Putting the Physics Back into Microphysics

Fingerprinting Microphysical Processes with Dual-Polarization Radar

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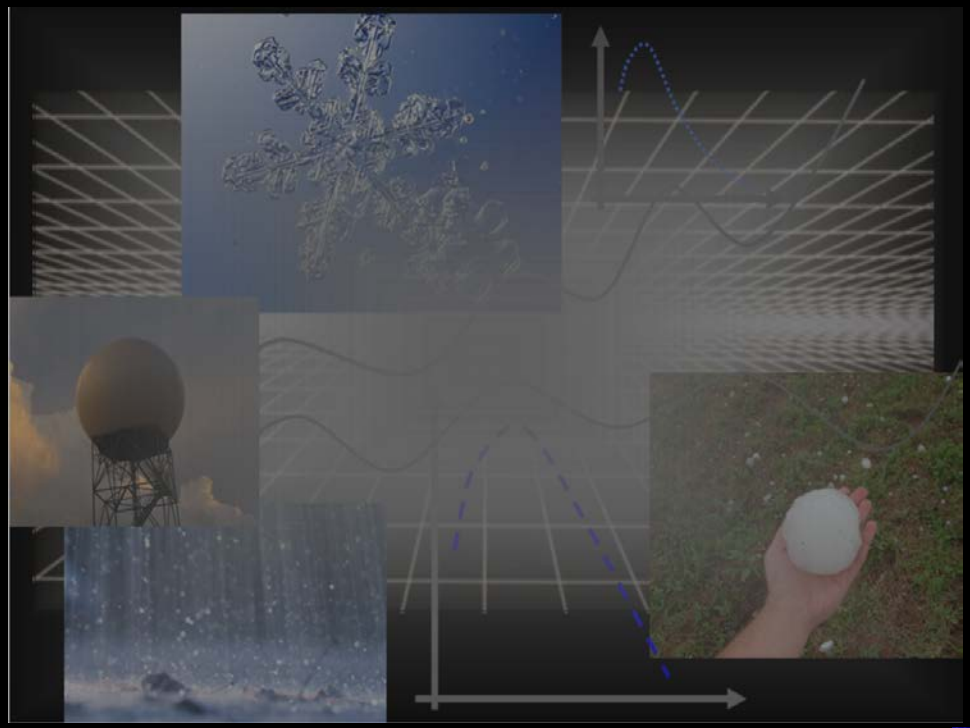


Radar Science Breakout Session
2013 ASR Fall Working Group Meetings
6 November 2013, Rockville, MD

*almost

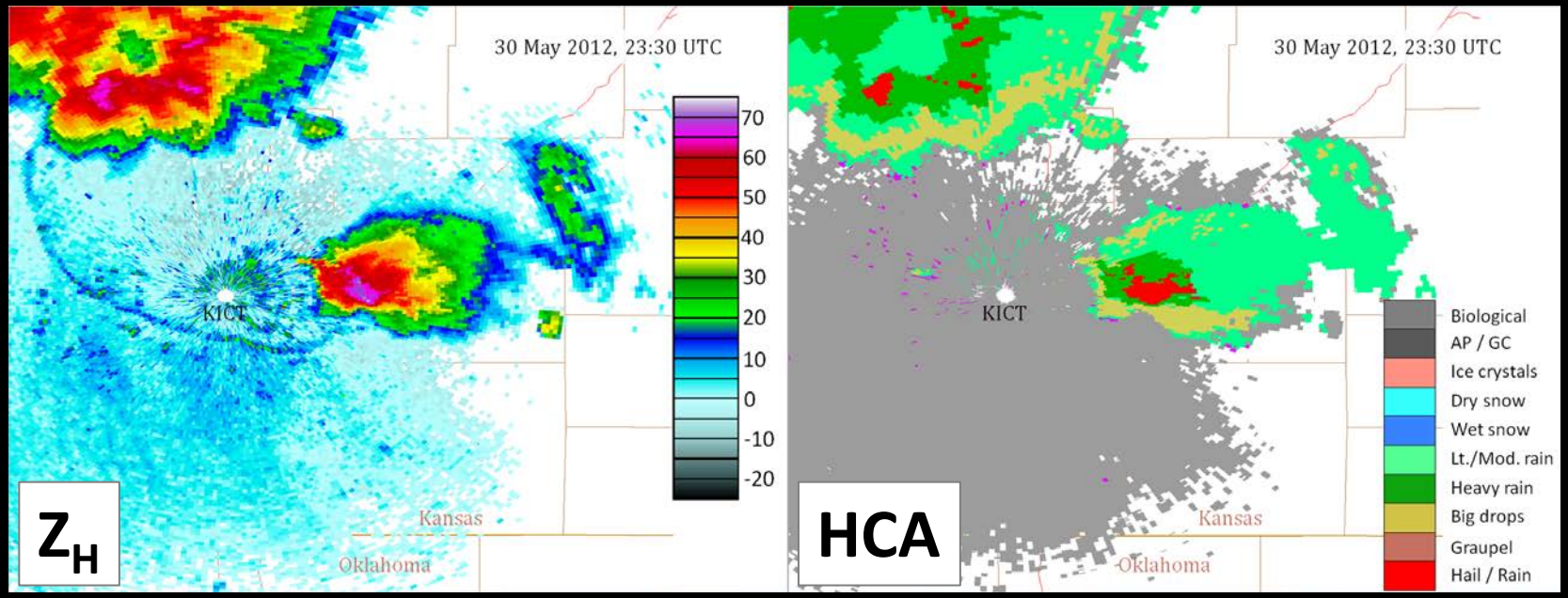
From the ASR website…

A tight coupling of the ARM Facility and ASR program will allow studies of the atmospheric system in a comprehensive, end-to-end fashion, resulting in a better understanding of processes that comprise the cloud and aerosol life cycles and the interactions among them, all of which are essential to improve the accuracy of climate models.

As ASR Radar Scientists, we should focus on how to use ARM radars to improve models

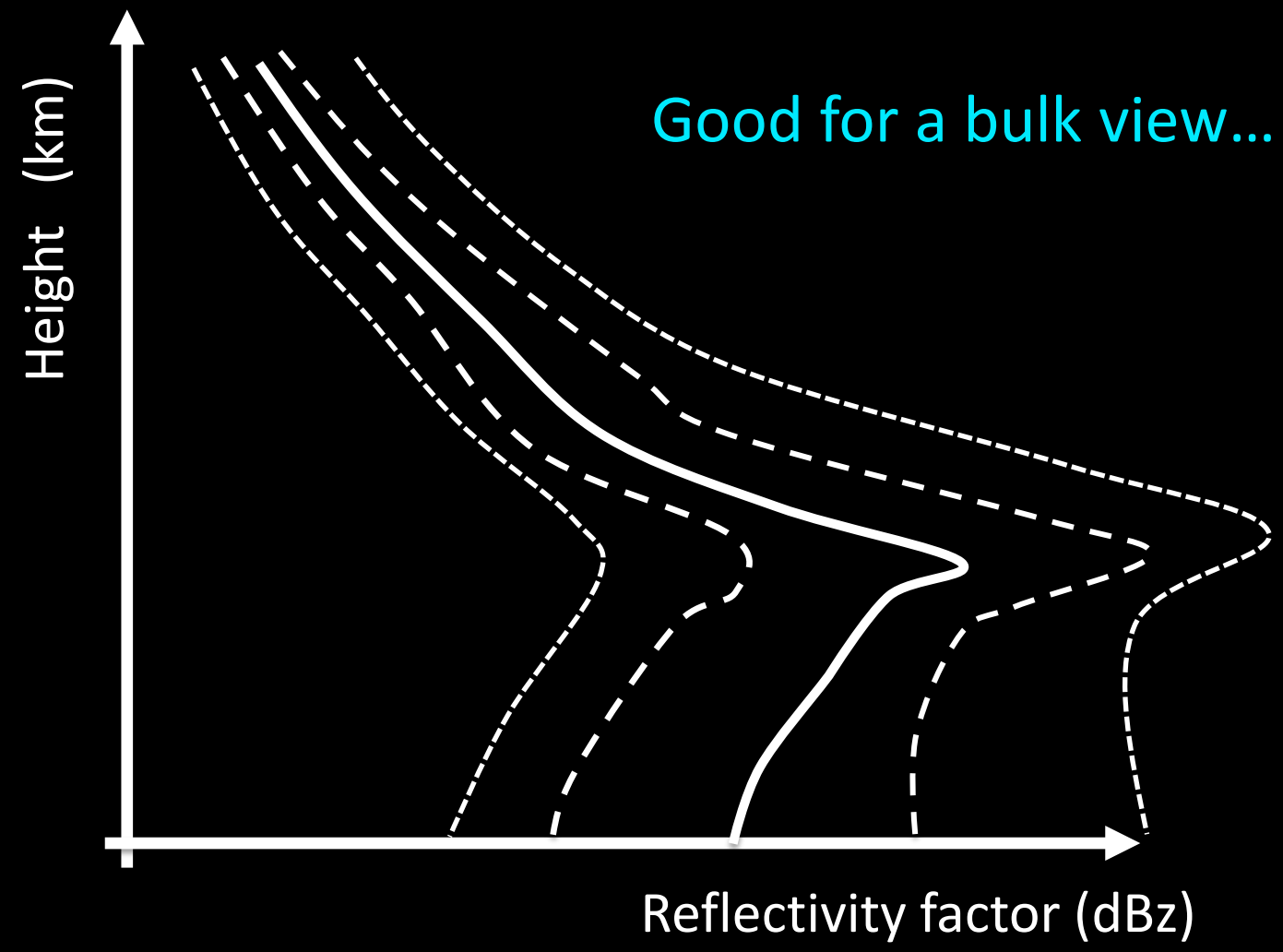
Microphysics → Physical Processes

Moving away from…



A qualitative snapshot of what we think the reflectivity-dominant hydrometeor type is (selected from a list of possible types defined *a priori*) provides only limited information about *microphysical processes*.

Moving away from…



Good for a bulk view…

…but not for evaluating model processes

Fingerprinting

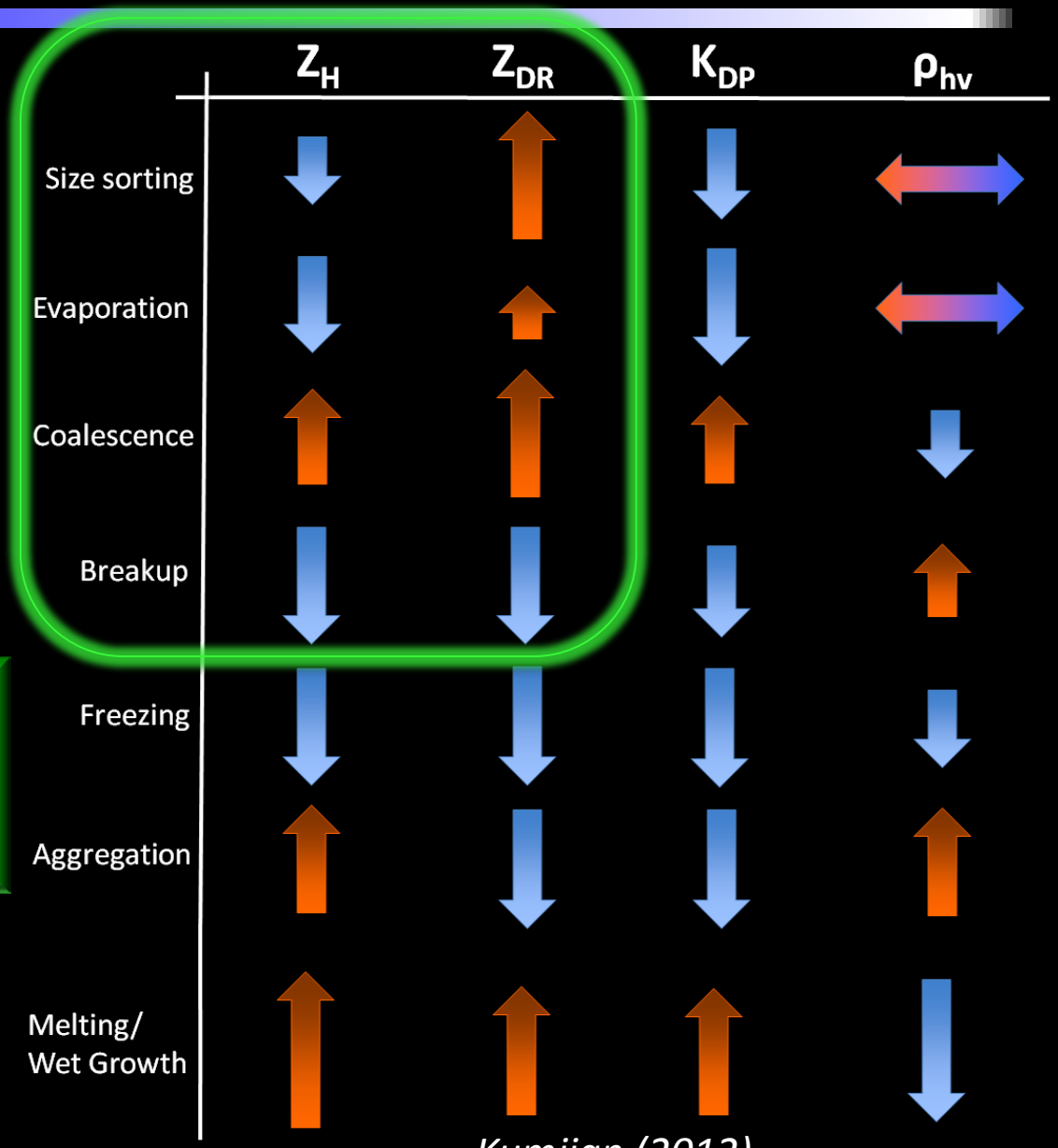
- Microphysical processes affect the distributions, types, shapes, and sizes of hydrometeors as they descend

- Any of all of these changes will have an impact on the observed polarimetric radar variables

These changes in the vertical profiles of the radar variables constitute the ***fingerprint***

Fingerprinting

Qualitative polarimetric radar fingerprints of different individual microphysical processes

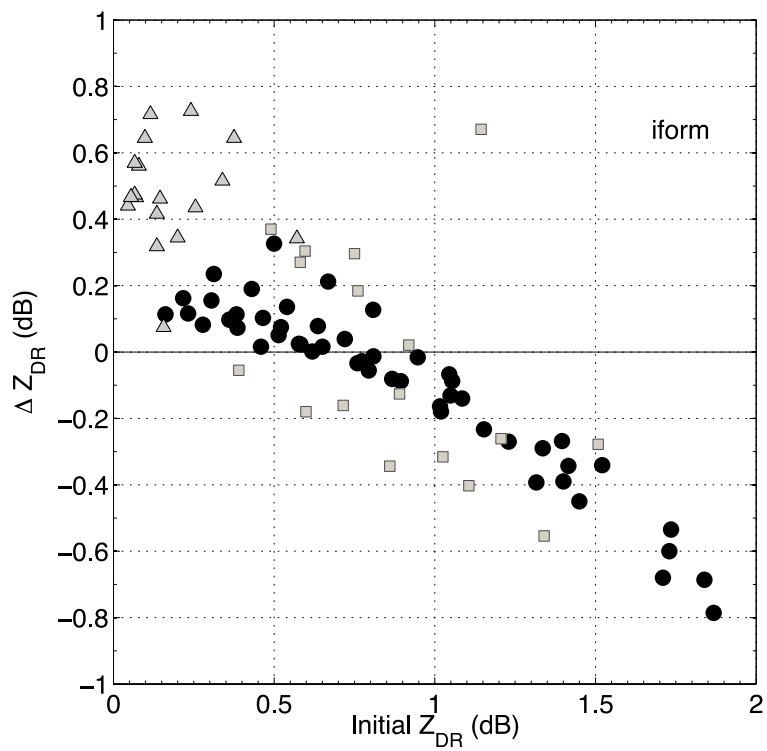


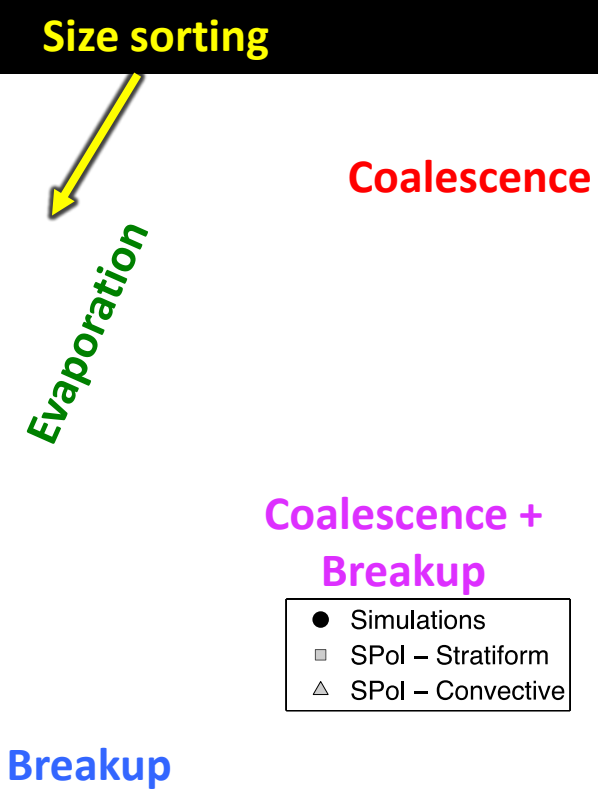
Kumjian (2012)

Individual processes and those acting in combination have distinctive fingerprints in polarimetric radar data

Quantitative Fingerprinting

Quantifying these fingerprints in observations can provide constraints for range of possibilities in model physics parameterizations and highlight where models are having problems





Example: Fingerprints of warm-rain collisional processes on Z_H and Z_{DR}

Fingerprinting

- Individual microphysical processes have distinctive fingerprints in polarimetric radar data

- These fingerprints may be quantified using ARM radar observations and process models

- Uncovering such quantitative fingerprints can provide constraints for physics parameterizations, and could be used to detect and quantify physical processes ongoing in clouds and precipitation.

- Is this useful for the modeling community?