

Review ESSD-2019-255, Energy budget

Overall a good important energy inventory. Unique coordinated comprehensive approach across ocean, atmosphere, land and ice. Valuable product in its own right, but also as a review of each component. A few small suggestions and changes below, along with a call for a clearer vision of future efforts.

Lines 53, 54: Good list but with redundancy? “warming oceans, atmosphere and land,” = “rising temperatures”. Need clarification.

Line 55, 56: Reader does not need to see ‘international’ twice in the same sentence.

Line 64: “There is a regime shift” Write instead ‘there was a regime shift’. Given data up to 2018, authors would do well to adopt past tense throughout? This concept of a regime shift gets lost later in the document?

Lines 92, 93: “represents a more robust measure of the rate of climate change that is more indicative of the time-evolution” more robust but also more indicative? Reader does not need both ‘more’.

Line 140: capitalize Arctic.

Lines 181-185: Too much redundancy in this list of ocean impact.

Line 283: “values are given for the ocean surface.” Units of J/m^2 , so column-integrated numbers. Understand 0-300, 0-700 and 0-2000, but how do the authors extrapolate 700-2000 to surface heat flux values? 0-2000 minus 0-700?

Lines 322, 323: “heat sequestration into the deeper ocean layers took place over the past 6 decades” Because all OHC trend values in Figure 2 are positive? Do readers need to see units on ordinate of Figure 2, e.g as W / m^2 ?

Lines 384, 385: “ F_{snow} cools the high latitude ocean” ? If F_{snow} represents an upward heat flux that warms high latitude atmosphere during snow formation, how does it also cool high latitude ocean? Snow falling on the ocean requires heat from the ocean to melt, but does that energy to melt = F_{snow} ? Some careful changes here could allay confusion.

Line 445: Confusion about “third ... dataset” here because in prior paragraph we just read about three observation techniques (ERA, JRA and Merra)? Soon after, in legend for Figure 3, reader encounters “four different reanalyses and two (left) or three (right, plus MSU) different observational datasets” Need some careful enumeration

Lines 491-497: Good summary but redundant with introductory text? Remnant from a prior stand-alone land product? Not needed here?

Line 509: “extreme heat events” heat and drought?

Line 585: Not sure why uncertainty (95% CI) should increase with time? These represent cumulative uncertainties?

Line 637: “snow and permafrost”. But, energetics of permafrost thaw already included in land heat estimates?

Line 687, 688: “past 40 decades” I hope the authors mean the past 4 decades?

Line 743: Useful important figure but it would help visual memory of this reader if colors in the side-by-side pie chart (Figure 7) matched those used in the time series chart (Figure 6).

Line 749: Conceptual discontinuity with prior section 5; here the text jumps to what next. Make this a separate section? Perhaps summarize major factors that contribute to overall uncertainty (well itemized in each individual section but not yet presented from an overall e.g. GCOS viewpoint)? Then move to recommendations? Lines 749 to 773 read like the standard GCOS wish list. No priorities? Nothing most urgent, e.g. to resolve/reduce key uncertainties?

Lines 772, 773: “remote sensing measurements have to be calibrated and validated by in situ measurements.” By now basically a platitude? Haven’t we been saying / writing this recommendation for decades? What new from this work heightens or refines that recommendation? I do not expect a consensus to arise from the full list of contributors, but here the lead author(s) could inject expert opinions?

Lines 775 to 783: Readers might expect a stronger outcome / summary? Builds on large communities for each component, needs more or higher level of coordination? What made it different from (improved over) prior efforts? Here, EEI calculated through 2018 (with some extrapolations for some components since 2016). How fast does the system evolve? How fast do our observations evolve? Next inventory in 5 years? Two years? What does the science require, compared to what the observations can provide? Vast amount of work summarized here but the conclusion leaves readers wondering what next?

Numerous small typos that I hope the proofreaders will correct.