

Interactive comment on “Long-term air concentrations, wet deposition, and scavenging ratios of inorganic ions, HNO₃ and SO₂ and assessment of aerosol and precipitation acidity at Canadian rural locations” by Irene Cheng and Leiming Zhang

Anonymous Referee #2

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This manuscript presents a detailed analysis of the trace gas concentrations and wet deposition fluxes measured at the Canadian Air and Precipitation Monitoring Network (CAPMoN) sites in the past thirty years (1983-2011). Long-term trends of aerosol ions and precipitation acidity at the Canadian sites are assessed from the aspect of acid deposition. The scavenging ratios for air pollutants as a measure of the wet scavenging efficiency are also estimated and compared with previous studies. The manuscript also presented a first attempt to quantify the relative contribution of gas and particle to

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measured wet deposition fluxes of ammonium, sulfate and nitrate.

Overall, the manuscript presents a very comprehensive summary of the air pollutant and wet deposition measurements at the Canadian network. While I also think that the manuscript can be difficult to follow due to the intense statistics reported in a parallel way, it is valuable to document the thirty-year dataset over Canada and the spatial and temporal patterns. The approach to estimate gas vs. aerosol contributions to wet deposition fluxes will be particularly helpful for model evaluation.

Specific comments 1) Abstract, Page 1, Line 19: Suggest change “because of the exclusion of gas scavenging” to “because of the exclusion of gas scavenging in previous studies” to avoid confusion.

2) Page 5, Line 10-13: This sentence is unclear. What is the difference between the Seasonal Kendall test and the Mann-Kendall test? Why are they inconsistent? Please clarify.

3) Page 5, Line 13-14 Page 10, last paragraph: “The relationship between meteorological factors and temporal trends in air concentrations and wet deposition were also examined by correlation analysis”. As shown in Table S1 and discussed on Page 10, the correlation analysis was only applied to some particulate ions and trace gases, and not to wet deposition fluxes.

It is not convincing that we can use the correlation coefficients based on monthly averages to explain the long-term trends based on annual values. For example, the weak correlation between monthly K⁺ concentration and precipitation may largely differ from their annual correlation, which is a better indicator for the descending trends in K⁺ concentrations during 1993-2010. Please clarify.

Also please state in the title of Table S1 that the correlations are computed using monthly values.

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- 4) Page 6, Line 7: Please clarify here how $W(K/2)$ as the scavenging ratio for coastal site is calculated here. As half of $W(K)$?
- 5) Page 7, Equ. (4)(5): Replace the * with cross using the standard equation format.
- 6) Page 10, Figure 2-4: The manuscript concludes that the temporal trends in atmospheric inorganic concentrations are consistent with their emissions. Can you please also present the trends in percentage to discuss that to what extent the trends in pollutant concentrations reflect trends in emissions?
- 7) Page 34, label of Figure 3: Please explain 'Cdn' in the caption. And 'Nox' should be 'NOx'.
- 8) Page 42, caption of Figure 10: Suggest change here (and a few places in the text, e.g., seasonal trend) "monthly trend" to "monthly variation" to avoid confusion with the long-term trend.
- 9) Supplement, Page S5, caption of Figure S4: "Five different months" should be "five different years".

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