

# Transport Working Group

([geos-chem-transport+subscribe@g.harvard.edu](mailto:geos-chem-transport+subscribe@g.harvard.edu))

## Hongyu Liu (co-chair)

NIA / NASA Langley Research Center, Hampton, VA  
([Hongyu.Liu-1@nasa.gov](mailto:Hongyu.Liu-1@nasa.gov))



## Andrea Molod (co-chair)

NASA Goddard Space Flight Center, Greenbelt, MD  
([Andrea.M.Molod@nasa.gov](mailto:Andrea.M.Molod@nasa.gov))

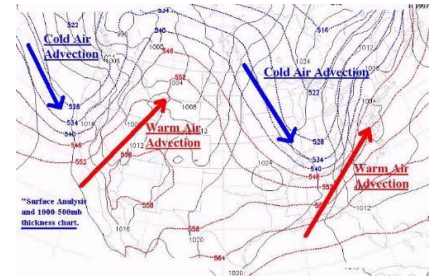


GCA1, NUIST, Nanjing, China  
May 21-23, 2018

# Processes Covered in the Transport WG

## Advection

- “The process of transport of an atmospheric property solely by the mass motion (velocity field) of the atmosphere”;
- “predominantly horizontal, large-scale motions of the atmosphere” (AMS)
- TPCORE & FV3 advection algorithms



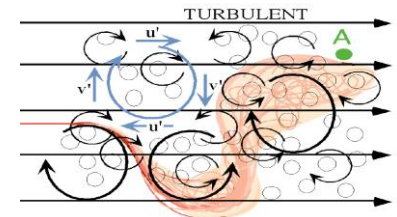
## Convection

- “predominantly vertical, locally induced motions”
- needs to be parameterized in global models
- deep & shallow (RAS, Zhang/McFarlane, Hack)



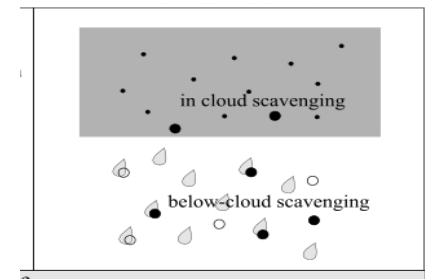
## Turbulent Mixing

- full PBL mixing vs. non-local PBL mixing



## Wet Scavenging/Deposition

- “The removal of atmospheric gases or particles through their incorporation into hydrometeors, which are then lost by precipitation.”
- large-scale (stratiform) vs. convective; rain vs. snow



# Transport / Wet Deposition Issues Addressed Over Recent Years

- Using  $^{222}\text{Rn}$ - $^{210}\text{Pb}$ - $^7\text{Be}$  tracers to validate transport & wet deposition (aerosol lifetime) for G-C benchmark (GCST; Harvard; NIA/LaRC)
- Investigating the impact of GEOS resolution & archiving on transport (Harvard; GMAO)
- Characterizing transport errors & impact (U. Toronto)
- Obtaining observation-constrained  $^{210}\text{Pb}$  aerosol lifetime against deposition (NIA/LaRC)
- IGC8 / GCSC:  
To implement a GMAO/G-C common set of tracers in G-C v11-03.

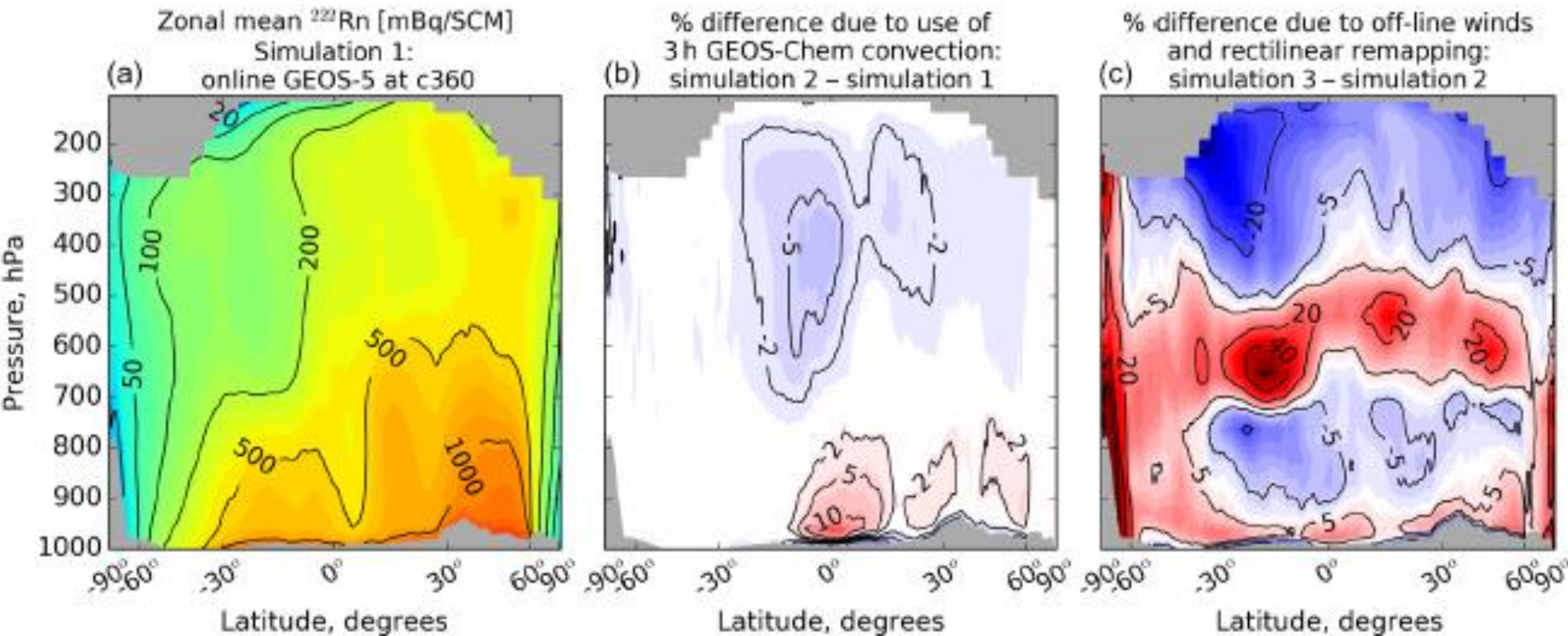
Current GEOS-Chem Transport Projects (please add yours!)

User Group	Description	Contact Person
U. Toronto	Assessing impact of transport biases on methane simulation and applying weak constraint 4D-Var to correct them	Ilya Stanevich <a href="#">✉</a>
U. Toronto	Characterizing model transport errors using weak constraint 4D-Var	Martin Keller <a href="#">✉</a>
U. Toronto	Quantifying the impact of errors in PBL mixing on CO2	Wei Lu <a href="#">✉</a>
Harvard	Examining the effect of grid resolution on vertical transport and convective mass fluxes	Karen Yu <a href="#">✉</a>
Harvard	Quantifying the impact of numerical diffusion on plume transport and comparing to observed atmospheric diffusion	Sebastian D. Eastham <a href="#">✉</a>
Harvard	Assessing the co-benefits of increasing vertical and horizontal grid resolutions for tracer transport	Jiawei Zhuang <a href="#">✉</a>
Dalhousie	Implementation of a new PBL mixing scheme	Aaron van Donkelaar <a href="#">✉</a>
NIA / NASA Langley	Constraints on Precipitation Scavenging and Transport of Soluble Trace Species From Airborne and Surface Radionuclide ( <sup>222</sup> Rn, <sup>210</sup> Pb, <sup>7</sup> Be, <sup>10</sup> Be) Observations	Bo Zhang <a href="#">✉</a> Hongyu Liu <a href="#">✉</a>
Harvard	Vertical resolution needs for GEOS-Chem global transport	Ada Shaw
Harvard U. Toronto	Re-diagnosed convection in off-line GEOS-Chem	Bob Yantosca Tailong He
Add yours here!		

# Errors and improvements in the use of archived meteorological data for chemical transport modeling

Karen Yu, et al., Geosci. Model Dev., 2018.

Off-line transport error in [ $^{222}\text{Rn}$ ] simulated at c360 (~25km) resolution

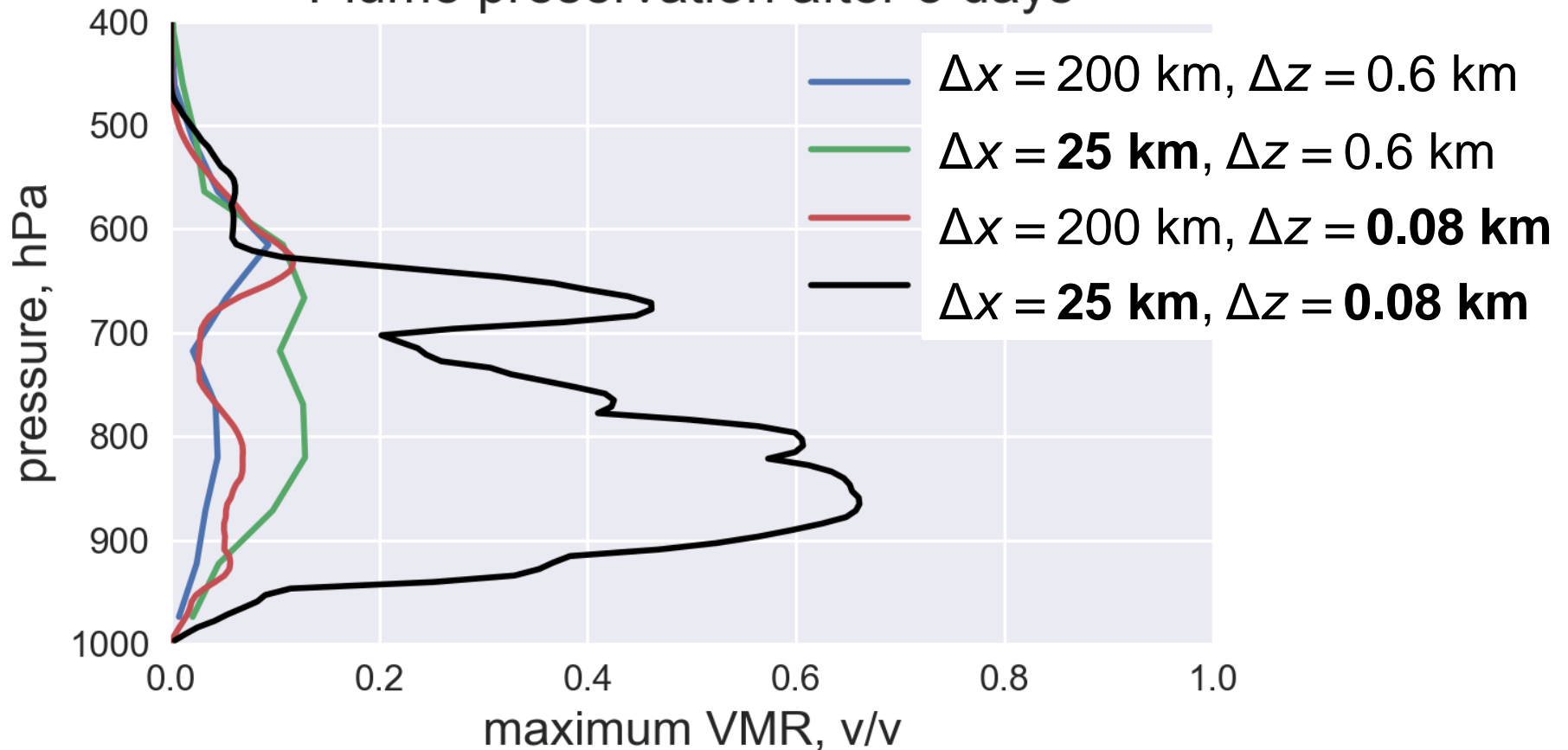


# The importance of vertical resolution in the free troposphere for modeling intercontinental plumes

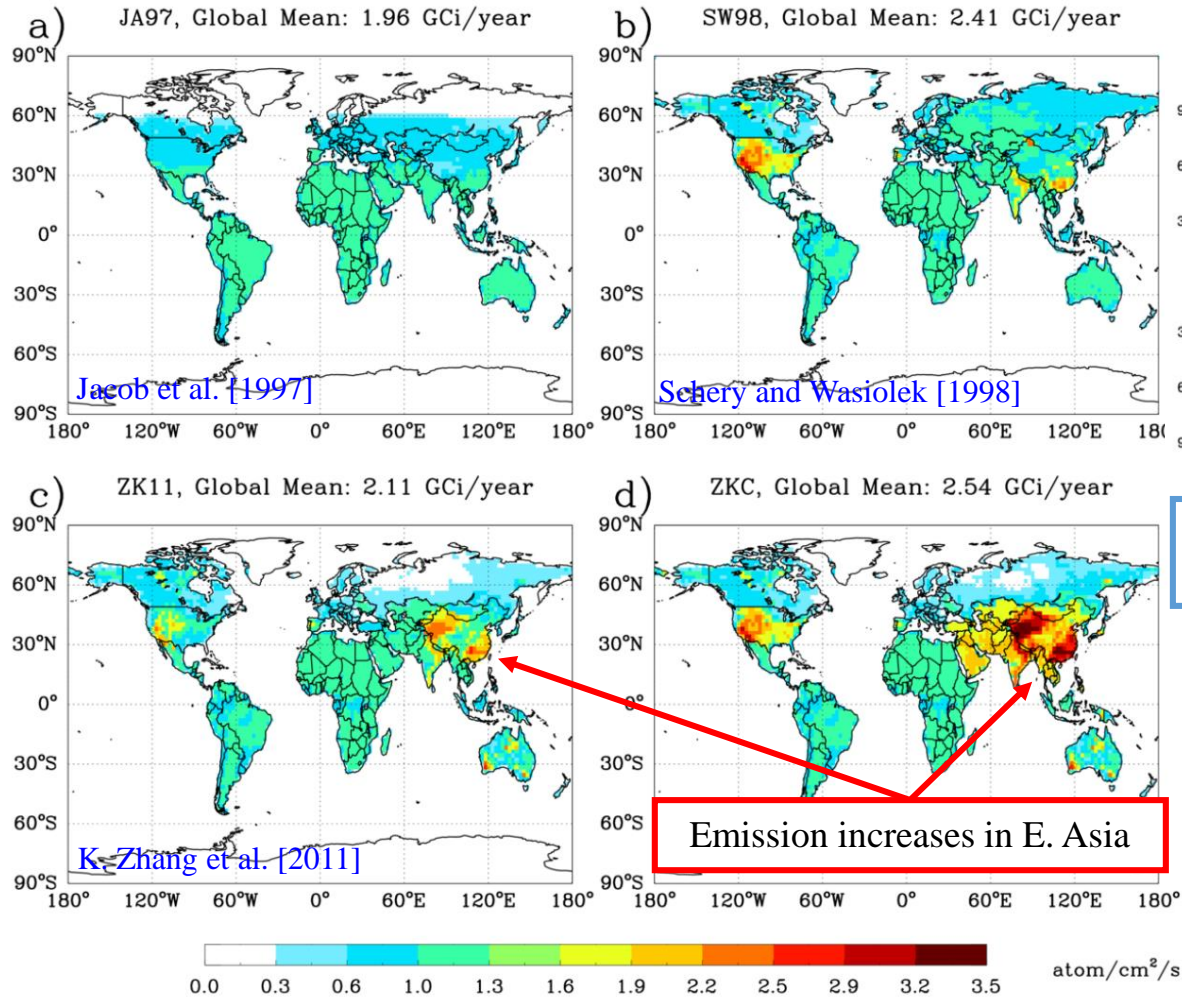
Jiawei Zhuang, Daniel J. Jacob, and Sebastian D. Eastham, ACP 2018

**(Talk, 2:30pm Tuesday)**

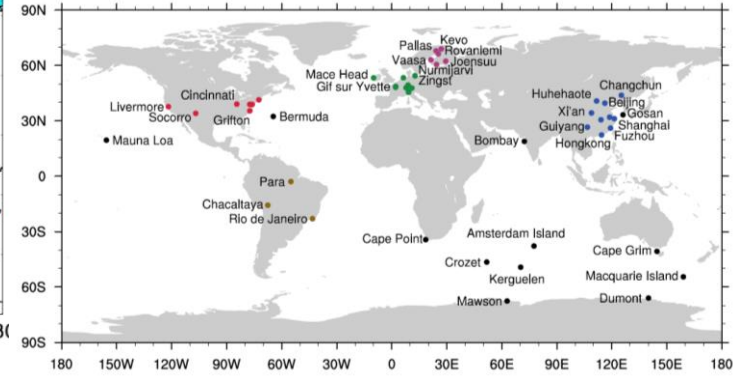
Plume preservation after 8 days



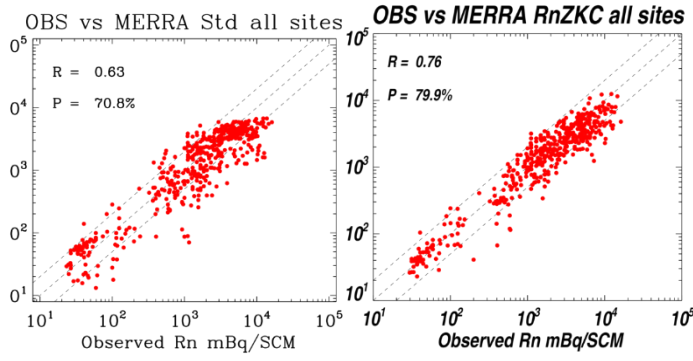
# Simulation of $^{222}\text{Rn}$ with GEOS-Chem: Emissions, Seasonality, and Convective Transport



Global  $^{222}\text{Rn}$  measurements



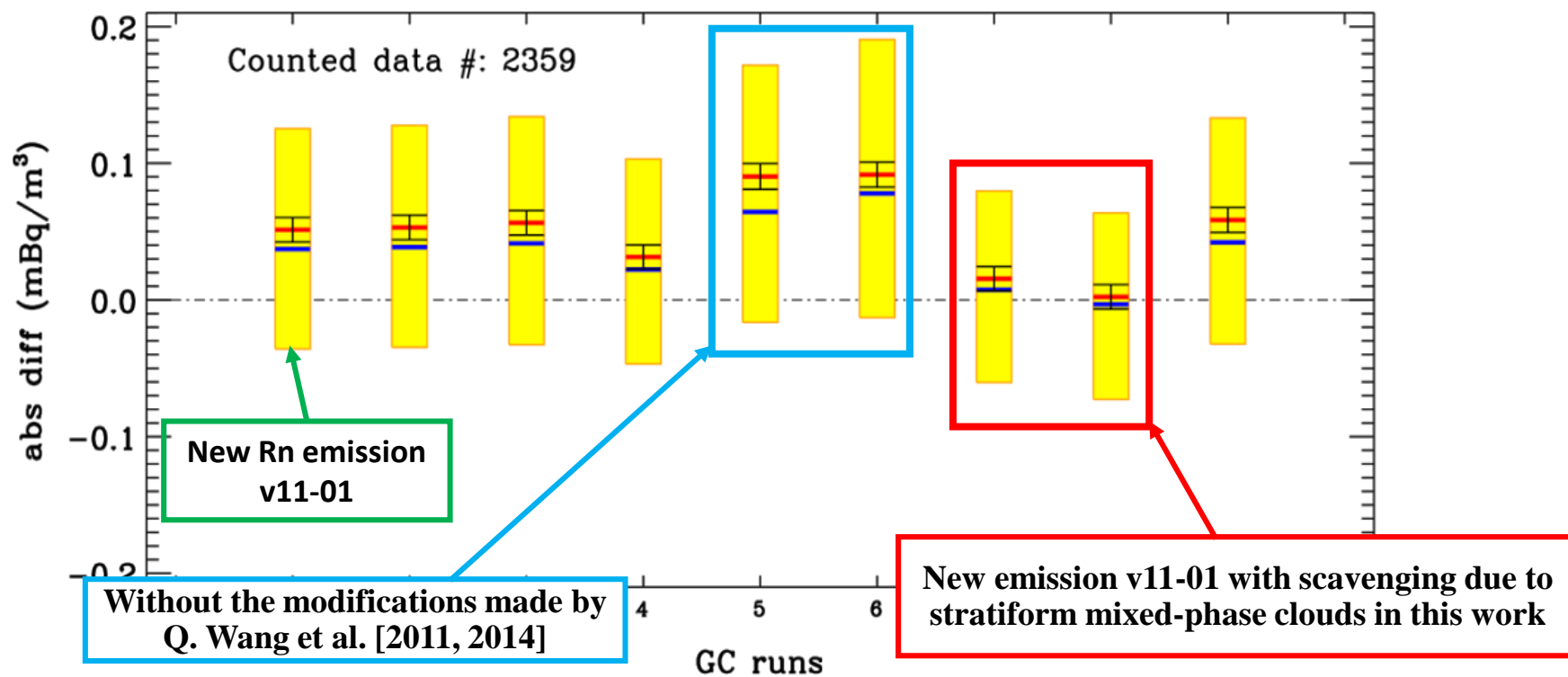
Comparison between model and observations before and after emission update



- New emission incorporated recent  $^{222}\text{Rn}$  flux measurements in Europe, N. America, China, and Australia.
- $^{222}\text{Rn}$  emissions need to be increased over East Asia to better match observed  $^{222}\text{Rn}$  concn. &  $^{210}\text{Pb}$  dep. fluxes.

# Constraints From Airborne $^{210}\text{Pb}$ Observations on Aerosol Scavenging and Lifetime

$^{210}\text{Pb}$  differences between G-C sensitivity runs and NASA aircraft observations



- Global tropospheric  $^{210}\text{Pb}$  aerosol lifetime reduced from 8.5 to 6.9 days due to stratiform mixed-phase cloud scavenging.
- The lifetime at NH high-latitudes reduced ~42% (from 13.8 to 8.1 days), which contributed most to the change in global  $^{210}\text{Pb}$  lifetime.

# **Transport Working Group Breakout**

**Tuesday, 3:45-4:45pm (Room 825)**