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Carbon dioxide (CO₂) is one of the major contributors in Global Warming. In this study, we aim to develop a system of differential equations using time series data of significant contributable variables of carbon dioxide in the atmosphere in the continental United States. We define the differential operator as data smoother and use the penalized least square fitting criteria to smooth the data. Finally, we optimize the profile error sum of squares to estimate the necessary differential operator. The proposed models will give us an estimate of the rate of change of carbon dioxide in the atmosphere. The data set is obtained from the Carbon Dioxide Information Analysis Center (CDIAC), the primary climate-change data and information analysis center of the United States Department of Energy. (Received September 11, 2014)