EPA-NOAA Brewer UV-ozone network-2 (UVnet2)
Overview and current status
UVnet-2 personnel

Dr Peter Kiedron
Senior research scientist

Scott Stierle
Programmer/technician
EPA-NOAA Brewer Monitoring Sites

- Ft Peck, MT
- Bondville, IL
- MRS-Niwot Ridge, CO
- Boulder, CO
- Raleigh, NC
- Houston, TX

Legend:
- EPA-NOAA
- SURFRAD
- USDA
NOAA SURFRAD site instrumentation:
- Visible multi-filter rotating shadowband radiometer
- Yankee UVB-1 broadband radiometer
- Spectrosun pyranometer
- Pyrgeometer
- LICOR sensor
- Meteorological tower, which includes upwelling PSP and pyrgeometer
- Tracker with normal incidence pyranometer, shaded PSP and pyrgeometer

USDA monitoring site instrumentation:
- Yankee visible multi-filter rotating shadowband radiometer
- Yankee UV multi-filter rotating shadowband radiometer
- Yankee UVB-1 broadband radiometer
- LICOR sensor
- Temperature and relative humidity probe
<table>
<thead>
<tr>
<th>BREWER</th>
<th>SERIAL #</th>
<th>LATITUDE</th>
<th>LONGITUDE</th>
<th>ELEVATION</th>
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<tbody>
<tr>
<td>Raleigh, NC</td>
<td>96-140</td>
<td>N 35.728</td>
<td>W 078.680</td>
<td>124 masl</td>
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<tr>
<td>MRS, CO</td>
<td>97-146</td>
<td>N 40.032</td>
<td>W 105.533</td>
<td>2923 masl</td>
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<tr>
<td>Ft Peck, MT</td>
<td>97-147</td>
<td>N 48.308</td>
<td>W 105.102</td>
<td>634 masl</td>
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<td>Houston, TX</td>
<td>97-154</td>
<td>N 29.718</td>
<td>W 095.341</td>
<td>84 masl</td>
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<tr>
<td>Bondville, IL</td>
<td>96-144</td>
<td>N 40.053</td>
<td>W 088.372</td>
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<tr>
<td>Table Mtn, CO</td>
<td>94-108</td>
<td>N 40.125</td>
<td>W 105.237</td>
<td>1689 masl</td>
</tr>
<tr>
<td>Table Mtn, CO</td>
<td>96-139</td>
<td>N 40.125</td>
<td>W 105.237</td>
<td>1689 masl</td>
</tr>
<tr>
<td>Table Mtn, CO</td>
<td>96-141</td>
<td>N 40.125</td>
<td>W 105.237</td>
<td>1689 masl</td>
</tr>
</tbody>
</table>
NETWORK OBJECTIVE

To produce high quality solar UV spectral irradiance and total column ozone measurements for our research and collaborating researchers.

GENERAL RESEARCH DIRECTIONS

How clouds and other meteorological conditions affect surface UV levels (and radiative forcings)?

How tropospheric pollution (ozone and fine particles) affect surface UV levels (and radiative forcings)?

How do surface UV and ozone observations compare to space-based measurements of UV and ozone at these sites?

How do variations in stratospheric ozone concentrations affect surface UV levels?
Brewer Mark IV command structure and sample schedule

O3-mode

DS – direct sun ozone measurement
ZS – zenith sky measurement
UM – Umkehr measurement
UX – extended UV spectral scan
PS – direct sun measurement

N2-mode

DS – direct sun NO₂ measurement
ZS – zenith sky NO₂ measurement

SAMPLE SCHEDULE
-115
jdb2w1ci
-105
pfo3rshgsltdsln2sl
-93
pf2zszszszszsz
-90
pfo3hgum
-85.803
pfWZuxzsum
-80.803
pfWZuxzsum
-75.803
pfWZb1uxhgzsds
-70.803
pfo3WZb1uxhgs2dso3psds
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pfo3WZb1uxhgs2dso3psds
-55.803
pfo3WZb1uxhgs2dso3psds
-50.803
pfo3WZb1uxhgs2dso3psds
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<tr>
<th>Slit Mask Position</th>
<th>Wavelengths</th>
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<td>UV</td>
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<td></td>
<td>303.2</td>
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<td>Wavelength 1</td>
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<td></td>
<td>Wavelength 3</td>
</tr>
<tr>
<td></td>
<td>Wavelength 2 &amp; 4</td>
</tr>
</tbody>
</table>

Brewer nominal slit mask operational wavelengths
Brewer 97-147 Ft Peck, Montana

Collocated Instruments:
- NOAA SURFRAD site
- USDA monitoring site
- NOAA Surface flux measurement
- Climate reference network site (CRN)
- IMPROVE site
Brewer 96-146  Mountain Research Station
Niwot Ridge, CO

**Collocated Instruments:**
- UV-MFRSR
- vis-MFRSR
- UVB-1 radiometer
- UVA radiometer
- Eppley PSP pyranometer
- Pressure, T & RH probe
Brewer 93-101 Table Mountain Test Facility, Boulder, Colorado

Collocated Instruments:
- NOAA SURFRAD site
- USDA research site
- USDA reference spectroradiometer
- SUNY UV-rotating shadowband spectroradiometer
- CUCF reference Yankee and Solarlight broadbands
- Smithsonian 18 channel UV-filter radiometer
- Biospherical Instruments GUV-511 UV radiometer
- Total Sky Camera
Brewer 97-154  
University of Houston  
Houston, Texas

**Collocated Instruments:**
USDA monitoring site  
Total Sky Camera  
Meteorological tower  
Cimel sun photometer
Brewer 96-144  Bondville, Illinois

Collocated instruments:
EPA/CASTnet IMPROVE protocol site
NOAA SURFRAD site
USDA UV site
Climate reference network (CRN)
Aeronet site-Cimel sun-photometer
Total Sky Camera
Brewer 96-140    Raleigh, North Carolina

Collocated instruments:
USDA monitoring site
The NOAA/EPA Brewer Spectrophotometer Network consists of six stations located in the central and eastern United States. Each Brewer instrument provides daily Ultra-Violet (UV) Radiation and Total-Column Ozone measurements. Some Brewers are co-located at NOAA SURFRAD stations equipped with UV instrumentation and Total Sky Imagers.

### Brewer Deployments:

- **Houston, TX**: July 24, 2006
- **HAO, CO**: Oct 25, 2006
- **Bondville, IL**: Sep 25, 2006
- **Raleigh, NC**: Oct 13, 2006
- **Ft. Peck, MT**: Nov 07, 2006

### Summary Data for yyyy-mm-dd

<table>
<thead>
<tr>
<th>Station</th>
<th>AVG UV</th>
<th>UV Index</th>
<th>AVG TC DS O3</th>
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<tr>
<td>HAO</td>
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<td>FT. PECK</td>
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<tr>
<td>RALEIGH</td>
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</tbody>
</table>
The Table Mountain Test Facility located 7-miles north of Boulder is the home for the NOAA-EPABrewer Network Reference Triad.

**Location:**
- Boulder, Colorado
- Latitude: 40.125
- Longitude: -105.237
- Elevation: 5541.3 ft, 1689 m

**Brewer Instruments:**
- Brewer MKIV Spectrophotometer:
  - BR-101, BR-108, BR-139

**Co-located Instruments:**
- Total Sky Imager
- U111 Spectroradiometer

**Contacts:**
- Patrick Disterhoft
  - 303-497-6355
  - patrick.disterhoft@noaa.gov
- Scott Stierle
  - 303-497-6620
  - scott.stierle@noaa.gov
- Peter Kiedron
  - 303-497-4937
  - Peter.Kiedron@noaa.gov

The Table Mountain Test Facility located 7-miles north of Boulder is the home for the NOAA-EPABrewer Network Reference Triad.
<table>
<thead>
<tr>
<th>Brewer UID</th>
<th>Active</th>
<th>Brewer Serial #</th>
<th>Tracker Serial #</th>
<th>Schedule</th>
<th>Heater Option</th>
<th>Comms Option</th>
<th>Comms Method</th>
<th>Property #</th>
<th>Notes</th>
<th>Create Date</th>
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<tr>
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<td>Yes</td>
<td>93-101</td>
<td>93-101</td>
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<td>C00001441619 Nov 6, 2006 - Logged into Brewer...</td>
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<td>EPA96e</td>
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<td>ICC-485s</td>
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<td>RS-485</td>
<td>C00001441601 Located at Raleigh, NC.</td>
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<td>BR103</td>
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<td>??-103</td>
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<td>RS-485</td>
<td>C00001441603 in storage at TMTF.</td>
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<td>??-109</td>
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<td>C00001441606 in storage at TMTF.</td>
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<td>IC-485s</td>
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<td>C00001441607 in storage at TMTF.</td>
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<td>IC-485s</td>
<td>RS-485</td>
<td>C00001441612 in storage at TMTF.</td>
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<td>2006-08-15 12:19:48</td>
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<td>??-137</td>
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<td>No</td>
<td>IC-485s</td>
<td>RS-485</td>
<td>C00001441615 In Lab at DSRC. CV Azimuth switch...</td>
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<td>2006-08-14 14:34:01</td>
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Record Count: 23 of 23
**Brewer Information (brewer)**

- **Brewer UID:** BR101  (*Example: BR199*
- **Active:** Yes
- **Brewer Serial #:** 93-101  (*Example: yy-###*
- **Tracker Serial #:** 93-101  (*Example: yy-###*
- **Schedule:** EPA96a
- **Heater Option:** No  Yes, if Brewer Inst. has internal heater installed
- **Comms Option:** ICC-11  Type of Internal 232-485 Converter
- **Comms Method:** RS-485  Comms Protocol
- **Property #:** CD0001441682
- **Notes:**
  - Sep 18, 2006 16:48 GMT - uploaded new HG.rtn and restarted Schedule.
  - Sep 11, 2006 - Brewer to PC Comms error timeout, Brewer responding to reset.
  - Operating at TNTF.
  - Slated for TNTF Reference Tried.

- **Create Date:** 2006-06-26 00:06:02
- **Created By:** postgres
- **Last Mod Date:** 2006-11-02 16:21:16
- **Last Mod By:** stierie
Quality control procedures for Brewer spectral UV data

Temperature corrections

Temporal corrections between external calibrations

Wavelength stability – Hg lamp stability, Fraunhofer algorithm

Cosine response correction

Removal of data spikes

Calculation of erythema
## Network instrument performance and stability tracking

<table>
<thead>
<tr>
<th>Command</th>
<th>Measurement</th>
<th>Function</th>
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<tbody>
<tr>
<td>AP</td>
<td>Voltages</td>
<td>Monitor power supplies and PMT supply voltage</td>
</tr>
<tr>
<td>AP</td>
<td>Humidity</td>
<td>Monitor internal instrument humidity</td>
</tr>
<tr>
<td>SL</td>
<td>Internal QTH lamp</td>
<td>Track ozone and SO2 calibration (also filters)</td>
</tr>
<tr>
<td>CI</td>
<td>Spectral scan of QTH lamp</td>
<td>Track UV calibration stability</td>
</tr>
<tr>
<td>DT</td>
<td>PMT dead-time test</td>
<td>Monitor signal detection electronics and PMT</td>
</tr>
<tr>
<td>RS</td>
<td>Shutter run/stop ratio test</td>
<td>Confirm proper shutter operation</td>
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<tr>
<td>UX</td>
<td>Extended UV scan</td>
<td>PMT dark signal</td>
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<tr>
<td>HG</td>
<td>302.1 nm mercury line scan</td>
<td>Update wavelength registration</td>
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<tr>
<td>SH</td>
<td>Shutter timing test</td>
<td>Insure proper timing constant</td>
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<tr>
<td>AP</td>
<td>Temperatures</td>
<td>Monitor 3 internal thermistors</td>
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## Site status: operations and calibrations

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<tr>
<th>BREWER</th>
<th>OPERATIONAL</th>
<th>UV CALIBRATION</th>
<th>OZONE CALIBRATION</th>
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<tbody>
<tr>
<td>Ft Peck, MT Brewer 97-147</td>
<td>YES</td>
<td>November 6, 2006</td>
<td>August 2006</td>
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<tr>
<td>Boulder, CO Brewer 94-108</td>
<td>YES</td>
<td>No</td>
<td>August 2006</td>
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<tr>
<td>Boulder, CO Brewer 96-139</td>
<td>YES</td>
<td>No</td>
<td>August 2006</td>
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<tr>
<td>Boulder, CO Brewer 96-141</td>
<td>YES</td>
<td>No</td>
<td>August 2006</td>
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<tr>
<td>MRS, Niwot Ridge Brewer 96-146</td>
<td>YES</td>
<td>No</td>
<td>August 2006</td>
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<td>Houston, TX Brewer 97-154</td>
<td>YES</td>
<td>July 21, 2006</td>
<td>No</td>
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<td>Bondville, IL Brewer 96-144</td>
<td>YES</td>
<td>September 24, 2006</td>
<td>August 2006</td>
</tr>
<tr>
<td>Raleigh, NC Brewer 96-140</td>
<td>YES</td>
<td>October 13, 2006</td>
<td>August 2006</td>
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DEVELOPING AND FUTURE WORK

• Ozone reference triad at Table Mtn, CO
  Brewers 108, 139 and 141

• Total column NO₂ retrievals
  431-453 nm range

• DSRC Brewer
  Complete the regional triad

• Mauna Loa Brewer Mark IV for ozone calibrations
  Derive ozone calibration from Langley method

• Traveling ozone reference Brewer
  Field verification of network instruments

• Temperature sensitivity of ozone measurements

• Component replacement to reduce temperature dependence of UV measurements