Scanning ARM Cloud Radar Value-Added Products: The First Generation

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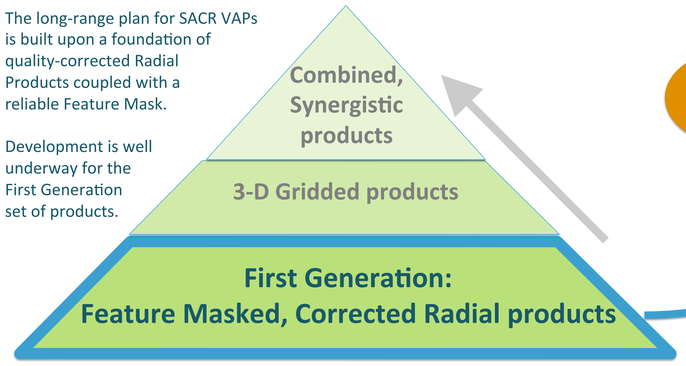
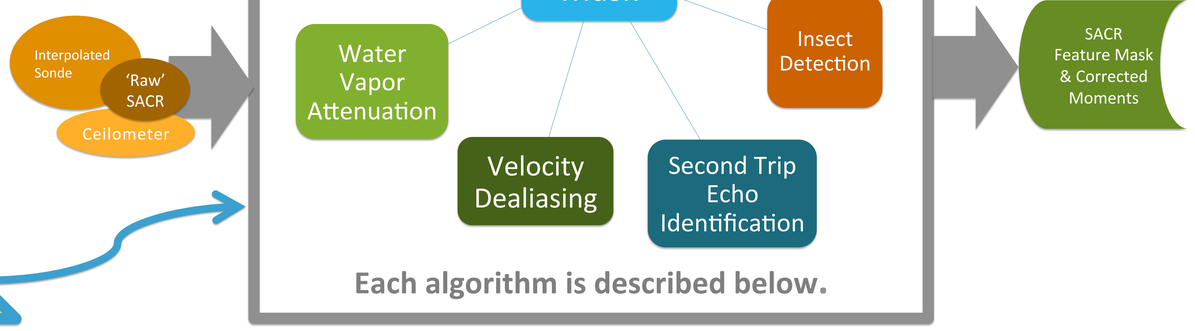
SACR VAPs

Scanning ARM Cloud Radar Value-Added Products

The long-range plan for SACR VAPs is built upon a foundation of quality-corrected Radial Products coupled with a reliable Feature Mask.

Development is well underway for the First Generation set of products.





The SACR Radars

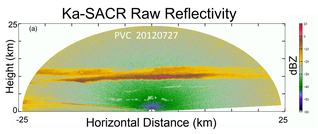
ARM continuously operates Scanning ARM Cloud Radars (SACRs), co-scanning dual-frequency pairs of dual-polarization cloud radars. Ka/W-band SACRs operate at the Southern Great Plains and North Slope of Alaska sites and at the first ARM Mobile Facility site (AMF1), currently on Cape Cod, MA. X/Ka SACRs are installed at the Tropical Western Pacific sites and will accompany future AMF2 deployments.

ARM Cloud Radar Band	Frequency (MHz)	Wavelength (mm)
W	94	3.2
Ka	35	8.6
X	9.7	31

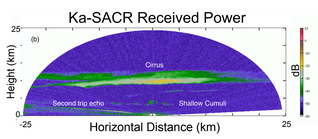
Feature Mask

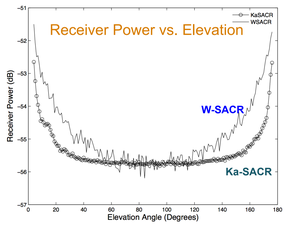
The SACR Feature Mask identifies significant returns from hydrometeors, and also from ground clutter, insects, and second-trip echoes.

Background, or noise reflectivity increases with range, so it is not suitable for use in feature identification.



Instead, received power is used for noise level determination and feature detection. However, power can be a function of elevation angle, so we must determine noise power separately for each elevation.

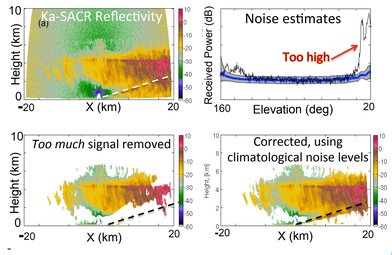




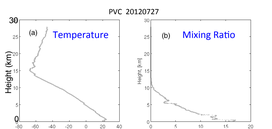
Noise power can be affected by the presence of atmospheric gases (primarily water vapor), particularly at low elevation angles. W-band is more sensitive than Ka-band.

Other factors affecting noise level are environmental conditions and hardware malfunctions.

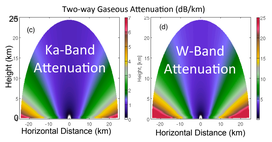
A radial-by-radial noise level estimate is determined using the Hildebrand and Sekhon (1974) technique. An upper, climatological, value for noise is used to avoid problems in radials containing all or mostly hydrometeor signal.



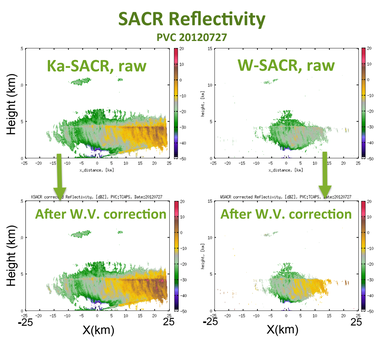
Water Vapor Attenuation Correction



Reflectivities are corrected for the effects of gaseous absorption. Water vapor attenuation is greatest in humid atmospheres, particularly at shorter millimeter wavelengths.

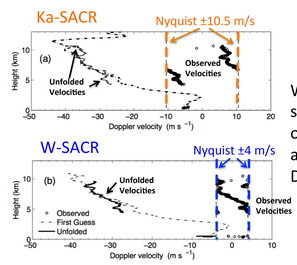


At each ARM site, interpolated atmospheric soundings provide temperature, pressure and water vapor density for calculating the attenuation correction, following Liebe (1985).

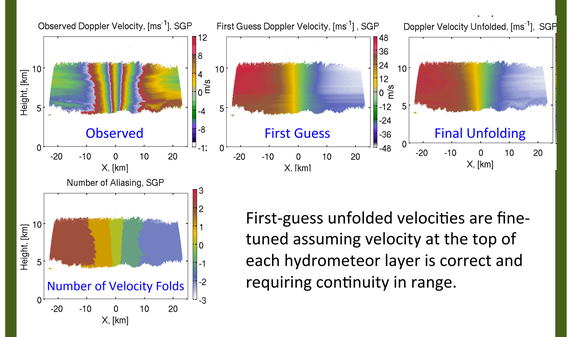


Velocity Dealiasing

Low SACR Nyquist velocities lead to the likelihood of multiple velocity folds, especially for upper level clouds.



Winds from the interpolated sounding VAP are projected onto the radial plane to give a first guess of expected Doppler velocities

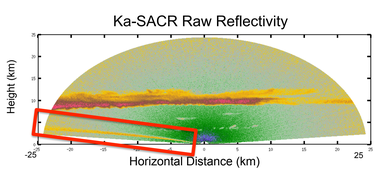


First-guess unfolded velocities are fine-tuned assuming velocity at the top of each hydrometeor layer is correct and requiring continuity in range.

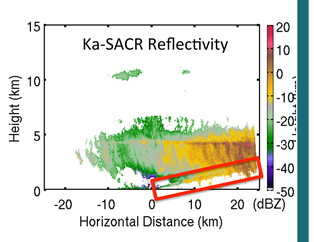
Second Trip Echo Identification

Second trip echoes, returns from targets outside the unambiguous range of the radar, must be flagged and, whenever feasible, removed.

Some cases are reasonably straightforward to identify, as in the cirrus deck below. The returns outlined in red below are second trip returns from cirrus which extend beyond the unambiguous range of the KaSACR radar.



Other cases are more difficult to identify and remove automatically, particularly in cases (see right) where second trip returns are intermingled with cloud echoes.



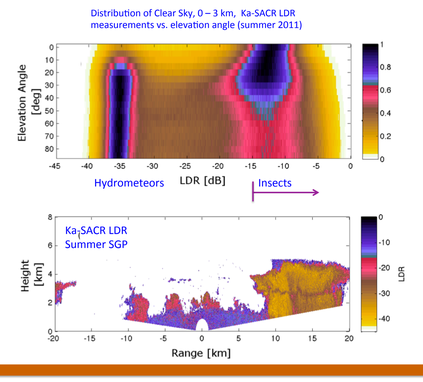
Insect Detection

Insect detection is primarily an issue at the Southern Great Plains site, in the lowest few kilometers.

While scanning, the SACRs do not collect spectra, so we rely primarily on single frequency linear depolarization ratio (LDR) measurements for insect detection in the first generation correction product.

Insect filtering is done for

* Temperatures > 5°C
* Heights below likely ceilometer cloud base
* LDR > -15 dB



Summary

The first generation of SACR VAPs will provide a Feature Mask and Corrected Radar Moments. An evaluation product is expected to be available this fall.

Questions?

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