Investigating the T-I annual and semiannual variations in WACCM-X and TIME-GCM using WACCM-X diffusion

John T. Emmert[1], Fabrizio Sassi[1], Jennifer Tate[2], McArthur Jones Jr.[1]

(1) Space Science Division, U.S. Naval Research Laboratory, Washington, D.C., USA.
(2) Computational Physics Inc. Springfield, VA, USA.

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WACCM-X AO/SAO Tuning with Prandtl Number

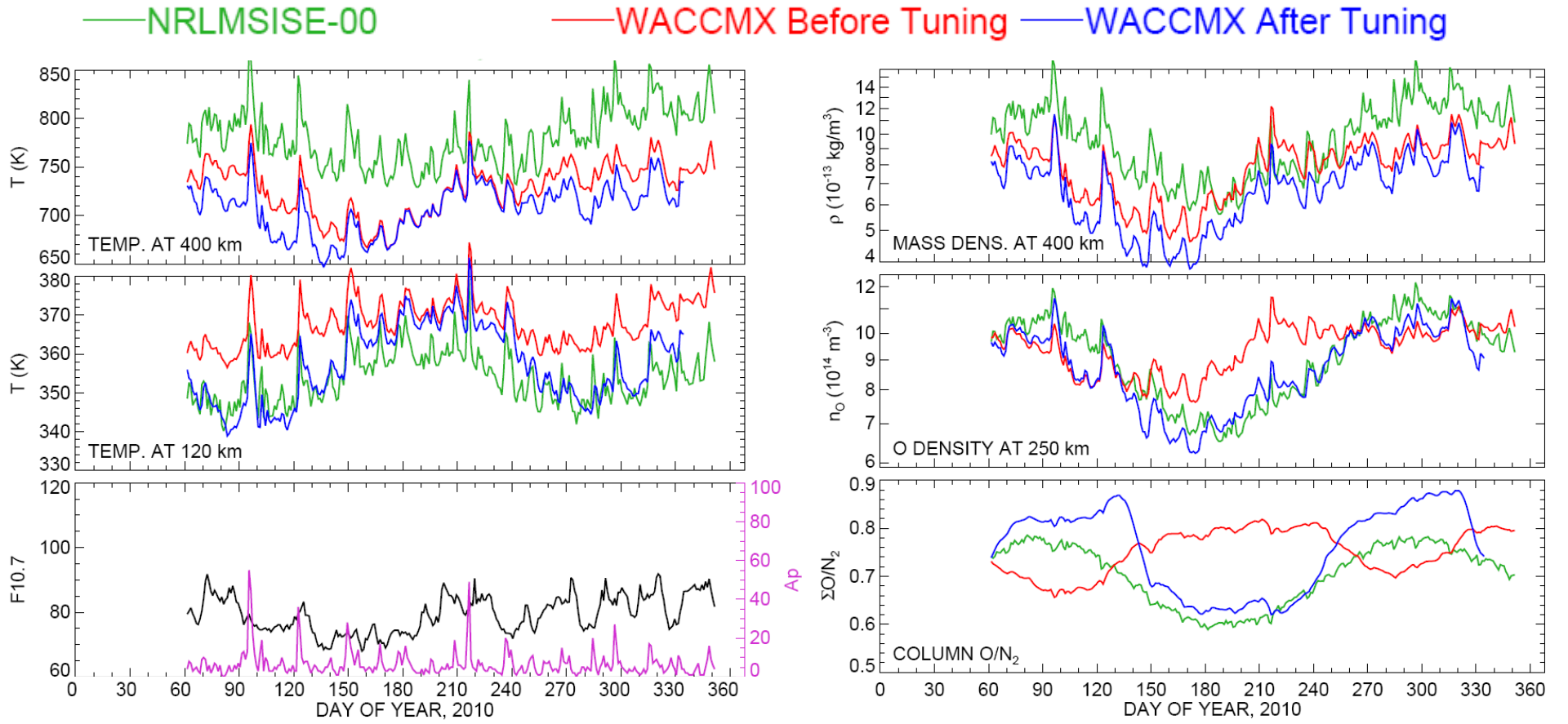
- WACCM-X 1.0 Simulations constrained by NAVGEM reanalyses up to ~90 km
- March-November 2010
- Tuned to NRLMSISE-00 O density AO/SAO at 250 km
- Species eddy diffusion decoupled from dry static energy diffusion via separate Prandtl number:

$$w_i \varphi_i = -\mathrm{Pr}_{den}^{-1} \left[\frac{\delta \overline{w'w'}}{k^2 \left(U-c\right)^2 + \delta} \right] \frac{\partial \varphi_i}{\partial z} = -K_{zz}^{eff} \frac{\partial \varphi_i}{\partial z}$$

Species eddy diffusion in TIME-GCM:

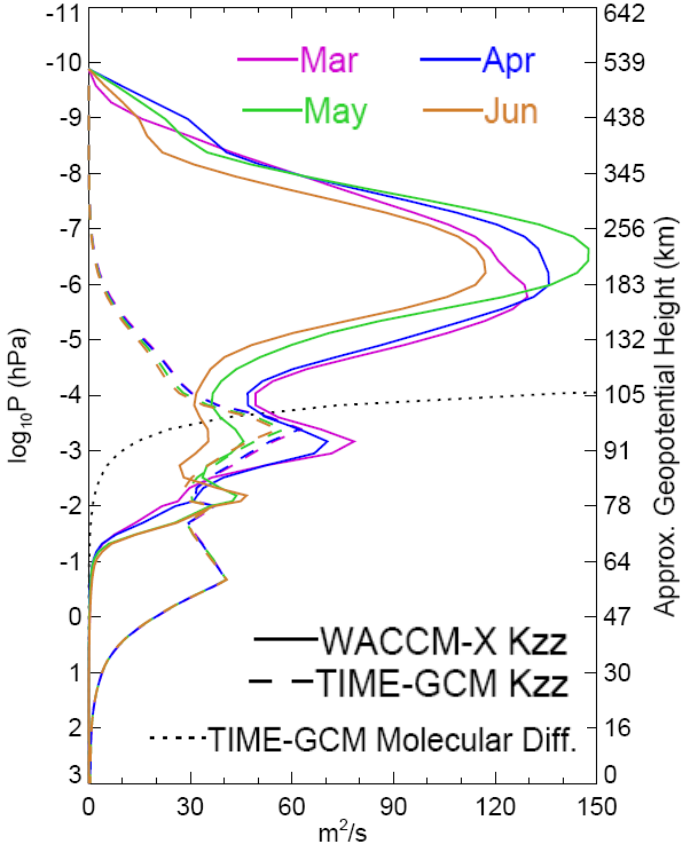
$$w_i \psi_i = -\left(K_{zz}^{back} + \mathrm{Pr}^{-1} k^2 e F_c^2 \delta \right) \left(\frac{\partial}{\partial z} + \frac{1}{\bar{m}} \frac{\partial \bar{m}}{\partial z} \right) \psi_i$$

WACCM-X AO/SAO Tuning with Prandtl Number

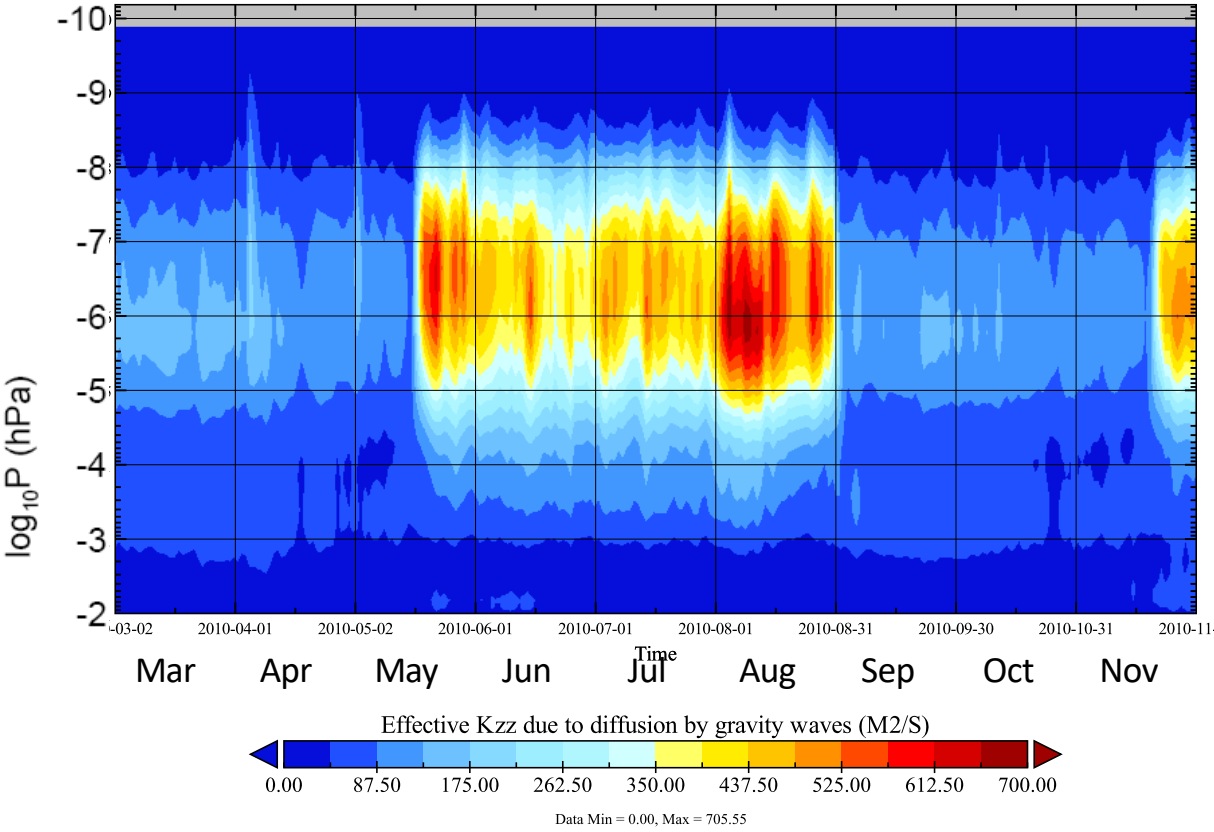


WACCM-X AO/SAO Tuning with Prandtl Number

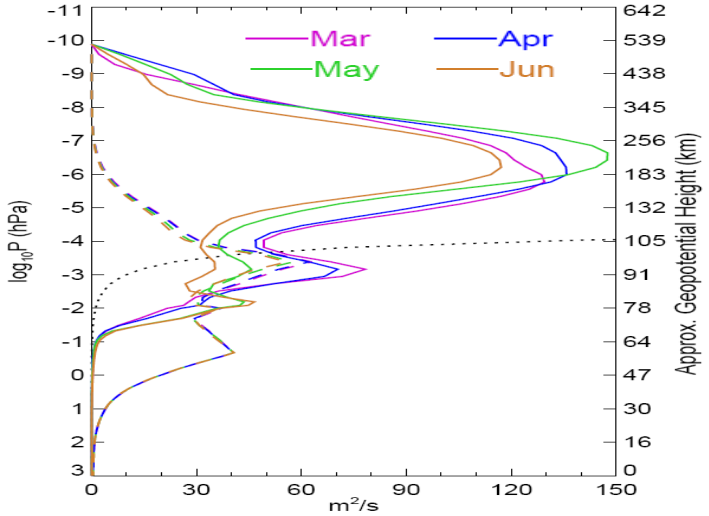
Before Tuning

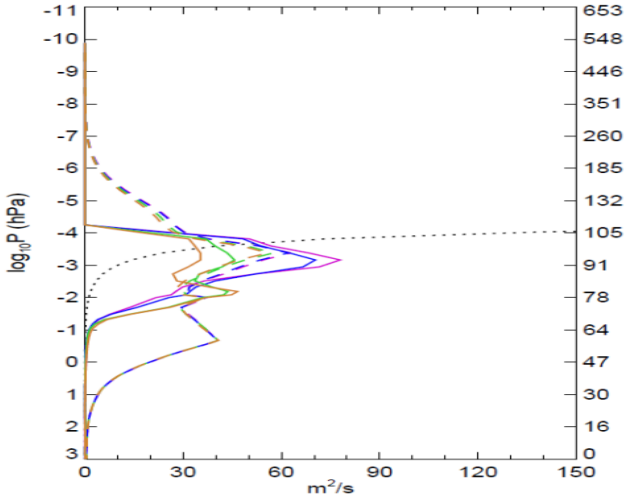


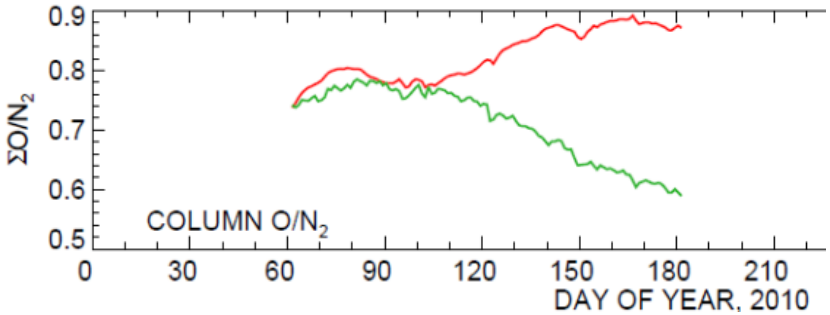
After Tuning

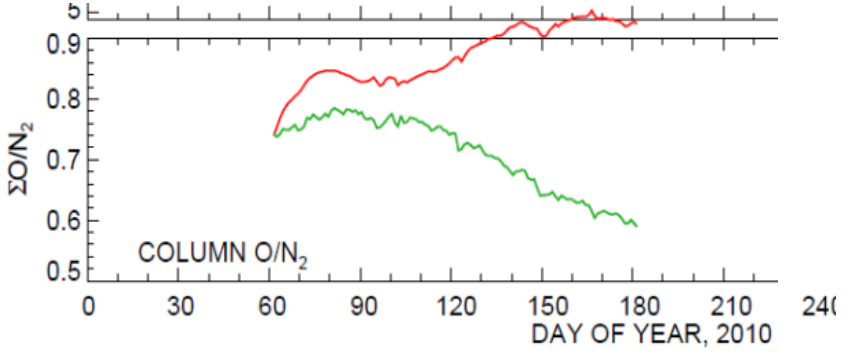


WACCM-X Effect of truncating K_{zz} above ~100 km









Globally Averaged Mass Density at 400 km simulated by the TIME-GCM

- **Three TIME-GCM Simulations**

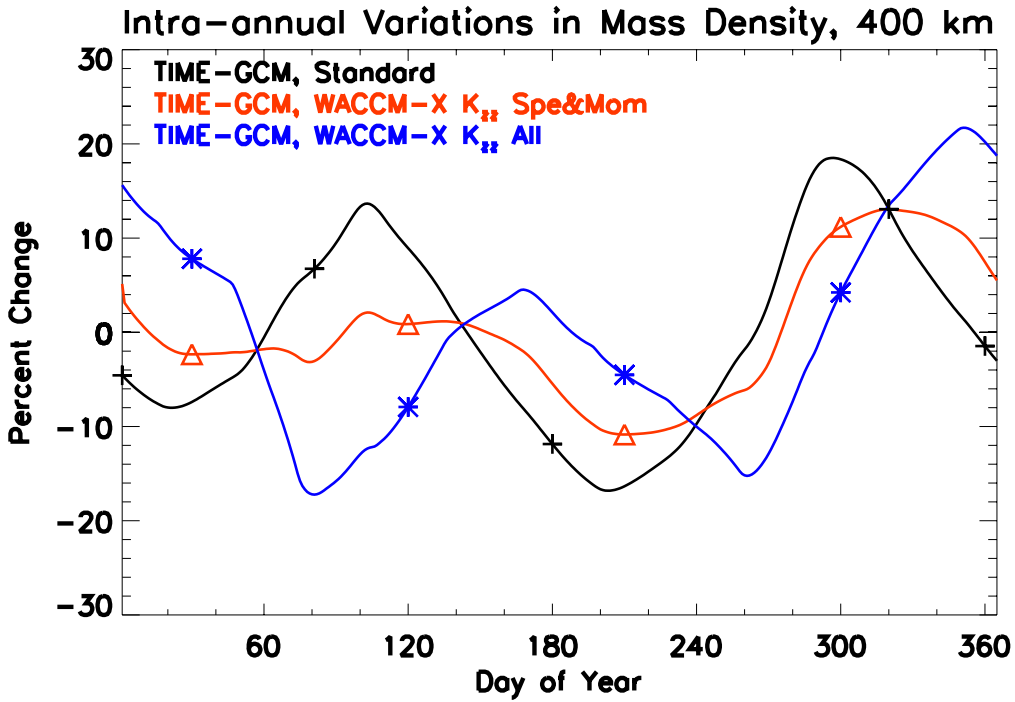
1. **TIME-GCM Out-of-the-box = "Standard"**
2. **TIME-GCM w/WACCM-X Background K_{zz} →**

$$K_{zz}^{back,TIME} = K_{zz}^{GM,WACCM-X}$$

Including eddy viscosity, thermal diffusion, and constituents

3. **TIME-GCM w/WACCM-X Background K_{zz} Spec&Mom →**

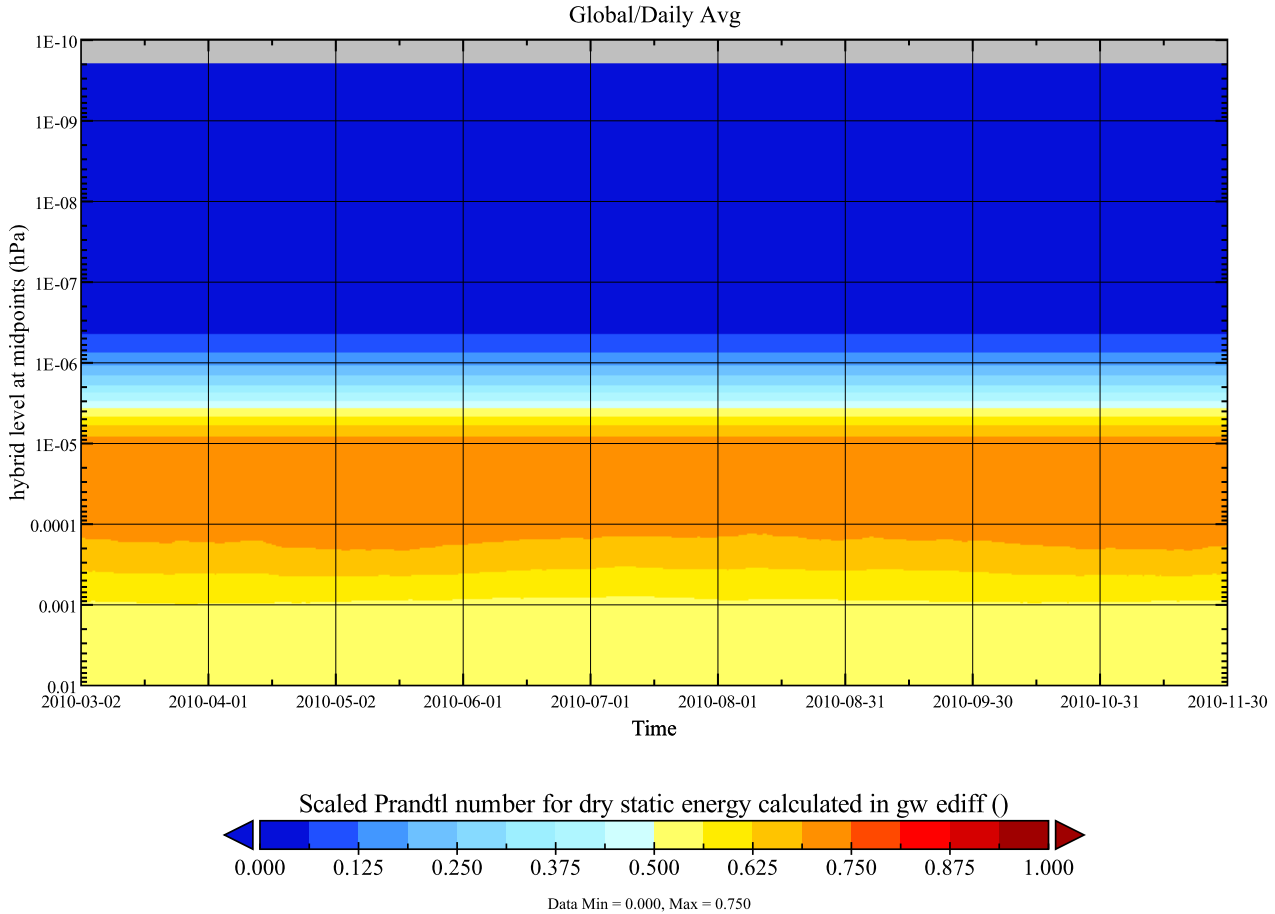
Only applied to eddy viscosity and constituents!!



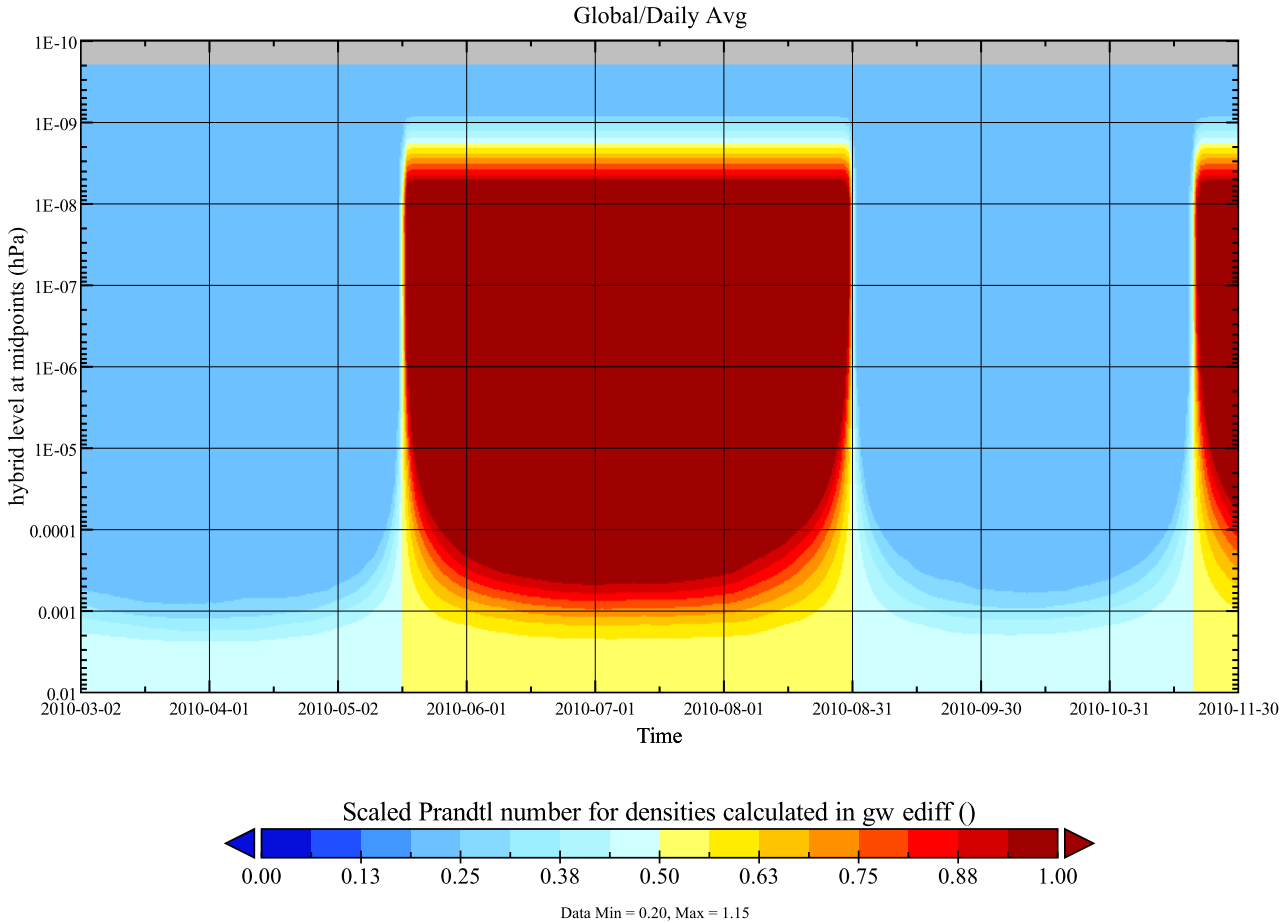
Changes in the K_{zz} profile greatly *affect modeled* IAVs at 400 km!!!

EXTRA SLIDES

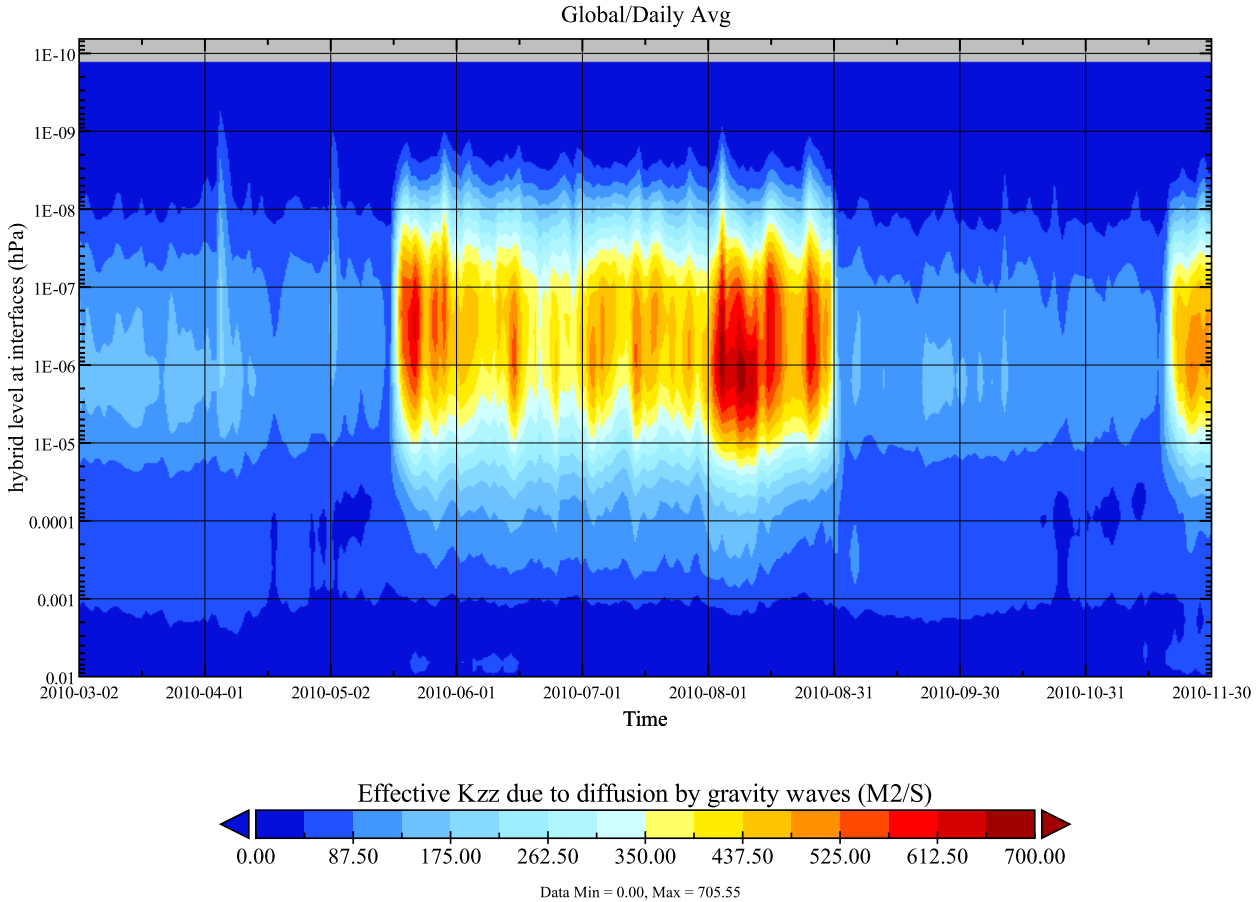
Scaled Pr for Dry Static Energy in SD-WACCM-X



Scaled Pr for Composition in SD-WACCM-X



Effective K_{zz} due to diffusion by GWs in SD-WACCM-X



Globally Averaged Temperature, Mass Density, and Composition (3 Different TIME-GCM Simulations)