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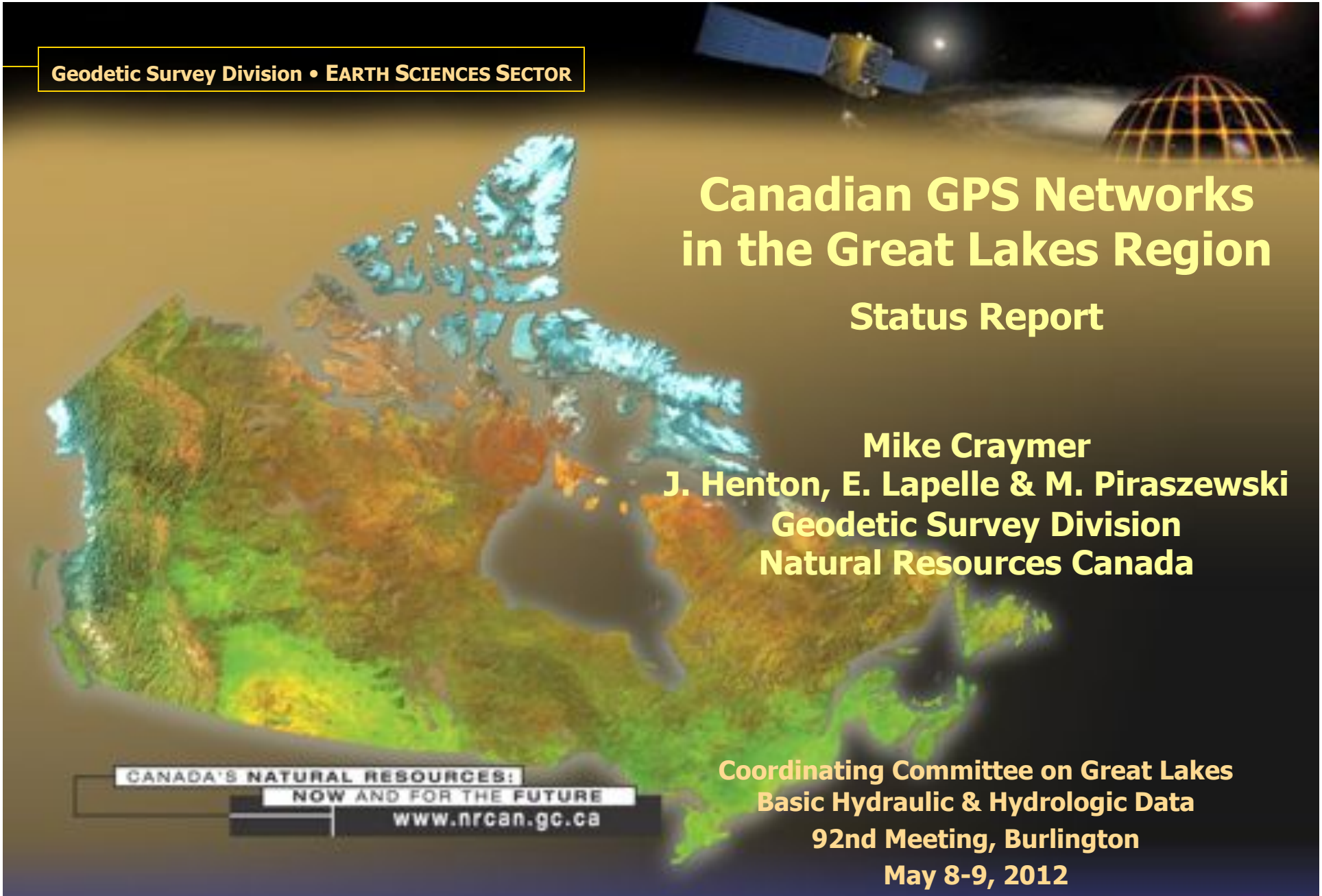

Canadian GPS Networks in the Great Lakes Region

Status Report

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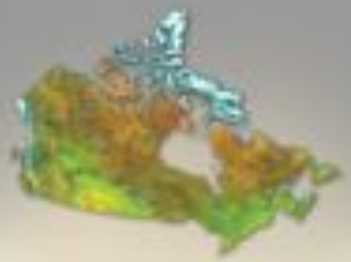
Geodetic Survey Division
Natural Resources Canada

Coordinating Committee on Great Lakes Basic Hydraulic & Hydrologic Data
92nd Meeting, Burlington
May 8-9, 2012

Natural Resources Canada | Ressources naturelles Canada

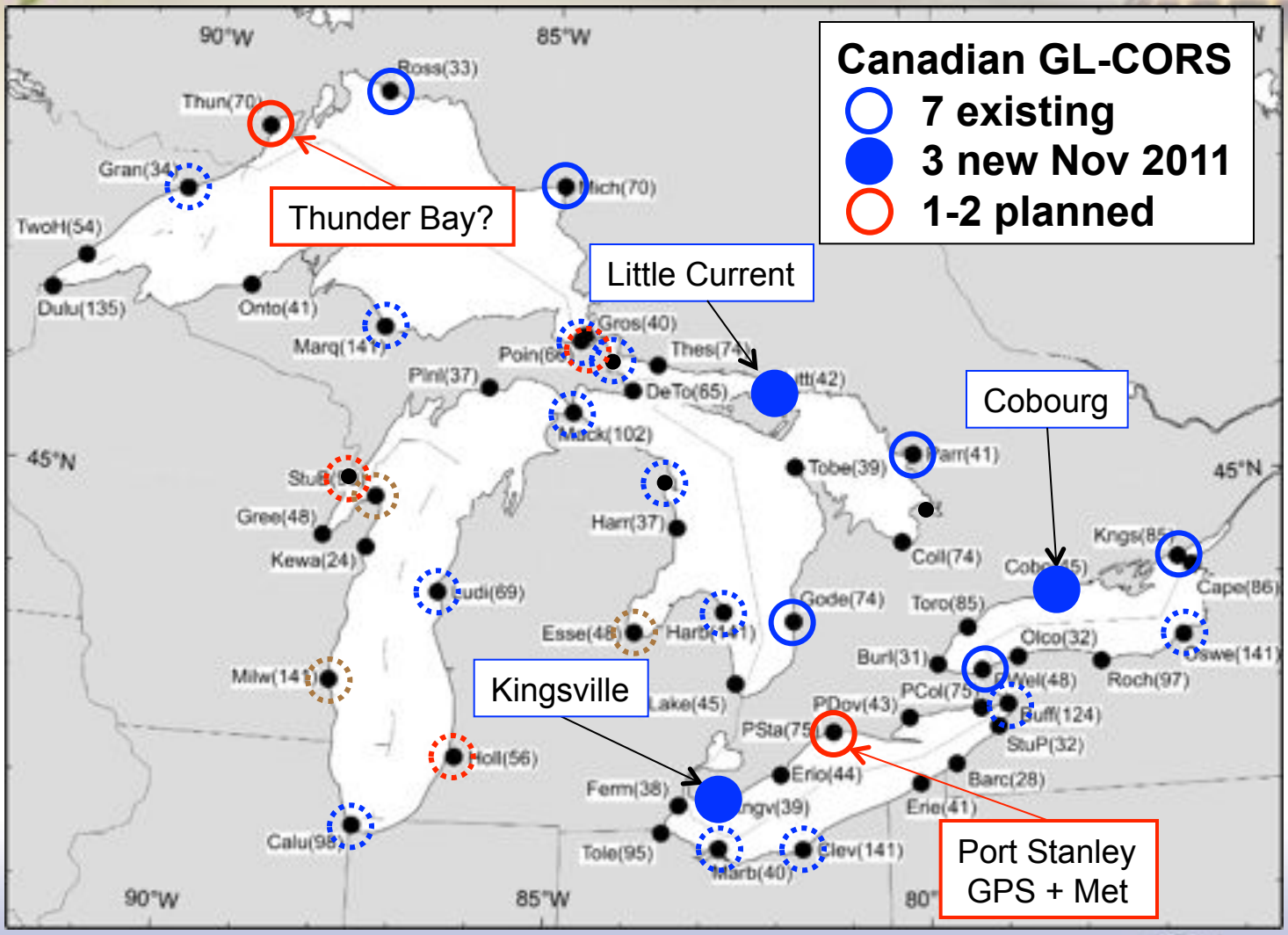
Canada

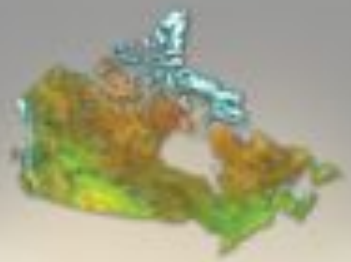


Outline

- **Status of Canadian CORS at Water Gauges**
- **GPS Roof Multipath Test – Final Results**
- **Reprocessed GPS Velocity Field**
- **Reprocessed IGLD GPS Survey Results**

CORS at Water Gauges





Roof Multipath Tests

- **Most CORS antennas located above a gauge building roof**
- **Possibility of biases from signal multipath off metal roofs**
- **Performed controlled tests of multipath**
  - Constructed different roofs over a pillar at GSD's antenna test site
    - Bare metal (PWEL)
    - Rocks (5-10 cm size) on metal (ROSS)
    - Crushed stone on metal
    - Tar paper on metal (PARY)
    - Low-pitched wood shingled roof (GODR)
  - Compared position results to that for no roof
  - Preliminary results with PPP reported at Nov 2011 meeting
  - Final results with Bernese Software – much more accurate

Roof Types

Bare Metal

Rocks on Metal

Crushed Stone on Metal
(also extended 1m higher)

Bare Metal – Flush

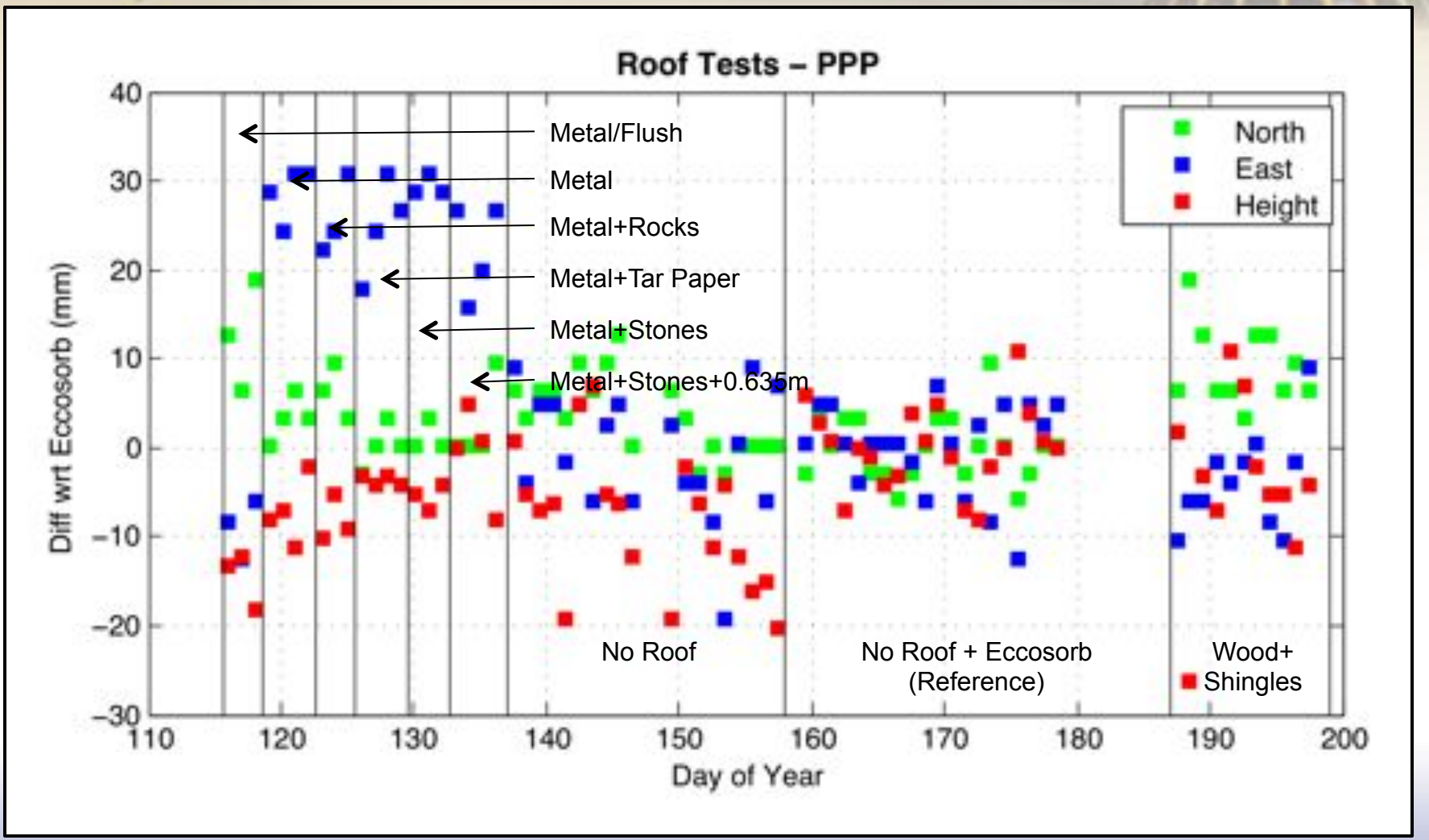
Roof Types

Shingled Wood Roof

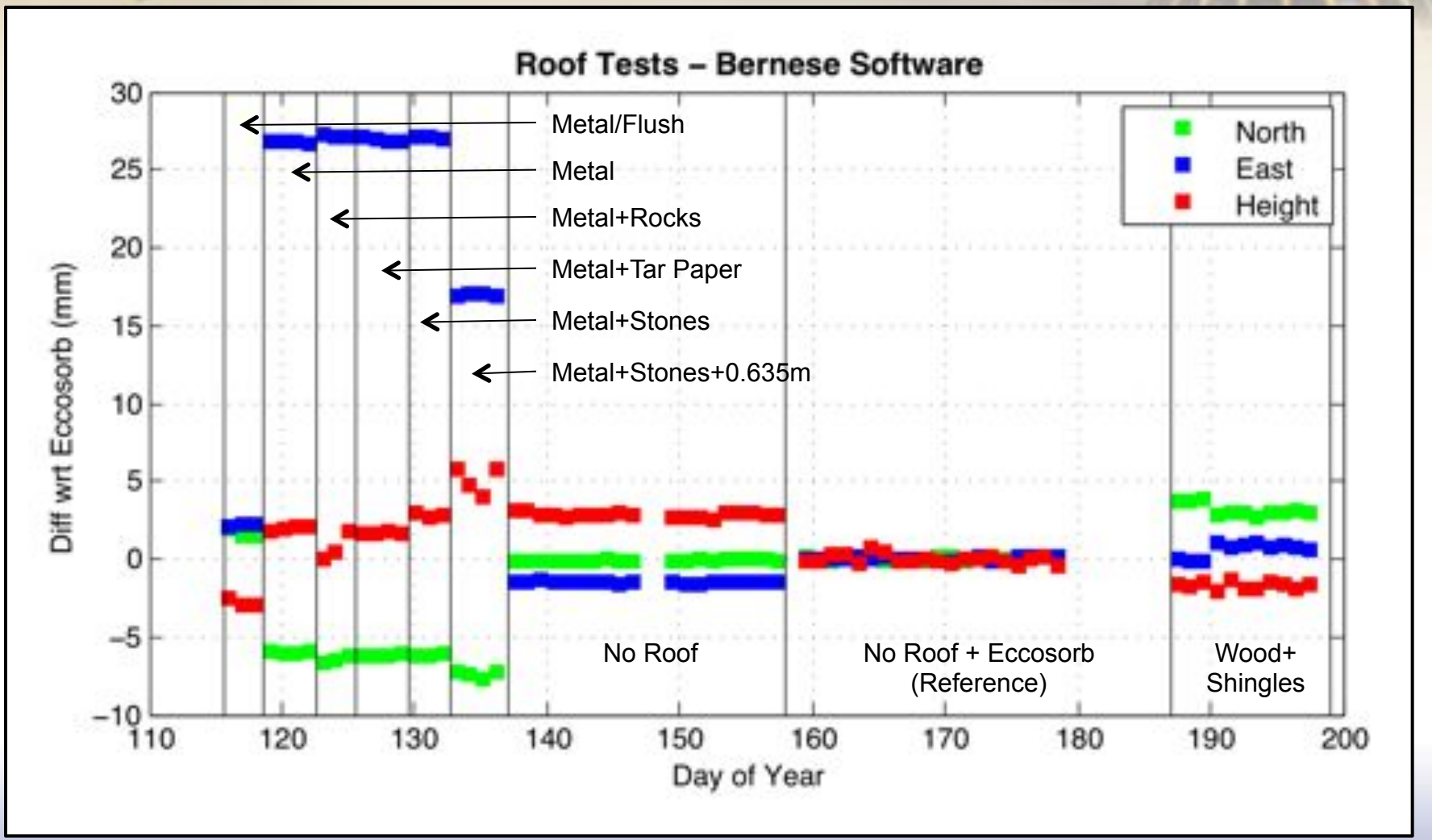
No Roof

No Roof + Eccosorb (absorbs multipath)

PPP Results

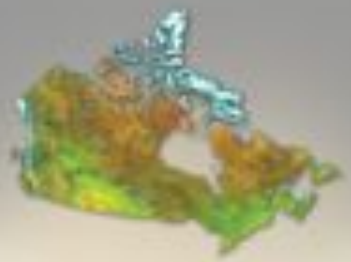

Roof Tests – PPP
Diff wrt Eccosorb (mm)
Day of Year
Metal/Flush
Metal
Metal+Rocks
Metal+Tar Paper
Metal+Stones
Metal+Stones+0.635m
North
East
Height
No Roof
No Roof + Eccosorb
(Reference)
Wood+
Shingles

Bernese Software Results (larger scale)



Roof Multipath Conclusions

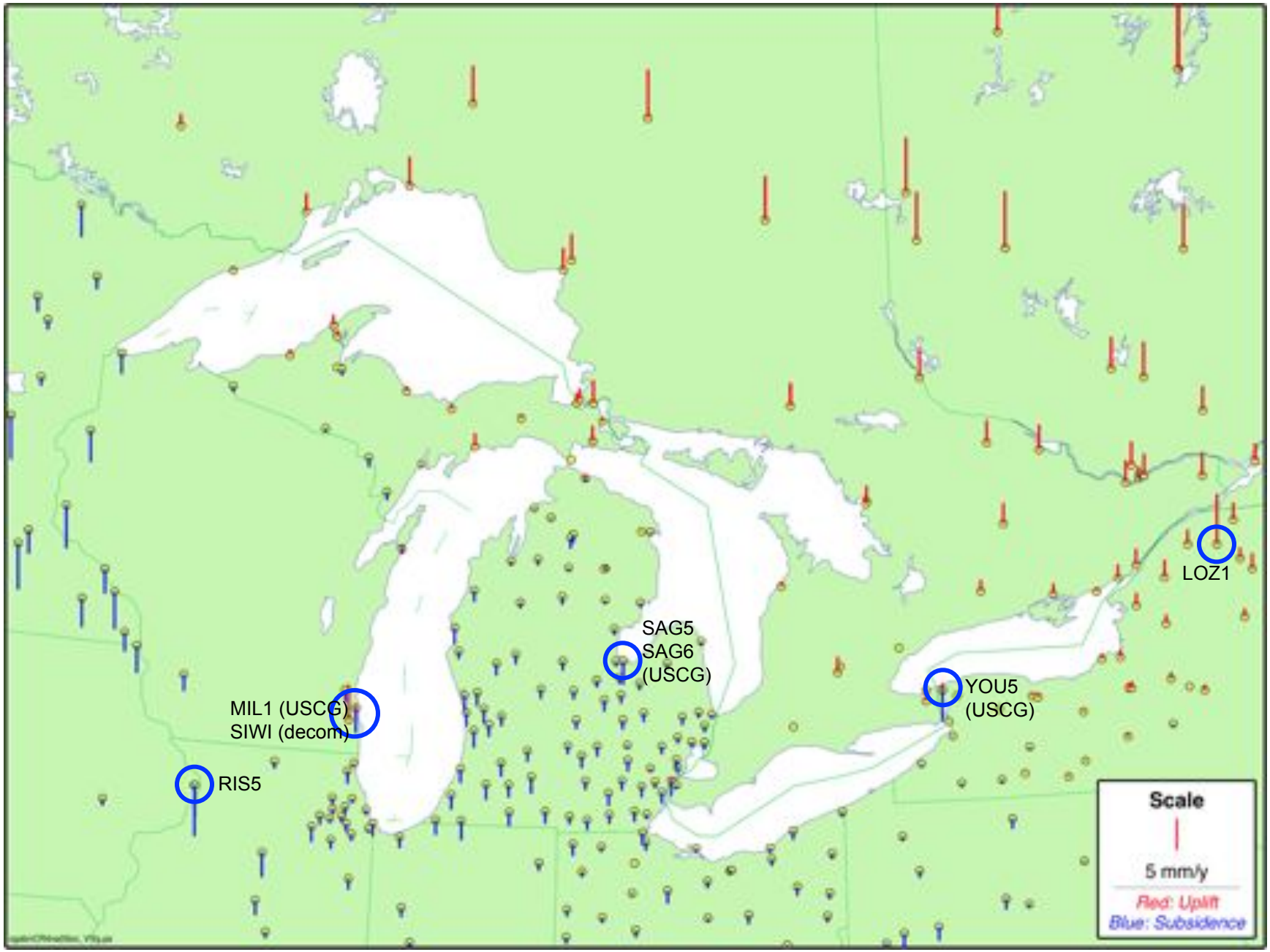
- **Metal roofs**
  - Caused large offsets in horizontal position (~3 cm)
  - Extending height of antenna significantly reduced horizontal offset
  - Vertical offsets are small (<5 mm)
  - Antenna flush on roof behaved well but not practical
- **Wood roof provided least bias**
- **Multipath is consistent from day to day even for metal roofs**
  - May not bias velocity estimation but...
  - Need much longer time series to verify no long term variation

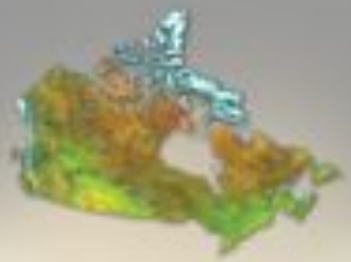


New GPS Velocity Field

- **Reprocessed all Canadian CORS and US Great Lakes CORS**
  - All data from 2000 to date
  - About 500 stations including all US Great Lakes CORS
  - Used latest Bernese GPS software, IGS orbits & IGS05 antenna calibrations
  - Corrected CORS for IGS08 calibrations using lat-dependent model
- **Reprocessing all CBN campaigns (~160 stations)**
  - All data from 1994 to 2011 (4 major campaigns)
  - Same processing procedures as CACS/CORS
  - Cannot correct for IGS08 antenna calibrations
- **Will reprocess again with IGS08 antenna calibrations**
- **Computed CACS/CORS + CBN velocity field**
  - Aligned and integrated with ITRF2008/IGS08 reference frame

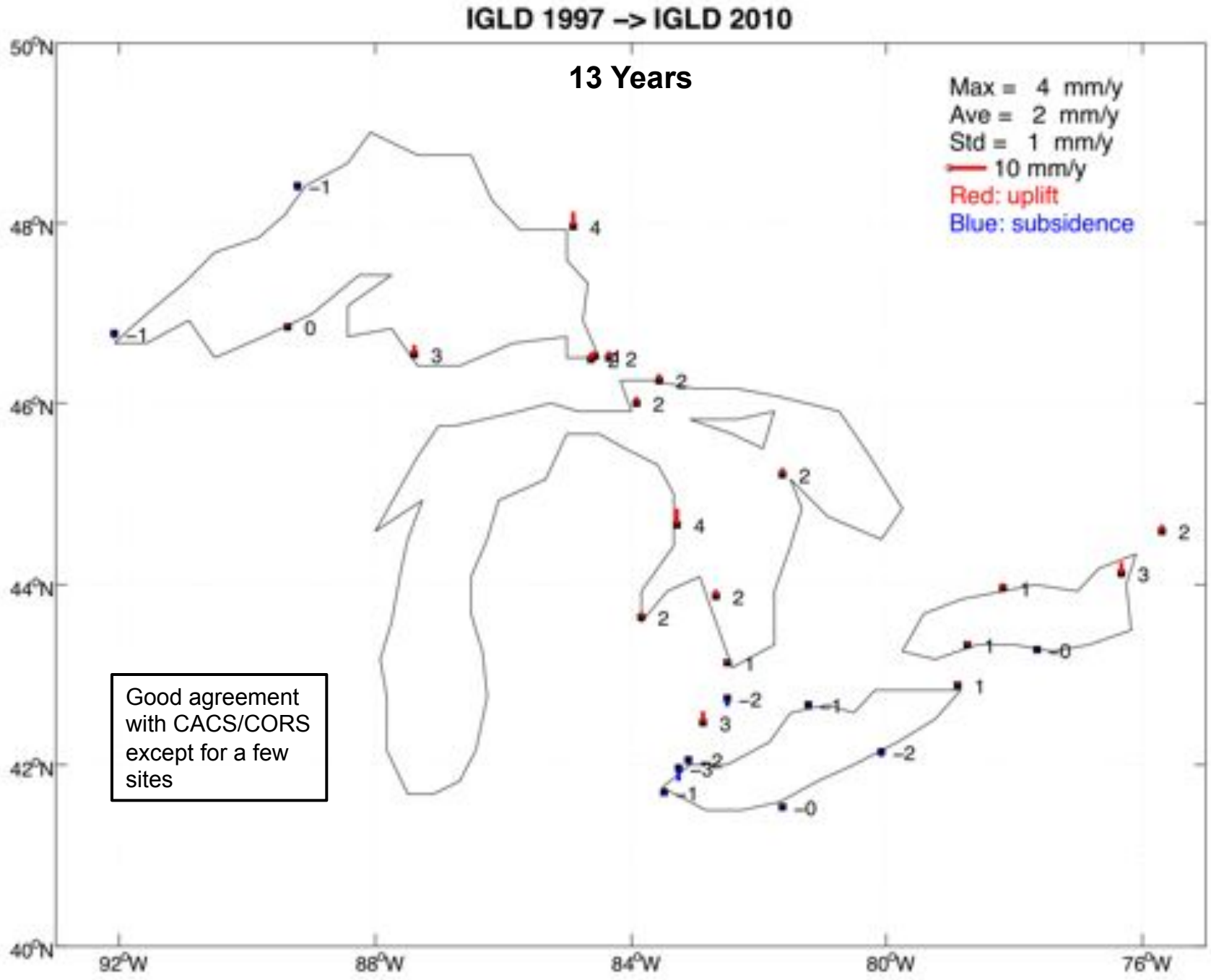
CACS/CORS+CBN Vertical Velocity Field

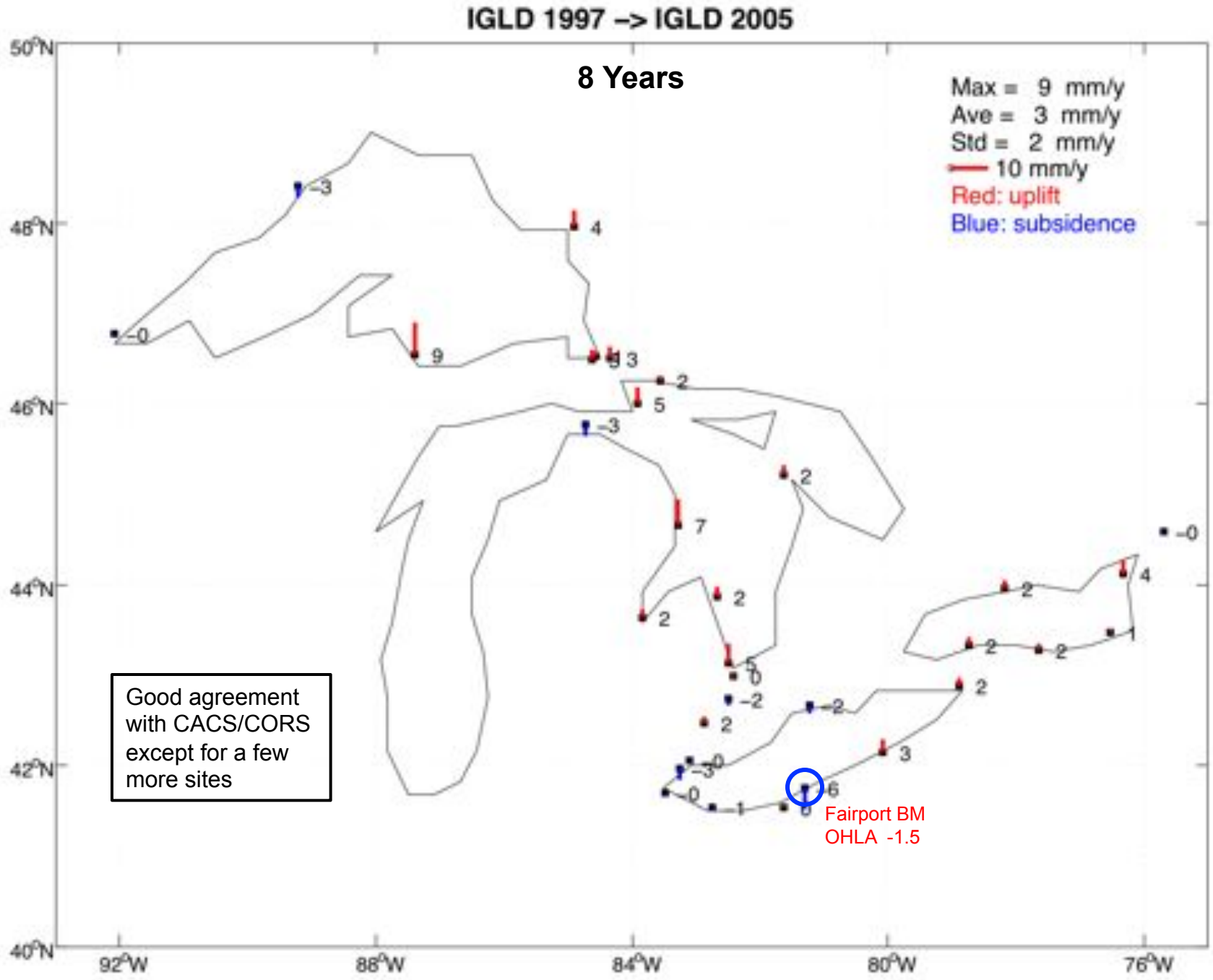


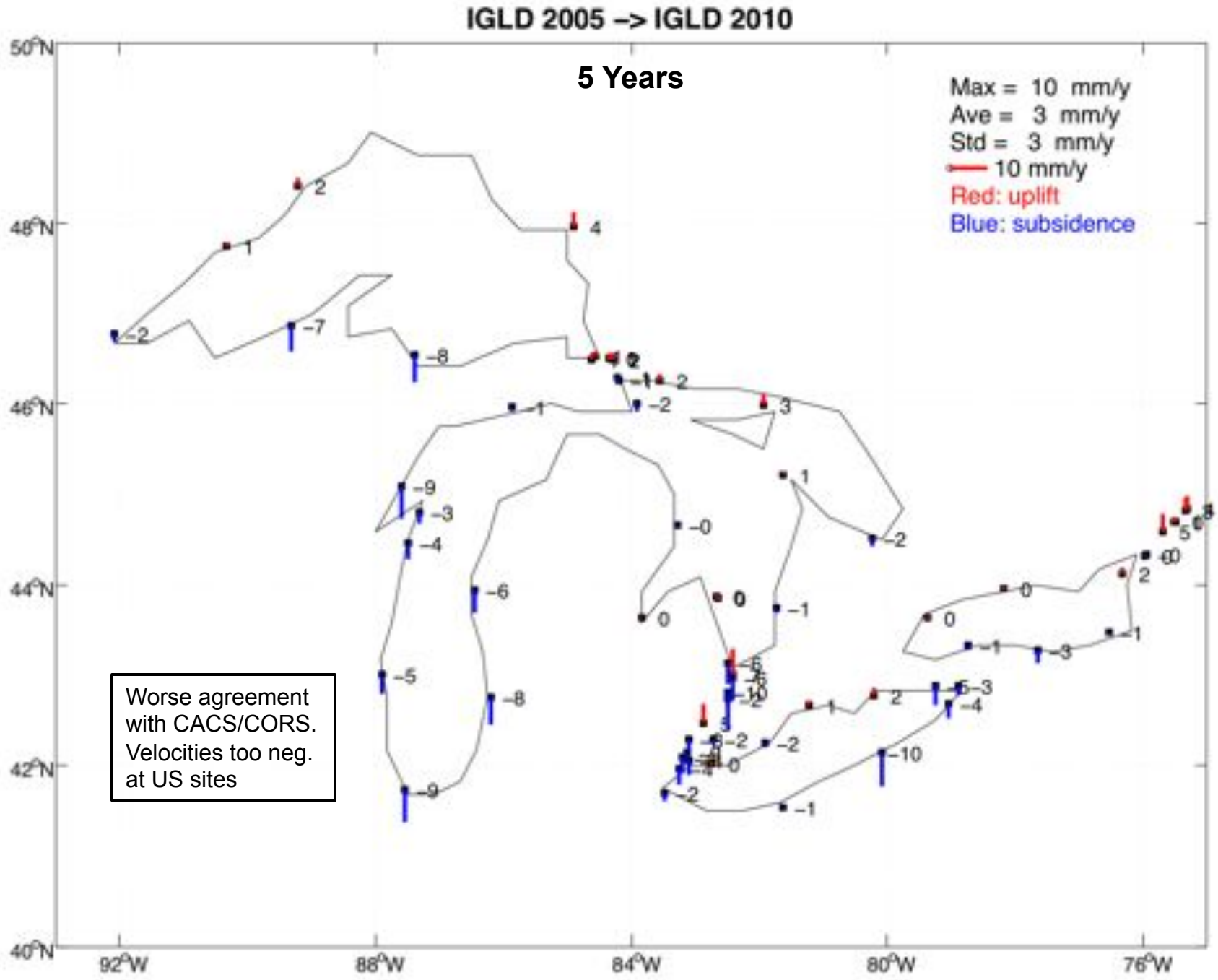


IGLD GPS Surveys

- **GPS surveys**
  - 1997 (partial Great Lakes)
  - 2005 (Great Lakes + St. Lawrence River)
  - 2010 (Great Lakes only)
- **All data reprocessed**
  - Using same procedures as for CACS/CORS & CBN
  - Cannot correct for IGS08 antenna calibrations
- **Will reprocess again with IGS08 antenna calibrations**
- **Comparisons between epochs**
  - Computed average relative velocities with respect to ALGO (coordinate difference / time difference)
  - Fixed ALGO to ITRF2008 velocity (3.6 mm/y)
  - Accuracy decreases with decreasing time span


IGLD 1997 -> IGLD 2010
13 Years
Max = 4 mm/y
Ave = 2 mm/y
Std = 1 mm/y
10 mm/y
Red: uplift
Blue: subsidence
50°N
48°N
46°N
44°N
42°N
40°N
92°W
88°W
84°W
80°W
76°W
Good agreement with CACS/CORS except for a few sites


IGLD 1997 -> IGLD 2005
8 Years
Max = 9 mm/y
Ave = 3 mm/y
Std = 2 mm/y
10 mm/y
Red: uplift
Blue: subsidence
50°N
48°N
46°N
44°N
42°N
40°N
92°W
88°W
84°W
80°W
76°W
Good agreement with CACS/CORS except for a few more sites
Fairport BM
OHLA -1.5


IGLD 2005 -> IGLD 2010
5 Years
Max = 10 mm/y
Ave = 3 mm/y
Std = 3 mm/y
10 mm/y
Red: uplift
Blue: subsidence
Worse agreement with CACS/CORS. Velocities too neg. at US sites
50°N
48°N
46°N
44°N
42°N
40°N
92°W
88°W
84°W
80°W
76°W