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P5_1 A New Solution to Climate Change (i)

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Abstract

This paper explores negating the impact of global warming due to greenhouse gases by altering the course of the Earth's orbit. The proposal includes moving an increased distance away from the Sun each year, resulting in an increase of 5×10^9 m over the course of the 95 year period 2005–2100.

Introduction

Due to modern-day civilisations, the Earth is warming at an alarming rate. Scientists attribute this increase in temperature to the rise in greenhouse gas emissions, which have increased by a factor of 182 since 1850 [1].

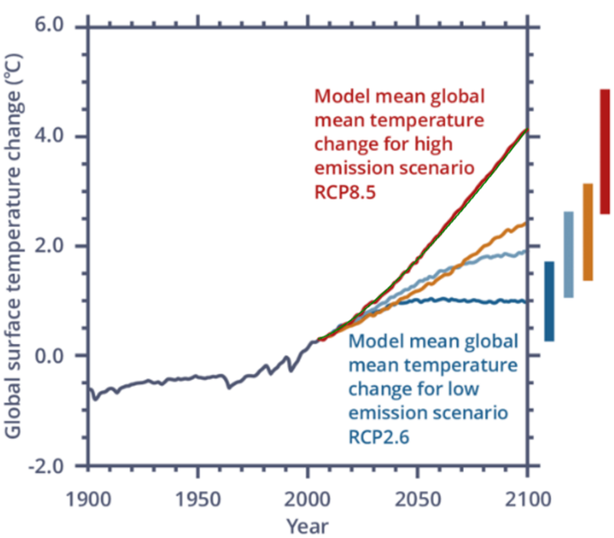

Figure 1: Global mean temperature change averaged across all Coupled Model Intercomparison Project Phase 5 (CMIP5) models (relative to 1986–2005) for the four Representative Concentration Pathway (RCP) scenarios: RCP2.6 (dark blue), RCP4.5 (light blue), RCP6.0 (orange) and RCP8.5 (red); 32, 42, 25 and 39 models were used respectively for these 4 scenarios [2].

Figure 1 shows predictions for the change in global mean temperature between 2005 and 2100 across differing climate response scenarios. In this paper, we consider the worst-case scenario, where greenhouse gas emissions continue to grow unmitigated [3], which is known as the RCP8.5 (Representative Concentration Pathways) model.

The model, produced in 2005, predicts an increase in global warming at an average of 8.5 watts per square meter across the planet by the year 2100. The resultant effect of this is a 4°C increase in the global mean temperature over the century [4]. This paper calculates the distance increase in Earth's orbit required to counteract this effect.

Method

To find a relationship between the temperature of the Earth and the distance from the Sun, we first have to work out the flux of solar radiation on Earth. This is known as the solar constant which we took to be 1361.5 Wm^{-2} [5].

As the data is not publicly available, a model was fitted to match the data shown in Figure 1, as shown by the green line.

Modelling the Earth's atmosphere as a multi-layer system, the temperature can be calculated as shown below [6]:

$$T = \sqrt[4]{S_\odot} \cdot \sqrt[4]{\frac{(n+1)(1-\alpha)}{4\epsilon\sigma}} \quad (1)$$

where $S.$ is the solar constant, n is the number of modelled atmospheric layers, α is the planetary albedo, ϵ is the planet emissivity and σ is the Stefan–Boltzmann constant.

As we know both the temperature (287 K [7]) and the solar constant (1361.5 Wm^{-2}), we can use ratios to work out the flux required for a given temperature, which is necessary when modelling the increase in the Earth's orbital radius:

$$F_E = \left(\frac{T_{model}}{287}\right)^4 \cdot S_\odot \quad (2)$$

where F_E is the solar flux on Earth accounting for greenhouse gases, T_{model} is the predicted temperature of the Earth, and $S_\odot$ is the solar constant.

In a model where the flux on the Earth is increasing due to greenhouse gases, the equation below calculates the distance from the Sun (in AU) required to negate the temperature increases.

$$d \propto \sqrt{\frac{flux}{S_\odot}} \quad (3)$$

Results

Using the equations above, the graph in Figure 2 was produced, showing the cumulative distance the Earth's orbital radius must be increased by to negate the effects of global warming.

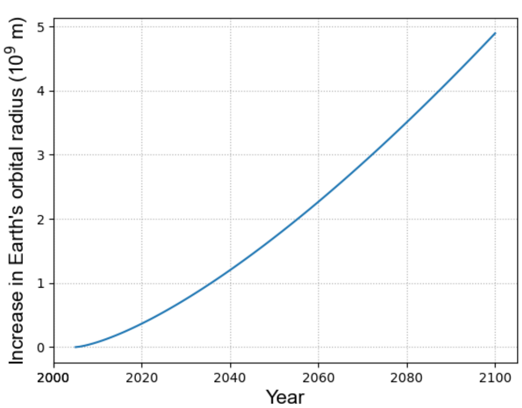

Figure 2: Proposed increase in Earth's orbital radius

This graph shows that the Earth must move nearly 5 billion metres over the 95 year period 2005–2100.

Conclusion

The results in this paper find the distance required, for the Earth to move away from the Sun, to stall the increase in global temperature due to greenhouse gases. It was found that for the RCP8.5 model, the distance the Earth would have to move increases each year up to a cumulative total of 4.89 billion metres in the year 2100.

References

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