

AC and C ACTIVITY 2:

“What processes control composition of troposphere above 5 km?”

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- **Processes:**
 - Advection by large-scale winds
 - **Convection**
 - **Wet scavenging**
 - Dry Deposition
 - Stratosphere-Troposphere Exchange (CCMval, SPARC)
 - Chemistry
 - In situ production of ozone precursors
- **Propose to start with convection/wet scavenging (aerosol bias?)**
- **Coordinate with other activities as noted above, as well as HTAP, AeroCom, dry deposition.**

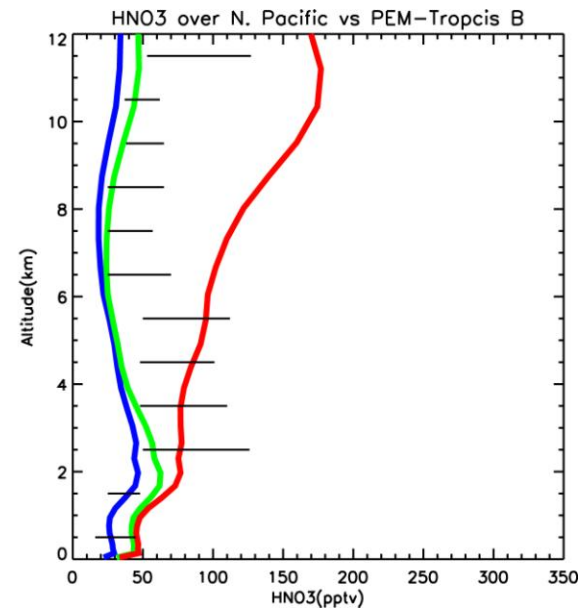
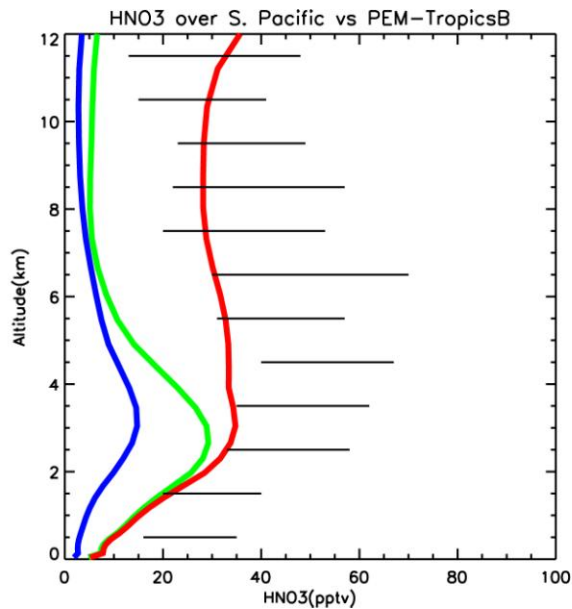
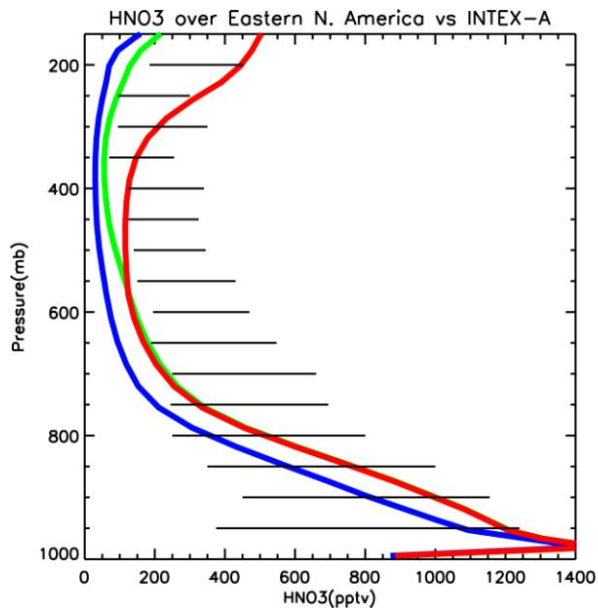
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– CONVECTION EXPERIMENTS

- a) A ^{222}Rn experiment, with specified 2-D emissions
- b) A CO-like tracer (from HTAP TP1X. experiment).
 - Anthropogenic
 - Biomass
 - Other sources.
- c) A CH_3I -like tracer for marine convection -
- d) All emissions will be specified
 - ^{222}Rn , Jacob et al., 1998
 - CO – HTAP
 - CH_3I – (Bell et al., 2002)?

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- **WET SCAVENGING EXPERIMENTS:**
 - a) A ^{210}Pb tracer, with specified 3-D production.
 - b) An " HNO_3 " tracer, produced by a specified OH field and heterogeneous chemistry, and specified NO_x emissions. Photolysis fields will also be specified, so that the only "free" parameter is removal by washout. Specified interactions with aerosols should also be discussed.
 - c) A "non reactive" aerosol (such as dust) that is assumed to be immediately hygroscopic, with specified emissions.
 - d) SO₂ and sulfate tracers, with specified emissions and OH oxidation, and specified total oxidation of SO₂ (depending on calculation, see below).
 - e) All aerosols with specified emissions



- $SCAV_{ice} = SCAV_{Liquid}$ No Cloud Overlap
- $SCAV_{ice} = SCAV_{Liquid}$ Cloud Overlap
- $SCAV_{ice} = \text{Impaction and Riming, Cloud Overlap}$

Courtesy of Neu and Prather

AC and C ACTIVITY 2: Convection

- Conv0: All tracers in “convection” but with convection turned off. This experiment will document the variability in results due to large-scale fields.
- Conv1: All tracers, but with prescribed fields of cloud mass fluxes, entrainment and detrainment. Differences in results should reflect primarily differences in convective transport algorithms. (Problem: Non-physicality!; convection may not occur in convergence regions, etc.).
 - Conv1a: Sensitivity experiment: Increase/decrease cloud mass fluxes, entrainment, etc. in each model by 20%. This experiment will diagnose the importance of convection in determining composition, relative to other processes.
 - Conv1b: Alternative or in addition to Conv1: Scale cloud mass fluxes, entrainment so as to have the same values, monthly and latitudinally averaged (?)
- Conv2: As in Conv1, but each model with its own convective parameters and transport (this would be the TP1X experiments, with additional diagnostics).
- Full chemistry, but with prescribed wet (dry?) deposition (wet1 or wet2).
- Wet 5: See below

AC and C ACTIVITY 2: Wet Scavenging

- Wet0: All above tracers, with prescribed convection (as in Conv1) and a prescribed first-order removal rate (probably scaled by precipitation fields). The SO₂ oxidation will be prescribed. The variability in model results would document the impact of differences in the meteorological field and transport.
- Wet 1: As in wet0, but using each model's wet deposition scheme with PRESCRIBED cloud distribution, precipitation fields, and scavenging efficiency. The SO₂ oxidation will be prescribed.
- Wet 2: As in wet1, but using each model's own cloud distribution and precipitation fields, and prescribed scavenging efficiencies. The SO₂ oxidation will be prescribed.
- Wet3: As in wet2, but using each model's own scavenging efficiencies. The SO₂ oxidation will be prescribed.
- Wet4: free SO₂: As in Wet3, but letting each model use its own SO₂ oxidation rates. In this calculation, we could consider cases in which a) H₂O₂ is prescribed or b) SO₂ oxidation can feedback on H₂O₂ abundances.
- Wet 5: Full chemistry, no constraints (e.g. on OH; photolysis) except for emissions.

AC and C ACTIVITY 2: Comparison to data (convection)

- **^{222}Rn (data very sparse)**
- **CO ground-based stations**
- **Aircraft campaigns (INTEX A, B, TC4, SCOUT/O3, AMMA, ...).**
 - **CO, CH_3I**
 - **NO_x/HNO_3 (?) (Bertram et al., 2007 – convective overturn).**
 - **CH_3I**
 - **Others?**
- **CO from MOPPIT, AIRS, TES – Signature of convection?**

AC and C ACTIVITY 2: Comparison to data

- **Cloud distribution:**
 - **MLS vertical distribution of ice water content above 250 hPa**
 - **MODIS ice/liquid water content**
 - **CloudSat ice/liquid water content profile**
 - **Merged CALIPSO/CloudSat cloud occurrence statistics**
- **Precipitation:**
 - **NOAA/CMAP precipitation product**
 - **TRMM precipitation product**
- **Aerosol (Total) distribution:**
 - **CALIPSO vertical backscatter profiles**
 - **MODIS/MISR aerosol optical depth and Anstrom coefficients**
 - **ARM/ERLINET raman lidar backscatter profiles**
 - **SAGE backscatter profiles**
- **^{210}Pb - campaign data**
- **HNO_3 - campaign data**
- **SO_2/SO_4 - campaign data**

AC and C ACTIVITY 2: Wet Scavenging/convection Diagnostics

- **3-D cloud fields**
- **3-D convective mass flux fields, entrainment, downdrafts (if applicable)**
- **Documentation of convective transport, wet scavenging algorithms.**
- **3-D tendencies for advection, convection, wet removal, chemistry?**
- **3-D precipitation fields: convective, stratiform**
- **3-D mixing ratios of tracer species**
- **2-D wet deposition by stratiform/convective precip. of tracer species**
- **Aerosol:**
 - **Backscatter profiles**
 - **Angstrom coefficients**
 - **Optical depth**

Issues:

- **The proposed experiments necessitate code changes. Community support? Can this happen in conjunction with other AC and C activities? What is a realistic time frame?**
- **Preliminary investigation of experiments by 1-2 groups**
- **Kick-off workshop**
 - **Review of convection, wet deposition in current models**
 - **Insights from cloud-resolving models, regional models**
 - **New developments in above parameterizations**
 - **Review available data for comparison**
 - **Finalize model intercomparison exercises.**