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NOAA Technical Memorandum ERL ARL-60



THE WMO REGIONAL PRECIPITATION CHEMISTRY NETWORK
IN THE UNITED STATES

John M. Miller
Ross Highsmith

Air Resources Laboratories
Silver Spring, Maryland
October 1976

noaa NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION

Environmental Research
Laboratories

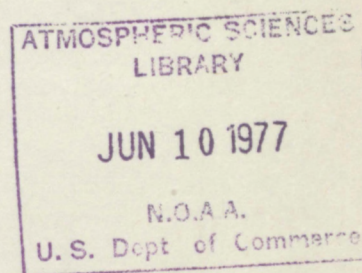
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UNITED STATES
DEPARTMENT OF COMMERCE
Elliot L. Richardson, Secretary

NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION
Robert M. White, Administrator

Environmental Research
Laboratories
Wilmot N. Hess, Director



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THE WMO REGIONAL PRECIPITATION CHEMISTRY NETWORK IN THE UNITED STATES

John M. Miller and Ross Highsmith¹

High-quality precipitation chemistry data are essential for the determination of chemical trends in the atmosphere and for the evaluation of the earth's geological and biological systems. The operation of the U.S. regional network of WMO precipitation sampling stations and suggestions for its improvement are outlined. In addition, a procedures manual detailing sampling rules and equipment and sample handling is given in the Appendix.

1. INTRODUCTION

The analysis of precipitation for its chemical constituents has been a part of scientific investigation for over two hundred years. Atmospheric chemistry, meteorology, geochemistry, limnology, agriculture, and ecology are among the disciplines that have recognized the importance of understanding the chemistry of precipitation. Scientists in these fields have conducted a multitude of precipitation chemistry studies, and their work forms a solid basis of reference for global and regional monitoring. However, to obtain valid quantitative data, it is important to sharply define the purpose and methods of precipitation chemistry.

Precipitation chemistry data can be used to obtain information about (1) chemical trends in the atmosphere and (2) changes in the Earth's geological and biological systems. The primary purpose of the U.S. regional network that was established under the auspices of the World Meteorological Organization (WMO) precipitation chemistry program is to monitor long-term changes in background composition with particular emphasis on monitoring regional trends, their interrelationships, and the relationship between the U.S. network and the other WMO networks. This purpose was confirmed at the Expert Meeting on Wet and Dry Deposition (WADEM), Toronto, Canada (see Kronebach, 1976), where it was agreed that the WMO background air pollution monitoring program is concerned with atmospheric composition, not deposition.

¹Environmental Protection Agency

In addition, the following questions must be answered:

- (1) Which properties of the atmosphere and which atmospheric constituents should be monitored in addition to the usual meteorological observations (precipitation, dry fall, or a combination of both)?
- (2) Which technique should be employed to collect samples?
- (3) Which technique should be employed to analyze samples?
- (4) How are data to be assessed and interpreted?

With reference to questions 2 and 3, a multitude of factors (e.g., cost, time, equipment) are involved. Usually, a compromise between the ideal program and the one actually undertaken has to be made.

In establishing precipitation chemistry as a part of the minimal regional site program (the other measurement being atmospheric turbidity (Junge, 1973)), the WMO has made a very important decision to monitor sulfur, nitric oxide, ammonia, and other atmospheric trace materials not solely by their concentrations in air but also by their concentrations in precipitation. The precipitation that is collected represents the complex processes in the atmosphere, which include condensation of water on particles, capture of particles and gases in the cloud, absorption of particles and gases by rain in accordance with the equilibrium constants involved, coagulation of the cloud droplets to form rain, and, finally, scavenging of gases and particles below the cloud. Variations in temperature, atmospheric pressure, and available kinetic energy (such as in convective storms) as well as the physical state of the rain precipitation itself may complicate the problem, since the equilibrium and stability constants for chemical species vary with each. We anticipate that by measuring sulfate, nitrate, and other specified chemical constituents we are measuring the gross integrated index of these different processes. Obviously it is necessary to make long-term and extremely careful measurements if we are to have enough data to determine trends.

A second part of the information that can be gathered from precipitation chemistry is the deposition of materials on the Earth's surface, although, as has been stated previously, it is not a major aim of the program. These data become extremely important for an evaluation of the Earth's geochemical and biological systems. Information acquired by monitoring the chemical cycles at the atmosphere-Earth interface and by analyzing precipitation chemistry data will be helpful in recognizing changes in the biosphere.

A case in point is the postulated increase in acidity of precipitation in Scandinavia ascribed to the increased injection of nitric oxide and sulfur dioxide into the air. Reduced tree growth and decreasing fish population are a direct consequence of this anthropogenic and regional phenomenon (*First International Symposium on Acid Precipitation and the Forest Ecosystem*, 1976). An even more subtle change could be the long-term synergistic effects caused by this modification in precipitation composition. Such trends in precipitation chemistry make it imperative to collect valid quantitative measurements at representative sites such as those established by WMO.

2. THE WMO REGIONAL NETWORK IN THE UNITED STATES

2.1 Establishment of the WMO Regional Network in the United States

As early as the 1870's, precipitation was collected for chemical analysis (Eriksson, 1952). Most of these early samples were obtained by geochemists who wished to see how precipitation contributed to the soil chemistry. Such measurements were made on an irregular basis both in the United States and in other countries until the end of World War II. In the late 1940's, because of the urging of Prof. Carl Gustav Rossby, a number of precipitation collection sites were established in Sweden. From these beginnings, the European network began to take shape, with Great Britain, France, Germany, Norway, and others cooperating with Sweden in widening the network. Independently, the Soviet Union also began an extensive precipitation network. Data from the European and Soviet networks have been widely published and interpreted.

The first program of precipitation chemistry in North America was organized by Junge in the early 1950's (Junge and Werby, 1958). Since that time, attempts have been made by the Public Health Service and the National Center for Atmospheric Research (NCAR) to continue the program with fewer stations (Lodge et al., 1968). The NCAR network was terminated in 1966.

In June 1969, the National Center for Air Pollution Control reactivated a dozen sampling sites for the collection of precipitation. In October 1970, a joint program was begun by NOAA and EPA to establish WMO regional sites in the United States. Without site surveys, ten National Weather Service (NWS) stations were chosen as regional collection points. The criterion for the choice was only that the NWS stations not be in industrialized areas. Table 1 and Figure 1 indicate the sites. Only two stations, Caribou and Huron, had been used in previous networks.

Table 1. WMO Regional Sites in the United States

Site	Coordinates	
Bishop, Calif.	37°22'N	118°22'W
Alamosa, Colo.	37°27'N	105°52'W
Salem, Ill.	38°39'N	88°58'W
Caribou, Maine	46°41'N	68°03'W
Meridian, Miss.	32°20'N	88°45'W
Atlantic City, N.J.	35°52'N	78°47'W
Pendleton, Oreg.	45°41'N	118°51'W
Huron, S. Dak.	44°23'N	105°52'W
Victoria, Tex.	28°51'N	96°55'W
Raleigh, N.C.	35°54'N	78°52'W

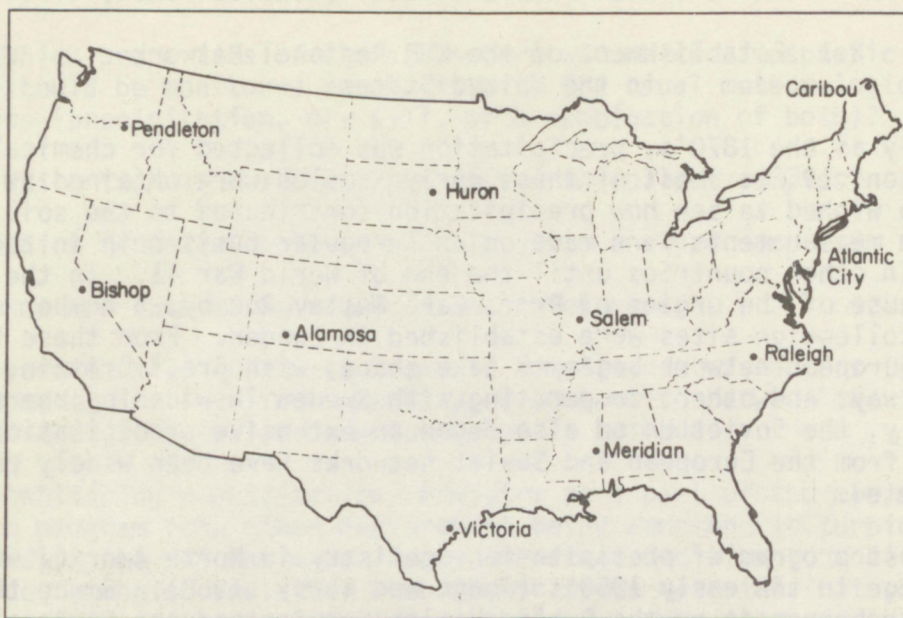


Figure 1. Sites of National Weather Service stations used as regional collection points.

NOAA, through the NWS, provided the initial ten sites where sampling would occur on a monthly basis. EPA analyzed the samples for chemical constituents at the Quality Assurance and Environmental Monitoring Laboratory (now EMSL), and the Air Resources Laboratory, NOAA, assisted in the interpretation of the data. Additional sites have been added since 1970.

In 1974, the EPA laboratory at Research Triangle Park began, by agreement with WMO, to serve as the WMO Precipitation Reference Laboratory.

2.2 Operation of the WMO Regional Network in the United States

2.2.1 Method of Collection

At the ten sites, a Misco open-close collector is used. Its principle of operation is as follows: When precipitation falls on the sensing head, an electronic circuit is closed, and the lid motor is thus activated; the lid swings up and around, allowing precipitation to fall into a 6-inch-diameter polyethylene container. When the precipitation event is over, the heating element in the sensor dries the sensor, the circuit deactivates, and the lid closes. This method prevents the collection of dry materials when precipitation is not occurring. Figure 2 is a picture of the collector at the Salem, Illinois, site.

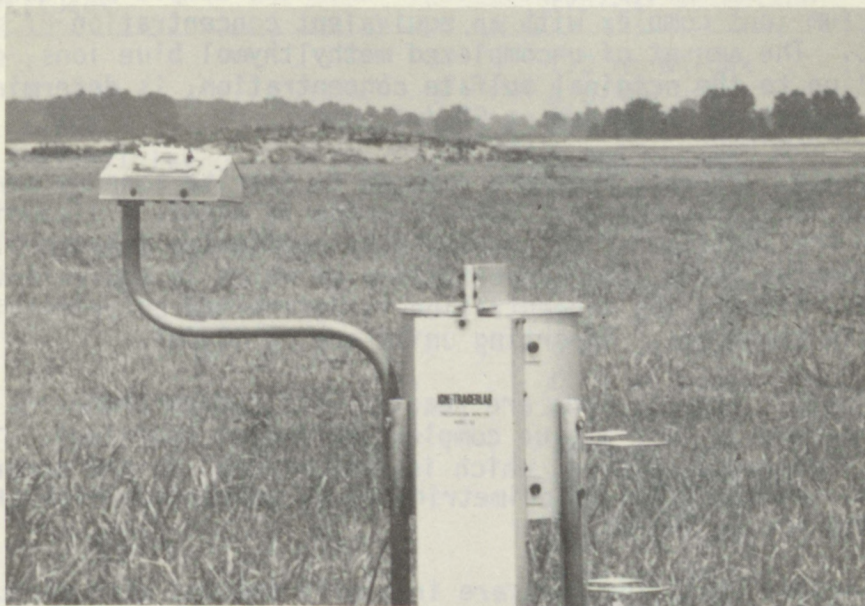


Figure 2. The Misco open-close collector at Salem, Illinois.

2.2.2 Analysis

Samples are received from the collection stations monthly. Constituent analysis follows as soon as possible after receipt of the samples. The analytical techniques are those employed routinely by the EPA:

(1) Precipitation Volume. Volume is measured in milliliters and converted by direct correlation into the height of sample (mm) that would have been measured in the U.S. national rain gage. Reporting units are height in mm.

(2) pH. pH is directly measured by using a standard pH meter with temperature compensator in conjunction with a combination electrode. Reporting units are pH units.

(3) Conductivity. Conductivity is directly measured by using a conductivity bridge with temperature compensator in conjunction with a conductivity cell. Reporting units are $\mu\text{S}/\text{cm}$.

(4) Acidity (Alkalinity). Acidity (alkalinity) of the precipitation sample is determined by an end point titration technique. An appropriate acid indicator is added to a known volume of sample. Base (acid), the normality of which is known, is added until the color end point is reached. The equivalent of acid (base) in the sample is then determined. Reporting units are $\mu\text{eq}/\text{ml}$ acidity (alkalinity).

(5) Sulfate. Sulfate ion concentration is determined by initially adding equivalent quantities of barium chloride and methylthymol blue to the sample with barium sulfate precipitating. When the sample pH increases, the remaining barium ions complex with an equivalent concentration of methylthymol blue ions. The amount of uncomplexed methylthymol blue ions, equivalent in concentration to the original sulfate concentration, is determined colorimetrically. Reporting units are $\mu\text{g SO}_4/\text{ml}$.

(6) Nitrate. Nitrate ions are reduced to nitrite ions by means of a copper-cadmium reduction column. Sulfanilamide is added; a diazonium salt is formed. Upon the addition of N-1-naphthylethylenediamine dihydrochloride, a colored azo complex forms, the concentration of which is equivalent to that of the sample. Nitrate ion concentration is determined colorimetrically by comparison with standards. Reporting units are $\mu\text{g NO}_3/\text{ml}$.

(7) Ammonia. Ammonia ions are reacted with sodium phenoxide and sodium hypochlorite to form a blue complex (Berthelot reaction). The intensity of this indophenol complex, which is proportional to the ammonia ion concentration, is determined colorimetrically by comparison with standards. Reporting units are $\mu\text{g NH}_3/\text{ml}$.

(8) Chloride. Chloride ions are initially treated with mercuric thiocyanate, followed by ferric ammonium sulfate. A colored ferric thiocyanate complex forms. Its intensity, which is proportional to the original chloride ion concentration, is determined colorimetrically by comparison with standards. Reporting units are $\mu\text{g Cl}/\text{ml}$.

(9) Fluoride. The fluoride ion concentration of the precipitation sample is directly measured by using a specific ion electrode in conjunction with a pH meter with expanded millivolt scale or a fluoride ion meter that is calibrated with standards. Reporting units are $\mu\text{g F}/\text{ml}$.

(10) Metals. The concentrations of eleven metals (Ca, Cd, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Zn) are determined by atomic absorption spectroscopy. The rain precipitation sample is aspirated into the system and converted into an aerosol spray. When this aerosol spray enters a high-temperature flame, atomization occurs. A predetermined energy source emits a radiation beam that is characteristic of the element of interest through that portion of the flame where atomization has occurred. The energy absorbed by the element of interest is monitored and converted into concentration by comparison with the responses from analysis of standard solutions. Reporting units are $\mu\text{g metal}/\text{ml}$.

2.2.3 Typical Detection Limits

Table 2 lists typical detection limits for the techniques employed in the analysis of rain precipitation samples for environmental constituents.

Table 2. Typical Detection Limits

Constituent	Typical Detection
Volume	1.0 mm height
pH	0.01 pH unit
Conductivity	0.1 $\mu\text{S}/\text{cm}$
Acidity/Alkalinity	0.005 $\mu\text{eq}/\text{ml}$
$\text{SO}_4^{=}$	0.1 $\mu\text{g SO}_4^{=}/\text{ml}$
NO_3^{-}	0.1 $\mu\text{g NO}_3^{-}/\text{ml}$
NH_3	0.1 $\mu\text{g NH}_3/\text{ml}$
Cl^{-}	0.01 $\mu\text{g Cl}^{-}/\text{ml}$
F^{-}	0.1 $\mu\text{g F}^{-}/\text{ml}$
Ca	0.01 $\mu\text{g Ca}/\text{ml}$
Cd	0.01 $\mu\text{g Cd}/\text{ml}$
Cu	0.01 $\mu\text{g Cu}/\text{ml}$
Fe	0.05 $\mu\text{g Fe}/\text{ml}$
K	0.01 $\mu\text{g K}/\text{ml}$
Mg	0.01 $\mu\text{g Mg}/\text{ml}$
Mn	0.02 $\mu\text{g Mn}/\text{ml}$
Na	0.01 $\mu\text{g Na}/\text{ml}$
Ni	0.05 $\mu\text{g Ni}/\text{ml}$
Pb	0.05 $\mu\text{g Pb}/\text{ml}$
Zn	0.01 $\mu\text{g Zn}/\text{ml}$

2.2.4 Shipment and Storage

Polyethylene containers are provided to the sites for collection, storage, and shipment of the samples to EPA. These containers are thoroughly cleaned and dried prior to shipment to the sites. Chlorobenzene is added to each container to prevent the formation of algae. A more detailed explanation of the operation of the network is given in the Appendix.

2.2.5 Archiving

All data from the WMO regional network in the United States are archived in *Atmospheric Turbidity and Precipitation Chemistry Data for the World*, published by the Environmental Data Service, National Climatic Center, Federal Building, Asheville, N.C. 28801.

3. EVALUATION OF NETWORK RESULTS

The WMO regional precipitation chemistry network in the United States (1970 to present) requires considerable upgrading before it can be considered, according to the WMO charter, a quality program for monitoring atmospheric composition. The main barrier to an adequate program is that there has been no firm commitment for long-term quality measurement of precipitation chemistry on a regional basis. To interpret precipitation chemistry

data, one requires decades, not years, of careful collection and analysis. The following is a critical review of the present effort and the actions that must be taken if the regional network in the United States is to produce data that can be used in a worldwide network.

3.1 Site Evaluation

The ten sites currently designated as WMO regional sites have never been evaluated as such; the locations were chosen arbitrarily without on-site evaluation. Certainly, most of the sites fit into the WMO guidelines (Anonymous, 1974). However, in order to document the network, an on-site evaluation has to be made for obtaining the following information: (1) future land use of area surrounding the site, (2) geographical features, (3) evaluation of climatological data, and (4) evaluation of meteorological measurements made in the vicinity. Also, periodic visits are necessary to review the station's qualifications as a regional or baseline site. If we are to have confidence in the data, site evaluation is of utmost importance.

3.2 Collection

The Misco collector has been used exclusively throughout the network. According to a recent Cornell University intercomparison study of over twenty different types of collectors, the Misco collector performed poorly in comparison with other collectors (Galloway and Likens, 1976). Comparisons of rain gages by Canadian, Finnish, British, and American workers have shown that the Misco sampler performs with less than desirable reliability. The AAPS type-19 Finnish version of the U.S. AEC wet or dry collector is apparently the most reliable collector commercially available. In the network, these findings are partially demonstrated by Table 3. For the 1972-1973

Table 3. 1972-1973 Collector Efficiency Expressed as a Ratio of the Precipitation Chemistry Collector to Standard Rain Gage (X 100)

	Mean (\bar{x}) (of mo. collector)	Median
Alamosa, Colo.	60%	82%
Atlantic City, N.J.	58	73
Bishop, Calif.	44	57
Caribou, Maine	58	59
Huron, S. Dak.*	46	47
Meridian, Miss.	82	80
Pendleton, Oreg.	51	53
Raleigh, N.C.	80	88
Salem, Ill.	76	81
Victoria, Tex.*	44	5

*No collection for last six months in 1973.

period, the efficiency rating of the volume of samples received by EPA as compared to the volume measured by the U.S. national rain gage is poor. Another factor that could influence these figures is evaporation of the sample when it has remained in the collection container over a monthly collection period. A re-evaluation of the collector should be made in light of this evidence.

3.3 Conclusions

The current U.S. precipitation sampling network should be considered only a basic network. A site evaluation program should be initiated with primary objectives of relocating and adding sites, as required, to the original network in order to insure that the network is representative. For an improvement of the present network, the following suggestions are made:

(1) Reorganization and redefinition of the administrative responsibilities are essential. At best, one agency should assume full responsibility of the operation of the network. At worst, one group would be responsible for the administration of the network, and another one for the implementation of formal and precise documentation.

(2) Existing collection techniques and apparatus should be reviewed. The Misco sampler is effective only in a temperate, wet climate. Sampler studies should be initiated to correlate rain and snow samplers with reference to the precipitation collection efficiency and chemical consistency of these samplers.

(3) More rigorous operational procedures are needed to insure that samples maintain original consistency during collection, storage, and shipment.

(4) Formal procedures and guidelines should be established for the statistical review of the analytical results.

There is no question that the regional network for precipitation chemistry is an important part of evaluating our changing environment. The actions outlined above are necessary if the United States is to acquire quality data that will make determination of chemical trends in the atmosphere possible.

4. REFERENCES

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APPENDIX

Procedures Manual

1. GENERAL DESCRIPTION

The Environmental Protection Agency and the National Oceanic and Atmospheric Administration, in conjunction with the World Meteorological Organization (WMO), have established a precipitation sampling site network to monitor pH, conductivity, and the quantity of various dissolved chemical substances deposited on the Earth's surface through natural wet precipitation (rain, snow, etc.). The projected precipitation network will, when fully operational, include one or more precipitation sampling sites located in each of the participating countries. Currently, the dissolved chemical substances that are analyzed in the U.S. precipitation samples include Cl, F, NO_3 , SO_4 , NH_3 , Mg, Na, K, Ca, Fe, Ni, Cu, Pb, Zn, Cd, and Mn. Through analysis of the precipitation samples collected monthly and by monitoring the change in the quantities of these constituents over long periods of time, EPA and WMO can establish projected long-term environmental trends and changes on both a regional and a global basis.

There are two types of precipitation sampling sites: the baseline site and the regional site. Although they are of equal importance, the samples collected at the two types of sites demonstrate different environmental effects and trends. The following criteria are generally used to distinguish the two types of sites:

Baseline Site: A baseline site is located in an area where no significant changes in land practices are anticipated for at least 50 years within 100 km of the site in all directions.

Regional Site: The only restriction to the location of a regional site is that it will not be located in a major urban center. Table A-1 lists the U.S. regional precipitation sampling sites.

2. CONTAMINATION

All individuals involved in the collection, shipping, and/or analysis of precipitation samples must be aware of the critical effects of contamination of these samples. Precipitation samples, unlike water samples from most other sources, contain only trace quantities of analyzable substances. In this case, "trace" normally implies less than 1.0 mg of substance per liter of water. Contamination of precipitation samples results in inaccurate analyses and consequently in inappropriate environmental predictions and planning. Some of the sources of contamination are given below.

(1) Foreign objects, such as fingers, sticks, etc., placed on the inside surface of a container. One fingerprint contains more sodium than is typically found in 1000 ml of rainwater.

Table A-1. Regional Precipitation Sampling Sites

Alaska	National Oceanic and Atmospheric Admin. Naval Arctic Research Laboratory Barrow, Alaska 99723	(907) 852-6588
Arizona	Grand Canyon National Park Grand Canyon, Arizona 85023	(602) 638-2411, Ext. 39
California	National Weather Service 705 Airport Road Bishop, California 93514	(714) 873-3213
Colorado	National Weather Service Box 449 Alamosa, Colorado 81101	(303) 589-3232
Hawaii	NOAA, ARL Mauna Loa Observatory P.O. Box 275 Hilo, Hawaii 96720	(808) 961-3788
Illinois	National Weather Ser. Met. Office Salem Leakrone Airport Salem, Illinois 62881	(618) 548-4851
Maine	National Oceanic and Atmospheric Admin. National Weather Service Office Caribou, Maine 04736	(207) 775-3131
Mississippi	National Weather Service P.O. Box 4262 Meridian, Mississippi 39301	(601) 483-5270
Montana	St. Mary Ranger Station Glacier National Park Browning, Montana 59417	(406) 732-4411
New Jersey	National Weather Service NAFEC Building 301 Atlantic City, New Jersey 08405	(609) 641-3475
North Carolina	National Weather Service P.O. Box 25879 Raleigh, North Carolina 27611	(919) 781-4436
Oklahoma	Cherokee County Health Department 912 South College Avenue Tahlequah, Oklahoma 74464	(918) 456-8826

Table A-1. (Continued)

Oregon	National Weather Service Box 668 Pendleton, Oregon 97801	(503) 276-4493
South Dakota	National Weather Service Huron Regional Airport Huron, South Dakota 57350	(605) 352-8298
Texas	State Fish Hatchery San Angelo Tom Green County San Angelo City Hall San Angelo, Texas 76901	(915) 655-9121 Ext. 214
	National Weather Service Victoria County Airport Victoria, Texas 77901	(512) 575-1782
Wisconsin	Park Ranger State Parks and Recreation Department Peninsula State Park Fish Creek, Wisconsin 54212	(414) 868-3553
American Samoa	GMCC Station P.O. Box 2568 Pago Pago, American Samoa 96799	622-7455

(2) Insects in the water.

(3) Sunlight and water temperatures, which enhance algae growth, evaporation, and chemical reaction.

(4) Leaching, i.e., extraction of trace substances, from the precipitation sample, by the container, over long periods of time.

(5) Contamination from sealants in gaskets, plastics, etc.

Contamination to a certain extent and in some aspects is unavoidable, yet every possible precaution should be taken to eliminate it. Foreign objects must not be allowed to enter the containers or touch the walls of the containers. Samples should be stored in dark, cool places and forwarded by air mail as soon as possible after the completion of the sampling period.

3. DESCRIPTION OF THE PRECIPITATION SAMPLER

3.1 General

The precipitation sampler (Figure A-1) has an automatic, heated, sensing device called a sensor grid plate that is activated by precipitation. The sensor is capable of distinguishing between heavy dew or fog and actual precipitation. The sensor sends an electronic signal to the lid-opening mechanism when activated by rain or snow. The lid opens and rotates in a counterclockwise movement to expose the wide-mouth collection container (6-inch diameter). When precipitation ends, the sensor is dried by the built-in heating unit, and the lid closes over the opening. The precipitation collector remains covered whenever precipitation has not accumulated on the sensor, and thus "dry fallout" collection is prevented. The operating circuitry and mechanism are preset. No attempt should be made to adjust any part of control, unless other instructions are given.

3.2 Gain Control Operation

The gain control on the Model 93 precipitation collector is designed to increase or decrease the sensitivity of the unit. It is located on the bottom of the control housing. To maintain peak sensitivity, the gain control should be turned fully counterclockwise. This may sometimes require a screwdriver. If the unit seems to open with little or no water (such as dew or fog), it is suggested that the gain control be adjusted clockwise until you reach the desired sensitivity.

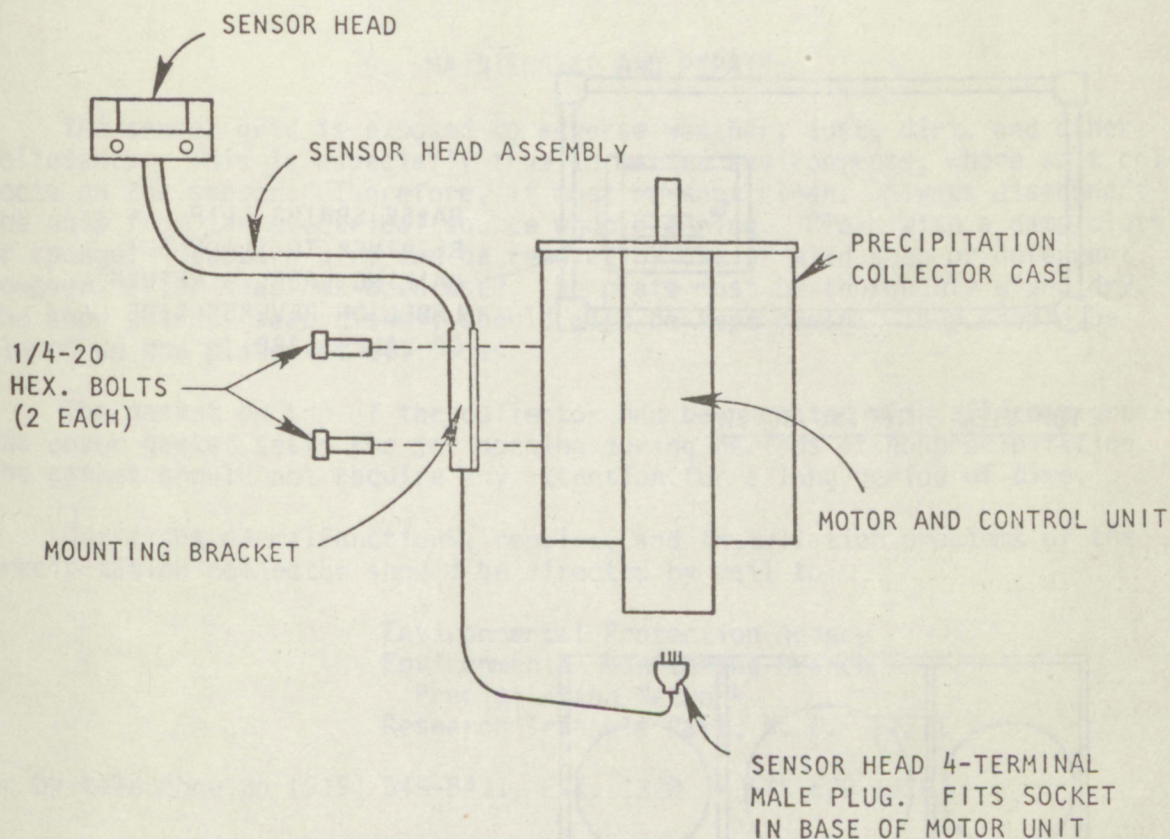
Periodic cleaning of the sensor head with alcohol will maintain good contact. If needed, very fine steel wool may be used. Also, the sensor head plug should have the contacts cleaned in order to assure good contact with the control box. They could be cleaned with a pocket knife or a screwdriver (scrape until the surface is shiny).

4. INSTALLATION

The precipitation collector should be mounted close to the permanent location of the station's official rain gage for a comparable precipitation collection sample. The collector should not require guy wires or weights for stability.

5. EQUIPMENT

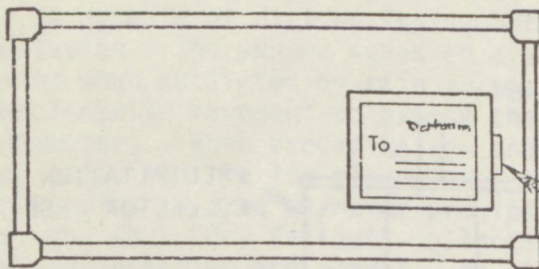
Equipment and supplies will be furnished by EPA. Additional supplies will be sent at a station's request. Shipping and storage cartons (Figure A-2) include two shipping and storage containers (4-inch-diameter mouth) and one collection container (6-inch-diameter mouth). When the first precipitation sample is returned for analysis, the reserve container is used for the



TO EXCHANGE SENSOR UNITS, REMOVE ELECTRICAL PLUG FROM MOTOR UNIT AND TWO BOLTS HOLDING MOUNTING BRACKET TO THE MAIN CASE ASSEMBLY. FASTEN REPLACEMENT UNIT IN REVERSE ORDER. CHECK SENSITIVITY CONTROL IN THE BASE OF THE MOTOR UNIT.

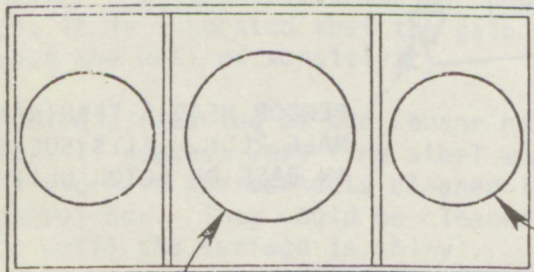
RETURN THE OLD UNIT, PACKING IT IN THE ORIGINAL SHIPPING CARTON. A RETURN LABEL WILL BE FOUND IN THE CARTON.

Figure A-1. Enlarged view of sensor unit attachment automatic precipitation collection model 93.



RAISE SPRING CLIP
RETAINER TO SLIDE OUT
MAILING LABEL. RETURN
LABEL ON REVERSE SIDE
OF LABEL CARD.

TOP VIEW SHIPPING COVER



TWO HALF-GALLON PRECIPITATION
COLLECTION STORAGE AND SHIPPING
CONTAINERS.

TOP VIEW SHIPPING
CONTAINER

SIX-INCH-DIAMETER INSTRUMENT PRECIPITATION
COLLECTION JAR. TO BE RETURNED EMPTY EACH
MONTH FOR LABORATORY CLEANING AND TREATMENT.

Figure A-2. Precipitation monitor monthly collection shipping container.

second sampling period. EPA will return a cleaned sampling container in time to be used for the next sampling period. The total precipitation collected is shipped to EPA once a month for analysis.

6. MAINTENANCE AND REPAIR

The sensor grid is exposed to adverse weather, dust, dirt, and other pollutants. This is especially true in marine environments, where salt collects on the sensor. Therefore, it must be kept clean. Always disconnect the unit from the electrical source when cleaning. Clean with a damp cloth or sponge. Stubborn dirt can be removed by use of mild soap or detergent. However, after soap has been used, the plate must be thoroughly wiped dry. The snow guards (soap dishes) should also be kept clean. They should be placed on the plates at all times.

The gasket on top of the collector has been coated with silicone grease. The cover gasket seals the jar opening during periods of nonprecipitation. The gasket should not require any attention for a long period of time.

Questions on malfunctions, repairs, and installation problems of the precipitation collector should be directed by mail to:

Environmental Protection Agency
Environmental Monitoring Branch -
Precipitation Network
Research Triangle Park, N. C. 27711

or by telephone to (919) 549-8411, Ext. 1328 -- FTS 629-1328.

7. PROCEDURES FOR SAMPLING

7.1 Initial Sampling Period

(1) Extreme caution is required to avoid contamination of the precipitation containers at all times. Avoid touching the inner walls of the collection/shipping containers or their caps.

(2) From the shipping/supply carton, furnished by EPA, uncap a clean plastic wide-mouth collection container (6-inch-diameter).

(3) The collector lid should be opened by placing tap water on the sensor head (Figure A-1). A consistent amount of water should be used to insure uniformity in sampling from site to site, month to month. (See section 3.2.)

(4) Place the clean precipitation collection container in the center of the collector. Avoid touching the interior of the collecting container. When the sensor is dry, the lid should close.

(5) If the starting date for the sampling period is not the first day of the month, record the actual starting date under the "Remarks" section of the Precipitation Data Card furnished by EPA (Figure A-3). This should apply only to cases where maintenance or replacement of the sampler is needed. Otherwise, the sampling period should begin on the first day of the month.

7.2 Ending/Starting Sampling Periods

(1) Prior to the end of each sampling period, a shipping/supply carton consisting of two clean shipping containers (4-inch-diameter) and one clean precipitation collection container (6-inch-diameter) will be furnished by EPA.

(2) Extreme care is required to avoid contamination of the precipitation containers and samples at all times. Avoid touching the inner walls of the collecting/shipping containers or their caps.

(3) From the second shipping/supply carton (Figure A-2), uncap a clean plastic wide-mouth precipitation collection container (6-inch-diameter).

(4) The collector lid should be opened by placing tap water on the sensor head (Figure A-1). (See section 3.2.) Remove the previous sampling period's precipitation collection container from the center of the collector. Always avoid touching the inside surfaces of the collection containers with foreign objects, especially fingers. Place the newly received, clean, wide-mouth plastic collection container (6-inch-diameter) in the center of the collector. When the sensor is dry, the collector lid should close.

(5) Pour all the contents collected during the previous sampling period from the collection container into one (or two if needed) of the narrow-mouth shipping containers (4-inch-diameter) and securely recap the shipping container(s) to prevent evaporation. DO NOT SHIP precipitation samples in the wide-mouth (6-inch-diameter) collection containers unless the quantity of precipitation collected during a sampling period exceeds the volume of the two shipping containers furnished for that period.

(6) Complete the Precipitation Data Card (Figure A-3) for the sampling period ended as follows:

- (a) Record the station identification name.
- (b) Record sampling date as the last two digits of the calendar year and the appropriate two-digit identification for the month.
- (c) Record the total rainfall as follows:

Sites with official rain gage. Enter the amount of precipitation to hundredths of an inch as recorded by the nearest official rain gage. Write "RG" by the Total Rainfall box.

PRECIPITATION
DATA CARD

<div style="border: 1px solid black; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin: 5px;">2</div> <div style="margin-top: 5px;">(1)</div>	<div style="font-family: cursive; font-size: 1.2em; margin-top: 5px;">Caribou, Maine</div> <div style="margin-top: 5px;">Station Name</div>	<div style="text-align: center; margin-bottom: 5px;">Station Code</div> <table border="1" style="width: 100%; height: 30px; border-collapse: collapse;"> <tr> <td style="width: 10%;"></td> <td style="width: 10%;"></td> <td style="width: 10%;"></td> <td style="width: 10%;"></td> <td style="width: 10%;"></td> <td style="width: 10%;"></td> <td style="width: 10%;"></td> <td style="width: 10%;"></td> </tr> </table> <div style="display: flex; justify-content: space-around; font-size: 0.8em;"> St Station Site </div> <div style="text-align: center; margin-top: 5px;">(2-10)</div>												
<div style="margin-bottom: 5px;">Total Rainfall</div> <table border="1" style="width: 100%; height: 30px; border-collapse: collapse;"> <tr> <td style="width: 10%;"></td> <td style="width: 10%;">2</td> <td style="width: 10%;">3</td> <td style="width: 10%;">6</td> </tr> </table> <div style="margin-left: 10px; font-size: 1.5em; font-family: cursive;">RG</div> <div style="margin-top: 5px;">Inches</div>		2	3	6	<div style="margin-bottom: 5px;">Agency</div> <div style="border: 1px solid black; width: 50px; height: 30px; display: flex; align-items: center; justify-content: center; margin: 5px;">0</div> <div style="margin-top: 5px;">(11)</div>	<div style="margin-bottom: 5px;">Project</div> <table border="1" style="width: 100%; height: 30px; border-collapse: collapse;"> <tr> <td style="width: 10%;">0</td> <td style="width: 10%;">8</td> </tr> </table> <div style="display: flex; justify-content: space-around; font-size: 0.8em;"> (12) (13) </div>	0	8	<div style="margin-bottom: 5px;">Time</div> <div style="border: 1px solid black; width: 50px; height: 30px; display: flex; align-items: center; justify-content: center; margin: 5px;">8</div> <div style="margin-top: 5px;">(14)</div>	<div style="margin-bottom: 5px;">Sampling Date</div> <table border="1" style="width: 100%; height: 30px; border-collapse: collapse;"> <tr> <td style="width: 10%;">7</td> <td style="width: 10%;">5</td> <td style="width: 10%;">0</td> <td style="width: 10%;">2</td> </tr> </table> <div style="display: flex; justify-content: space-around; font-size: 0.8em;"> Yr Mo </div> <div style="text-align: center; margin-top: 5px;">(15-18)</div>	7	5	0	2
	2	3	6											
0	8													
7	5	0	2											
<div style="margin-top: 20px;">Length of exposure in days</div> <div style="border: 1px solid black; width: 60px; height: 30px; display: flex; align-items: center; justify-content: center; margin: 5px;">30</div> <div style="margin-top: 5px;">(19) (20)</div>	<div style="margin-top: 20px;">No. of days in sampling period when measurable amounts of precip. were recorded</div> <div style="border: 1px solid black; width: 60px; height: 30px; display: flex; align-items: center; justify-content: center; margin: 5px;">08</div> <div style="margin-top: 5px;">(21) (22)</div>		<div style="margin-top: 20px;">Volume shipped: <u>100mL</u></div> <div style="margin-top: 20px;">Volume received: _____</div>											
<div style="margin-top: 20px;">Remarks:</div> <div style="font-family: cursive; font-size: 1.1em; margin-top: 5px;">Forest fire in Southern Maine Snowstorm 2/18/75 - 25" snow</div>		<div style="margin-top: 20px;">Date sample rec'd by lab</div> <table border="1" style="width: 100%; height: 30px; border-collapse: collapse;"> <tr> <td style="width: 20%;"></td> <td style="width: 20%;"></td> <td style="width: 20%;"></td> </tr> </table> <div style="display: flex; justify-content: space-around; font-size: 0.8em;"> Yr Mo Day </div>												
<div style="margin-top: 20px;">12/7/74</div>		<div style="margin-top: 20px; text-align: right;">_____ Analyst</div>												

Figure A-3. Sample EPA data card.

Sites without an official rain gage. Enter the amount of precipitation to hundredths of an inch as recorded by the nearest official rain gage. Write "Other" by the Total Rainfall box.

- (d) Remarks section. Enter under the "Remarks" section the date and description of unusual occurrences during the sampling period, such as forest fires, hurricanes, tornadoes, typhoons.

(7) Complete the Precipitation Data Card for the sampling period started as described in section 7.1, paragraph (5).

(8) Place the Precipitation Data Card with the two shipping containers (4-inch-diameter), and the collection container (6-inch-diameter) for the sampling period completed in the shipping/supply carton. Reverse the mail address card and ship the carton by mail to:

Environmental Protection Agency
Analytical Chemistry Branch (MD-78)
Research Triangle Park, N.C. 27711

Precipitation samples should always be stored/shipped in a dark, cool place to eliminate evaporation and the possible growth of algae.

7.3 Periods With No Precipitation Collected

Sites collecting no precipitation samples because of mechanical failure or because of no measureable precipitation will prepare and forward the Precipitation Data Card ONLY, annotated to read 0.00 total rainfall collected and "No precipitation", "mechanical failure", or other applicable statement(s) recorded under "Remarks" section.