

1.5. TRINIDAD HEAD OBSERVATORY

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1.5.1. OPERATIONS. Trinidad Head is located along the rugged northern coast of California (41.054°N, 124.151°W, elevation 32.6 m (107 ft)), approximately 40 km (25 miles) north of Eureka, California, the principle regional population center. The coastal climate is dominated by maritime influences, with moderate year-round temperatures and moderate-to-high relative humidity. To the immediate west of Trinidad Head is the unobstructed Pacific Ocean, and to the east are coastal redwood and sitka spruce dominated forest lands. The city of Trinidad represents the primary residential community in the immediate vicinity and supports approximately 400 year-round residents. The Telonicher Marine Laboratory (TML), a satellite facility of Humboldt State University (HSU), is also located in Trinidad.

Because of the characteristics of a relatively remote coastal location (insignificant anthropogenic influences and prevailing maritime airflow), the Trinidad Head site is important to the Earth System Research Laboratory-Global Monitoring Division (ERSL-GMD) Baseline Monitoring Network, providing an opportunity to observe and monitor both regional and global influences, especially inter-continental transport of air pollutants across the Pacific ocean from the Asian continent. Trinidad Head historically has been the site for both NOAA and Scripps Institution of Oceanography (SIO) supported trace gas monitoring networks and other regional scale air quality studies. The SIO Advanced Global Atmospheric Gases Experiment (AGAGE) group incorporated Trinidad Head into their network during 1995. The Ozone and Water Vapor Group has launched balloon-borne ozonesondes at Trinidad since 1997, and flask sampling for the Halocarbon and other Atmospheric Trace Species (HATS) program started in 2002. The GMD Trinidad Head Observatory (THD) was officially initiated during March 2002 to coincide with the 2002 Intercontinental Transport and Chemical Transformation (ITCT2K2) campaign, a major research project of the International Global Atmospheric Chemistry (IGAC) program.

Instrumentation at the THD Observatory are currently housed within a 2.43-m (8 ft.) × 4.57-m (24 ft.) climate-controlled trailer (Figure 1.5). A 12.2-m (40 ft.) aerial intake stack serves as the sample intake for aerosols, surface ozone, greenhouse gases and other trace gases. In addition to the aerosol. micropulse lidar and surface ozone instrumentation, the site also supports solar radiation and gas sampling equipment. Through a cooperative arrangement with HSU, the THD observatory is staffed daily by HSU personnel. Basic station maintenance includes equipment and instrument troubleshooting, repair, replacement, and servicing. Daily tasks include filter changes, instrumentation support, and manual data logging. Weekly tasks include instrument calibrations,

filter/impactor changes, and shipment of filters to NOAA's Pacific Marine Environmental Laboratory (PMEL) and filled flasks to GMD. The THD staff also support other programs such as the Atmospheric Brown Cloud (ABC) studies conducted by the University of Wisconsin-Madison and SIO/UC San Diego.

In addition to supporting the THD observatory, TML supports the weekly launching of balloon-borne ozone measuring ECC sondes. Since the initiation of the ozonesonde program in August 1997 through August 2006, over 540 ozonesonde soundings have taken place. A total of 87, 49, and 73 ozonesondes were flown during calendar years 2004, 2005 and the first eight months of 2006, respectively.

A CIMEL robotic sunphotometer was deployed at THD during February 2005 and became operational on 17 February 2005. The CIMEL is an automated multi-channel sun-and-sky scanning sunphotometer that measures direct solar irradiance and sky radiance. The Aerosol Robotic Network (AERONET) is a large scale global network of ground based remote sensing instruments used to determine aerosol absorption, aerosol extinction, aerosol optical properties, sky radiance, and particle size distribution and concentration. THD is a member of AERONET (<http://aerosol.gsfc.nasa.gov>), a program coordinated by NASA's Goddard Space Flight Center (GSFC).

An eye-safe visible light micropulse lidar (MPL) was deployed at THD during early May 2005 and became operational on 6 May 2005. THD is a member of MPLNET (<http://mplnet.gsfc.nasa.gov>), a network of MPL sites coordinated and supported by GSFC. The goal of MPLNET is to collect long-term observations of aerosol and cloud vertical structure at key sites around the world and serve as a validation tool for NASA's satellite programs such as the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) satellite. Combined with AERONET data, the MPL and CIMEL measurements are used to produce quantitative aerosol and cloud products, such as optical depth, sky radiance, vertical structure, and extinction profiles. Deployment of MPL equipment is listed as a high priority in the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

An automated window washer was designed and implemented during June 2006 for the THD MPL. Since the site encounters significant salt build-up on exterior surfaces due to its close proximity to the surfzone, the new window washer is able to maintain a clean skylight window with minimal intervention of on-site staff, thus enhancing and maintaining stable signal to noise.

The THD observatory hosted the SIO-sponsored Cloud Indirect Effects Experiments (CIFEX)

conducted during April 2004. The CIFEX campaign focused on the atmospheric brown cloud and the relationship between aerosol microphysics and cloud microphysics. The study also investigated the impact of particles on cloud properties and precipitation efficiencies. The CIFEX investigation leveraged and complemented the results of the 2002 ITCT2K2 study.

The ABC project was initiated by the United Nations Environment Programme (UNEP) and gains financial support from NOAA. A primary goal of the project is to set up a network of ground-based monitoring stations throughout the Indo-Asian and the Pacific regions to study the composition and seasonal patterns of brown clouds. Dr. James Schauer and his research group at the University of Wisconsin in Madison are researching the chemical composition of the brown clouds and have installed a network of ground-based sampling sites in the Maldives, Nepal, and Trinidad Head. At THD, particulate matter (PM) is collected routinely (every-other day) by an URG air sampler on both quartz fiber and Teflon filters. Both PM 10 (coarse) and PM 2.5 (fine) size fractions are collected and analyzed for total particulate mass, organic carbon, elemental carbon, ions, trace metals, and organic species. The URG air sampler was installed in August 2005 and became operational on 3 August 2005. Over 175 sets of samples have been collected through August 2006.

Another ABC related research project led by Dr. Craig Corrigan of SIO was initiated during February 2006 with the intent of characterizing and quantifying black carbon aerosols found in rainwater and snow at both coastal and high elevation sites in California. The project deployed an automated Eco-Tech rain sample collector (model 200) at THD during February 2006. The sampler is designed specifically to operate autonomously in the field, collecting precipitation from up to eight rain events. The sampling equipment was removed from the site during May 2006 with the potential for future seasonal deployment.

A new meteorological system is in the acquisition stage and should be deployed shortly at THD. The ZENO @ 3200 weather station, including wind, RH, temperature and barometric pressure sensors, will be web accessible.

Significant efforts focusing on community outreach were initiated during Spring 2006 including the development of a new THD Observatory pamphlet, as well as providing tours and demonstrations to high school/college students, summer educational program participants and members of the community.

1.5.2. PROGRAMS Table 1.5 summarizes the programs at THD for 2004-2006. Operational highlights follow:

Carbon Cycle-Green House Gases. Weekly AIRKIT flask sampling for the GMD Cooperative Air Sampling Network continued uninterrupted throughout the reporting period. An experimental high-resolution *in situ* continuous CO₂ monitoring system deployed by Atmospheric Observing Systems, Inc. was discontinued and removed during the July 2005.

Ozone and Water Vapor. *In situ* surface ozone monitoring by the Thermo Environmental Instruments (TEI) ultraviolet (UV) photometric ozone analyzer continued uninterrupted throughout the reporting period. Currently, the TEI is operating well with only occasional diaphragm replacement needed for the intake pump. Weekly ozonesonde flights continued throughout the reporting period with launches initiated from the TML launch site. In addition to the weekly flights, intensive daily flights as part of the INTEX Ozonesonde Network Study (IONS) program were conducted during 2004 (July-August) and 2006 (March, April-May, and August). The balloon launching facility at TML was slightly damaged by falling trees resulting from the 2005 New Year's Eve extreme wind event. The building has subsequently been repaired and ozonesondes launches continue from this facility.

Halocarbons and other Atmospheric Trace Species. Weekly flask sample pairs for the HATS group have been filled since February 2002 at the SIO AGAGE site. Flasks are returned to GMD at Boulder, CO for analysis. A future task will be moving the HATS flask sampling system to the THD trailer and tower.

Aerosols. Aerosol measurements continued uninterrupted throughout the reporting period with minimal downtime. Because of the typically moist and corrosive operating environment, certain equipment (such as blowers, pumps and sensors) required regular replacement. Modifications to the system design included the replacement of a single wavelength Particle Soot Absorption Photometer (PSAP) with a three wavelength PSAP during October 2005. GMD Aerosol staff visited the station for annual maintenance, calibrations, and instrument replacements during February 2005, October 2005 and April 2006. The humidograph system was removed from the aerosol rack during May 2006 and redeployed at the Point Barrow Observatory (BRW).

Solar and Thermal Atmospheric Radiation. The solar radiation and meteorological instruments continued to operate throughout the reporting period. On-site staff replaced both normal incidence pyroheliometers, the global pyranometer, both diffuse pyranometers, and the IR-pyrgeometer during June 2005. Both SPO2 sunphotometers were replaced during February 2005.

TABLE 1.5. Summary of Measurement Programs at THD during the Period 2004-2006

Program/Measurement	Instrument	Typical Sampling Frequency
<i>Gases</i>		
CO ₂ , CH ₄ , CO, H ₂ , N ₂ O, SF ₆ , and ¹³ C/ ¹² C and ¹⁸ O/ ¹⁶ O of CO ₂	2.5-L AIRKIT	1 pair wk ⁻¹
Surface O ₃	TEI Model 49C surface ozone analyzer	Continuous
Ozone vertical profiles	Balloonborne ECC sonde	1 wk ⁻¹
CFC-11, CFC-12, CFC-113, CFC-114/CFC-114a, HCFC-21, HCFC-22, HCFC-124, HCFC-141b, HCFC-142b, HFC-134a, HFC-152a, H-1211, H-1301, CH ₃ Cl, CH ₂ Cl ₂ , CHCl ₃ , CCl ₄ , CH ₃ CCl ₃ , C ₂ Cl ₄ , CH ₃ Br, CH ₂ Br ₂ , CHBr ₃ , CH ₃ I, N ₂ O, SF ₆ , COS, C ₆ H ₆	0.85-L, 2.5-L, or 3.0-L stainless-steel flasks 2.5-L glass flasks, pump unit	2 pair mo ⁻¹ (~1 st and 15 th) 1 pair mo ⁻¹ (~15 th)
<i>Aerosols</i>		
Condensation nuclei	TSI CNC	Continuous
Optical properties	3-wavelength nephelometer (dry and humidified)	Continuous
Aerosol light absorption	3-wavelength Radiance Research PSAP	Continuous
Aerosol chemistry	Major ions, mass	1 day ⁻¹
ABC chemistry	URG 10PM and 2.5PM filters	Every other day
Aerosol vertical structure	Sigma Space Corporation Micropulse lidar (MPL4)	Continuous
<i>Solar Radiation</i>		
Global (total) irradiance	Eppley pyranometer with Q filter	Continuous
Direct irradiance	2-Eppley pyrhelimeter with Q and RG8 filters (tracking NIP)	Continuous
Diffuse irradiance	Eppley pyranometer with shading disk and Q filter Eppley pyranometer, black and white 8-48	Continuous
Aerosol Optical Depth	SP02-A multi-wavelength sunphotometer	Continuous
Aerosol Optical Depth	CIMEL robotic sunphotometer	15 min interval
<i>Terrestrial (IR) Radiation</i>		
Downwelling	Eppley pyrgeometer	Continuous
<i>Meteorology</i>		
Air temperature (2-m)	Vaisala platinum resistance probe	Continuous
Pressure (2-m)	Setra capacitive pressure transducer	Continuous
Wind (speed and direction)(2-m)	R.M. Young wind monitor	Continuous
Relative humidity (2-m)	Vaisala meter	Continuous



Figure 1.5. Trinidad Head Atmospheric Observatory: Latitude 40.8°N; Longitude 124.16°W; elevation 107 m. Instrumentation is housed in a 7-m long modular unit and a 10-m tower located on the top of a hill north of Humboldt Bay, Humboldt County, California.