EXOPLANETS

Balmy snowballs

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Planets are considered to be in a snowball state when their oceans are completely covered in ice from pole to equator. This climatic condition is less exotic that one might think, as there is convincing geological evidence that our own Earth underwent a snowball episode in its past, possibly more than once. The possibility that rocky exoplanets in the classical habitable zone could be or evolve into snowballs has been usually considered detrimental to life. Adiv Paradise and colleagues paint a more nuanced picture.

Paradise et al. use a 3D general circulation model, which includes a detailed treatment of weathering effects. Weathering contributes to the global climate of a planet by favouring the trapping of atmospheric CO_2 on the surface (thus reducing the global temperature) through the formation of carbonate rocks. Weathering is counterbalanced by outgassing of CO_2 from the same rocks once they are recycled into the mantle, eventually reaching an equilibrium temperature.

By applying their model to Earth-like planets at different values of stellar fluxes and CO_2 partial pressures, Paradise et al. find that, when the energy from the star is moderate to high, in addition to full-fledged snowballs and globally warm planets (like modern Earth), there exists a third stable regime of 'temperate snowballs' whose continents are not covered in ice and experience temperatures above 0 °C during summer. This is enough to create meltwater, enhance precipitation and feed the weathering–outgassing cycle. Such conditions should be more conducive to habitability than those experienced by classical snowballs.

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