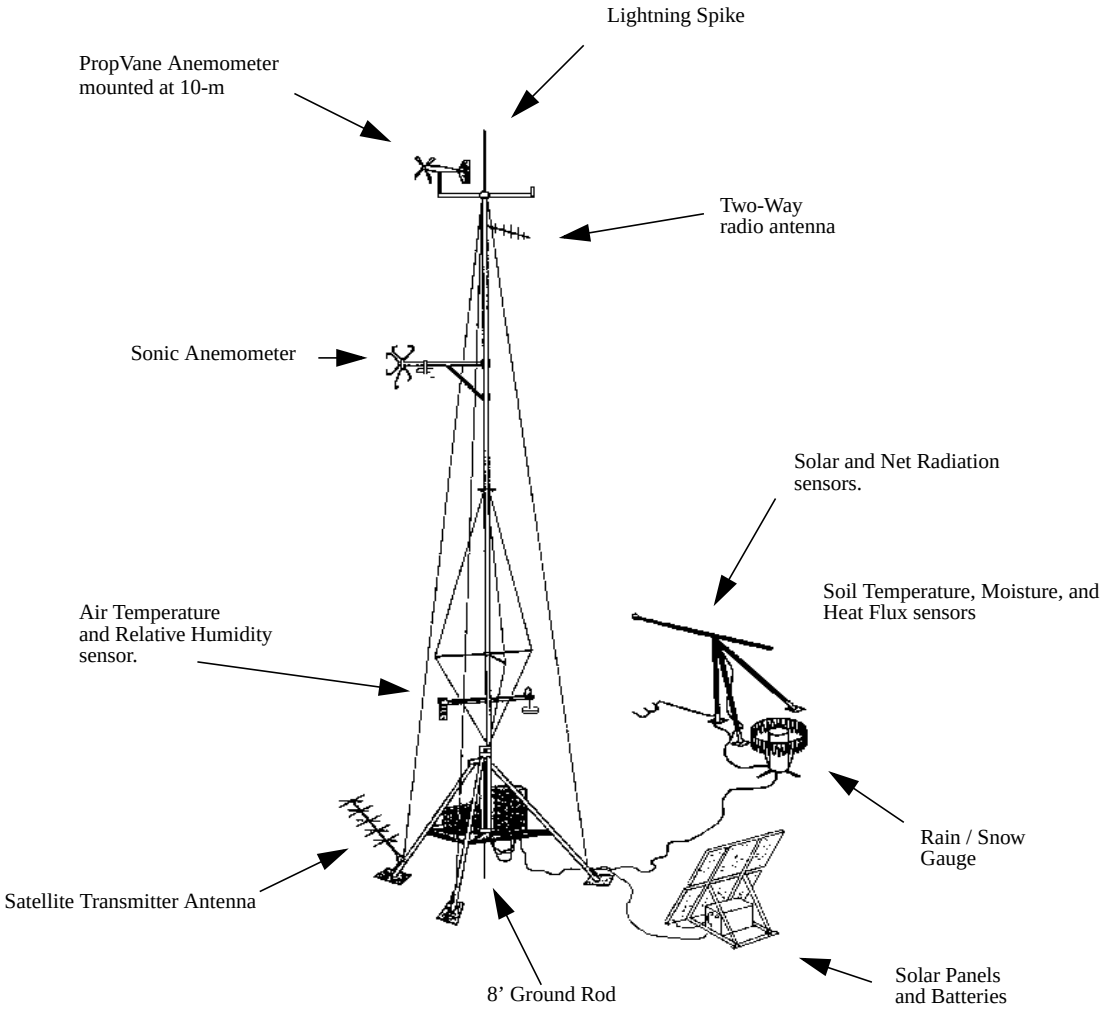
PAM-Station Land-Owner Information Guide
Project: CuPIDO, Tucson AZ, Jul/Aug 2006



National Center for Atmospheric Research
Earth Observing Laboratory
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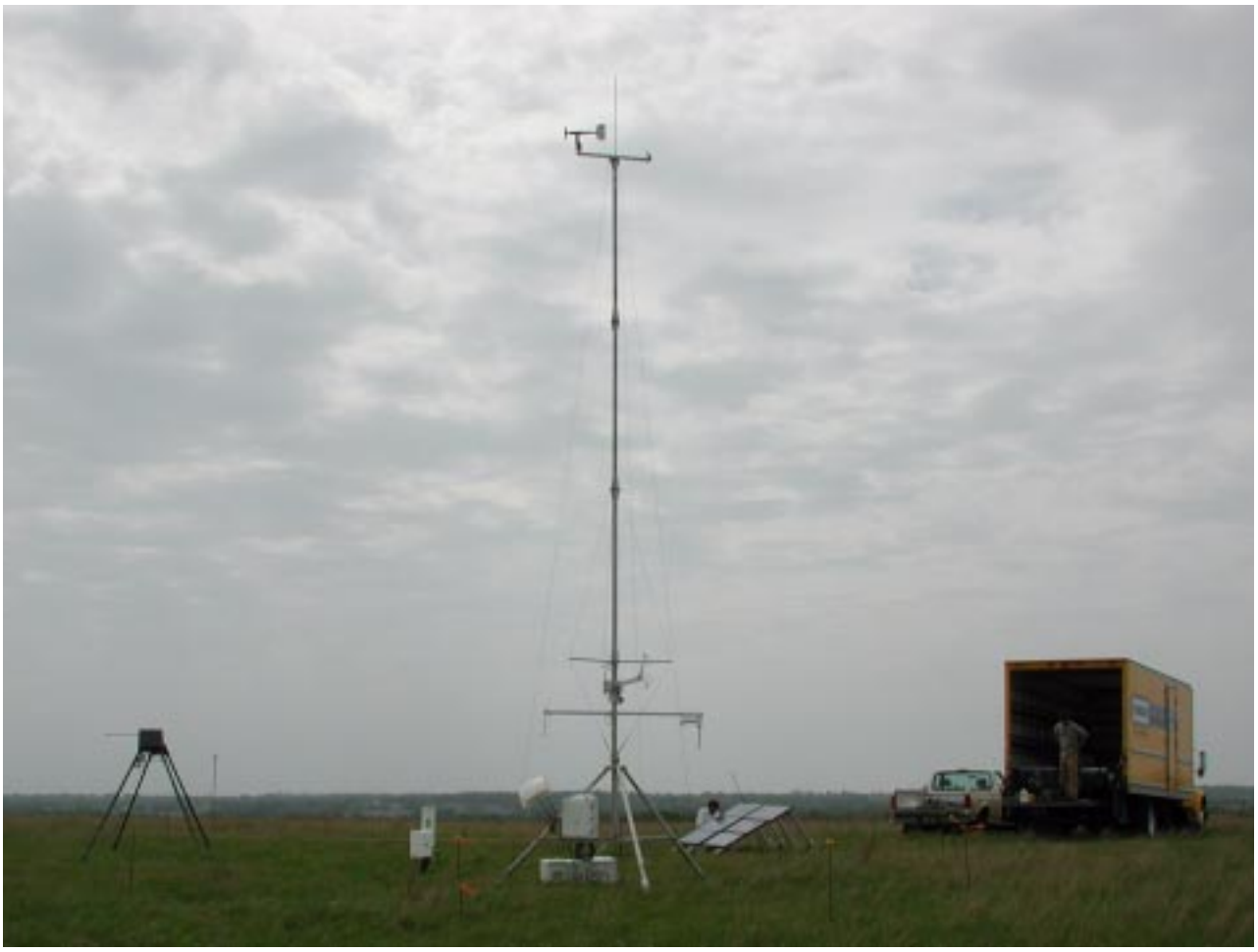
Boulder, CO 80307-3000

Photograph of PAM Flux Station:



Station Description:

The PAM Flux monitoring stations are transportable, automated surface measurement systems deployed for short-term scientific research projects. They sample and record atmospheric information including air temperature and humidity, wind speed and direction, barometric pressure, solar radiation, soil moisture, temperature and heat flow, and precipitation. They are also used to monitor the absorption and release (Flux) of solar thermal energy and water vapor from the ground and surrounding vegetation. Sometimes atmospheric chemistry measurements are taken such as for Ozone, Carbon-Dioxide and similar gases depending upon the needs of the investigator scientists. For many projects, PAM station measurements complement data collected by other observational systems such as weather radar, balloon and radio sounding systems, and atmospheric research aircraft.

The data collected by PAM stations are delivered to a home-base-station in Boulder, Colorado and/or a transportable tractor-trailer base-station deployed in the region where the networks of stations is located. Data can be forwarded in real-time by a variety of methods including geostationary satellites, radio-modems, wireless ethernet, or cell-phones. At the base-stations the data are processed, stored and analyzed by scientists. The transportable base station also serves as an operations center for maintenance personnel and scientists to monitor and to analyze the data during the project. This permits quick repair if any problems arise, as well as intensive study of the information being collected during the conditions of greatest interest.

PAM stations are normally powered by solar charged batteries. In some cases, a wind generator and/or hydrogen fuel cells may be used in addition to or instead of solar panels. These options allow stations to be self-contained and located away from commercial utilities. It typically takes 3 people about 1/2-day to set-up a station. The equipment is secured using 20” rebar stakes through footpads that are part of the structure. One or more 8’ copper ground rods are used to provide lightning protection. Thirty foot communication and power cables are placed on top of the ground between the main tower assembly and the solar panel array and precipitation gauge. Soil monitoring sensors are typically buried 2”-4” deep and are placed near or directly underneath any solar radiation sensors which are mounted on an adjustable six foot tall ‘saw-horse.’ EOL will provide an electric fence around the station in pastures that have curious livestock. Setup and teardown of a station generally requires access by pick-up truck. Otherwise the equipment can be hauled in over short distances by hand. After a station is setup, service personnel will visit the site on a periodic basis to calibrate sensors, download additional data, and to repair any problems which may occur. Under normal circumstances, service visits will occur about once or twice per week.

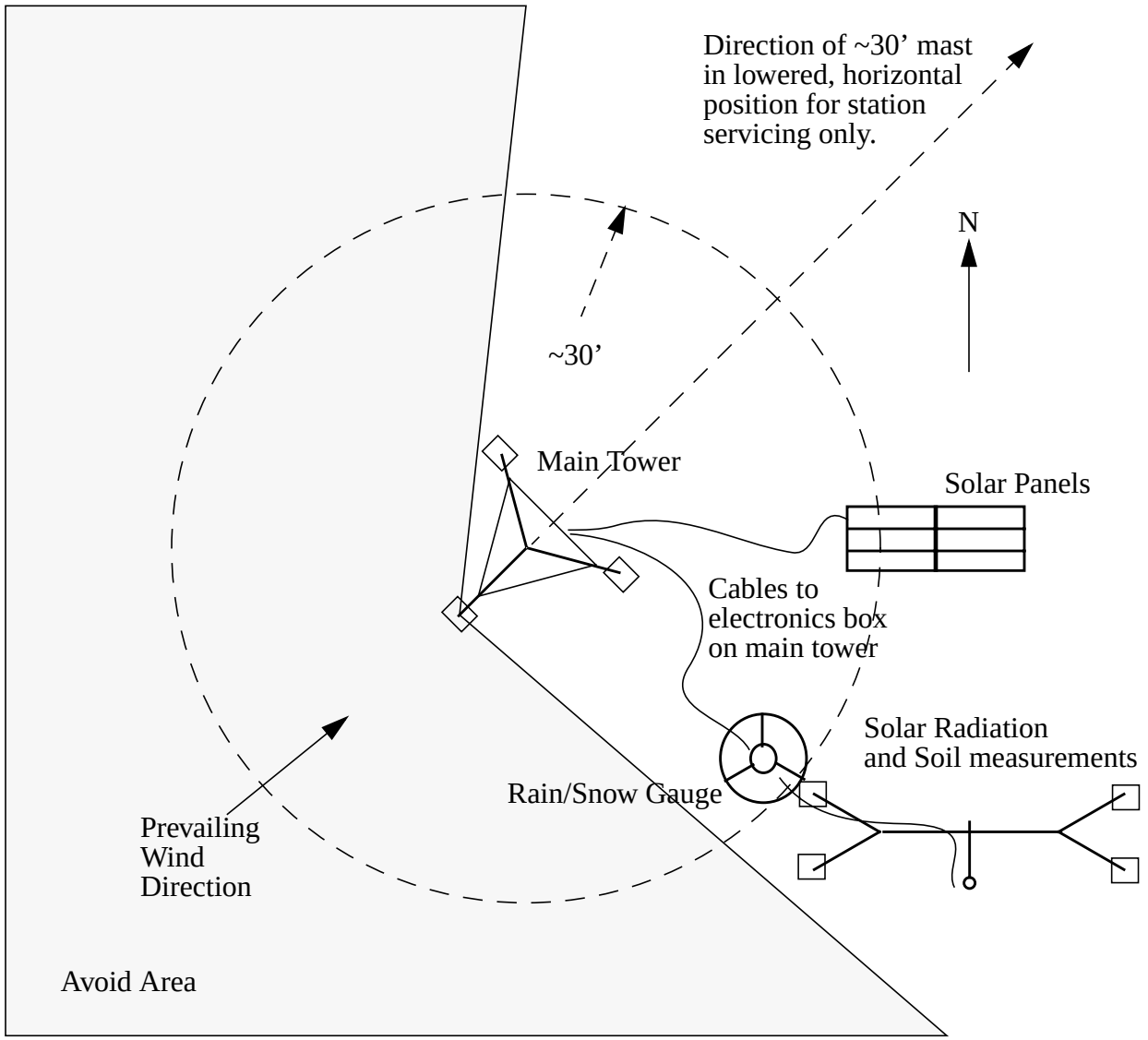
Summary of Logistics and Other Considerations:

Security	Vandalism is rarely a problem, however EOL prefers having stations placed away from casual access and/or vulnerable locations such as local ‘party sites.’
Livestock	If needed, EOL will place temporary electric fencing around any station to protect the sensitive equipment in areas where livestock are kept.
Anchoring	Stations are secured to the ground using ~20” long rebar stakes. For sites that are on rock or otherwise impenetrable, the legs of the primary 10-m mast can be weighted down with either battery boxes, or sandbags. Properly installed stations can withstand 100mph winds without tipping.
Lightning	An ~8-ft. ground rod is pounded to a depth of ~6-ft. to provide protection. In high-activity areas, often a small amount of salt may be soaked down into the earth around the ground rod to improve its ability to dissipate energy. In areas where installation of a rod is very difficult or the quality of the ground is poor, for example in mountains, an alternative technique of digging a shallow trench for a horizontal rod or tube may be used.
Education	EOL scientists or engineers are available for ‘show-and-tell’ for groups or individual members of the public upon request.
Wind Flow Obstructions	Stations are typically placed 100-300m away from wind obstructions such as tall trees, hedge-rows and buildings. Exceptions are made per the siting requirements of the investigator.
Site Access	Setup and teardown are typically accomplished with a pickup truck often accompanied by a 5-10 ton box transport truck used to haul the complete set of stations. If possible, service visits are also accomplished with a vehicle, depending upon any restrictions desired by the landowner.

Damages	At the end of the project, all equipment is removed with no permanent change to the land. However, any crops in the immediate vicinity of and along access to the station are often damaged.
Compensation	Landowners can be compensated for the modest impacts to their property.

Typical Deployment Configuration:

A typical site layout is shown below which indicates relative hardware placement and approximate separation distances. Station orientation is usually dictated by the direction of prevailing winds and the type of vegetation distributed through the area. In the case of full Flux monitoring configurations, a sonic anemometer is oriented toward the direction of prevailing winds. Typically visitors and service personnel need to avoid the area indicated after setup to prevent disruption of the Flux measurements. Specific placement of components may be adjusted depending upon installation requirements and equipment needed..



Project Specific Considerations:

CuPIDO stands for Cumulous Photographic Investigation and Doppler Observations. It is a study of cumulus development induced by terrain effects over the Santa Catalina Mountains during the monsoon season. Testing of cloud formation and volume estimations based upon stereographic photography from distributed locations will be the primary interest. PAM stations and balloon sounding facilities will be used the help characterize and detect onset of convective activity. The Principal investigating scientist leading CuPIDO is Dr. Joe Zehnder from Arizona State University.

All PAM stations will take measurements of temperature, humidity, winds at 10-meters, barometric pressure, rain rate/accumulation, and net solar radiation. At four sites, Flux measurements will be taken with a sonic anemometer, fast hygrometer and soil probes. Some sites may have special GPS sensors added to estimate total atmospheric humidity. These will probably be mounted on a small surveyor's tripod. Arrangements for these sensors are pending. The transportable base station will be located in Tuscon. Due to road limitations and logistical considerations, setup and teardown will be accomplished using pickup trucks only. Servicing will be accomplished via 4WD pickup or SUV.

For More Information Please Contact:

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