EFFECT OF SEA SURFACE TEMPERATURE ON THE ACTUAL PARAMETERS OF CYCLONE NISHA: A SIMULATION STUDY USING WRF MODEL

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Abstract

Sea Surface Temperature (SST) is one of the genesis parameter for the formation of Tropical Cyclone (TC). This parameter also has strong interaction with other actual parameters such as Rain Fall (RF), Sea level pressure (SLP) at 200 hpa and 850 hpa, Wind direction at 200 hpa and 850 hpa, Wind speed at 200 hpa and 850 hpa, Relative Humidity at 500 hpa and 850 hpa which has been studied and its differences and error structure have been analyzed by using Weather Research & Forecasting (WRF) Model during the period when the tropical cyclone Nisha formed over Bay of Bengal. NOAA AVHRR RTG SST, NCEP FNL data are fed to the model as input. This model runs with FNL data for the period 24th November 2008 to 28th November 2008 with and without SST data. The effect of SST data in the forecast fields of (i). Rain Fall (RF), (ii). Sea level pressure (SLP) at 200 hpa (12.3 km above mean sea level (a.m.s.l)) and 850 hpa (1.5 km a.m.s.l), (iii). Wind direction at 200 hpa and 850 hpa, (iv). Wind speed at 200 hpa and 850 hpa, (v). Relative Humidity at 500 hpa and 850 hpa are studied and shown in pictorial form. In this study Bay of Bengal (BOB) is taken as the study area, because of its significant contribution to Climate Change and its impacts on our east coast. These model derived result well agree with the Satellite Data derived result.

Key words: Sea surface Temperature, Tropical Cyclone, Rainfall, Sea level pressure, Wind speed, Wind direction, Relative humidity

I. INTRODUCTION

A. Objective

To retrieve the Data sets used for the model run

- Run the model with and without SST
- Study the impacts of SST on forecast output

B. Study area

The domain selected is 75.03° E to 90.96° E and 2.09° S to 17.72° N. The area covering Tamil Nadu, Bay of Bengal region and parts of Indian Ocean is chosen as our study area. The study area is given in figure 1.0.

C. Data used

1. The data of Global forecasting system (GFS) of National Centre for Environmental Prediction (NCEP), USA is used as input to the WRF model. The model forecast for 120 hours based on the 00UTC of 24.11.2008.
2. NOAA AVHRR real time gridded averaged Sea Surface Temperature.
3. Tropical rainfall measuring mission (TRMM) Rain fall data.
4. Nisha Cyclone Data.

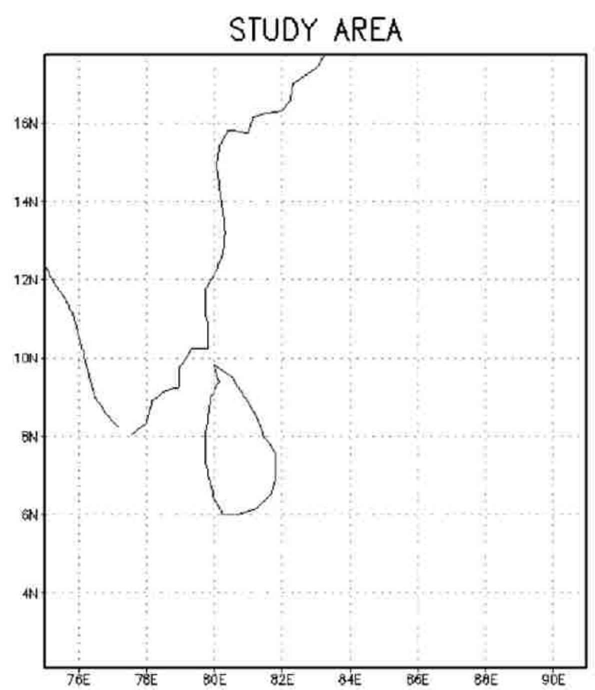


Fig. 1.0 Study area

II. METHODOLOGY

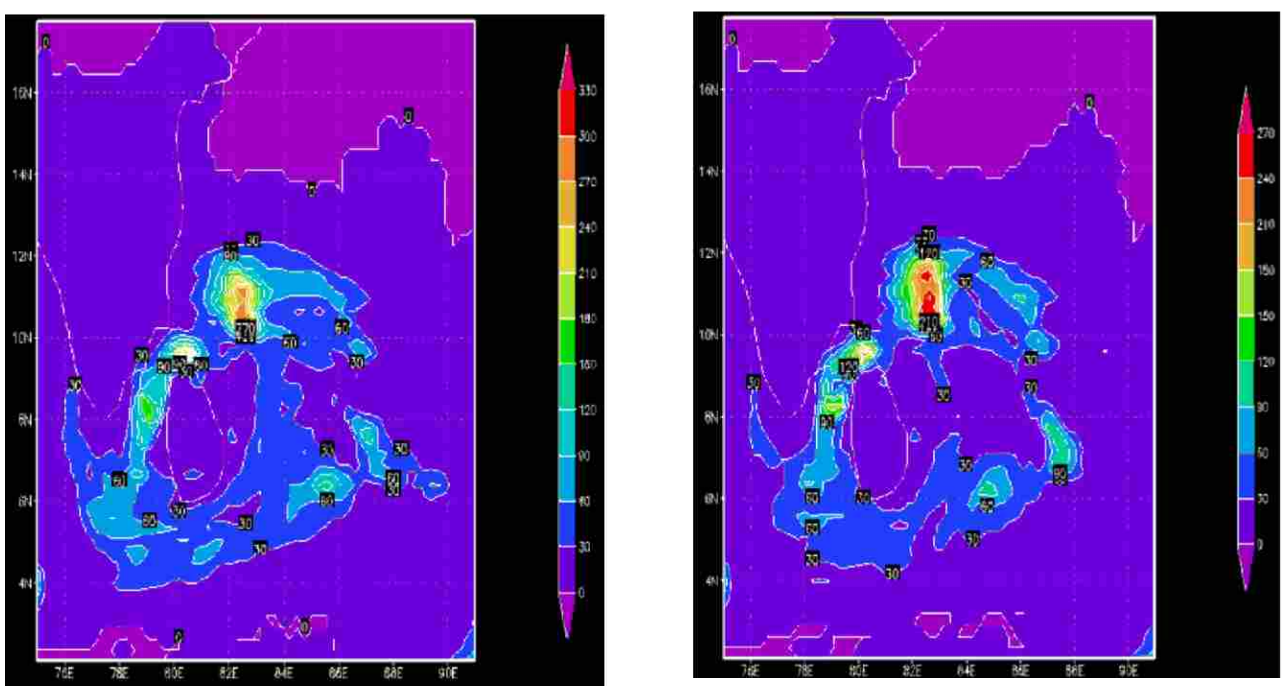
The Numerical weather prediction model WRF3.0 is run with NCEP FNL Gridded average atmospheric data (wind vector data, sea level pressure, wind speed, rain fall data) and the forecast output is generated for next five days. Also the model is with an additional input of NOAA AVHRR RTG SST data and the forecast out is generated for the same five days. The outputs are compared to see the effect of injecting SST data in the model. The outputs in pictorial form (Grads output) is presented in the paper. The tools to be used are (i) Weather Research Forecasting Model Version 3.0 (ii) Grades Visualization Tool.

III. RESULTS AND DISCUSSION

Tropical cyclogenesis is the technical term describing the development and strengthening of a tropical cyclone in the atmosphere. Tropical cyclogenesis involves the development of a warm-core cyclone, due to significant convection in a favorable atmospheric environment. While six factors appear to be generally necessary, tropical cyclones may occasionally form without meeting all of the following conditions. In most situations, water temperatures of at least 26.5 ° C (79.7 ° F) are needed down to a depth of at least 50 meter (160 ft); waters of this temperature cause the overlying atmosphere to be unstable enough to sustain convection and thunderstorms. Another factor is rapid cooling with height, which allows the release of the heat of condensation that powers a tropical cyclone. High humidity is needed, especially in the lower-to-mid troposphere; when there is a great deal of moisture in the atmosphere, conditions are more favorable for disturbances to develop. Low amounts of wind shear are needed, as high shear is disruptive to the storm's circulation. Tropical cyclones generally need to form more than 555 kilometers (345 mi) or 5 degrees of latitude away from the equator, allowing the Coriolis Effect to deflect winds blowing towards the low pressure center and creating a circulation. Lastly, a formative tropical cyclone needs a pre-existing system of disturbed weather, although without a circulation no cyclonic development will take place. Here in this study WRF model is run without ingesting SST data and with ingesting SST data in the model and the various output puts are compared. The results are presented here.

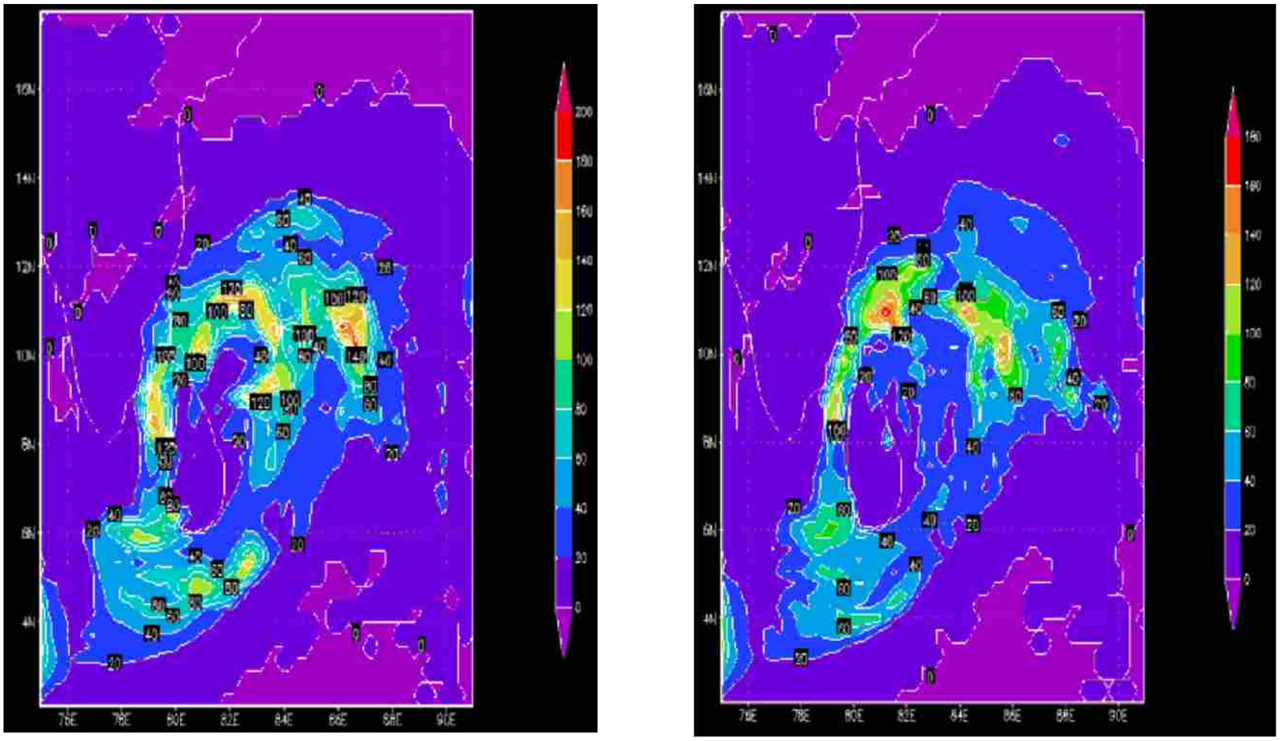
A. Rain Fall

Figures 5.1 to 5.4 display the forecast rainfall pattern of 25th, 26th, 27th and 28th November 2008 without SST and with SST data ingested in the model. Figures 2.5 display the TRMM derived rainfall pattern.



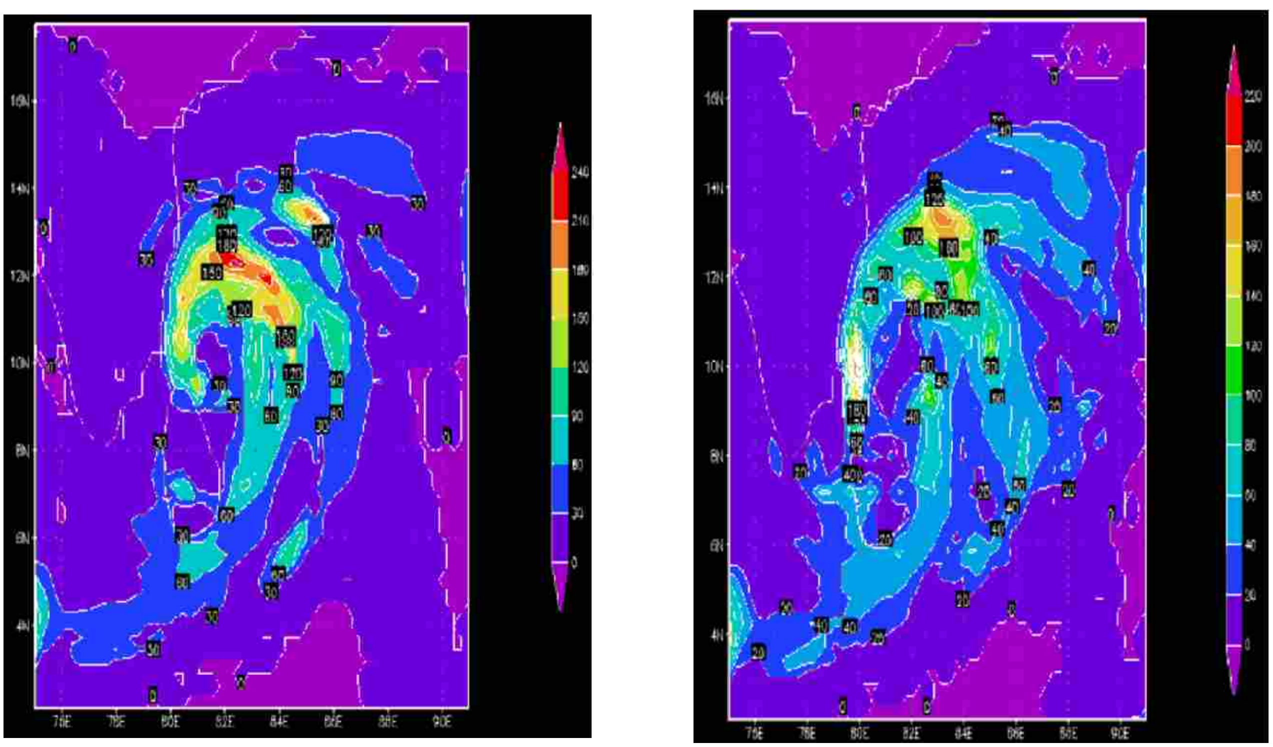
(a) (b)

Fig. 2.1 Rainfall forecast for 25.11.2008: (a) WRF model output without SST (b) WRF model output with SST



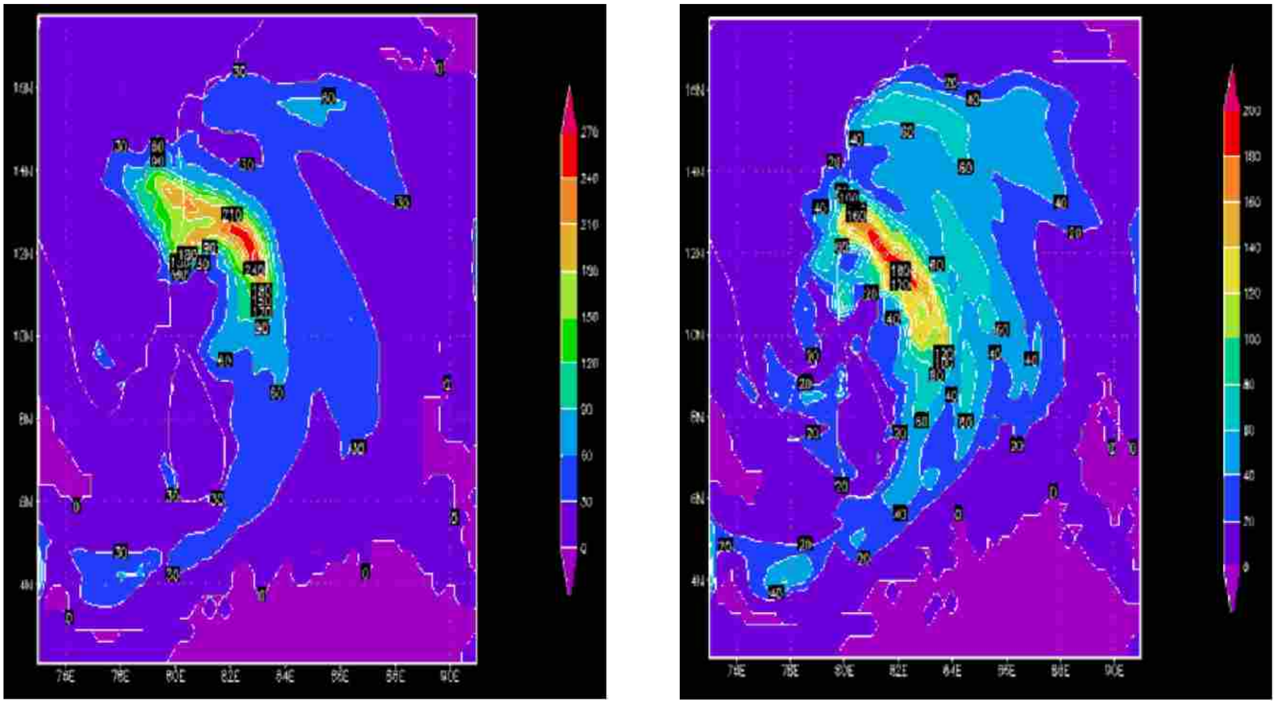
(a) (b)

Fig. 2.2 Rainfall forecast for 26.11.2008: (a) WRF model output without SST (b) WRF model output with SST



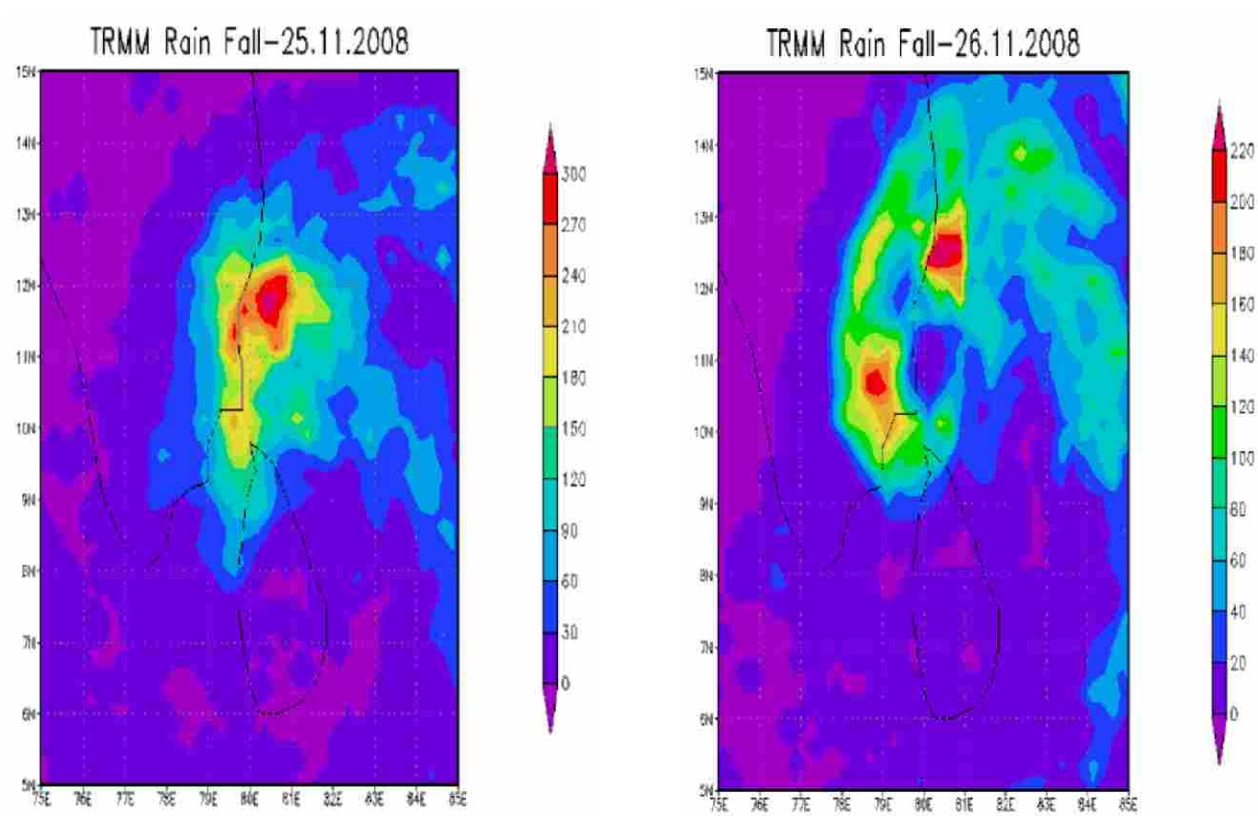
(a) (b)

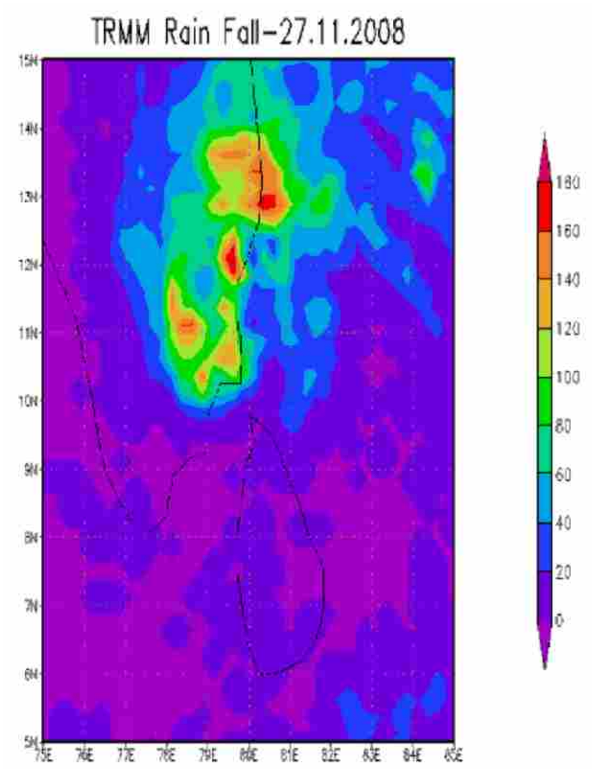
Fig. 2.3 Rainfall forecast for 27.11.2008: (a) WRF model output without SST (b) WRF model output with SST



(a) (b)

Fig. 2.4 Rainfall forecast for 28.11.2008: (a) WRF model output without SST (b) WRF model output with SST





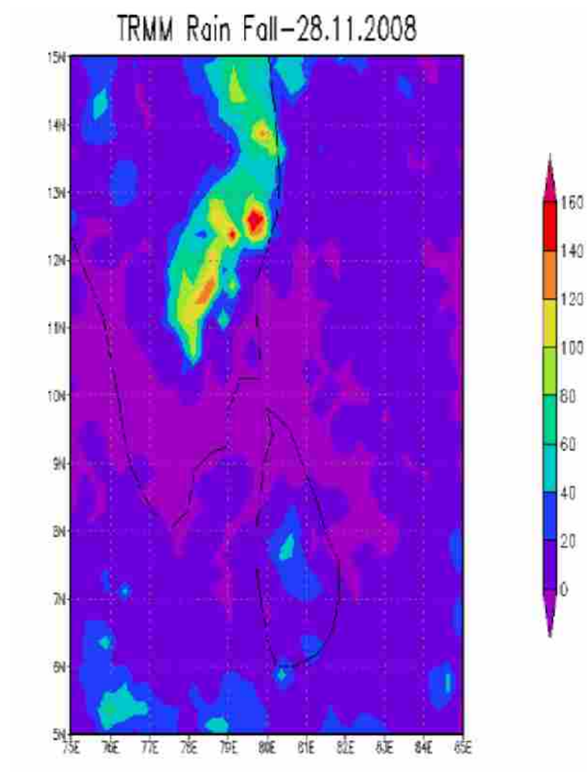
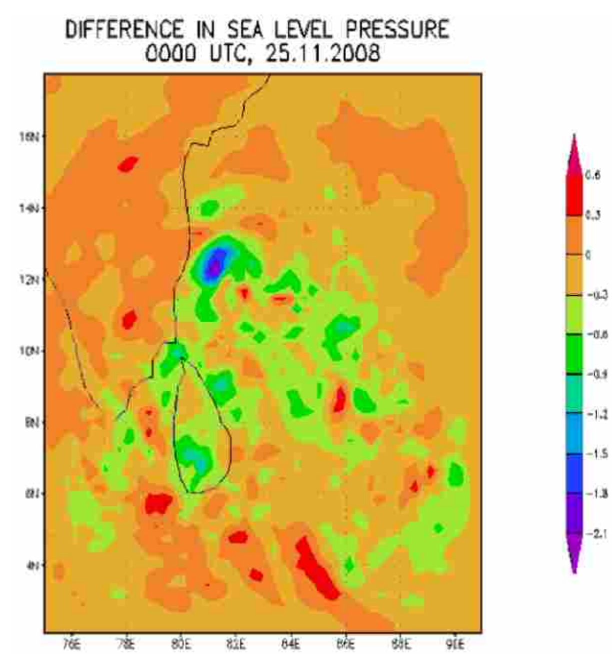


Fig. 2.5 TRMM rainfall for 25^{th}, 26^{th}, 27^{th} and 28^{th} November 2008

A. Pressure Field

At sea level, atmospheric pressure is the force per unit area exerted against a surface by the weight of air above that surface in the Earth's atmosphere. In most circumstances atmospheric pressure is closely approximated by the hydrostatic pressure caused by the weight of air above the measurement point. Low pressure areas have less atmospheric mass above their location, whereas high pressure areas have more atmospheric mass above their location. Similarly, as elevation increases there is less overlying atmospheric mass, so that pressure decreases with increasing elevation. A column of air one square inch in cross-section, measured from sea level to the top of the atmosphere, would weigh approximately 14.7 lbf (65 N). The following figure shows the percentage difference of Sea level pressure due to the impact of SST has derived from WRF model.

Difference of sea level pressure at 850 hPa:



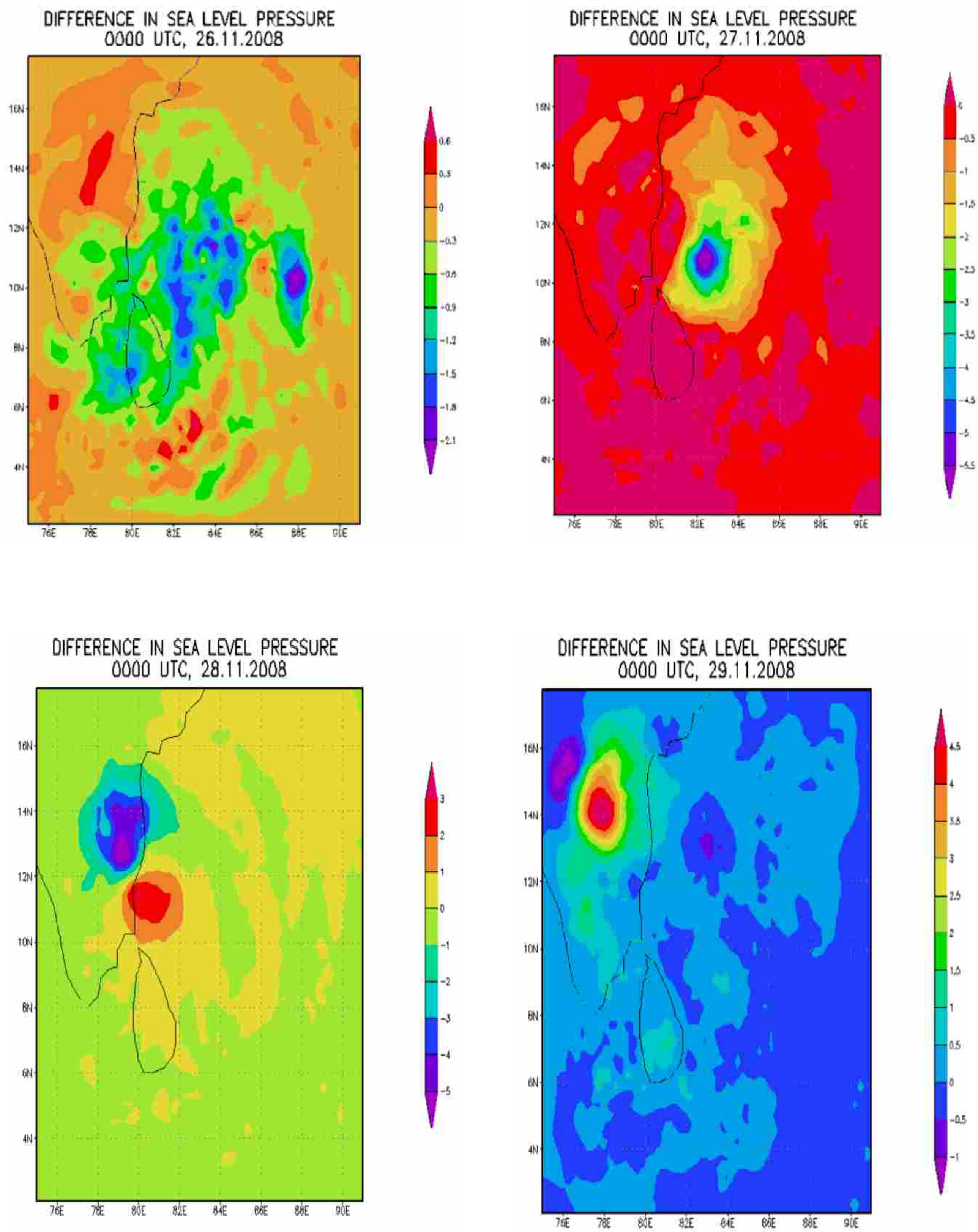
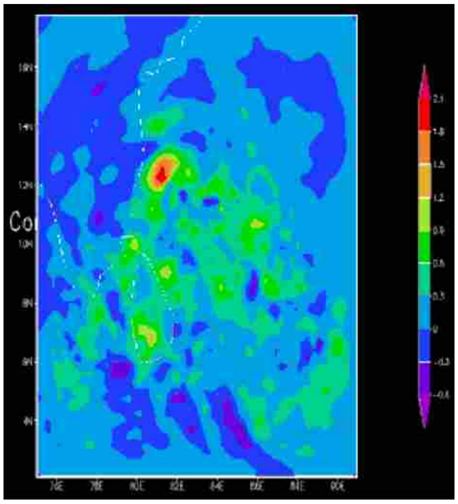


Fig. 2.3.1 WRF Model derived Sea Level Pressure Difference at 850 hPa.

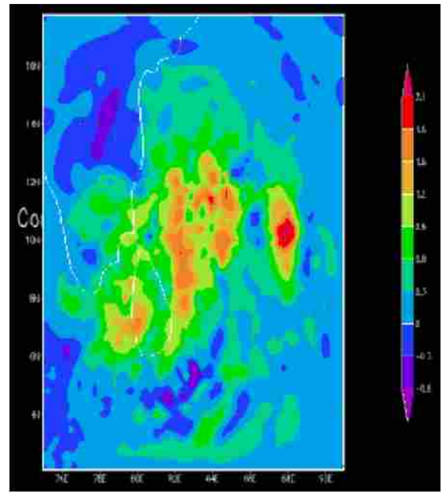
Pressure difference at 200 hPa:

The following results show the difference of sea level pressure with and without SST at 200 hPa.

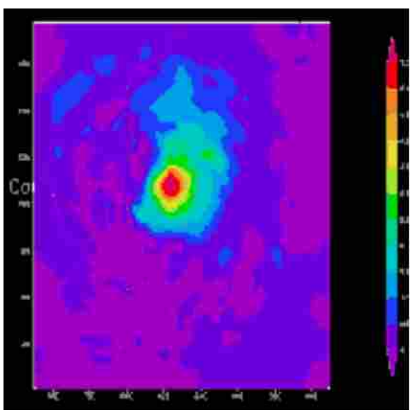
Pressure Difference at 200 hPa 00 UTC, 25.11.2008



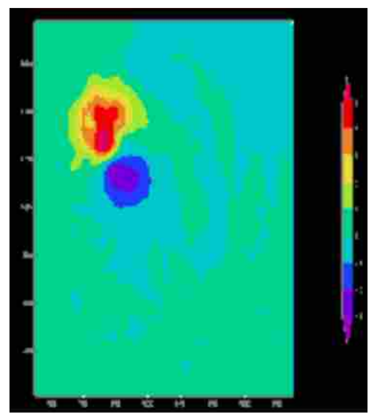
Pressure Difference at 200 hPa 00 UTC, 26.11.2008



Pressure Difference at 200 hPa 00 UTC, 27.11.2008



Pressure Difference at 200 hPa 00 UTC, 28.11.2008



Pressure Difference at 200 hPa 0000 UTC, 29.11.200

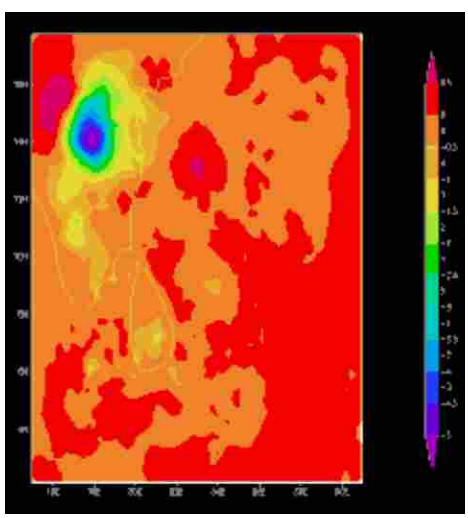


Fig. 2.3.2 WRF Model derived Sea Level Pressure Difference at 200 hPa.

Error in Sea Level Pressure

The following Table 2.3.3 (a) shows the mean error, absolute mean error and root mean square error between model forecast Sea Level Pressure values without ingesting SST and with ingesting SST values in the model. From the table it can be seen that the error values are zero at the starting date of forecast, 24th November 2008. The mean error is positive for 06 hours, 30 hours, 54 hours 78 hours and 102 hours Sea Level Pressure values forecasted by the model with SST data ingested are lower than that by the model without SST data ingested. The 54 hours forecast error values are higher than other forecast values.

Table 2.3.3 (a) Mean error, Absolute Mean error and root mean square error of sea level pressure forecast for 06 UTC based on model without SST and with SST ingested.

Date	Time (UTC)	Forecast Hour	Mean Error (hPa)	Mean Absolute Error (hPa)	RMS Error (hPa)
24.11.2008	0600	06	0.0584	0.0848	0.1242
25.11.2008	0600	30	0.1466	0.2282	0.3148
26.11.2008	0600	54	0.3228	0.3880	0.5876
27.11.2008	0600	78	0.1841	0.3961	0.0099
28.11.2008	0600	102	0.0929	0.3938	0.8021

The following table 2.3.3 (b) shows the mean error, absolute mean error and root mean square error between model forecast Sea Level Pressure values without ingesting SST and with ingesting SST values in the model. From the table it can be seen that the error values are zero at the starting date of forecast, 24th November 2008. The mean error is negative for 120 hour forecast that means the Sea Level.

Pressure value forecasted by the model with SST ingested is higher than that by the model without SST data ingested. The mean error is positive for 24 hour, 48 hours, 72 hours and 96 hours that means Sea Level Pressure values forecasted by the model with SST data ingested are lower than that by the model without SST data ingested. The 48 hours forecast error values are higher than other forecast values.

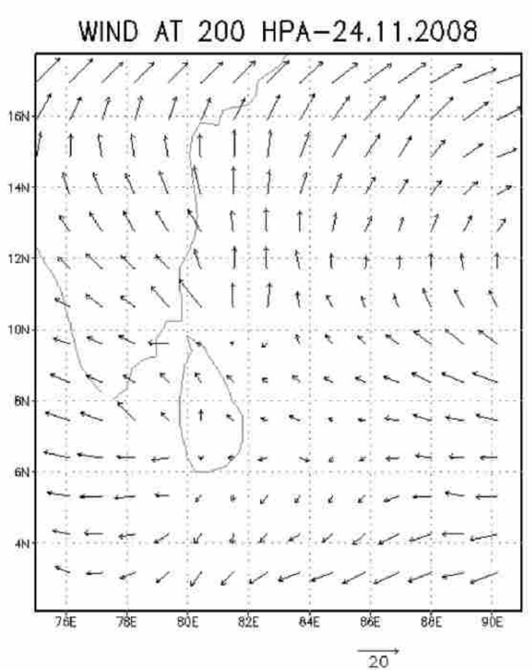
Table 2.3.3 (b) Mean error, Absolute Mean error and root mean square error of sea level pressure forecast at 0000 UTC based on model without SST and with SST ingested

Date	Time (UTC)	Forecast Hours	Mean Error (hPa)	Mean Absolute Error (hPa)	RMS Error (hPa)
24.11.2008	0000	0	0.000	0.000	0.000
25.11.2008	0000	24	0.1328	0.1877	0.2830
26.11.2008	0000	48	0.3106	0.3462	0.5135
27.11.2008	0000	72	0.2519	0.3532	0.7134
28.11.2008	0000	96	0.1496	0.3407	0.7488
29.11.2008	0000	120	–0.1617	0.2696	0.6067

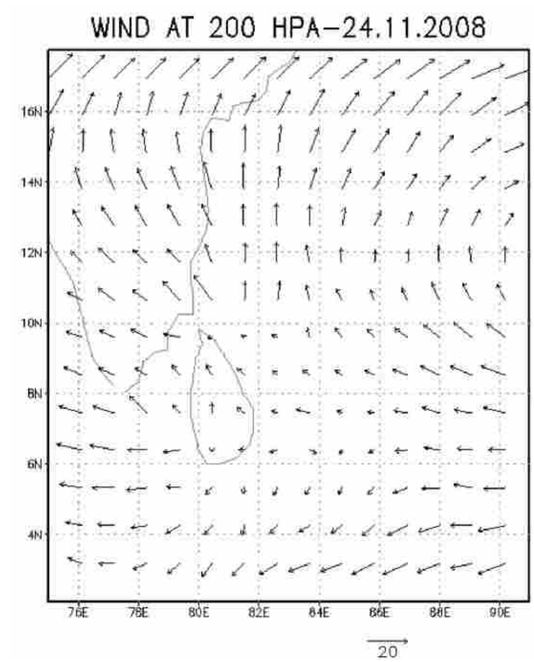
Wind direction

Wind direction study is very much important for the Study of Cyclone. From which we know the strength or intensity of the cyclone. Here the figure shows the pressure level at 200 hPa and 850 hPa of the atmosphere during the Nisha Cyclone occurrence over Bay of Bengal from 25.11.08 to 28.11.08. This model runs with and without SST data. The final outcome of wind direction shows some significant change while running with SST data. Pressure level at 200 hPa and 850 hPa of the atmosphere during the Nisha Cyclone occurrence over Bay of Bengal from 25.11.08 to 28.11.08 is given below. Due to the impact of SST the wind pattern changed which has shows significantly in the model derived graphical result shown below.

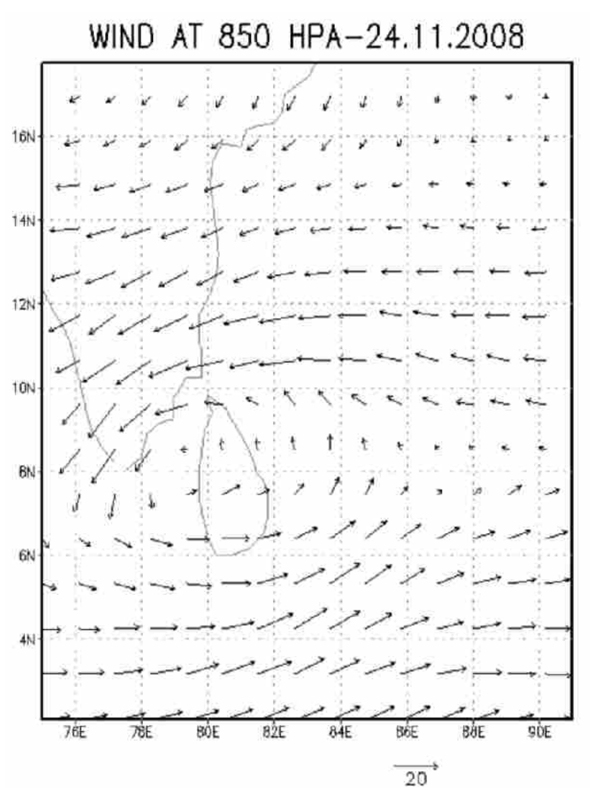
Wind Direction



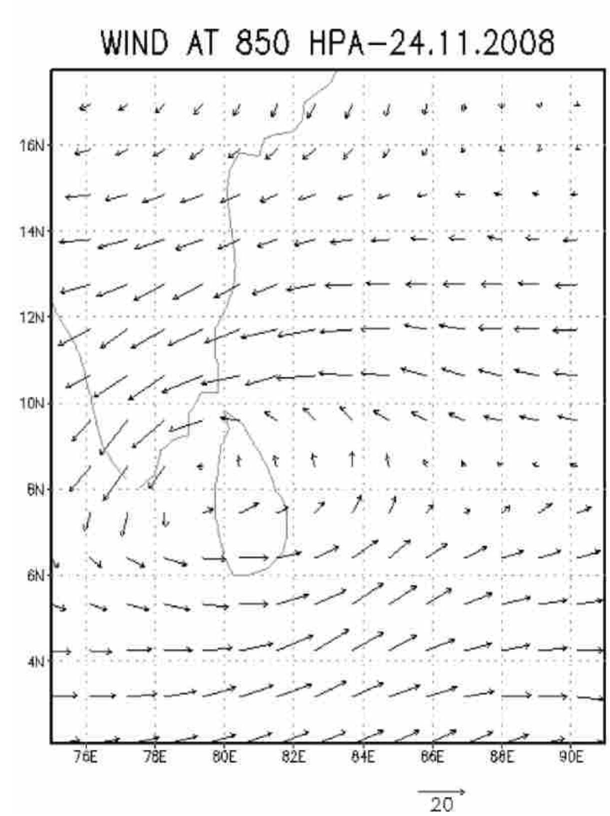
(a) wind at 200 hPa without SST



(b) wind at 200 hPa with SST

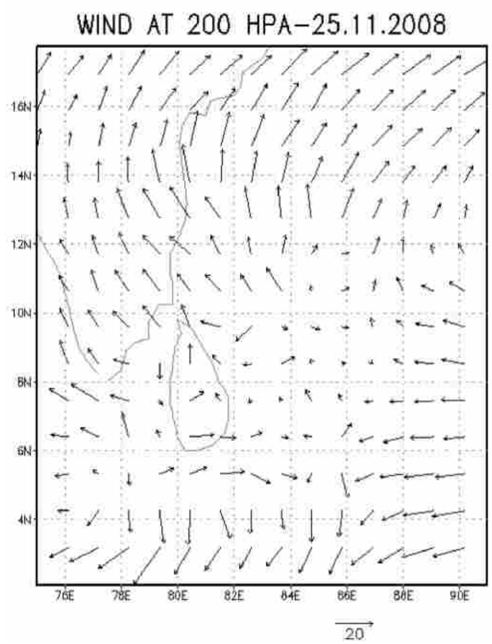


(c) WIND at 850 hPa without SST

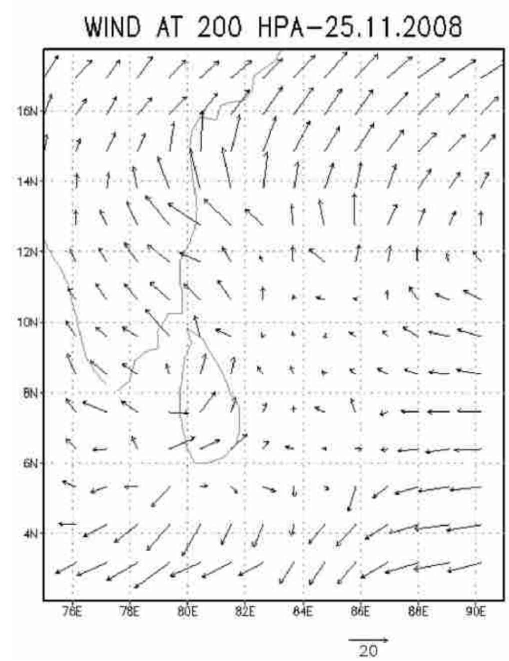


(d) Wind at 850 hPa with SST

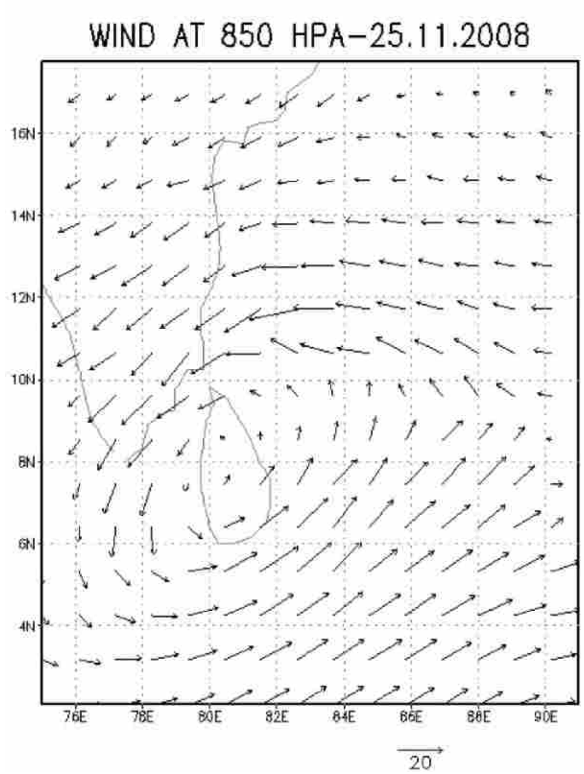
Fig. 2.4.1 (i) Wind at 200 hPa and 850 hPa level for 24.11.2008



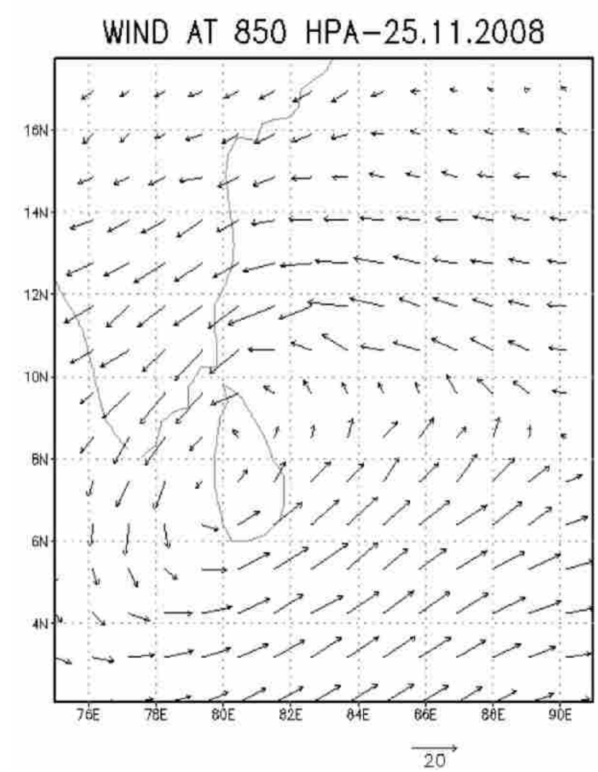
(a) wind at 200 hPa without SST



(b) wind at 200 hPa with SST

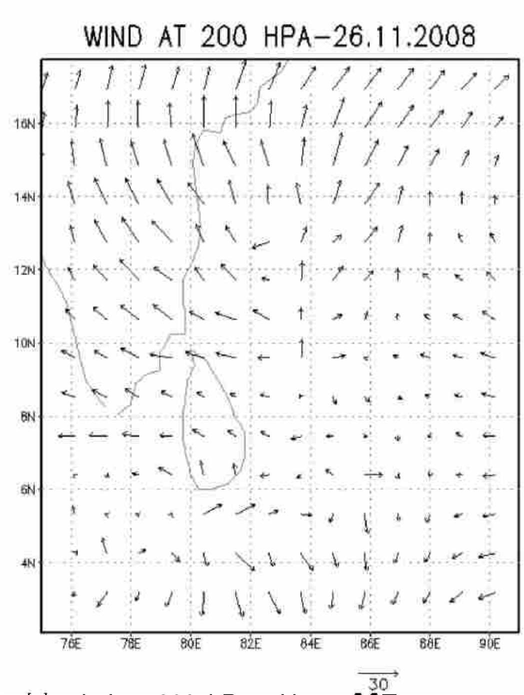


(c) WIND at 850 hPa without SST

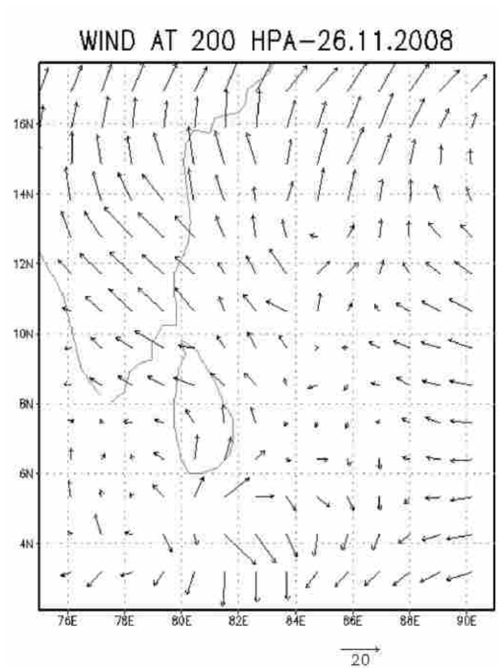


(d) Wind at 850 hPa with SST

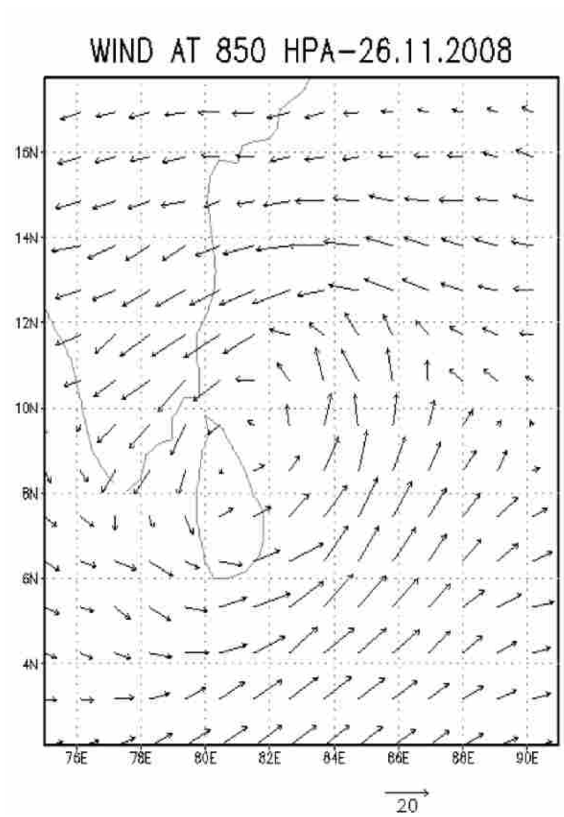
Fig. 2.4.1 (ii) Wind at 200 hPa and 850 hPa level for 25.11.2008



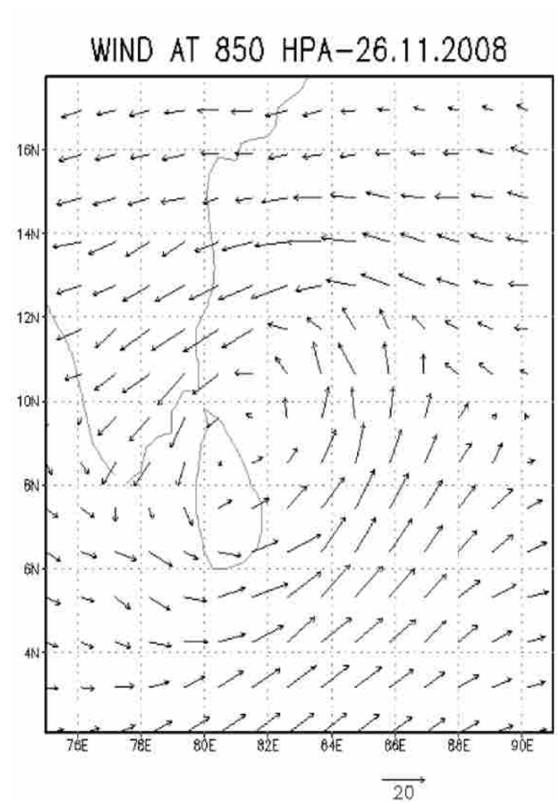
(a) wind at 200 hPa without SST



(b) wind at 200 hPa with SST

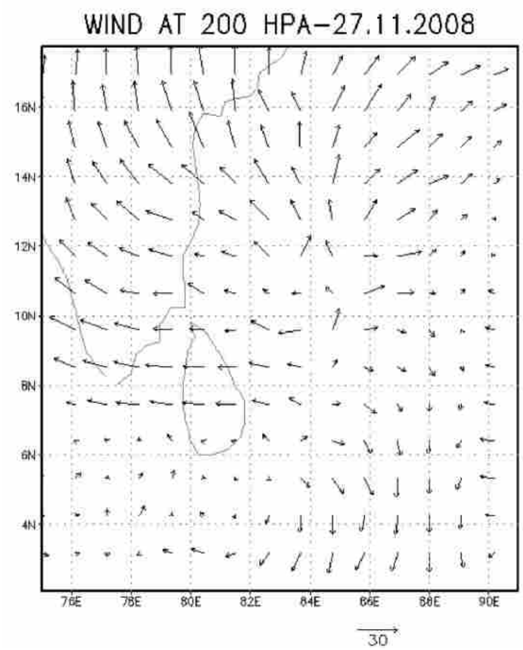


(c) WIND at 850 hPa without SST

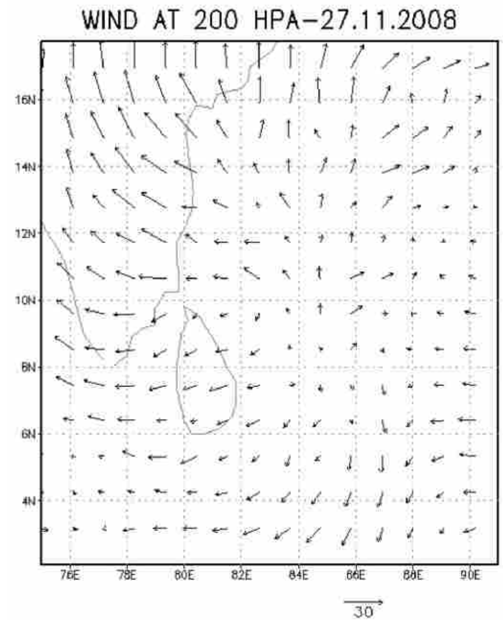


(d) Wind at 850 hPa with SST

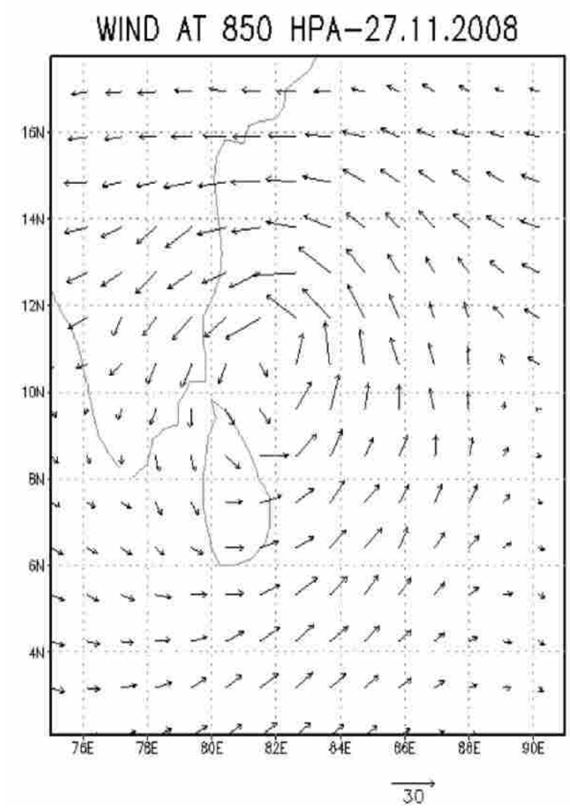
Fig. 2.4.1 (iii) Wind at 200 hPa and 850 hPa level for 26.11.2008



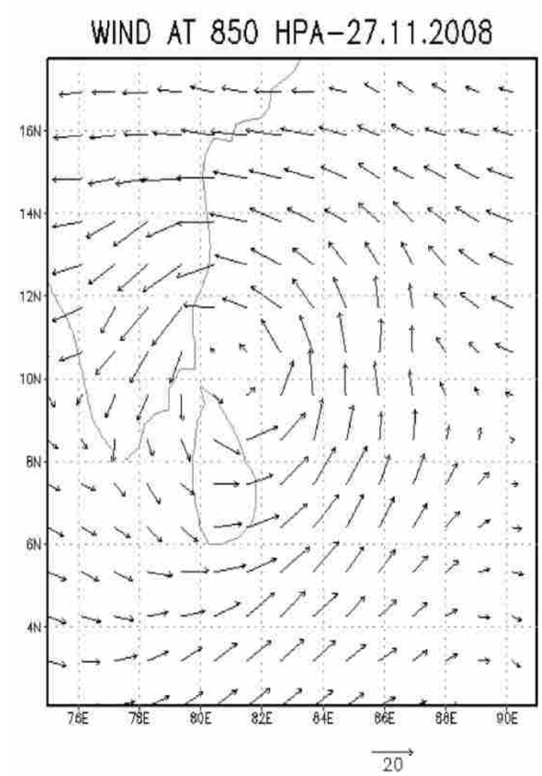
(a) wind at 200 hPa without SST



(b) wind at 200 hPa with SST

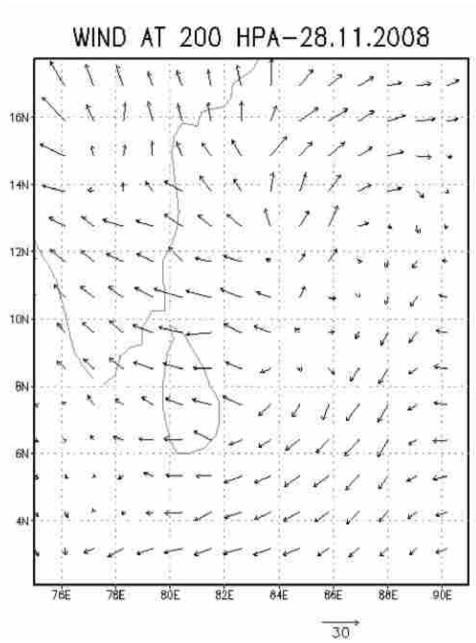


(c) WIND at 850 hPa without SST

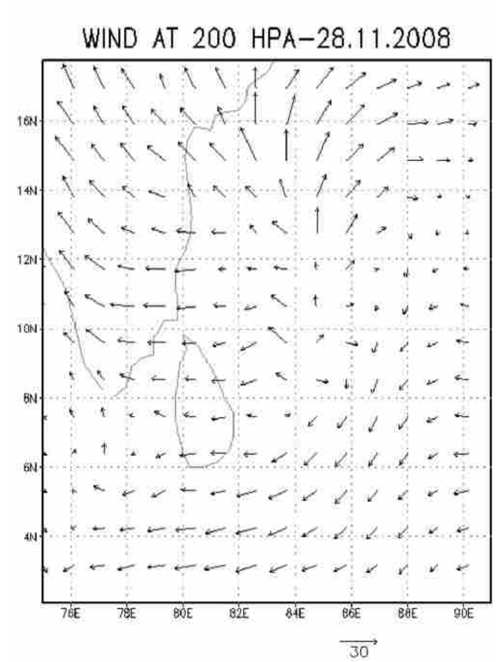


(d) Wind at 850 hPa with SST

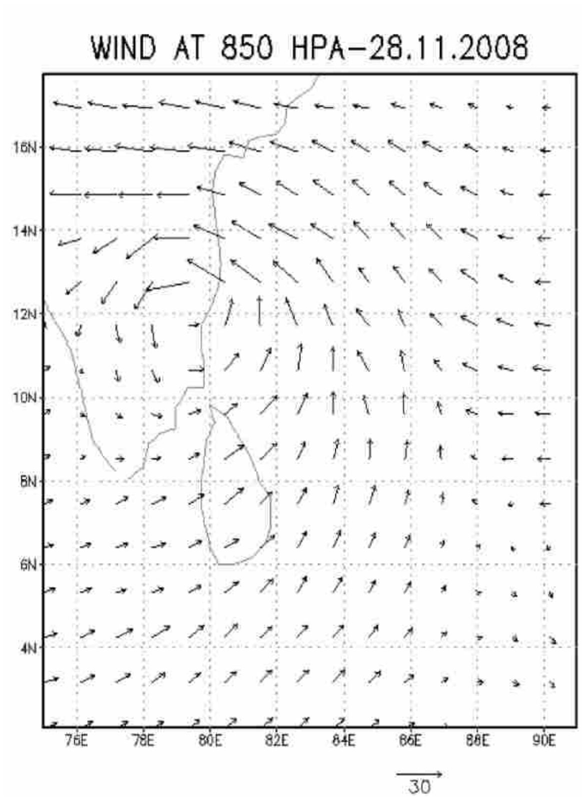
Fig. 2.4.1 (iv) Wind at 200 hPa and 850 hPa level for 27.11.2008



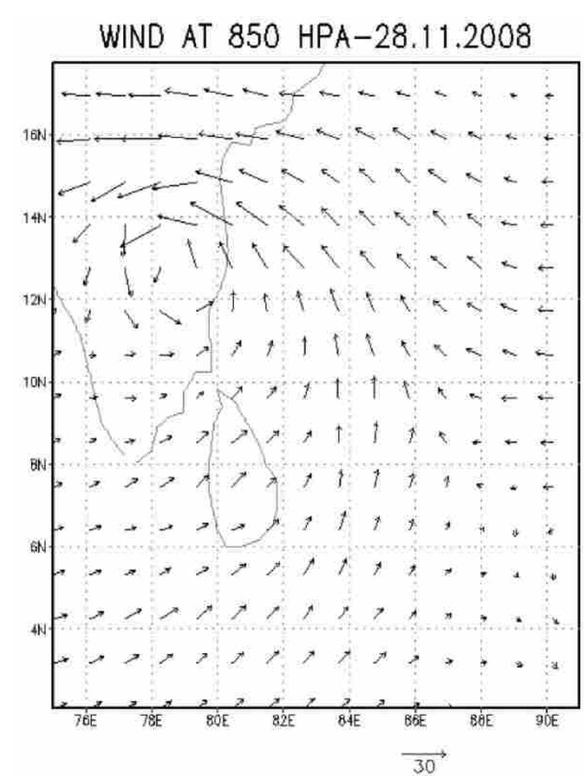
(a) wind at 200 hPa without SST



(b) wind at 200 hPa with SST



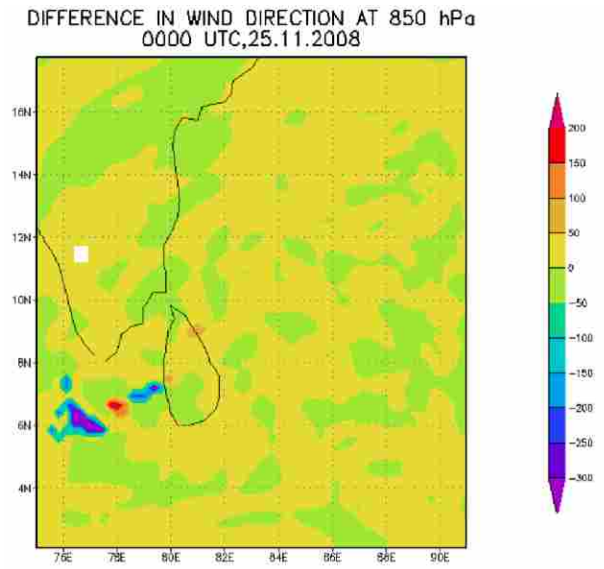
(c) WIND at 850 hPa without SST

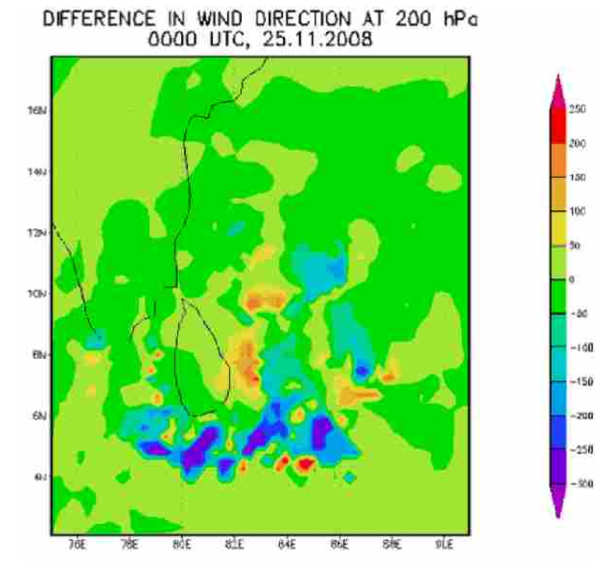


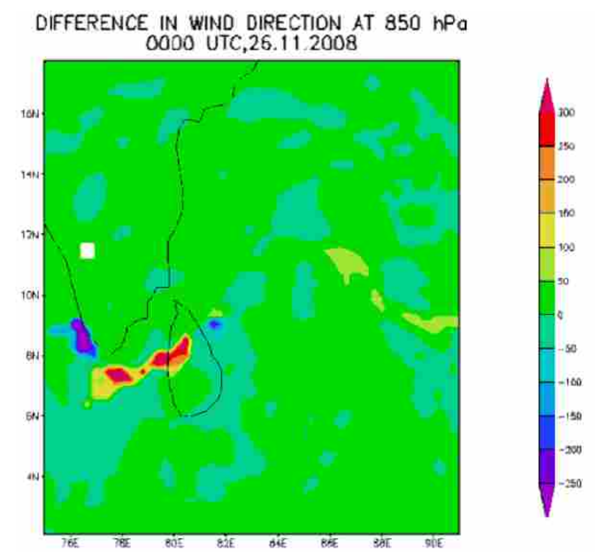
(d) Wind at 850 hPa with SST

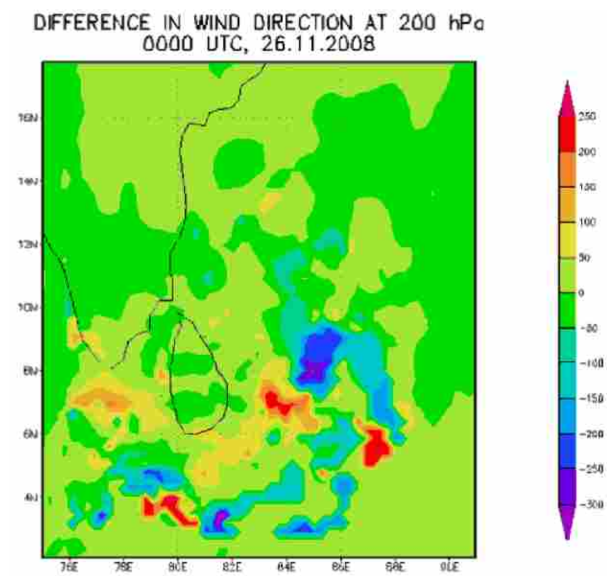
Figure 2.4.1 (v) Wind at 200 hPa and 850 hPa level for 28.11.2008

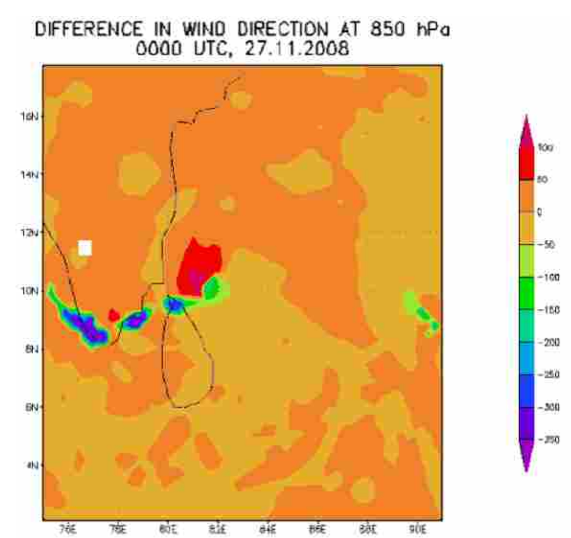
Difference of wind direction at 850 hPa

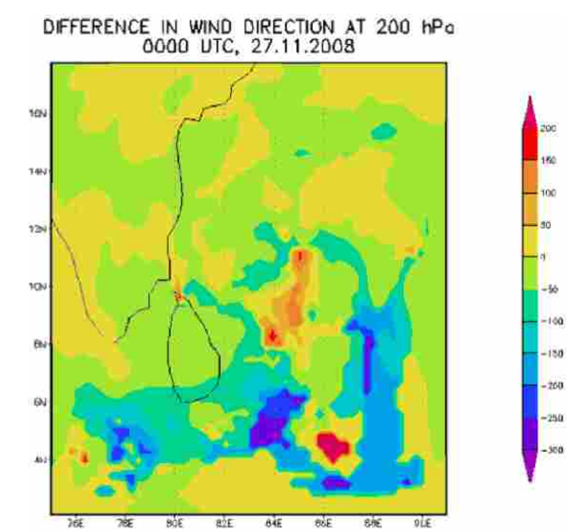












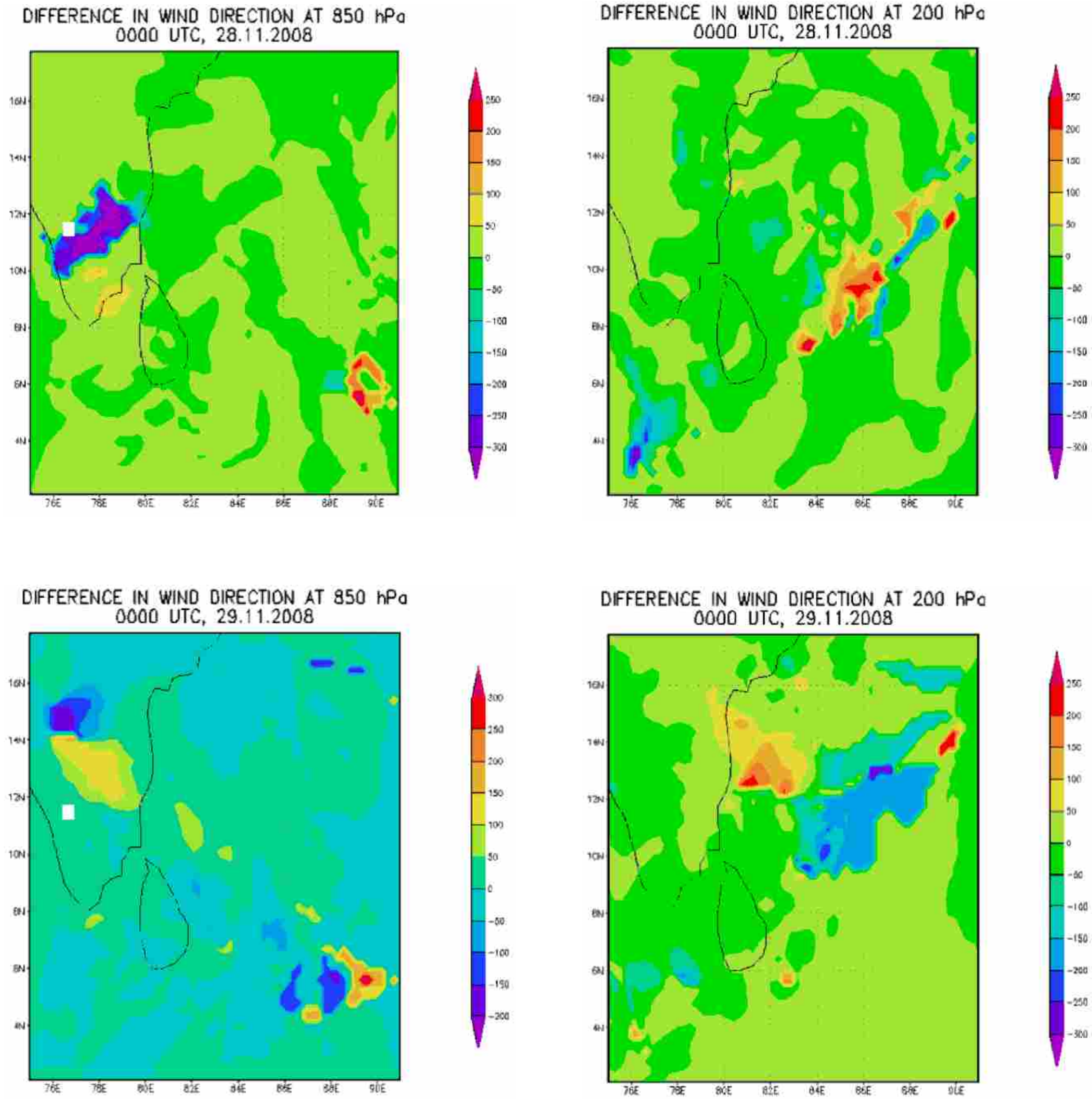


Fig. 2.4.2 WRF Model derived difference on Wind Direction at 850 hPa

Error in wind direction at 850 hPa

The following table 5.4.3 (a) shows the mean error, absolute mean error and root mean square error between model forecast Wind Direction values without ingesting SST and with ingesting SST values in the model. From the table it can be seen that the error values are zero at the starting date of forecast, 24^{th} November 2008. The mean error is negative for 72 hour and 96 hour forecast that means the Wind Direction value forecasted by the model with SST ingested is higher than that by the model without SST data ingested. The mean error is positive for 24 hours, 48 hours and 120 hours, which means Wind Direction values forecasted by the model with SST data ingested, are lower than that by the model without SST data ingested. The 48 hours forecast error values are higher than other forecast values.

Table 2.4.3 (a) Mean error, Absolute Mean error and root mean square error of wind direction at 850 hPa forecast for 00 UTC based on model without SST and with SST ingested

Date	Time UTC	Forecast Hour UTC	Mean Error hPa	Mean Absolute Error hPa	RMS Error hPa
24.11.2008	0000	0	0.0000	0.0000	0.0000
25.11.2008	0000	24	0.0899	5.2865	22.8212
26.11.2008	0000	48	4.4075	9.6754	31.4500
27.11.2008	0000	72	–2.5226	10.0934	33.4416
28.11.2008	0000	96	–2.7605	14.3773	47.0577
29.11.2008	0000	120	3.8051	16.3566	36.1714

Error in wind direction at 200 hPa

The following table 5.4.3 (b) shows the mean error, absolute mean error and root mean square error between model forecast Wind Direction values without ingesting SST and with ingesting SST values in the model. From the table it can be seen that the error values are zero at the starting date of forecast, 24^{th} November 2008. The mean error is negative for 24 hour, 48 hour, 72 hour, 96 hour and 120 hour forecast that means the Wind Direction value forecasted by the model with SST ingested is higher than that by the model without SST data ingested.

Table 2.4.3 (b) Mean errors, Absolute Mean error and root mean square error of wind direction at 200 hPa forecast for 00 UTC based on model without SST and with SST ingested.

Date	Time UTC	Forecast Hour UTC	Mean Error	Mean Absolute Error	RMS Error
24.11.2008	0000	0	0.0000	0.0000	0.0000
25.11.2008	0000	24	–8.8672	23.7646	54.4505
26.11.2008	0000	48	–3.3695	27.8651	54.9093
27.11.2008	0000	72	–25.4331	38.0395	69.2494
28.11.2008	0000	96	–2.8815	19.5261	40.6891
29.11.2008	0000	120	–6.3524	28.0780	52.2946

Wind Speed

Occurrence of maximum wind speed can be analyzed at 850 hPa and 200 hPa for the cyclone days and it can be tabulated as follows.

Maximum wind speed at 850 hPa and 700 hPa

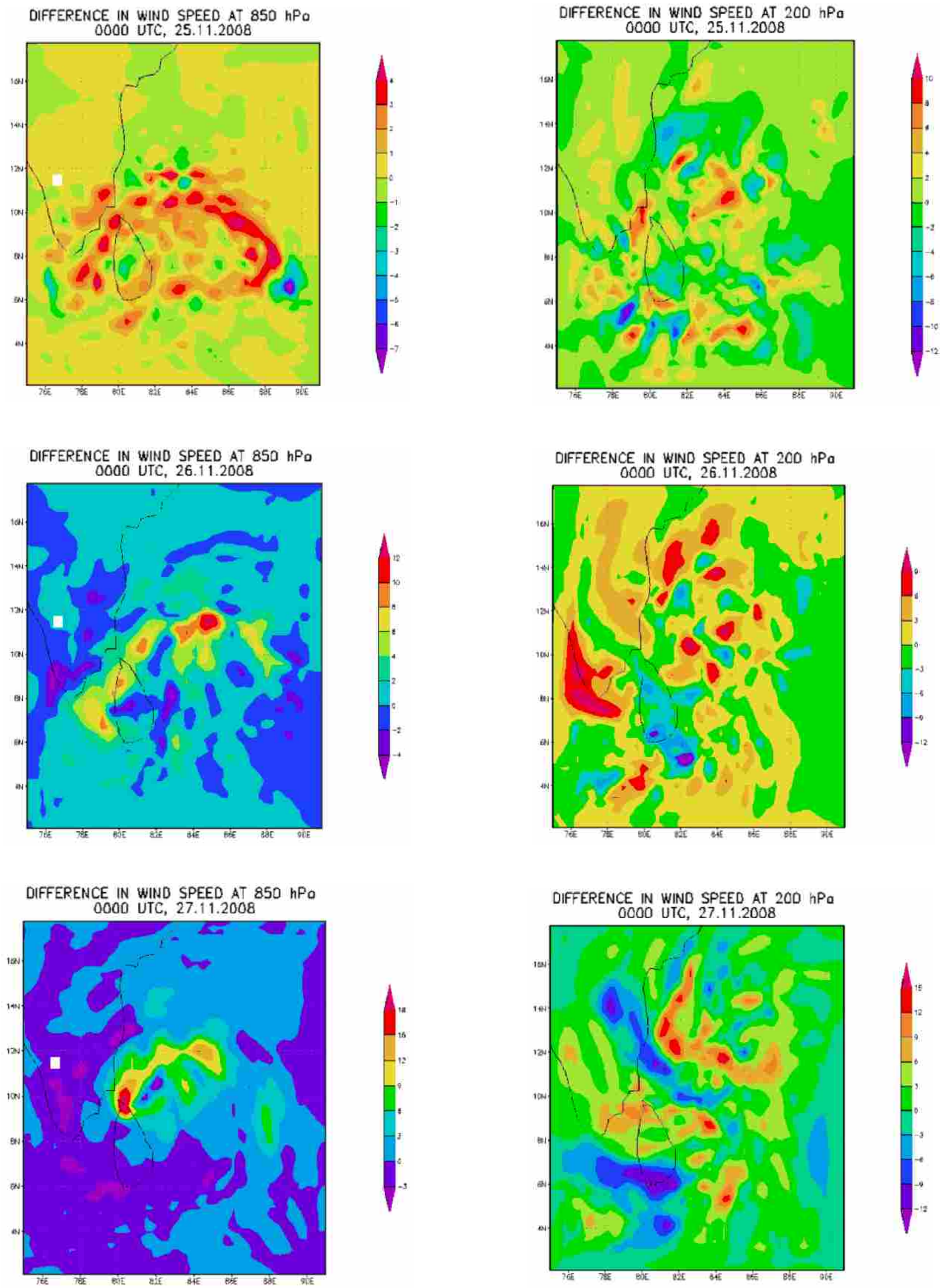
Table 2.5.1 (a) Maximum Wind Speed at 850 hPa for 24^{th}, 25^{th}, 26^{th}, 27^{th} and 28^{th} November 2008

Time	Without Sea Surface Temperature Ingested			With Sea Surface Temperature Ingested		
	Lat	Lon	Maximum Speed m/s	Lat	Lon	Maximum Speed m/s
2403	5.8584	83.1349	21.1585	5.8584	32.8650	21.1431
2412	6.9310	83.1349	19.9558	6.3950	82.8650	20.3613
2503	9.3349	84.7539	22.2779	8.2683	84.7500	22.0970
2512	6.6630	83.4047	25.0559	7.1988	83.9444	22.3121
2603	10.132	86.3729	24.9026	10.928	78.8175	21.3144
2612	8.0012	85.5634	26.7983	7.1988	85.2936	22.9152
2703	10.132	84.4841	31.7376	6.6630	85.2936	25.2039
2712	7.1988	85.0237	37.0001	9.6011	84.7539	30.1029
2803	6.1267	87.4523	35.6562	6.3950	86.1031	31.0846
2812	5.0525	88.8015	32.2124	6.1267	87.7221	31.4354

Table 2.5.1 (b) Maximum Wind Speed at 700 hPa for 24^{th}, 25^{th}, 26^{th}, 27^{th} and 28^{th} November 2008

Time	Without Sea Surface Temperature			With Sea Surface	Temperature	
	Lat	Lon	Maximu m Speed m/s	Lat	Lon	Maximum Speed m/s
2403	6.3950	83.4047	17.4922	6.1267	83.1349	17.2032
2412	11.1935	78.0079	16.5342	11.4581	78.0079	16.6933
2503	9.3349	84.7539	23.0209	8.5352	84.7539	21.4229
2512	6.9310	84.2142	22.7746	7.1988	83.6746	20.8938
2603	10.3983	86.3729	22.6990	10.6636	78.5476	18.9228
2612	9.0686	85.8333	23.5977	9.3349	86.6428	20.5597
2703	10.1328	84.4841	28.4080	6.3950	85.5634	21.8832
2712	7.7339	86.1031	36.3439	9.6011	84.7539	26.7996
2803	5.3213	87.1825	37.1033	6.1267	85.8333	25.5378
2812	4.5147	89.0713	34.6822	5.8584	87.4523	27.9781

Differences of wind speed at at 850 hPa and 200 hPa



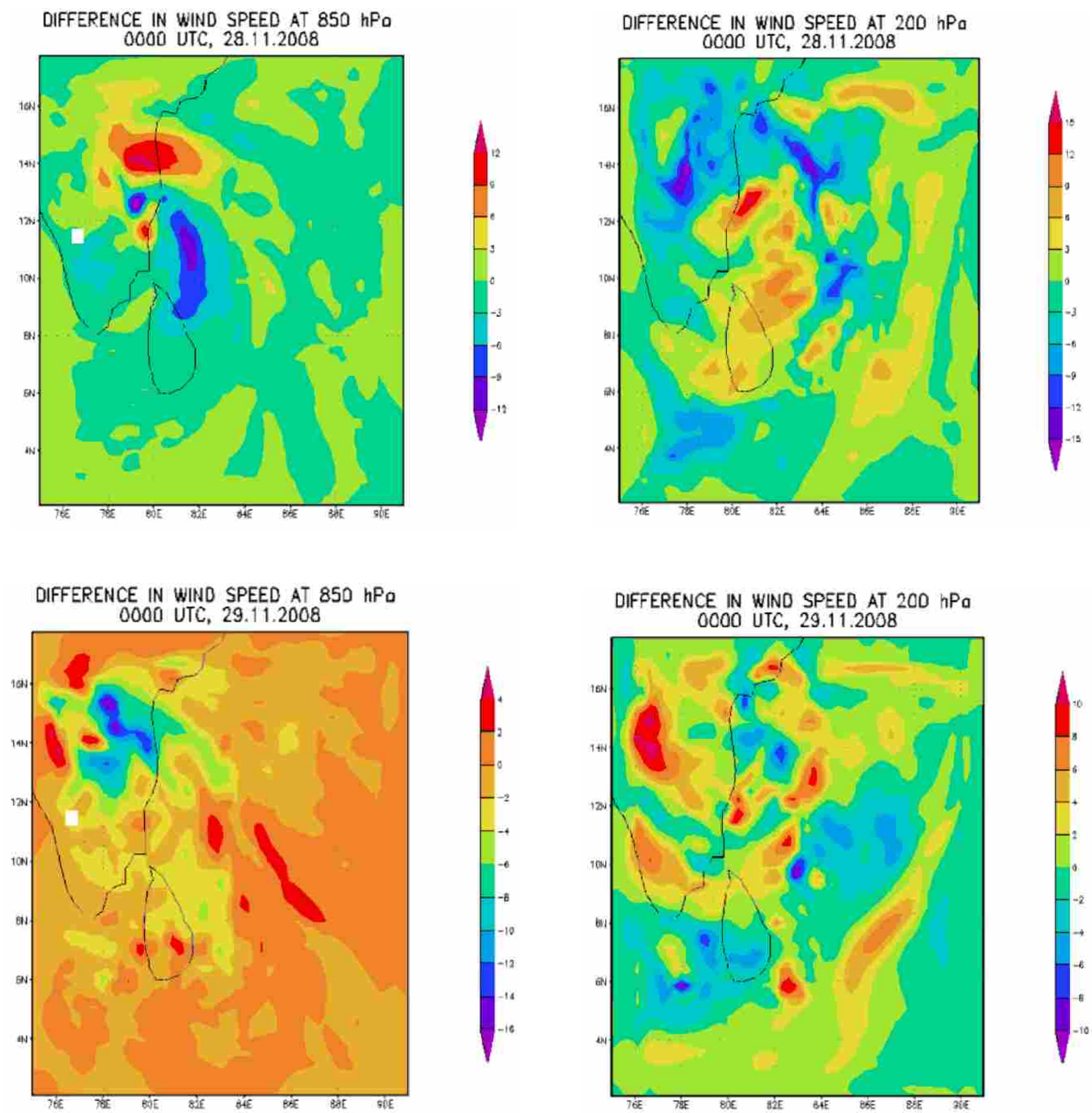


Fig 2.5.2.(a) WRF Model derived Wind Speed at 850 hPa and 200 hPa

Error in wind speed at 850 hPa and 200 hPa

The following table 2.5.3 (a) shows the mean error, absolute mean error and root mean square error between model forecast Wind Speed values without ingesting SST and with ingesting SST values in the model. From the table it can be seen that the error values are zero at the starting date of forecast, 24^{th} November 2008. The mean error is negative for 24 hour, 48 hour and 72 hour forecast that means the Wind Speed value forecasted by the model with SST ingested is higher than that by the model without SST data ingested. The mean error values are positive for the 96 hours and 120 hours forecast that means Wind Speed values forecasted by the model with SST data ingested are lower than that by the model without SST data ingested. The 120 hours forecast error values are higher than other forecast values.

Table 2.5.3 (a) Mean error, Absolute Mean error and root mean square error of wind speed at 850 hPa forecast for 00 UTC based on model without SST and with SST ingested

Date	Time UTC	Forecast Hour UTC	Mean Error m/s	Mean Absolute Error m/s	RMS Error m/s
24.11.2008	0000	0	0.0000	0.0000	0.0000
25.11.2008	0000	24	–0.3420	0.6494	1.1258
26.11.2008	0000	48	–0.6776	1.1520	1.9904
27.11.2008	0000	72	–0.6917	1.4472	2.6566
28.11.2008	0000	96	0.1521	1.3030	2.3458
29.11.2008	0000	120	0.8175	1.2584	2.3690

The following table 2.5.3 (b) shows the mean error, absolute mean error and root mean square error between model forecast for Wind Speed values without ingesting SST and with ingesting SST values in the model. From the table it can be seen that the error values are zero at the starting date of forecast, 24th November 2008. The mean error is negative for 24 hour; 48 hour, 72 hour and 120 hour forecast that means the cape value forecasted by the model with SST ingested is higher than that by the model without SST data ingested. The mean error is positive for 96 hours that means wind speed values forecasted by the model with SST data ingested are lower than that by the model without SST data ingested. The 96 hours forecast error values are higher than other forecast values.

Table 2.5.3 (b) Mean error, Absolute Mean error and root mean square error of wind speed at 200 hPa forecast for 00 UTC based on model without SST and with SST ingested

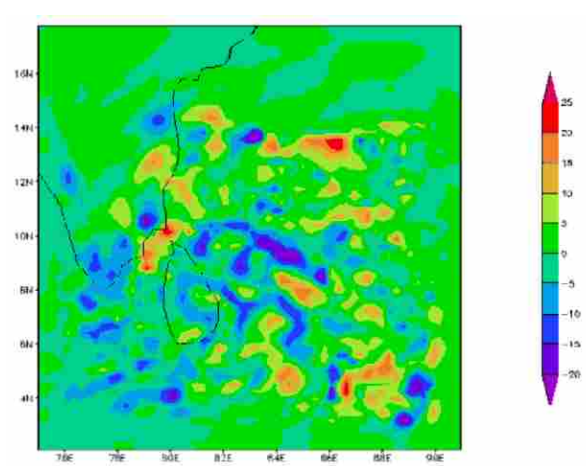
Date	Time UTC	Forecast Hour UTC	Mean Error m/s	Mean Absolute Error m/s	RMS Error m/s
24.11.2008	0000	0	0.0000	0.0000	0.0000
25.11.2008	0000	24	–0.4096	1.5437	2.2761
26.11.2008	0000	48	–0.6448	2.1376	3.0000
27.11.2008	0000	72	–0.7008	2.7004	3.7918
28.11.2008	0000	96	0.2631	2.7113	3.8339
29.11.2008	0000	120	–0.4999	1.9203	2.6901

Relative Humidity

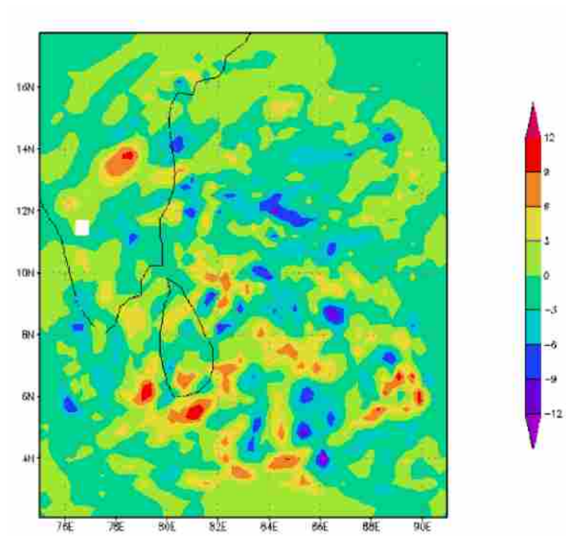
Relative humidity is the measure of moisture in the atmosphere and it is expressed in percentage. The second basic condition for any system to intensify in to a cyclonic storm is that low level relative humidity must be greater than 50%. The Relative Humidity has strong impact due to the SST which are shown in the following figures. Differences of Relative Humidity due to SST are shown in the following figures. The error differences shown by the tables at 850 h Pa and 200 hPa.

Differences of relative humidity at 500 hpa and 850 hpa

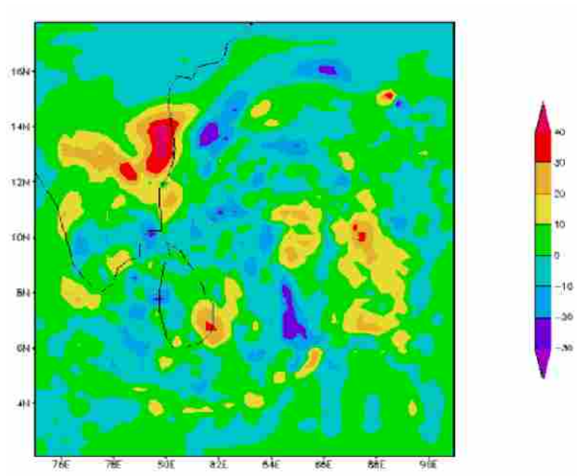
Relative Humidity difference at 500 hPa 00 UTC, 25.11.2008



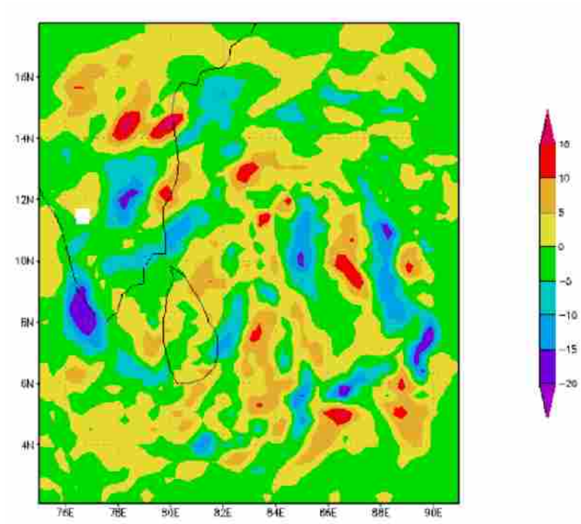
Relative Humidity difference at 850 hPa 00 UTC, 25.11.2008



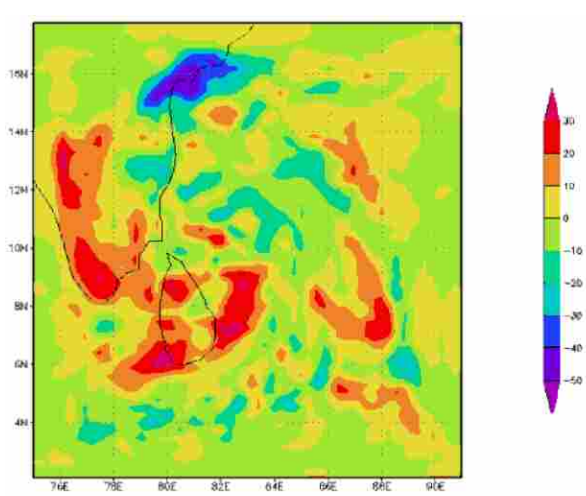
Relative Humidity difference at 500 hPa 00 UTC, 26.11.2008



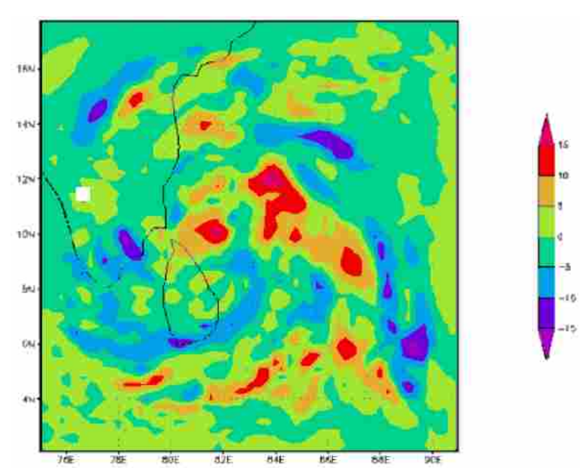
Relative Humidity difference at 850 hPa 00 UTC, 26.11.2008



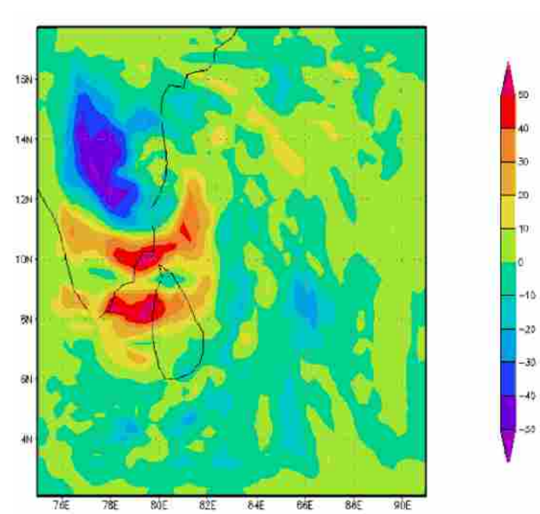
Relative Humidity difference at 500 hPa 00 UTC, 27.11.2008



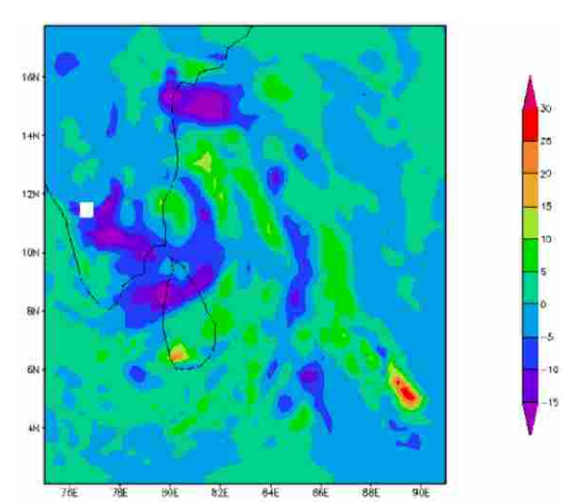
Relative Humidity difference at 850 hPa 00 UTC, 27.11.2008



Relative Humidity difference at 500 hPa 00 UTC, 28.11.2008



Relative Humidity difference at 850 hPa 00 UTC, 28.11.2008



Relative Humidity difference at 500 hPa 00 UTC, 29.11.2008

Relative Humidity difference at 850 hPa 00 UTC, 29.11.2008

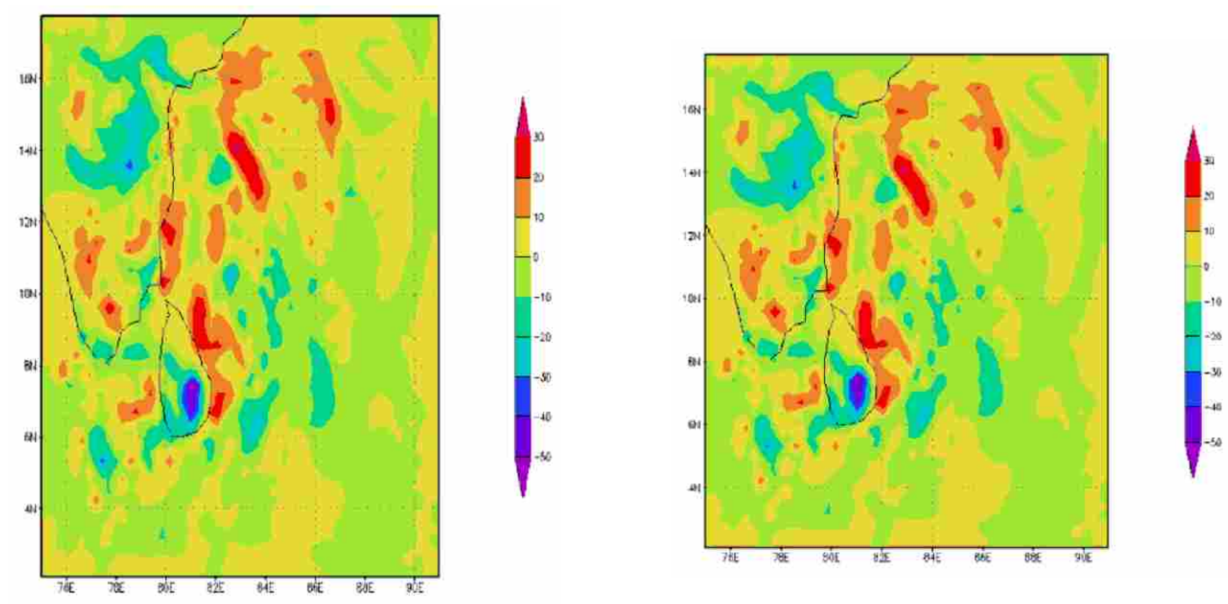


Fig 2.6.1.(a) WRF Model derived differences of Relative Humidity at 500 hPa and 850 hPa.

From the figures, it can be seen that the relative humidity over the cyclone area are more than 50% and hence relative humidity also favors the system to intensify as cyclonic storm.

Error in relative humidity at 850 hpa

The following table 2.6.2 (a) shows the mean error, absolute mean error and root mean square error between model forecast for Relative Humidity at 850 hPa values without ingesting SST and with ingesting SST values in the model. From the table it can be seen that the error values are zero at the starting date of forecast, 24^{th} November 2008. The mean error is negative for 24 hour, 48 hour, 72 hour, 96 hour forecast that means the relative humidity value forecasted by the model with SST ingested is higher than that by the model without SST data ingested. The mean error is positive for 120 hours that means relative humidity values forecasted by the model with SST data ingested are lower than that by the model without SST data ingested. The 120 hours forecast error values are higher than other forecast values.

Table 2.6.2 (a) Mean error, Absolute Mean error and root mean square error of Relative Humidity at 850 hPa forecast for 00 UTC based on model without SST and with SST ingested

Date	Time (UTC)	Forecast Hour (UTC)	Mean Error	Mean Absolute Error	RMS Error
24.11.2008	0000	0	0.0000	0.0000	0.0000
25.11.2008	0000	24	–0.1029	1.8778	2.7960
26.11.2008	0000	48	–0.5549	3.1280	4.7780
27.11.2008	0000	72	–0.4720	3.0319	4.4917
28.11.2008	0000	96	–0.5664	2.7324	4.3777
29.11.2008	0000	120	0.5349	3.3518	5.2297

Error in relative humidity at 500 hPa

The following table 2.6.3 (a) shows the mean error, absolute mean error and root mean square error between model forecast of Relative Humidity values without ingesting SST and with ingesting SST values in the model. From the table it can be seen that the error values are zero at the starting date of forecast, 24^{th} November 2008. The mean error is negative for 24 hour, 96 hour, 120 hour forecast that means the relative humidity value forecasted by the model with SST ingested is higher than that by the model without SST data ingested. The mean error is positive for 48 hours and 72 hours that means relative humidity values forecasted by the model with SST data ingested are lower than that by the model without SST data ingested. The 48 hours forecast error values are higher than other forecast values.

Table 2.6.3 (a) Mean error, Absolute Mean error and root mean square error of Relative Humidity at 500 hPa forecast for 00 UTC based on model without SST and with SST ingested.

Date	Time UTC	Forecast Hour UTC	Mean Error	Mean Absolute Error	RMS Error
24.11.2008	0000	0	0.0000	0.0000	0.0000
25.11.2008	0000	24	–0.0545	3.3610	5.4365
26.11.2008	0000	48	1.4727	5.4348	8.7123
27.11.2008	0000	72	0.4135	6.7404	10.4553
28.11.2008	0000	96	–0.3834	7.3473	12.5585
29.11.2008	0000	120	–0.4800	5.1488	8.1034

IV. SUMMARY AND CONCLUSION

The primary objective of this study is to identify how SST impacts on cyclone forecasting using WRF model. These results produce the structure of the cyclone. The results shows SST impact on cyclone parameters such as of (i) Rain Fall (RF), (ii) Sea level pressure (SLP) at 200 hpa (12.3 km above mean sea level (a.m.s.l)) and 850 hpa (1.5 km a.m.s.l), (iii) Wind direction at 200 hpa and 850 hpa, (iv) Wind speed at 200 hpa and 850 hpa, (v) Relative Humidity at 500 hpa and 850 hpa are the main conditions for the formation of Nisha cyclone due to the impacts of SST as the input to the WRF model. From which we concluded that SST having significant impacts over on Cyclone formation which are studied and shown in pictorial form and its differences and error structure has been analyzed by using Weather Research & Forecasting (WRF) Model with GrADS visualization tool during the period when the tropical cyclone Nisha formed over Bay of Bengal. Hence, SST plays a vital role for the formation of cyclone. This work shows that WRF model can be used to systematically identify the SST impact on Cyclone fore casting. Here the result shows the different level which leads to study the structural analysis of the Cyclone Nisha.

V. SCOPE FOR FUTURE WORK

The current paper succeeded in identifying SST impacts on Cyclone Forecasting using WRF model. Here, different actual cyclone parameters were analyzed. This work has the scope to extending the other useful information which might be helpful in understanding the nature of the SST impact on the derived products such as Reflectivity, Convective Available Potential Energy, percentage difference at 200 hpa and 850 hpa level, SST patterns, wind direction with speed in contour pattern, SLP contour pattern, RH in contour pattern, wind speed contour pattern etc may give the structural analysis of the Cyclone with the effect of SST.

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