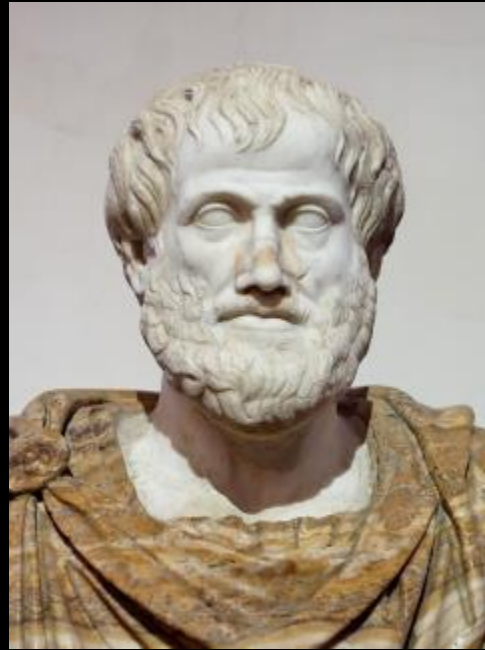




What is ARISTOTLE and how do we use ECMWF forecasts to contribute?

Dr Jenny Rourke

With special thanks to Gavin Iley, Bob Turner, Helen Titley, Julian Heming, the ERCC and all of the ARISTOTLE members.



ARISTOTLE:
All Risk
Integrated
System TOwards
Trans-boundary
hoListic Early-
warning



What is ARISTOTLE?

Emergency Response Coordination Centre (ERCC)



The Emergency Response Coordination Centre supports and coordinates a wide range of prevention and preparedness activities, from awareness-raising to field exercises simulating emergency response. © Ezequiel Scagnetti



Met Office

What is ARISTOTLE?

EU Civil Protection Mechanism Operations

Number of operations* of the EUCP Mechanism



*Operations = any event open in CECIS (request for assistance, early warning (pre-alert), monitoring)



Met Office

What is ARISTOTLE?

Met Office – MO
(Severe Weather)

Iceland - IMO
(Volcano and flooding)

Sweden – SMHI
(Flooding)

Austria - ZAMG
(Earthquakes)

Romania – NIEP
(Earthquakes)

Portugal - IPMA
(Tsunamis)

Turkey - KOERI
(Earthquakes and Tsunamis)

Italy – INGV
(Earthquakes and Tsunamis)

Greece - NOA
(Earthquakes and Tsunamis)



How does the Met Office contribute to ARISTOTLE?

Severe Weather Lead



How does the Met Office contribute to ARISTOTLE?



Severe Weather Lead



How does the Met Office contribute to ARISTOTLE?

Severe Weather Hazard Group

Likelihood	High	Monitor	prepare	Act
	Medium	nil	monitor	prepare
	Low	nil	nil	monitor
Decision Matrix		Sub-national	National Resources	International Resources
		Estimated resources		

- Met Office (UK)
- FMI (Finland)
- IMO (Iceland)
- KNMI (Netherlands)
- ZAMG (Austria)
- IPMA (Portugal)

How does the Met Office contribute to ARISTOTLE?

- ARISTOTLE EMERGENCY REPORT -

RED THREAT LEVEL FROM TROPICAL CYCLONE ENAWO

Date	Time
Report: 05 March 2017	14:00 (UTC)
Event: 05 March 2017	00:00 (UTC)
Area	Type of report
SUBSAP and CENTRAL ASIA ASA and OCEANIA NORTH AFRICA LATIN AMERICA and CARIBBEAN MIDDLE EAST and NORTH AFRICA Sub-SAHARAN AFRICA	<ul style="list-style-type: none"> • Windy Squall Report • Emergency Report (+SR) • Reactive • Proactive • Update

Hazardous phenomena

- Hurricane-force winds
- Storm surge (mainly to the south of the Cyclone's centre)
- Coastal flooding
- Inland flash flooding
- River flooding



Geographical location

Overall Impact

High

Coping Capacity

1.2 (Madagascar)

Alert Level

IMPACT LEVEL	High			X
	Medium			
	Low			
Required Resources	Con-tinuous	Inter-mittent	Inter-mittent	Inter-mittent

SEVERE WEATHER HAZARD

The latest model runs have come in line with the track of the Cyclone and we have more confidence that it will make landfall in the NE of Madagascar, close to (and to the south of) Antananarivo. It is then likely to track SW towards the eastern coastline before turning more SW and then S, bringing torrential rain to large parts of S Madagascar.

Figure 1. Latest information from La Réunion showing the accepted path of the Tropical Cyclone.



The main hazards will initially be the wind, with hurricane strength winds affecting the SE of the country. There is potential for a storm surge to affect most of the NE coast to the south of the Cyclone's centre, with coastal flooding causing destruction to coastal communities. There is likely to be widespread torrential rainfall with 500-750mm rain over the event, possibly more locally. The winds of the Cyclone will quickly reduce once it makes landfall, however during the first day (especially through the latter part of Monday and through Tuesday) the winds will be hurricane force across SE Madagascar, with very strong winds continuing to affect S parts into Wednesday and, to a lesser extent, Thursday as the remnants of the cyclone move S.

The communities most severely hit will be the regions in the NE, Sava and Andriantoana initially, then also Atsinanana. These regions are downhill from many some of the highest points of the island, so heavy rain may cause landslides along with other damages due to wind and rain. As the cyclone moves S the regions in the SE will also be affected by flooding, including Vohivohy-Matohomy. These are low lying regions with relatively high populations (<https://www.metoffice.gov.uk/news/updates-of-madagascar>).

There is also a concern about flooding in Madagascar's second City, Toamasina. This is a coastal city in the E around 200 miles to the S of Antananarivo. The whole area is quite flat with a river, although it is away from the strongest winds, it is likely to receive a lot of rainfall, at least 200mm, possibly 300mm, so flooding is likely. There is also a risk that the storm surge will affect the far S and therefore there may be coastal flooding as well as river and surface water flooding. It will be worth monitoring for disruption as this is the second largest city with many large industrial facilities as well as a large population.

ARISTOTLE Emergency Reports

3 hours to produce a report for the ERCC giving a multi-hazard overview, focusing on Impacts.

Real-life ARISTOTLE case study: Tropical Cyclone Enawo



- Formed as a moderate Tropical Storm 3rd March 2017
- Landfall 7th March 2017 as an Intense Tropical Cyclone
- Sustained winds 110kt (203km/hr)
- 186mm rain recorded in 6hrs
- Main impacts across NE Madagascar, with system weakening as it moved S across the country

Real-life ARISTOTLE case study: Tropical Cyclone Enawo

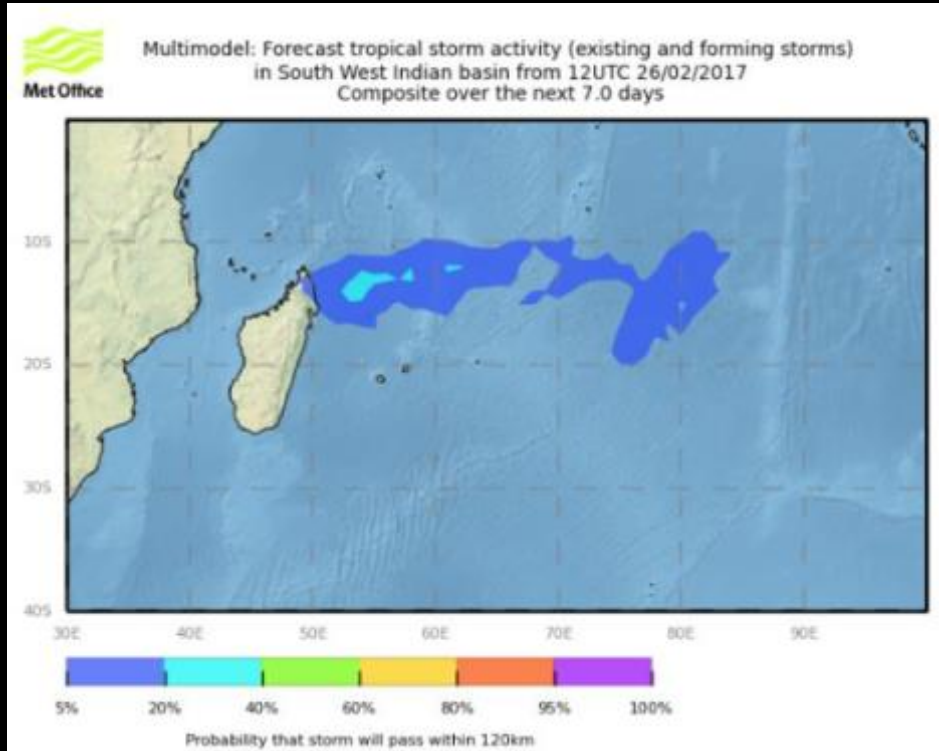


- The NE sustained significant damage to housing and agriculture
- Antalaha port was inaccessible with more than half the City's homes destroyed
- Severe flooding (up to 4 meters) in the NE, with 2 schools destroyed
- Humanitarian support was requested but was managed by in-country teams.

Real-life ARISTOTLE case study: Tropical Cyclone Enawo

Multi-model forecast of
Tropical Storm Activity

9 days before landfall



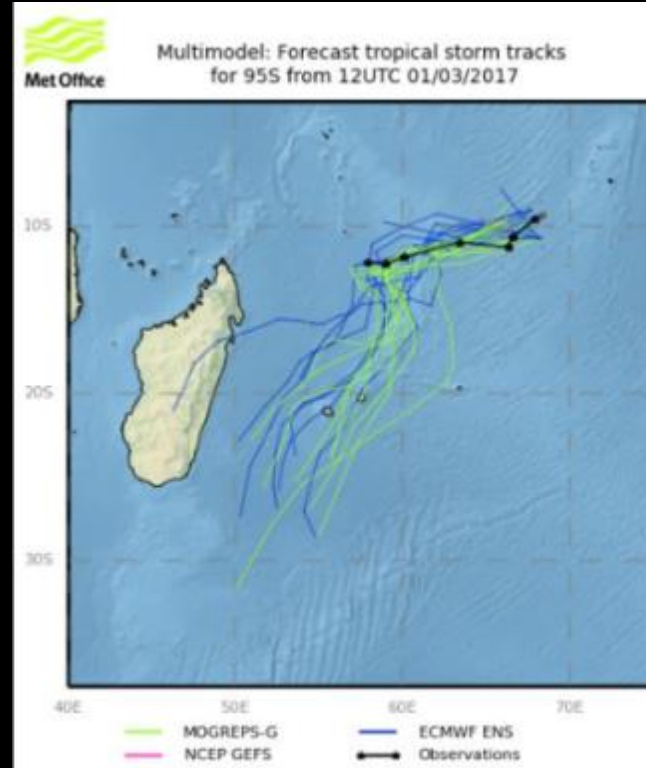
Real-life ARISTOTLE case study: Tropical Cyclone Enawo

Multi-model forecast
Tropical Storm Tracks

6 days before landfall

EC has best indication of
track

MOGREPS-G too far
east with all its members



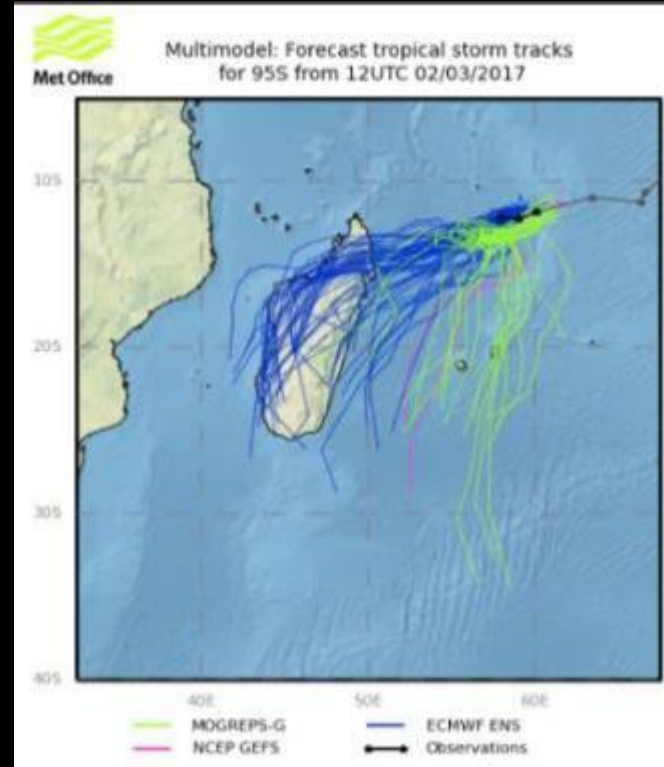
Real-life ARISTOTLE case study: Tropical Cyclone Enawo

Multi-model forecast
Tropical Storm Tracks

5 days before landfall

EC had even more
members making landfall
over NE Madagascar.

MOGREPS-G still too far
E with track.

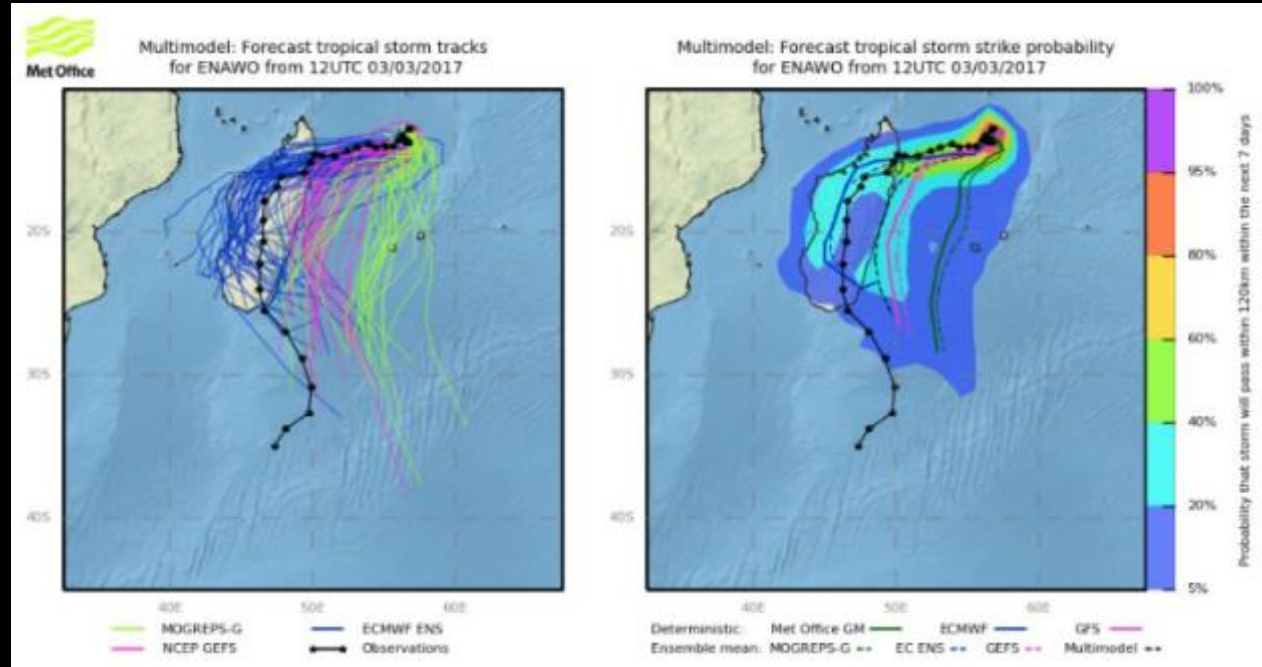


Real-life ARISTOTLE case study: Tropical Cyclone Enawo

Multi-model
forecast Tropical
Storm Tracks
(left) and Strike
Probability (right)

4 days before
landfall

Enawo now a
Moderate Tropical
Storm

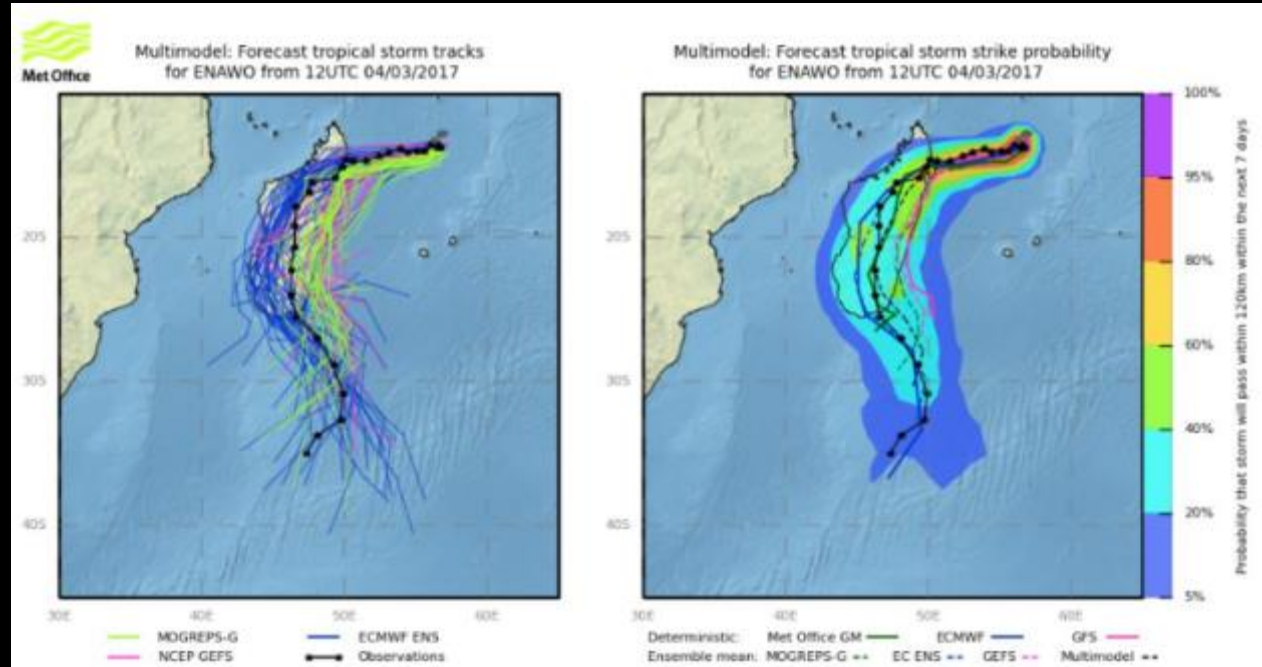


Real-life ARISTOTLE case study: Tropical Cyclone Enawo

Multi-model
forecast Tropical
Storm Tracks
(left) and Strike
Probability (right)

3 days before
landfall

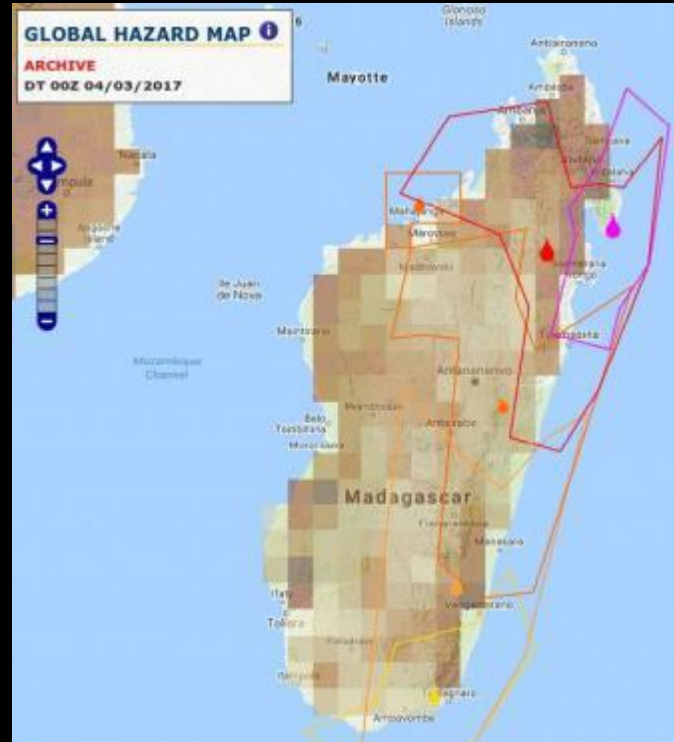
Contact with
ERCC: monitoring
phase



Real-life ARISTOTLE case study: Tropical Cyclone Enawo

		0.4-0.6	0.6-0.8	0.8-1.0				
Symbol size varies with probability and colour indicates forecast day	Tropical cyclone							
	Precipitation							
	Wind gust							
	Snow							
	Heatwave							
	Coldwave							
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Named TC tracks are coloured by day number. Symbol key: Ensemble means: MM EC MOG UM Deterministic: X								

Global Hazard Map (summary map)

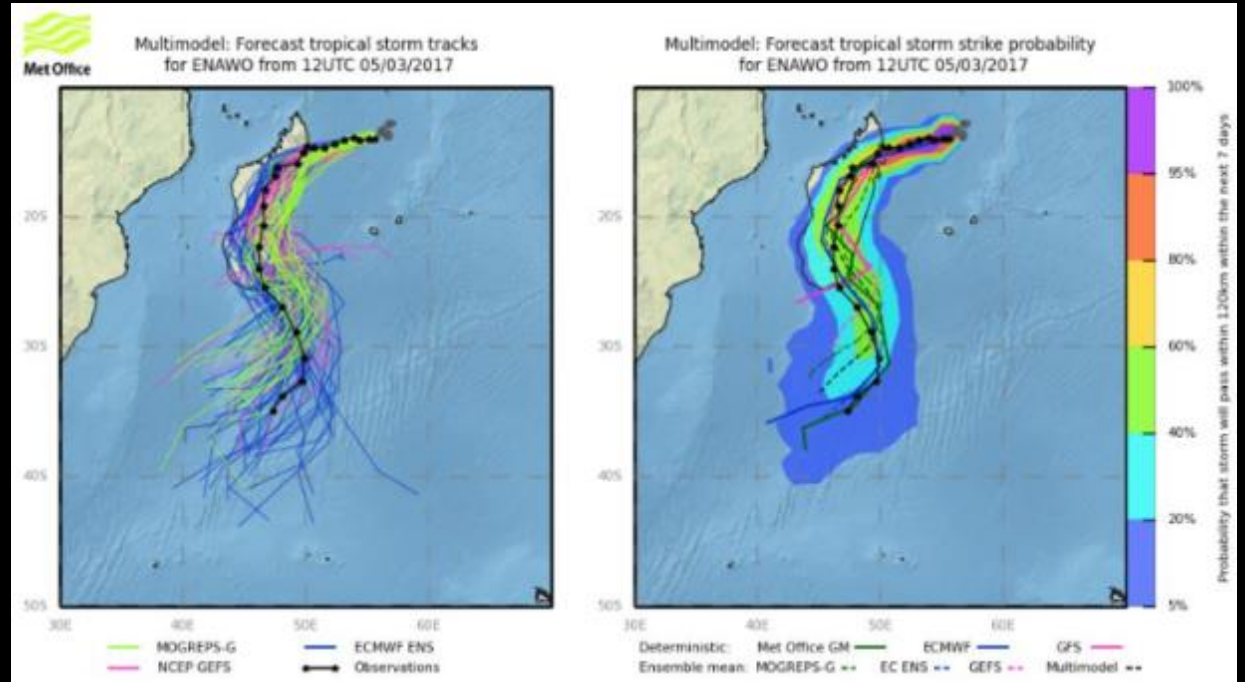


Real-life ARISTOTLE case study: Tropical Cyclone Enawo

Multi-model
forecast Tropical
Storm Tracks
(left) and Strike
Probability (right)

2 days before
landfall

ARISTOTLE
report issued to
the ERCC



Real-life ARISTOTLE case study: Tropical Cyclone Enawo

Report issued to ERCC

Focus on impacts across NE Madagascar

Report updated next day 24 hours ahead of landfall

- ARISTOTLE EMERGENCY REPORT -


RED THREAT LEVEL FROM TROPICAL CYCLONE ENAWO

Date	Time
Report: 03 March 2017	14:00 (UTC)
Event: 03 March 2017	00:00 (UTC)

Area	Type of report
SURGE and CENTRAL ASIA ASIA and OCEANIA NORTH AMERICA LATIN AMERICA and CARIBBEAN MIDDLE EAST and NORTH AFRICA SUB-SAHARAN AFRICA	Vividly Sitational Report Emergency Report (4-5H) Reactive Proactive Update

Hazardous phenomena

- Hurricane-force winds
- Storm surge (mainly to the south of the Cyclone's centre)
- Coastal flooding
- Inland flash flooding
- River flooding



Geographical location

Overall Impact
High

Coping Capacity
2.2 (Madagascar)

Alert Level

Alert Level	High			X
Medium				
Low				
Required Resources	Sub-national	National	International	

SEVERE WEATHER HAZARD

The latest model runs have come in line with the track of the Cyclone and we have more confidence that it will make landfall in the NE of Madagascar, close to (and to the south of) Antananarivo. It is then likely to track SW towards the eastern coastline before turning more SEV and then E, bringing torrential rain to large parts of E Madagascar.

Figure 1. Latest information from La Reunion showing the accepted path of the Tropical Cyclone.



The main hazards will initially be the wind, with hurricane strength winds affecting the NE of the country. There is potential for a storm surge to affect most of the NE coast to the south of the Cyclone's centre, with coastal flooding causing destruction to essential communities. There is likely to be widespread torrential rainfall with 500-750mm rain over the event, possibly more locally. The winds of the Cyclone will quickly reduce once it makes landfall, however during the first day (mainly through the latter part of Monday and through Tuesday) the winds will be hurricane force across NE Madagascar, with very strong winds continuing to affect E parts into Wednesday and, to a lesser extent, Thursday as the remnants of the cyclone move E.

The communities most severely hit will be the regions in the NE, Sava and Andohahelo initially, then also Atananarivo. These regions are downhill from very some of the highest points of the island, so heavy rain may cause landslides along with other damages due to wind and rain. As the system moves E the regions in the SE will also be affected by flooding, including Vavovavy-Mbovany. These are low lying regions with relatively high populations (https://esa.unh.org/docstore/indicators/indicators_of_madagascar).

There is also a concern about flooding in Madagascar's second City, Toamasina. This is a coastal city in the E around 200 miles to the S of Antananarivo. The whole area is quite flat with a river, although it is away from the strongest winds. It is likely to receive a lot of rainfall, at least 200mm, possibly 300mm, so flooding is likely. There is also a risk that the storm surge will affect the S and therefore there may be coastal flooding as well as river and surface water flooding. It will be worth monitoring for disruption as this is the second largest city with many large industrial facilities as well as a large population.

Summary



- ARISTOTLE EMERGENCY REPORT

RED THREAT LEVEL: FROM TROPICAL CYCLONE WARNING

Name:	03-Nov-2017	14-00 UTC
Event:	03-Nov-2017	00-00 UTC

Area: **SWANAD**

Hazardous phenomena

- Hurricane force winds
- Storm surge (likely to the south of the Cyclone centre)
- Coastal Flooding
- Major Road Flooding
- River Flooding

Geographical location: **SWANAD**

Overall Impact: **High**

Capacity: **12**

Alert Level: **3**




Likelihood	High	Monitor	prepare	Act
	Medium	nil	monitor	prepare
	Low	nil	nil	monitor
Decision Matrix		Sub-national	National Resources	International Resources
		Estimated resources		





Met Office

Many thanks to:

Helen Titley, Julian Heming, Gavin Iley,
Bob Turner, all at the ERCC and
all of the many ARISTOTLE members

