P5.11 TWO CASES ILLUSTRATING LIMITATIONS IN FORECASTING TROPICAL CYCLONES

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Two cases illustrating the current limitations in forecasting tropical systems are presented here. The first case illustrates a cyclogenesis missed by the Numerical Weather Products (NWP). The second case deals with the wreck of the ferry "Samson" in the northern Mozambique Channel in March 2004, during tropical cyclone Gafilo's event.

1. THE NUMERICAL WEATHER MODELS LIMITATIONS IN FORECASTING CYCLOGENESIS
The Tropical Cyclone ERNEST's case

Despite progress made over the last few years by the NWP in terms of cyclogenesis forecasting, unforecasted cyclogenesis still remains possible, as illustrated by ERNEST (a tropical cyclone with an explosive development in the northern part of the Mozambique Channel during January 2005). This system had been stagnating during three days to the northeast of Madagascar in a weak embryonic state, without any significant evolution; when in 24 hours, it intensified into a mature tropical cyclone (Figures 1 and 2). This was an exceptional deepening, as the Dvorak intensity rose from 2.0- to 4.5- in 24 hours span. This deepening of 2.5 on the Dvorak scale broke the Dvorak rules, only allowing a 2.0 increase at this stage.

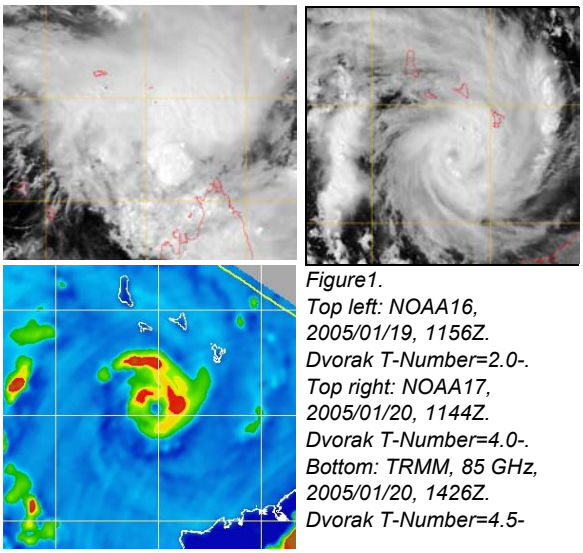

Figure1.
Top left: NOAA16, 2005/01/19, 1156Z. Dvorak T-Number=2.0-.
Top right: NOAA17, 2005/01/20, 1144Z. Dvorak T-Number=4.0-.
Bottom: TRMM, 85 GHz, 2005/01/20, 1426Z. Dvorak T-Number=4.5-

NOAA 16 and TRMM pictures are 24 hours apart, and in between, the weak embryonic state system intensified into a mature tropical cyclone.

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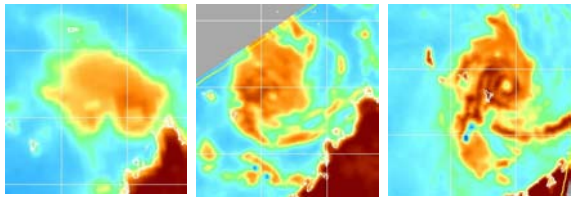

Figure 2. Left: SSMI, 37 GHz, 19 Jan 2005, 1526Z.
Middle: TRMM, 37GHz, 19 Jan 2005, 2335Z.
Right: Windsat, 37 Ghz, 20 Jan 2005, 0301Z.
Source: NRL Monterey
The rapid intensification shown by microwave imagery.

ERNEST's development was not forecasted by any NWP, which analysed a low but failed to forecast any deepening of the system as shown on the following graphs (Figure 3).

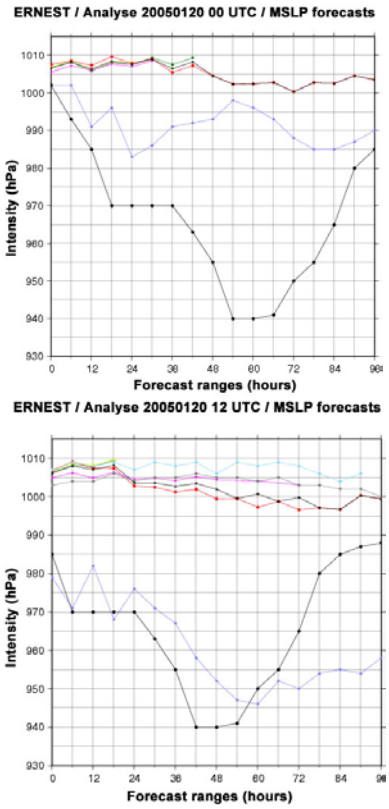

Figure 3.
Top: Intensity in hPa versus Forecast ranges in hours for different models. Run 20050120 0000Z.

Bottom: Same, but at 1200Z.

Line at the bottom of the graph is the MSLP analyzed at the Centre, others are French, European, English, AVNO and NOGAPS models. The intermediate one is the GFDN model.

Conclusion

Without the aid of the NWP, forecasters lack of guidance in predicting the development of tropical cyclones. This becomes especially problematic when such an exceptionally explosive and unforecasted cyclogenesis occurs in the vicinity of an inhabited area and may result in the failure of the "normal" warning process with very short warning notice.

2. HURRICANE FORCE WINDS FOLLOWING THE LANDFALL OF A TROPICAL CYCLONE
The tropical cyclone GAFILO's event.

Gafilo is one of the most violent cyclones having occurred in the last 20 years on the Southwest Indian ocean. 24 hours after Gafilo made a landfall on the northeastern Malagasy coast at 1900Z on the 7th March 2004, a ferry known as the "Samson" sank in the Mozambique Channel, resulting in over 100 fatalities.
An exceptional fact was hurricane force winds continued to blow locally in the vicinity of the northwestern malagasy coast (obs from Mahajunga city showed a sharp peak of winds with 70 knots 10-min max wind) despite the cyclone weakening for more than 24 hours inland.
What were the meteorological conditions off coast, when the "Samson" sank? Seawinds scatterometer data, available the March 7th, 1444Z and the 8th, 0312Z (prior to and after the sinking) showed a rather broad area of strong winds, moving southwestwards and reaching speeds of between 50 - 60 knots (Figure 4.).

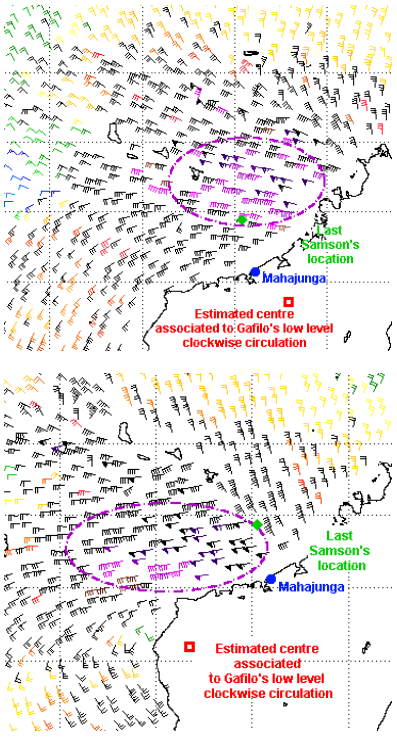

Figure 4.
Top: QuikSCAT, 2004/03/07,1444Z According to Quikscat data, strong west-northwesterly winds locally reaching 50 to 60 knots (storm force winds) were present north of the last Samson's position)
Bottom: QuikSCAT, 2004/03/08, 0312Z. Strong west-southwesterly winds have shifted southwestwards, getting over last Samson's position. Green point: last Samson's position. Red square: overland estimated Gafilo's center. Source: NOAA/NESDIS

However different studies prove that strong winds measured by scatterometers can be underestimated due to rain contamination, and with a resolution of 25 km, Seawinds scatterometer is moreover unable to detect strong gradients of winds. Infrared and microwave imagery, identify a very active outer cloud band associated with the broad clockwise circulation which swept through the region between Mayotte and the northwestern Malagasy coast. Deep convection, heavy rainfall and enhanced winds are associated with such active outer rain bands. Thanks to TRMM radar imagery (Figure 5), details of this band show the local extreme density of the convection, which appeared to resemble a powerful squall line over 30 km in width, which passed over the last position of the "Samson" at a time corresponding to the estimated time of wreck. The storm force or hurricane force winds and very high seas experienced by the ship under this outer band probably caused its loss

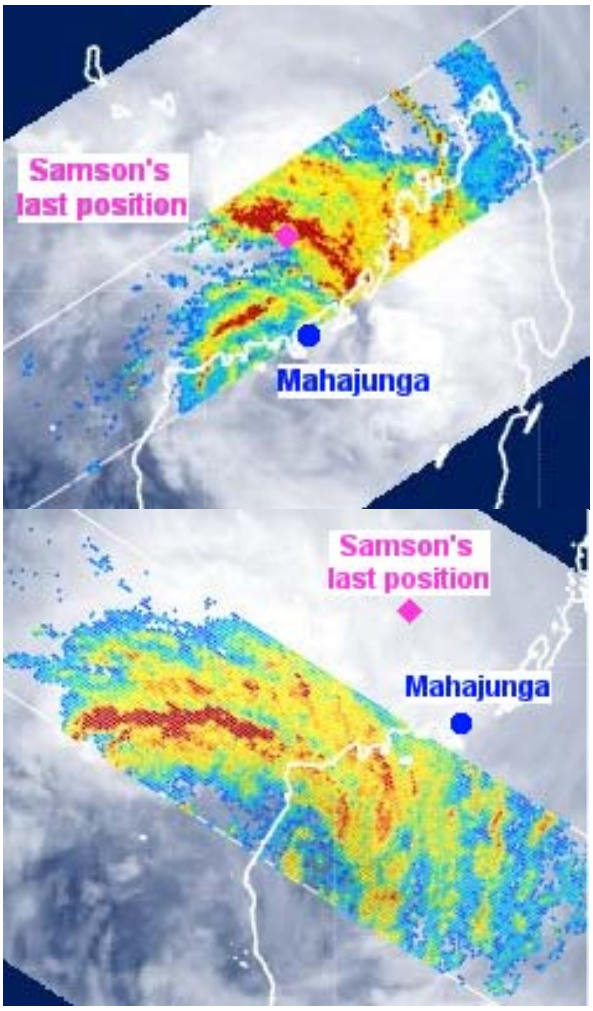

Figure 5. Top: TRMM/PR, 2004/03/07, 1653Z
Bottom: TRMM/PR, 2004/03/08, 0745Z.
The heavy rainfall band displayed on these pictures, respectively available two hours prior and twelve hours after the estimated time of the Samson's sinking, shows a very similar pattern and is likely the same. Source: NASDA

Conclusion
The continuation of such strong winds more than 24 hours after the landfall of a tropical cyclone is truly exceptional. Although warning for hurricane force winds could not be anticipated, thorough analyses of QuikSCAT data, available less than 3 hours prior to the shipwreck, would have helped to call for at least a storm warning .

3. CONCLUSION

These two examples highlighted the limitations in tropical cyclone forecasting skill when dealing with extreme events like explosive cyclogenesis with no anticipating signal on the NWP or unusual feature like the persistence of localized very violent winds within the outer circulation of a TC having made landfall more than 24 hours ago. Further investigations and research should be conducted in order to better understand and forecast the mechanisms leading to such extreme cases and provide guidance to forecasters.