Referee comment on "Climate projections from IPCC models and regression models: A comparison" by Umberto Triacca, EGUsphere, https://doi.org/10.5194/egusphere-2022-134-RC2, 2022

Arrhenius found that the global temperature is linked to the logarithm of CO2 concentration. Starting from this assumption, the author builds two linear models based on data of the last decades and then tries to make predictions for the future in various scenarios. He claims that his results are very similar to the temperatures projections coming from GCMs.

In my opinion, this paper could be acceptable only after major revisions. In fact, first of all the results by linear models are similar to those by GCMs only in the highest emission scenarios, while in the low emission ones there are notable differences, so that the conclusions by the author are wrong. Secondly, in my opinion the importance of this paper could be just in the discussion of these differences.

For instance, it is very impressive to see how in RCP2.6 and also in SSP2.6 the last decades of the century show a decrease of temperature in the linear models and an almost stationary trend in GCMs. In my opinion, this is a clear hint that the linear model fails to catch the inertia of the climate system, for instance this "hysteresis" effect on the global temperature. Why? Is this failure related only to the absence of nonlinear terms in the model? The author could develop a nonlinear model and test this hypothesis. Or he needs other variables, even only through a decomposition between land and sea temperatures (the inertia of the oceans is well known). Studying these differences in performance could be the adjoint value of this paper and it should revised in this perspective.

In doing so, the author should also stress more clearly that, in any case, his very simple
model cannot substitute GCMs. On the contrary, it can highlight the differences to be discussed from a physical point of view.