“Global warming” from increased greenhouse gases really refers to a global energy imbalance at the top-of-atmosphere (TOA). TOA measurements of radiation from space can track changes over time but lack absolute accuracy. An inventory of energy shows that over 90% of the imbalance is manifested as ocean heat content (OHC). The ORAS4 ocean reanalysis data and other OHC estimates are used to compare the OHC rates of change with model-based estimates of TOA energy imbalance (from CCSM4), and with TOA satellite measurements for the year 2000 onwards. Most of the ocean-only OHC analyses extend to only 700 m depth, have large discrepancies among the rates of change of OHC, and do not resolve interannual variability adequately to capture ENSO and volcanic eruption effects. For the first time we show that ORAS4 OHC quantitatively agrees with the radiative forcing estimates of impacts of the 3 major volcanic eruptions since 1960 (Mt. Agung 1963, El Chichón 1982, and Mt. Pinatubo 1991). The natural variability of the energy imbalance is substantial from month-to-month associated with cloud and weather variations, and interannually mainly associated with ENSO, while the sun affects 15% of the climate change signal on decadal timescales. All estimates (OHC and TOA) show that over the past decade the energy imbalance ranges between about 0.5 and 1 W m-2. By using the full-depth ocean, there is a better overall accounting for energy, but discrepancies remain at interannual timescales between OHC and TOA radiation measurements, notably in 2008-09.