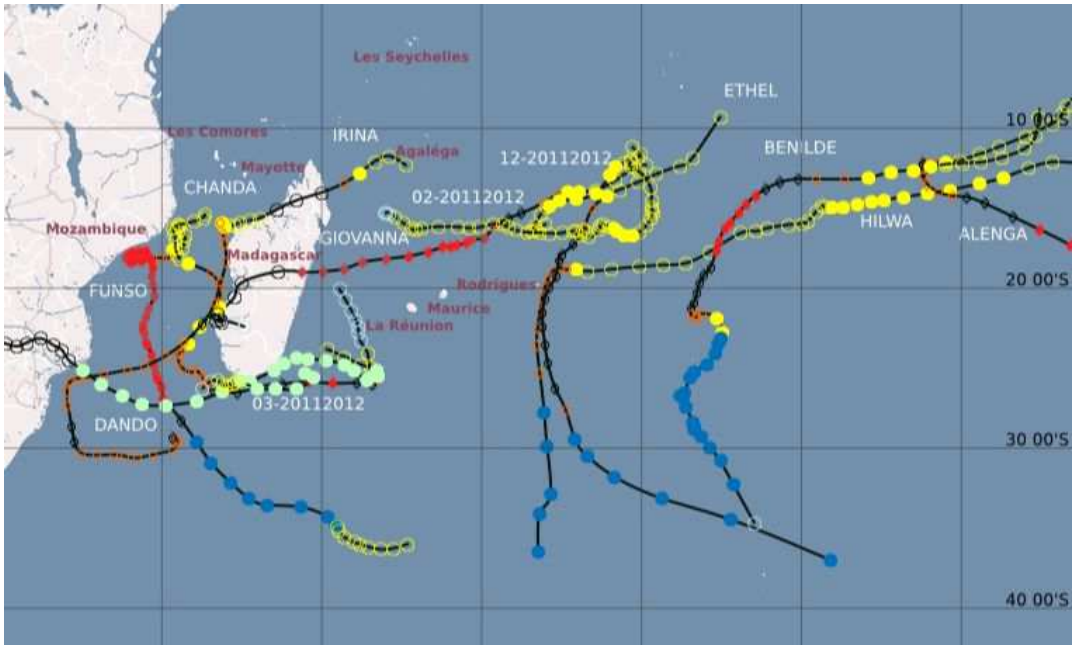


2. Availability of tropical cyclone hazard information

RSMC databases : a prominent by-product of their operational activity

While the major mission of the RSMCs is to ensure the operational monitoring (analysis and forecasting) of tropical cyclones, one important related mission is to keep the memory of the climatology of all tropical systems in each of their areas of responsibilities.

Thus, as a prominent by-product of their operational activities, they maintain historical databases of tropical storms and cyclones, in particular the ones called 'Best-track' databases that include 6-hourly positions of the storms' centres and all relevant related parameters on intensity, size and structure…



Those databases constitute the main basis for all tropical cyclone related studies/applications.

These include risk mapping linked to tropical cyclone activity and impacts.

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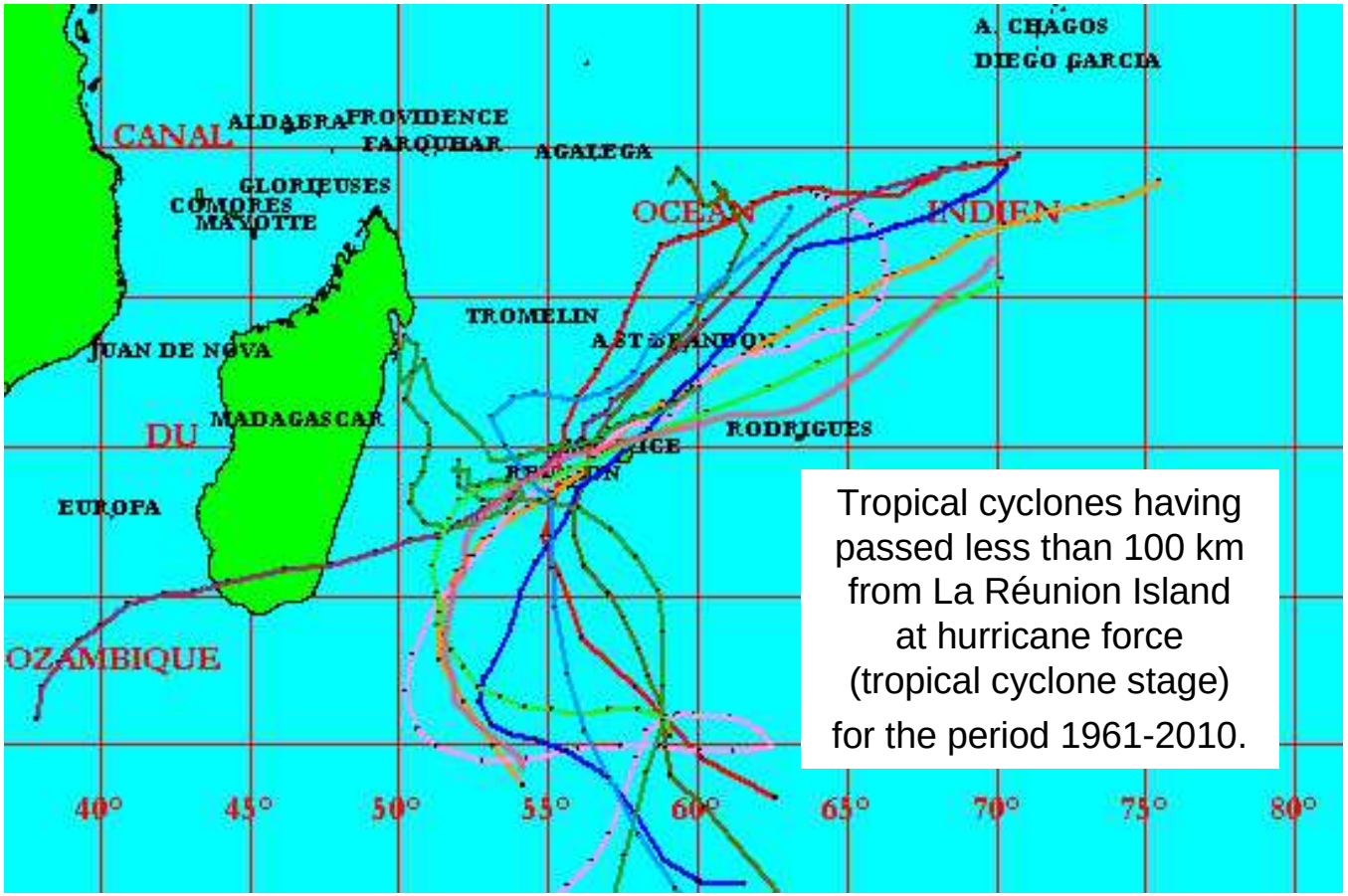
Using best-track data for assessing TC hazard : local scale



Tropical cyclones having passed less than 100 km from La Réunion Island at hurricane force (tropical cyclone stage) for the period 1961-2010.

Jenny (February 1962)
Giselle (February - March 1964)
Denise (January 1966)
Hermine (January 1970)
Hyacinthe (January 1980)
Florine (January 1981)
Firinga (February 1989)
Colina (January 1993)
Hollanda (February 1994)
Dina (January 2002)

The 'Best-Track' database can be used for TC risk assesment and mapping at local scale (for instance for La Réunion Island).

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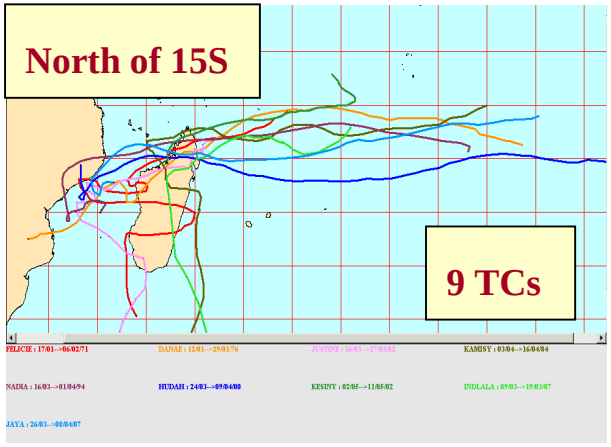
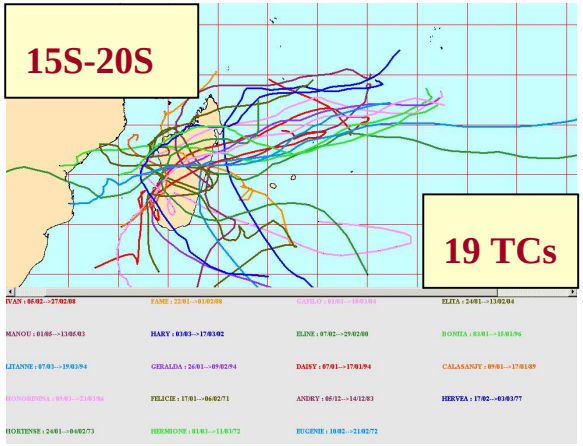
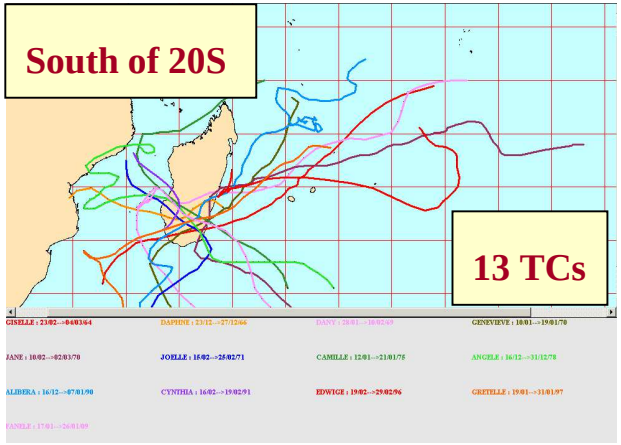
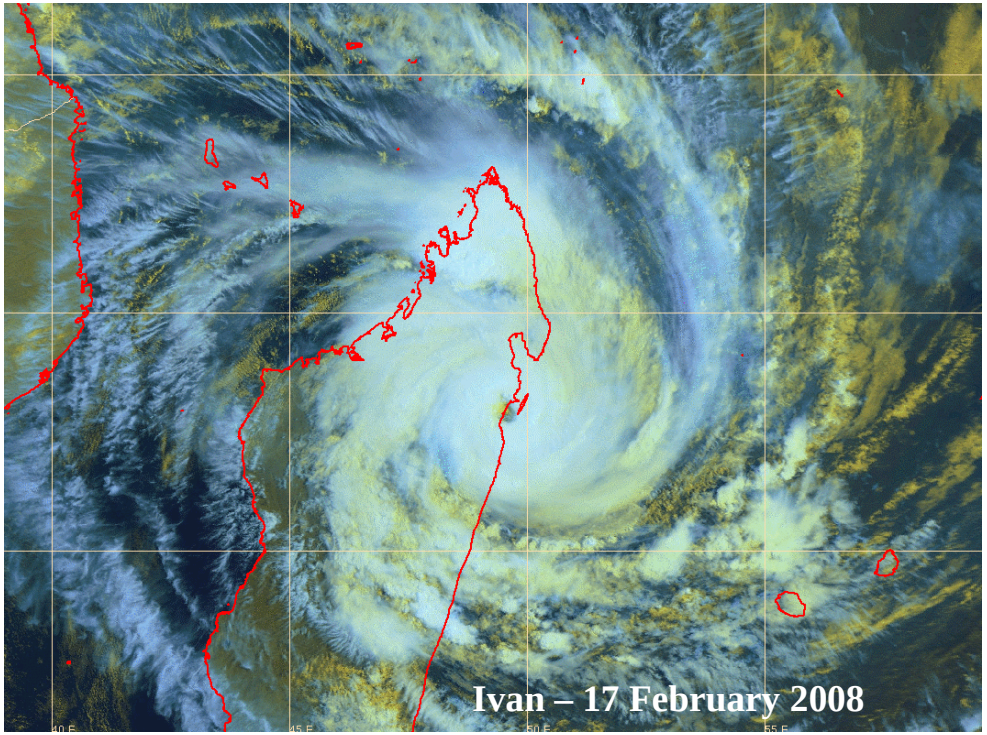
Madagascar TC landfalls (1963 –2009)









- **41 landfalls !!** (almost one every year in average)
- **Mainly between 15S-20S**
- **15% of landfalls along western coast**

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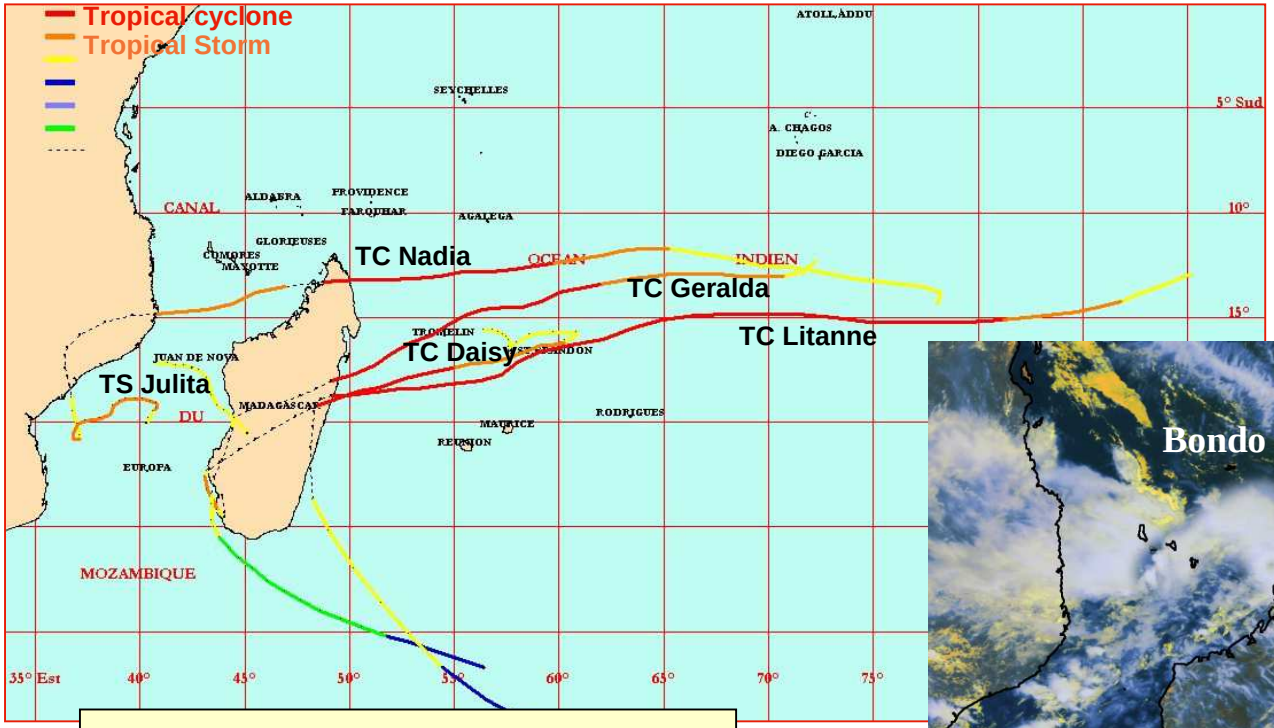
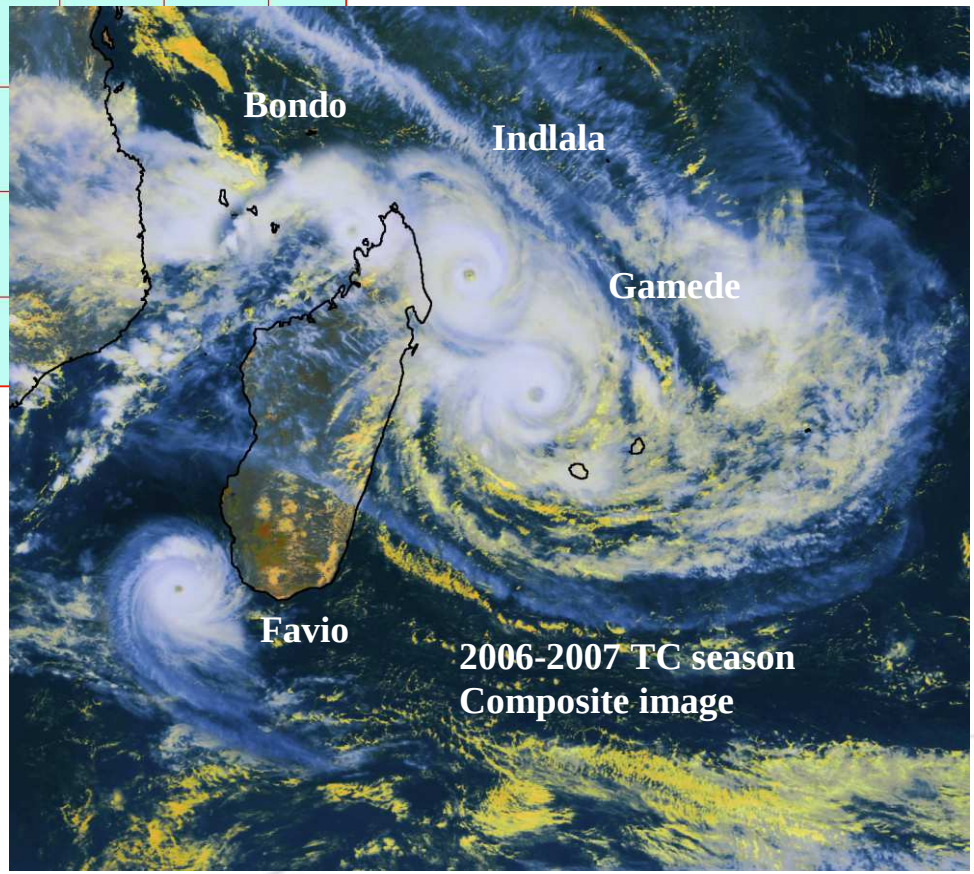
Madagascar TC landfalls (1963 –2009)

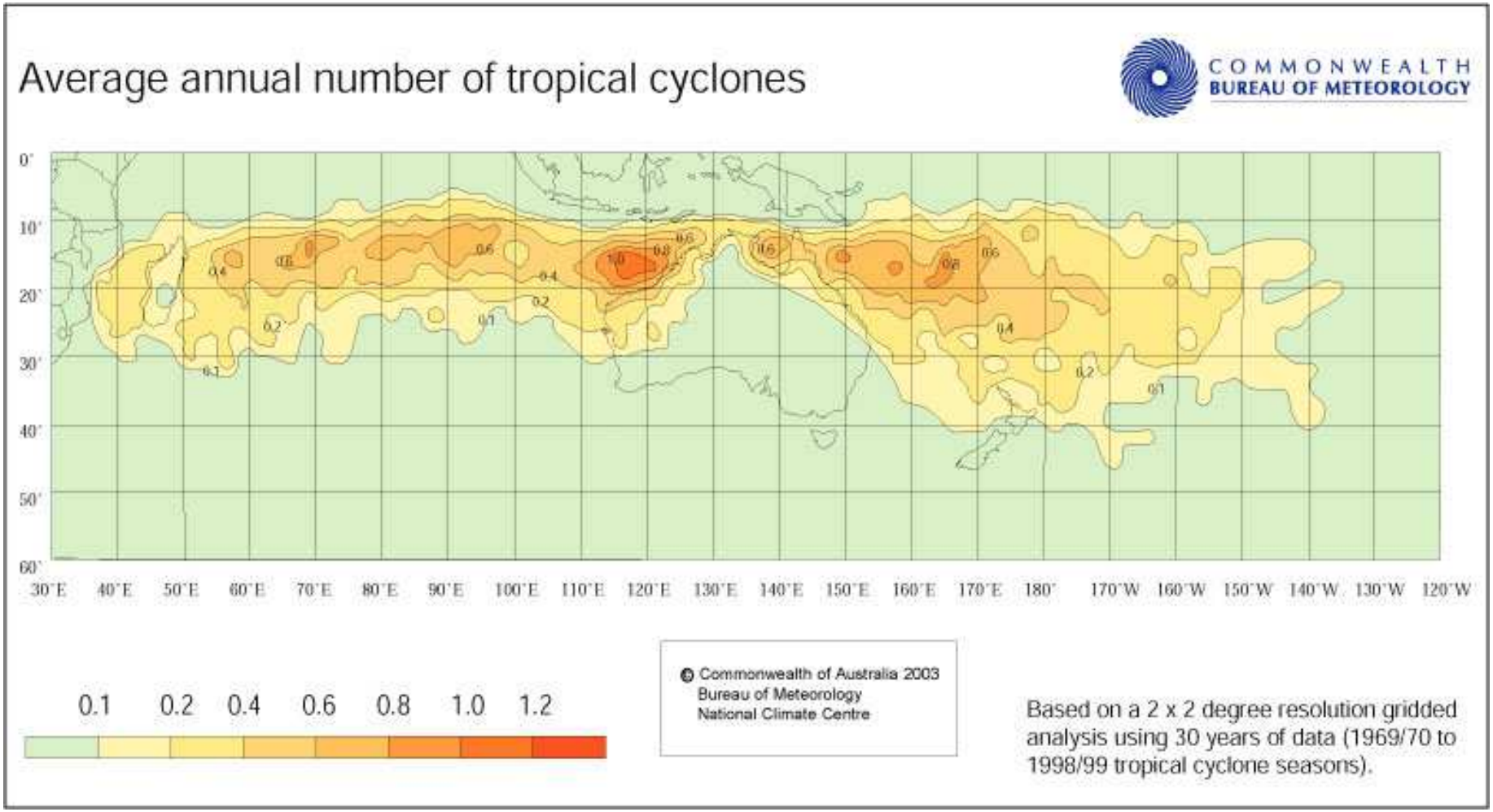


1993-1994 : "annus horribilis" for Madagascar with 5 landfalls including 4 at intense tropical cyclone stage

Some active seasons with much more than one TC roaming near Madagascar or hitting the island…



Using best-track data for assessing TC hazard : regional or global scale



Annual frequency of tropical cyclones : all data

30 years period of reference (cyclone seasons 1969/1970 to 1998/1999).

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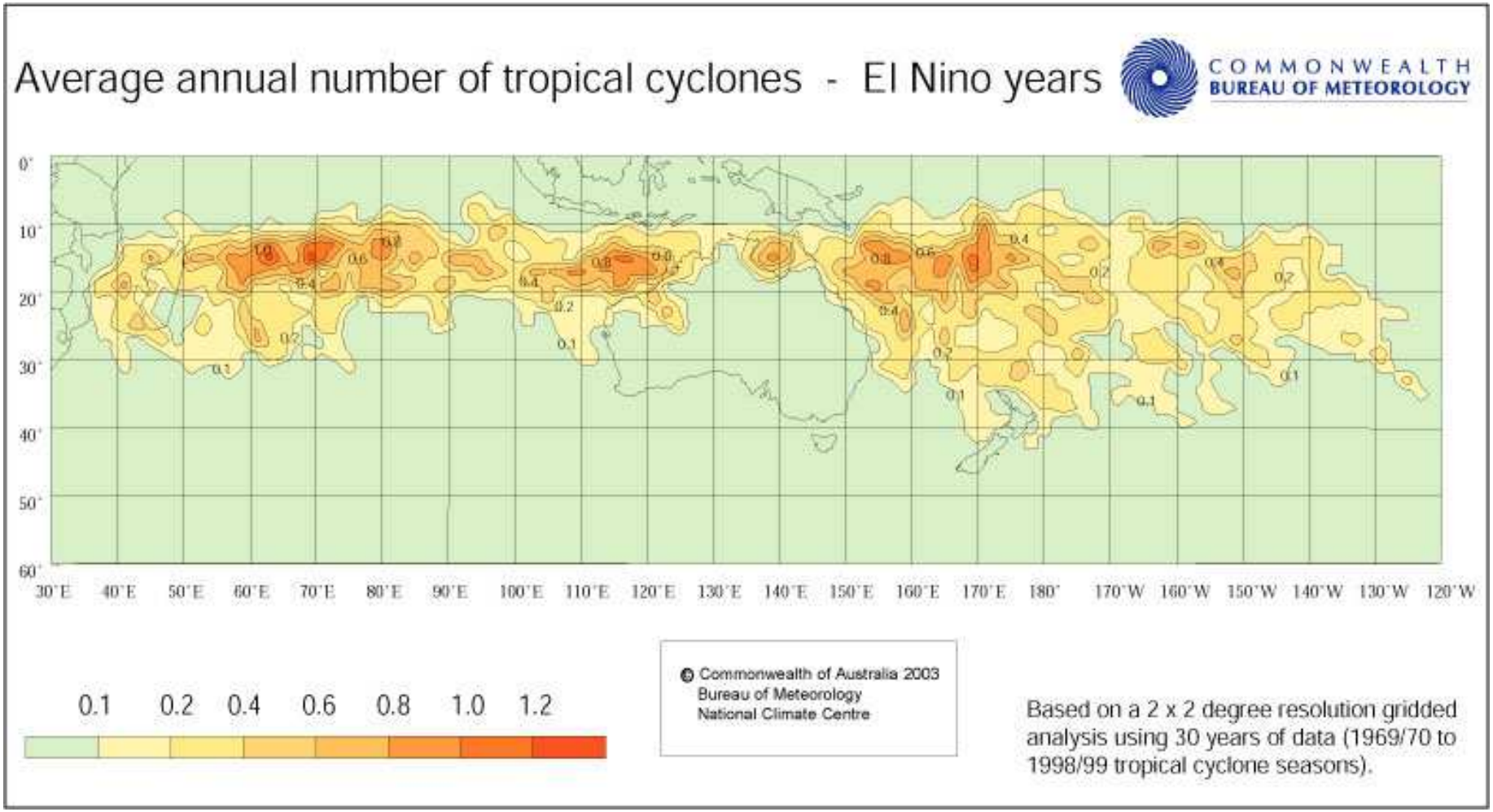
Using best-track data for assessing TC hazard : regional or global scale



Annual frequency of tropical cyclones : El Niño years

30 years period of reference (cyclone seasons 1969/1970 to 1998/1999).

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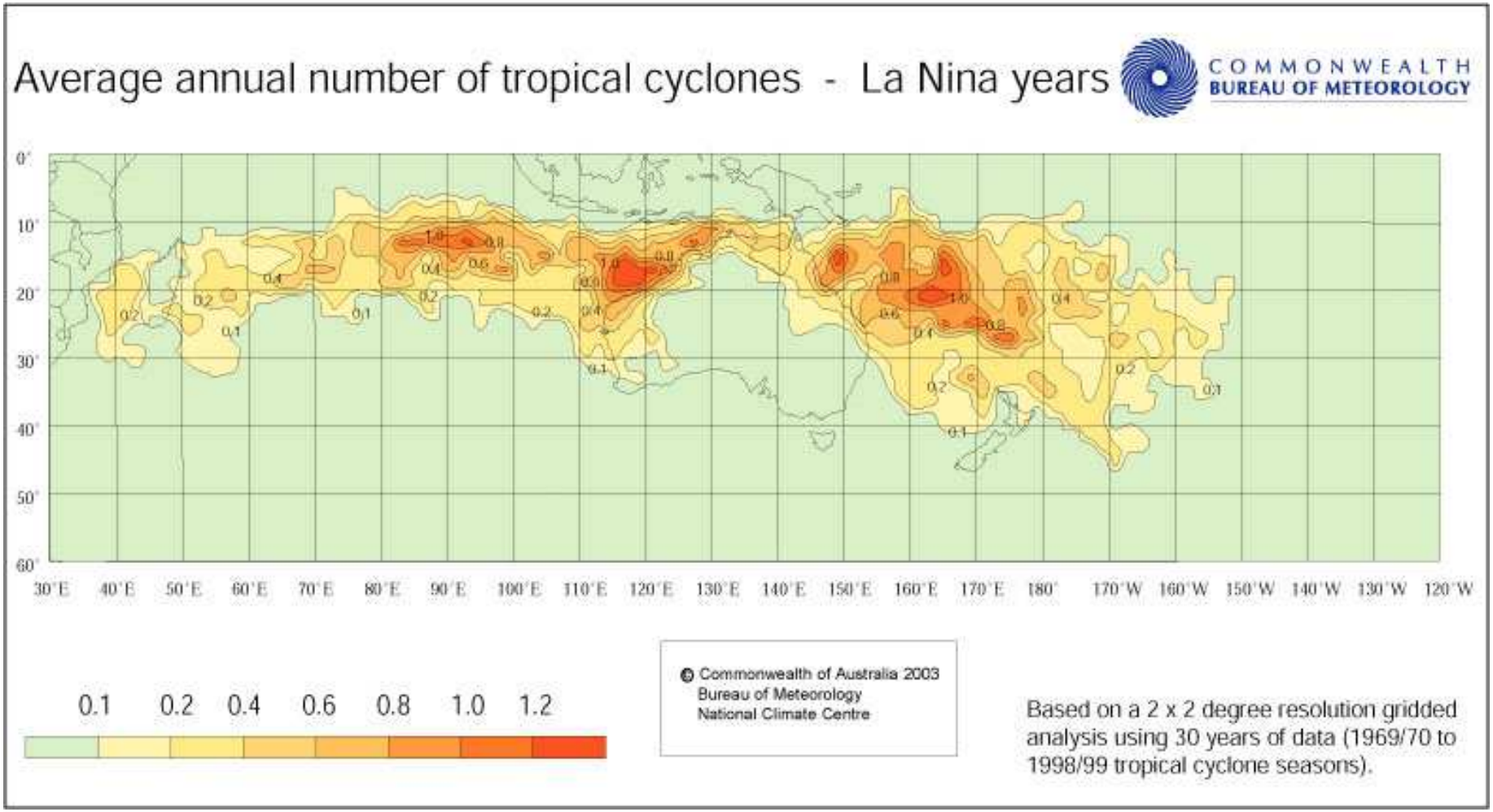
Using best-track data for assessing TC hazard : regional or global scale



Annual frequency of tropical cyclones : La Niña years

30 years period of reference (cyclone seasons 1969/1970 to 1998/1999).

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RSMC La Réunion historical database : the ongoing Re-analysis project (1)

To permit the best usage of the data for any study/application on tropical cyclones (for instance to detect any trend in the time-evolution of TC activity – a critical issue being a potential link with global warming) it is of course crucial to provide the best quality-controlled database.

It has therefore being recognized that a re-analysis of past best-track data, in particular via the re-analysis of past satellite imagery, should be a high priority (major recommendation of IWTC-V and VI – International Workshops on Tropical Cyclones).

Accordingly, RSMC La Réunion has undertaken a pluri-annual re-analysis project of past satellite data (focussing on the period 1978-1998) in order to rise the content and quality of its historical best-track database at the state-of the art level.

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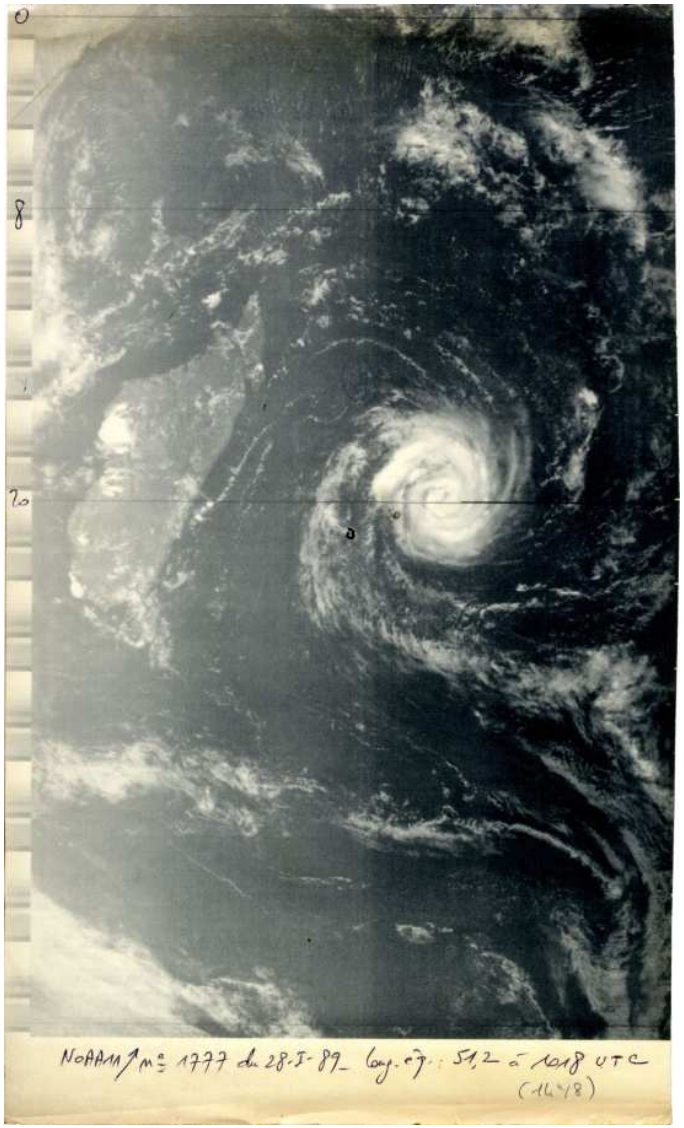
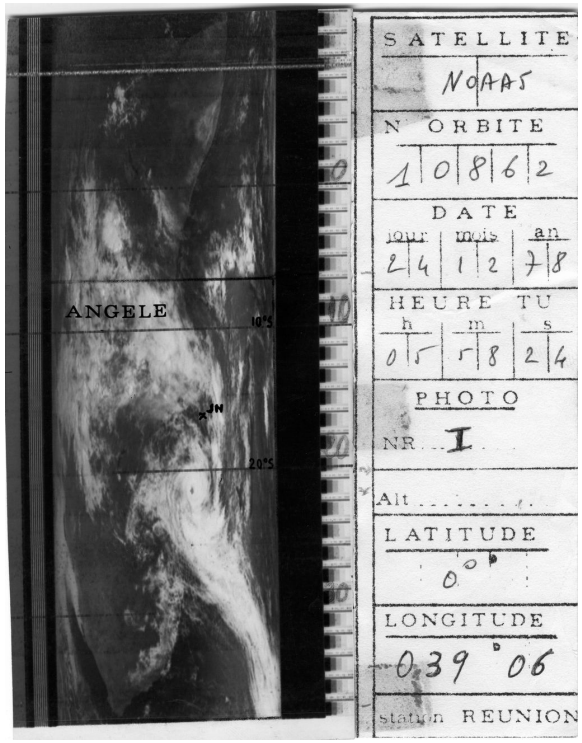
RSMC La Réunion historical database : the ongoing Re-analysis project (2)





Plenty satellite pictures were not available at La Réunion's Tropical Cyclone Centre in the past (DMSP, NOAA orbits outside of our scope of acquisition, microwave imagery) or have been more or less poorly exploited (Dvorak Technique not used or inappropriately used … no digital but "manually gridded" hardcopy printouts pictures.

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RSMC La Réunion historical database : the ongoing Re-analysis project (3)

Past geo-referenced digital in

- NCDC : National Climatic Data
- Tro
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- ter re-analysis period)
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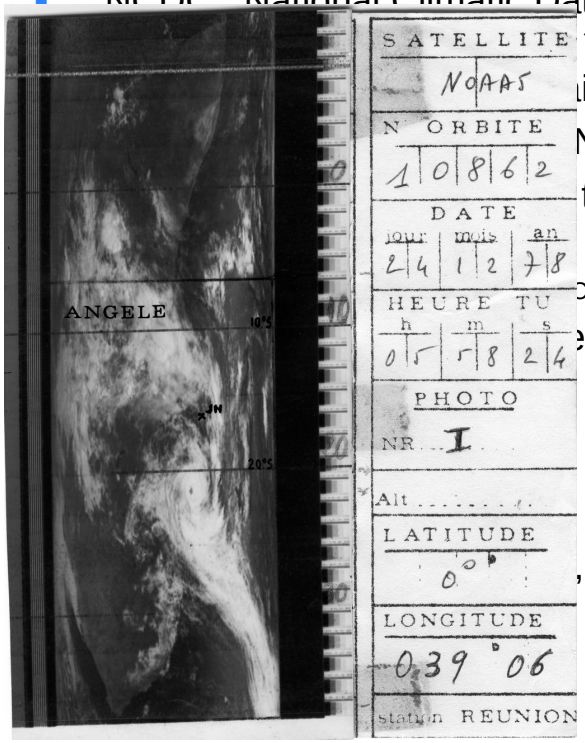
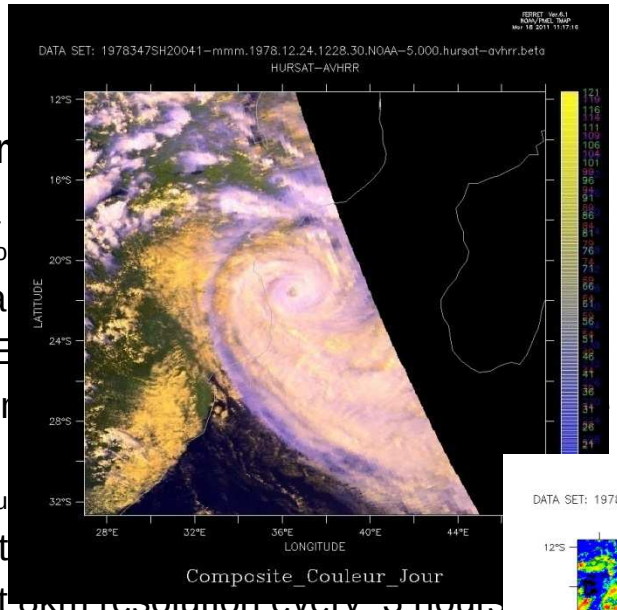
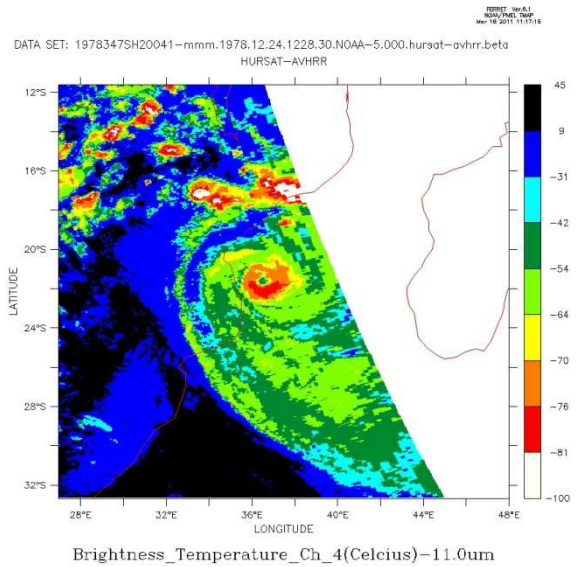
- ellit
- at 8km resolution every 3 hours





- , VIS, VW at 4km resolution ever



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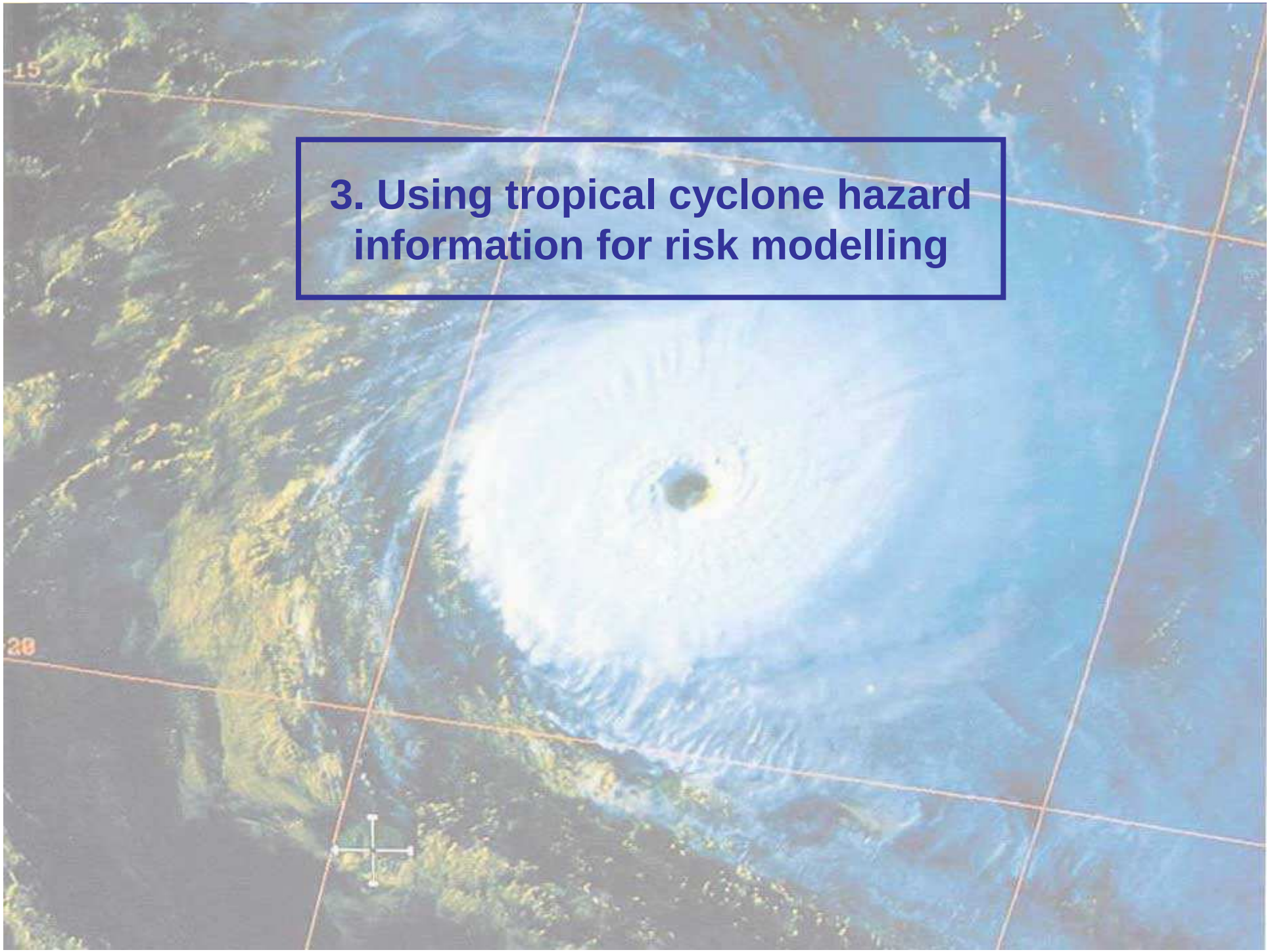


3. Using tropical cyclone hazard information for risk modelling

Example of ongoing project about risk modelling (1)

An engineering firm (the JBA Risk Management Ltd) will develop for the CCR (Caisse Centrale de Réassurance – a reinsurance company) a single and multi-peril model for La Réunion Island dealing with the following meteorological related hazards :

- **sea surge flood**
- **windstorm**
- **surface water flooding (i.e. heavy rainfall – runoff) due to cyclone or non-cyclone events**

The model will include both probabilistic and deterministic components and additionally enable the analysis of individual scenario events.

The probabilistic model will be accompanied by deterministic flood hazard maps for sea surge and surface water flood.

Hazard maps providing the extent and depth of flooding for given return periods will be developed for sea surge and surface water flooding.

Inclusion of a 'built environment model' and of 'vulnerability functions' relating hazard intensity (e.g. water depth or windspeed) to the expected mean damage ratio, and hence enabling the calculation of ground-up loss per property in the probabilistic model, will enable the quantification of return period losses and the output of a loss exceedance curve and event-by-event losses

Example of ongoing project about risk modelling (2)

The development of the model will require the access to different databases (such as Bathymetry, Built environment data, Cyclone data, etc…).

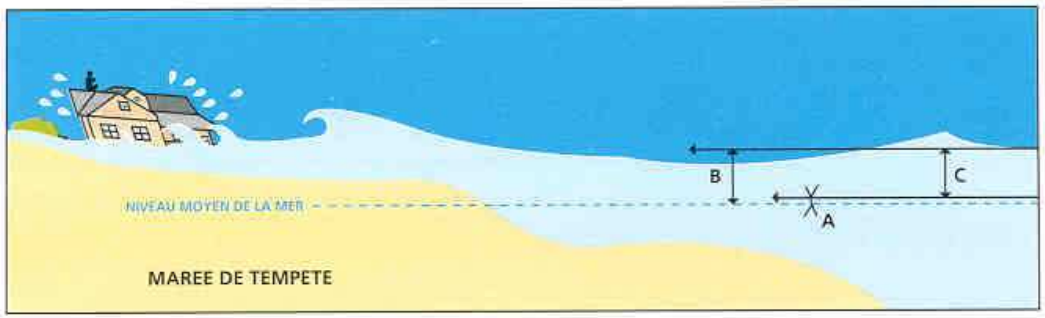
Météo-France has been sollicited by the CCR for :

- **providing access to its historical database of tropical storms in the South-West Indian Ocean basin**
- **providing access to the climatological records of wind and rainfall observations on La Réunion Island**
- **intervening as an expert to check the specifications of the project**

Ongoing work at Météo-France La Réunion about storm surge

Météo-France La Réunion has an ongoing project on tropical cyclone induced storm surge.

Using the Météo-France storm surge model, first step will aim to generate an atlas of potential storm surge depending on TC intensity, TC structure (size, radius of maximum winds), track, etc… for a number of coastal sites of the region (from Mozambique and Madagascar essentially) selected for their socio-economic importance and/or vulnerability.



A : Marée astronomique (ici, environ 1 m)

B : Marée de tempête (ici, environ 5 m)

C = B - A : Onde de Tempête (ici, environ 4 m)

The database linked to this atlas will serve as first-level guidance for the tropical cyclone forecasters during operational assessment of storm surge during real TC events.

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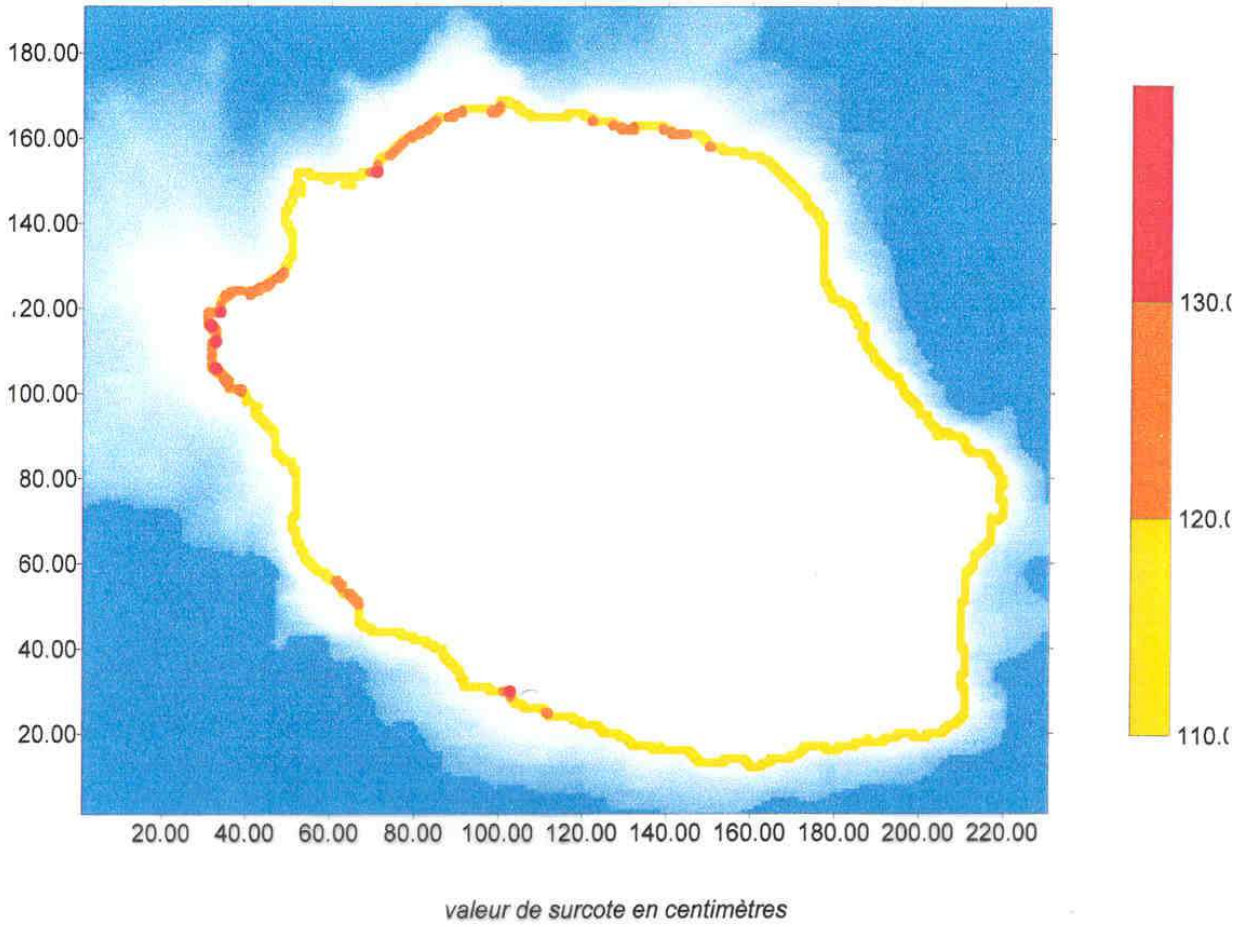
Mapping of maximum potential storm surge at La Réunion

Maximum height of sea level rise due to storm surge simulated with the Meteo-France storm surge model for La Réunion (figures in cm)



The work endeavoured for the coasts of Madagascar and Mozambique will extend the similar study done in the early 1990s when an atlas had been developed for mapping storm surge risk at La Réunion.

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THANK YOU

Dessin. de Mr P. CASSIEN. 1861 A. Roussin litho.

PENDANT L'OURAGAN