Multi-Frequency Radar Facility for Small-Scale, Fast-Evolving Cloud System Research

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RADAR SCIENCE

KASPR, WCR-QC, MRRPro, Ceilometer, Parsivel, Pluvio, MWR

Multi-Frequency Radars

| Instruments	Measurement	VAP	Technical Capability
Ka-band Scanning Polarimetric Radar (KASPR, 35 GHz)	Reflectivity, Doppler velocity, Doppler spectrum width, Doppler spectra, full polarimetric observables (co- and cross- polarization)	Vertical and horizontal wind, cloud particle properties, precipitation particle properties supercooled liquid droplets, rime fraction, IWC, LWC, ice particle multiplication	Full polarimetry, pulse compression, dual PRF, Doppler spectra,
W-band profiling radar (WCR-QPC, 94 GHz)	Reflectivity, Doppler velocity, Doppler spectrum width, Doppler spectra	Vertical velocity, particle size and fall speed, snow particle multiplication	Continuous FMCW, quadratic phase coding for high duty cycle
Micro Rain Radar (MRRPro, 24 GHz)	Reflectivity, Doppler velocity, Doppler spectrum width, Doppler spectra	Precipitation particle fall speed, snow particle multiplication	FMCW
X-band Phased Array Radar (SKYLER I, II)	Reflectivity, Doppler velocity, Doppler spectrum width, Doppler spectra	Vertical and horizontal wind, precipitation particle properties, precipitation particle properties supercooled liquid droplets, rime fraction, IWC, LWC, ice particle multiplication	Mobile Facility (SKYLER II), full polarimetry, pulse compression, dual PRF

Ancillary Instruments

| Instruments	Measurement	VAP
Ceilometer	Lidar backscatter	Cloud base height, boundary layer height
Microwave radiometer (MWR)	Atmospheric absorption	Liquid water path, T, RH, water vapor profile
Parsivel	Snow particle size distribution, particle fall speed	Water content, precipitation particle bulk density, rime fraction
Pluvio Weighing gauge	Precipitation amount	

Science

Atmospheric Feature Tracking

KASPR is fully integrated with the Multisensor Agile Adaptive Sampling flamework, which allows it to automatically track atmospheric features and cloud entities of interest such as convective cells, shallow cumuli, and fall streaks. KASPR samples RHIs every 20 to 30 sec.
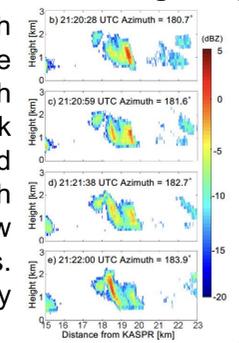
Snow Microphysics

Multi-frequency, multi-parameter radar measurements in conjunction with lidar and radiometer enables reliable estimations of detailed microphysical processes and snow particle properties (e.g., size, number density, shape, rime degree).
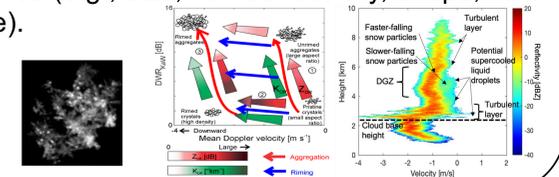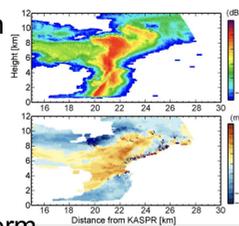

Severe Weather

High-spatiotemporal resolution observations of dynamics and microphysics are available for:
- Waterspout
- Hurricane
- Thunderstorm
- Generating cells in snowstorm

KASPR polarimetry captures many microphysical and dynamical features (e.g., electrification, vorticity, riming).
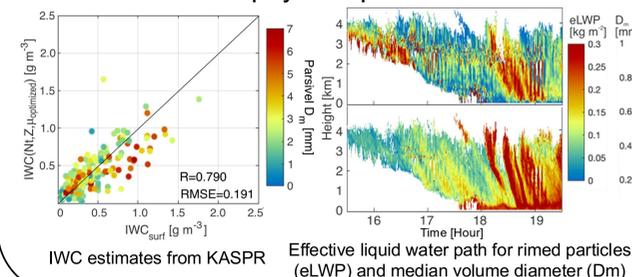

Automated Agile Adaptive Scan

Multi-sensor observations are used in real time to optimize frequent spatiotemporal sampling of atmospheric processes. The tailored pointing and increase in sensitivity enables the steered radars to sample a diverse set of atmospheric phenomena.

MAAS (Mutlisensor Agile Adaptive Sampling) framework (Kollias et al., 2020; Lamer et al., 2023)
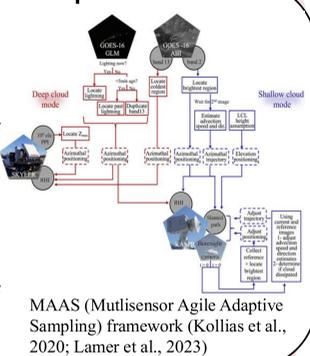
Quantitative Estimates

Multi frequency capability advances quantitative estimates of microphysical parameters.

IWC estimates from KASPR

Effective liquid water path for rimed particles (eLWP) and median volume diameter (Dm)

Field Campaigns

KASPR for S2noCliME at Steamboat Springs, CO

SKYLER II for IMPACTS, TRACER, ESCAPE, INCUS

The facility can be deployed in different environments for field campaigns.

Outreach

Summer School

The first Summer School in MM-Wavelength Radar Observations of Clouds and Precipitation was held from June 4 to June 9, 2023, in Stony Brook University. Students were given a total of ten lectures about radar basics, instrumentation, and atmospheric physics and a tour of the facility. They also worked on group researches using the datasets.

Virtual Facility Tour

https://you.stonybrook.edu/somas/2019/11/15/radar-observatory/

Related Links

https://connectedweather.org