Metadata

Dataset Title:

Cary_Precip_Chemistry_Data.csv

Cary Environmental Monitoring Program Precipitation Chemistry Data: 1984-2018

Abstract

The Cary Institute of Ecosystem Studies Environmental Monitoring Program is a long-term data collection program designed to understand how the environment changes over time. The program includes monitoring of climate including temperature and precipitation, as well as variables related to air pollution, such as acid deposition and ozone, water pollution and streamwater hydrology. The Cary Institute of Ecosystem Studies, Environmental Monitoring Program furnishes data under the following conditions: The data have received quality assurance scrutiny by our program, and, although we are confident of the accuracy of these data, the Cary Institute will not be held liable for errors in these data. Data are subject to change resulting from updates in data screening or models used. Data citation: The following is a standard citation for referencing data from the Cary Institute of Ecosystem Studies, Environmental Monitoring Program:

Cary Institute of Ecosystem Studies, Environmental Monitoring Program. 2019 (or current year). Cary Institute of Ecosystem Studies, Box AB, Millbrook, NY 12545, www.caryinstitute.org.

Those wishing to publish data from the Cary Institute of Ecosystem Studies, Environmental Monitoring Program are encouraged to contact Data Manager Vicky Kelly, kellyv@caryinstitute.org.

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Keywords

Cary Institute, Cary Institute of Ecosystem Studies, data, climate, precipitation, chemistry, wet deposition conductivity, conductance, pH, calcium, magnesium, potassium, sodium, chloride, sulfate, nitrate, ammonium, phosphate

Timeframe

The data in this file start January 1984 and end December 2018. Data collection is ongoing.

Geographic location

The precipitation collector is located in a flat, open field at an elevation of 128 m. GPS coordinates for the site are: N41.785823 W073.741447.

Methods

Precipitation samples are collected using the wet side of an automatic wet-dry collector. The collector uses a moisture sensor that causes a motor to remove a cover from a clean bucket when it senses precipitated moisture. Samples are collected on an event basis; an event is defined as continuous precipitation that has not been interrupted by more than 6-hours. At the end of an event, the sample is collected, weighed, and transferred to a labeled sample bottle. If the sample is frozen, it is allowed to sit at room temperature until

the entire sample is melted. After the sample is bottled, it is analyzed at the Cary Institute analytical laboratory for pH, sulfate, nitrate, ammonium, phosphate, chloride, sodium, calcium, magnesium and potassium ions. See Table 1 for analytical methods. If the quantity of sample is insufficient for all of these analyses, as many of the analyses as possible are completed with preference given to pH, sulfate, nitrate and ammonium in that order.

In 1999, we changed the sample-handling protocol as follows. A 60-ml aliquot of sample is preserved with 2 drops of chloroform and refrigerated. This aliquot is analyzed for phosphate, ammonium, and nitrate. Comparisons of phosphate, ammonium and nitrate were made for one year between samples treated with chloroform and samples left untreated. There was no significant difference between treated and untreated samples for ammonium and nitrate, but phosphate was higher in samples treated with chloroform. We made no adjustments to data collected prior to 1999. For estimation of monthly volume-weighted mean concentrations and total deposition, values that are below detection limits are replaced with one half of the detection limit. Datasets include monthly volume-weighted means and monthly total deposition.

PRECIPITATION CHEMISTRY INSTRUMENT MAKE, MODEL, DATES USED, SENSITIVITY, RECOMMENDED SIGNIFICANT FIGURES

Precipitation sample collection 1983-2008 Aerochem Metrics, Model 301, Automatic Sensing Wet/Dry Precipitation Collector, 2009-present Yankee Environmental model TPC-3000 Total Precipitation Collector Precipitation volume 1983-June 2007 Belfort Instrument Co. Universal Recording Rain Gauge, Series 5-780, sensitivity +0.05 inch (1.3 mm), recommended significant figs. 2. Gauge was encircled by wind alter-shields. The tops of the alter-shields were level with the opening of the rain gauge. Precipitation amount from each event was checked using a standard plastic rain gauge and/or a snow depth / rain gauge. July 2007-present, Geonor Precipitation Gauge Model T-200B from co-located USCRN station.

PRECIPITATION CHEMISTRY DATA QUALITY ASSURANCE & QUALITY CONTROL PARAMETERS & METHODS

Each sample is weighed to check that the volume of sample collected is within a reasonable range of the volume of precipitation that is recorded by the precipitation gauges. Sample buckets are discarded every 3-12 months and replaced with new, clean buckets. To clean new buckets, they are rinsed 10 times with deionized water, 10 times with double deionized water, filled with double deionized water and allowed to stand overnight, rinsed again 10 times with double deionized water and filled again with double deionized water. The conductivity of the double deionized water in the bucket is checked. If it is more than the conductivity of double deionized water in a clean beaker (less than 1 umho), the process is repeated. Sample bottles are cleaned by rinsing with deionized water 7 times, filling with deionized water, allowed to stand overnight and rinsed again 4 times. A small amount of the precipitation sample is used to rinse the bottle before it is filled with the sample. Once each year a bucket is placed in the collector and retrieved before a precipitation event occurs. This bucket is returned to the lab where it is filled with double deionized water, which is bottled, preserved and analyzed as a regular sample. This is to ensure that sample-handling techniques introduce no contamination.

When analytical results are received from the Cary Institute analytical lab, data are examined and checked using two methods. First, ion balances and ionic strength are calculated using the following equations:

Ion Balance = ((ANIONS - CATIONS)/((CATIONS+ANIONS)/2))*100;
Ionic Strength = ANIONS + CATIONS;
Where:
CATIONS = caueq + mgueq + naueq + kueq + nh4ueq + hueq;
ANIONS = no3ueq + so4ueq + clueq + po4ueq;
And:
caueq=((conc_Ca/(40.08/2)))*1000;

mgueq=((conc_Mg/(24.305/2)))*1000;
naueq=(conc_Na/22.98977)*1000;
kueq=(conc_K/39.098)*1000;
nh4ueq=(conc_NH4/18.0383)*1000;
hueq=(conc_H/1.0079)*1000;
no3ueq=(conc_NO3/62.0049)*1000;
so4ueq=((conc_SO4/(96.0576/2)))*1000;
clueq=(conc_Cl/35.453)*1000;
po4ueq=((conc_PO4/(94.97136/3)))*1000;

concentrations are in mg/L and conc_H=1000*EXP(-2.3026*PH)

Ion balances and ionic strength are examined and samples are considered for reanalysis if the following criteria are met:

Ionic Strength (ueq) and Ion Balance (%)
Less than 50greater than 40
Between 50 and 100greater than 20
Greater than 100greater than 10

The quality of data is also checked by examining time series graphs of sample concentrations for each analyte. If any samples are obvious outliers, they are considered for reanalysis.

Analytical methods and Instrument notes including calibration schedule, malfunctions and repairs, new instrumentation, anecdotal information etc. are available on request.

Data Table

Column name	Description	Unit or code explanation or date format	Empty value code
START_DATE	Date precipitation event started in MM/DD/YYYY format where MM is month number, DD is date number and YYYY is year		empty cell
START_TIME	Time precipitation event started in hhmm format. Note that data are from the preceding hour. For example, data for hour 0100 are from midnight to 1:00 a.m EST.	Eastern Standard Time	empty cell
END_DATE	Date precipitation event ended in MM/DD/YYYY format where MM is month number, DD is date number and YYYY is year		empty cell
END_TIME	Time precipitation event ended in hhmm format. Note that data are from the preceding hour. For example, data for hour 0100 are from midnight to 1:00 a.m EST.	Eastern Standard Time	empty cell
VOL_CM	Total volume of precipitation during that month (cm)	Cm	empty cell
CA_DEP	Calcium ion deposition (g/ha)	g/ha	empty cell

CL_DEP	Chloride ion deposition (g/ha)	g/ha	empty cell
K_DEP	Potassium ion deposition (g/ha)	g/ha	empty cell
MG_DEP	Magnesium ion deposition (g/ha)	g/ha	empty cell
NA_DEP	Ammonium_N deposition (g/ha)	g/ha	empty cell
NH4_N_DEP	Ammonium_N deposition (g/ha)	g/ha	empty cell
NO3_N_DEP	Nitrate_N ion deposition (g/ha)	g/ha	empty cell
PO4_DEP	Phosphate ion deposition (g/ha)	g/ha	empty cell
SO4_DEP	Hydrogen ion deposition (g/ha)	g/ha	empty cell
H_DEP	Hydrogen ion deposition (g/ha)	g/ha	empty cell
CA_VWM	Calcium ion volume-weighted mean (mg/L) (DL 0.01 mg/L)	mg/L	empty cell
CL_VWM	Chloride ion volume-weighted mean (mg/L) (DL 0.02 mg/L)	mg/L	empty cell
K_VWM	Potassium ion volume-weighted mean (mg/L) (DL 0.01 mg/L)	mg/L	empty cell
MG_VWM	Magnesium ion volume-weighted mean (mg/L) (DL 0.01 mg/L)	mg/L	empty cell
NA_VWM	Sodium ion volume-weighted mean (mg/L) (DL 0.01 mg/L)	mg/L	empty cell
NH4_VWM	Ammonium ion volume-weighted mean (mg/L) (DL 0.02 mg/L)	mg/L	empty cell
NH4_N_VWM	Ammonium_N volume-weighted mean (mg/L) (DL 0.02 mg/L)	mg/L	empty cell
NO3_VWM	Nitrate ion volume-weighted mean (mg/L) (DL 0.02 mg/L)	mg/L	empty cell
NO3_N_VWM	Nitrate_N volume-weighted mean (mg/L) (DL 0.02 mg/L)	mg/L	empty cell
PO4_VWM	Sulfate ion volume-weighted mean (mg/L) (DL 0.02 mg/L)	mg/L	empty cell
PO4_P_VWM	Phosphate ion volume-weighted mean (mg/L) (DL 0.002 mg/L)	mg/L	empty cell
SO4_VWM	Sulfate ion volume-weighted mean (mg/L) (DL 0.02 mg/L)	mg/L	empty cell
H_VWM	Hydrogen ion volume-weighted mean (mg/L)	mg/L	empty cell

Intellectual Rights

Methods of Analysis
Cary Institute of Ecosystem Studies Analytical Laboratory

ION	INSTRUMENT	TECHNIQUE
$NH4^+$	Lachat QuikChem 8000	Phenate method[1] #10-107-06-1-J
$SO_4^=$, NO_3^- (PPT, AQ), Cl^-	Dionex ICS2000 Ion Chromatograph	Ion exchange chromatography, AS18 and AG18 columns, SRS (self-regenerating) suppressor[2] with CRD 200 (carbonate removal device)
K^+, Na^+	Perkin Elmer Aanalyst 300 Atomic Absorption Spectrometer	Flame atomization, direct air[3]
Ca^{++}, Mg^{++}	Leeman Labs Inductively Coupled Plasma/Profile	Emission spectroscopy
NO_3^- (WC)	Lachat QuikChem 8000	Cadmium diazotization[1] Method #10-107-04-1-C
PO_4	Lachat QuikChem 8000	Phosphomolybdate[1] Method #_10-115-01-1-M
pH	Fisher-Accumet AR20 pH meter with Fisher glass electrode, Fisher calomel reference probe	Standardization with Fisher 7.00 and 3.00 buffer solutions; samples and buffers at room temperature
Specific Conductance	Fisher-Accumet AR20 pH/conductivity meter	Conductivity probe w/ 1.0 cm^{-1} cell constant
DOC (Dissolved Organic Carbon)	Shimadzu TOC 5050	High temperature combustion of sample; platinum catalyst C to CO2, NDIR detect.

[1] Standard Lachat methods, 2000, Lachat Instruments, Milwaukee, WI

[2] Small, H., Stevens, T.S., and Bauman, W.C. *Anal. Chem.* 1975, 47:1801-1809

[3] Slavin, W. *Atomic absorption spectroscopy.* Wiley-Interscience, New York. 1968. PPT=precipitation samples, AQ=air samples, WC=Wappinger Creek samples

Updated 01/27/2006