# Climate Implications of the Sun transition to high Activity mode

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It was recently found that the Sun appears to be significantly less variable than stars with near-solar fundamental parameters and rotation periods [1]. It suggests that the Sun could eventually switch to a state of high magnetic activity. Such transition of the Sun to higher magnetic activity state can lead to dramatic changes of the solar irradiance consisting of 0.9% decrease of the total solar irradiance (TSI) and a large counteracting increase of the UV irradiance. We attempted to evaluate possible consequences of the Sun's high activity on the terrestrial climate and ozone layer using recently developed Earth System Model SOCOLv4.0. The model (see Figure 1) interactively includes atmosphere, ocean, ozone related chemistry and sulfate aerosol microphysics allowing to treat all processes driven by solar irradiance changes.

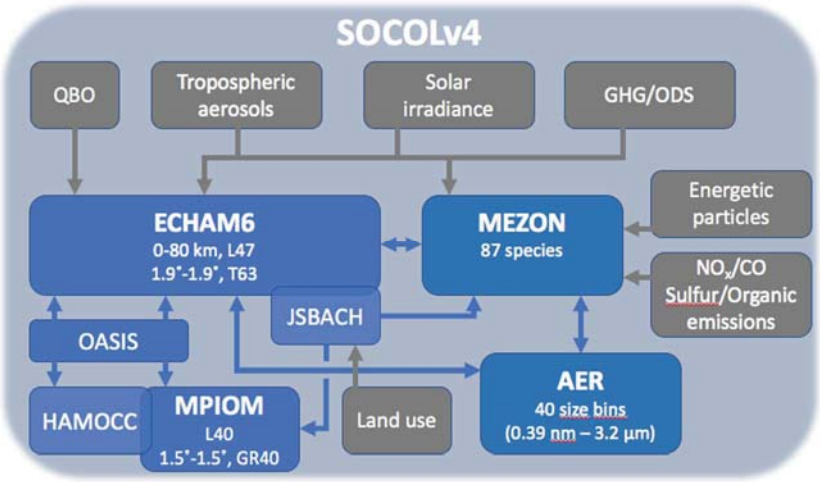


Figure 1. *Components and information flow in ocean-atmosphere-aerosol-chemistry-climate-system model SOCOLv4.*

Preliminary results suggested that global mean cooling due to smaller TSI could be as high as 2 K. This result is in qualitative agreement with the work performed with previous version of the SOCOL. However, at local scale this cooling is partially compensated by a substantial ozone enhancement and warming in the tropical stratosphere followed by extensive temperature increase over the northern landmasses during the cold season.

## References

[1] T. Reinhold, A.I. Shapiro, S.K. Solanki, B.T., N.A. Krivova, R.H Cameron, E.M. Amazo-Gomez," The Sun is less active than other solar-like stars", Science, **368**, 6490, May, 2020, pp 518, doi: 10.1126/science.aay3821.
[2] S. Muthers, C. Raible, E. Rozanov, and T. Stocker, Response of the AMOC to reduced solar radiation – the modulating role of atmospheric chemistry, Earth Syst. Dynam., 7, 877–892, 2016, doi:10.5194/esd-7-877-2016.