



## **ACTRIS Ground Based Remote Sensing and In Situ Observation Capacity for Satellite Calibration and Validation**

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Space-based measurements of the Earth System, including its atmosphere, require extensive prelaunch and post launch calibration and validation activities to ensure scientific accuracy and fitness for purpose throughout the lifetime of satellite missions. Since the atmosphere is very variable in time and space, and the retrieval algorithms used must be accurate under the full range of conditions, calibration and validation needs to be carried out over the lifetime of missions in order to assure that any long-term variation in observation can be definitely be tied to the evolution of the Earth system.

ACTRIS (Aerosols, Clouds and Trace gases Research Infrastructure, <http://www.actris.eu>) is a pan-European initiative consolidating actions amongst European partners producing high-quality observations of aerosols, clouds and trace gases. Different atmospheric processes are increasingly in the focus of many societal and environmental challenges, such as air quality, health, sustainability and climate change. ACTRIS aims to contribute in the resolving of such challenges by providing a platform for researchers to combine their efforts more effectively, and by providing observational data of aerosols, clouds and trace gases openly to anyone who might want to use them.

The ACTRIS Research Infrastructure currently consists of over 30 stations distributed over Europe where remote sensing observations of aerosol (EARLINET) and cloud (Cloudnet) vertical distributions are made. The perspectives from space observations and ground based measurements are complementary: from space a global overview is obtained, built up from snap-shot like observations over different locations, while a temporal development over one place is obtained from a ground based station. Ground-based stations have the ability to provide spatio-temporal development of the state of the atmosphere for many parameters simultaneously, and in much greater detail than from space. This offers a unique opportunity for validation of observations from space.

ACTRIS provides invaluable data for the initial, as well as long term validation of space borne instruments that measure vertical aerosol and cloud distributions. Moreover, the ACTRIS profiling stations provide important background information for the validation of space borne observations of e.g. NO<sub>2</sub> and other trace gases from so-called hyperspectral imagers. Since the trace gas retrieval techniques take into account the light path of scattered sunlight though the entire atmosphere, detailed knowledge of the atmospheric state over validation sites, including in-situ observations, provides the necessary background information to validate the observations, as well as the underlying retrieval algorithms.

In particular, ACTRIS is involved in CAL/VAL activities for the following missions:

- Calipso/CALIOP – 2006-present
- ISS/CATS– 2015-2017
- Sentinel-5p/TROPOMI – 2017-present
- ADM-Aeolus – Launch 2018
- EarthCare – Launch 2019

Validation strategies and examples will be shown for past and ongoing activities.