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Weather & Climate Impacts on Military Operations Workshop

10 September 2018
CIMMS Overview

• Established in 1978 as largest & second oldest research center at OU

• Center of excellence in mesoscale meteorology, modeling research, forecast improvements & related subjects (5 main themes):
  1. Weather Radar
  2. Stormscale and mesoscale modeling
  3. Forecast improvements
  4. Impact of climate change on high-impact weather
  5. Socioeconomic impact of severe/high-impact weather
Highlights

• Research & Development Expenditures
  - $19.1 Million ($15.09M NOAA, $444K State, DoE
    $1.15 M, NASA $118K, DoD $157K, NSF $1.02M, 
    Other $1.08M)

• Personnel
  - 189 people (130 Staff, 34 grad students & 32 
    undergrads)

• Publications
  - 119 peer-reviewed journal articles in FY16, 62 led 
    by CIMMS personnel

• Research to Operations
  - Many accomplishments in this area
Demonstrate Advantages of Rapid-Scan Radar Technology
Terry Schuur et al.

• Faster Volume Updates
  o Improved Probability of Detection (POD) and False Alarm Ratio (FAR), increased tornado warning lead-times
  o Data assimilation into numerical weather models (Warn On Forecast)

• Electronic Adaptive Scanning
  o Based on prioritization – Scan when and where needed

**Goal: Investigate scientific and operational advantages of rapid-scan radar data**

• Studies conducted using National Weather Radar Testbed Phased-Array Radar & rapid-scan polarimetric radar using sector scans with the KOUN WSR-88D radar.

Investigations include studies of:
  o Advantages of adaptive scanning
  o Tornadic supercell; downbursts in multi-cell storms
  o Storm mergers; quasi-linear MCS
  o Lightning activity in a hail-producing storm
  o ZDR columns
Warn-on-Detection

Use observations to detect where tornadoes are occurring

Warn-on-Forecast

Use models to predict where tornadoes will occur
The Grand Challenge for Warn-on-Forecast

*Can individual thunderstorms be accurately predicted using weather models?*

Take Hurricane forecast track concept and apply it to thunderstorms.
NSSL Experimental Warn-on-Forecast System for Ensembles

Thomas Jones (Thomas.Jones@noaa.gov), Kent Knopfmeier, Patrick Skinner, Nusrat Yussouf, Jessica Choate, Anthony Reinhat, Gerry Creager, and NSSL and GSD collaborators

Motivation

- Create short-term (0-3 h) probabilistic forecasts of high impact weather (tornadoes, hail, wind, flashfloods)
- Use to improve severe weather watch/warning guidance

Approach

- Create a high resolution (3 km) regional numerical weather prediction system based on an ensemble data assimilation approach
- 3 h forecasts generated every 30 minutes
- Assimilate conventional, radar, and satellite observations
- Tested during 2016 and 2017 Hazardous Weather Testbeds

Key Impacts

- NEWS-e forecasts predicted high probabilities of reflectivity and updraft helicity prior to severe weather reports
- Real time forecasts showed potential for tornado warning guidance.

Website: https://www.nssl.noaa.gov/projects/wof/news-e/
**Forecasting a Continuum of Environmental Threats (FACETs)**

**Travis Smith, Kristin Calhoun, Kim Klockow, Holly Obermeier, Kiel Ortega, Tony Reinhart**

**Goal:** Reinvention of NWS’s teletype-era hazardous weather watch/warning program by quantifying and communicating forecast uncertainties through Probabilistic Hazard Information (PHI). FACETs is a large-scale collaboration spread across academia, government research / operations & private sector.

**Approach:** FACETs integrates observational and forecast data from many platforms to create PHI that can be manipulated by forecasters and tailored to a variety of end users. The approach is extensible to all environmental threats.

**Examples:** PHI generated by a Warn-on-Forecast model run (top) and via extrapolation from MRMS-based observational data (bottom).
Hazardous Weather Testbed (HWT)/Experimental Warning Program (EWP) Overview

**Motivation:** HWT/EWP is a joint effort between CIMMS, NSSL, NWS, & JPSS to improve the detection and prediction of hazardous weather events 0-2 hours in advance.

**Approach:** During EWP experiments, NWS forecasters come to HWT to evaluate and improve new techniques, applications, observing platforms, and technologies within the operational environment (AWIPS-2).

**Advantages:**
- Allows researchers to participate in forecasting exercises
- Allows forecasters to test & evaluate new forecasting tools
- Easier for researchers to understand operational challenges
- Provides 2-way feedback between research & operations

**Ongoing HWT/EWP Projects:**
- PHI-Hazard Services (2016-18)
- PHI-Prototype (2015-17)
- GOES-R (2010-18)
- PHI-Broadcaster (2016-18)
- PHI-Emergency Manager (2016-18)
- Hydro (2014-18)
Science Question

• How does the continuous flow of probabilistic hazard information (PHI) impact broadcast meteorologists and their decision making?

Approach

• Broadcast meteorologists perform typical job functions under a simulated television studio environment as they receive experimental PHI and warnings from NWS forecasters during three real-time and three displaced real-time events.

• Update frequencies are varied to better understand the optimal flow of information for viewing audiences and station technology.

Key Insights

2016 Coverage Decisions

2017 Coverage Decisions

• PHI complicated participants' typical process
• Struggled to communicate PHI, preferred qualitative scale
• When viewing with radar data, preferred deterministic polygons
• Faster updates (2 min) were too quick for crawl systems, felt 5-10 min would be optimal for viewers

Future Work

• Test in a team environment, use a green screen, and include live social media use during cases.
Applications to Military

- Radar technology
- Flooding
- Transportation
- Severe Storms
- Forecasting
- Understanding changing patterns/frequency of extreme weather events