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Simulation of a supercritical fluid flow with extremely high temperature gradients[1] SATOKO KOMURASAKI, Nihon Univ - Tokyo — Eruption of geothermally heated water from the hydrothermal vent in deep oceans of depth over 2,000 meters is numerically simulated. The hydrostatic pressure of water is assumed to be over 200 atmospheres, and temperature of heated water is occasionally more than 300°C. Under these conditions, a part of heated water can be in the supercritical state, and the physical properties can change significantly by the temperature. Particularly, thermal diffusivity at the critical temperature becomes so small which prevents heat diffusion and the temperature gradients can become high. The compressible Navier-Stokes equations are solved using a method for the incompressible equations under the constant pressure. The equations are approximated by the multidirectional finite difference method, and for the highly-unsteady-flow computation, KK scheme is used to stabilize the high-accuracy computation. To treat high temperature gradients in the computation, the energy equation is solved which is derived by transformation of thermodynamic variable ϕ into φ that is $\varphi = -\mathrm{sgn}\phi \cdot \log(1 - \phi \cdot \mathrm{sgn}\phi)$. Solving the equation about φ instead of ϕ allows the sharp boundaries of ϕ to be properly preserved in the computation.

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