A CLOSER LOOK AT SEA SURFACE TEMPERATURE TRENDS
HOW EFFECTIVE IS GREENHOUSE (GH) WARMING OF SST?

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Oceans cover 71% of the globe and play the most important role in the control of climate changes, whether natural or manmade. However, physical arguments based on the measured refractive index of sea water suggest that IR radiation cannot penetrate and contribute effectively to ocean warming. Therefore the greenhouse (GH) warming of the sea surface (SS), generally taken for granted, may require closer scrutiny.

The upper layers of the ocean are heated by solar short-wave (SW) radiation, which penetrates to some considerable depth, depending on wavelength and turbidity [Jerlov 1976, Lee et al 2005]. With an average ocean albedo of only 0.09, most of the visible part of the solar spectrum heats the euphotic zone; then wave action and eddy mixing communicates this energy downward, heating the "mixed layer," conventionally taken as the upper 100 meters. But infrared (IR), long-wave (LW) radiation, typically around 10 microns and downwelling from the warm atmosphere as a result of the GH effect, cannot penetrate into water; it is absorbed in the "skin." From there, much of the LW energy is re-radiated upward and also transmitted to the overlying atmosphere as sensible heat or used up in the evaporation of the "skin," adding latent heat to the atmospheric boundary layer. Therefore, the LW contribution to heating the bulk ocean may be reduced. While the normal GH effect could be effective, applied over a long time scale, the SST may not rise appreciably in response to the decadal-scale anthropogenic GH effect.

But what fraction of the downwelling anthropogenic IR flux actually contributes to warming the ocean? Informed estimates range from zero (if none of the energy is mixed into layers below the skin) to 100 percent (as conventionally assumed in climate models and elsewhere). The processes involved cannot be reliably calculated. We describe a measurement program, consisting of an experimental scheme for varying the downwelling IR flux and measuring resultant temperature changes in the uppermost layers.

However, SST records of the past 25 years (referring to temperature of the mixed layer) do report an increase, comparable to that of land data. This temperature rise has generally been ascribed to GH warming [IPCC 2001]. To investigate a possible disparity with the fact that GH radiation cannot penetrate beyond the skin, we examine more closely the types of measurements that make up the SST. They consist principally of temperature data from engine-cooling water measured at ship inlets (typically around 10 meter depth, below the euphotic zone) and – since 1980 -- an increasing amount of data from floating drifter buoys in the (warmer) euphotic zone. We hypothesize that the reported SST warming may be an artifact of the increasing percentage of (higher-temperature) buoy data and suggest various tests for falsifying this hypothesis.

<u>CONCLUSIONS</u>: 1. Based on currently available analyses of data there is a real disparity between temperature trends reported at the surface (that show a warming) and tropospheric trends (that show a lesser warming). This result is quite contrary to greenhouse theory, with all climate models showing the troposphere as warming more rapidly than the surface.

2. The downwelling IR radiation from the atmospheric GH effect cannot penetrate into the ocean beyond a thin skin and may therefore not contribute appreciably to SST. This assumption can be verified by suitable experiments.

3. Our analysis of temperature observations shows that the major contribution to the disparity comes from the tropics and seems to occur at the ocean–atmosphere interface. We have identified a possible contributing cause, namely a fictitious SST warming trend as an artifact of the measurement scheme: The mixing of ship data with increasing amounts of buoy data – with the latter having a slightly higher temperature because they are in the warmer photic zone. This hypothesis can be checked or falsified in various ways by a more detailed analysis of the data. We are currently analyzing proxy SST data from corals.