Ground-based Lower Atmospheric Observing Facilities (LAOF)

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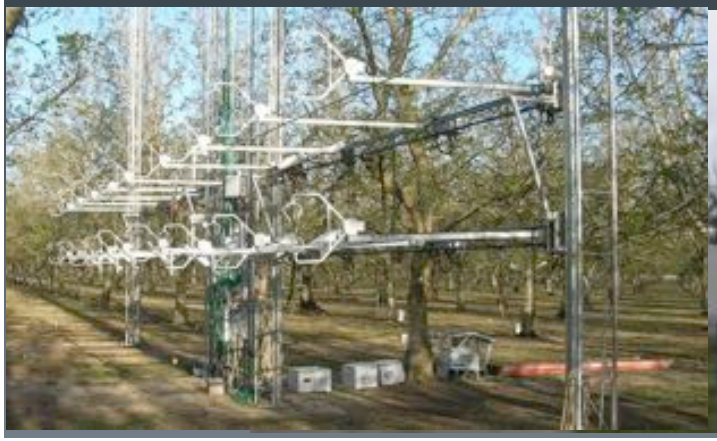
With input from CSU-CHILL, CSWR, EOL, and others….

Overview

- Available Facilities
- Illustrative Climate-motivated Deployments
- Measurement Challenges

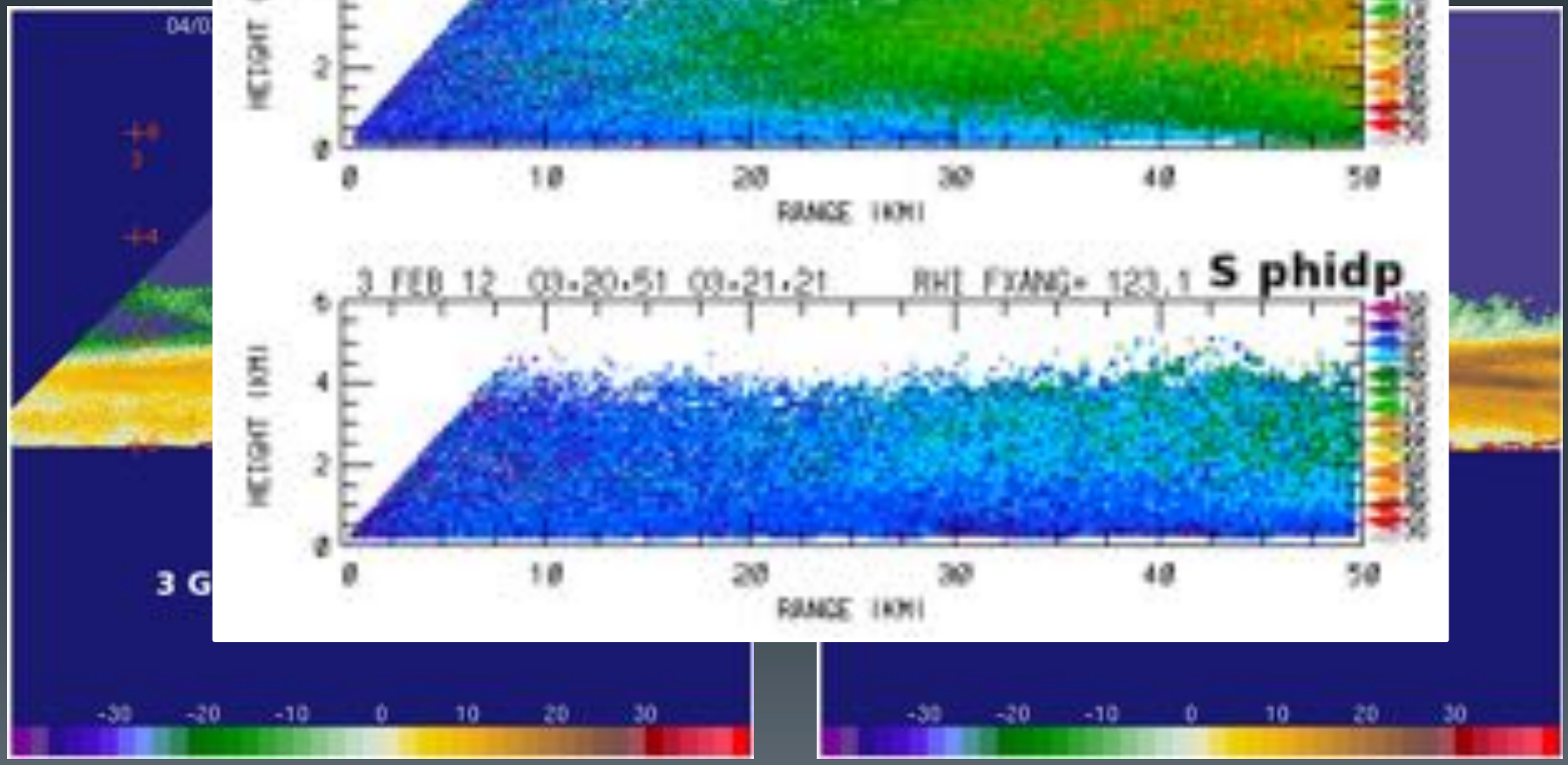


CSU-CHILL Radar Facility

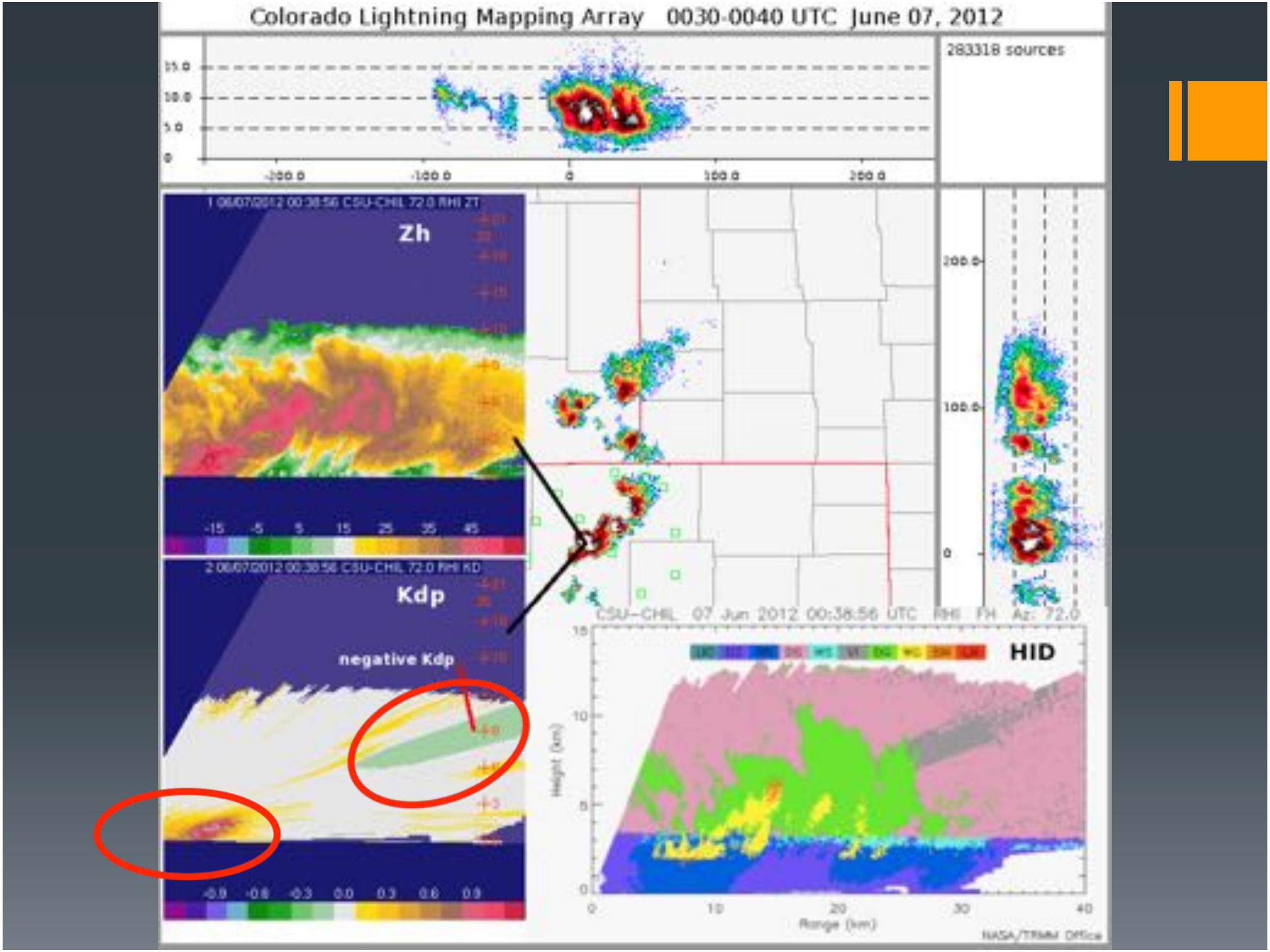
- Dual-polarization deployable research weather radar system (S-band/X-band)
- Unique dual-offset dual-wavelength 8.5m antenna
  - 1° S-band beam width
  - 0.3° X-band beam width
  - Low sidelobe levels
  - Low cross-pol contamination, LDR limit < -38 dB
- Transmitter:
  - Dual-klystron S-band 800 kW transmitter system
    - -13 dBZ at 30km
  - Magnetron X-band 25 kW transmitter system
    - -10 dBZ at 30km
- Signal processor outputs data in variety of standard formats, including UF, netCDF and NEXRAD Level II
- Easy-to-use web-based interface

CSU-CHILL Example Data

Dual f



- High resolution (0.5°) X-band beam width
- Improved fdp (differential phase) sensitivity at X-band


Colorado Lightning Mapping Array 0030-0040 UTC June 07, 2012
283318 sources
Zh
Kdp
negative Kdp
HID
CSU-CHIL 07 Jun 2012 00:38:56 UTC
Height (km)
Range (km)
NASA/TRMM Office

CSU-CHILL Solid State Upgrade

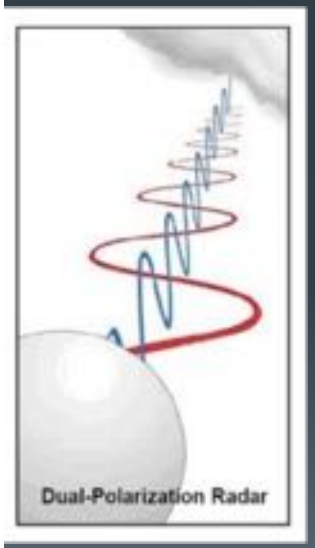
- New S-band Solid-State Transmitter/Electronics
  - Expanded Capabilities:
    PRF and Waveform Agility,
    Frequency Hopping
    Wideband Waveform Research
  - System Stability and Reliability Improvements
    Enables better remote operation;
    Reduces O&M

Leads to better Measurements

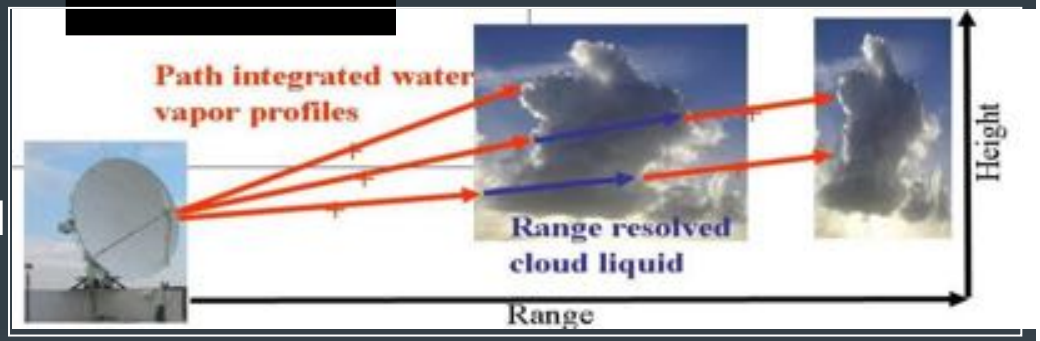
- Range-Velocity Ambiguity Mitigation
- Rapid Volume Scanning
- Improved Range Resolution
- Better Data Quality

See CSU-CHILL poster

S-PolKa: S-band/Ka-band
Dual Wavelength, Dual Polarization



Drop size distribution
QPE and integrated rainfall
Clutter mitigation
Hydrometeor identification
Near surface humidity

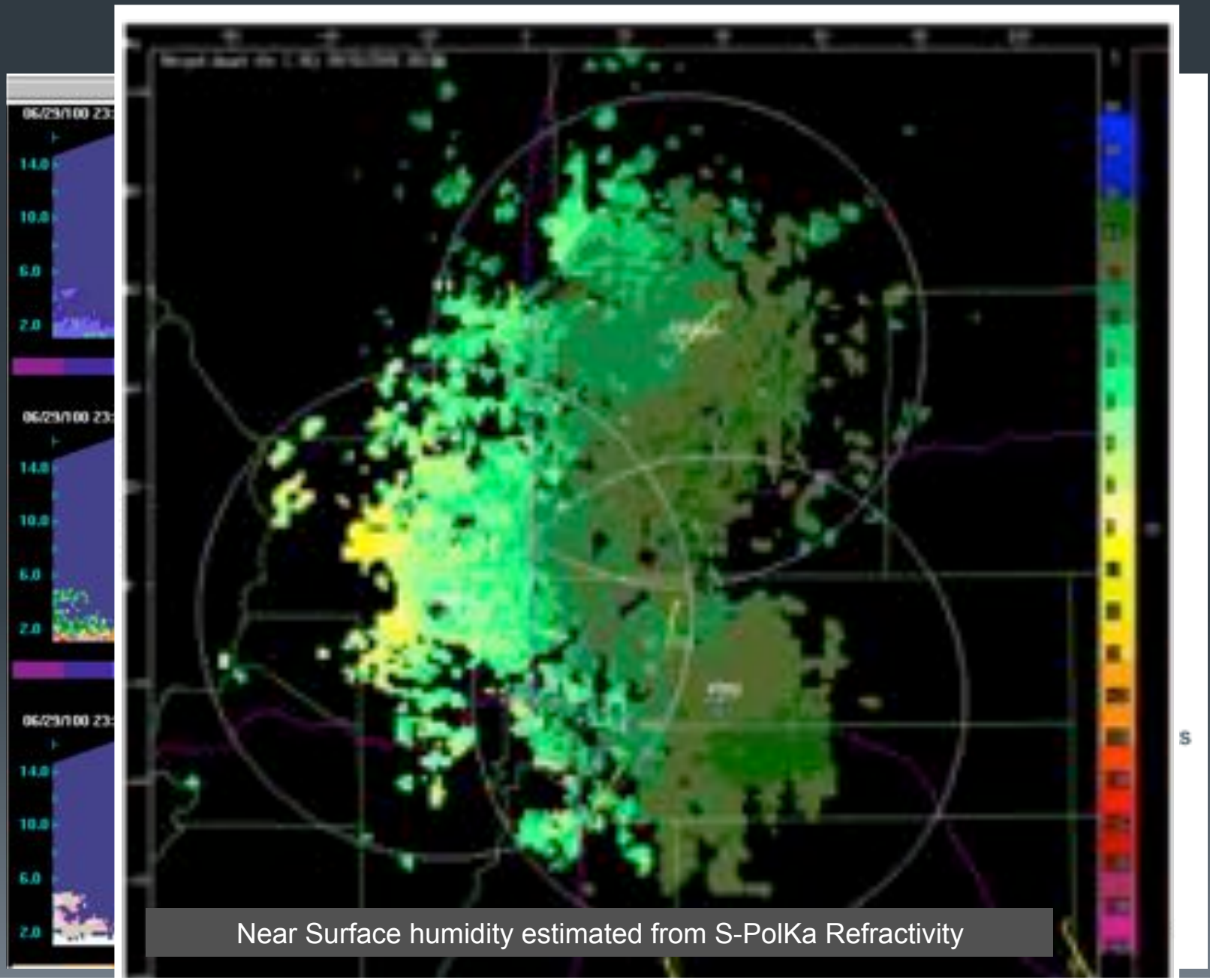


Total cloud liquid water content
Path-integrated humidity and vertical profiles
Drop medium volume diameter

Transmit H & V Polarized Waves

Rain Drop Shapes by Size

S-PolKa Scientific Products

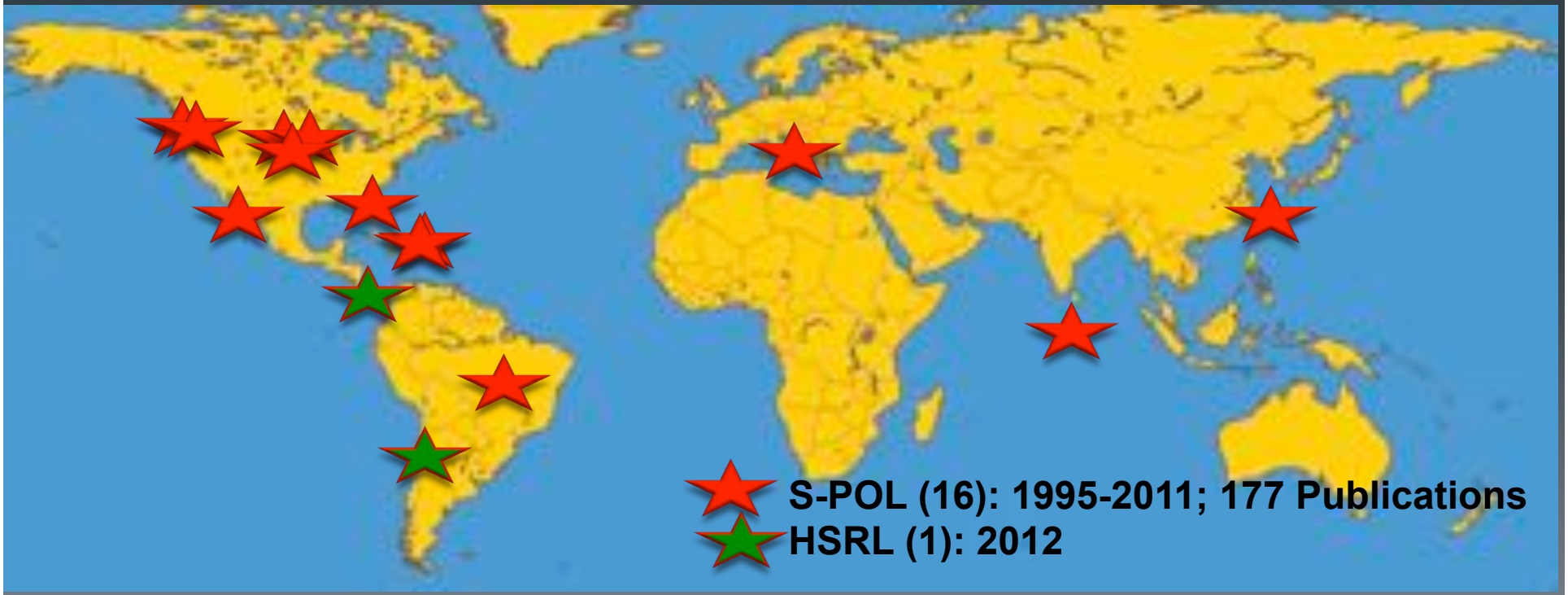


Near Surface humidity estimated from S-PolKa Refractivity

S-PolKa Deployments

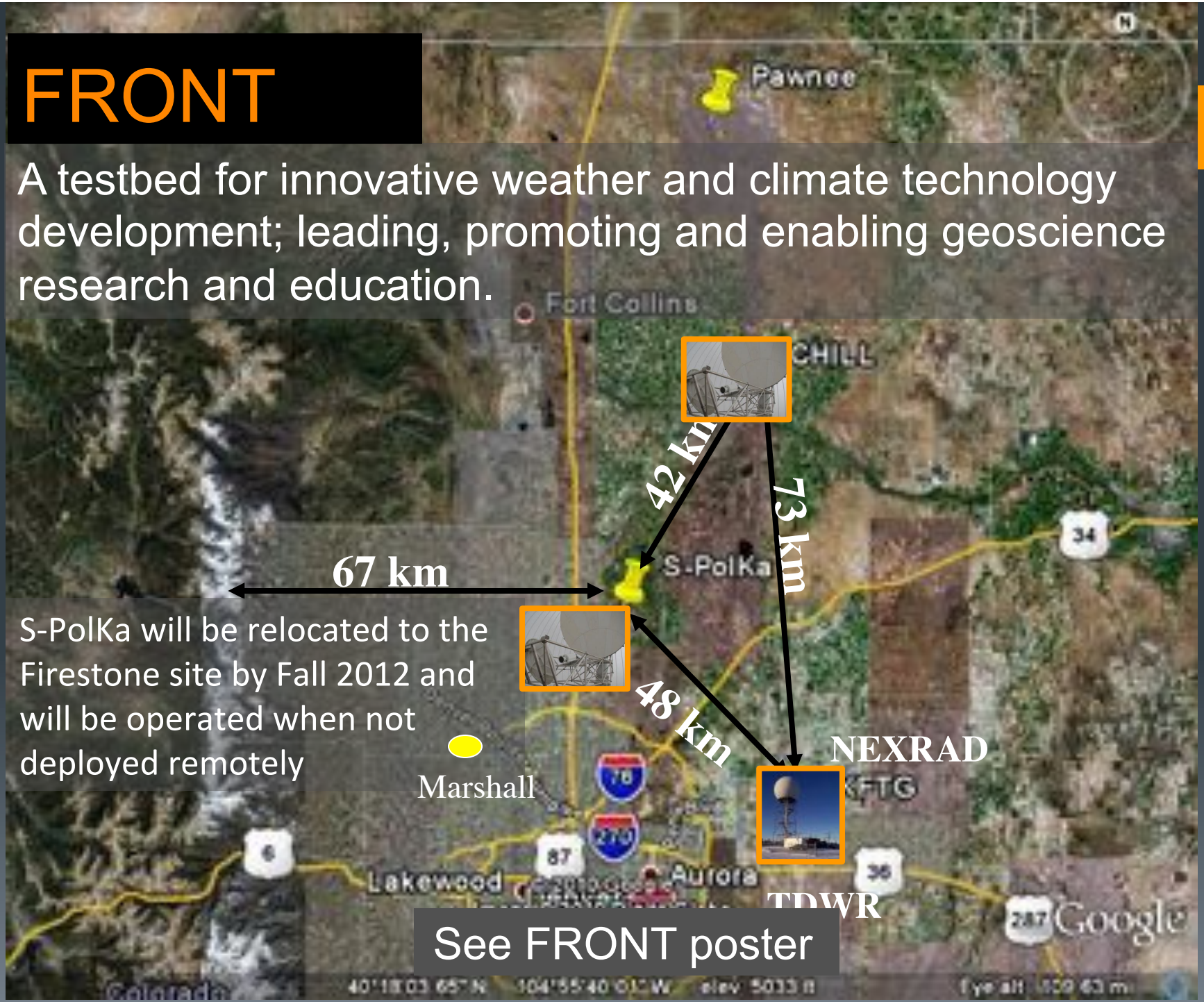
No concrete pad needed
Transportable
Shipped with 8 seatainers
Self-contained with generator power

Winter Storms
Tropical Convection
Tropical Cyclone
Orographic Precipitation
Severe Weather
Cloud and Aerosol



FRONT

A testbed for innovative weather and climate technology development; leading, promoting and enabling geoscience research and education.



S-PolKa will be relocated to the Firestone site by Fall 2012 and will be operated when not deployed remotely

See FRONT poster

High Spectral Resolution Lidar (HSRL)
HIAPER Cloud Radar (HCR)

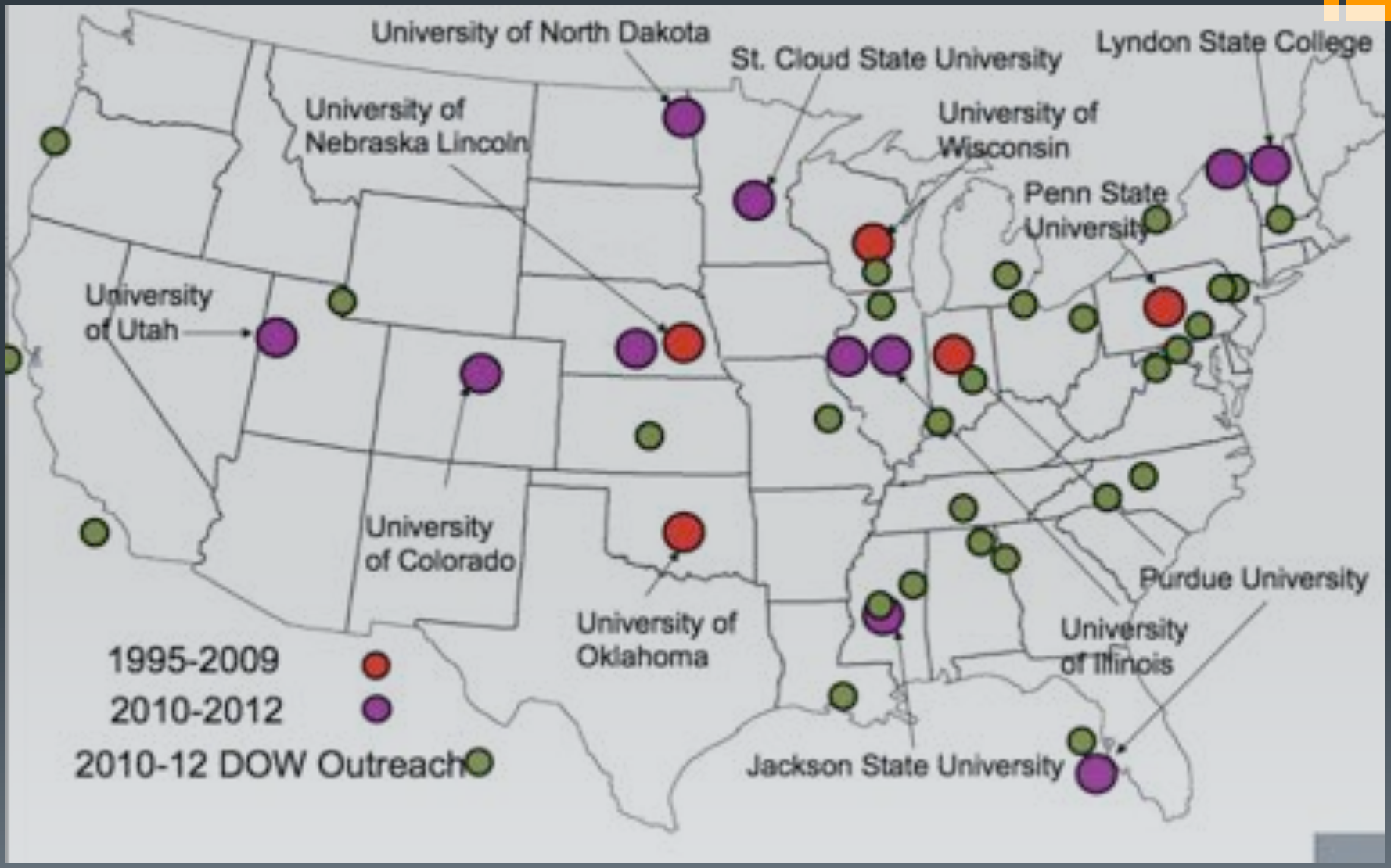
Both deployable as ground-based systems

Described later this morning

Doppler on Wheels (DOW)

- Network of Mobile Radars for targeted observations
- Quick, easily deployable for rapidly evolving weather
- Long duration observations at single or multiple sites
- Matched spatial and temporal scales
- Inexpensive, fully student operable

DOW Deployments

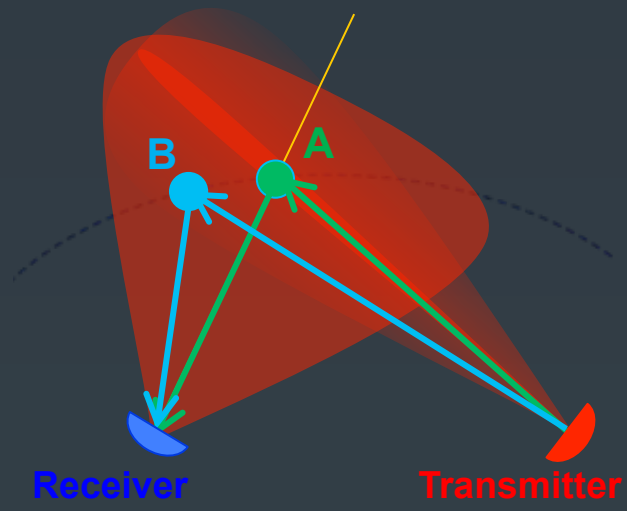


DOW Network Specs Summary

- Two dual-polarization dual-frequency
  - Dual polarization
  - Dual Frequency = 2x independent samples
  - Dual Frequency = simultaneous 45 deg and H/V products
  - Quick scanning: 20-120 s volumetric scanning
  - Products: Z, V, ZDR, Phi-DP, Rho-HV etc
  - Dual 250kW transmitters, 0.9 deg beamwidth, 30m gates
- One Rapid Scan
  - Multiple beam multiple frequency for steering
  - 7-14 s volumetric sanning
  - Single Polarization
  - 40 kW TWT tx, 0.8 deg beamwidth, 25m gates
- Combined
  - Multiple-Doppler 3D vector winds
  - Gap filling in terrain
  - Operations Center in DOW7

Future Improvements to DOW Network

- Bistatic network capability: one DOW with several remote receivers to measure vector winds
- Additional satellite and microwave real-time data transfers for real-time vectors. Remote operation for long-term 24/7 operations
- Pulse compression for Rapid-Scan DOW
- Integration with DOW-network ground sensors including Mobile Mesonets and quickly deployable pods



Integrated Sounding System (ISS) Network
GPS Advanced Upper-air Sounding System (GAUS)

A network of stations with remote sensors, radiosondes and surface measurements to probe the boundary layer and above

Standard Components	Optional	PI-supplied (eg.)
915 MHz Wind Profiler	Sodar-RASS	Lidars
RASS	GPS WV	Disdrometers
GAUS	Ceilometer	MW Radiometer
Rain Gauge	Webcams	Micro-rain Radar
Met Tower	(etc)	
Solar Sensors		

Deployment Options
Fixed and mobile GAUS (6)
Fixed and mobile ISS (3)
MAPR (spaced antenna)
Shipboard deployments
New: 449 MH modular profiler

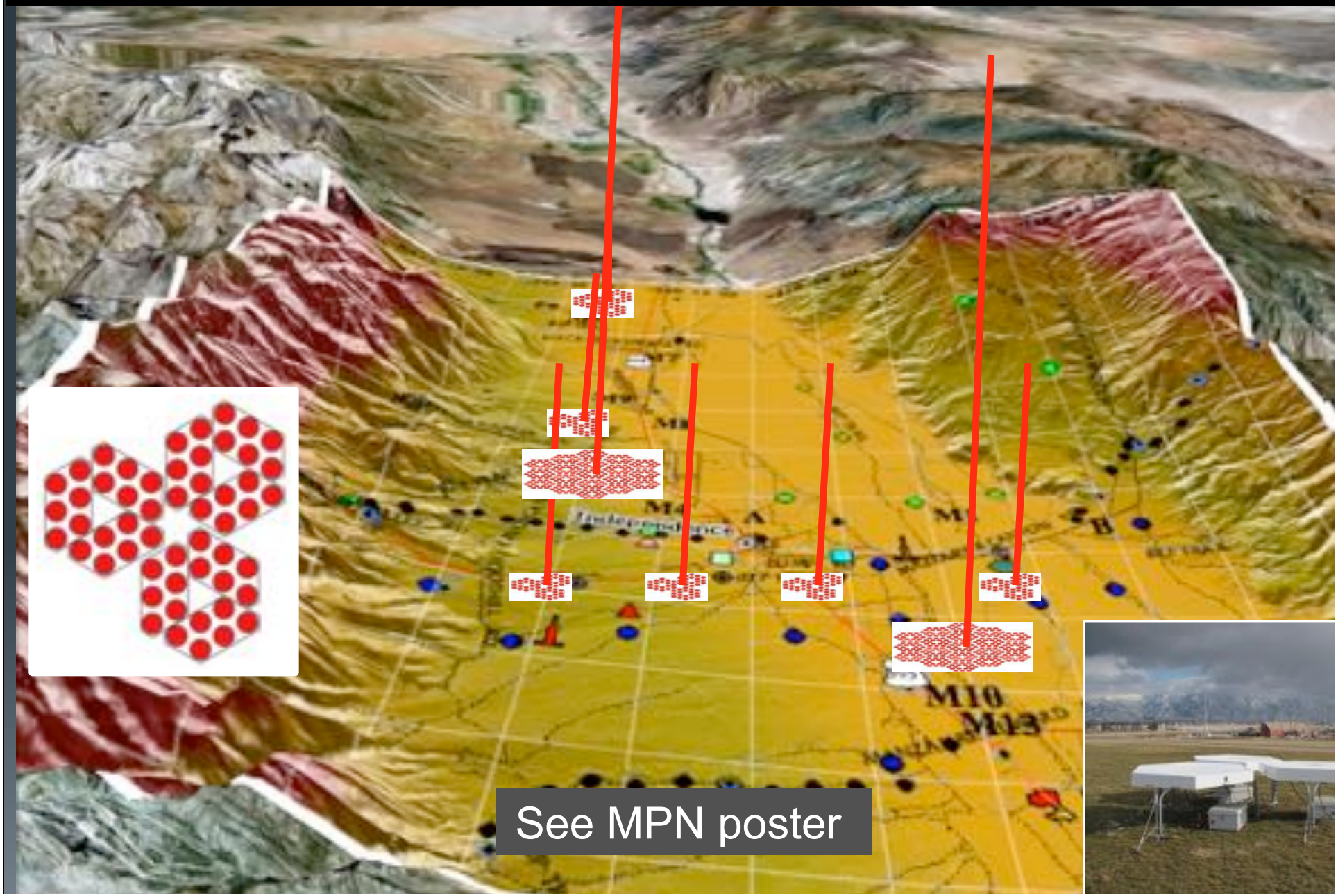
ISS/GAUS Science & Deployments

Deployments (ISS & GAUS)	1992-2011 (20 years)	2009-2011 (3 years)
Total Projects	84 (64 NSF)	11 (all NSF)
Shipboard wind profiler	7	1
Shipboard GAUS	7	1
International	21 (+3 AK)	1

See ISS poster

Common Science Targets
Dynamics in the Tropics
Fine Structure of Fronts
Mountain Valley Flows
Topographic Influences on Winter Storms
Lake Effects on meso- and synoptic scales
Ice/Raindrop Fall Speed and Evolution
Boundary Layer Height and Entrainment
Turbulence Effects on Aviation Safety

Modular Wind Profiler (MPN)



Integrated Surface Flux System

Arrays and networks of high precision sensors to measure turbulent fluxes, energy balance and state variables

ISFS Deployment Mode: distributed arrays and intensive arrays

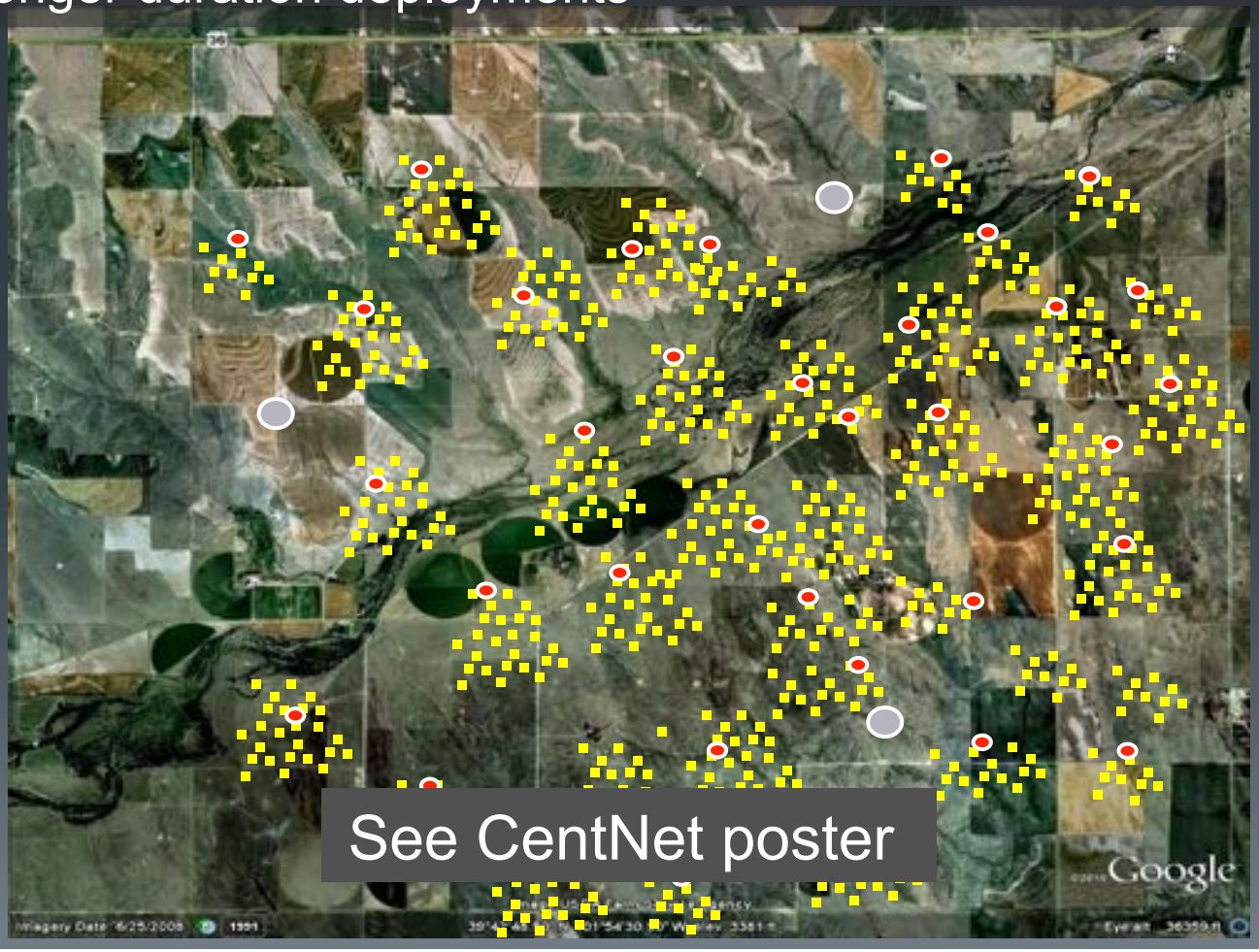
ISFS Science & Deployments

Common Science Targets
Turbulence/Micrometeorology
Planetary BL Structure
Surface Energy Budget
Scalar Fluxes (O3, CO2, NO, Aerosol)
Ozone Depletion
Atmosphere/Biosphere Carbon Exchange
Heat/Chemical Exchange in Polar Regions
Instrument Development

ISFS Deployments	1990-2011
Structure and Dynamics of PBL	12
Surface Energy Budget	5
Turbulence Structure of Surface Layer	10
Atmosphere-Surface Exchange	7
Sensor Development	7

CentNet Development

- Broaden scientific application with a 100-station, wireless, off-the-grid capability
- Heterogeneous landscapes, multiple scales
- Longer duration deployments



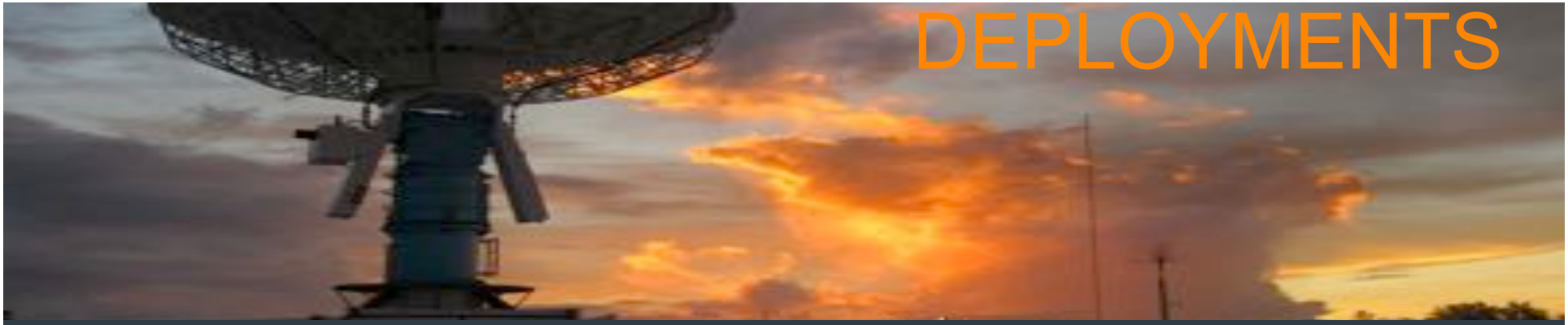
DEPLOYMENTS

DC3: Deep Convective Clouds and Chemistry (2012)

Goal:

to obtain a comprehensive set of chemistry measurements alongside storm kinematic and microphysics structure data from radar and lightning data from lightning mapping arrays.

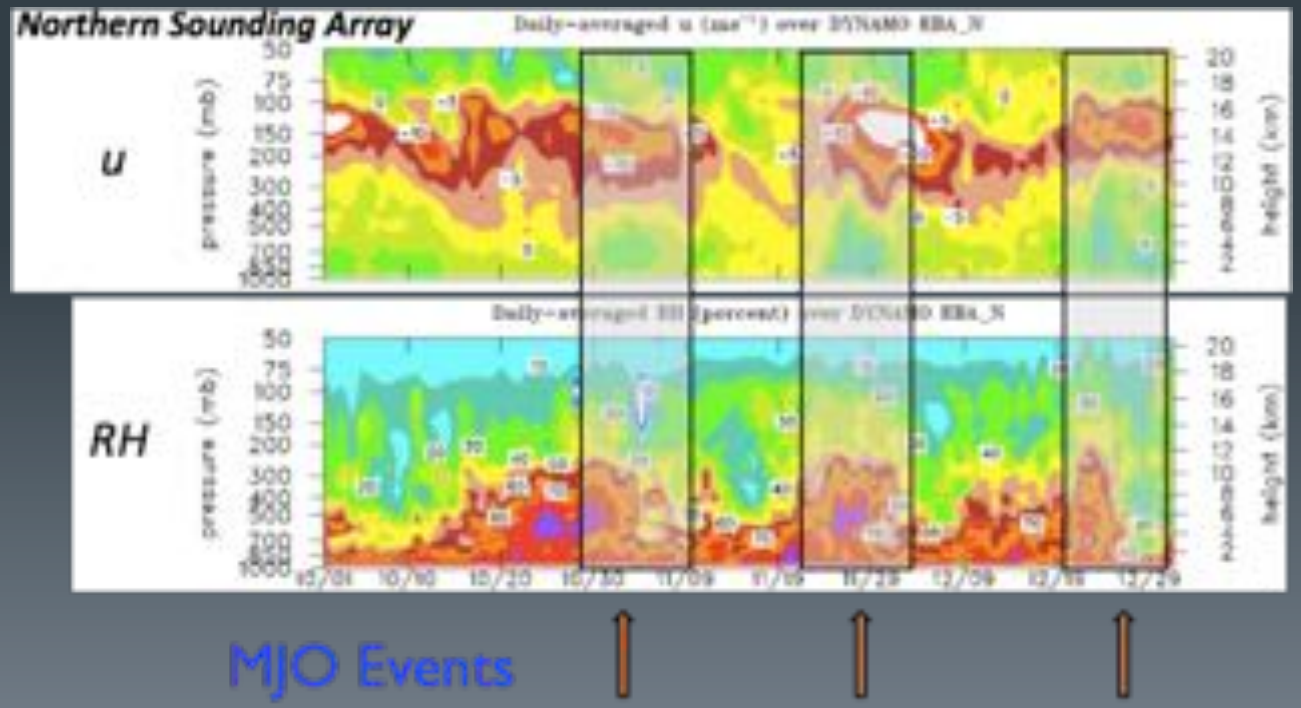
“Improved understanding of UT ozone in the coldest part of the atmosphere where it exerts the largest influence on climate"



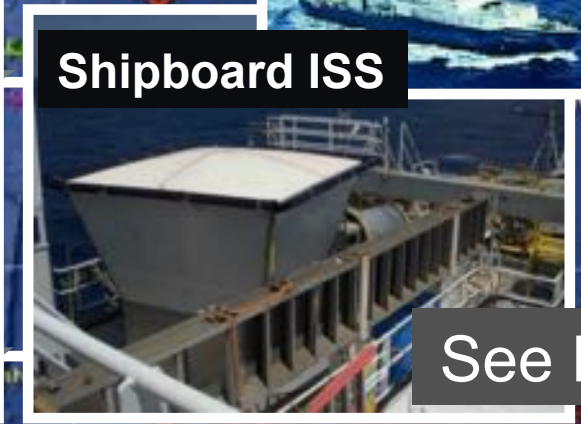
DEPLOYMENTS

DYNAMO: Dynamics of the Madden Julian Oscillation (2011/12)

Long-term observations of key processes required for accurate simulation and prediction of the MJO



DYNAMO Platforms



See DYNAMO poster

DEPLOYMENTS

SHEBA: The Surface Heat Budget of the Arctic Ocean

SHEBA was governed by two broad goals:

(1) understand the ice–albedo and cloud–radiation feedback mechanisms
(2) use that understanding to improve the treatment of the Arctic in large-scale climate models

4 ISFS stations on the Arctic Ice for one year

Ground-based Facilities "Measurement Challenges"

- Profiling and spatial determination of thermodynamics, and water vapor/chemical species and their fluxes
- Interfaces: entrainment zone; tropopause, stable BL properties
- Networks for more integrated and comprehensive measurements
- More, Better, Longer (parameters, accuracy, resolution, network size, automation…)

Thank you ***Questions?***