Abstract

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Project Title : Improving the estimation of forest fire emissions in the Greater Mekong Sub-region using high resolution satellite products and ground truthing corrective factors to support air quality modeling and management

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Abstract :

The purpose of this research was to improve the evaluation of air pollution from biomass open burning (wildfires and agricultural fires) in the Greater Mekong Sub-region (consisting of Myanmar, Thailand, Laos, Cambodia, and Vietnam), which is considered to be a wildfire-prone area, particularly in the dry season from December to April of the following year. The scope of improvement encompassed the evaluation of areas damaged from wildfires, which were previously obtained from MCD64A1 monthly gridded 500-meter product of MODIS with medium resolution of 500 m. Concerning the fact that the evaluation of areas damaged from wildfires and crop burning entails the use of burned area data with higher resolution in order to improve the results, this research obtained burned area data (reference fires) from LANDSAT-8 with the resolution of 30 meter. The obtained results were subsequently used to evaluate the actual amount of burned biomass and the amount of air pollution emitted from wildfires and agricultural fires in the Greater Mekong Sub-region (GMS) from 2010 to 2017. In addition, the obtained results were compared with the data derived from the fourth version of Global Fire Emissions Database (GFEDv4) in 2015. The GFEDv4 was used as an emission database to input data concerning the biomass open burning emissions into the air quality model. Based on the

data from MCD64A1, there were approximately 81.403 million hectares (Mha) of burned areas during 2010 to 2017. These areas consisted of croplands (16.410 Mha), deciduous forests (0.340 Mha), evergreen forests (16.679 Mha), mixed forests (4.388 Mha), grasslands (0.562 Mha), savannas (41.986 Mha), shrublands (0.017 Mha), and wetlands (1.022 Mha). The country with the highest number of burned areas was Myanmar (32.684 Mha), followed by Cambodia (22.985 Mha) and Thailand (10.883 Mha). The comparison between the burned area data of MCD64A1 and LANDSAT-8 during 2014 to 2016 in the northern region of Thailand suggested that the total burned area from MCD64A1 was approximately 0.35 times lower than the total burned area from LANDSAT-8. Accordingly, the burned area data obtained from MCD64A1 should be multiplied by a constant, 2.89, to determine the actual number of the total area burned. In the case of categorizing the type of fires occurred in each area, specifically savanna fires, forest fires, and agricultural fires, the data should be multiplied by a constant, 2.11, 3.33, and 5.21, respectively. After applying the adjusted coefficients to the obtained data, it was found that there were 247.614 Mha of total area burned in the GMS during 2010 to 2017. These areas were composed of croplands (85.496 Mha), deciduous forests (1.132 Mha), evergreen forests (55.540 Mha), mixed forests (14.612 Mha), grasslands (1.187 Mha), savannas (88.591 Mha), shrublands (0.035 Mha), and wetlands (1.022 Mha). Moreover, it was found that the total area burned contributed to 1,762.170 million tons (Mt) of biomass burned, categorized into croplands (532.210 Mt), deciduous forests (6.547 Mt), evergreen forests (321.301 Mt), mixed forests (409.721 Mt), grasslands (5.094 Mt), savannas (478.036 Mt), shrublands (0.222 Mt), and wetlands (9.039 Mt). Biomass open burning led to the emission of significant air pollutants, comprising 2,736,136 kt of CO_2, 7,165 kt of CH_4, 281 kt of N_2O, 143,462 kt of CO, 5,335 kt of NO_X, 715 kt of SO_2, 2,191 kt of NH_3, 12,584 kt of $PM_{2.5}$, 18,737 kt of TPM, 898 kt of BC, and 5,363 kt of OC.