Navigability facts of the Northern Sea Route from recent activities

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The Northern Sea Route (hereinafter described as NSR), which passes along the Russian Arctic coast between the Atlantic Ocean and the Pacific Ocean, can shorten the shipping distance between Europe and the East Asia by 30 to 40% compared to the Suez Canal route. Since 2010, the NSR becomes almost ice free in every summer. Against the back ground of the Arctic sea ice retreat, escalating fuel price and economic development of the East Asia, international transit shipping through the NSR has been increasing since 2010. So far, gas condensate, iron ore, jet fuel, naphtha, coal, and frozen fish were mainly transported to and from the East Asia. However, since 2014, number of transited ship and transported cargo volume has been drastically decreased due to the sharp fall of fuel price, natural resource market in Asia and freight market. On the othernhand, destination shipping toward the Russian Arctic coast has been increasing fueled by naturarl resource development in the Arctic coastal areas(Figure 1.).

Authors have been investigating these shipping activities of the NSR by satellite monitoring in terms of ship position, speed and ice condition. Examination of thsese ship movements would eneble us to investigate actual navigability in the NSR area, which has been one of the major obstacles for shipping companies and business fields. This paper describes current status of the shippong activity of the NSR, and examination results on the actual sailing speed along the NSR from satellite monitoring information.

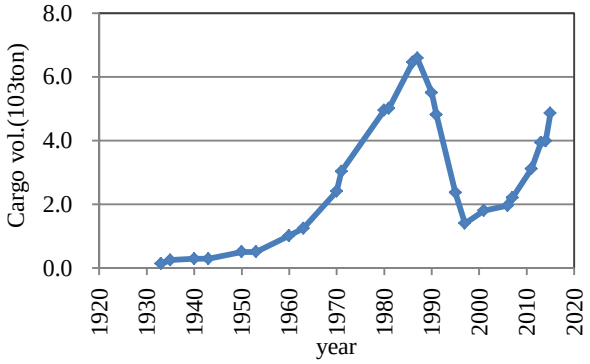

Figure 1. Historical cargo volume of the NSR(1933~2015)

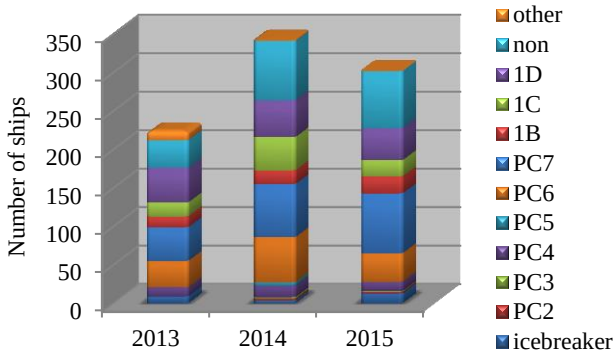

Figure 2. Ice class of ships that sailed the NSR

In 2013, Russian regulation for ships navigating into the NSR was revised and this new regulation enables to lower ice class ship to sail the NSR if sea ice condition is calm enough. Due to this new regulation, number of lower ice class ships started to sail the NSR as can be seen in the Figure 2. Most of these ships had sailed under support of Russian nuclear icebreaker in ice covered field. However, if extensive coverage of water area becomes ice free, not only high ice class ship but also lower ice class ships were sailing independently, based on the satellite AIS monitoring.

Figure 3 and 4 shows ship speed along the NSR based on the satellite AIS in 2014 from June to November. In this figure, 13 ships of larger than 5,000DWT cargo ships (ice class of PC7&6) that had sailed the NSR were examined. In this figure, there are four areas where sailing speed becomes slower compare to the other water areas.

- Ob bay area where longitude ranges from70E to 73E. In early summer, ship speed sometimes slows.
- Vilkitsky Strait where longitude ranges 100E~113E. In this water area, ice massifs had been found. Currently, due to the retreat of summer sea ice, ice condition becomes calmer than former years but still ice condition in this area tend to become harder than other areas. And the ship speed slowed mainly in late fall.
- Sanikov Strait where longitude ranges around 140E. Due to shallow depth of the strait, ship must slow her speed to keep bottom clearance.
- The East Siberian Sea where longitude ranges 150E~170E. In the 1st half of July in 2014, heavy ice field occurred in the eastern part of the East Siberian Sea. And sailing speed was drastically slowed even under the Russian nuclear icebreaker assistance. However, in late summer and late fall, ship speed was not slowed so much even in November when water area was almost fully covered by sea ice.

Figure 5 shows half monthly average sea ice concentration along the NSR in 2014 derived from Arctic Data Archive System[1]. From Figure 3, 4 and 5, we can see correlation between ship speed and ice concentration. In the water area from 70E to 100E

in the Kara Sea, high ice concentration is found in June, but ship speed is not slowed. On the other hand in the East Siberian Sea in July, ship speed was slowed under the similar ice concentration. This indicates that we need to take into account other ice conditions such as ice thickness, size of ice sheet, existence of multiyear ice and ice ridge, internal stress of ice floe and so on. In this regard, authors are examining the relationship between ice conditions and ship speed records from satellite monitoring. This study will provide basic database for navigation support system in the NSR and for shipping business assessment model.

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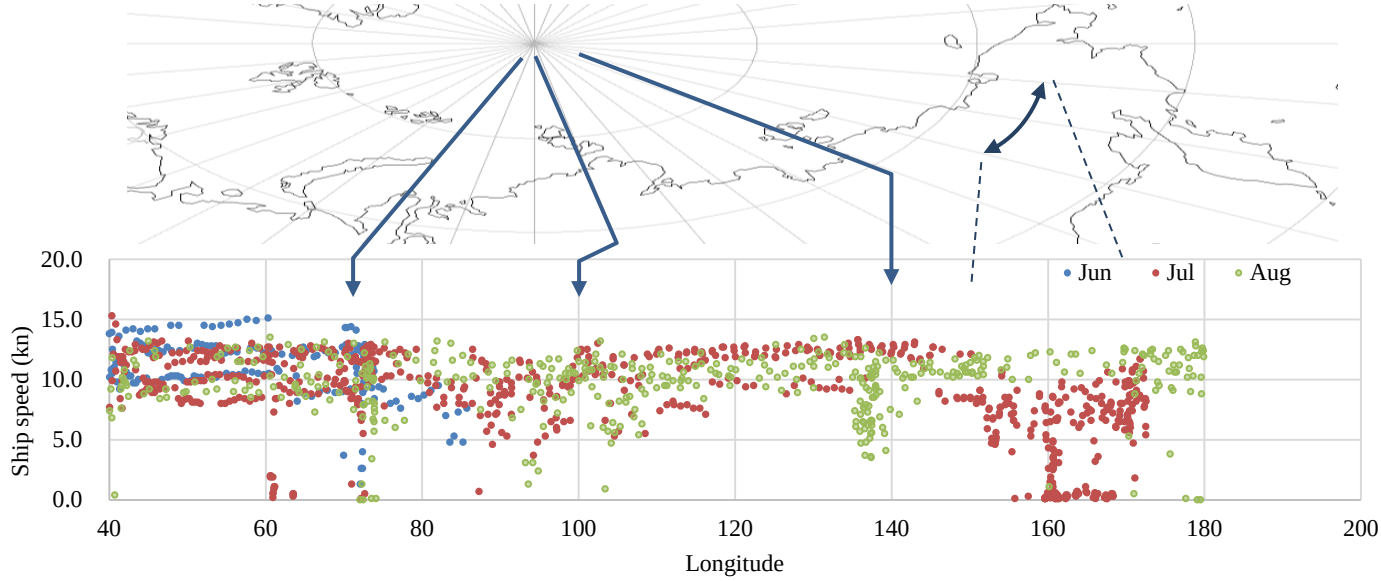

Figure 3. Ship speed distribution along the NSR from Jun. to Aug.

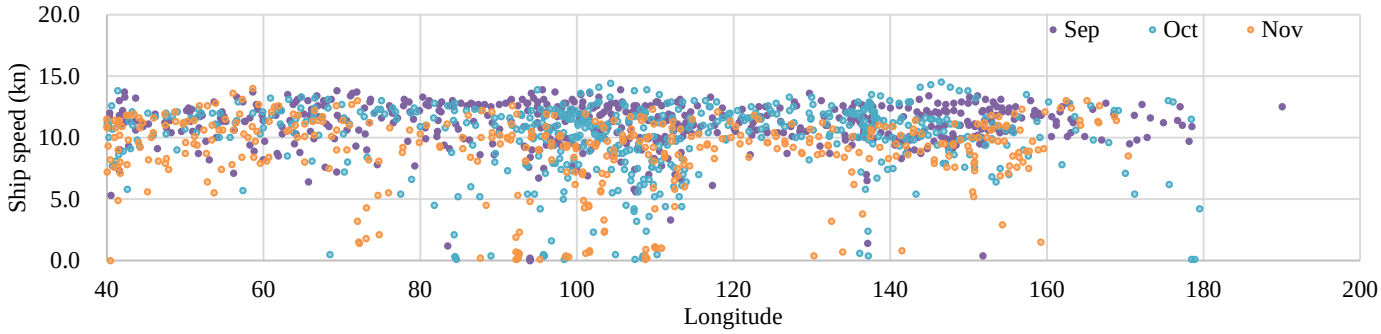

Figure 4. Ship speed distribution along the NSR from Sep. to Nov.

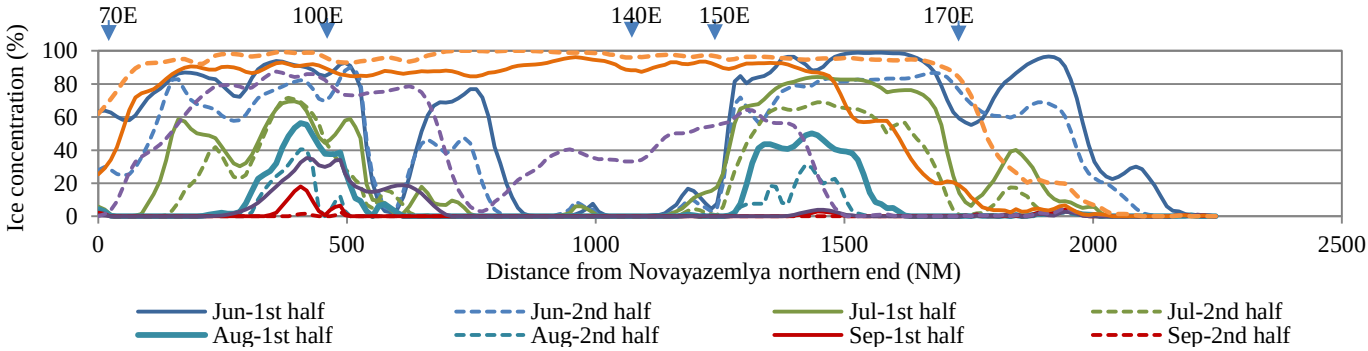

Figure 5. Half monthly ice concentration along the NSR

References

1) National Institute of Polar Research, Arctic Environment Research Center, Arctic Data Archive System, https://ads.nipr.ac.jp/index.html