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On the detection of strong emissions of methane in the Arctic using spectral measurements from IASI and GOSAT

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Boreal ecosystems store significant quantities of organic carbon (C) for thousands of years. Most are presently sequestered in permafrost. In recent years, several studies highlighted that climate warming and thawing of permafrost in the Arctic acts on the mobilization of old stored carbon (c) and contribute to a sustained release of methane (CH_4) to the atmosphere [1],[2],[3].

Because methane is an important greenhouse gas, it is necessary to estimate his sources and sinks in the Arctic. The objective of this study is to evaluate and quantify methane strong emission in this region of the globe using spectral measurements from two satellite instruments: IASI-MetOp and TANSO-FTS.

The Infrared Atmospheric Sounding Interferometer (IASI) is a Fourier transform spectrometer coupled with an integrated imaging system that observes and measures infrared radiation emitted by the Earth and the atmosphere in the spectral range 645-2760cm^{-1}, which covered the methane ?$_4$ and ?$_3$ absorption band[4]. IASI provides global Earth's coverage twice a day and delivers about 1 300 000 spectra per day[5].

The second instrument which we will use in this study is the Thermal And Near-infrared Sensor for Carbon Observation-Fourier Transform Spectrometer (TANSO-FTS), it has a wide TIR band (5,5-14,3μm)which contain the methane ?$_4$absorption band.TANSO-FTS completes one revolution in about 100 minutes and it comes back to the same location in 3 days period. Over these 3 days, FTS takes 56 000 measurements covering the entire globe[6].

To have a good estimation of methane emission above the Arctic, we must exploit a vast amount of spectral information from IASI and TANSO-FTS. But it is well known that performing line-by-line radiative transfer model is a time-consuming process. So, if we need to exploit large data we have to look fast method. In this work, we will use a simple approach based on the Singular Value Decomposition (SVD) to identify spectra over large source of methane. A more accurate algorithm will be used next to perform an accurate retrieval of methane vertical column.

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