The SouthWest Indian Ocean cyclone basin

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1. Introduction- Global cyclonic activity

2. Southwestern Indian Ocean (SWIO) TC activity
   - Practices in use
   - Interannual evolution
   - Monthly and space distribution
   - Typical tracks

3. Mean synoptic pattern over SWIO

4. Remarkable TC
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DEFINITIONS:

A tropical cyclone is the generic term for a non-frontal synoptic scale low-pressure system over tropical or sub-tropical waters with organized convection (i.e. thunderstorm activity) and definite cyclonic surface wind circulation (Holland 1993)

Max wind < 34 kt → Tropical depression

33 kt < max wind < 64 kt → Tropical storm

Max wind > 63 kt → "hurricane" (north ATL, NEPAC)

"typhoon" (the NWPAC west of the dateline)

"severe tropical cyclone" (the SWPAC and SEI east of 90E)

"severe cyclonic storm" (the North IND)

"tropical cyclone" (the SWIO)
Cyclone basins

Statistiques sur la période 1968-1990

A : Nombre annuel moyen de tempêtes et cyclones tropicaux
B : Nombre annuel moyen de cyclones tropicaux
C : Pourcentage de la population mondiale (tempêtes et cyclones)

Frequency of tropical cyclones per 100 years within 140 km of any point. Solid triangles indicate maxima, with values shown. Period of record is shown in boxes for each basin. (Neumann 1993)
Tracks of tropical cyclones (with maximum winds greater than 63km/h, 34kt) for the period 1985-2005. Best-track from JTWC

- Warm waters at high latitudes
- Cold waters (<23°C)
World cyclone watch

TCP, tropical cyclones programme, programme of the World Weather Watch created in 1972 by WMO

A specific organisation leaded by WMO: 6 RSMCs (Regional Specialized Meteorological Centres) and 6 TCWCs (Tropical Cyclone Warning Centres)
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Area of Responsability extended southwards (30S → 40S) since september 2003, to monitor singular warm core systems.
**Practices in the SWIO:**

- Dvorak scale used since 1982
- Wind-Pressure relationship: newly used of Courtney & Knaff (2009) – Atkinson & Holliday (1977) used before
- Criteria: average wind (10mn)

**Modifications in September 1999:**

- Conversion factor between 1 min and 10 min winds changes from 0.80 to 0.88
- Gust factor changes from 1.5 to 1.41.

**Recommendations from Harper et al. (2010):**

Conversion factor from 1 min to 10 min is **0.93** (open sea)

Gust factor for a 3 sec gust associated with a 10 min average wind is **1.23** (open sea)
Naming in the South West Indian Ocean

TC names 2013/2014

<table>
<thead>
<tr>
<th>Names</th>
<th>Provided by</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMARA</td>
<td>Tanzania</td>
</tr>
<tr>
<td>BEJISA</td>
<td>Swaziland</td>
</tr>
<tr>
<td>COLIN</td>
<td>Seychelles</td>
</tr>
<tr>
<td>DELIWE</td>
<td>Zimbabwe</td>
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<tr>
<td>EDILSON</td>
<td>Mozambique</td>
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<tr>
<td>FOBANE</td>
<td>Lesotho</td>
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<tr>
<td>GUITO</td>
<td>France</td>
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<tr>
<td>HELLEN</td>
<td>South Africa</td>
</tr>
<tr>
<td>IVANOE</td>
<td>Mauritius</td>
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<tr>
<td>JIRANI</td>
<td>Comores</td>
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<tr>
<td>KATUNDU</td>
<td>Malawi</td>
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<td>LETSO</td>
<td>Botswana</td>
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<td>MIRANA</td>
<td>Madagascar</td>
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<tr>
<td>NASERIAN</td>
<td>Kenya</td>
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<tr>
<td>OPANG</td>
<td>Lesotho</td>
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<td>PAYA</td>
<td>Comores</td>
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<td>QUERIDA</td>
<td>Tanzania</td>
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<td>ROMANE</td>
<td>France</td>
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<td>SINGAND</td>
<td>Malawi</td>
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<tr>
<td>TARUS</td>
<td>Kenya</td>
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<td>UNAMI</td>
<td>Botswana</td>
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<td>VUMA</td>
<td>Mozambique</td>
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<td>WAMIL</td>
<td>Mauritius</td>
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<tr>
<td>XOLILE</td>
<td>South Africa</td>
</tr>
<tr>
<td>YASMINE</td>
<td>Seychelles</td>
</tr>
<tr>
<td>ZAMILE</td>
<td>Swaziland</td>
</tr>
</tbody>
</table>

List changing on 1st July

List of names defined during the Tropical Cyclone Committee (TCC, every 2 years), among the propositions of the 15 members

Naming criteria:

- 10 min average winds reaching 34 kt over half of the clockwise circulation and near the centre.

Naming:

- Mauritius east of 55E
- Madagascar west of 55E
# Classification of tropical disturbances in the South West Indian Ocean basin

## Wind Force

<table>
<thead>
<tr>
<th>Stage Description</th>
<th>Wind Force</th>
</tr>
</thead>
<tbody>
<tr>
<td>No clear circulation center</td>
<td>&lt; 28 kt (&lt; 51 km/h)</td>
</tr>
<tr>
<td>Disturbance area</td>
<td>28-33 kt (51-63 km/h)</td>
</tr>
<tr>
<td>Tropical depression</td>
<td>34-47 kt (63-88 km/h)</td>
</tr>
<tr>
<td>Moderate tropical storm</td>
<td>48-63 kt (89-117 km/h)</td>
</tr>
<tr>
<td>Severe tropical storm</td>
<td>64-89 kt (118-165 km/h)</td>
</tr>
<tr>
<td>Intense tropical cyclone</td>
<td>90-115 kt (166-212 km/h)</td>
</tr>
<tr>
<td>Very intense tropical cyclone</td>
<td>&gt; 115 kt (&gt; 212 km/h)</td>
</tr>
</tbody>
</table>

**The wind force is averaged over 10 mn.**
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Annual distribution of number of tropical storms and cyclones

Variation interannuelle du nombre de tempêtes et cyclones tropicaux dans le Sud-Ouest de l'océan Indien

Average values since 1967: 9 named systems with 4-5 TC
Annual variation in cyclone activity

Cyclone activity is defined as the total number of days on which disturbances were storm or cyclone.

Average values since 1967: 51 days for cumulated activity
36 TS days / 15 TC days
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Monthly variation of cyclone activity in the South-West Indian Ocean

Each saison : 1 july to 30 june, since july 2002 (before :1 august to 31 july). 90% of tropical activity between the 15th of november and the 30th of april, period usually called « official cyclonic season »
Monthly variation of cyclogenesis

Operationnal definition of cyclogenesis:
*When a system is classified as a Tropical Depression*

- Earliest TC in oct (Blanche, 7 oct 69), latest in may (Lila in 86, Konita in 93, Kesiny in 2002 and Manou in 2003)
- No TC from june to september
- Storm possible all over the year even during austral winter.
- Since 62, in may: 14 TS (4 TC), in june: Gritelle in 91, Kuena in 2012, in july: Odette in 71, in september: 4 TS (Alice, Aviona) and more recently TS 01-20022003 (landfall in Seychelles) and Abaimba in 2003.
**First and last cyclogenesis over the basin**

<table>
<thead>
<tr>
<th>Over the 67-10 period</th>
<th>Date of season’s start</th>
<th>Date of season’s end</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most early</td>
<td>15 August 1996</td>
<td>16 January 1983</td>
</tr>
<tr>
<td>First quantille</td>
<td>End September-early October</td>
<td>End March</td>
</tr>
<tr>
<td><strong>Mediane</strong></td>
<td><strong>15 November</strong></td>
<td><strong>18 April</strong></td>
</tr>
<tr>
<td>Last quintille</td>
<td>10 December</td>
<td>11 May</td>
</tr>
<tr>
<td>Most lately</td>
<td>16 January 1987</td>
<td>25 July 1997</td>
</tr>
</tbody>
</table>
Cyclogenesis over the basin from 1966 to 2000

- Main cyclogenesis between 10S and 15S, more generally between 5S and 20S.
- Few cyclogenesis south of 20S and north of 5S (never north of 2.5S, because Coriolis is too weak).
- 13% of the cyclogenesis over the Mozambique Channel.
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Some typical tracks

1. TC ALBERTINE 23/11 - 03/12/94
2. TC BELLAMINE 29/10 - 12/11/96
3. TC BONITA 03/01 - 15/01/96
4. TC HUDAH 24/03 – 09/04/00
5. TC HYACINTHE 15/01 - 31/01/80
6. TC ODILLE 29/03 - 17/04/94
7. TS DESSILIA 16/01 - 24/01/93
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Mean atmospheric circulation during the southern summer

Northern high

Subtropical high

Convergence of the trade winds flow and the monsoon flow

ITCZ # The monsoon trough

Janvier
Mean surface streamlines during southern summer

Source: Saddler, 1975
Mean surface streamlines during austral fall

Source: Saddler, 1975
Mean atmospheric circulation during southern winter

- Heat low over India
- Stronger trade winds flows
- Stronger and more northwards high pressures

Alizé boréal
Mousson
Alizé austral

Juillet
Mean surface stream lines during southern winter

Source: Saddler, 1975
Mean surface streamlines during austral spring

Source: Sadler, 1975

Double near equatorial trough
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Some remarkable values in the SW Indian Ocean

**Minimum pressure recorded:**
- 932 hPa at Tromelin with *Lydie* in 1973
- 933 hPa at Rodrigues with *Monique* in 1968

**Max wind gusts recorded:**
- 280 km/h at Mauritius with *Gervaise* in 1975
- 278 km/h at Rodrigues with *Monique* in 1968
- 277 km/h at La Reunion with *Dina* in 2002 (montainous area)
- 223 km/h at La Reunion with *Jenny* in 1962

**Maximum amount of rainfall recorded:**
- 1825 mm in 24 h at La Reunion with Denise in 1966 (world record)
- 4869 mm in 4 days at La Reunion with Gamede in 2007 (world record)
- 6083 mm in 15 days at La Reunion with Hyacinthe in 1980 (world record)
Some statistics about landfalling TC in SWIO

67/68 → 12/13 – 45 years
Mozambique TC landfalls

10 TC, 1 every 4-5 years
2 predilected areas:
- Between Pemba & Quelimane
- Between Beira & Inhambane

67/68 → 12/13 – 45 years
Madagascar TC landfalls

- 43 landfalls!! (nearly 1 every year …)
- Mainly between 15S-20S
- 15% of landfalls along western coast

67/68 → 12/13 – 45 years
La Reunion TC less than 1°

8 TC, 1 every 6 years

67/68 → 12/13 – 45 years
Mauritius TC less than 1°

13 TC, 1 every 3-4 years

67/68 → 12/13 – 45 years
Rodrigues TC less than 1°

67/68 → 12/13 – 45 years

16 TC (!!), 1 every 3 years
- Up to 4 TC during the same season (72/73) !!!!
St-Brandon TC less than 1°

15 TC, 1 every 3 years
- up to 3 TC the same year (93/94)

67/68 → 12/13 – 45 years
Agalega TC less than 1°

5 TC, 1 every 9 years

67/68 → 12/13 – 45 years
Comoros arch. & Mayotte
TC less than 1°

3 TC, 1 every 15 years

67/68 → 12/13 – 45 years