



**Government of India**  
**Ministry of Earth Sciences**  
**Earth System Science Organisation**



## **National Workshop on Enhanced and Unique Cyclonic Activity during 2013**

### **Background**

During the year 2013, 10 cyclonic disturbances developed over north Indian Ocean including one deep depression over Arabian Sea, one land depression and 8 cyclonic disturbances over Bay of Bengal. Out of 8 disturbances 3 intensified into Very Severe Cyclonic Storm (VSCS), one each into a Severe Cyclonic Storm (SCS) & Cyclonic Storm (CS) and three upto depression. Considering season-wise distribution, out of 10 disturbances, 2 developed during pre-Monsoon, 2 during monsoon and 6 during post-monsoon season. Salient features of cyclonic disturbances during 2013 are given below.

- (i) There were five cyclones over the Bay of Bengal and no cyclone over the Arabian Sea against the long period average of 5.5 per year over the entire north Indian Ocean including Bay of Bengal and Arabian Sea.
- (ii) Five cyclones developed over the Bay of Bengal for the first time after 1987. Considering north Indian Ocean as a whole, five cyclones occurred in 2010.
- (iii) Four severe cyclonic storms developed over Bay of Bengal for the first time since 1982. Considering north Indian Ocean as a whole, four such severe cyclonic storms occurred in 2010.
- (iv) Three very severe cyclonic storms occurred over north Indian Ocean for the first time since 1999.
- (v) Post-monsoon season was very active, especially over the Bay of Bengal with the formation of three very severe cyclonic storms and one severe cyclonic storm.
- (vi) Though there were five cyclones, only one cyclone (Phailin) crossed coast as very severe cyclonic storm and other two (Viyaru and Helen) as cyclonic storms. Other two cyclones (Lehar and Madi) crossed the coast as depressions. However, cyclone Lehar crossed Andaman and Nicobar Islands as a severe cyclonic storm. Such a severe cyclonic storm crossed Andaman and Nicobar Islands for the first time in November 1989.
- (vii) While track of Lehar was straight moving, tracks of all other cyclones were recurving in nature. While Phailin recurved after landfall, cyclone Viyaru recurved northeastwards over the sea, cyclone Helen recurved west-southwestwards just before landfall and cyclone Madi recurved southwestwards over the sea. Comparing the tracks, the track of Madi was most unique in nature and had a rare analogue with past records.
- (viii) The total period of cyclonic disturbances during 2013 was maximum as compared to previous years (1990-2012)
- (ix) The annual cyclone energy over the north Indian Ocean has also been maximum in 2013 as compared to previous years (1990-2012).

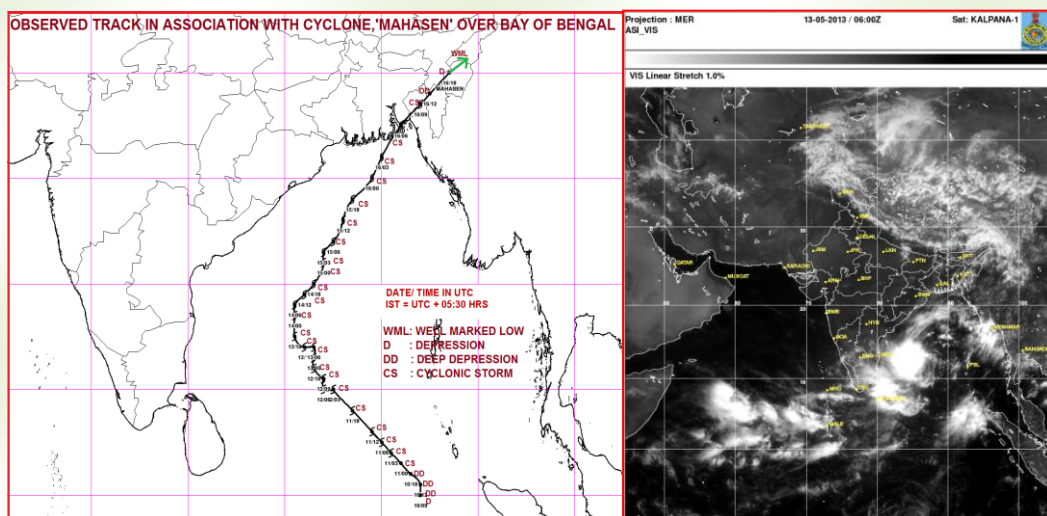
## Brief Characteristics of cyclones over the Bay of Bengal during 2013

Brief descriptions of the disturbances with intensity of cyclonic storm and above are given in the following sections.

### **Cyclonic Storm 'Viyaru' (10-13 May 2013)**

A cyclonic storm, Viyaru crossed Bangladesh coast near lat.22.8°N and long. 91.4°E, about 30 km south of Feni around 1330 hrs IST of 16<sup>th</sup> May 2013 with a sustained maximum wind speed of about 85 -95 kmph. The track of the cyclone and the typical satellite imagery are shown in Fig.1. The salient features of this storm are as follows.

- The genesis of the disturbance took place in a lower latitude, near 5°N.
- It was one of the longest track over north Indian Ocean in recent period after the very severe cyclonic storm, Phet over the Arabian Sea (31 May-07 June, 2010)
- The cyclonic storm moved very fast (about 40-50 km per hour on the day of landfall, i.e. on 16<sup>th</sup> May 2013. Such type of fast movement of the cyclonic storm is very rare.
- Due to the faster movement, the adverse weather due to the cyclonic storm was relatively less.



**Fig.1 Track and typical satellite imagery of Cyclonic Storm 'Viyaru' over the Bay of Bengal (10-16 May, 2013)**

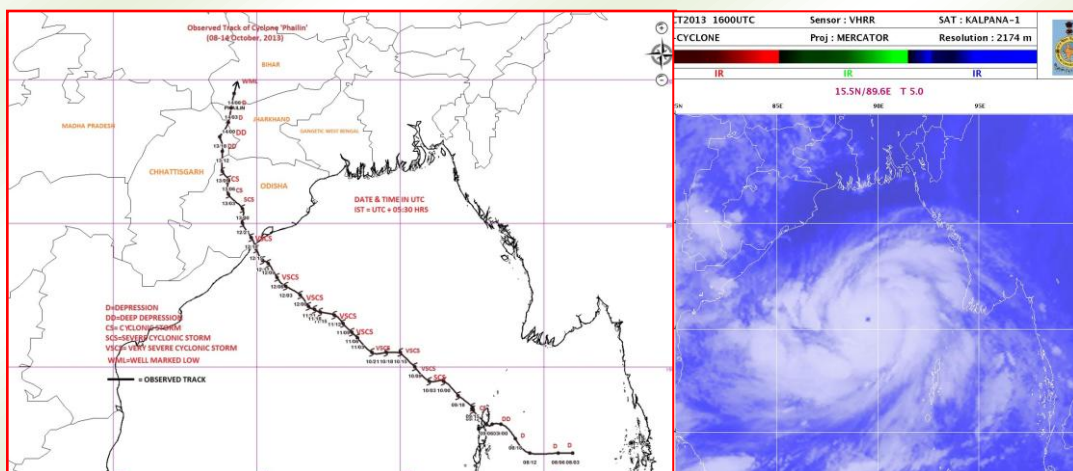
### **Very Severe Cyclonic Storm (VSCS) PHAILIN over the Bay of Bengal (08-14 October 2013)**

A Very Severe Cyclonic Storm (VSCS) PHAILIN originated from a remnant cyclonic circulation from the South China Sea. The cyclonic circulation lay as a low pressure area over Tenasserim coast on 6<sup>th</sup> October 2013. It lay over north Andaman Sea as a well marked low pressure area on 7<sup>th</sup> October. It concentrated into a depression over the same region on 8<sup>th</sup> October near latitude 12.0°N and longitude 96.0°E. Moving west-northwestwards, it intensified into a deep depression on 9<sup>th</sup> morning and further into cyclonic storm (CS), '**PHAILIN**' in the same evening. Moving northwestwards, it further intensified into a severe cyclonic storm (SCS) in the morning and into a VSCS in the forenoon of 10<sup>th</sup> Oct. over east central Bay of Bengal. The VSCS, **PHAILIN** crossed Odisha & adjoining north Andhra Pradesh coast near Gopalpur (Odisha) around 2230 hrs IST of 12<sup>th</sup> October 2013 with a sustained maximum surface wind



speed of 200-210 kmph gusting to 220 kmph. The track of the cyclone and the typical satellite imagery are shown Fig.2. The salient features of this storm are as follows.

- VSCS PHAILIN was the most intense cyclone that crossed India coast after Odisha Super Cyclone of 29<sup>th</sup> October 1999.
- There was rapid intensification of the system from 10<sup>th</sup> Oct. morning to 11<sup>th</sup> Oct. morning leading to an increase in wind speed from 45 knots to 115 knots.
- At the time of landfall on 12<sup>th</sup> Oct, maximum sustained surface wind speed in association with the cyclone was about 115 knots (215 kmph) and estimated central pressure was 940 hPa with pressure drop of 66 hPa at the centre compared to surroundings
- It caused very heavy to extremely heavy rainfall over Odisha leading to floods, and strong gale wind leading to large scale structural damage and storm surge leading to coastal inundation over Odisha.
- Maximum rainfall occurred over northeast sector of the system centre at the time of landfall. Maximum 24 hr cumulative rainfall of 38 cm has been reported over Banki in Cuttack district of Odisha.
- Based on post-cyclone survey report, maximum storm surge of 2-2.5 meters above the astronomical tide has been estimated in the low lying areas of Ganjam district of Odisha in association with the cyclone and the in-land inundation of saline water extended upto about one kilometer from the coast.
- The numerical weather prediction (NWP) and dynamical statistical models provided good guidance with respect to its genesis, track and intensity. Though there was divergence in model guidance with respect to landfall point in the initial stage, the consensus among the models emerged as the cyclone moved closer to the coast.



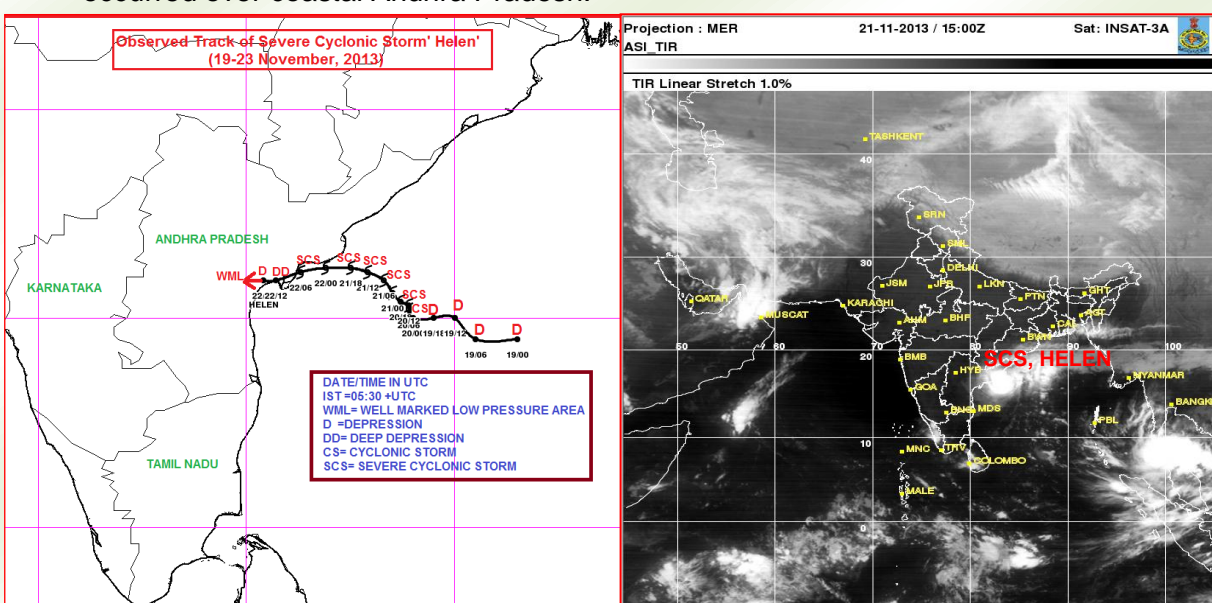
**Fig.2 Observed track and typical satellite imagery of VSCS PHAILIN during 8<sup>th</sup>-14<sup>th</sup> October 2013**

### **Severe Cyclonic Storm 'HELEN' over Bay of Bengal (19-23 Nov 2013)**

Under the influence of active inter-tropical convergence zone (ITCZ), a depression formed over the west central Bay of Bengal in the early morning of 19<sup>th</sup> Nov. 2013 (Fig.3). It moved west-northwestwards and intensified into a deep depression in the night of 19<sup>th</sup> Nov. 2013 and further into a cyclonic storm, 'HELEN' in the morning of 20<sup>th</sup> Nov. at about 330 km east-southeast of Machilipatnam. It continued to move west-northwestwards and intensified into

a severe cyclonic storm in the early morning of 21<sup>st</sup> Nov. at a distance of 260 km east-southeast of Machilipatnam. On 22<sup>nd</sup> November, It moved initially westwards and then west-southwestwards and crossed Andhra Pradesh coast close to south of Machilipatnam (near lat. 16.1°N and long. 81.2°E) between 1330-1430 hrs IST of 22<sup>nd</sup> Nov. 2013 as a cyclonic storm with a wind speed of 80-90 kmph gusting to 100 kmph. It then weakened gradually while moving west-southwestwards across Andhra Pradesh and lay as a low pressure area over coastal Andhra Pradesh and neighborhood in the early morning of 23<sup>rd</sup> Nov. 2013. The salient features of this storm are as follows.

- (i) It moved west-southwestward 12 hrs before landfall
- (ii) It weakened rapidly after the landfall and hence caused less rainfall over coastal Andhra Pradesh.
- (iii) Under its influence rainfall at most places with isolated heavy to very heavy rainfall occurred over coastal Andhra Pradesh.



**Fig.3. Track and typical satellite imagery of severe cyclonic storm Helen (19-23 Nov 2013)**

### **Very Severe Cyclonic Storm VSCS 'Lehar' (23-28 Nov. 2013)**

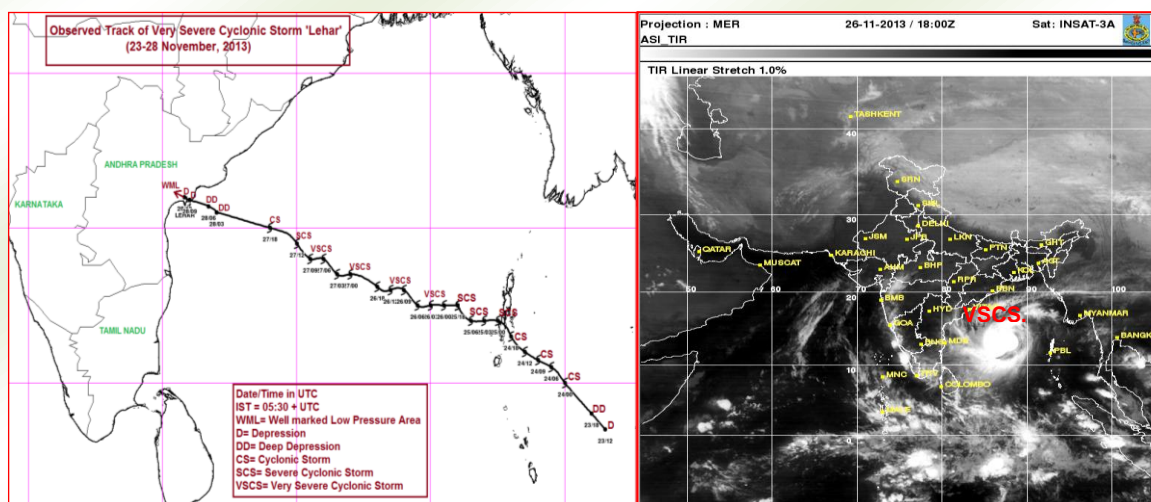
The very severe cyclonic storm, Lehar developed over south Andaman Sea from a remnant cyclonic circulation from South China Sea on 23<sup>rd</sup> evening when it lay as depression located about 550 km south-southeast of Port Blair (Fig.4). It intensified into a deep depression in the same night and into a cyclonic storm in the early morning of 24<sup>th</sup> November 2013 while moving northwestward towards Andaman & Nicobar Islands. It further intensified into a severe cyclonic storm and crossed Andaman & Nicobar Island near Port Blair in the morning (around 0630 hrs IST) of 25<sup>th</sup> Nov. 2013 with a wind speed of about 110-120 kmph. It caused extremely heavy rainfall and coastal inundation leading to uprooting of trees, damage to structures and flooding of low lying areas.

On 25<sup>th</sup> it emerged into southeast Bay of Bengal and moved west-northwestward, intensified into a very severe cyclonic storm in the early hours of 26<sup>th</sup> Nov. near southeast Bay of Bengal. It maintained its very severe cyclonic storm intensity with a maximum wind speed reaching upto 140-150 gusting to 165 kmph till noon of 27<sup>th</sup> Nov. It then came under the influence of colder sea, high vertical wind shear and entrainment of dry & cold air into the



cyclone field. As a result it rapidly weakened into a deep depression by early morning of 28<sup>th</sup> (i.e. within 18 hours). It crossed Andhra Pradesh coast close to south of Machilipatnam around 1400 hrs IST of 28<sup>th</sup> Nov. 2013. The salient features of this system are given below.

- (i) It was the first severe cyclonic storm to cross Andaman and Nicobar Islands after November, 1989.
- (ii) It had second landfall near Machillipatnam as a depression.
- (iii) It rapidly weakened over the sea from the stage of very severe cyclonic storm to depression in 18 hrs.
- (iv) It did not cause any significantly heavy rainfall over Andhra Pradesh

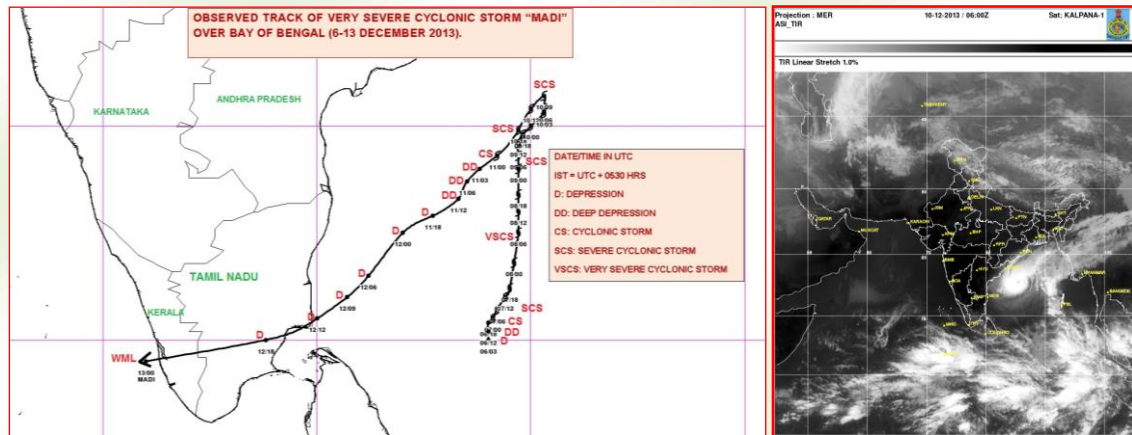


**Fig.4. Track and typical satellite imagery of Very Severe Cyclonic Storm 'Lehar' (23-28 Nov. 2013)**

#### **Very Severe Cyclonic Storm VSCS 'MADI' (06-13 December 2013)**

A low pressure area formed over southeast Bay of Bengal on 1<sup>st</sup> December 2013. It moved westwards and became well marked over central part of south Bay of Bengal on 2<sup>nd</sup> Dec. 2013. The well marked low pressure area lay over southwest Bay of Bengal on 3<sup>rd</sup> to 5<sup>th</sup> Dec. 2013. It concentrated into a depression in the morning of 6<sup>th</sup> December and deep depression in the same midnight. It moved very slowly northward and intensified into a cyclonic storm, 'Madi' in the morning of 7<sup>th</sup> December. It continued to move slowly and intensified into a severe cyclonic storm in the afternoon of 7<sup>th</sup> Dec. and into a very severe cyclonic storm in the forenoon of 8<sup>th</sup> December 2013 (Fig.5). However due to entrainment of cold air, colder sea and increase in vertical wind shear, the very severe cyclonic storm weakened into severe cyclonic storm in the evening of 9<sup>th</sup> Dec. Due to weakening, the system moved southwestward after reaching the latitude of 15.7°N under the influence of lower and middle tropospheric steering ridge. It further weakened into cyclonic storm in the early hours of 11<sup>th</sup> Dec., into deep depression in the morning of 11<sup>th</sup> and depression in the night of 11<sup>th</sup>. It crossed Tamil Nadu coast near Vedaranniyam around 1900 hrs IST of 12<sup>th</sup> Dec., emerged into Palk strait around 2030 hrs IST and again crossed Tamil Nadu coast near Tondi around 2230 hrs IST. It then emerged into southeast Arabian Sea as a well marked low pressure area in the early morning of 13<sup>th</sup> Dec. 2013. The salient features of this system are given below.

- i. It has a unique track with near northerly movement till 15.7°N and then recurving southwestwards to Tamil Nadu coast.
- ii. It moved very slowly during its northward journey and speed peaked up gradually after the recurvature to southwest.



**Fig.5. Track of Very Severe Cyclonic Storm 'MADI' (06-13 Dec. 2013)**

### **Objective/Theme of Brainstorming Workshop**

The principal objective/theme of the workshop will be to understand the characteristic features of the cyclone season, 2013. The key scientific themes are as follows.

- (i) Role of Ocean parameters for enhanced cyclogenesis, intensification/weakening and frequent recurving tracks.
- (ii) Role of atmospheric parameters for enhanced cyclogenesis, intensification/weakening and straight & recurving tracks
- (iii) Role of large scale environment (Madden Julian Oscillation, ENSO, Indian Ocean Dipole etc) for characteristic genesis, track and intensification/weakening of cyclonic disturbances
- (iv) Tele-connection with cyclonic and other activities in Pacific and Atlantic Ocean
- (v) Predictability of the numerical weather prediction models for individual cyclones and the climate model for short range prediction to seasonal prediction/outlook
- (vi) Cyclonic activity during 2013 and the impact of climate change
- (vii) Landfall processes including heavy rain, gale wind, storm surge, coastal inundation and high waves
- (viii) Strengthening collaborative mechanism for further improvement in observation, exchange of data, modeling and products dissemination

### **Expected Outcome**

Followings are the expected outcomes of the workshop.

- (i) Better understanding and characterisation of physical processes leading to genesis, intensification/weakening and tracks of cyclonic disturbances over the north Indian Ocean.
- (ii) Identification of crucial observational parameters for assimilation in NWP model for improvement in model forecast.
- (iii) Strategy for extended and seasonal prediction of genesis of cyclonic disturbances over north Indian Ocean.
- (iv) Strengthening of collaborative mechanism to assimilate R&D output from various organizations/institutes into operational system for cyclone forecasting.
- (v) All the above will help in reducing the loss of lives and property from the dangers of cyclones over the region.

## Participants of the workshop

The workshop will be participated by the scientists working in the field from IMD, IITM, NCMRWF, INCOIS, NIOT, IITs, ISRO, universities and other institutes including laboratories of CSIR and DST.

## Workshop Venue and duration

The two day national workshop will be organized by Cyclone Warning Division, India Meteorological Department (IMD) at **Mausam Bhawan, Lodi Road, New Delhi-110003** during **19-20 June, 2014**.

## Call for Abstracts

Abstracts are being solicited in the research areas as listed in the scientific themes. The authors are requested to send only original/review contributions on research work related to the themes of the conference. Abstracts should be submitted online and should not exceed 400 words. The last date for submission of Abstract is **19 May 2014**. Abstracts should be submitted as word format recommend single-column format, single-spaced 12-pt standard Arial font and A4 letter paper. Paper title should be in 14-pt font, author/s full name in 12-pt font, Organization/Affiliation along with the address in 11-pt font, italics<sup>1</sup>. The language should be English only. The abstracts should be sent to Cyclone Warning Division of IMD through email (cwdhq2008@gmail.com).

## Important Dates

<b>Date of Workshop :</b>	<b><u>19-20 June 2014</u></b>
<b>Submission of Abstracts:</b>	<b><u>19 May 2014</u></b>
<b>Acceptance of Abstracts:</b>	<b><u>26 May 2014</u></b>
<b>Registration:</b>	<b><u>02 June 2014</u></b>
<b>Submission of Full Papers:</b>	<b><u>09 June 2014</u></b>

## Travel & Accommodation

Every effort will be made to arrange transport to the delegates from the airport to the recommended hotel. For commuting between the recommended hotel and the meeting venue, transport will be provided by the organiser. Please indicate your flight number, arrival date and time in the registration form. Limited seats are available in IMD Guest House, which can be provided on request.

## Registration

There will be no registration fee for the participants. However, the participants are requested to fill up the registration form as given below to enable the organisers to prepare for the workshop.



## REGISTRATION FORM

National Workshop on Enhanced and Unique Cyclone Activity during 2013

IMD New Delhi

19-20 June, 2014

Name:.....  
Position: .....  
Institute:.....  
Address:.....  
.....  
Telephone:.....Fax:.....  
E-mail:.....  
Do you wish to present a paper ?                      Yes/ No

Title of your Paper and Authors

Do you intend to present a full paper for the peer reviewed Workshop Volume? : Yes/No

Do you need us to arrange transport and accommodation for you on payment basis? :  
Yes/No

If Yes, give details of your travel plan

Date & Time of Arrival and Airline:

Date & Time of Departure and Airline

### Secretariat

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