The efficiency of the aerial drop of fire-fighting products: a modelling approach

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Abstract

Forest fires have a major impact on societies, namely with the lost of human lives and natural heritages or through the harmful effect of the emitted toxic gases on the exposed people. The aerial drop of suppressant and retardant products assumes, in this context, a significant importance in the global strategy of increasing the efficiency of fire-fighting techniques, in particular, due to the rapid access to remote areas. New products have been tested with this purpose along the last decades. Also, new aerial delivery systems, as the Modular Airborne Fire Fighting System (MAFFS) or the Aerial Fire Fighting System (AFFS), were designed.

To be effective the total amount of product deposited on the ground should attain certain levels and several factors have to be considered when the aerial dropping is going on. However, the evaluation of the synergetic effects involved is difficult to analyse at full scale. Computational Fluids Dynamics (CFD) models are a privileged tool for a detailed assessment of the entire range of phenomena interacting in the aerial drop of fire-fighting products. The current work intends to fulfil some of the gaps that persist on the scientific understanding of the behaviour of suppressant and retardant products in the atmosphere. In this sense, a CFD modelling approach to this problem was developed and applied for a series of real scale drop tests. At the current stage of knowledge, meteorological parameters are usually neglected or assumed to be constant in time and space, although the strong interaction with the dispersion of atomized products. In this sense, the relevancy of heat induced turbulence or the atmospheric stability on three-dimensional flow conditions is evaluated. At lower levels, also the influence of vegetative canopy on local wind field is investigated. All these effects can have a different importance towards the final ground deposition of the correct amount of product at the desired location, in order to reduce drift and the associated environmental impacts (especially in aquiferous).

Nowadays, drop's efficiency is still highly dependent from the pilot's skills. The ultimate goal of the work is related with the development of a friendly-user operational tool to be used with different purposes: during training of fire-fighters; as part of an on-board decision support system available for the pilot; or even at the development of new products, as an alternative way of assessing the behaviour and efficiencies, and consequently reducing the need to perform costly real scale drops.

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