

Weather Monitoring  
at  
Denali National Park  
and Preserve



# 14 Weather Observation Stations in Denali National Park and Preserve

**Watershed Level:** 6 Automated weather stations - Rock Creek (+1 at Teklanika Flats)

**Fire Management:** 4 RAWs (Remote Automated Weather Stations) - Parkwide

**National Weather Service Cooperative Station:**  
Headquarters

**Seasonal observations:** Wonder Lake and Eielson Visitor Center

7 of these stations are located within a 2 mile radius of park headquarters

# Rock Creek Watershed



◆ Upper Ridge

Lower Ridge ◆

◆ Treeline

Forest ◆

Permafrost ◆

Air Quality ↘

# Stations are instrumented to electronically collect and record weather data

**3**

10-m towers

Located in lower, middle and upper elevations of the study area



**4**

3-m towers

Located in characteristic habitats, such as forest, permafrost, treeline, tundra

The number and placement reflect complementary objectives to describe regional and local weather conditions

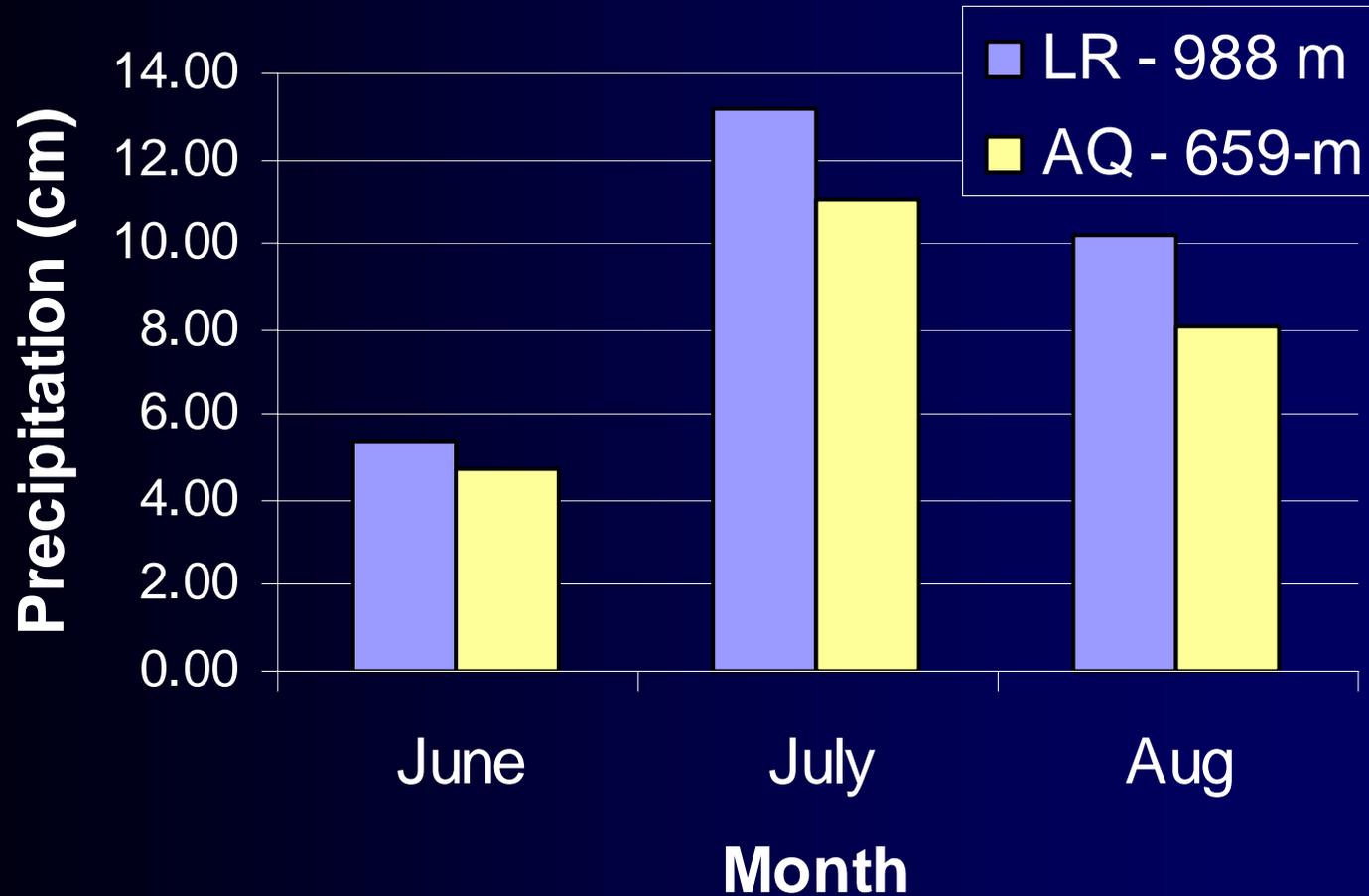
# Rock Creek Weather Station Measurements

- Air temperature
- Relative humidity
- Wind speed
- Wind direction
- Solar radiation
- Precipitation\*  
(2 stations)
- Barometric pressure  
(1 station)

\* Air Quality is the only station in the Rock Creek network that measures precipitation year round.

# Precipitation Gradient - 1998

## Rock Creek



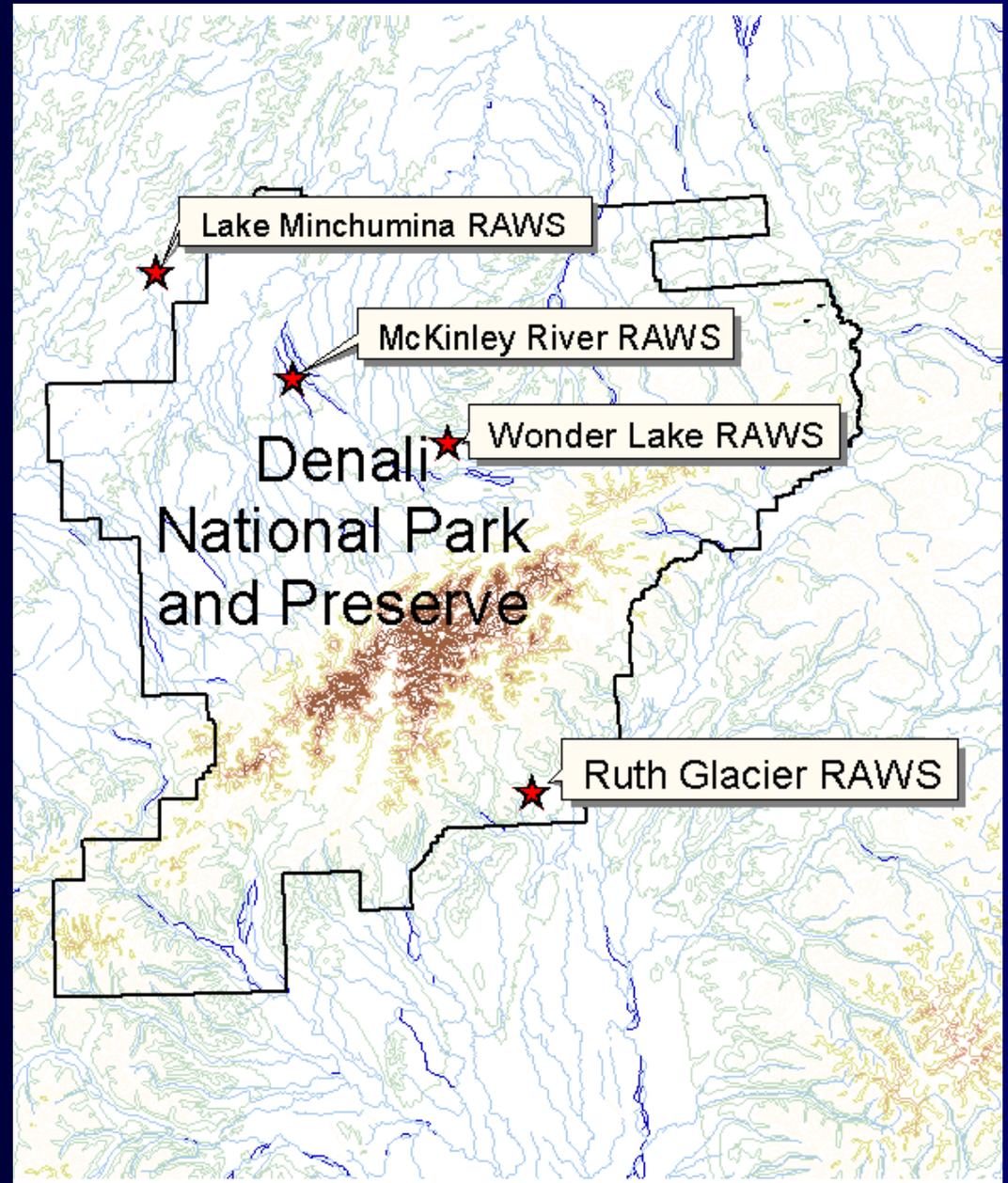
Remote  
Automated  
Weather  
Stations  
(RAWS)

Wonder Lake

McKinley River

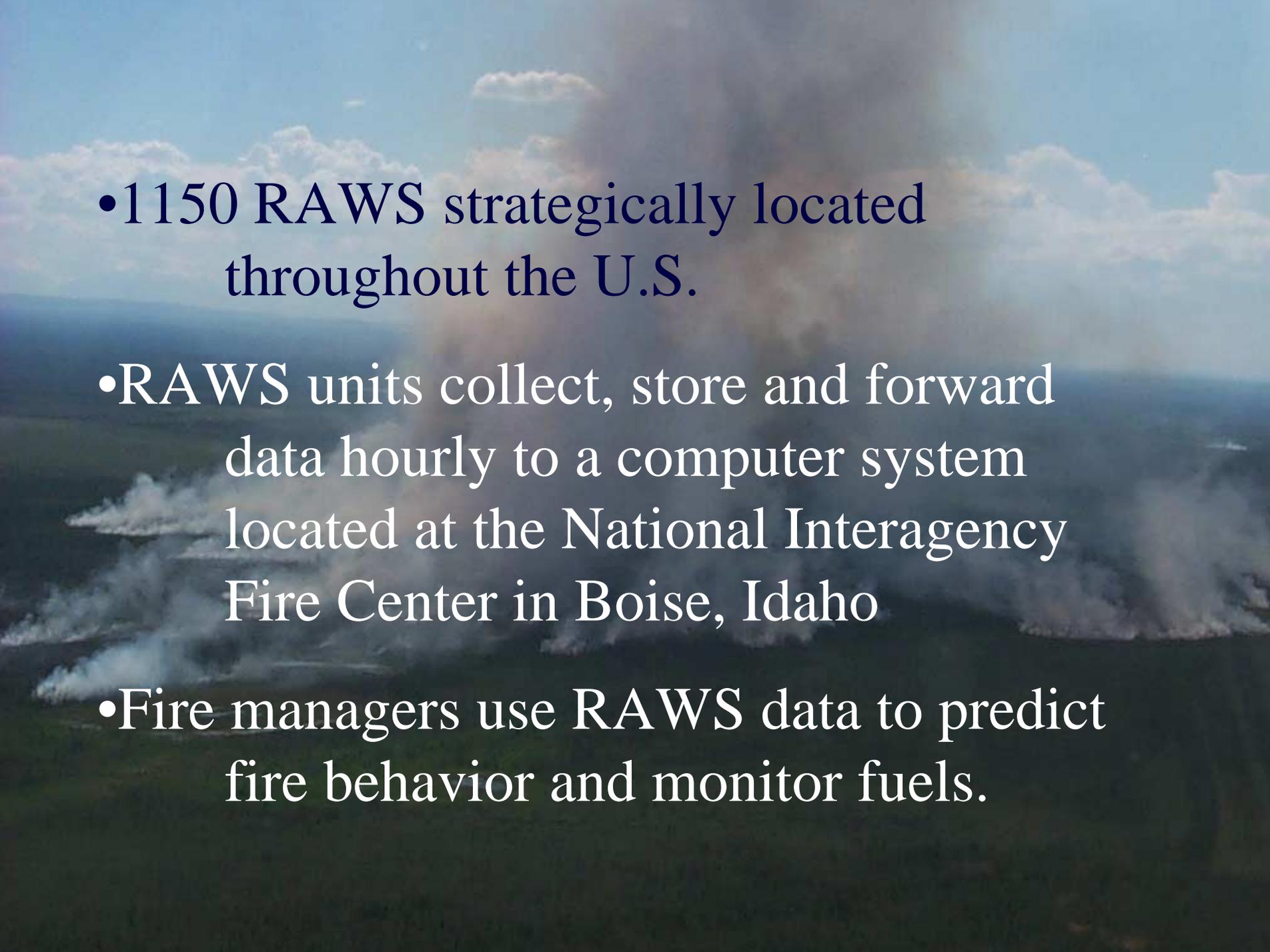
Lake Minchumina

Ruth Glacier



# RAWS (Remote Automated Weather Stations)

- Solar powered weather stations with satellite telemetry
- Maintained through a cooperative agreement between:
  - BLM
  - State of Alaska
  - U.S. Fish and Wildlife Service
  - U.S. Forest Service

- 
- 1150 RAWS strategically located throughout the U.S.
  - RAWS units collect, store and forward data hourly to a computer system located at the National Interagency Fire Center in Boise, Idaho
  - Fire managers use RAWS data to predict fire behavior and monitor fuels.

# RAWS

## Measurements

- Air Temperature
- Relative Humidity
- Windspeed and Direction
- Hourly Precipitation
- Peak Wind Speed/Direction
- Fuel Temperature
- Fuel Moisture



# AFS Fire Weather Database - Weather for WONDER LAKE

Date Range: 10/17/00 - 10/17/00

Query date / time: 10/18/00 2:21:53 PM

DAY HR AT RH WS PR RG WSP WD WDP FT BV

FM10

10/17 00 27 66 0 .00 .01 6 284 115 22

12.8 15

10/17 01 27 67 1 .00 .01 5 77 80 22

12.7 15

10/17 02 26 67 0 .00 .01 7 24 106 22

12.7 15

# Seasonal Observations

Wonder Lake and Eielson Visitor Center

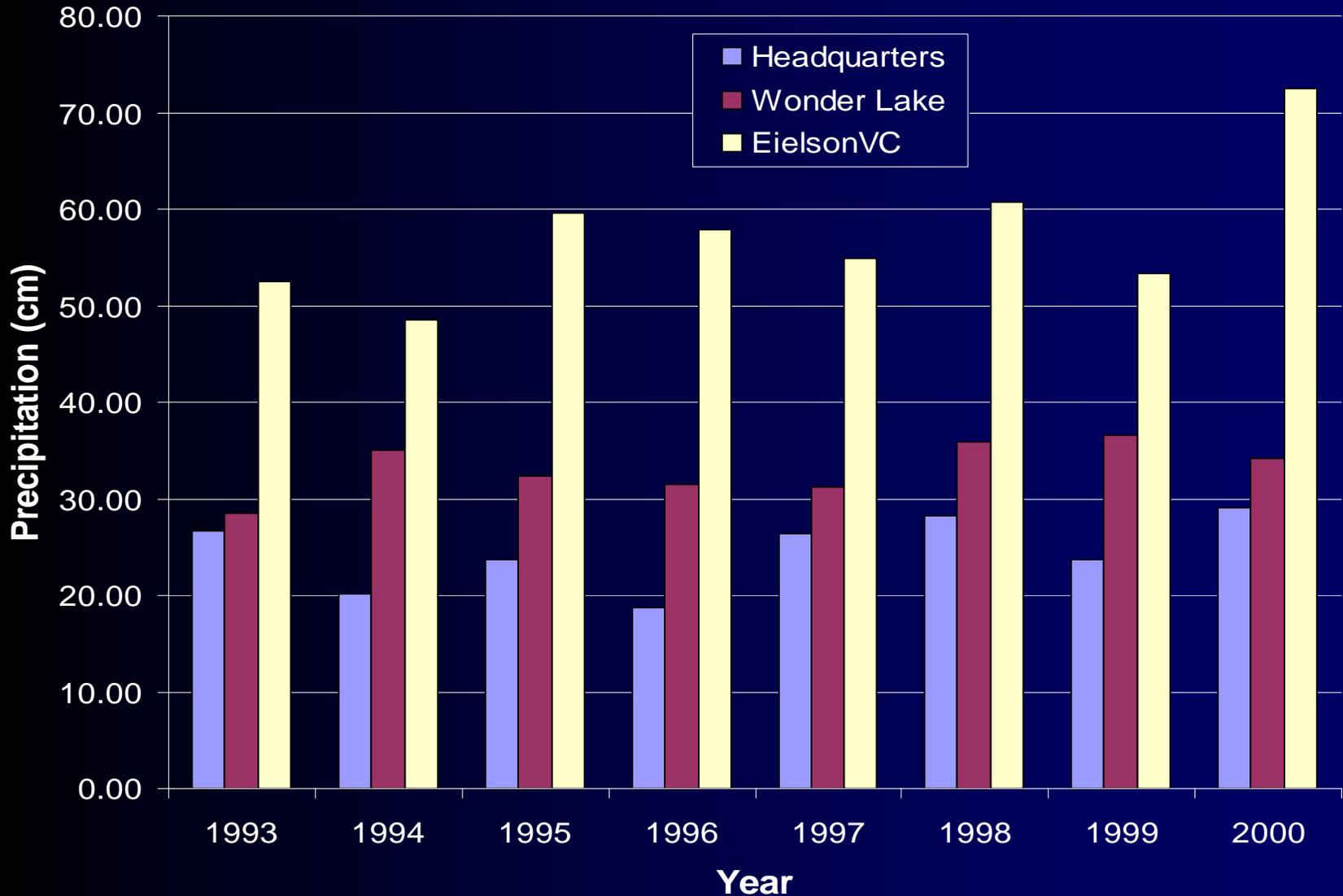
Measurements:

- Air Temperature - Minimum And Maximum (24 hour period)
- Precipitation (total in past 24 hours)

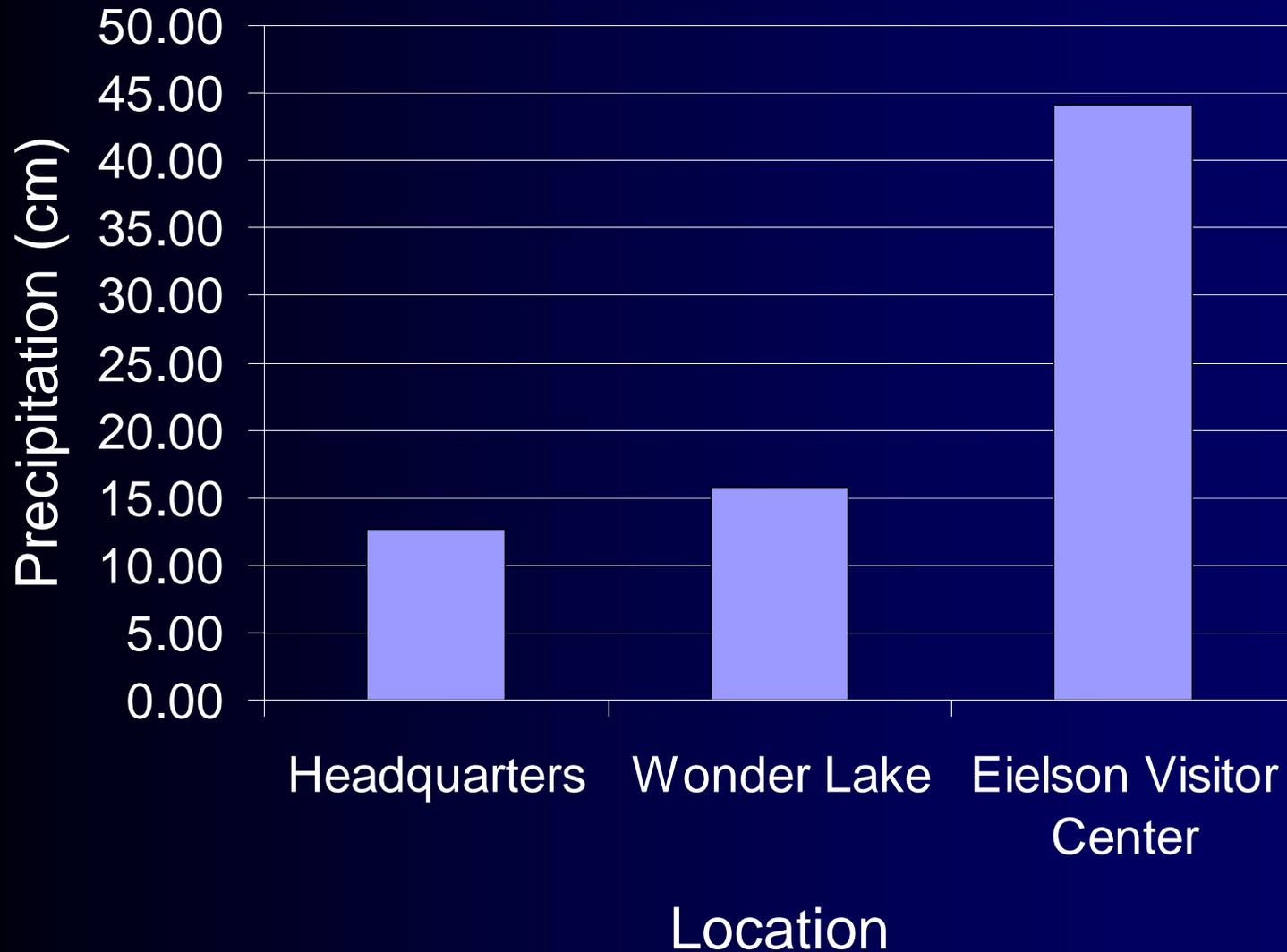
Seasonal Rangers record this information daily at 8:00/9:00 a.m.

Disseminated daily to public/park personnel

# Precipitation at 3 Sites in Denali



# August 2000 - Precipitation



# “Doggie Data”



75 Years of Weather Observations at Denali  
Headquarters

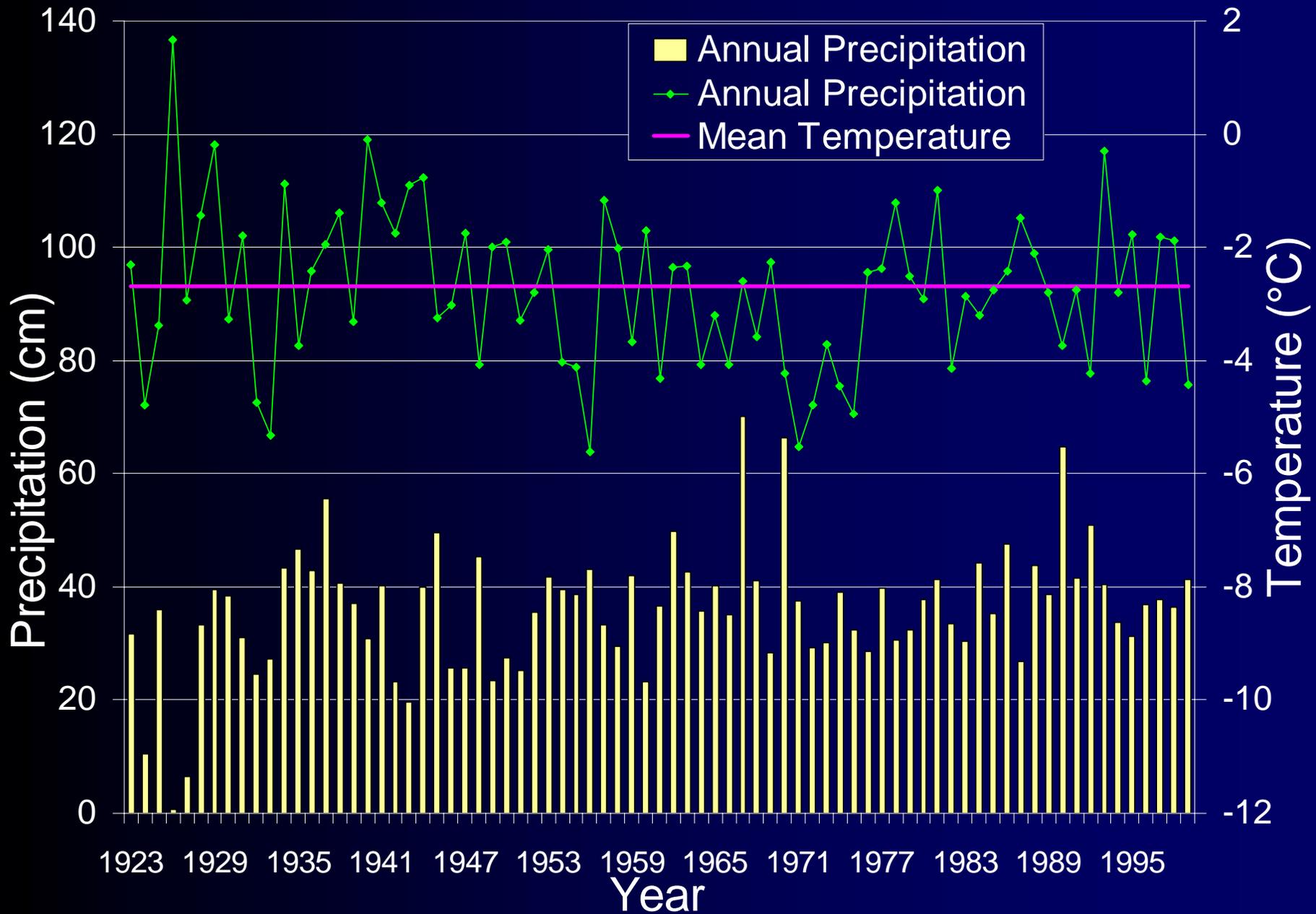
# Value of a Long Term Data Set

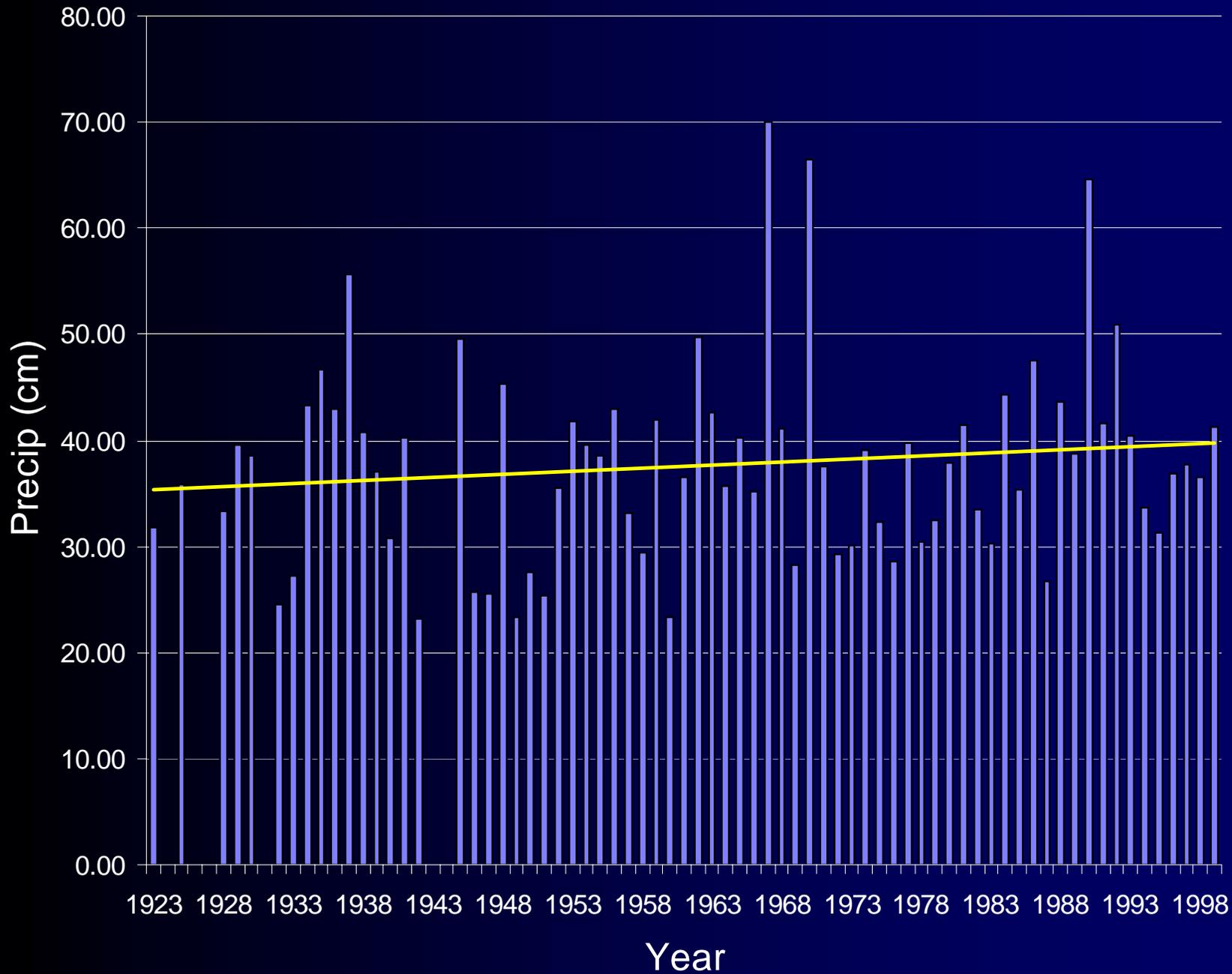
- Data gain significant additional scientific value with increasing length of record
- Increased probability of confidence in analysis
- Contributes an invaluable data legacy for future science and management

Thank You

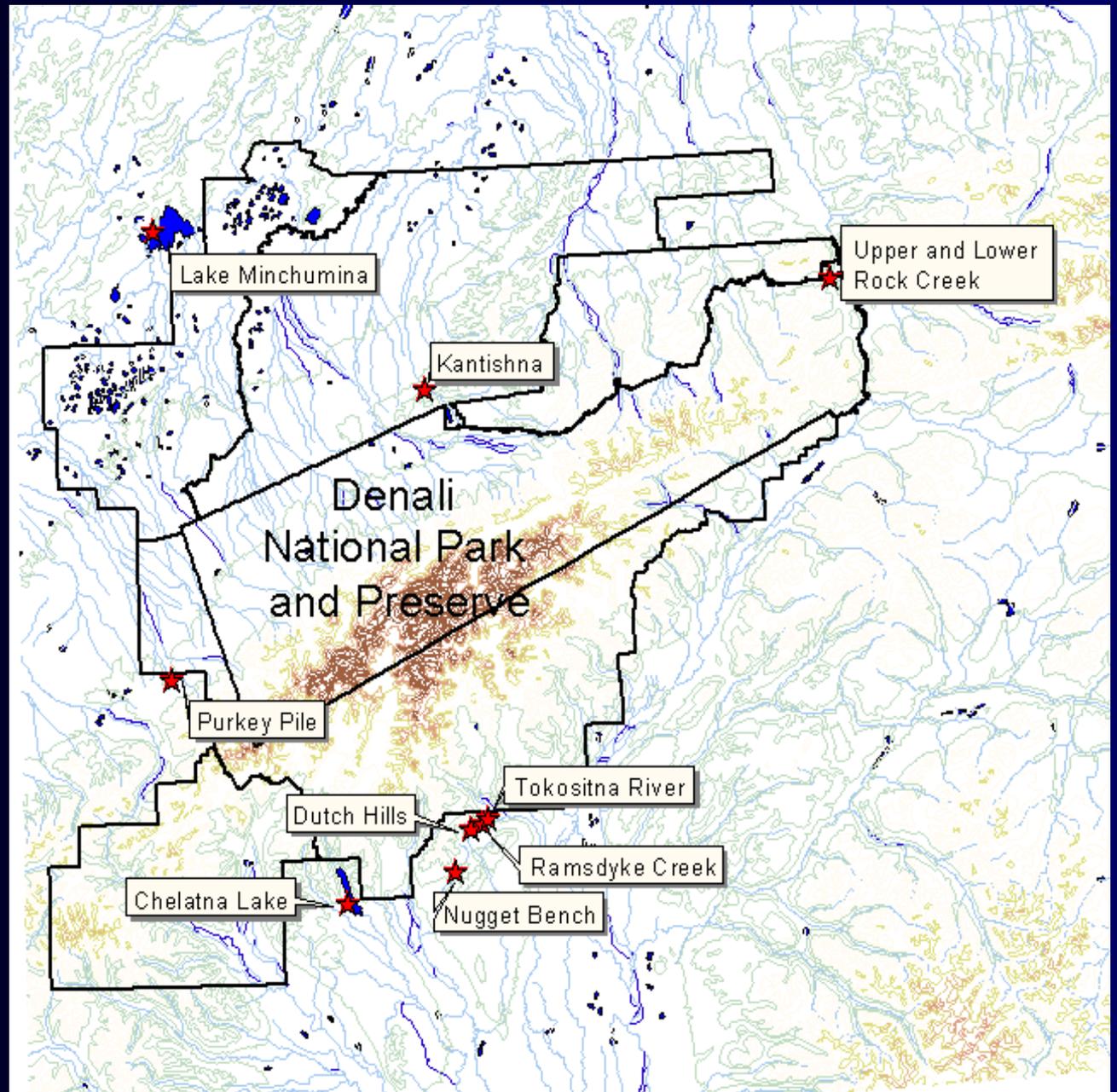
Al Smith - Data Management Technician 1998

All park personnel who have collected data for the past 75  
years





# SNOW



# Snow Surveys

## Snow Courses

A snow sampling tube is used to determine the depth and density of the snow at 5 stakes in a 50 - 75 foot transect.



## Aerial Markers

Low level  
passes by  
fixed-wing to  
determine  
height of  
snow on  
marker.



The objective of the snow survey is to efficiently obtain, manage, and disseminate high quality information on snow, water, climate, and hydrologic conditions



- Snowpack information also provides additional understanding of a large number of natural resource processes within the park including:

Population density

Birth survival rates

Herd movements

Vegetation succession

- Snowpack information also aids park management with decisions regarding recreational winter use



# Snow Depth and Snow Water Equivalent

Data retrieved from NRCS website at  
<http://ak.nrcs.usda.gov/>

Month	Site	1994		1995	
		Depth	SWE	Depth	SWE
M A R C H	Chelatna Lake	38	9.7	41	9.7
	Dutch Hills	80	27.6	63	20.2
	Kantishna			10	2.6
	Minchumina	14	2.3	31	6.9
	Nugget Bench			48	15.1
	Purkey Pile			30	6
	Ramsdyke Creek	60	20.4	57	17.8
	Rock Creek Ridge	22	4.2	23	5.2
	Rock Creek Bottom	24	4.4	25	5.4

# Climate Change

## Temperature

Global temperatures are rising. Observations collected over the last century suggest that the average land surface temperature has risen 0.45-0.6°C (0.8-1.0°F) in the last century.

# Climate Change

## Precipitation

Precipitation has increased by about 1 percent over the world's continents in the last century. High latitude areas are tending to see more significant increases in rainfall, while precipitation has actually declined in many tropical areas.

# Effects Of Climate Change

## Biological

### Ecosystem Structure

- Treeline
- Biodiversity
- Animal population and structure
- Migration patterns
- Immigrant species
- Soil biota

# Effects Of Climate Change

## Biological

### Ecosystem Function

- Nutrient cycling and decomposition
- Carbon cycling
- Energy budget
- Green up patterns
- Water cycling

# Effects Of Climate Change

## Physical

### Water

- River run-off patterns
- Freeze up/Break up dates
- Pollution deposition
- Glaciers
- Snowfall, snow depth, snow duration

# Effects Of Climate Change

## Physical

### Air

- Ozone/ UV-B
- Pollution deposition
- Nitrogen deposition
- Particulates and pollutants
- Clouds, cloud patterns
- Upper air temperature changes
- Circulation patterns

# Effects Of Climate Change

## Physical

### Soils

- Thermokarst
- Active Layer
- Permafrost

# UV -B

## PRIMENet - Park Research and Intensive Monitoring of Ecosystems

Anthropogenic influences on climate variability.

25 years ago scientists discovered...



Stratospheric Ozone



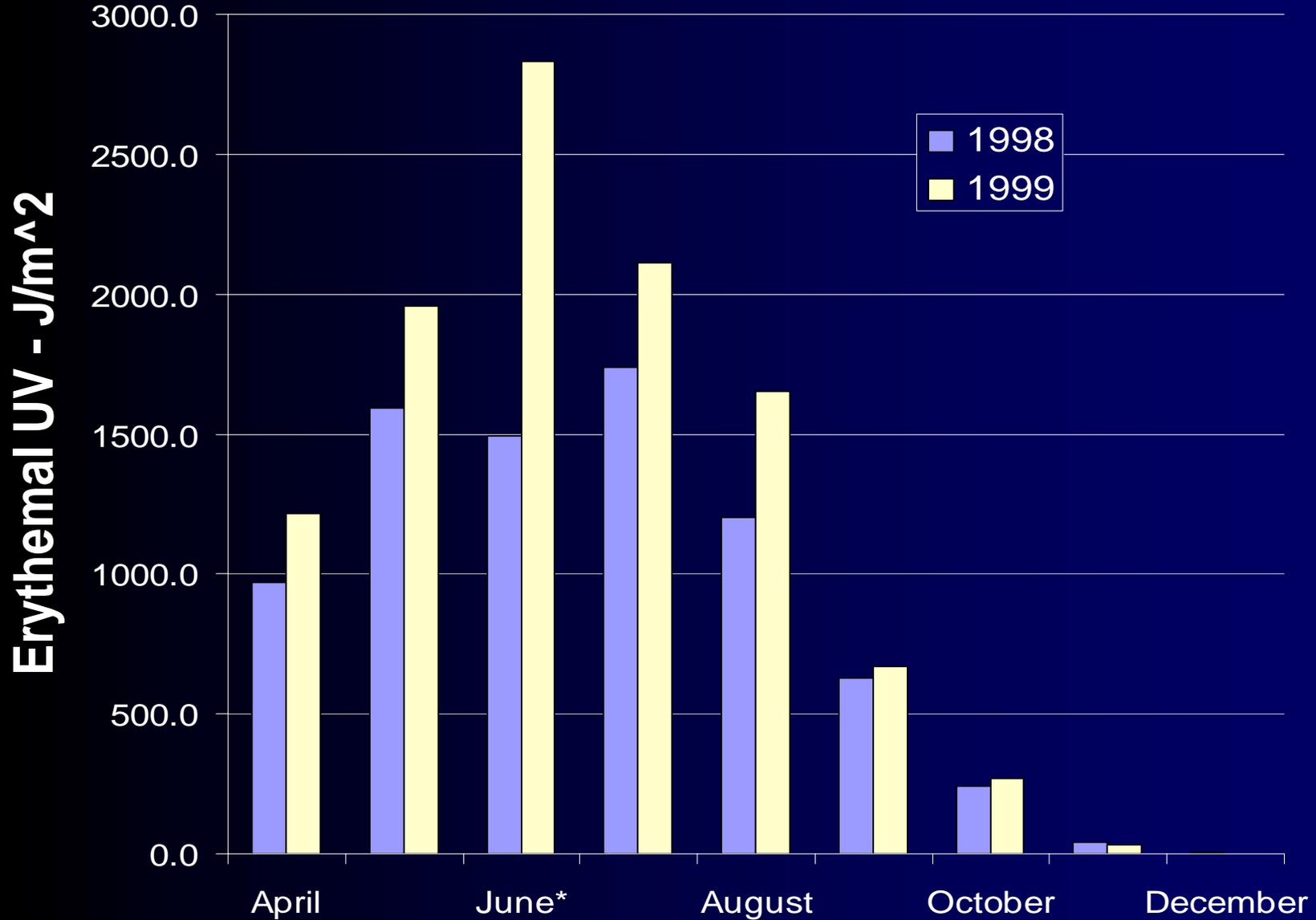
UV Radiation Reaching the Earth's  
Surface.

# UV Monitoring

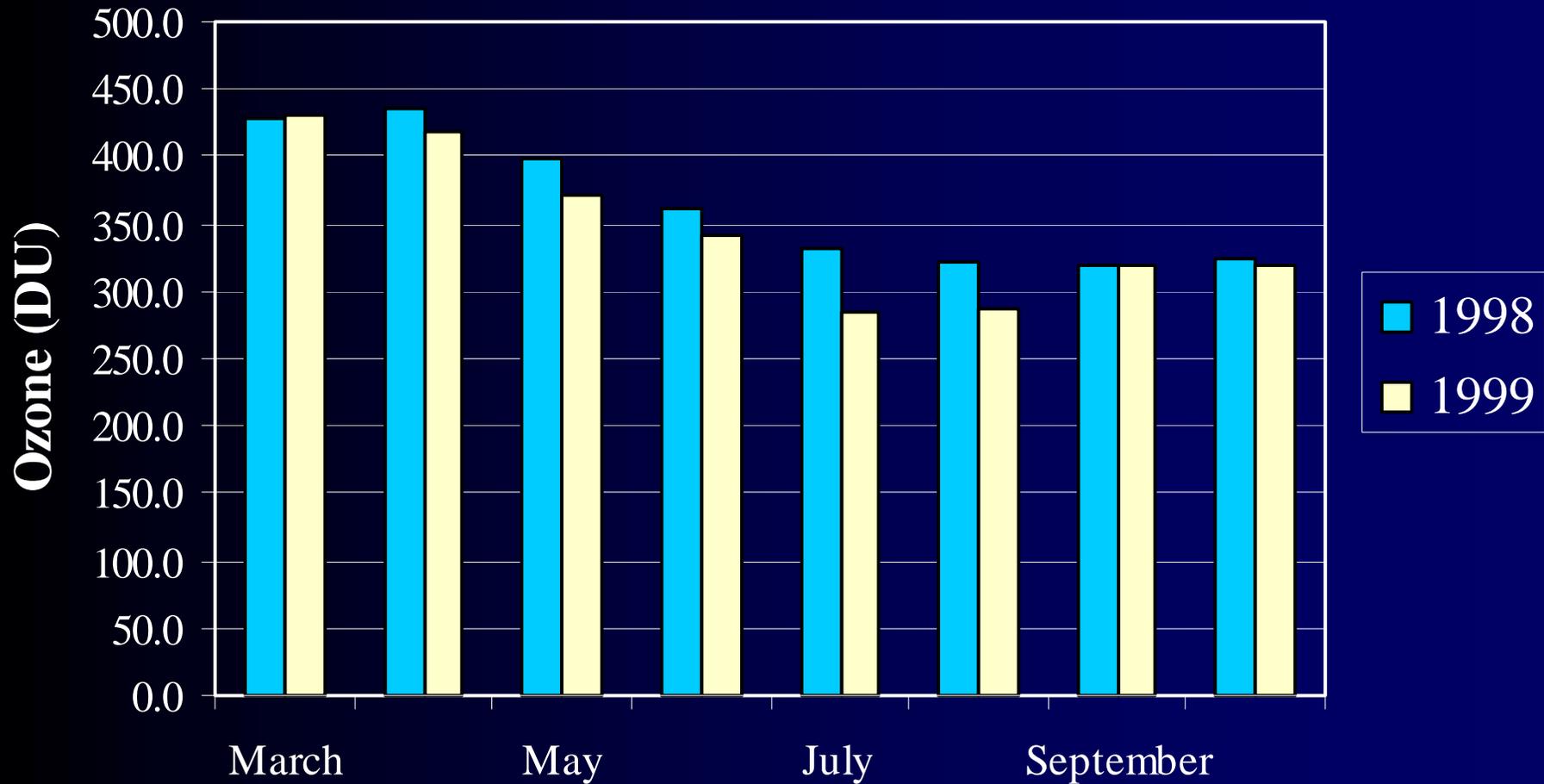


We are currently monitoring the levels of UV at Denali NP&P, and hope to incorporate research on the effects of this stressor on the sub-arctic environment.

# UV -B 1998 -1999



# Total Column Ozone 1998-1999



# Data Archiving

- NPS - Park Database
- WRCC (Western Regional Climate Center) - RAWS
- NIFC (National Interagency Fire Center) - RAWS
- AFS (Alaska Fire Service) - RAWS

# Data Archiving

- **NWS** (National Weather Service) - HQ (Doggie), Eielson & WonderLake
- **NCDC** ( National Climatic Data Center) - HQ
- **NRCS** (Natural Resource Conservation Service) - Snow

# Integration

Examples of requests for weather information for projects/research:

Snowfall data for population dynamics modeling for caribou and wolves

- Layne Adams, USGS-BRD

Weather anomalies affecting Grizzly bear cub production

- Pat Owen, NPS

Small mammal abundance based on derived climate indices

- Ed Debevec, Eric Rextad, UAF

Weather data requests continued...

Visitor/Public Information- Weather Summaries

- Camp Denali Newsletter, Denali Park Resorts, Southeast Contractors, NWS.

Watershed data for vegetation simulation modeling in forest and tundra of DNP&P

- Chris Potter NASA, Carl Roland NPS

Precipitation and maximum temperatures for sediment discharge of Yukon River

- Kaz Chakita, Hokkaido University

## Weather data requests continued...

Precipitation data to calibrate a numerical model that simulates surface runoff response of Rock Creek Basin

-Kenneth Karle, NPS

Relating tree growth to tree location and microclimate

- Martin Wilmking, UAF



# Integration with Park Management Issues

Input for EIS/EA's

- Snowmachines
- North Access
- Spruce IV
- Maintenance Projects