



Rx Antenna Direction Verification

David Kitrosser

University of Massachusetts Lowell
Environmental, Earth, & Atmospheric Sciences Department
Center for Atmospheric Research



XI INTERNATIONAL DIGISONDE FORUM
30 APRIL TO 3 MAY 2007

Rx Antenna Calibration

- Verify correct directions in Ionograms and Drift
- Matched antenna cables
- Corrections for varying antenna heights
- Detect defective cables and Antenna Pre-amps
- Confirm Settings in Station UDD file
D:\ Dispatch\ udd \ xxx.udd
- Confirm Settings Real-Time Drift Configuration
file D:\ Dispatch \ ddasetup.onl

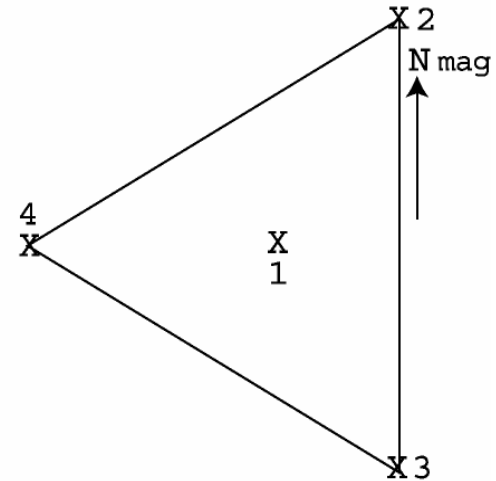
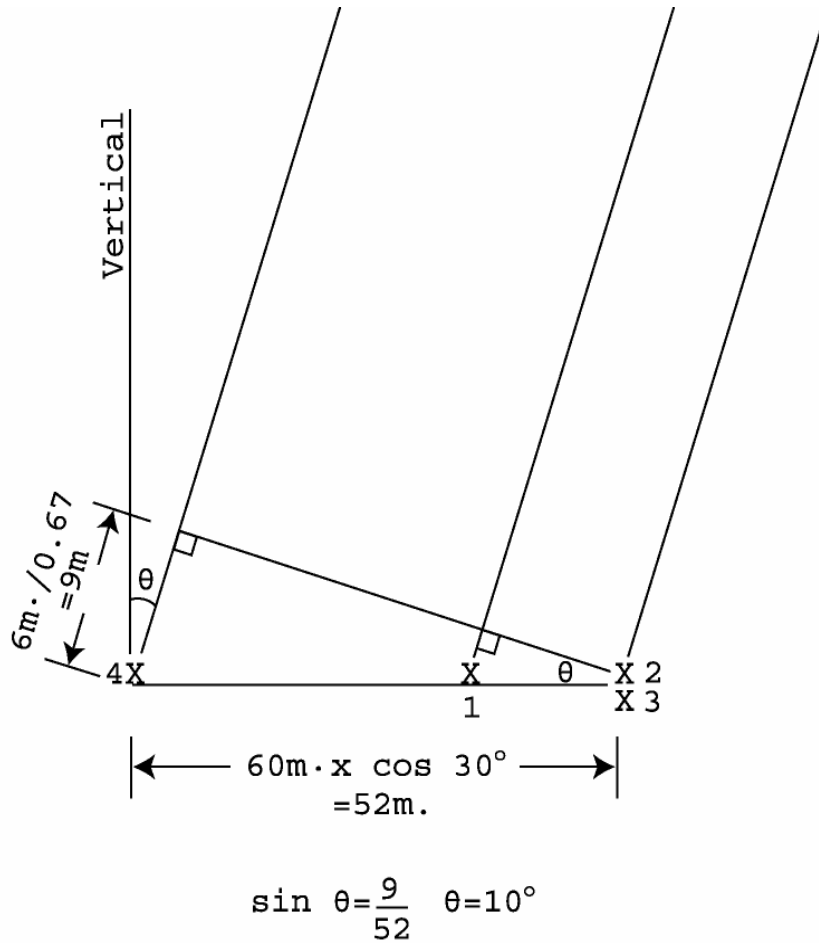
Phase calibration of sounder excluding antennas and cables

- DPS - Periodically running a Calibration Ionogram (Disk Parameter = C) calibrates phase variation in Receiver and Tuner Cards. Usually the E Program. Phase calibration saved in RCVRCAL0.dft file. Automatically corrects phase in subsequent Ionograms and Drift.
- DGS256 – Run Test Drift with Splitter connected to Card 40B feeding all 7 inputs to Antenna Switch. Card 40B generates test synthesized signal every 250 kHz. Rarely any significant phase shifts since there is no tuning before antenna signals are combined.

Calibration of antennas and cables

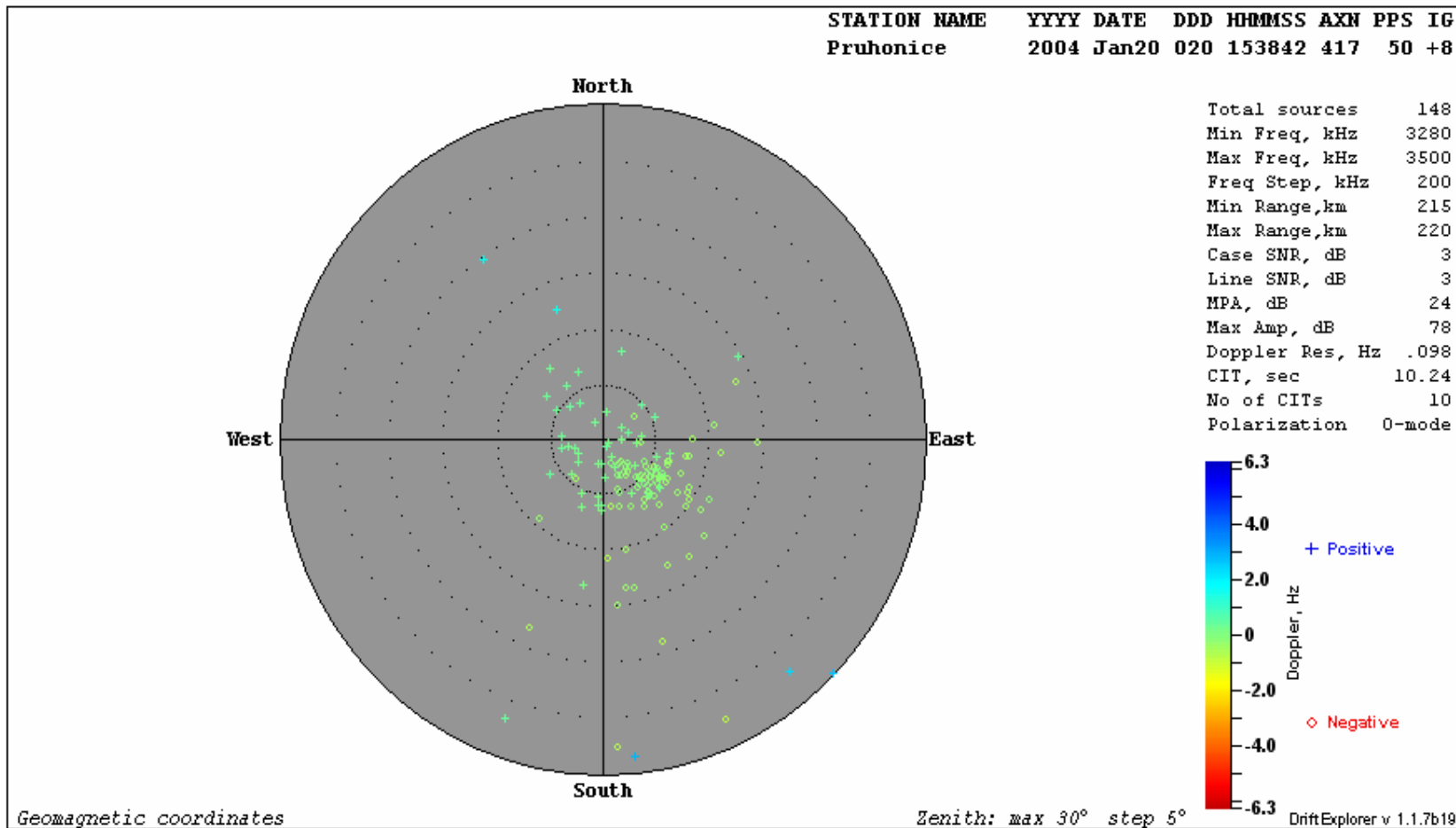
- With quiet Ionosphere, Ionograms with directions should generally be overhead. Skymaps from Drift should be overhead.
- Add two test cables to artificially tilt antenna array
- For a four antenna array, 60 meters on a side, add 6 meters to an outer antenna cable and add 2 meters to the center antenna cable. Tilts the beam approx. 10 degrees away from outer antenna with extra cable length.
- A seven antenna array requires four cables. For example: 9 m., 6 m., 6 m., and 3 m.

Rx Antenna Calibration

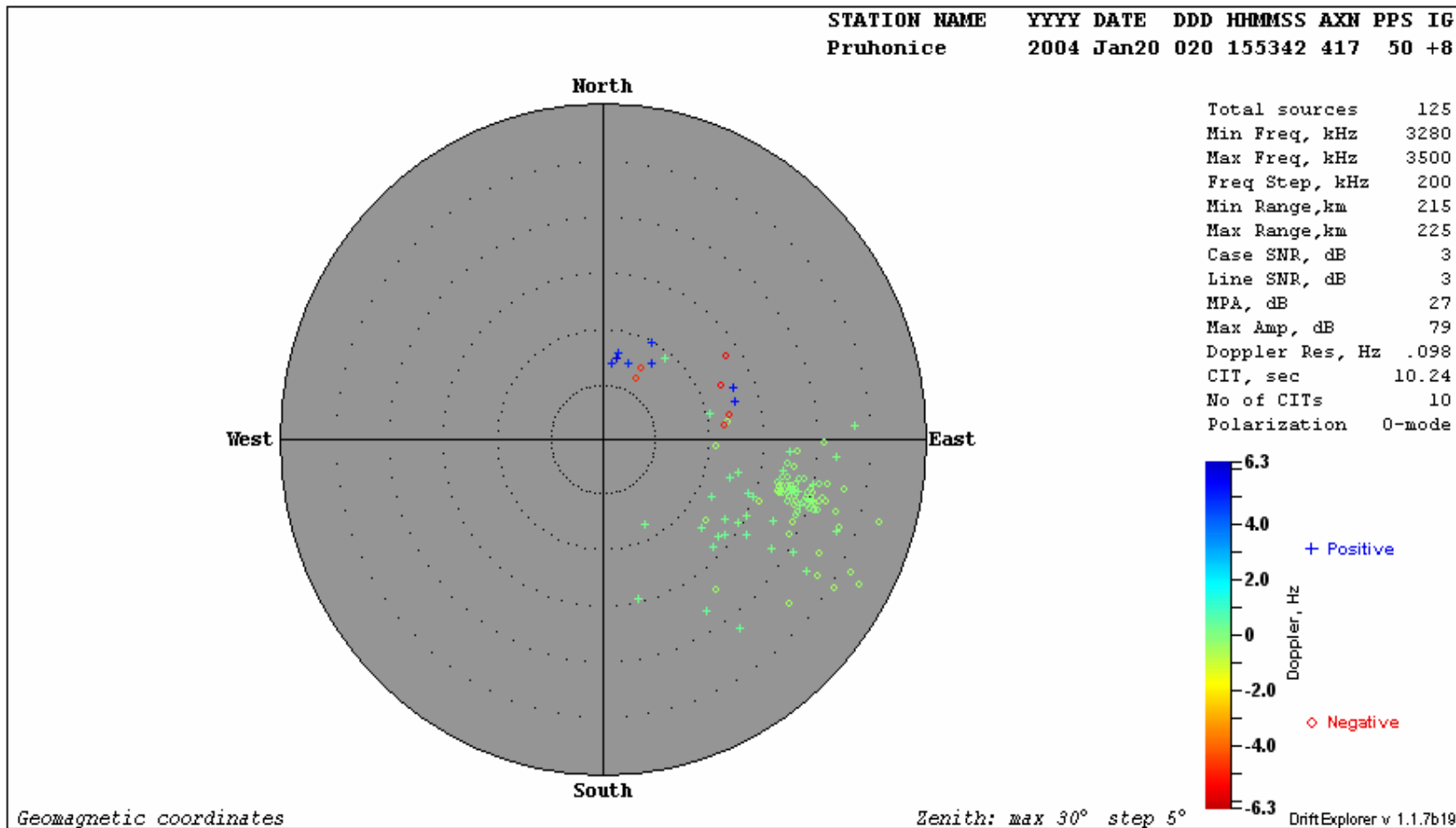


Almost overhead ionosphere

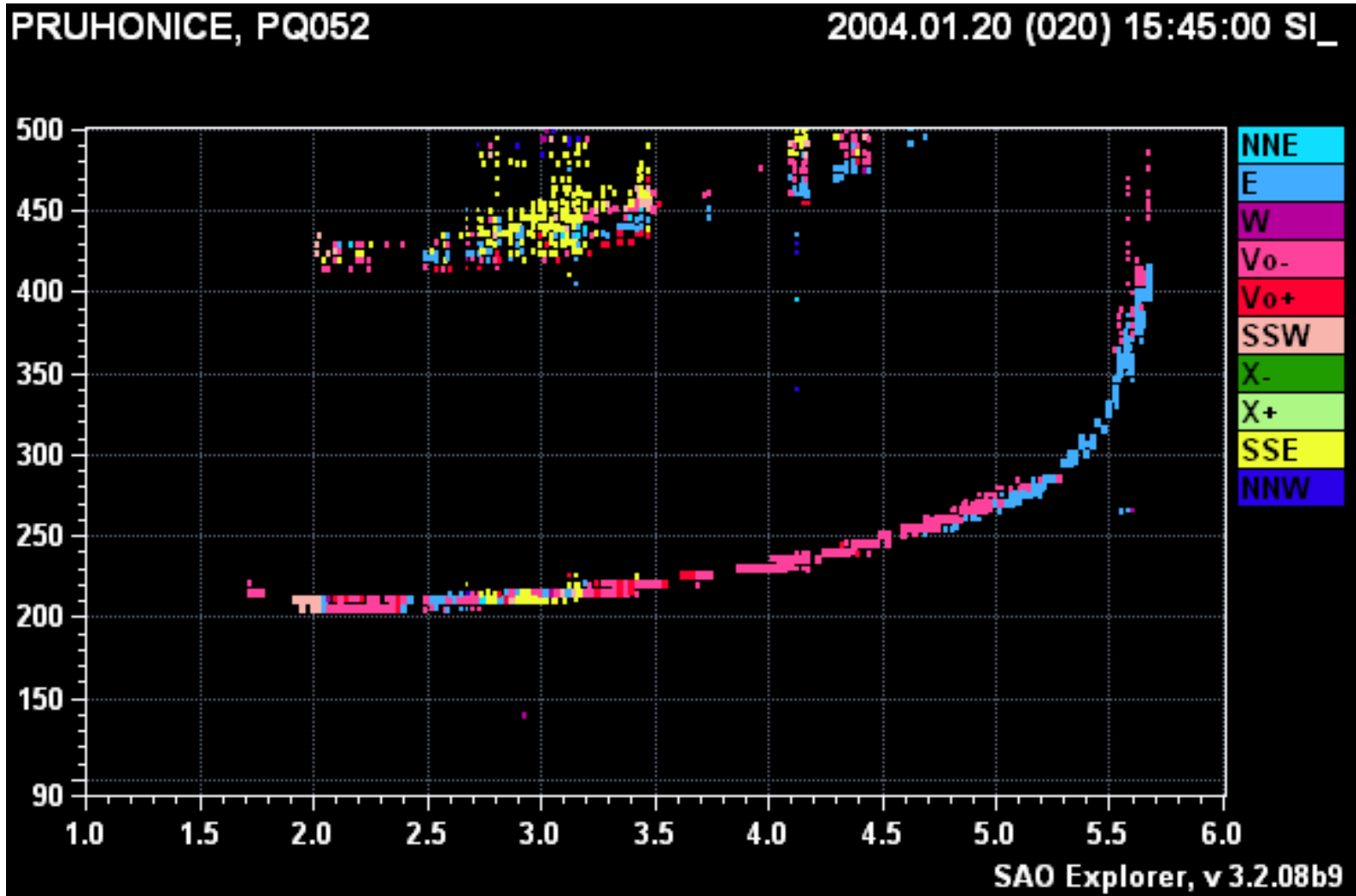
No test cables



Apparent echoes shifted 10 degrees East with test cables



Apparent echoes shifted East



Station UDD file

ANTENNA POSITIONS (X Y Z)

Assume the (central) antenna 1 at (0, 0, 0)

All length are in meters relative to antenna 1

Assume X pointing ground level compass North

Assume Y pointing ground level compass West

	Ant1	Ant2	Ant3	Ant4	Pruhonic	Mirror Image
*080 <	0.00	30.00	-30.00	0.00	> X	North
*081 <	0.00	-17.32	-17.32	34.64	> Y	West
*082 <	0.00	0.00	0.00	0.00	> Z	

Station UDD file

ANTENNA LAYOUT

- 0 Standard per Manual
- 1 180 deg rotation (Karachi, Pakistan, Beijing, China, Kokubunji, Japan)
- 2 Mirror Image (Millstone, Beveridge, Goose Bay)
- 3 None of the above

*086 < 2 >

ANTENNA ROTATION

(accompanies L parameter in Preface)

- 0 clockwise
- 1 counter-clockwise

*085 < 0 >

ddasetup.onl file

```
Ant 1  Ant 2  Ant 3  Ant 4  Ant 5  Ant 6  Ant 7
*170 X < 0.0000, 30.0000, -30.0000, 00.0000, 999.0000, 999.0000, 999.0000 >
*177 Y < 0.0000, -17.3200, -17.3200, 34.6400, 999.0000, 999.0000, 999.0000 >

LAT. LONG. CGPLAT CGPLONG COMPN MAXSEP DEVN ROTATA
*185 Pruhonice < 50.0, 14.5, 80.00, -80.00, 2.3, 103.92, 30.00, 4 >
```

To measure antenna cable lengths

- Ideally all cables should be matched to 6 inches or 20 cm.
 1. Match physically. Layout cables on flat surface.
 2. Use Time Domain Reflectometer (TDR)
 3. Use Frequency synthesizer and oscilloscope
 - Either open or shorted far end of cables
 - Frequency range 2 MHz to 10 MHz
 - Measure average Δf between R. F. voltage nulls to 1 KHz resolution
 - L (meters) $\approx 100 / \Delta f$ (MHz)

Rx antennas not on level terrain

- It is preferable to keep antennas approximately same distance from ground to keep effect of ground reflection on antennas the same.
- Add short cables of Length = $0.66 \times$ height difference (with respect to lowest antenna) to cables of each higher antenna.