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Which climate drivers are responsible for the climate warming during early 20th century?

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The understanding of the mechanisms behind past climate change is a key point for the prediction of future climate. One of the most interesting climate anomalies is the observed early 20th century warming. We study the relative importance of different natural and anthropogenic forcings for the surface temperature and ozone layer changes using the chemistry-climate model with interactive ocean. We have carried out several 100-year (1850-1950) long ensemble runs considering separately the contribution of well-mixed greenhouse gases, tropospheric ozone precursors, solar irradiance, energetic particle precipitation and volcanic eruptions. Model simulates only about 0.3 K of global and annual mean warming from 1910 to 1940 which is about $\frac{3}{4}$ of trend obtained from observations. About a half of the obtained warming is due to the well-mixed greenhouse gases increase, while the increase of the weakly absorbed solar irradiance contributes one third of the total warming. The contribution from other considered forcing agents to the annual and global mean climate change is small, however it can be observed at smaller space and shorter time scales. We conclude that if the greenhouse gas forcing is well constrained only stronger solar forcing can help to reach better agreement with observations. We also show that the solar UV irradiance is solely responsible for the total ozone increase in all but polar areas. This total ozone response can help to refine the applied solar irradiance changes, but this possibility is limited by the short record of the total ozone observations, which started only in 1926 at Arosa site.