Evaluations of submarine groundwater discharge by uses of surface and subsurface temperature

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Submarine groundwater discharge (SGD) in the coastal zone is now recognized as an important pathway for water and dissolved material from the land to the ocean. There are several methods to evaluate the magnitude of the groundwater discharge rate, however, the method of evaluating spatial distribution of direct groundwater discharge has not been established yet. In order to evaluate SGD for regional-scale by using temperature as a signal, an infrared sensor was used in many areas. However, SGD values were not evaluated quantitatively though the locations of SGD were evaluated. These detectable locations are attributed to the spatial and temporal variation of both seawater and groundwater temperatures, which requires intensive field calibration. In this study, the areas of groundwater discharge into the coastal zone were evaluated by uses of infrared method from remote controlled helicopters. Measurement wave length of thermo-tracer ranged 8 to 14 micro meter, and spatial resolution was 50 cm (from the height of 500ft) with the accuracy of the temperature was 2 %. Fiber optics cables and thermometers were also used in situ to compare the surface temperature for evaluating the groundwater discharge into the ocean. Measurements have been made on August 21 to 25, 2006. Soil surface temperature measured in situ at the transect line with thermister thermometers and optical fiber cable agreed well with the infrared thermal data. The temperature difference between seabed and the depth of 5cm decreases with increase in the magnitude of SGD rate. Therefore remote sensing method using infrared temperature with in situ temperature measurements can be a good tool for evaluating SGD.