

Long-term deposition of atmospheric nutrients to the North Eastern Tropical Atlantic: Influence of anthropogenic and natural sources

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Motivation

Atmospheric deposition of nutrients is known to influence ocean biota. However, the influence of anthropogenic and natural sources that contribute to the nutrient fluxes and their long-term dynamics is not yet well understood. Based on long-term sampling and monitoring of aerosol derived nutrients at the Cape Verde Atmospheric Observatory (CVAO), we evaluated the role of Saharan dust and continental emissions from Europe and Africa on the nutrient fluxes in this region of the Atlantic.

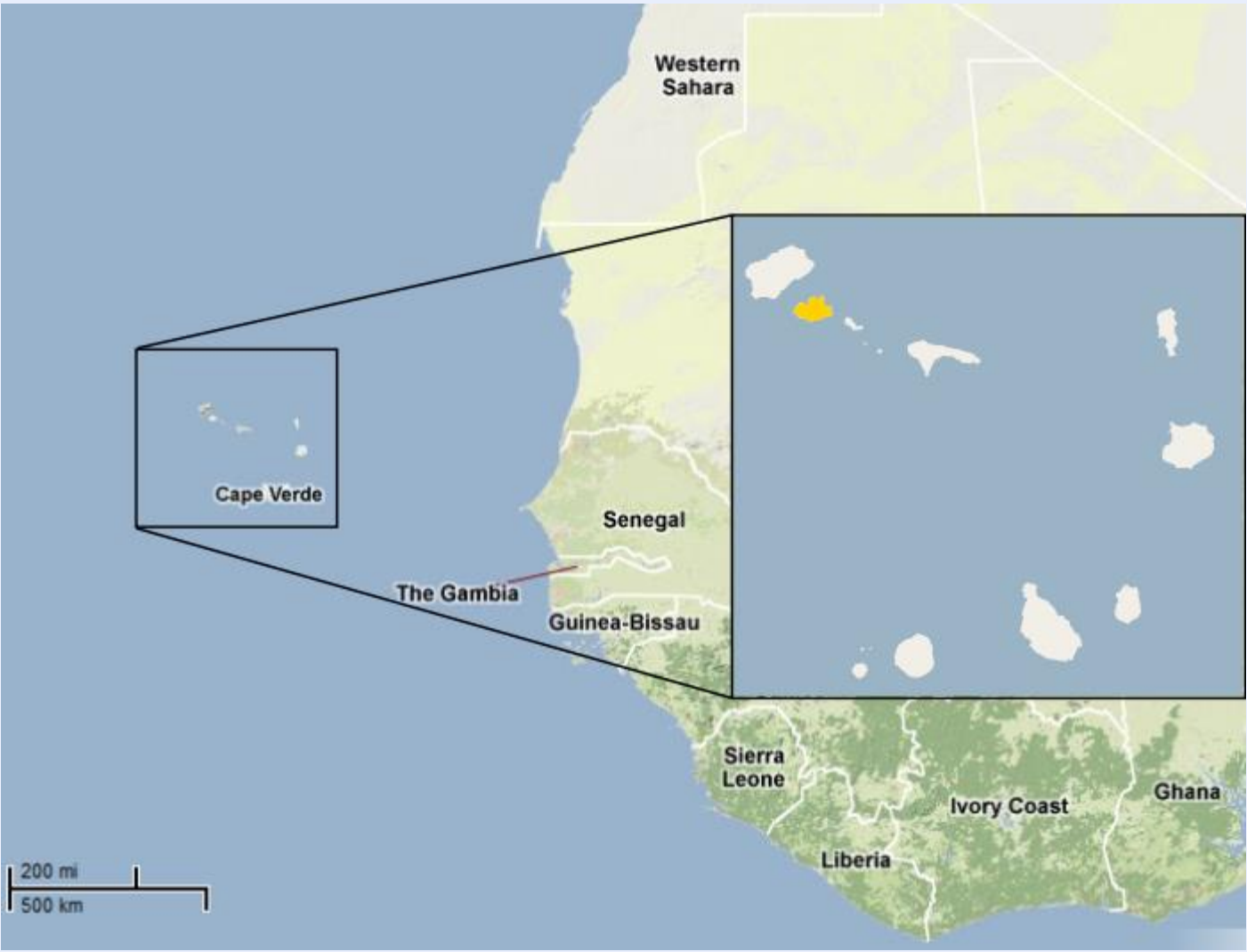


Fig. 1: The North Eastern Tropical Atlantic (Source: Niedermeier et al., ACP, 2014)

Aerosol Sampling

Aerosol particles were collected from 2017 to 2018 at the top of a 30 m tower on quartz fiber filters using a high volume DIGITEL sampler with a PM10 inlet. The filters were subsequently analyzed for inorganic ions and trace elements.



Fig. 2: The CVAO, with the sampling instrument as insert

Results

Atmospheric nutrient fluxes

Strong inter-annual variation in nutrient fluxes with elevated fluxes observed in 2018 compared to 2017. Iron fluxes peaked at 27 $\mu\text{mol}/\text{m}^2\text{d}$ and showed good agreement with other co-nutrients

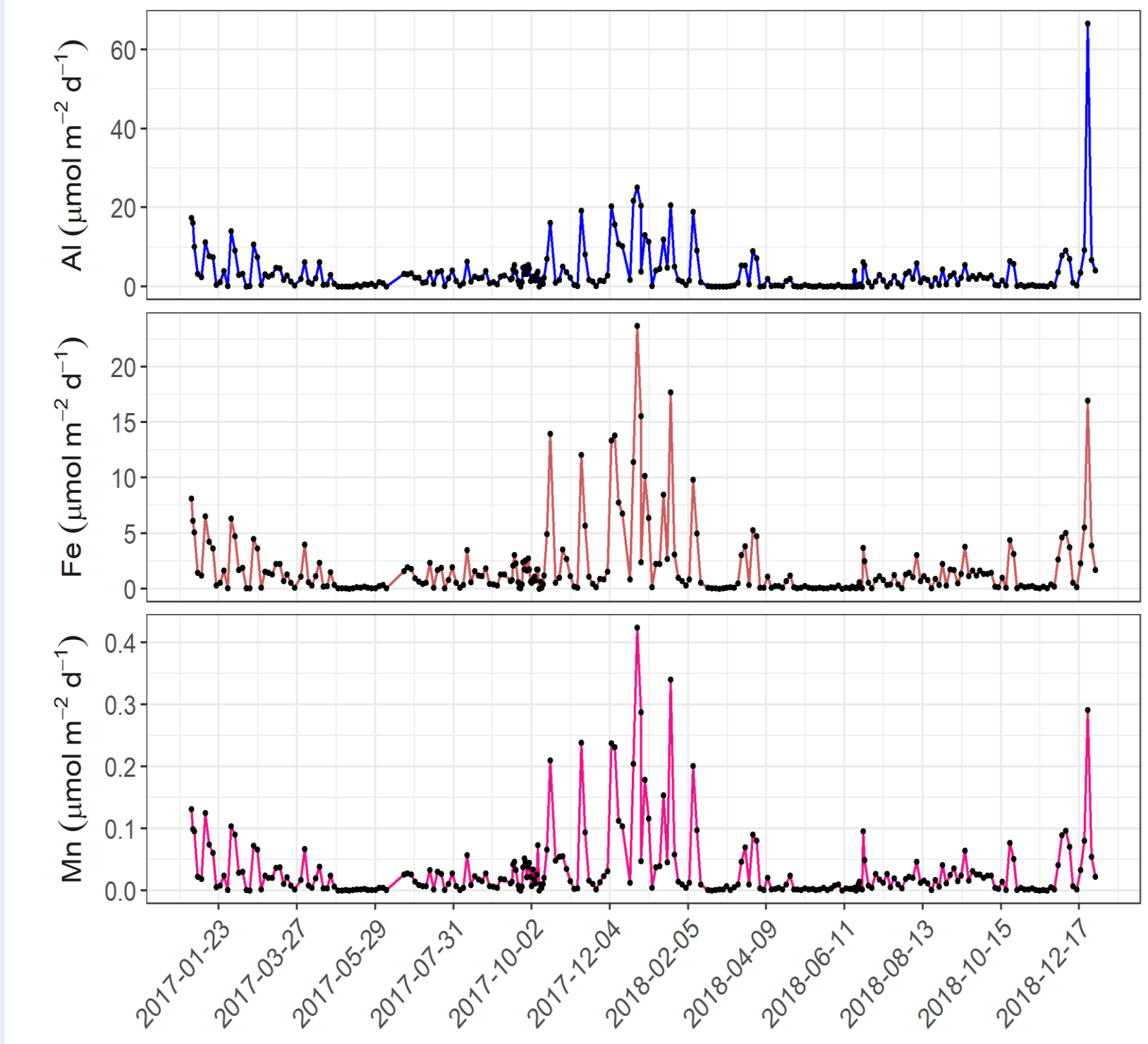


Fig. 3: Inter annual trends of deposition fluxes of Fe, Mn, Al

Seasonal trends of fluxes

Clear seasonal trends, ammonia shows spring and autumn peaks, due to ocean bio productivity. Nitrate no clear trend, while P show winter maximum due to Saharan dust

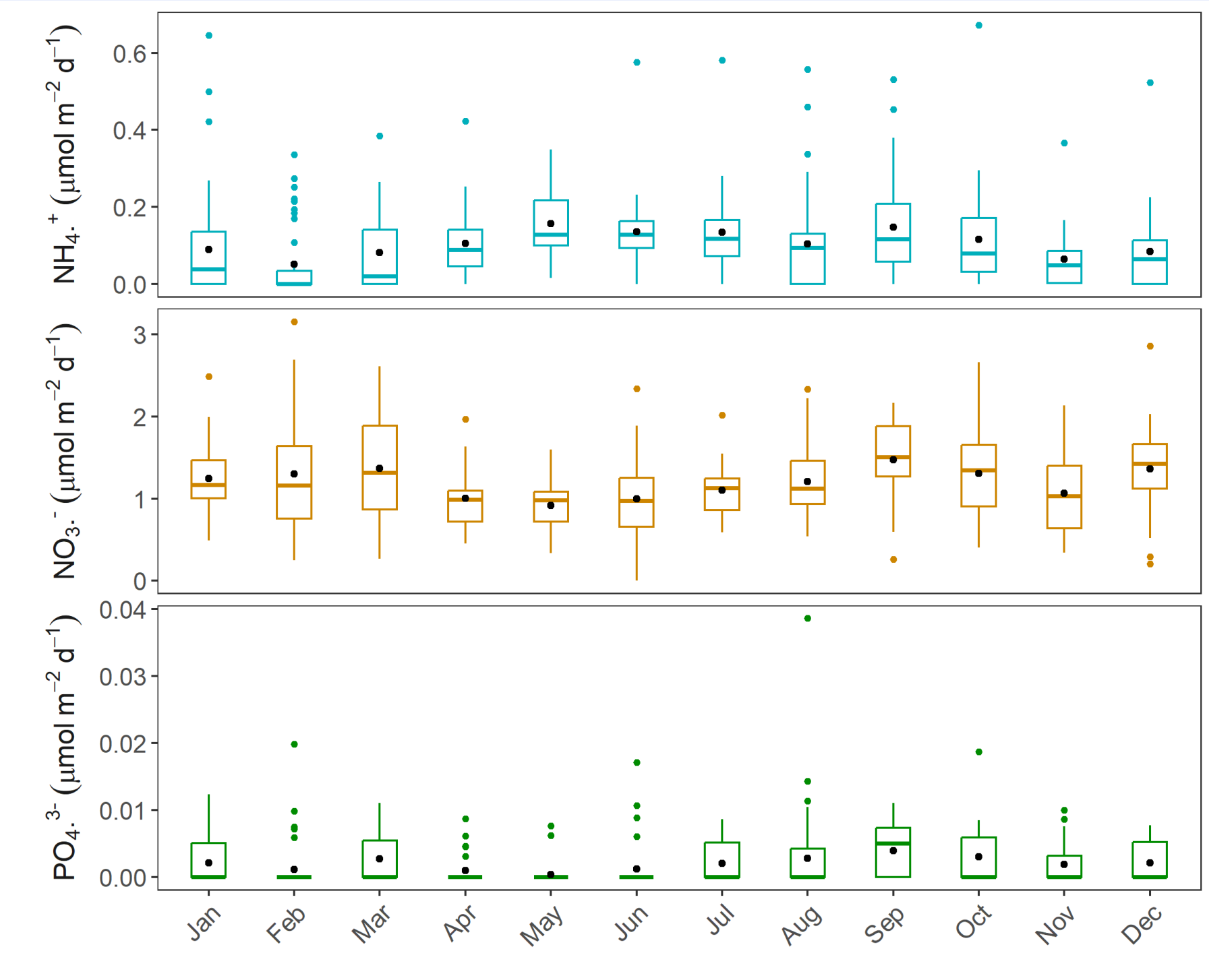


Fig. 4: Monthly and seasonal fluxes of nitrogen species and phosphate

Source regions and signature of nutrients

Air mass trajectory highlights 4 main influences, over ocean, Europe and African Continent contributing to PM composition in this region

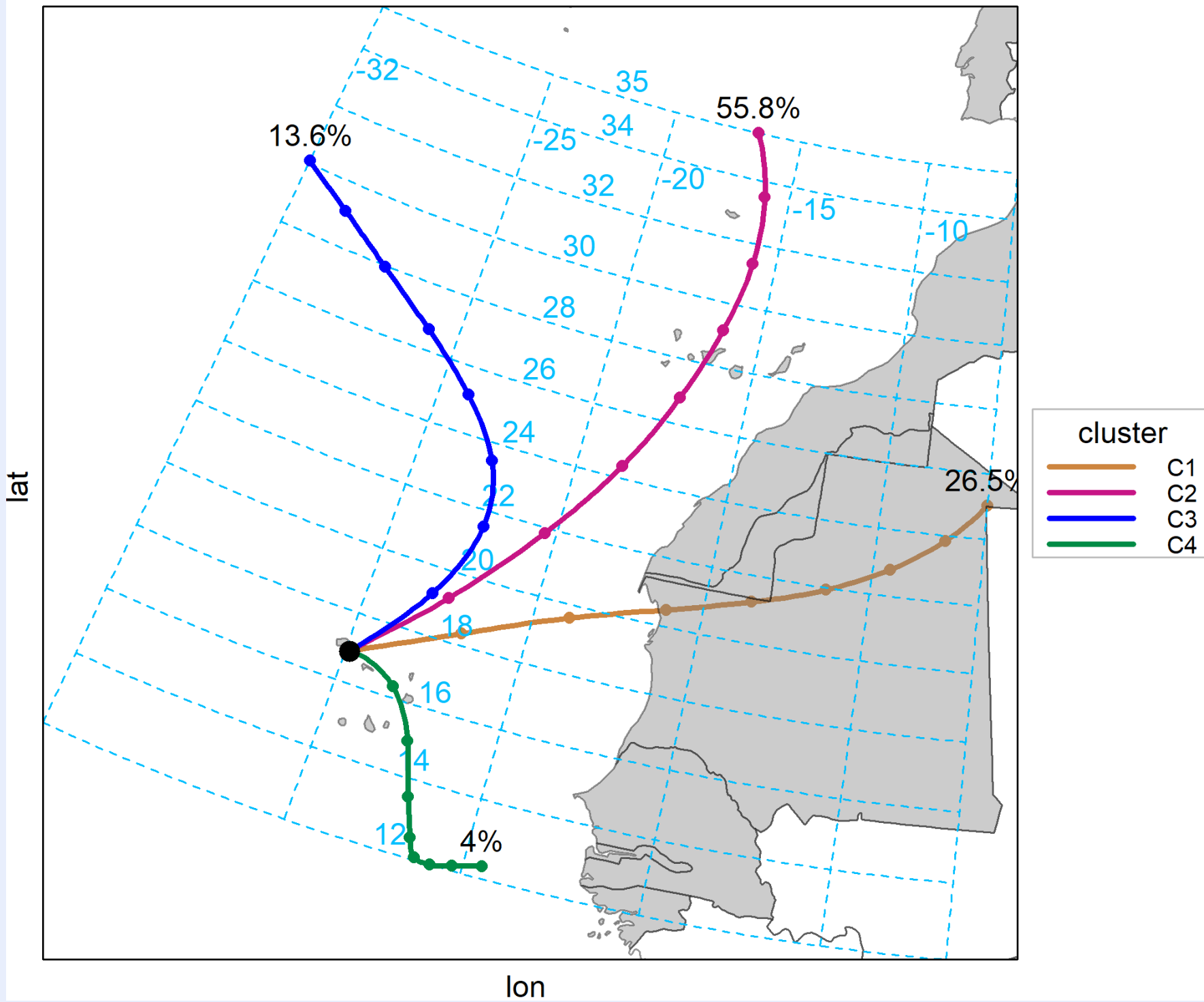


Fig. 5: Four main air mass directions with their frequencies of influence during sampling period

Low inter-annual variation in nitrate and phosphate fluxes indicating a relative uniform influence of atmospheric deposition over the years

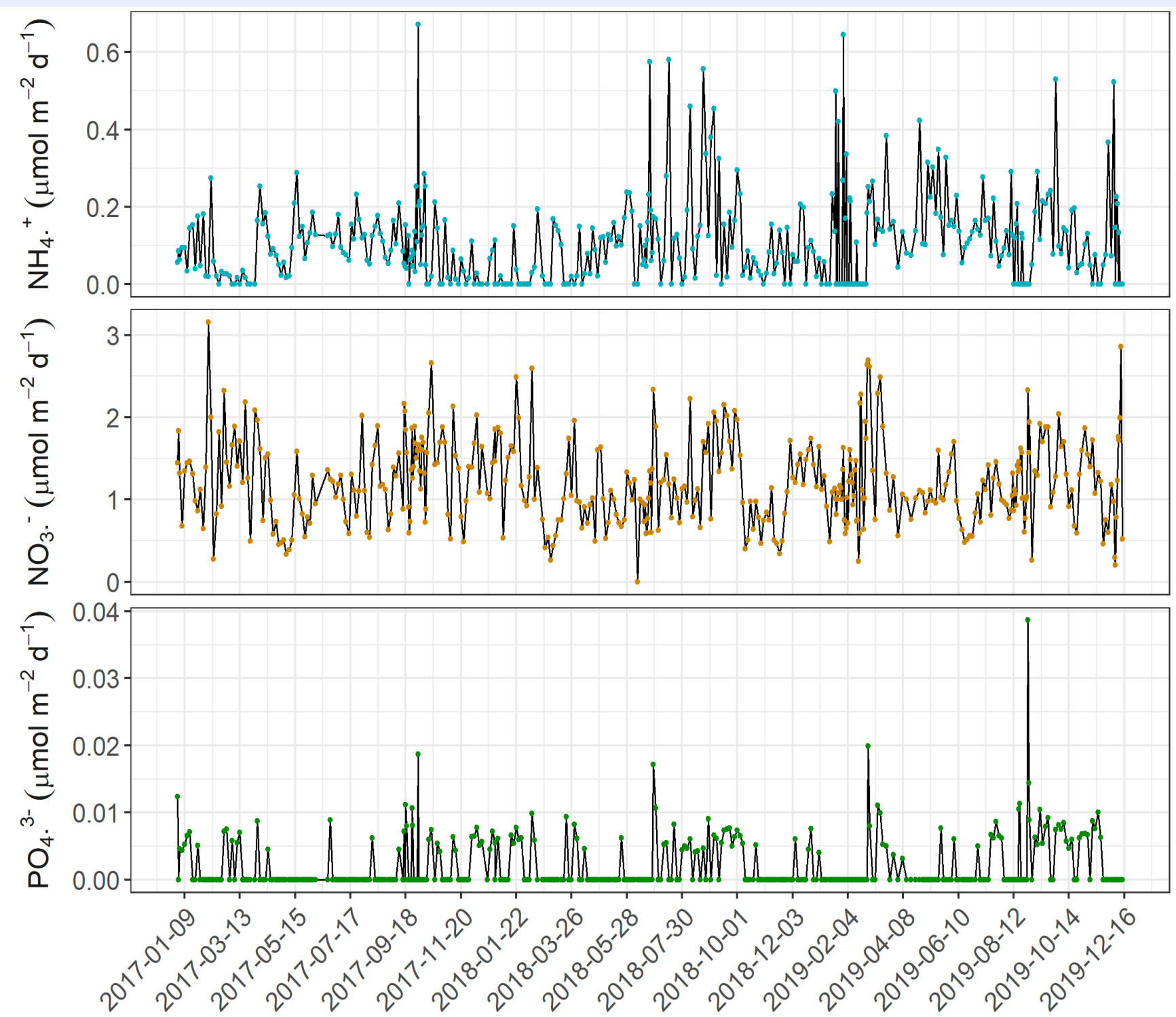


Fig. 6: Major nutrient deposition fluxes of phosphate and nitrogen species

Enhanced nss-K in winter indicates biomass burning contribution to nutrient bioavailability in addition to Saharan dust.

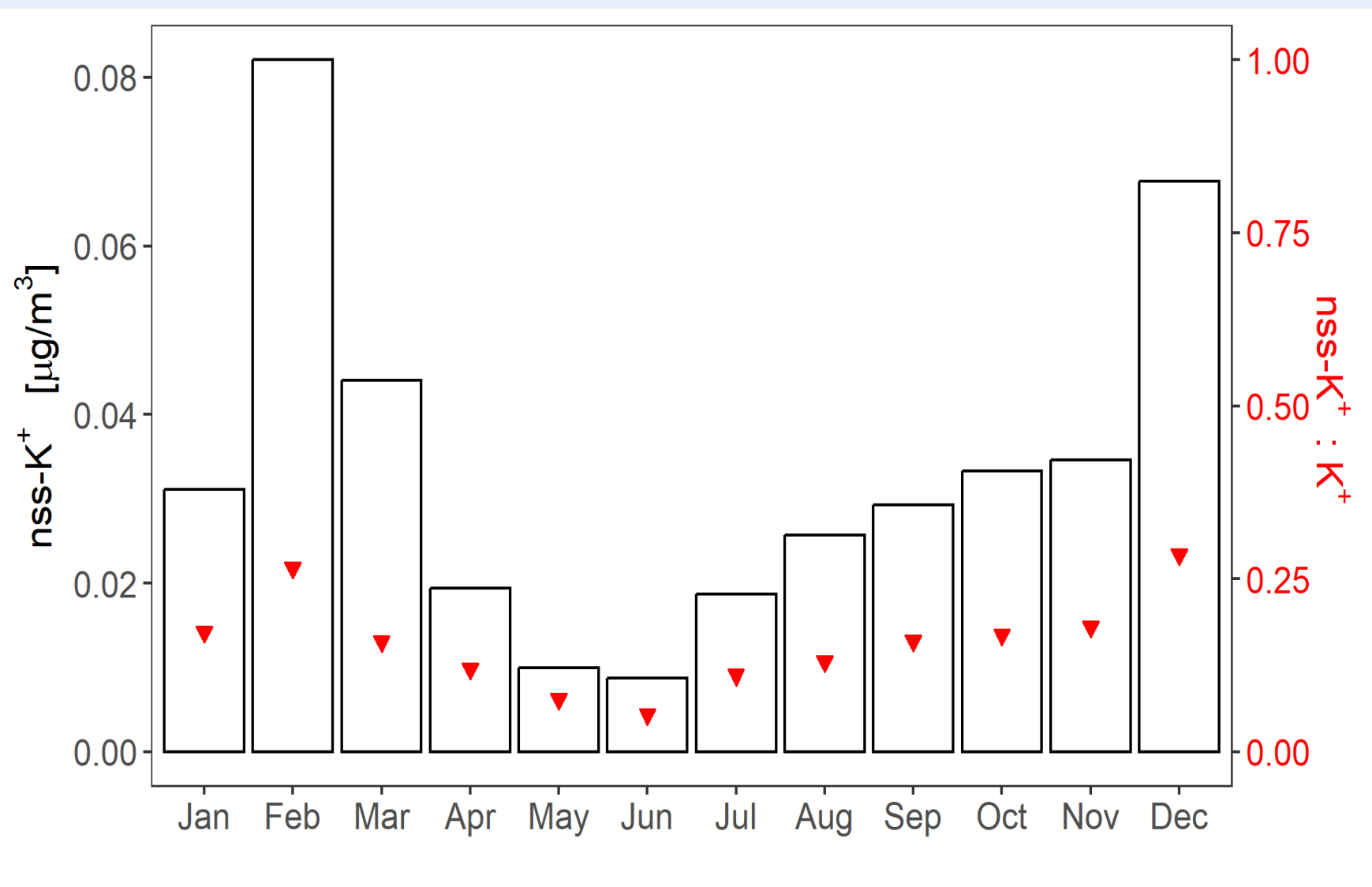


Fig. 7: Seasonal variation of non-sea salt potassium during the sampling period

Saharan dust contribute to 60% Fe, Mn and only 35% of phosphate and nitrates. Europe and Sahel regions are more important during non-dust period

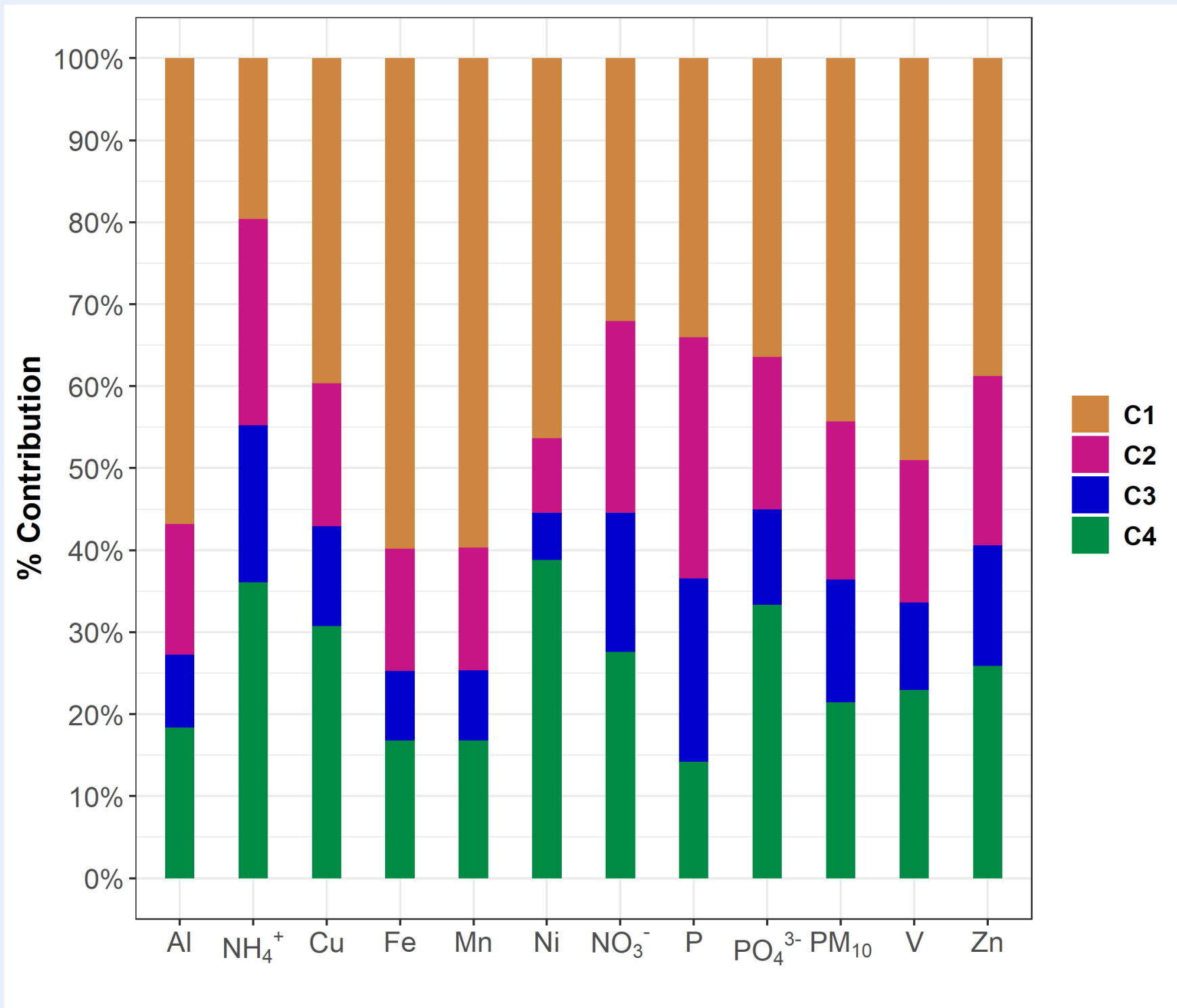


Fig. 8: Influence of air masses on major and minor atmospheric derived nutrients

Acknowledgement

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Conclusions

Despite being a source of pollution in cities, anthropogenic emissions may also contribute to ocean fertilization with associated consequences on the climate.

References

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