

# The weight of a world

What's in a name? Would a super-Earth by any other name smell as sweet? It should, but maybe it wouldn't get as many clicks.

It's an inconvenient truth that the most common type of planet in the Galaxy (Universe?) does not exist in our Solar System. As they have a mass between those of Earth and Neptune, they are collectively known as 'super-Earths' or 'sub-Neptunes'. Their Latin prefixes (super = over; sub = below) were meant to define the planets as being bigger than Earth and smaller than Neptune. Over time, however, the terms developed an additional meaning connected to the planet with which they are compared, so super-Earth is considered a synonym of big rocky planet and sub-Neptune of small icy giant. In reality, for many of them we do not know their exact nature, whether they are rocky, icy or even ocean worlds. Let alone if they have an atmosphere or not.

But the term Earth is loaded with meaning. And should an article also include the phrase habitable zone, the public immediately thinks that we are talking about Earth 2.0: a rocky planet with surface water and an atmosphere and perhaps a more striking sunset than ours. And who can blame them? However, the habitable zone is most commonly defined as the region around a star in which the surface of an Earth-like planet would be temperate enough to support liquid water. Note that the Moon, Mars and Venus are also in the habitable zone of our Sun. To maintain liquid water on the surface, the Earth needs greenhouse gases in its atmosphere to warm it up. Otherwise the equilibrium temperature of the Earth would be 257 K — well below the freezing point of water (under standard atmospheric conditions).

When two papers, a [preprint](#) by Björn Benneke et al. and a [Letter](#) by Angelos Tsaras et al., reporting the detection of water vapour in the atmosphere of exoplanet K2-18 b — eight times the mass of the Earth and therefore technically a super-Earth — appeared online within a day of each other, it was no wonder that over 3,800 news outlets covered the results. Finding water in the atmosphere of a temperate exoplanet is hugely exciting. It is also technically challenging, and heralds our ability to study the atmospheres of exoplanets smaller than

Neptune. This advance is huge, as we really want to target terrestrial planets. As K2-18 b is in the habitable zone, it means we can get down to business and probe terrestrial atmospheres in this mass region.

From a perspective of habitability, we specifically want to focus on exoplanets with radii less than 1.5 times that of the Earth. As explained — in an entertaining fashion — in a [blog](#) by Elizabeth Tasker, planets larger than that tend to be less dense than Earth and in possession of a warmer cloak of light gases. Indeed, both papers additionally report the presence of hydrogen on K2-18 b. According to Tasker, the hydrogen-dominated atmosphere invalidates any talk of habitability, as the surface temperature is likely to be way too high. Let's be clear: humans could not survive on K2-18 b. Moreover, we do not know if K2-18 b has a surface for a human to stand on, or indeed lie on, given the pressure is so high. Still, not many news stories focused on the inhospitable nature of a planet in close orbit around an M dwarf with high X-ray and ultraviolet activity. XKCD, however, totally nailed it in their [comic](#).

From a scientific point of view, however, exoplanets such as K2-18 b are a mine of information. They are common in size, except within the Solar System. NASA's Kepler mission detected hundreds of exoplanets in this mass range, and hundreds more are expected from the Transiting Exoplanet Survey Satellite (TESS) mission. We do not know whether K2-18 b is a large terrestrial planet or a small ice giant. Thus, it could equally be called a sub-Neptune rather than a super-Earth. We should drop these names altogether. In their [Comment](#), William Moore et al. outline the need for precision: "terrestrial planet in a temperate orbit" is not the same as "Earth-like planet in the habitable zone". It's a view supported in a [Comment](#) by Tasker et al., yet more than two years have passed since these articles were published and the situation has not improved.

And let's not forget that many molecules could be abiotic as well as biological in origin. To even suggest the presence of life

(as we know it), Carl Sagan et al. explained in an [Article](#) that the detection of oxygen and methane in disequilibrium would be necessary. Michael Mendillo, Paul Withers and Paul Dalba more recently argued in a [Perspective](#) that a detection of O<sup>+</sup> in an exoplanet's ionosphere would be sufficient as a sign of oxygenic photosynthesis. To search for biomarkers on rocky exoplanets, we will need the James Webb Space Telescope and the Atmospheric Remote-sensing Infrared Exoplanet Large-survey (ARIEL) mission.

When these observatories come online, it will be even more important to use precise scientific terminology. At a recent Exoclines V conference in Oxford, UK, Joseph Harrington suggested a kind of Torino scale for the reporting of biosignatures. The Torino Impact Hazard Scale for the public communication of a potential asteroid impact ranges from zero to ten and is colour coded. Thus, a score of zero lies in the white zone, with a negligible threat of collision or minimal impact on life, and eight to ten lie in the red zone, indicating certain collision, with ten meaning that we can expect a hit with global-scale consequences, such as the Chicxulub impact that wiped out the dinosaurs. A level-three asteroid has a 1% chance of collision, and that's when astronomers are brought in to monitor the object. A similar scale for the exoplanet community was enthusiastically received, so we can hope for some guidance soon.

Calling for more care in the language of reporting takes nothing away from these amazing discoveries. There is simply no need to be ambiguous (at best) or deliberately misleading (at worst). For over two years, this journal has minimized the use of unqualified instances of super-Earth, sub-Neptune, hot-Jupiter and so forth, though we could do better. Similarly, the habitable zone has too many implications and needs to go. Let us all be more vigilant. □

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