Detecting the location of submarine groundwater discharge using thermal infrared imaging

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Submarine groundwater discharge (SGD) has been considered to be one of the important pathways for the transport of freshwater and dissolved constituents from land to coastal ocean. To better understand the infuluence of SGD on the sea environment, it is necessary to determine spatial distribution of SGD. In this study, Thermal infrared (TIR) survey was conducted to evaluate the ability of this technique for detecting the discharge points. The temperature of discharged freshwater was about 14 degree C lower than that of ambient seawater because this measurement were done in August. The sea surface temperatures were measured by a TIR sensor with high spatial resolution (1-2cm) and with high frequency (1Hz) at the intertidal zone where groundwater discharge has been found and described. The measurements were conducted from sunset to late at night to remove the effects of sunlight on the sea surface temperature. The lower temperature region at sea surface due to the effect of SGD was observed. During the half-day measurements, seawater depth changed from 0 to 1.5m caused by the tidal fluctuation, which enabled us to discuss the water depth-dependant change of sea surface temperature variation. In the observation result, the maximum water depth where we could detect the signal by SGD was 1.3m in this study and the maximum temperature drops were 1.1 and 0.4 degree C where water depths were 0.5 and 1.1m, respectively. It was concluded that the studied SGD could be detected by TIR survey with 50cm spatial resolution even though this resolution has not been achieved in the present airborne TIR survey. However, by using balloon sonde or powered paraglider, we can provide the above mentioned resolution and could use the TIR technique for capturing the spatial distribution of SGD.