Thermal modeling of the middle solar corona

Thanassis Katsiyannis[(1)] & Joseph Lemaire [(2)]

(1) Royal Observatory of Belgium

(2) Royal Belgian Institute for Space Aeronomy

The DYN model

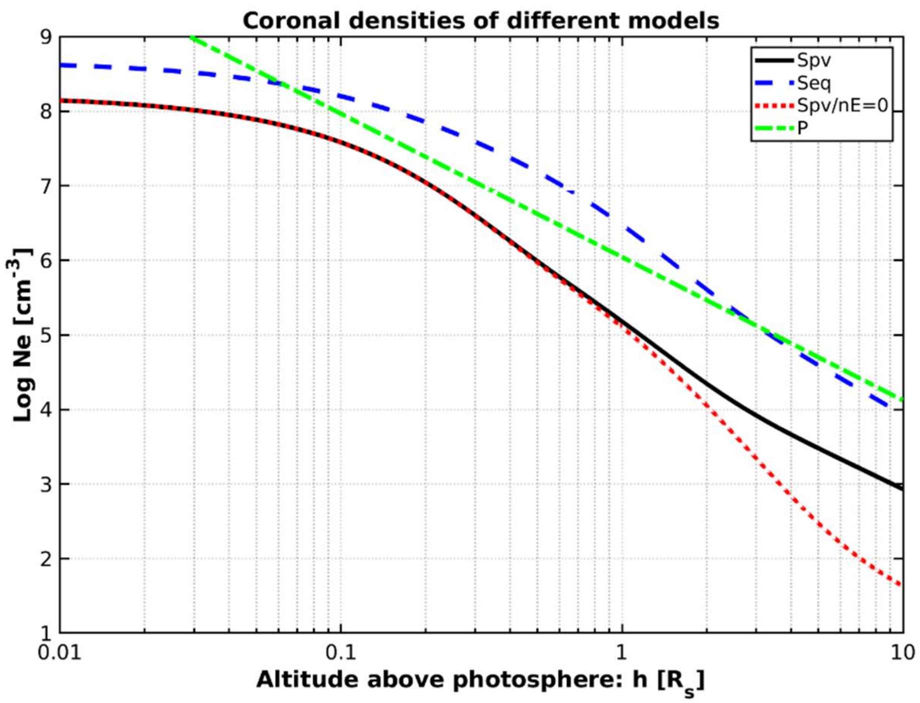
- Pottach (1960), Brandt et al (1965) and Gibson et al (1999) used Parker's hydro-dynamical model with $T(\infty)=0$ and $P(\infty)=0$.

- Lemaire & Stegen (2016) added the $m_H*ne(r)*du/dt$ factor to Parker's (1958) model:

$$dT(r)/dr + [d(\ln n_e)/dr]^{-1} + m_H*g * R_S^2 / (k\ r^2) + m_H*n_e(r)*du/dt = 0$$

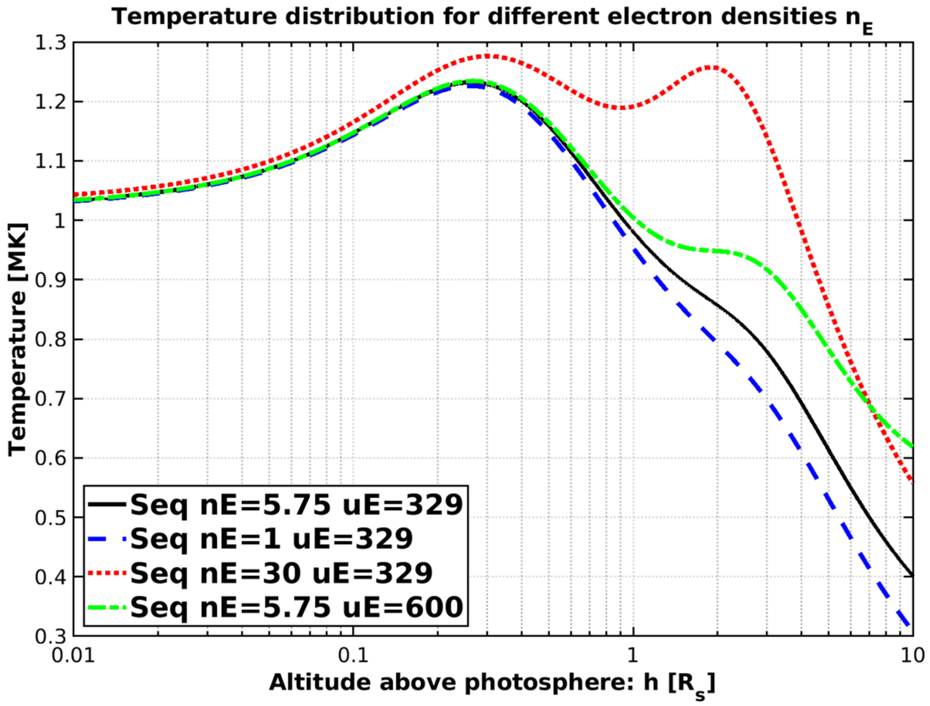
- Lemaire & Stegen (2016) also added a term to Saito (1970)'s fit. This was to correct for n_e(1AU). Saito (1970)'s fit was for $h < 3\ R_S$

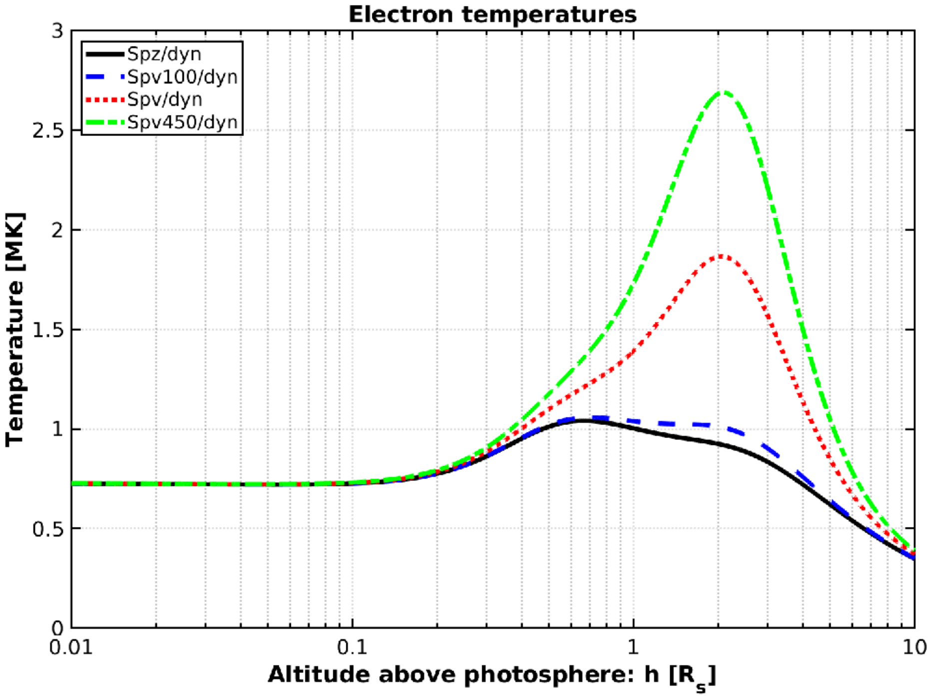
$$n_e(r)= 10^8\ [3.09\ r^{-16}\ (1-0.5\ \sin(\phi)) + 1.58\ r^{-6}\ (1-0.95\ \sin(\phi)) + 0.0251\ r^{-2.5}\ (1-\sqrt{\sin(\phi)})] + n_e(1AU)\ (215/r)^2$$



Temperature distributions / Model limitations

$$T(r) = \frac{T^{*}}{n(r)} \int_{r}^{\infty} \frac{n(x)}{x^{2}}\,dx, \text{ where } T^{*} = m_H * g * R_S^2 / (k\ r^2)$$





Future Work

- Use different $n_e(r)$ observations as input to the model
- Use $T(r)$ observations as boundary conditions
- Calculate the energy flow for all radial distances