

Air-Sea Exchange of Nutrients, Trace Metals and Organic Micro Pollutants at the North Sea

A contribution to subproject AEROSOL/CAPMAN

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Summary

As part of a project concerning the air-water exchange of nutrients and inorganic micropollutants to the North Sea, the atmospheric deposition of nutrients and trace metals via various forms and pathways was investigated. This was done by intensive sampling campaigns on the research vessel Belgica, combined with a sampling campaign over a period of one year at a sampling point at Knokke-Heist, near the Dutch border, and for a period of three months at Adinkerke, near the French border. Samples were taken for nutrients, trace elements, rain water and gases.

Aim of the period's work

The sample treatment and analysis of the different kinds of samples was already optimised. In this period the main goal was to achieve a large dataset over a sampling period of more than one year.

Activities during the year

Most of the samples, taken in 2000, are analysed.

Due to heavy weather during the Belgica campaigns (ns 9/00 from 27/3 until 31/3 (terminated on 29/3 due to storm) and ns 24/00 from 2/10 until 6/10), almost all the samples were contaminated by sea spray. The campaign at the sampling point at Knokke-Heist in Het Zwin (at a distance of 500 m from the sea and at a distance of 2 km of the Dutch border) was terminated successfully at the end of May. This sampling campaign had a duration of almost one year and the samples were taken on a weekly basis. Intensive sampling periods of one week were also organised in order to investigate the daily variations.

In the beginning of June, the sampling equipment was removed to Adinkerke, a sampling station near the French border at a distance of 5 km to the sea. There, the pollution of the atmospheric particles over the French-Flemish North Sea coast was investigated, with special attention to the borderline transports and the impact on the environment. The sampling was terminated at the end of July and restarted for the month of December.

Almost all the analysis have been carried out and these data will be used, in combination with meteorological data, for the calculation of fluxes.

Principal results

4.1 Belgica sampling campaigns

The first sampling campaign on board of the research vessel Belgica during the ns 9/00 (from March 27 to 31, 2000) had to be aborted on the 29th of March due to stormy weather. All the filter samples were ruined due to seaspray blown over the ship. There were also two samples taken, using a May impactor. All the different stages were leached and the results of one of these samples is depicted in *Figure 1*.

The second sampling campaign on the Belgica (ns 24/00 from October 2-6) was also not a big success. There was a wind speed of 8-9 Bft and only a fraction of the sampling could be carried out.

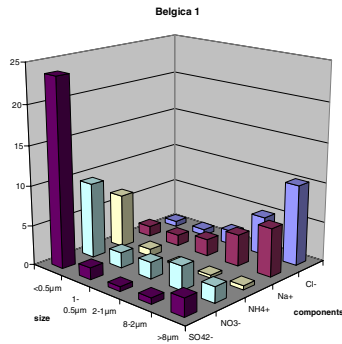


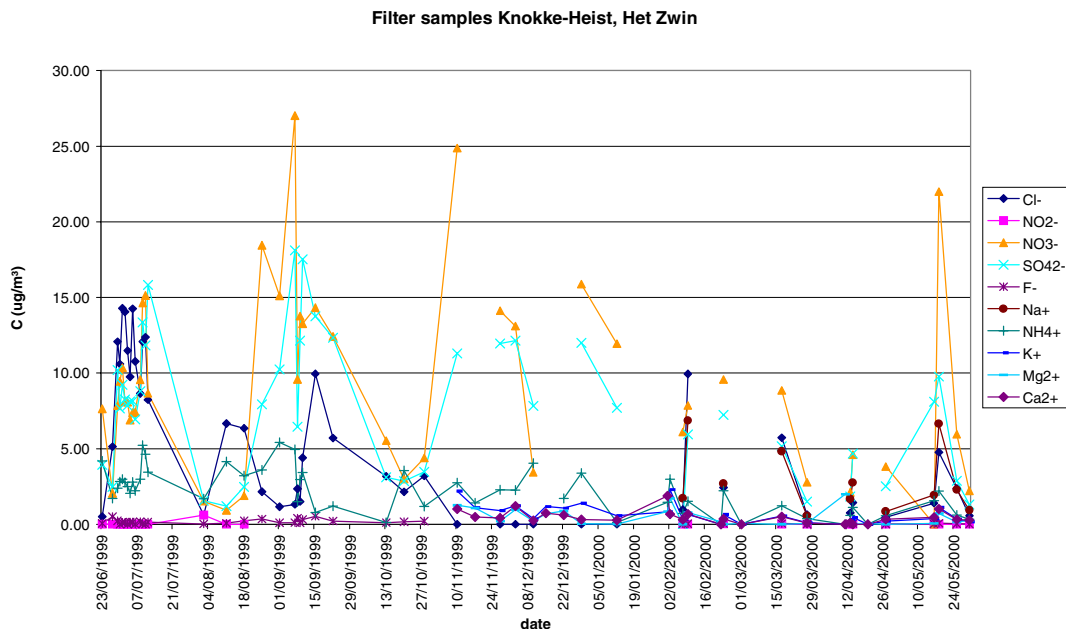
Fig 1: On the first Belgica sample (March 27, Belgian Continental Shelf) we can see a clear marine influence (coarse sea salt particles), combined with a continental history (small secondary sulphate, nitrate and ammonia aerosols).

4.2 Sampling at the Belgian Coast

4.2.1 Particulate matter

A) Nutrients

The sampling started on June 23, 1999 and was terminated at the end of May 2000. Over one week, around one thousand cubic meters of air were sampled, using a high-volume pump, and the particles were collected on a glass fibre filter. Afterwards, the particles were dissolved in Milli-Q water and analysed by Ion Chromatography. In *Figure 2*, the weekly averages of the different concentrations are depicted.

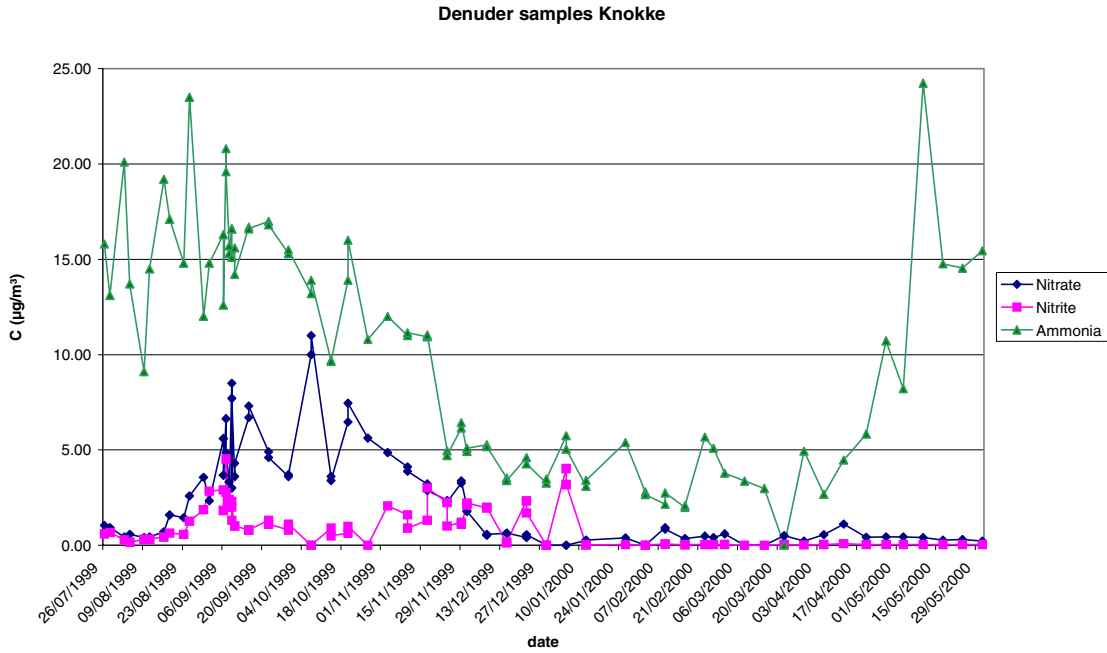


B) Trace metals

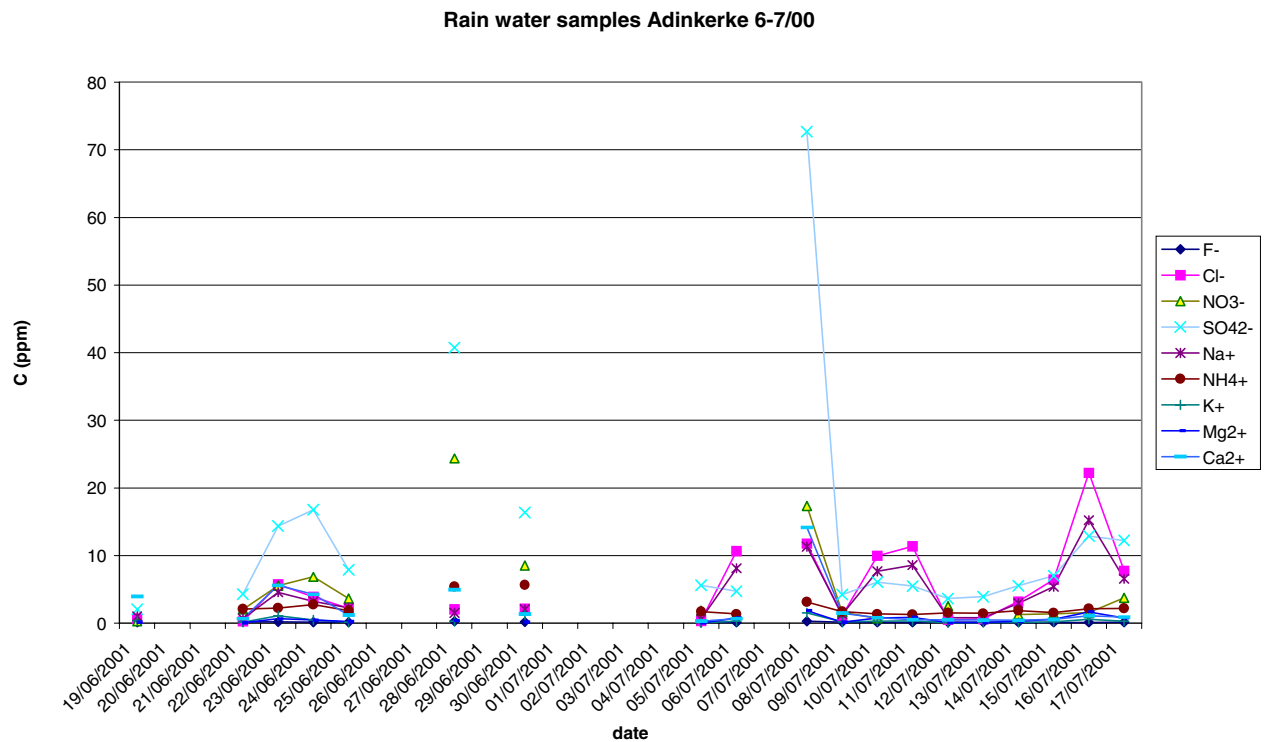
Trace metal samples were analysed but the results still have to be interpreted.

4.2.2 Gases

Gases were sampled with an annular denuder system, URG, 2000-01-K. Here, we can see a very high concentration of ammonia during August and September, decreasing over the winter period and increasing sharply in the beginning of May as a result of the fertilisation of the fields. The higher temperatures can also be responsible for the decomposition of ammoniumsalts, resulting in higher concentrations during spring and summer. The nitric acid concentration was rather low before September, and had normal to rather high concentration values in the period September-October.



4.2.3 Rain water



Rain water was collected over the months June and July, using an automatic sequential rain water sampler. The data have to be compared with the meteorological data and wet fluxes can be calculated.

Main conclusion

Almost all the sampling has been carried out and the results seem to be comparable with values found in literature. The sampling period lasted almost one year and major conclusions can be drawn. For the particulate fraction, there are clear fluctuating concentrations for all the different compounds, due to the changing wind direction and marine or continental influences. For the gases, and especially for ammonia, there is a clear seasonal variation in the concentrations. During spring and summertime, there is a higher concentration due to agricultural activities and the higher temperatures, with a sharp increase in these concentrations during the first fertilization activities in spring. Wet deposition fluxes can directly be calculated when the rain water results will be compared with meteorological data.

Aims for the coming year

Two sampling campaigns of one month, during February and June, are planned in Adinkerke. Most of the time will be used for the calculation of wet and dry atmospheric fluxes and the major results and conclusions will be drawn.

Acknowledgements

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List of publications

- G Eyckmans, K., J. Zhang, J. de Hoog, P. Joos and R. Van Grieken. Leaching of nutrients and trace metals from aerosol samples; a comparison between a re-circulation and an ultrasound system, *International Journal of Environmental Analytical Chemistry*, submitted and accepted
- Osán, J., J. de Hoog, A. Worobiec, C.-U. Ro, K.-Y. Oh, I. Szalóki and R. Van Grieken, Application of chemometric methods for classification of atmospheric particles based on thin-window EPMA data, *Analytica Chimica Acta*, submitted and accepted
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- Van Grieken, R., K. Gysels, S Hoornaert, P. Joos, J. Osan, I. Szaloki and A. Worobiec. Characterisation of individual aerosol particles for atmospheric and cultural heritage studies., *Water, Air and Soil Pollution*, **123**, 215-228, 2000