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Revised Estimate of Earth's Surface Heat Flow: 47 +- 2 TW

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Earth's surface heat flow provides a fundamental constraint on solid Earth dynamics. However, deriving an estimate of the total surface heat flux is complex, due to the inhomogeneous distribution of heat flow measurements and difficulties in measuring heat flux in young oceanic crust, arising due to hydrothermal circulation.

A database of 38347 measurements (provided by G. Laske & G. Masters), representing a 55% increase on the number of measurements used previously, and the methods of Geographical Information Science (GIS), is used to derive a revised estimate of Earth's surface heat flux (Davies & Davies, 2010). To account for hydrothermal circulation in young oceanic crust, we use a model estimate of the heat flux, following the work of Jaupart et al., 2007; while for the rest of the globe, in an attempt to overcome the inhomogeneous distribution of measurements, we develop an average for different geological units. Two digital geology data sets are used to define the global geology: (i) continental geology - Hearn et al., 2003; and (ii) the global data-set of CCGM – Commission de la Carte Géologique du Monde, 2000. This leads to > 93,000 polygons defining Earth's geology. The influence of clustering is limited by intersecting the geology polygons with a 1 by 1 degree (at the equator) equal area grid. The average heat flow is evaluated for each geology class. The contribution of each geology class to the global surface heat flow is derived by multiplying this estimated average surface heat flux with the area of that geology class. The surface heat flow contributions of all the geology classes are summed. For Antarctica we use an estimate based on depth to Curie temperature and include a 1TW contribution from hot-spots in young ocean age. Geology classes with less than 50 readings are excluded. The raw data suggests that this method of correlating heat flux with geology has some power.

Our revised estimate for Earth's global surface heat flux is 47 ± 2 TW, which is similar but slightly higher than previous estimates (e.g. Pollack et al., 1993 – 45 ± 1 TW; and Jaupart et al., 2007, - 46 ± 3 TW). It is difficult to reconcile such a high heat flow with estimates of internal heat sources in a monotonically cooling mantle. We will discuss alternative solutions and the extension of this work to produce a best estimate of the local heat flux globally.

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