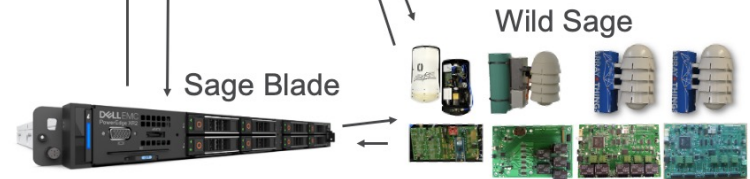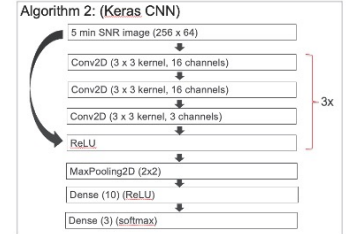# ARMing The Edge

Can we utilize Array of Things + AI to identify time periods when detailed cloud and rain drop information needed?
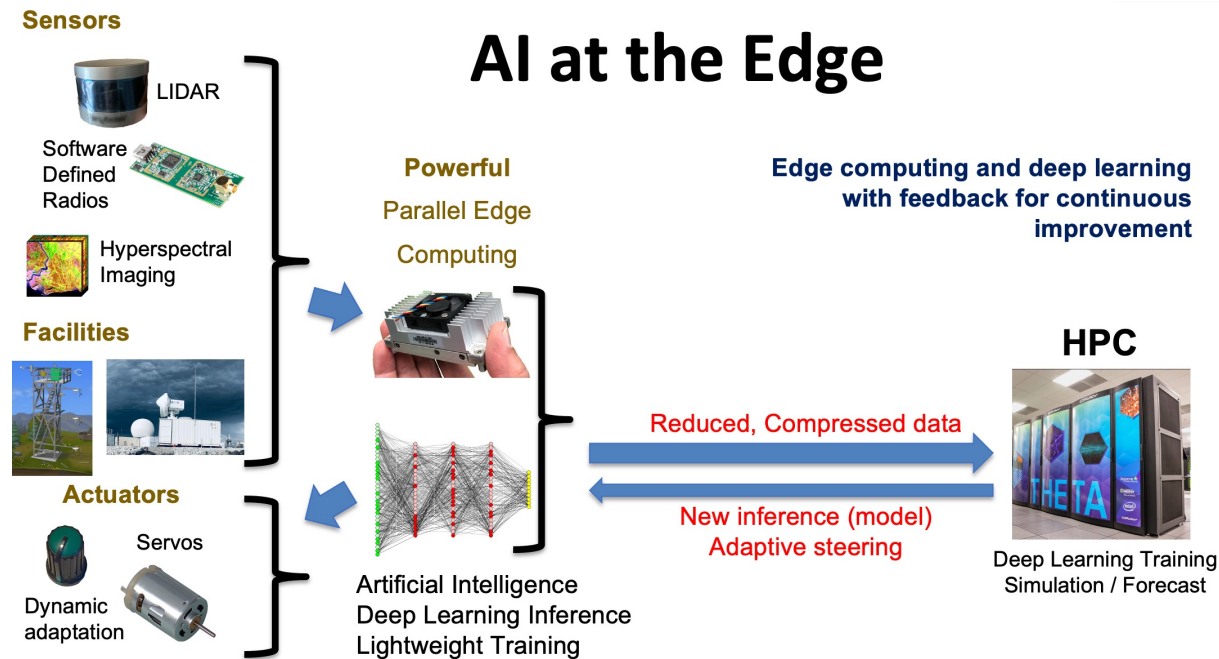
SCOTT COLLIS, ROBERT JACKSON, NICOLA FERRIER, PETE BECKMAN, RAJESH SANKARAN, SEAN SHAHKARAMI, JOSEPH SWANTEK, CHARLIE CATLETT, ROBERT NEWSOM AND JEREMY CORNER

June 22, 2021
ARM/ASR PI meeting

What is Edge Computing?

Edge computing turns an IO bound problem to compute bound.

- Compute as close as possible to the point of data collection/control.
- Greatly enabled by the proliferation of small compute. RPi, Jetson, Arduino et al.
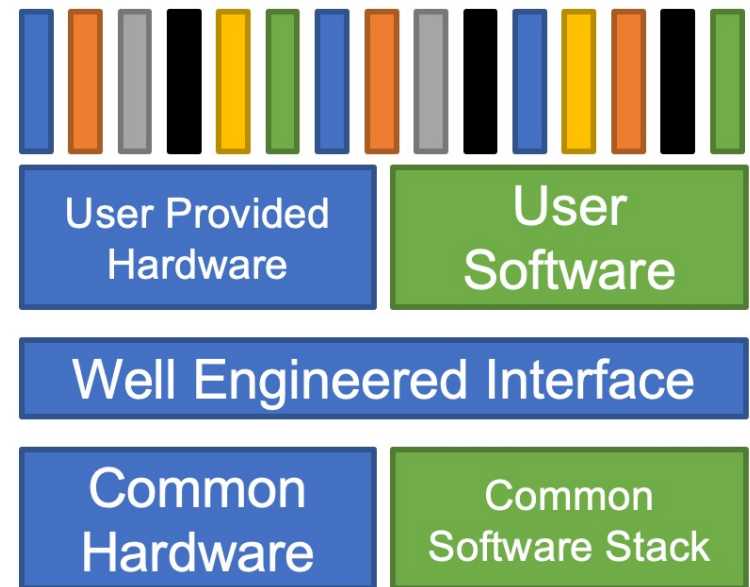
AI at the Edge

Sensors

LIDAR

Software Defined Radios

Hyperspectral Imaging

Facilities

Actuators

Servos

Dynamic adaptation

Powerful Parallel Edge Computing

Artificial Intelligence
Deep Learning Inference
Lightweight Training

Edge computing and deep learning with feedback for continuous improvement

Reduced, Compressed data

New inference (model)
Adaptive steering

HPC

THETA

Deep Learning Training
Simulation / Forecast

Introducing Sage

Enabling Science at the Edge

- Sage is a multi-agency funded project that focuses on *cyberinfrastructure (CI).*

- This is the layer between the instrument and the science (control, logging, network, storage etc..).

- Specifically Sage is building CI which enables **AI@Edge**

Many Applications Across Domains

User Provided Hardware	User Software

Well Engineered Interface

| Common Hardware	Common Software Stack

ARMing the Edge

So exactly what are we doing?

- Deploying both indoors (rack mounted GPU + CPU dell blade) and outdoor (Waggle multi-architecture units with sensor packages and cameras). To the SGP site.

- Working with Waggle sensors and ARM data streams doing AI@Edge for scene classification and demonstration purposes.
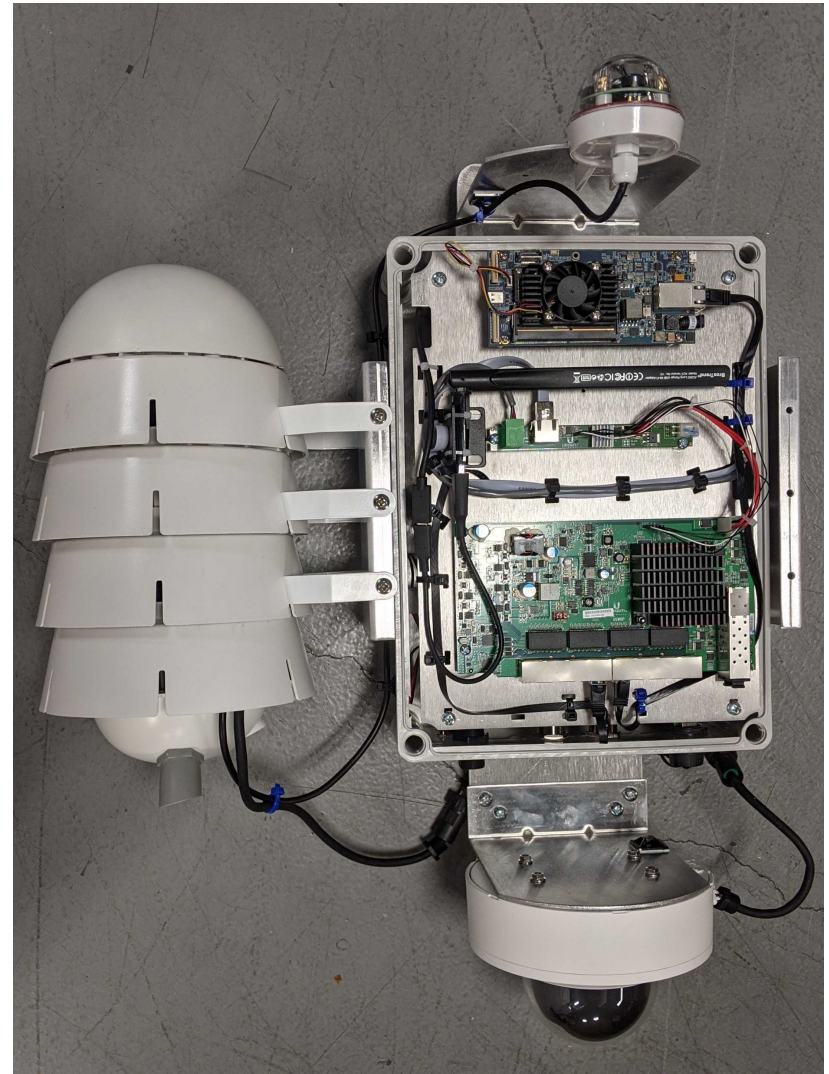
Focus on challenges with the Doppler LIDAR (DL)

- The DL is a great target for edge processing.

- Currently only moments are archived.

- Spectra contains rich information that should be processed differently when different phenomena are present.

- Similar to radar and RWP data.

- Can we classify sky state from DL Spectra?

range = 810.0, time = 2017-08-04T00:39:00.440000

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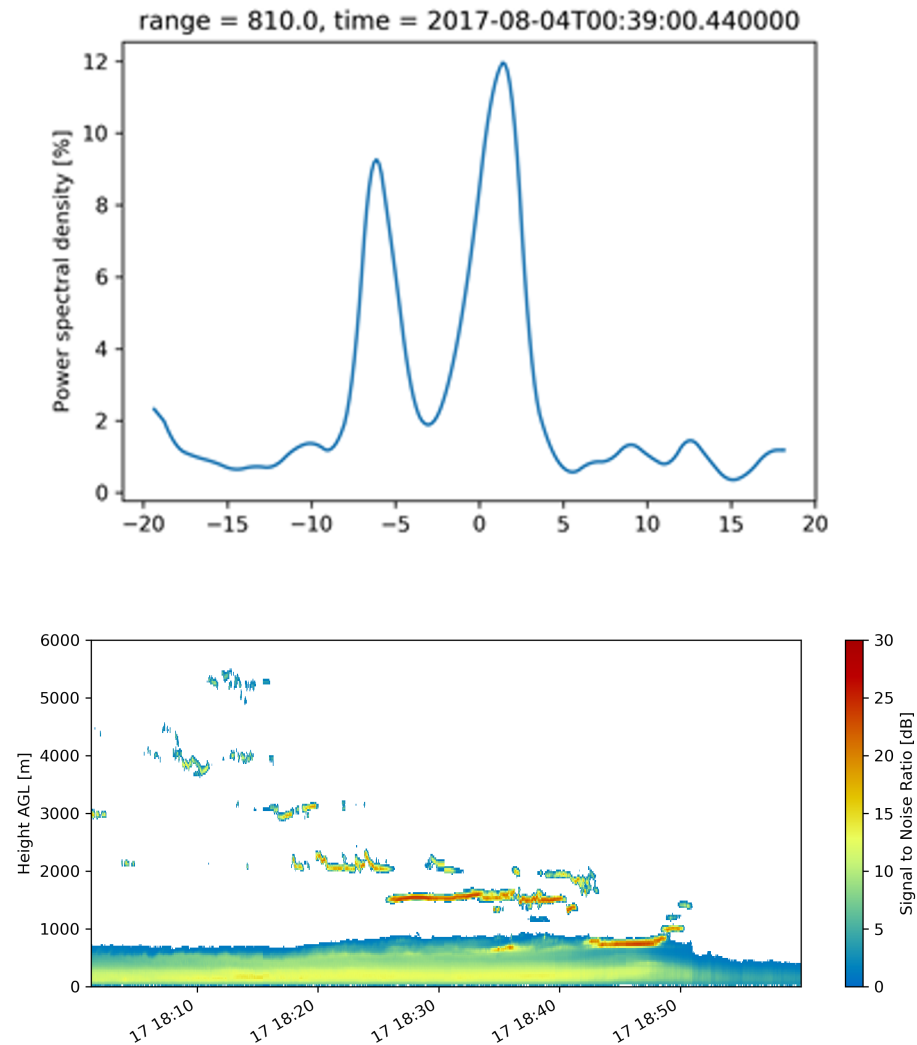
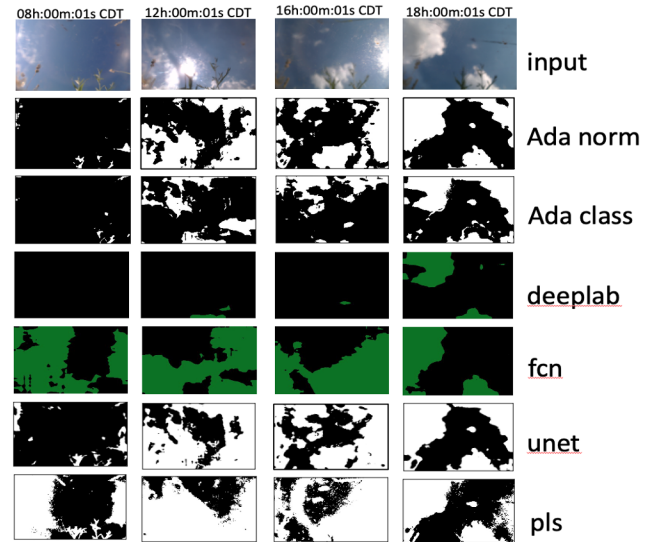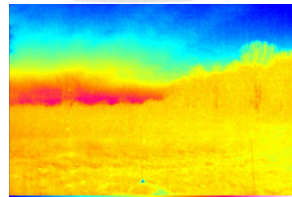- Can we classify sky state from DL Spectra?

	Clear	Cloudy	Rain
Clear	9745	310	166
Cloudy	130	2898	46
Rain	14	4	226

94% accuracy

	Clear	Cloudy	Rain
Clear	7207	2497	162
Cloudy	2345	818	55
Rain	709	244	17

88% accuracy

Future and other work: https://sagecontinuum.org/science/
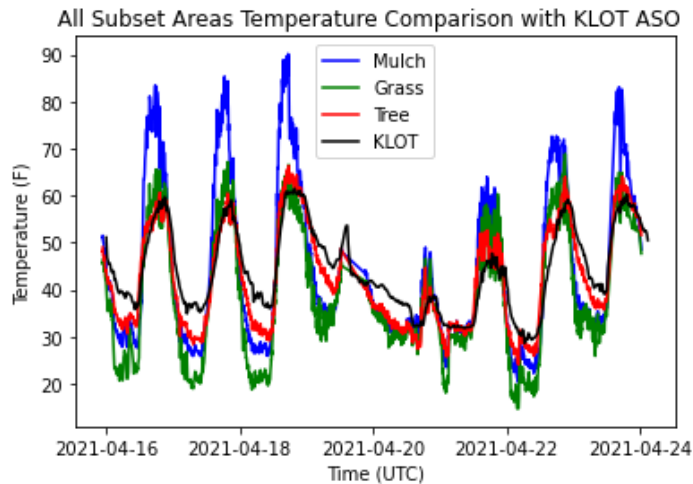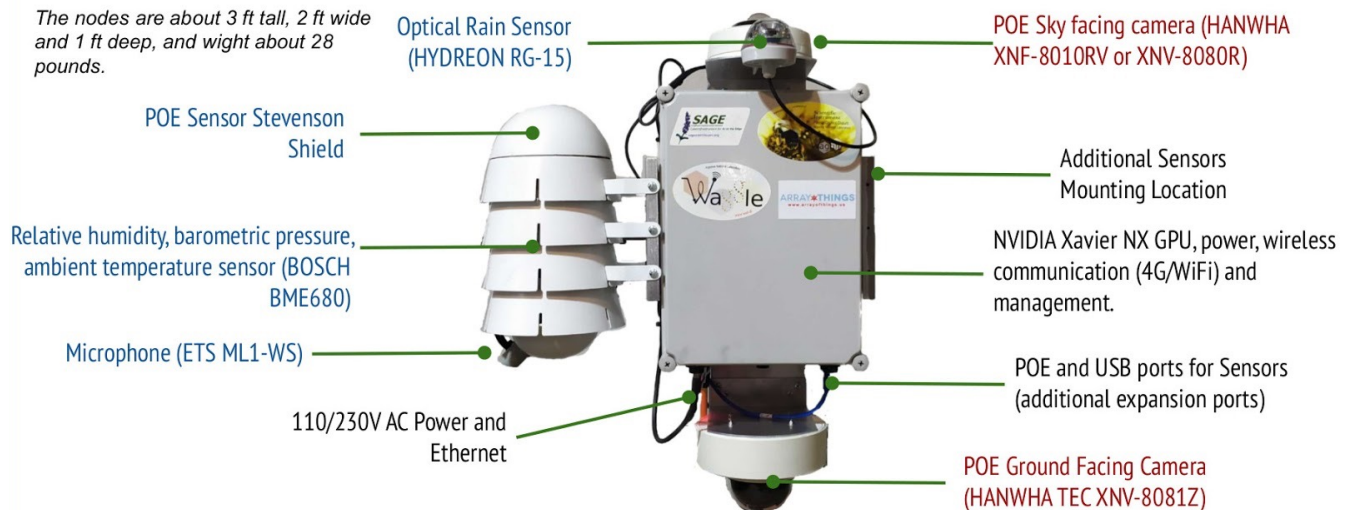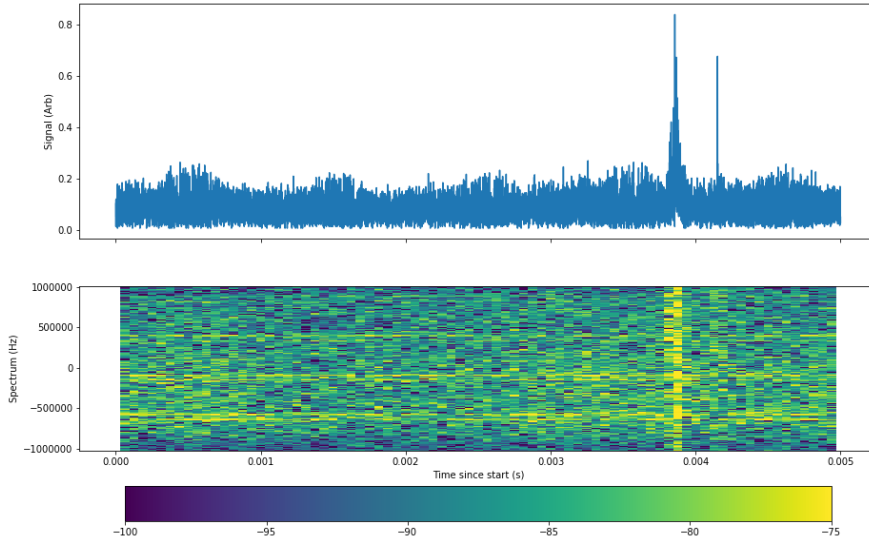

Can we use thermal cameras to look at land surface temperatures as well as cloud temperatures?

Can a camera be used to determine cloudiness and predict solar irradiance?

The nodes are about 3 ft tall, 2 ft wide and 1 ft deep, and wight about 28 pounds.

Optical Rain Sensor (HYDREON RG-15)

POE Sky facing camera (HANWHA XNF-8010RV or XNV-8080R)

POE Sensor Stevenson Shield

Additional Sensors Mounting Location

Relative humidity, barometric pressure, ambient temperature sensor (BOSCH BME680)

NVIDIA Xavier NX GPU, power, wireless communication (4G/WiFi) and management.

Microphone (ETS ML1-WS)

POE and USB ports for Sensors (additional expansion ports)

110/230V AC Power and Ethernet

POE Ground Facing Camera (HANWHA TEC XNV-8081Z)

Future and other work: https://sagecontinuum.org/science/

Can we use Software defined Radios to detect lightning?
(Collab with Eric Bruning and Tim Logan)

Can we combine optical imagery and a scanning LIDAR for smart sampling?

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Acknowledgments and References

Huge thanks to the whole Sage CI team and the ARM Southern Great Plains staff for supporting our field campaign!

Sage: Coming to an integrated field laboratory near you!