J.B.BODA

# EARTH

May-June 2021

# Cyclone Risk in India

The extensive coastal belt of India is very vulnerable to the deadly storms known as tropical cyclones. About 4 to 6 such storms originate in the Bay of Bengal and the Arabian Sea every year.

Tropical cyclones, which are characterised by torrential rain, gales, and storm surges, cause heavy loss of human lives and destruction of property. They also result in extensive damage to standing crops and loss of cattle.

The Bay of Bengal cyclones more often strike Odisha-West Bengal coast in October, Andhra coast in November and the Tamil Nadu coast in December. Over 60 percent of the events in the Bay of Bengal strike different parts of the east coast of India, 30 percent strike coasts of Bangladesh and Myanmar, and about 13 percent dissipate over the sea itself.

The cyclones crossing different coastal states are shown in Fig.1. Considering Arabian Sea, a significant number of cyclones dissipate over the sea itself before making any landfall (about 48.5%). Gujarat coast is the most prone for the cyclones developing over the Arabian Sea, with about 23% of total cyclones developing over the Arabian Sea, crossing the Gujarat coast, and 11% each crossing the Pakistan and Oman coasts.

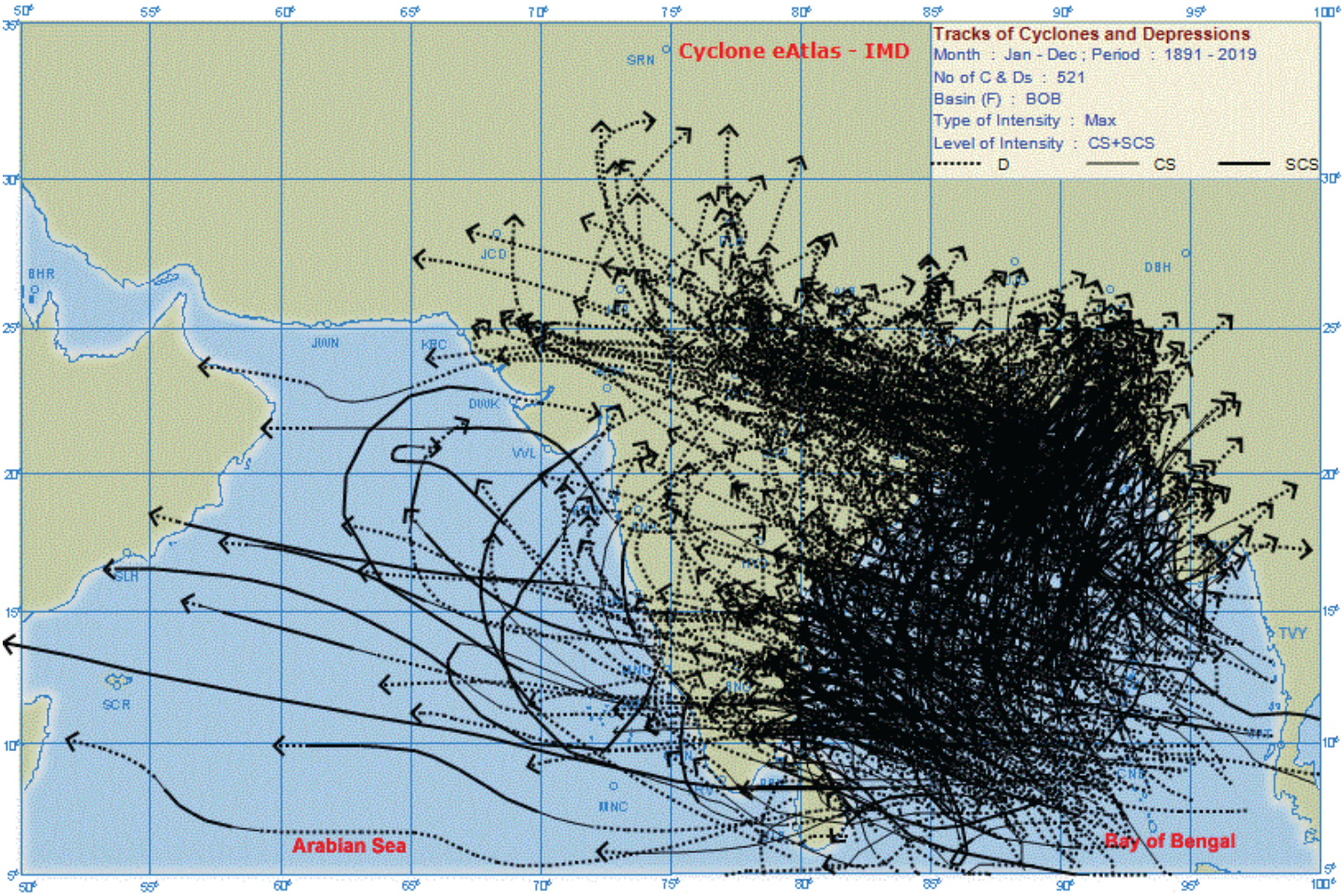



Fig.1 (a) Frequency of cyclones/severe cyclones over the Bay of Bengal landfalling over different coastal states during 1891-2019.

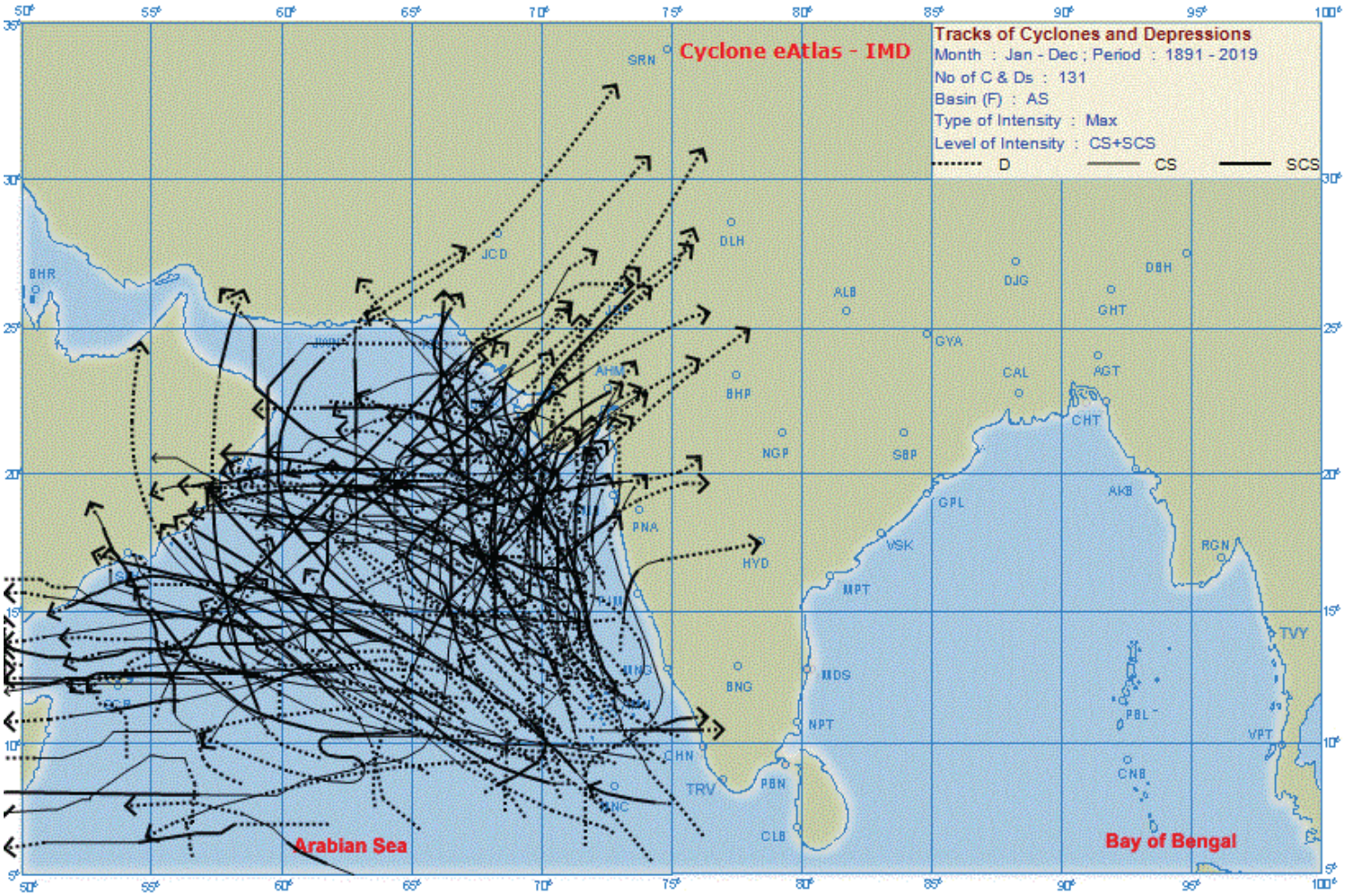



Fig.1 (b) Frequency of cyclones/severe cyclones over the Arabian Sea landfalling over different coastal states during 1891-2019.

Kindly note that the monitoring system over the region has undergone several changes with augmentation of surface observatories, introduction of RS/RW observations during the 1930's, use of satellites since the 1960s, and implementation of meteorological buoys since 1997. Hence all these facts should be taken into consideration while analysing the climatological characteristics of cyclonic disturbances over the North Indian Ocean (NIO).

## Classifications of Cyclones

The Indian Meteorological Department (IMD) classifies Cyclonic disturbances depending upon the wind speed around the circulation centre. Satellite cloud imageries are used along with other meteorological features to estimate the intensities and the wind speed associated with these intense systems. The satellite cloud configurations, expressed by 'T' numbers, have a unique relationship with the wind field of a cyclonic disturbance. The wind speed, condition of sea, and wave height associated with 'T' numbers of various categories of cyclonic disturbances are given below.

| Type of Disturbances | Associated Wind Speed in the Circulation | Satellite 'T' No. | Condition of Sea | Wave Height (m) |
|---|---|---|---|---|
| Depression | 17 to 27 knots (31 to 49 kmph) | 1.5 | Moderate to Rough | 1.25-2.5 2.5-4.0 |
| Deep Depression | 28 to 33 knots (50 to 61 kmph) | 2.0 | Rough | 4.0-6.0 |
| Cyclonic Storm | 34 to 47 knots (62 to 88 kmph) | 2.5-3.0 | High | 6.0-9.0 |
| Severe Cyclonic Storm | 48 to 63 knots (89 to 118 kmph) | 3.5 | Very High | 9.0-14.0 |
| Very Severe Cyclonic Storm | 64 to 119 knots (119 to 221 kmph) | 4.0-4.5 | Phenomenal | Over 14.0 |
| Extremely Severe Cyclonic Storm | 119 knots and above (221 kmph and above) | 5.0-6.0 | Phenomenal | Over 14.0 |
| Super Cyclonic Storm | 120 knots or more (222 kmph or more) | 6.5 or more | Phenomenal | Over 14.0 |

Source: IMD | 1 knot = 1.85 kilometers

## Damage Caused by Cyclone

Cyclones cause severe damage to infrastructure through high-velocity winds. Very strong winds that accompany a cyclonic storm damages installations, dwellings, communications systems, trees etc., resulting in loss of life and property. Gusts are short but rapid bursts in wind speed are the main cause for damage.

Torrential rainfall (more than 30 cm/hour) associated with cyclones gives rise to unprecedented floods. People living in low-lying areas are the worst affected. Heavy rainfall from a cyclone is usually spread over a wide area and causes large-scale soil erosion and weakening of embankments.

Storm Surge-abnormal rise of sea level due to cyclones-impacts marine infrastructure, damages properties nearby, and erodes beaches.

## 2021 Cyclones

### Tauktae

Extremely Severe Cyclonic Storm Tauktae was a powerful, deadly, and damaging tropical cyclone in the Arabian Sea that became the strongest tropical cyclone to make landfall in the state of Gujarat since the 1998 Gujarat cyclone and is one of the strongest tropical cyclones to ever affect the west coast of India.

It made landfall in Gujarat at around 8:30 pm on Monday, May 17, packing winds with speed of 155-165 kilometers per hour, gusting to 190 km/hour.


Fig 2: Tracks of Cyclone Tauktae | Source: IMD

It damaged thousands of houses, boats, and state infrastructure in Kerala, Karnataka, Goa, Maharashtra, and Gujarat. According to initial estimates, Cyclone Tauktae caused INR 100 billion (USD 1.4 billion) worth of damage in Gujarat. In Karnataka and Goa, estimated losses are of INR 2 billion (USD 29 million) and INR 1.46 billion (USD 20.4 million) respectively.

## Cyclone Yaas

Very Severe Cyclonic Storm Yaas was a relatively strong and very damaging tropical cyclone that made landfall in Odisha and brought significant impacts to West Bengal during late May 2021.

It was first monitored on May 23 and it made landfall on May 26 near Balasore in the state of Odisha.

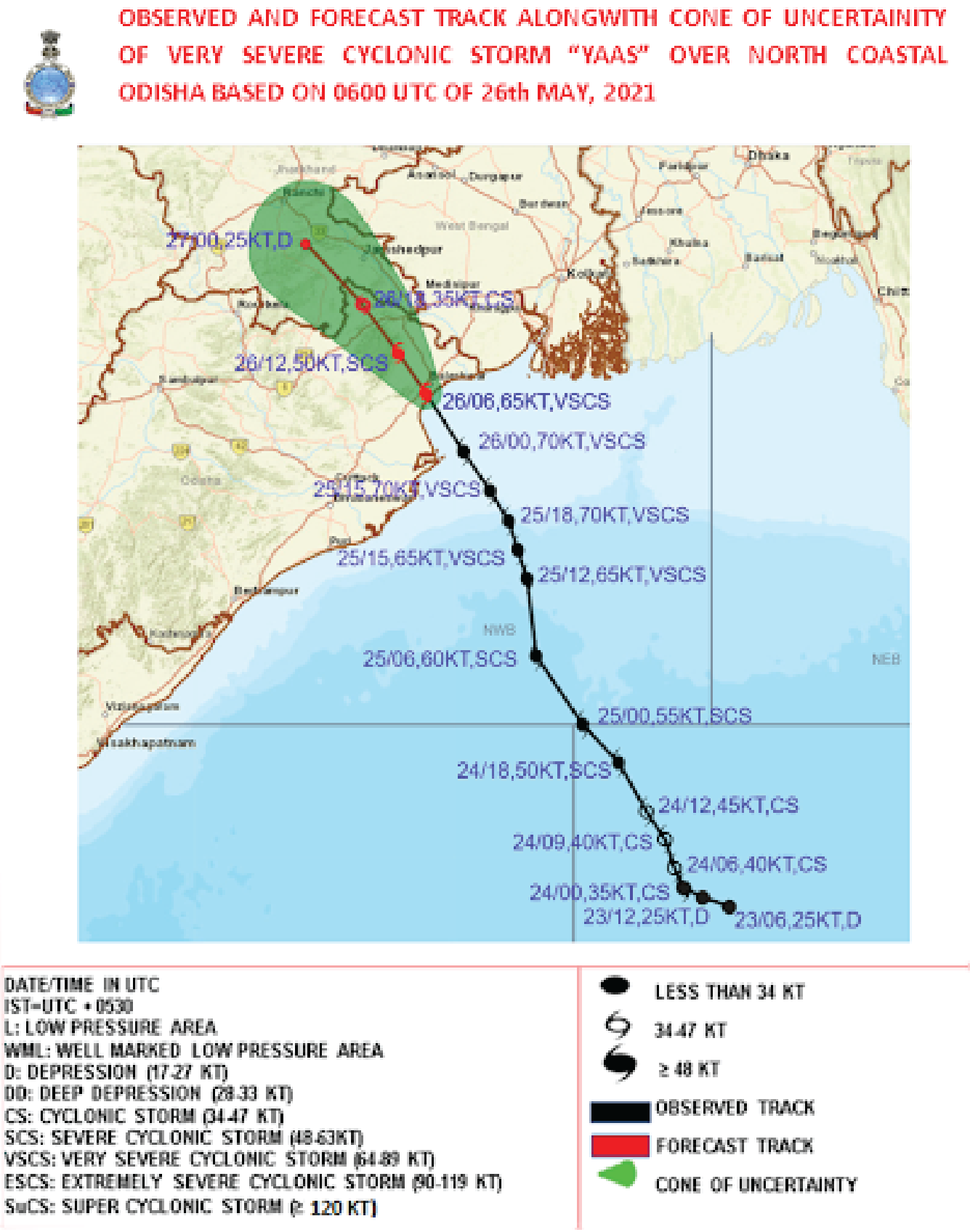



Fig 3: Tracks of Cyclone Yaas | Source: IMD

Though it made landfall in Odisha, most of the damage it caused was in the state of West Bengal. According to initial estimates, the state suffered a loss worth INR 210 billion (USD 2.94 billion). Around 0.221 million hectares of crops and 71,560 hectares of horticulture was damaged.

In Odisha, a total of 6.0 million people in 11,000 villages were affected due to the cyclonic storm. The initial damage to infrastructure is worth INR 6.100 billion (USD 85 million), including the damage of government infrastructure worth INR 5.20 billion (USD 72.8 million) and personal assets worth INR 900 million (USD 12.6 million). Further, damages to large tracts of crops affected betel–vine farmers, paddy farmers, and vegetable growers in Kendrapara, Balasore, Mayurbhanj, and Bhadrak districts.

In Bangladesh, low-lying areas in some districts were flooded. Total damage of around USD 13.28 million was reported in Cox's Bazar and Khulna districts.

Due to low insurance penetration, the protection gap would be high.

**Table 1 below shows Economic and Insured Losses for some recent cyclones.**

| Date | Name of Event | Regions Impacted | Economic Loss (USD) | Insured Loss (USD) & Source |
|---|---|---|---|---|
| 23-27 November 2020 | Nivar | Sri Lanka, India (Tamil Nadu, Puducherry, Andhra Pradesh) | 600 million | NA |
| 1-4 June 2020 | Nisarga | India (Maharashtra) | 803 million | NA |
| 16-21 May 2020 | Amphan | India, Bangladesh | 13.7 billion | Minor (Munich Re) |
| 5–11 November 2019 | Bulbul | India (Odisha, West Bengal, Andhra Pradesh), Bangladesh | 3.37 billion | AN |
| 24 October–3 November 2019 | Kyarr | India, Pakistan, Oman, UAE | NA | NA |
| 10-18 June 2019 | Vayu | India (Gujarat), Pakistan | 0.14 million | NA |
| 26 April–5 May 2019 | Fani | India (Odisha, West Bengal, Andhra Pradesh), Bangladesh | Around 8 billion | Over 500 million |
| 13-17 December 2018 | Phethai | Sri Lanka, India | 100 million | NA |
| 10-19 November 2018 | Gaja | Southern Vietnam, Malay Peninsula, Andaman Islands, Sri Lanka, Southern India (Tamil Nadu, Puducherry) | 775 million | NA |

| | | | | |
|---|---|---|---|---|
| 8-12 October 2018 | Titli | India (Northern Andhra Pradesh, Odisha, West Bengal), Bangladesh | 920 million | NA |
| 29 November-2 December, 2017 | Ockhi | Sri Lanka, India (Kerala, Tamil Nadu, Maharashtra) | Around 520 million | NA |
| 6-13 December, 2016 | Vardah | Tamil Nadu | 1 billion | 52 million |
| 7-14 October, 2014 | Hudhud | Andhra Pradesh, Orissa, Chhatisgarh, Madhya Pradesh, Uttar Pradesh | 7 billion | 632 million (Swiss Re) |
| 4-14 October, 2013 | Cyclone Phailin | Orissa, Andhra Pradesh, | 4.5 billion | 100 million (Swiss Re) |
| 25 October–3 November, 1999 | | Orissa | 4.5 billion | 100 million (GIC) |
| 4-10 June, 1998 | | Gujarat | 590 million | NA |

## Role of Global Warming

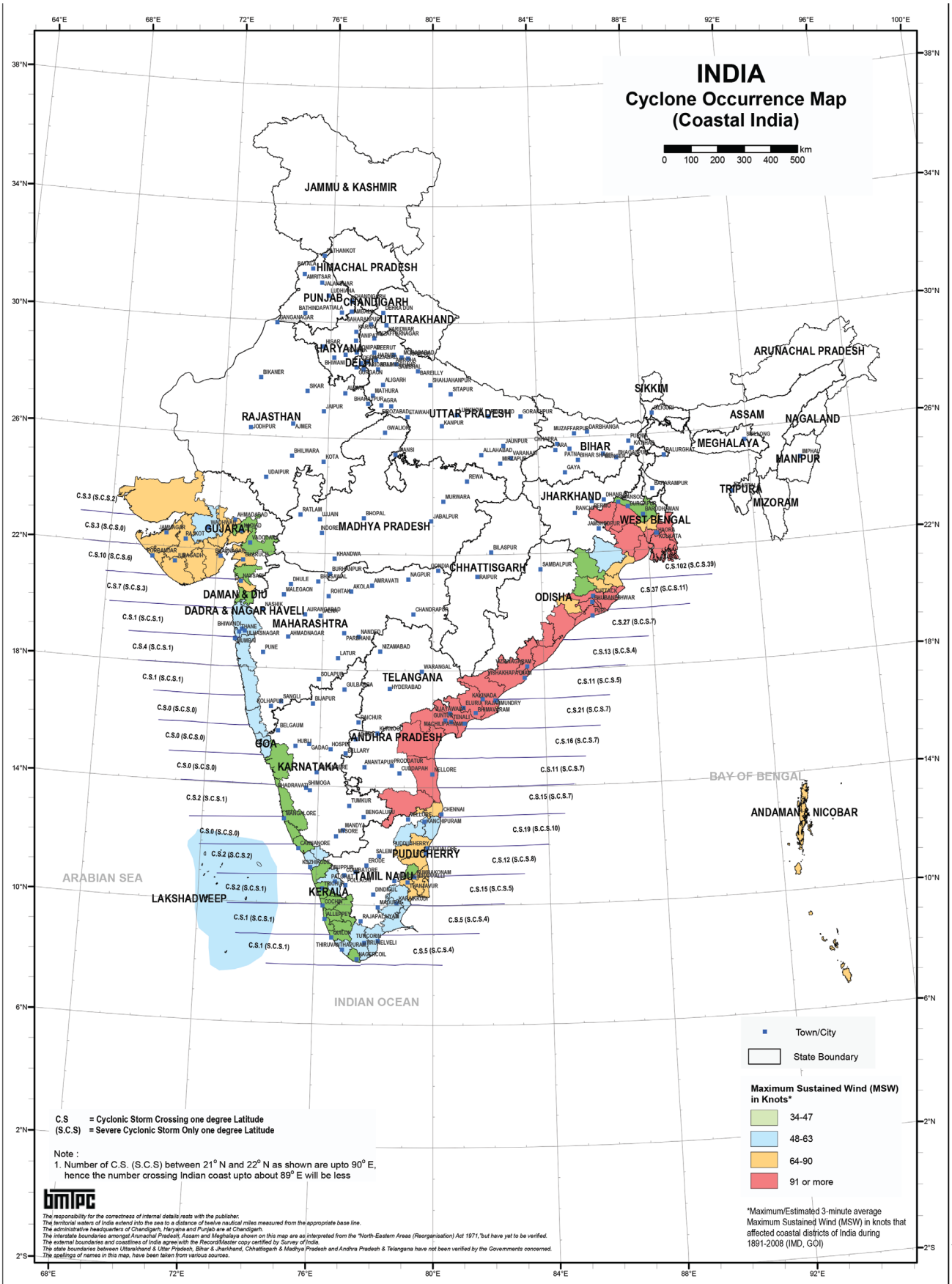
Historical data suggests that Arabian Sea, which is relatively cooler than the Bay of Bengal, experienced just 93 cyclones between 1891-2000 while the warmer Bay of Bengal recorded 350 cyclones in this period.

But, between 2001 and 2021, 28 cyclones formed in the Arabian Sea, along with a marked increase in storm intensity, fuelled by rising sea surface temperatures which reached as high as 31°C (88°F). Scientists found that the entire Indian Ocean is warming at a faster rate compared to the Atlantic or Pacific. And within the Indian Ocean, the western parts of the Indian Ocean are warming much more. We see that sea surface temperature rise is connecting well with the changes in the intensity and frequency of cyclones especially in the Arabian Sea and also the rapid intensification.

Huge insured exposure is at risk in coastal cities due to economic activities. Fig 4 below shows the Cyclone Occurrence Map of India categorising districts based on maximum sustained winds.

**References:**


- IMD
- BMTPC, Government of India
- Business Standard
- The Guardian
- The Times of India
- The Hindu
- Munich Re
- Swiss Re




BMTPC : Vulnerability Atlas- 3rd Edition; Peer Group, MoHUA; Map is Based on digitised data of SOI, GOI; Maximum Sustained Wind (MSW) Data from IMD, GOI. Disclaimer: The maps are solely for thematic presentation.