Aerosol Optical Depth measurements from the GAW-PFR network

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1. Project description

The GAW-PFR Network

Aerosol optical depth (AOD) is the most important parameter related to aerosol radiative forcing studies. Multiwavelength AOD has been defined as an essential climate variable from various global bodies and agencies such as the Global Climate Observing System, the Global Atmosphere Watch (GAW) Program of the World Meteorological Organization, the European Space Agency Climate Change Initiative and others.

Ground-based sun-photometers have been deployed during the last 20-25 years in order to provide long term series of AOD measurements at various locations. PMOD/WRC during the start of the 90's has developed the Precision Filter Radiometer (PFR) that has been used for long term AOD measurements under a GAW-PFR Network of sun-photometers started in 1995 at Davos Switzerland and from 1999 at other locations, worldwide (Kazadzis et al., 2018, 2022).

Currently, more than 40 PFR instruments are operating worldwide. 15 of them are located in locations defined by the WMO Scientific Advisory Group for aerosols and maintained/calibrated by PMOD/WRC (including the Jungfraujoch station). Another 14 instruments owned by scientific institutes are also associated with PMOD/WRC as they are regularly calibrated by the WRC section WORCC that is the WMO defined World Aerosol Optical depth Research and Calibration Center. WORCC mandate also includes actions towards world AOD homogenization (Nakajima et al., 2020), including the recent (October, 2021) filter radiometer comparison and measurements for high altitude stations including Jungfraujoch, Mauna Loa, USA (Toledano et al., 2018) and Izana, Tenerife, Spain (Cuevas et al., 2019). An overview of the results of the GAW-PFR station measurements till 2018 have been presented in Kazadzis et al., 2019.

Aerosol Observations at Jungfraujoch (JFJ) have started in 1999. PFR instruments are measuring direct sun irradiance and only under cloudless sky conditions (minutes) they derive the AOD in four wavelengths and the Ångström exponent (AE). Table 1 shows the current GAW-PFR instrumentation. The instrument specifications are according to WMO recommendations.

Table 1. Current GAW-PFR AOD instrumentation at Jungfraujoch.

Instrument type	PFR-N
Measuring wavelengths (nm)	368, 412, 500, 863
Field-of-view (deg)	2.5
FWHM (nm)	3.8-5.4
Measurement principle	Sun pointing on tracker

During the period 2021-2022 JFJ activities have been included (together with all other GAW-PFR instruments) in the project "GCOS - Aerosol Optical Depth data Web Interface for data communication to scientists and the public" funded by the Federal Office of Meteorology and Climatology MeteoSwiss / International Affairs Division, Swiss GCOS Office.

Overview GAW-PFR at high-mountain stations including JFJ

GAW-PFR instruments are measuring predominantly at remote areas away from anthropogenic aerosol pollution. Five of such stations are located at high altitude areas:

Table 2. List of high elevation GAW-PFR stations.

Station name	Acronym	country	Altitude (Km)
Jungfraujoch	JFJ	Switzerland	3.5
Mauna Loa	MLO	USA	3.4
Izana	IZO	Spain	2.3
M. Walliguan	WLG	China	3.8
Davos	DAV	Switzerland	1.6

Measurements at MLO, JFJ, DAV and IZO have started in the late 90s early 00s and WLG late 00s.

Figure 1 shows the long-term AOD levels and Ångström Exponent (AE) means for the 5 stations listed in Table 2:

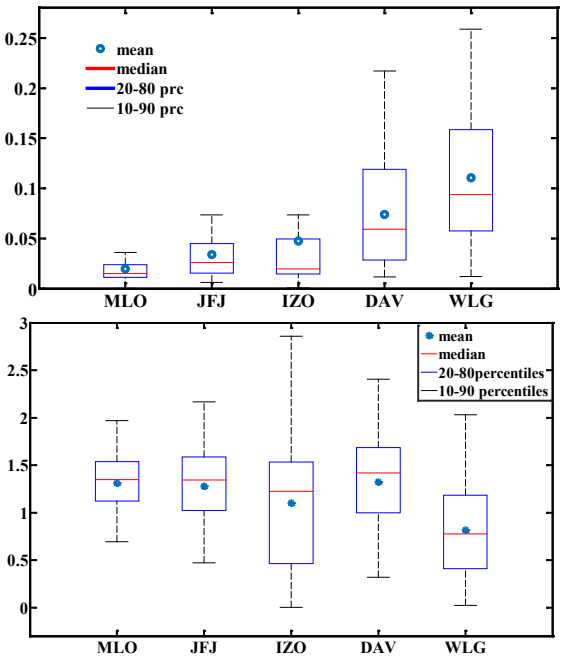

Figure 1. AOD at 500nm (up) and AE (down) mean and median for 5 high altitude stations.

Lowest values of average AODs can be seen in MLO and JFJ stations while IZO shows a bit larger values due to its proximity to the Sahara desert and the (few) related desert dust episodes. However, median AOD values for all three stations are below 0.04. WLG shows higher AODs, despite the fact that it is the highest altitude location, mainly due to the proximity of desert areas in central China, something that is also supported with the lowest AE averages related with the presence of larger particles (Toledano et al., 2022).

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Internet data bases

http://ebas.nilu.no

Collaborating partners / networks

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Dr. Africa Barreto, AEMET, Spain
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Scientific publications and public outreach 2022

Conference Papers

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Book sections

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