

Atmospheric Moisture Data from Canadian GPS Stations

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GPS Observables

Range Observation

$$P = \rho + d\rho + c(dt_s - dt_r) + \text{ion} + \text{SD} + \varepsilon_p$$

ρ = geometric range

$d\rho$ = orbital errors

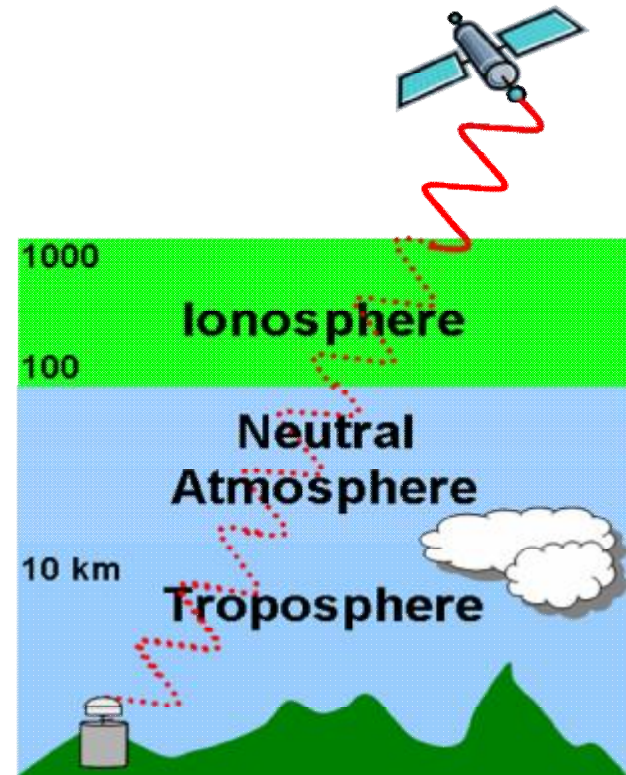
dt_s = satellite clock error

dt_r = receiver clock error

ion = ionosphere range delay

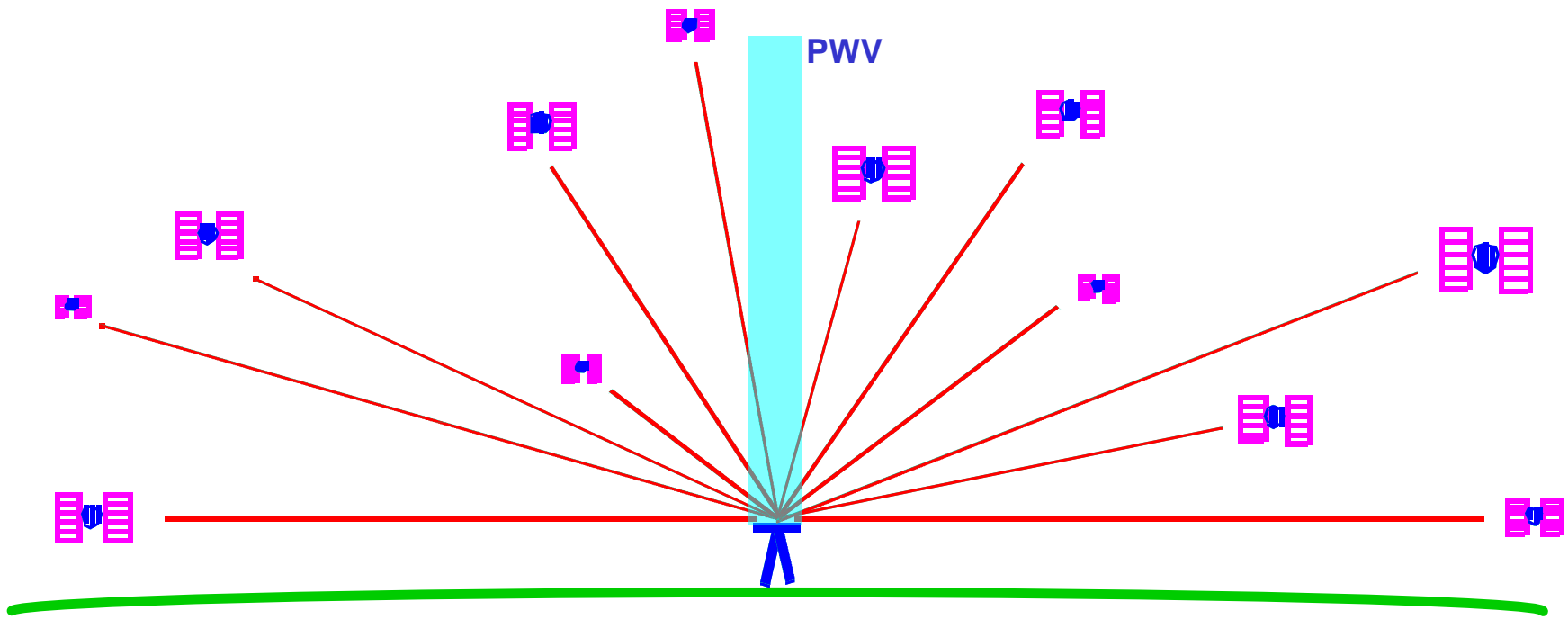
SD = neutral atmosphere range delay

ε = noise and multipath



$$SD = SHD + SWD = 10^{-6} \int N_h(P) ds + 10^{-6} \int N_w(e, T) ds$$

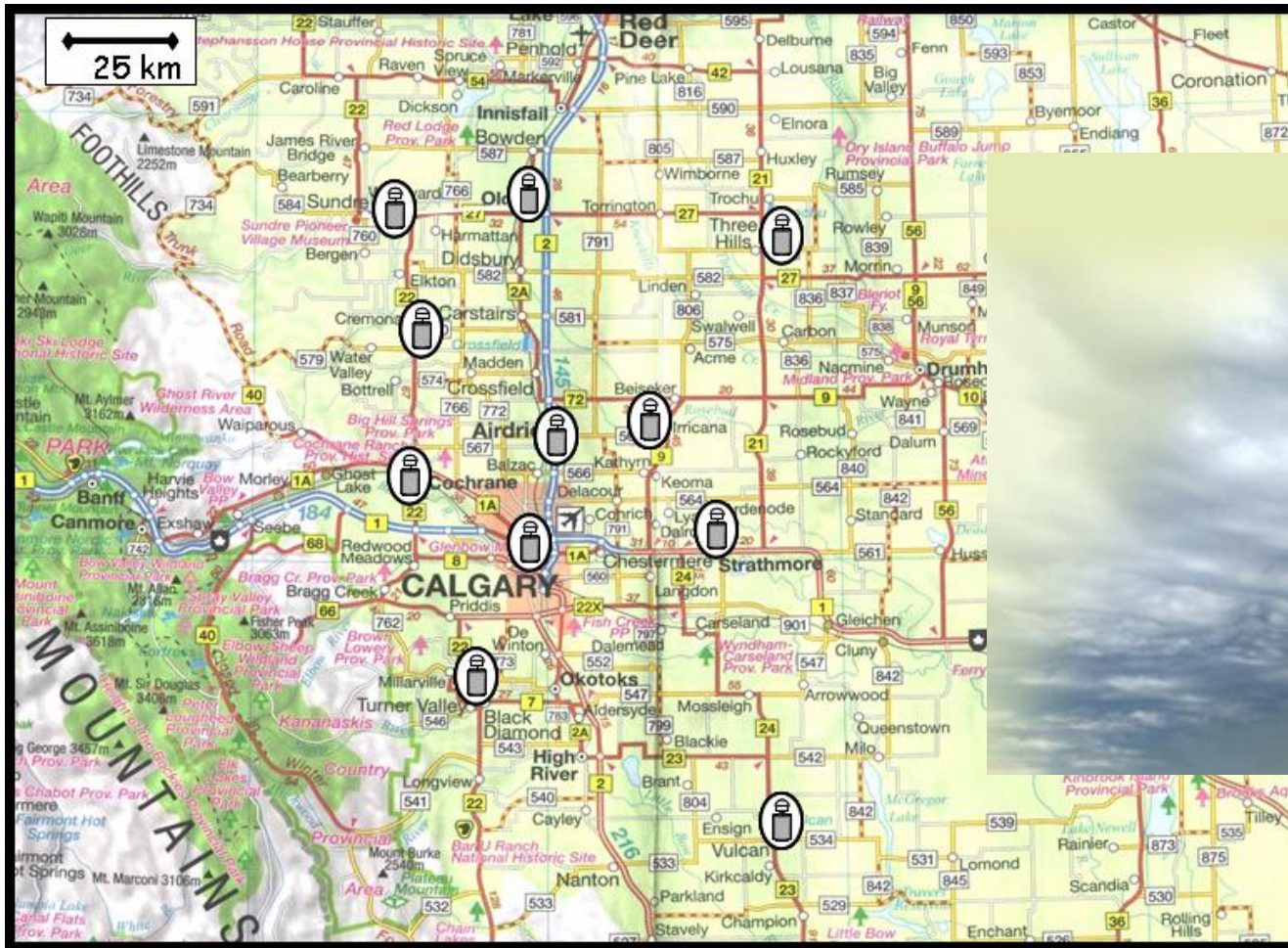
PWV Estimation



$$\text{SWD} = M(E) \times \text{ZWD}$$

$$\text{PWV} = \Pi \times \text{ZWD}$$

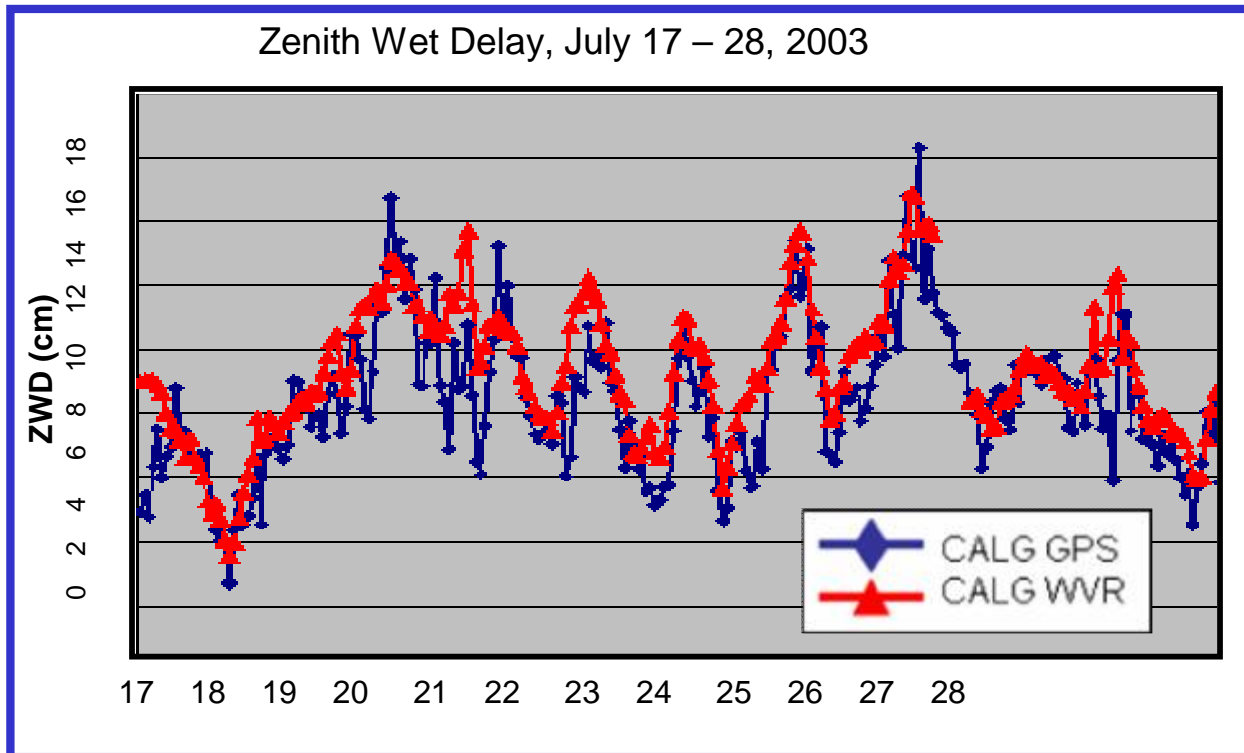
U of C Network



Continuous 30-s data since 2003

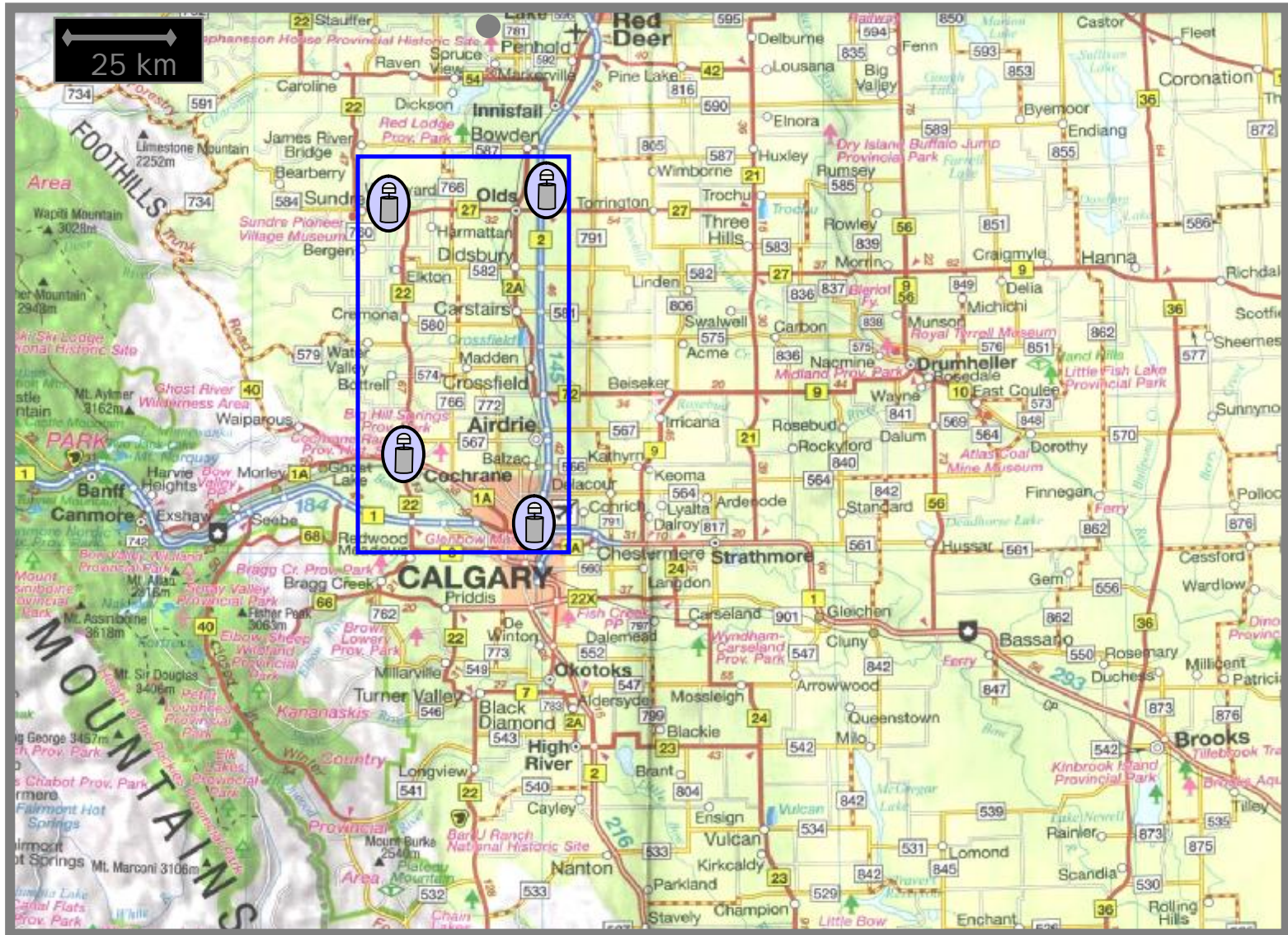
Processed to derive 30-minute PWV estimates at each site

PWV Accuracy



RMS of PWV estimates is approx. 1 mm

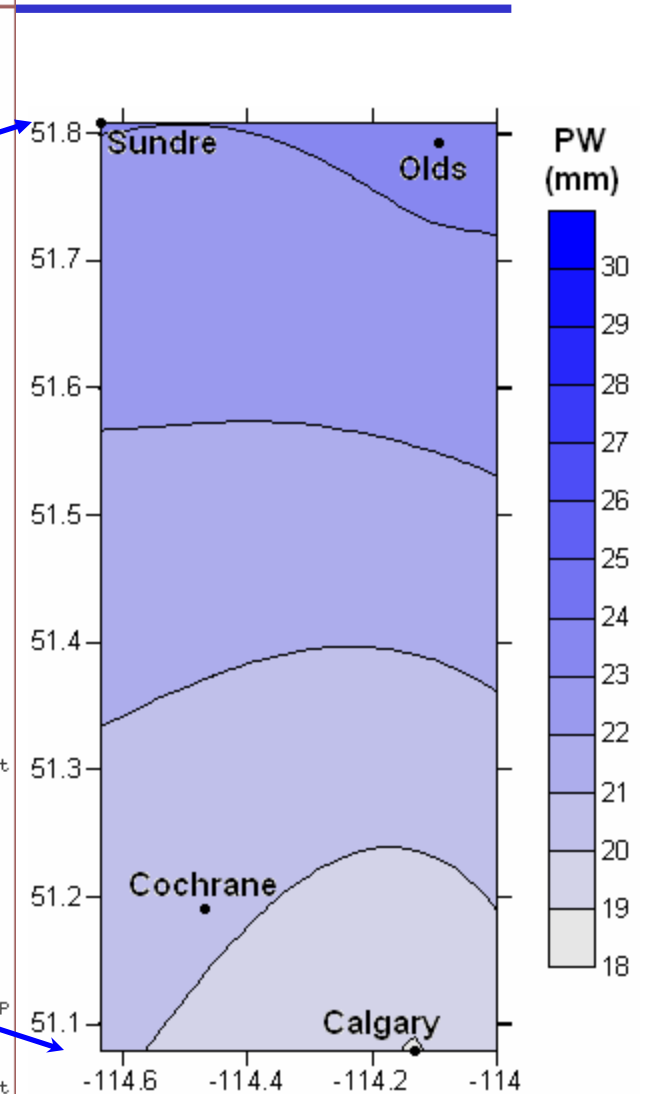
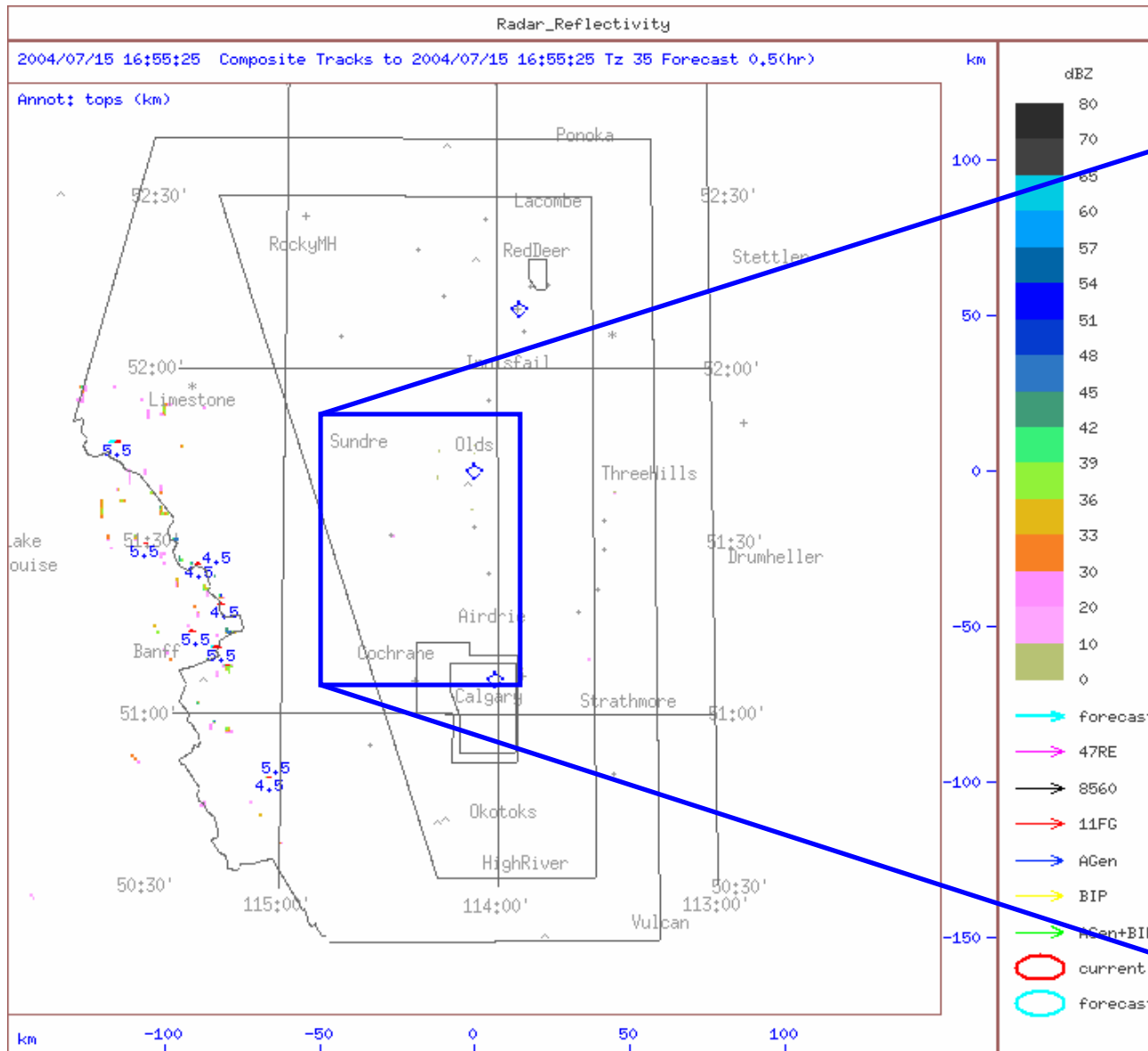
PWV Resolution




GPS receiver

Radar

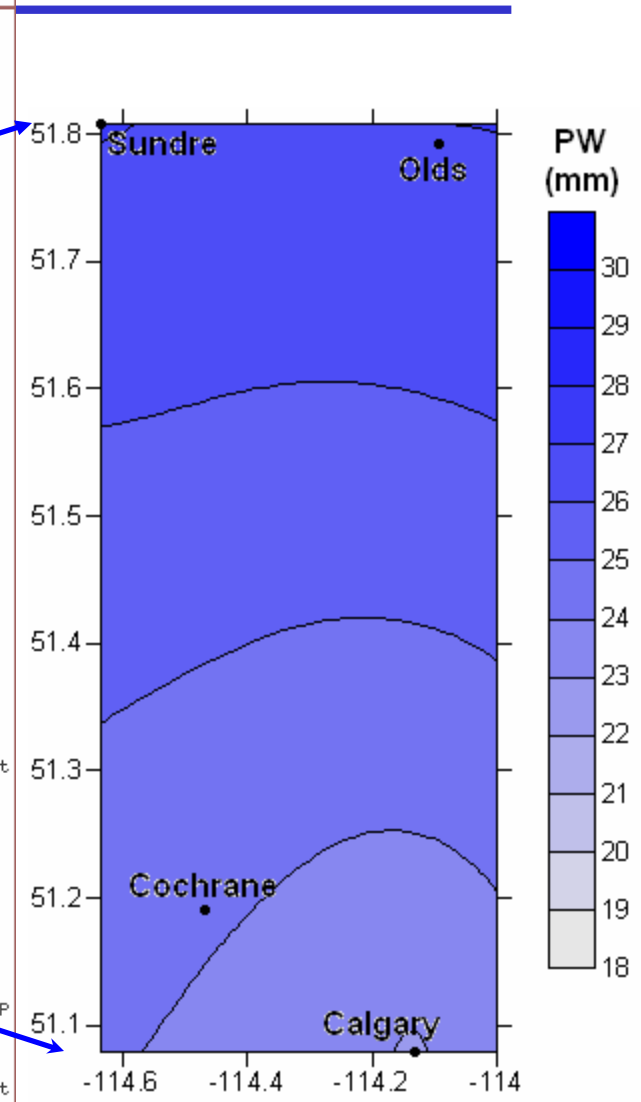
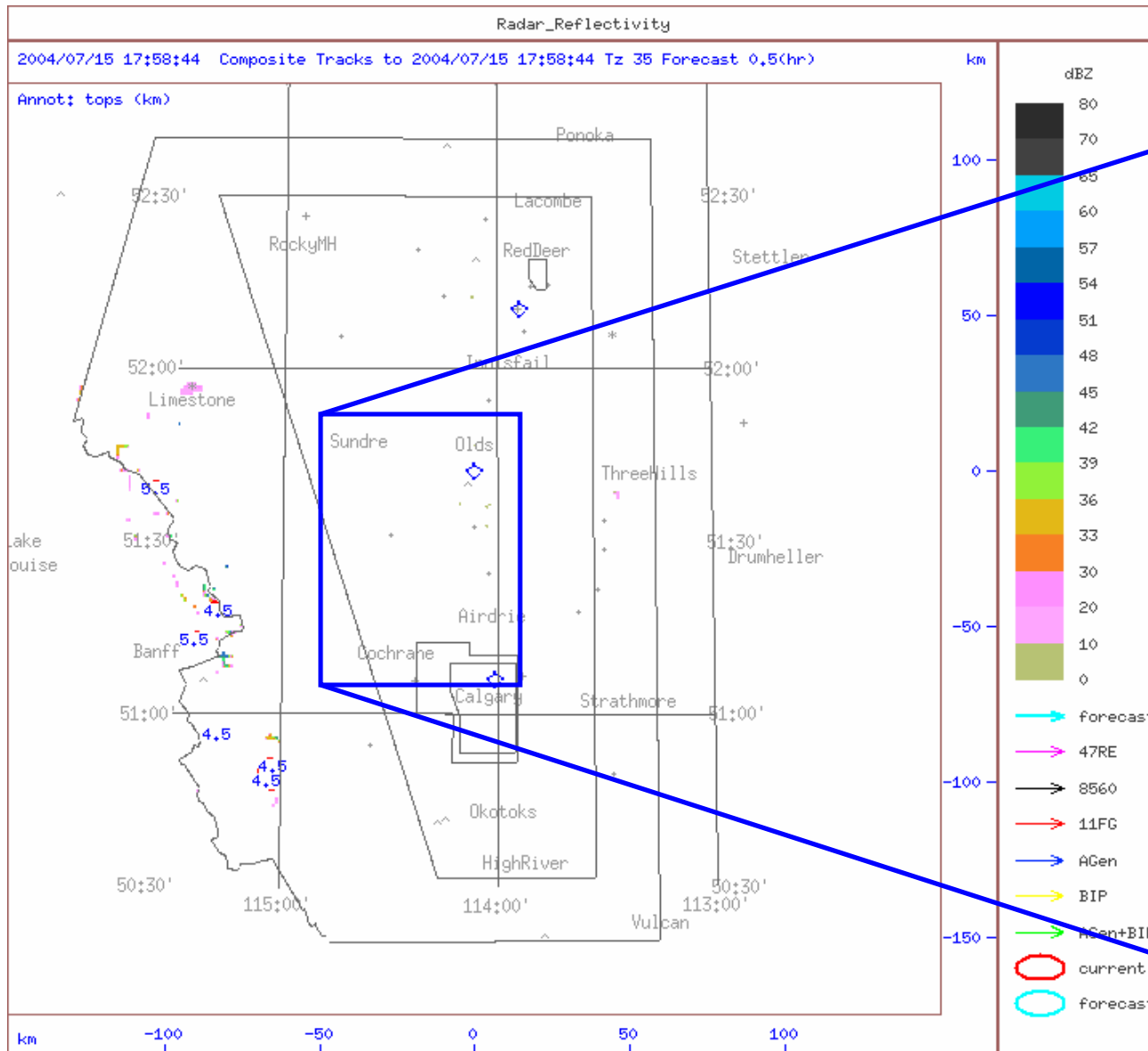
GPS



1000 LT

Radar

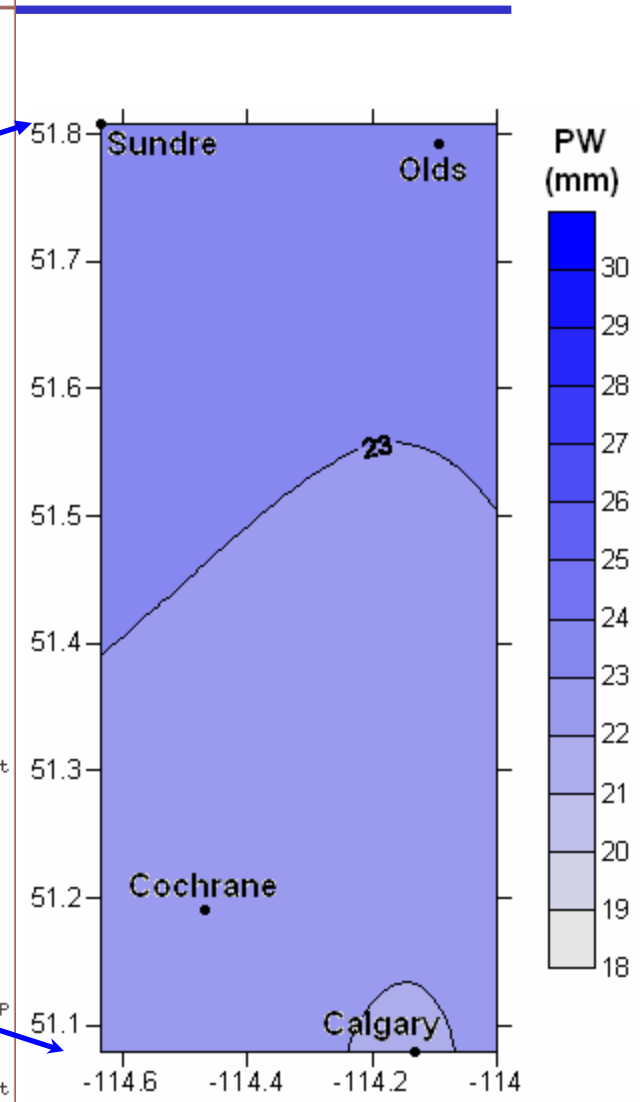
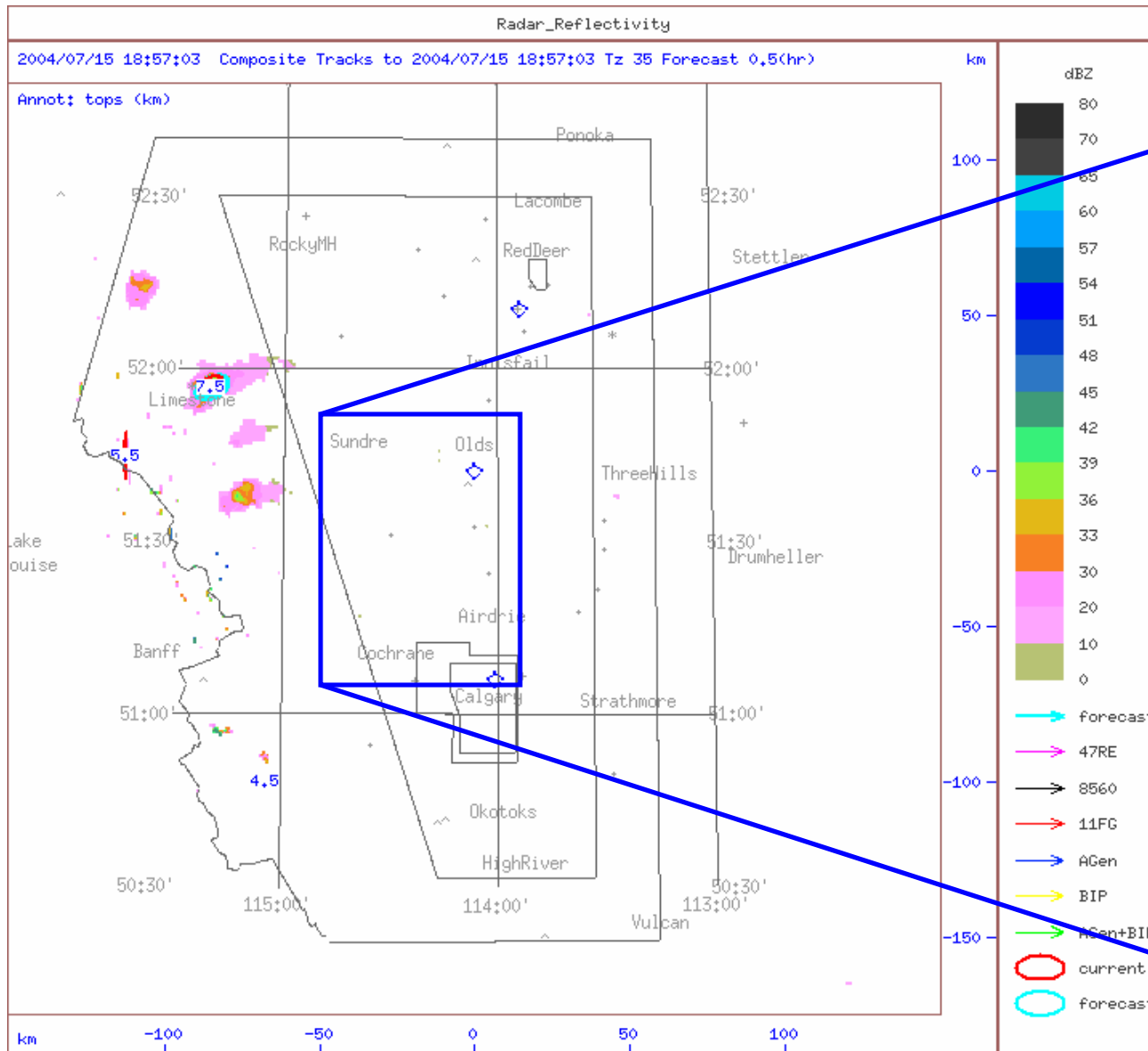
GPS



1100 LT

Radar

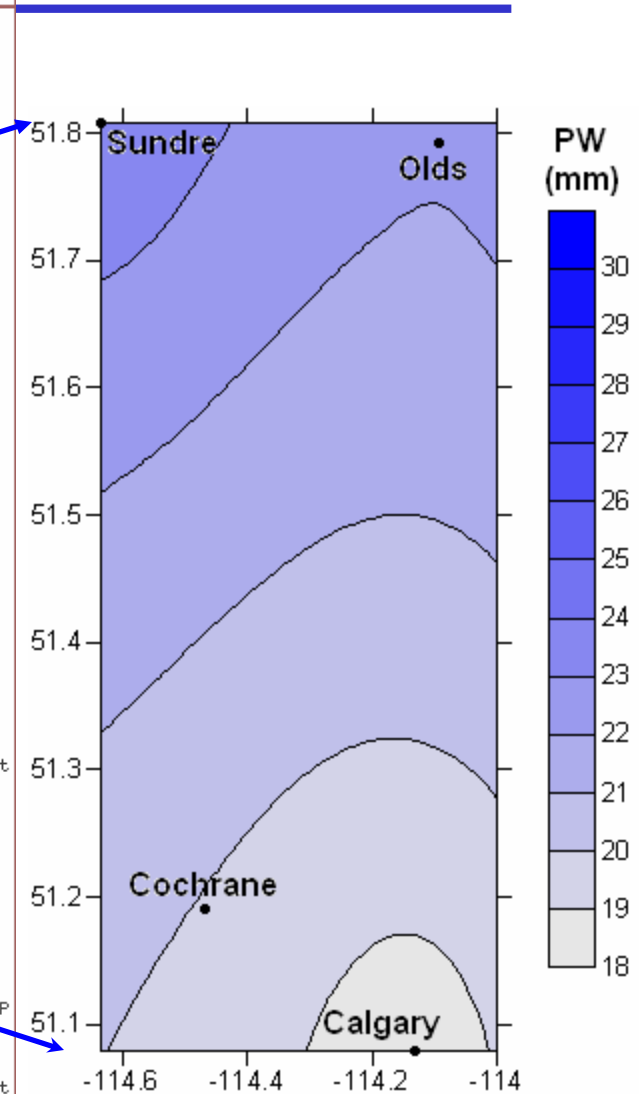
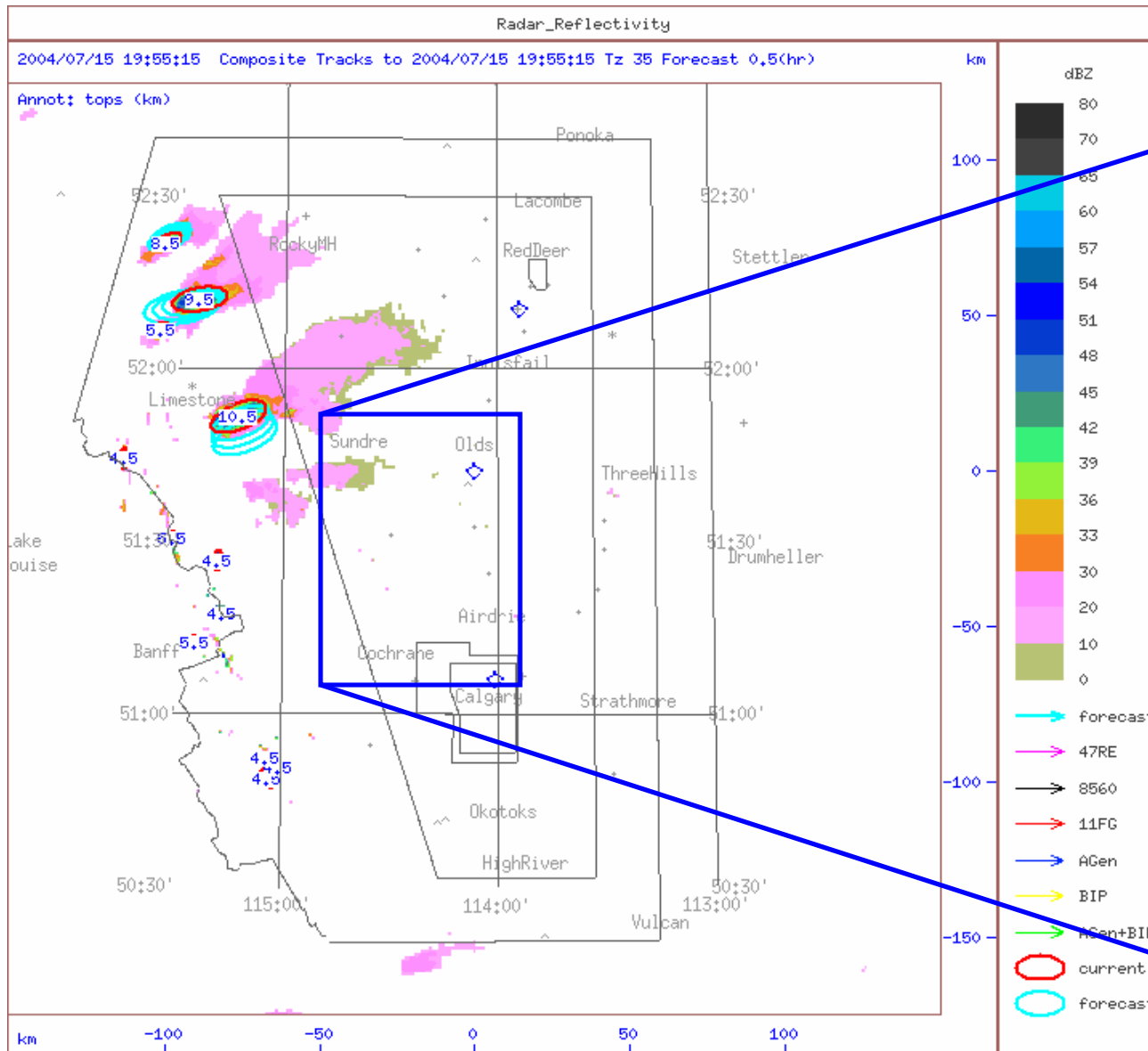
GPS



1200 LT

Radar

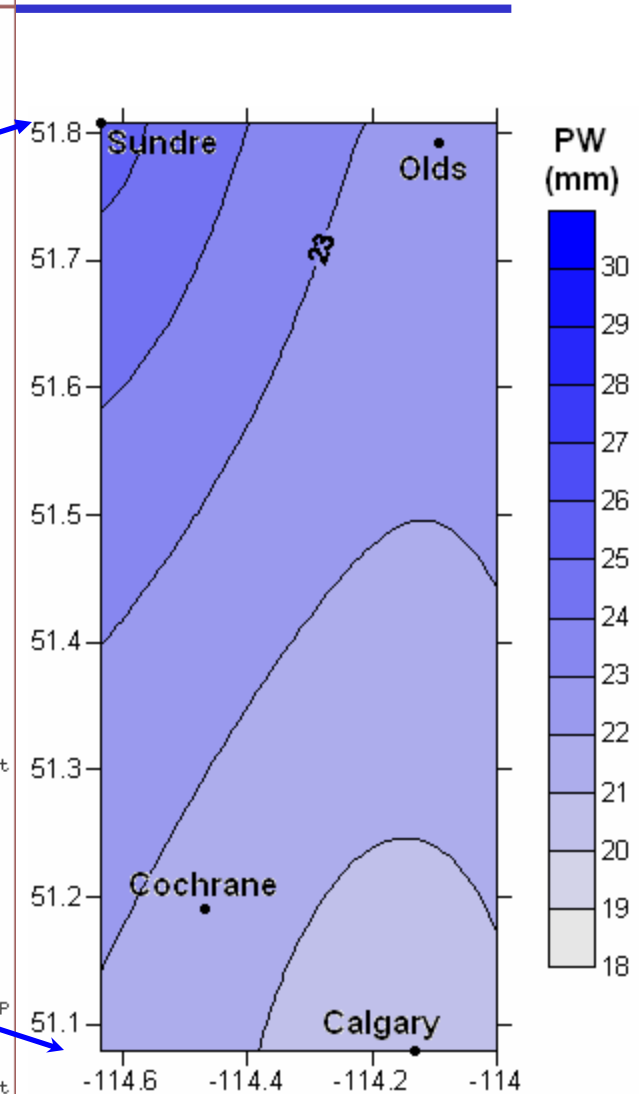
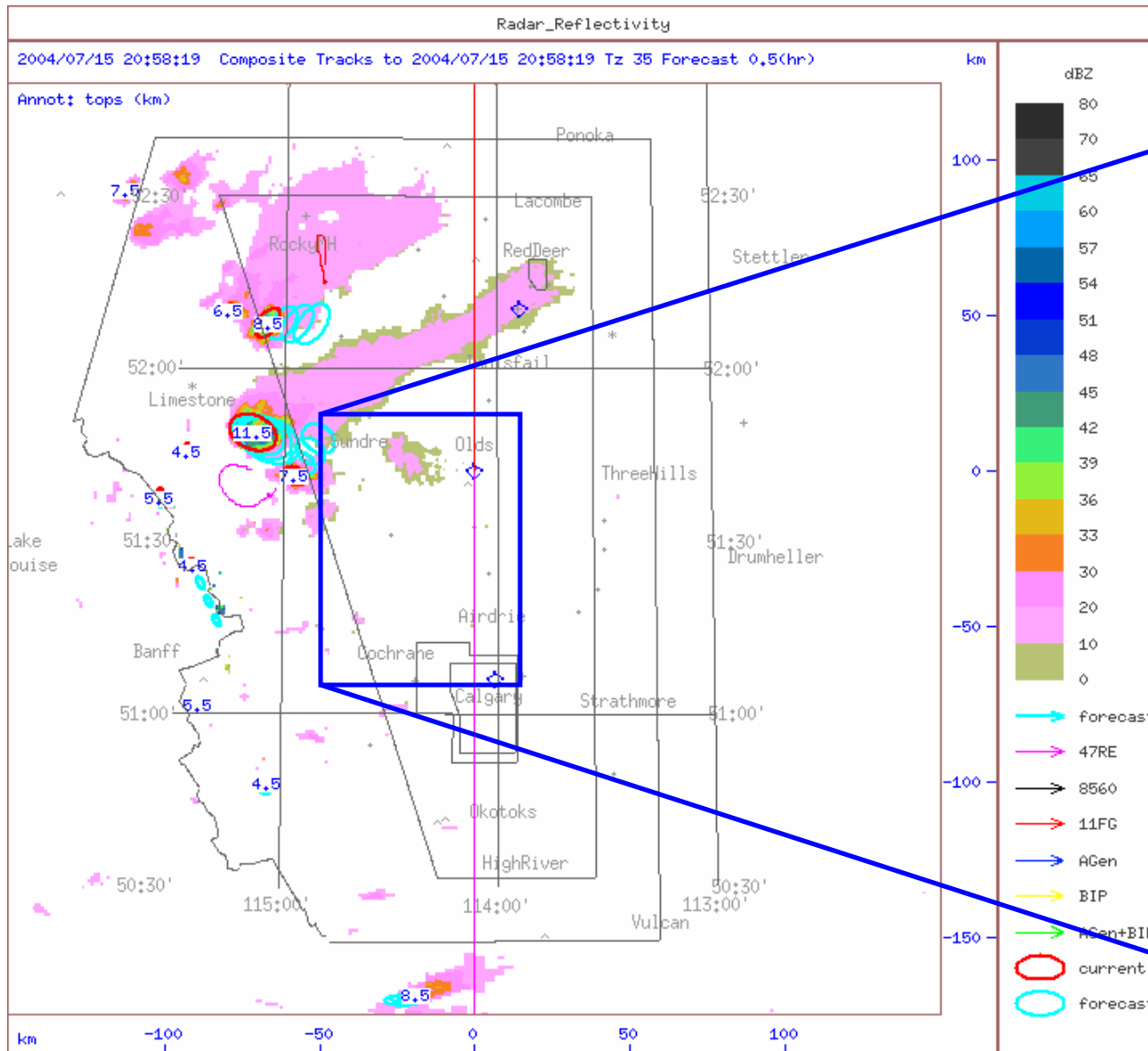
GPS



1300 LT

Radar

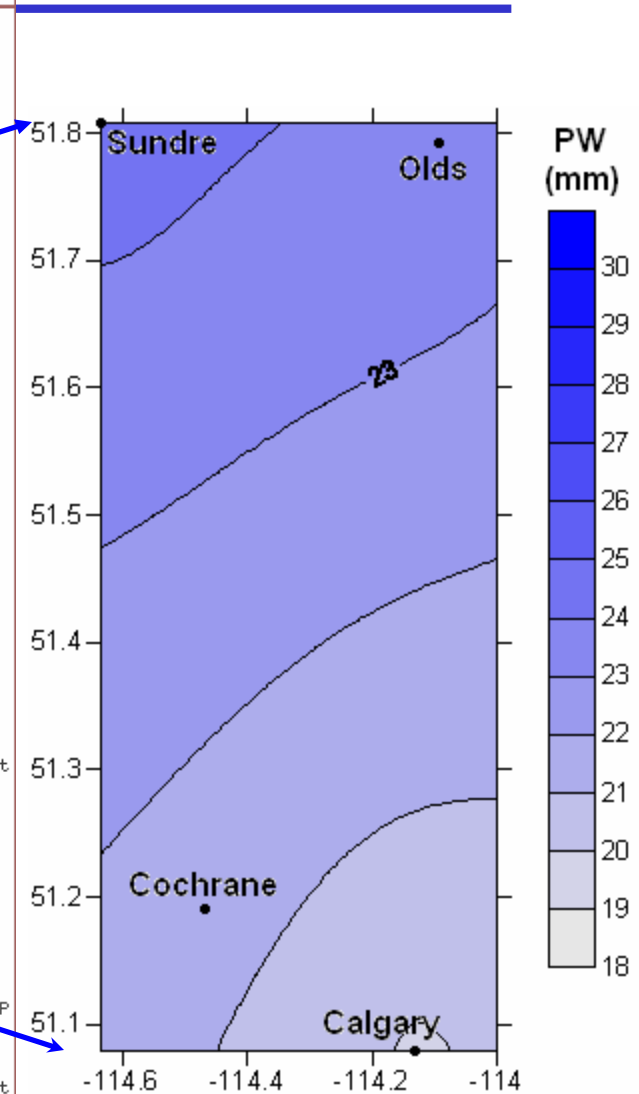
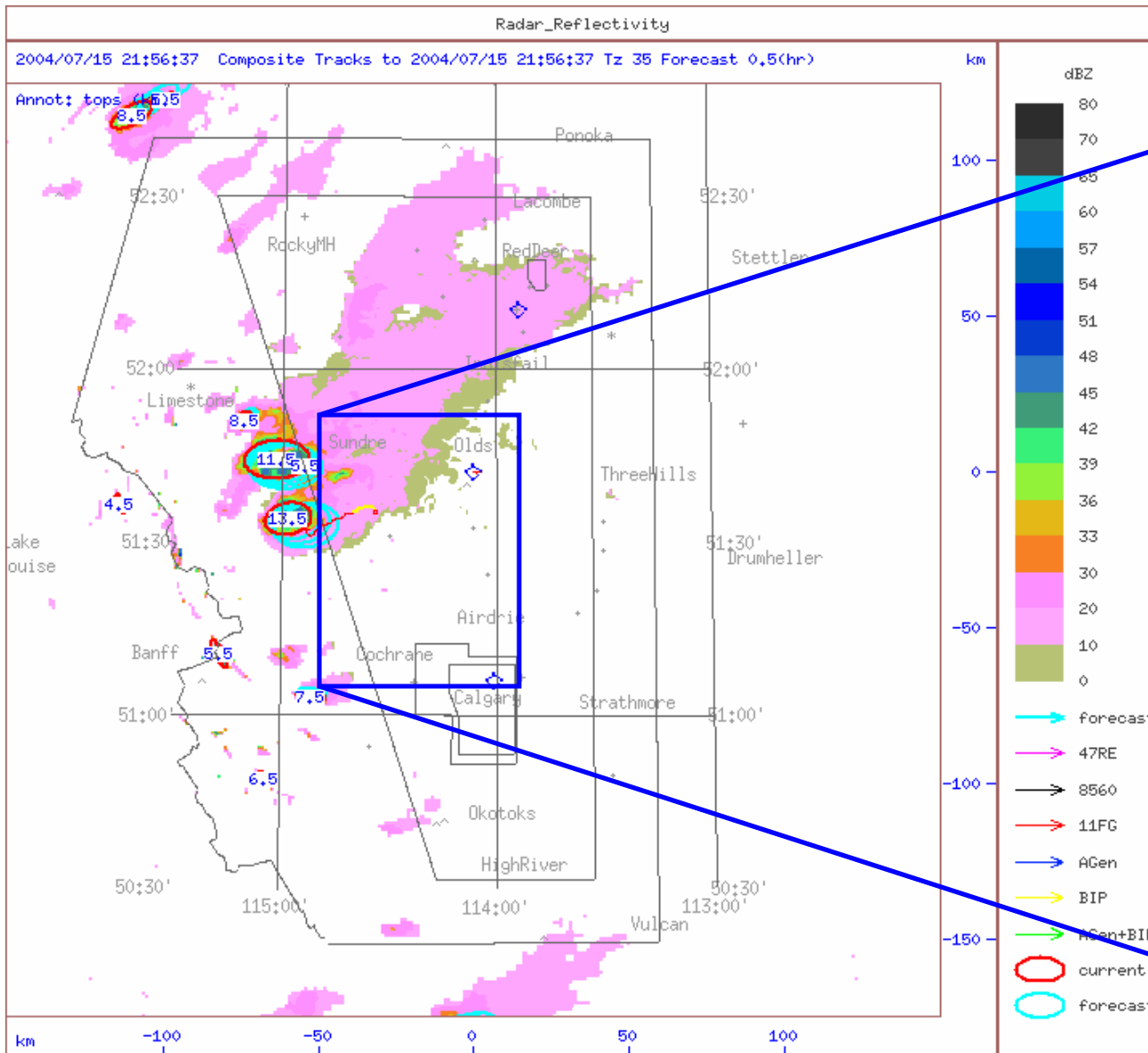
GPS



1400 LT

Radar

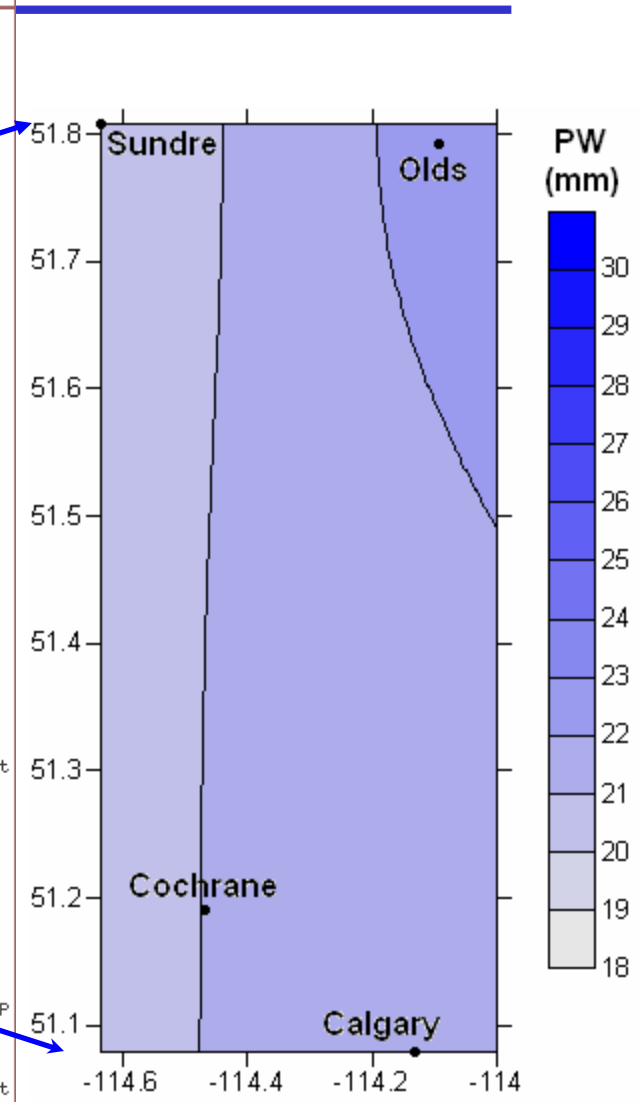
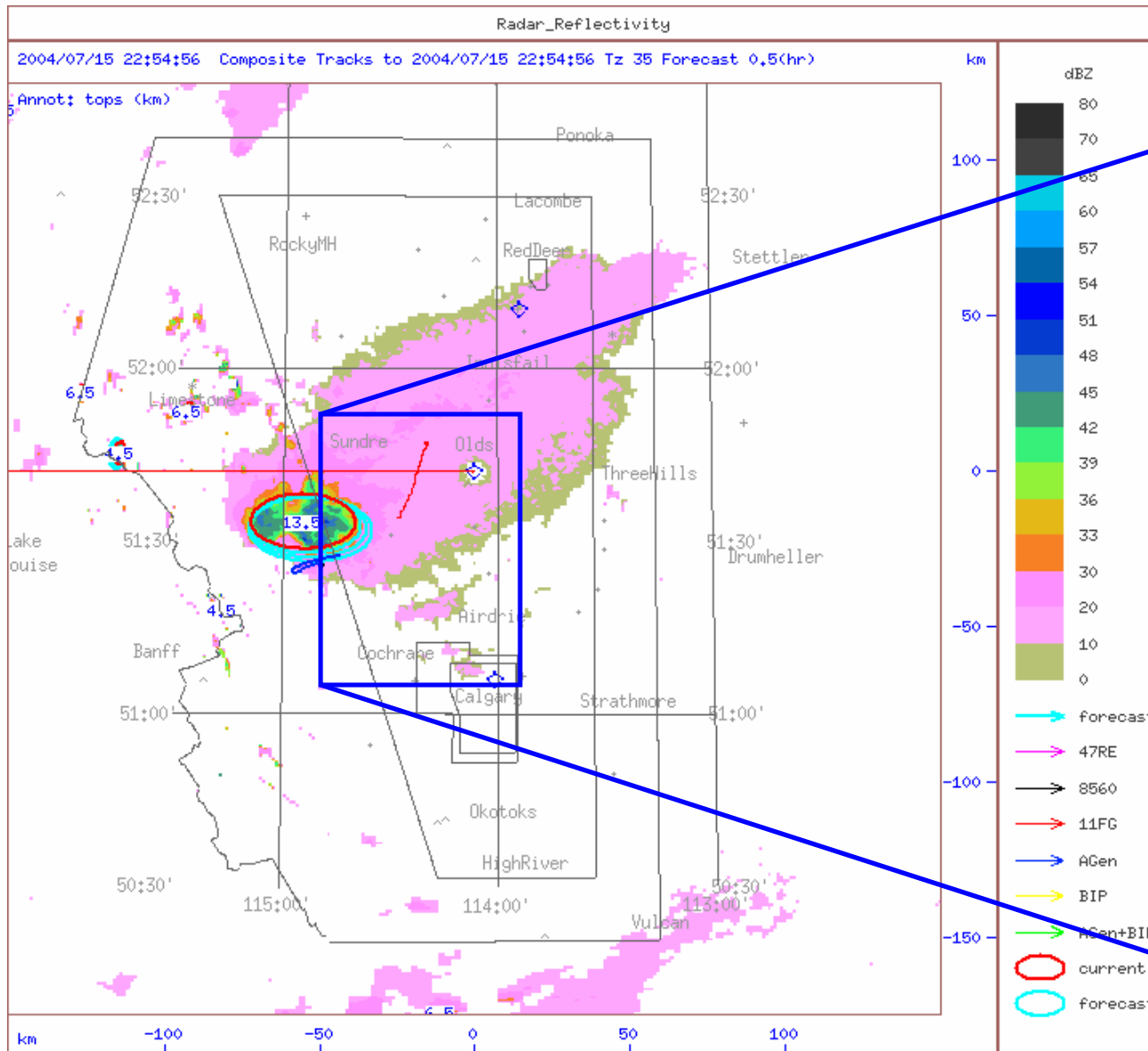
GPS



1500 LT

Radar

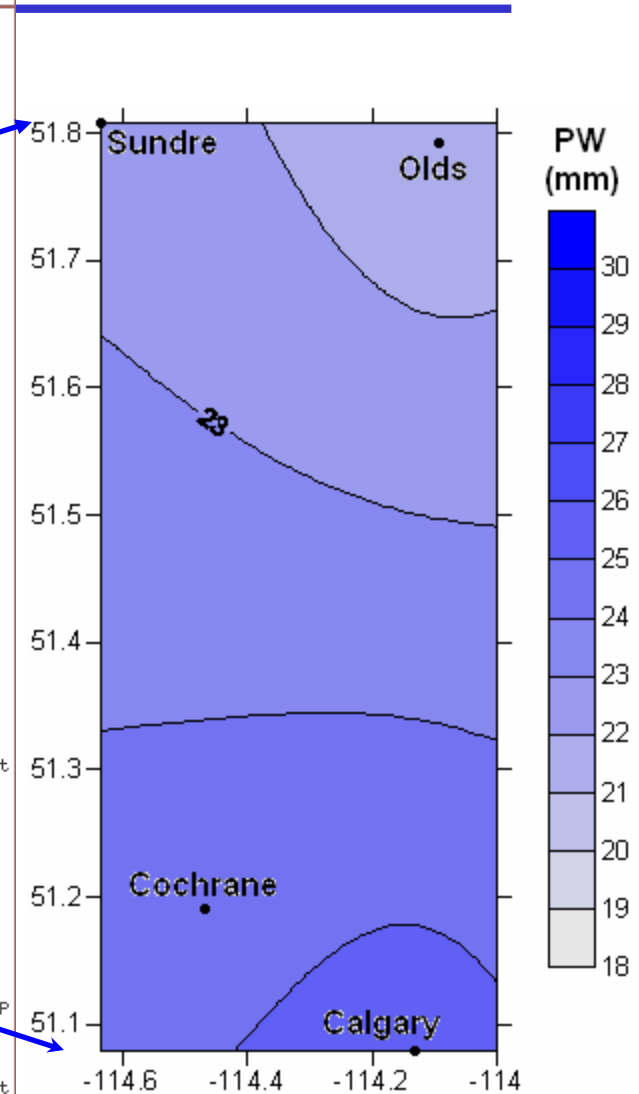
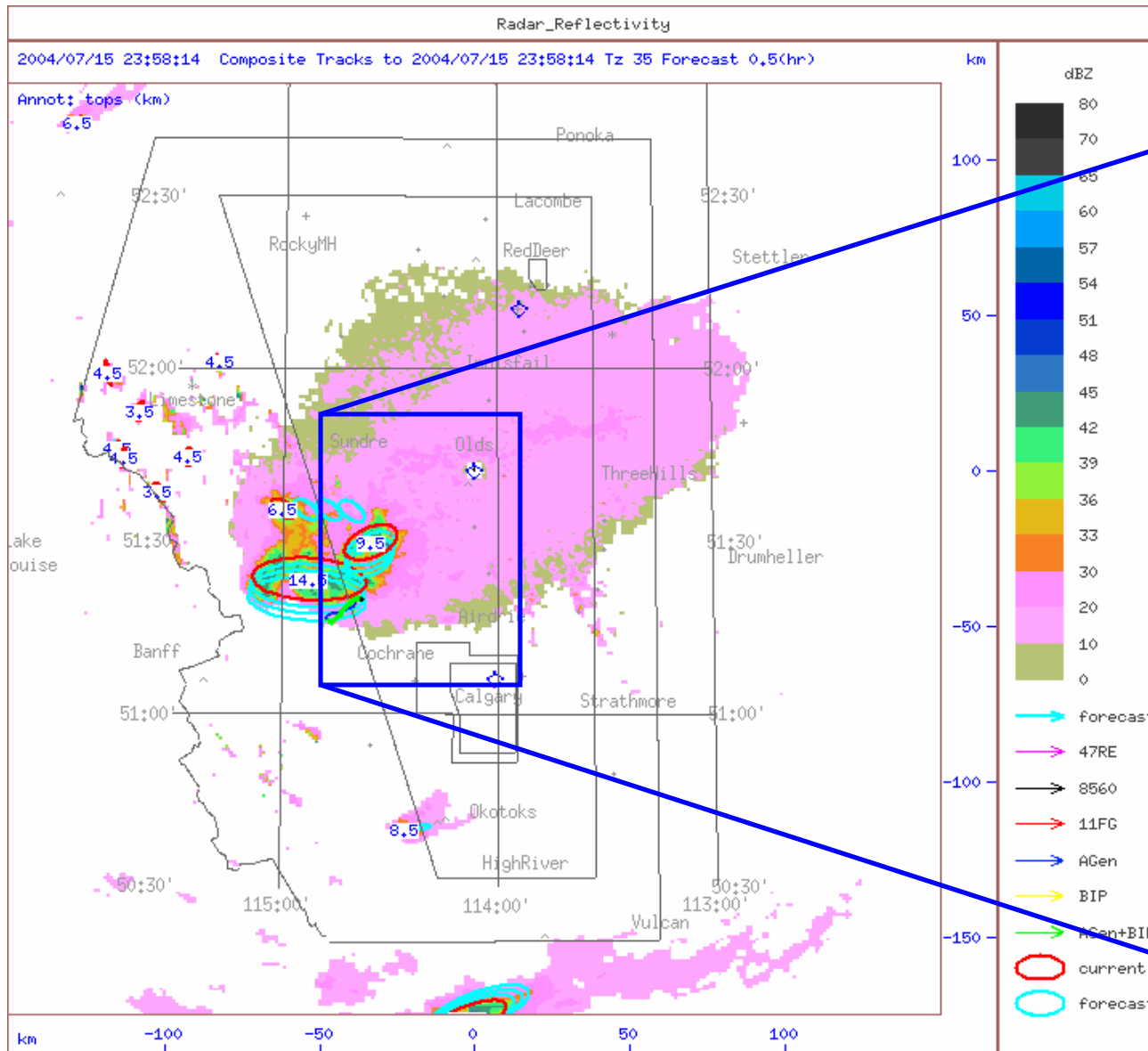
GPS



1600 LT

Radar

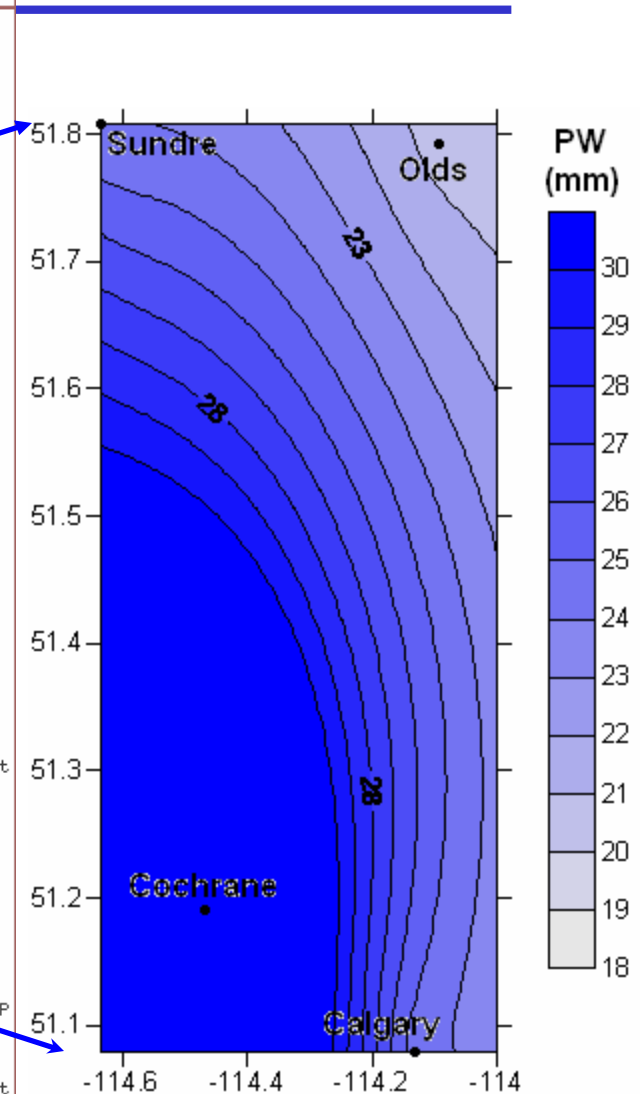
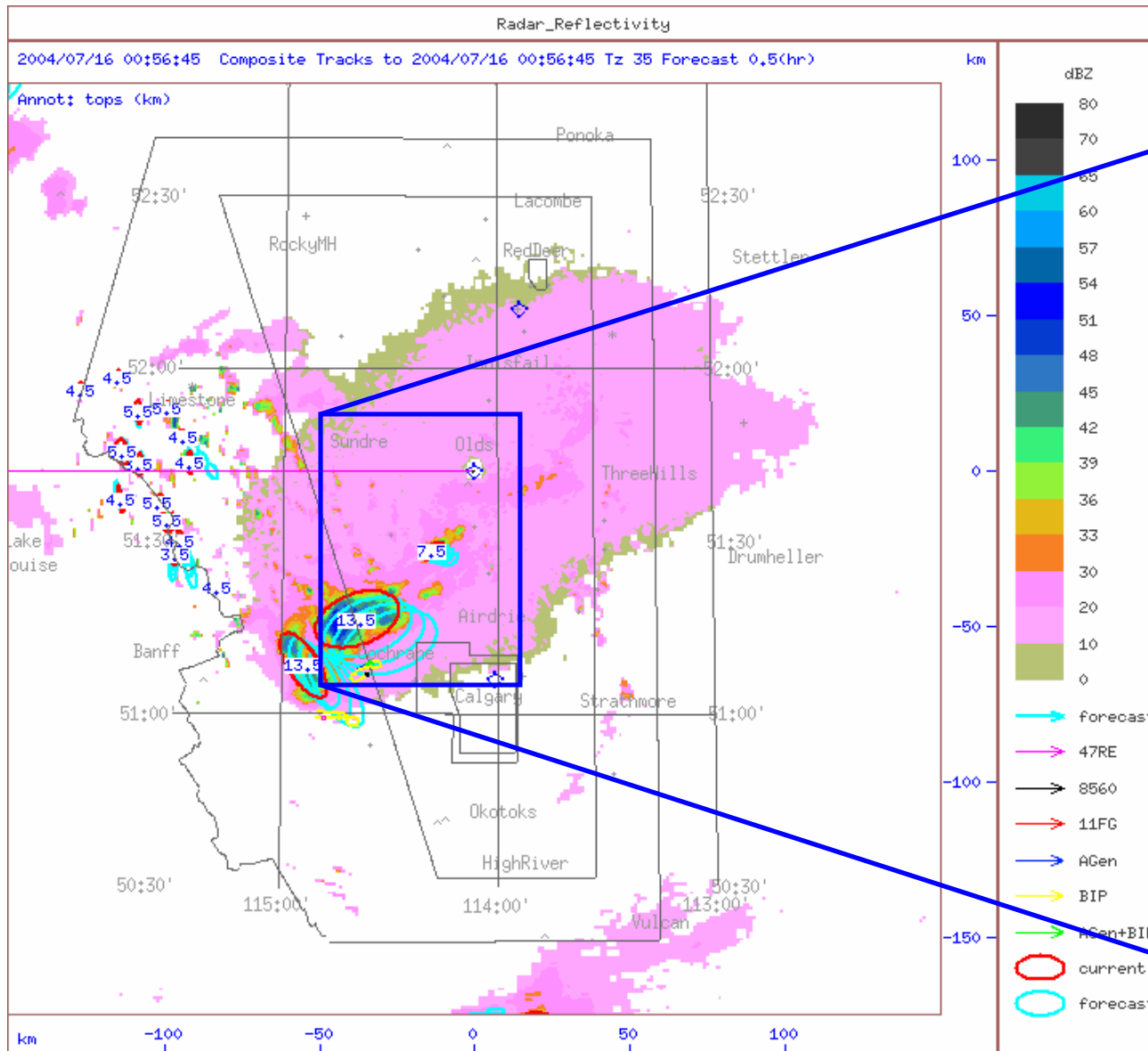
GPS



1700 LT

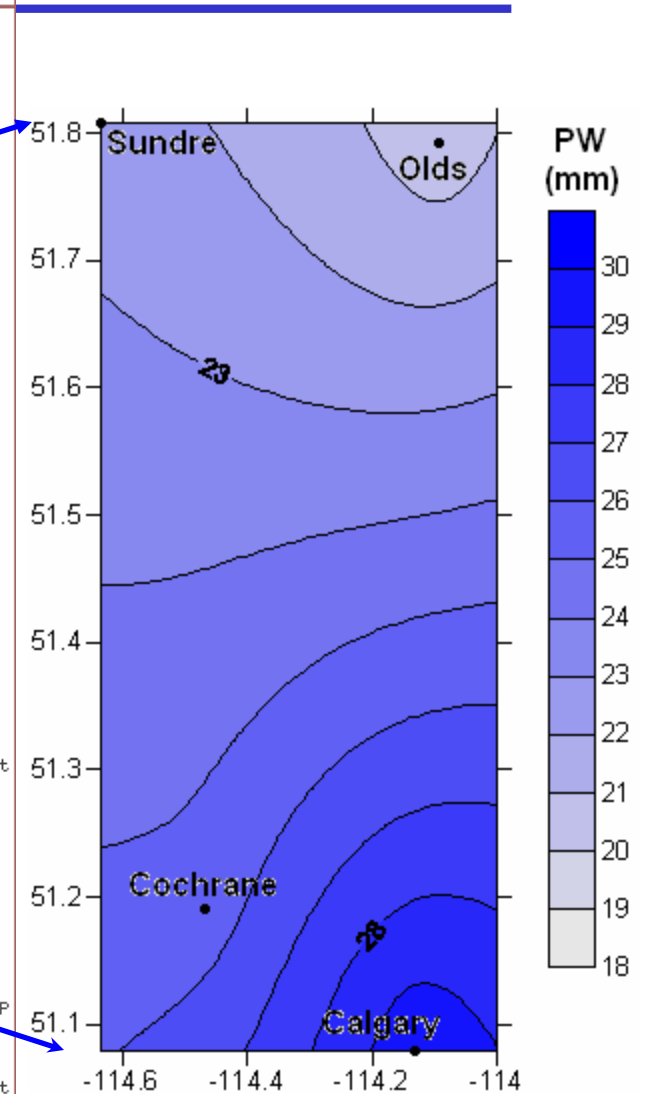
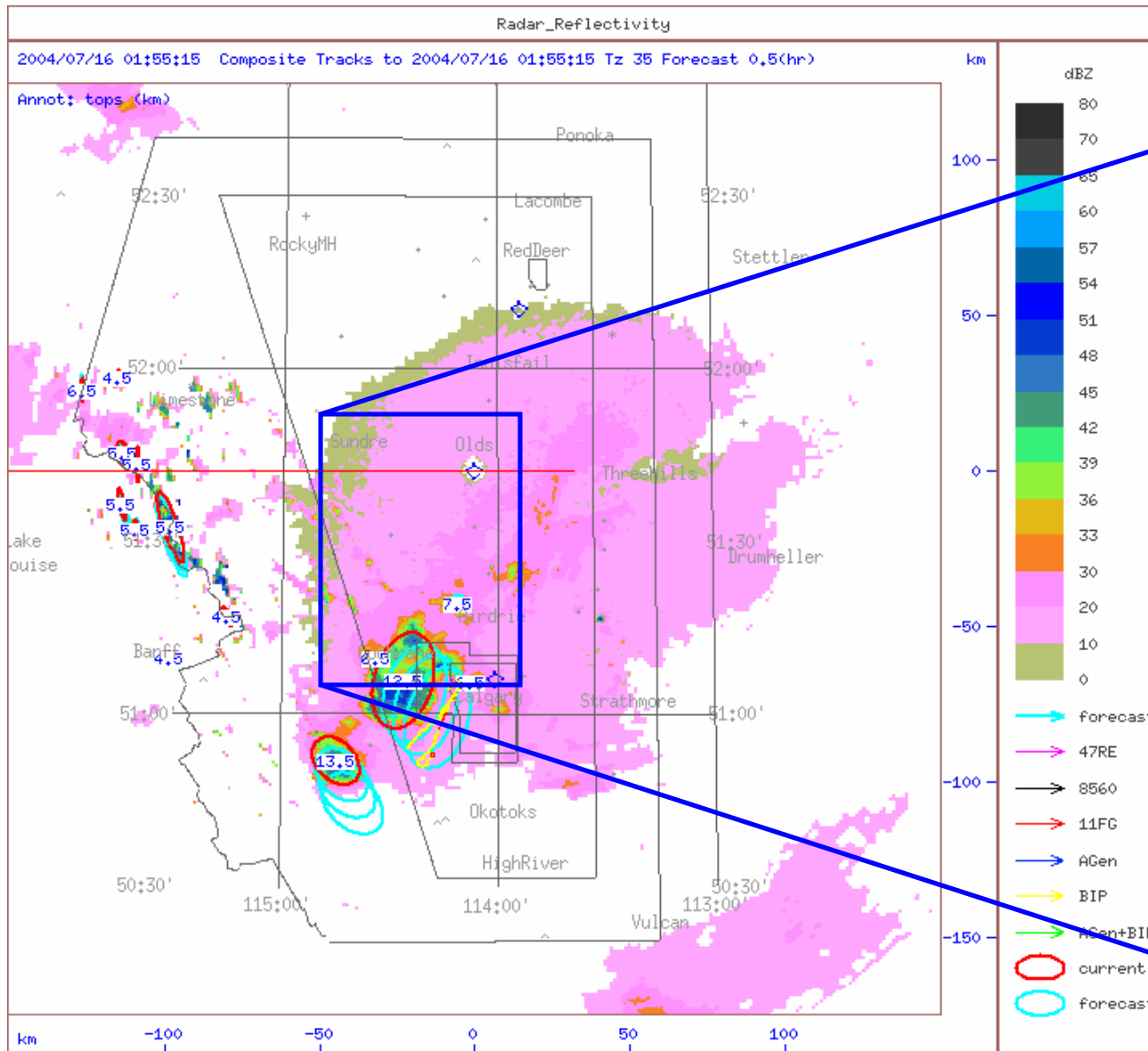
Radar

GPS



Radar

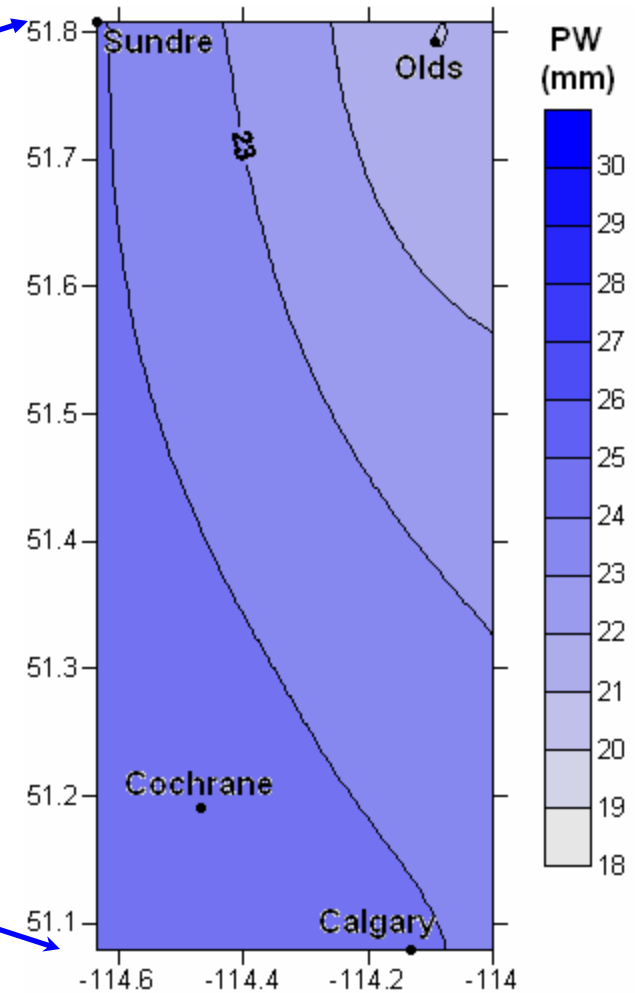
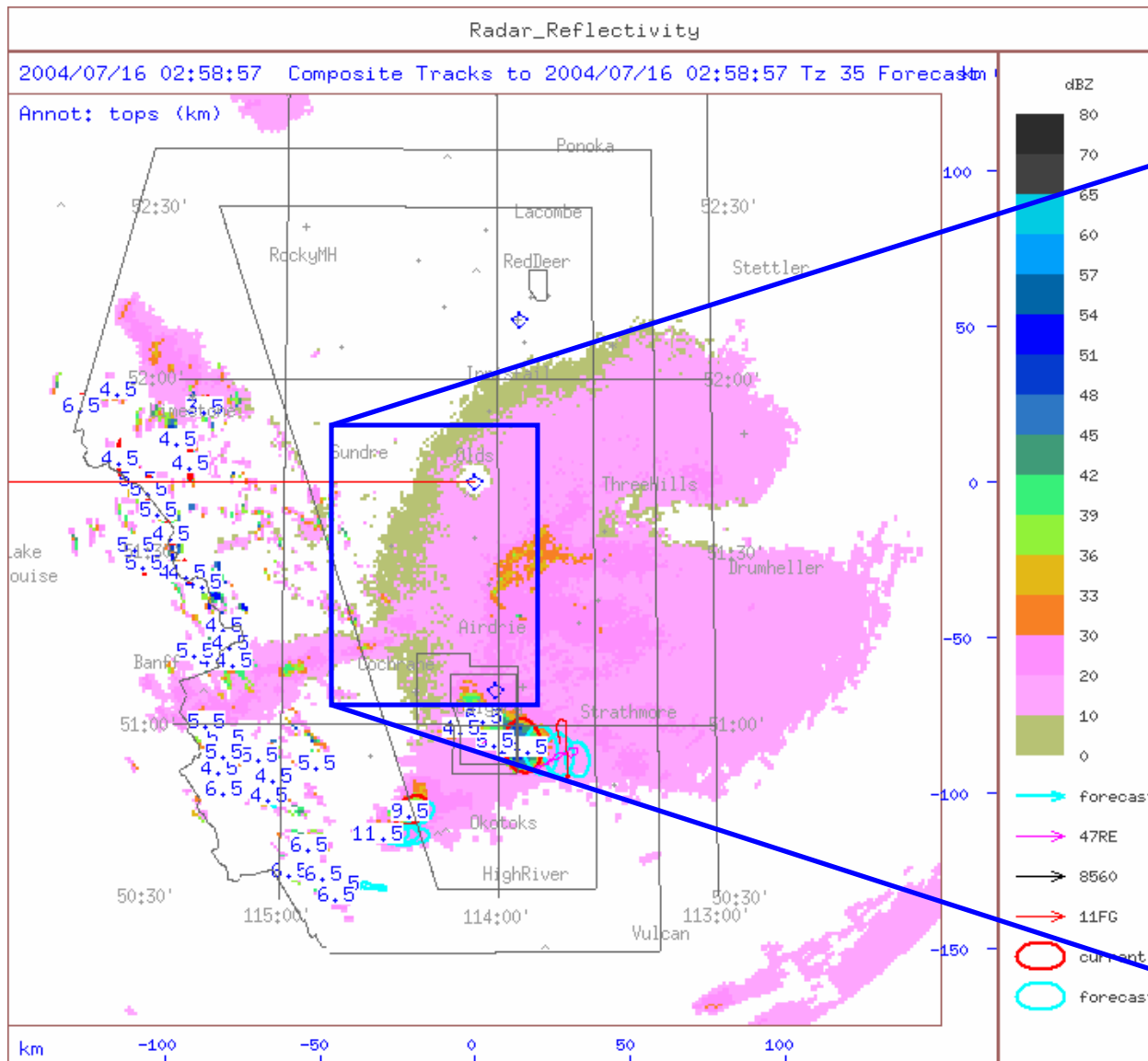
GPS



1900 LT

Radar

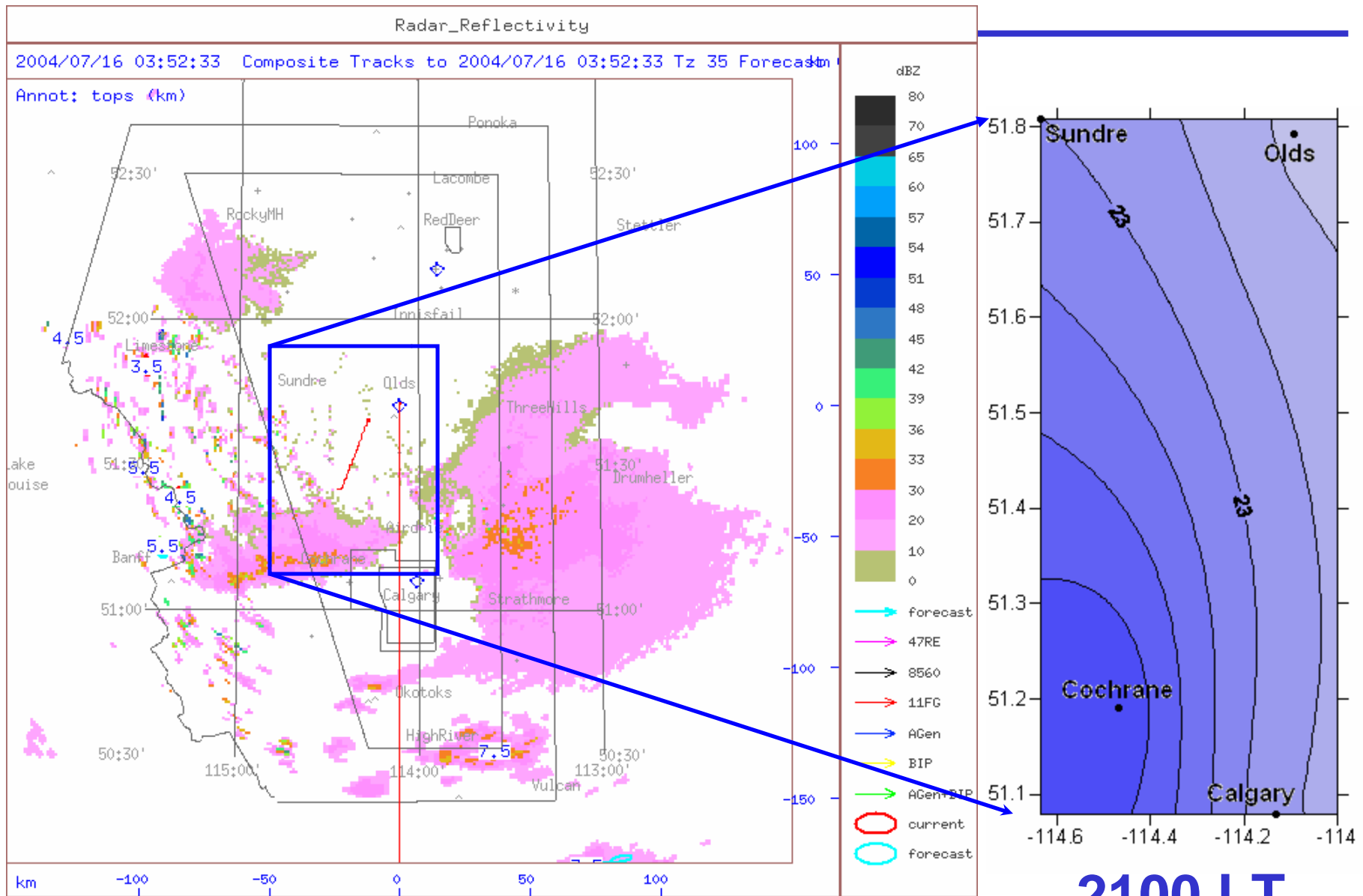
GPS



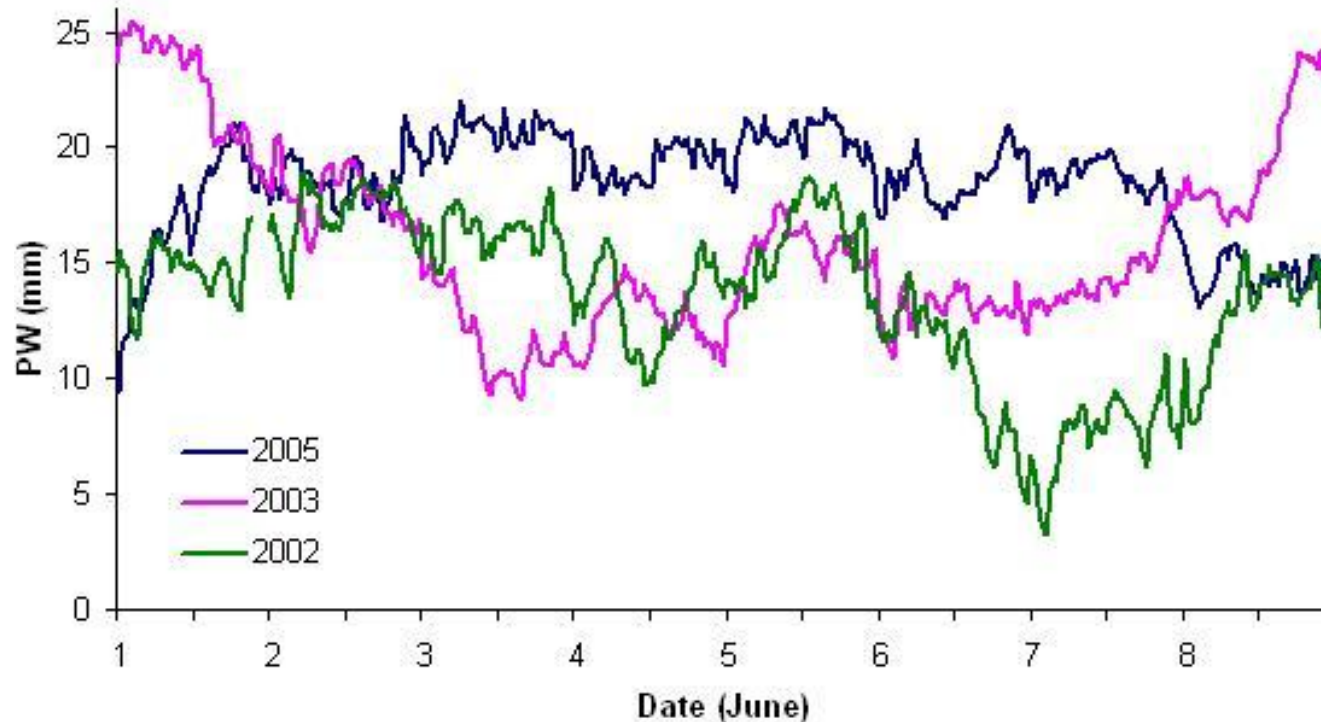
2000 LT

Radar

GPS

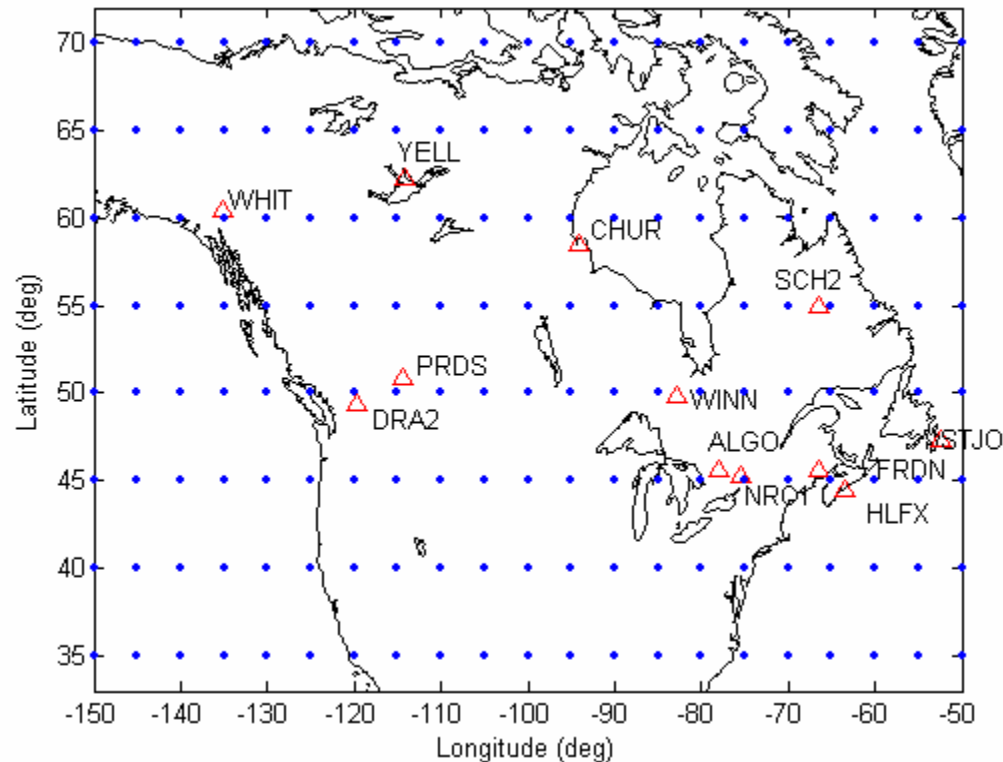


Annual Variations at Calgary



- June 1-8 period compared for 2002, 2003 and 2005
- Larger values consistent with flooding in 2005

Real-time National Database



- GEOIDE NCE project
- Partner NRCan provides real-time data streams from 13 sites
- Real-time PWV database processed centrally at U of C

Summary

- Several years of southern Alberta PWV estimates available
- Southern Alberta network operation to continue with some industry support
- Potential access to further Alberta data through industry partnership
- Real-time national PWV database under development