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Tracing of gorundwater nitrogen source driving *Ulva lactuca* bloom using ^{15}N-NO_3, ^{18}O-NO_3 stable isotope ratios

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Recently, occurance of opportunistic macroalgae bloom (*U. lactuca*) is a globally considered a sign of eutrophication. The aims of this study were to determine the cause of the bloom using multi-isotope techniques($\delta^{13}C$, $\delta^{15}N$, $\delta^{15}N$-NO_3 and $\delta^{18}O$-NO_3) and investigate why the bloom sustained in the lower reach of the bay. *Ulva* coverd Bangdu bay were measured along 9 line transects(20 sites). Water column samples including seawater, groudwater, aquaculture and agriculture drainage were collected for nutrinet and isotope analysis to investigate the flux of nitrogen from the anthropogenic source. *Ulva* tissue was collected and analysed both concentration and isotope values for C, N and metals(Cd, Cu, Pb.. etc). The results showed that anthropogenic nitrogen source, specifically ammonium and nitrate, from the agriculture and aquaculture drainage and input from a nearby groundwater acted as a consistent source of nutreint that enabled the bloom to persist in Bangdu bay, Jeju island. With the modeling approach we found a high range in the estimate proportion of groundwater N, indicating that the mixing models is good tool to reveal contribution of N source. The low concentration of metals and high concentration of N in the tissue of *U. lactuca* mean this algae has the potential to be used as a fertilzer or composted if harvested. Better characterization of tributary $\delta^{15}N$-NO_3 and $\delta^{18}O$-NO_3 by better measurements or a more detailed modeling approach will aid in understanding N-cycle dynamics in estuary ecosystem.