



The nitrogen dioxide sonde

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Nitrogen dioxide is an important pollutant in the atmosphere, it is toxic for living species, it forms photochemical ozone (O₃), and acid rain in the form of nitric acid (HNO₃). Nitrogen dioxide is a member of the nitrogen oxides (NO and NO₂). In the troposphere they are typically formed as a by-product of the combustion of fossil fuels at high temperatures.

A growing number of space-born instruments measures nitrogen dioxide (NO₂) concentrations in the troposphere, but validation of these instruments is hampered by the lack of ground-based and in situ profile measurements.

The Royal Netherlands Meteorological Institute (KNMI) has developed a working NO₂ sonde. The sonde is attached to a small meteorological balloon and measures a tropospheric NO₂ profile. The NO₂ sonde has a vertical resolution of 5m and a measurement range between 1 and 100 ppbv. The instrument is light in weight (0.7 kg), cheap (disposable), energy efficient and not harmful to the environment or the person that finds the package after use. The sonde uses the chemiluminescent reaction of NO₂ in an aqueous luminol solution. The NO₂ – luminol reaction produces faint blue/purple light (at about 425 nm), which is detected by an array of silicon photodiodes. The luminol solution is optimised to be specific to NO₂.

Sodium sulphate, sodium EDTA and Triton X-100 are added to the luminol solution to exclude ozone (O₃) and PAN (peroxy acetyl nitrate) interference. The efficiency of the NO₂ luminol reaction depends on the pH of the solution. To avoid acidification of the system by carbon dioxide, the chemicals are refreshed constantly. Furthermore, treating the luminol solution with clean air for an extended period before the measurement, makes the luminol-NO₂ reaction more efficient.

An on-ground comparison with an in-situ NO₂ monitor of The National Institute for Public Health and the Environment (RIVM), shows that both instruments measure similar NO₂ variations in ambient air. In the summer of 2009, during the Cabauw Intercomparison of Nitrogen Dioxide measuring Instruments (CINDI) campaign and in the winter of 2010-2011, several NO₂ sondes were launched, for which the results will be showed in this presentation.