



World Academy of Art and Science

Webinar “Science for Human Security: Natural
Geoengineering Methods for Cooling the Planet”

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The role of water vapor phase transitions generated by forests in cooling the atmosphere: Can forests regenerate a healthy climate?

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Climate sensitivity and how ecosystems can change it

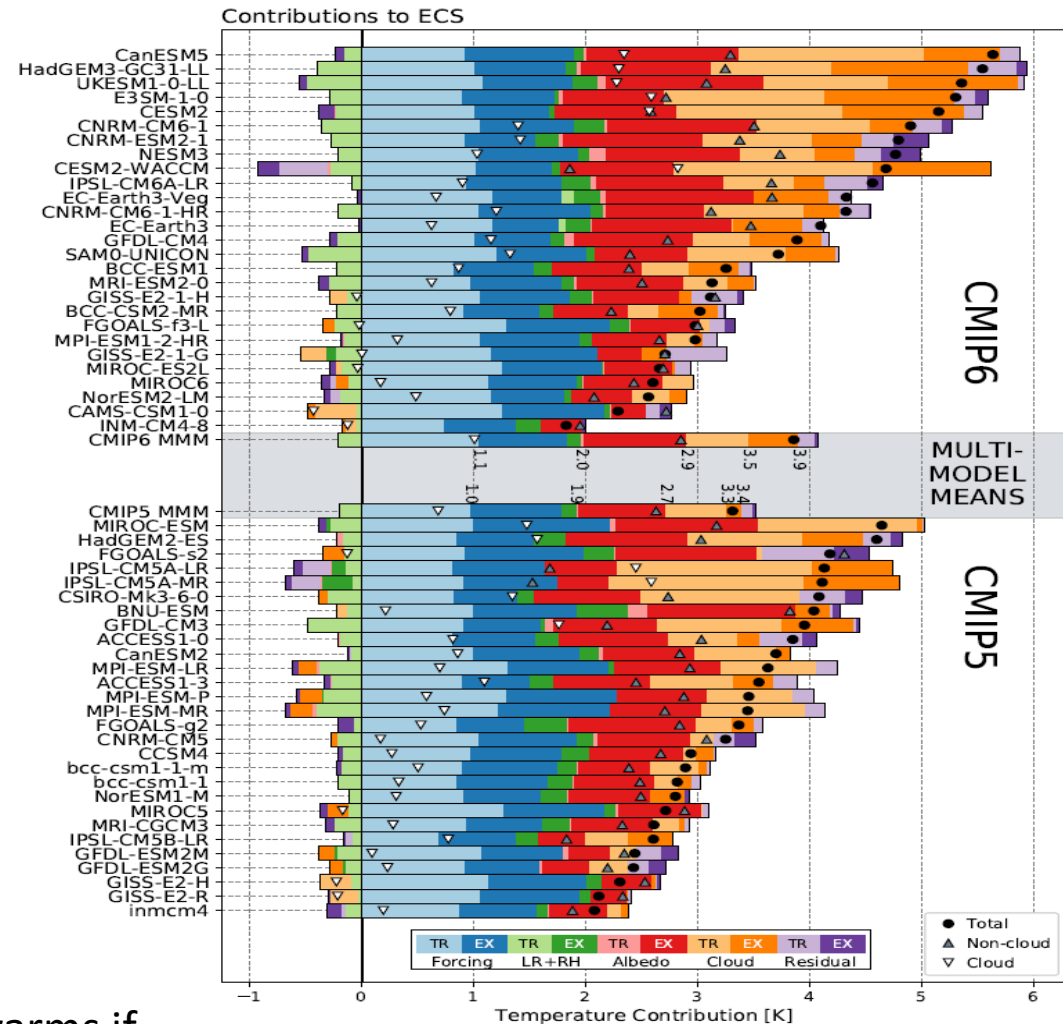
- Problem:

Models that describe the present well, have a higher climate sensitivity

Models that describe the past well, have a lower climate sensitivity

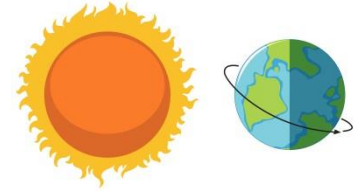
How so?

Climate sensitivity: by how many degrees the planet warms if CO2 doubles



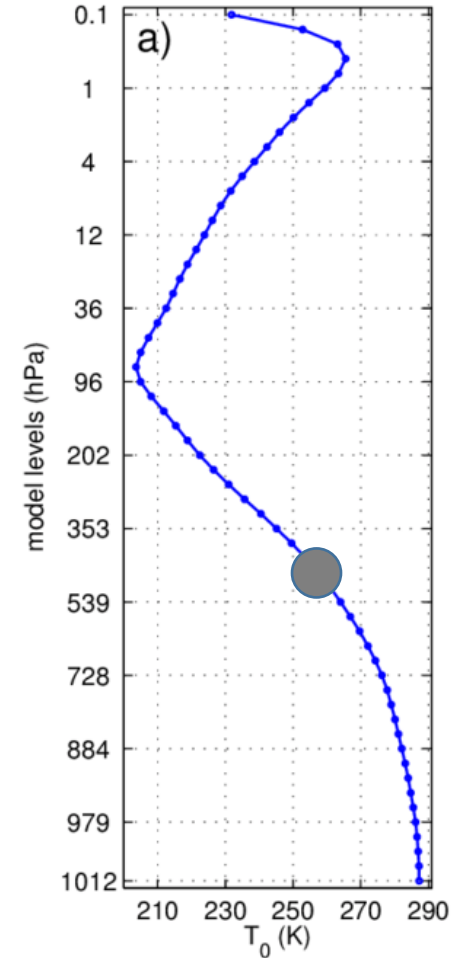
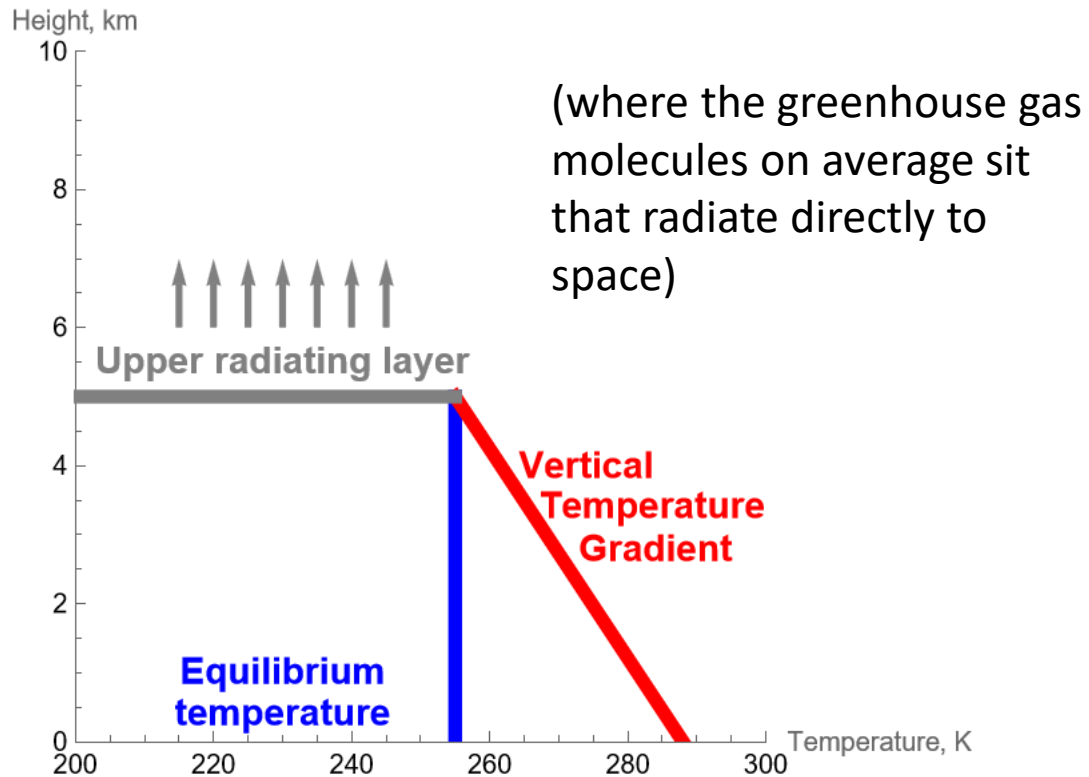
Three legs of climate sensitivity

Image by [brgfx](#) on Freepik



Earth's equilibrium temperature 255 K

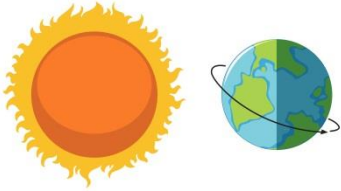
Earth's surface temperature 288 K



Žagar et al. 2015 10.5194/gmd-8-1169-2015

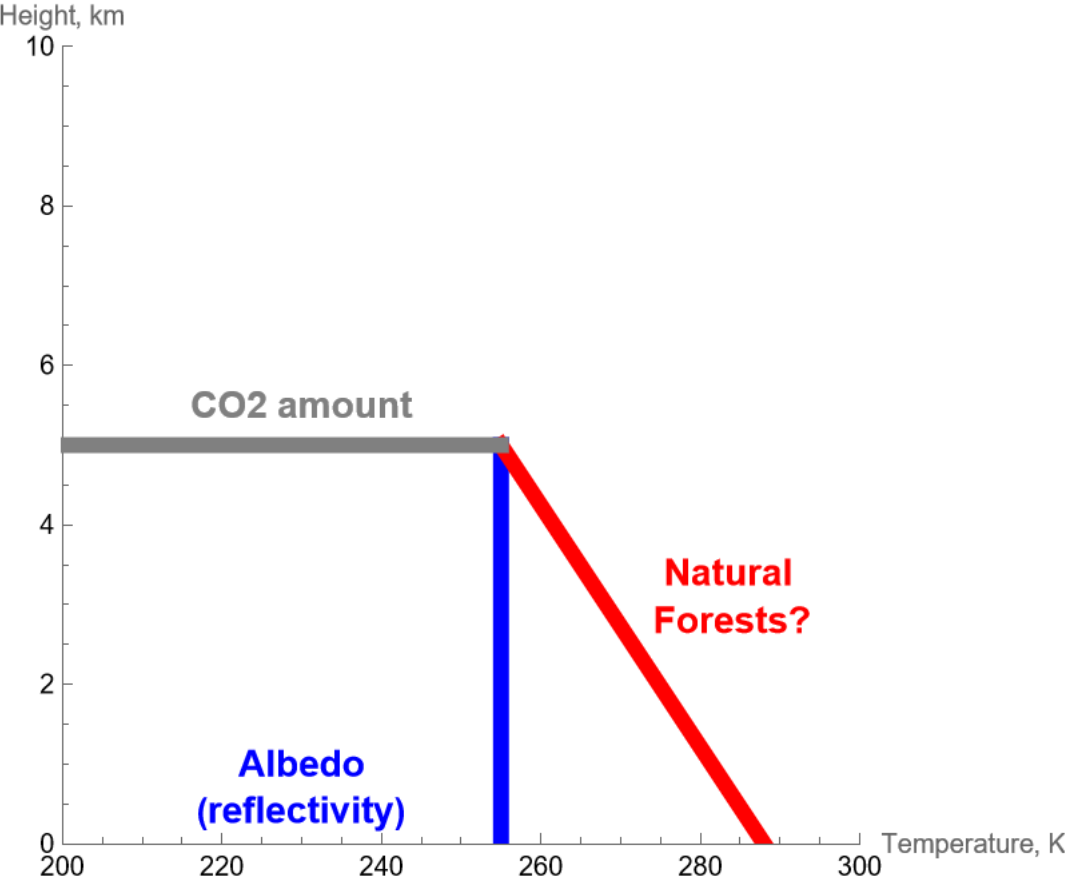
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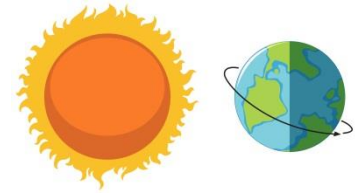
Earth's equilibrium temperature 255 K

Earth's surface temperature 288 K



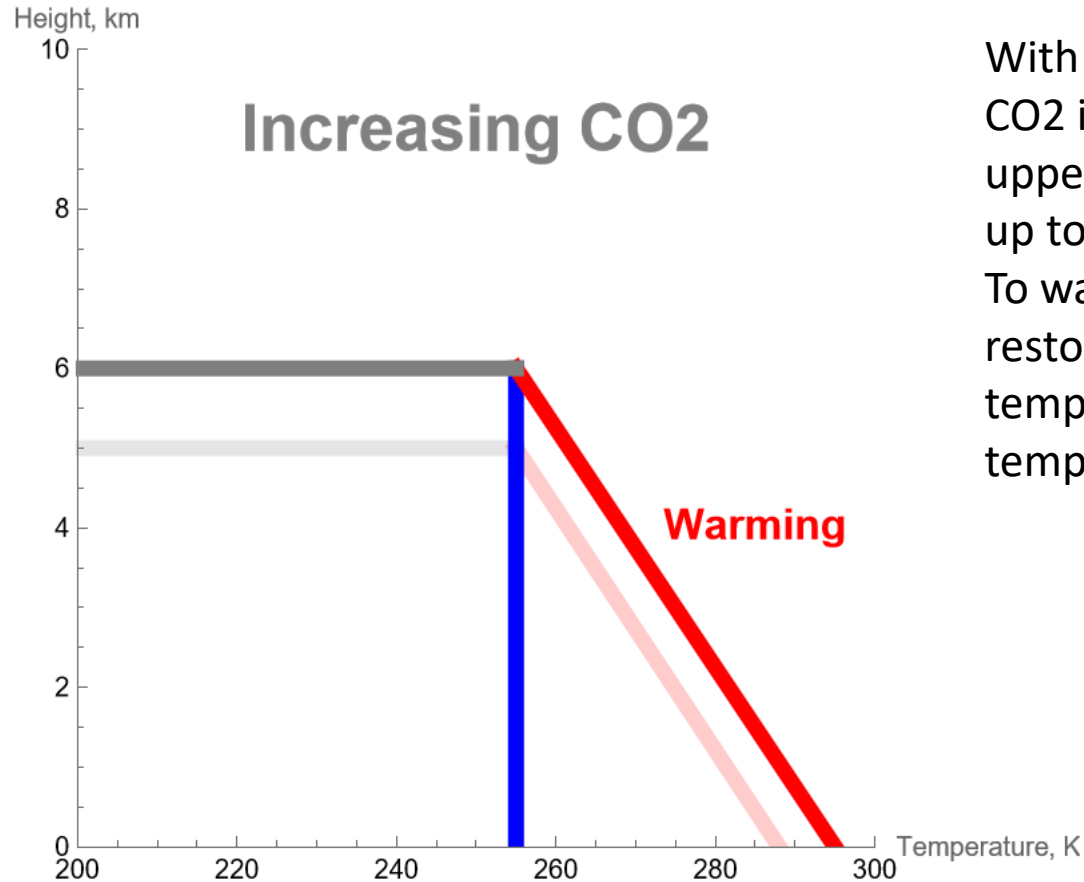
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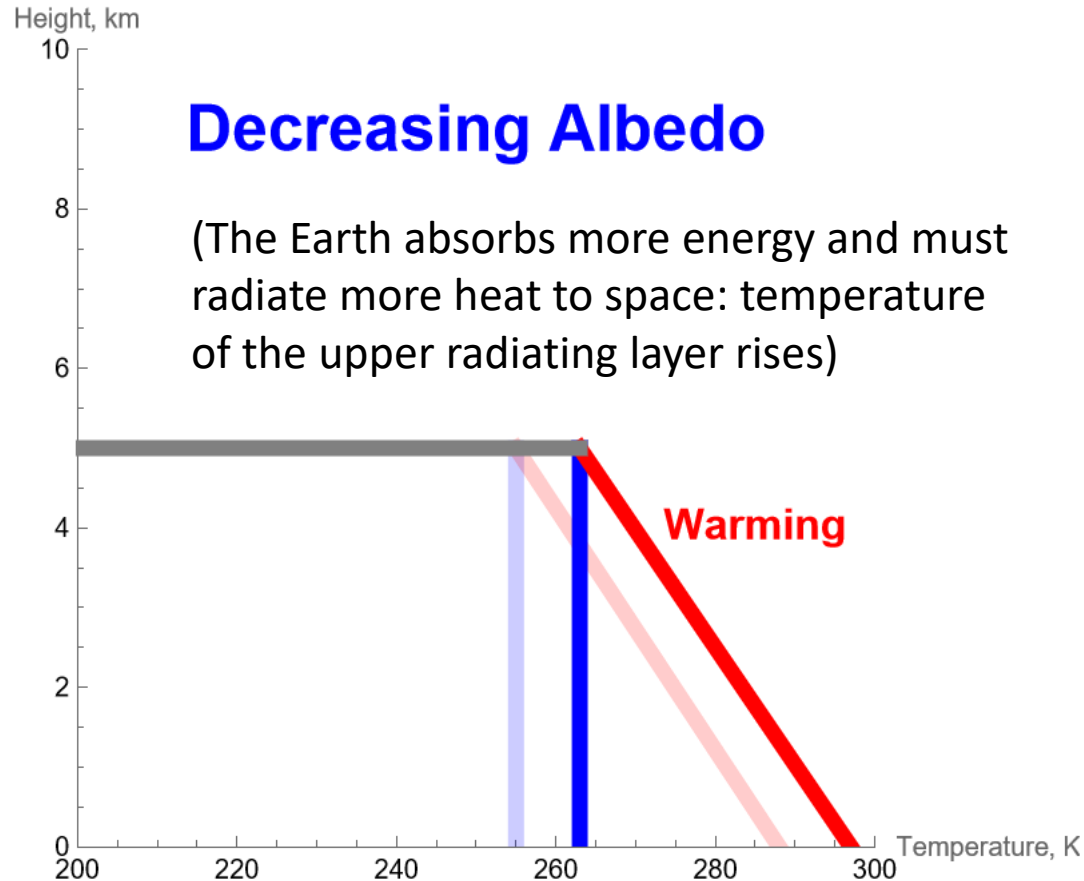
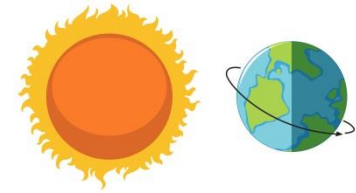
Earth's surface temperature 288 K



With increasing amount of CO₂ in the atmosphere, the upper radiating layer moves up to the colder atmosphere. To warm this layer and restore its equilibrium temperature, the surface temperature must increase.

Three legs of climate sensitivity

Image by [brgfx](#) on Freepik



Deforestation can reduce the cloud cover, which reflects sunlight.

How strong this effect could be?

A reasonable assumption: the effect is proportional to evapotranspiration (and latent heat release)

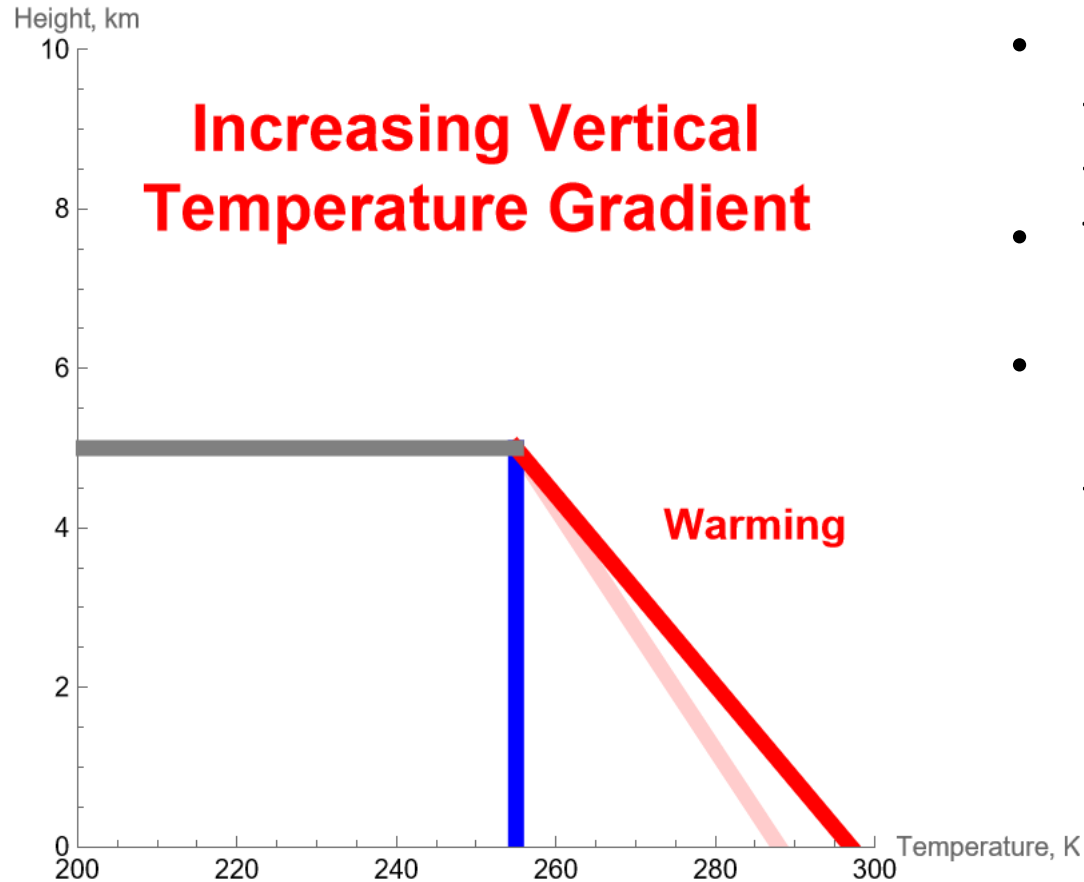
Earth's equilibrium temperature 255 K

Earth's surface temperature 288 K

D Ellison, J Pokorný, M Wild (2024)
Global Change Biology. On the power of forests to (water the Earth and) cool the planet.

<https://doi.org/10.1111/gcb.17195>

Three legs of climate sensitivity

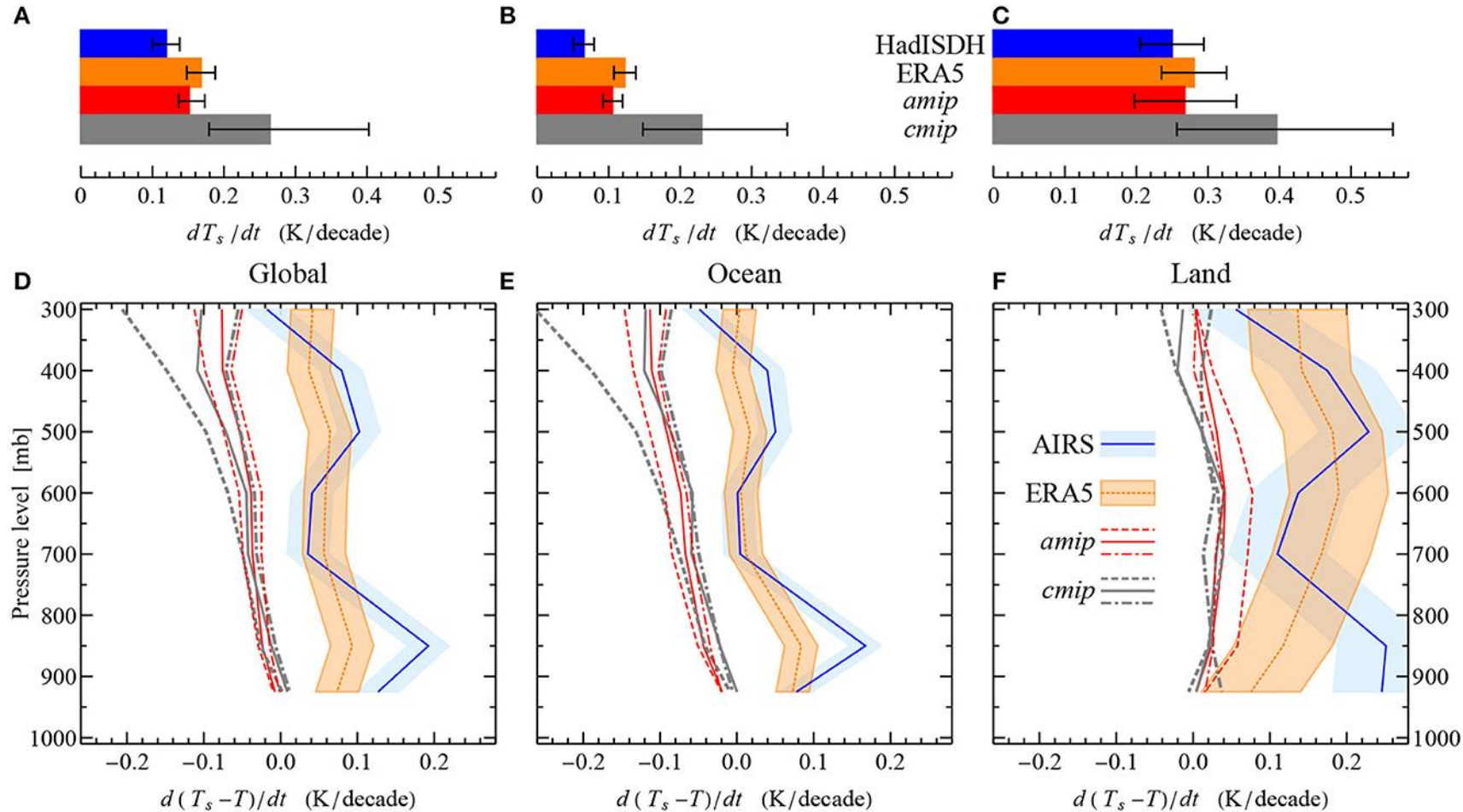


- Capturing solar energy by evapotranspiration, natural forests send the latent heat up to the troposphere, from where it can be released unimpeded to space.
- This source of heat in the upper troposphere smooths the vertical temperature gradient.
- Upon deforestation, this upward transport of “hidden” heat discontinues, and the vertical temperature gradient becomes sharper.

AM Makarieva, AV Nefiodov, AD Nobre, A Rammig (2023) Front For Glob Chang. Re-appraisal of the global climatic role of natural forests ...
<https://doi.org/10.3389/ffgc.2023.1150191>

Infinite sensitivity! (because CO₂ does not change)

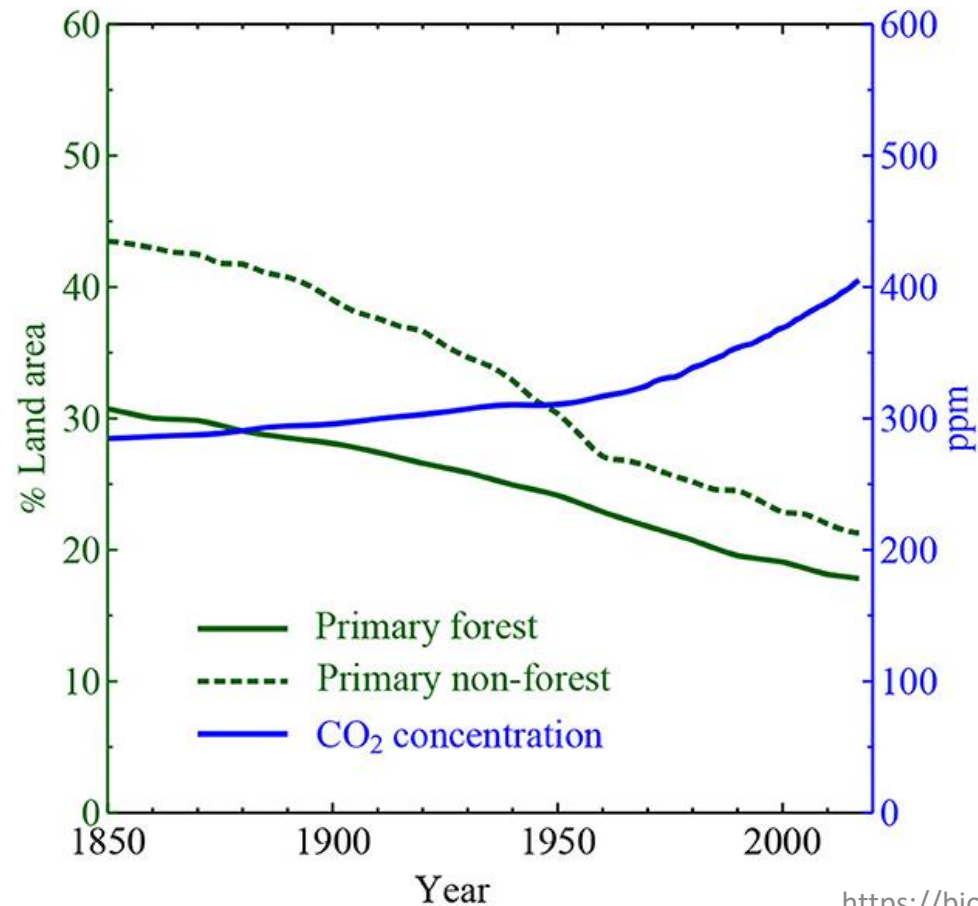
Climate models consistently underestimate changes in the vertical temperature gradient...



...this can be related to increasing climate sensitivity...

*Today, climate science faces a new challenge. Global climate models with an improved representation of clouds display a higher sensitivity of the Earth's climate to CO₂ doubling than models with a poorer representation of clouds ([Zelinka et al., 2020](#); [Kuma et al., 2023](#)). This implies more dire projections for future climate change, but also poses the problem of how to account for the past temperature changes that are not affected by the model improvements and have been satisfactorily explained assuming a lower climate sensitivity. The concept of the environmental homeostasis and the [biotic regulation](#) of the environment provide a possible solution: **the climate sensitivity may have been increasing with time**—reflecting the decline of natural ecosystems and their global stabilizing impact ([Figure 1](#)).*

...meanwhile natural forests and other natural ecosystems continue to decline due to logging and burning



- Since V. Vernadsky, we do know that ecosystems have a major climatic impact. What is the nature of this impact? Is it chaotic?
- No
- Natural ecosystems have evolved a **stabilizing impact** on their own environment (would you survive long in an environment that you destabilize yourself?)
- Hence, their loss leads to climate destabilization.

Replacing natural forests with carbon sticks increases climate sensitivity and destabilization



**Conversely,
preserving
natural climate-
regulating forests**
prevents climate
sensitivity from
increasing even
further

What to do?

Simply stopping the ongoing destruction of the remaining global wilderness, including currently self-recovering ecosystems (proforestation), can slow down climate destabilization. International protection of these ecosystems and ambitious investigations to understand them, are key for preserving human identity both as a biological species and as a highly-developed ethically and intellectually competent society.

We call for a global moratorium on logging in natural climate-regulating forests. (see more [here](#))