Simulations of underwater explosion phenomena

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Underwater explosions (UNDEX) refer to the detonation of explosive devices immersed in water. UNDEX present many challenges for numerical modeling. The density ratio between explosion gases and the surrounding liquid are typically of order (10^3), and the pressure ratios can be just as high. Numerical examples include verification and validation for a number of canonical test cases for two different computational fluid dynamics codes (MSC.Dytran and OpenFOAM). Shallow water explosions near a free surface was modeled and compared with experimental data obtained in NRC KI. Different masses of charges (ranging from 1.3 to 100 gram of TNT) and different experimental volumes (ranging from $0.32m^3$ to $5.6m^3$) were used. The qualitative phenomena of bubble expansion, collapse, re-expansion and crowning are all captured by both codes. But only one code is capable to predict vaporized cloud formation that occurs from the UNDEX plumes. The attempt to simulate vaporized cloud was made using OpenFOAM code. It is shown that OpenFOAM qualitatively captured the effects of dispersion, atomization and evaporation that take place in a plumes resulting from UNDEX. The main differences, advantages and drawbacks of the codes are shown.