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Clustering XCO_2 temporal change to assess CO_2 exchanging strength of biosphere-atmosphere with GOSAT observations

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The temporal change of atmospheric carbon dioxide (CO_2) concentration, greatly related to the local activities of CO_2 uptake and emission, including biospheric exchange and anthropogenic emission, is one of important information for regions identification of carbon source and sink. Satellite observations of CO_2 has been used for detecting the change of CO_2 concentration for a long time. In this study, we used the grid data of column-averaged CO_2 dry air mole fraction (XCO_2) with the spatial resolution of 1 degree and the temporal resolution of 3 days from 1 June 2009 to 31 May 2014 over the land area of 30° - 60° N to implement a clustering of temporal changing characteristics for the Greenhouse Gases Observing Satellite (GOSAT) XCO_2 retrievals. Grid data is derived using the gap filling method of spatio-temporal geostatistics. The clustering method is one adjusted K-mean for the gap existed time-series data. As a result, types and number of clusters are specified based on the temporal characteristic of XCO_2 by using the optimal clustering parameters. The biospheric absorption and surface emission of atmospheric CO_2 is discussed through the analysis of the different yearly increase and seasonal amplitude of XCO_2 each cluster combined with correlation analysis with vegetation index from the Moderate-resolution Imaging Spectroradiometer (MODIS) and fossil fuel CO_2 emission data from Open-source Data Inventory for Anthropogenic CO_2 (Odiac). Regions of strong or weak biosphere-atmosphere exchange, or significant disturbance from anthropogenic activities can be identified. In conclusion, gap filled XCO_2 from satellite observations can help us to take an analysis of atmospheric CO_2, results of the coupled biosphere-atmosphere, by their spatio-temporal characteristics as well as the relationship with the other remote sensing parameters e.g. MODIS related with biospheric photosynthetic or respiration activities.