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The Second Cabauw Intercomparison Campaign for Nitrogen Dioxide Measuring Instruments — CINDI-2 — Overview

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For the validation of space borne observations of NO_2 and other trace gases from hyperspectral imagers, ground based instruments based on the MAXDOAS technique are an excellent choice, since they rely on similar retrieval techniques as the observations from orbit. In both cases, retrievals take into account the light path of scattered sunlight though the entire atmosphere. Since MAXDOAS instruments are relatively low cost and can be operated autonomously almost anywhere, they are credible candidates to form a world-wide ground based reference network for satellite observations. To ensure proper traceability of the MAXDOAS observations, a thorough intercomparison is mandatory.

The Cabauw Experimental Site for Atmospheric Research (CESAR) site in centre of The Netherlands was the stage of the Cabauw Intercomparison of Nitrogen Dioxide Measuring Instruments (CINDI) in June-July 2009 and again for the second campaign, CINDI-2, in 2016. Cabauw was chosen because the flat terrain offered a free view of large parts of the horizon, needed to accommodate the viewing geometry of the MAXDOAS observations. The location is under influence of both clean as well as polluted airmasses. This gives a wide range of possible trace gas concentrations and mixtures. Furthermore, at CESAR a wide range of observations are routinely carried out that fulfil the requirement to provide the background necessary for unraveling the differences between the observations from different MAXDOAS instruments that can be quite diverse in design and data treatment. These observations include parameters needed to understand the light paths, i.e. in-situ aerosol observations of optical and microphysical properties, as well as vertical profiles of aerosol optical properties by (Raman) lidar. In addition, vertical profiles of NO_2 could be measured during CINDI-2 using the unique NO_2 sonde, and a NO_2 lidar system.

With the imminent launch of Sentinel-5 Precursor/TROPOMI, with a nadir pixelsize of 3.5 $\times$ 3.5 km^2, and recent developments in MAXDOAS instruments there was a need for CINDI-2. This campaign was completed in September 2016 and had the goals to:

1. To assess the consistency of slant column measurements of key target species (NO_2, O_3, O_2O_2 and HCHO) relevant for the validation of S5P and the future ESA atmospheric Sentinels, from a large number of DOAS and MAXDOAS instruments from all over the world,
2. to study the relationship between remote-sensing column and profile measurements of those species and reference measurements of the same species, and
3. to investigate the horizontal representativeness of MAXDOAS measuring systems in view of their use for the validation of satellite tropospheric measurements on the scale of 25-50 km^2.

A feature of recent MAXDOAS developments is the use azimuthal scanning, in addition to elevation scanning such as in e.g. the PANDORA type of instruments. This, and the number of participating instruments, that expanded to 42, posed a challenge to the design of the CINDI-2 campaign. To support the campaign goals, NO_2 profiles were again provided by NO_2 sondes and lidar, as well as through in-situ observations using the Cabauw meteorological tower. Extensive aerosol information was gathered using Raman aerosol lidar as well as by in situ samplers. The analysis of the CINDI-2 data is ongoing. In the presentation a campaign overview will be given.

http://www.cesar-observatory.nl
http://www.tropomi.eu/science/cindi-2