Citizen Weather Observer Program (CWOP)
for Collection and Use of Citizen Weather Data

Russ Chadwick (FSL), Patty Miller (FSL), and Dave Helms (NWS)

Great Divide Weather Workshop
Billings Weather Forecast Office
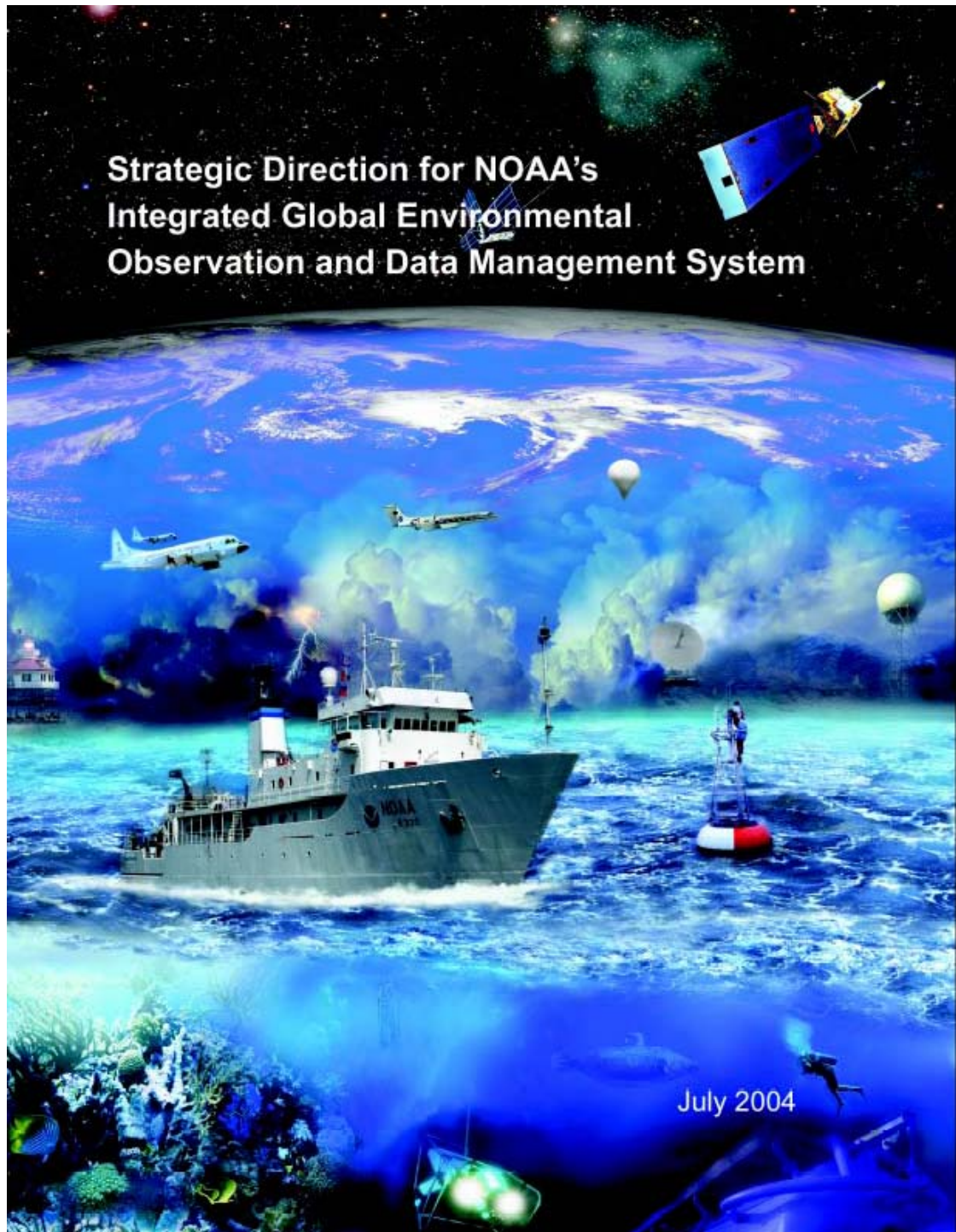September 8-10, 2004

Contributors to CWOP Success

- Mike Barth CW0004
- Steve Dimse K4HG
- Philip Gladstone CW0003
- Pete Loveall AE5PL
- Bill Moninger
- Phil Pacier AD6NH
- Dick Stanich KB7ZVA

Strategic Direction for NOAA's
Integrated Global Environmental
Observation and Data Management System

July 2004

Citizen Weather Observer Program

APRSWXNET

Purpose of CWOP

Private-public partnership with goals:

1. Collect weather data contributed by private citizens;

2. Make these data available for public and private weather services;

3. Provide feedback to the contributors so they have tools to improve data quality.

Private-Public Partnership

- **Data Collection** (privately owned and operated)
  - WX stations operated by private citizens
  - Data transfer by APRS-IS (internet service)
  - Data management by findu.com

- **Data Distribution** (provided by NOAA)
  - Data distribution by MADIS
  - Data quality checking by QCMS
 - NOAA FSL Central Computer Facility

Comparison of CWOP with other NWS Volunteer Observing Programs

|	CWOP	COOP	COOP-M	Skywarn
Equipment - Hardware	Private; access to $700K weather equipment	GFS	GFS	NA
Equipment - Software	Private; access to $70K data logging applications	NA	GFS	NA
Communications	Private (Internet/ Wireless Packet Radio) – 10 volunteer SYSOPS; $100K/yr in donated bandwidth	GFS (Mail, WxCoder, IV-ROCS)	GFS	Private (Internet/Phone)
Site Lease	Private	Private	Private/GFS	NA
Training	Web (developed by volunteers)	Web/DVD (GFS)	Web/DVD (GFS)	Classroom Certification
Government Site Inspections	No – Guidance Only and statistical monitoring	Yes – Periodic Inspections	Yes – Periodic Inspections	NA
Climate Quality	No	Yes (most)	Yes	NA
Parameters	T, Td, Wind, Pressure, Precip (most 5 minute)	T (max/min), Precip (daily)	T, Precip (5 minute)	Tornados, Funnel Clouds, Hail, Wind Damage Reports, Snow Depth (event based reporting)
Current # Observers	3,686	11,000	200	275,000 (est.)
Current Coverage	50 states, US territories, DC, 35 countries	50 states, US territories, DC	6 states	50 states, US territories, DC
Recent Growth	40% Year, unlimited potential	None	Possible 8,000 total	None

CWOP Data Flow
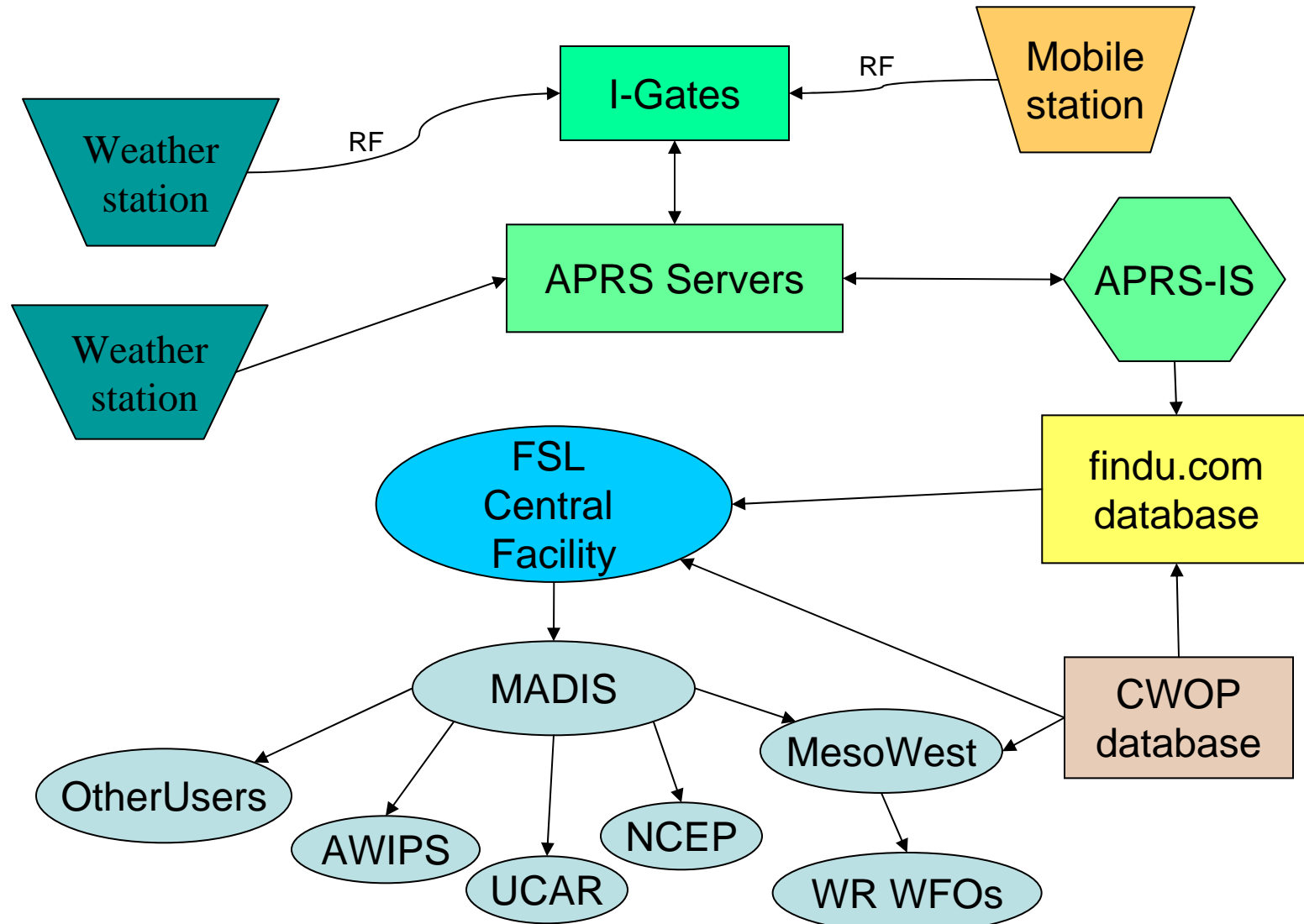
Real-time CWOP Traffic Check

MesoWest CWOP
North American
traffic last 4 days.

Linked from
www.wxqa.com

Or direct
http://www.met.utah.e
du/mesowest/monitor/
APRSWXNET.gif
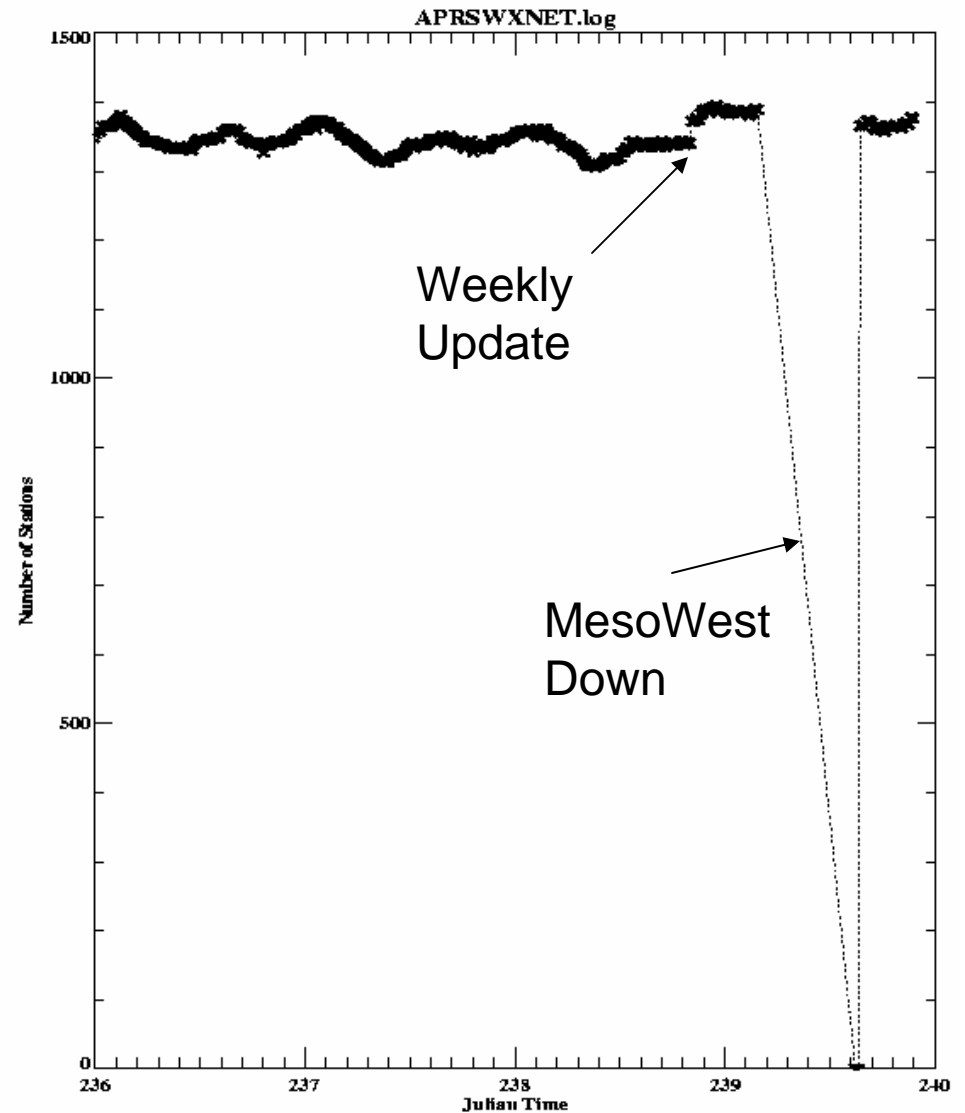
CWOP Membership

- CWOP database - 3686
- AP001 – AR495, 1465 hams by callsign
- C0000 – C2467, 2221 citizens
- Registered stations – 2803
- Inactive stations – 830
- US states and territories - 52
- International countries participating - 53
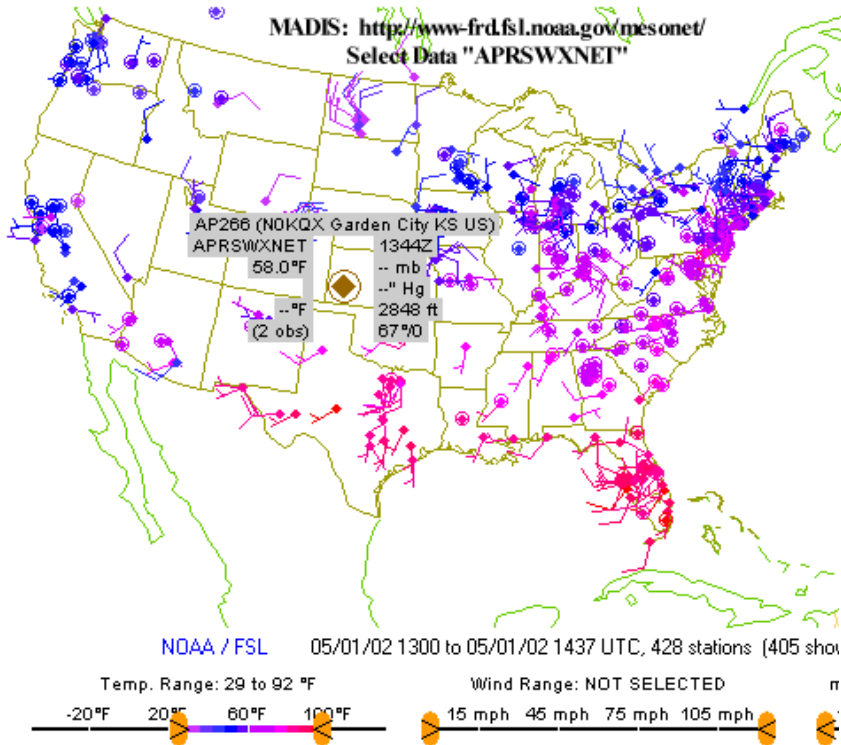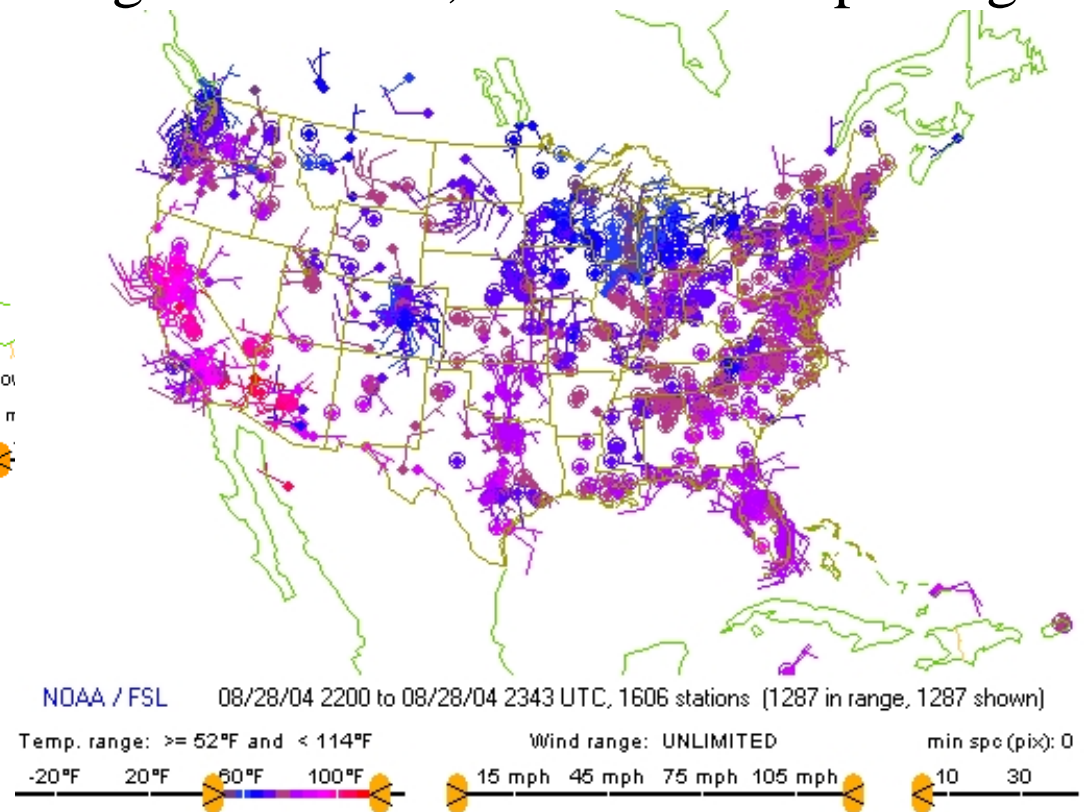- Currently sending data – 1615 stations

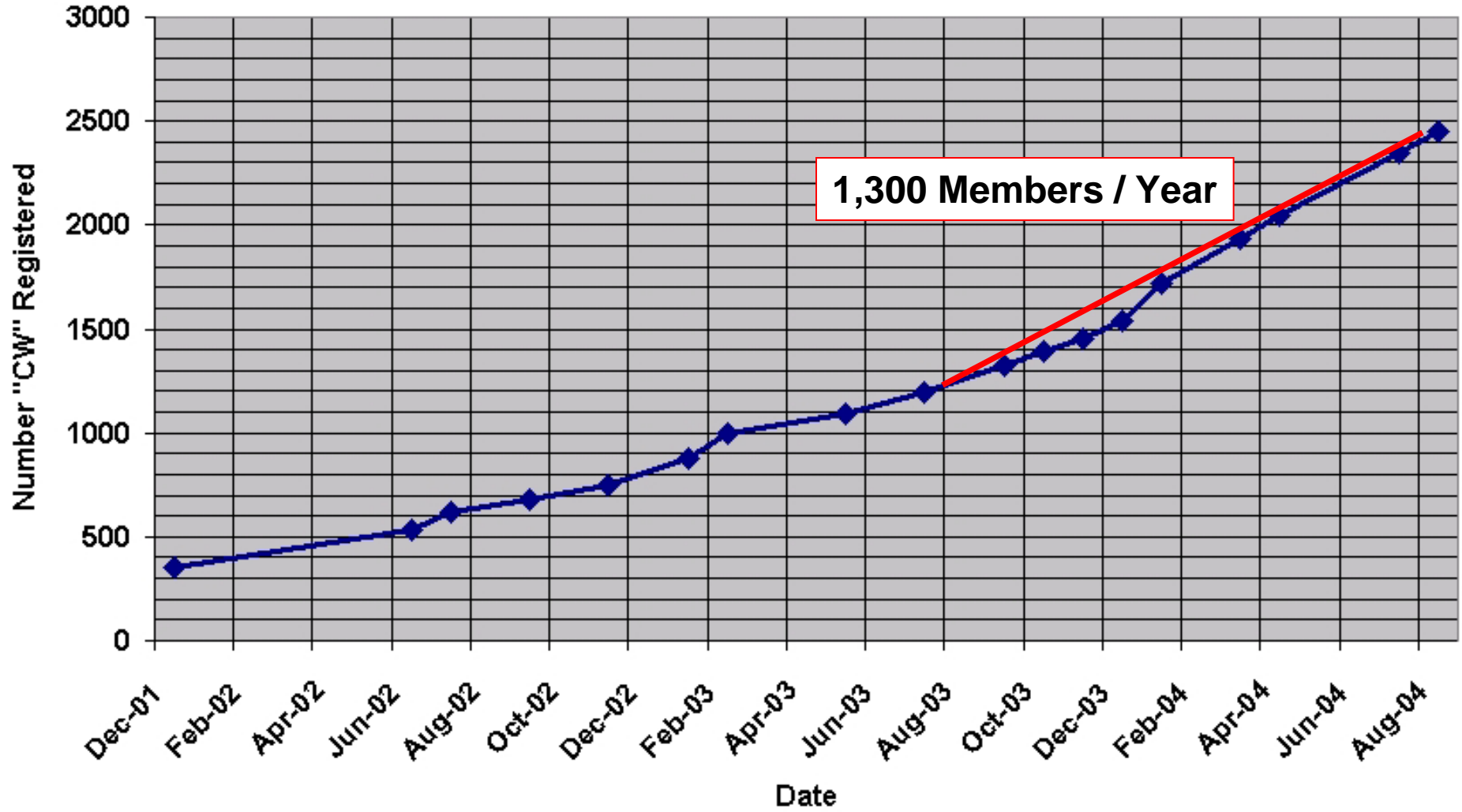# CWOP Growth:
4x in 2 Years

May 2002: 400 stations reporting

August 2004: 1,600 stations reporting

CWOP Membership Time-Series

1,300 Members / Year

CWOP Registered Stations

CWOP Registered Stations in US
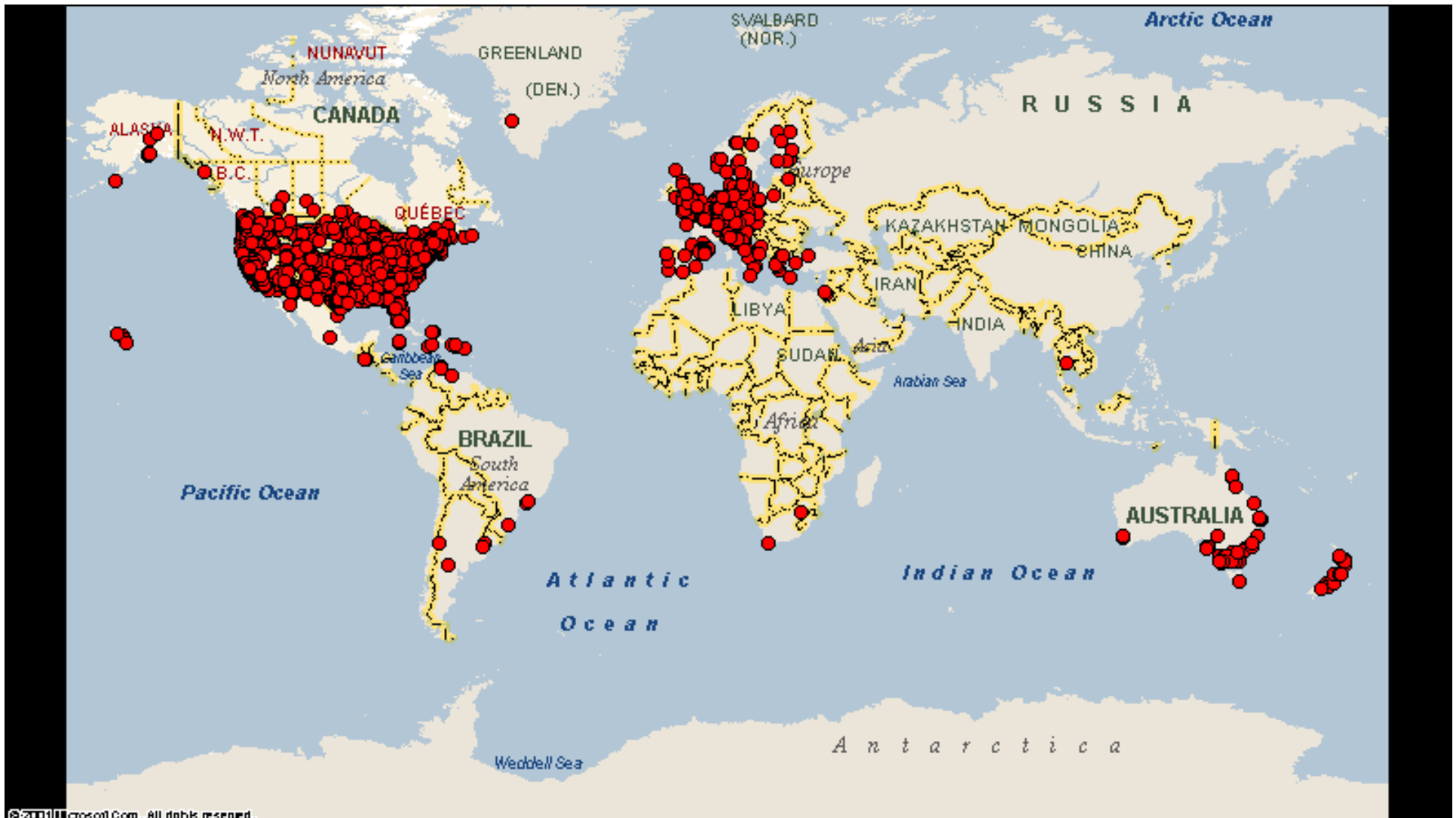
CWOP QC Feedback to Members

Quality Checking and Monitoring System (QCMS)

- part of MADIS involved with checking data quality

- http://www.wxqa.com/aprswxnetqc.html gives links

- diurnal differences between observations and analysis

- daily QCMS results can be e-mailed to members

- and…..

Philip Gladstone's CWOP QC Time Series: QCMS Analysis vs. Station Report

Barometric Pressure for C0351

Dew Point for C0351

Temperature for C0351
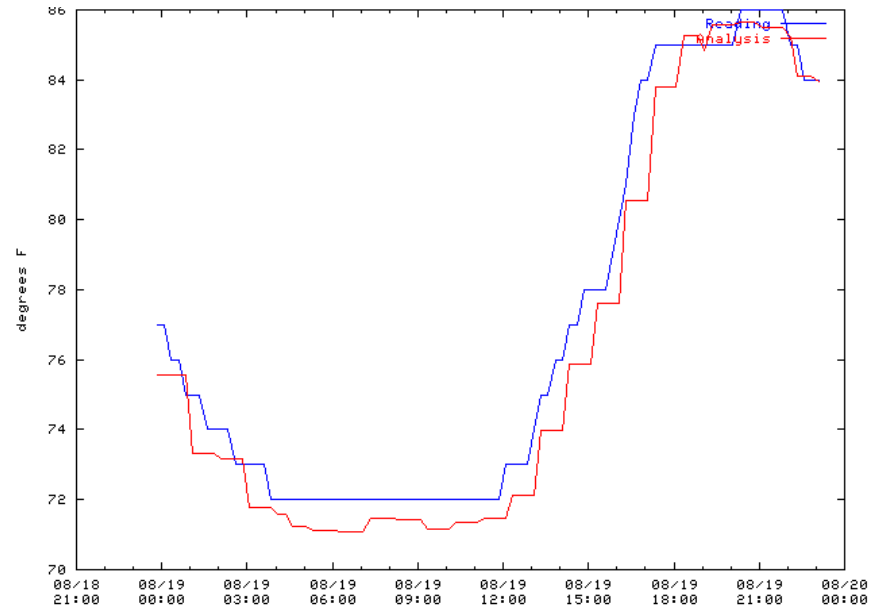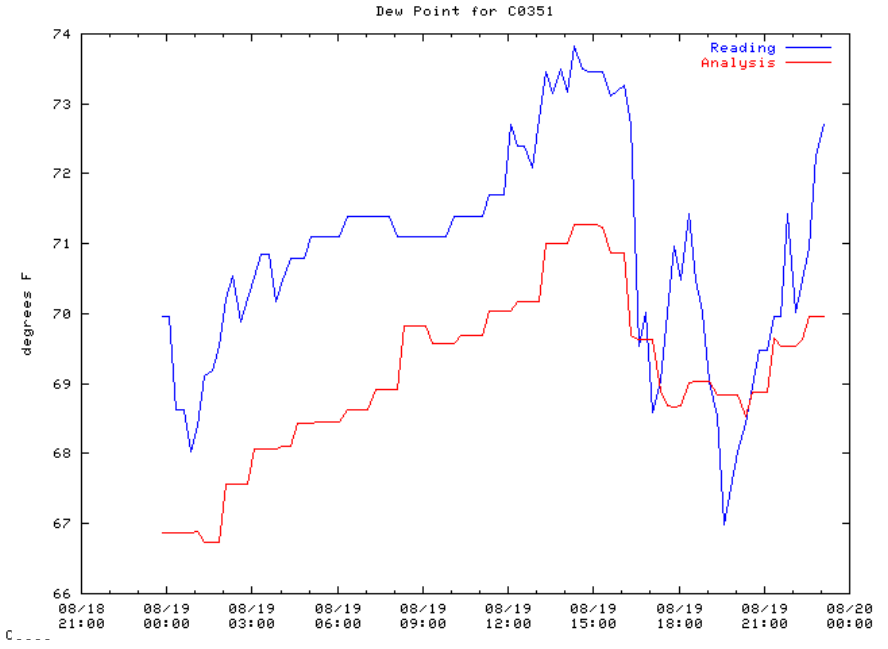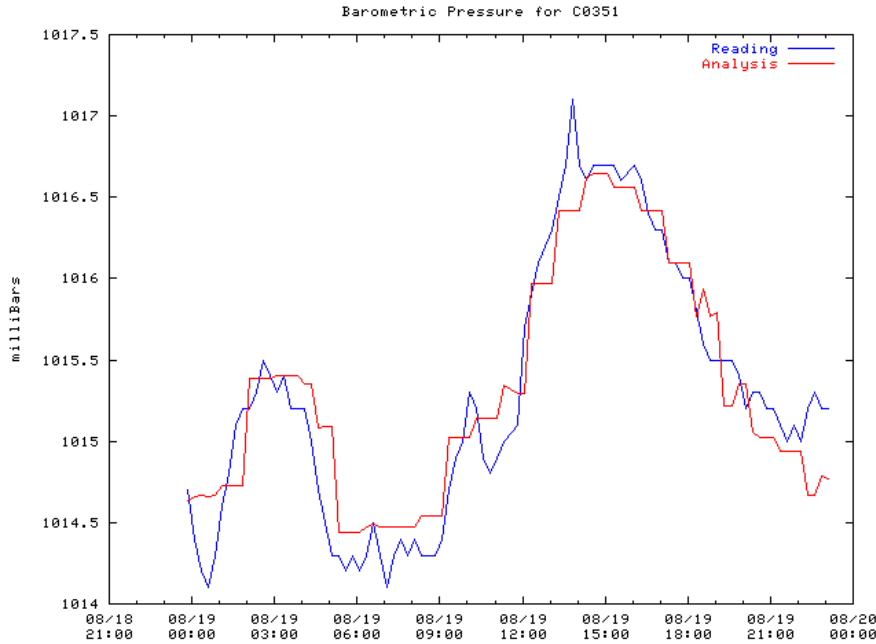
MesoWest:

## Additional Views of CWOP Data

Tabular Reports

**Weather Conditions for C0351**

Current time: August 29, 2004 - 2:18 EDT

Most Recent Observations at August 29, 2004 - 2:05 EDT

	2:05	Max since Midnight	Min since Midnight	24 Hour Max	24 Hour Min
Temperature	74.0° F	76.0 at 0:05	74.0 at 1:20	87.0 at 14:50	71.0 at 5:05
Dew Point	71.9° F	72.9 at 0:05	71.9 at 1:20	74.2 at 13:50	70.1 at 5:05
Relative Humidity	93%	93 at 1:20	90 at 0:05	100 at 7:35	60 at 15:20
Wind Speed	0 mph	0 at 0:05	0 at 0:05	5 at 12:05	0 at 2:20
Wind Gust	0 mph	0 at 0:05	0 at 0:05	9 at 16:20	0 at 2:20
Pressure	29.43 in	29.46 at 0:05	29.43 at 2:05	29.53 at 8:35	29.41 at 18:35
Sea Level Pressure	29.93 in	29.96 at 0:05	29.93 at 2:05	30.03 at 8:35	29.90 at 18:35
Altimeter	29.95 in	29.98 at 0:05	29.95 at 2:05	30.05 at 8:35	29.93 at 18:35
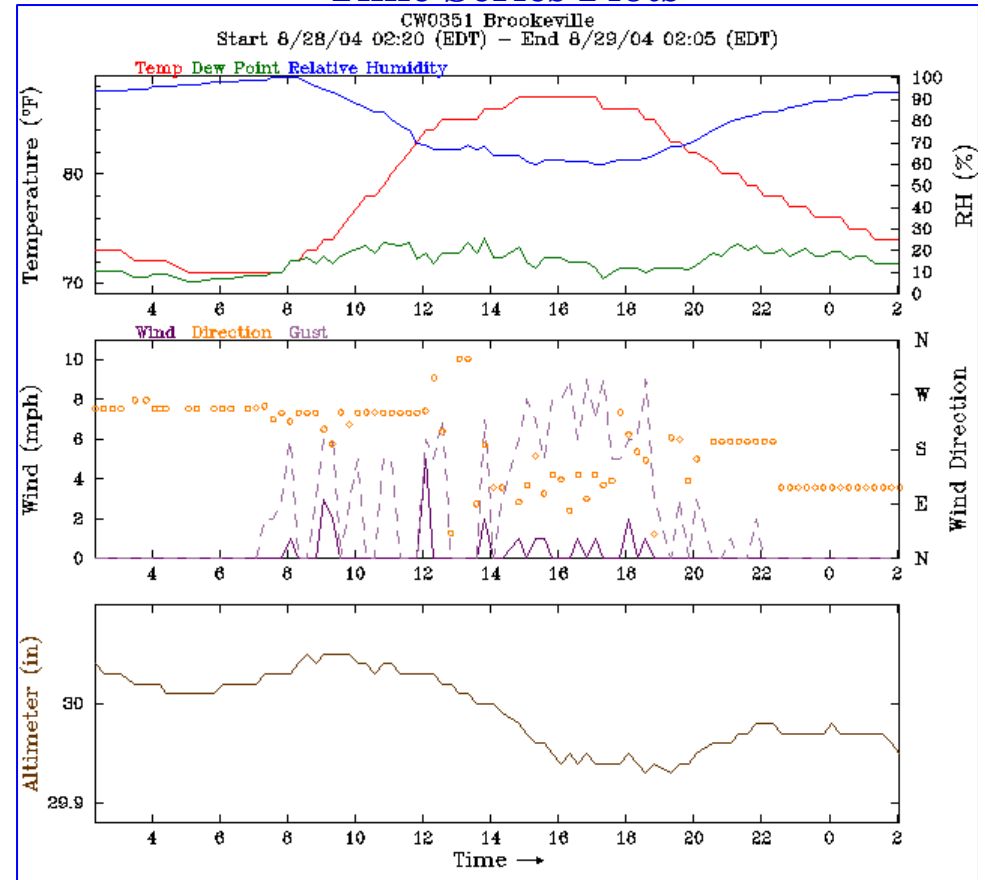
Quality Control Regression Analysis

Time Series Plots
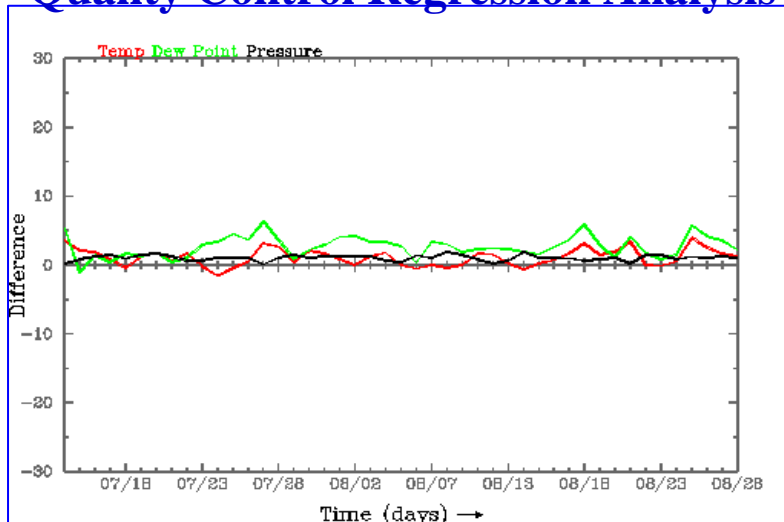
CWOP User Guide in Development
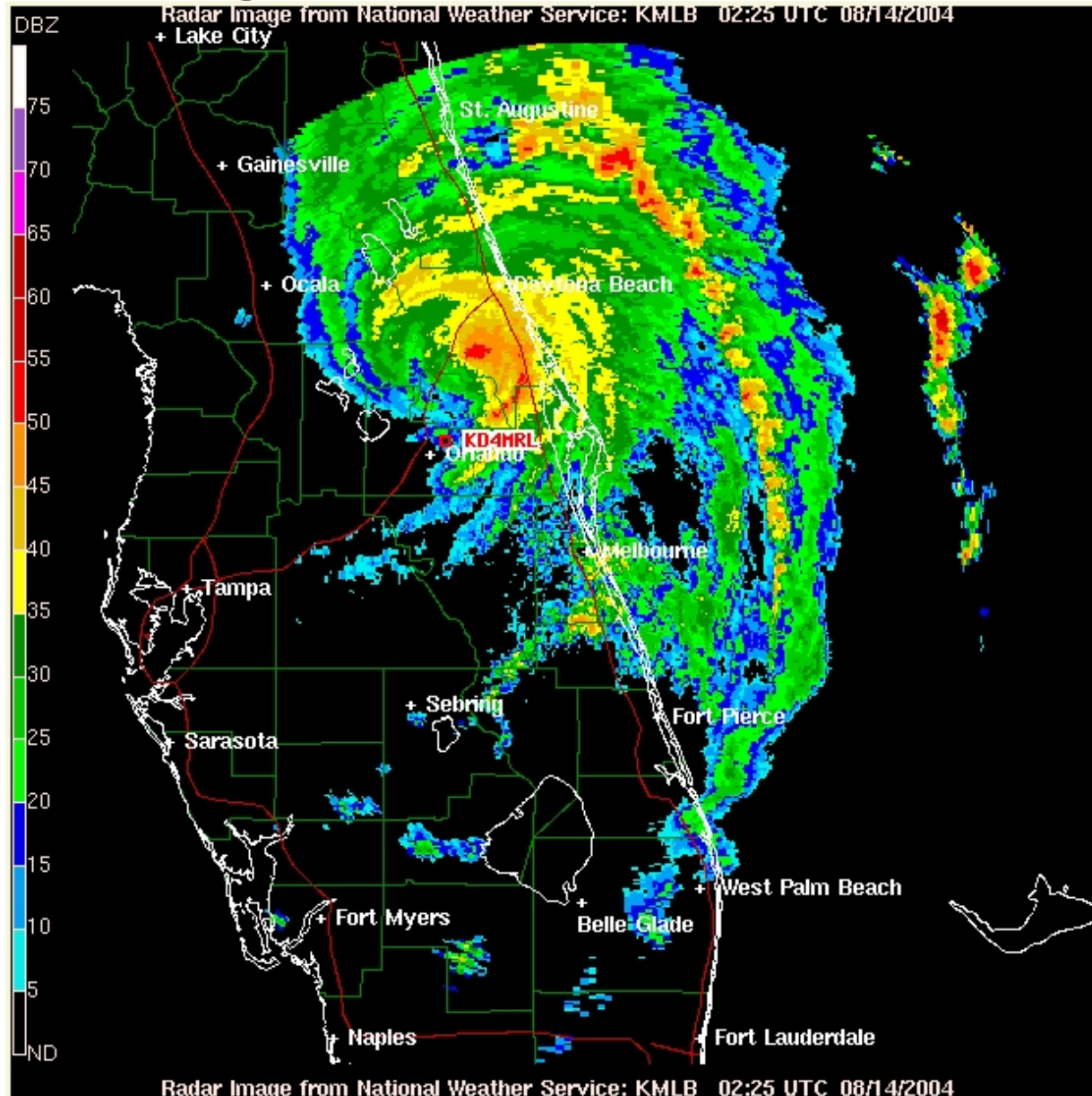
Citizen Weather Observer Program (CWOP)

Weather Station Siting, Performance, and Quality Control Guide

Version 1.0
August 2004

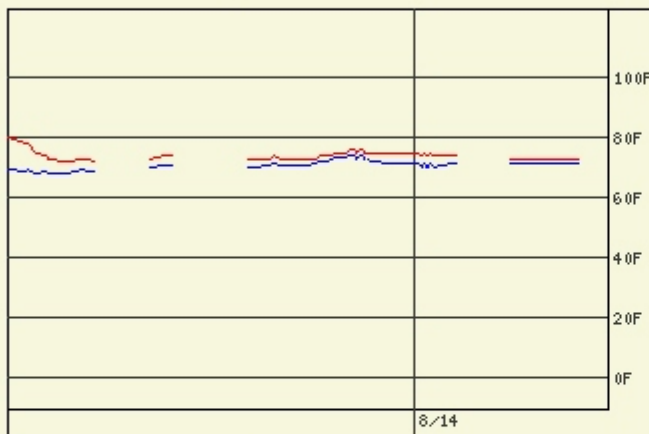# Hurricane Charley over Orlando, FL
August 14, 2004 at 0225UTC

Radar Image from National Weather Service: KMLB   02:25 UTC 08/14/2004

CWOP Station KD4MRL

Wind from 222 degrees @ 34.0 MPH Gusts to 63.0 MPH
Temp 73 F Humidity 96%
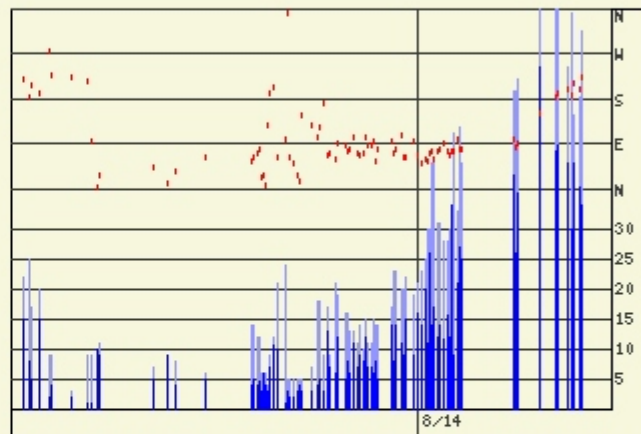
5 days ▼   Change History Interval
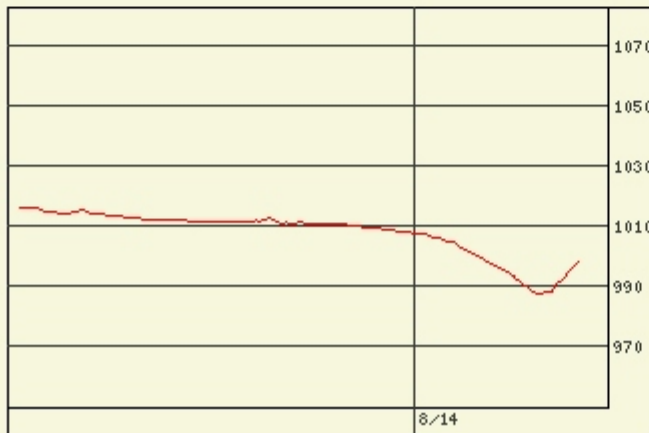
Historical Data (Last 8 hours)

Temperature/Dew point

Wind

Barometer

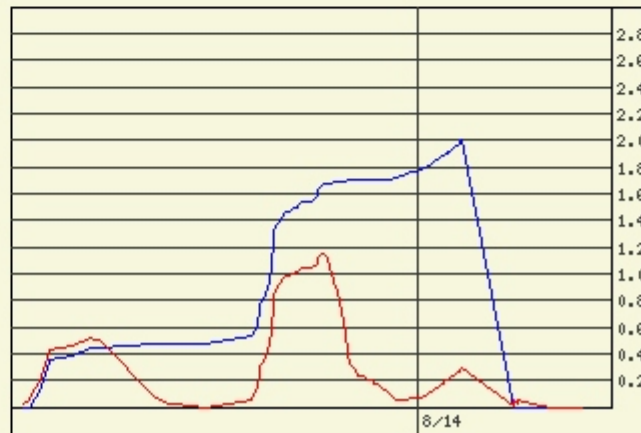Rain (last hour / since local midnight)

CWOP Station KB2RC
6.6 miles ENE
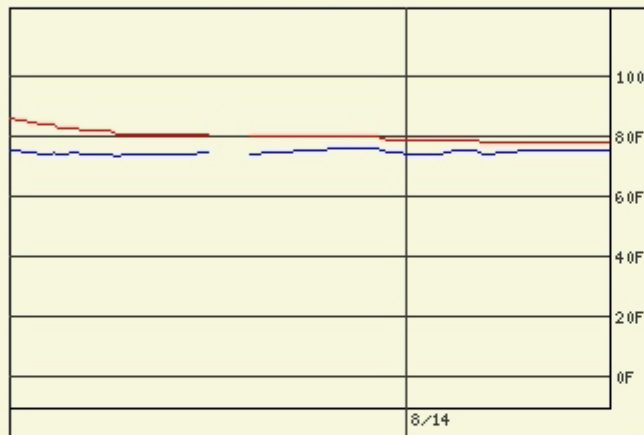
Wind from 194 degrees @ 33.0 MPH Gusts to 52.0 MPH
Temp 78 F Humidity 92% Rain last 24 hours 2.14 inches

| 5 days ▼ | Change History Interval |

Historical Data (Last 8 hours)

Temperature/Dew point

Wind
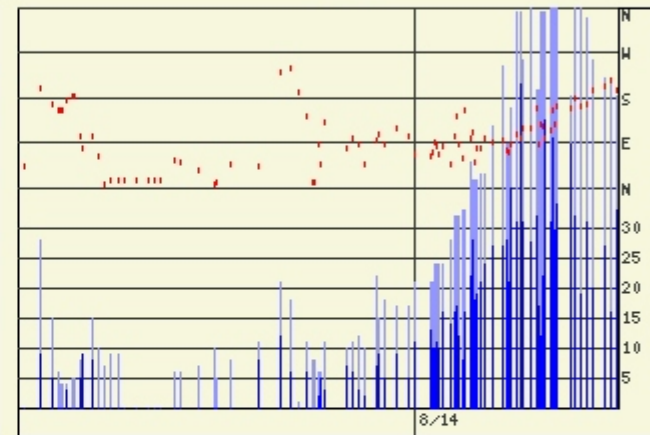
Barometer
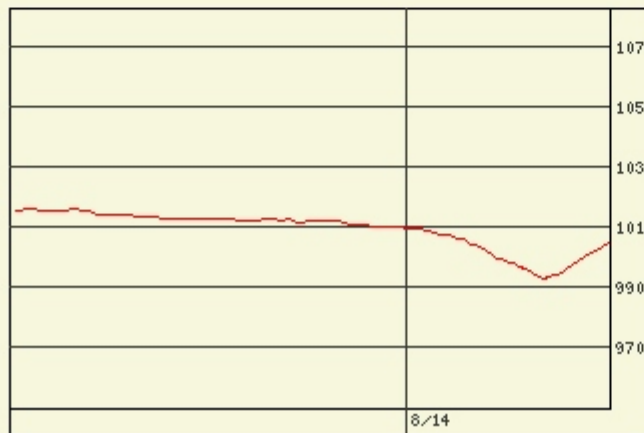
Rain (last hour / since local midnight)
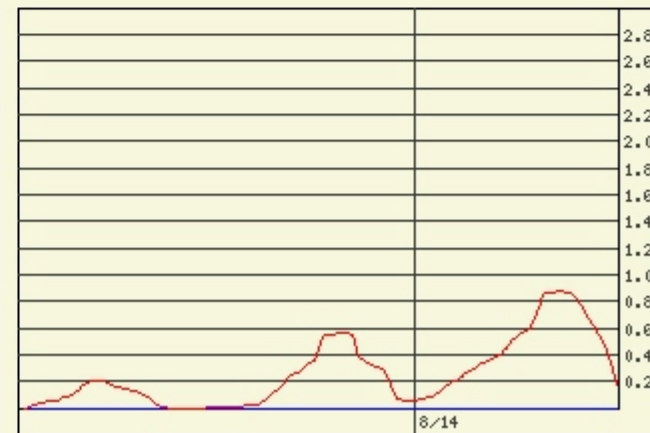
Circulation associated with Charley near Orlando, Florida
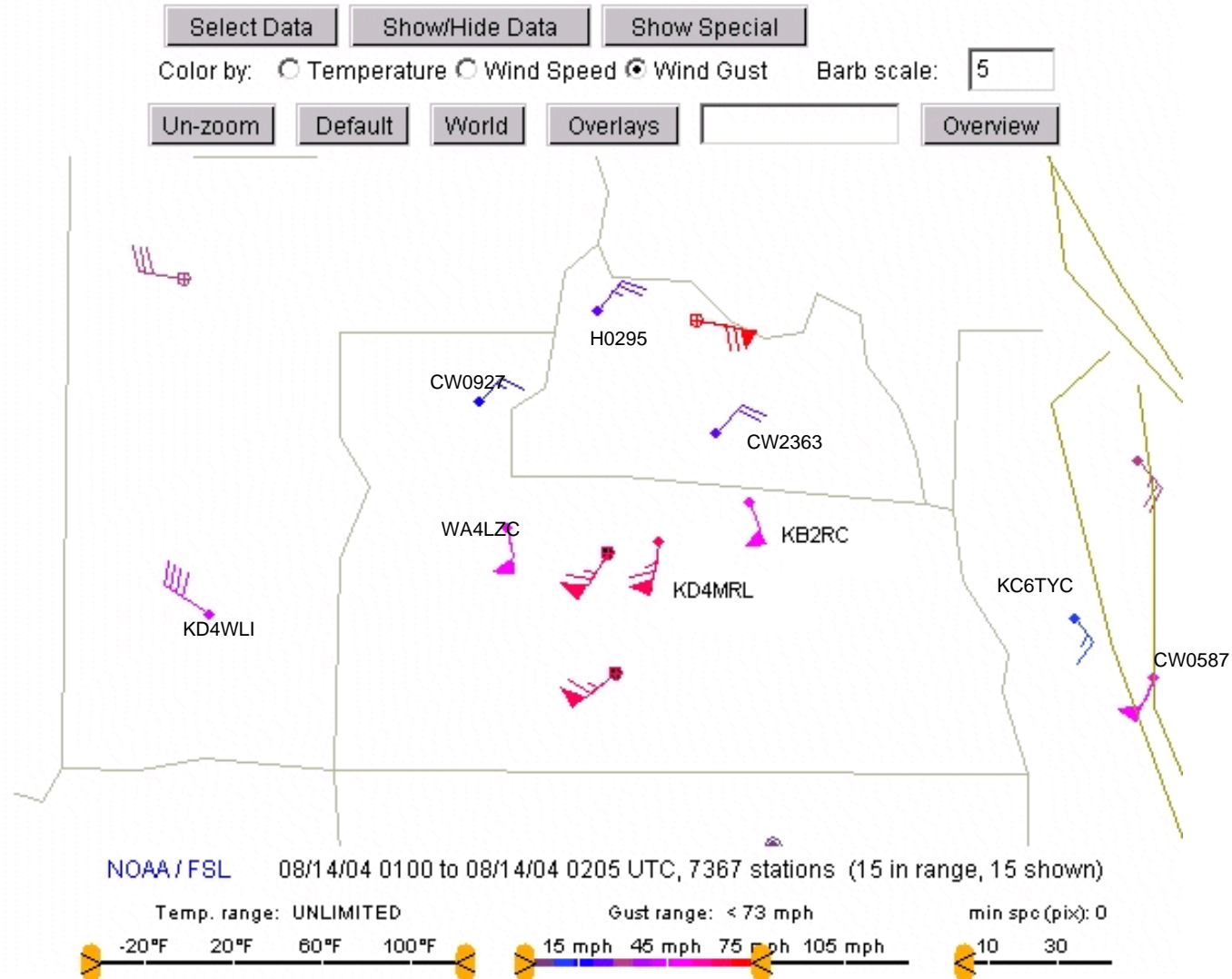
Hypothetical Poison-Gas Release in Washington DC
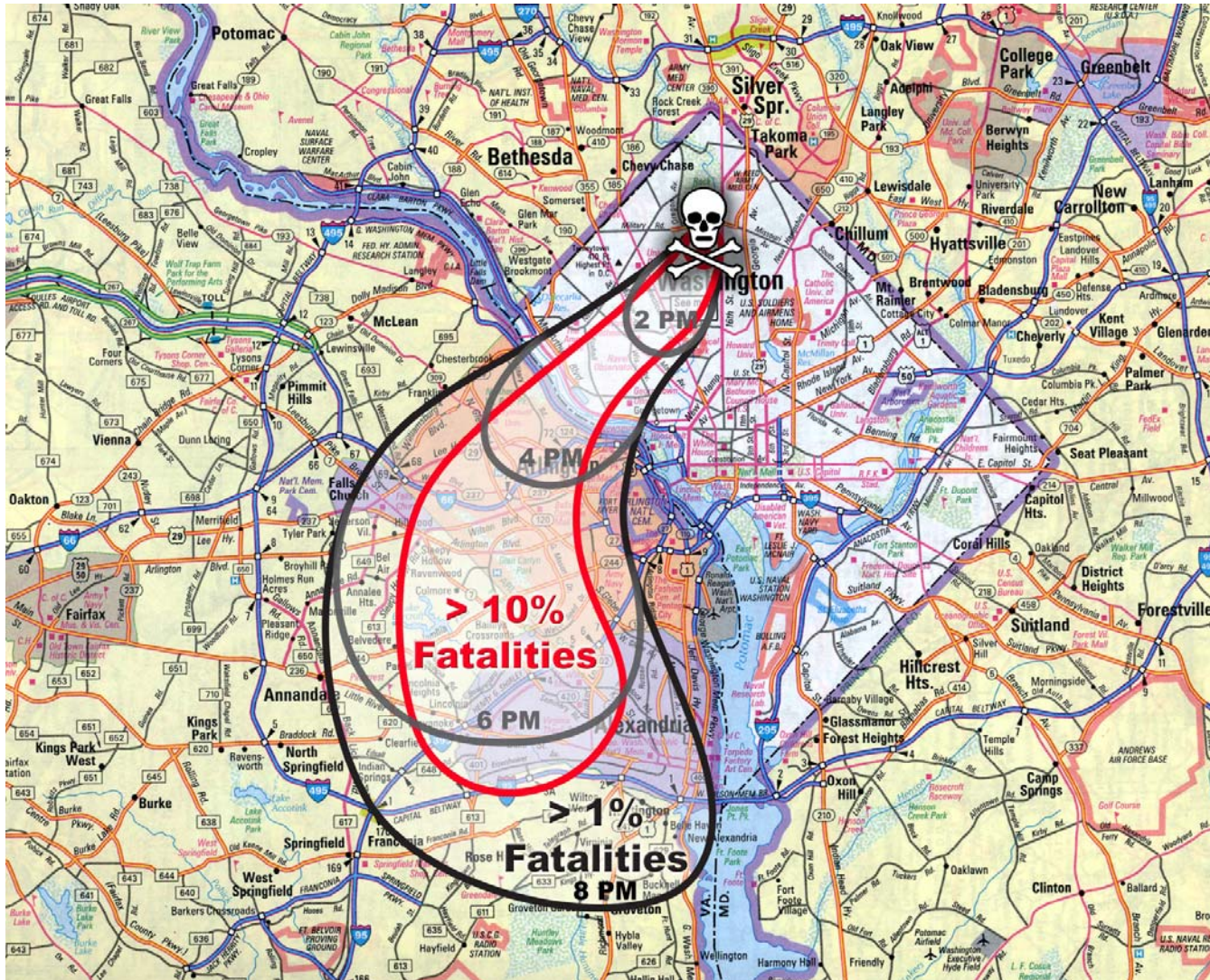
Homeland Security Response

Lawrence Livermore

IMAC

HSOC
FXC

Intrado Intellicast Call-out

First Responders

MADIS

Sterling WFO

hysplit (40s) FXC

NCEP

hysplit (10m) FXC
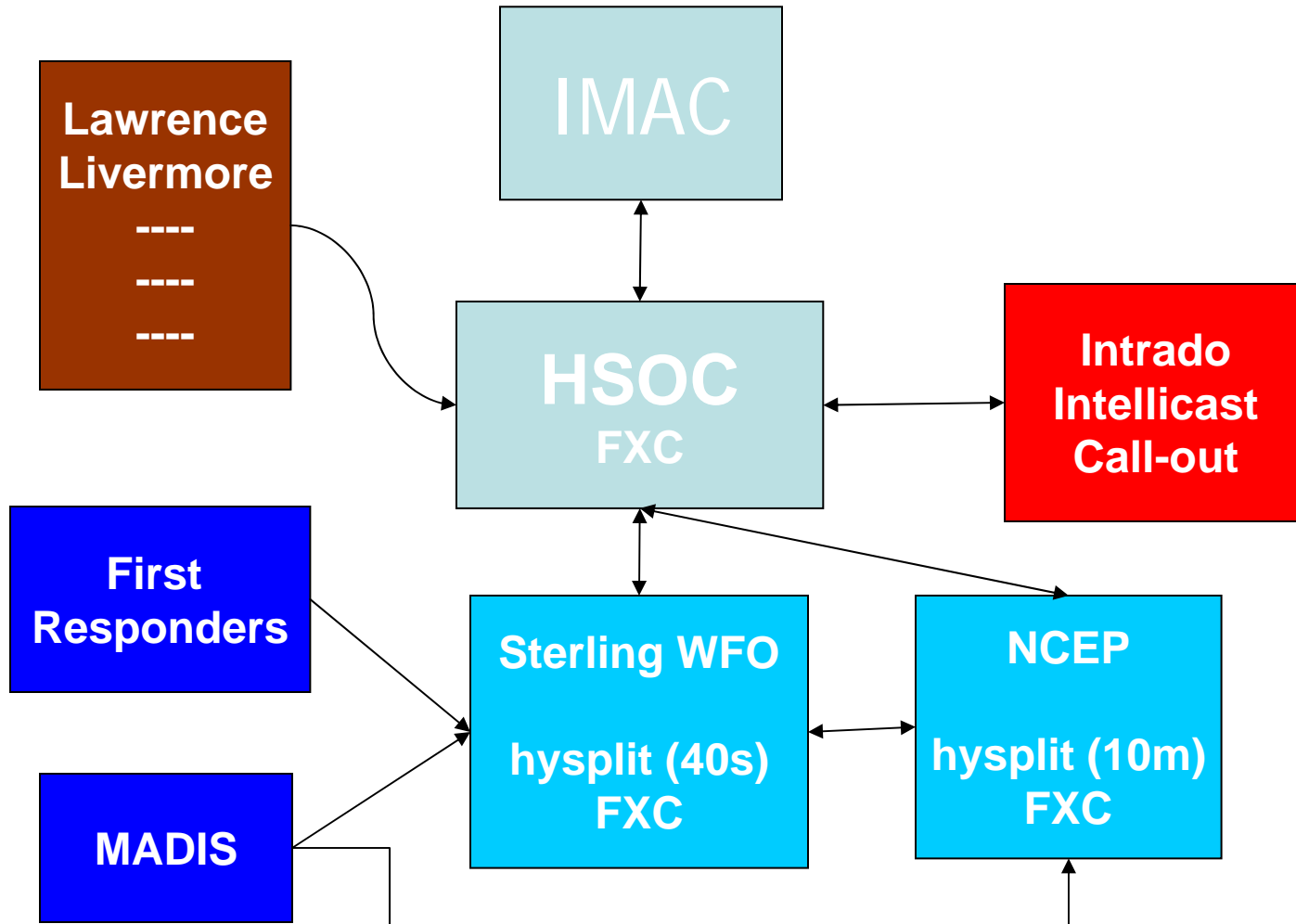
CWOP stations in Washington DC Area
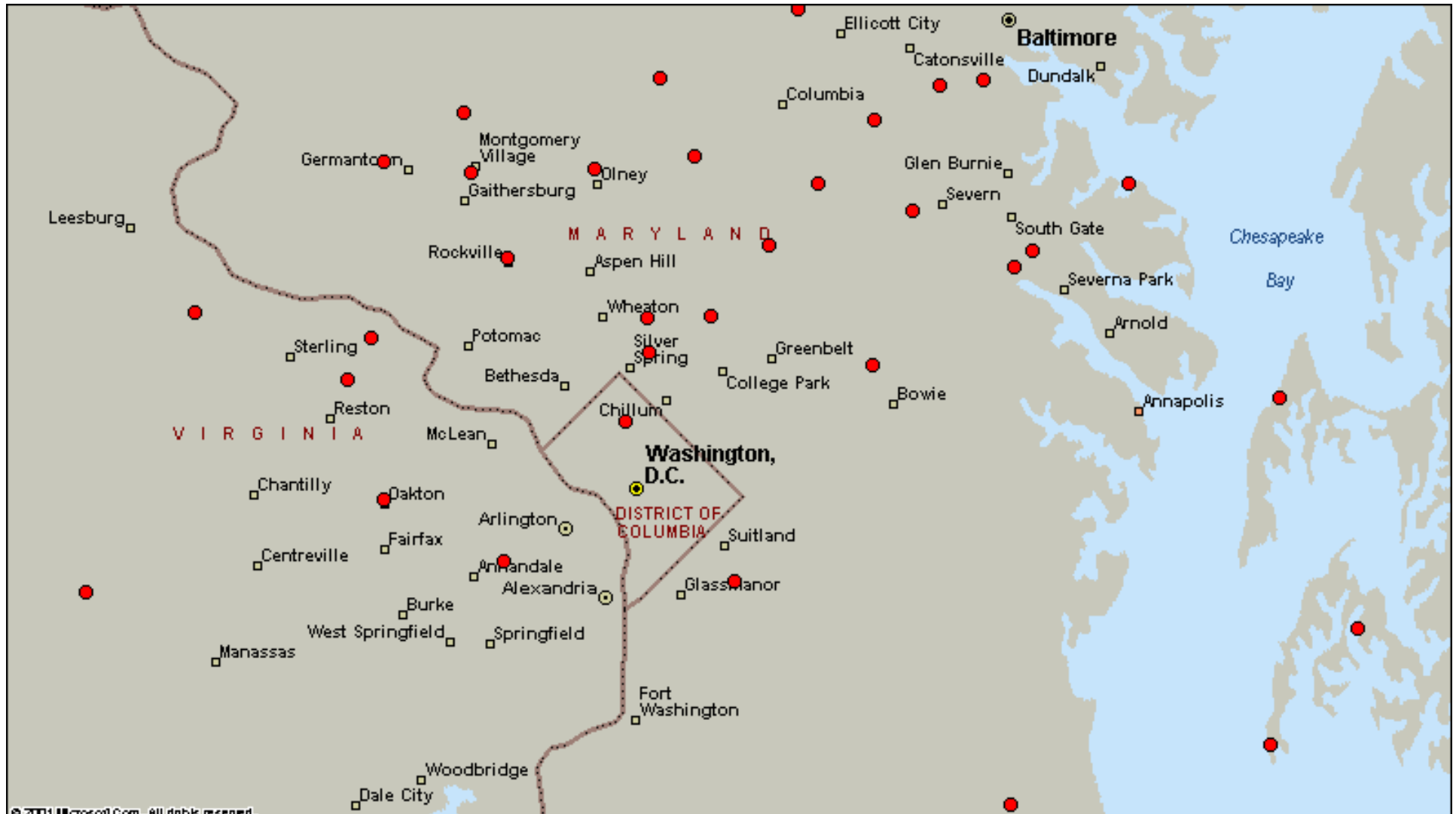
Regional CWOP Stations
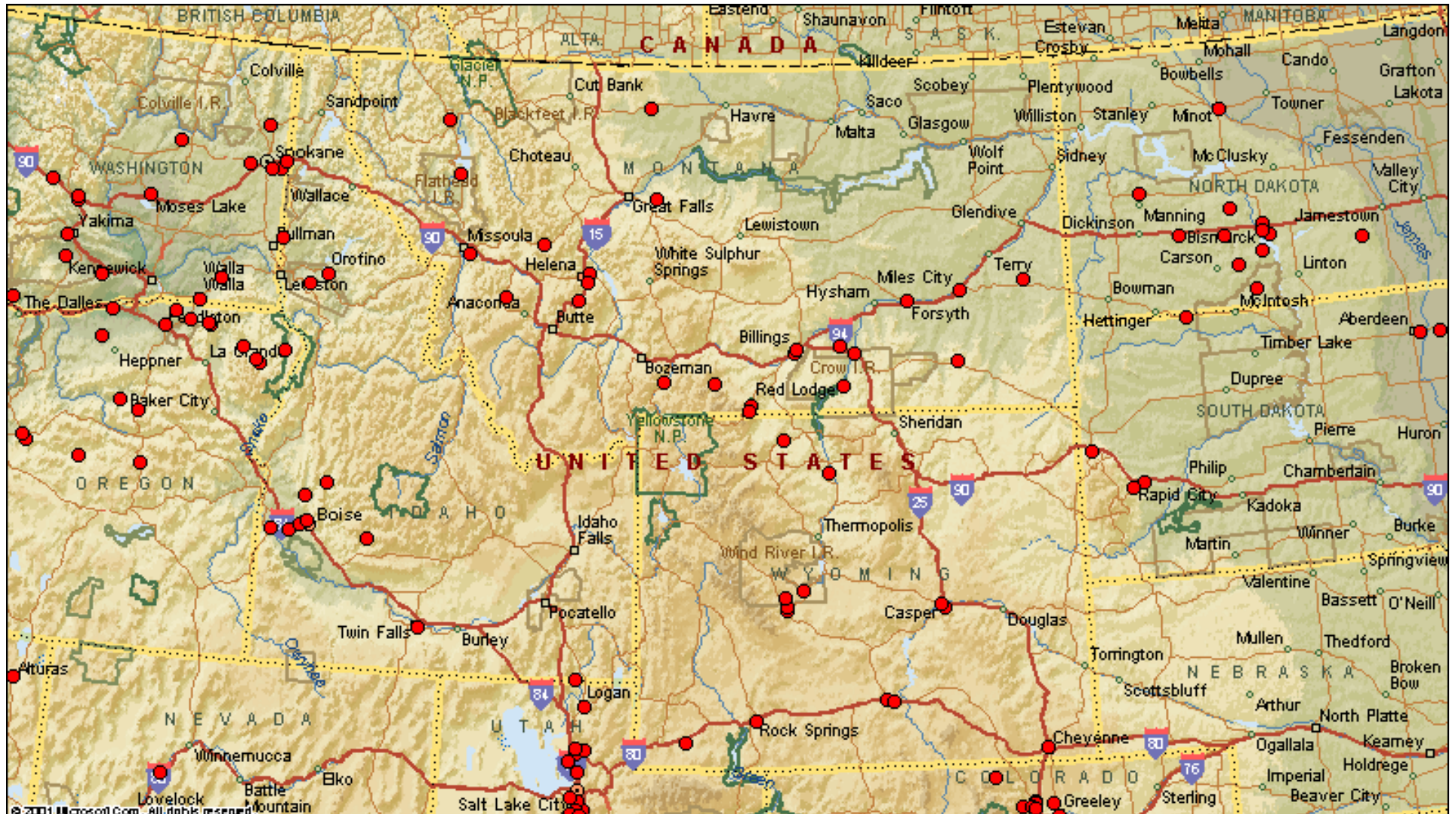
Growing a Mesonet in your CWA

-Brief the public about CWOP during Skywarn training sessions. Many already have home weather stations or would be interested in purchasing and operating one if they knew the data would be useful.

-Tell your local Ham Radio chapters and clubs about benefits of CWOP to your office. They may help support APRS-IS infrastructure and contribute additional stations to the network.

-Consider appropriate home weather station as Birthday or Christmas gift to a deserving friend or relative who has DSL. Convince them of the desirability of leaving their computer on.

-Suggest that your child's school purchase and install a home weather station and incorporate it into their science classes (REALM).

Applications of CWOP data at WFOs

- WFO Bismarck, ND (local mesonet)

- WFO Grand Rapids, MI (local mesonet)

- WFO Billings, MT (local Mesonet)

- WFO Riverton, WY (local mesonet with school participation)

- WFO Pendleton, OR (local mesonet)

- WFO Melbourne, FL (ARPS Local Model assimilation)

- WFO Huntsville, AL (ham radio collaboration adds stations
  and earns two hams 2004 NOAA Environmental Hero Awards)

How to join CWOP and send in WX data

You need: computer with internet access, WX station hardware, WX station software, CW number

www.wxqa.com click "CWOP info" for list of stations and software

www.wxqa.com click "how to join CWOP" and fill out the form to get a CW number

www.wxqa.com click "CW Packet Checking" for links to set-up software

How to join CWOP
and send WX data (cont)

Select and enter aprs server name and port number
and send a data packet

http://map.findu.com/CWxxxx where xxxx is your CW
number and check your location on the maps

If your location is OK, send e-mail to
Russell.B.Chadwick@noaa.gov

If location is wrong, recheck set-up and lat/long values
(item #3, FAQ),   4545.03N/10834.19W

Percentage of WX programs supporting CWOP currently in use
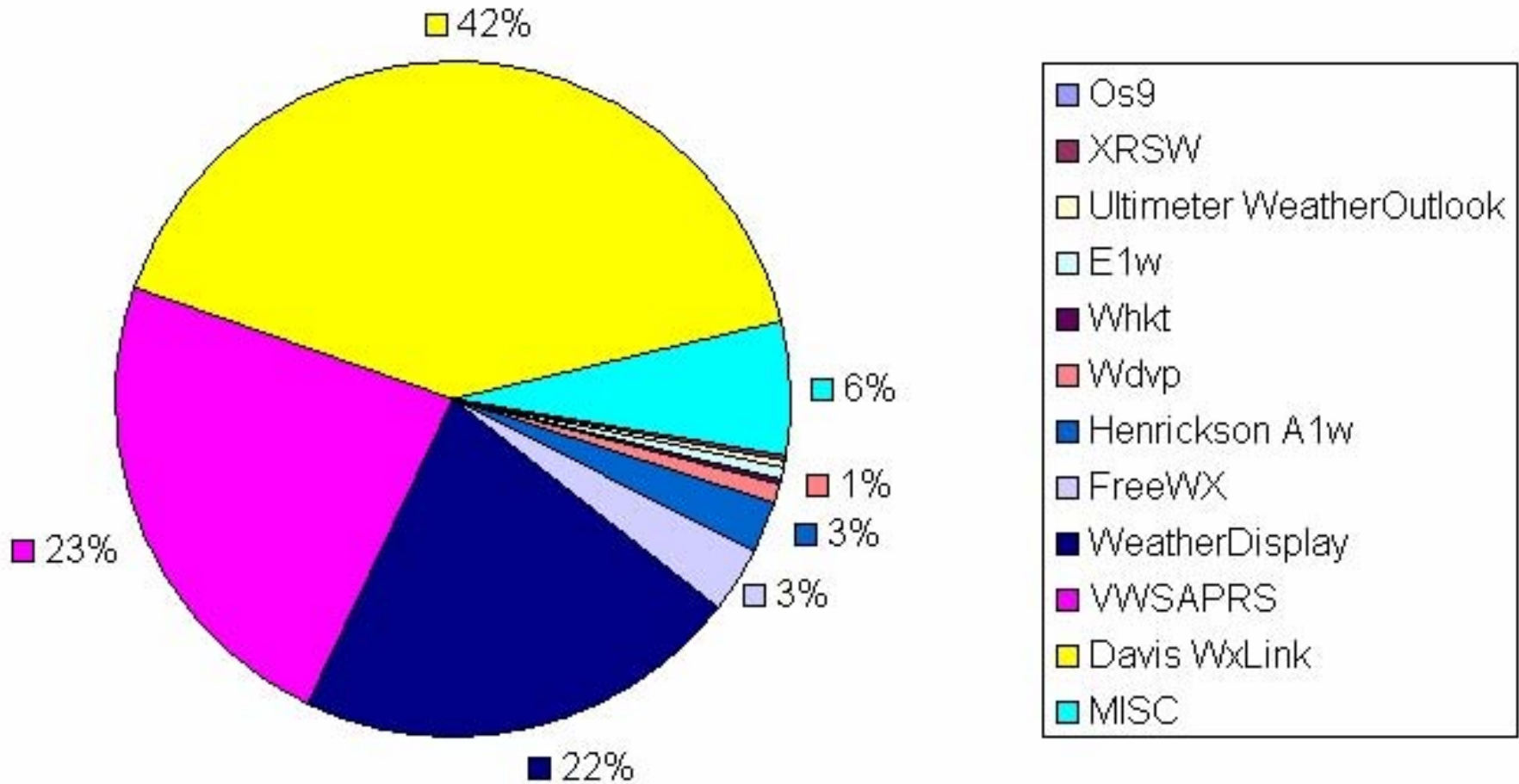
Meteorological Assimilation Data Ingest System (MADIS)

Goal: To share observations and observation-handling technology with the greater meteorological community.

Features

- Access to real-time and archived data sets
- Observational quality control
- Application Program Interface (API)
- User documentation and utility programs

MADIS Data Sets

- Upper Air Observations
  - Radiosonde
  - Automated Aircraft
  - NOAA Profiler Network (NPN) Wind Profiler
  - Multi-Agency Profiler
  - Satellite Winds

- Surface Observations
  - Meteorological Aviation Reports (METARs)
  - Maritime
  - Surface Aviation Observations (SAOs)
  - Modernized Cooperative Observer Program (COOP)
  - Mesonet

MADIS Mesonet Providers
8/30/2004

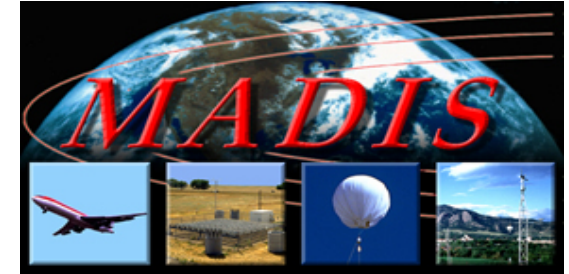| Mesonet Description	Provider Name	No. of Sites	Coverage
U.S. Army Aberdeen Proving Grounds	APG	5	Maryland
Automated Position Reporting System	APRSWXNET	2446	Global
Anything Weather Network	AWX	64	CONUS
AWS Convergence Technologies, Inc.	AWS	5648	U.S.
Colorado Department of Transportation	CODOT	108	Colorado
Colorado E-470 Public Highway Authority	CO_E-470	7	Colorado
Florida Mesonet	FL – Meso	39	Florida
Ft. Collins Utilities	FTCOLLINS	5	Colorado
Goodland WFO Miscellaneous	GLDNWS	15	CO/KS/NE
Gulf of Maine Ocean Observing System	GoMOOS	9	Gulf of Maine
FSL Ground-Based GPS	GPSMET	340	U.S.
Hydrometeorological Automated Data System	HADS	59	New England
Iowa Department of Transportation	IADOT	50	Iowa
Iowa Environmental Mesonet	IEM	88	Iowa
Boulder WFO Miscellaneous	INTERNET	13	Colorado
Kansas Department of Transportation	KSDOT	41	Kansas
LSU – JSU Mesonet	LSU-JSU	26	Louisiana/Miss.
Multi-Agency Profiler Surface Observations	MAP	15	CONUS
Cooperative Mesonets in the Western U.S.	MesoWest	2294	West CONUS
Minnesota Department of Transportation	MNDOT	92	Minnesota
National Ocean Service Physical Oceanographic Real-Time System	NOS – PORTS	39	CONUS
National Weather Service Cooperative Observer Program	NWS – COOP	113	New England
Oklahoma Mesonet	OK - Meso	116	Oklahoma
Remote Automated Weather Stations	RAWS	1863	U.S.
Radiometer	RDMTR	2	U.S.
Denver Urban Drainage & Flood Control Dist.	UDFCD	17	Colorado
Wisconsin Department of Transportation	WIDOT	58	Wisconsin
West Texas Mesonet	WT-Meso	41	Texas
Weather for You	WXforYou	413	U.S.

Total = 14,026

MADIS Mesonet Acquisition

Provides easy ingest of mesonet observations and also provides data integration and time zone and unit resolution

Input (for each mesonet)

- Data files (in any format)
- "Station" file specifying location, ID, and time zone
- "Description" file specifying variables and units

Output

- Integrated mesonet files

MADIS Surface Observation QC and Monitoring System (QCMS)

- Automated Quality Control Checks
  - Validity, temporal consistency, internal consistency, spatial consistency
- Station Monitoring
  - Hourly, daily, weekly, and monthly summaries of the frequency of failure and RMS and mean errors
- Quality Control Flag and Text Outputs

MADIS Output Data Files

- Include Observations and Quality Control Flags
- Real-Time Distribution
  - ftp, LDM, OPeNDAP
- On-Line Archive (saved real-time data files)
  - From July 1, 2001

MADIS Distribution

Provides easy distribution of observation and QC information to:

- NWS forecast offices and modeling centers
- Universities and research organizations
- Private companies
- Citizen weather data contributors
- Others

Distribution Categories:

- Distribution to NWS
- Distribution to government, research, and education organizations
- Full distribution

MADIS Software Support

- Application Program Interface (API) to read the observation and QC information

  API Advantages

  - Invisible data formats and file structures
  - Multiple retrieval of similar observations
  - Variable transformation
  - Time windowing
  - Domain specification
  - Sounding generation
  - QC information
  - Utility routines
  - Portability

MADIS/CWOP URLs

- MADIS Home Page

    www-sdd.fsl.noaa.gov/MADIS

- Real-Time Surface Observation Display

    www-frd.fsl.noaa.gov/mesonet/

- Real-Time Profiler Display

    www.profiler.noaa.gov/jsp/profiler.jsp

- Real-Time Aircraft Display

    acweb.fsl.noaa.gov

- Real-Time Upper Air Soundings

    www-frd.fsl.noaa.gov/soundings/java

- CWOP Home Page

    www.wxqa.com