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Forecasting the weather
- ensemble techniques
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Climatic impact of spectrally resolved irradiances during the Archean as modeled with EMAC-FUB

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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 the irradiance of our young sun at 2.5 Ga we use the G0V-dwarf star beta Com, which is scaled to have a total solar irradiance of 82% the present value.
The EMAC-FUB is used in a configuration with mixed layer ocean, where the sea surface temperatures and ice thicknesses are derived from the thermodynamics of an ocean layer. We analyse the climatic impact of 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.
We can show that an increase of the CO_2 concentration by a factor of 10 is sufficient to get liquid oceans in the tropics. Further analysis concentrates on the thermal and dynamical state of the atmosphere with emphasis on the middle atmosphere.