From passive samplers to estimates of nitrogen deposition in arid and semi-arid areas of the western United States

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Passive samplers have been used for determinations of concentrations of nitrogenous (N) air pollutants such as nitrogen oxides (NO_x), nitrogen dioxide (NO_2), ammonia (NH_3), and nitric acid vapor (HNO_3). Their use has allowed for an improved understanding of the distribution of concentrations of these pollutants in topographically complex landscapes, such as in mountainous areas. A USDA Forest Service team in collaboration with various partners conducted numerous monitoring campaigns to determine concentrations of NH_3, NO, NO_2 and HNO_3 in remote areas of the western United States and Canada. These results aided by geostatistical methodologies (ArcGIS Geostatistical Analyst, ESRI, USA) allowed us to generate pollution distribution maps in the Sierra Nevada Mountains (including Sequoia & Kings Canyon National Parks and the Lake Tahoe Basin), the White Mountains, the San Bernardino Mountains, Joshua Tree National Park, wildland-urban areas of southern California and the Athabasca Oil Sands Region in northern Alberta, Canada. Examples of such maps and information on spatial and temporal changes of reduced vs. oxidized forms on N pollutants as well as total inorganic gaseous reactive nitrogen (Nr) species will be presented and will focus on southern California and the Sierra Nevada Mountains. We will also provide an outline of a GIS-based inferential method for estimation of N deposition especially designed for arid and semi-arid areas. This methodology is based on measurements of gaseous concentrations of N air pollutants obtained with passive samplers, empirical values of surface deposition velocity for NH_3 and HNO_3; empirically and literature-based values of stomatal conductance for NH_3, NO_2 and HNO_3; satellite information on leaf area index (LAI); and detailed information on landscape cover. Results obtained with this methodology will be illustrated for the San Bernardino Mountains of southern California for 2002-2006. Information on N deposition distribution helps to estimate exceedances of N deposition critical loads for better understanding of potential threats of N air pollution to ecosystem health and services.

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