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Improved flux and aerosol forcing calculation using the MODIS enhanced vegetation albedo

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A MODIS enhanced vegetation albedo (MEVA) algorithm is proposed to improve calculations of flux and aerosol forcing at the top of the atmosphere by estimating the spectral dependence of the vegetation reflectance spectrum, given observed values at seven Moderate Resolution Imaging Spectrometer (MODIS) channels (0.47, 0.55, 0.67, 0.86, 1.24, 1.63, and 2.11 μm). Corrections are based on three missing features associated with linearly connecting reflectance at these seven channels: vegetation red edge near 0.7 μm, vegetation absorption features at 1.48 and 1.92 μm. Investigations about aerosol forcing in different spectral ranges show that the correction at 0.7 μm is the most sensitive and important, due to the presence of the red edge and strong solar radiation; while the other two corrections are less sensitive, due to the weaker solar radiation and strong atmospheric water absorption. Four traditional approaches estimating reflectance spectrum and MEVA are applied to various vegetation types: dry grass, green grass, conifer, and deciduous from the John Hopkins University (JHU) spectral library; aspens from the U.S.Geological Survey (USGS) digital spectral library; and Amazon vegetation types. Compared to traditional approaches, MEVA improves the accuracy of the outgoing flux at the top of the atmosphere by over 60 W/m2 and aerosol forcing by over 10 W/m2. Specifically, for Amazon vegetation types, MEVA can improve the accuracy of daily averaged aerosol forcing by 7.5 W/m2 (about 70% of the aerosol forcing calculated with high spectral resolution surface reflectance). These improvements indicate that MEVA can contribute to vegetation covered regional climate studies, and help to better understand climate processes and climate change.