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Biomass Burning:Significant Source of Nitrate and Sulfate for the Andean Rain Forest in Ecuador

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Forest fires are significant sources of carbon, sulfur and nitrogen compounds which, along with their photochemically generated reaction products, can be transported over very long distances, even traversing oceans.

Chemical analyses of rain and fogwater samples collected on the wet eastern slopes of the Ecuadorian Andes show frequent episodes of high sulfate and nitrate concentration, from which annual deposition rates of about14 kg/ha and 7 kg/ha ,respectively, are derived. These are comparable to those observed in polluted central Europe.

Regular rain and fogwater sampling along an altitude profile between 1800 and 3185 m, has been carried out since 2002.The research area located at 3^0 58'S ,79^0 5' W is dominated by trade winds from easterly directions. The samples, generally accumulated over 1-week intervals, were analysed for pH, conductivity and major ions(K^+,Na^+,NH_4^+,Ca^{2+},Mg^{2+},SO_4^{2-},NO_3^-,PO_4^{3-}).For all components a strong seasonal variation is observed, while the altitudinal gradient is less pronounced.

About 65 % of the weekly samples were significantly loaded with cations and anions, with pH often as low 3.5 to 4.0 and conductivity up to 50 uS/cm. Back trajectories (FLEXTRA) showed that respective air masses had passed over areas of intense biomass burning, sometimes influenced by volcanoes, ocean spray, or even episodic Sahara and/or Namib desert dust interference not discussed here.

Enhanced SO_4^{2-} and NO_3^- were identified, by combining satellite-based fire pixels with back trajectories, as predominantly resulting from biomass burning. For most cases, by using emission inventories, anthropogenic precursor sources other than forest fires play a minor role, thus leaving biomass burning as the main source of nitrate and sulphate in rain and fogwater.

Some SO_4^{2-} , about 10 % of the total input, could be identified to originate from active volcanoes, whose plumes were sometimes encountered by the respective back trajectories.

While volcanic, oceanic and desert sources are natural, large scale biomass burning is an anthropogenic source which adds about 7 kg/ha of $NO3^-$ and 14 kg/ha of $SO4^{2-}$ per year to the forest which has developed on poor acidic soil conditions. Controlled fertilizing experiments within an interdisciplinary research consortium are presently carried out to investigate the impact of this disturbance on the forest ecosystem and its biodiversity.