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Prediction possibility of a strong local-wind “Hijikawa-arashi” found in Ozu City, Japan using the horizontal pressure gradient data

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“Hijikawa-arashi” is a locally strong gap-wind observed during seasons from autumn to winter along the Hijikawa river near the Nagahama area of Ozu City in Ehime Prefecture, Japan. The river is connected to the inland Ozu basin where a cold air mass is accumulated during nighttime by surface radiation cooling. The cold air overflows to the Seto Inland Sea through a narrow valley along the river. Although the wind speed of Hijikawa-arashi (HA) sometimes exceeds 10m/s (e.g., Nakata 1982), how the horizontal pressure gradient along the valley works for this locally strong wind. In this study, we analyzed the air pressure and wind speed by in-situ observations at three sites: Ozu basin located at inland, Nagahama area at estuary of the Seto Inland Sea, and Yamato area at a gap of valley between Ozu basin and Nagahama. Then, we discussed a prediction possibility of strong HA on the basis of spatio-temporal relationships among the air pressure, temperature, and wind speed.

Understanding a behavior of HA on the surface, our meteorological observations were conducted at the above three sites from October 25, 2017 to March 26, 2018. Observed meteorological elements included wind speed and direction, air temperature, humidity (weather transmitter WXT520), and air pressure (YOUNG 61302V). The pressures acquired by our observation were corrected to the sea surface level pressure (SLP). In addition, the development of HA was confirmed by a surveillance camera.

After sunset of the day before the HA development, the observed SLP increased in temporal order of Ozu (inland), Yamato (gap), and Nagahama (estuary) until midnight when the air temperature decreased gradually. And then, the SLP became to decrease at midnight on the three sites while the HA began to occur.

The analysis for day-to-day observational data revealed that the wind speed of HA exceeded 16 m/s at the daily maximum. The relationship between the daily maximum wind speed at Nagahama (WSmax) and the daily maximum SLP difference between Ozu and Nagahama (SLPdiff) was investigated. The result showed that the more SLP difference increased, the stronger HA was. This relation equation was given by “WSmax = - 0.9563 * SLPdiff + 7.1209 * SLPdiff + 2.0313 (r^2 = 0.7408).” Such a feature was not found for the daily maximum temperature difference between Ozu and Nagahama instead of pressure. Consequently, the horizontal pressure gradient data obtained from multi-site observational SLP can be an important indicator of the maximum wind speed of developing HA.