



Climate Change Confirmation: Humans Have Driven the Earth's Energy Out of Balance



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Climate change is a response to Earth's growing energy imbalance.

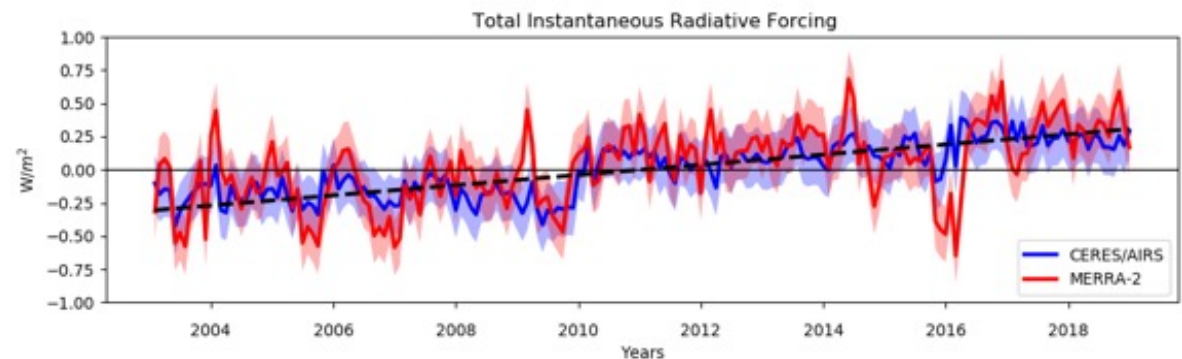
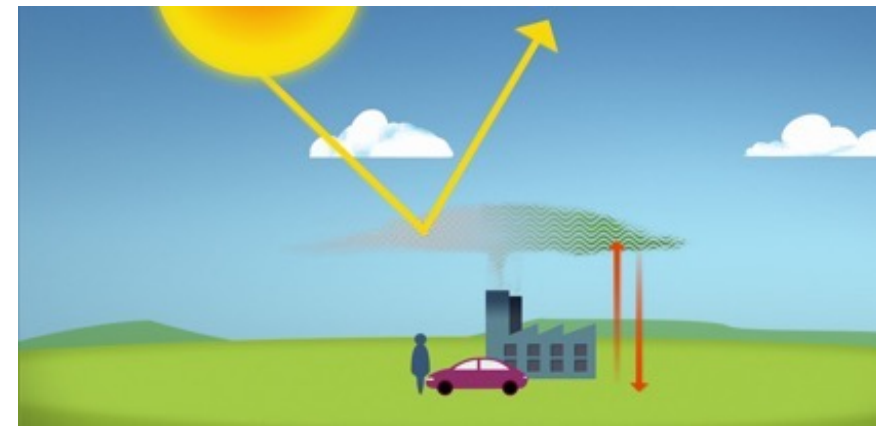
- CERES (Clouds and the Earth's Radiant Energy System) Instruments on multiple satellites show solar energy absorbed by the Earth is exceeding the amount of heat emitted to space, warming the planet.
- Natural processes (like clouds and moisture changes) measured by our CERES instruments alone cannot explain this.

Using additional data from the CloudSat and CALIPSO satellites and the AIRS instrument, we showed for the first time that **human activity is the main cause of the increasing energy imbalance.**

- Natural processes account for year-to-year energy variability but not the long-term trend.
- 80% of the growing imbalance from 2003-2018 is from energy added due to rising greenhouse gas concentrations.

This imbalance is directly attributable to human action.

- This positive trend is the most direct observational evidence to date that human activity is causing climate change.
- Measuring this imbalance can serve as a valuable measure for real-time monitoring of mitigation efforts.



Rising greenhouse gas concentrations cause more outgoing thermal energy to be absorbed in the atmosphere and emitted back to the surface (red arrows, top), warming the planet. This “radiative forcing” has been increasing (bottom) in satellite measurements (red curve) and in observation-supported NASA climate model (blue), as shown clearly by the upward trend of the dashed black line.