Cloud Resolving Model **R**adar **SIM**ulator 2.0
Latest Updates and Applications

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About the CR-SIM

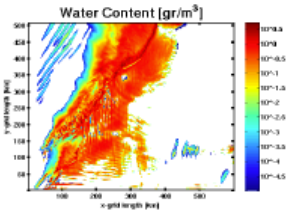
- Designed to directly accept the high resolution Cloud Resolving Model (e.g, WRF, SAM, DHARMA) output

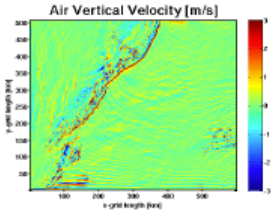
- Provides scanning and profiling radar observables (Doppler and polarimetric variables) at the model vertical and horizontal resolution

- Examples of WRF microphysical packages implemented:
  - MP_PHYSICS=10 2-moment bulk microphysical scheme (Morrison et al, 2015)
  - MP_PHYSICS=20 the spectral bin microphysical scheme (Fan et al., 2012)

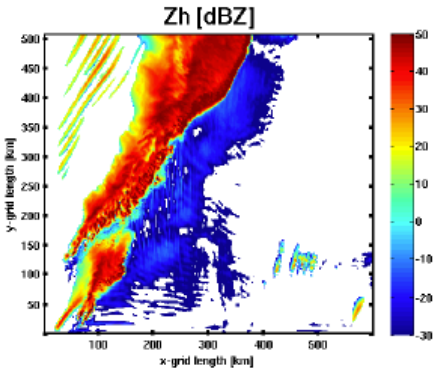
- The scattering LUT's are obtained by using the Mueller-matrix-based code kindly provided by Dr. J. Vivekanandan and fully described in Vivekanandan et al. (1991) and Vivekanandan and Bringi (1993).

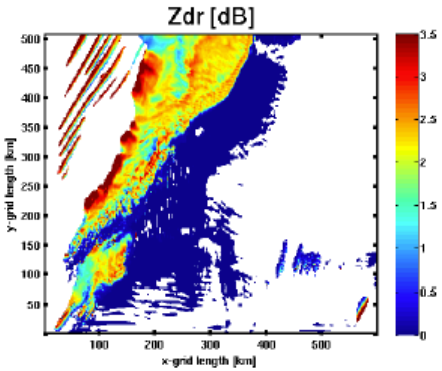
Cross sections of the *CRSIM* output at fixed height

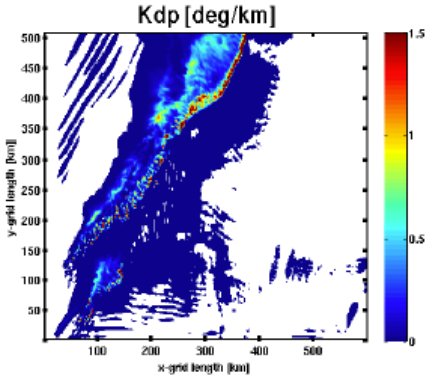


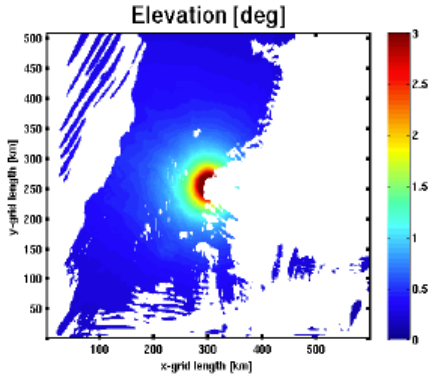


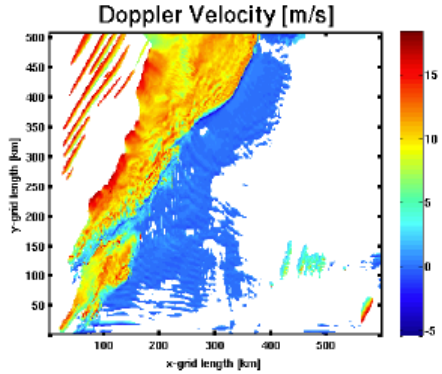
At 1 km height

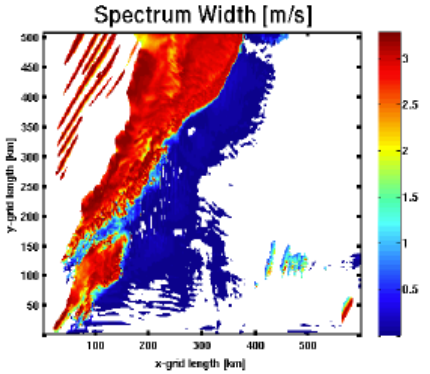


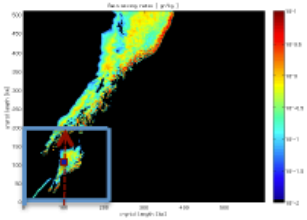






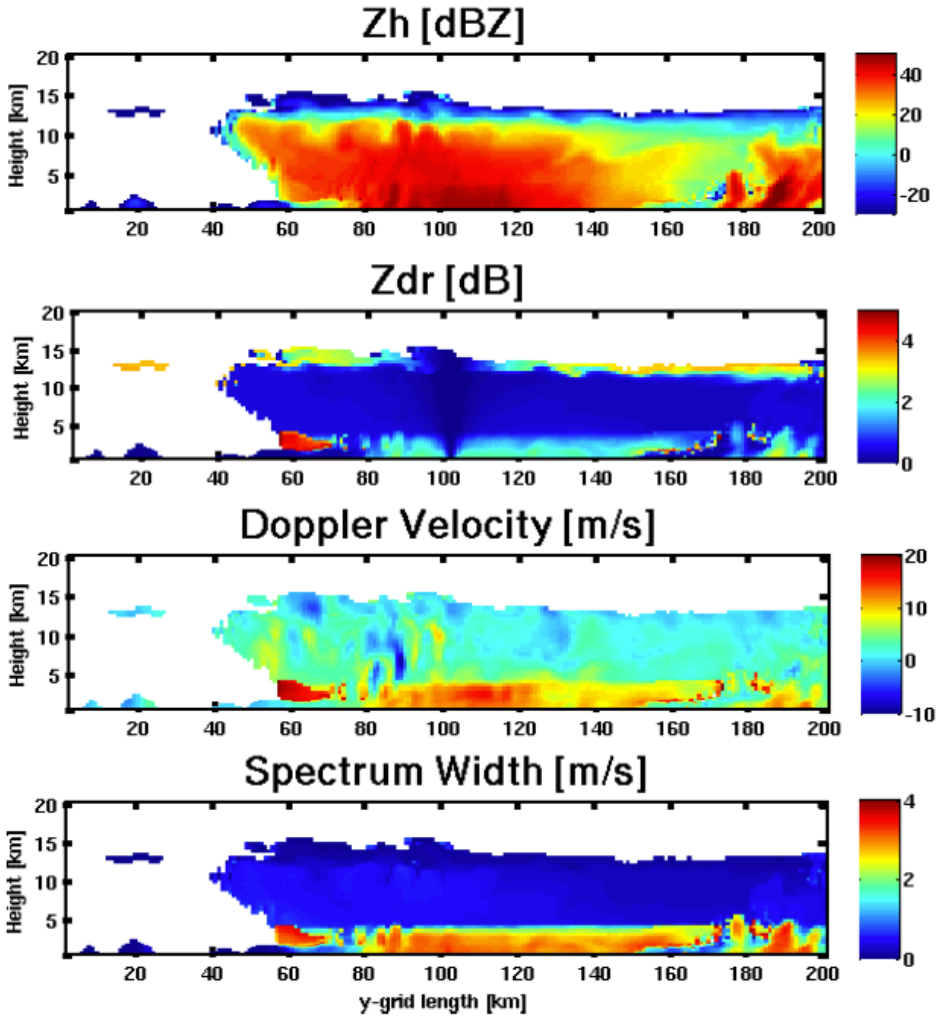






Radar is positioned at center of the small domain, 3 GHz

CRSIM OUTPUT



Latest Updates – CR-SIM 2.0 (available for download

1. computation of simulated measured radial Doppler velocity and spectrum width (in addition to "vertical").

2. the three radar coordinates (range, azimuth, elevation) are computed for every WRF grid point and reported out

3. the spectrum width contributions due to turbulence, wind shear in radar volume and cross-wind in radar volume are also computed.

4. included computation of radar sensitivity limitation with range

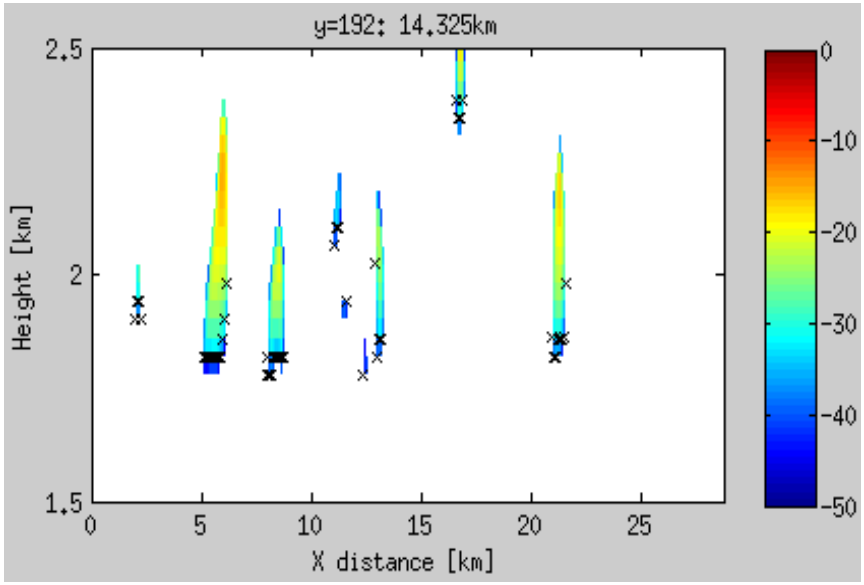
5. included computation of simulated **ceilometer** measurements

6. few severe bugs found and corrected

7. the structure of the output netcdf file(s) modified

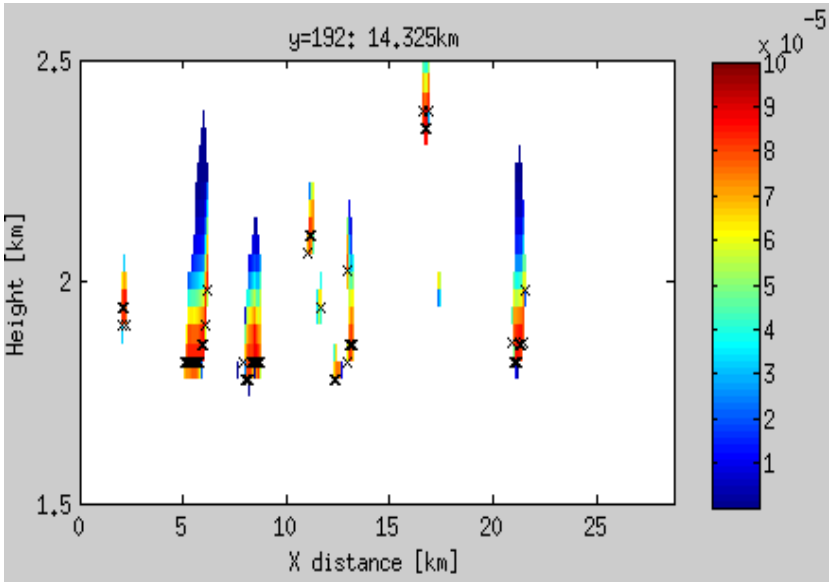
Introduce ceilometer simulator

KAZR dBZ



x: ceilometer first cloud base

Attenuated ceilometer backscatter



x: ceilometer first cloud base

Simulation of KAZR/Ceilometer Cloud Fraction Profile

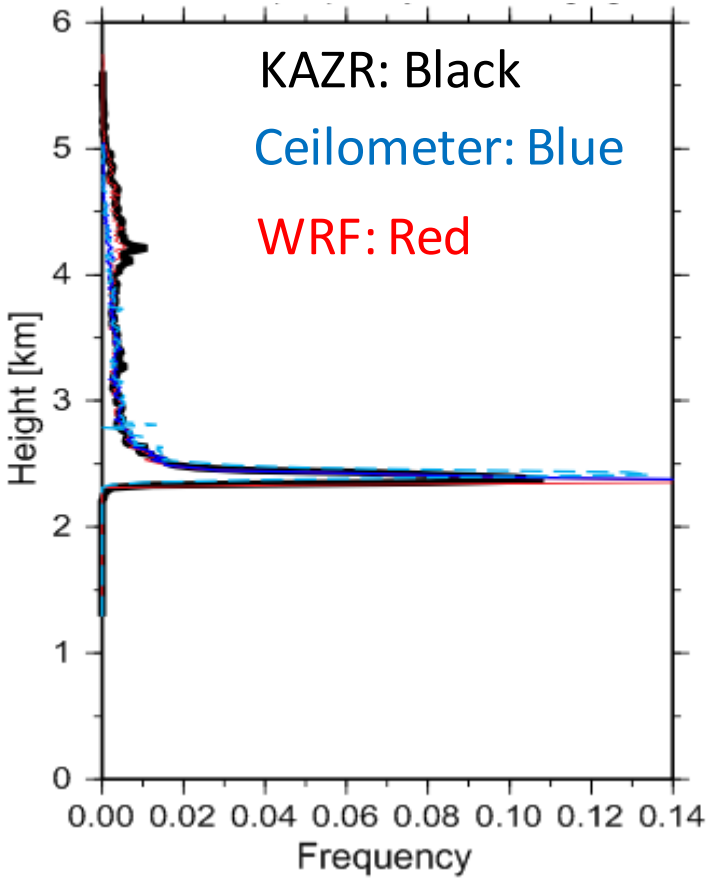
CRSIM for KAZR and Ceilometer

Assuming vertically-pointing radar and lidar everywhere

Red: WRF hydrometeor mixing ratio > 0.01 g/kg

Blue: Lowest height of lidar (ceilometer) backscatter (> 10^{-4} sr^{-1} m^{-1})

Black: Lowest height of Ka-band Zhh (-50+20log10(R) dBZ is applied)



- Ceilometer CBH is consistent with WRF (>0.01 g/kg) CBH
- KAZR not capture all CBH compared to lidar and WRF CBH.

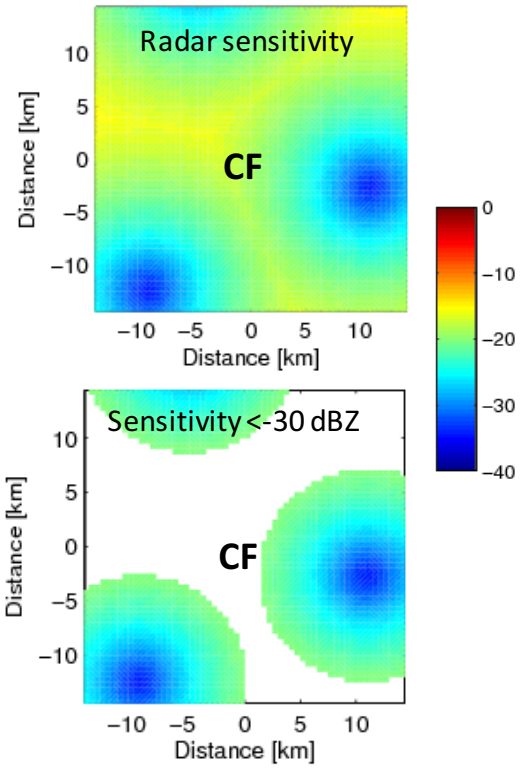
CR-SIM-KAZR
CR-SIM-Ceilometer

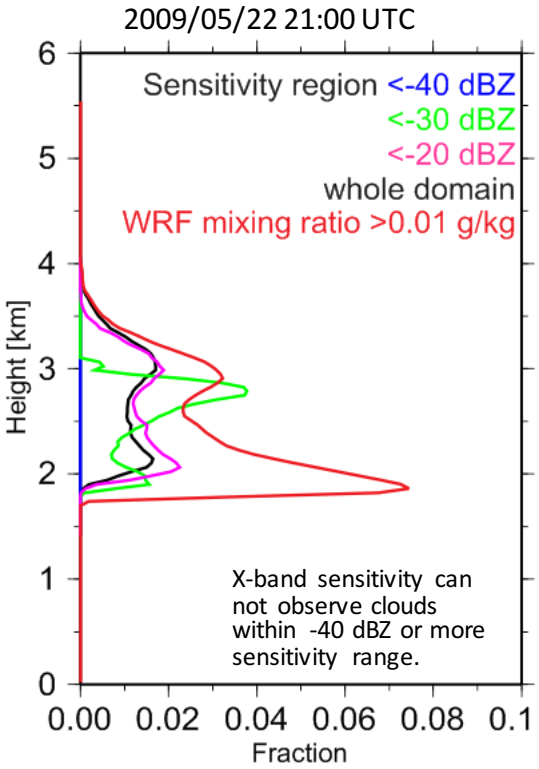
Simulate ARSCL

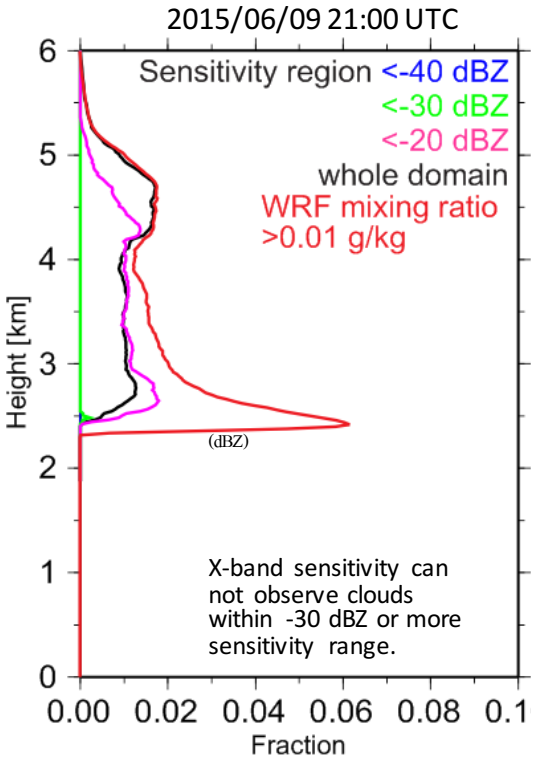
Simulation of SGP X-band Network

CR-SIM for X-band Network

Height: 2 km altitude



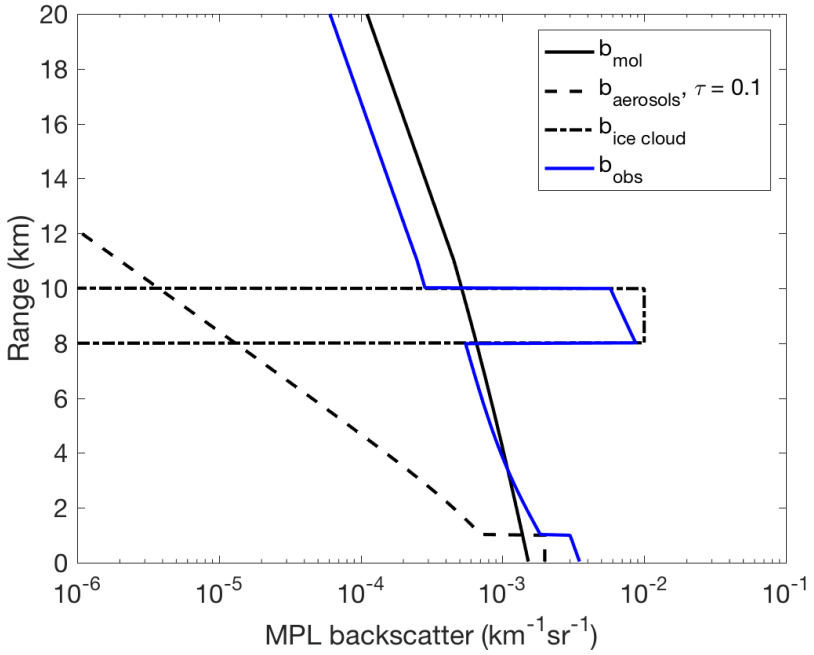




Next version – CR-SIM 2.1 (summer 2016)

Micro pulse lidar (MPL): A lidar forward simulator for the ARM MPL is under final testing.

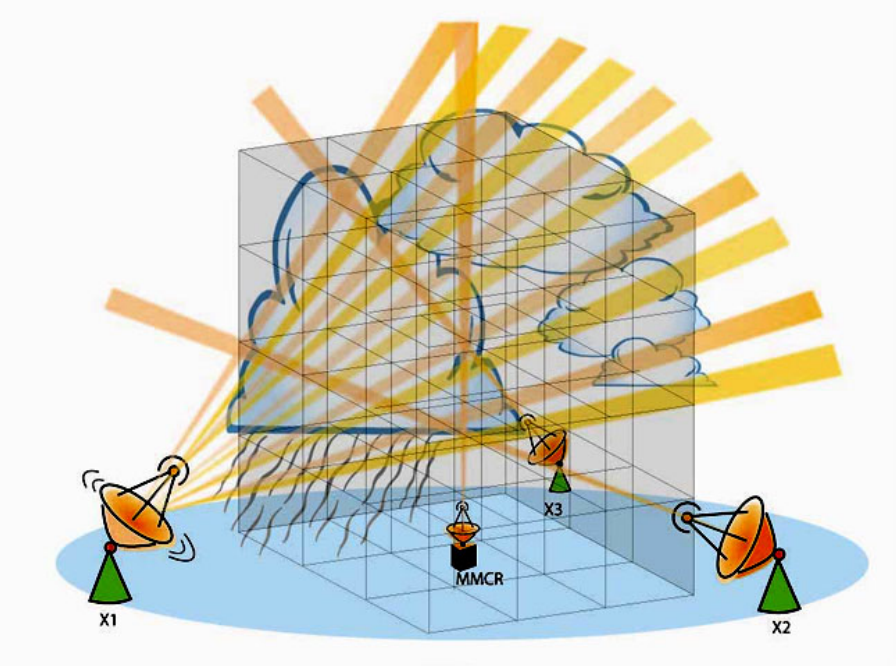
The MPL forward model will account for Rayleigh (molecular) and Mie (aerosols and hydrometeors) scattering.



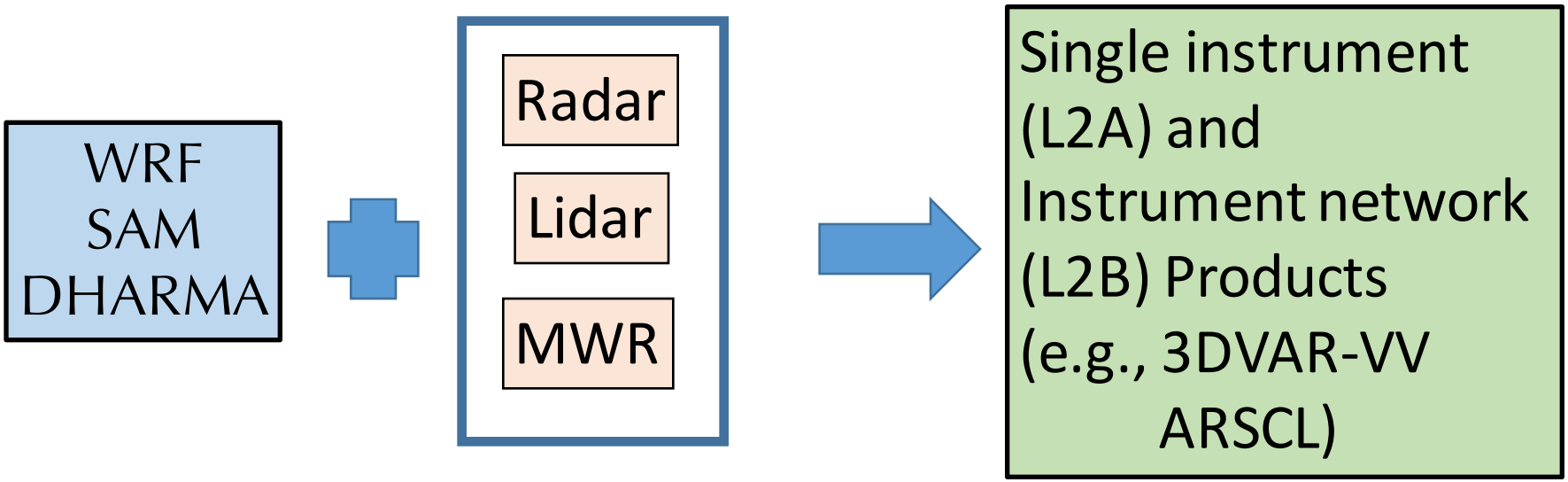
Spinhirne, 1993

Next version – CR-SIM 2.1 (summer 2016)

Radar Filter: The user can specify the radar scan strategy (sequence of PPI's, or RHI, or VPT) and the radar filter will map the CR-SIM output to radar coordinate system using the radar spatial and temporal sampling configuration.



Future upgrades and applications



The CR-SIM 2.0 source code and extensive user manual (56 pages) are available at http://radarscience.weebly.com/radar-simulators.html

Support for interfacing models is provided by:
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Mariko Oue (mariko.oue@stonybrook.edu)