Facilities, Instruments, Equipment, and Other Resources

Department of Atmospheric Sciences Facilities

The Department of Atmospheric Sciences is within the John D. Odegard School of Aerospace Sciences at the University of North Dakota (UND). The department offers Bachelor of Science, Master's, and Ph.D. degrees with recent enrollments of 70–80 undergraduate and 35–40 graduate students. Students take part in experiential learning classes, such as the Storm Experience and Data Skills Pathways classes, as well as student volunteer programs at the National Weather Service, which is located near the department. Office space, electrical power, clerical staff, and meeting facilities are provided for faculty, staff, visiting scientists, graduate students, and undergraduate researchers. The department works closely with units within the College as well as departments across campus, including a hypersonic project with Mechanical Engineering and an air quality project with the Chemistry Department. Furthermore, the department collaborates with several companies, including Weather Modification International (WMI), which operates the North Dakota Citation Research Aircraft for cloud physics, aerosol science, and instrumentation testing research. WMI and UND collaborated to conduct the recent CapeEx19 and SARPEC field projects by sharing instruments and equipment, providing students and faculty opportunities to leverage the resources available within the department.

Airborne Instruments

The department owns several aircraft instruments that have recently been deployed on the NASA P-3 aircraft and the North Dakota Citation Research Aircraft (Figure 1). Aircraft probes include a Cloud Droplet Probe (CDP), Two-Dimensional Stereo Cloud Probe (2D-S), two High-Volume Precipitation Spectrometers (HVPS3), Multi-Element Water Content Meter System (WCM), Nevzorov Hot Wire Probe, King Hot Wire Probe, Passive Cavity Aerosol Spectrometer Probe (PCASP), Tunable Laser Hygrometer (TDL), and aircraft Data Acquisition Systems (M300). The department also has an iMet, a Graw, and multiple mini-sonde balloon systems for obtaining temperature, relative humidity, and wind profiles. The department has worked with WMI to utilize their weatherized Unmanned Aircraft System (UAS) for atmospheric measurements, as the platform holds a Federal Aviation Administration (FAA) waiver to conduct flights in heavy fog. Instruments such as the InterMet IMET-XQ2 and a mini-visibility sensor (Sten Lofving Optical Sensor, MiniOFS) can be deployed on the UAS platform. The department also has a balloon launch facility that includes three Windsond Gen 1 receivers, two Windsond Gen 2 receivers, and two GRAW mobile receivers. The ballooning facility includes preparation and calibration equipment for ozone-sonde and several OSCRE precipitation imaging sensors (1.5 kg, 45-minute run time).

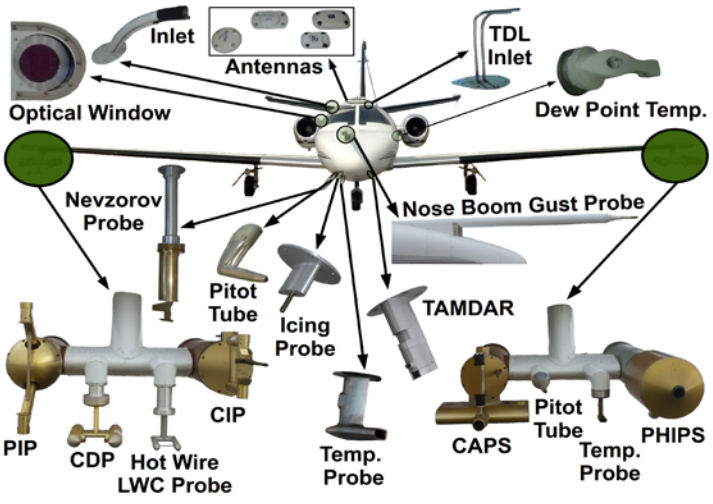

Figure 1: Image showing the external instruments deployed on the University of North Dakota's Citation Research Aircraft during the CapeEx19 field project.

Equipment

UND operates a dual-polarization Doppler weather radar (NorthPol) for educational and research purposes. The radar system is used to track severe weather events in eastern North Dakota and northwestern Minnesota. The original components of the UND radar were built by Enterprise Electronics Corporation (model: Weather Surveillance Radar - 1974 C-band: WSR-74C). In January 2003, the radar was upgraded with a SIGMET Inc. digital receiver and signal processor (RVP8), radar antenna controller (RCP8), and radar control, analysis, and display software (IRIS). In January 2004, the radar was further upgraded to a dual-polarized system. In September 2025, the department obtained equipment to upgrade the receiver and controller to a SIGMET Inc. version 9 system. NorthPol continues to be operated in support of the research and academic programs of the Department of Atmospheric Sciences.

The MetTrailer (Figure 2) is a 2.4 m wide by 3 m long enclosed trailer with a roof 2.7 m above the ground, equipped with a telescoping mast. The mast has two horizontal bars, one at 6 meters and the other at 12 meters, with instruments also mounted on the roof at 4 meters. The 12-meter bar is equipped with an R.M. Young 81000 3-Axis Sonic Anemometer and a Vaisala HMP45C temperature and humidity probe with a 10-plate radiation shield. A junction box is also attached to the 12-meter bar, connecting instrument wiring to the main cable that leads into the trailer and a data logger. The MetTrailer also includes a visibility sensor (Campbell Scientific Visibility Sensor, model CS125) and several cameras: two Amazon Web Services DeepLens cameras, an all-sky camera, and several web cameras. An aerosol inlet enables measurements with instruments such as a Cloud Condensation Nuclei (CCN) counter and a Condensation Particle Counter (CPC).

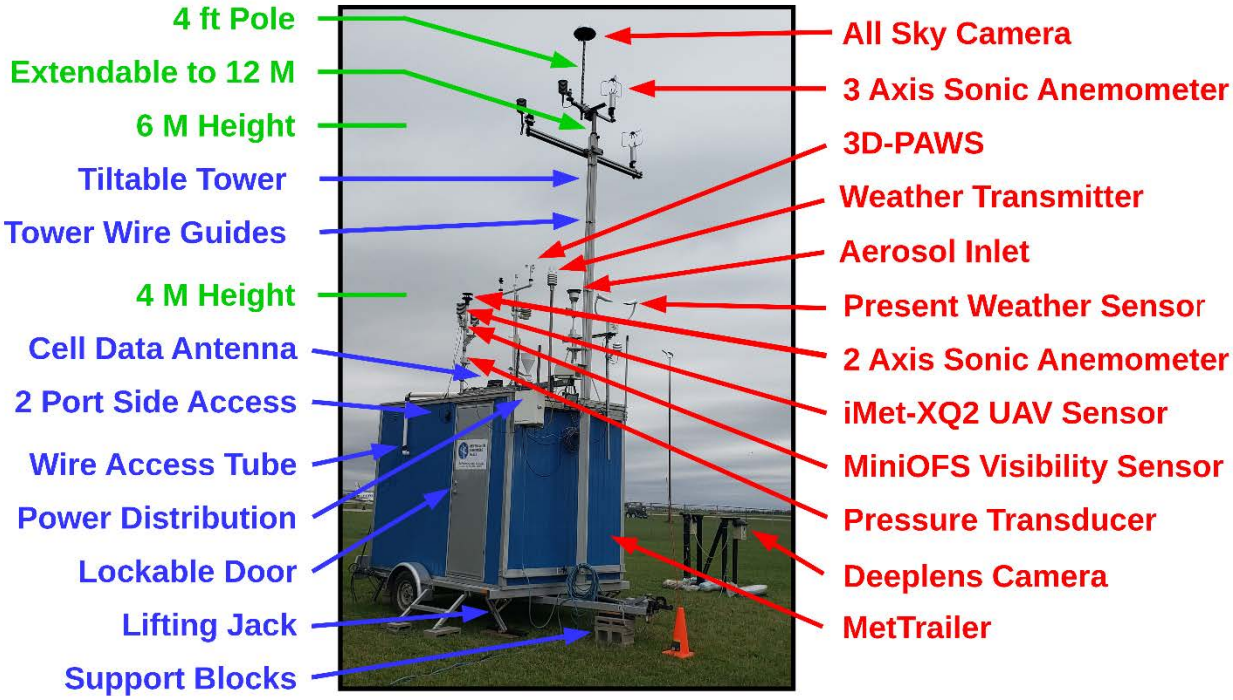

Figure 2: Image showing the Meteorological Observation Trailer (MetTrailer) with cameras and labels of instruments for measurement of atmospheric state parameters and visibility.

Other Resources

Surface Field Sites

The department has access to several surface sites for conducting atmospheric measurements and instrument testing. Clifford Hall has rooftop access for easy instrument deployments and includes a Tripod Instrumentation Meteorological Measurement System (TIMMS) for temperature, humidity, pressure, wind, and visibility measurements. The rooftop also has three cameras that provide a real-time view of Grand Forks weather. Surface observations are also currently being conducted at the Gorman Field Small UAS Airport and the Grand Forks International Airport. The department has also established the Glacial Ridge Atmospheric Observatory, a long-term atmospheric and hydrologic research facility located on the Nature Conservancy Glacial Ridge Restoration Project site. The Glacial Ridge property is located 65 km southeast of the University of North Dakota, between Crookston and Mentor, Minnesota.

These surface field site facilities are used to deploy a variety of instruments to better observe and understand atmospheric and hydrologic processes. They provide verification data for remote sensing (weather radar, satellite) and airborne measurements. Instruments deployed at the field site include an AERONET (AErosol RObotic NETwork) sensor for ground-based remote sensing of aerosols, which is part of the network established by NASA and LOA-PHOTONS (CNRS). Surface equipment includes a 10 m tower, various visibility sensors, precipitation measuring systems including high-speed cameras for imaging hail, snow, rain, and blowing snow, cloud particle sampling using the CDP, 2D-S, and HVPS probes deployed in ground-based mode, a network of blowing snow mass flux sensors, ground Electric Field Mills (EFMs), lightning sensors, and several ceilometers.

Information System Facilities

The department works closely with the Scientific Computing Center to maintain workstations, Linux servers, and classroom facilities. Classrooms include the Regional Weather Information Center, which serves as a dedicated weather laboratory with AWIPS II (Advanced Weather Interactive Processing System) used for operational meteorology training. Additionally, there is the Broadcast Meteorology and Media Studio where students gain experience communicating weather and science topics. The department has dedicated computer servers for storage and processing of both aircraft and radar data. The Airborne Data Processing and Analysis (ADPAA) is an open-source software package developed at UND that will be used to process and visualize project data. ADPAA can process data acquired from many data acquisition systems. For example, ADPAA has an extensive tool set for processing data recorded by the Droplet Measurement Technologies (DMT) Cloud Condensation Nuclei (CCN) counter. ADPAA also includes several Python programs for acquiring and archiving RS232/RS422 data streams. The ADPAA software provides utilities for conducting quality control checks of aircraft instruments before, during, and after field projects, as well as quality assurance utilities so instrumentation experts can review measurements by inserting missing value codes to create a "clean" data set. The ADPAA repository has been hosted at SourceForge since 2007 and is available under the open-source GNU General Public License, version 3. In addition to using commercially available repositories, faculty and students deposit data sets into the UND Scholarly Commons when project sponsor data archives are not available. Together, these facilities, instruments, and resources provide a comprehensive infrastructure for conducting and supporting the proposed research activities.