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Sahara dust, ocean spray, volcanoes, biomass burning: pathways of nutrients into Andean rainforests

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Abstract. Regular rain and fogwater sampling in the Podocarpus National Park, on the humid eastern slopes of the Ecuadorian Andes, along an altitude profile between 1960 and 3180 m, has been carried out since 2002. The samples, accumulated over about 1-week intervals, were analysed for pH, conductivity and major ions (K^+, Na^+, NH_4^+, Ca^{2+}, Mg^{2+}, Cl^-, SO_4^{2-}, NO_3^-, PO_4^{3-}).

About 35% of the weekly samples had very low ion contents, with pH mostly above 5 and conductivity below 10 µS/cm. 10-days back trajectories (FLEXTRA) showed that respective air masses originated in pristine continental areas, with little or no obvious pollution sources.

About 65%, however, were significantly loaded with cations and anions, with pH as low as 3.5 to 4.0 and conductivity up to 50 µS/cm. The corresponding back trajectories clearly showed that air masses had passed over areas of intense biomass burning, active volcanoes, and the ocean, with episodic Sahara and/or Namib desert dust interference.

Enhanced SO_4^{2-} and NO_3^+ were identified, by combining satellite-based fire pixel observations with back trajectories, as predominantly resulting from biomass burning. Analyses of oxygen isotopes ^{16}O, ^{17}O, and ^{18}O in nitrate show that nitrate in the samples is indeed a product of atmospheric conversion of precursors. Some SO_4^{2-}, about 10% of the total input, could be identified to originate from active volcanoes, whose plumes were encountered by about 10% of all trajectories.

Enhanced Na^+, K^+, and Cl^- were found to originate from ocean spray sources. They were associated with winds providing Atlantic air masses to the receptor site within less than 5 days. Episodes of enhanced Ca^{2+} and Mg^{2+} were found to be associated with air masses from African deserts. Satellite aerosol data confirm desert sources both on the Northern (Sahara) as on the Southern Hemisphere (Namib), depending on the season. A few significant PO_4^{3-} peaks are related with air masses originating from North African phosphate mining fields.

Full Article in PDF (PDF, 1985 KB)

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