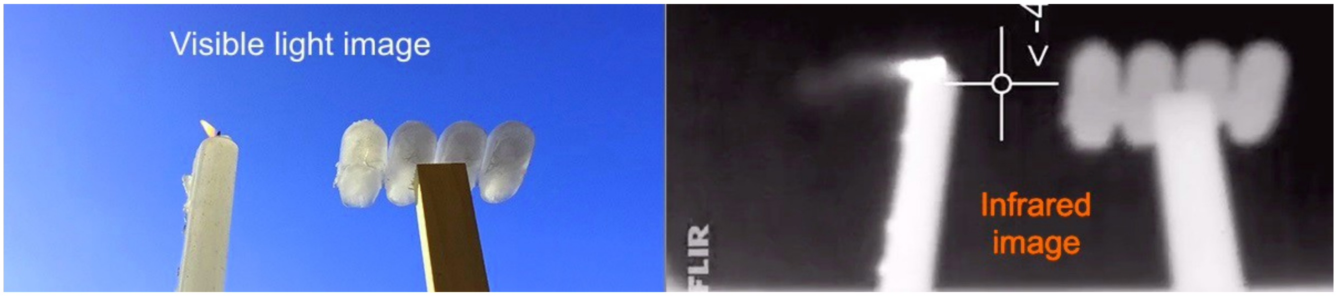
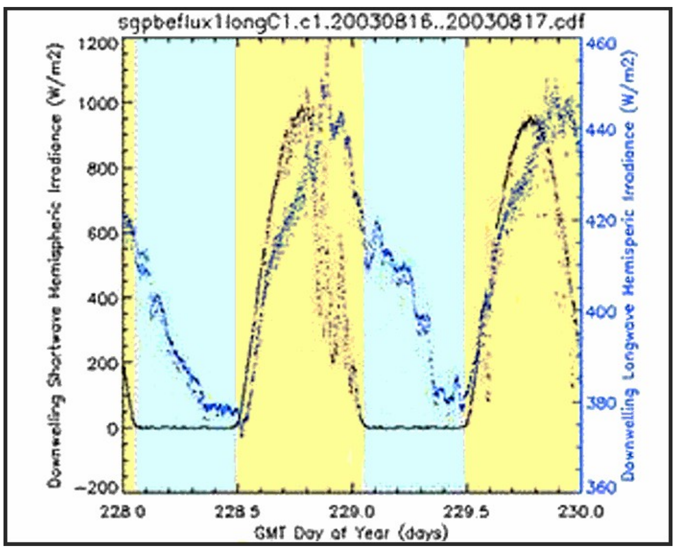
Empirical Refutation of Back-radiation



Looking up at a platform holding a lit candle and ice on a pedestal, a typical thermal imaging camera shows that the ice is appreciably warmer than the clear blue background sky. Assuming a 0.95 emissivity, ice at 0°C would be radiating about 299.88 watts per square meter. This means that a typical thermal imaging camera is capable of detecting 300 W/m² of thermal radiation.

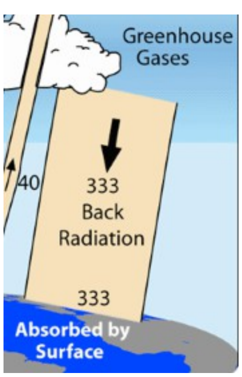
Now examine this record from an ARM (Atmospheric Radiation Measurement) station.



The blue profile and scale refer to "downwelling longwave irradiance," which is thought mainly due to thermal emissions from greenhouse gases in the atmosphere.

Although the worldwide downwelling average is adjudged to be 333 W/m², the ARM chart for Oklahoma shows a diurnal swing between about 380 and 445 W/m², well within the range of a thermal camera. But this whole-sky irradiance is detected by curious devices called pyrgeometers.

If you look up 'pyrgeometer calibration' on the internet you will find information like this, from a 2005 government report:



Pyrgeometer Calibrations: Important Considerations

- There is currently **no accepted international measurement reference** for longwave irradiance.
- Temperature-controlled **blackbodies are central to the calibration** and operation of longwave radiation measuring instruments.
- Pyrgeometer measurements and blackbody calibration standards provide **no information about uncertainty** of the absolute value of atmospheric longwave radiation measurements (Philipona et al., 2001)....
- Pyrgeometer blackbody **calibration differences are greatest during clear-sky conditions** (high levels of net radiation) and least during cloudy sky periods (low levels of net radiation)

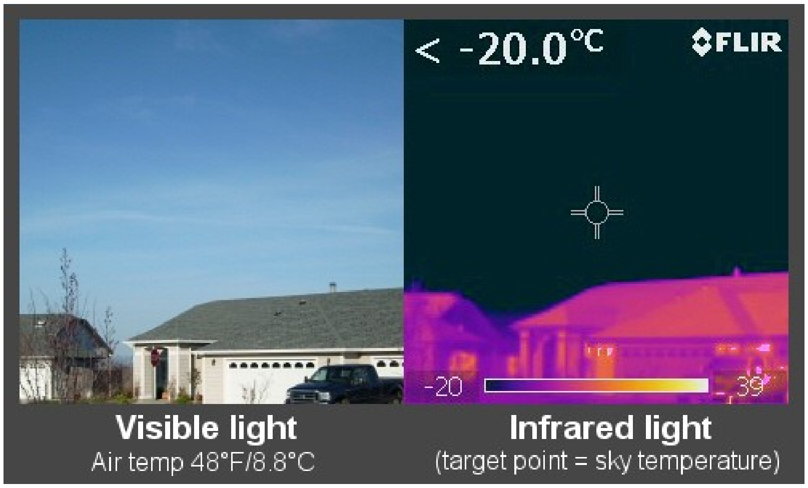
And this:

> **pyrgeometers are calibrated during the nighttime only**, because no consensus reference has yet been established for the daytime longwave irradiance.

The most recent reference I've found is in the *Journal of Atmospheric and Solar-Terrestrial Physics*, July 2015. The header cites "**Lack of a daytime reference** for longwave radiometers, i.e. pyrgeometers."

Yet these devices are the backbone of back-radiation estimates.

We've seen above that a typical thermal imaging camera is able to detect at least 300 W/m² of radiation, i.e., below the 333 back-radiation average. But what are its limits? Here I borrow a daytime thermal image posted by Anthony Watts.



The reticle on the sky fairly close to the horizon can only report that the temperature is somewhere below minus 20°C. More sensitive equipment, though, is able to identify a clear sky's temperature as minus 50° to minus 60°C.

Thermographers call this phenomenon "cold diffuse celestial radiation," and it's much the same both day and night. Given the low radiating power of gases, I would imagine that this temperature is due to ice crystals and other frigid particles in the air.

Conclusion: There is no reason to assume that the magnitude of back-radiation from greenhouse gases reported by pyrgeometers is valid. Observing the rich blackness of a clear sky in a thermal imaging camera refutes it.

Alan Siddons