Atmospheric Deposition of Soluble Organic Nitrogen due to Biomass Burning

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Atmospheric deposition of reactive nitrogen (N) species from large fires may contribute to enrichment of nutrients in aquatic ecosystems. Here we use an atmospheric chemistry transport model to investigate the supply of soluble organic nitrogen (ON) from open biomass burning to the ocean. The model results show that the annual deposition rate of soluble ON to the oceans is increased globally by 13% with the increase being particularly notable over the coastal water downwind from the source regions. The estimated deposition of soluble ON due to haze events from the secondary formation is more than half of that from the primary sources. We examine the secondary formation of particulate C-N compounds (e.g., imidazole) from the reactions of glyoxal and methylglyoxal with atmospheric ammonium in wet aerosols and upon cloud evaporation. These ON sources result in a significant contribution to the open ocean, suggesting that atmospheric processing in aqueous phase may have a large effect. We compare the soluble ON concentration in aerosols with and without open biomass burning as a case study in Singapore. The model results demonstrate that the soluble ON concentration in aerosols is episodically enriched during the fire events, compared to the without smoke simulations. However, the model results show that the daily soluble ON concentration can be also enhanced in the without smoke simulations during the same period, compared

to the monthly averages. This indicates that care should be taken when using in-situ observations to constrain the soluble ON source strength from biomass burning. More accurate quantification of the soluble ON burdens with no smoke sources is therefore needed to assess the effect of biomass burning on bioavailable ON input to the oceans.