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The spatial flux of Earth's meteorite falls found via Antarctic data: implications for future searches

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Contemporary calculations for the flux of extra-terrestrial material falling to the Earth's surface (each event referred to as a 'fall') rely upon either short duration fireball monitoring networks [Howie et al., 2017; Bland et al., 2012] or spatially limited ground-based meteorite searches [Hutzler et al., 2016; Gattacceca et al., 2011]. To date, fall flux estimates from the much-documented Meteorite Stranding Zones (MSZs) of Antarctica [Righter et al., 2014], have been limited due to complicating glacial ice dynamics and pairing uncertainties [Zolensky, 1998; Zolensky et al., 2006; Bland, 2005].
For the first time we show how to extract Antarctic fall fluxes from combining glaciological modelling and recovered meteorite collection data, inferring the associated flux of falls over 50 g as 25.8 per km2 per million years (km–2 Myr –1). We further show there is a clear latitudinal variation in fall frequencies, finding a significant pole to equator ratio of ∼65% exists. We take account of this variation, allowing our flux estimates (based upon ∼4,100 falls) to be compared with earlier geographically-distinct flux estimates (based upon ∼200 falls) [Halliday et al. 1996, Bland et al. 1996]. In so doing, we are able to provide the most accurate values to date: we calculate the mass flux of falls in the 10 g to 1 kg interval to be 3680 kg yr–1 with an associated expected total recoverable mass flux to Earth of 16.6 tonnes per year, and estimate the global fall flux over 50 g to be approximately 17,600 falls per year. Our modelling also enables a reassessment of the risk to Earth from larger meteoroid impacts — now 12% higher at the equator and 27% lower at the poles than if the flux were globally uniform.
Taking this further the inferred flux to Earth and our glaciological modelling can be inverted to assess potential, as yet unsearched, MSZs and identify those that might yield the highest densities of meteorite finds. Indeed we have used this method to identify and prioritise MSZs for an upcoming Antarctic field campaign in Austral Summer 2018/19. To conclude we will provide a short progress report on this meteorite recovery mission.

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