Low-Power Instrumentation for Ozone Data Collection at Remote Sites

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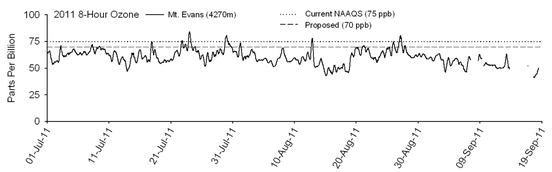
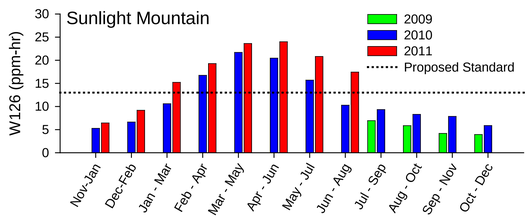
Introduction:

The US Environmental Protection Agency (USEPA) has proposed regulatory changes that may increase the need for remote-site ozone data collection. A new primary 8-hour ozone standard of 70 ppb may be established, and a secondary standard using a new metric, W126, may be used in the future to evaluate ozone effects on vegetation. We have developed hardware and procedures for deploying low-power ozone analyzers in remote locations where data collection may be required in support of the proposed standards. These stand-alone installations are automated, solar-powered, and pack-transportable. Three versions of the installation, ranging in cost from $7960 to $14,600, have been extensively field-tested at up to 4300m elevation and down to -25°C ambient temperature.



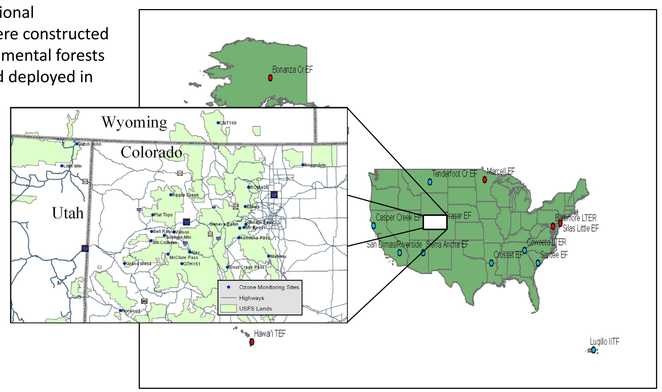
A high-elevation site (Mt. Evans, Colorado, 4270m) recorded multiple exceedances of the current and proposed 8-hour ozone NAAQS in 2011.

Another high-elevation site (Sunlight Mtn., Colorado, 3224m) exceeded the proposed daytime W126 standard of 13 ppm-hours in spring and summer of 2010 and 2011.



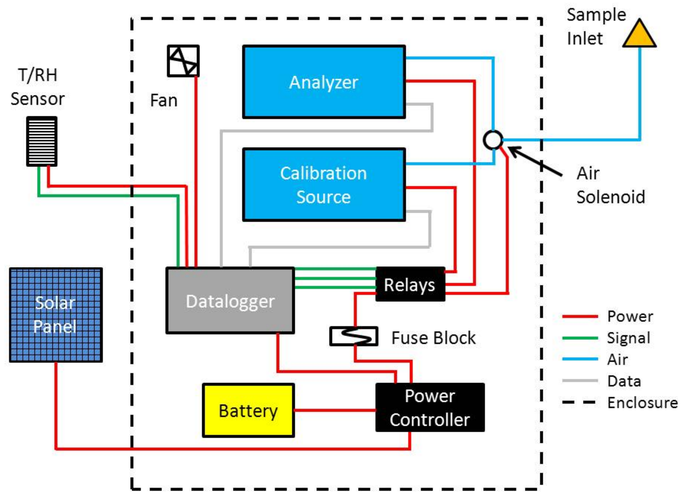
Portable ozone data collection facilities were established at 17 locations in Colorado during 2007-2011. Data collected from these sites (and three CASTNet sites) indicated that rural and high-elevation sites were often subject to greater-than-expected ozone loading, particularly at night.

Fourteen additional installations were constructed for USFS experimental forests nationwide and deployed in 2008-09.



Design Constraints:

- The installation must be self-contained and run unattended except for monthly site visits.
- It must not be dependent on grid power or require fixed shelter.
- Diagnostic data for instrumentation performance must also be collected along with ambient ozone data.
- Must be operable in air temperatures of 0° to 40°C (Versions 3.1 and 5.0) or -25°C to +40°C (Version 5.1).
- Must be pack-transportable by two people.
- Compliant with EPA equivalency-method siting criteria where possible.
- Must conduct weekly zero (Version 3.1) or zero-span-precision checks (Versions 5.0 and 5.1).



- All components (except power relays and associated driver circuitry) are available off-the-shelf.
- A Campbell CR800 or CR1000 datalogger records ozone, meteorologic, and diagnostic data continuously and outputs 15-minute averages for all variables.
- Site visits are required monthly for data download and inlet filter media replacement.
- Standard satellite and cellphone modem components may also be used for remote communications.
- Datalogger capacity is sufficient to support additional sensors (e.g., meteorology) if desired.
- Expanded cold-weather capability (Version 5.1) uses insulation and calibration source "hibernation" mode, where ozonator heater operates to keep instruments warm.
- Download via RS-232 communications with laptop or handheld.
- Known problems include air pump failure, failure/deterioration of UV lamp, photodiode failure, and inadequate protection of air pump control circuitry. RMRS has worked closely with 2B Technologies to identify and address these issues.

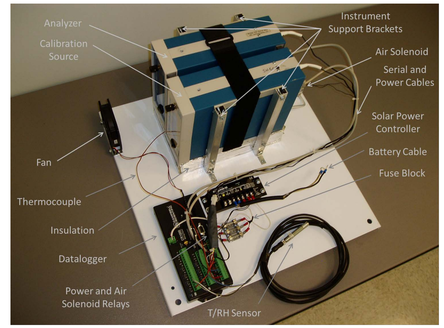
Installation Details:

Version 3.1 installation, Workman Creek, AZ; (Sierra Ancha Experimental Forest)

- Construction cost: $7960
- 2B Model 202 analyzer only, no calibration source
- Campbell CR800 datalogger
- Total weight: 22kg
- Three-season data collection (0° to 40°C)
- Requires 40W solar panel and 32 A-hr battery capacity
- Programmable periodic zero checks; must use portable calibration source for ZSP checks

Version 5.0 Installation (enclosure and battery removed)

- Construction cost: $13,770
- 2B Model 205 analyzer and Model 306 calibration source
- Campbell CR1000 datalogger
- Total weight: 25kg
- Three-season data collection (0° to 40°C)
- Requires 40W solar panel and 32 A-hr battery capacity
- Programmable periodic ZSP checks



Version 5.1 Installation (Briggsdale, CO; Pawnee National Grassland)

- Construction cost: $14,600
- 2B Model 205 analyzer and Model 306 calibration source
- Campbell CR1000 datalogger
- Total weight: 40kg
- Insulation provides year-round data collection (-25° to 40°C)
- Requires 75W solar panel and 60 A-hr of battery capacity
- Programmable periodic ZSP checks

Engineering details, parts lists and cost estimates will be available upon publication of:
Korfmacher, J.L. and R. C. Musselman. Ozone Monitoring at Remote Sites Using Low-Power Instrumentation, *Environmental Monitoring and Assessment*, in review.

Results of the five-year remote site ozone study will be available upon publication of:
Musselman, R.C. and Korfmacher, J.L. Ozone in Remote Areas of the Southern Rocky Mountains, *Atmospheric Environment*, in review.