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MONITORINGVARIATIONS IN $\delta\ ^{15}N\text{-}NO_3$ IN SAMPLES TAKEN IN UPSTREAM OKURA RIVER DURING SNOW MELTING PERIODS

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Abstract-This study aims to narrow the value of $\delta^{15}N\text{-}NO_3$in precipitation reported in wide rang, by monitoring the variations of the values during limited periods at the same point at upstream Okura River, Sendai, in northern part of Japan. Because we monitored the variations during snow melting periodsin 2013 and 2014, we could know the values of$\delta^{15}N\text{-}NO_3$in precipitation itself without being merged with those of soil water.The value varied 0.5-2.7 and 0.4-3.8, in 2013 and 2014, respectively. The average values were 1.8 and 1.2 in 2013 and 2014, respectively. Big discrepancy was not shown in these two years. The results obtained here may help to know the origin of a river water and then to establish environmental plans considering nutrients delivery.

***Keywords*–**$\delta^{15}N\text{-}NO_3$,Precipitation, Snowmelt water, Soil Water, Okura River

I. INTRODUCTION

The simultaneous $\delta^{18}O\text{-}NO_3$and $\delta^{15}N\text{-}NO_3$measurement technique [1] is widely used after the development of denitrification technique [2].

So far, the authors utilized $\delta^{18}O\text{-}NO_3$to know the snowmelt dependence ratio in a river water [3][4] because the value in precipitation is higher than that in a soil water significantly [5].

On the other hand, theisotope ratio $\delta^{15}N\text{-}NO_3$ in precipitationvaries to a wide range (ca. -7 to +10 in [1]) andoverlaps that in soil water [1]. Moreover, the ratio fluctuates reflecting the increase and decrease of anthropogenic pollutants input to the river waters [1].

We underlined the importance to know the ratio of snowmelt water in a river water in order to plan receiving waters' and farmlands'environmentbecause snowmelt water increases nutrients runoff loads [4][6].

In the present study, spatially, we focused on the variations in$\delta^{15}N\text{-}NO_3$at forestry area. Next, temporary, we focused on the variations during snow melting periods. We succeeded in narrowing the range of $\delta^{15}N\text{-}NO_3$and obtained somewhat representative values of snowmelt water.

We introduce our measurement on the variations in $\delta^{15}N\text{-}NO_3$and NO_3 concentration in Okura river upper Okura Dam (Sendai, northern part of Japan) during the period covering the snow melting season in 2013 and 2014.

II. MATERIALS AND THE METHODS

At the begging of every month, since, April 2011, we collected Okura River water sample with the close collaboration with the Sendai Waterworks Bureau (Harada et al. 2014, Harada et al. in preparation). Of the samples, here, we focus on the samples taken during January to May in 2013 and January to June in 2014.

River water was immediately filtered by glass fiber filter GF75 (47 in diameter, 0.3 micrometer in average pore size). A part of the filtrate was preserved under freezing in plastic centrifugation pipes until the measurements. The remainder was used for some water quality indices measurement including NO_3 concentration (based on HACH DR5000) [4][6].

Variations in $\delta^{18}O\text{-}NO_3$ were measured by the denitrifying method [2] at the International Research Center for River Basin Environment under "Cooperation Agreement between the Yamanashi University and Miyagi University".
The precision of the measurements decided by the replicate measurements is less than ± 0.2 ‰.

III.RESULTS AND DISCUSSION

Variations in$\delta^{15}N\text{-}NO_3$in 2013 and 2014 both seem to be following to those in NO_3 (Figures 1 and 2).Correlations between $\delta^{15}N\text{-}NO_3$and NO_3 in 2013 and 2014 (Figures 3 and 4)support this observation.

Nagata & Miyajima (2008) showed that $\delta^{15}N\text{-}NO_3$in river water varied ca. -5 to +23 in their Fig. 3-1-10 [1] reflecting fairly wide range of $\delta^{15}N\text{-}NO_3$in precipitation (ca. -7 to +10 [1]) and soil water (ca. -10 to +5 [1]) even in forestry areas. Moreover, anthropogenic NO_3 inputs to river increases the values [1].

In our figures 1 and 2, the effect of anthropogenic input could be neglected because there are no human activities around at the sampling site. Then, things we have to determine is the extent of snow melting effect on the observed variations in $\delta^{15}N\text{-}NO_3$.

Figures 5 and 6 indicates the temporal snowfall patterns in 2013 and 2014, respectively. The data were obtained at HP of Japan Metrological Agency. Cleary, the snowfall period ended earlier in 2013 than in 2014. This discrepancy in the

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length of snowfall period is consistent with that of the snowmelt period

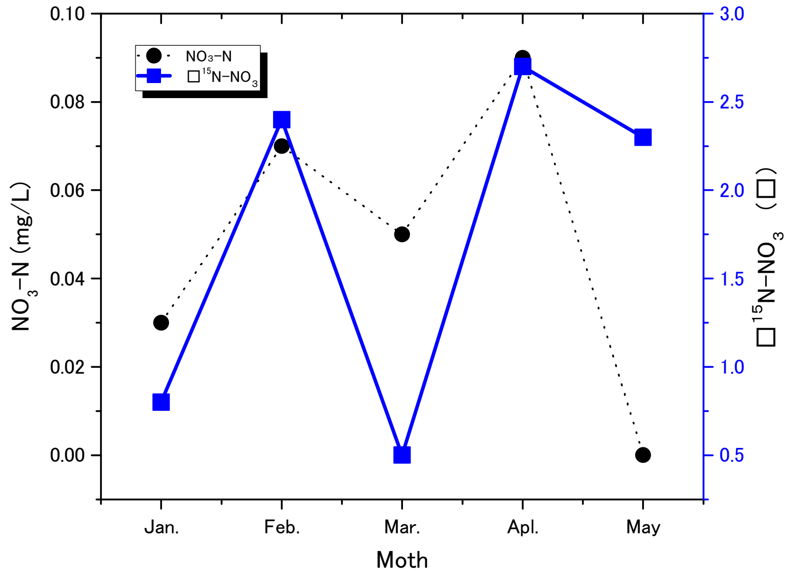

Fig. 1The variations in NO_3 andδ^{15}N-NO_3in 2013

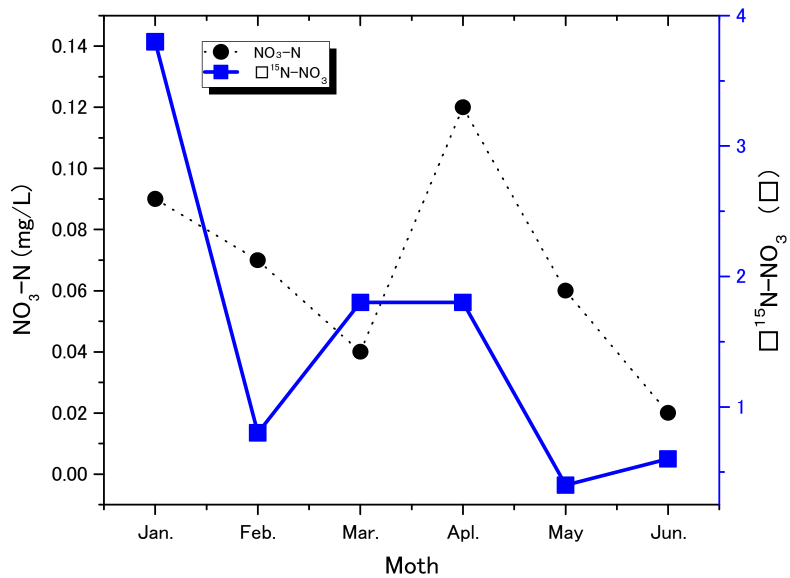

Fig. 2The variations in NO_3 andδ^{15}N-NO_3in 2014

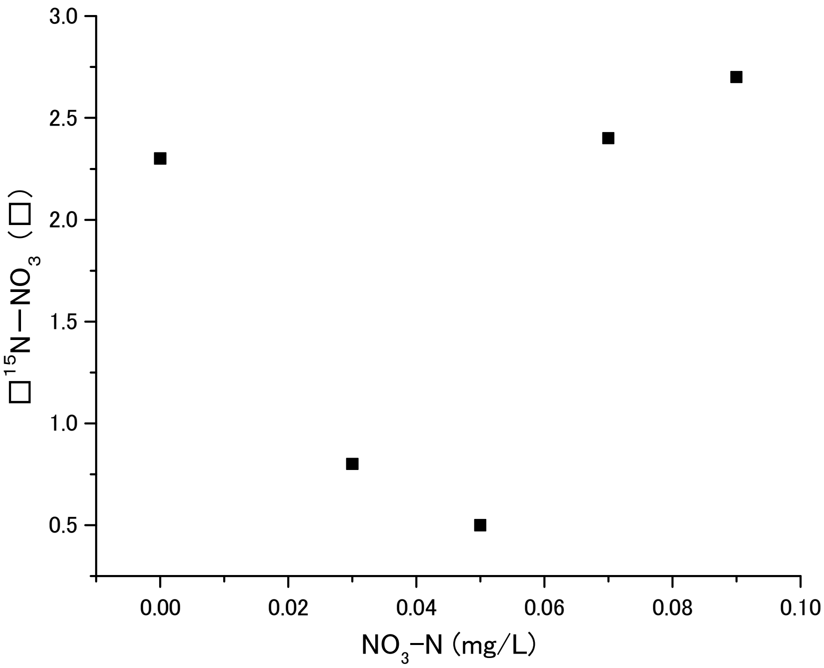

Fig. 3The correlations of NO_3 and$\delta^{15}N$-NO_3in 2013

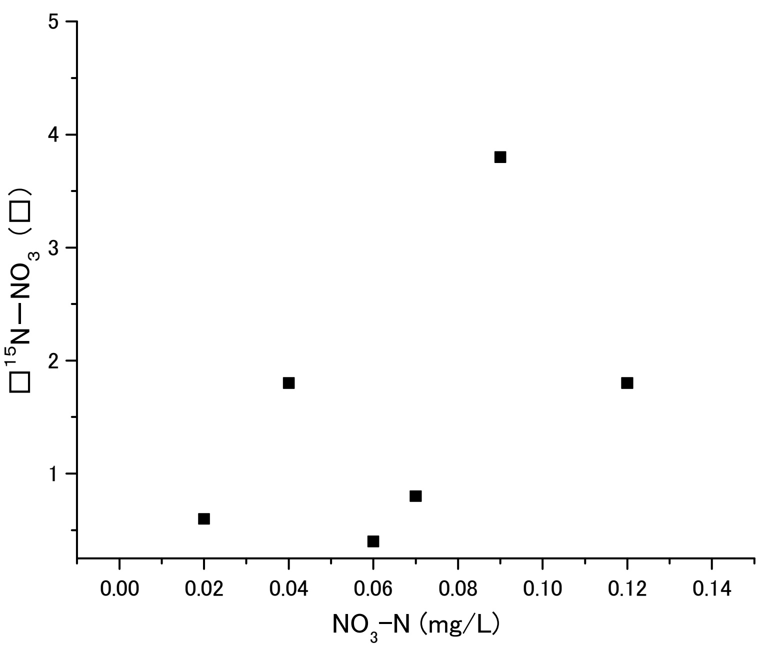

Fig. 4The correlations of NO_3 and$\delta^{15}N$-NO_3in 2014

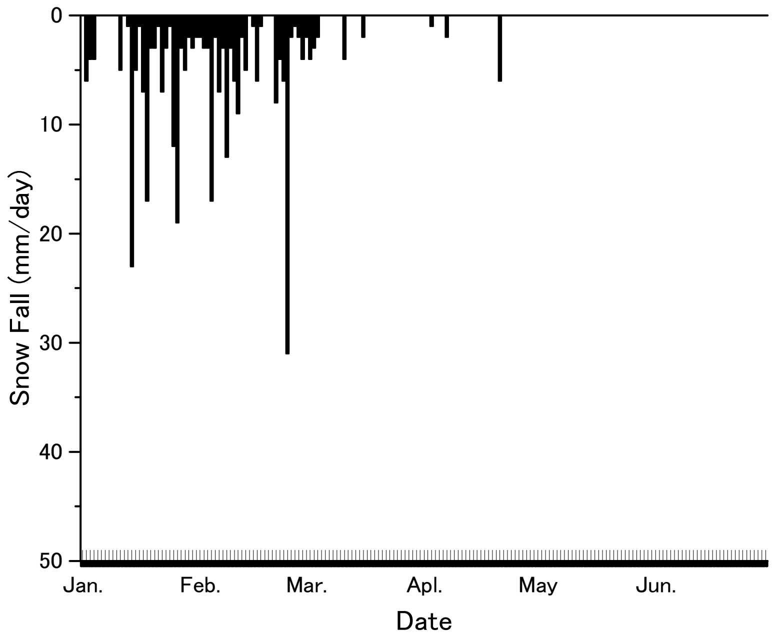

Fig. 5The variations in the snowfall intensity in 2013

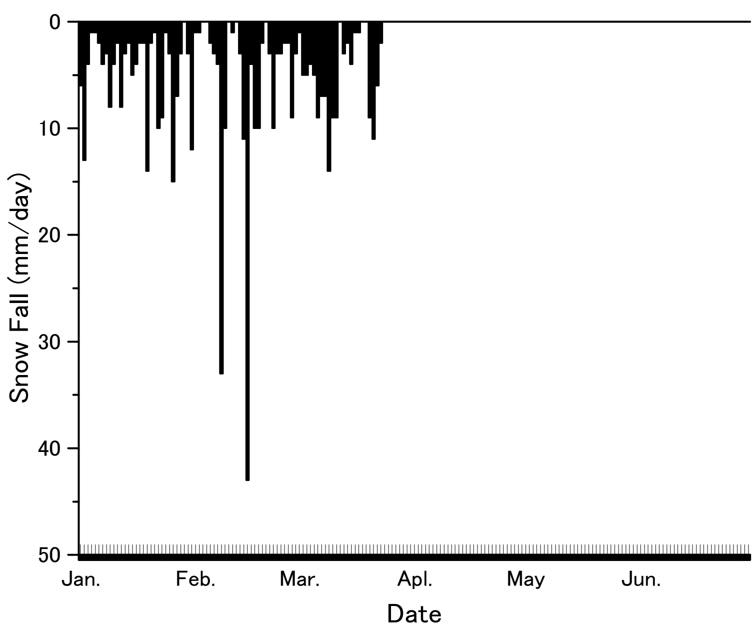

Fig. 6The variations in the snowfall intensity in 2014 mentioned in our own other studies [4][6]. In 2013, the snowmelt period was from February to April [4][6].. In 2014, that was from February to May [4][6]. Then we excluded the observed $\delta^{15}N\text{-}NO_3$in January and May in the Figure 1 and in January and June in 2014. The values, restricted to snow melting period, varied 0.5-2.7 and 0.4-3.8, in 2013 and 2014, respectively. The average values were 1.8 and 1.2 in 2013 and 2014. The values were similar. Moreover,$\delta^{15}N\text{-}NO_3$in snow obtained besides the river on 9 April in 2013 was 0.9, very similar to the value obtained by the river water sample. Thus we conclude that the representative value of $\delta^{15}N\text{-}NO_3$in this period at the site ranged 0.5-3.8, the average being around 1-2.the results obtained here may be used to know the origin of the river water in this site, the analyses may help the planning environmental control of receiving waters and farmlands, because significant nutrients runoff including Si occurs during the snow melting periods.

IV. CONCLUSION AND THE FUTURE WORKS

We could show the representative values of $\delta^{15}N\text{-}NO_3$during the snowmelt season at Upper Okura River. Further monitoring including morefrequent monitoring of the variations in $\delta^{15}N\text{-}NO_3$in river waters and snow itself is needed.

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