



# Wet Deposition of Nitrogen at different locations in India

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**Background:** Depositions of air pollutants especially S and N affect the various ecosystems like forest, soil, and lakes. The studies related to them are very much essential to understand the acid rain phenomenon, air quality, removal processes and major Bio-Geo Chemical cycles.

**Sampling and Analysis:** Wet deposition samples are being collected at Pune and at other locations (for limited period) representing different environments (i.e., Urban, rural, Industrial, high altitude, marine, traffic etc.) in India by using rain collection gadgets. All the rain water samples were analyzed for pH, conductivity, anions (Cl, SO<sub>4</sub> and NO<sub>3</sub>) and cations (NH<sub>4</sub>, Na, K, Ca and Mg). The wet deposition data for the period 2000-2007 and for the other locations for the different time periods during 2001- 2007 were considered in this study. Also, the wet deposition data for the 10 GAW (Global Atmospheric Watch) locations in India for a period of 8 years during 2000 – 2007 were studied. The wet deposition fluxes of Nitrogen along with the other major ionic components were estimated.

## Rain Water Collectors



Wet-Only Collector



Bulk Collector

## Analytical Instruments for Chemical Analyses



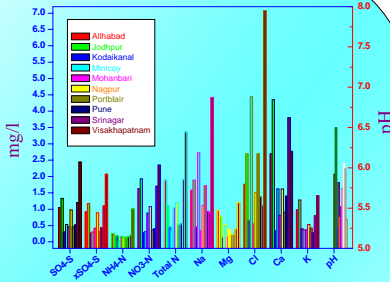
Ion Chromatograph



Atomic Absorption Spectrophotometer

## GAW Sampling locations in India

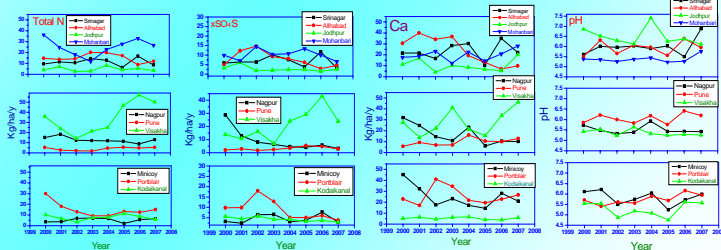
GAW Stations	Altitude (meters)	Type of Environment
Srinagar	1587	High Altitude
Allahabad	98	Continental
Jodhpur	217	Continental
Mohanbari	111	Continental
Nagpur	310	Continental
Pune	559	Continental
Visakhapatnam	60	Coastal
Minicoy	2	Island
Portblair	79	Island
Kodaikanal	2343	High Altitude



Average chemical composition of rain water at different locations in India



## Spatial variation in Wet Deposition of Total N, NH<sub>4</sub>-N, NO<sub>3</sub>-N, xSO<sub>4</sub>-S, Ca and pH of rain water at 10 Locations in India



Temporal Variation in Wet Deposition of Total N, xSO<sub>4</sub>-S, Ca and pH of rain water at 10 Locations in India



Spatial variation in Wet Deposition of NH<sub>4</sub>-N, NO<sub>3</sub>-N, Ca and pH of rain water at four locations representing different environments in Pune region (2006-07)

Average pH and concentration of major ionic components (mg/l) in rain water over Arabian Sea (2002-03) during ARMEX (Arabian Monsoon Experiment)

Collector	Cl	xSO <sub>4</sub>	xSO <sub>4</sub> -S	NO <sub>3</sub> -N	NH <sub>4</sub> -N	Na	K	Ca	Mg	pH
Wet-Only (SM)	11.9	0.66	0.22	0.02	0.008	6.67	0.26	1.42	0.54	6.43
Bulk (SM)	16.3	1.45	0.48	0.03	0.008	9.15	0.39	2.16	0.81	6.48
Bulk (WM)	3.34	1.16	0.39	0.25	0.055	1.62	0.11	0.98	0.21	5.36

(SM) Summer Monsoon : 21<sup>st</sup> June to 16<sup>th</sup> August 2002  
(WS) Winter Monsoon: 14<sup>th</sup> March to 9<sup>th</sup> April 2003

## Summary of Results:

- In general, rain water in India is alkaline. Out of 10 GAW locations, the 8 years' average pH was slightly acidic (pH 5.15 – 5.48) at only four locations. At the remaining 6 locations the pH was alkaline (pH > 5.6). This alkaline nature of rain water is due to high atmospheric dust levels.
- Neutralization factors indicate that Ca is the major neutralizing cation in wet deposition.
- The Ca concentrations were higher in N and NW regions and lower in the southern and NE regions.
- The eight years' average annual wet deposition fluxes of total Nitrogen for 10 GAW locations in India varied between 4.7 and 34.3 Kg/ha/y and yearly depositions varied between 1.8 and 57 Kg/ha/y.
- At all the locations, the NO<sub>3</sub>-N depositions were higher compared to NH<sub>4</sub>-N.
- The total Nitrogen deposition at four different locations in Pune region varied from 10.4 to 13.2 Kg/ha/y.
- In regional perspective, the excess SO<sub>4</sub>-S deposition was higher at an industrial location and the Nitrogen deposition was higher at a traffic junction in Pune region.
- At a high altitude rural location (Sinhagad) near Pune, the concentrations of excess SO<sub>4</sub>, NO<sub>3</sub>, NH<sub>4</sub> and Ca were lower but their depositions were higher due to high rainfall amounts. The similar feature has been observed at some of the GAW locations.
- Air mass back trajectory analyses indicated the long range transport of Ca and SO<sub>4</sub> over the Arabian Sea from north African and Gulf countries during summer monsoon.

## Acknowledgement

Authors are grateful to Director, IITM and Head, PM&A Division, IITM, Pune for their encouragement. Also, authors are thankful to ADGM (R), India Meteorological Department, for providing the GAW data and MISU, Stockholm University for providing rain collection gadgets for Sinhagad site.