Prediction of Cyclogenesis based on observations of 0300 UTC of 6th and 7th October 2014
– Case Study of Hudhud

Cyclone Warning Division, RSMC New Delhi

भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT
To analyse the various prognostic and diagnostic features to predict the possible cyclogenesis.

If cyclogenesis is predicted what will be the predicted track and intensity forecast for next five days
Satellite Pictures (visible)

06/0300 UTC

07/0300 UTC

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Satellite Pictures (visible)

07/0600 UTC

07/0600 UTC
Satellite Pictures (IR)

06/0000 UTC

07/0000 UTC
Satellite Pictures (WV)

Water Vapour imageries 06/0630 and 07/0300 UTC
Satellite Pictures
06/0000 and 1030 UTC and 07/0600 UTC
Observations

06/0300 UTC
Observations

ASCAT winds 0328 UTC (Descending)
6th October 2014

ASCAT winds 0328 UTC (Descending)
7th October 2014
Observations (Environmental features – 6th Oct. and 7th October 2014)

850 hPa Rel. Vorticity

Low level Convergence
Observations (Environmental features – 6th Oct. and 7th October 2014)

UL Divergence

Wind shear

UL Divergence

Wind shear
Observations (Environmental features – 6th Oct. and 7th October 2014)

Mid and Lower level winds

Mid and Upper level winds

Mid and Lower level winds

Mid and Upper level winds
Observations (Environmental features – 6th Oct. and 7th October 2014)

Wind shear tendency

Wind shear tendency

TCHP

TCHP
Observations (Environmental features – 6th Oct. 2014)

SST

SHA

SST

SHA
Observations (Environmental features – 6th Oct. and 7th October 2014)

Depth 26°C

Depth 26°C
### Summary of observations

#### INSAT 3D Positions

<table>
<thead>
<tr>
<th>Date</th>
<th>Time (UTC)</th>
<th>Lat (°N)</th>
<th>Long (°E)</th>
<th>Intensity</th>
</tr>
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<tbody>
<tr>
<td>06.10.2014</td>
<td>0600</td>
<td></td>
<td></td>
<td>LLC</td>
</tr>
<tr>
<td></td>
<td>1200</td>
<td>11.5</td>
<td>95.5</td>
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<tr>
<td></td>
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<td>11.5</td>
<td>95.5</td>
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<tr>
<td></td>
<td>2100</td>
<td>11.5</td>
<td>95.5</td>
<td>1.0</td>
</tr>
<tr>
<td>07.10.2014</td>
<td>0000</td>
<td>11.5</td>
<td>95.2</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>0300</td>
<td>11.5</td>
<td>95.0</td>
<td>1.0</td>
</tr>
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<td></td>
<td>0600</td>
<td>11.5</td>
<td>94.7</td>
<td>1.5</td>
</tr>
</tbody>
</table>

#### Position and intensity of all available satellite positions

<table>
<thead>
<tr>
<th>DATE/ TIME UTC</th>
<th>INSAT-3D Position</th>
<th>JTWC Position</th>
<th>NOAA Position</th>
<th>IMD Positions/ Intensity (Real Time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>07/0000 UTC</td>
<td>11.5/95.2, T1.0</td>
<td>11.3/95.3</td>
<td>11.5/95.0, T1.0</td>
<td></td>
</tr>
<tr>
<td>07/0300 UTC</td>
<td>11.5/95.0 T1.0</td>
<td>11.5/95.1</td>
<td>11.2/94.8, T1.5</td>
<td>11.5/95.0 D</td>
</tr>
</tbody>
</table>
Climatology

Direction of Movement in the month of October

Number of D, CS and SCS formed in the month of October (1961-2014)
Climatology

Frequency of D, CS and SCS during the month of October

Tracks of Cyclonic Storms and Depressions during the month of October with genesis area (in the grid 2.5 X 2.5°) same as that of Hudhud (9-14°N /93-97°E)
Climatology

Probability of
1. Depression intensifying into Cyclonic Storm (NIO:46.4    BOB:45.1 )

1. Depression intensifying into Severe Cyclonic Storm (NIO: 25.5    BOB: 25.6)

1. Cyclonic Storm intensifying into Severe Cyclonic Storm (NIO: 54.9    BOB: 56.8)

Over Indian Ocean and Bay of Bengal
Climatology

Systems that crossed Andhra Pradesh (26) during the month of October 1961-2014

Systems that crossed Odisha (13) during the month of October 1961-2014

BHARAT MAUSAM VIRAJAN VIJAYA
INDIA METEOROLOGICAL DEPARTMENT
TIGGE MJO index forecast (Initial: 2014.10.06.12UTC)

- Analysis:
  - +0–2days
  - +2–4days
  - +4–6days
  - +6–8days
  - +8–10days
  - +10–12days
  - +12–14days
  - +14–16days
MJO

TIGGE MJO index forecast (Initial: 2014.10.07.12UTC)

Analysis
+0–2days
+2–4days
+4–6days
+6–8days
+8–10days
+10–12days
+12–14days
+14–16days
Summary of observations

- Satellite observations indicate a pre-existing low pressure area.
- Environmental features are favorable for further intensification of the low pressure area.
- MJO is in Phase 6, which is favorable for intensification of the system over the Bay of Bengal.
Extended Range Prediction based on 1200 UTC of 6th October

Well marked Low Pressure Area lies over North Andaman Sea (11.5N 95.1E)
NWP Guidance
NWP Guidance

IMD GFS (T574) MSL Pressure (hPa) FORECAST (96 HR)
based on 60 UTC of 06-10-2014 valid for 60 UTC of 10-10-2014

IMD GFS (T574) MSL Pressure (hPa) FORECAST (120 HR)
based on 60 UTC of 06-10-2014 valid for 60 UTC of 11-10-2014

IMD GFS (T574) MSL Pressure (hPa) FORECAST (144 HR)
based on 60 UTC of 06-10-2014 valid for 60 UTC of 12-10-2014

IMD GFS (T574) MSL Pressure (hPa) FORECAST (168 HR)
based on 60 UTC of 06-10-2014 valid for 60 UTC of 13-10-2014
NWP Guidance

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (96 HR)
based on 00 UTC of 05-10-2014 valid for 00 UTC of 10-10-2014

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 05-10-2014 valid for 00 UTC of 11-10-2014

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (144 HR)
based on 00 UTC of 05-10-2014 valid for 00 UTC of 12-10-2014

IMD GFS (T574) 850 hPa WIND (kt) FORECAST (168 HR)
based on 00 UTC of 05-10-2014 valid for 00 UTC of 13-10-2014

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NWP Guidance

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (00 HR)
based on 00 UTC of 06-10-2014 valid for 00 UTC of 06-10-2014

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (24 HR)
based on 00 UTC of 06-10-2014 valid for 00 UTC of 07-10-2014

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (48 HR)
based on 00 UTC of 06-10-2014 valid for 00 UTC of 08-10-2014

IMD GFS (T574) 500 hPa WIND (kt) FORECAST (72 HR)
based on 00 UTC of 06-10-2014 valid for 00 UTC of 09-10-2014

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INDIA METEOROLOGICAL DEPARTMENT
NWP Guidance
NWP Guidance
NWP Guidance
Track forecast

Probability of Rapid Intensification (RI) (Intensity increase by 30 kts or more in next 24 hr) = 9.4%
INFERENCES: RI probability VERY LOW

INDIA METEOROLOGICAL DEPARTMENT
Consolidated tracks of all NWP outputs with observed track at 070000 UTC
LATEST OBSERVATIONS INDICATE THAT A DEPRESSION HAS FORMED OVER NORTH ANDAMAN SEA AND LAY CENTRED AT 0300 UTC OF TODAY, THE 7TH OCTOBER 2014 NEAR LATITUDE 11.5° NORTH AND LONGITUDE 95.0° EAST, ABOUT 250 KM EAST-SOUTHEAST OF LONG ISLAND (43310). IT WOULD MOVE WEST-NORTHWESTWARDS AND INTENSIFY INTO A DEEP DEPRESSION WITHIN NEXT 24 HRS AND SUBSEQUENTLY INTO A CYCLONIC STORM. IT WOULD CROSS ANDAMAN AND NICOBAR ISLANDS CLOSE TO LONG ISLAND BY TOMORROW FORENOON. THEREAFTER, THE SYSTEM WOULD CONTINUE TO MOVE WEST-NORTHWESTWARDS FOR SOME MORE TIME AND THEN NORTHWESTWARDS TOWARDS NORTH ANDHRA PRADESH AND ODISHA COAST DURING SUBSEQUENT 72 HOURS.

ACCORDING TO SATELLITE IMAGERIES, THE INTENSITY OF THE SYSTEM IS T 1.5. THE ASSOCIATED INTENSE TO VERY INTENSE CONVECTION LIES OVER BAY ISLANDS, ANDAMAN SEA AND OVER BAY BETWEEN LATITUDE 9.0° NORTH TO 16.0° NORTH AND EAST OF LONGITUDE 90.0° EAST. THE ASSOCIATED CONVECTION HAS INCREASED GRADUALLY WITH RESPECT TO HEIGHT AND ORGANISATION DURING PAST 24 HRS. THE LOWEST CLOUD TOP TEMPERATURE (CTT) IS ABOUT – 60 °C.
MAXIMUM SUSTAINED SURFACE WIND SPEED IS ESTIMATED TO BE ABOUT 25 KNOTS GUSTING TO 35 KNOTS AROUND THE SYSTEM CENTRE. THE STATE OF THE SEA IS ROUGH TO VERY ROUGH AROUND THE SYSTEM CENTRE. THE ESTIMATED CENTRAL PRESSURE IS ABOUT 1004 HPA.

REMARKS: SCATTEROMETRY DATA INDICATES THE CYCLONIC CIRCULATION OVER THE REGION AND ASSOCIATED WIND SPEED TO BE ABOUT 25-35 KNOTS WIND SPEED IS RELATIVELY HIGHER IN NORTHERN SECTOR. BUOY LOCATED NEAR 10.5° NORTH AND 93.9° EAST REPORTS MEAN SEA LEVEL PRESSURE OF 1005.1 HPA AND SURFACE WIND OF SOUTHWESTERLY 25 KNOTS. THE UPPER TROPOSHERIC RIDGE RUNS ALONG 19°N AND IS PROVIDING POLEWARD OUT FLOW IN ASSOCIATION WITH THE ANTICYCLONIC CIRCULATION TO THE NORTHEAST OF THE SYSTEM CENTRE. HENCE UPPER LEVEL DIVERGENCE IS FAVOURABLE FOR INTENSIFICATION. THE LOW LEVEL CONVERGENCE ALONG WITH LOW LEVEL RELATIVE VORTICITY HAS INCREASED FURTHER IN PAST 24 HRS. THE SEA SURFACE TEMPERATURE IS ABOUT 30-32°C AND OCEAN THERMAL ENERGY IS ABOUT 60-80 KJ/CM². THE VERTICAL WIND SHEAR OF HORIZONTAL WIND HAS DECREASED AND IS ABOUT 10-20 KNOTS (LOW TO MODERATE). THE MADDEN JULLIAN OSCILLATION (MJO) INDEX LIES OVER PHASE 6 WITH AMPLITUDE LESS THAN 1. NWP MODELS SUGGEST THAT MJO WOULD CONTINUE IN PHASE 6 DURING NEXT 3 DAYS. MOST OF THE NWP MODELS SUGGEST WEST-NORTHWESTWARD TO NORTHWESTWARD MOVEMENT OF THE SYSTEM AND INTENSIFICATION DURING NEXT 72 HRS.
Thank you