Middle Atmosphere RMR Lidar Soundings at Kühlungsborn/Germany: An Update on Current Capabilities

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We operate a daylight capable lidar Rayleigh-Mie-Raman (RMR) for temperature soundings up to 75 km (~90 km during the night) as well as detection of noctilucent clouds (NLC) at ~83 km since 2010 at Kühlungsborn/Germany (54°N, 12°E). Previous nighttime soundings even date back to 1996. Like most middle atmosphere lidars, this system was designed for attended operation. However, the reliability of the system has allowed us to operate the lidar by undergraduate students, resulting in ~1300°h of observations per year.

Manpower limitations motivated us to automate the lidar operation to a large extent in 2019/2020, just soon enough before the Covid-19 pandemic made human operations more complicated. In this talk, we will describe the basic automation concept, which might also be adapted to other already existing and heterogeneous systems. Two topics turned out to be most prominent: i) Safety issues with a high-power lidar that is integrated into an office building but not a dedicated lab building, and ii) the integration of different pre-existing hardware and software into one system with mutual control. We decided on the Message Queuing Telemetry Transport (MQTT) protocol where a variety of interfaces exists for many programming languages. That allowed us to keep most of the existing software with only partial adaptations. The main controller is coded in Python and called KLAUS (Kühlungsborn Lidar AUtomation System). As soon as the lidar is started (by a human operator), the KLAUS software continuously checks the data and the proper operation of the subsystems. In case of bad weather or the rare event of a technical problem, the software safely switches off all components, closes the hatch of the telescope, etc. Interim issues like passing airplanes or re-aligning the beam are handled automatically.

We will present some scientific highlights that have been achieved recently with the semi-automatic temperature and NLC lidar. In addition to the previously described RMR lidar, we are currently installing a new Doppler wind RMR lidar at our site. The lidar is adapting the DORIS wind measurement concept of the ALOMAR RMR lidar. Technically, we build on our experience and knowledge gained with the ALOMAR lidar as well as the Kühlungsborn RMR lidar. In this talk, we will present the overall lidar concept in combination with the existing temperature/NLC lidar. Details of the new RMR wind lidar are presented in the talk by Wing et al.