Meteorological Monitoring

A Supplement to the
INL Site Environmental Report for 2025

METEOROLOGICAL MONITORING

Background

The Special Operations and Research Division of the National Oceanic and Atmospheric Administration Air Resources Laboratory (NOAA ARLSORD) provides meteorological support to the Idaho National Laboratory (INL) Site. This includes issuing weather forecasts and hazardous weather alerts, maintaining the NOAA/INL meteorological tower network (the NOAA/INL Mesonet), and providing emergency operations center on-call support.

History of Monitoring

Meteorological monitoring at the INL started with the creation of the National Reactor Testing Station (NRTS) in 1949. At that time, the U.S. Weather Bureau, by agreement with the Reactor Development Division of the Atomic Energy Commission (AEC), established a Weather Bureau Research Station as part of the Special Projects Section at the NRTS. This station included a complete complement of meteorologists and technicians. The initial objective of the station was to describe the meteorology and climatology of the NRTS with a focus on protecting the health and safety of site workers and nearby residents. The office provided a full range of hourly and daily meteorological observations, including balloon soundings, which were transmitted to the U.S. Weather Bureau [and later the National Weather Service (NWS)] observations network.

After 15 years of operation, the first complete climatology of the area was published (Yanskey et al. 1966). It was based on an assemblage of four previous reports (DeMarrais 1958a, b; DeMarrais and Islitzer 1960; Johnson and Dickson 1962). Regular observation functions related solely to weather forecasting were then reduced to allow for more intense research on atmospheric transport and diffusion. However, basic meteorological observations at the renamed Idaho National Engineering Laboratory (INEL) were continued to satisfy U.S. Department of Energy (DOE) environmental and safety requirements.

Numerous other climatological and specialized research studies of atmospheric transport and diffusion have been conducted and reported over the years (Start 1984). However, in 1989, the second official edition of the climatology (Clawson et al. 1989) was issued to integrate new information acquired since the publication of the first edition. The period of record permitted, for the first time, the calculation of standard 30-year normalized climatological values for all important atmospheric parameters. Building upon the atmospheric dispersion climatology of the first edition, it also included summaries of wind transport trajectories for sources near the Central Facilities Area (CFA). By this second edition, the Idaho research station had been reorganized as the Field Research Division of the National Oceanic and Atmospheric Administration's Air Resources Laboratory (NOAA ARLFRD).

In 2007, a third edition of the INL climatology was published (Clawson et al. 2007) with climatological parameters updated through 2006. That edition included new insights on winds and temperatures aloft derived from remote sensing systems, channeled wind flows, statistical wind trajectory groupings, and precipitation return periods. Three distinct local microclimate regimes (INL

North, INL Southwest, INL Southeast) were also introduced during this edition, based primarily on wind flow patterns.

In 2018, a fourth edition of the INL climatology was published (Clawson et al. 2018) based on meteorological observations through 2015. In addition to updating various climatological parameters, this edition included new research focused on the outflows of the Birch Creek Valley that strongly affect the Specific Manufacturing Capability (SMC) wind regime on the north end of the INL. The fourth edition of the INL climatology is anticipated to continue to be helpful to planners and operations staff.

In 2022, the division was renamed Special Operations and Research Division of the National Oceanic and Atmospheric Administration's Air Resources Laboratory (ARLSORD). It was formerly known as the NOAA Air Resources Laboratory Field Research Division (ARLFRD). ARLSORD's support to the INL Site is provided through an interagency agreement between NOAA and the DOE Idaho Operations Office. This long-term partnership provides significant benefits to both agencies. ARLSORD continues to furnish weather and climate support to the INL, producing weather forecasts/alerts and contributing to INL Emergency Operations Center drills and on-call staffing.

NOAA/INL Mesonet

What is now called the NOAA/INL Mesonet (MESOscale meteorological monitoring NETwork) began with a single monitoring station at CFA in 1949. Between 1950 and 1970, six on-site and 16 off-site monitoring stations were added to form an expanded observational network. The number of meteorological monitoring stations continued to expand and change over the years in support of various projects and also to gain a better understanding of the climatology of the INL Site, in particular, and the Eastern Snake River Plain (ESRP) in general. The current configuration of the Mesonet meets the needs of INL Site planners, emergency managers, scientists, engineers, operations personnel, and the general public.

As of December 31, 2025, 35 meteorological observation stations were in operation at the INL and the surrounding area. Fourteen of these are located within the INL Site boundaries, with the remaining stations sited at key locations throughout the ESRP. The Mesonet tower locations are depicted in Figure 1 (on-site) and Figure 2 (off-site). Twenty-nine stations have 50 ft. (15 m) tall towers. Three towers, ranging in height from 150 to 250 ft. (46 to 76 m), serve as the "primary" on-site observation stations for the three INL microclimate zones. These are located at Grid 3/INTEC (GRI), MFC, and SMC. For aesthetic reasons, towers Big Southern Butte summit and Craters of the Moon National Monument are restricted to heights of 20 ft. (6 m) and 30 ft. (9 m) tall, respectively. In 2025, weather instrumentation was installed up to the 30 ft level (9m) on an existing communications tower atop East Butte. A typical Mesonet tower, illustrating the standard configuration and instrument layout, is shown in Figure 3.

Four of the NOAA/INL Mesonet stations, called Community Monitoring Stations (CMS), are at locations frequented by the public to enhance relations with the local communities. These CMS locations were developed in partnership with the DOE Idaho Operations Office, the State of Idaho INL Oversight Program, the Shoshone-Bannock Tribes, the City of Idaho Falls, and the Idaho Transportation Department. The CMS stations include a walk-up kiosk that displays current meteorological parameters and describes each measured variable.

Standard meteorological parameters are measured at each Mesonet station. All meteorological instruments are carefully selected to meet required and generally accepted guidelines, including DOE/EH-0173T, Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE 1991); DOE Guide 151.1D, Comprehensive Emergency Management System (DOE 2016); and ANSI/ANS 3.11-2015, Determining Meteorological Information at Nuclear Facilities.

Tables 1 and 2 list the parameters and the location of each Mesonet station on and off the INL Site, respectively. The station name (location), three-letter designator, elevation, instrument height, and types of data being collected at each level on the tower are provided in the tables. Air temperature and relative humidity are measured at all Mesonet stations at the conventional

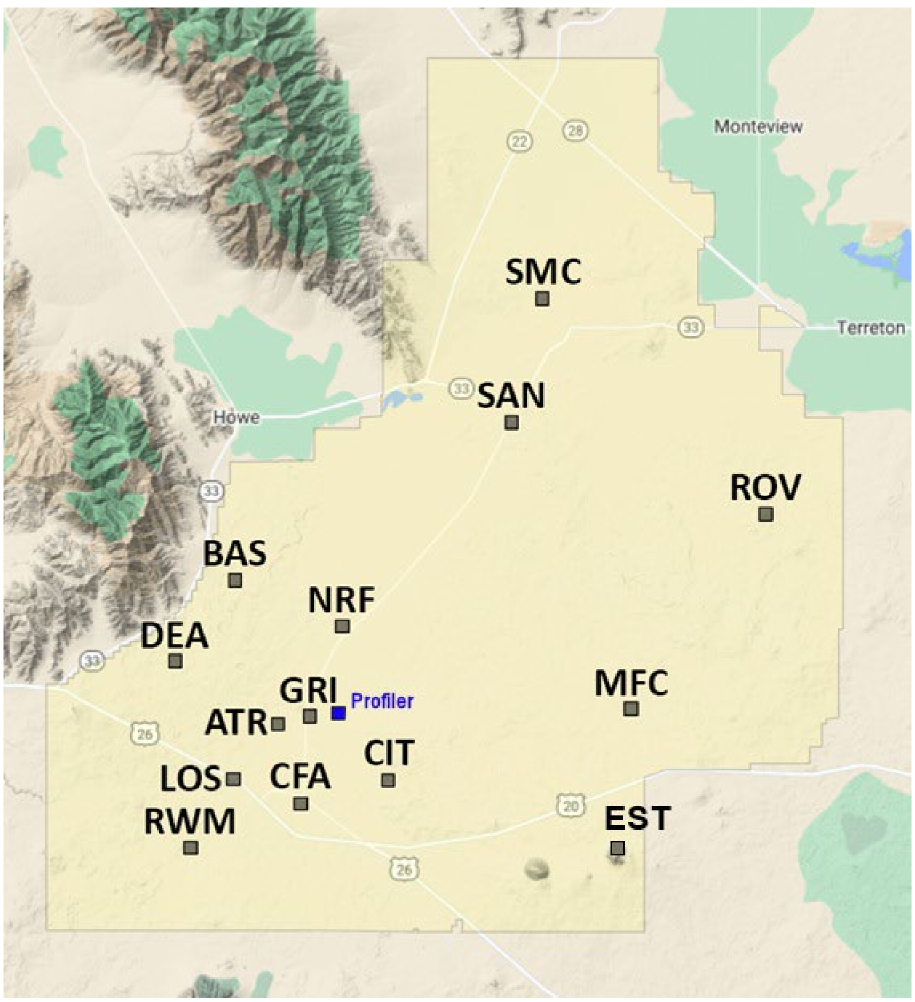

Figure 1. Onsite NOAA/INL Mesonet stations as of December 31, 2025. The blue square is the location of the profiler.

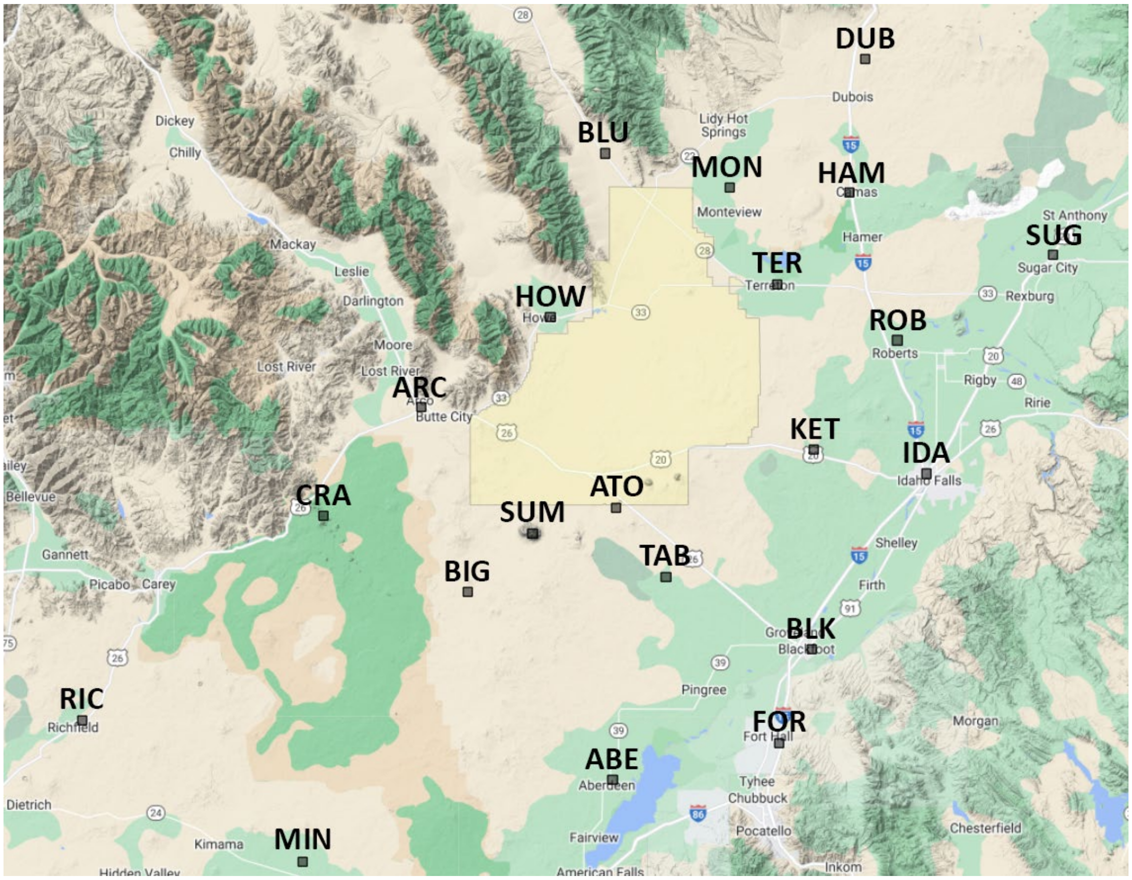

Figure 2. Off-site NOAA/INL Mesonet stations as of December 31, 2025.

Figure 3. Example NOAA/INL Mesonet station layout with the addition of the Community Monitoring Station kiosk (foreground) on the Idaho Falls Greenbelt at the John's Hole Bridge and Forebay.

Table 1. On-site NOAA/INL Mesonet stations as of December 2025.

Station Name	Station ID	Latitude (deg N)	Longitude (deg W)	Elevation MSL (ft)	Bottom Level		Middle Level(s)		Top Level		Other Data
					Data	Height	Data	Height	Data	Height	
ATR Complex	ATR	43.584633	112.968667	4,937	t,r	6 ft (2 m)	w,T	50 ft (15 m)			p,s,b
Base of Howe Peak	BAS[b]	43.677533	113.006033	4,900	t,r	6 ft (2 m)	w,T	50 ft (15 m)			s,b
Central Facilities Area Building 690	CFA[b,c]	43.532617	112.947733	4,950	t,r	6 ft (2 m)	w,T	50 ft (15 m)			p,s,b
Critical Infrastructure Test Range Complex	CIT	43.547483	112.869683	4,910	t,r	6 ft (2 m)	w,T	50 ft (15 m)			p,s,b
Dead Man Canyon	DEA[b]	43.625067	113.059783	5,108	t,r	6 ft (2 m)	w,T	50 ft (15 m)			s,b
East Butte	EST	43.500617	112.665644	6,739	t,r	6 ft (2 m)	w	30 ft (9 m)			
Grid 3/INTEC	GRI	43.589700	112.939933	4,897	t,r	6 ft (2 m)	w,T w,T w,T	33 ft (10 m) 50 ft (15 m) 150 ft (46 m)	w,T	200 ft (61 m)	p,s,b, l
Lost River Rest Area	LOS[b]	43.548683	113.009900	4,983	t,r	6 ft (2 m)	w,T	50 ft (15 m)			p,s,b
Materials and Fuels Complex	MFC	43.594133	112.651733	5,143	t,r	6 ft (2 m)	w,T w,T w,T	33 ft (10 m) 50 ft (15 m) 150 ft (46 m)	w,T	250 ft (76 m)	p,s,b, l
Naval Reactor Facility	NRF	43.647867	112.911233	4,847	t,r	6 ft (2 m)	w,T	50 ft (15 m)			p,s,b
Radioactive Waste Management Complex	RWM	43.503433	113.046033	5,025	t,r	6 ft (2 m)	w,T	50 ft (15 m)			p,s,b
Rover	ROV	43.720600	112.529567	5,008	t,r	6 ft (2 m)	w,T	50 ft (15 m)			s,b
Sand Dunes	SAN	43.779667	112.758183	4,820	t,r	6 ft (2 m)	w,T	50 ft (15 m)			p,s,b
Specific Manufacturing Capability	SMC	43.859767	112.730267	4,790	t,r	6 ft (2 m)	w,T w,T	33 ft (10 m) 50 ft (15 m)	w,T	150 ft (46 m)	p,s,b, l

a. Abbreviations: b = Barometric pressure (mean pressure); l = Soil temperature and moisture (mean temperature and volumetric water content); p = Precipitation (total precipitation); r = Relative humidity (mean relative humidity); s = Solar radiation (mean solar radiation); T = Temperature (mean temperature); t = Temperature (mean temperature, maximum temperature, minimum temperature); w = Wind (mean speed, peak 3-second wind gust, mean direction, direction standard deviation)

b. New stations since 2nd edition of Climatography of the INEL was published (BAS, CFA and DEA started in April 1993, LOS started in April 1995).

c. CFA Building 690's public Station ID has remained CFA even though it is a different station than the CFA tower in the 2nd edition of Climatography of the INEL.

Table 2. Off-site NOAA/INL Mesonet stations as of December 2025.

Station Name	Station ID	Latitude (deg N)	Longitude (deg W)	Elevation MSL (ft)	Bottom Level		Middle Level		Other Data
					Data[a]	Height	Data	Height	
Aberdeen	ABE	42.954933	112.824533	4,392	w,t,r	6 ft (2 m)	w,T	50 ft (15 m)	p,s,b,l
Arco	ARC	43.624550	113.297100	5,290	t,r	6 ft (2 m)	w,T	50 ft (15 m)	p,s
Atomic City	ATO[b]	43.443733	112.815650	5,058	t,r	6 ft (2 m)	w,T	50 ft (15 m)	p,s,b
Blackfoot	BLK	43.189850	112.333200	4,520	t,r	6 ft (2 m)	w,T	50 ft (15 m)	p,s,b
Blue Dome	BLU	44.075000	112.842033	5,680	t,r	6 ft (2 m)	w,T	50 ft (15 m)	p,s
Cox's Well	COX[b]	43.294167	113.181283	5,200	t,r	6 ft (2 m)	w,T	50 ft (15 m)	s
Craters of the Moon	CRA[b]	43.429183	113.538300	5,996	t,r	6 ft (2 m)	w,T	30 ft (9 m)	p,s,b
Dubois	DUB	44.242383	112.201833	5,465	t,r	6 ft (2 m)	w,T	50 ft (15 m)	p,s,b
Fort Hall	FOR[b]	43.022000	112.411983	4,452	t,r	6 ft (2 m)	w,T	50 ft (15 m)	p,s,b
Hamer	HAM	44.007417	112.238833	4,843	t,r	6 ft (2 m)	w,T	50 ft (15 m)	p,s
Howe	HOW	43.784117	112.977317	4,815	t,r	6 ft (2 m)	w,T	50 ft (15 m)	p,s
Idaho Falls	IDA	43.504133	112.050133	4,709	t,r	6 ft (2 m)	w,T	50 ft (15 m)	p,s,b
Kettle Butte	KET	43.547567	112.326250	5,190	w,t,r	6 ft (2 m)	w,T	50 ft (15 m)	p,s,b
Minidoka	MIN	42.804417	113.589650	4,285	t,r	6 ft (2 m)	w,T	50 ft (15 m)	p,s,b
Monteview	MON	44.015367	112.535917	4,797	w,t,r	6 ft (2 m)	w,T	50 ft (15 m)	p,s,b
Richfield	RIC	43.060600	114.134583	4,315	t,r	6 ft (2 m)	w,T	50 ft (15 m)	p,s,b
Roberts	ROB	43.743517	112.121117	4,760	t,r	6 ft (2 m)	w,T	50 ft (15 m)	p,s
Sugar City	SUG[b]	43.896583	111.737617	4,895	t,r	6 ft (2 m)	w,T	50 ft (15 m)	p,s,b
Big Southern Butte Summit	SUM[b]	43.396333	113.021850	7,576	t,r	6 ft (2 m)	w	20 ft (6 m)	s,b
Taber	TAB	43.318683	112.691800	4,730	t,r	6 ft (2 m)	w,T	50 ft (15 m)	p,s
Terreton	TER	43.841683	112.418250	4,792	t,r	6 ft (2 m)	w,T	50 ft (15 m)	p,s,b

a. Abbreviations: b = Barometric pressure (mean pressure); l = Soil temperature (mean temperature); p = Precipitation (total precipitation); r = Relative humidity (mean relative humidity); s = Solar radiation (mean solar radiation); T = Temperature (mean temperature); t= Temperature (mean temperature, maximum temperature, minimum temperature); w = Wind (mean speed, peak 3-second wind gust, mean direction, direction standard deviation)

b. New station since 2nd edition of Climatography of the INEL was published (ATO began in April 1995, BLK began in August 2001, COX and CRA began in April 1993, FOR began in March 1997, SUG began in April 1993, SUM began in November 2000).

6 ft. (2 m) level. Wind measurements (speed and direction, gusts, and standard deviation of the wind direction) are collected at the top of all Mesonet stations, normally at 50 ft. (15 m) above ground level. For the three tall towers, additional wind and air temperature measurements are recorded at the 33 ft (10 m), 50 ft (15 m), and 150 ft (46 m) levels. Other reported parameters include precipitation, atmospheric pressure, and solar radiation at most stations. Still more wind measurements are made at the 6 ft. (2 m) level at the Aberdeen, Kettle Butte, and Monteview stations in support of the U.S. Bureau of Reclamation's Agrimet Program. ARLSORD provides these additional meteorological measurements through a partnership agreement with Agrimet for regional crop water use modeling.

Mesonet data are recorded as averages, totals, or extremes over a 5-minute period. Wind speed, wind direction, air temperature, relative humidity, and solar radiation are measured every 1 second and averaged over a 5-minute period. Precipitation is totaled over the 5-minute interval. Maximum and minimum air temperatures for each 5-minute period are based on the one-minute averages collected during the period. A 3-second average wind gust is computed as the maximum of a 3-second running average of wind speed. Data are collected at each station by a datalogger and transmitted every 5 minutes through a radio link back to ARLSORD. Data are also stored for a short time at each station and can be retrieved manually if the radio link fails for an extended period of time. Each datalogger is also supplied with power by a deep-cycle marine battery for extended operation and data storage in the absence of line power. These data are continuously added to the INL climatological database and are available for customized analyses.

Additional Equipment

The CFA weather station, established in 1949, was the first meteorological observation station at the INL Site and remains its longest continually operating station. Historically, CFA temperatures were recorded using a mechanical thermograph housed within a thermoscreen shelter. This mechanical system has since been retired. The daily temperatures are now obtained from the standard electronic sensor located 2 m above ground on the CFA Mesonet tower. Precipitation was previously collected in a rain gauge approximately 50 feet (15.2 m) southwest of the tower. These measurements were taken manually on a weekly basis and interpolated into daily values using data from the CFA electronic rain gauge, located about 15 feet (4.6 m) east of the tower. The official precipitation record is now derived from the CFA Mesonet electronic rain gauge. While snow depth was historically measured manually alongside precipitation, it is now primarily determined via the CFA Mesonet snow depth sensor. The final daily depth also incorporates precipitation totals and air temperatures recorded during the event to ensure accuracy. This thermoscreen dataset comprises the National Weather Service cooperative observer station, Idaho Falls 46W (or IDA 46W). The data from IDA 46W are also included in NOAA's National Centers for Environmental Information (NCEI) database, the nation's primary climatological database.

The NOAA/INL Mesonet previously provided upper-air data from a profiler and sodar. Both are remote sensing instruments designed to collect meteorological data above the surface. Historically, the profiler captured wind and temperature data from approximately 521 to 9,500 feet (160 to 2900 m) AGL, while the sodar collected wind data between 66 and 656 feet (20 to 200 m) AGL. Both instruments have since been retired. While ARLSORD anticipates that future funding may allow for the purchase of new remote sensing equipment, interim solutions are in place. Currently, a NOAA sponsored field project has installed a profiler at Grid 3 (Fig 4). Although ARLSORD does not own the equipment, the division maintains near real-time access to the upper-level wind data.

Figure 4. Profiler near Grid 3.

A camera for monitoring weather phenomena during daylight hours was installed at Grid 3 in 1998. The data are available in real time through a dedicated line at the ARLSORD office. The camera can be remotely controlled and can zoom and pan to areas of interest, such as wildfires or severe storms. It has proven to be a valuable tool for monitoring site weather from the office in Idaho Falls. Routine archiving of the images began in May 2007.

Data Quality Control

The NOAA/INL Mesonet uses a detailed and comprehensive data quality assurance program. ARLSORD has adopted the standards listed in ANSI/ANS 3.11-2015*, Determining Meteorological Information at Nuclear Facilities*, and ANSI/ANS 3.2-2012, *Managerial, Administrative, and Quality Assurance Controls for the Operational Phase of Nuclear Power Plants,* for data quality control guidance. To help follow these guidelines, the quality assurance program uses an excellent set of software tools to display trended meteorological data. This enhances the data quality evaluations and makes them more efficient. The quality control program consists of both manual and automated processes. Every 5-minute data period for every station is plotted for missing or spiked data. Data are also screened for electronic noise, malfunctioning aspirators that affect air temperature and relative humidity values, orientation errors in the wind direction, stalled wind sensors, rime icing in the winter that degrades wind speeds, and other erroneous values caused by maintenance, sprinklers, bird droppings, small animals, etc. Plotting the data allows the meteorologist to identify and flag any problems in the database and, if needed, notify a technician to fix the problem quickly.

Data Dissemination

The primary method of dissemination of NOAA/INL Mesonet data is through the NOAA/INL Weather Center (NIWC) web page (Figure 5) at https://niwc.noaa.inl.gov/. This centralized web

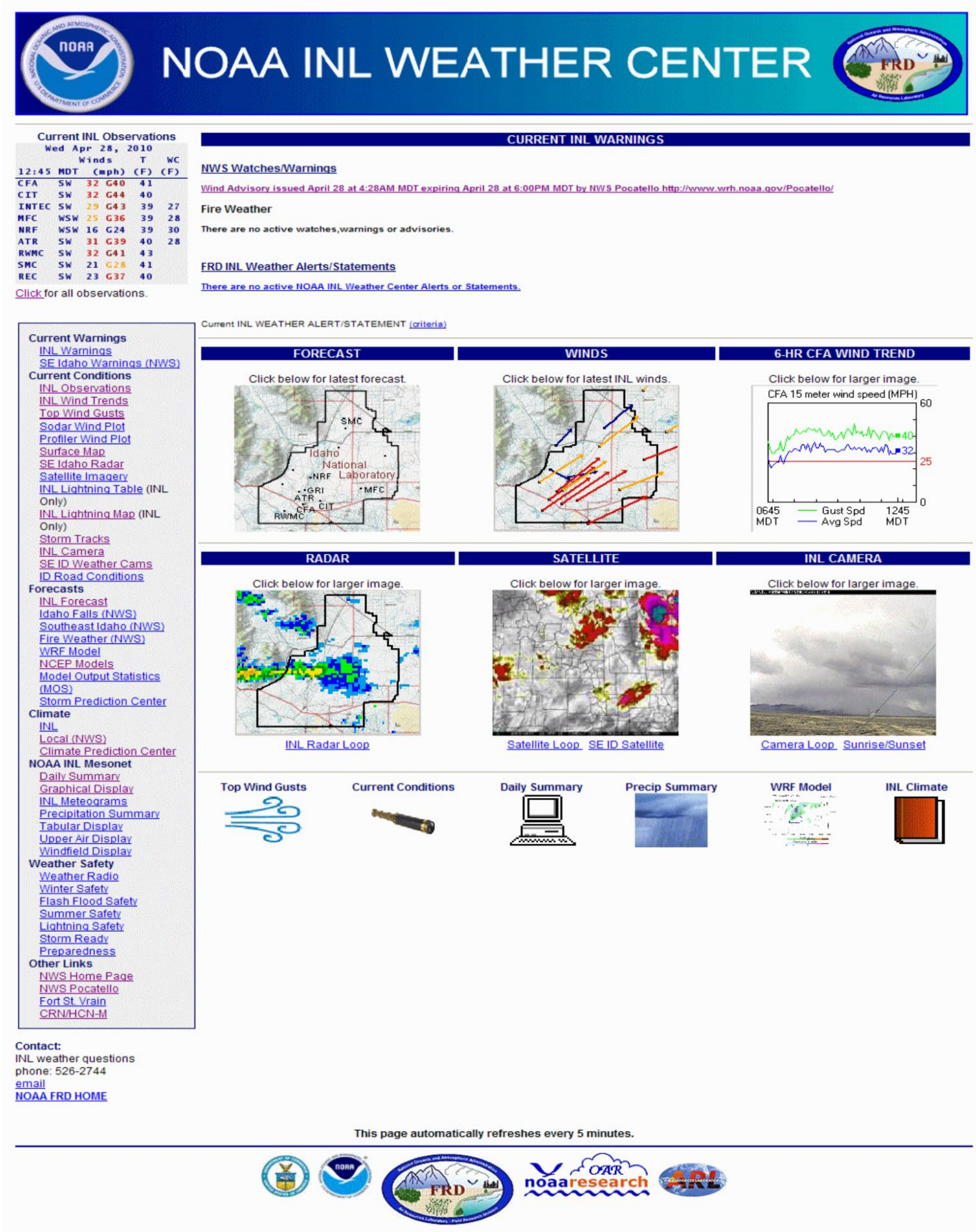

Figure 5. NOAA/INL Weather Center web page.

page is designed to provide INL site-specific meteorological data for both emergency and daily operations managers. A key highlight of the page is the presentation of severe weather hazards. Since the INL has unique weather requirements exceeding those of the general public, ARLSORD issues its own weather statements tailored to the site. These specialized notifications are displayed under the “Current INL Warnings” section.

Directly below the warnings, six large thumbnails provide real-time snapshot of current weather products. They include: the current 7-day INL Site weather forecast, current NOAA/INL Mesonet wind vectors, a graph of the CFA wind speed trend for the last 6 hours, a current weather radar image and satellite imagery, and the current image from the ITD road camera at the highway 20/26 intersection. These thumbnail images allow emergency and daily operations managers weather conditions at a glance, and each can be enlarged for detailed viewing. To ensure operational accuracy, the page automatically refreshes every 5 minutes. Additional resources including lightning, observations, forecast models, climate data, and weather safety can be accessed from the menu on the left side of the page.

Atmospheric Dispersion Modeling

ARLSORD for many years used the MDIFF and MDIFFH computer models (Sagendorf et al. 2001) for estimating concentration patterns of airborne materials released from a single location. They were designed to use wind data derived from the NOAA/INL Mesonet and were well suited for calculating the transport and dispersion of airborne material on and near the INL Site. The models were based on the MESODIF computer program (Start and Wendell 1974), one of the first diffusion models developed for use on modern computers. MDIFF and MDIFFH are both classified as puff models because they simulate an atmospheric release using a series of puffs that move and grow independently.

MDIFF was used to model short-term releases based on the 5-minute averages from the Mesonet, but has been superseded by the HYSPLIT model described below. MDIFFH was used for annual or other long-term simulations but has now also been replaced by a special configuration of the HYSPLIT model. MDIFF and MDIFFH both used the same basic code, but MDIFFH included modifications to allow an annual simulation to be completed in a reasonable amount of time on available computing resources.

The HYSPLIT dispersion model (Draxler and Hess 1997) is maintained and used by NOAA and is also used by many other organizations. Within NOAA, it is used for many applications, including plume forecasting for toxic releases, predicting smoke from wildfires, and forecasting the movement of ash plumes from volcanic eruptions. Instead of using puffs like MDIFF and MDIFFH, HYSPLIT uses a Lagrangian particle approach to model dispersion. A release is represented by a cloud of individual particles transported by the wind and scattered apart by atmospheric turbulence. Mathematically, the effect of the turbulence is computed using a random number generator that imparts a random displacement to each particle. The primary advantage of this approach is that it provides a more realistic representation of plume dispersion in complicated situations such as mountainous terrain or when the wind speed and direction change significantly with height.

In 2009, ARLSORD developed software to generate a three-dimensional HYSPLIT wind field based directly on the NOAA/INL Mesonet data. This capability is crucial to ensure that the projected plume movement is derived from the most up-to-date information available from the tower network. When plume forecasts are desired, either NOAA forecast models or local modeling can provide HYSPLIT with forecast winds many hours into the future. This model was a valuable tool in the INL Emergency Operations Center for many years.

Finally, in recent years, the NARAC (National Atmospheric Release Advisory Center) suite of model products has played an important role in current emergency management operations. NARAC assimilated observations into a plume model and increased it substantially to produce results for not just our region, but globally. NARAC's operations center and staff are available 24/7 to respond to emergencies anywhere in the world. NARAC has become the go-to product for DOE facilities across the nation, and indeed, its usage is mandated by DOE Guide 151.1D (DOE, 2016).

INL Site Climate During 2025

The climate of the high desert environment at the INL Site is characterized by sparse precipitation (about 21.4 cm/yr [8.41 in./yr]), warm summers (with an average daily temperature of 18.6°C [65.4°F]), and cold winters (with an average daily temperature of -7.4°C [18.7°F]), based on observations at the Central Facilities Area (CFA) from 1950 through 2025.

In 2025, the average daily mean temperature measured at CFA was warmer than the 1991-2020 normal period (Table 3). The 2025 average temperature was 42.7°F, 3.2°F above normal. July was the warmest month, with an average daily mean temperature of 71.9°F, 2.5°F above normal. December saw the year's largest departure from normal, averaging 13.8°F above normal. January was the coldest month, with an average of 12.2°F, 3.9°F below normal. The highest recorded temperature in 2025 was 100°F and was recorded on July 1st while the lowest was -17°F on February 13th.

In 2025, sixteen daily maximum temperature records were either broken or tied beginning with a warm spring and summer that saw record highs on March 26 (70 °F), April 11 (73 °F), May 10 (85 °F), May 31 (90 °F), July 1 (100 °F), August 19 (97 °F), August 23 (96 °F). An unprecedented streak occurred in December, with records broken on the 10th (54 °F), 11th (55 °F), 12th (53 °F), 14th (50 °F), 15th (51 °F), 16th (55 °F), 17th (53 °F), 24th (50 °F), and 25th (52 °F). The most remarkable aspect of the December records was the margin that the temperatures surpassed previous all-time highs by 3 to 9 degrees. Most notably, the Christmas Day high shattered the 1980 record by a staggering 9 °F.

One lowest daily maximum temperature record was set: June 22 (58 °F).

Regarding nighttime extremes, three daily minimum temperature records were broken: February 13 (-17 °F), April 19 (14 °F), and June 23 (26 °F). Eleven highest daily minimum temperature records were also broken: May 11 (49 °F), July 2 (61 °F), August 25 (62 °F), October 10 (46 °F), November 14 (39 °F), November 18 (39 °F) and December 19 (31°F), 22 (39 °F), 23 (34 °F), December 25 (35 °F), and 26 (32 °F).

Table 3. Average daily maximum, minimum, and mean air temperatures by month for CFA from 1991 through 2020 compared with 2025, including departure from the average, and annual average and departures.

	Average Daily Maximum Temperature			Average Daily Minimum Temperature			Average Daily Mean Temperature		
Month	1991-2020 (°F)	2025 (°F)	Departure (°F)	1991-2020 (°F)	2025 (°F)	Departure (°F)	1991-2020 (°F)	2025 (°F)	Departure (°F)
January	28.3	24.8	-3.5	5.9	-0.3	-6.2	17.1	12.2	- 3.9
February	33.3	32.5	-0.8	10.2	12.9	+2.7	21.8	22.7	+0.9
March	46.4	48.7	+2.3	21.3	24.7	+3.4	33.9	36.7	+2.8
April	57.4	59.8	+2.4	28.4	26.4	-2.0	42.9	43.1	+0.2
May	67.3	71.4	+4.1	36.8	38.1	+1.3	52.1	54.7	+2.6
June	77.5	82.3	+4.8	43.6	45.0	+1.4	60.6	63.6	+3.0
July	88.9	91.7	+2.8	49.9	52.2	+2.3	69.4	71.9	+2.5
August	86.8	88.2	+1.4	47.7	51.1	+3.4	67.3	69.6	+2.3
September	76.0	79.5	+3.5	38.4	41.6	+3.2	57.2	60.5	+3.3
October	59.7	58.1	-1.6	27.2	30.9	+3.7	43.5	44.5	+1.0
November	42.5	51.7	+9.2	16.2	23.0	+6.8	29.4	37.4	+8.0
December	29.1	42.5	+13.4	6.6	20.9	+14.3	17.9	31.7	+13.8
Annual	57.8	61.1	+3.3	27.7	30.7	+3.0	42.7	45.9	+3.2

The year 2025 was drier than normal at CFA. Table 4 shows the monthly and annual precipitation summary. The annual total was 7.69” (0.74” below the mean) or 91% of normal. The wettest month was December (2.30” of precipitation), which was 1.58” above normal or 319% of normal. December was also the month with the largest departure from normal. The driest month of the year was in November (with 0.06” of normal), which was 0.43” below normal.

Seven daily precipitation records were set last year. February 2nd recorded 0.46” of precipitation, breaking the previous daily record of 0.44” from 1961. May 14th, recorded 0.48” of precipitation breaking the previous daily record of 0.40” from 1962. July 4th recorded 0.15” breaking the 0.12” record from 1961. August 26th recorded 0.32” of precipitation, breaking the 0.23” record from 2012. December 17th recorded 0.47” of precipitation, breaking the 0.23” record from 1973. December 21st recorded 0.70” precipitation breaking the 0.62” record from 1964. December 24th recorded 0.82” of precipitation, breaking the 0.52” record from 1959.

Monthly and annual total snowfall and monthly average snow depth statistics for 2025 are given in Table 4, together with the 30-year normal. Average annual snow depth statistics are not included because they are not meaningful. Total snowfall for 2025 was 19.5” or 5” below normal (or 80% or normal). February was the snowiest month with 11.5”, 7.0” above normal (or 255% of normal). The highest average monthly snow depth during 2025 occurred in January and February with 4.0” and 3.9” respectively or 1.7” or 2.2” below normal (or 70% and 64% of normal, respectively).

One daily snowfall record was set in 2025. December 21st recorded 3.5” of snowfall, which broke the previous daily record of 2.0” from 2008.

Table 4. Monthly and annual average precipitation, snowfall and snow depth for CFA from 1991 through 2020 and 2025 and total precipitation departures.

Month	Total Precipitation			Total Snowfall		Mean Snow Depth	
	1991-2020 (in.)	2025 (in.)	Departure (in.)	1991-2020 (in.)	2025 (in.)	1991-2020 (in.)	2025 (in.)
January	0.67	0.15	-0.52	6.7	1.0	5.7	4.0
February	0.50	1.03	+0.53	4.5	11.5	6.1	3.9
March	0.64	0.54	-0.10	1.9	3.0	2.0	0.2
April	0.91	0.53	-0.38	1.0	0.0	0.0	0.0
May	1.31	0.80	-0.51	0.0	0.0	0.0	0.0
June	0.96	0.08	-0.88	0.0	0.0	0.0	0.0
July	0.37	0.18	-0.19	0.0	0.0	0.0	0.0
August	0.47	0.51	+0.04	0.0	0.0	0.0	0.0
September	0.67	0.31	-0.36	0.0	0.0	0.0	0.0
October	0.72	1.20	+0.48	0.4	0.0	0.0	0.0
November	0.49	0.06	-0.43	2.6	0.0	0.3	0.0
December	0.72	2.30	+1.58	7.4	4.0	2.8	0.1
Annual	8.43	7.69	-0.74	24.5	19.5	NA[a]	NA[a]

a. NA = Not applicable.

Climate Trends at the INL Site

An analysis of long-term observations at CFA was undertaken to determine if climate trends are detectable in the available data. However, it should be pointed out that computing climate trends from a single station has significant limitations due to instrument uncertainty, land-use changes, and the natural variability in the observations. The temperature and wind data are taken from the NOAA/INL CFA Mesonet station between 1994 through 2025, whereas the precipitation data (including snowfall) is taken from the CFA Thermoscreen dataset measured between 1950 through 2025. Daily mean, maximum, and minimum air temperatures were averaged annually to create a long-term climate profile. A linear regression and analysis of variance was conducted to determine any long-term trends. The regression analysis indicates a slight upward trend in all three temperature data sets (Figure 6) with annual daily annual temperatures rising 0.025°F per year (or 0.25°F per decade). Consistent with broader climate research (IPCC, 2018), CFA observations show that minimum temperatures are rising at a faster rate than maximum temperatures. However, despite these positive slopes, the trend for annual daily average temperatures is not significant at the 95% confidence level. These observations alone do not constitute definitive evidence of a long-term temperature shift in this record.

The seasonal analysis of air temperature was focused on winter (December-February) and summer (June-August) periods. The regression analysis for the winter season indicates a cooling trend across all three datasets (Figure 7). The most pronounced decline was observed in daily maximum temperatures which decreased by -0.086°F per year (or -0.86°F per decade). While the average winter temperature also showed a negative slope 0.073°F (or -0.73°F), the analysis of variance determined that this trend is not significantly different from zero at a 95% confidence level. In contrast, the summer season provided the strongest warming signals in the data (Figure 8). Consistent with the annual findings, the most significant summer increase occurred in daily minimum air temperatures with 0.112°F per year (or 1.12°F per decade). The average summer time trend is 0.094°F per year (or 0.95°F per decade). This trend is statistically significant, confirming the existence of a long-term summer warming pattern with 95% confidence.

While the summer season temperature dataset demonstrates statistical significance at the 95% confidence interval, the winter and annual datasets do not. This suggests that the temperature trends are seasonally dependent and that summer observations are likely diluted or offset by higher variability in other months. Essentially, the observational data is enough to overcome natural variability during the summer, but not during the winter. Consequently, a longer observational period may be required to help understand a more definitive long-term temperature trend.

A similar regression analysis of variance was undertaken for both precipitation (Figure 9) and snowfall (Figure 10) data. The precipitation analysis indicates a minor negative trend of 0.004" per year (or 0.04" per decade). However, the analysis of variance confirms that this trend is not statistically significantly at a 95% confidence level. Snowfall observations show a negative trend of 0.048 inches per year (or 0.48" per decade). Similar to precipitation, this decline is not significantly different from zero at a 95% confidence level.

A regression analysis of variance was used to identify a long-term pattern in annual wind speed (Figure 11). The analysis showed a slight negative trend of 0.020 mph per year or (0.20 mph) per decade. Despite the small magnitude of change, this trend is statistically significant at the 95% confidence level, suggesting a measurable long-term shift in the wind speeds.

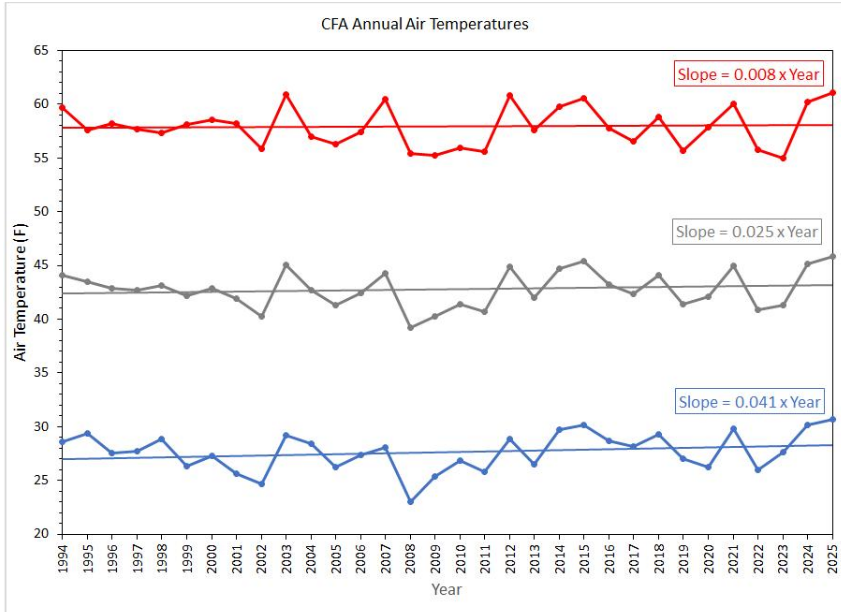

Figure 6. Mean air temperature for CFA using daily maximum (red line), daily average (gray line), or daily minimum (blue line) temperatures from 1994 through 2025. Linear trend lines and the linear regression slopes are also shown.

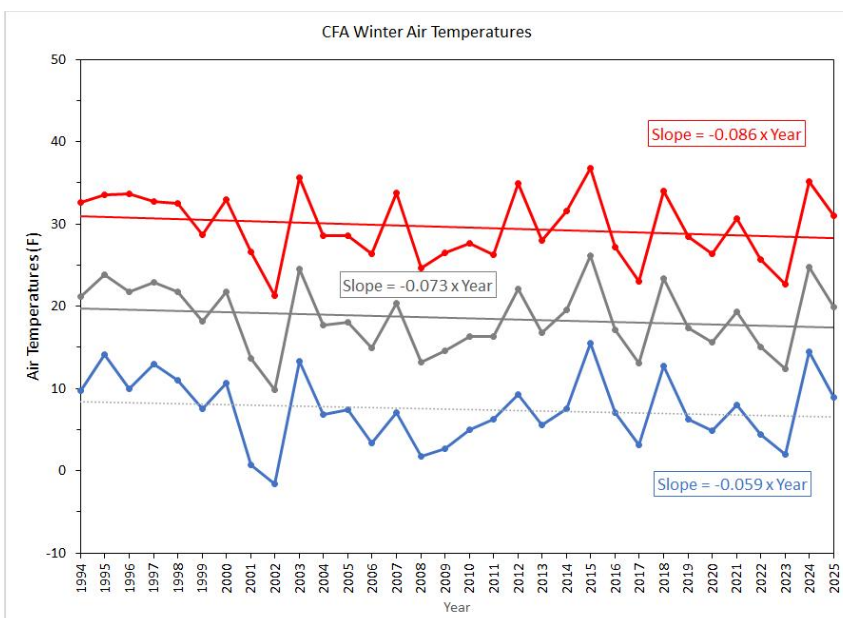

Figure 7. Winter season mean air temperature for CFA using daily maximum (red line), daily average (gray line), or daily minimum (blue line) temperatures from 1994 through 2025. Linear trend lines and the regression slopes are also shown. Data is averaged December-February (year refers to January).

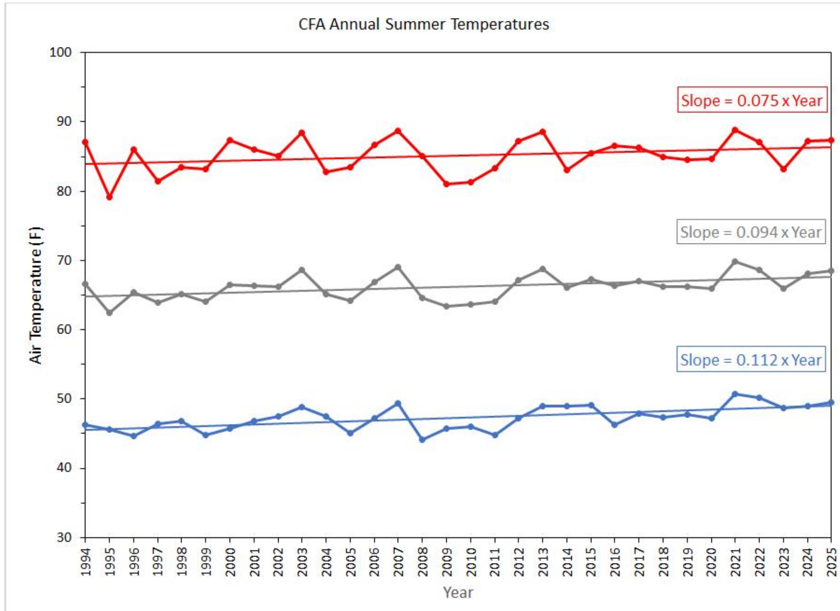

Figure 8. Summer season mean air temperature for CFA using daily maximum (red line), daily average (gray line), or daily minimum (blue line) temperatures from 1994 through 2025. Linear trend lines and the regression slopes are also shown.

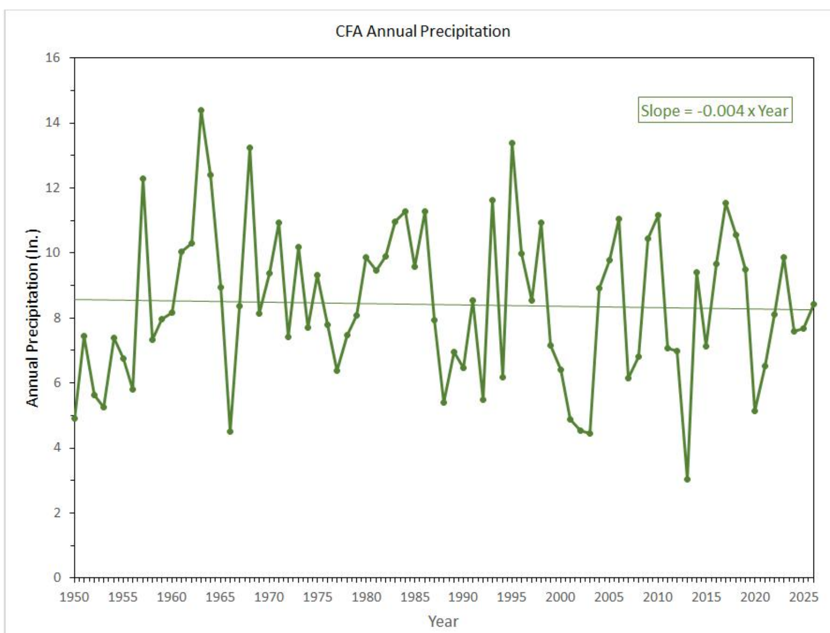

Figure 9. Mean annual precipitation for CFA using daily precipitation totals averaged for each year of record at CFA from 1950 through 2025. The linear trend line and regression slope are also shown.

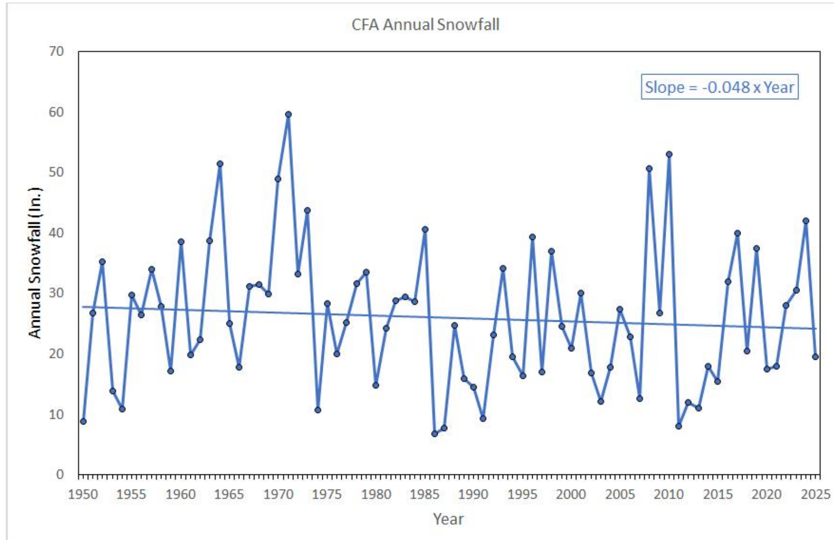

Figure 10. Mean annual snowfall data for CFA using daily snowfall totals averaged for each year of record at CFA from 1950 through 2025. The linear trend line and regression slope are also shown.

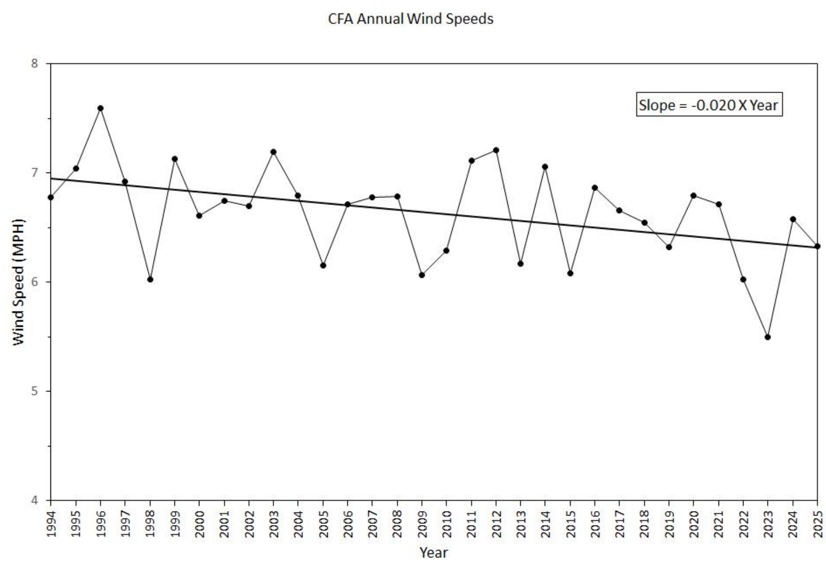

Figure 11. Mean annual wind speed data for CFA using five-minute wind speed data totals averaged for each year of record at CFA from 1994 through 2025. The linear trend line and regression slope are also shown.

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