RELATIONSHIP BETWEEN RED TIDE EVENT AND BROAD CURRENT PATTERN DERIVED FROM OCEAN SURFACE RADAR IN A CLOSED SEA

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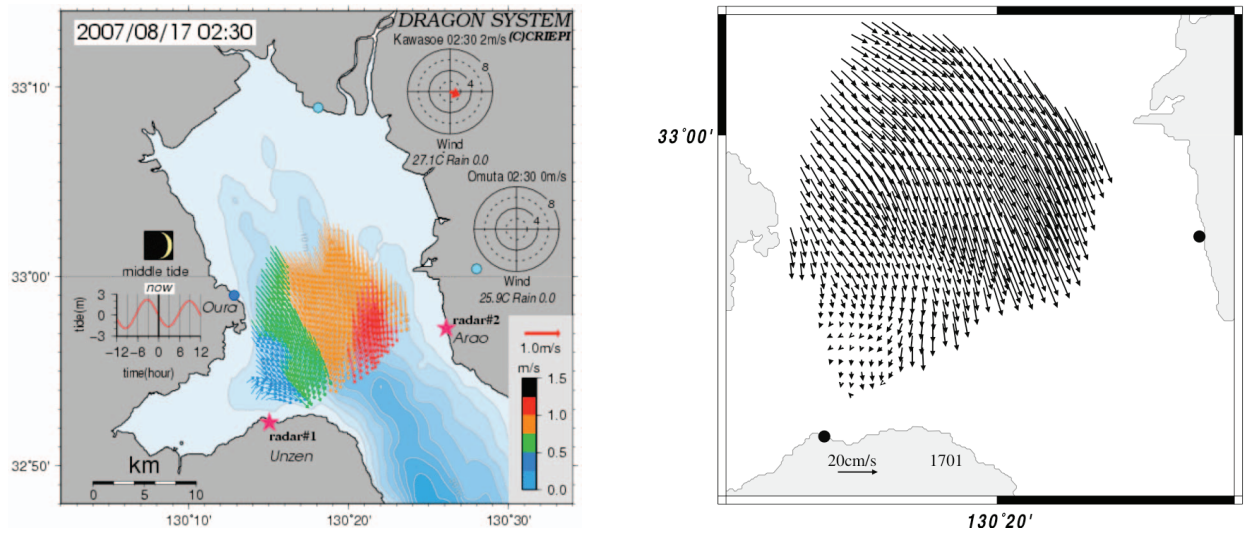
Ocean radar can detect surface currents swiftly and safely over an extensive area by analyzing the backscattering of radio waves transmitted from land based upon Doppler theory. Central Research Institute of Electrical Power Industry (CRIEPI) has developed the Doppler radar grid operation (DRAGON) system for the real-time monitoring of coastal currents using a high-resolution ocean radar with a VHF band, which updates the vector map of the currents every 15 minutes via the Internet and is capable of assessing a broad range of coastal currents. Ariake Sea located in the west of Japan is a closed sea with a surface area of 1,700km^2 and its northern part has distinguishing physical features with great tidal range ~6m and the huge tidal flats famous for seaweed cultivation. Recently the increasing occurrence of red tide causes serious damage to the fisheries in the north area. However the mechanism of red tide in Ariake Sea is yet-to-be-defined because its mechanism is complicatedly related to some elements such as supply of nutrients, seawater stratification, advection and diffusion of coastal current, and insolation condition.

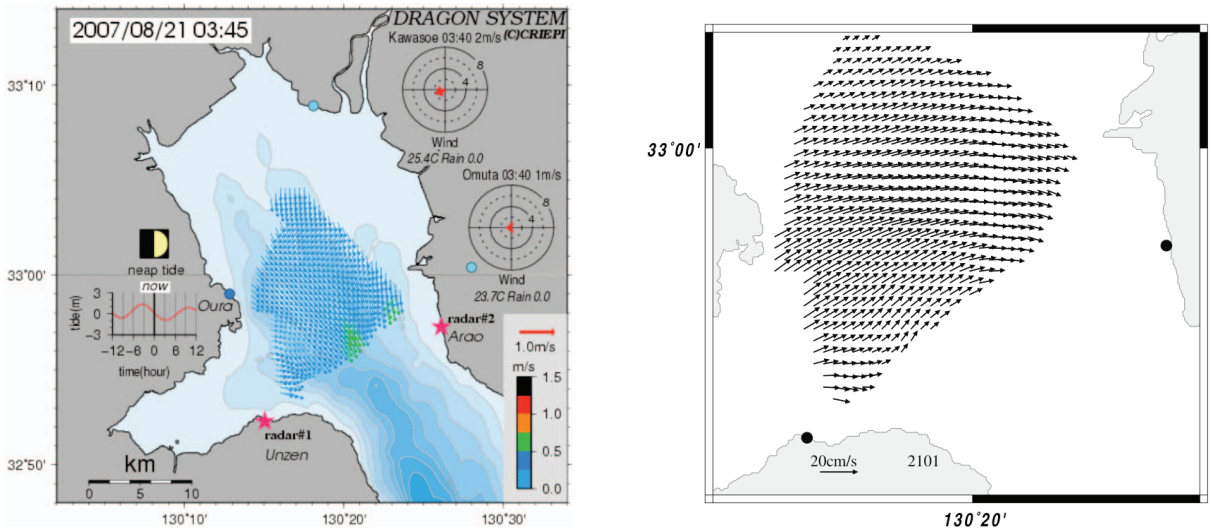
The authors conducted the field observation using DRAGON system in the northern part of Ariake Sea from autumn 2005 to spring 2008, and investigated the relationship between the red tide event in summer 2007 and coastal current feature derived from DRAGON system. Subsidiarily, in-situ water quality data of sea temperature, salinity and chlorophyll-a were also measured at four stationary points near Isahaya Bay mouth in the area. Due to the chlorophyll-a data, the red tide occurred centered in the north-west part of Ariake Sea on August 19 and lasted till August 26. As a result of flow pattern analysis during the red tide event, the red tide grew up when the phase of tidal current changed from middle to neap within a few days after certain measure of rainfall. Figure 1 and Figure 2 show the current pattern at the ebb tide and daily mean current before appearance and after occurrence of red tide respectively. Figure 1 shows that the nutrients supplied from the river mouth mainly fro the northern area after rainfall flush out through the analytical domain by strong tidal current at the middle tide. On the contrary, the weak currents about half to that of the middle tide are distributed in the whole domain at the neap tide. The latter flow pattern sustains the density stratification near the sea surface suits for the phytoplankton growth because the vertical mixing rate at the neap tide is less than that at the middle or spring tide. Solar radiation data during red tide event

showed that the daily values were relative low against the monthly mean value with the exception of August 24th. So the insolation seems not to be the dominant factor relating to the red tide process in summer. Eventually the main reason of red tide reproduction in summer is owing to the flow pattern of neap tide which easily maintains the density stratification at the upper layer and to the supply of the nutrients from the river after rainfall. Spatial distribution of divergence and rotation derived from current vector map also help to understand the characteristic of physical circulation at the sea surface related red tide event.



(a) Surface current pattern at ebb tide (b) Daily mean surface current

Figure 1 Current pattern at middle tide on August 17, 2007. The outer upper (northern) area of the figure is the bay head of Ariake Sea where principal nutrients supplied by Chikugo River and some other rivers. The outer lower right (southern) area is connecting to the bay mouth of Ariake Sea.



(a) Surface current pattern at ebb tide (b) Daily mean surface current

Figure 2 Current pattern at nap tide on August 21, 2007.