Investigation of Offshore Wind Climate in the Southeast Asia

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Offshore winds in the Southeast Asia were analyzed using satellite observations and reanalysis data. Since the Southeast Asian region are passed by the East Asian monsoon and Australian monsoon, it is promising for the development of offshore wind energy. Therefore, detail information of wind distribution and variability associated with monsoon are needed to be identified. In this study, we analyzed wind measurements acquired by ASCAT onboard MetOP-A and MetOP-B satellites for 2010–2018 and ERA5 reanalysis data for 2003–2018. The ASCAT wind measurements has a spatial resolution of 12.5 km providing observational evidence of surface winds in the island-studded seas. On the other hand, the ERA5 reanalysis data provide hourly wind fields at a spatial resolution of 0.25˚ and allow to analyze temporal variations from monsoon variations to diurnal variations. Hence, we obtain these following results.

The monsoon in the Southeast Asian region pass the Indonesian seas consisting of a main route and secondary routes. The wind routes are composed of small seas and straits. The main route of the northwest monsoon (East Asian monsoon) extends from the South China Sea to the northern Australian continent through the Arafura Sea, Banda Sea, Java Sea, and Karimata Strait. Small seas and straits adjacent to the main route work as the secondary routes of the monsoons. Meanwhile, the main route of the southeast monsoon (Australian monsoon) extends from the northern Australian continent to the Halmahera Sea and the Molucca Sea. The Java Sea and Karimata Strait work as secondary monsoon route. These monsoon routes align with the coastlines and are well represented by the major-axis directions of variance ellipses of wind velocities. Moreover, the velocity variance ellipses are highly anisotropic in the Indonesian seas.

We investigate the seasonal variations of monsoons in the Indonesian seas. The peak of monthly climatology of vector wind during the Australian monsoon is in August and during the East Asian monsoon is in January. Along the main monsoon route, the monsoon changes its direction from northwest to southeast in April and vice versa in November. The periods of southeast monsoon are longer than those of northwest monsoon. In addition, wind speeds during southeast monsoon are greater than those during northwest monsoon. In the lee of island (around Sulawesi), the wind is consistently weak.

Wind variabilities along the main monsoon routes in the Indonesian seas are induced by the variabilities of SLP. Two key regions were identified using the correlation analyses between the major-axis wind component and SLP. One is a region fully covering northern Australian continent and the other region covers the South China Sea. The result shows that monsoon systems in the South China Sea and northern Australian continent induce the offshore wind variability in Indonesia.

We analyzed the diurnal variations of the wind. Near the coast, diurnal wind variation dominates throughout the year. Moreover, the wind fields show divergent and convergent patterns along the main monsoon routes during daytime and night-time, respectively. The seasonal variation of diurnal wind is consistent with the daily maximum of surface temperature difference between land and sea. The diurnal variations are roughly separated into southern and northern region. In the southern region, the peak is in

September while in the northern region, two peaks are in February and September.

Keywords: offshore wind, surface wind, wind climatology, monsoon, wind energy

