1. Fully compressible

$$\frac{D\rho}{Dt} = -\rho\nabla\cdot\boldsymbol{u} \quad \text{where} \quad \frac{D}{Dt} \coloneqq \frac{\partial}{\partial t} + \boldsymbol{u}\cdot\nabla \tag{1.1}$$

$$\rho\frac{D\boldsymbol{u}}{Dt} = -2\boldsymbol{\Omega}_0\times\boldsymbol{u} - \nabla P + \rho\boldsymbol{g} + \nabla\cdot\boldsymbol{\mathsf{D}} + \frac{1}{\mu}(\nabla\times\boldsymbol{B})\times\boldsymbol{B}, \tag{1.2a}$$

$$\text{where} \quad \mathsf{D}_{ij} = \rho\nu\left[\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i} - \frac{2}{3}(\nabla\cdot\boldsymbol{u})\delta_{ij}\right], \tag{1.2b}$$

$$\rho T\frac{DS}{Dt} = \nabla\cdot(\rho\kappa C_\mathrm{p}\nabla T) + Q + \mathsf{D}_{ij}\frac{\partial u_i}{\partial x_j} + \frac{1}{\mu}|\nabla\times\boldsymbol{B}|^2, \tag{1.3}$$

$$S = S(P,T) \tag{1.4}$$

$$\frac{\partial\boldsymbol{B}}{\partial t} = \nabla\times(\boldsymbol{u}\times\boldsymbol{B}) - \nabla\times(\eta\nabla\times\boldsymbol{B}) \tag{1.5}$$

$$\nabla\cdot\boldsymbol{B} \equiv 0 \tag{1.6}$$