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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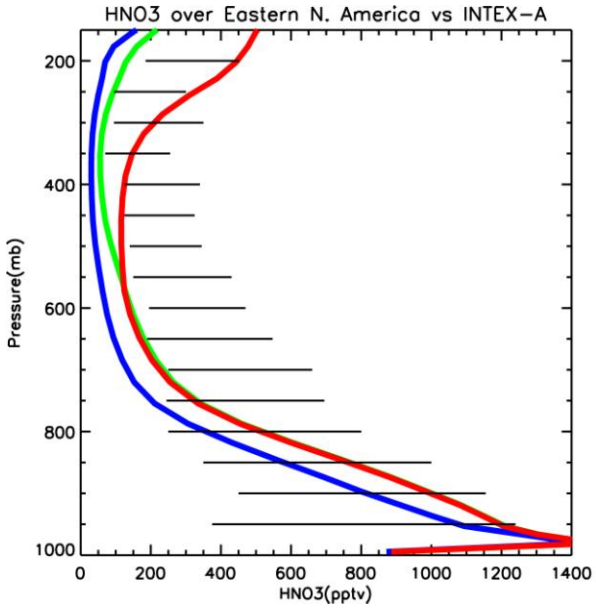
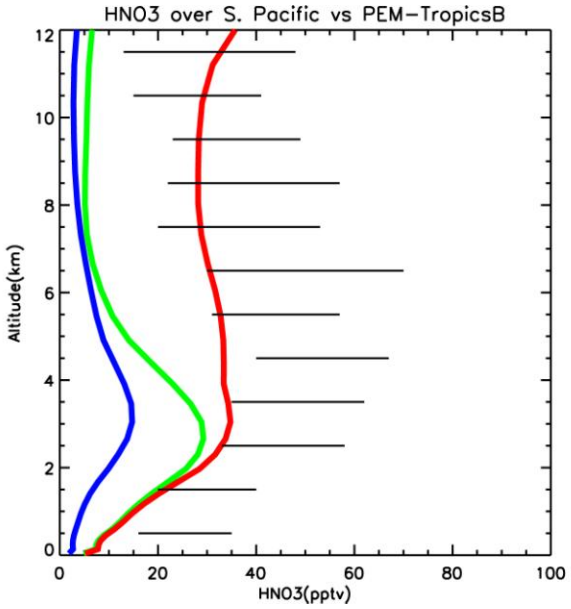
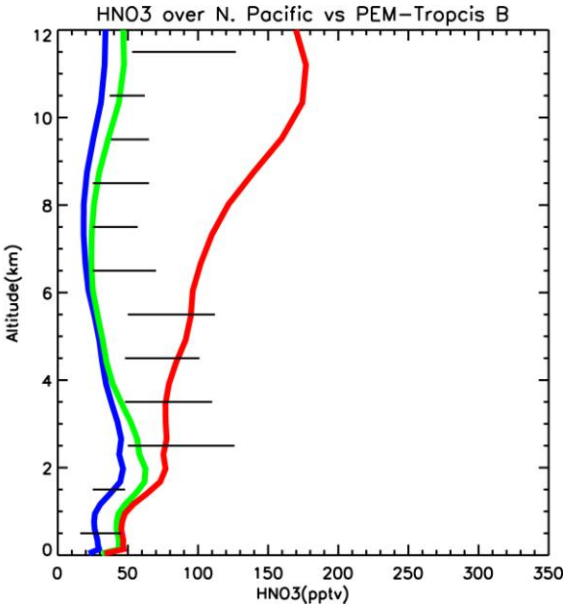
- **WET SCAVENGING EXPERIMENTS:**

- 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 NOx 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) SO_2 and sulfate tracers, with specified emissions and OH oxidation, and specified total oxidation of SO_2 (depending on calculation, see below).
- e) All aerosols with specified emissions







$SCAV_{ice} = SCAV_{Liquid}$ No Cloud Overlap

$SCAV_{ice} = SCAV_{Liquid}$ Cloud Overlap

$SCAV_{ice}$ = 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) H_2O_2 is prescribed or b) SO_2 oxidation can feedback on H_2O_2 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**
  - **NOx/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**
- **SO2/SO4 - 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.**