A model explains effects like the formation of clouds from the sea

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Credit: Ray Bilcliff from Pexels

All liquids always contain gases in a greater or lesser concentration depending on the pressure and temperature to which it is subjected. These gases almost always end up as more or less small bubbles on the surface of the liquid. When these bubbles explode, especially if they are microscopic, minuscule drops are expelled at great velocity, and the drops almost instantly travel notable distances from the surface of the liquid that they came from.

A new study explains everyday phenomena like what really causes clouds and rain, what gives sparkling wines their distinctive aroma, and why tyres generate so much smoke when they burn. The University of Seville teacher Alfonso Gañán has developed a particularly exact model to show the origin of all these phenomena from a universal microscopic mechanism that occurs on the surface of liquids independently of evaporation. His results have been published in *Physical Review Letters*.

Liquid, especially when it is in continuous movement, always contains gases in a greater or lesser concentration, depending on the pressure and temperature to which it is subjected. These gases almost always end up as small bubbles on the surface of the liquid. When these bubbles explode, especially if they are microscopic, minuscule drops are expelled at great velocity, and these drops almost instantly travel notable distances from the surface of the liquid that they came from.

These microscopic drops generate the seeds of clouds (microscopic grains of salt that form the condensation nuclei of the drops of the clouds) on the surface of the sea, or they can form smoke on burning liquids.

The size of these "ghost drops" and their speed are the principle factors that the model explains and precisely determines, predicting the results of hundreds of exhaustive experiments carried out from the start of the 20th century until the present day. In accordance with this model, in function of the properties of a determined liquid, there exists a critical size of gas bubble that determines a remarkable singularity: The drop expelled becomes incredibly small, while its speed increases limitlessly as the size of the bubble shrinks and approaches this limit. Below this limit, no drops are expelled. Specifically, when this size is small enough (as in the case of small bubbles in water), the new model shows that the "ghost" micro-drops can reach supersonic speeds and reach truly meaningful heights.

More information: Alfonso M. Gañán-Calvo, Revision of Bubble Bursting: Universal Scaling Laws of Top Jet Drop Size and Speed, *Physical Review Letters* (2017). DOI: 10.1103/PhysRevLett.119.204502

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