Micro scale wind pattern over the Hinase archipelago under the Typhoon attack and its impact on surface tidal current

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Abstract

In Hinase Archiperago area in the southwestern part of Japan (Fig. 1a-c), oyster cultivation is a prevailing industry. However, sometimes, due to "*mizushio*", which is shallow surface tidal current with low salinity affects the oyster causing severe deficit. *Mizushio*'s are caused by heavy rainfall associated with Typhoons. We investigated the impact of Typhoons on the micro-scale wind pattern over this area using weather stations and salinity gauge, and WRF atmospheric model.

We found an important difference in wind direction during the passage of Typhoons. In mizushio case on 17 Jul. 2015, south westerly to South easterly wind prevails, which may keep *mizushio* in inner channel.

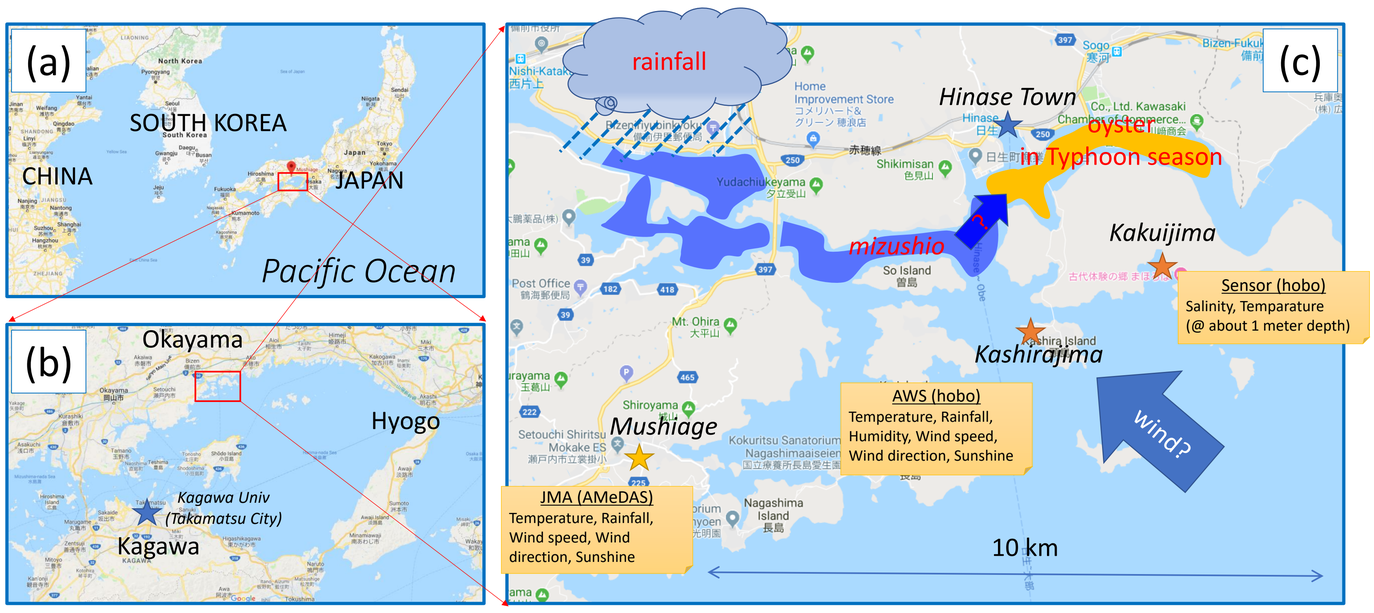
1. Introduction

Oyster in Hinase Archiperago is cultivated within a channeling area between Honshu and Kakuijima Island as indicated by yellow colored sea area in the Typhoon season (Fig. 1c).

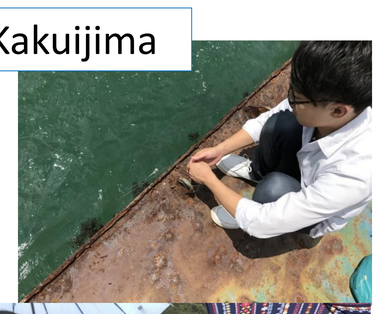
This area is usually relatively safe for oyster cultivation, since it is not connected with outer ocean. However fresh water provided by rivers due to heavy rainfall creates *mizushio*, a shallow surface tidal current with low salinity, in this channeling area (Blue arrow in Fig. 1c).

We investigated two major Typhoon cases on 17 Jul. 2015 and 17 Sep. 2017, the formar was reported to be much affected and the latter was not, to find out possible impact of *mizushio* on oyster cultivation.

2. Geography, Methods and Observations



(e) Kakuijima



(d) Kashirajima

Fig. 1: (a)-(c) Location of observation sites utilized for current research. (d), (e) Photos of instruments.

3.1 Affected Case: 17 Jul. 2015

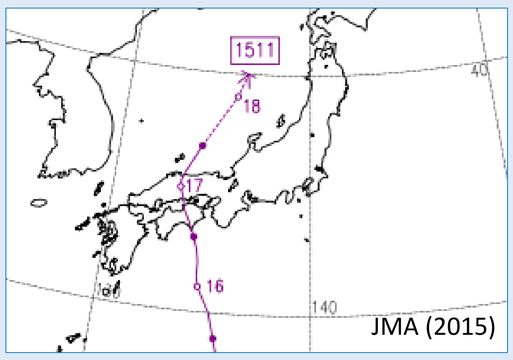


Fig. 2: Track of Typhoon. Violet numbers are dates in Jul. 2015.

Typhoon 1511 passed just to the west of Hinase (Fig. 2). Rainfall peaked at around 2:00-4:00 at Mushiage AMeDAS station (Fig. 3). Due to the course of the Typhoon, the wind direction was ENE to SE (Fig. 7).

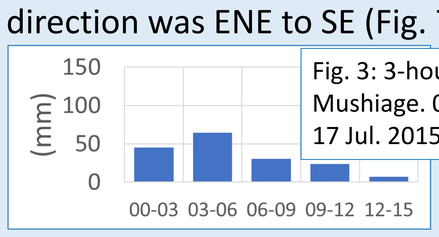


Fig. 3: 3-hourly rain at Mushiage. 00-15h (LT) on 17 Jul. 2015.

3.2 WRF Modeling: 17 Jul. 2015

We conducted a model simulation using Weather Research and Forecasting Model (WRF Model) for the Typhoon case on 17 Jul. 2015. We calculated the case from 03 JST 16 Jul. to 06 JST 18 Jul. with very fine resolution at 200 m grids. The model reproduced the observed variation of wind speeds and wind directions well. Instead of the complex terrain, over the sea surface, the wind directions were southerly or easterly, i. e. inshore wind, during the peak time of the Typhoon. This wind pattern suggests that the wind keeps the *mizushio* inner channel

3.3 Not affected case: 17 Sep. 2017

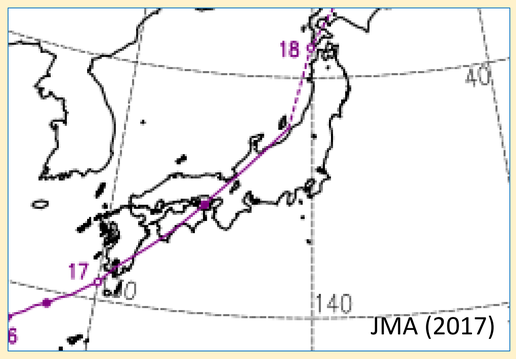


Fig. 4: Track of Typhoon. Violet numbers are dates in Sep. 2017.

Typhoon 1718 passed just to the south of Hinase (Fig. 4). Rainfall peaked at around 17:00-21:00 at Kashirajima Island (Fig. 1d, Fig. 5). Due to the course of the Typhoon, the wind direction was NE to WSW (Fig. 7).

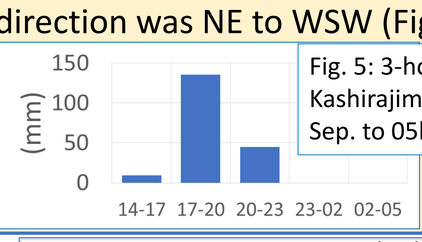


Fig. 5: 3-hourly rain at Kashirajima. from 14h 17 Sep. to 05h 18 Sep. 2017.

4. Conclusion

In *mizushio* case, southeasterly wind prevails over the Hinase area during the peak of Typhoon wind several hours after the rainfall peak. This suggests that the inshore strong Typhoon wind keeps *mizushio* in inner channel causing damage. WRF calculation also supported.

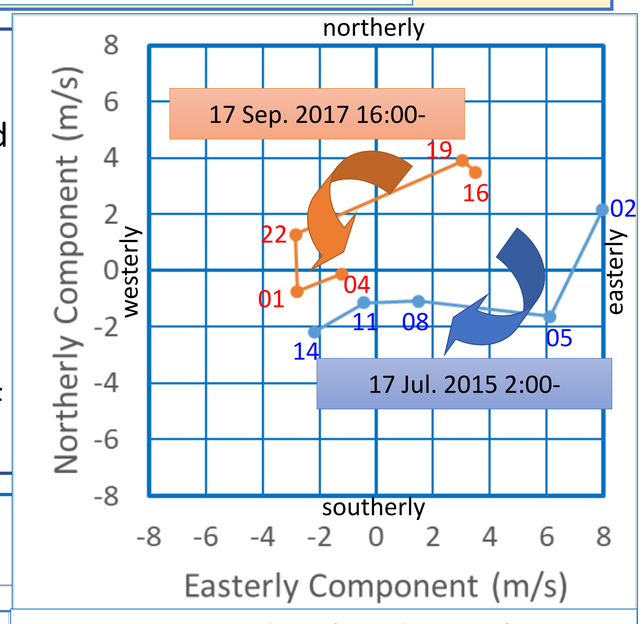


Fig. 7: Hodographs of Typhoons for three hourly averaged wind.

Appendix. Validation of Data at Kashirajima

We validated the rainfall data at Kashirajima against AMeDAS Mushiage about 10 km west-southwest of Kashirajima (Fig. 1c) as for the daily rainfall.

This result suggested that the raingauge installed at Kashirajima, whose data was utilized in section 3.3, was working properly.

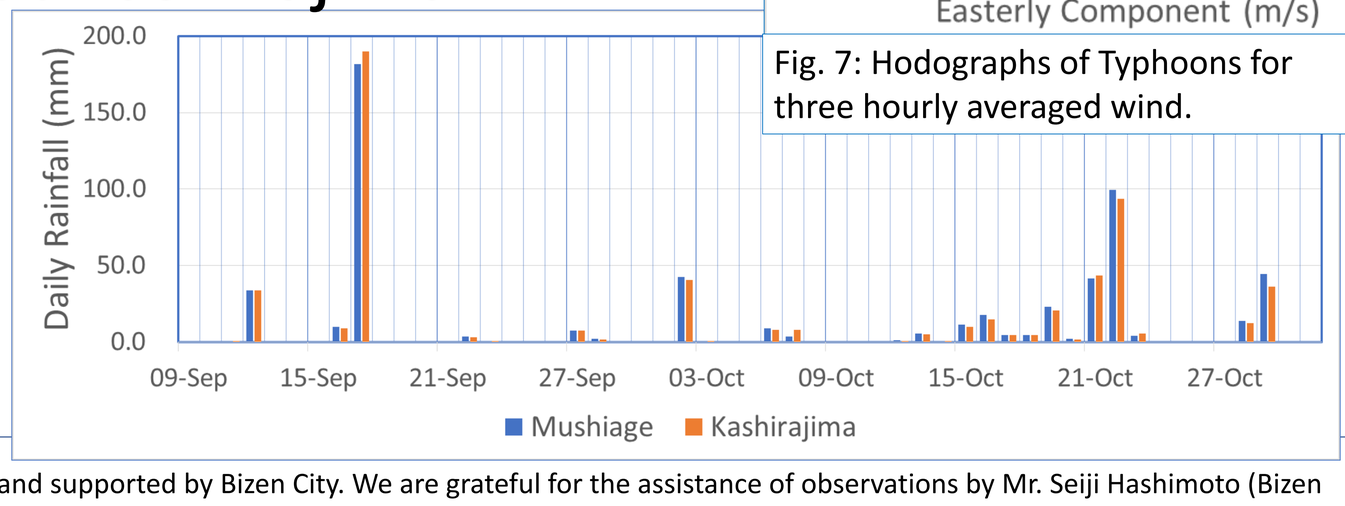


Fig. A1: Daily rainfall from at 9 Sep. to 31 Oct. at Kashirajima and Mushiage (Fig. 1c).

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