Apply PETSc to a Three Dimensional Cloud Model Based on the Vector Vorticity Equation

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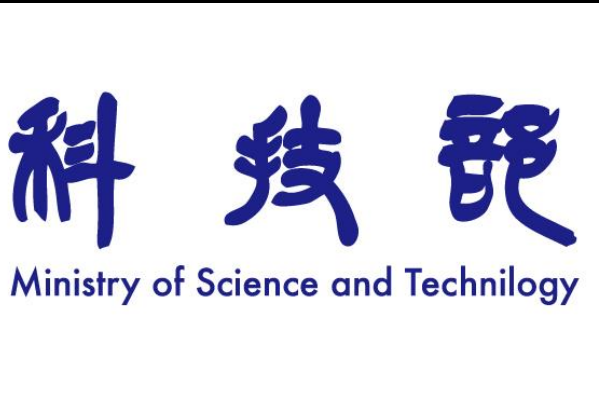


Model Problem

- Anelastic equation (incompressible) in vector vorticity form [Jung and Arakawa, 2005]

PETSc is applied to solve

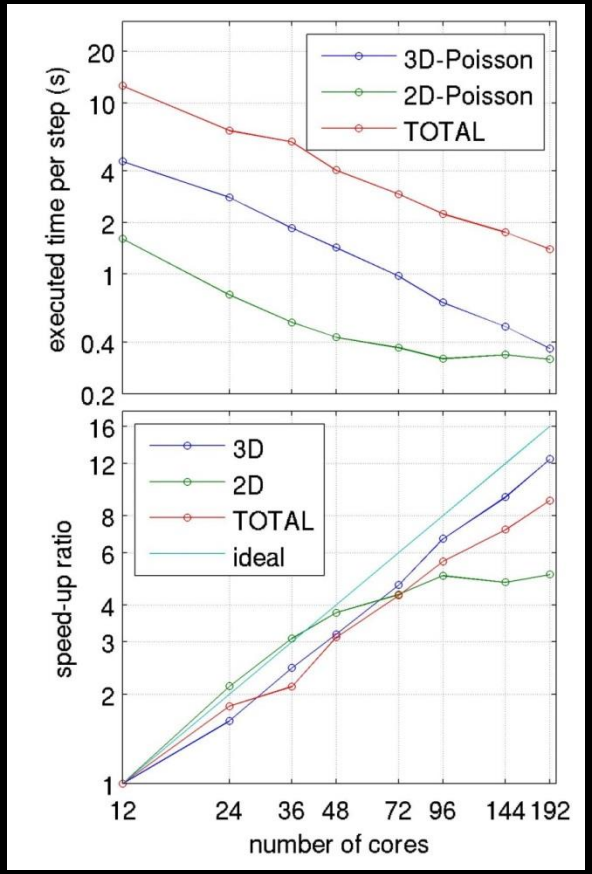
- 3D-Poisson Equation for diagnosing vertical velocity

$$\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)w+\frac{\partial}{\partial z}\left(\frac{1}{\rho_0}\left(\frac{\partial \rho_0 w}{\partial z}\right)\right)=-\frac{\partial}{\partial x}\rho_0\eta+\frac{\partial}{\partial y}\rho_0\xi$$

- 2D-Poisson Equation for Boundary conditions

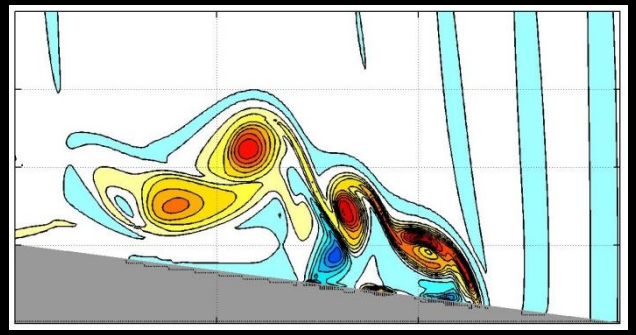
$$\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)\psi=\rho_0\zeta \text{ and } \left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)\chi=-\frac{1}{\rho}\frac{\partial}{\partial z}(\rho_0 w)$$

- Maximum 400+ cores with $2048 \times 2048 \times 240$ grid
- PETSc Application in VVM
  - Coupling grid by DMDA structure
  - CG + SSOR/ FBCGS+MG

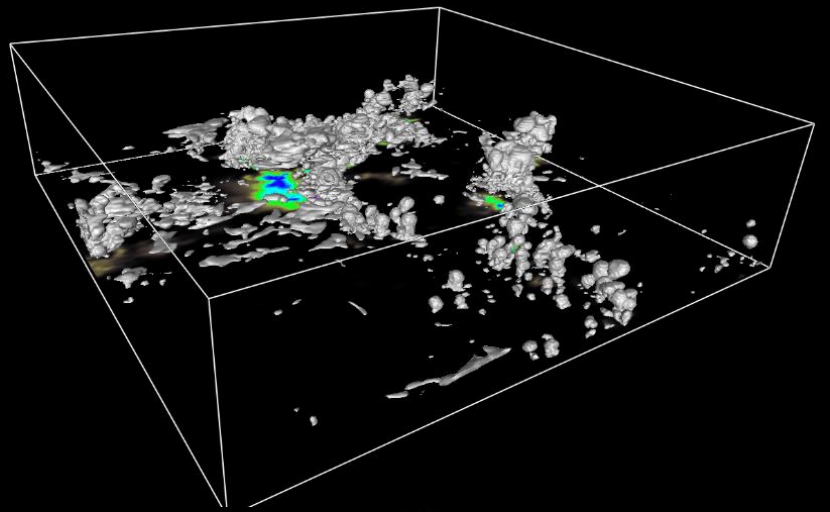


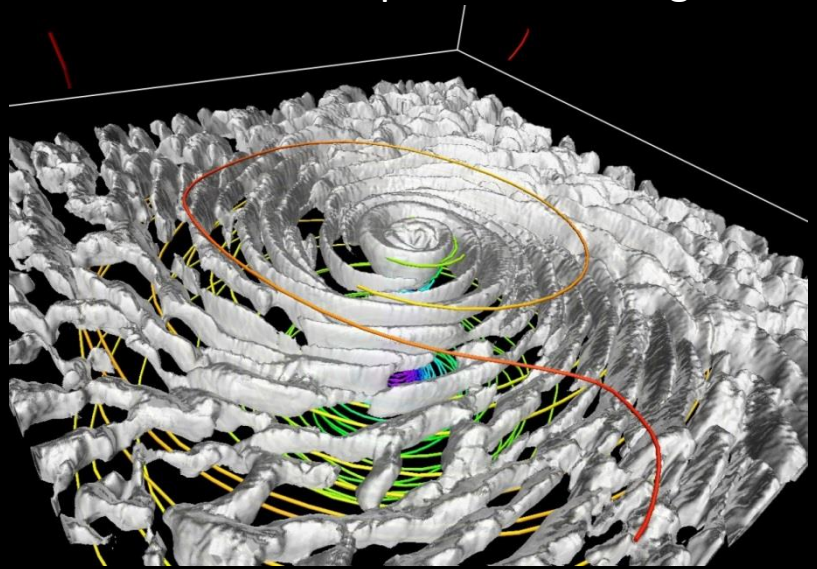
Speed-up test for VVM with 720x720x34 grid

Results

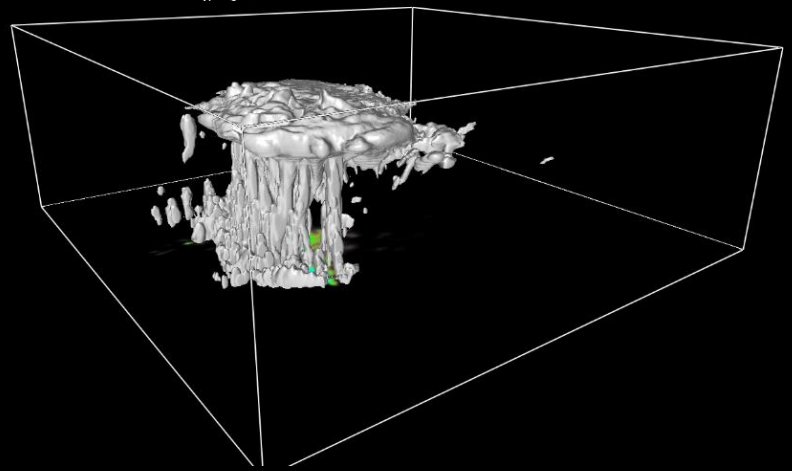


Cold bubble experiment over gentle slope





Hurricane simulation



Deep Convection – Madden Julian Oscillation