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Empirical estimate of variability in clear-sky surface longwave radiation over the ocean

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The surface net (up minus down) longwave radiative flux (SNL) is crucial both for the surface radiation budget as well as the atmospheric balance between radiative cooling and latent heating through the atmospheric hydrological cycle. It is problematic to remotely measure SNL while ground-based measurements are sparse and mainly available over land. Over low-latitude oceans much of the longwave electromagnetic spectrum is saturated with respect to water vapour absorption and the net flux is primarily determined by the atmospheric window in which column integrated water vapour (CWV) plays a dominant role. Here we use a well-calibrated satellite estimate of CWV as input to a physically-based empirical formula to estimate the clear-sky SNL and its variability from 1979 to 2004. Comparisons are made with reanalyses and other datasets. A tropical ocean mean clear-sky SNL of 64 Wm-2 over the period 1988-1993 is found to be smaller than reanalysis datasets by about 10 Wm-2 although agreement with the European Centre for Medium-range Weather Forecasts 40-year reanalysis is better than other reanalysis datasets. A strong increase in CWV with surface temperature of 3 kgm-2K-1 over the tropical oceans for the period 1979-2004 explains the reduction of clear-sky SNL with temperature (a surface heating) of 3 Wm-2K-1. We discuss caveats of the present methodology and the potential use of ship-based cloud data in extending the empirical estimate to cover cloudy skies.