EGU22-2922
https://doi.org/10.5194/egusphere-egu22-2922
EGU General Assembly 2022

Constraining the uncertainty in CO_2 seasonal cycle metrics by residual bootstrapping.

Theertha Kariyathan[1,2], Wouter Peters[2], Julia Marshall[3], Ana Bastos[1], and Markus Reichstein[1]
[1]Max Planck Institute for Biogeochemistry, Integration, Germany
[2]Wageningen University and Research, Netherlands
[3]Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institut für Physik der Atmosphäre, Oberpfaffenhofen, Germany

The analysis of long, high-quality time series of atmospheric greenhouse gas measurements helps to quantify their seasonal to interannual variations and impact on global climate. These discrete measurement records contain, however, gaps and at times noisy data, influenced by local fluxes or synoptic scale events, hence appropriate filtering and curve-fitting techniques are often used to smooth and gap-fill the atmospheric time series. Previous studies have shown that there is an inherent uncertainty associated with curve-fitting processes which introduces biases based on the choice of mathematical method used for data processing and can lead to scientific misinterpretation of the signal. Further the uncertainties in curve-fitting can be propagated onto the metrics estimated from the fitted curve that could significantly influence the quantification of the metrics and their interpretations. In this context we present a novel-methodology for constraining the uncertainty arising from fitting a smooth curve to the CO_2 dry air mole fraction time-series, and propagate this uncertainty onto commonly used metrics to study the seasonal cycle of CO_2. We generate an ensemble of fifitted curves from the data using residual bootstrap sampling with loess-fitted residuals, that is representative of the inherent uncertainty in applying the curve-fitting method to the discrete data. The spread of the selected CO_2 seasonal cycle metrics across bootstrap time-series provides an estimate of the inherent uncertainty in curve fitting to the discrete data. Further we show that the approach can be extended to other curve-fitting methods by generating multiple bootstrap samples by resampling residuals obtained from processing the data using the widely used CCGCRV filtering method by the atmospheric greenhouse gas measurement community.