The Geobiosphere Emergy Baseline: A synthesis

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Abstract

Following the Eighth Biennial Emergy Conference (January, 2014), the need for revisiting the procedures and assumptions used to compute the Geobiosphere Emergy Baseline (GEB) emerged as a necessity to strengthen the method of Emergy Accounting and remove sources of ambiguity and potential misunderstanding. As a result of that awareness, three studies were undertaken to compute refined baselines using the most recently available data and understanding of Earth processes. They represent an effort to move towards a solution of this important and urgent issue. We hoped that the results of these studies would result in the development of a synthesis document to clarify the baseline issue and perhaps, ultimately result in the adoption of a single baseline. The reasoning was that several different approaches to the GEB computation, carried out by different emergy practitioners, would allow for comparison and accommodation of different perspectives and theories related to integration of Earth's driving energies into a single emergy baseline. Of course, given the uncertainty that exists in our understanding of the geobiosphere system, as well as in the available data about global processes, we did not expect that each approach would yield the same baseline, but rather that results achieved through different procedures and assumptions might fall within an acceptable range of values. In so doing, a single agreed upon baseline might be selected to reflect a reconciliation of diverse perspectives within a scientifically sound estimate of uncertainty.

Three studies were undertaken, that are to be published in Ecological Modeling (Brown and Ulgiati, 2016; Campbell, 2016; and De Vilbiss et al., 2016). They represent three different methods of determining the equivalences needed to express tidal dissipation and geothermal exergy as solar equivalent exergy. The methods have in common the fact that each of them computed solar equivalence ratios (SERs: solar equivalent exergy per unit of exergy; seJ J^{-1}) that when multiplied by the exergy of the primary sources to the geobiosphere, yield flows of solar equivalent exergy.

The final synthesis GEB recommended based on the three approaches is 12.0 E+24 seJ y^{-1}. The solar equivalent exergy of the three primary sources of exergy to the biosphere are as follows: Solar energy absorbed = 3.7E+24 seJ y^{-1}, Geothermal energy flows = 4.7E+24 seJ y^{-1}, and Tidal energy absorbed = 3.5E+24 seJ y^{-1}. The emergy of all products and flows produced in the geobiosphere can now be computed using standard emergy accounting methods starting from the common baseline, 12.0E+24 seJ y^{-1}. The units of these products and flows, derived from the GEB, are solar emjoules, abbreviated sej.

Literature Cited

Brown, M.T. and S. Ulgiati. 2016. Assessing the Global Environmental Sources Driving the Geobiosphere: A Revised Emergy Baseline. *Ecological Modelling (forthcoming)*

Campbell, D.E. 2016. Emergy Baseline for the Earth: Review of the Science and a New Calculation. *Ecological Modelling (forthcoming)*

De Vilbiss, C., M.T. Brown, E. Seigel, and S. Arden. 2016. A New Approach to the Planetary Emergy Baseline. *Ecological Modelling (forthcoming)*