1. Introduction

- Simulation of BC over Arctic is considered difficult: large disagreement between observations and models. Many factors are potentially contributive to this discrepancy, such as the treatments in models for spatial and temporal variability of emission rates of BC, transport, and deposition. The sensitivity of BC concentration of aging time and wet/dry deposition has been studied in several recent publications, however few studies focused on the sensitivity of BC to spatial and temporal distribution of BC emission.

- This study evaluated the sensitivity of BC in Arctic to anthropogenic emission inventory from Bond et al.(2007) and Zhang et al. (2009) and to biomass burning emission inventory of FLAMBE (Reid et al.), GFED3 (van der Werf et al., 2010) and updated GFED3 accounting for small fires (Randerson et al., 2012).

2. Observations and Model Description

- GEOS-Chem v9-01-03
- GEO-5 reanalysis meteorological data, 2° lat x 2.5° long, April 2008
- Distinguished wet scavenging between rain and snow, fine and coarse particles (Wang et al., 2011).
- Constant aerosol dry deposition velocity of 0.03 cm s⁻¹ over snow and ice.
- 50% BC aerosols are emitted as hydrophobic and are converted to hydrophilic with an e-folding time of 1.15 days.

3. Results and Discussion

All the five simulations reproduce the BC variability during flights without severe plumes, but they do not resolve fire plumes.

- UpGFED3_ZHANG simulated the amplitude of observations (mean and median) the best for ARCTAS
- UpGFED3_BOND simulated the mean BC observations for ARCPAC (no plume) the best
- All simulations underestimated BC concentration in plumes
- FLAMBE × BOND is the best to simulate the variability
- All simulation underestimated the variation

Simulation UpGFED3_ZHANG agree with the observed mean and median vertical profile of BC the best during the ARCTAS and ARCPAC campaign in Arctic.

- More crop/grass fire emission is captured by Update of BC inventory, and FLAMBE than original GFED3 emission inventory.
- Anthropogenic emission mainly locates at East China and North Indian in both BOND and ZHANG emission, but ZHANG emission flux is larger because small industries are included.

Biomass burning contributes 58% of BC in mid-troposphere, larger than previous estimate of 46%. Fires in Eurasia are the largest contributor to BC in mid-troposphere Arctic even on day without severe fire plumes.