CBN Version 3.1

Processing, Adjustment & Integration Status Report

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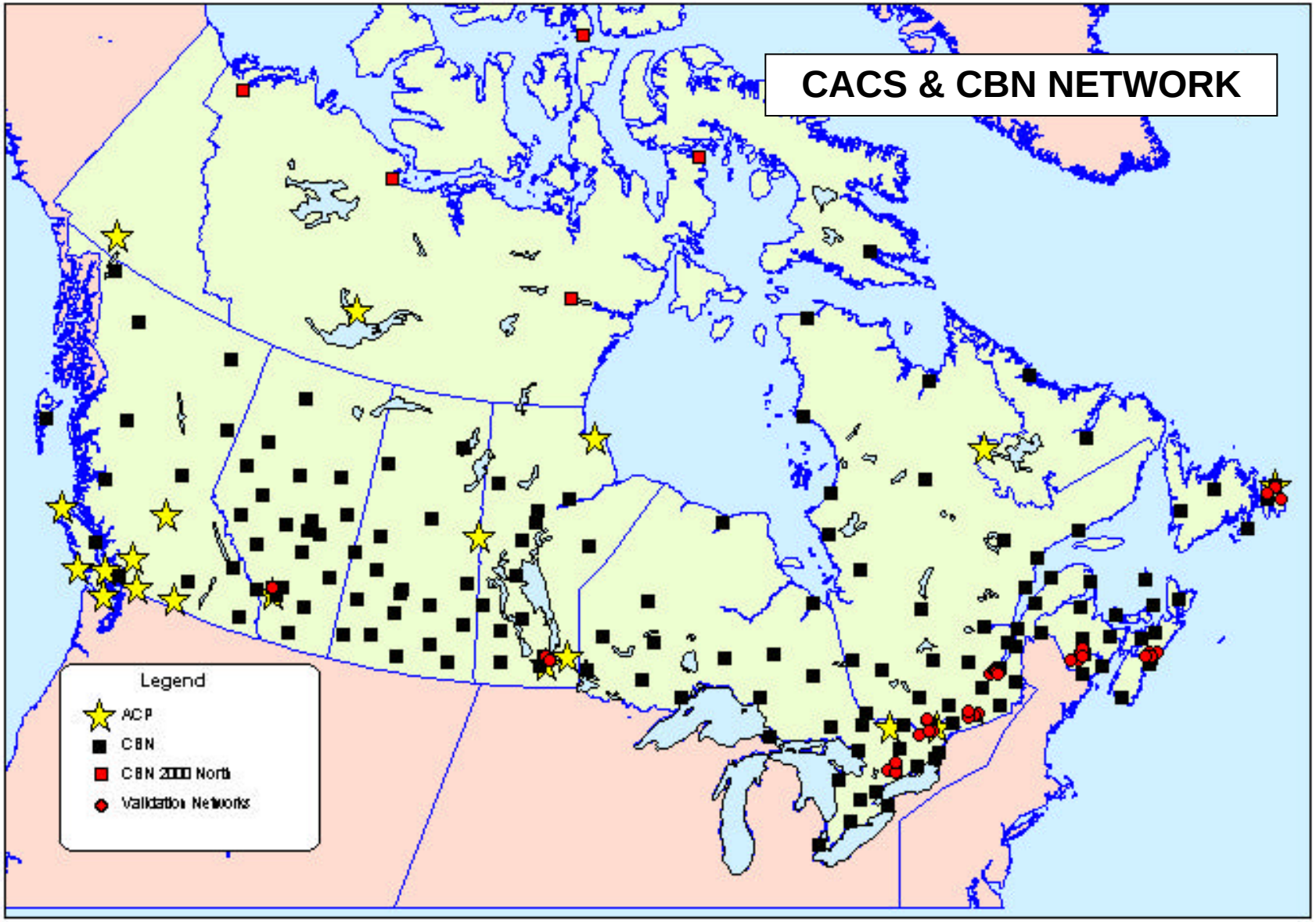
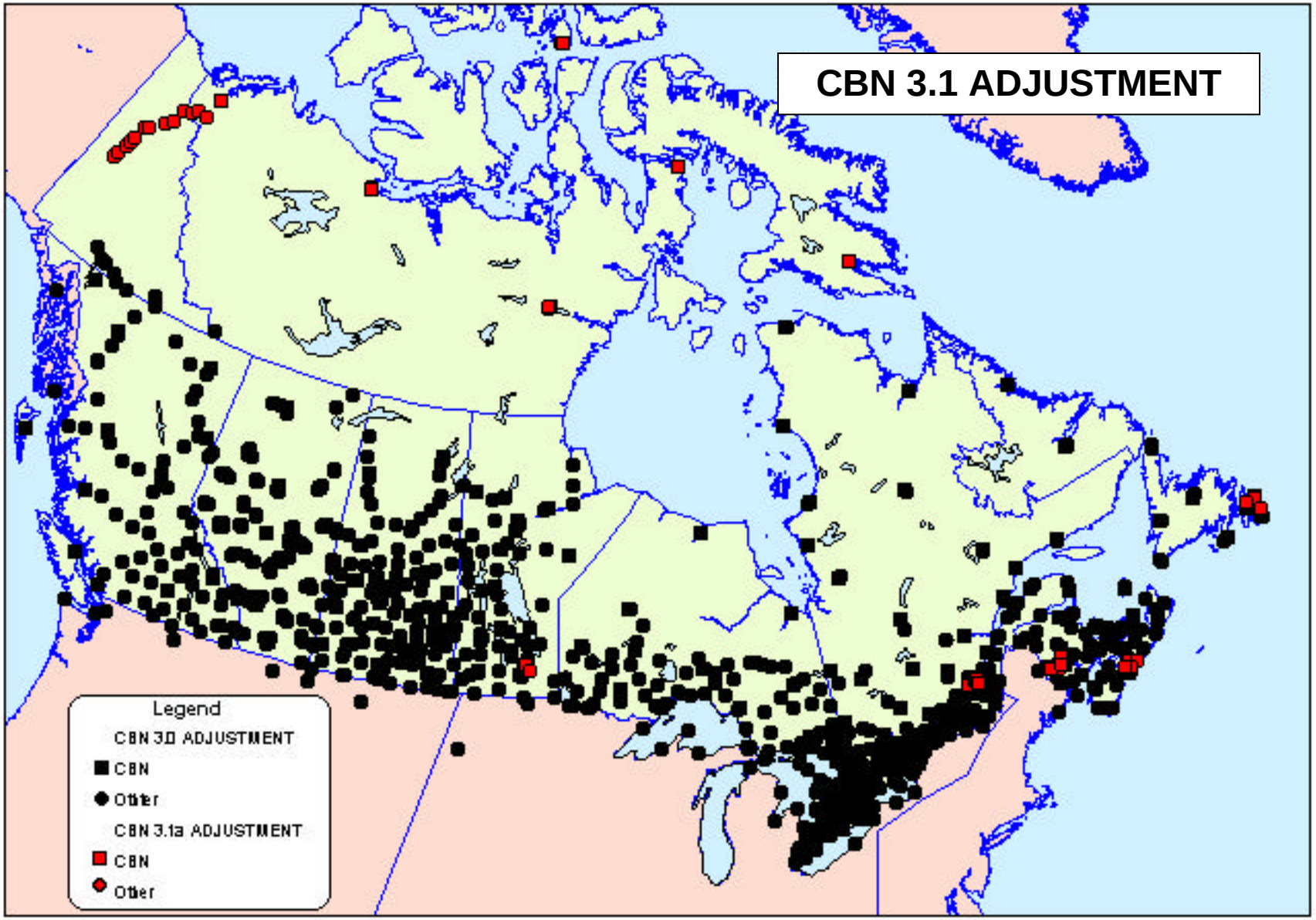

CACS & CBN NETWORK
Legend
ACP
CBN
CBN 2000 North
Validation Networks

Data Used in CBN 3.1

- *CBN Survey Campaigns*
  - 1994 (S. Quebec, Maritimes)
  - 1995 (Alberta, Saskatchewan)
  - 1996 (E. Saskatchewan, Manitoba, N.W. Ontario)
  - 1997 (Ontario, N. Quebec, Newfoundland/Labrador)
  - 1999 (British Columbia)
  - 1996 (S. Quebec, Maritimes) -- Absolute-G stations
  - 2000 (Yukon, NWT, Nunavut)

- *Validation Networks*
  - 1996 (Halifax, Montreal, Ottawa, Peterborough, Calgary)
  - 1997 (Halifax)
  - 2000 (St.John's, Halifax, Fredericton, Quebec City, Winnipeg)
- *Other*
  - 1996 CBN Reobs (Alberta)
  - 1996 GPS on BM (N. BC)
  - 2000 GPS on BM (N. Yukon)


CBN 3.1 ADJUSTMENT
Legend
CBN 3.0 ADJUSTMENT
CBN
Other
CBN 3.1a ADJUSTMENT
CBN
Other

Network Hierarchy

- *By network type and GPS session length*
  - Federal CBN (>three 24 hr sessions)
  - GPS Validation Networks (three 24 hr sessions)
  - GPS on IGLD BMs (two 24 hr sessions)
  - GPS on BM (one 12 or 24 hr session)
  - NAD83 horizontal control (one 12 or 24 hr session)
  - Provincial (varied, usually multiple 3-8 hr sessions)
  - US HARN (multiple 6 hr sessions)
  - US CORS (> three 24 hr sessions)

GPS Processing

- *Software & Procedures*
  - Bernese GPS Software v4.0 (1994-99) & 4.2 (2000)
  - GSD GPS Processing Guidelines (1997 & 2000)
  - Simultaneous observations processed simultaneously
  - IGS/NRCan precise orbits
  - IGS antenna phase centre offsets
  - Tropospheric zenith delay parameters every 2 hrs
  - L3 (ionospheric corrected) for final solutions (L1 for baselines < 2 km)
  - Ambiguities fixed using QIF method (all lines)

Reference Frames

- *GPS Processing*
  - ITRF of date of observations
    - ITRF92 – CBN94
    - ITRF93 – CBN95, MarReobs96, Basenets96
    - ITRF94 – CBN96/97, AlbReobs96, NorBC96, Basenets96/97
    - ITRF96 – CBN99, PetBasenet98
    - ITRF97 – CBN00, Basenets00
- *Adjustment & Integration*
  - Transformed GPS sessions to NAD83(CSRS98)
  - Using adopted transformation (TRNOBS software)

Adjustment & Integration

- *Minimally Constrained Adustments*
  - Each campaign adjusted separately
  - Checked for outliers
    - None found
  - Scaled cov. matrices by estimated variance factors
    - CBN surveys: 170–297
    - Other surveys: 88–420

- *NAD83(CSRS) Integration*
  - Combined all min constraint adjustments together
  - Estimated separate rotation/scale parameters for each
  - CACS stations constrained to ITRF97
    - Transformed to NAD83(CSRS)
    - Constrained using full covariance matrix from ITRF
    - Same as CBN 3.0
  - Further scaled cov. matrices by variance factor from integration adjustment
    - Did not scale CACS/ITRF cov. matrix (assumed correct)
    - Scaled only observation cov. matrices (relative to ITRF)
    - Iterated adjustment & scaling until VF = 1
    - Min. constraint scale factors were scaled an additional 1.322

Integration Problem

- *Crustal Motion*
  - Observations span many years (1994–2000)
  - Post-glacial rebound can amount to 1-2 cm/yr !!

    SCHE & SCH2: 2 cm/yr DUBO: –1.6 cm/yr ??

    CHUR: 1 cm/yr YELL: 0.4 cm/yr
  - Causes large discrepancies between CBN surveys, especially at CACS stations
  - ITRF97 coordinates for CACS given at 1997.0
  - Need to account for movement between surveys

- *Solution*
  - Estimated different coordinates for different observation years at affected CACS stations (used different station numbers in GHOST)

    CHUR (1995/96/97/2000) DUBO (1996/97/2000)

    SCHE (1994/96) YELL (1995/96/99/2000)

    SCH2 (1997/2000)
  - Constrained "epoch" coordinates with respect to 1997.0 using estimated velocities from ITRF97
  - Adjustment fits better overall with CACS constraints
- *But*
  - ITRF97 velocities not very reliable at some stations
  - May want to use ITRF2000 instead if better velocities

Adjustment Summary

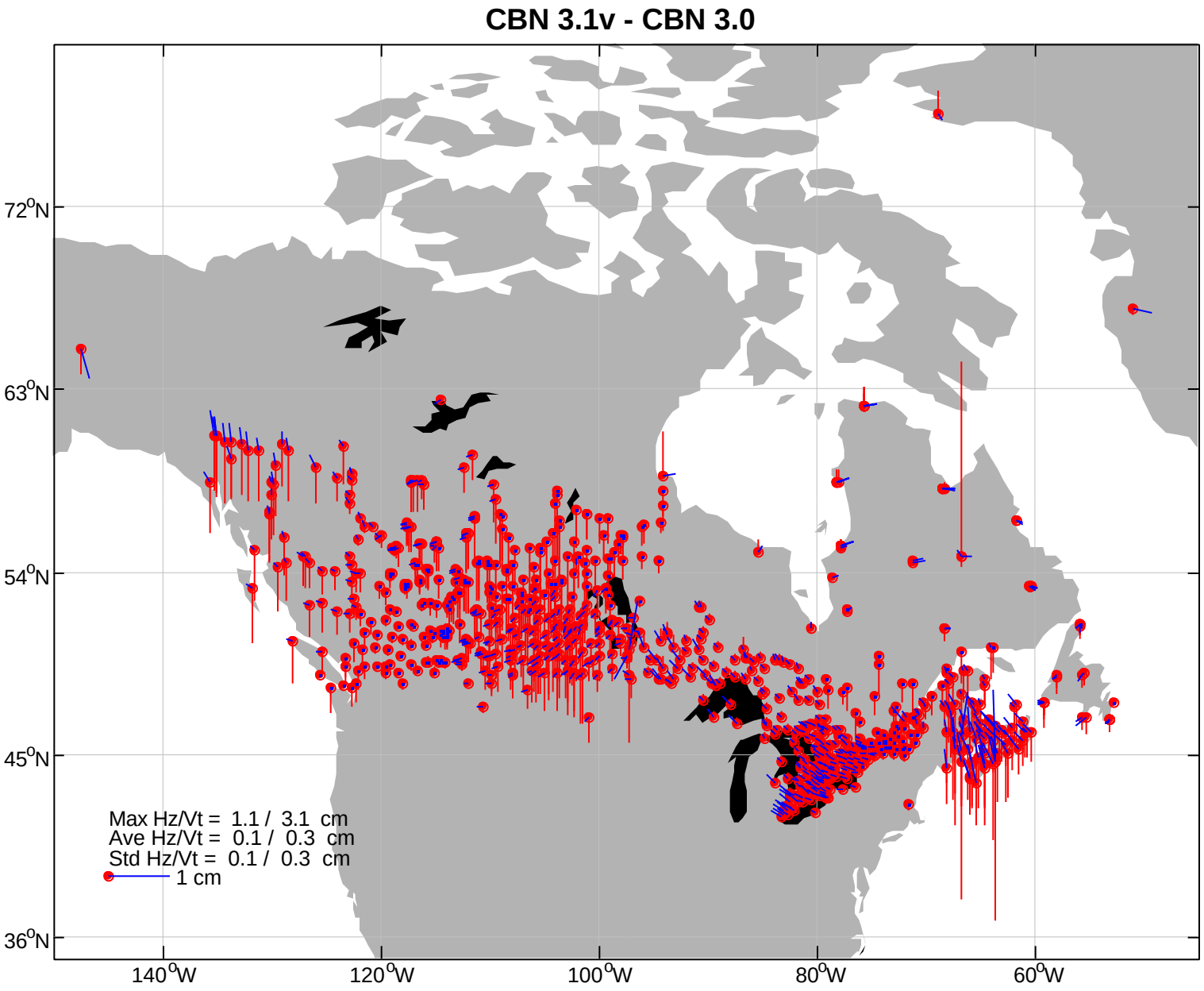
- Software: GHOST on Linux
- Observations: 2726 baselines, 32 position/vel. constraints
- Parameters: 2974 Deg. of freedom: 5300
  - 3 rotations + scale per campaign: 76 aux parms
  - Stations 966 (90 additional)
    - 21 CACS/WCDA/IGS stations
    - **154 CBN stations** (8 additional)
    - 54 GPS validation network stations (32 additional)
    - 232 GPS on BM stations & GPS at tide gauges (7 additional)
    - 41 IGLD BM stations
    - 12 CCG DGPS stations
    - 153 Horizontal control stations (26 additional)
    - 260 Provincial stations
    - 19 US CORS/HARN/FBN stations
    - 20 Miscellaneous Geomag, GNWT, LSD, etc. stations (17 additional)

CBN 3.1–3.0 Discrepancies (mm)

	Mean	Std	Max
Horizontal	1	1	11
Vertical	3	3	–31

Adopted–CBN 3.1 Horz. Discrepancies (m)

	Mean	Std	Max	Pts
All	**0.34**	**0.30**	**1.65**	**432**
North	0.32	0.33	1.07	37
BC	0.12	0.08	0.44	53
AB	0.21	0.15	0.79	98
SK	0.40	0.34	1.65	48
MB	0.57	0.26	1.01	22
ON	0.46	0.26	1.56	83
QC	0.21	0.11	0.57	49
Mar	0.29	0.17	0.72	15
NF	0.86	0.46	1.32	8



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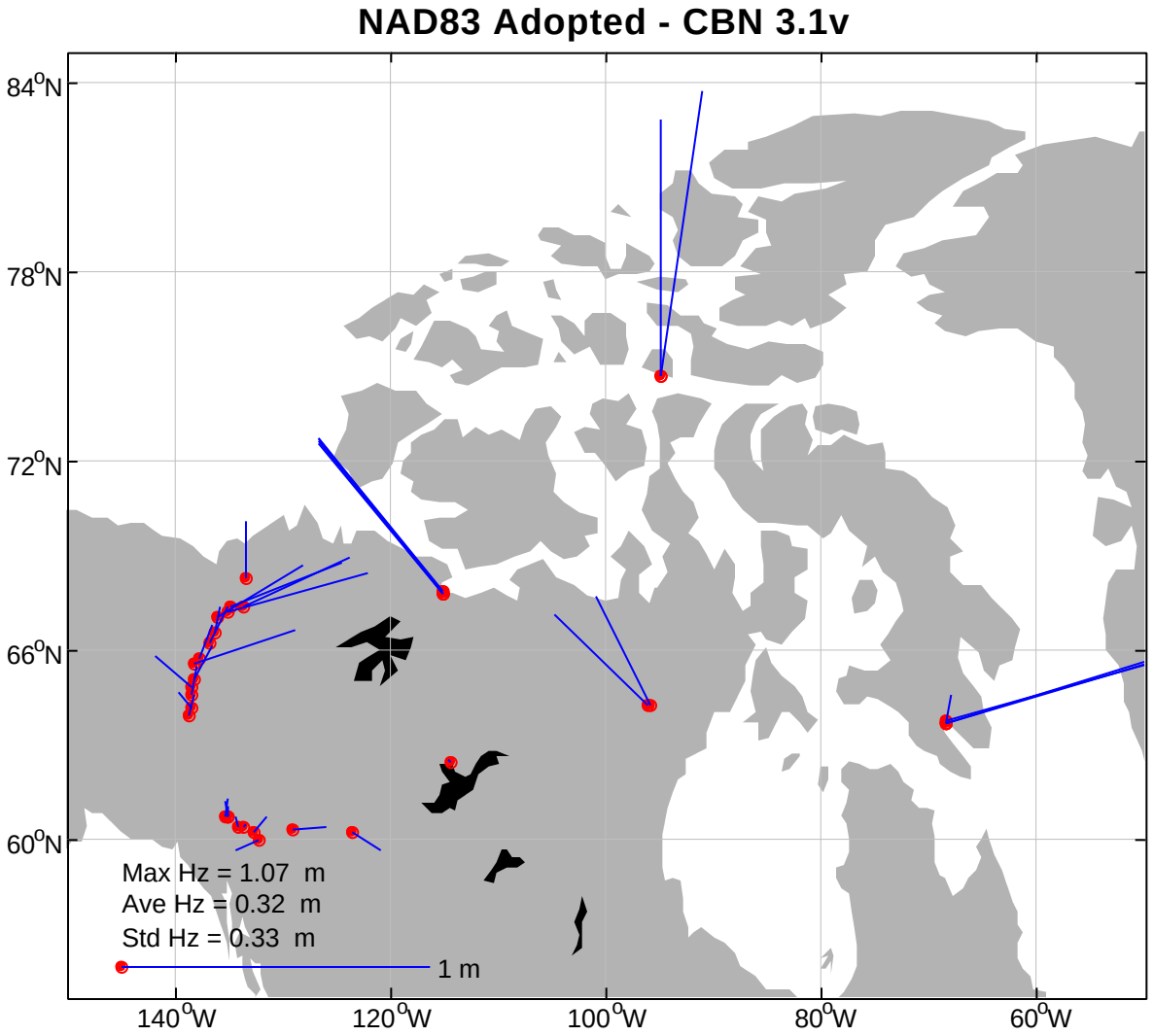
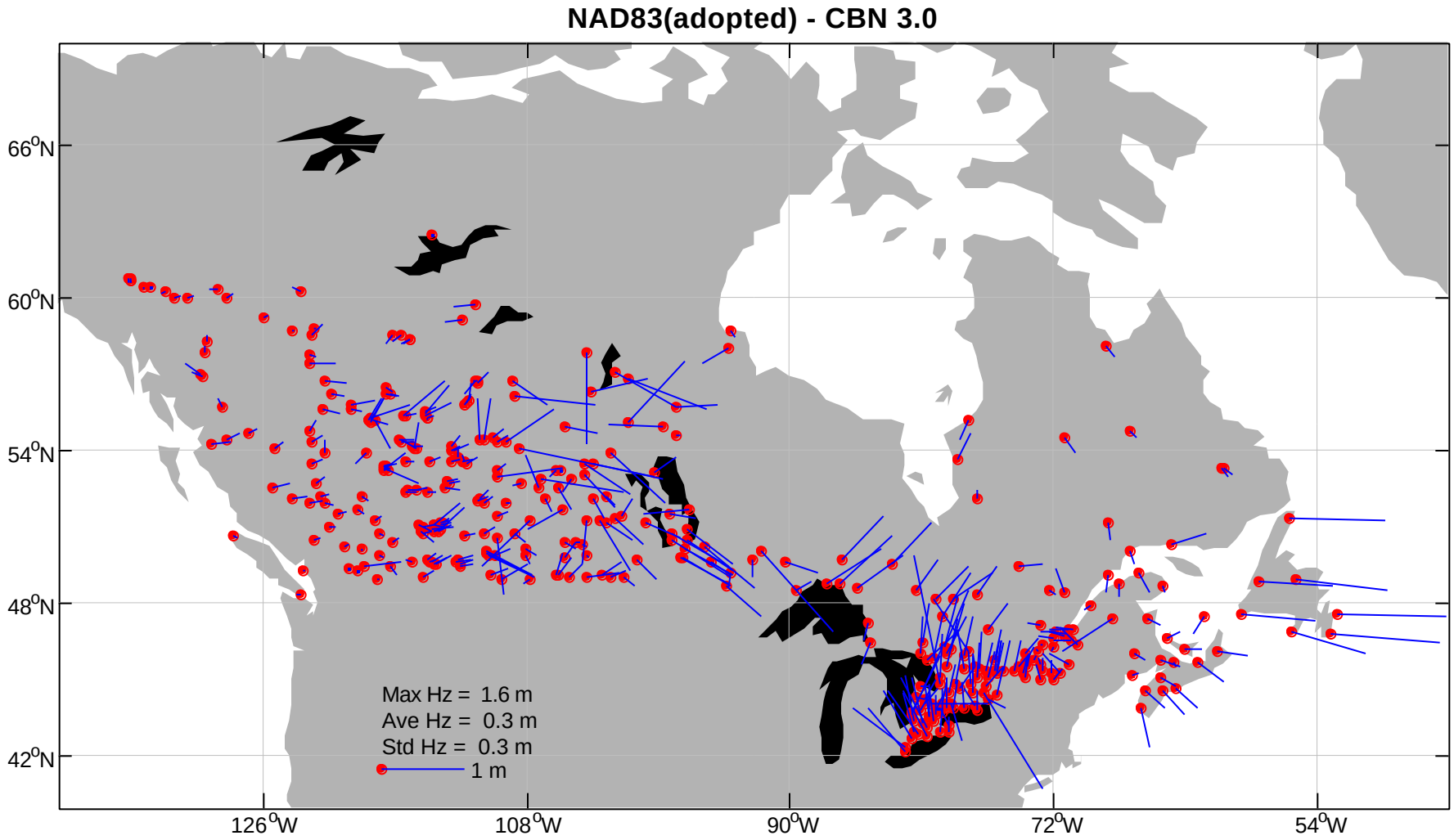

NAD83 Adopted - CBN 3.1v
84°N
78°N
72°N
66°N
60°N
140°W
120°W
100°W
80°W
60°W
Max Hz = 1.07 m
Ave Hz = 0.32 m
Std Hz = 0.33 m
1 m



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