Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Large-eddy simulations of a solid-rocket booster jet ROBERTO PAOLI, ADELE POUBEAU, DANIEL CARIOLLE, CERFACS — Emissions from solid-rocket boosters are responsible for a severe decrease in ozone concentration in the rocket plume during the first hours after a launch. The main source of ozone depletion is due to hydrogen chloride that is converted into chlorine in the high temperature regions of the jet (afterburning). The objective of this study is to evaluate the active chlorine concentration in the plume of a solid-rocket booster using large-eddy simulations. The gas is injected through the entire nozzle of the booster and a local time-stepping method based on coupling multi-instances of a fluid solver is used to extend the computational domain up to 600 nozzle exit diameters. The methodology is validated for a non-reactive case by analyzing the flow characteristics of supersonic co-flowing under expanded jets. Then, the chemistry of chlorine is studied offline using a complex chemistry solver and the LES data extracted from the mean trajectories of sample fluid particles. Finally, the online chemistry is analyzed by means of the multispecies version of the LES solver using a reduced chemistry scheme. The LES are able to capture the mixing of the exhaust with ambient air and the species concentrations, which is also useful to initialize atmospheric simulations on larger domains.

Roberto Paoli
CERFACS

Date submitted: 30 Jul 2014 Electronic form version 1.4