Field Studies

Program Name	Dates	Scope	Short Description/Goal	PSL Role
Advanced Quantitative Precipitation Information (AQPI)	Oct 2017 – Dec 2021	Regional	A project awarded to NOAA and collaborating partners by the California Department of Water Resources. The AQPI system consists of improved weather radar data for precipitation estimation and short-term nowcasting (0-1 hours); additional surface measurements of precipitation, streamflow and soil moisture; and a suite of forecast modeling systems to improve lead time on precipitation and coastal Bay inundation from extreme storms–especially moisture-laden atmospheric rivers.	PSL is involved with developing advanced methods to estimate rainfall from radar in the SF Bay area and merging estimates from gap-filling radars with estimates from traditional radar networks. PSL is using observations to improve physical process understanding to evaluate the NOAA HRRR, GFS, and National Water Models in the SF Bay area and guide future model development. PSL is also working with the USGS to develop a real-time coastal flood forecast system for SF Bay, using National Water and HRRR model data as input.
Atlantic Tradewind Ocean–Atmosphere Mesoscale Interaction Campaign (ATOMIC)	Jan–Feb 2020	International	This field study took place in the tropical North Atlantic east of Barbados and investigated cloud and air-sea interaction processes with the goal of advancing understanding and prediction of U.S. weather and climate. ATOMIC is the U.S. complement to the European field campaign called EUREC4A. This collaborative effort involved a unique combination of ships, piloted and remotely-controlled aircraft, and remotely-controlled ocean vehicles to characterize ocean and atmospheric properties. A suite of instruments will be deployed from NOAA's research ship Ronald H. Brown and WP-3D Orion "Hurricane Hunter" aircraft, and on land.	PSL researchers collected measurements using the NOAA Air-Sea Flux System and additional shipborne oceanographic instruments. In partnership with the University of Washington, PSL collected similar observations of near-surface atmospheric conditions, air-sea energy exchanges, waves, and the upper ocean from six drifting SWIFT drifting buoys and two Wave Gliders. On the NOAA P-3 aircraft, measurements were taken by the tail Doppler X-band precipitation radar and PSL's W-Band cloud radar, stepped frequency microwave radiometer for wind, and wide swath radar altimeter for waves. In partnership with the University of Colorado (CIRES and IRISS), PSL's newly-developed miniFlux instrument package flew on a small, island-based RAAVEN drone. PSL also

				provided forecast guidance for planning and is conducting post-experiment data and model analysis.
ARO Network	Summer 2017-Present	Regional	Coastal observing sites in Washington and Oregon completed a West Coast picket fence of observing equipment known as atmospheric river observatories (AROs) that provide weather and river forecasters with detailed wind, temperature, and water vapor information associated with landfalling atmospheric rivers embedded within Pacific extratropical cyclones	PSL owns, operates and maintains the AROs in Oregon and Washington. PSL operates and maintains the AROs in California for the California Department of Water Resources.
CalWater 2015	Jan–Mar 2015	Regional	A field campaign focusing on two key phenomena that play key roles in the variability of the water supply and the incidence of extreme precipitation events along the West Coast of the United States. These phenomena include the role of Atmospheric Rivers (ARs) in delivering much of the water vapor associated with major storms along the U.S. West Coast, and Aerosols from local sources as well as those transported from remote continents—and their modulating effects on western U.S. precipitation.	PSL played a central role in the planning and implementation of the campaign as well as deploying instrumentation, and contributing to forecast briefings and flight planning.
Chequamegon Heterogeneous Ecosystem Energy-balance Study Enabled by a High-density Extensive Array of Detectors (CHEESEHEAD)	Jul–Oct 2019	Local	An intensive field campaign sponsored by the National Science Foundation to address long-standing questions of how diverse land cover affects atmospheric boundary-layer circulations. The experiment was anchored around a well-instrumented 400-m tall tower in Park Falls, Wisconsin.	PSL set up two field sites (at 42 and 45 km away), forming a right triangle with the tower. Equipment at these locations will measure wind, temperature, water vapor, and turbulence profiles. Since the experiment, PSL conducted quality control on the data, and the final data were submitted to the NCAR EOL archive and are also available from the PSL data archive.

Clouds, Aerosols, Precipitation, Radiation, and Atmospheric Composition over the Southern Ocean (CAPRICORN)	Mar–Apr 2016	International	A collaboration with scientists from Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Australian Bureau of Meteorology to investigate the interaction of air-sea fluxes and boundary layer clouds, which will help expand the very sparse database of measurements in the Southern Ocean.	PSL installed NOAA's seagoing Air-Sea Flux System on a new research vessel, the R/V Investigator, which is operated by CSIRO.
De-Icing Comparison Experiment (D-ICE)	Aug 2017 – Jul 2018	Regional	The purpose of this experiment was to test strategies developed by research institutes and industry for preventing radiometer icing. Specifically to identify a method to be adopted by the research community that is effective at mitigating ice while also minimizing adverse effects on measurement quality, and to serve the needs of the community best, while also being energy efficient.	Led by PSL in collaboration with GML, the Baseline Surface Radiation Network (BSRN) and the US DOE Atmospheric Radiation Measurement (ARM) Program. Twenty-five radiometric systems were deployed and monitored alongside an additional nine operational systems at the NOAA GML Atmospheric Baseline Observatory and ARM observatories near Utqiaġvik (formerly Barrow), and Oliktok Point, Alaska.
El Niño Rapid Response (ENRR) Field Campaign	Jan–Mar 2016	International	The major El Niño of 2015-2016 presented an unprecedented scientific opportunity for NOAA to accelerate advances in understanding and predictions of an extreme climate event and its impacts through research conducted while the event was ongoing. Of particular interest was the increased risk for intense wintertime storms and heavy rainfall affecting the US West Coast during this event. The campaign deployed NOAA's Gulfstream IV research plane and NOAA Ship Ronald H. Brown, NASA's Global Hawk unmanned aircraft equipped with specialized sensors, and researchers stationed on Kiritimati (Christmas) Island in the Republic of Kiribati, approximately 1,340 miles south of Honolulu. Together, scientists collected atmospheric data from this	PSL played a central role in the planning and implementation of the campaign as well as deploying instrumentation, and contributing to forecast briefings and flight planning. After the experiment, PSL staff performed quality control measures and shared the data online.

			vast and remote expanse of the tropical Pacific where El Niño-driven weather systems are spawned.	
ERASMUS	Summer 2015 and Spring 2016	Local	This DOE-funded project aimed to demonstrate the potential of low-cost unmanned aircraft in sampling this harsh environment. Two types of small, lightweight unmanned aircraft were deployed: the CU-designed DataHawk2 and the CU-owned and modified Pilatus Porter kit aircraft. The purpose of these flights is to obtain measurements of temperature, humidity and winds over the lowest levels of the Arctic atmosphere. The data collected during these flights will aid in understanding the lifecycle of Arctic cloud properties, small scale wind patterns, and the vertical mixing of air between the surface and cloud height, all of which are critical components of improving the predictability of the Arctic atmosphere and sea-ice.	PSL/CIRES researcher worked with a team of University of Colorado faculty and students to deploy two small unmanned aircraft from Oliktok Point, Alaska.
Great Lakes Water and Carbon Dioxide Flux study	Feb 2017 – Sep 2020	Regional	Measurements of evaporation are critical for improving models and forecasting changes in water levels, as well as lake-effect snow and water temperature. This joint effort between PSL, CIRES, CU's Department of Geography, and NOAA's Great Lakes Environmental Research Laboratory (GLERL) was a follow-on to continuous measurements from three offshore Great Lakes locations including Lake Michigan, Lake Huron, and Lake Superior. These locations, in addition to other established Great Lakes Evaporation Network sites, served as calibration points for an instrumented ship passing by.	A PSL/CU research team developed a modified version of NOAA's Air-Sea Flux System—which is used to study fluxes of heat, water, and momentum between the ocean and the atmosphere—for use in freshwater applications. The instrument package was installed aboard a ship to measure fluxes of water and carbon dioxide across the Great Lakes and their impact on freshwater evaporation.

Hydromet Forecast Improvement Project (Hydro-FIP)	Dec 2015 – Aug 2019	Regional	The goal of this program was to help fill gaps in the observation, understanding and predicting of extreme precipitation and resulting streamflow in regions of complex terrain. Hydro-FIP advances in predicting the location, intensity, and duration of extreme precipitation events in this region will be used to improve NOAA/NWS forecasts, and shared with the water resource management agencies, emergency managers, and the hydropower production community.	Additional instrumentation was installed to augment the WFIP2 observing network in order to better monitor and predict extreme precipitation and its impacts. Also, PSL developed a gap flow detection and precipitation hazard tool for forecasters at the Portland Weather Forecast Office. The tool combines profile observations of wind, temperature, water vapor, as well as surface measurements of precipitation amount and type.
Integrated Characterization of Energy, Clouds, Atmospheric state, and Precipitation at Summit (ICECAPS)	May 2010 – Present	Local	Extended field program to observe atmospheric processes over the central Greenland Ice Sheet and how these impact the surface energy and surface mass budgets. Specifically, the project examines the atmospheric structure, cloud, aerosol, and precipitation processes, along with surface radiation.	PSL has been a leader of this project, including taking the lead on data archival and handling, cloud radar measurements, sodar measurements, surface precipitation, and a radiosounding system.
LAPSE-RATE	Jul 2018	Local	UAS technology demonstration in Colorado's San Luis Valley.	PSL researchers helped organize this event, and deployed drones with a University of Colorado team.
Multidisciplinary Drifting Observatory for the Study of Arctic Climate (MOSAiC)	Sep 2019 – Oct 2020	International	An international research expedition to study the physical, chemical, and biological processes that coupled the Arctic atmosphere, sea ice, ocean, and ecosystem. The RV Polarstern icebreaker drifted with the Arctic sea ice for a full year, and served as an intensive observatory, allowing scientists to collect data in every	PSL scientists were heavily involved in MOSAiC since the beginning, including developing the initial concept for a year-long, multi-disciplinary project in the Arctic sea ice; playing the chief editorial role for the MOSAiC Science Plan; serving in many leadership roles; implementing multiple science

			season. Surrounding the ship was a distributed network of key measurements to capture information on spatial variability. Coordinated activities from land-based stations, aircraft, additional ships, and satellites supported the expedition, providing the large-scale context. Jointly this constellation of observations and subsequent analyses will contribute to model improvements at many scales, as well as sea-ice forecasting, representations of local- and large-scale weather, and climate prediction.	projects; deploying instrumentation; and engaging in outreach and communications activities.
Profiling at Oliktok Point to Enhance YOPP Experiments (POPEYE)	Jul–Sep 2018	International	Detailed profiling of the lower Arctic atmosphere using remotely-piloted aircraft, tethered balloon systems and radiosondes. These observations provide critically-needed measurements with which to evaluate and improve prediction tools, as well as offer new data for assimilation into global prediction systems. Observations were taken over regular intervals over the three month time period, which coincided with the Year of Polar Prediction (YOPP) summer special observing period.	PSL scientists made up the PI team for POPEYE, and used these observations to help evaluate the RAP model (together with GSL colleagues) as well as the Coupled Arctic Forecast System (CAFS) developed at PSL. Participants were present in the field and contributed to the planning, development and execution of the activity.
Propagation of Intra-Seasonal Tropical Oscillations (PISTON)		International	Field campaign in Philippine Sea throughout typhoons and boreal summer MJO/intraseasonal oscillation events to investigate the role of ocean-air versus land-air interactions atmospheric convection, and upper ocean turbulence in the daily cycle of convective precipitation in coastal regions.	PSL the NOAA Air-Sea Flux system and W-Band radar aboard a research ship to collect air-sea flux, cloud, and boundary-layer turbulence observations.

SeaState	Sep–Nov 2015	Regional	A field campaign to investigate the dynamics of the autumn sea ice recovery in the Arctic. An expedition on board R/V Sikuliaq collected data on the dynamics of air, sea, and ice with an emphasis on wave effects and surface energy balance on ice dynamics. During this time, the ice edge moved 250 nautical miles southward from the summer ice minimum in the Beaufort and Chukchi seas, reaching the Alaskan coast.	PSL Air-sea flux system was deployed on the research vessel. Also deployed a scanning laser altimeter and fast pressure sensors to measure waves and wave effects.
Stratified Ocean Dynamics of the Arctic (SODA)	Sep–Oct 2018	Regional	This U.S. Office of Naval Research Directed Research Initiative aimed to improve understanding of upper oceanic stratification in the Arctic, a central driver in the formation and melt of sea ice. The SODA strategy included deployment of drifting ice-based buoys and instruments, fixed moorings, localized underwater glider sampling, floats and sounders and a ship-based process study, augmenting these components with remote-sensing and model studies. In combination, these tools provided comprehensive measurements of the Chukchi and Beaufort Seas.	PSL deployed instrumentation developed jointly with the University of Colorado, Boulder on a SeaHunter unmanned aircraft system that was operated by the University of Alaska – Fairbanks.
Stratus	Annual	International	This research cruise in the eastern Tropical Pacific off the coast of Chile seeks better understanding of the effects of persistent stratus cloud coverage on ocean temperatures to help improve climate models and predictions. The cruise represents a scientific collaboration between groups within and external to NOAA including WHOI.	PSL deploys the NOAA Air-Sea Flux System aboard a research ship to collect high-quality meteorological observations to characterize clouds in the region, and to perform a comparison of shipboard data with data from the buoy to address general calibration issues.
Verification of the Origins of Rotation in Tornadoes EXperiment-Southeast (VORTEX-SE)	Dec 2019-Present	Regional	An effort to understand how environmental factors characteristic of the southeastern U.S. affect the formation, intensity, structure, and path of tornadoes in this region.	PSL deployed a radar wind profiler with RASS and surface meteorology instrumentation.

Wind Forecast Improvement Project (WFIP2)	Oct 2015 – Mar 2017	Regional	A DOE and NOAA funded public-private partnership whose goal is to improve NWP model forecast skill for turbine-height winds in regions with complex terrain. A core element of WFIP2 is an 18 month field deployment located in the Pacific Northwest, focusing on the Columbia River Gorge and Columbia Basin in eastern Oregon and Washington states.	PSL led the observational field campaign and deployed remote and in situ sensors (radar wind profilers w/RASS, scanning microwave radiometers, ceilometers, microbarograph array, surface met).