Whole Atmosphere Community Climate Model

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HEPPA Meeting – Oct. 6-8, 2009

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Originally developed by R. Garcia, B. Boville, D. Marsh, D. Kinnison, F. Sassi, S. Walters, F. Vitt, etc. (NCAR)

- Based on NCAR:
  - Community Atmospheric Model , version 3, (CAM3)
  - Thermosphere-Ionosphere-Mesosphere-Electrodynamics General Circulation Model (TIME-GCM)
  - Model for Ozone And Related chemical Tracers (MOZART)
    - Known as WACCM3
- Domain and grid
  - Global - 90^{o}S – 90^{o}N, 0 - 145 km (4.5×10^{-6} hPa)
  - Latitude grid 4^{o}; Longitude grid 5^{o}
  - Vertical res. ≤ 1.5 km up to 25 km; ~2 km in stratosphere; ~3.5 km in mesosphere; ½ local scale height above mesopause ; 66 levels
- Interactive dynamics
  - Meridional, vertical, & zonal winds
  - Gravity waves, vertical diffusion, molecular diffusion

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- Interactive atmospheric radiation
  - Photolysis and photoionization
  - Shortwave heating
  - Infrared radiative transfer (heating, cooling); non-LTE
  - Heating due to chemical reactions
  - Joule heating from charged particles
- Interactive chemistry
  - Neutral: 57 constituents, 211 reactions
  - Ion: 6 constituents, 14 reactions, E-region ionosphere
  - HO_x production by solar protons: Use lookup table from Solomon et al. (Planet. Space Sci., 1981)
  - NO_x production by solar protons: 1.25 N atoms per ion pair [0.55 as $N(^4S)$ and 0.7 as $N(^2D)$, from Porter et al. (J. Chem. Phys., 1976)]
- Transport with finite-volume dynamical core

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- Several model references
  - Garcia, R. R., et al., JGR, 2007
  - Kinnison, D. E., et al., JGR, 2007
  - Marsh, D. R., et al., JGR, 2007
  - Jackman, C. H., et al., ACP, 2008
  - Sassi, F., et al., JGR, 2002, 2004
  - Forkman, P., et al., GRL, 2003
  - Richter, J. H., and R. R. Garcia, GRL, 2006