Characterization of Air Quality by Statistical Analysis of Chemical Facies of Rainwater

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Atmospheric aerosol particles play a major role in the chemistry of the rainwater. Rain water samples were collected during the cloud seeding operations carried out in Andhra Pradesh from 2005-2007. These samples were analyzed for the various chemical components. The present paper involves the use of multivariate statistical analysis in the interpretation of the ionic components of rainwater in the Kurnool, Anantapur, Chittoor, and Nellore districts of Rayalaseema region in Andhra Pradesh. Statistical and mathematical methods for treating and interpreting rainwater chemical compositions have been applied to understand the ionic compositions of precipitation. Attempts have been made to correlate the seeding material used in the operations to the chemical constituents found in the collected rainwater samples. Principal component analysis and factor analysis were applied to certain chemical components to identify the similarities. The statistical tests were carried out using SYSTAT 7.0 Software. These statistical tests have indicated the presence of certain chemicals used in the operations in rain water samples. However all these chemicals were found to be within the Indian Standards (IS) prescribed limits for irrigation and drinking water purposes. Procedures followed for analysis have been in accordance with the "Standard methods for examination of water and wastewater of the American Public Health Association (APHA, 1998 The acidity of rainwater depends on the concentration of anionic as well as cationic species. Acidic pH indicates the presence of strong acids while neutral pH indicates neutralization by calcium or other alkaline ions. The basic statistical median value of pH has been observed to be 7.08, values of pH in all samples being higher than 5.0, which is the pH of rainwater at equilibrium with atmospheric CO_2 . The data shows that the standard deviation values of the elements very widely, the different ions which are indicate of the influence of anthropogenic factors. Skewness indicates whether a distribution is symmetrical about the mean. When it is positive, the distribution is positively skewed or skewed to the right, i.e., the mean is larger than the median. When it is negative, the distribution is negatively skewed or skewed to the left. When the skewness is zero, the distribution is perfectly symmetrical about the mean. The data was found to be positively skewed due to the calcium ions which were induced into the rain bearing clouds during the seeding activity. Plot obtained between the sum of cations and anions showed a regression coefficient of 0.73. Neutralization factor was calculated, $Ca > Mg > Na \sim K$ and its order shows which clearly indicates that calcium is a major ion participating in the neutralization process. Factor 1 and 2 in factor analysis also shows that the calcium, magnesium, sodium and chloride ions are the primary contributing factors.