

| | |
|------------------|--|
| Title | 東アジア及び日本における酸性雨モニタリングの現状 |
| Sub Title | Present status of acid deposition monitoring East Asia and Japan |
| Author | 大歳, 恒彦(Otoshi, Tsunehiko) |
| Publisher | Keio Economic Observatory, Sangyo Kenkyujo, Keio University |
| Publication year | 1999 |
| Jtitle | KEO discussion paper. G : 『アジア地域における経済および環境の相互依存と環境保全に関する学際的研究』 (KEO discussion paper. G : "Inter-disciplinary studies for sustainable development in Asian countries"). No.G-60 |
| JaLC DOI | |
| Abstract | 近年の急激な経済発展、工業化によって深刻な酸性雨の被害が懸念される東アジア及び日本における酸性雨モニタリングの現状について示した。東アジア酸性雨モニタリングネットワーク(EAN ET)はその試行的活動を1998年4月より開始し、現在、中国、日本を含む東アジア地域の10カ国がこのネットワークに参加し、それぞれの国内において降水(湿性沈着)、ガス・粒子(乾性沈着)、土壌・植生及び陸水環境に関するモニタリングデータを蓄積している。このネットワークの正式稼働は、試行稼働期間中の観測結果を考慮して、2000年中頃に予定されている参加国の政府間会合の決定により開始されることになっている。一方、我が国においては環境庁が数次にわたる全国規模の酸性雨対策調査を実施してきており、1997年において全国48カ所の国設酸性雨測定局が設置されている。我が国において観測されている酸性雨は欧米のものとはほぼ同じレベルであり、近年は発生源対策の進んできた硫酸イオンに比べて硝酸イオンが降水の酸性化に寄与する割合が増加する傾向がみられる。 |
| Notes | 表紙に"Research for the Future Program (RFTF), Japan Society for the Promotion of Science (JSPS)"の表示あり |
| Genre | Technical Report |
| URL | https://koara.lib.keio.ac.jp/xoonips/modules/xoonips/detail.php?koara_id=AA12113622-00000060-0001 |

慶應義塾大学学術情報リポジトリ(KOARA)に掲載されているコンテンツの著作権は、それぞれの著作者、学会または出版社/発行者に帰属し、その権利は著作権法によって保護されています。引用にあたっては、著作権法を遵守してご利用ください。

The copyrights of content available on the Keio Associated Repository of Academic resources (KOARA) belong to the respective authors, academic societies, or publishers/issuers, and these rights are protected by the Japanese Copyright Act. When quoting the content, please follow the Japanese copyright act.

東アジア及び日本における 酸性雨モニタリングの現状

大 歳 恒 彦

No.G-60

学振未来 WG4-11

東アジア及び日本における酸性雨モニタリングの現状

大歳恒彦¹

1999年10月

<キーワード>

酸性雨、東アジア、モニタリングネットワーク、硫酸イオン、硝酸イオン

<要約>

近年の急激な経済発展、工業化によって深刻な酸性雨の被害が懸念される東アジア及び日本における酸性雨モニタリングの現状について示した。東アジア酸性雨モニタリングネットワーク (EANET) はその試行的活動を1998年4月より開始し、現在、中国、日本を含む東アジア地域の10カ国がこのネットワークに参加し、それぞれの国内において降水(湿性沈着)、ガス・粒子(乾性沈着)、土壌・植生及び陸水環境に関するモニタリングデータを蓄積している。このネットワークの正式稼働は、試行稼働期間中の観測結果を考慮して、2000年中頃に予定されている参加国の政府間会合の決定により開始されることになっている。一方、我が国においては環境庁が数次にわたる全国規模の酸性雨対策調査を実施してきており、1997年において全国48カ所の国設酸性雨測定局が設置されている。我が国において観測されている酸性雨は欧米のものと同レベルであり、近年は発生源対策の進んできた硫酸イオンに比べて硝酸イオンが降水の酸性化に寄与する割合が増加する傾向がみられる。

¹ 日本環境衛生センター酸性雨研究センター

PRESENT STATUS OF ACID DEPOSITION MONITORING IN EAST ASIA AND JAPAN

Tsunehiko OTOSHI¹

October 1999

1. INTRODUCTION

In recent years, the East Asian region faces increasing risks of problems related to excess deposition of acidic substances as a result of rapid industrialization. The First Intergovernmental Meeting on the Acid Deposition Monitoring Network in East Asia (EANET) held in March 1998 agreed to implement the preparatory-phase activities of the Network on an interim basis. Participating countries of the preparatory-phase activities of EANET launched the monitoring of acid deposition as well as the ecological impact monitoring. The Network is intended to be established by the Second Intergovernmental Meeting taking account the results obtained by the preparatory-phase activities. Before the EANET, the National Committee on Acid Deposition was established in Japan in 1983 and the First Survey (in fiscal '83 to '87) on the National Acid Deposition Monitoring was performed followed by the Second Survey (in fiscal '88 to '92) and the Third Survey (in fiscal '93 to '97). This paper describes the present status of acid deposition monitoring in East Asia and Japan focus on the preparatory-phase activities of the EANET and the result obtained by the Third Survey on the National Acid Deposition Monitoring in Japan.

2. PREPARATORY-PHASE ACTIVITIES OF THE EANET

Preparatory-phase monitoring activities for the EANET will be implemented to initiate cooperative efforts among the countries in East Asia aimed at facilitating common understanding of the state of acid deposition in the region, and providing useful inputs to the second intergovernmental meeting tentatively to be held in mid-2000. For the implementation of the preparatory-phase activities, three interim bodies namely the i) Interim Scientific Advisory Group (ISAG) ii) Interim Secretariat (IS), and iii) Interim Network Center (INC), were established. The ISAG consists of scientist/experts nominated from each participating country and implements tasks concerning the scientific aspects of the preparatory-phase activities. The Environment Agency Japan has been designated as the IS, and the Acid Deposition and Oxidant Research Center as the INC.

Acid deposition monitoring during the preparatory-phase activities covers four environmental media – wet deposition, dry deposition, soil and vegetation, and inland aquatic environments. Monitoring for wet and dry deposition monitoring are being implemented in order to observe concentrations and fluxes

¹ Data Management Department, Acid Deposition and Oxidant Research Center

of acidic substances deposited to the land surface, while monitoring for soil/vegetation and inland aquatic environments is being implemented to assess adverse impacts on terrestrial and aquatic ecosystems. These monitoring data will be utilized to assess the state of acid deposition as well as impact on ecosystems such as forests in East Asia. Major components of acid deposition monitoring during the preparatory-phase activities are described in Table.1.

Table.1 Major components of acid deposition monitoring during the preparatory-phase activities of the EANET

| Items | Component |
|-----------------------------|---|
| Wet Deposition | <u>Monitoring interval:</u> every 24 hours or every precipitation event ^{a)} <u>Parameters:</u> pH, EC, concentration of SO_4^{2-} , NO_3^- , Cl^- , NH_4^+ , Na^+ , K^+ , Ca^{2+} , and Mg^{2+} <u>Meteorological measurement:</u> ^{b)} |
| Dry Deposition | <u>Monitoring interval:</u> every two weeks to one month ^{c)} <u>Parameters:</u> concentration of SO_2 , NO_2 , NO ^{d)} , O_3 and PM <u>Meteorological measurement:</u> ^{b)} |
| Soil and Vegetation | <u>Monitoring interval:</u> more than once during the preparatory -phase <u>Parameters:</u> (Soil) pH, cation exchange capacity (CEC), and concentration of exchangeable ions (Na^+ , K^+ , Ca^{2+} , and Mg^{2+}) (Vegetation) degree of decline of trees, and abnormalities of leaves and branches |
| Inland Aquatic Environments | <u>Monitoring interval:</u> more than four times a year (seasonally) <u>Parameters:</u> pH, EC and alkalinity |

a) Precipitation sampling is carried out by the wet-only sampler

b) Wind direction/speed, temperature, humidity, precipitation amount, and solar radiation

c) Every hour when measured by automatic instruments

d) Only if the chemiluminescence method is available

As of January 1999, ten countries are participating to the preparatory-phase activities of the EANET, namely China, Japan, Mongolia, Republic of Korea, and Russia from the North-east Asian region, and Indonesia, Malaysia, Philippines, Thailand, and Vietnam from the South-east Asian region. Outline of the monitoring sites of the participating countries are shown in Fig.1. Based on their own national monitoring plan and the national QA/QC program, monitoring data are being accumulated to the National Center (NC) of each country. All NCs of the participating countries are expected to submit the monitoring data to the INC October 1999 and thereafter. While the INC have to prepare the data report on acid deposition in East Asia based on the data submitted from the NCs of participating countries. The INC will also summarize the QA/QC activities of participating countries during the preparatory-phase. Then the ISAG will prepare the final report on the state of acid deposition in East Asia.

To obtain the equivalent quality of monitoring data, each participating country carries out acid deposition monitoring by common methodologies specified in the "Guideline and Technical Manuals for the EANET" developed by the expert meetings held four times from 1993 to 1997. As described in the "Technical Manual for Monitoring Wet Deposition", wet deposition monitoring techniques in terms of siting, sampling, shipping, chemical analysis, QA/QC, and data reporting are outlined taking into consideration currently available technical manuals from other international wet deposition monitoring network. Most of the participating countries are using the wet-only sampler which is designed to collect precipitation samples only during the precipitation period by installing the precipitation sensor and motor-driven tightfitting lid to cover a collecting bucket or funnel.

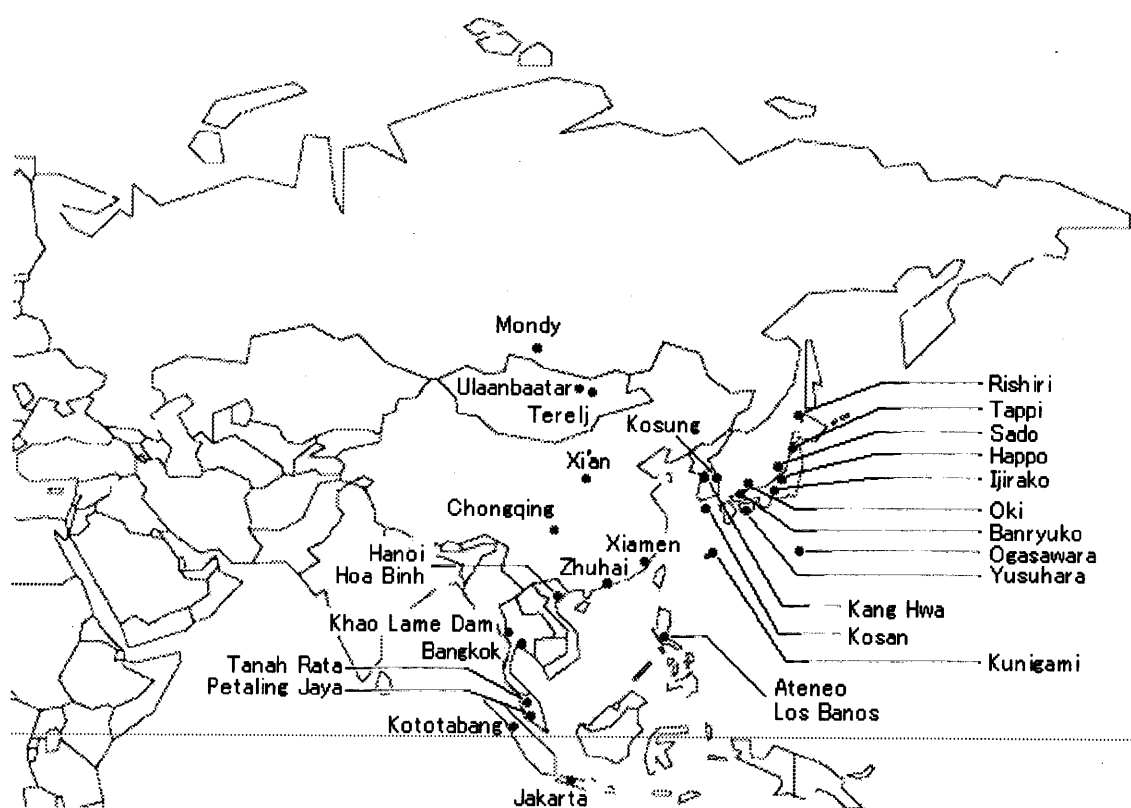


Fig.1 Site map of the participating countries to the preparatory-phase activities of the EANET

Ion Chromatography is a major analytical method adopted by the participating countries for chemical analysis of both anions and cations contained in precipitation samples. Atomic Absorption Spectrometry for Na^+ , K^+ , Ca^{2+} , and Mg^{2+} , and Spectrophotometry for NH_4^+ are also useful tools for the determination of these cations. However, some countries have to solve a problem of poor detection limit because of using traditional method which have not enough analytical sensitivity. For wet deposition samples collected in a tropical region, preservation of sample from microbial decomposition should be considered. Biocides such as Thymol are added for that purpose when a refrigerator is not available during sampling and storage period. On the other hand, collection of wet deposition samples in the higher latitude region

such as Mongolia and Russia during a winter season faces difficulties because of low temperature sometimes reaches below minus 10 to 20 degree centigrade.

To assist the participating countries in implementing the preparatory-phase monitoring activities in a smooth and effective manner, the INC held the First and the Second Training Workshop in November 1998, and in August-September 1999 respectively. As a part of QA/QC activities of the EANET, the INC conducted an inter-laboratory comparison program as round robin analysis of artificial rain water samples. These activities and other relevant support and training for the participating countries is essential to obtain acceptable monitoring data, and to reach the goal of preparatory-phase activities of the EANET.

3. THIRD SURVEY ON NATIONAL ACID DEPOSITION MONITORING

In Japan, the Committee on Acid Deposition was first established by the Environment Agency, and the First Survey on National Acid Deposition Monitoring was started among 17 sampling sites from fiscal 1983. However, the sampling device mainly used for the survey was the bulk sampler with separating filter. The Second Survey on National Acid Deposition Monitoring among 23 sampling sites was started from fiscal 1988, employing sampling equipments almost same as the present wet-only samplers. During the Second Survey, 6 monitoring stations located at remote islands had been added to the monitoring network year by year. These newly established monitoring stations at remote area were the prototype of the present Japanese monitoring stations which participating to the EANET. The report of the Second Survey concluded:

- i) pH and deposition amount of precipitation in Japan were virtually same level as in Western countries. There has been no significant fluctuations since the first survey,
- ii) pH values of most of lakes and marshes were around 7, and more than 90% of pH values of rivers were between pH7 to pH8. However, there were several lakes and marshes with low pH values,
- iii) As regards the impacts of acid deposition on soil, there had been no evidence of acidification of soil caused by acid deposition, though the existence of acidic soil and soil which is highly sensitive to acid deposition was recognized,
- iv) To evaluate these results, clear indication of adverse effect by acid deposition on the ecosystem such as inland aquatic environments, soil and vegetations was not found, though the acid precipitation same as western countries were widely observed. However, the adverse effect on ecosystem can be appeared in the future, in the case when acid precipitation of same as present level will continue.

The Third Survey on National Acid Deposition Monitoring was started from fiscal 1993 among 29 sampling stations. Number of sampling stations was increased more than ten in fiscal 1994 and the present monitoring network consists of 48 sites as described in Fig.2. Sampling frequency of the wet precipitation was daily to monthly depending on the site. However for newly built sampling station and when the renewal of old samplers, daily sampler had given priority to be introduced to the sites. Along with the wet precipitation samples, dust fall samples during the non-precipitation period were also

collected in every two weeks. Property of collected sample was investigated by measurement of pH and EC, and determination of major anions and cations. Annual average pH of all sites of the Third Survey was from pH4.7 to pH4.9 and that was almost same as the hole average pH value of the Second Survey (pH4.8). Concentrations of nss-SO_4^{2-} and nss-Ca^{2+} in wet precipitation samples of the Third Survey were slightly decreased compared with the Second Survey. While the average concentration ratio of $(\text{NO}_3/\text{nss-SO}_4^{2-})$ in equivalent weight increased from 0.44 in 1993 to 0.53 in 1997. It showed the contribution of nitrate to the acidification was becoming larger in recent years (Fig.3). Trend of deposition amount of ions were almost same as the trends of concentrations; nss-SO_4^{2-} and nss-Ca^{2+} deposition amount decreased.



Fig.2 Site map of national acid deposition monitoring network in Japan

Concerning the spatial variation of the acid deposition, both nss-SO_4^{2-} and NO_3^- deposition amount was larger along the South China Sea side. For nss-SO_4^{2-} , its deposition rate increased along the North Western coast during winter seasons as shown in Fig.4.

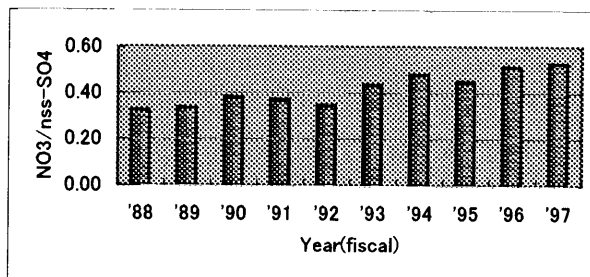


Fig.3 Average concentration ratio of $\text{NO}_3^-/\text{nss-SO}_4^{2-}$ in 22 monitoring sites in Japan

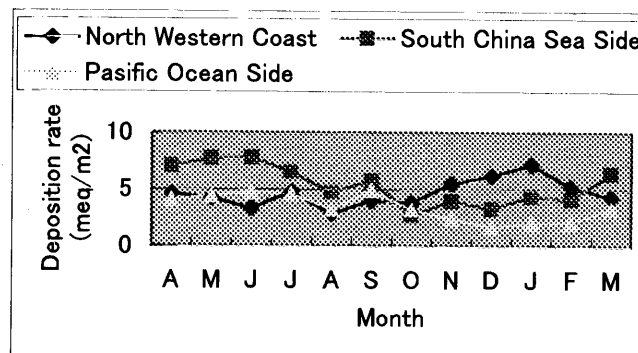


Fig.4 Example of the seasonal variation of nss-SO_4^{2-} deposition rate in Japan

In the Third Survey of National Wet Deposition Monitoring, 29 lakes and marshes were investigated, and several ponds with low pH and low alkalinity values were found. Possibility of a diverse effect by acid precipitation should be considered, because these ponds were not affected by volcanoes or other anthropogenic pollution sources. Evaluating the trend of physicochemical properties of the soil such as “cations/Al ratio” in continuously observed areas from the Second Survey, there has been no significant change by acid precipitation. Regarding the impact of acid deposition on vegetation, decline of the forest was observed at about half of monitoring areas. Most of the cause of decline was identified such as damage by harmful insects, and strong wind and so on. On the other hand, the cause was not identified in some areas. In these areas, most of the soil types were classified into the “moderately sensitive” soil to acid deposition, and the relationship between decline cause of the forest and the acid deposition was not still clear.

4.CONCLUSION

Present status of acid deposition monitoring in East Asia and Japan was introduced. The Acid Deposition Monitoring Network in East Asia (EANET) started its preparatory-phase activities in 1998. Ten participating countries are now accumulating monitoring data concerning wet-deposition, dry-deposition, soil and vegetation, and inland aquatic environment. Formal stage of the EANET is expected to start by the decision of the Second Intergovernmental Meeting in mid 2000 taking into consideration the result of the preparatory-phase activities. Environment Agency of Japan have been carried out several national surveys on acid deposition monitoring. There were 48 monitoring sites across the nation at the end of the Third Survey in 1997. The states of the acid precipitation observed in Japan are almost same as in western countries. Precipitation amount of ns-s-SO_4^{2-} is decreasing, while the contribution of the NO_3^- to the acidification became larger in these years.

5. REFERENCES

- 1) Acid Deposition Monitoring Network in East Asia (Proceedings of the first meeting of the Interim Scientific Advisory Group, and the Third Meeting of the Working Group), Interim Secretariat of EANET, October 1998.
- 2) Guidelines and Technical Manuals for Acid Deposition Monitoring Network in East Asia, Environment Agency Government of Japan, March 1997.
- 3) Report of the Third Survey on National Acid Deposition Monitoring (in Japanese), Environment Agency – National Committee on the Acid Deposition, March 1999.

(A part of this paper was presented in the “5th International Joint Seminar on Regional Deposition Processes in the Atmosphere”, October 1999, Seoul)

Appendix 1 Annual mean value (pH) during the third survey³⁾

| Site Name | 1993 | 1994 | 1995 | 1996 | 1997 | Mean |
|---------------|-------|-------|-------|-------|-------|-------|
| Rishiri | 4.9 | [5.3] | [5.3] | 5 | [4.9] | [5.0] |
| Sapporo | 5.1 | 4.7 | 4.6 | 4.6 | 4.6 | 4.7 |
| Nopporo | [4.8] | 5 | 5.1 | 5.2 | 5.3 | [5.1] |
| Tappi | | 4.7 | 4.9 | 4.7 | 4.8 | 4.8 |
| Obanazawa | | [4.8] | 4.8 | 4.7 | 4.7 | [4.8] |
| Sado | 4.7 | 4.7 | 4.7 | 4.6 | 4.8 | 4.7 |
| Niigata | 4.6 | 4.5 | 4.6 | 4.6 | 4.7 | 4.6 |
| Niitsu | 4.6 | 4.6 | 4.7 | 4.5 | 4.7 | 4.6 |
| Wajima | | 4.6 | 4.6 | 4.6 | 4.7 | 4.6 |
| Happo | | 4.7 | [4.9] | [4.8] | 4.8 | [4.8] |
| Tateyama | | [4.7] | 4.8 | 4.7 | 4.7 | [4.7] |
| Echizenmisaki | | | 4.5 | 4.5 | 4.6 | 4.5 |
| Oki | [4.9] | 5.1 | 4.8 | 4.7 | 4.8 | [4.8] |
| Kyoto-yasaka | | [4.6] | 4.7 | 4.5 | 4.8 | [4.7] |
| Matsue | 4.9 | 4.8 | 4.7 | 4.6 | 4.9 | 4.8 |
| Masuda | | 4.7 | 4.6 | 4.5 | 4.7 | 4.6 |
| Hachimantai | | [4.9] | 4.8 | 4.7 | 4.8 | [4.8] |
| Nonodake | 5.2 | 4.8 | [4.8] | 4.8 | 4.9 | [4.9] |
| Sendai | 5.3 | [5.3] | 5.1 | 5.1 | 5.2 | [5.2] |
| Oze | | | [5.0] | [4.8] | [4.8] | [4.8] |
| Nikko | | | | | [4.9] | [4.9] |
| Akagi | | | | [4.6] | [4.7] | [4.6] |
| Tsukuba | [4.3] | [4.5] | [4.7] | 4.8 | 4.9 | [4.6] |
| Kashima | [4.9] | 5.6 | 5.7 | [5.8] | 5.8 | [5.3] |
| Tokyo | 5.2 | 5 | 5.2 | [5.4] | 5.4 | [5.2] |
| Ichihara | 5.2 | 5.5 | 5.3 | 5.4 | 5.0 | 5.2 |
| Kawasaki | 5.1 | 4.7 | 4.8 | 5 | 4.8 | 4.9 |
| Tanzawa | | | 4.8 | 4.8 | 4.9 | 4.8 |
| Inuyama | 4.7 | 4.8 | 4.7 | 4.7 | 4.8 | 4.7 |
| Nagoya | 5.3 | 5.3 | 4.7 | 4.7 | 5.0 | 4.9 |
| Shionomisaki | | 4.6 | 4.6 | 4.5 | 5.2 | 4.7 |
| Ashizuri | | [4.6] | [4.6] | [4.6] | 4.6 | [4.6] |
| Ogasawara | 5.1 | 5.3 | 5.3 | 5.4 | 5.6 | 5.3 |
| Kyoto-yawata | 4.7 | 4.7 | 4.8 | 4.7 | 4.8 | 4.7 |
| Amagasaki | 5 | 4.8 | 4.8 | 4.7 | 4.9 | 4.9 |
| Osaka | 4.8 | 4.5 | 4.7 | 4.7 | 4.9 | 4.7 |
| Kurashiki | 4.7 | 4.7 | 4.6 | 4.5 | 4.7 | 4.6 |
| Kurahashijima | [4.6] | 4.4 | 4.6 | 4.5 | 4.6 | [4.6] |
| Ube | 5.9 | 5.7 | 5.8 | 5.6 | 5.7 | 5.7 |
| Oita-kuju | | 4.5 | 4.7 | 4.7 | 5.0 | 4.8 |
| Tsushima | 4.8 | [4.7] | 4.9 | 4.7 | 4.8 | [4.8] |
| Kitakyushu | 4.8 | 5.2 | 5.2 | 5.2 | [5.2] | [5.1] |
| Chikugo-ogori | 4.9 | 4.7 | 4.8 | 4.8 | 4.9 | 4.8 |
| Omuta | 5.3 | 5.5 | 5.5 | 5.5 | 5.5 | 5.4 |
| Goto | | [4.8] | 4.9 | 4.7 | 4.8 | [4.8] |
| Yakushima | | 4.6 | 4.6 | 4.7 | 4.8 | 4.7 |
| Amami | 5.5 | 5 | 5.1 | [5.5] | 5.3 | [5.2] |
| Kunigami | | [4.9] | 4.9 | 5.1 | [5.1] | [5.0] |
| Max. | 5.9 | 5.7 | 5.8 | 5.6 | 5.8 | 5.7 |
| Min. | 4.6 | 4.4 | 4.5 | 4.5 | 4.6 | 4.5 |
| Mean | 4.9 | 4.8 | 4.8 | 4.7 | 4.8 | 4.8 |

Note: Data in parentheses are informal, and should be used only as reference data

Appendix 2 Annual mean value (nss-SO₄²⁻) during the third survey³⁾

| Site Name | (μ eq/L) | | | | | Mean |
|---------------|----------|--------|--------|--------|--------|--------|
| | 1993 | 1994 | 1995 | 1996 | 1997 | |
| Rishiri | 27.0 | [23.1] | [34.0] | 26.0 | [30.5] | [28.4] |
| Sapporo | 41.2 | 30.2 | 36.3 | 34.1 | 32.7 | 35.0 |
| Nopporo | [26.9] | 21.5 | 20.9 | 25.2 | 16.3 | [22.1] |
| Tappi | | 33.9 | 29.0 | 35.1 | 28.8 | 31.2 |
| Obanazawa | | [19.7] | 24.3 | 27.2 | 20.7 | [22.8] |
| Sado | 29.4 | 33.7 | 32.9 | 37.9 | 20.3 | 30.1 |
| Niigata | 33.2 | 46.6 | 40.9 | 52.1 | 36.3 | 41.7 |
| Niitsu | 27.9 | 38.0 | 30.2 | 38.5 | 29.4 | 32.3 |
| Wajima | | 38.4 | 38.5 | 45.0 | 25.2 | 35.7 |
| Happo | | 26.6 | [22.1] | [18.0] | 16.7 | [20.1] |
| Tateyama | | [31.1] | 28.6 | 30.5 | 24.2 | [28.2] |
| Echizenmisaki | | | 35.6 | 34.6 | 26.8 | 32.1 |
| Oki | [21.7] | 34.1 | 35.4 | 30.5 | 22.6 | [27.7] |
| Kyoto-yasaka | | [37.6] | 34.7 | 39.5 | 27.4 | [34.0] |
| Matsue | 28.2 | 32.7 | 34.2 | 28.2 | 21.4 | 28.4 |
| Masuda | | 37.1 | 32.4 | 37.2 | 22.5 | 30.3 |
| Hachimantai | | [24.5] | 29.9 | 30.6 | 24.6 | [27.7] |
| Nonodake | 13.8 | 31.2 | [26.0] | 25.0 | 18.5 | [21.4] |
| Sendai | 26.1 | [27.8] | 36.6 | 34.6 | 30.1 | [30.4] |
| Oze | | | [13.4] | [20.9] | [17.0] | [18.8] |
| Nikko | | | | | [9.2] | [9.2] |
| Akagi | | | | [36.7] | [30.8] | [32.8] |
| Tsukuba | [21.1] | [33.7] | [27.8] | 27.7 | 26.2 | [26.9] |
| Kashima | [47.7] | 42.1 | 40.6 | [44.3] | 49.3 | [45.2] |
| Tokyo | 54.4 | 75.6 | 59.4 | [65.2] | 58.2 | [61.6] |
| Ichihara | 20.3 | 33.7 | 28.5 | 33.7 | 34.1 | 29.4 |
| Kawasaki | 28.0 | 39.8 | 37.5 | 26.4 | 41.5 | 33.8 |
| Tanzawa | | | 14.9 | 15.9 | 11.6 | 14.0 |
| Inuyama | 22.8 | 21.7 | 23.2 | 25.4 | 21.6 | 25.5 |
| Nagoya | 25.8 | 28.0 | 30.7 | 32.5 | 21.2 | 27.0 |
| Shionomisaki | | 22.0 | 32.5 | 23.8 | 20.1 | 24.2 |
| Ashizuri | | [23.0] | [29.6] | [24.4] | 25.8 | [25.7] |
| Ogasawara | 8.7 | 12.9 | 25.0 | 15.8 | 40.6 | 22.2 |
| Kyoto-yawata | 30.7 | 29.7 | 30.2 | 30.4 | 26.5 | 29.3 |
| Amagasaki | 26.7 | 35.9 | 30.5 | 27.5 | 23.4 | 27.9 |
| Osaka | 25.6 | 39.2 | 33.0 | 31.0 | 26.5 | 30.0 |
| Kurashiki | 27.6 | 28.4 | 29.0 | 36.1 | 29.2 | 29.7 |
| Kurahashijima | [25.3] | 37.8 | 25.0 | 25.5 | 22.8 | [25.9] |
| Ube | 46.1 | 52.9 | 38.9 | 51.6 | 34.7 | 43.5 |
| Oita-kuju | | 34.8 | 30.7 | 27.7 | 20.7 | 27.4 |
| Tsushima | 29.4 | [43.2] | 29.0 | 33.2 | 23.6 | [30.8] |
| Kitakyushu | 46.0 | 51.1 | 44.8 | 52.3 | [40.2] | [45.7] |
| Chikugo-ogori | 28.4 | 46.7 | 30.6 | 37.7 | 21.4 | 29.8 |
| Omuta | 37.4 | 55.1 | 46.2 | 34.0 | 25.8 | 37.0 |
| Goto | | [31.0] | 26.1 | 30.0 | 24.0 | [26.7] |
| Yakushima | | 28.6 | 30.3 | 23.2 | 21.4 | 25.5 |
| Amami | 13.8 | 25.8 | 24.3 | [20.8] | 15.0 | [19.6] |
| Kunigami | | [17.6] | 14.9 | 12.9 | [16.3] | [15.4] |
| Max. | 54.4 | 75.6 | 59.4 | 52.3 | 58.2 | 43.5 |
| Min. | 8.7 | 12.9 | 14.9 | 12.9 | 11.6 | 14.0 |
| Mean | 29.1 | 34.7 | 31.6 | 31.2 | 25.3 | 29.7 |

Note: Data in parentheses are informal, and should be used only as reference data

Appendix 3 Annual mean value (NO₃⁻) during the third survey³⁾

| Site Name | (μeq/L) | | | | | Mean |
|---------------|---------|--------|--------|--------|--------|--------|
| | 1993 | 1994 | 1995 | 1996 | 1997 | |
| Rishiri | 11.7 | [11.6] | [15.0] | 11.9 | [14.4] | [13.1] |
| Sapporo | 11.9 | 9.6 | 11.9 | 12.3 | 14.1 | 11.9 |
| Nopporo | [11.1] | 8.0 | 7.9 | 9.8 | 7.0 | [8.7] |
| Tappi | | 15.7 | 15.2 | 18.9 | 17.1 | 16.7 |
| Obanazawa | | [9.7] | 12.1 | 24.7 | 12.0 | [14.2] |
| Sado | 16.1 | 15.8 | 15.1 | 19.6 | 10.9 | 15.2 |
| Niigata | 10.3 | 15.8 | 15.3 | 19.5 | 14.6 | 15.3 |
| Niitsu | 15.5 | 18.9 | 14.8 | 19.7 | 16.0 | 16.7 |
| Wajima | | 16.5 | 18.2 | 23.0 | 15.0 | 17.9 |
| Happo | | 13.8 | [10.0] | [9.3] | 9.2 | [10.1] |
| Tateyama | | [13.7] | 15.6 | 15.0 | 12.8 | [14.3] |
| Echizenmisaki | | | 22.2 | 23.1 | 17.8 | 20.9 |
| Oki | [10.8] | 18.0 | 18.2 | 21.4 | 16.6 | [16.7] |
| Kyoto-yasaka | | [16.9] | 17.4 | 21.3 | 14.5 | [17.1] |
| Matsue | 12.1 | 16.7 | 16.6 | 17.5 | 12.4 | 14.6 |
| Masuda | | 19.3 | 18.9 | 20.8 | 12.2 | 16.8 |
| Hachimantai | | [11.3] | 14.8 | 17.8 | 14.8 | [14.9] |
| Nonodake | 10.7 | 19.1 | [18.9] | 15.6 | 12.5 | [14.7] |
| Sendai | 13.5 | [11.0] | 21.9 | 19.5 | 20.4 | [16.8] |
| Oze | | | [7.9] | [12.7] | [11.3] | [11.6] |
| Nikko | | | | | [8.1] | [8.0] |
| Akagi | | | | [39.0] | [27.6] | [31.6] |
| Tsukuba | [18.4] | [27.9] | [24.3] | 22.0 | 22.4 | [22.7] |
| Kashima | [8.1] | 11.8 | 16.1 | [14.7] | 17.3 | [13.4] |
| Tokyo | 39.2 | 72.4 | 87.7 | [48.1] | 51.2 | [56.7] |
| Ichihara | 8.3 | 17.2 | 13.5 | 13.6 | 18.7 | 13.9 |
| Kawasaki | 12.3 | 20.2 | 19.5 | 11.9 | 22.7 | 16.7 |
| Tanzawa | | | 14.5 | 15.1 | 11.7 | 13.7 |
| Inuyama | 16.3 | 15.6 | 15.1 | 20.2 | 16.8 | 18.6 |
| Nagoya | 16.4 | 21.4 | 18.5 | 24.7 | 15.9 | 18.7 |
| Shionomisaki | | 14.0 | 14.7 | 16.3 | 17.5 | 15.8 |
| Ashizuri | | [9.8] | [13.8] | [12.7] | 13.7 | [12.8] |
| Ogasawara | 3.5 | 3.2 | 6.7 | 8.0 | 3.7 | 5.0 |
| Kyoto-yawata | 19.0 | 22.6 | 16.4 | 21.3 | 19.6 | 19.6 |
| Amagasaki | 11.5 | 22.2 | 12.8 | 14.5 | 12.2 | 13.6 |
| Osaka | 10.8 | 28.0 | 14.6 | 15.9 | 13.5 | 15.1 |
| Kurashiki | 13.2 | 19.0 | 15.8 | 17.1 | 14.4 | 15.3 |
| Kurahashijima | [12.1] | 17.6 | 15.2 | 16.5 | 12.9 | [14.1] |
| Ube | 13.1 | 18.2 | 11.9 | 21.2 | 15.1 | 15.1 |
| Oita-kuju | | 10.0 | 8.7 | 8.9 | 7.8 | 8.6 |
| Tsushima | 13.2 | [19.3] | 13.8 | 16.5 | 12.7 | [14.7] |
| Kitakyushu | 23.6 | 28.2 | 25.2 | 31.2 | [21.5] | [25.1] |
| Chikugo-ogori | 8.2 | 16.0 | 10.8 | 15.1 | 8.8 | 10.8 |
| Omuta | 9.8 | 15.6 | 13.5 | 9.2 | 8.1 | 10.5 |
| Goto | | [14.9] | 11.4 | 14.5 | 11.1 | [12.4] |
| Yakushima | | 11.8 | 11.5 | 9.6 | 8.3 | 10.1 |
| Amami | 6.6 | 9.5 | 11.2 | [8.9] | 7.4 | [8.7] |
| Kunigami | | [6.1] | 6.9 | 5.4 | [6.5] | [6.2] |
| Max. | 39.2 | 72.4 | 87.7 | 31.2 | 51.2 | 20.9 |
| Min. | 3.5 | 3.2 | 6.7 | 5.4 | 3.7 | 5.0 |
| Mean | 13.4 | 17.1 | 15.4 | 16.8 | 13.6 | 15.1 |

Note: Data in parentheses are informal, and should be used only as reference data

Appendix 4 Annual mean value (nss-Ca²⁺) during the third survey³⁾

| Site Name | (μ eq/L) | | | | | |
|---------------|----------|--------|--------|--------|--------|--------|
| | 1993 | 1994 | 1995 | 1996 | 1997 | Mean |
| Rishiri | 5.4 | [25.8] | [12.0] | 8.3 | [5.6] | [11.2] |
| Sapporo | 17.9 | 8.8 | 8.2 | 10.2 | 8.7 | 10.8 |
| Nopporo | [7.7] | 5.0 | 4.0 | 7.7 | 2.8 | [5.3] |
| Tappi | | 10.1 | 12.1 | 10.1 | 8.3 | 10.1 |
| Obanazawa | | [3.6] | 7.1 | 7.6 | 4.4 | [5.6] |
| Sado | 11.0 | 10.4 | 7.5 | 14.1 | 8.7 | 10.1 |
| Niigata | 8.3 | 8.2 | 6.1 | 10.4 | 6.4 | 7.5 |
| Niitsu | 9.3 | 12.2 | 7.3 | 9.9 | 7.3 | 8.9 |
| Wajima | | 9.3 | 12.8 | 17.0 | 4.7 | 10.5 |
| Happo | | 7.0 | [5.8] | [5.2] | 5.3 | [5.6] |
| Tateyama | | [6.9] | 13.8 | 11.0 | 3.5 | [8.8] |
| Echizenmisaki | | | 7.4 | 7.1 | 6.5 | 7.0 |
| Oki | [2.9] | 7.3 | 6.3 | 7.4 | 8.7 | [6.5] |
| Kyoto-yasaka | | [9.8] | 9.1 | 7.6 | 5.8 | [7.9] |
| Matsue | 9.0 | 7.4 | 7.3 | 7.6 | 8.1 | 8.0 |
| Masuda | | 8.6 | 7.2 | 6.4 | 5.1 | 6.5 |
| Hachimantai | | [5.3] | 7.5 | 6.3 | 1.4 | [5.2] |
| Nonodake | 6.4 | 13.7 | [8.6] | 6.1 | 3.7 | [6.9] |
| Sendai | 12.1 | [12.7] | 15.9 | 13.3 | 10.5 | [12.7] |
| Oze | | | [5.4] | [6.4] | [2.6] | [5.4] |
| Nikko | | | | | [5.6] | [5.6] |
| Akagi | | | | [9.4] | [6.6] | [7.6] |
| Tsukuba | [9.4] | [8.1] | [14.9] | 9.7 | 20.6 | [12.6] |
| Kashima | [23.7] | 32.6 | 19.1 | [28.1] | 37.6 | [27.7] |
| Tokyo | 47.7 | 64.0 | 79.6 | [67.1] | 47.6 | [59] |
| Ichihara | 12.0 | 22.8 | 20.6 | 26.3 | 21.0 | 19.9 |
| Kawasaki | 13.2 | 17.5 | 26.3 | 9.8 | 19.4 | 16.7 |
| Tanzawa | | | 5.4 | 5.3 | 2.4 | 4.2 |
| Inuyama | 4.9 | 7.1 | 6.1 | 6.4 | 5.3 | 6.5 |
| Nagoya | 12.7 | 12.8 | 10.6 | 13.5 | 7.3 | 11.1 |
| Shionomisaki | | 8.3 | 11.5 | 11.6 | 16.9 | 12.6 |
| Ashizuri | | [2.4] | [4.2] | [3.8] | 1.9 | [3.0] |
| Ogasawara | 3.3 | 8.0 | 6.0 | 7.6 | 20.2 | 10.0 |
| Kyoto-yawata | 6.9 | 17.3 | 10.5 | 17.8 | 14.1 | 12.9 |
| Amagasaki | 7.8 | 10.7 | 8.8 | 7.5 | 7.7 | 8.2 |
| Osaka | 6.4 | 12.6 | 8.2 | 7.6 | 7.5 | 7.9 |
| Kurashiki | 5.1 | 11.3 | 7.0 | 11.4 | 7.0 | 7.6 |
| Kurashijima | [7.1] | 1.9 | 3.4 | 4.9 | 4.8 | [4.9] |
| Ube | 31.4 | 50.9 | 11.3 | 18.4 | 29.3 | 26.3 |
| Oita-kuju | | 2.7 | 6.6 | 8.0 | 2.6 | 5.2 |
| Tsushima | 7.1 | [12.1] | 14.5 | 10.7 | 6.3 | [9.5] |
| Kitakyushu | 21.0 | 29.8 | 22.7 | 42.8 | [34.0] | [29.6] |
| Chikugo-ogori | 6.3 | 10.3 | 6.5 | 5.6 | 3.3 | 5.6 |
| Omuta | 12.6 | 23.3 | 14.9 | 12.9 | 5.3 | 12.0 |
| Goto | | [38.4] | 13.8 | 9.2 | 5.9 | [13.1] |
| Yakushima | | 5.3 | 6.4 | 4.1 | 3.7 | 4.8 |
| Amami | 6.3 | 6.4 | 6.0 | [7.0] | 4.8 | [6.0] |
| Kunigami | | [2.5] | 2.7 | 2.4 | [2.5] | [2.5] |
| Max. | 47.7 | 64.0 | 79.6 | 42.8 | 47.6 | 26.3 |
| Min. | 3.3 | 1.9 | 2.7 | 2.4 | 1.4 | 4.2 |
| Mean | 11.8 | 13.3 | 10.4 | 10.1 | 8.4 | 10.3 |

Note: Data in parentheses are informal, and should be used only as reference data

Appendix 5 Annual precipitation during the third survey³⁾

| Site Name | 1993 | 1994 | 1995 | 1996 | 1997 | Mean |
|---------------|--------|--------|--------|--------|--------|--------|
| Rishiri | 599 | [711] | [777] | 714 | [939] | [748] |
| Sapporo | 995 | 977 | 953 | 845 | 925 | 939 |
| Nopporo | [999] | 985 | 1059 | 919 | 1052 | [1003] |
| Tappi | | 759 | 1075 | 842 | 1194 | 968 |
| Obanazawa | | [1313] | 1560 | 1227 | 1634 | [1434] |
| Sado | 1605 | 1158 | 1720 | 1284 | 1856 | 1525 |
| Niigata | 792 | 1124 | 1853 | 1167 | 1801 | 1347 |
| Niitsu | 1747 | 1501 | 2403 | 1745 | 2231 | 1925 |
| Wajima | | 1618 | 2254 | 1785 | 2577 | 2059 |
| Happo | | 1089 | [2258] | [1997] | 2259 | [1901] |
| Tateyama | | [1707] | 2684 | 2623 | 2947 | [2490] |
| Echizenmisaki | | | 1720 | 1895 | 2036 | 1884 |
| Oki | [1609] | 843 | 1158 | 1499 | 1787 | [1379] |
| Kyoto-yasaka | | [1876] | 2307 | 1597 | 2627 | [2102] |
| Matsue | 2192 | 1308 | 1623 | 1359 | 2021 | 1701 |
| Masuda | | 878 | 1693 | 1223 | 2311 | 1526 |
| Hachimantai | | [1173] | 2063 | 1476 | 1726 | [1609] |
| Nonodake | 1232 | 553 | [996] | 877 | 1256 | [983] |
| Sendai | 1470 | [1147] | 994 | 870 | 1128 | [1122] |
| Oze | | | [468] | [1742] | [563] | [924] |
| Nikko | | | | | [1222] | [1222] |
| Akagi | | | | [532] | [992] | [762] |
| Tsukuba | [1220] | [875] | [969] | 1064 | 1097 | [1045] |
| Kashima | [1593] | 807 | 1211 | [1208] | 1237 | [1211] |
| Tokyo | 1226 | 770 | 699 | [790] | 958 | [889] |
| Ichihara | 1481 | 1076 | 1054 | 1067 | 1126 | 1161 |
| Kawasaki | 1642 | 1152 | 1183 | 1377 | 1115 | 1294 |
| Tanzawa | | | 1256 | 2004 | 2076 | 1334 |
| Inuyama | 1643 | 1058 | 1522 | 1134 | 1872 | 1294 |
| Nagoya | 1689 | 1062 | 1398 | 968 | 1658 | 1355 |
| Shionomisaki | | 1297 | 1456 | 1533 | 2008 | 1574 |
| Ashizuri | | [1231] | [1625] | [2086] | 2433 | [1844] |
| Ogasawara | 1266 | 1119 | 1233 | 1346 | 1882 | 1369 |
| Kyoto-yawata | 1436 | 633 | 856 | 1218 | 1621 | 1153 |
| Amagasaki | 1468 | 566 | 1188 | 1164 | 1203 | 1118 |
| Osaka | 1326 | 600 | 1361 | 1204 | 1453 | 1189 |
| Kurashiki | 1420 | 542 | 1016 | 820 | 1106 | 981 |
| Kurashijima | [2037] | 764 | 1253 | 1029 | 2071 | [1431] |
| Ube | 2159 | 858 | 1814 | 1254 | 1777 | 1572 |
| Oita-kuju | | 723 | 1774 | 1504 | 1782 | 1446 |
| Tsushima | 2565 | [1295] | 1425 | 1772 | 1921 | [1796] |
| Kitakyushu | 1711 | 1121 | 1638 | 1167 | [2317] | [1591] |
| Chikugo-ogori | 1903 | 836 | 2009 | 1545 | 2993 | 1857 |
| Omuta | 2285 | 678 | 1898 | 1345 | 2386 | 1718 |
| Goto | | [634] | 1180 | 932 | 1861 | [1152] |
| Yakushima | | 2228 | 2714 | 2062 | 3716 | 2680 |
| Amami | 2498 | 1977 | 2526 | [1848] | 2439 | [2258] |
| Kunigami | | [1799] | 2087 | 2201 | [2796] | [2221] |
| Max. | 2565 | 2228 | 2714 | 2623 | 3716 | 2680 |
| Min. | 599 | 542 | 699 | 714 | 925 | 939 |
| Mean | 1598 | 1021 | 1572 | 1341 | 1837 | 1474 |

Note: Data in parentheses are informal, and should be used only as reference data

Appendix 6 Annual deposition(nss-SO₄²⁻) during the third survey³⁾

| Site Name | (meq/m ² /year) | | | | | |
|---------------|----------------------------|--------|--------|--------|--------|--------|
| | 1993 | 1994 | 1995 | 1996 | 1997 | Mean |
| Rishiri | 16.2 | [16.4] | [26.4] | 18.6 | [28.6] | [21.2] |
| Sapporo | 41.0 | 29.5 | 34.6 | 28.8 | 30.2 | 32.8 |
| Nopporo | [26.9] | 21.2 | 22.1 | 23.2 | 17.2 | [22.1] |
| Tappi | | 25.7 | 31.2 | 29.6 | 34.4 | 30.2 |
| Obanazawa | | [25.8] | 38.0 | 33.4 | 33.8 | [32.8] |
| Sado | 47.2 | 39.0 | 56.6 | 48.7 | 37.7 | 45.8 |
| Niigata | 26.3 | 52.4 | 75.9 | 60.7 | 65.5 | 56.2 |
| Niitsu | 48.7 | 57.1 | 72.7 | 67.2 | 65.5 | 62.2 |
| Wajima | | 62.2 | 86.7 | 80.3 | 64.9 | 73.5 |
| Happo | | 29.0 | [49.9] | [35.9] | 37.8 | [38.2] |
| Tateyama | | [53.0] | 76.8 | 80.1 | 71.4 | [70.3] |
| Echizenmisaki | | | 61.3 | 65.6 | 54.6 | 60.5 |
| Oki | [34.9] | 28.7 | 41.0 | 45.7 | 40.4 | [38.1] |
| Kyoto-yasaka | | [70.6] | 80.1 | 63.1 | 71.9 | [71.4] |
| Matsue | 61.8 | 42.8 | 55.5 | 38.4 | 43.3 | 48.4 |
| Masuda | | 32.5 | 54.8 | 45.4 | 52.0 | 46.2 |
| Hachimantai | | [28.7] | 61.7 | 45.2 | 42.5 | [44.5] |
| Nonodake | 17.0 | 17.2 | [25.9] | 22.0 | 23.3 | [21.1] |
| Sendai | 38.4 | [31.9] | 36.4 | 30.1 | 33.9 | [34.1] |
| Oze | | | [6.3] | [36.3] | [9.6] | [17.4] |
| Nikko | | | | | [11.3] | [11.3] |
| Akagi | | | | [19.5] | [30.5] | [25] |
| Tsukuba | [25.7] | [29.5] | [26.9] | 29.5 | 28.7 | [28.1] |
| Kashima | [76.0] | 34.0 | 49.2 | [53.5] | 61.0 | [54.7] |
| Tokyo | 66.8 | 58.2 | 41.5 | [51.5] | 55.7 | [54.7] |
| Ichihara | 30.0 | 36.2 | 30.0 | 35.9 | 38.4 | 34.1 |
| Kawasaki | 45.9 | 45.8 | 44.4 | 36.4 | 46.3 | 43.8 |
| Tanzawa | | | 18.7 | 31.9 | 24.0 | 18.7 |
| Inuyama | 37.5 | 23.0 | 35.3 | 28.9 | 40.4 | 33.0 |
| Nagoya | 43.6 | 29.7 | 42.9 | 31.5 | 35.1 | 36.6 |
| Shionomisaki | | 28.5 | 47.2 | 36.5 | 40.3 | 38.1 |
| Ashizuri | | [28.3] | [48.1] | [50.8] | 62.7 | [47.5] |
| Ogasawara | 11.1 | 14.4 | 28.4 | 21.3 | 76.5 | 30.3 |
| Kyoto-yawata | 44.1 | 18.8 | 25.9 | 37.0 | 43.0 | 33.8 |
| Amagasaki | 39.1 | 20.3 | 36.3 | 32.0 | 28.2 | 31.2 |
| Osaka | 34.0 | 23.5 | 44.9 | 37.3 | 38.4 | 35.6 |
| Kurashiki | 39.2 | 15.4 | 29.4 | 29.6 | 32.2 | 29.2 |
| Kurahashijima | [51.6] | 28.9 | 31.4 | 26.2 | 47.2 | [37.1] |
| Ube | 99.6 | 45.4 | 70.5 | 64.7 | 61.6 | 68.4 |
| Oita-kuju | | 25.2 | 54.4 | 41.7 | 37.0 | 39.6 |
| Tsushima | 75.4 | [56.0] | 41.3 | 58.8 | 45.2 | [55.3] |
| Kitakyushu | 78.6 | 57.3 | 73.3 | 61.0 | [93.1] | [72.7] |
| Chikugo-ogori | 54.1 | 39.1 | 61.4 | 58.2 | 64.1 | 55.4 |
| Omuta | 85.5 | 37.4 | 87.7 | 45.8 | 61.5 | 63.6 |
| Goto | | [19.6] | 30.7 | 27.9 | 44.7 | [30.7] |
| Yakushima | | 63.8 | 82.3 | 47.8 | 79.7 | 68.4 |
| Amami | 34.5 | 50.9 | 61.3 | [38.4] | 36.6 | [44.3] |
| Kunigami | | [31.7] | 31.2 | 28.4 | [45.5] | [34.2] |
| Max. | 99.6 | 63.8 | 87.7 | 80.3 | 79.7 | 73.5 |
| Min. | 11.1 | 14.4 | 18.7 | 18.6 | 17.2 | 18.7 |
| Mean | 46.5 | 35.4 | 49.6 | 41.9 | 46.4 | 44.0 |

Note: Data in parentheses are informal, and should be used only as reference data

Appendix 7 Annual deposition(NO_3^-) during the third survey³⁾

| Site Name | (meq/m ² /year) | | | | | |
|---------------|----------------------------|--------|--------|--------|--------|--------|
| | 1993 | 1994 | 1995 | 1996 | 1997 | Mean |
| Rishiri | 7.0 | [8.2] | [11.7] | 8.5 | [13.5] | [9.8] |
| Sapporo | 11.9 | 9.4 | 11.4 | 10.4 | 13.0 | 11.2 |
| Nopporo | [11.1] | 7.9 | 8.4 | 9.0 | 7.4 | [8.8] |
| Tappi | | 11.9 | 16.3 | 15.9 | 20.4 | 16.1 |
| Obanazawa | | [12.7] | 18.9 | 30.3 | 19.6 | [20.4] |
| Sado | 25.9 | 18.3 | 25.9 | 25.2 | 20.3 | 23.1 |
| Niigata | 8.2 | 17.8 | 28.3 | 22.8 | 26.3 | 20.7 |
| Niitsu | 27.1 | 28.4 | 35.5 | 34.5 | 35.6 | 32.2 |
| Wajima | | 26.7 | 41.0 | 41.1 | 38.7 | 36.9 |
| Happo | | 15.1 | [22.6] | [18.6] | 20.8 | [19.3] |
| Tateyama | | [23.4] | 42.0 | 39.2 | 37.7 | [35.6] |
| Echizenmisaki | | | 38.2 | 43.7 | 36.3 | 39.4 |
| Oki | [17.3] | 15.2 | 21.1 | 32.0 | 29.7 | [23.1] |
| Kyoto-yasaka | | [31.6] | 40.0 | 34.0 | 38.0 | [35.9] |
| Matsue | 26.5 | 21.9 | 26.9 | 23.7 | 25.0 | 24.8 |
| Masuda | | 16.9 | 32.0 | 25.5 | 28.1 | 25.6 |
| Hachimantai | | [13.2] | 30.5 | 26.3 | 25.6 | [23.9] |
| Nonodake | 13.2 | 10.6 | [18.9] | 13.7 | 15.7 | [14.4] |
| Sendai | 19.8 | [12.6] | 21.8 | 17.0 | 23.0 | [18.8] |
| Oze | | | [3.7] | [22.0] | [6.4] | [10.7] |
| Nikko | | | | | [9.8] | [9.8] |
| Akagi | | | | [20.7] | [27.4] | [24.1] |
| Tsukuba | [22.5] | [24.4] | [23.5] | 23.4 | 24.6 | [23.7] |
| Kashima | [12.9] | 9.5 | 19.4 | [17.7] | 21.4 | [16.2] |
| Tokyo | 48.0 | 55.7 | 61.3 | [38.0] | 49.0 | [50.4] |
| Ichihara | 12.3 | 18.5 | 14.2 | 14.5 | 21.1 | 16.1 |
| Kawasaki | 20.3 | 23.3 | 23.1 | 16.3 | 25.3 | 21.7 |
| Tanzawa | | | 18.3 | 30.2 | 24.4 | 18.2 |
| Inuyama | 26.8 | 16.5 | 23.0 | 22.9 | 31.4 | 24.1 |
| Nagoya | 27.7 | 22.7 | 25.9 | 24.0 | 26.4 | 25.3 |
| Shionomisaki | | 18.1 | 21.4 | 24.9 | 35.1 | 24.9 |
| Ashizuri | | [12.1] | [22.4] | [26.6] | 33.4 | [23.6] |
| Ogasawara | 4.4 | 3.6 | 8.3 | 10.8 | 7.0 | 6.8 |
| Kyoto-yawata | 27.3 | 14.3 | 14.0 | 25.9 | 31.7 | 22.6 |
| Amagasaki | 16.9 | 12.6 | 15.2 | 16.8 | 14.7 | 15.2 |
| Osaka | 14.3 | 16.8 | 19.9 | 19.2 | 19.7 | 18.0 |
| Kurashiki | 18.7 | 10.3 | 16.1 | 14.0 | 15.9 | 15.0 |
| Kurashijima | [24.7] | 13.5 | 19.1 | 17.0 | 26.8 | [20.2] |
| Ube | 28.2 | 15.6 | 21.6 | 26.6 | 26.9 | 23.8 |
| Oita-kuju | | 7.3 | 15.4 | 13.3 | 13.9 | 12.5 |
| Tsushima | 33.9 | [25.0] | 19.7 | 29.2 | 24.4 | [26.4] |
| Kitakyushu | 40.4 | 31.6 | 41.3 | 36.4 | [49.8] | [39.9] |
| Chikugo-ogori | 15.5 | 13.3 | 21.6 | 23.3 | 26.4 | 20.0 |
| Omuta | 22.4 | 10.6 | 25.5 | 12.4 | 19.3 | 18.0 |
| Goto | | [9.4] | 13.5 | 13.5 | 20.6 | [14.3] |
| Yakushima | | 26.3 | 31.2 | 19.8 | 30.7 | 27.0 |
| Amami | 16.4 | 18.8 | 28.3 | [16.5] | 17.9 | [19.6] |
| Kunigami | | [11.0] | 14.5 | 11.9 | [18.1] | [13.9] |
| Max. | 48.0 | 55.7 | 61.3 | 43.7 | 49.0 | 39.4 |
| Min. | 4.4 | 3.6 | 8.3 | 8.5 | 7.0 | 6.8 |
| Mean | 21.4 | 17.5 | 24.2 | 22.5 | 25.0 | 22.1 |

Note: Data in parentheses are informal, and should be used only as reference data

Appendix 8 Annual deposition(nss-Ca²⁺) during the third survey³⁾

| Site Name | (meq/m ² /year) | | | | | Mean |
|---------------|----------------------------|--------|--------|--------|--------|--------|
| | 1993 | 1994 | 1995 | 1996 | 1997 | |
| Rishiri | 3.2 | [18.3] | [9.3] | 5.9 | [5.2] | [8.4] |
| Sapporo | 17.8 | 8.6 | 7.8 | 8.6 | 8.1 | 10.2 |
| Nopporo | [7.6] | 4.9 | 4.2 | 7.1 | 3.0 | [5.4] |
| Tappi | | 7.7 | 13.0 | 8.5 | 9.9 | 9.8 |
| Obanazawa | | [4.7] | 11.1 | 9.3 | 7.2 | [8.1] |
| Sado | 17.7 | 12.0 | 12.9 | 18.2 | 16.1 | 15.4 |
| Niigata | 6.5 | 9.3 | 11.2 | 12.1 | 11.6 | 10.1 |
| Niitsu | 16.2 | 18.3 | 17.4 | 17.3 | 16.2 | 17.1 |
| Wajima | | 15.0 | 28.8 | 30.3 | 12.2 | 21.6 |
| Happo | | 7.6 | [13.0] | [10.3] | 11.9 | [10.7] |
| Tateyama | | [11.7] | 37.0 | 28.9 | 10.2 | [22] |
| Echizenmisaki | | | 12.7 | 13.5 | 13.3 | 13.2 |
| Oki | [4.6] | 6.2 | 7.3 | 11.1 | 15.6 | [9] |
| Kyoto-yasaka | | [18.3] | 21.0 | 12.1 | 15.1 | [16.6] |
| Matsue | 19.7 | 9.7 | 11.8 | 10.3 | 16.5 | 13.6 |
| Masuda | | 7.5 | 12.3 | 7.8 | 11.9 | 9.9 |
| Hachimantai | | [6.2] | 15.4 | 9.4 | 2.4 | [8.4] |
| Nonodake | 7.9 | 7.6 | [8.6] | 5.3 | 4.7 | [6.8] |
| Sendai | 17.7 | [14.5] | 15.8 | 11.6 | 11.8 | [14.3] |
| Oze | | | [2.5] | [11.1] | [1.5] | [5] |
| Nikko | | | | | [6.9] | [6.9] |
| Akagi | | | | [5.0] | [6.6] | [5.8] |
| Tsukuba | [11.4] | [7.1] | [14.4] | 10.3 | 22.6 | [13.2] |
| Kashima | [37.7] | 26.3 | 23.1 | [34.0] | 46.6 | [33.5] |
| Tokyo | 58.6 | 49.3 | 55.6 | [53.0] | 45.6 | [52.4] |
| Ichihara | 17.7 | 24.5 | 21.7 | 28.1 | 23.6 | 23.1 |
| Kawasaki | 21.6 | 20.2 | 31.1 | 13.5 | 21.6 | 21.6 |
| Tanzawa | | | 6.8 | 10.6 | 5.0 | 5.6 |
| Inuyama | 8.1 | 7.5 | 9.3 | 7.3 | 9.9 | 8.4 |
| Nagoya | 21.5 | 13.6 | 14.8 | 13.1 | 12.0 | 15.0 |
| Shionomisaki | | 10.7 | 16.7 | 17.8 | 33.9 | 19.8 |
| Ashizuri | | [2.9] | [6.8] | [7.9] | 4.6 | [5.6] |
| Ogasawara | 4.2 | 8.9 | 7.4 | 10.2 | 38.0 | 13.7 |
| Kyoto-yawata | 9.9 | 11.0 | 9.0 | 21.6 | 22.8 | 14.9 |
| Amagasaki | 11.5 | 6.0 | 10.4 | 8.7 | 9.3 | 9.2 |
| Osaka | 8.5 | 7.5 | 11.2 | 9.1 | 10.9 | 9.4 |
| Kurashiki | 7.2 | 6.1 | 7.1 | 9.3 | 7.7 | 7.5 |
| Kurahashijima | [14.4] | 1.5 | 4.2 | 5.1 | 9.9 | [7] |
| Ube | 67.8 | 43.7 | 20.5 | 23.1 | 52.0 | 41.4 |
| Oita-kuju | | 1.9 | 11.7 | 12.0 | 4.6 | 7.6 |
| Tsushima | 18.2 | [15.7] | 20.6 | 19.0 | 12.1 | [17.1] |
| Kitakyushu | 36.0 | 33.4 | 37.3 | 49.9 | [78.9] | [47.1] |
| Chikugo-ogori | 11.9 | 8.6 | 13.1 | 8.7 | 9.7 | 10.4 |
| Omuta | 28.8 | 15.8 | 28.2 | 17.3 | 12.6 | 20.5 |
| Goto | | [24.4] | 16.2 | 8.6 | 11.1 | [15.1] |
| Yakushima | | 11.7 | 17.5 | 8.4 | 13.7 | 12.8 |
| Amami | 15.8 | 12.7 | 15.2 | [12.9] | 11.6 | [13.6] |
| Kunigami | | [4.4] | 5.5 | 5.4 | [6.9] | [5.6] |
| Max. | 67.8 | 49.3 | 55.6 | 49.9 | 52.0 | 41.4 |
| Min. | 3.2 | 1.5 | 4.2 | 5.1 | 2.4 | 5.6 |
| Mean | 18.9 | 13.6 | 16.3 | 13.6 | 15.5 | 15.6 |

Note: Data in parentheses are informal, and should be used only as reference data