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Spring-summer variation analysis in OCO-2's Solar Induced Fluorescence during the European heatwave in 2018

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The European heatwave of 2018 exhibited record breaking temperatures and extreme dry conditions across the whole continent. Our study considers novel and very recent solar induced fluorescence (SIF) data acquired from the Orbiting Carbon Observatory (OCO-2) satellite. We explore SIF variation during spring and summer months across different vegetation types (agriculture, broad-leaf forest, coniferous forest and mixed forest) during the European heat and drought in 2018 and compare it to non-drought conditions.

SIF is proposed to be a direct proxy for gross primary productivity (GPP) and thus can be used to draw inferences about changes in photosynthetic activity in vegetation due to extreme events. About one-third of Europe experienced a consecutive spring and summer drought, and about one-sixth a severe spring and summer drought in 2018. A definite pattern change in SIF variation is observed within the spring season for all vegetation types, with lower SIF during the start of spring followed by increased in fluorescence from mid-April, even though the SIF difference from the mean was not significant. Summer, however, showed significant decrease in SIF with the values constantly lower than the mean value.

Our results shows that particularly agricultural areas were severely affected by the drought and heat of 2018. Further, the variation in the spring-summer SIF was captured across different Köppen climate zones in Europe. The intense heat wave in Central Europe showed about 31% decrease in SIF value during July and August as compared to the mean over three years. We concluded that despite of few technical limitations of OCO-2 SIF measurement such as the 16-days repeat cycle, it provides excellent potential to study vegetation fluorescence variation and can improve our understanding of changes in ecosystem processes during extreme events.

Keywords: OCO-2, SIF, Europe, Drought, Spring, Summer