CIMMS Forecast and Warning Improvements

Don Burgess, CIMMS

Partners from CIMMS
Partners from NSSL
Partners from ROC
Early CIMMS (1980ish): Basics Being Developed

- Experimental Doppler Radar (NRO, CIM); Very Little Forecaster Radar Understanding: DOPLIGHT (1984-1987)
- Scientific Storm Intercept for Verification of Radar Signatures and Understanding Storm Structures
- Basic Understanding of Mesoscale and Near Storm Environments Were Aided by Field Programs
Initial WSR-88D Severe Storm Detection & Algorithms

- Initial WSR-88D Display Products (not Level 2 resolution): Reflectivity, Velocity, Spectrum Width
- Initial Single-Radar WSR-88D Algorithms from CIMMS/NSSL/ROC:
  - SCIT: Storm Cell Identification & Tracking
  - MESO: Mesocyclone Algorithm
  - HA: Hail Algorithm
  - TVS: Tornadic Vortex Signature
  - VWP: VAD Wind Profile
  - VDA: Velocity Dealiasing Algorithm
### New/Improved Severe Storm Algorithms*: 1995-2018

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- **HSDA with Large Hail (LH) and Giant Hail (GH)**
- **TDS with Shading for Confidence Intervals**

* Single-Radar Algorithms

**Not Added to Baseline**

**Added to Baseline**

**Dual-Polarization**

**Experimental**

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CIMMS 40th Anniversary Celebration  November 15, 2018
WSR-88D Data Display and Archive

• Data Display (Level 2 Data)
  • WSR-88D Algorithm Testing & Display System (WATADS)
  • Warning Decision Support System (WDSS)
  • WDSS – Integrated Information (WDSSII)
  • System for Convective Analysis & Nowcasting (SCAN)
  • Four-Dimensional Stormscale Investigator (FSI)

• Data Archive (Level 2 Data)
  • Collaborative Data Acquisition Field Test (CRAFT)
  • Radar Interface & Data Distribution (RIDDS)
  • Integrated Radar Data Services (IRADS)

WDSS Image: May 3, 1999

FSI Image: Reflectivity Analysis; From NWS AWIPS2 System

CRAFT Radars Sending Data to OU & NCDC in 2001; Project Lasted until 2004

CIMMS 40th Anniversary Celebration
November 15, 2018
The Improvement in Tornado Warnings

NWS Tornado Warning Skill Scores

Department of Commerce Gold Medal (NSSL; and CIMMS) “for achieving scientific and technical breakthroughs leading to the continuous improvements in the national network of Doppler radars” (1997)
• Multi-Radar Multi-Sensor Applications Have Significant Advantages Over Single-Radar Applications
• First Called Quantitative Precipitation Estimation – Segregation Using Multiple Sensors (QPE-SUMMS)
• MRMS Combines QPE and Severe Storm Applications
  • Rotation Tracks (Shear Swaths)
  • Maximum Expected Size of Hail (MESH) Swaths
    • NSSL On Demand (Experimental)

MESH Swath Overlaid with Hail Reports from the Severe Hazards Analysis & Verification Experiment (SHAVE). Note Correspondence between MESH Output and SHAVE Reports. Note also the Low Number of Hail Reports Received by the NWS Offices.
Advances in WSR-88D Radar Quantitative Precipitation Estimation (QPE)

Single Radar

PPS (Fulton et al. 1998):
- single radar, single-pol
- single R(Z)/per radar; manually set

Stage-II (Baldwin & Mitchell 1996):
- multi-radar, single-pol
- Inverse distance weighted (IDW) mosaicking
- 4km, hourly

DPR (Giangrande & Ryzhkov 2008):
- single radar, dual-pol
- Hydrometeor classification
- R(Z)/R(Z,ZDR)/R(KDP) synthetic

MRMS-Q3RAD (Zhang et al. 2016):
- Multi-radar, single-pol
- dual-pol QC,
- multi R(Z),
- Precip classification
- Bright band correction
- Conditional IDW mosaicking
- Canadian radar
- 1km, 2min

Multi-Radar Multi-Sensor (MRMS)

Z: reflectivity; ZDR: differential reflectivity; KDP: specific differential phase; A: specific attenuation

DOC Silver Medal for Operational MRMS (2015)

Thanks to Jian Zhang; Poster by S Martinatis, et al
MRMS QPE and Flood Warnings

Flooded Locations and Simulated Hydrographs (FLASH) Project

FLASH uses rainfall observations from MRMS and a hydrologic model to introduce a new paradigm in flash flood prediction that produces outputs at 1-km 5-min resolution. It is now operational within the NWS.

Coastal and Inland Flooding Observation and Warning (CI-FLOW)

CI-FLOW captures the complex interaction between MRMS rainfall, river flows, waves, tides and storm surge, and how they will impact ocean and river water levels.

Ratio of QPE to Flash Flood Guidance for an event in North Texas on May 29, 2015

Maximum Unit Streamflow for an event in North Texas on May 29, 2015
Forecast & Warning Improvement Success Tied to Training

- NWS Radar, Severe Storm and QPE/Flash Flood Training Done in Norman Since the 1990’s by: OTB, FIRSTT, WDTB, WDTD
- Tornado Warning Guidance, Distance Learning Courses, Workshops, Weather Event Simulator (WES)

Thanks to B. Grant & A. Wood

[Posters by A. Wood et al & D. Morris et al]
Forecasts & Warnings of the Future: FACETs

FACETs Is...

• Forecasting a Continuum of Environmental Threats
• A modernization of NOAA’s current teletype-era, deterministic (binary), product-centric paradigm.
• Focused on entire forecast/warning process.

Thanks to Alan Gerard

[Posters by K. Calhoun et al & G. Stumpf et al]
How FACETs Might Look for an April 27, 2011-Type Event

Thanks to Greg Stumpf
QUESTIONS?