



## **Climate, water and carbon cycles: terrestrial records across a hierarchy of time scales**

**J. Veizer**

Ottawa-Carleton Geoscience Center, University of Ottawa, Canada (jveizer@uottawa.ca)

The observed temperature increase of  $\sim 0.6^{\circ}\text{C}$  over the last century has been attributed (IPCC) by  $\sim 2/3$  to greenhouse gases (GHG) and  $\sim 1/3$  to an increase in solar irradiance (TSI). Such relative attribution reflected the general consensus that no credible amplifier to muted changes in TSI was known. Recently, however, a spate of empirical observations demonstrates that sun-climate connections are apparent in a plethora of high-fidelity climate indicators, suggesting that “solar influence on climate is greater than would be anticipated from radiative forcing estimates” (Hadley Centre technical note 62). The most likely amplification candidates are high-energy particles such as cosmic rays and solar protons, via their potential role in cloud formation. Juxtaposition of empirical records of paleoclimate with proxies for atmospheric  $\text{CO}_2$  levels vs. celestial (solar and cosmic rays) intensities, across a  $10^8 - 10^1$  hierarchy of time scales, indeed favours a reversal of the relative impact of the above climate “drivers”, the last few decades being the focal point of the ongoing controversy. In the above scenario, the celestially modulated planetary energy balance drives the hydrological cycle, with the carbon cycle “piggy-backing” on the water cycle “thermostat”