National Weather Service

Multifunction Phased Array Radar: View from Operations

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Operational Environment Is Changing

- **Decisions made with increasing speed**
- **Weather data quantity exploding**
- **Demand for decision support services increasing**
- **Thirst for accurate, reliable, accessible weather information by decision makers and industry to:**
  - *Safeguard citizens*
  - *Protect property*
  - *Enable national economy and global competitiveness*
- **Federal deficits and resource constraints point to:**
  - ***Integrated observations***
  - ***More efficient Research to Operations (projects, modeling)***
  - ***Making every dollar count!***

NWS Developing Strategic Plan and Science/Tech Roadmap

NWS Strategic Themes (Draft)		S&T Roadmap Themes (Draft)
- Establish Earth System Prediction Capabilities - Revolutionize Climate Services - Transform Water Services	Science-service Focus Areas	ü Integrated observing and analysis system ü Integrated environmental modeling: data assimilation, prediction, post-processing (e.g. ensembles)
- Expand Sector-Specific Services - Deliver Robust Decision Support Services		ü Next generation Forecast and Decision Support System ü 4D Digital Weather Information Database (WIDB) – on-demand access ü Transforming dissemination/communication/ outreach capabilities ü Incorporating social sciences strategies in research and operations

Accelerate transition of applications from research to operations

PRE-DECISIONAL

S&T Stretch Goals (2025)

Science Service Area	Key Products/ Services	S&T Goal 2025 Examples	Research Needs and Opportunities: Examples
Fire Weather	Red Flag Warning	>24hr Lead Time (LT) with 95% POD	Simulations (high-resolution) of integrated fire weather/behavior
Hydrology	Flash Flood Warning	2 – 4 hour leadtimes	Physically based hydrologic models and ensembles
Aviation	**Convection Initiation**	**30 mins LT**	Initiation and evolution of convection
Severe Weather	Tornado Warning	Warn on Forecast, LT > 1hr	Improved understanding of tornado formation and severe weather microphysics
Winter Weather	Winter Storm Warning	30 hour LT	Snow band formation and snow intensity
Marine	Storm Warnings	Probabilistic Warning, LT > 5 days	Improve wave model physics from shelf to shore
Tropical Weather	Hurricane Track, Intensity Forecasts	Errors reduced by 50%	Causes of rapid intensity changes
Climate	Seasonal/IA Forecasts	Accurate 6 month+ LTs on forcing events	Earth system modeling with ensemble prediction and uncertainty
Air Quality	Air Quality Predictions	Accuracy >85% out to day 5	Advanced simulations of generation and reactive chemical transport of airborne particulate matter
Space Weather	Geomagnetic Storm Warnings	>90% accuracy, out to day 2	Data Assimilation: Ionosphere, Magnetosphere, and Solar Wind
Tsunami	Tsunami Warnings	<5 mins after triggering event	Enhanced observations and models
Emerging Areas/ Surface Wx	Wind Forecasts	1km resolution, 5 min updates	Meteorological influences on renewable and sustainable energy systems

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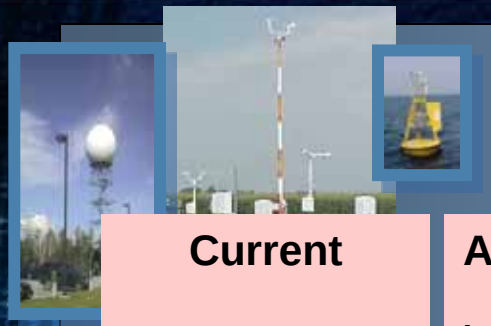
Integrated Observation/Analysis System



Current

Individual Systems
Public
Private
Universities

Radar
Satellite
Surface; in-Situ
Upper Air
Etc

Analysis

Inventory systems, and metadata standards

Assess interdepend-encies, oversampling, gaps, levels of criticality

Strategies

National Mesonet

Network of networks

Integrated Radar (Lidar, gap-fillers, MPAR)

Global Systems

Multisensor platforms

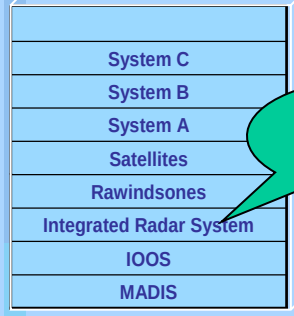
Optimization with OSEs, OSSEs

Standards, Architectures, Protocols

Maximize value of investment

Future

Weather Information Database



Open Architecture

Exploit Strengths and Weaknesses of all Data to Optimize Capabilities Synergistically

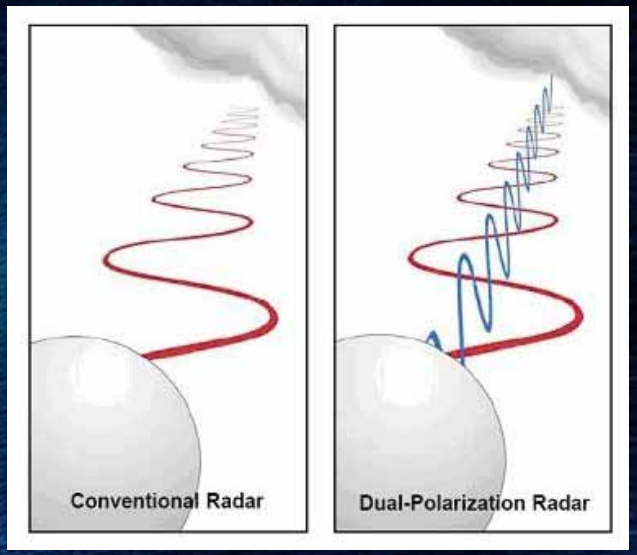
Stroll Down Memory Road

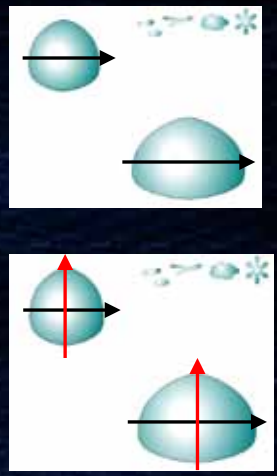
WSR-3	WSR-57	WSR-74	WSR-88D
			
Ca. 1957	1958	1976	1992

NWS is dedicated to infusing the best science and technology into operations

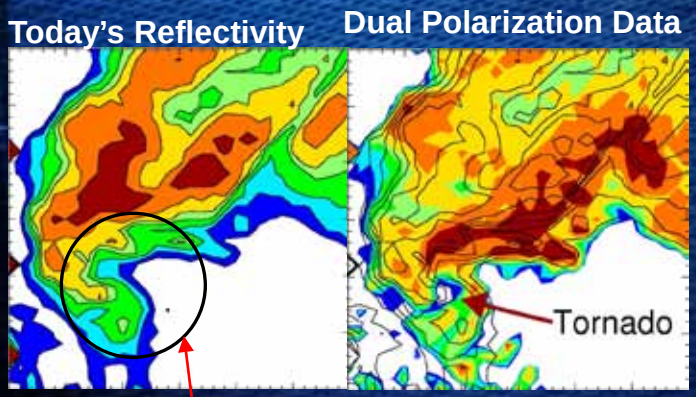
WSR-88D Improvements
Dual Polarization

- Current radar transmits horizontal beam only
- Dual Polarization radar will transmit horizontal and vertical beams
- Complete deployment to all 122 NWS NexRad radars in FY13

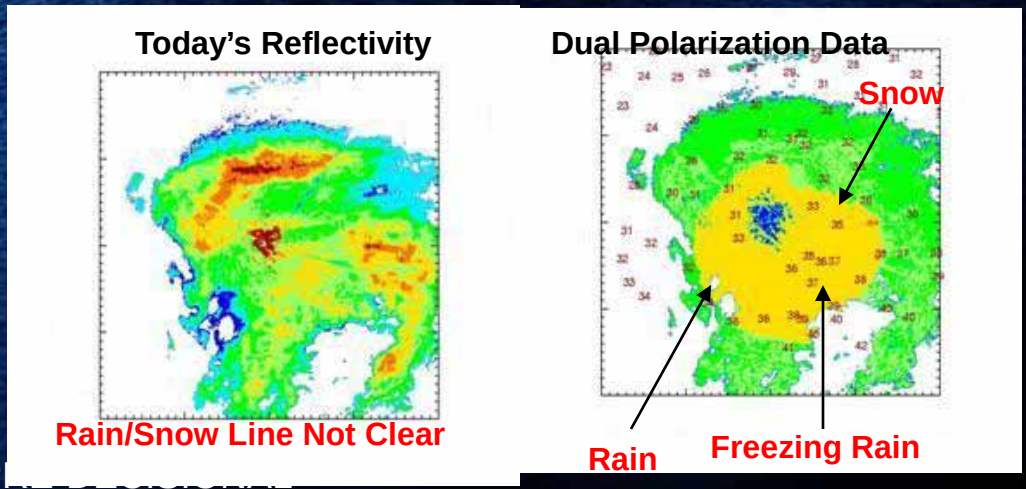




Specific Location of Tornadoes



Better Rain/Snow Discrimination



Radar is NWS Mission Critical

- **Radar will remain a vital and cost-effective component of the NWS observing network**
  - *NEXRAD—extremely cost-effective sensor*

Facts post NEXRAD:

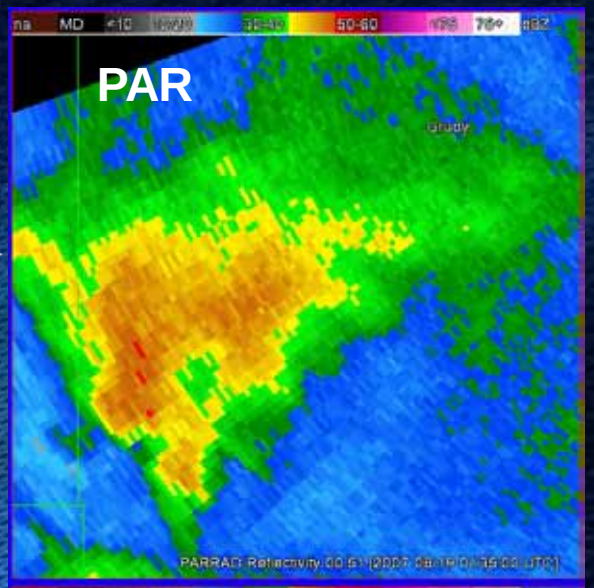
- ***3 X Flash Flood Lead times***
- ***2 X Tornado Leadtimes***
- ***Tornado injuries down 40%***
- ***Tornado deaths down 45%***

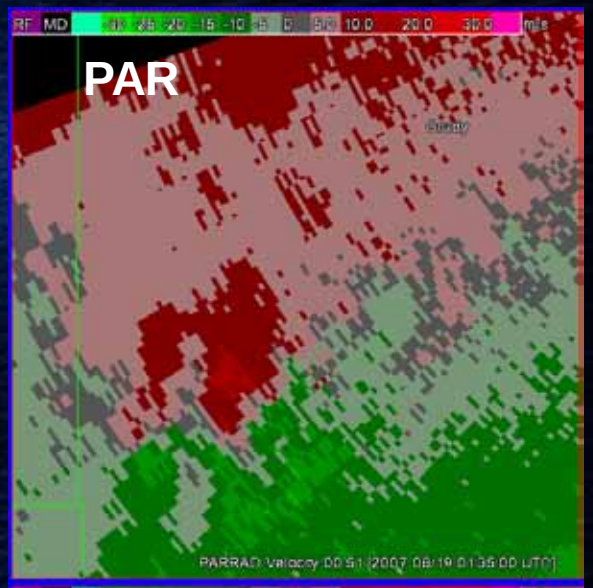
Next Generation Technology
May 19, 1960 / Tornado 19 Aug 2007

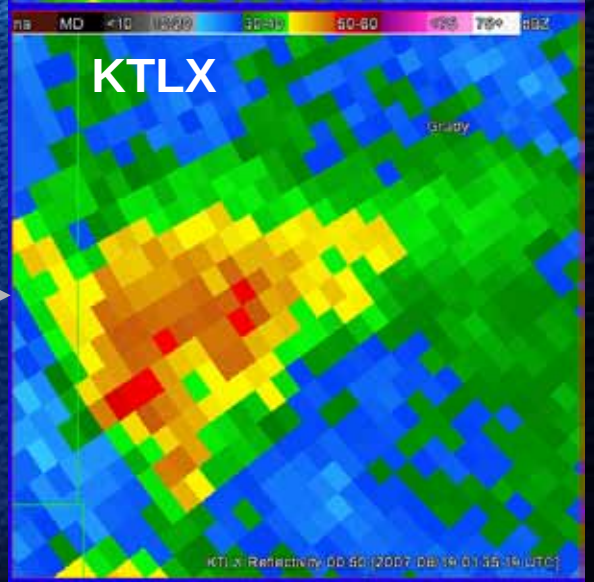
Phased Array Radar advantage

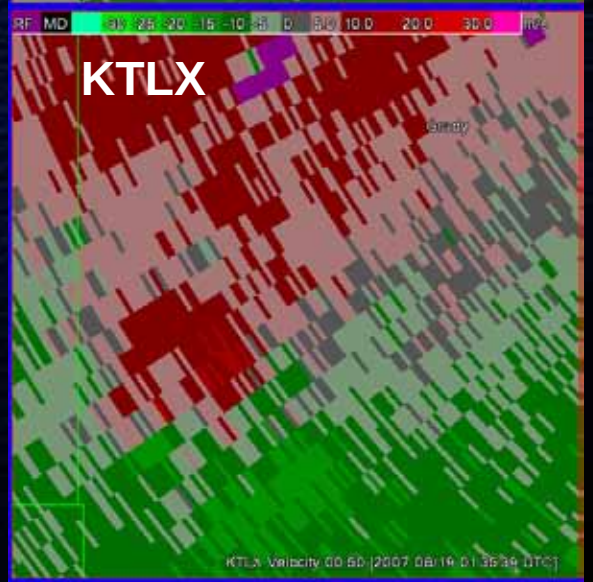
- Faster sampling
- Flexible pointing
- Variable dwell
- No moving parts

Mechanical rotator (WSR-88D)

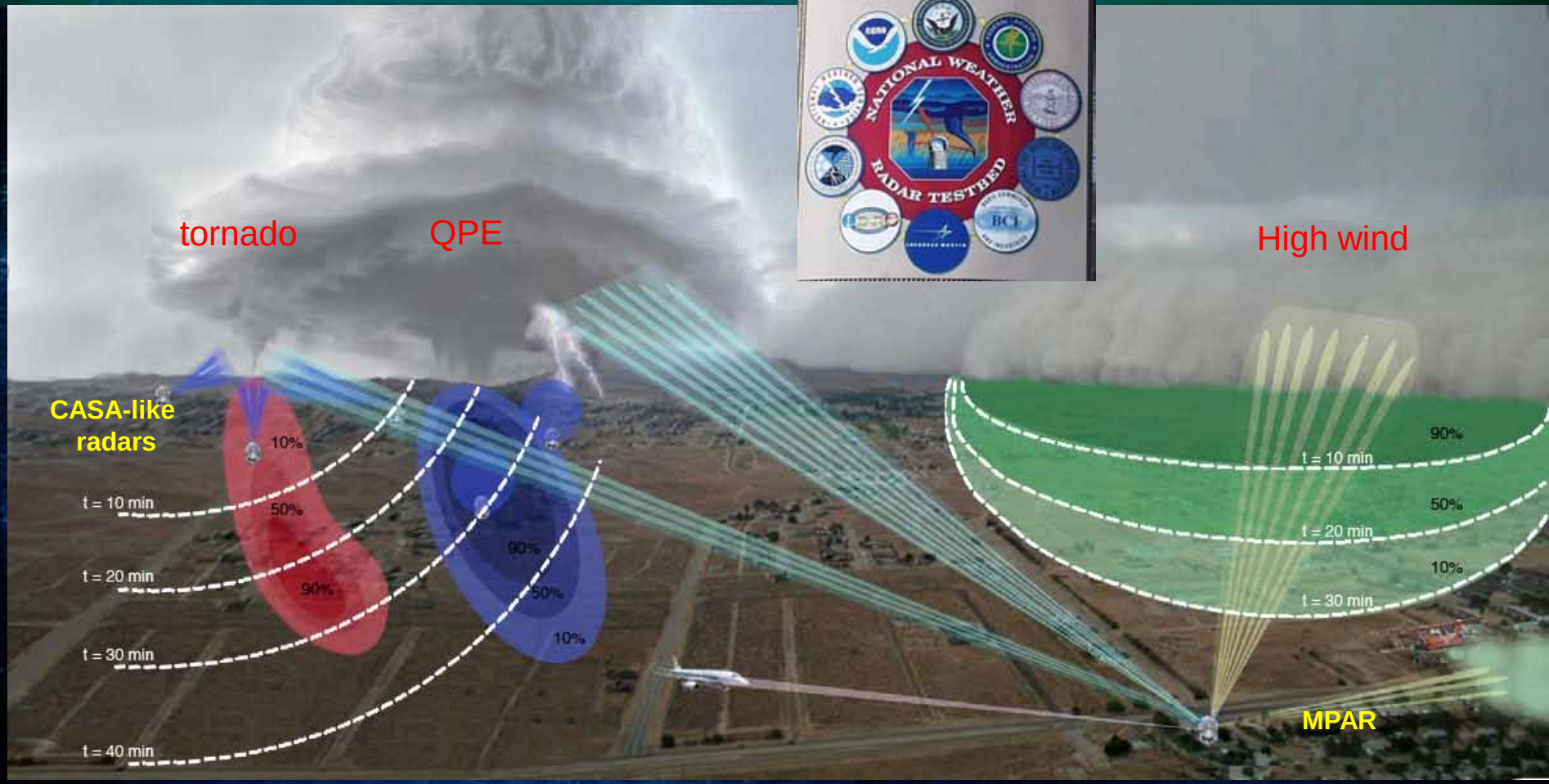








Opportunities
Integrated multi-agency operation



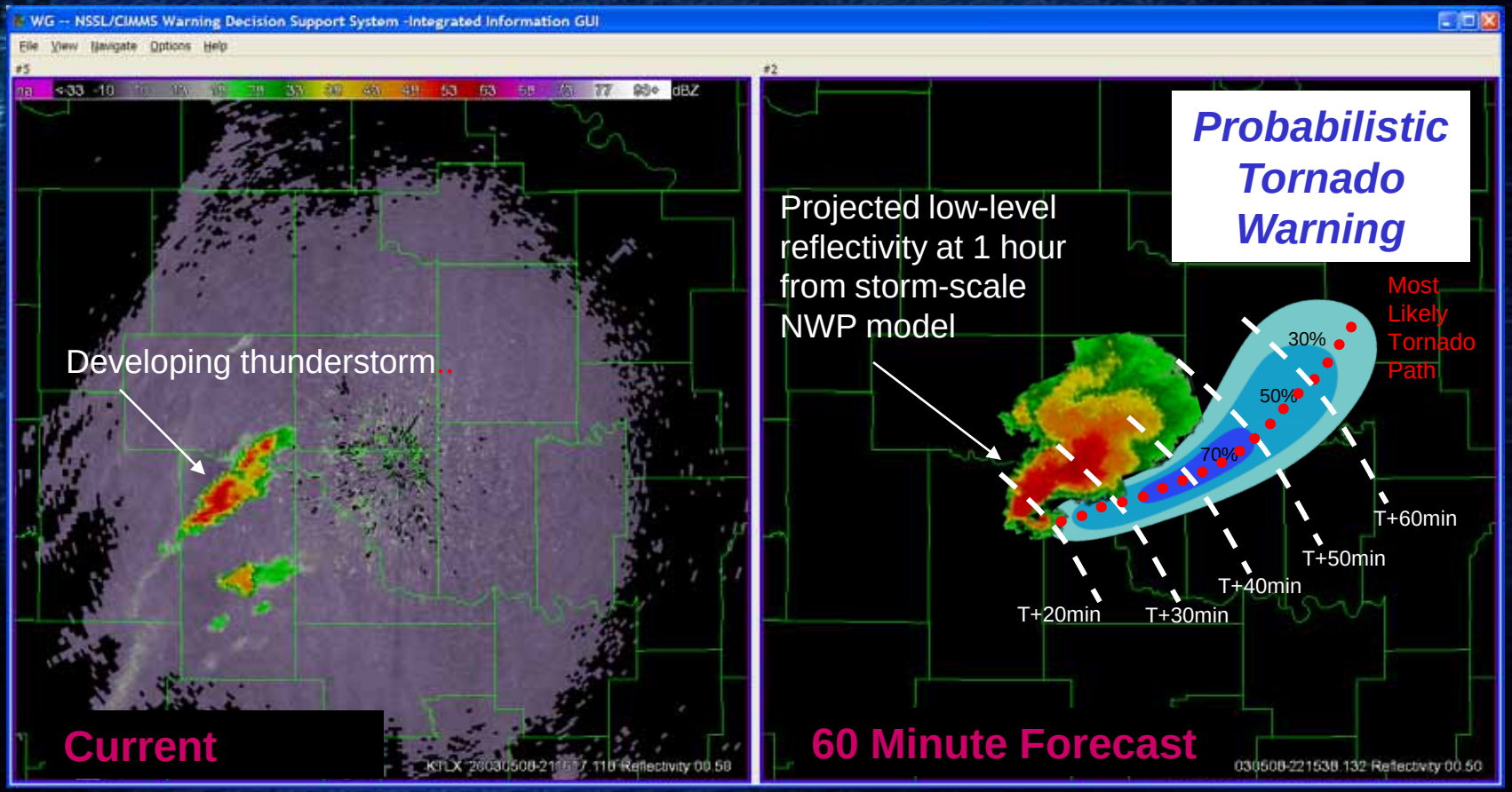
Integrated strategy combining sensors and models to improve:

- Convective initiation, evolution and decay
- Quantitative Precipitation Estimation and Forecast **(**snow/icing airport forecasting)

The Future: Warn-on-Forecast

Fore-cast	Observed		
	None	Weak	Strong
Weak	82	30	2
Strong	21	23	8

Time = 0 minutes **Storm-scale Model Forecast at 60 min**



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Vision for the Future (2025)

Integrated Radar Strategy

Neighborhood-scale (~1-km) warnings of:

60 minute probabilistic tornado lead time

Flash flood lead time from 2 to 4 hours

Convective initiation forecast of 30-60 min

Increase quantitative precipitation estimation accuracy by reducing bias four-fold

Enabled by the integration of radar and other sensors adaptively sampling the boundary layer…
driving regional integrated cloud-scale models…
and exploiting intelligent computing

Vision for the Future

Integrated radar strategy challenges

- *Radar weather requirements are demanding*
  - *Dual pol, narrow beam, low attenuation, high Res*
- *MPAR tech still evolving – dual polarization and agile beam capabilities*
- *Integrating other boundary layer data*
  - *Gap-filling radars, surface networks, lidars, profilers, and other remotely-sensed and in-situ data*
- *Developing adaptive data integration technology*
  - *Dynamically drive sensor targeting configuration and data mining to optimize forecast accuracy*
- *Developing capabilities to ingest non-NOAA weather radar data into operations and NWP*

The Challenge: Demonstrate cost-benefit

- Demonstrate value of new technology to NOAA mission
- Business case based on value/benefit
- Show compelling examples of how warnings and services will improve

Questions?