Precipitable water vapor at the Roque de los Muchachos Observatory from GPS measurements

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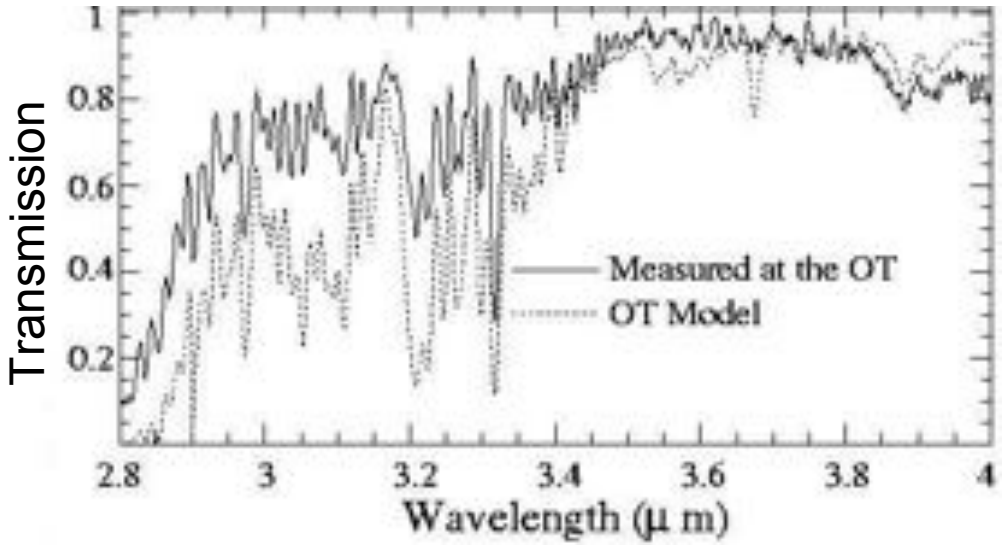
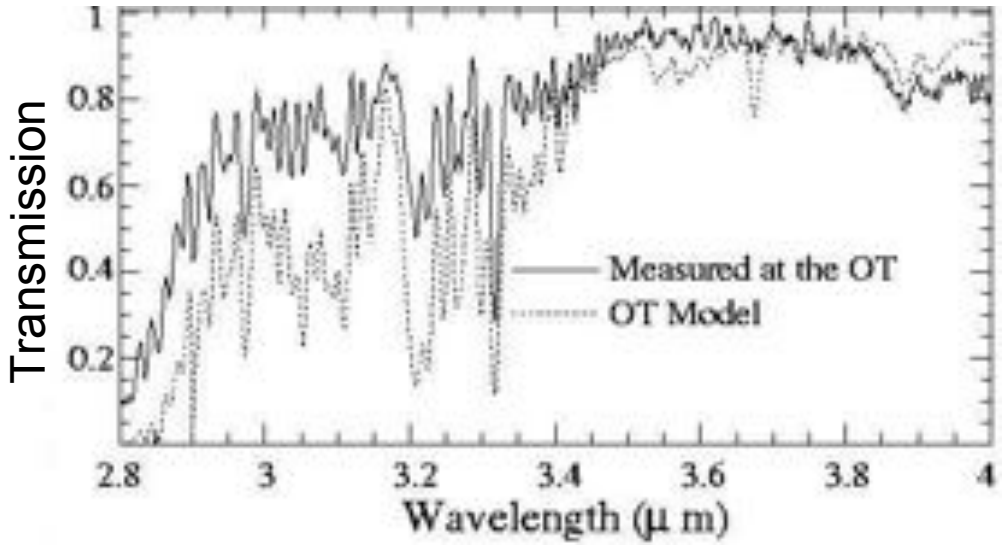
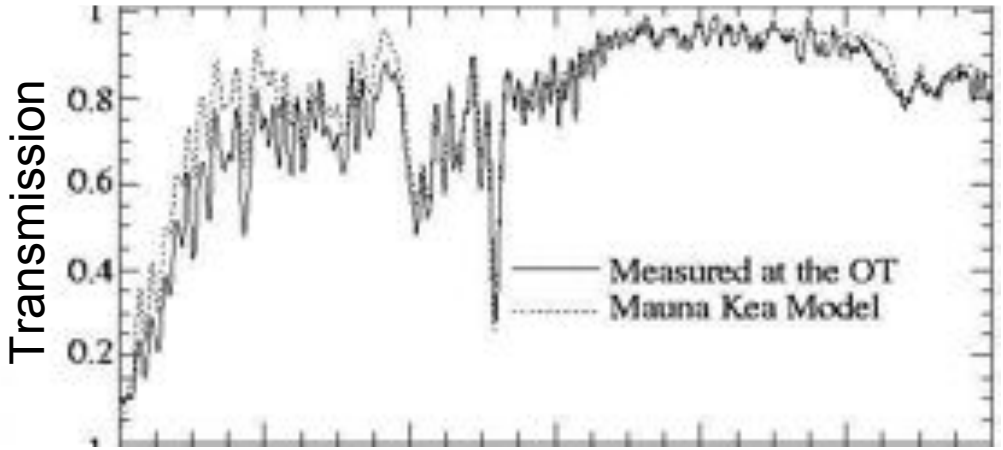
Introduction



Altitude: 2400 m

Introduction





Altitude: 2400 m

Altitude: 4100 m

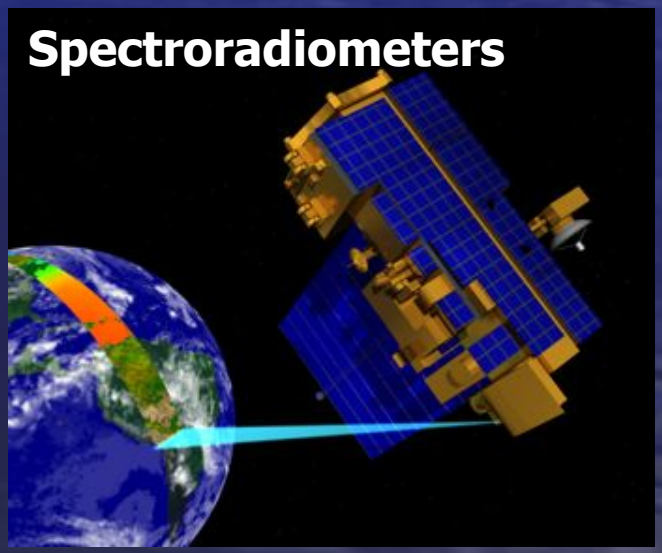
Introduction


Radio sondes

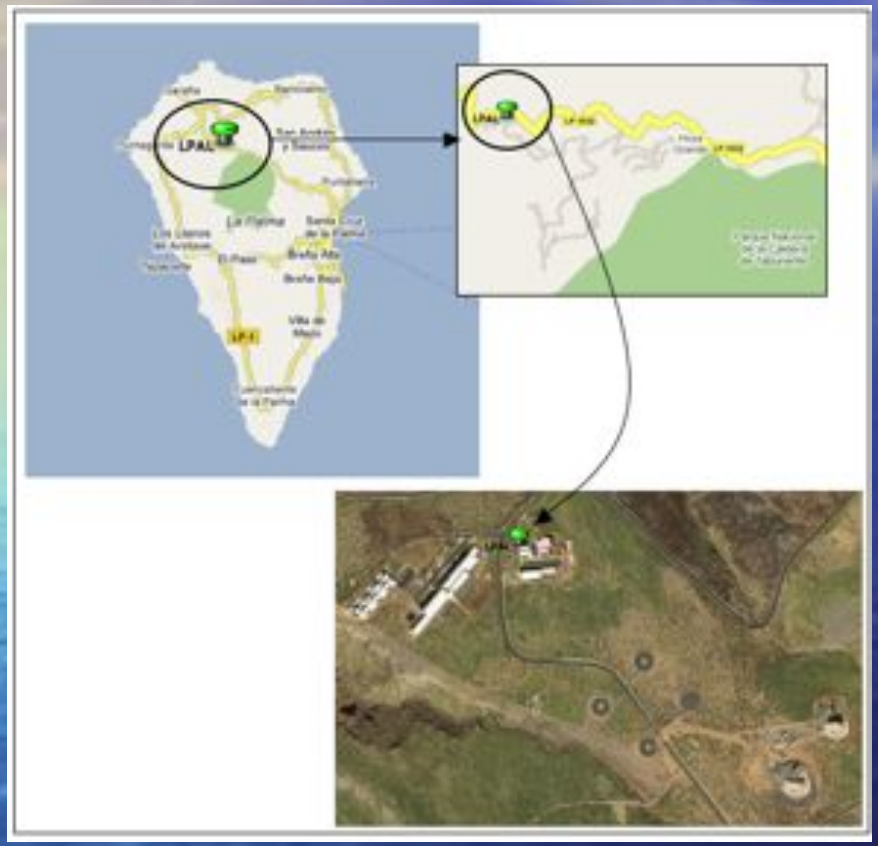

Photometers


GPS

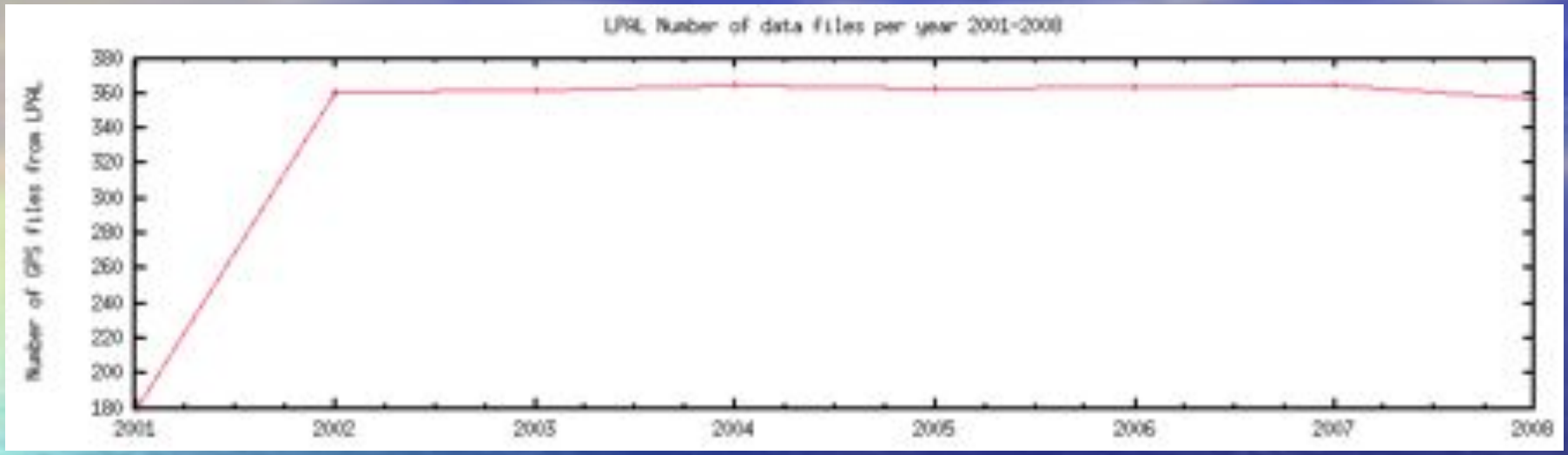

Radiometers

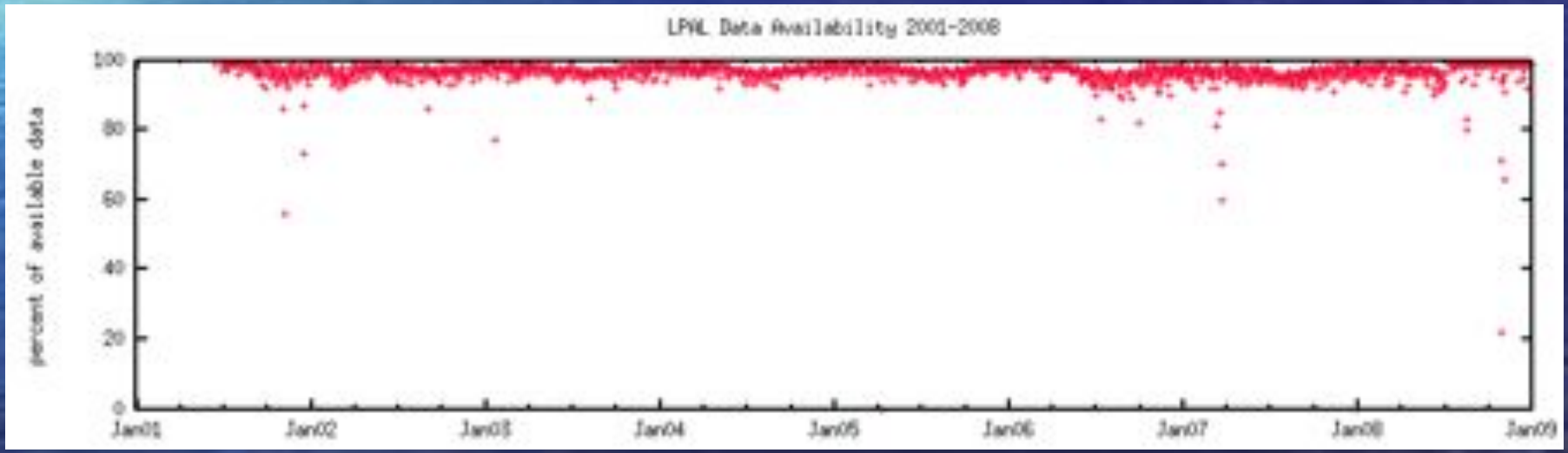

Spectroradiometers

GPS station LPAL



GPS station data at LPAL





GPS processing

- Time is distance; $PR_{code} = c(t_r - T_t)$
- Actually times are not synchronized:

$$PR_{code} = c[(t_r + dt_r) - (T_t + dT_t)]$$

- Where: dt_r ; rcvr clock error,
  dT_t ; sat. clock error.
- The PR_{code} is also influenced by atmospheric delay and other errors;

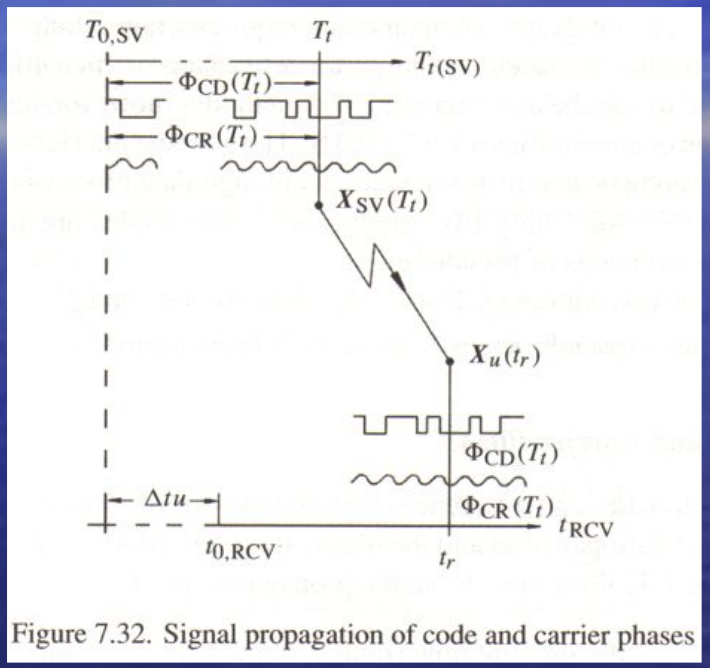


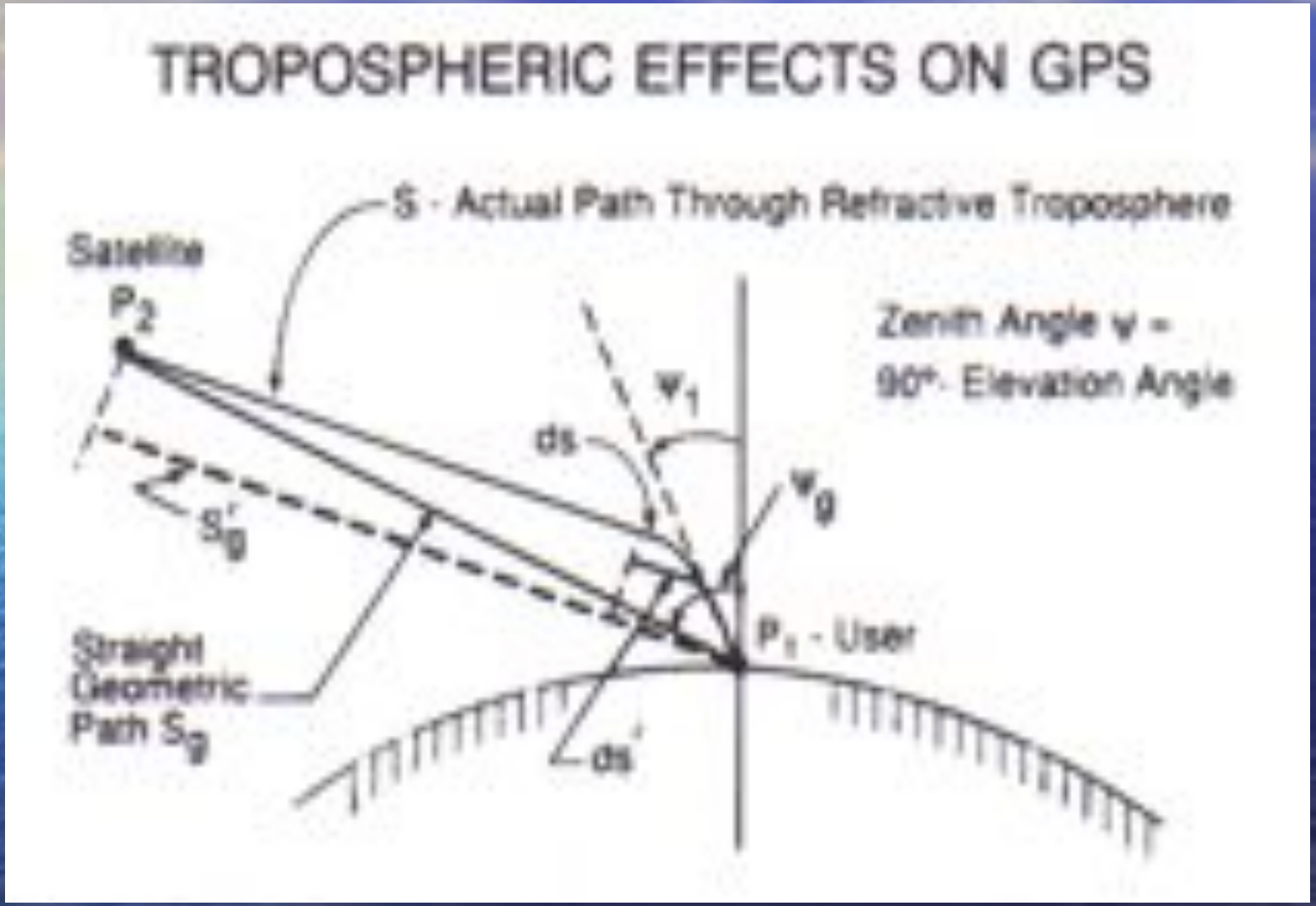
Figure 7.32. Signal propagation of code and carrier phases

(Seeber, 2003)

$$PR_{code} = c(t_r - T_t) = R - c \cdot dt_r + c \cdot dT_t + c \cdot dt_{atm} + \varepsilon_R$$

- Where: dt_{atm} ; atmospheric propagation delay
  ε_R ; observation noise
  R ; slant range = $\left|\vec{x}_s(T_t) - \vec{x}_p(t_r)\right| \quad ; T_t = t_r - \frac{R}{c}$

GPS processing



TZD estimation

- The Tropospheric delay is generalized as one estimated parameter (TZD) averaged over 2 hours.
- Elevation dependent mapping function relates all measurements in the estimation 'bin' to the TZD
- All TZD values are initialized to 2.1 m, the parameter is estimated as a step function

PWV estimation

- The TZD values are composed of a Wet component ZWD (water vapor), and a dry component ZHD (inert gases).

$$ZHD = 0.0022768 \frac{\Pr es(hPa)}{(1 - 0.00266\cos(2\varphi) - 0.28 \cdot 10^{-6} \cdot H(m))}$$

$$PWV_{gps} = ZWD_{gps} \prod(T_m) \begin{cases} \prod = \dfrac{10^6}{\rho R_v \left[\left(k_3 / T_m \right) + k_2' \right]} \\ T_m = 70.2 + 0.72 T_s \end{cases}$$

Precipitable water vapor statistics