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DOAS measurements from Kinshasa: Context and First results

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During the last decades, it has been extensively demonstrated that spectral measurements (UV/VIS) of scattered sunlight with a Multi-Axis Differential Optical Absorption Spectroscopy (MAX-DOAS) instrument can be used for the detection of trace gases and aerosols in the troposphere. Trace gases like nitrogen dioxide (NO_2), formaldehyde (HCHO), sulphur dioxide (SO_2), etc, can be retrieved thanks to measurements performed at different elevation angles towards the horizon, where the sensitivity to absorbers present close to the ground is high. The ZenithSky geometry is on the other hand allowing to measure stratospheric content, especially at twilight when the light path is longest in the higher layers of the atmosphere, allowing measurements of NO_2 and ozone (O_3).

Several groups have instruments measuring around the globe, but the African continent is under-sampled compared to other regions of the world, with only regular measurements in Nairobi and Bujumbura. There is a need within the scientific community to develop more stations on the African continent, and promote projects in order to set up collaborations with local universities. Any mid-to-long term measurements in Africa is thus of great interest, e.g. in term of satellite validation or model evaluation. Biogenic emissions (measurable e.g., through the formaldehyde content) related to annual cycles of tropical forest are indeed among the highest in the world (De Smedt, et al., 2015). The air quality is also an issue in rapid developing urban areas (such as in the Kinshasa megacity with its 11 million inhabitants), and measurement of nitrogen dioxide and aerosols are crucial to measure the predicted deterioration of the air quality in the next decade if no emission regulations are taken (Liousse et al., 2014).

BIRA-IASB and UniKin have thus set up a collaboration to create a cheap and portable MAXDOAS instrument, that have been tested against BIRA-IASB MAXDOAS in Uccle (Belgium) in beginning of 2017 and set up at the Kinshasa University (RD Congo) in May 2017. The instrument is based on a AVANTES spectrometer (290-450nm), connected through a fiber to a commercial Nextstar motorized support. A GPS is also integrated to the instrument, allowing measurements onboard of a car.

This poster reports on the instrument development, its installation at the Kinshasa University and the continuous measurements in ZenithSky mode and punctual MAXDOAS measurements during clear-sky days performed since the installation in May 2017. Clear signals of NO_2 in the troposphere and stratosphere have been highlighted, as well as HCHO and aerosols signals in the troposphere.