

Satellite remote sensing of fires and biomass burning emissions in Indian region

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Fires are one of the major causes of disturbance and destruction in several forested regions in India. Also, human induced fires due to agricultural residue burning in the Indian region are one of the major causes of air pollution. In this study, we review in detail the major causes of fires and associated greenhouse gas emissions from varied forested and agroecological regions of India. We also estimate the contribution of biomass burning emissions from Indian region using satellite remote sensing datasets. Potential causes of fires and the amount of biomass burned in the Indian region were assessed for different time periods using both Indigenous satellite data (IRS-1D, and IRS-P3 WiFS) along with global satellite data sets (NOAA AVHRR, MODIS and SPOT). Spatial patterns in forest fires and the associated causes were analyzed in a robust statistical framework through integrating topographic, vegetation, climate and socioeconomic factors, to arrive at a predictive model that best explained the variation in fires across diverse geographical and climatic gradients. Results from satellite derived burnt area estimates for Indian region suggested nearly 644.48 Tg of biomass burnt during the year 2000. Of the different states, Maharashtra recorded highest number of fires followed by Gujarat, Madhya Pradesh, Karnataka, Andhra Pradesh and others. Further, more than 60% of fires occurred during summer season. Of the different vegetation classes, 92% of the fires occurred in woodlands and shrub lands, followed by croplands (6.5%), grasslands (0.5%), etc. Of the total biomass, needle leaf and mixed forests contributed to 58.0%, broadleaf forests to 23.72%, woodlands and shrub lands to 14.5%, grasslands, and croplands to 3.64%. Results on greenhouse gas emissions suggested emissions of 143 Tg of CO₂, 9.42 Tg CO, CH₄ (0.61 Tg), total NMHC's (0.73Tg), NO_x (0.14Tg), N₂O (0.017 Tg), NH₃ (0.11 Tg), N₂ (0.28 Tg), SO₂ (0.051 Tg), COS (0.003 Tg), etc for the entire Indian region. Results also suggest that biomass burning from India contributes 13.0% of total CO₂, 14.1% of CO, 19.7% of CH₄, 13.8% of SO₂, 5.0% of NO_x in the Asian region. The implications of these emissions on the regional air quality including human health risks, visibility and components of climate forcing in India were discussed in the study.