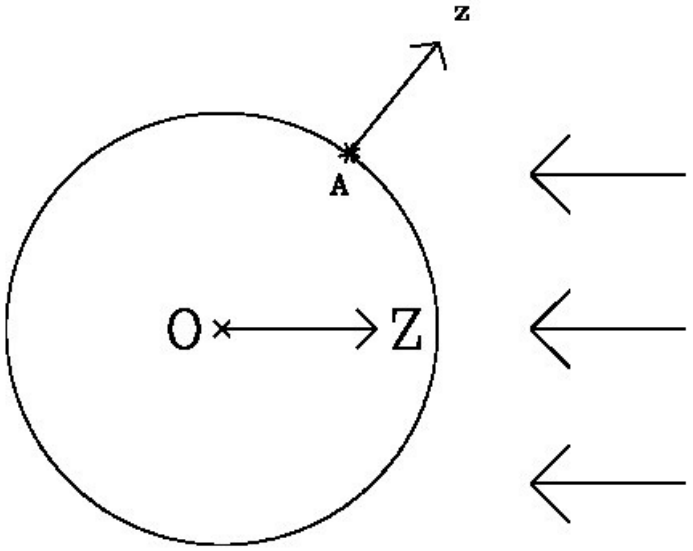
Climate, secular changes in orbit and irradiation of the Earth

Szabolcs Barcza
Konkoly Observatory,
Research Centre for Astronomy and Earth Sciences of the Hungarian Academy of Sciences
Budapest, April 21, 2017

Climate, secular changes in orbit and irradiation of the Earth

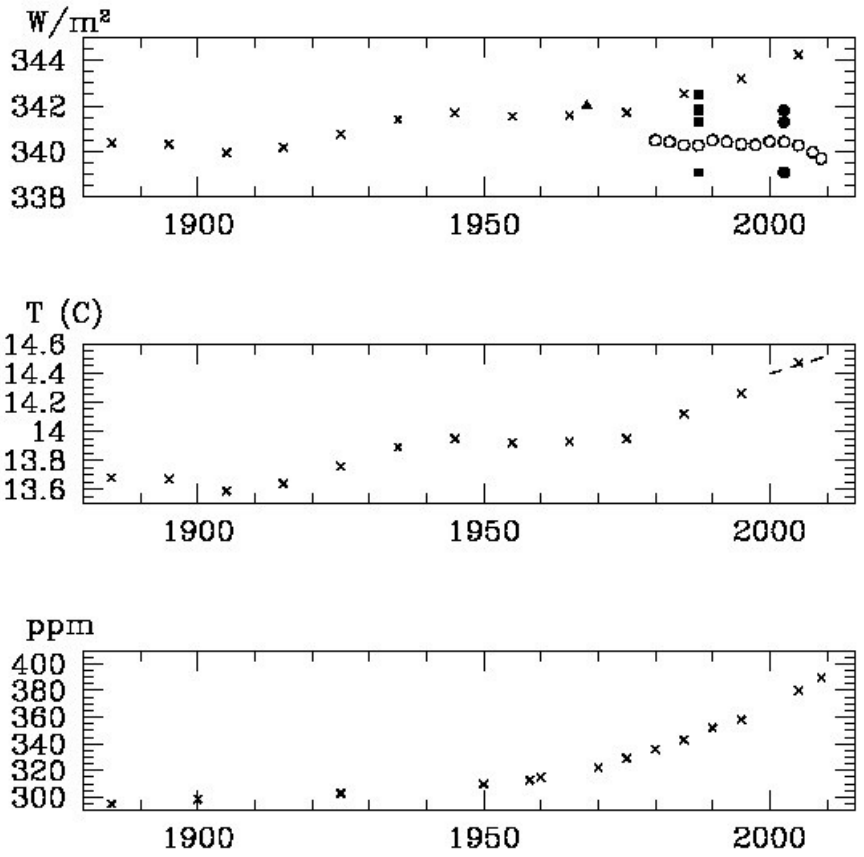


- TSI: $W=\pi R^2 F R_{\odot}^2/d^2$

Factors for climate (variation)

  - astronomical: F, d
  - terrestrial: areal distribution

Climate, secular changes in orbit and irradiation of the Earth



- Upper panel: TSI in units W/m² (computed from surface temperature T, surface and satellite observations)
- Observed significant changes over O(10) time scale ≈ 0.001
- Milankovich and Bacsák assumed constant F

Climate, secular changes in orbit and irradiation of the Earth

- Orbital parameters: a, eccentricity, inclination, obliquity, precession(s).

  Non-harmonic cycles (on geological time scales,

  idea by Milankovich, elaborated in details by Gy.

  Bacsák)
- External factor: variation of d (it is more or less well known, however,

  STOF – short term orbital forcing is not fully explored) etc.
- Internal factor: the areal distribution of the TSI. There are a number of important degrees of freedom for climate, their effect is not known completely.

  (Distribution of plates, mountain ranges, oceans, atmospheric and

  ocean circulation. Chemical composition of the atmosphere, aerosols, water vapour, condensed water (effect: back warming.)

Climate, secular changes in orbit and irradiation of the Earth

Milankovich and Bacsák were able explore partially the effect of the orbital parameters.

The enormous steps forward of the numerical techniques in the XXth century rendered possible to treat the effect of the external factors of climate in more details.

Milankovich and Bacsák were able to discover the problem at all and to find significant relations concerning climate and orbital parameters of the Earth.

Thank you for your attention