Divide by volume $(\delta x \delta y \delta z)$:

$$\boxed{\frac{\partial}{\partial t}\underbrace{\left(\frac{m}{\delta x\,\delta y\,\delta z}\right)}_{\rho} = \underbrace{-\frac{\partial}{\partial x}(\rho u) - \frac{\partial}{\partial y}(\rho v) - \frac{\partial}{\partial z}(\rho w)}_{\text{convergence of mass flux}}}$$

We can subtract equality on both sides

· convergence of mass flux

$$\underbrace{-\nabla\cdot}_{\text{"convergence"}}(\rho\vec{V})$$

"convergence" uses $\underbrace{\vec\nabla}_{} = \hat i\frac{\partial}{\partial x} + \hat j\frac{\partial}{\partial y} + \hat k\frac{\partial}{\partial z}$

Called: "Del", "Nabla",

Used in: · "gradient" (scalar field to right)

· "vergence"

· etc.

Same way we write vectors

$$\vec V = \hat i u + \hat j v + \hat k w$$

components

Physical statement of water vapor mass:

$$\frac{\partial}{\partial t}(q\rho) = \begin{pmatrix}\text{sources}\\ -\text{sinks}\end{pmatrix} + \underbrace{-\nabla\cdot(q(\rho\vec V))}_{\text{transport}}$$

(evap − cond)

$$q\frac{\partial\rho}{\partial t} + \rho\frac{\partial q}{\partial t} = e - c - \frac{\partial}{\partial x}(q(\rho u)) - \frac{\partial}{\partial y}(q(\rho v)) - \frac{\partial}{\partial z}(q(\rho w))$$

$$\cancel{q\frac{\partial\rho}{\partial t}} + \rho\frac{\partial q}{\partial t} = e - c - q\left[\cancel{-\frac{\partial}{\partial x}(\rho u) - \frac{\partial}{\partial y}(\rho v) - \frac{\partial}{\partial z}(\rho w)}\right]$$

$$-\rho\left[u\frac{\partial q}{\partial x} - v\frac{\partial q}{\partial y} - w\frac{\partial q}{\partial z}\right]$$

Zero!

We can subtract this equality from both sides

Divide by ρ:

$$\boxed{\frac{\partial q}{\partial t} = -u\frac{\partial q}{\partial x} - v\frac{\partial q}{\partial y} - w\frac{\partial q}{\partial z} = \underbrace{-\vec V\cdot\vec\nabla q}_{\text{"advection" of } q} + e - c}$$