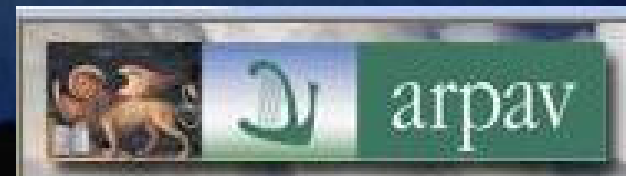


Thunderstorm Forecasting and Warnings in the US: Applications to the Veneto Region

Bill Conway
Vice President
Weather Decision Technologies
Norman, Oklahoma, USA

Andrea Rossa
ARPAV Lead Scientist
Centre Meteorological di Teolo
Teolo, Italy



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

WDT WEATHER DECISION TECHNOLOGIES
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News

Sharpening the Cutting Edge
WDT is the global leader in state-of-the-science weather tools. Our constant search for weather innovation and our ability to customize this innovative weather content for real world application is what sets us apart.
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Our Products and Services

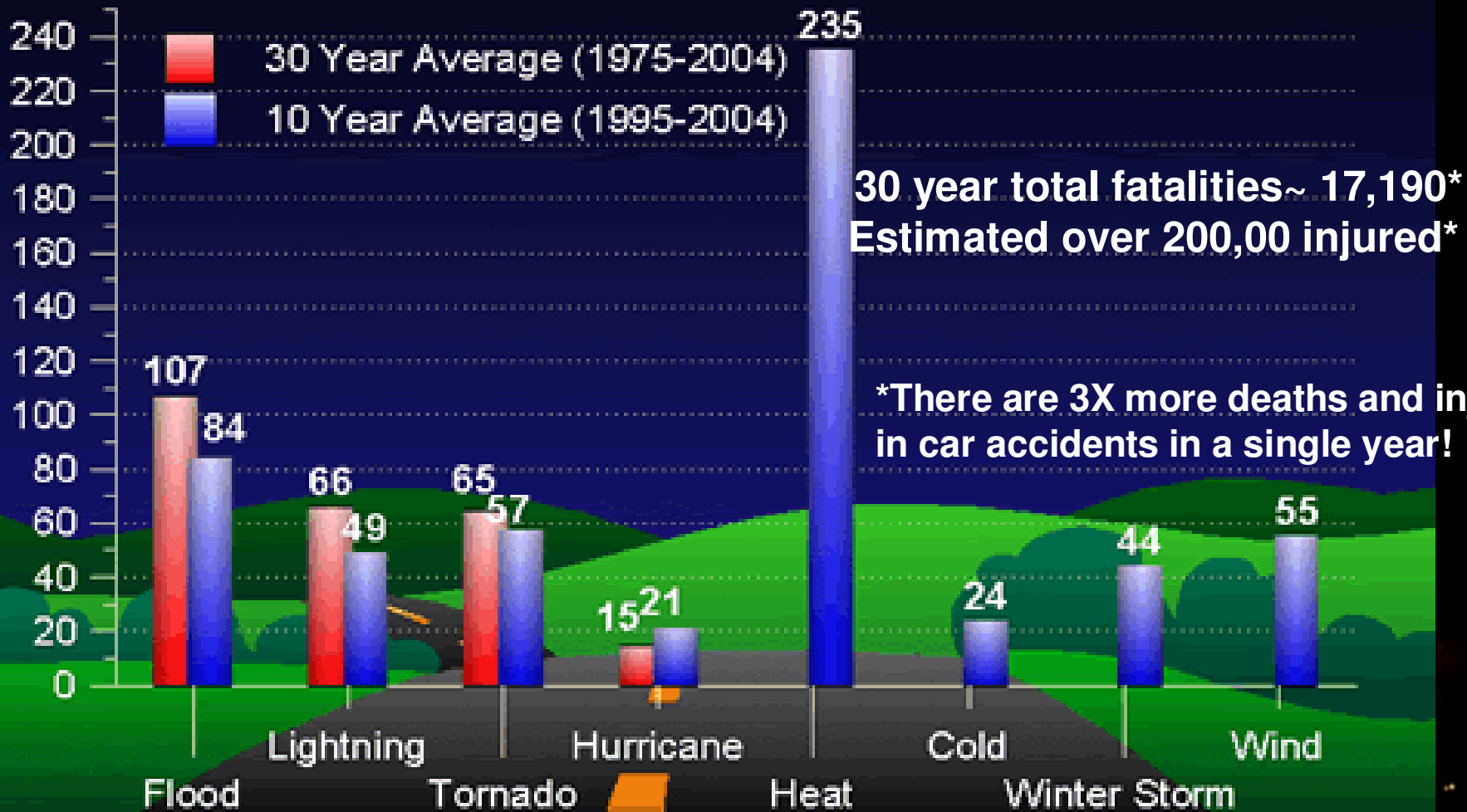
- Precipitation Tools
- Severe Weather Nowcasts
- GIS Weather
- Lighting Safety Tools
- Forensic Weather Reports
- Decision Support Systems
- Weather Models
- Watch

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Weather Related Deaths in the US



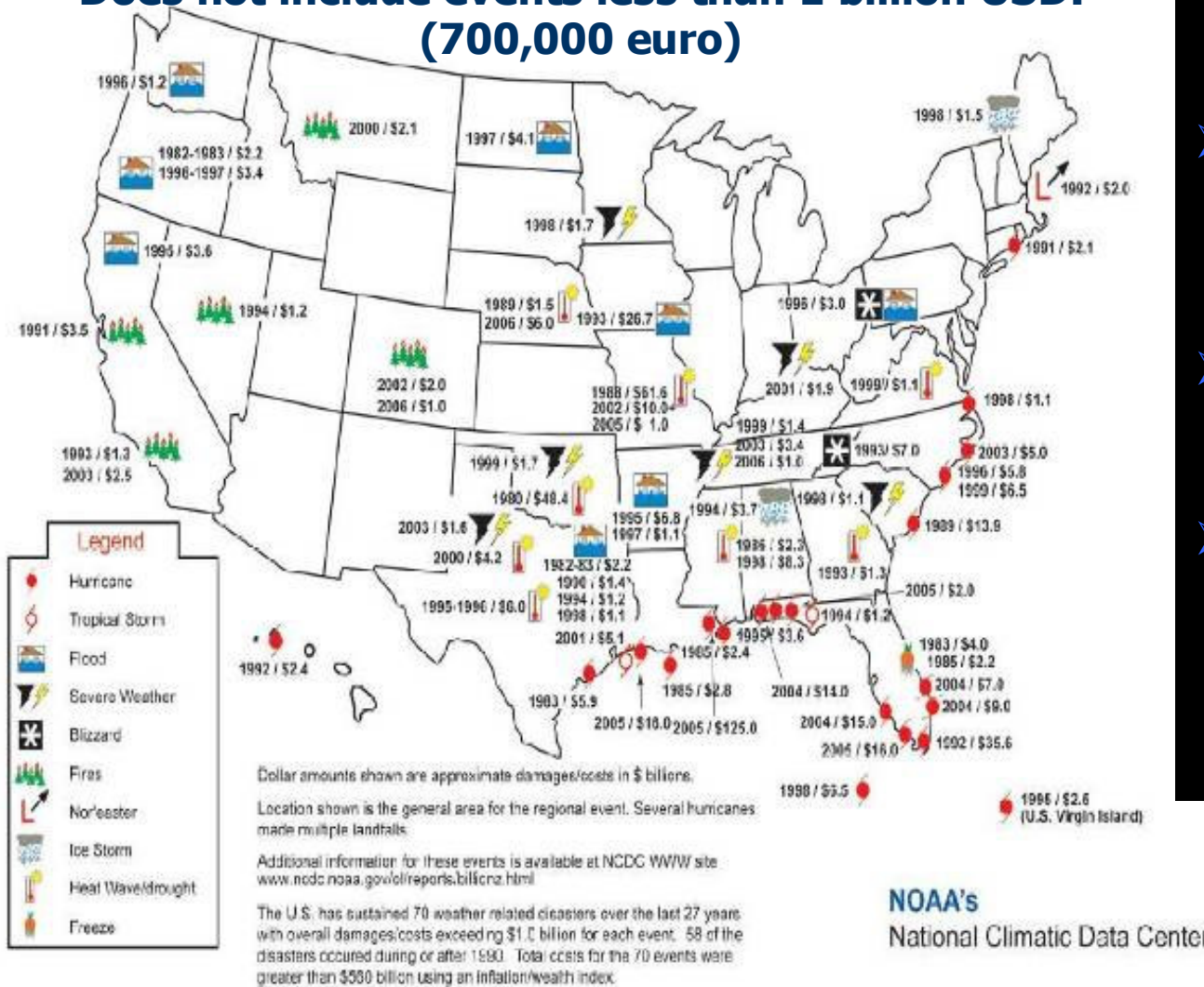
Weather Fatalities



Weather Damage Costs in the US

Billion Dollar Weather Disasters 1980 - 2006

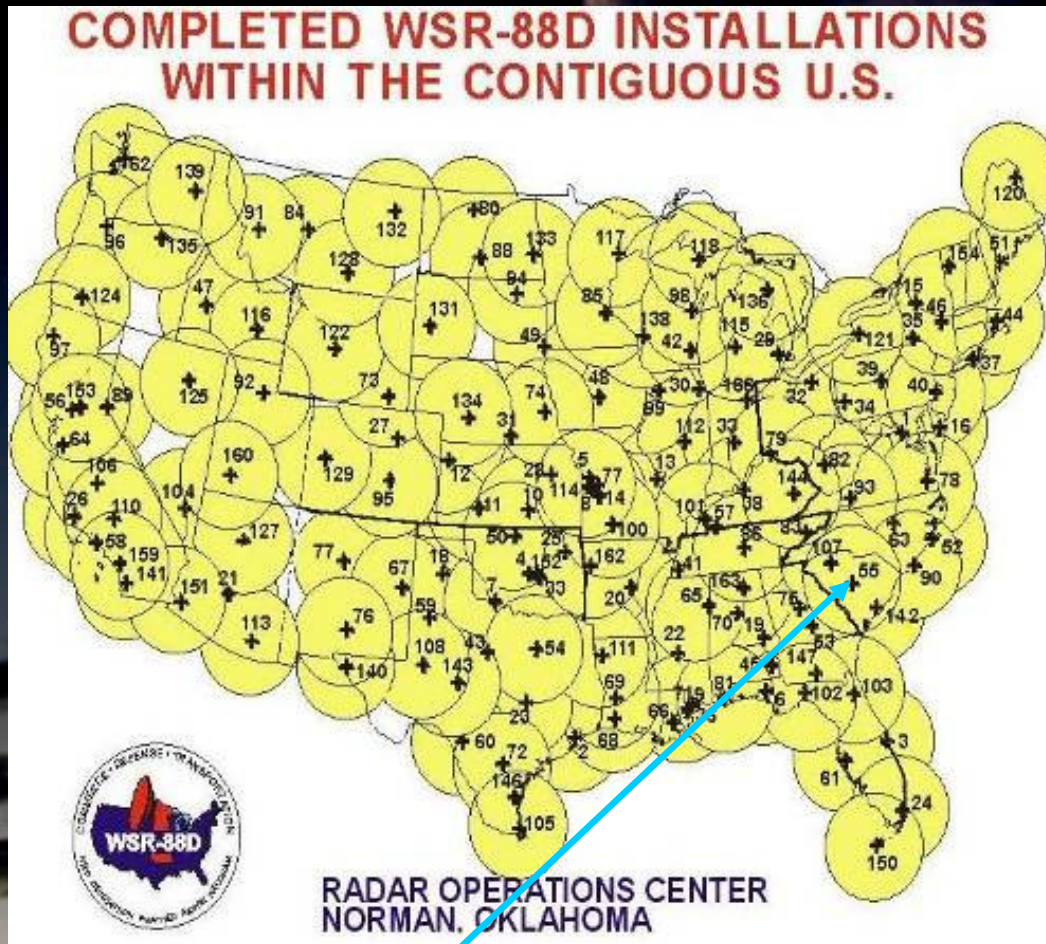
Does not include events less than 1 billion USD!
(700,000 euro)



- Total – 560 billion USD (395 miliardi euro)
- Hurricanes most costly
Katrina – 125 billion USD (87 miliardi euro)
- Thunderstorms – 16 billion USD (11.2 miliardi euro)
- Floods – 62.4 billion USD (43.6 miliardi euro)



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)

WSR-88D



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**



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Storm Prediction Center



NOAA's National Weather Service

Storm Prediction Center

Site Map News Organization

Local forecast by "City, St" or "ZIP"
City, St Go

Overview
SPC Products
All SPC Forecasts
Current Watches
Meso. Discussions
Conv. Outlooks
Fire Wx Forecasts
XML RSS Feeds

Weather Information
Storm Reports
Watch/Warning Map
National RADAR
Product Archive
Norman, OK WX

Research
Non-op. Products
Forecast Tools
Svr. Tstm. Events
SPC Publications

Education & Outreach
About the SPC
SPC FAQ
About Tornadoes
About Derechos
WCM Page
Enh. Fujita Page
Cool Images

Moderate Risk for severe storms...

The following Weather Watches are currently in effect:
0170...

More news items below the overview graphic. Updated: Tuesday, 24-Apr-2007 03:40:16 CDT

Overview | Conv. Outlooks | Watches | MDs | WWA | Storm Reports | Fire Weather

Severe thunderstorm watch (blue)
Tornado watch (red)

General thunderstorm area (brown)
Slight risk of severe thunderstorms (green)
Moderate risk of severe thunderstorms (red)
High risk of severe thunderstorms (not shown here)

NOAA SPC Activity Chart
20070424/0604
National Weather Service
Storm Prediction Center
Norman, Oklahoma

- 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"

Particularly Dangerous Situation (PDS) Tornado Watch 179

< Previous WW Next WW >

Public | Counties | Probabilities | Aviation | Warnings | Initial RADAR | Related MD



Tornado Watch # 179 - Valid from 400 PM until 1100 PM CDT

NOAA/NWS/Stone Prediction Center

Updated: 20070424/2102 UTC

- 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



Severe Weather Verification

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

NOAA's National Weather Service
Storm Prediction Center

Site Map News Organization

Local forecast by "City, St" or "ZIP"
 City, St Go

Overview
 SPC Products:
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Today's Storm Reports
 < 070423 Reports 070424 Reports >

SPC Storm Reports for 04/24/07
 Map updated at 1841Z on 04/25/07

TORNADO REPORTS... (22)
WIND REPORTS/HL... (49/1)
HAIL REPORTS/LG... (61/2)
TOTAL REPORTS... (152)

• High Wind Report (55KT +)
 • Large Hail Report (2" dia. +)

PRELIMINARY DATA ONLY

Note: All data are considered preliminary

Tornado Reports (in CSV format)

Time	Location	County	State	Lat Lon	Comments
1816	T W WILD HORSE	CHEYENNE	CO	3882 10300 (GLD)	DAMAGE TO A QUONSET HUT. SOME
1840	WILD HORSE	CHEYENNE	CO	3882 10300	DEBRIS IN TOWN. POSSIBLE DAMAGE TO HOUSE WINDOWS. (GLD)
1845	12 NW WILD HORSE	LINCOLN	CO	3894 10318	JUST EAST OF LINCOLN COUNTY LINE NEAR JUNCTION OF HIGHWAYS 287 AND 94. (GLD)
1846	6 SE BOYER				
1858	6 SE BOYER				

TORNADO ON GROUND NEAR

Home > Topics > News > World

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

View Larger Image

Lorenzo Tijerina, 9, right, and his brother, Armondo, 5, look through the debris of their neighbour's home in Eagle Pass, Texas. (AP Photo/Eric Gay)

Michelle Roberts, Canadian Press
 Published: Thursday, April 26, 2007

EAGLE PASS, Texas (AP) - Ricardo Tijerina saw the sky darken and expected a typical spring storm to roll in.

Article tools
 Printer friendly
 E-mail

Tornado kills 10, injures 48

understorms 2007, Abano

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

Thu

Hail



© 2004 Tom Santillo, Simon Br



©Matt Grantham



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Tornadoes

“Wedge” F5 tornado – the worst type!



“Satellite” vortex tornado

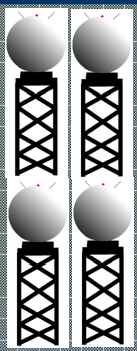


F5 Tornado Damage



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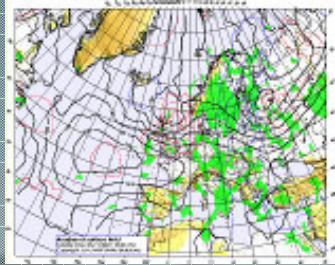
Data Integration



Radar
s



Satellite



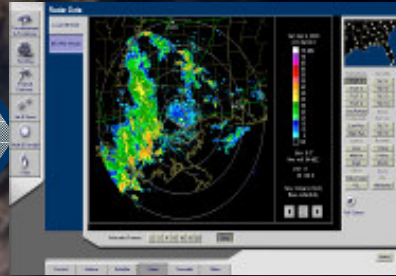
Numerical
Models



Upper
Air



Lightning



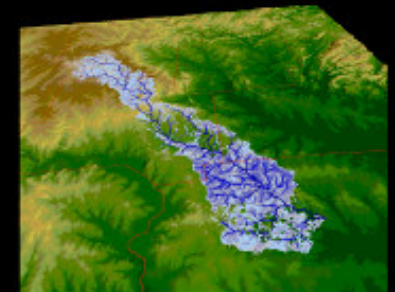
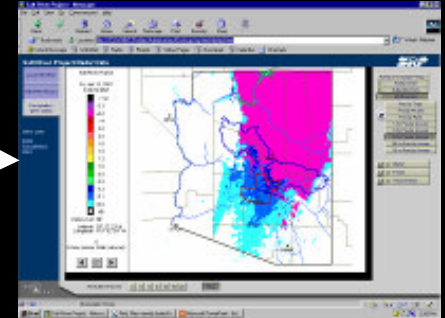
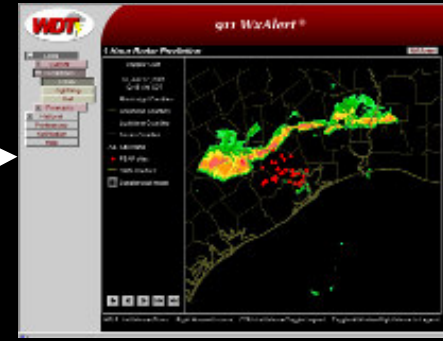
**Hydromet Decision
Support System**

Thunderstorm,
damaging
winds, hail,
predictions

Precipitation
Estimates
and
Predictions

Lightning
Predictions

Flash Flood
Predictions



WDT Central Computer Facility

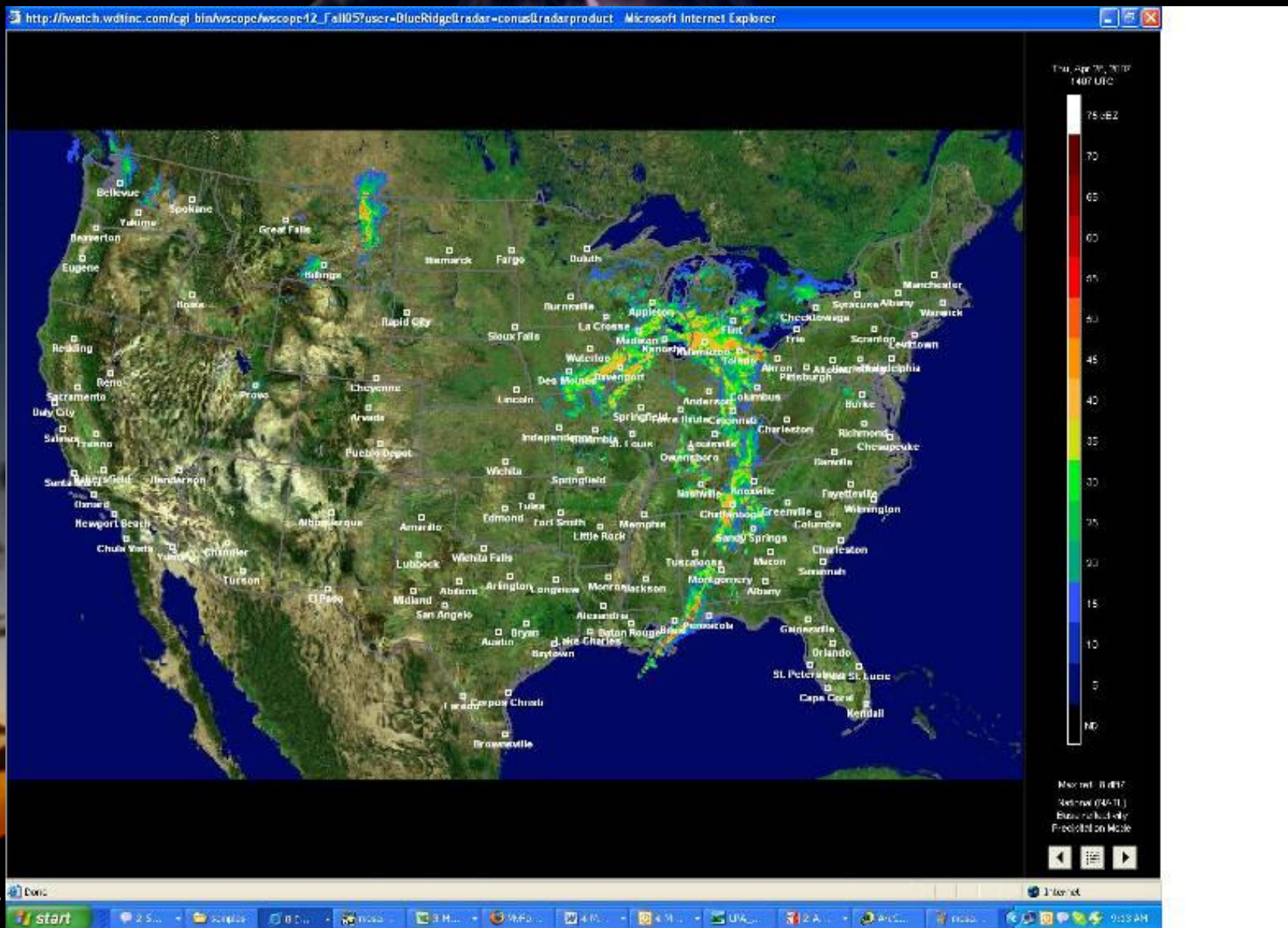
(1.7 million USD in computers – 1.2 milione euro)



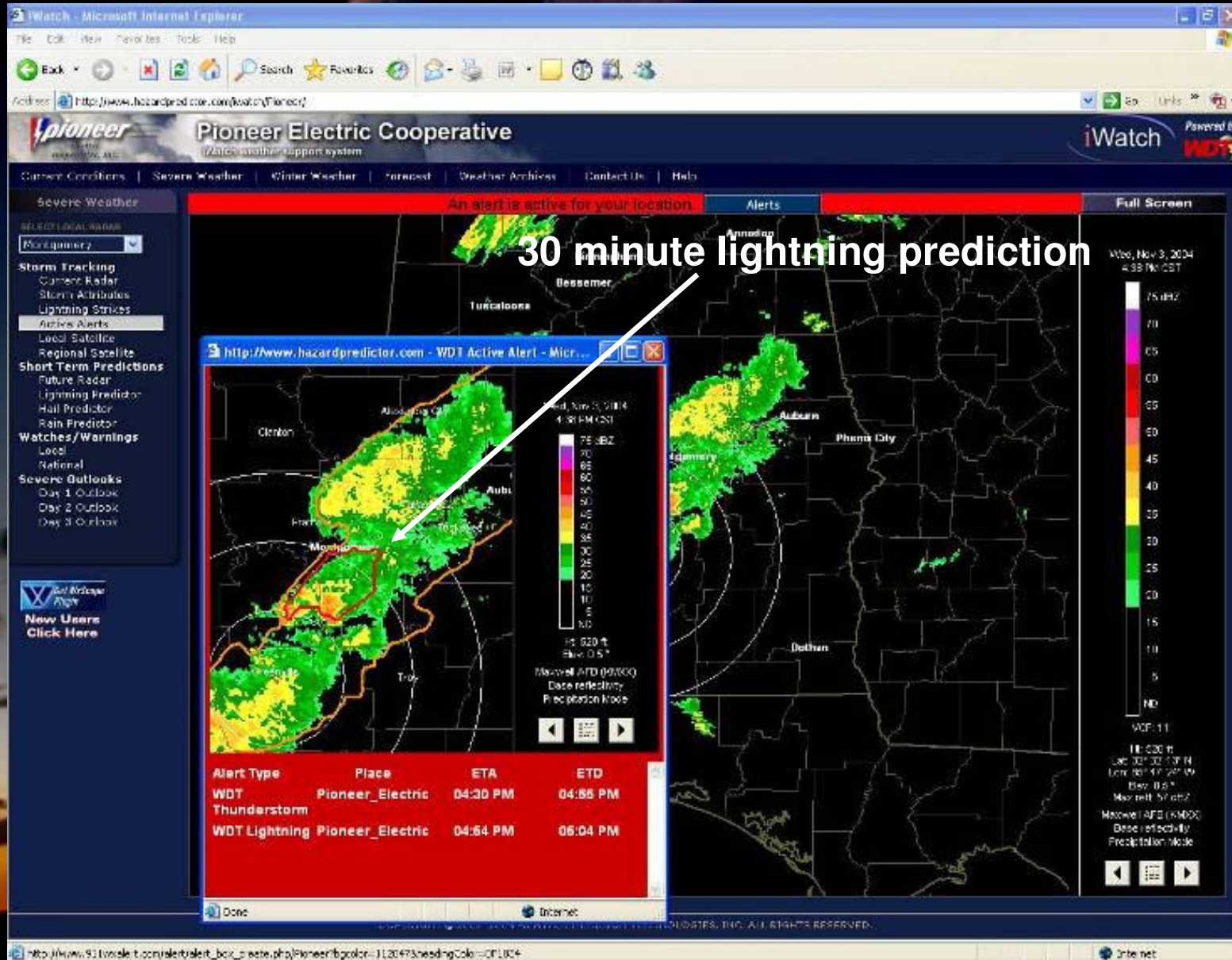
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Thunderstorms 2007, Abano

National High Resolution Mosaic of all Radars



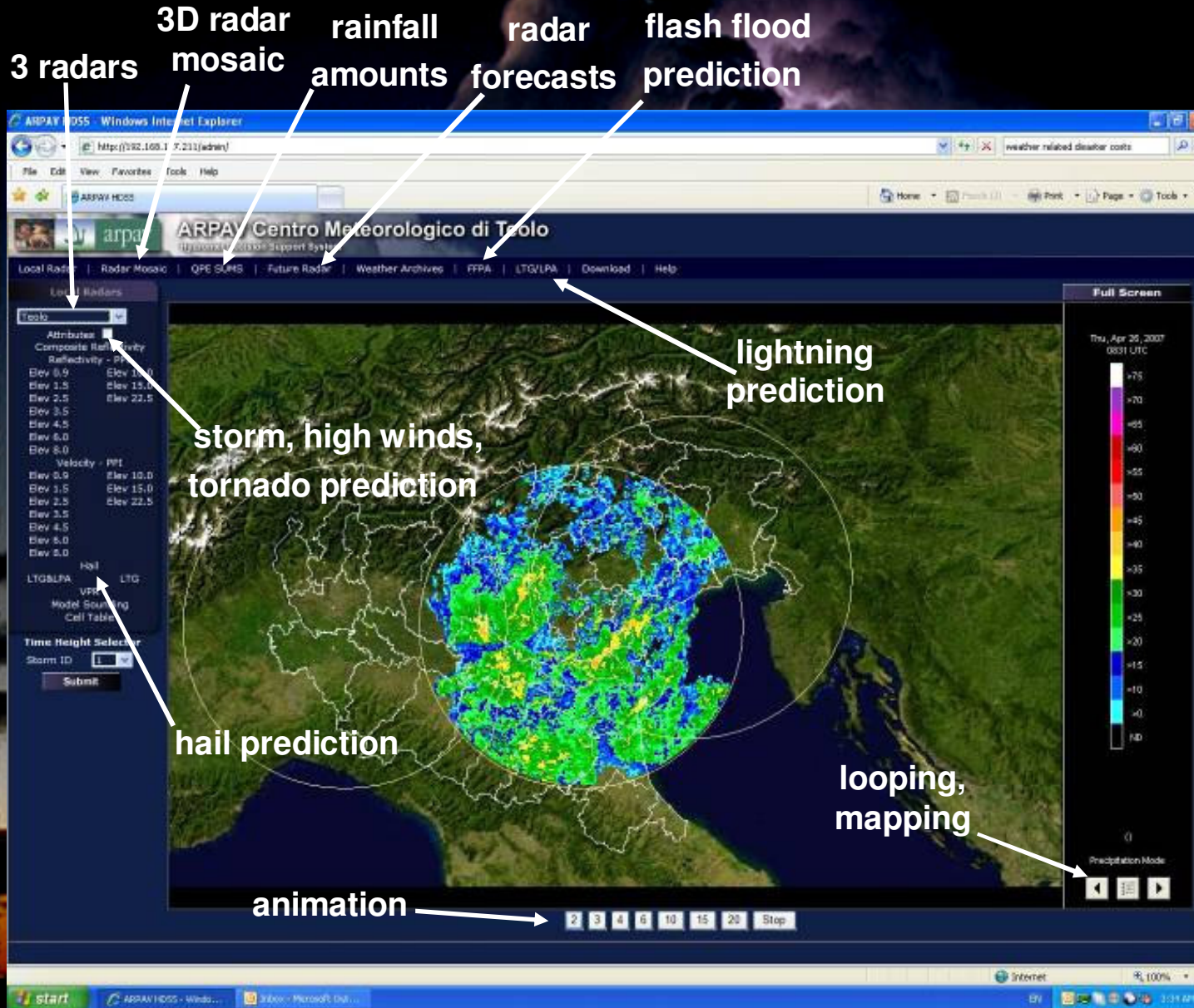
Example of HDSS in the US (electricity generation company)



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Thunderstorms 2007, Abano

ARPAV HDSS Web Page



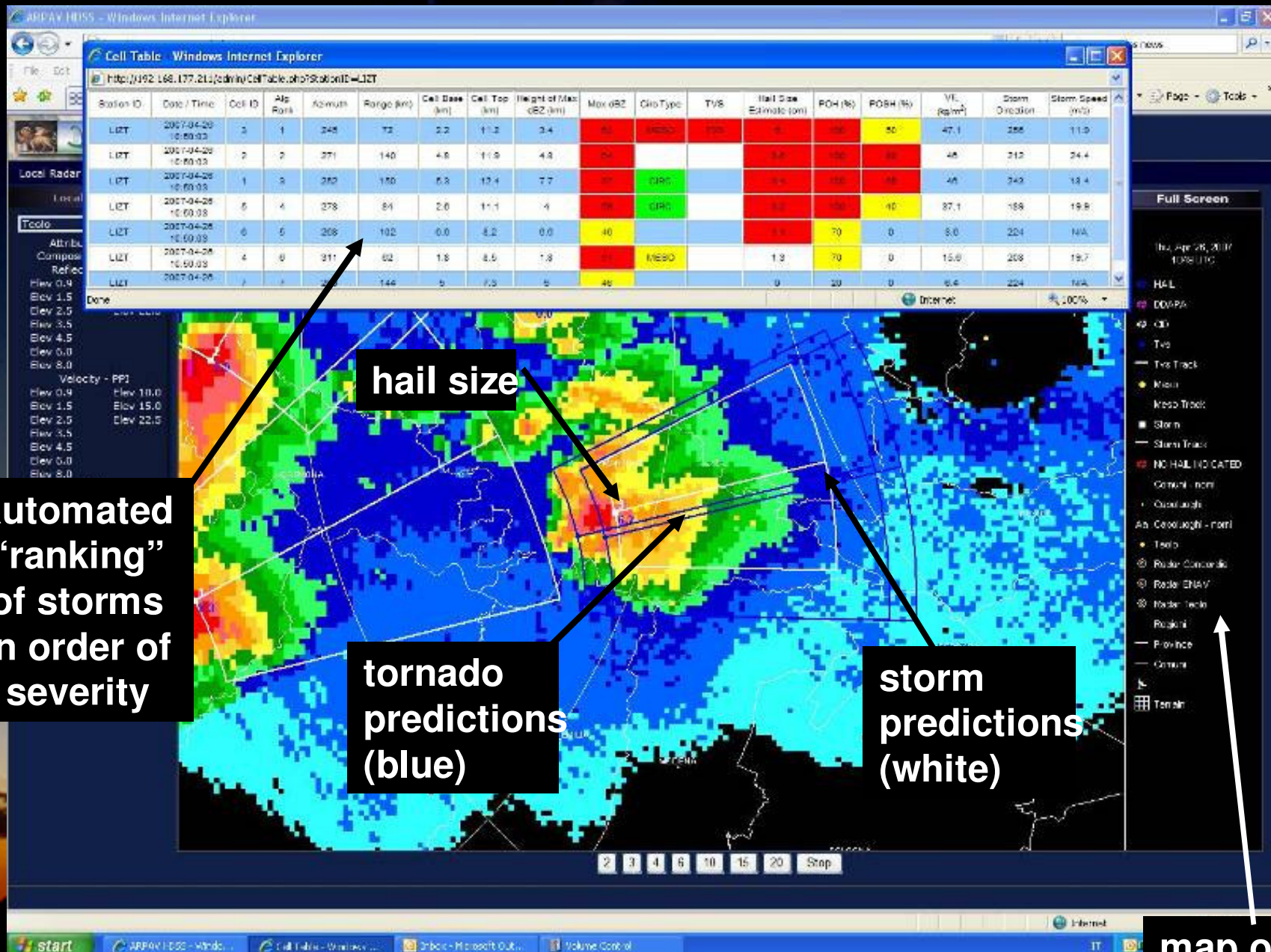
➤ Integrates Teolo, Lonco, ENAV radars, model, satellite, rain gauge data

➤ Can be accessed 24 hours a day through the internet

➤ Expandable to ingest a number of radars

➤ Can be customized for any location

Storm Alerts and Predictions



automated "ranking" of storms in order of severity

hail size

tornado predictions (blue)

storm predictions (white)

map options

Flash Flood Prediction

Basin map alerts

Basin table alerts

Basin Name	QPC-SUMS Output					Current			SWAPLE Forecast		
	20:55 T-1:45	21:55 T-1:20	22:55 T-1:00	23:25 T-30	23:40 T-15	23:55 T-0	00:10 T+15	02:35 T+30	00:55 T+60	01:55 T+120	02:55 T+180
Abano	3.4	3.4	1.9	1.1	0.5	2.0	3.0	5.0	9.4	12.0	23.0
AbanoMontebelluna	3.8	3.8	2.8	1.4	0.8	2.8	2.8	11.8	12.5	12.5	18.3
AbanoSantolucato	6.8	6.8	4.1	2.5	0.8	4.8	1.8	11.5	38.5	38.5	33.5
AbanoSantolucato	6.3	6.3	3.7	1.9	0.3	3.1	5.1	8.2	11.4	11.4	27.0
AbanoSantolucato	1.2	1.2	0.3	0.2	0.2	0.1	0.5	1.1	3.4	3.4	25.0
AbanoSantolucato	1.4	1.4	0.4	0.2	0.1	0.4	0.8	2.0	6.7	6.7	31.0
AbanoSantolucato	8.3	8.3	4.7	2.8	0.8	1.8	4.8	10.7	22.7	22.7	28.7
AbanoSantolucato	2.5	2.5	0.8	0.5	0.3	1.3	0.9	1.4	3.4	3.4	20.7
AbanoSantolucato	3.4	3.4	1.1	0.8	0.5	0.8	1.6	1.2	3.7	3.7	18.9
AbanoSantolucato	5.9	5.9	4.1	1.8	0.5	3.1	5.5	12.8	20.5	20.5	35.2
AbanoSantolucato	8.4	8.4	2.3	1.3	0.8	2.0	3.0	4.8	8.8	8.8	21.5
AbanoSantolucato	6.3	6.3	4.1	1.8	1.0	3.0	5.2	11.0	22.5	22.5	39.4
AbanoSantolucato	1.0	1.0	0.3	0.1	0.2	0.0	0.3	0.5	1.4	1.4	22.5
AbanoSantolucato	4.5	4.5	3.2	1.8	0.7	2.5	1.8	11.2	10.5	10.5	22.5
AbanoSantolucato	3.8	3.8	3.3	1.8	0.8	3.8	18.8	22.5	18.8	18.8	43.5
AbanoSantolucato	1.5	1.5	0.5	0.3	0.2	0.8	0.8	1.1	2.4	2.4	16.2
AbanoSantolucato	8.1	8.1	4.0	1.8	0.8	4.0	8.4	18.8	18.8	18.8	48.2
AbanoSantolucato	9.9	9.9	2.0	2.2	1.2	2.1	6.2	12.5	12.5	12.5	37.2

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Thunderstorms 2007, Abano

Examples of ARPAV Customer Pages

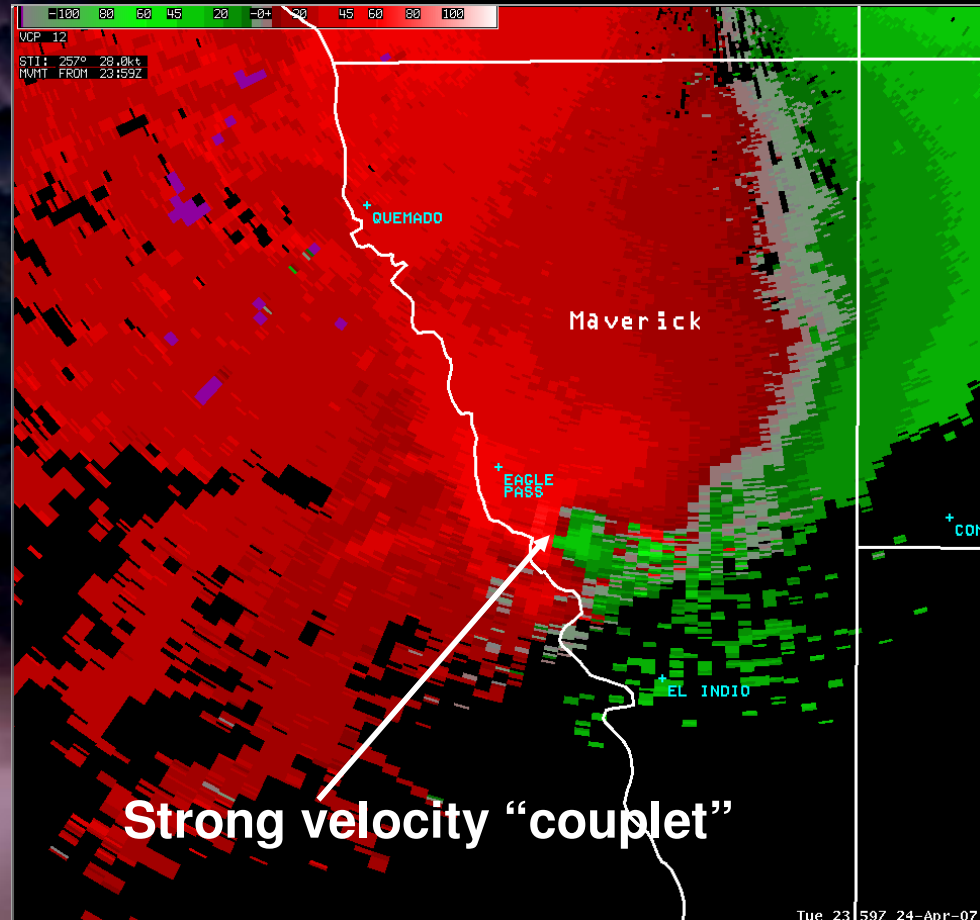
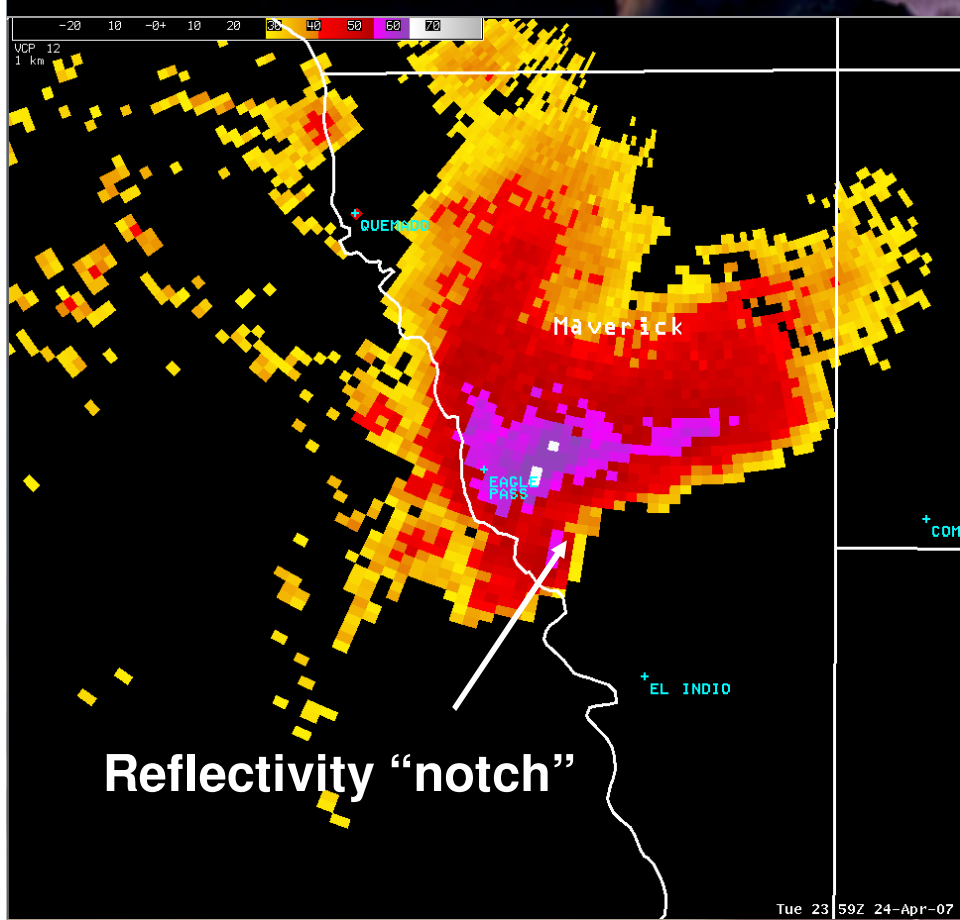


Future projects:

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

Texas Tornado Signature

(far range from the radar)

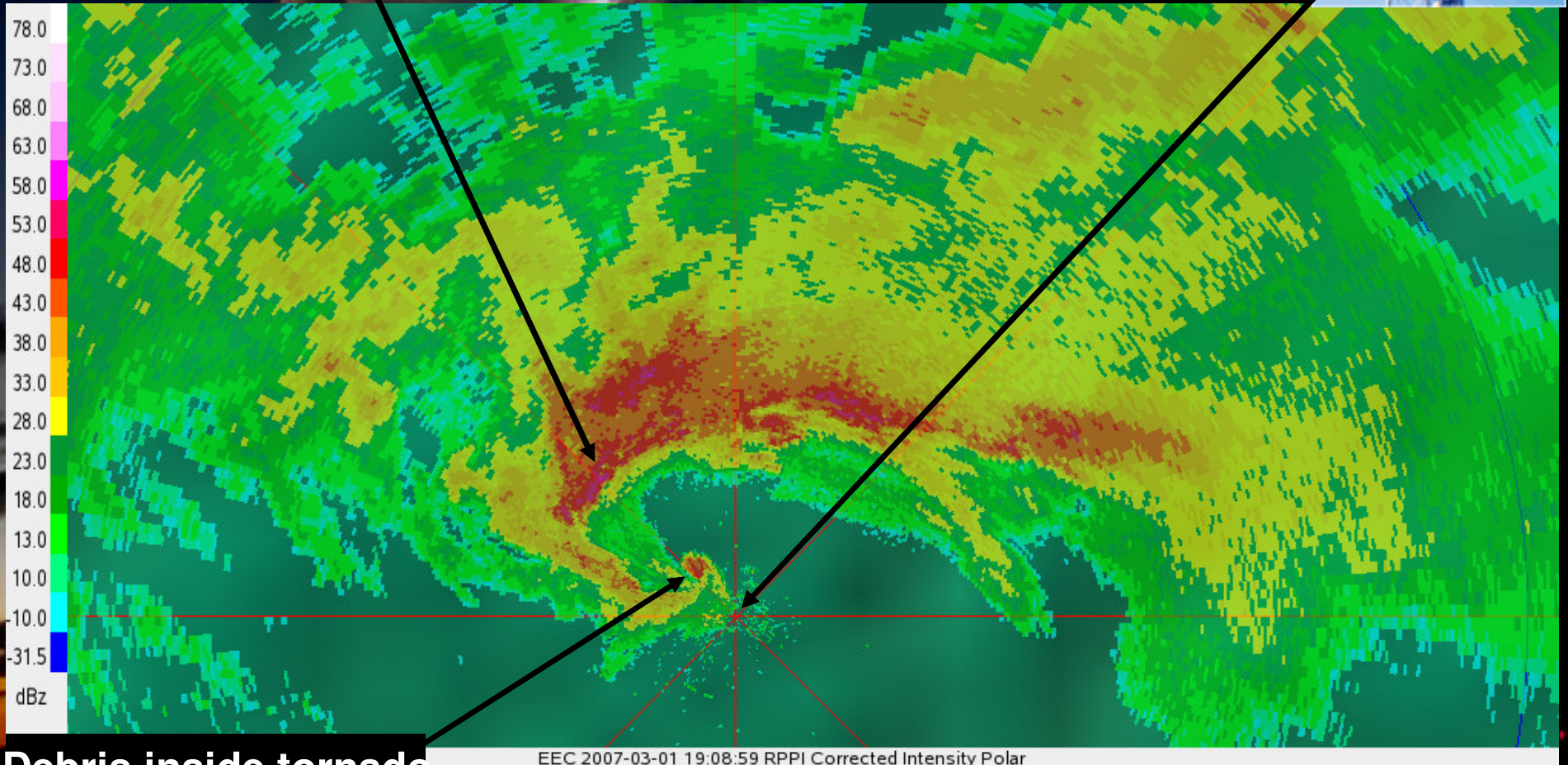


Very Close Range Tornado!

(Enterprise Radar Factory)



Reflectivity “hook echo”



Debris inside tornado

27 aprile

Thunderstorms 2007, Abano

Storm Prediction Center "Mesoscale Discussions"

NOAA's National Weather Service
Storm Prediction Center

Site Map News Organization

Local forecast by "City, St" or "ZIP"
City, St Go

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Mesoscale Discussion 525

< Previous MD Next MD >

TORNADO WATCHES LIKELY ACROSS THESE AREAS NEXT HOUR.

SPC HCD #0525

MESOSCALE DISCUSSION 0525
NWS STORM PREDICTION CENTER NORMAN OK
0244 PM CDT SAT APR 21 2007

AREAS AFFECTED...ERN CO...WRN KS...TX/OK BHDLs...ERN NM/WRN TX

CONCERNING...SEVERE POTENTIAL...TORNADO WATCH LIKELY

VALID 211944Z - 212115Z

TSTMS ARE EXPECTED TO FORM AND INCREASE ACROSS THE HIGH PLAINS OF ERN NM/ERN CO OVER THE NEXT FEW HOURS. THIS ACTIVITY WILL THEN DEVELOP EAST AND INTO AN INCREASINGLY FAVORABLE ENVIRONMENT FOR HIGH-BASED SUPERCELLS...AND POSSIBLY TORNADOES. WATCHES WILL BE ISSUED SHORTLY FOR PARTS OF ERN NM/CO...EWD INTO PORTIONS OF WRN TX/OK/KS.

- Within the outlook areas (previous slide) there are small scale analysis to determine which type of "watch" to issue

