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Master Thesis
Satellite remote sensing of atmospheric carbon dioxide: TanSAT

Greenhouse gases: Man-made emissions of the greenhouse gases carbon dioxide (CO_2) and methane (CH_4) drive contemporary climate change. While the rising atmospheric CO_2 and CH_4 concentrations in the Earth's atmosphere are evident, our knowledge on how sources and sinks act on regional-to-local scales and how they evolve in the future under climatic and societal change is highly uncertain. To reduce these uncertainties, it requires advanced observation techniques, data reduction methods, and modelling tools that enable attribution of the minute atmospheric concentration gradients to the driving processes of the carbon cycle and human activity.

Project: Satellite remote sensing of carbon dioxide and methane promises information on emission and uptake of the greenhouse gases for regions which are currently devoid of observations. However, the required measurement accuracy challenges instruments and data reduction techniques. We have developed an accurate radiative transfer and retrieval model that is in routine operation for the first generation of greenhouse gas satellites such as the Japanese GOSAT, NASA's OCO-2 and the European Sentinel-5 Precursor. Here, we propose to extend it to the Chinese TanSAT in collaboration with partners at the Chinese Academy of Sciences. The goal is to establish a consistent data record among the various satellites.

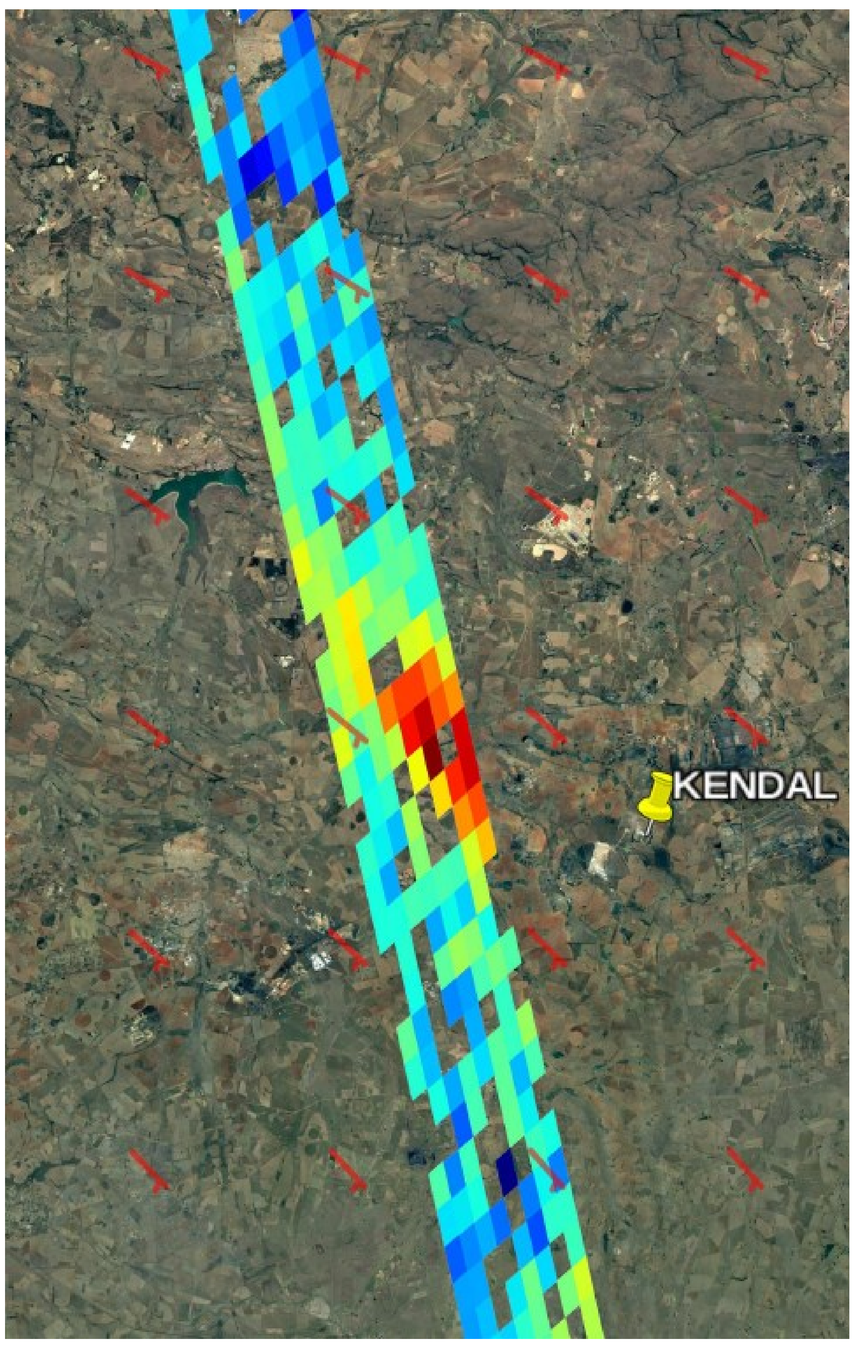

Figure. Carbon dioxide enhancement (scale: ~400 ppm blue, ~406 ppm red) observed by the OCO-2 satelite downwind of a coal-fired powerplant in South Africa (Kendal). Background wind barbs are representative of winds at 950 hPa.

Tasks:

- Learn how to operate the RemoTeC radiative transfer and retrieval algorithm.
- Adapt the algorithm to process TanSAT measurements for CO_2, evaluate accuracy by comparison to ground-based measurements.
- Compare the TanSAT records to correlative satellite measurements by GOSAT, OCO-2; establish a consolidated multi-satellite CO_2 record.

Requirements:

- Keen interest in atmospheric composition remote sensing, radiative transfer.
- Hands-on approach to scientific programming.
- Willingness to collaborate with international partners.

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Relevant work:

A. Butz, et al., doi:10.1029/2011GL047888, 2011

D. Yang et al., doi:10.1007/s00376-018-7312-6, 2018