

Interactive comment on “Ice melt, sea level rise and superstorms: evidence from paleoclimate data, climate modeling, and modern observations that 2 °C global warming is highly dangerous” by J. Hansen et al.

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The fundamental error of Nabil Swedan is that he is using an overly simplified definition of the Second Law of Thermodynamics i.e. heat can only flow from hot to cold. The more precise definition is that in a closed system any natural process moves toward greater entropy or disorder.

It must first be noted that the GHG in the atmosphere and the surface of the Earth alone do not constitute a closed system—energy is freely moving into and out of this

C5343

system. Of course, per the Second Law, the Earth's surface cannot warm the GHGs greater than its surface temperature nor can the GHGs heat the surface of the Earth to temperatures greater than the temperature of the GHGs. However, the system is receiving energy from the sun, which can warm both the surface and the GHG. It is clearly the sun that is causing the surface to be warmer than the GHG and not the re-radiation from the GHG; therefore, there is no violation of the Second Law.

There is no spiraling of temperature out of control because the rate of heat loss from the surface is to the fourth power per the Stefan-Boltzmann Law while the GHG is cooler hence the re-radiation does not increase as rapidly as the surface radiation. Therefore, the exponential increase in surface radiation brings the system back in balance i.e. energy in is equal to energy out. The GHG does not create any energy that obviously comes from the sun.

It is well known that all bodies with a temperature above absolute zero radiate heat. The amount of heat radiated by an object is based on its emissivity, which is a property of the material and its surface temperature to the fourth power per the well-established Stefan-Boltzmann Law. This heat is radiated equally in all directions. The environment or the presence of other objects in the proximity of the object have zero influence on how this heat radiates from the object. There is no mysterious force that can stop the heat from radiating toward a warmer object. The radiating object has no idea of its surroundings, it just simply radiates. A body certainly can radiate heat to a warmer object because there is nothing that can prevent that from occurring and it is simply in itself not a violation of the Second Law. Now, in a closed system containing two objects at different temperatures, both objects will freely radiate heat at each other while the hotter object will radiate at a higher rate due to the Stefan-Boltzmann Law and therefore the net heat flow will be in the direction of hot to cold until the objects reach equilibrium per the Second Law.

Nabil Swedan obviously has no understanding of radiative heat transfer nor thermodynamics.

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C5345