Thunderstorm Forecasting and Warnings in the US: Applications to the Veneto Region

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Who am I and Why am I here?

- Bill Conway
  - Weather Decision Technologies (private US company)
  - specialty – radar meteorology and systems design
  - work with ARPAV on the Hydromet Decision Support System
    - HDSS – automated weather detections and predictions
- My Presentation:
  - discuss thunderstorm forecasting methods in the US
  - show applications of HDSS in the US and Veneto
Weather Related Deaths in the US

30 year total fatalities ~ 17,190* 
Estimated over 200,000 injured*

*There are 3X more deaths and injuries in car accidents in a single year!
Weather Damage Costs in the US

Total – 560 billion USD (395 milardi euro)

Hurricanes most costly
Katrina – 125 billion USD (87 milardi euro)

Thunderstorms – 16 billion USD (11.2 milardi euro)

Floods – 62.4 billion USD (43.6 milardi euro)
US National Weather Service

- 136 regional offices
- Operate 24 hours a day
- Responsible for all public forecasts and warnings
- Responsible for aviation forecasts
- 2006 Budget: 270 million USD (190 milioni euro)

Norman, Oklahoma
US center for thunderstorm forecasting and research
US National Weather Radar Network
(460 Km coverage map)

- S-band radars (WSR-88D)
- First radar installed in 1988
- Located at regional NWS offices
- Cost – 6 billion USD (4.2 miliardi euro)

All data go to the regional NWS offices and the National Climatic Data Center in real-time
National Weather Center
Norman, Oklahoma

- National Severe Storms Laboratory
  - US center for severe storms research
- Norman National Weather Service
  - Regional forecasts and warnings
- Storm Prediction Center
  - US center for national thunderstorm forecasts
- WSR-88D Radar Center
  - US center for radar network
- University of Oklahoma School of Meteorology (250 students)
  - One of the top schools in the world for thunderstorm studies

Over 400 positions in meteorology, computer science, and support.
Forecasts areas of severe thunderstorms out to 8 days in advance

Forecast specific areas of severe weather by providing severe thunderstorm or tornado watches

Maintain a database of severe weather reports
Storm Prediction Center “Watch Boxes”

- **Severe Thunderstorm Watch** – expect non-tornadic thunderstorms with hail greater than 2 cm in diameter and/or winds greater than 90 km/hr

- **Tornado Watch** – expect severe thunderstorms with the possibility of tornadoes

- **Particularly Dangerous Situation Tornado Watch** – expect severe thunderstorms with the possibility of long track strong tornadoes
When Severe Thunderstorms and Tornadoes Occur!

- National Weather Service Offices issue severe thunderstorm and tornado warnings
- Television and radio broadcast the warnings
- Sirens are activated

27 aprile Thunderstorms 2007, Abano
Severe Weather Verification

- Severe weather is reported by police, the public, storm chasers, and others.
- All reports are sent to the Storm Prediction Center.

Devastation 'stunning' after twisters kill 10 along Texas-Mexico border

Tornado kills 10, injures 48
Damaging Winds (non-tornadic)

“Shelf clouds”, leading edge of very strong winds

Thunderstorms 2007, Abano
Flash Floods

27 aprile
Thunderstorms 2007, Abano
Lightning

27 aprile

Thunderstorms
Hail

27 aprile Thunderstorms 2007, Abano Hail
Tornadoes

“Wedge” F5 tornado – the worst type!

“Satellite” vortex tornado

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F5 Tornado Damage
Data Integration

Thunderstorms, damaging winds, hail, predictions
Precipitation Estimates and Predictions
Lightning Predictions
Flash Flood Predictions

Hydromet Decision Support System

Thunderstorms 2007, Abano
WDT Central Computer Facility
(1.7 million USD in computers – 1.2 milione euro)
National High Resolution Mosaic of all Radars
Example of HDSS in the US (electricity generation company)

30 minute lightning prediction
Integrates Teolo, Loncon ENAV radars, model, satellite, rain gauge data.

Can be accessed 24 hours a day through the internet.

Expandable to ingest any number of radars.

Can be customized for any location.

- 3 radar mosaics
- Rainfall amounts
- Radar forecasts
- Flash flood prediction
- Lightning prediction
- Storm, high winds, tornado prediction
- Hail prediction
- Animation
- Looping, mapping
Storm Alerts and Predictions

- Automated "ranking" of storms in order of severity
- Tornado predictions (blue)
- Storm predictions (white)
- Hail size
- Map options
Flash Flood Prediction

Basin map alerts

Basin table alerts

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Examples of ARPAV Customer Pages

Future projects:
- Include more radars
- Continue to improve results
- Continue to add new customers
- Install in other locations in Italy

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Texas Tornado Signature
(far range from the radar)

Reflectivity “notch”

Strong velocity “couplet”

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Very Close Range Tornado!
(Enterprise Radar Factory)

Reflectivity “hook echo”

Debris inside tornado

27 aprile
Thunderstorms 2007, Abano
Within the outlook areas (previous slide) there are small scale analysis to determine which type of “watch” to issue.