1. Oxalate (\(C_{2}O_{4}^{2-}\)) and Fe(III)/Fe(II) redox cycling

\[C_{2}O_{4}^{2-} = 0.05 \cdot [SO_{4}^{2-}] - 0.273 \quad [\text{Yu et al., 2005}]\]

2. Seasonally-averaged dust column concentration

3. Seasonally-averaged dissolved Fe(III) deposition

4. Seasonally-averaged dissolved Fe(II) deposition

5. Seasonally-averaged dissolved Fe fraction (DF)

6. Percent increase in total Fe\(_{d}\) deposition due to oxalate

7. Percent change in total Fe\(_{d}\) deposition due to mineralogy

8. Fe dissolution of different Fe-containing minerals

9. Model-predicted Fe(III)/Fe(II) compared with in situ data

Results

- Advanced module for the production of dissolved Fe in mineral dust was developed and implemented in GEOS-Chem.
- The new module treats inorganic and organic (oxalic) acid-promoted Fe dissolution processes, photochemical redox cycling between Fe(III) and Fe(II), dissolution of different Fe-containing minerals, and detailed mineralogy of wind-blown dust from the major desert regions.
- With global dust mineralogy and source-specific dust-Fe treatment, the contribution of individual deserts to total Fe\(_{d}\) deposition fluxes can be estimated.
- Model-predicted oxalate and Fe(II)/Fe(II) concentrations are generally consistent with available measurement data.
- Fe bound to aluminosilicate minerals (in the presence of oxalate) can increase dissolved Fe production from mineral dust.
- Photolysis and oxalate-promoted Fe dissolution processes can considerably increase the amount of Fe\(_{d}\) deposition rates to surface oceans.
- The model results show that:
  - Using a constant a priori/percentage of dust-Fe solubility may lead to large uncertainties in dissolved Fe fluxes to the oceans.

Future Work

- Implement additional sources of dissolved Fe (e.g., biomass burning, combustion).
- Continue model evaluation with laboratory and field measurements.
- Couple GEOS-Chem with the advanced dust-Fe dissolution scheme with climate and ocean models to simulate biogeochemical cycling of nutrients and the effect on global carbon cycle.

8. Fe dissolution of different Fe-containing minerals

- Hematite
- Goethite
- Ilite

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