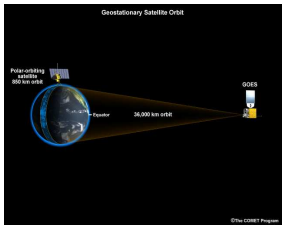
Future Radar and Satellite Technology



Daniel C. Miller
National Weather Service Columbia, SC

The Big Idea

New radar and satellite technology will improve NWS operations!

Outline

- Introduction
  - The Big Idea
- Part I. Dual-Polarization Radar Technology
  - Benefits
  - What is it?
  - Applications
  - When?
- Part II. Next Generation Weather Satellite
  - Benefits and New Features
  - Applications
  - When?
- Conclusion
  - Summary

Part I. Dual-Polarization Radar Technology

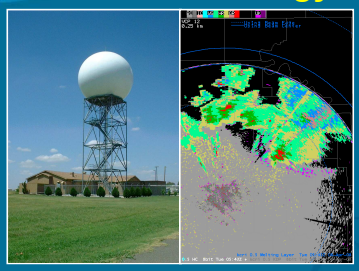
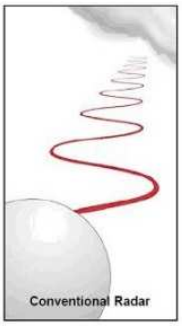


Photo courtesy of NSSL

Dual-Polarization Radar Technology Key Benefits

- Better Determination of Precipitation Type
- Better Estimates of Rainfall Amount
- Better Detection of Hail

What does Dual-Polarization Mean?



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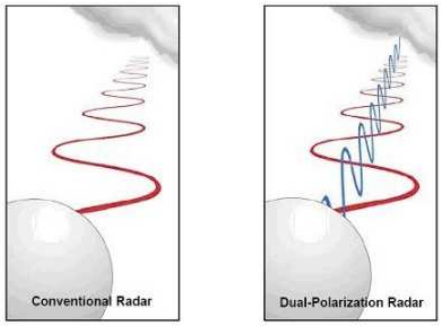
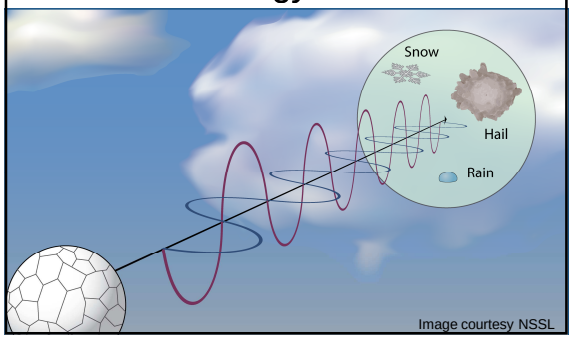


How Is Dual-Polarization Radar Technology Useful?



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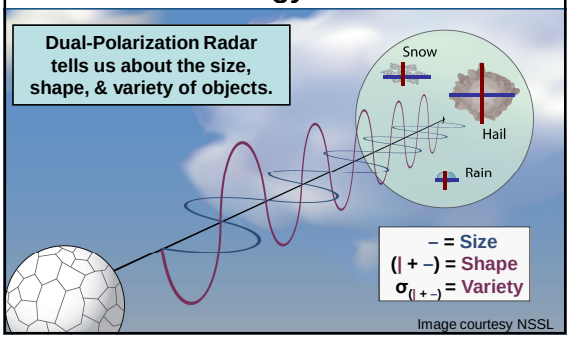
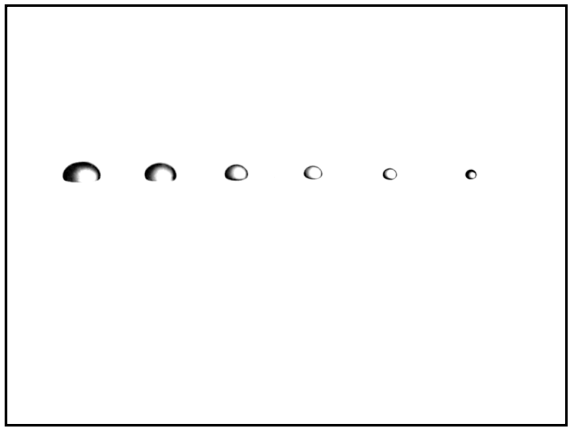
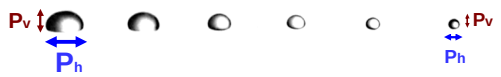




Differential Reflectivity (Z_{DR})

Z_{DR} ~ 10log (Ph/Pv) (dB)

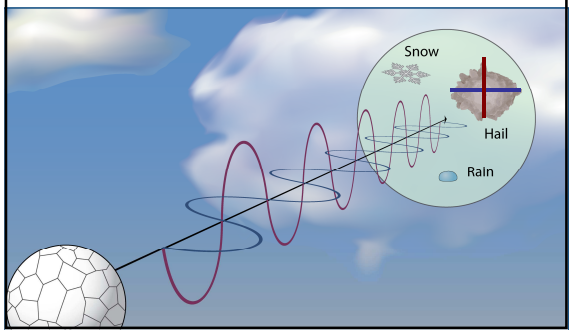


$P_h >> P_v$
$Z_{DR} >> 0$

$P_h \sim P_v$
$Z_{DR} \sim 0$

Z_{DR} Values for Hail ~ 0

$P_h \sim P_v$



Differential Reflectivity (Z_{DR}) Applications

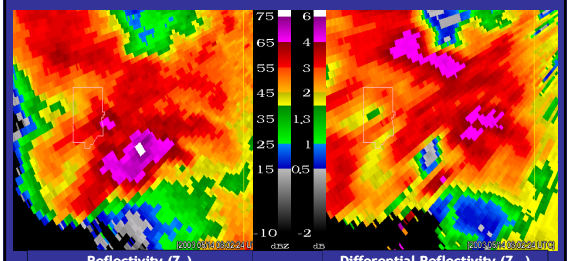


Image courtesy CIMMS-OU

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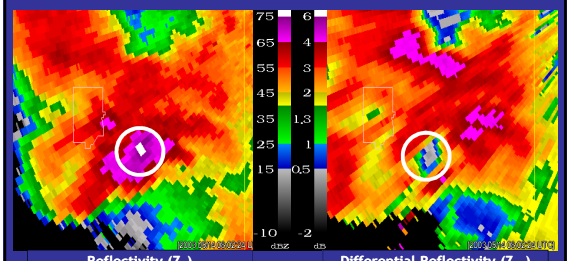


Hail !!

Image courtesy CIMMS-OU

Correlation Coefficient (CC)

- A statistical correlation that describes the similarities in the backscatter characteristics of the horizontally and vertically polarized echoes.
- It is a good indicator of regions where there is a mixture of precipitation types, such as rain and snow.

Correlation Coefficient Values

- $0.96 \leq CC \leq 1$ → Small hydrometeor diversity*
- $0.85 \leq CC < 0.96$ → Large hydrometeor diversity*
- $CC < 0.85$ → Non-hydrometeors present

* Sizes, shapes, orientations, etc.

Using CC to Differentiate between Rain & Snow

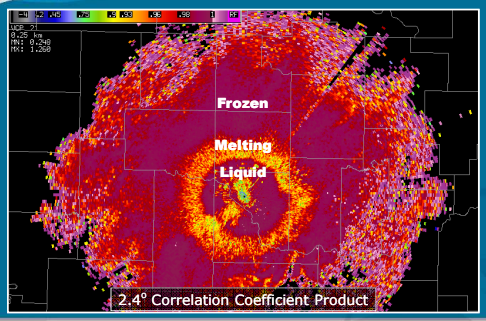
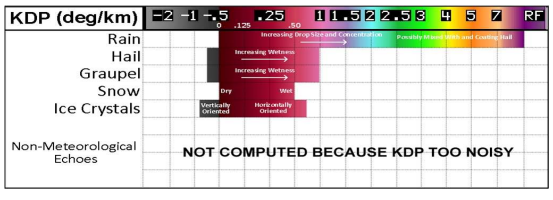


Image courtesy NSSL

Specific Differential Phase (KDP)

- Measures the rate of change of horizontally and vertically-polarized phase shift with distance
- Improves Precipitation Amount Estimates
  - Detects where most liquid water content is
  - Removes effect of hail contamination



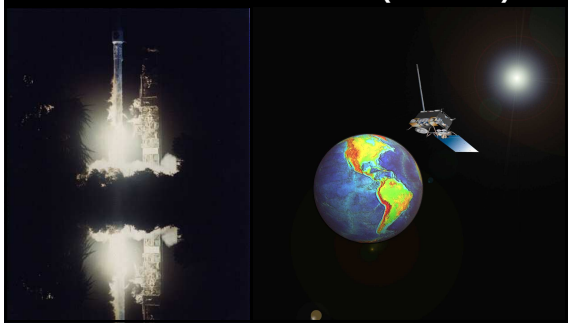
When will Dual-Polarization Radar Technology Arrive?

- 4 NWS beta test sites Fall 2010
- Nationwide installation 2011-2012
  - *Including Columbia, SC (CAE)*

Summary of Benefits with Dual-Polarization Radar Technology

- Better Determination of Precipitation Type
- Better Estimates of Rainfall Amount
- Better Detection of Hail

Part II. Next Generation Geostationary Operational Environmental Satellite (GOES-R)



GOES-R New Capabilities

- Higher Resolution Images
- Data Received in More Frequent Time Intervals
- A Large Suite of New Products

Comparison of GOES-R Imager to current GOES

	GOES-R	Current
Spectral Coverage	16 bands	5 bands
Visible Resolution	0.5 km	~1 km
IR/WV resolution	2 km	~4-8 km
Full disk	Every 15 min	Every 3 hr
CONUS	Every 5 min	Every 15 min
Mesoscale	Every 30 sec!	N/A

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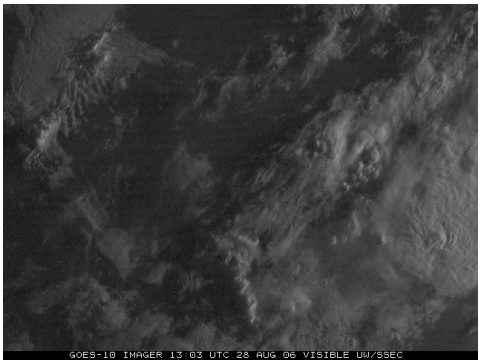
Example of Visible Loop Using 1-Min Images



Courtesy Timothy J. Schmit, NOAA/NESDIS/STAR Madison, WI

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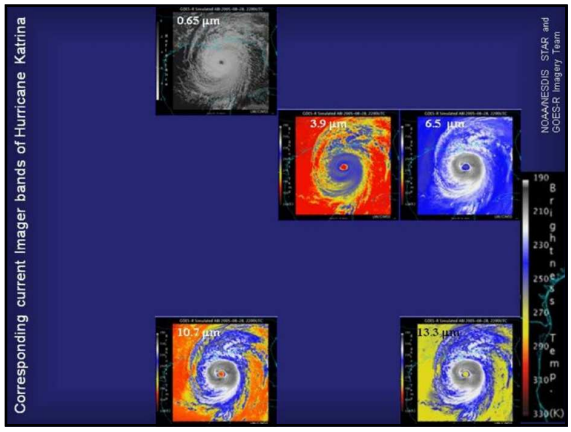

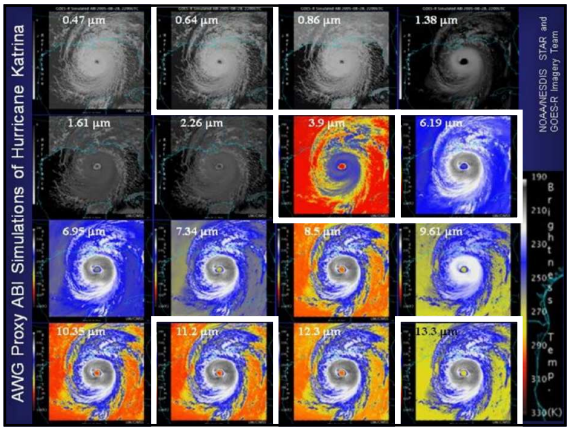

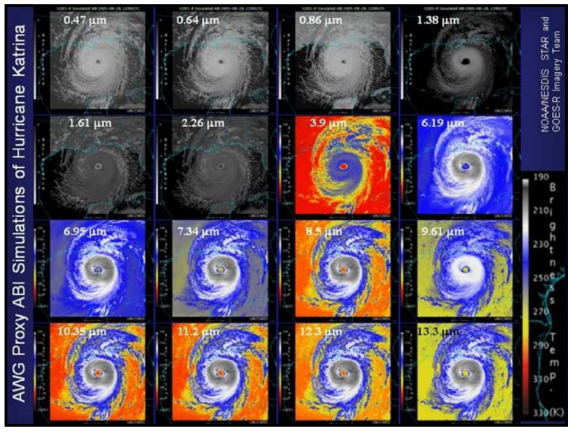

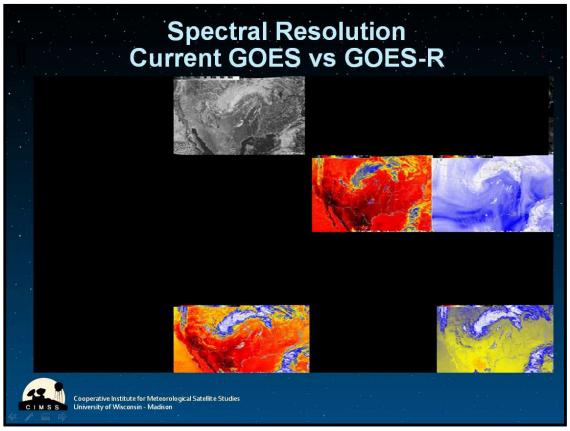

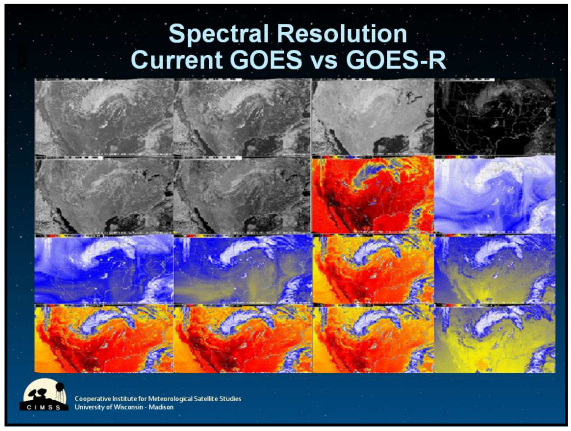

GOES-R New Capabilities (Cont'd)

- **Provide Better Detection and Measurements of:**
  - **Cloud Structure**
    - **Type, Height, Phase, & Temperature**
  - **Other Atmospheric Elements:**
    - **Wind, Moisture, & Temperature**
    - **Lightning**

Some Applications of New GOES-R Data:

- Improved Convective Initiation Predictions
- Identification of Severe Weather Precursors
- Improved Rainfall Amount Estimates
- Better Estimates of Tropical Cyclone Intensity
- Identify Areas of Turbulence and Icing
- Improved Input to Numerical Weather Prediction Models

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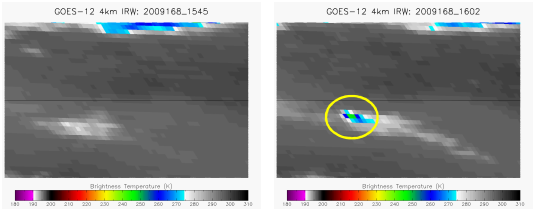
How will GOES-R improve warning lead times?

- Rapid Cloud top cooling detection

Convective Initiation



- Detections of Rapid Cloud Top Cooling
  - can precede precipitation reaching the surface by 30-60 minutes
  - precedes first cloud-to-ground lightning strikes

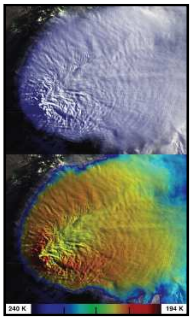
Images Courtesy CIMSS-UW Madison

How will GOES-R improve warning lead times?

- Rapid Cloud top cooling detection
- Severe Thunderstorm Structures Better Detected and Monitored

Severe Thunderstorm Structures Better Detected and Monitored

- Overshooting tops
  - Collapse of overshooting top can precede severe weather/tornado on ground



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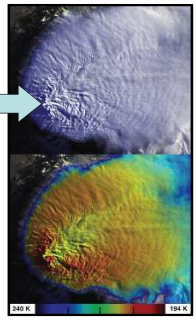

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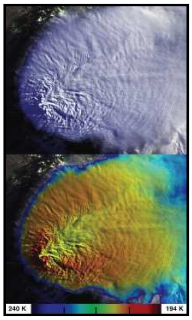
  - Usually related to Supercell/Severe Weather



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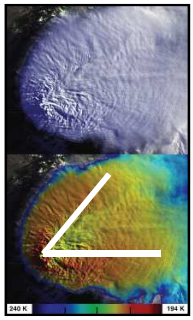
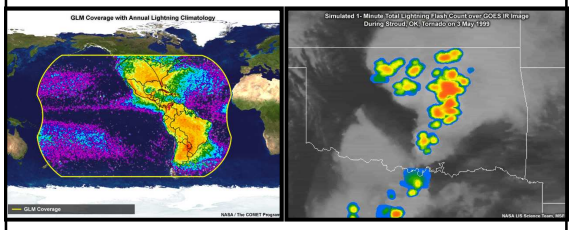


How will GOES-R improve warning lead times?

- Rapid Cloud top cooling detection
- Severe Thunderstorm Structures Better Detected and Monitored
- Better Rainfall Estimates
- Real-Time Lightning Monitoring (GLM)

Geostationary Lightning Mapper



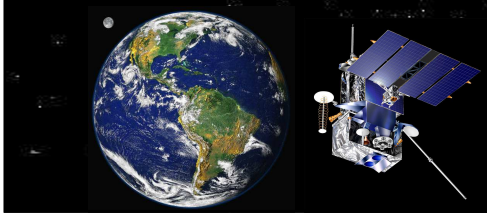
- Real-Time detection of lightning across most of the Western Hemisphere
- Flash Rate and Trends
- IC/CC as well as CG lightning

When?

- **GOES-R launch scheduled for Fall 2015**
  - ***Operational, with products available, in 2016***

Summary of GOES-R New Capabilities and Applications

- Higher resolution images received in more frequent time intervals
- A large suite of new products and applications



Conclusion

- New radar and satellite technology will result in improved forecast and warning operations.

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Thank You!

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