ID: W2155725298

TITLE: Nitrogen and sulfur deposition on regional and global scales: A multimodel evaluation

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ABSTRACT:

We use 23 atmospheric chemistry transport models to calculate current and future (2030) deposition of reactive nitrogen (NO y , NH x ) and sulfate (SO x ) to land and ocean surfaces. The models are driven by three emission scenarios: (1) current air quality legislation (CLE); (2) an optimistic case of the maximum emissions reductions currently technologically feasible (MFR); and (3) the contrasting pessimistic IPCC SRES A2 scenario. An extensive evaluation of the present?day deposition using nearly all information on wet deposition available worldwide shows a good agreement with observations in Europe and North America, where 60?70% of the model?calculated wet deposition rates agree to within ±50% with quality?controlled measurements. Models systematically overestimate NH x deposition in South Asia, and underestimate NO y deposition in East Asia. We show that there are substantial differences among models for the removal mechanisms of NO y , NH x , and SO x , leading to ±1 ? variance in total deposition fluxes of about 30% in the anthropogenic emissions regions, and up to a factor of 2 outside. In all cases the mean model constructed from the ensemble calculations is among the best when comparing to measurements. Currently, 36?51% of all NO y , NH x , and SO x is deposited over the ocean, and 50?80% of the fraction of deposition on land falls on natural (nonagricultural) vegetation. Currently, 11% of the world's natural vegetation receives nitrogen deposition in excess of the ?critical load? threshold of 1000 mg(N) m ?2 yr ?1 . The regions most affected are the United States (20% of vegetation), western Europe (30%), eastern Europe (80%), South Asia (60%), East Asia (40%), southeast Asia (30%), and Japan (50%). Future deposition fluxes are mainly driven by changes in emissions, and less importantly by changes in atmospheric chemistry and climate. The global fraction of vegetation exposed to nitrogen loads in excess of 1000 mg(N) m ?2 yr ?1 increases globally to 17% for CLE and 25% for A2. In MFR, the reductions in NO y are offset by further increases for NH x deposition. The regions most affected by exceedingly high nitrogen loads for CLE and A2 are Europe and Asia, but also parts of Africa.

SOURCE: Global biogeochemical cycles

PDF URL: None

CITED BY COUNT: 926

PUBLICATION YEAR: 2006

TYPE: article

CONCEPTS: ['Deposition (geology)', 'Environmental science', 'Air quality index', 'Vegetation (pathology)', 'Nitrogen', 'Atmospheric sciences', 'Acid deposition', 'Reactive nitrogen', 'Chemical transport model', 'Sulfate', 'Climatology', 'Environmental chemistry', 'Hydrology (agriculture)', 'Chemistry', 'Soil science', 'Meteorology', 'Geography', 'Geology', 'Soil water', 'Medicine', 'Paleontology', 'Geotechnical engineering', 'Organic chemistry', 'Pathology', 'Sediment']