Land/Atmosphere Interactions and Campaigns

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Relevance to OAR goals

This theme/component is linked to:

OAR Strategic Goal 2.2 (Identify and address gaps in observation requirements needed to understand causes of variability and change)

OAR Strategic Goal 3.1 (Develop interdisciplinary Earth system models)

OAR Strategic Goal 3.2 (Design tools and processes to forecast high-impact weather, water, climate, ocean, and ecosystem events)

"ARL's endeavor to develop and improve BL parameterizations for weather and climate predictions. Short and long-term measurements are part of a suite of carefully designed networks and planned observation campaigns". [Strategic Plan 2021-2016]

What ARL Expertise Brings to Collaborative Campaigns

- **A leader in the development and application of micrometeorological methods to observe lower land/atmosphere interactions including surface fluxes and controls, and linkages to the boundary layer processes and feedbacks**

- **Replicate sampling of point measurements known to be highly variable (e.g. soil moisture, soil temperature, vertical atmospheric gradients). In addition, eddy covariance observations are also taken at two levels to address concerns regarding advection issues (representativeness)**

- **Expertise in observing ancillary data especially those needed in Land Models and satellite derived fluxes (leaf area index, canopy and soil properties, surface temperature)**

- **Using innovative technologies (UxS platforms and sensors) to observe surface and atmospheric variables (i.e. air temperature, humidity, wind, canopy structure, albedos)**

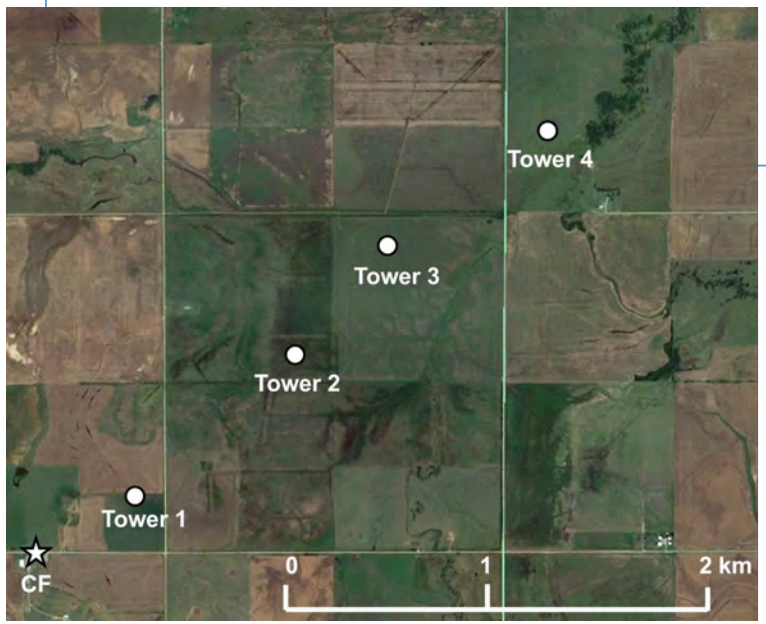
LAFE (Land-Atmosphere Feedback Experiment)

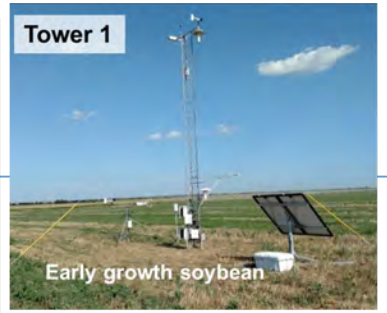
Goal – To investigate Land–Atmosphere interactions and feedbacks at high spatial resolution in the Southern Great Plains region

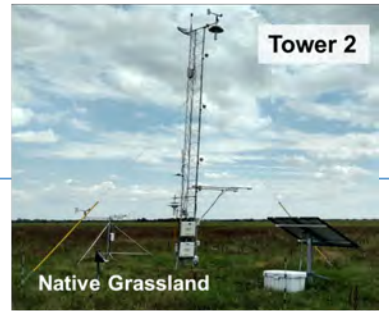
Study Period – August 2017

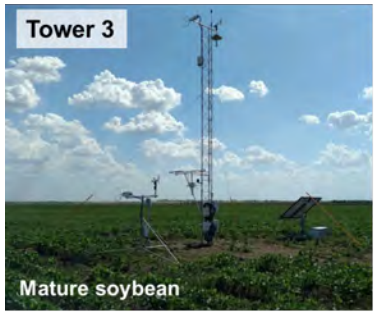
Location– Atmospheric Radiation Measurement (ARM) Southern Great Plains (SGP) site in Northern Oklahoma, USA

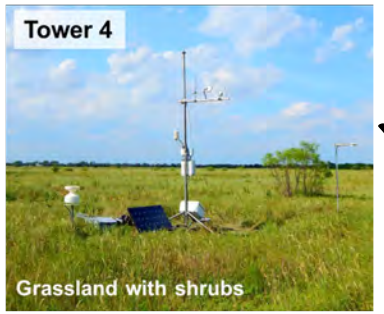
Collaborators-NOAA, University of Hohenheim, NCAR, CIMSS and several other universities.

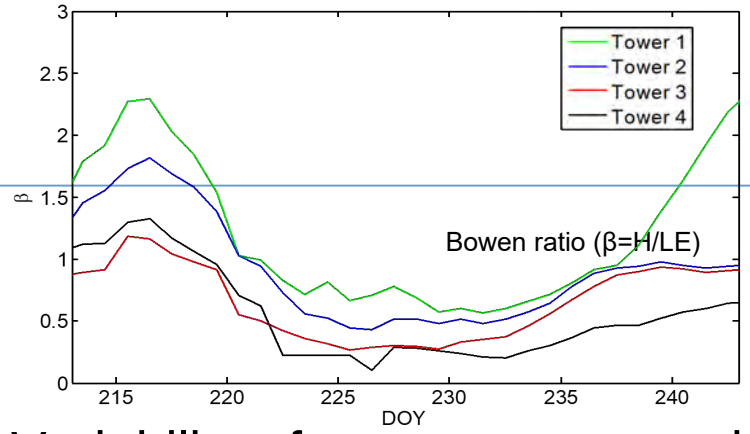








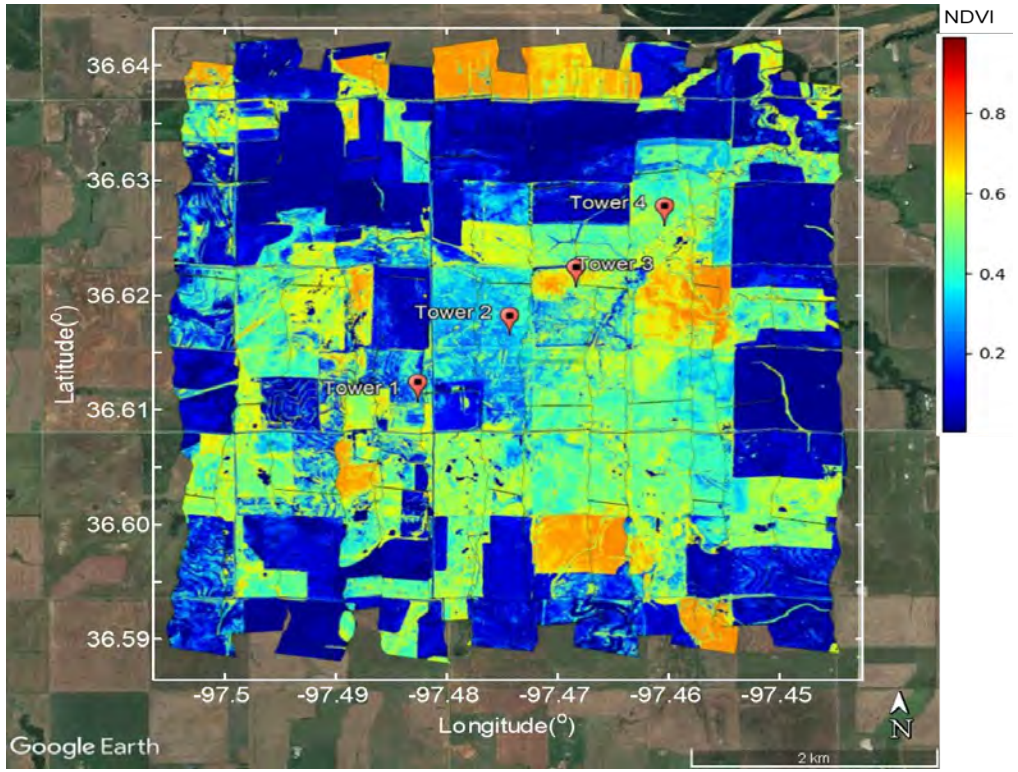




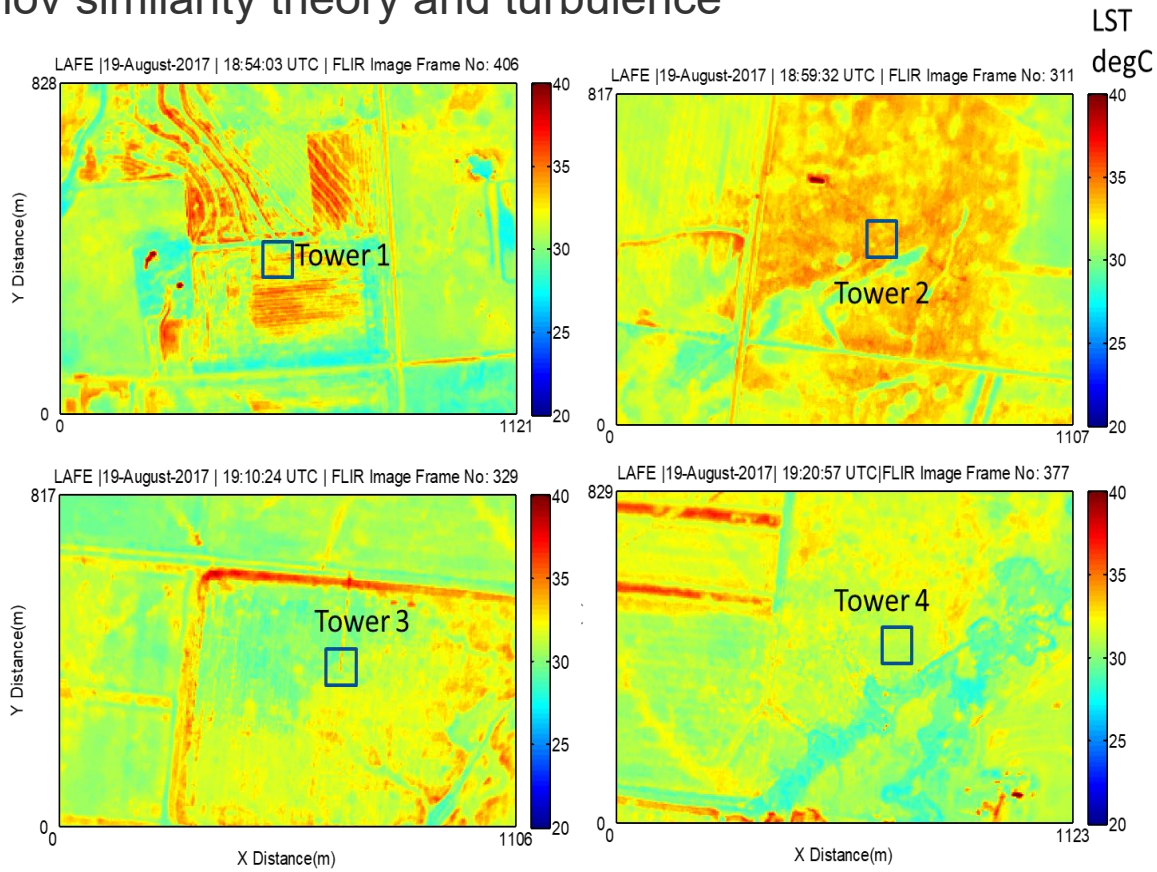
✓ Variability of energy, water and CO_2 fluxes at the four sites using tower-based measurements

LAFE Observations and Results

Data used to explore mapping the surface momentum, sensible heat, and latent heat fluxes in heterogeneous terrain; the testing of Monin–Obukhov similarity theory and turbulence parameterizations



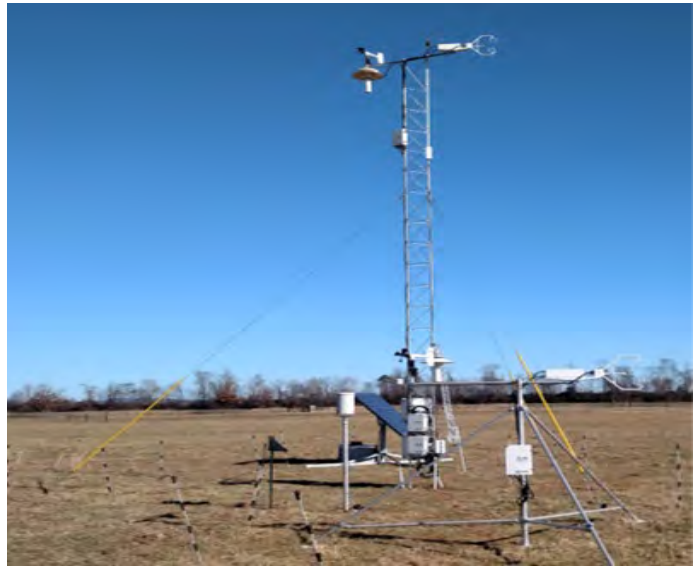
Vegetation indices using airborne hyperspectral data (aircraft obs)



Land surface temperature(LST) using airborne thermal observations (UxS)

VORTEX-SE (Verification of the Origins of Rotation in Tornadoes Experiment-Southeast)

Goal – To understand how environmental factors characteristic of the Southeast affect the formation, intensity, structure, and path of tornadoes in this region
Study Period – Spring 2016, 2017
Location– Southeastern U.S, Alabama
Collaborators-NOAA, NCAR, NASA, CIMSS, and many others



Cullman, AL

DJIS-1000

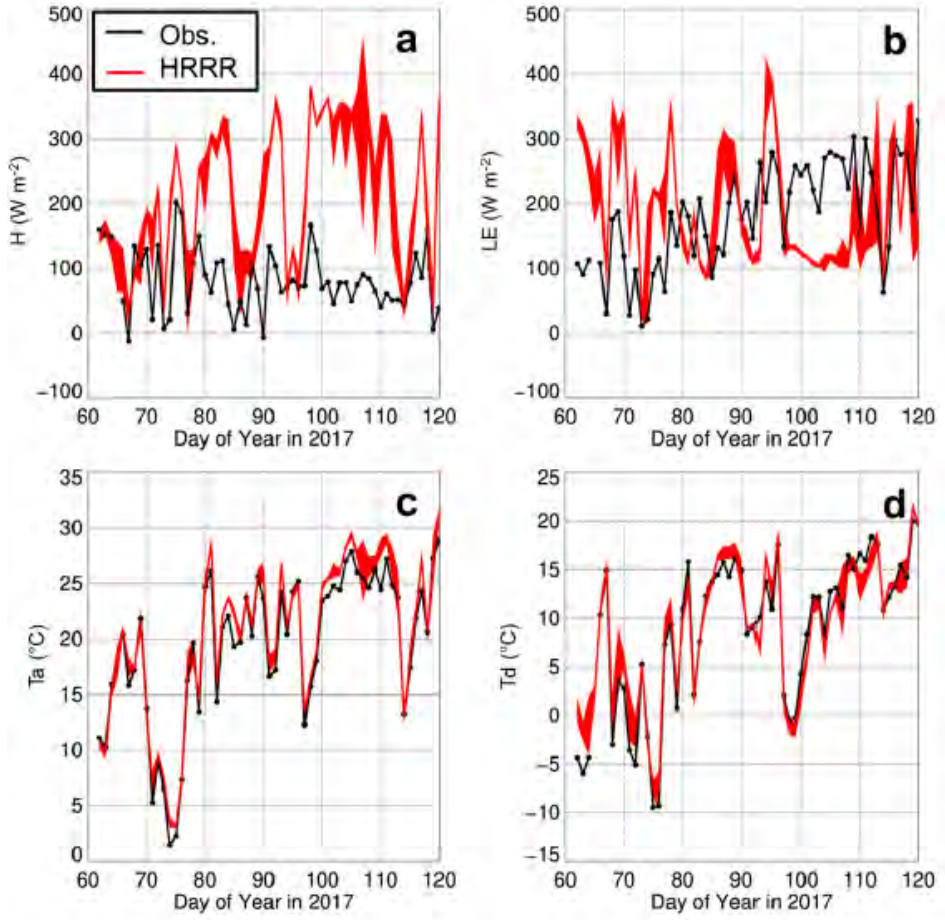
MD4-1000

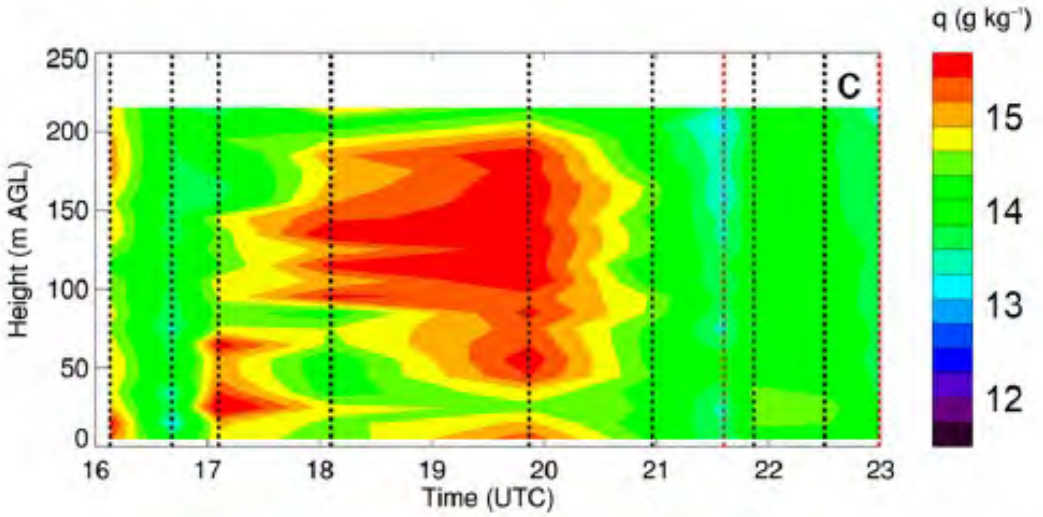
sUxS to sample thermodynamics of lower PBL during IOPs

100 rawinsonde launches to sample pre-storm environment

VORTEX-SE Observations and Results

HRRRv2 does well forecasting T_{air} and T_d but poorly represents H and LE right result, but incorrect physics! *Lee et al. 2019 WAF*





sUxS used to provide information on near-sfc. *T*, *q* fields *Lee et al. 2019 Sensors*

CHEESEHEAD (Chequamegon Heterogeneous Ecosystem Energy-balance Study Enabled by a High-density Extensive Array of Detectors)

Goal – To investigate the role of surface heterogeneity on boundary layer development and processes

Study Period – July - October 2019

Location– 10 km x 10 km domain around the WLEF TV tower (450 m) near Park Falls, WI

Collaborators-University of Wisconsin, NOAA, NCAR, NEON many other university participants, both national and international

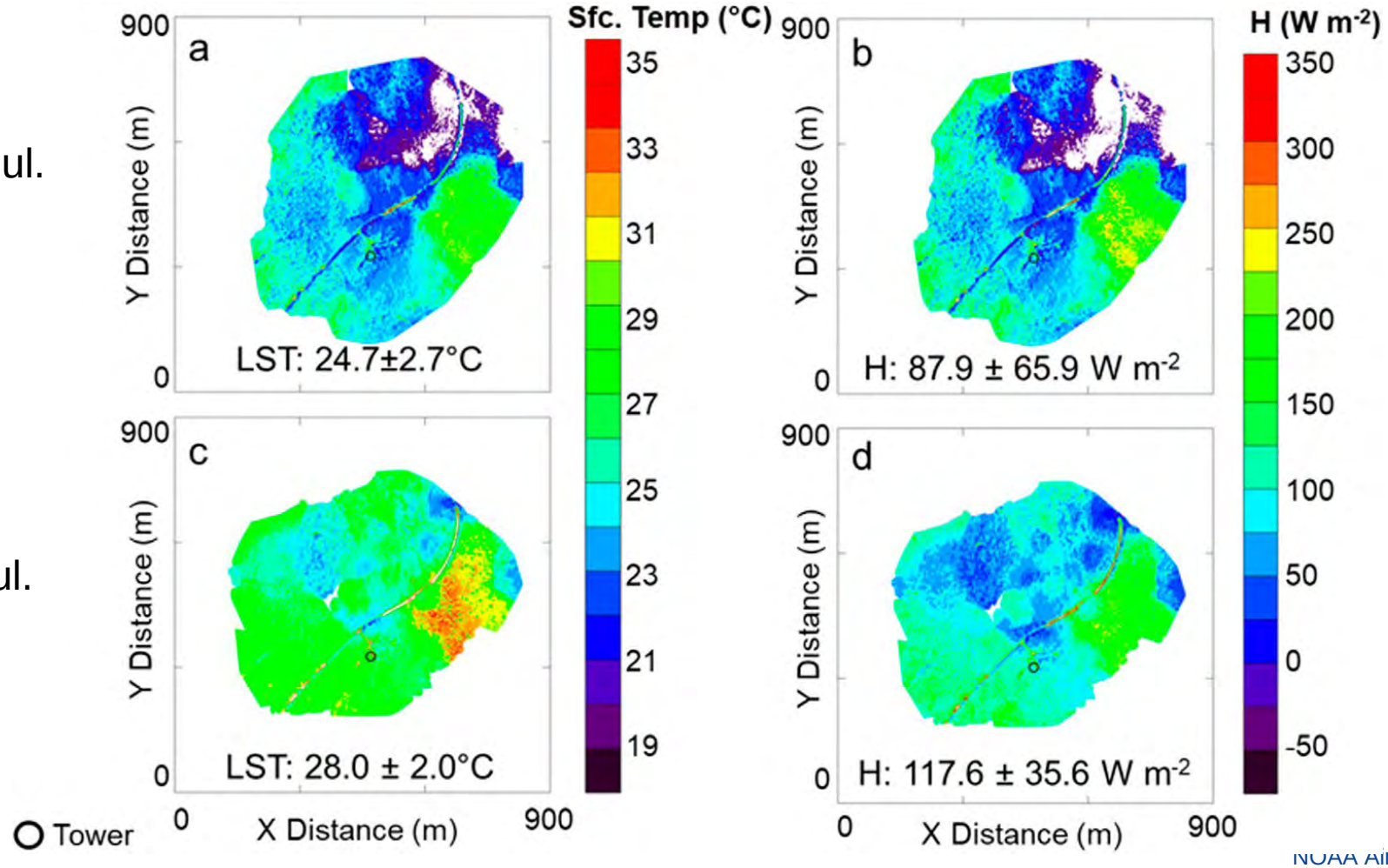
147 Flights during CHEESEHEAD IOPs using two small Unmanned Aircraft Systems (sUAS). These platforms were used to obtain both vertical profiles of T, q, and winds as well as obtaining IR imagery (surface temperature) to assess the horizontal heterogeneity of heat fluxes.

CHEESEHEAD - Observations and Results

Horizontal sUAS flights captured the fine-scale variability in surface temperature and were used to estimate sensible heat flux

~1500 UTC 12 Jul.

~1600 UTC 12 Jul.



SPLASH (Study of Precipitation, the Lower Atmosphere and Surface for Hydrometeorology) complements a U.S. Department of Energy campaign called the Surface-Atmosphere Integrated field Laboratory (SAIL) and will use observations from the USGS's Next Generation Water Observing System in the Upper Colorado River Basin to help evaluate and improve NOAA's latest suite of modeling tools,

Goal – To improve our understanding of hydrometeorological processes in complex terrain in order to advance our weather and water prediction capabilities, UFS, HRRR, NWM

Study Period – Oct 2021 - Sept 2023

Location – The East River basin near Crested Butte, CO

Collaborators-RMBL, NOAA, DOE, USGS, UCAR

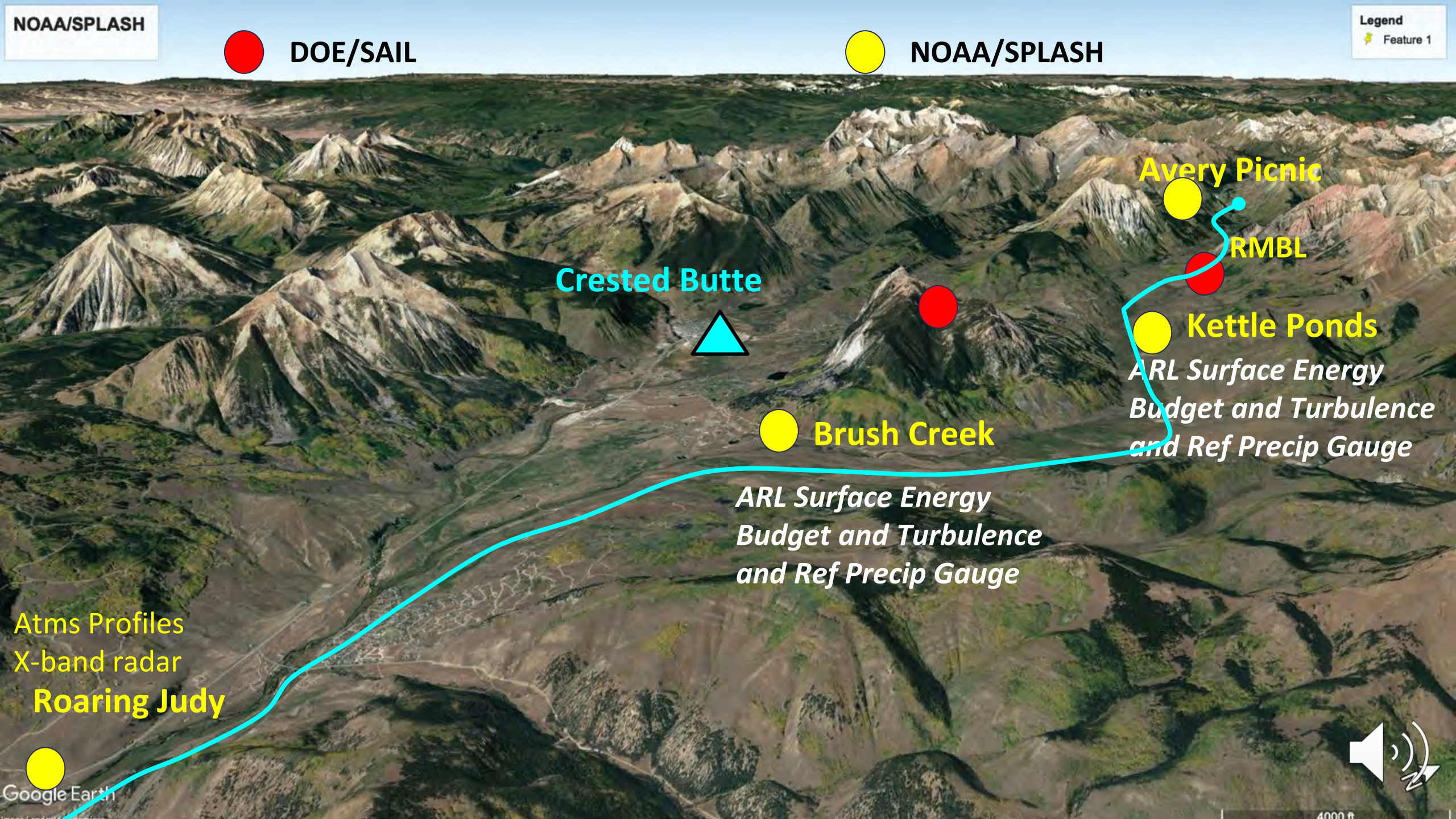
PSL- Snow level radars, surface energy balance systems, hydrometeor properties, sUAS for atmospheric and surface observing, precip radar, soil moisture, boundary layer winds/T/RH

GML- Surface radiation budget

GSL - HRRR model output, model eval

ARL - USCRN Precip gauges, surface energy balance systems, soil moisture,UxS Observations for surface temperature, NDVI

NSSL - BL winds/T/RH


NOAA/SPLASH
DOE/SAIL
NOAA/SPLASH
Legend
Feature 1
Avery Picnic
RMBL
Crested Butte
Kettle Ponds
ARL Surface Energy Budget and Turbulence and Ref Precip Gauge
Brush Creek
ARL Surface Energy Budget and Turbulence and Ref Precip Gauge
Atms Profiles
X-band radar
Roaring Judy
Google Earth

SPLASH Campaign (ongoing)

ARL Micrometeorological Flux Tower Kettle Ponds (22 OCT 2021)

ARL Micrometeorological Flux Tower Kettle Ponds (23 Jan 2022)

SPLASH Campaign (cont.)

Reference precip gauge (USCRN) with new low porosity double fence (LPDF) at Kettle Ponds. Similar gauge is also at the Brush Creek site.

Quality and Performance

Presentations and Publications presented by previous ARL presenters.

This presentation has demonstrated the continued growth of the collaborative effort within OAR laboratories to advance our understanding of boundary layer processes and surface-atmosphere interactions to improve our predictive capabilities on a wide range of temporal scales.