# New EC Research Initiatives in the Great Lakes Region

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**+**

***Nowcasting and Remote Sensing Meteorology (NoRM) Lab***

Photo: Jonathan Ponce

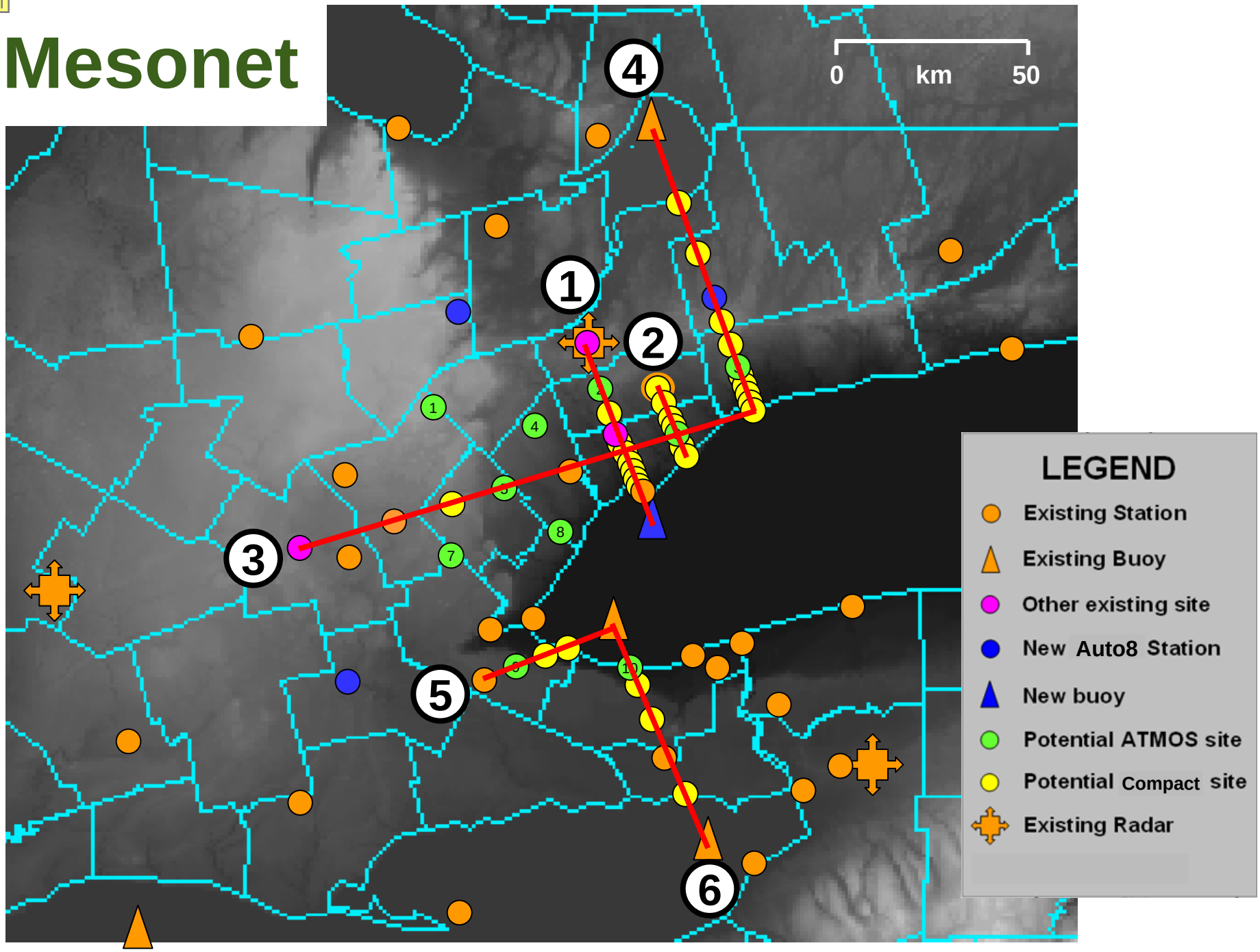
# Outline

- 2015 Pan / ParaPan American Games
  - Quick Overview
- Research ‘Showcase’ Activities
  - Mesonet / NWP
  - Lightning
  - Next Generation Weather Office Demo
- EF-scale at EC
  - if time

# 2015 Pan / ParaPan Am Games

- To take place in the ‘Greater Golden Horseshoe’ region surrounding Toronto Jul-Aug 2015
- More outdoors venues and athletes than the Olympic Games
- EC operations will provide enhanced safety and security services
    - e.g., point-based warnings for venues
- Also several related ‘showcase’ research initiatives…

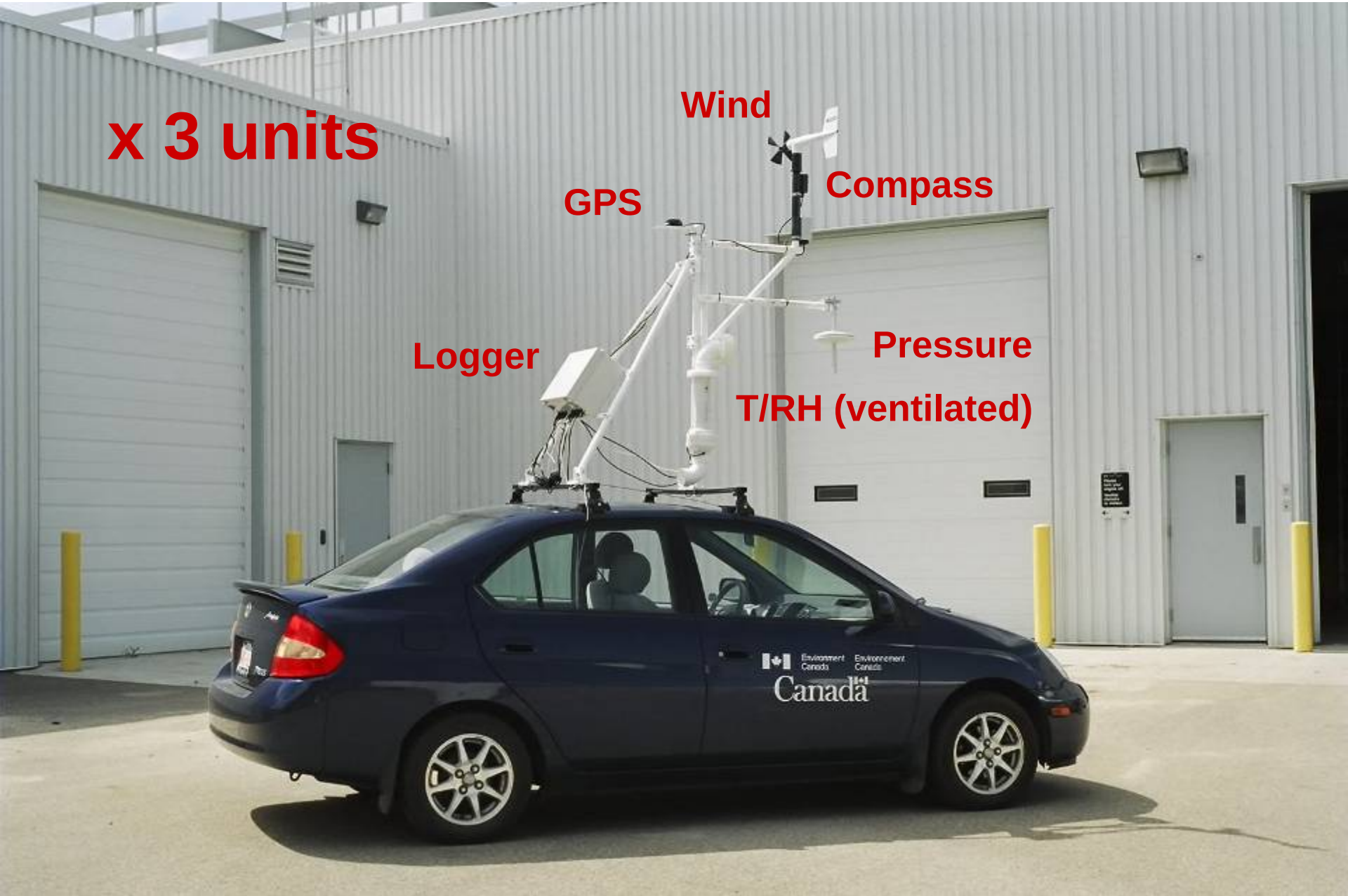
# Mesonet

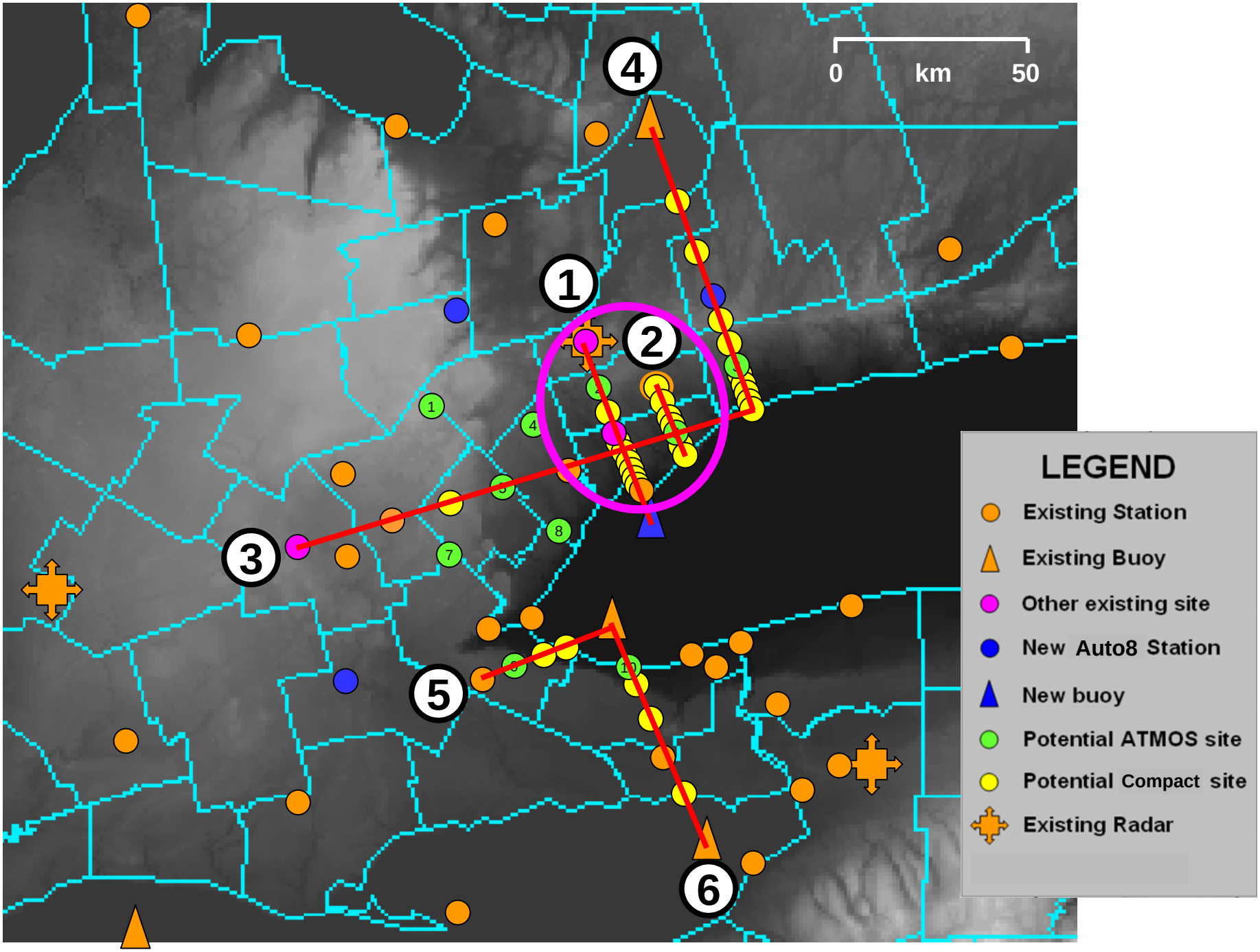

0
km
50
1
2
3
4
5
6
LEGEND
Existing Station
Existing Buoy
Other existing site
New Auto8 Station
New buoy
Potential ATMOS site
Potential Compact site
Existing Radar

# EC *ATMOS* Surface Mesonet Stations

x 10 units

# EC *AMMOS* Mobile Mesonet Stations

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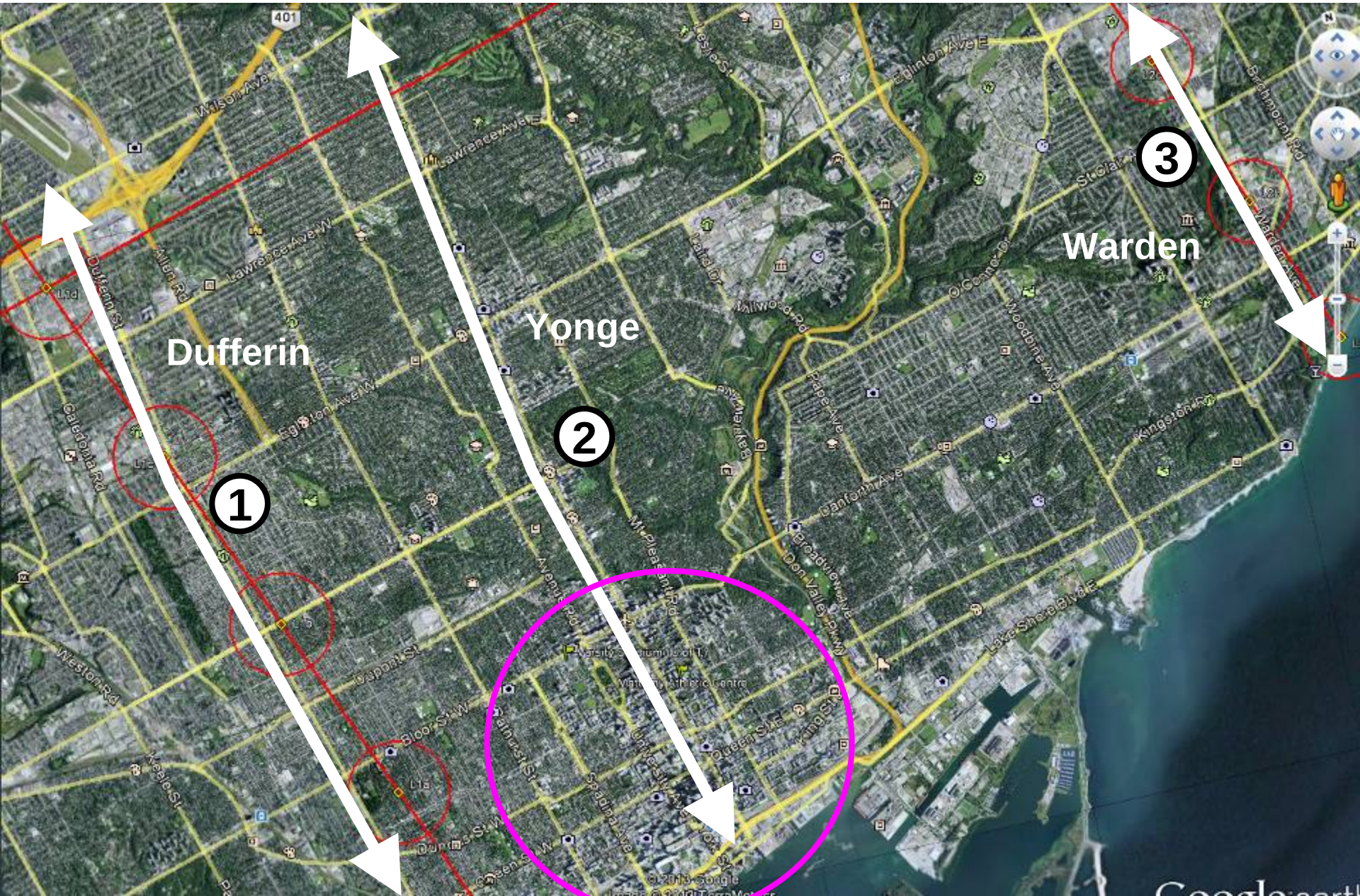
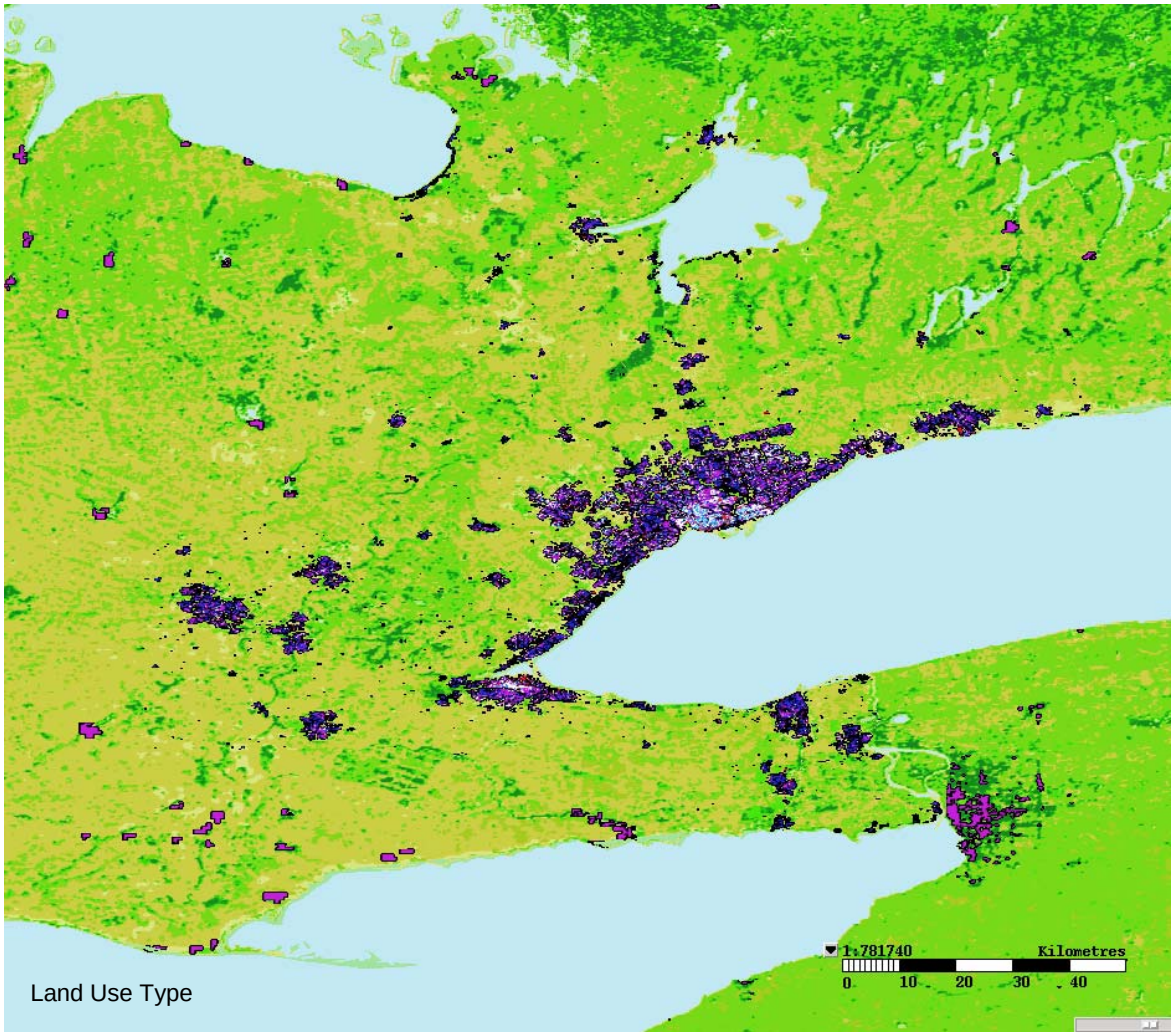


# Ultra High-Resolution NWP



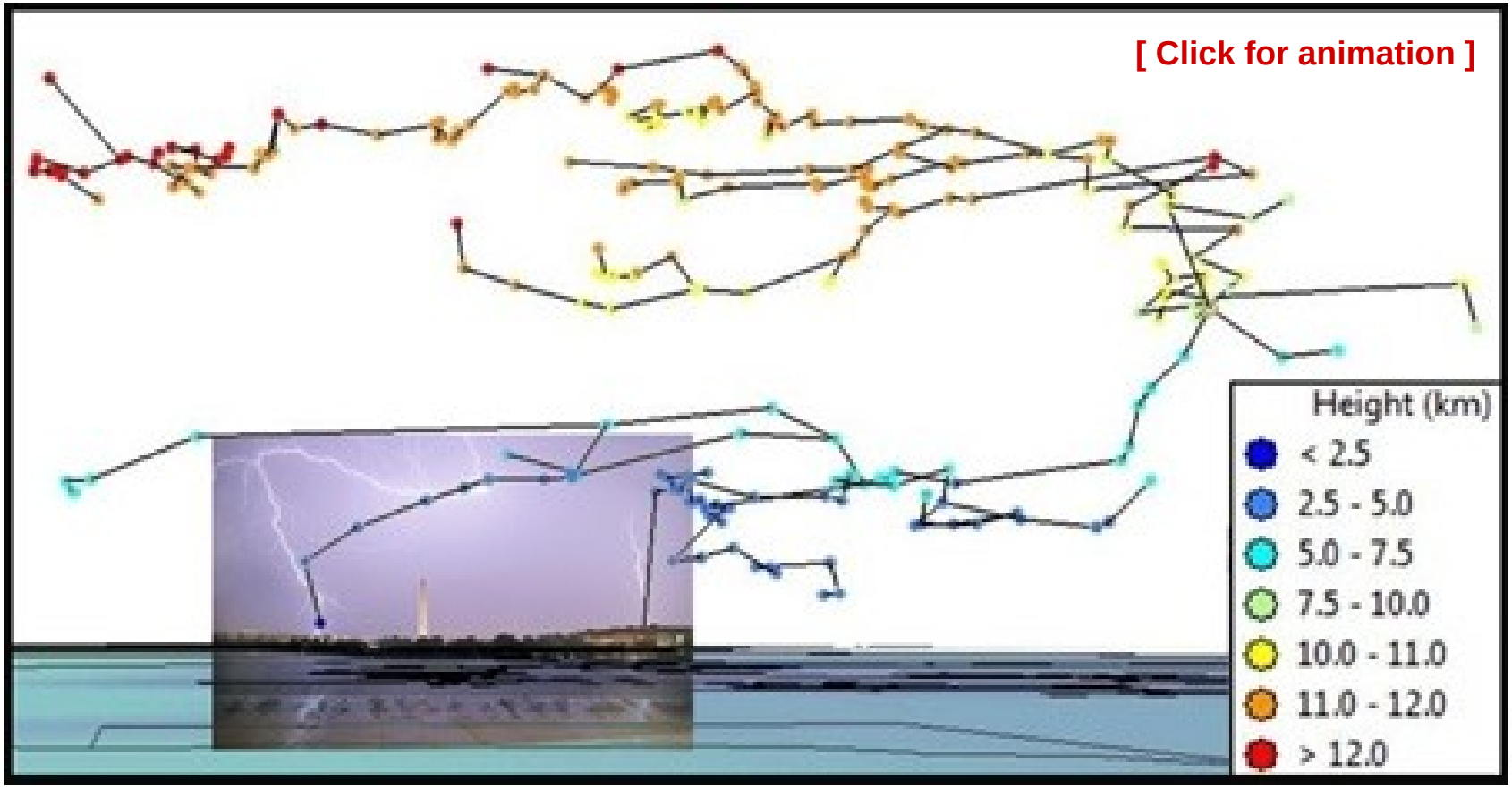

- 250m grid spacing computational domain
- About 800x800 (200km x 200km)
- Integrated four times per day
- 24h integrations

# Lightning Mapping Array

- Lightning mapping array (LMA) being acquired by EC from New Mexico Tech
- Will give 3D coverage over all of GTA, 2D coverage over most of south-central Ontario
- Research system – will be deployed 2014-2018 (covering Pan Am Games period)
- IC lightning should give lead time on first CG
- Total lightning trends are closely associated with updraft strength – anticipate better lead times for severe weather warnings

# Lightning Mapping Array

- New Mexico Tech LMAs have been installed in several US locations (e.g. Washington D.C.) – Toronto will be first in Canada



# Next Gen Wx Office Demo

**MSC 'Signature Projects' require:**

- New forecasting, nowcasting and alerting tools that facilitate the best application of human skills and enable optimal use of technological progress to improve detection and prediction
- To better define exactly how forecasters will use these new tools during a shift ('Concept of Operations') to ensure effective interaction with the forecast database
- To improve efficiency via automated product generation
- New watch/warning products and dissemination approaches to provide improved, more impact-based decision support to Canadians and to public authorities
- To integrate wherever possible with MSC NinJo Workstation

# Objectives

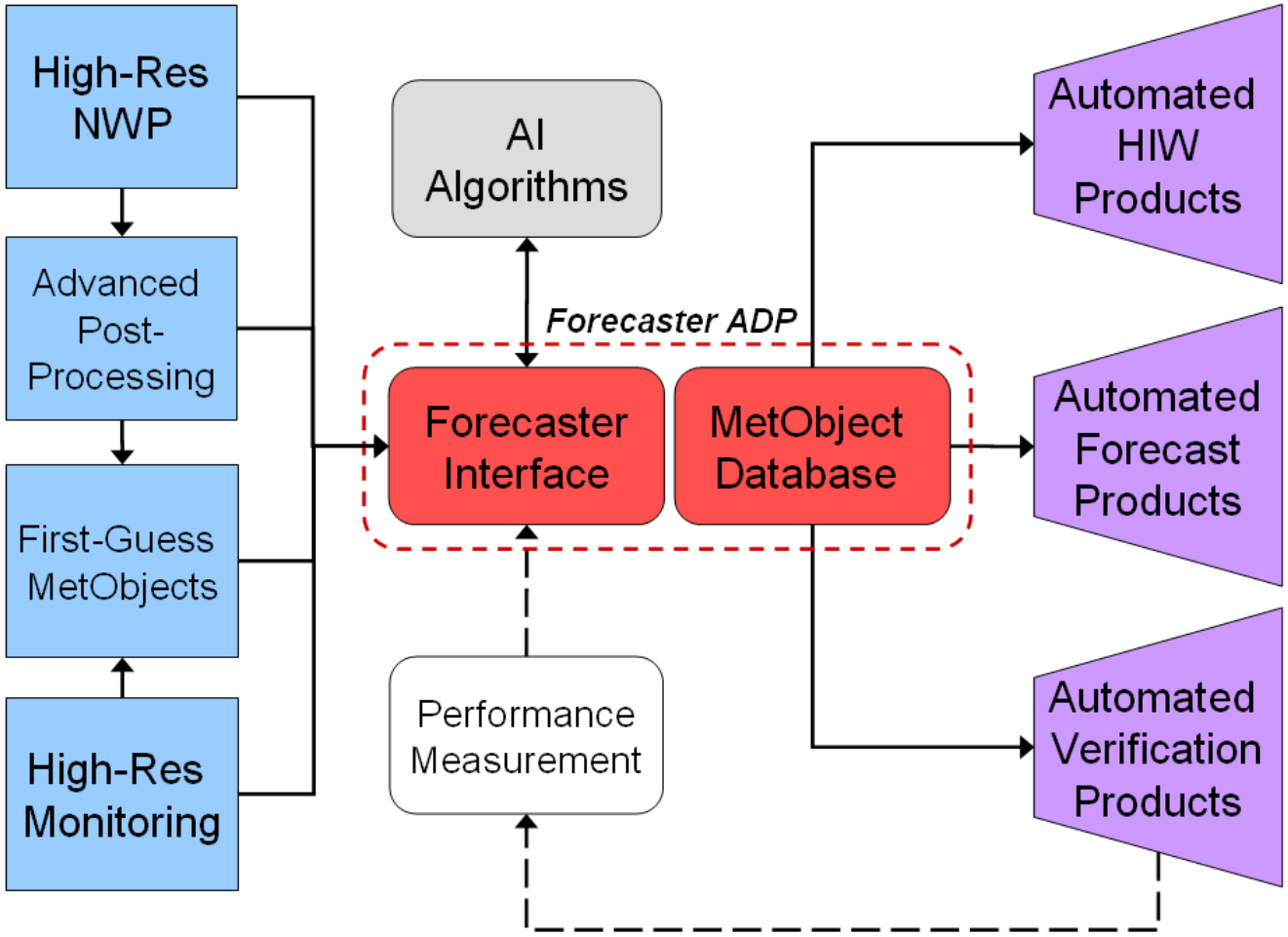
**For the Next Generation Forecast and Warning Process Demonstration Project:**

- Demonstrate an event-based, multi-scale (spatial and temporal) approach to forecasting, nowcasting and alerting focused on warm season mesoscale features and high-impact weather
- Demonstrate how MetObjects facilitate forecaster interaction with high-resolution forecast databases and enhance forecaster analysis / diagnosis / prognosis (ADP)
- Demonstrate the potential for increased efficiencies via the automated generation of a wide variety of cutting-edge products from the MetObject database

# What exactly are ‘MetObjects’?

- MetObjects can be used to greatly simplify complex weather features
- Can use points, lines, areas, tracks to represent storm cells, fronts / jets, threat areas, storm tracks
- Enables ‘knowledge representation’ in a digital database using conceptual models as building blocks
- Very intuitive for forecasters, able to use extensive library of conceptual models: enhances analysis / diagnosis / prognosis process

# Nex Gen Prediction Process



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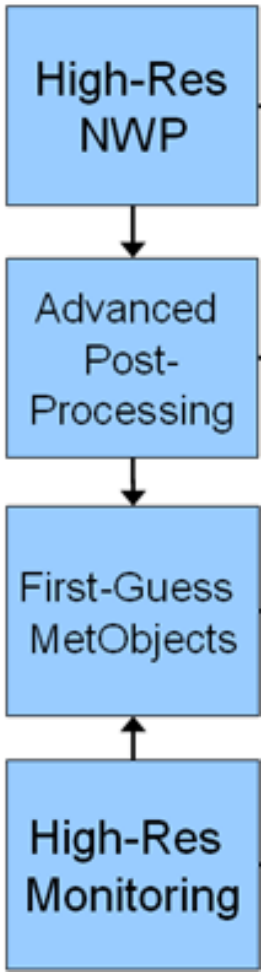
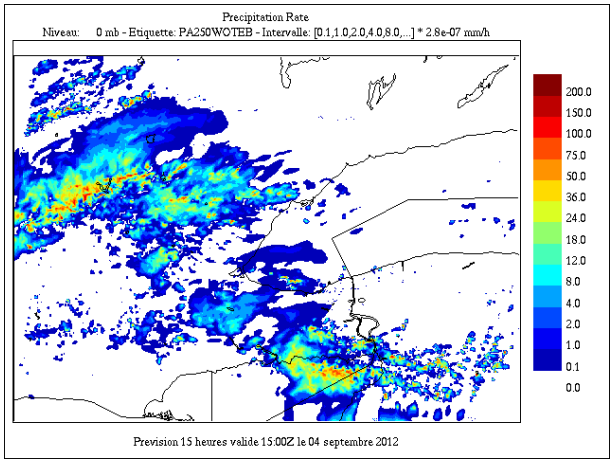
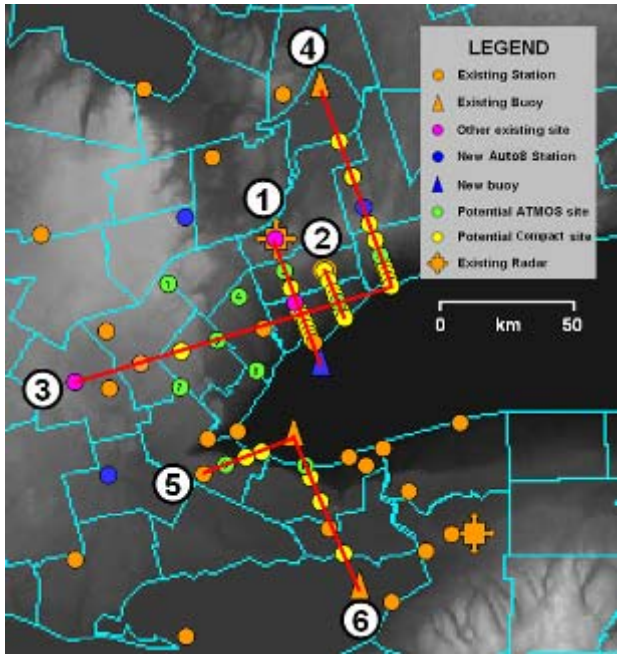


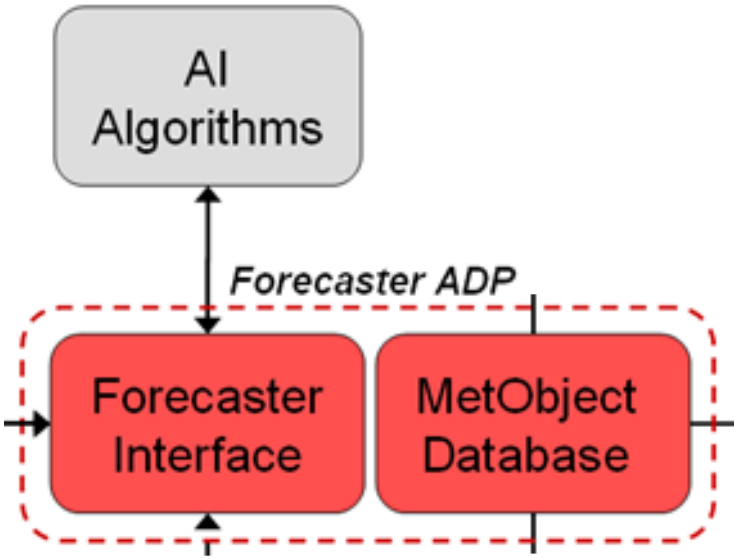



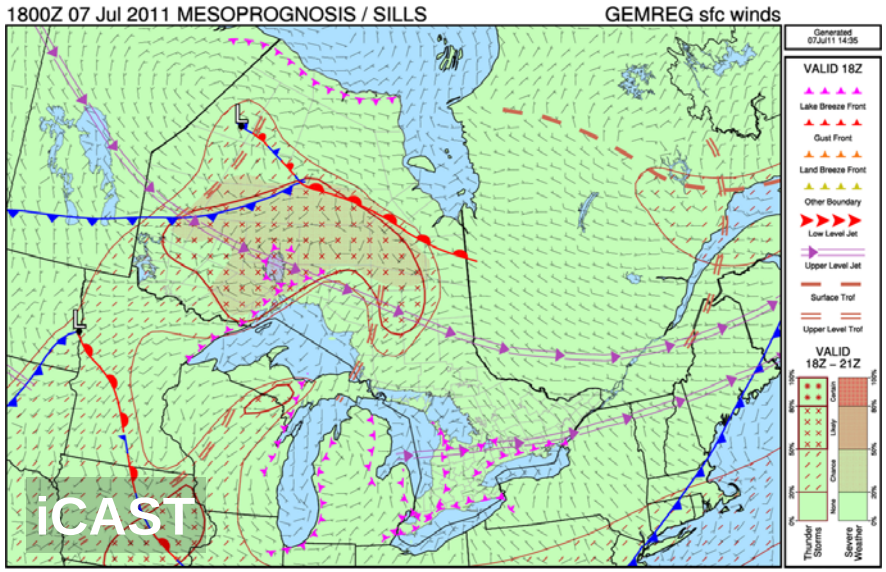

- 250 m HRDPS

- 60 Station Mesonet
- Satellite
- Radar
- Lightning



# Synoptic / Mesoscale

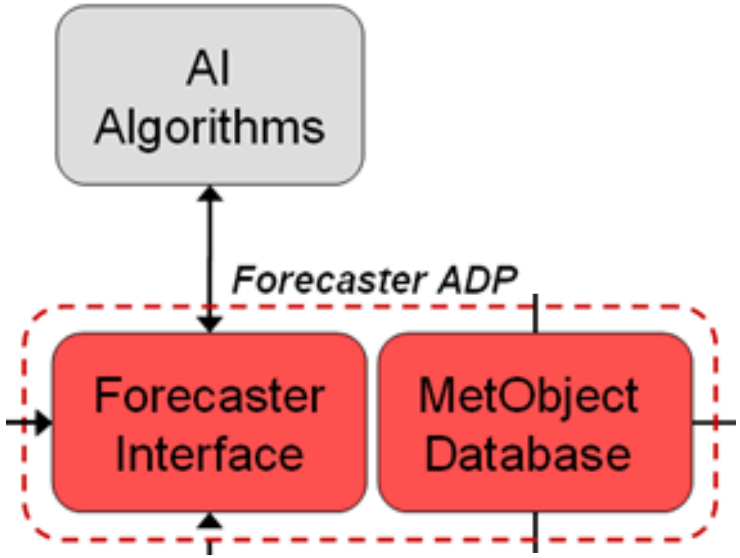


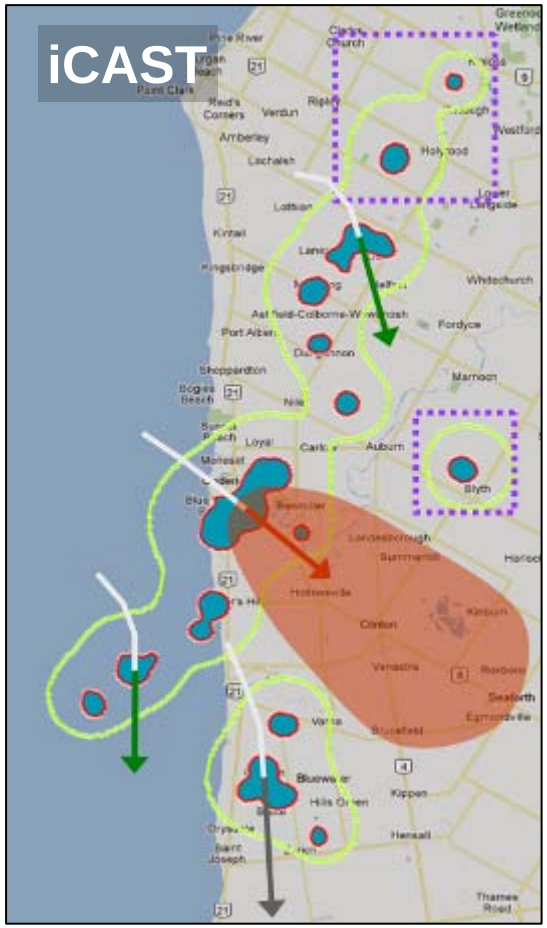




MetObject depictions:

- Synoptic-scale and mesoscale features important for convection based on observations, NWP, conceptual models, etc.
- Probabilistic areas for thunderstorm likelihood and severity
- Series of depictions from T0 (analysis) to T0+48

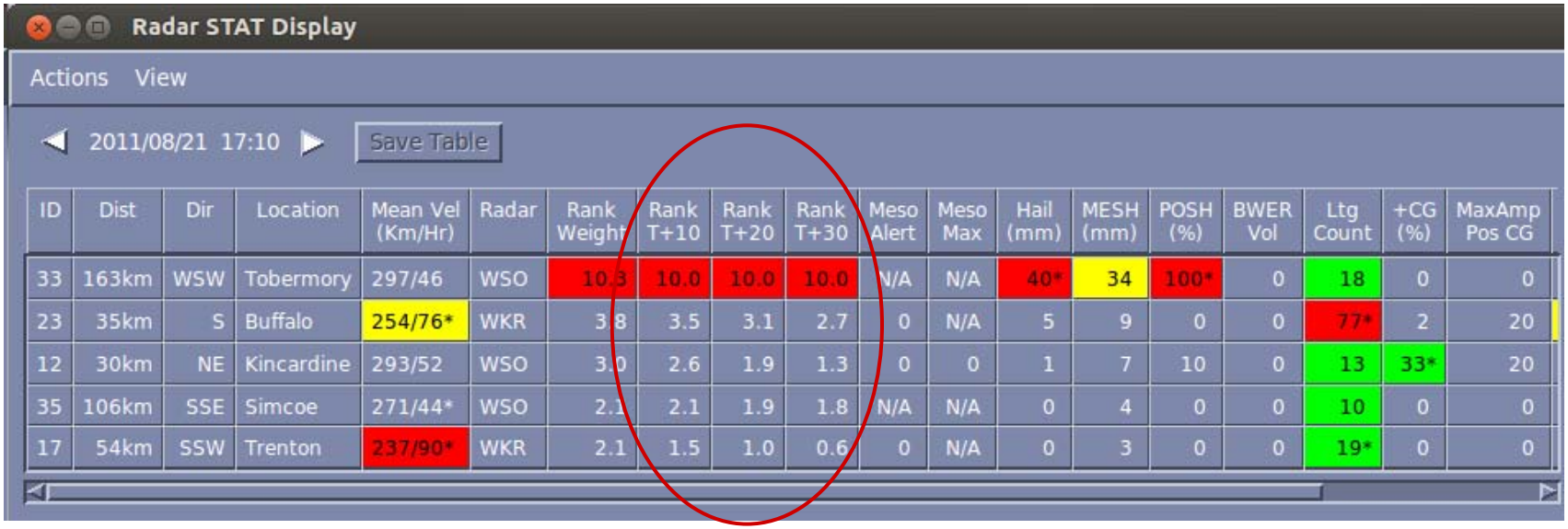
# Storm-Scale




- New approach to severe thunderstorm nowcasting and alerting
- Forecaster manages track MetObjects / intensity trends for significant storms
- Alerts derived from MetObjects

# Storm-Scale




| ID | Dist | Dir | Location | Mean Vel (Km/Hr) | Radar | Rank Weight | Rank T+10 | Rank T+20 | Rank T+30 | Meso Alert | Meso Max | Hail (mm) | MESH (mm) | POSH (%) | BWER Vol | Ltg Count | +CG (%) | MaxAmp Pos CG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33 | 163km | WSW | Tobermory | 297/46 | WSO | 10.3 | 10.0 | 10.0 | 10.0 | N/A | N/A | 40* | 34 | 100* | 0 | 18 | 0 | 0 |
| 23 | 35km | S | Buffalo | 254/76* | WKR | 3.8 | 3.5 | 3.1 | 2.7 | 0 | N/A | 5 | 9 | 0 | 0 | 77* | 2 | 20 |
| 12 | 30km | NE | Kincardine | 293/52 | WSO | 3.0 | 2.6 | 1.9 | 1.3 | 0 | 0 | 1 | 7 | 10 | 0 | 13 | 33* | 20 |
| 35 | 106km | SSE | Simcoe | 271/44* | WSO | 2.1 | 2.1 | 1.9 | 1.8 | N/A | N/A | 0 | 4 | 0 | 0 | 10 | 0 | 0 |
| 17 | 54km | SSW | Trenton | 237/90* | WKR | 2.1 | 1.5 | 1.0 | 0.6 | 0 | N/A | 0 | 3 | 0 | 0 | 19* | 0 | 0 |

- Developing an interactive Storm Attributes Table
- Provides an extrapolated composite ‘rank weight’
- Can turn off / modify parameter values then recalculate rank and intensity trend

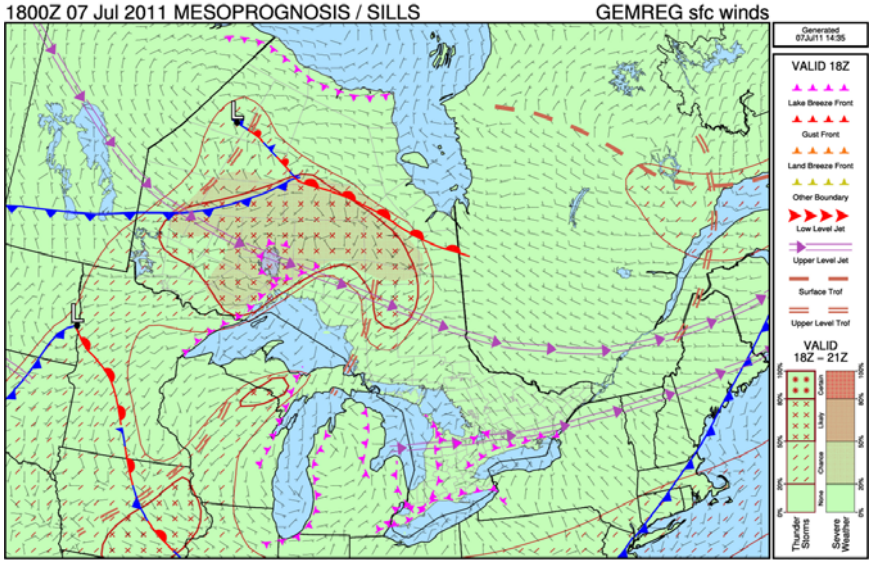
# Product Generation

Automated HIW Products

Automated Forecast Products

Automated Verification Products

Probabilistic
Thunderstorm
Nowcast



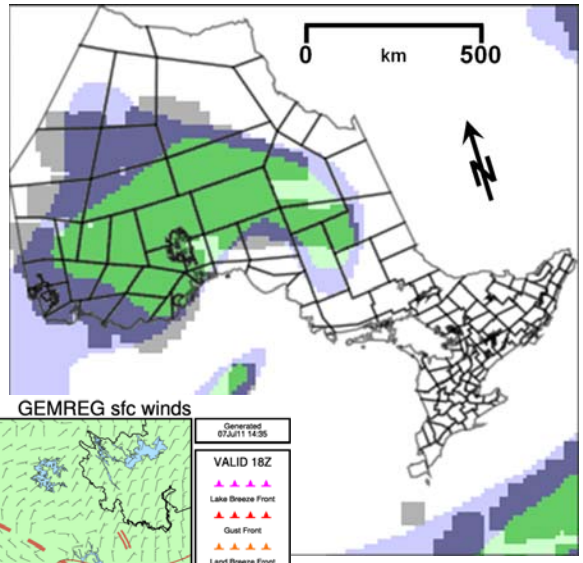
# Product Generation

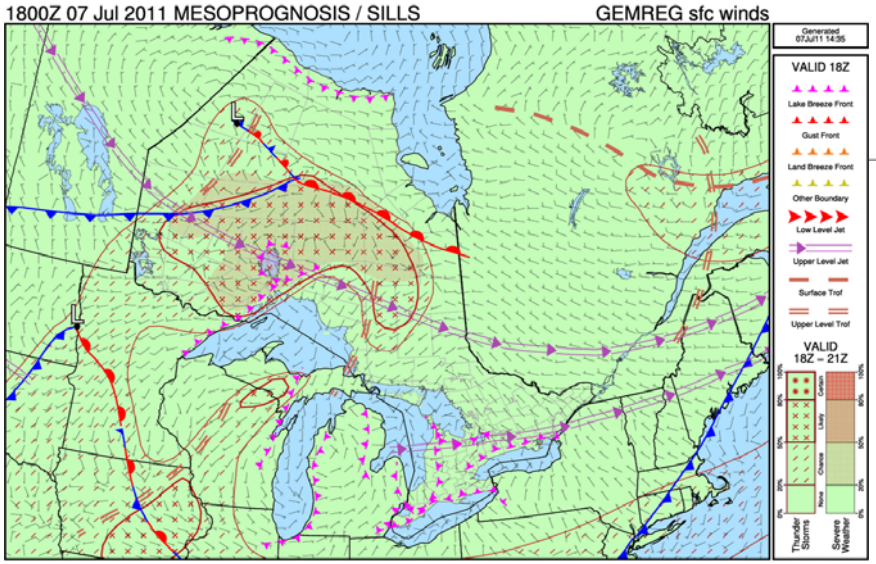
Automated HIW Products

Automated Forecast Products

Automated Verification Products

Verification Using Lightning Obs



# Product Generation

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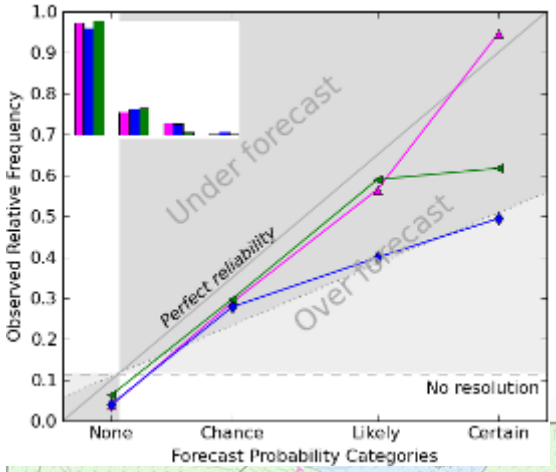
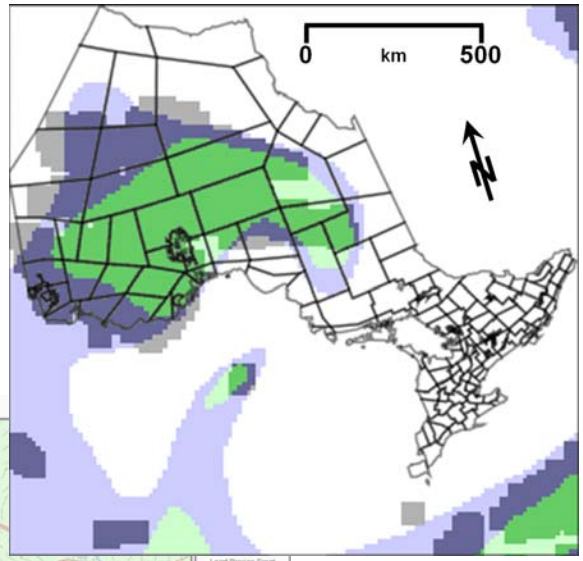
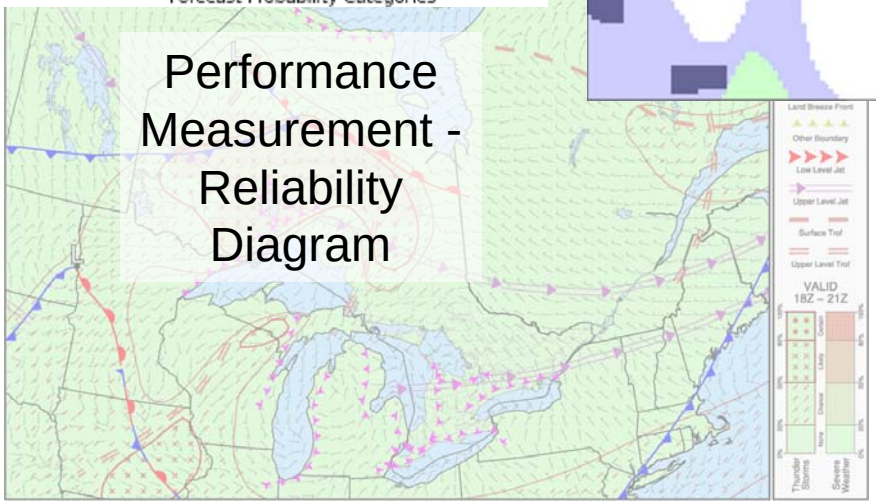
Automated Forecast Products

Automated Verification Products



Performance Measurement - Reliability Diagram

# Product Generation

Automated HIW Products

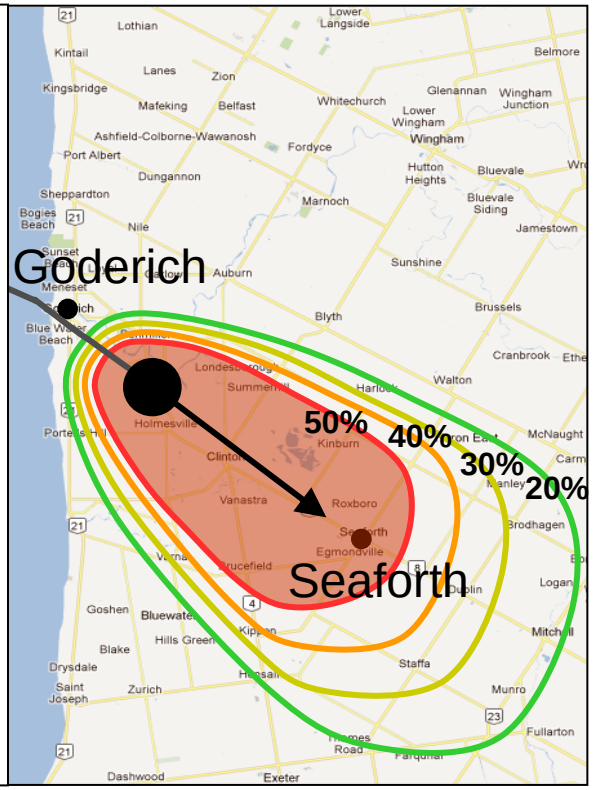
Automated Forecast Products

Automated Verification Products

**SEVERE THUNDERSTORM WARNING FROM ENVIRONMENT CANADA AT 7:10 PM EDT THURSDAY 28 JULY 2012.**

**SEVERE THUNDERSTORM WARNING FOR:**
**=NEW= GODERICH – BLUEWATER – SOUTHERN HURON COUNTY**

**A SEVERE THUNDERSTORM PRODUCING LARGE HAIL, DAMAGING WINDS AND HEAVY RAIN 10 KM SOUTHEAST OF GODERICH IS MOVING SOUTHEAST AT 40 KM/H. THIS STORM IS EXPECTED TO REACH SEAFORTH AT 8:05 PM EDT.**



# Implementation

Dual ‘Research Support Desks’ in OSPC ‘Pan Am Area’:

- RSD1 – Graphical prognoses and outlooks for thunderstorms / severe weather derived from the MetObject forecast database
- RSD2 – Graphical mesoscale analyses, storm-scale nowcasts, and severe weather threat areas derived from the MetObject nowcast database
- Real-time demonstration!

# Anticipated Benefits

- Forecasters focus on meteorology, not the details of product generation – *better situational awareness*
- Automated generation of many products from forecaster-modified database – *greater efficiency*
- Enhances ability to employ conceptual models – *better use of extensive forecaster training*
- Products with more precision, greater utility, longer lead times
- Can use new and emerging object-based verification to provide near real-time feedback

# Enhanced Fujita Scale @ EC

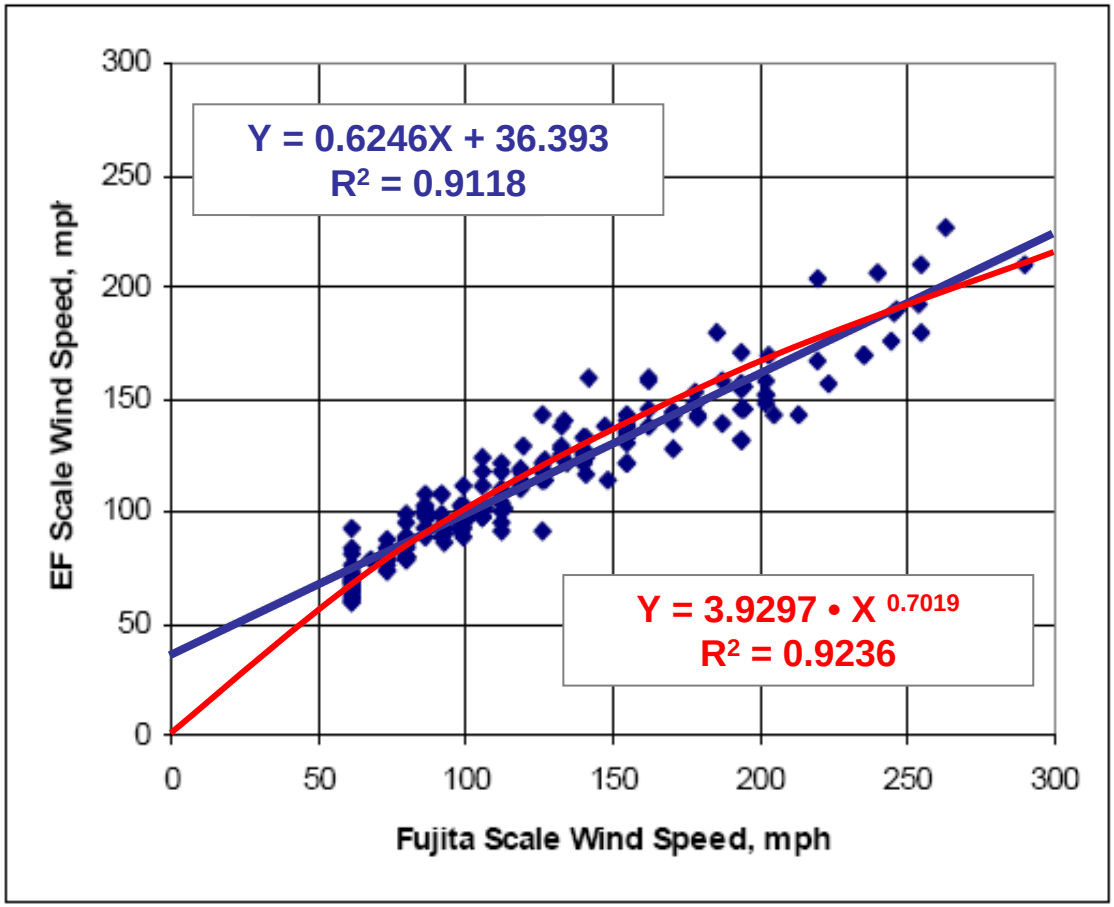
| F/EF Rating | F-Scale Wind Speed Rounded to 10 km/h | EF-Scale Wind Speed Rounded to 5 km/h |
|---|---|---|
| 0 | 60 – 110 | 90 – 130 |
| 1 | 120 – 170 | 135 – 175 |
| 2 | 180 – 240 | 180 – 220 |
| 3 | 250 – 320 | 225 – 265 |
| 4 | 330 – 410 | 270 – 310 |
| 5 | 420 – 510 | 315 or more |

- **Main difference is wind speed relationship**

# Speed Scale Adjustment

If *power law* regression used instead of *linear* :

- better fit
- goes through origin
- lower bound of EF0 becomes ~90 km/h instead of 105 km/h




After McDonald and Mehta (2006)

# 31 Damage Indicators

| Number | Damage Indicator (DI) |
|---|---|
| 1 | Small Barns or Farm Outbuildings (SBO) |
| 2 | One- or Two-Family Residences (FR12) |
| 3 | Manufactured Home: Single Wide (MHSW) |
| 4 | Manufactured Home: Double Wide (MHDW) |
| 5 | Apartments, Condos, Townhouses (ACT) |
| 6 | Motel (M) |
| 7 | Masonry Apartment or Motel (MAM) |
| 8 | Small Retail Building (SRB) |
| 9 | Small Professional Building (SPB) |
| 10 | Strip Mall (SM) |
| 11 | Large Shopping Mall (LSM) |
| 12 | Large, Isolated Retail Building (LIRB) |
| 13 | Automobile Showroom (ASR) |
| 14 | Automobile Service Building (ASB) |
| 15 | Elementary School (ES) |
| 16 | Junior or Senior High School (JHSH) |
| 17 | Low-Rise Building: 1 - 4 Storeys (LRB) |
| 18 | Mid-Rise Building: 5 - 20 Storeys (MRB) |
| 19 | High-Rise Building: Greater than 20 Storeys (HRB) |
| 20 | Institutional Building (IB) |
| 21 | Metal Building System (MBS) |
| 22 | Service Station Canopy (SSC) |
| 23 | Warehouse Building (WHB) |
| 25 | Free-Standing Towers (FST) |
| 26 | Free-Standing Light Poles, Luminary Poles, Flag Poles (FSP) |
| C1 | Electrical Transmission Lines (ETL) |
| C2 | Trees (T) |
| C3 | Heritage Church (HC) |
| C4 | Solid Masonry House (SMH) |
| C5 | Farm Silos or Grain Bins |
| C6 | Sheds, Fences or Lawn Furniture (SFLF) |

Farms / Residences

Commercial / retail structures

Schools

Professional buildings

Metal buildings / canopies

Towers / poles

Canadian DIs!

# Acknowledgments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