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Earth's Surface Heat Flux

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We present a revised estimate of Earth's surface heat flux that is based upon an improved heat-flow data-set and new methodologies. Our estimate is 47 ± 2 TW.

Our data-set contains 38,347 measurements, which is ~55% greater than used in previous studies. Our final estimate is made up of 4 components:

(i) Young oceanic crust: our methodology, like others, accounts for hydrothermal circulation in young oceanic crust by utilising a half-space cooling approximation.

(ii) Continents and older oceans: the novel part of this work is the implementation of this second component. For the rest of Earth's surface (i.e. excluding oceanic crust < 65Ma), we estimate the average heat flow for different geologic domains as defined by global digital geology maps. We then produce a global estimate by multiplying these averages by the total global area of that geologic domain (note that this methodology depends upon a correlation between geology and heat flux, which is demonstrated in our data. While the correlation is weak, it is sufficient enough to be included in the estimate - an alternative would be to undertake a simple global area-weighted average. Indeed previous studies that have done so yield similar results). The averaging is done on a polygon set which results from an intersection of a 1° equal area grid with the original geology polygons; this minimises the adverse influence of clustering. These operations and estimates are derived accurately using methodologies from Geographical Information Science (GIS).

(iii) Antarctica: the virtually un-sampled Antarctica is considered separately. We use heat-flow estimates based on magnetic field measurements, which are supported by seismic measurements.

(iv) Hot-spot correction: we make a small correction for hot-spots in young oceanic lithosphere, since the parameters for the half-space cooling approximation were derived from observations that avoided hot-spot tracks.

A range of analyses will also be presented, including: (i) the use of various digital geology data-sets; (ii) estimates derived with and without the grids; and (iii) removing geology domains with less than a threshold number of observations. Our preferred analysis only uses geological domains with at least 50 observations. These analyses, combined with rigorous statistical estimates of the error, provide a measure of robustness. Our final preferred estimate of 47 ± 2 TW is slightly greater than previous estimates.