Modelling the Ionosphere for ASKAP

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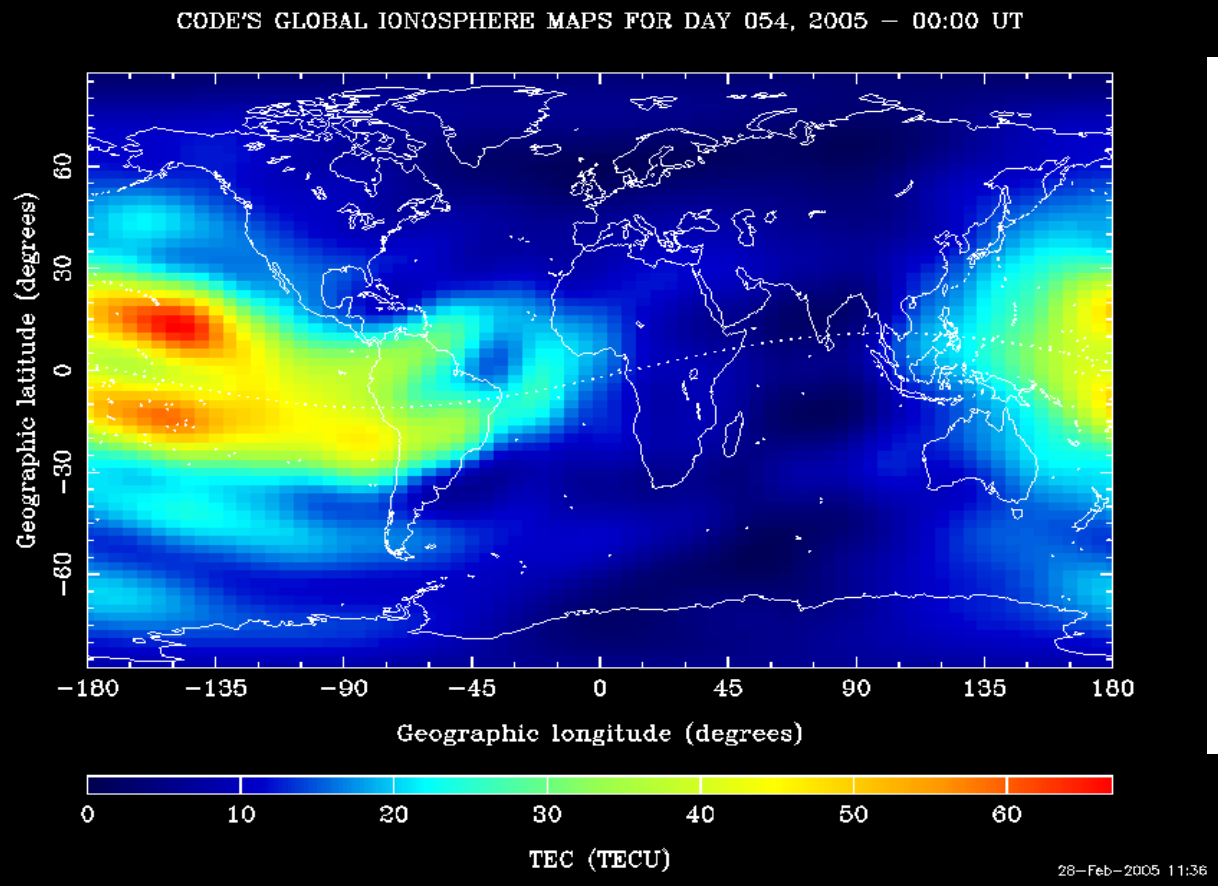
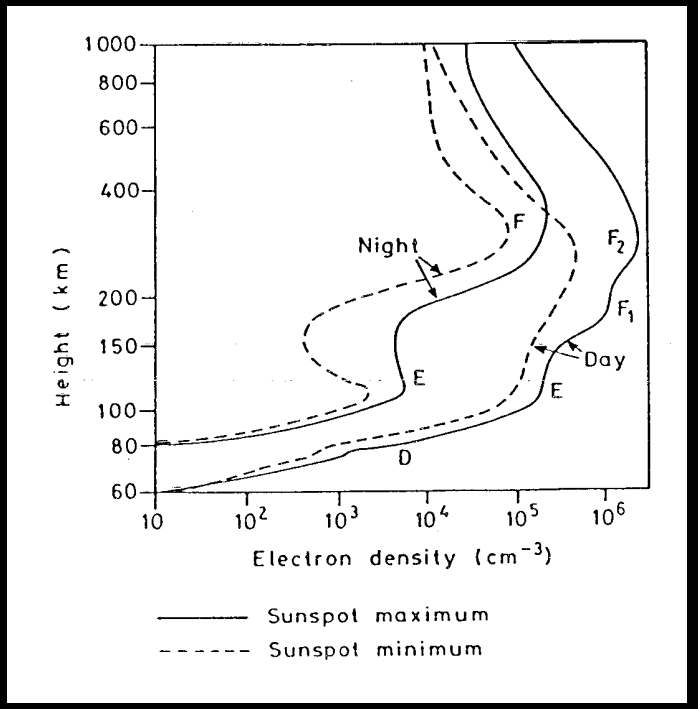
Why do we need to worry about the ionosphere?

- The ionosphere is a magnetized plasma
- Faraday rotation in the ionosphere can fluctuate from 1 to 10 rad m^{-2}
- Ionospheric RM varies with pointing direction and time of day and time of year
- Ionospheric RM has to be corrected sample by sample (approximately every 30 seconds)
- We need a tool that will predict Ionospheric RM on this timescale

Ionosphere Varies with Latitude, Longitude, and HEIGHT





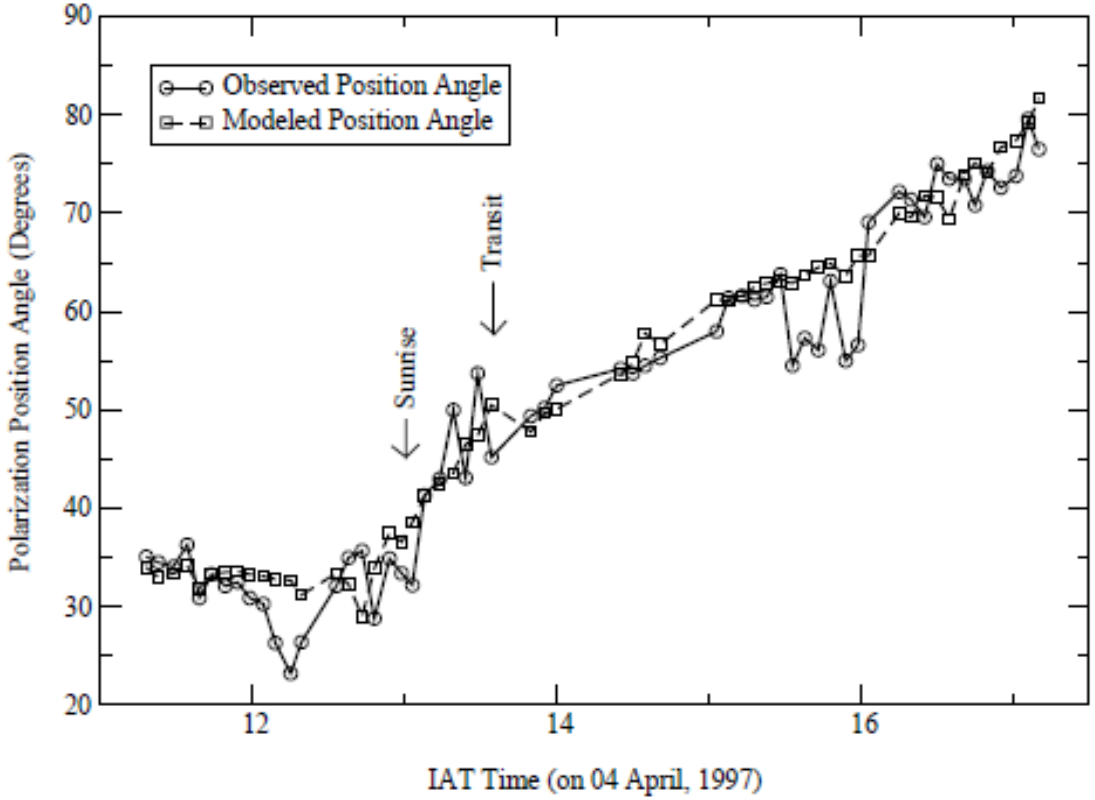
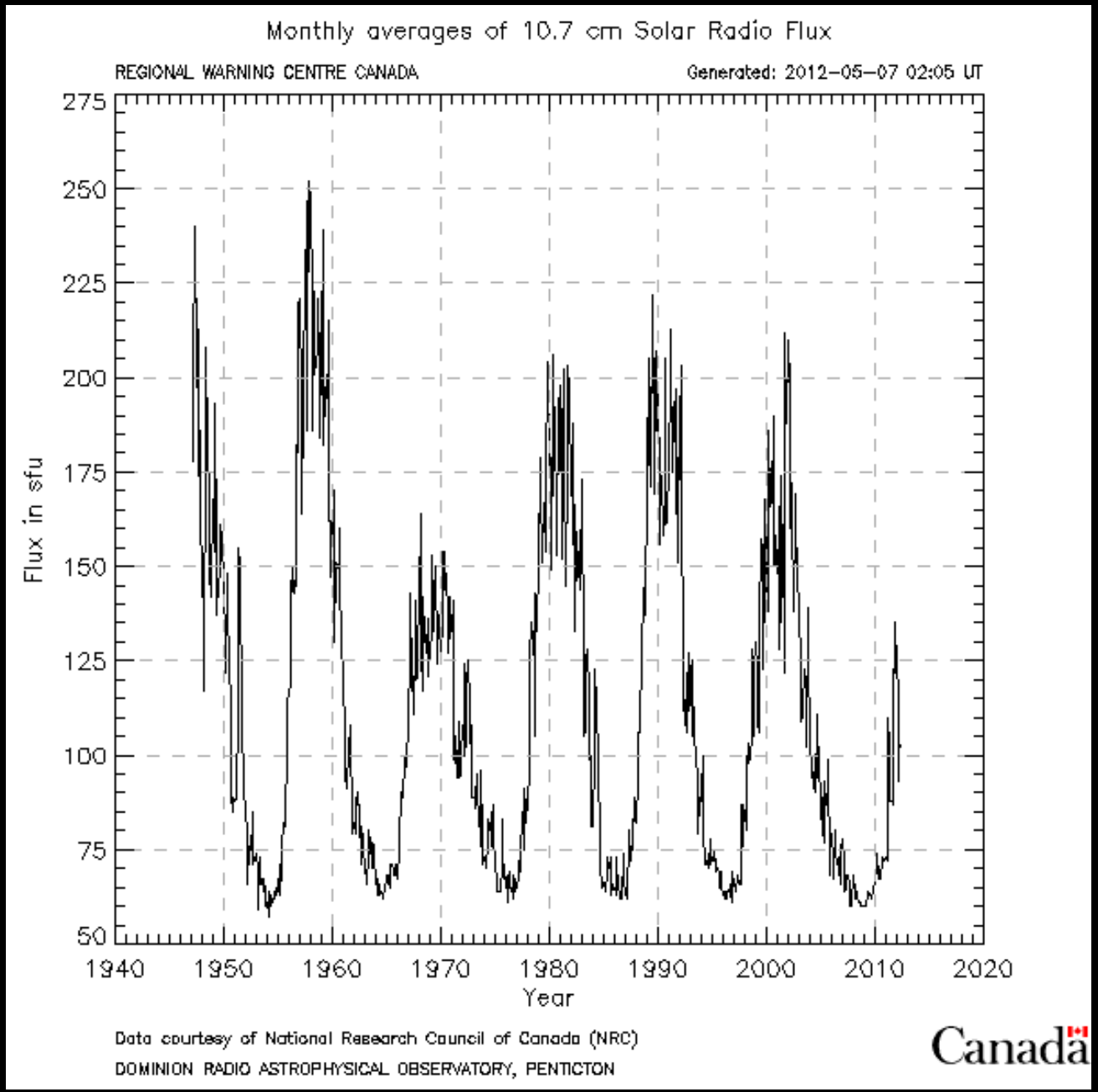


Fig. 9. The change of observed and predicted plane of polarization of the pulsar PSR 1932+109 through dawn on 4 April 1997. The standard deviation between the observation and the model for a single 5-min integration is $4.^{\circ}7$. The standard deviation of the mean of the 59 integrations, i.e. $4.^{\circ}7/\sqrt{58}$, is $0.^{\circ}6$

Erickson et al. (2001) VLA 322 MHz


Monthly averages of 10.7 cm Solar Radio Flux
REGIONAL WARNING CENTRE CANADA
Generated: 2012-05-07 02:05 UT
Flux in sfu
275
250
225
200
175
150
125
100
75
50
1940
1950
1960
1970
1980
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2010
2020
Year
Data courtesy of National Research Council of Canada (NRC)
DOMINION RADIO ASTROPHYSICAL OBSERVATORY, PENTICTON
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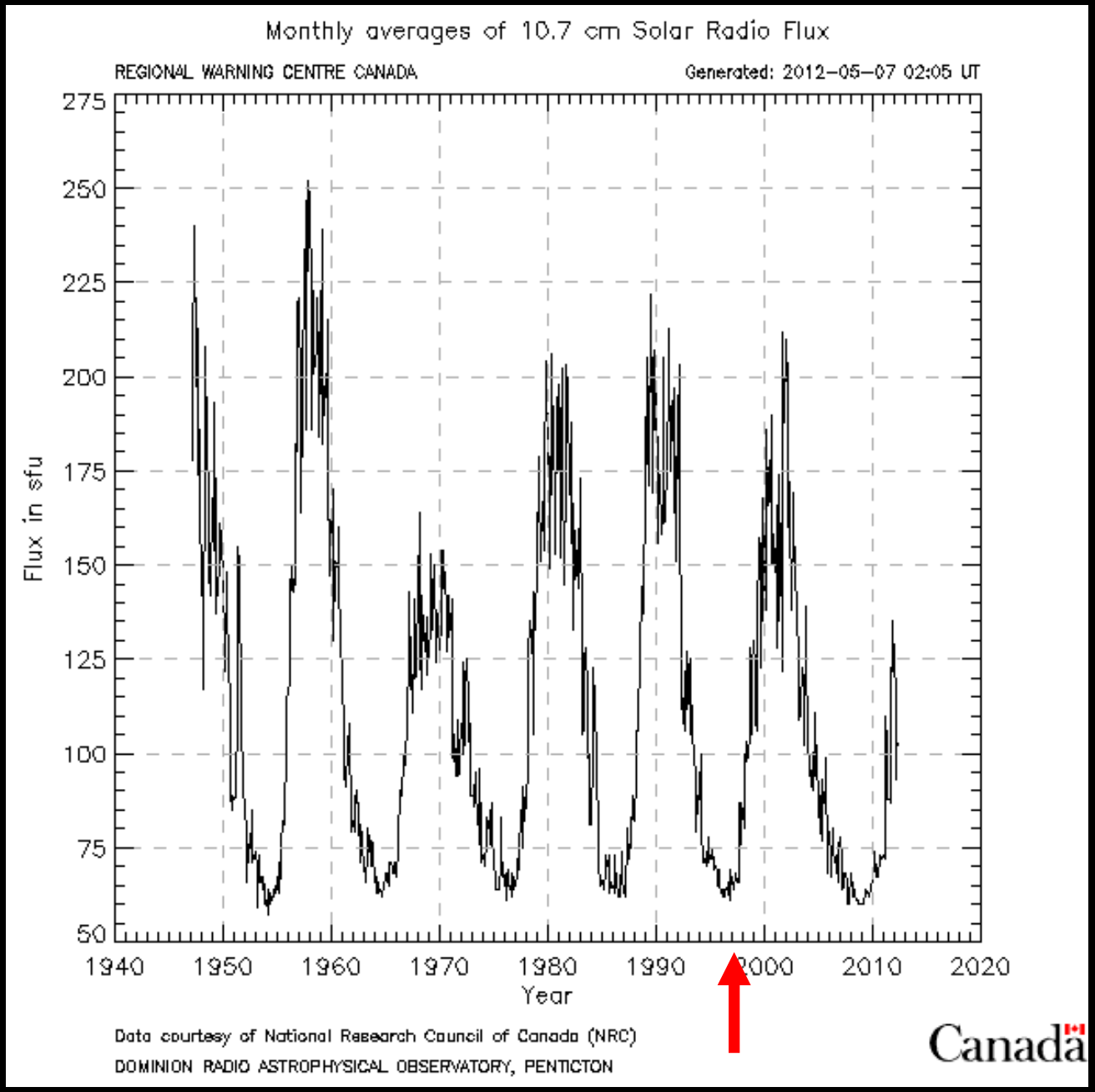
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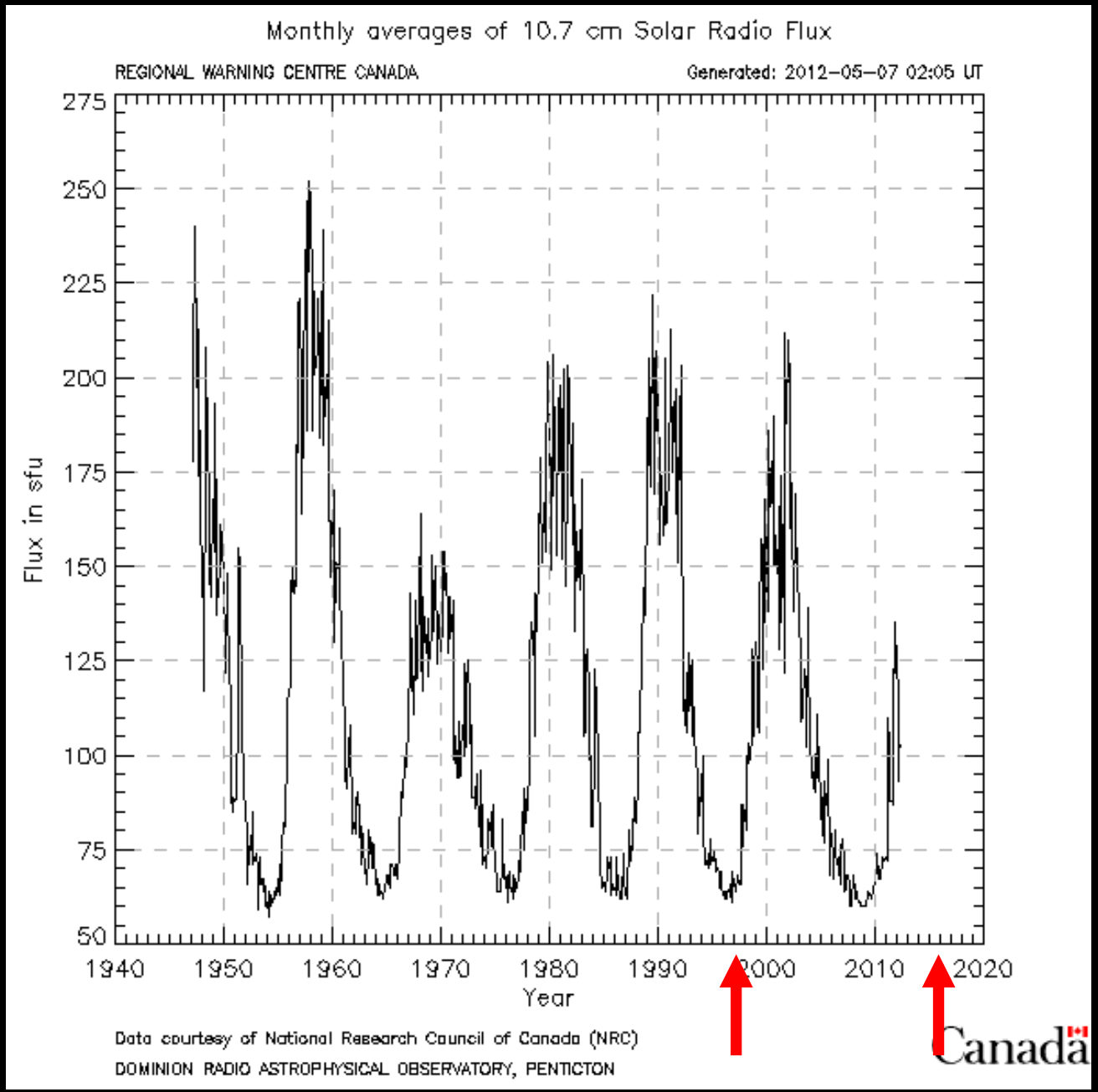
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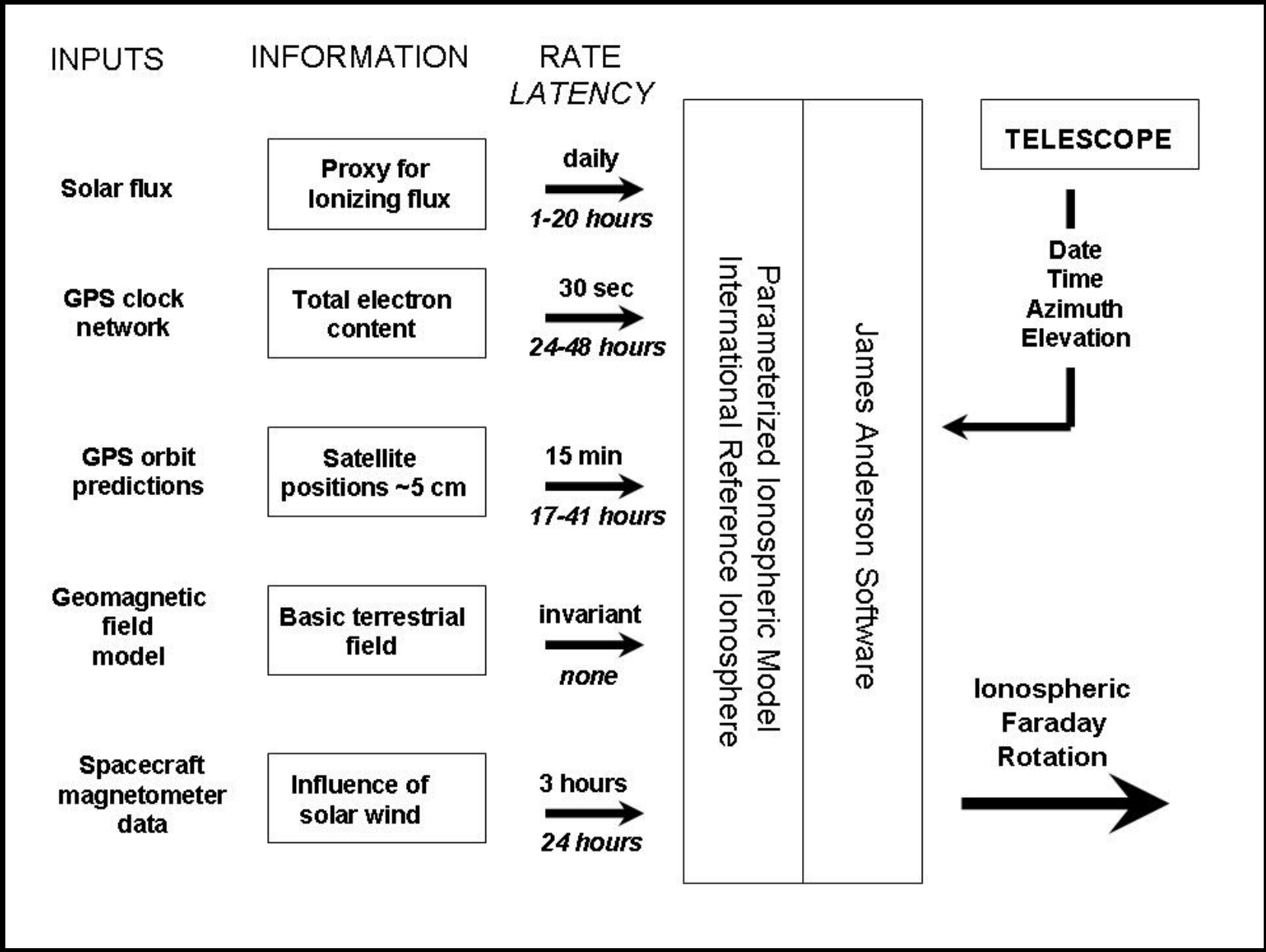
Available software

- All available software is based on GPS data
- All software packages use either the International Reference Ionosphere or the Parameterized Ionospheric Model
- Most software packages use a quasi-static model of the geomagnetic field
- James Anderson's software promises greater precision

Information from GPS clocks

- GPS frequencies, L1 = 1575.42 MHz,
  L2 = 1227.60 MHz
- Measure difference in arrival time of modulation on L1 and L2, ΔT nSec
- Total Electron Content,
  TEC = 2.853 ΔT x 10^{16} electrons m^{-2}



James Anderson's Ionospheric Software