Scanning Cloud Radar Observations at Azores: Preliminary 3D Cloud Products for the SACRs

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Scanning Cloud ARM Radars

-Three 35/94-GHz and three 35/9.4-GHz Doppler, polarimetric systems
-35-GHz: primary cloud sensing frequency
-94-GHz: LWC, WV retrievals in clouds, velocity, size retrievals in rain
-9.4-GHz: LWC in drizzle, 20-50 km mapping of drizzle/light rain
-Doppler: Cloud/Drizzle turbulence and shear information
-Polarimetry: Non-spherical particles and attenuation-correction (9.4-GHz)

Searching for clouds in 3D: Challenges

Scanning clouds in three-dimensions has never been done in a continuous operating mode. Cloud properties are vastly different from the rain and snow shafts that are the primary target of precipitation radars. While ARM program members expect to reuse many of the ideas implemented in scanning weather radar systems, the need to detect both low- and high-level stratiform clouds, broken clouds and multi-layer cloud conditions requires new sampling approaches.
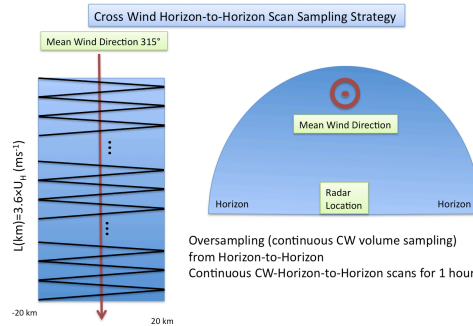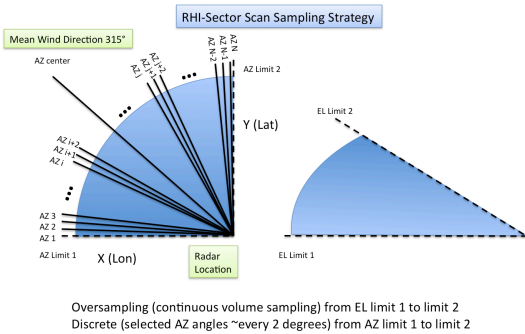
S-WACR deployment at Azores
Prelude for SACR continuous observations

The deployment of the Scanning W-Band ARM Cloud Radar (SWACR) during the AMF campaign at Azores signals the first deployment of an ARM Facility-owned scanning cloud radar and offers a prelude for the type of 3D cloud observations that ARM will have the capability to provide at all the ARM Climate Research Facility sites by the end of 2010. The primary objective of the deployment of Scanning ARM Cloud Radars (SACRs) at the ARM Facility sites is to map continuously the 3D structure of clouds and shallow precipitation and to provide 3D microphysical and dynamical retrievals for cloud life cycle and cloud-scale process studies

The new scanning radar (foreground) joins the ARM Mobile Facility instrument suite operating on Graciosa Island

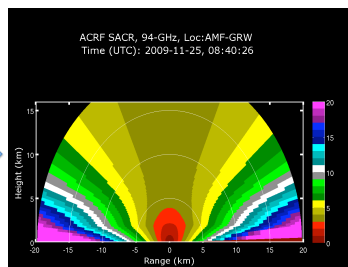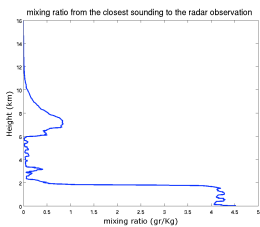# Searching for clouds in 3D - SACR: Scan strategies

RHI-Sector Scan Sampling Strategy

Mean Wind Direction 315°

Oversampling (continuous volume sampling) from EL limit 1 to limit 2
Discrete (selected AZ angles ~every 2 degrees) from AZ limit 1 to limit 2

Cross Wind Horizon-to-Horizon Scan Sampling Strategy

Mean Wind Direction 315°

$L(km)=3.6×U_H (ms^{-1})$

Mean Wind Direction

Oversampling (continuous CW volume sampling) from Horizon-to-Horizon
Continuous CW-Horizon-to-Horizon scans for 1 hour

Planned SACR Data Products
@ each radar frequency

☐ Hydrometeor Mask
☐ Water Vapor Correction
☐ Doppler Velocity Unfolding
☐ Wind Shear, TKE diss. rate

☐ 3D Gridded Cloudiness
  ▪ Probability of cloud presence
  ▪ Interpolated radar observables
  ▪ Cloud field statistics
  ▪ Cloud Overlap

SACR: Preliminary Value Added Products

Water vapor attenuation correction

Doppler Velocity Unfolding