The contradiction of a reduced solar luminosity by 15-25% during the Archean and the geologic evidence for relative high surface temperatures that allowed the presence of liquid water is known as the faint young sun problem. It is supposed that the cooling induced by a fainter sun was offset by higher levels of greenhouse gases during the Archean.

We present a study in which we investigate this problem using the Chemistry Climate model EMAC-FUB (ECHAM/MESSy Atmospheric Chemistry) with a constructed, spectrally resolved irradiance dataset valid for the Archean. As proxy for our young sun at 2.5 Ga we use the G0V-dwarf star beta com. The irradiances are scaled to have a total solar irradiance of 82% the present value. The EMAC-FUB is used to analyse the sensitivity of the model dynamics to the spectrally resolved irradiances and other parameters valid for the late Archean Earth, such as the composition of the atmosphere and the land sea mask.

Our experimental setup includes a control run, which has a zero land fraction, a mixed layer ocean, the present day atmospheric composition, and the present day solar luminosity. Three sensitivity experiments are performed with reduced solar irradiance for: (1) present day atmospheric composition, (2) a moderate greenhouse gas scenario with 3xPAL CO2, and (3) a high greenhouse gas scenario with 10xPAL CO2. We show that a CO2 concentration of 10xCO2 is sufficient to get liquid oceans in the tropics. The further analysis concentrates on the thermal and dynamical state of the atmosphere.