ARM Data Product Development in Support of the Cloud Lifecycle Working Group - BNL

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ARM VAP Development Team

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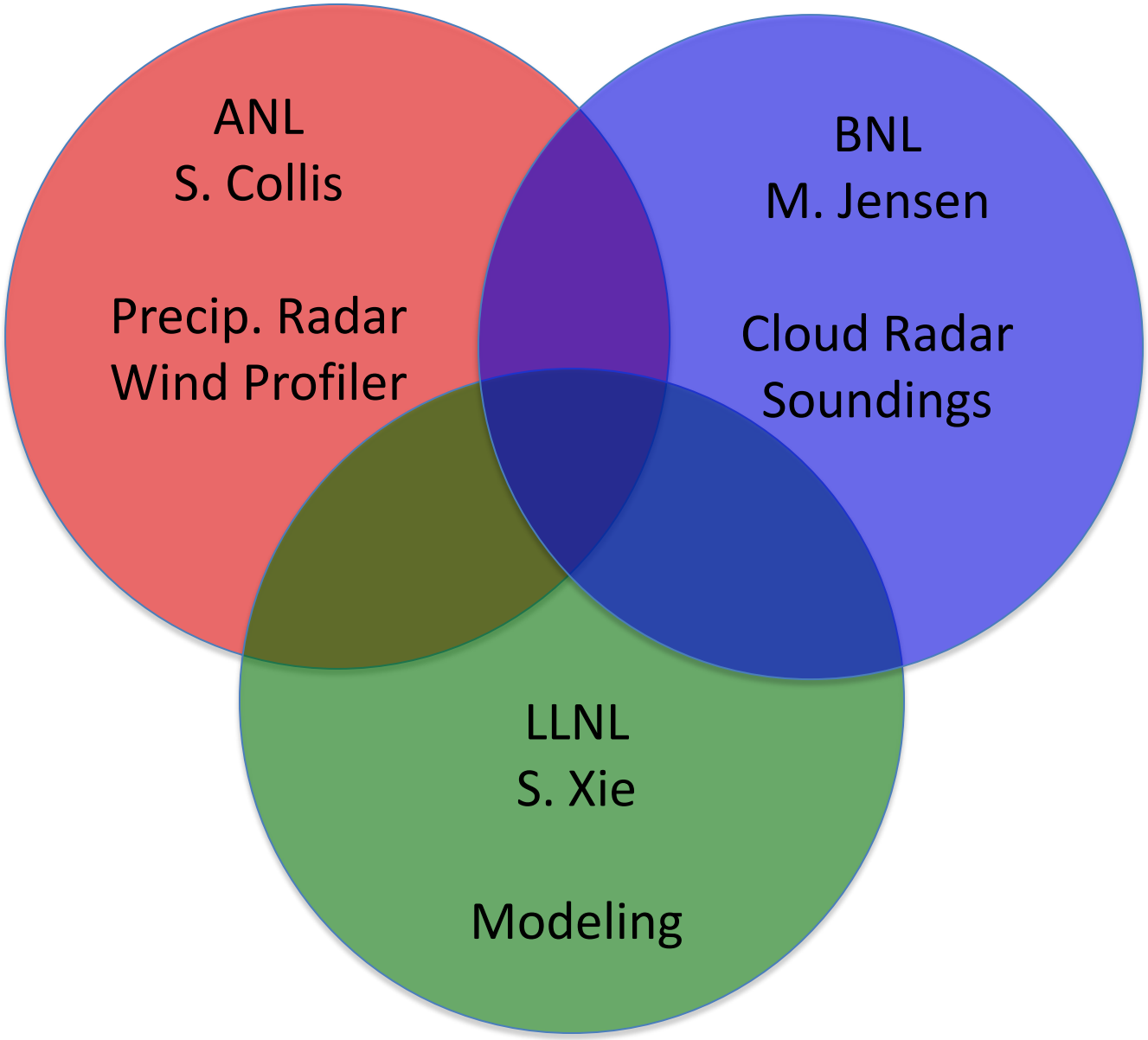
MAGIC VAPS

Cloud Lifecycle VAP Development Teams

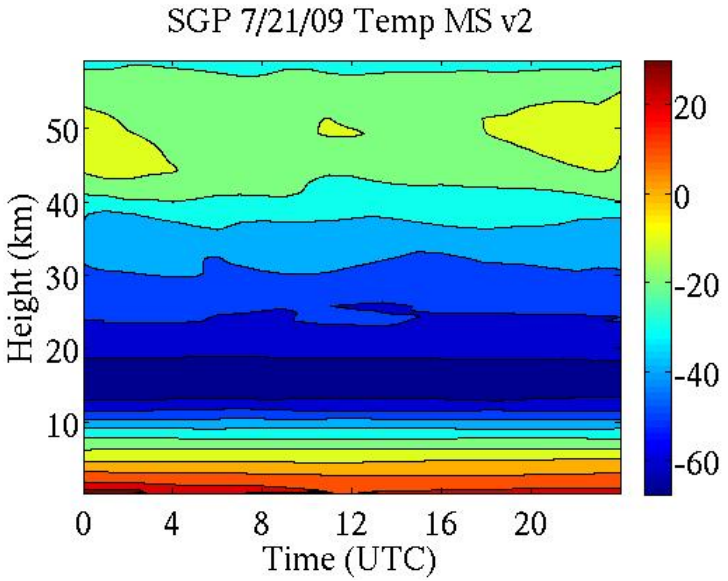


ARM Sounding Products (Developer: David Troyan)

Merged Sounding

• Uses a combination of radiosonde profiles, MWR integrated water vapor, surface meteorology, and ECMWF model output to provide a thermodynamic profile of the atmosphere at one minute intervals. Now operational VAP!

• Version 2 (available as an Evaluation Product)
  • Released to archive (waiting on other reprocessing tasks)
  •Uses ARM radiosondes corrected for using Miloshevich method
  •315 Altitude Levels to 60 km AGL



Interpolated Sonde

• Intermediate step in MS processing
• Immediate users – radar VAPs
• Final data formatting, release imminent

Sonde Adjust Now operational!

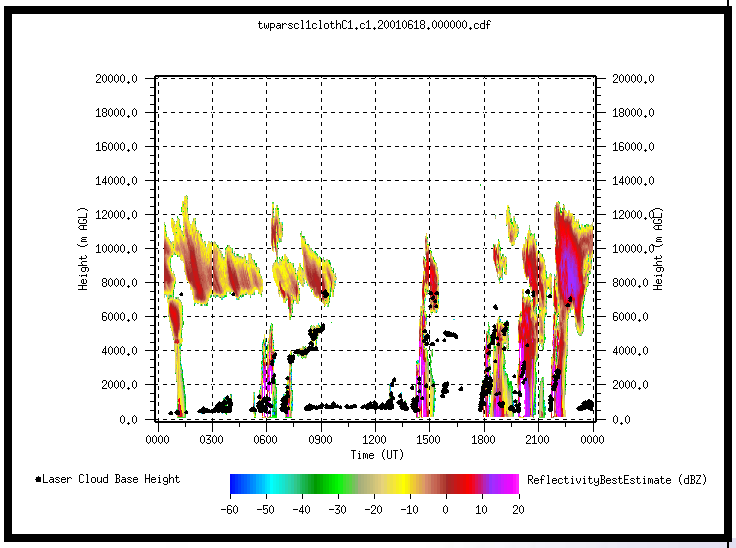
• Corrects the dry-bias found in Vaisala (RS-80 , RS-90, RS-92)radiosondes
• Employs the correction algorithms described in
  • Miloshevich et. al. (2001, 2004, 2006)
  • Turner et. al. (2003)
  Wang et. al. (2002)
  Vomel et. al. (2007)
• New Viasala software accounts for these biases. Need to validate.

Active Remote Sensing of CLouds (ARSCL)

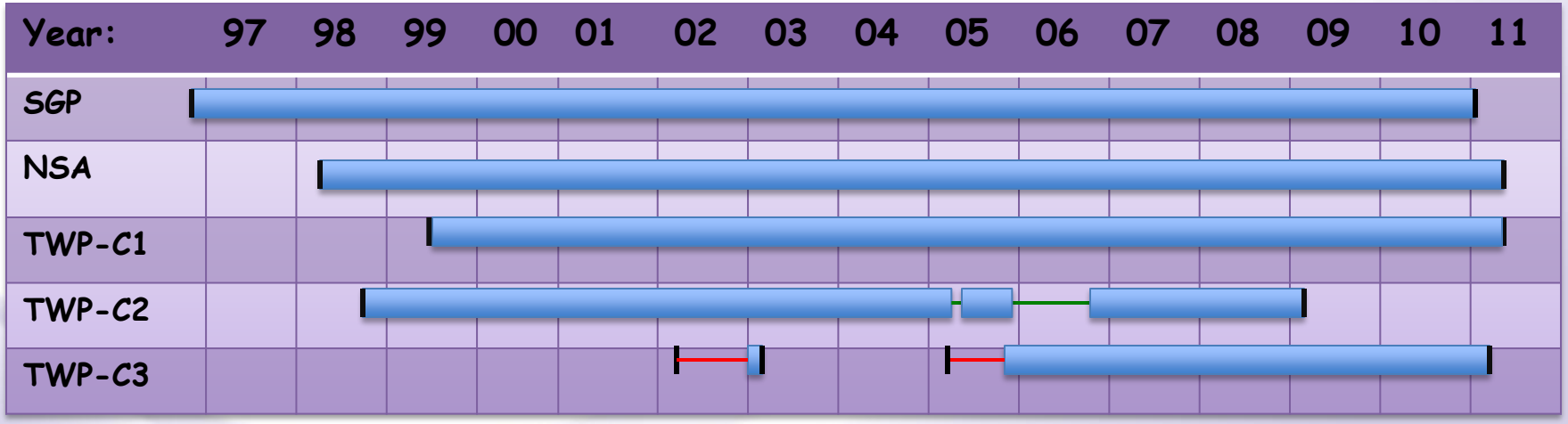
Developers: Karen Johnson, David Troyan, Meng Wang

Provides:

- Cloud boundaries,
- Hydrometeor height distributions and radar reflectivity estimates
- Vertical velocities
- Doppler spectral widths



Availability at ARM Archive:

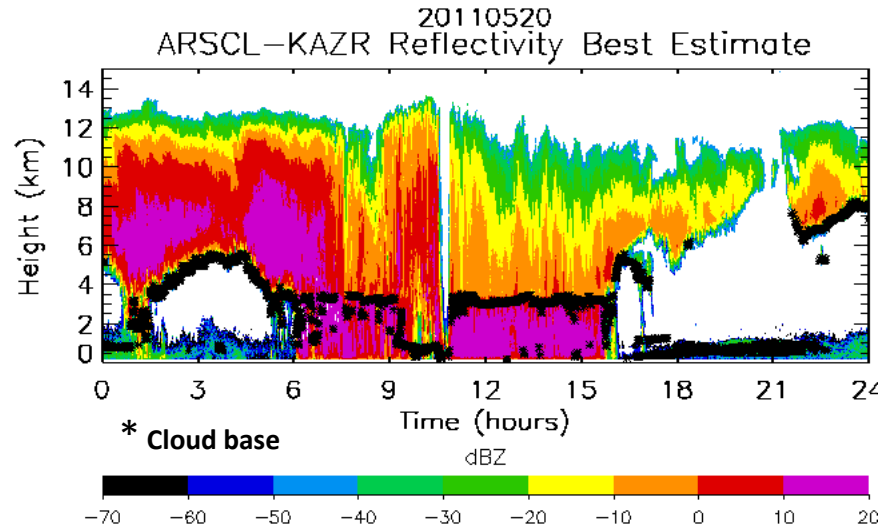


WACR – ARSCL Value-Added Product:

NIM, FKB, HFE, available GRW, SGP addressing clutter issues

KAZR Active Remote Sensing of CLouds (KAZR –ARSCL)

cloud radar, micropulse lidar, ceilometer
+ interpolated sonde
+ rain gauge
+ microwave radiometer



Why a *new* VAP?

- New radar operating modes → Simpler mode merging
- Improved polarization modes → LDR used in insect detection
- Insect detection algorithm expanded (LWP, temperature,…)
- Reflectivities corrected for water vapor attenuation
- Improved velocity dealiasing algorithm
- New KAZR-ARSCL software easier to maintain, update
- More timely processing

Data Availability: Evaluation Product - SGP(MC3E), TWP(GAN)

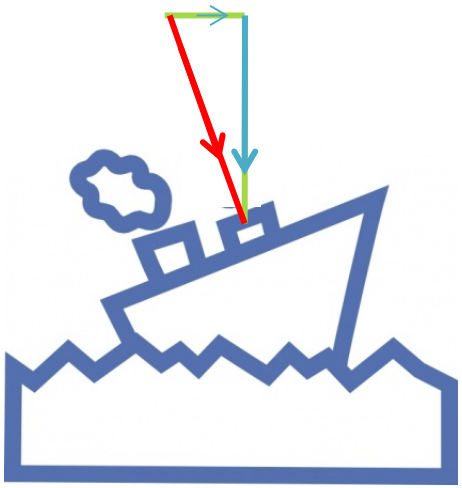
From Ship-based to Earth-based Vertical Velocity (KAZRSHIPCOR)

$$V_{3,ship} = -(\cos\phi \sin\theta \cos\psi + \sin\phi \sin\psi)\, V_1 \quad \textit{E-W}$$
$$+ (-\cos\phi \sin\theta \sin\psi + \sin\phi \cos\psi)\, V_2 \quad \textit{N-S}$$
$$+ \cos\phi \cos\theta\, V_3 \quad \textit{upward}$$

Radar measures this

Observed by a Stabilized radar

Where…
- φ = Pitch
- θ = Roll
- ψ = Yaw



Solving for V_3:

$$V_3 = (V_{3,ship} + (\cos\varphi \sin\theta \cos\psi + \sin\varphi \sin\psi)\, V_1 + (\cos\varphi \sin\theta \sin\psi - \sin\varphi \cos\psi)\, V_2\,) / (\cos\varphi \cos\theta\,)$$

Finally, $\boxed{V_{hydrometeor} = V_3 + V_{ship_heave}}$

- Soon available as an evaluation product (1st half of MAGIC campaign)
- Extend to MPL, CEIL, HSRL
- More complete treatment of horizontal wind contribution

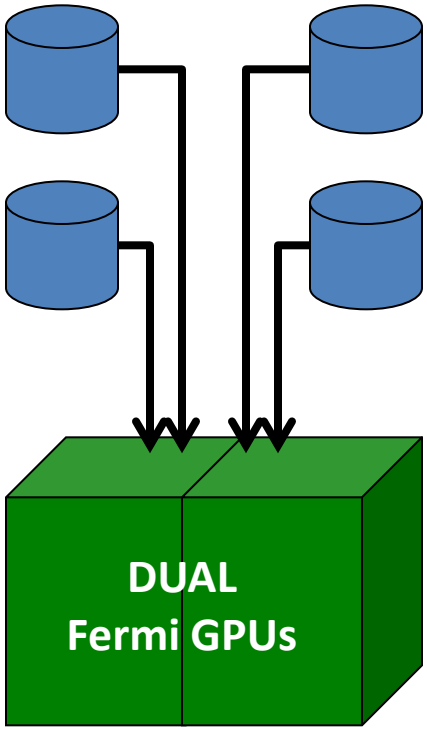
MicroARSCL: A VAP Developed for the GPU

New microphysical information from radar Doppler spectra

4 microseconds / spectrum

- Noise Floor Estimation
- Edges Determination
- Primary Extended Moments Computation
- Secondary Extended Moments Computation
- Subpeaks Measurment
- Clutter Detection

- 240,000 spectra/second processed by GPU
- 160,000 spectra/second net including I/O
- ~ 40 minutes to process a year of SGP KAZR
- ~ 17 x 10^{10} spectra in ARM archive (140 TB)
- ~ 12 days to process all spectra in archive
- MicroARSCL can be processed **"on demand"**
- **Release Imminent!**



160,000 spectra/sec (with I/O)

240,000 spectra/sec

SACR CORMASK VAP: Feature Mask and Moments Correction

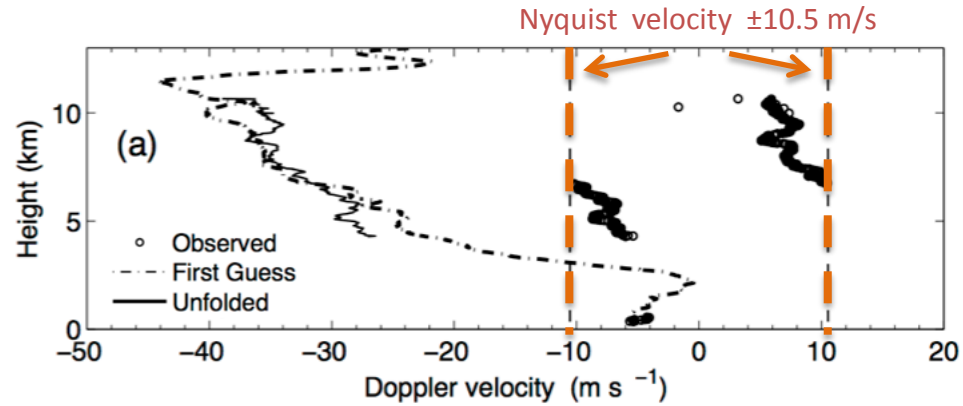
Velocity Dealiasing

(Attenuation & Velocity Dealiasing)

Low SACR Nyquist velocities lead to multiple velocity foldings, especially for upper level clouds.

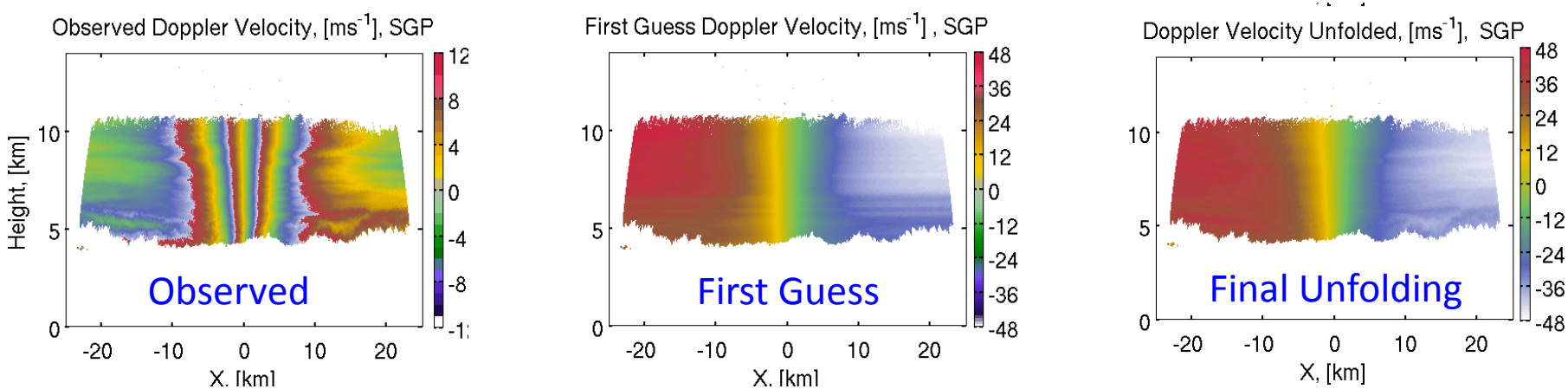
First guess of expected velocities: Winds from interpolated sounding are projected onto the radial plane.

Ka-SACR Velocity Profile



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

Implementation Plan Approved – Development Underway!



Priorities for FY 2014 (subject to change)

1) Produce a SACR Corrected Moments VAP
    - Release as an Evaluation Product
2) KAZR-ARSCL
    - Move to production for all permanent sites
    - KAZR-ARSCL for MAGIC (depends on ship corrections)
3) Complete Historical ARSCL
    - Goal to complete by end of calendar year
4) KAZRSHIPCORR (MAGIC)
    - Extend to MPL, HSRL, CEIL
    - More rigorous treatment of horizontal wind contribution
    - Move from evaluation to archive
5) INTERPSONDE
    - Move to production by end of calendar year
6) WACR-ARSCL
    - Release Azores dataset
    - WACR-ARSCL for MAGIC (depends on ship corrections)
7) Drizzle VAP
    - Drizzle rate, drizzle water content, effective size

VAP Development for future

- Historical ARSCL re-processing
- Incorporation of UAZR Observations into ARSCL
- Gridded SACR moments
- Release of VERVELSR
- Best-estimate Microphysical product
- Combined Vertical Velocity Product

Questions?
Comments on Priorities?
Other ARM data needs?

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