

ALOS-2/PALSAR-2によるハリケーンの海上風検出

Hurricane ocean surface wind retrieval from ALOS-2/PALSAR-2

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Strong winds induced by typhoons and hurricanes cause disasters and have a great impact on social activities, so there is an increasing demand for their monitoring and prediction. Synthetic aperture radar (SAR) can be the only satellite sensor capable of measuring sea surface winds with high spatial resolution O (100 m). For the purpose of wind speed detection by Japanese L-band SAR (Phased Array type L-band Synthetic Aperture Rader-2: PALSAR-2) and use for operational weather forecasting under typhoon conditions, Japan Aerospace Exploration Agency (JAXA)-Meteorological Research Institute cooperation study has launched. Typhoons/hurricanes observations were being carried out under the cooperation by programming the PALSAR-2 observations based on the predicted course of typhoons and hurricanes. So far, simultaneous observations with National Oceanic and Atmospheric Administration (NOAA)'s airborne Stepped Frequency Microwave Radiometer (SFMR) has been made for four cases of hurricanes. Based on these data, estimating the wind structure of the hurricane by PALSAR-2 was developed.

The 3 km average PALSAR-2 normalized radar cross section (NRCS) and the incidence angle were collocated with the SFMR-measured ocean surface wind speed and rain rate. It was confirmed that the incidence angle dependence was small for the cross-polarized (HV) NRCS, so we developed a model function for the strong winds for the HV polarization. In order to investigate the dependency of NRCS on wind speed and incidence angle, the match-ups were classified into "bins" of 2 m/s wind speed and 5° incidence angle. Any data of which deviation exceeded 2σ in each bin were excluded.

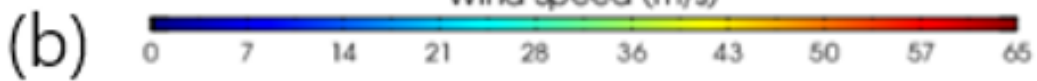
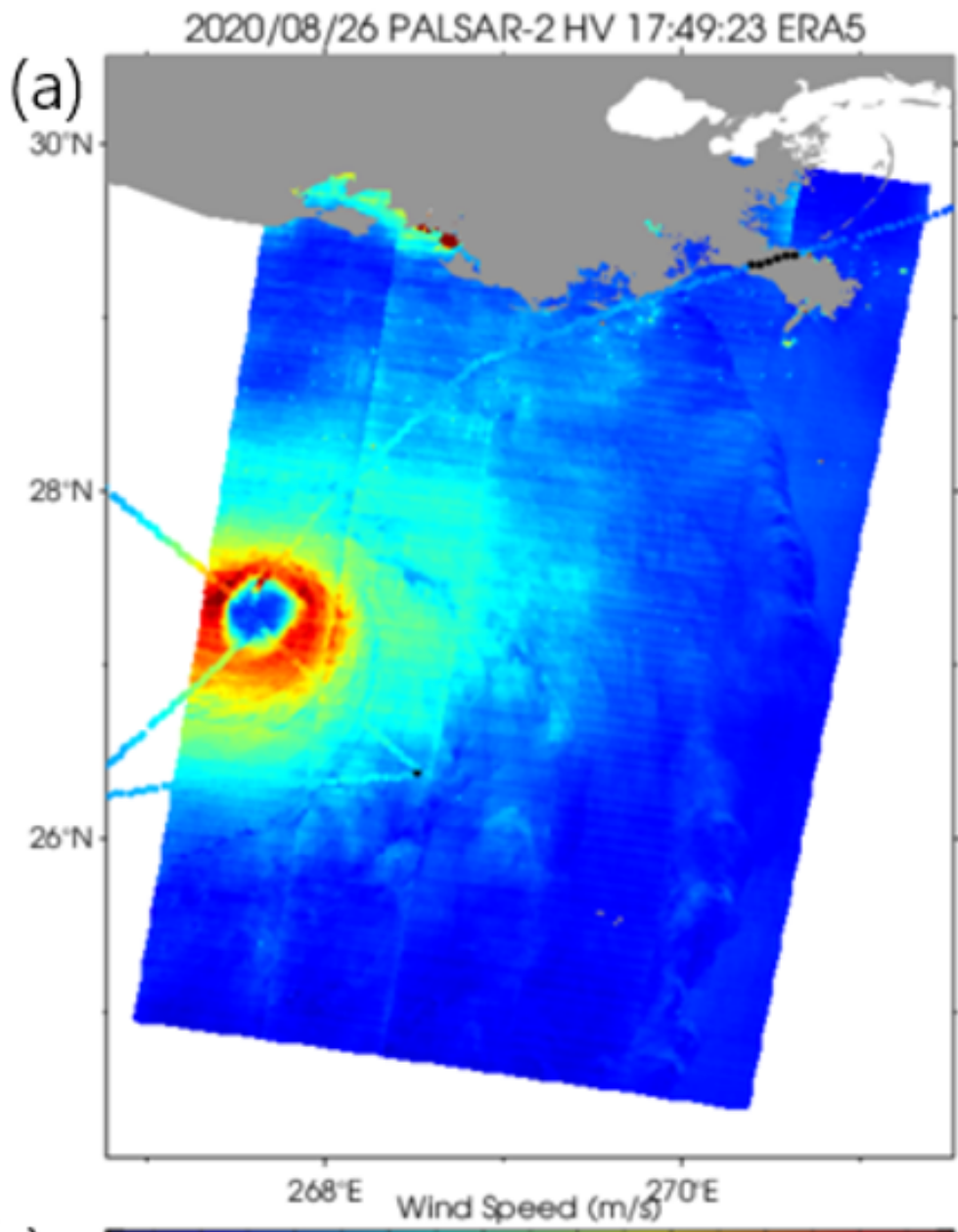
A relationship between the PALSAR-2 HV NRCS and ocean surface wind speeds measured by SFMR showed that NRCS increased with respect to the wind speed up to about 55 m/s. Based on the method proposed by Hwang et al. (2015), a geophysical model function (GMF) was constructed as a function of wind speed and incidence angle. The wind speed was then inversely estimated from the matchup data (HV NRCS) and compared with the wind speed of SFMR. Bias and RMSE are -0.2m/s and 4.1m/s, respectively. It indicates that the wind speed can be detected up to about 50 m/s or more without depending on the incidence angle.

The derived GMF was applied to the PASLAR-2 HV image of Hurricane Laura to calculate the ocean surface wind speed, and the comparison was performed along the SFMR observation tracks (Fig. 1). Although there are some biased differences, fluctuation trends including maximum wind speed of about 60m/s and sudden changes in wind speed near the eye wall are captured. The derived wind speed structure of the hurricane was compared with the best track data. Omnidirectional surface wind profiles as a function of distance from the hurricane center for the four geographical quadrants (NW, SW, SE, and NE) were calculated from the PALSAR-2-derived wind speed and compared with wind speed radii at three wind speed levels (34Knot, 50Knot, 64Knot) obtained from the best track data. Wind speed radius is smaller in NW and SW than in NE and SE, which indicates the same spatial asymmetry structure as the best track. In addition, the absolute value of the wind speed radius and the decreasing tendency with respect to the distance are approximately the same.

It was confirmed that the L-band HV NRCS has a relationship with wind speed up to about 55 m/s in the data used in the present study and the wind speed can be estimated. On the other hand, the stronger the wind, the lower the increasing rate of NRCS with respect to the wind speed, so the radiometric accuracy of the SAR product has a strong impact on the wind speed estimation especially under the extreme wind condition.

キーワード：台風・ハリケーン、海上風検出、合成開口レーダ、パルサー2

Keywords: typhoons/hurricanes, wind speed retrieval, SAR, PALSAR-2



Comparison of surface wind speed of PALSAR-2 HV & SFMR

