OCCULTATIONS FOR PROBING ATMOSPHERE AND CLIMATE: SETTING THE SCENE

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Since the early use of the occultation measurement principle for sounding planetary atmospheres and ionospheres, its exploitation in atmospheric remote sensing has seen tremendous advances. A particular boost was felt since the late eighties when a variety of intriguing opportunities for application to the atmosphere of our home planet Earth were increasingly recognized, such as utilizing new signal sources like Global Navigation Satellite System (GNSS) signals.

Today we deal with and plan sensors on Low Earth Orbit (LEO) platforms, which exploit solar, lunar, stellar, GNSS, and LEO-crosslink signals. Also airborne and "mountain-top" platforms are explored. The sensors, together, smartly utilize the whole electromagnetic spectrum from EUV/UV via VIS/IR and MW to Radio and exploit all kinds of atmosphere-radiation interaction such as absorption and scattering, both by molecules and aerosols, as well as refraction. The geophysical parameters obtained - from the Earth's surface up through the entire atmosphere - extend from the fundamental mass field variables temperature, pressure, and geopotential via the fundamental variable trace gases water vapor and ozone (and many further important trace species) to key particulate species such as aerosols and cloud liquid water. Furthermore, ionospheric electron density is sensed.

All these measurements rest on one and the same occultation principle with its unique properties of providing self-calibration, high accuracy and vertical resolution, global coverage, and (if using radio signals) all-weather capability. Occultation data thus bear enormous utility for applications in climate monitoring and research, weather analysis and numerical weather prediction, atmospheric physics and chemistry, and other fields such as space weather and planetary research. The self-calibration property is particularly crucial for climate change monitoring, as it enables unique long-term stability in climate datasets. The latter can be built from occultation data of different satellites and times without inter-calibration efforts. In fact, a controversy such as the recent one on the tropospheric temperature record over the last two decades, involving the heavily calibration-dependent Microwave Sounding Unit (MSU) data, could have been presumably saved had suitable occultation data been available.

This opening talk will highlight, along the lines outlined above, the general principles, properties, capabilities, and exploitation possibilities of occultation methods as well as point out how they provide key contributions to a better understanding of the Earth's atmosphere and climate system and to better prediction of its future evolution. At the same time the talk introduces in a general manner to the scope and main topics of the workshop.