

# A Comparative Analysis of Wind and Significant Wave Height on Extreme Weather Events on the Sea Around Sri Lanka

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## Introduction

Extreme weather events such as tropical cyclones, Storms and swell surges pose serious threats to marine and coastal areas in tropical regions due to the combination of strong winds and extreme sea wave heights. Extreme weather events in the Indian Ocean are influenced by various climatic factors, including monsoonal winds. The Bay of Bengal and the Arabian Sea play a significant role in generating and intensifying cyclones and other severe weather phenomena. Sri Lanka's strategic position along major global shipping routes makes it a crucial hub for maritime trade. However, its location also exposes it to climate-related challenges that impact both its land and maritime environments. Understanding the region's climate patterns, cyclone behavior, and sea state is essential for mitigating risks and ensuring the safety of maritime operations. The past 12 years of extreme weather events (2011 – 2022), including tropical cyclones, storms, and swell surges, that primarily affected Sri Lanka's sea area and its surroundings, covering 70°E to 100°E and 2°N to 20°N, were the focus of this study.

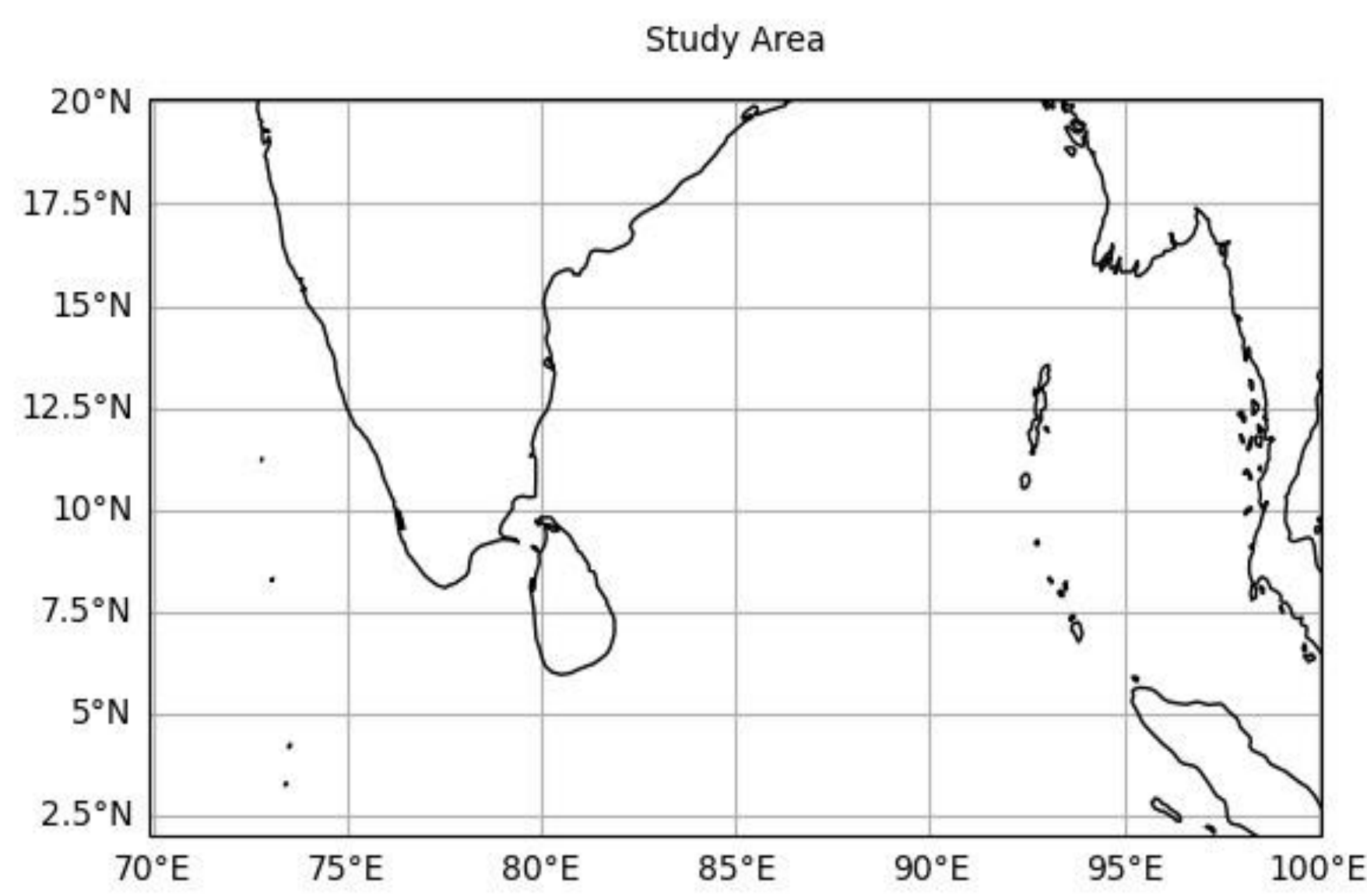


Figure:1 The map showing selected study area of Indian ocean

## Methodology

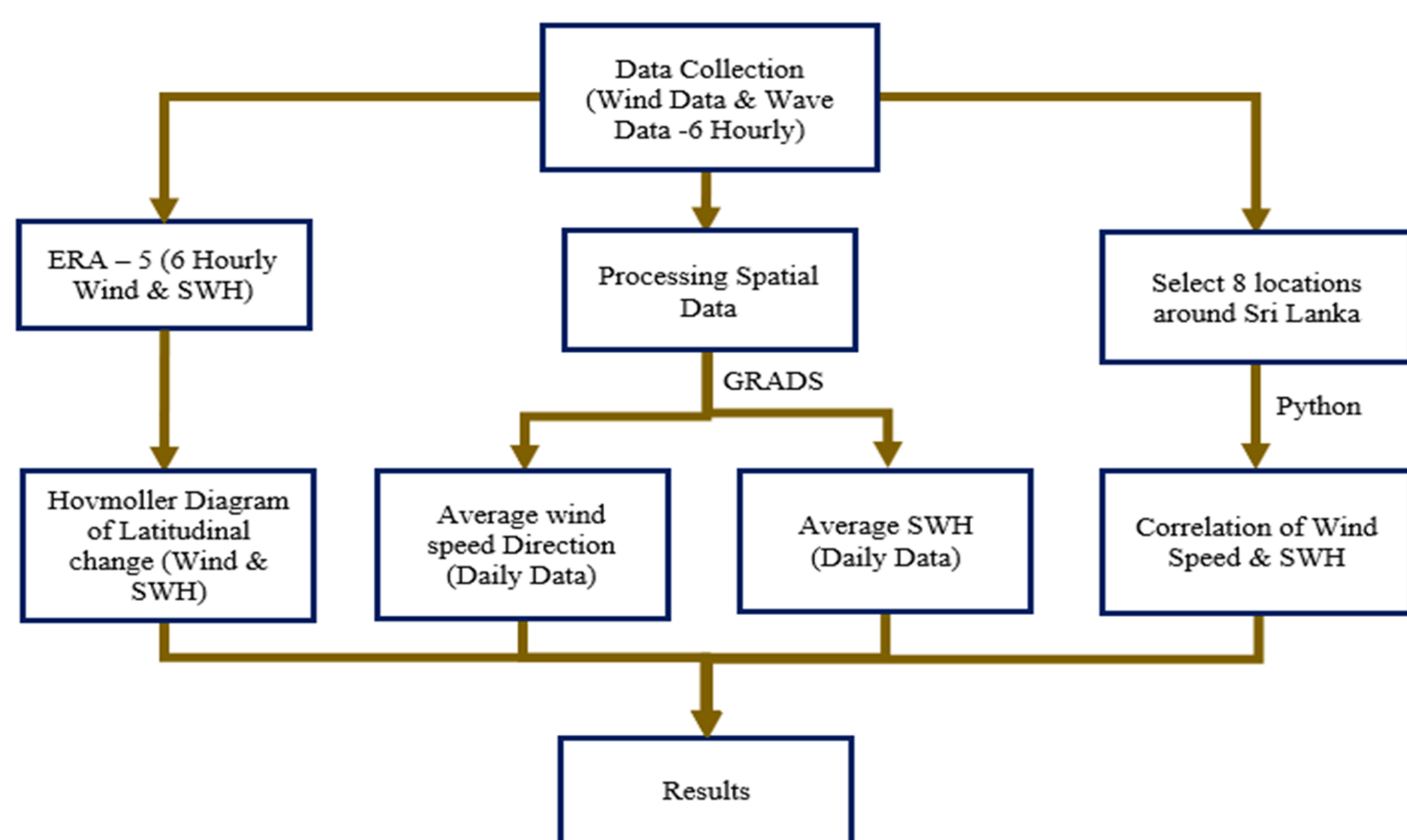


Figure 2. Flow chart of the methodology

Table 1. Study locations

Location	Location Number	Latitude (Degrees)	Longitude (Degrees)
North (Point Pedro)	1	10.00N	80.20E
East (Trincomalee)	2	08.86N	81.90E
Southeast (Oluvil)	3	07.27N	82.00E
South-1 (Hambanthota)	4	05.99N	81.13E
South-2 (Matara)	5	05.67N	80.56E
Southwest (Galle)	6	05.83N	80.00E
West (Colombo)	7	05.95N	79.79E
Northwest (Kalpitiya)	8	08.25N	79.67E

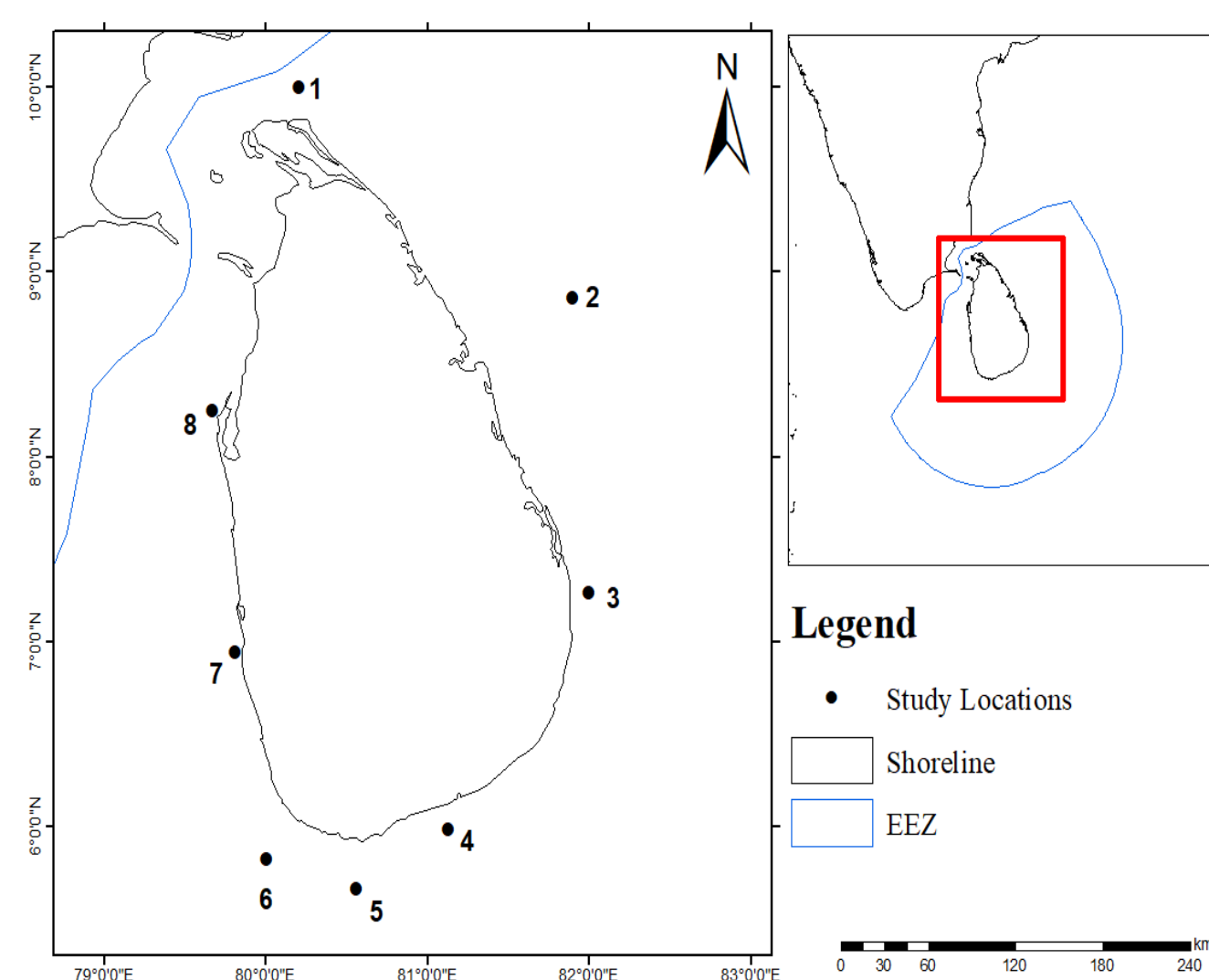


Figure:3. The map showing selected locations around Sri Lanka

- The study highlights that high wave heights and strong winds contributed to rough sea conditions.
- The study highlights that the exact location of SWH does not always depend on the wind at that location, as distant storms can influence SWH. Because of this, a strong positive correlation is not found in all affected areas. While wind and SWH are generally related, where an increase in one often leads to an increase in the other, this study found that this is not always the case.
- Up to 2 m wave height can make rough sea conditions near coastal areas and not for high sea areas but up to 3 m wave height made rough sea that not suitable for the navigation. During the southwest monsoon strong wind impact in 2013 highlights, high wind speed and high SWH can cause accidents at the sea.
- The study finds that strong winds of 10-12 ms<sup>-1</sup> can generate SWH up to 3 m, while winds up to 16 ms<sup>-1</sup> can increase SWH to 6 m. Calm seas are observed when SWH is below 2 m and wind speeds range from 1-4 ms<sup>-1</sup>. Cyclonic and swell surges mainly impact the north, east, southeast, and south sea areas of Sri Lanka due to frequent cyclonic activity in the Bay of Bengal. The western sea area has lower vulnerability to cyclones, but the southwest monsoon period significantly affects the west and south sea regions.

## References

- [1]. Avia, L. Q. (2020). A Comparative Analysis of the Wind and Significant Wave Height on the Extreme Weather Events (TC Cempaka and TC Dahlia) in the Southern Sea of Java, Indonesia. *IOP Conference Series: Earth and Environmental Science*, 572(1), 012033. <https://doi.org/10.1088/1755-1315/572/1/012033>
- [2]. Mowla, K. G. (1968). Cyclogenesis in the Bay of Bengal and Arabian Sea. *Tellus*, 20(1), 151–162. <https://doi.org/10.1111/j.2153-3490.1968.tb00359.x>
- [3]. Xinhua. (2013, September 6). *Storm kills 14 Sri Lankan fishermen, more missing—World—Chinadaily.com.cn*. Chinadaily. [https://www.chinadaily.com.cn/world/2013-06/09/content\\_16600353.htm](https://www.chinadaily.com.cn/world/2013-06/09/content_16600353.htm)

## Results

### Monsoonal Strong winds in 2013

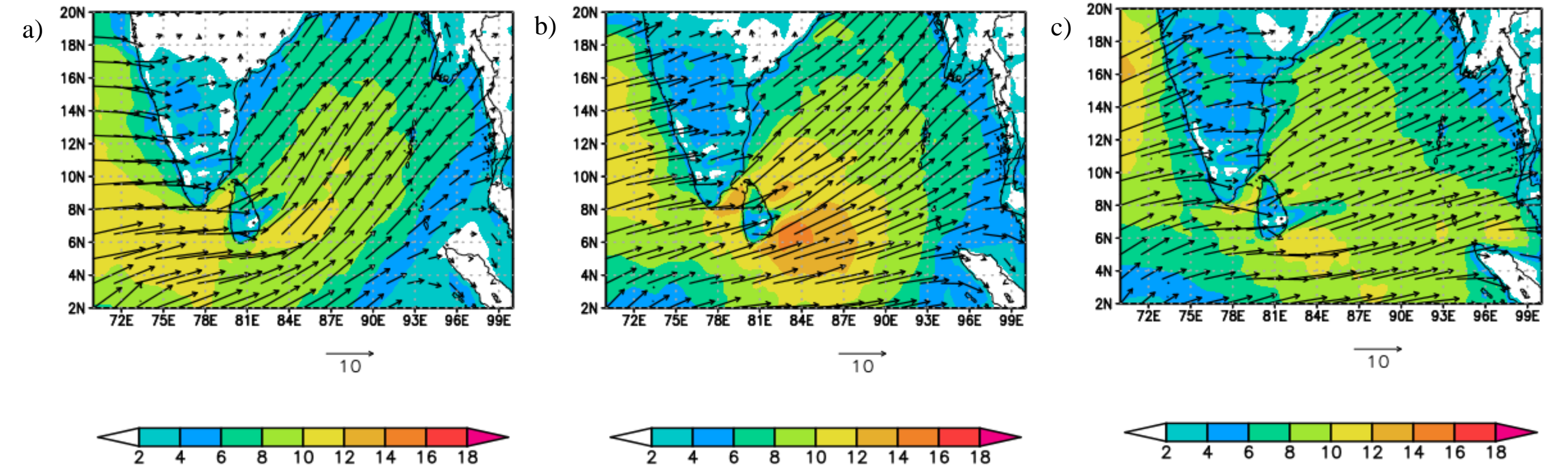


Figure:4. Average wind speed (ms<sup>-1</sup>) during the period of southwest monsoon in 2013 (a): 07/06/2013, b): 08/06/2013, c): 09/06/2013)

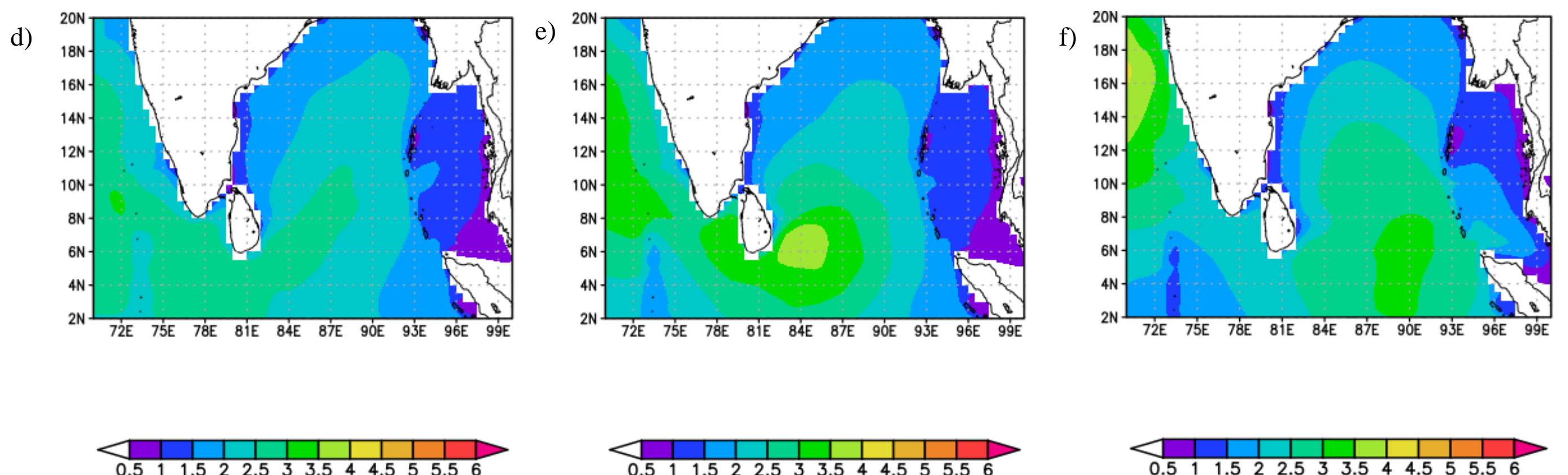


Figure:5. Average significant wave height (m) during the period of southwest monsoon in 2013 ( d): 07/06/2013, e): 08/06/2013, f): 09/06/2013)

### Correlation between Average wind speed & Significant wave height

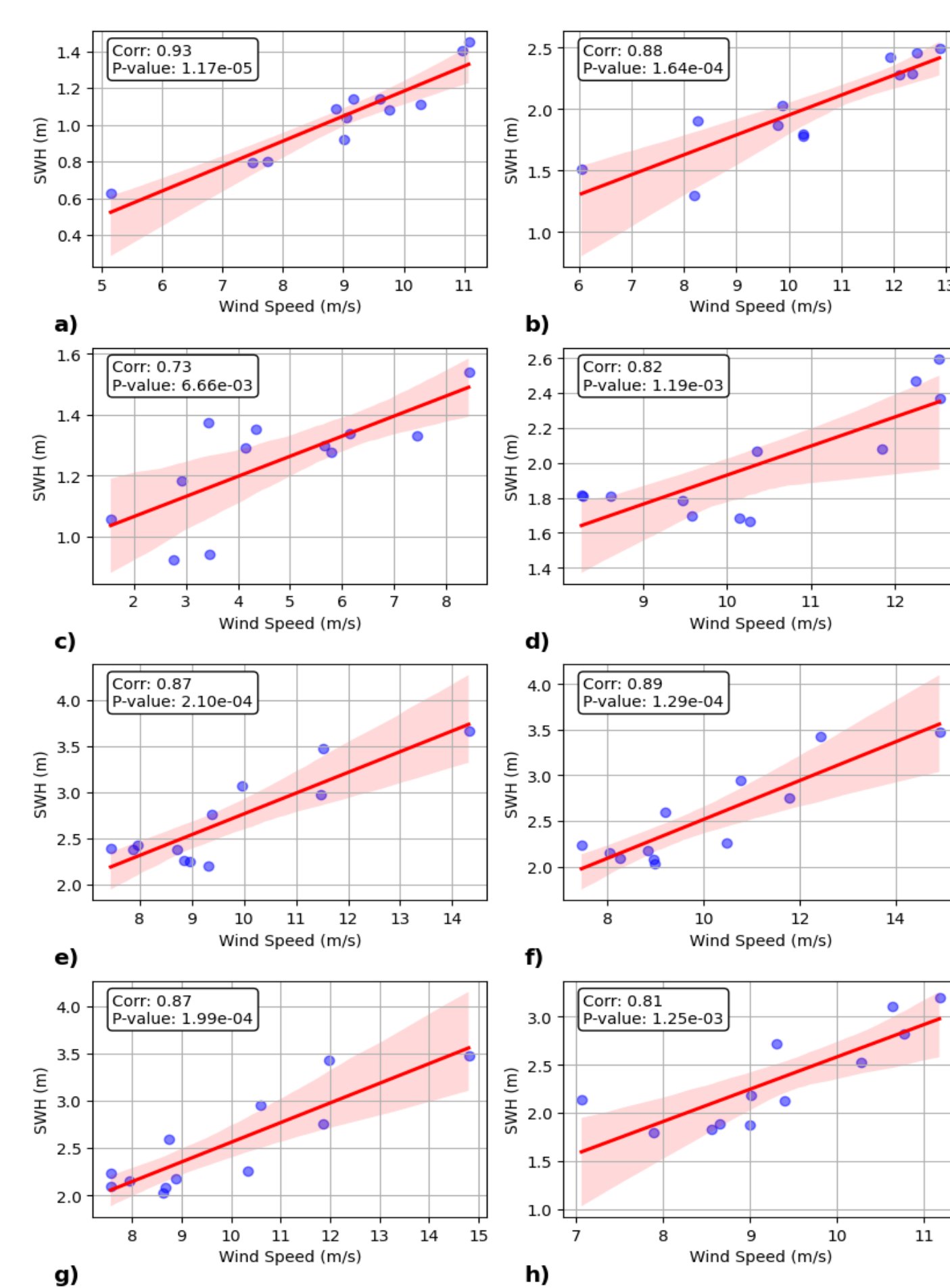


Figure:6. Correlation between AWS and SWH during Monsoonal Winds ( a): North SL, b): East SL, c): Southeast SL, d): South-1 SL, e): South-2 SL, f): Southwest SL, g): West SL, h): Northwest SL)

### Hovmoller diagrams

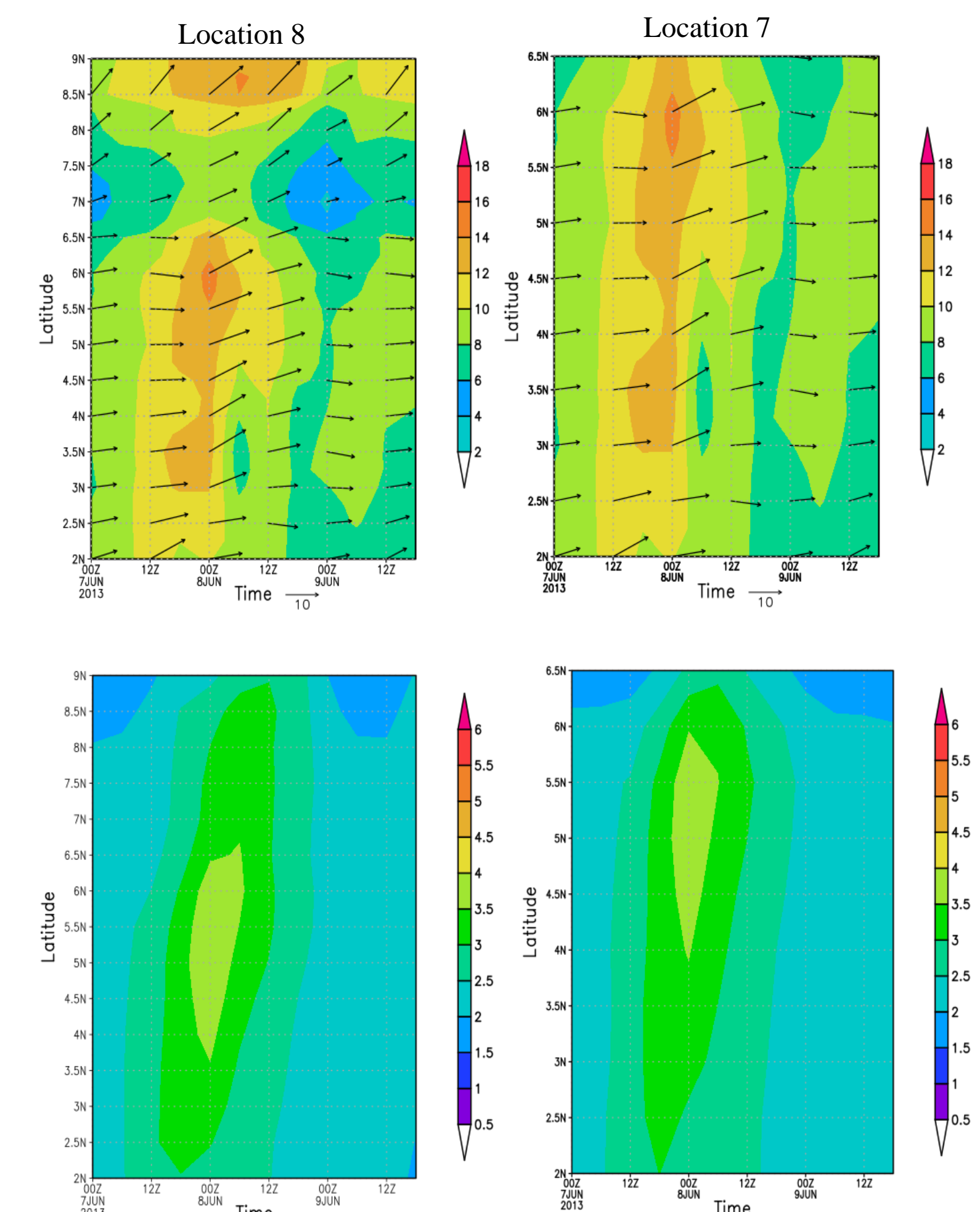


Figure 7. Latitudinal distribution of average wind speed and significant wave height on Northwest and West Sri Lanka during Monsoonal Winds 2013

## Conclusion

- The study found that most extreme weather events occurred during the main monsoonal periods, with the majority happening during the Southwest Monsoon period.
- During the Southwest Monsoon period, most extreme events resulted in rough sea conditions across the majority of locations.
- Within the Southwest Monsoon period, the two most significant events that affected Sri Lankan waters were:
  - Southwest strong winds in 2013
  - Tropical Cyclone Roanu in 2016