Geophysical Research Abstracts
Vol. 21, EGU2019-8279-1, 2019
EGU General Assembly 2019

Bag-breakup mechanism of sea spray generation in strong winds: direct numerical simulation

Anna Zotova, Yuliya Troitskaya, Daniil Sergeev, and Alexander Kandaurov

Institute of Applied Physics of the Russian Academy of Sciences, Nonlinear geophysical processes department, Nizhny Novgorod, Russian Federation (aniazotova@yandex.ru)

In [1] the mechanisms of spray generation under hurricane winds were experimentally studied and it was found that for friction velocity $u^* > 1$ m/s (for wind speeds at 10 m height exceeding 20 m/s), bag-breakup determines the contribution to the formation of large droplets. A typical event of this type begins with a small-scale increase in the water surface, which then turns into a “micro-sail”, swells into a water film bounded by a thicker rim, and finally explodes, producing hundreds of droplets. In the dynamics of engineering fluids [1], this phenomenon is known as the “bag-breakup” mode of liquid fragmentation in gas streams.

For the direct numerical simulation of the bag-breakup phenomenon, the Gerris Flow Solver was used. As an initial configuration for numerical simulation a drop of liquid was placed in the air flow. A drop of water with a diameter of 1 cm (the characteristic size of the perturbation from which the bag arises) placed in the air stream at a speed of 20 m/s corresponds best to the experimental situation, such a system is characterized by the Weber number We = 54. Modeling the dynamics of two media with very different densities, such as water and air, require a lot of computational time, so we used liquids that differ in density by a factor of 10, but to keep the same Weber number, we changed the other parameters of the problem. The calculation was carried out with keeping the same Reynolds number and also with the Reynolds number reduced and increased by a factor of 10. In our simulation just as in an experiment under the action of an air stream a drop is blown into a micro-sail that bursts to form a micro-spray. As the Reynolds number decreases (with increasing of viscosity of both media), the process of destruction of the drop after the formation of a micro-sail from it changes.

This work was partly supported by the RFBR grants (18-55-50005, 18-35-20068, 19-05-00249). Carrying out experiments themselves was supported by Russian Science Foundation (18-77-00074).

[1] Troitskaya Yu., et al., Sci. Rep. 7 1614 (2017).