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Interagency Effort Will Measure Carbon Dioxide Profiles

Beginning in June, the ARM Climate Research Facility (ACRF) is supporting an off-site field campaign in Iowa to make a variety of carbon dioxide (CO_2) measurements. The purpose is to evaluate the accuracy, precision, and utility of CO_2 profiles measured by a National Aeronautics and Space Administration (NASA) differential absorption lidar (DIAL).

To make the atmospheric CO_2 measurements, the science team will deploy an ACRF balloon-borne sounding system (BBSS) alongside a ground-based DIAL, a CO_2 monitoring tower sponsored by the National Oceanic and Atmospheric Administration, and a temporary mesoscale network of tower-based CO_2 sensors supported by the Department of Energy (DOE). The test will evaluate the suitability of the new DIAL CO_2 technology for future experiments, potentially including space-based measurements.

Current CO_2 observational technology is limited to either *in situ* or atmospheric column measurements. During the DIAL CO_2 field campaign, the science team will test the ability of the DIAL CO_2 system to measure the difference in CO_2 concentrations between the atmospheric boundary layer (surface to 1 km altitude) and the free troposphere (up to 10 km), as well as weather-related variability of CO_2 concentrations in both the free troposphere and the atmospheric boundary layer.

A graduate student from Penn State releases a weather balloon to support the DIAL CO_2 field campaign. Soundings are focused on daytime measurements, when sunlight heats Earth's surface and creates convection that results in a "well-mixed" atmospheric boundary layer (photo courtesy of Grach Koch, NASA Langley).

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Temperature and humidity profiles from the BBSS will be used to convert CO_2 density measured with the DIAL system into mixing ratio values. The mixing ratio is the proportion of CO_2 in air, usually given as parts per million by volume.

For three weeks in June and July, soundings are occurring once or twice daily, while DIAL CO_2 measurements are also being collected. Daytime measurements are best for evaluating differences in mixing ratio between the atmospheric boundary layer (typically well mixed by clear-air convection during the day) and the free troposphere.

The DIAL can provide continuous measurements for both the atmospheric boundary layer and the free troposphere. The instrument's continuous measurements of free tropospheric mixing ratios would be valuable as input for atmospheric budget calculations used to infer sources and sinks of CO_2.

Interagency observations during the DIAL CO_2 field campaign, nested within the DOE-supported mesoscale network (also located in the study region), will be merged into the broader observations of the North American Carbon Program Mid-Continent Intensive campaign.

ARM Mobile Facility Anchors Multisite Aerosol Study in China

In its most complex ARM Mobile Facility (AMF) deployment to date, the ACRF is coordinating operations and data collection at four different sites for the Aerosol Indirect Effects Study in China. Anchored by the AMF in Shouxian, the campaign also includes a supplemental facility at Lake Taihu and an ancillary facility operating in series at two sites to the north.

The challenging campaign preparations culminated with opening ceremonies in May at the Shouxian and Lake Taihu sites. Attended by several Chinese dignitaries, media, and science team representatives, the ceremonies marked the official start of data collection by the AMF in Shouxian on May 16.

In preparation for the deployment, the AMF operations team worked to reduce the facility's footprint. They redesigned the Aerosol Observing System tower to lighten it and decrease installation time. Similarly, the 10-meter meteorological tower was redesigned to accommodate instruments previously operated on tripods, as well as to match international height standards for ground radiation and wind measurements.

Meanwhile, operations staff at the SGP site scrambled to calibrate extra instruments to support the supplementary and ancillary facilities — including a sunphotometer, ceilometer, microwave radiometer profiler, and narrow-field-of-view radiometer. In addition, the AMF operations team coordinated the deployment of a guest instrument called the Sun and Aureole Measurement system. This instrument is operating with the AMF and ancillary facility to obtain data for a related study about the optical depth of thin clouds in East Asia.

Operations at the various study sites started sequentially, beginning in April with data collection at the ancillary facility at Zhangye. Operated by collaborators from the Lanzhou University, this facility has a limited suite of instruments and will be moved to Xianghe in July.

Following the start of AMF data collection at Shouxian on May 16, the supplementary facility at Lake Taihu came online a few days later. This facility is located at the permanent observatory maintained by the Chinese Academy of Sciences and was enhanced by additional instruments and staff from the

Nanjing University of Information Science and Technology and the University of Maryland. AMF operations staff assisted with the installation and calibration of several instruments at the Taihu site and provided training for local support staff.

Data collection and data processing among the sites is being coordinated by the ACRF data system team. Extensive measurements of cloud, aerosol, radiation, and precipitation at the sites will provide comparative measurements for studies of regional aerosol effects.

The AMF installation in Shouxian includes the primary shelters and operations area, an adjacent instrument field, and several additional instruments on the roof of a nearby building (ARM image).