

RECOMMENDATION ITU-R RS.1744

Technical and operational characteristics of ground-based meteorological aids systems operating in the frequency range 272-750 THz

(Question ITU-R 235/7)

(2006)

Scope

This Recommendation provides the operational and technical characteristics of representative MetAids systems operating in the optical frequency range 272-750 THz.

The ITU Radiocommunication Assembly,

considering

- a) that observations in the frequency range 272-750 THz (hereafter referred to as optical) provide data critical to operational meteorology and scientific research of the atmosphere and climate;
- b) that the spectrum in the optical frequency range is used for active and passive meteorological sensor systems as well as many other applications;
- c) that the technology for meteorological sensors using optical spectrum is continuously evolving to provide better accuracy and resolution of measurement data;
- d) that frequencies in the optical frequency range are now being used for data links, range measuring devices, and other active systems on ground-based and space-based platforms, and as these systems are rapidly expanding and increasing in number, the interference between optical meteorological sensors and other optical systems is likely to increase;
- e) that many applications of active and passive systems operating in the optical range are very similar to those being used at lower frequencies in the electromagnetic spectrum;
- f) that it is timely to consider the nature of protective measures and sharing considerations to ensure that ground-based optical meteorological sensors can continue to operate without interference,

recommends

- 1 that operators of meteorological aids operating in the optical frequency range should take into account the possibility of interference from other optical transmitters in their choices of observatory sites and in the design of sensors;
- 2 that studies of interference to and from optical meteorological aids systems should take into account the technical and operational parameters provided in Annex 1.

Annex 1

1 Introduction

Ground-based meteorological sensor systems using spectrum in the optical frequency range are operated typically in the range 272-750 THz by a variety of meteorological services and other organizations interested in meteorological and climate research. This Annex provides the operational and technical characteristics of a representative set of meteorological sensors that transmit and receive signals at optical frequencies.

2 Laser ceilometers

2.1 Ceilometer technical characteristics

A ceilometer contains a laser as the transmitting source, and a photodetector for the receiver. A laser ceilometer senses and reports cloud levels in the atmosphere by using invisible laser radiation to detect cloud levels. They operate by transmitting a pulse of laser light into the atmosphere and sensing the light return as it is reflected back toward the ceilometer by objects in its path. By timing the interval between the transmission and reception, the height of particles (such as water droplets or ice crystals in clouds) above the ceilometer is calculated and reported to the data collection package.

Ceilometers are light detection and ranging (LIDAR) devices. Cloud height determination is based on electronic interpretation of backscattered returns, based on the LIDAR equation:

$$Pr(h) = E_0 \times \frac{c}{2} \times \frac{A}{h^2} \times \beta(h) e^{-T} \quad (1)$$

where:

- $Pr(h)$: instantaneous power received from height h (W)
- E_0 : effective pulse energy, compensated for optics attenuation (J)
- c : speed of light (m/s)
- A : receiver aperture (m²)
- h : origination height of the backscattered return (m)
- $\beta(h)$: volume backscatter coefficient at height h , the portion of light which is reflected back towards the ceilometer (m⁻¹sr⁻¹) (sr = steradian)
- T : atmospheric transmittance which accounts for the transmitted and backscattered power by extinction at various heights between transceiver and height of backscatter; equal to 1 in a clear atmosphere (i.e. no attenuation); this term in the LIDAR equation allows for determining which backscattered returns are from cloud interaction and which are from other obstructions such as fog or precipitation.

2.2 Representative Ceilometer System A

System A is capable of measuring cloud heights to approximately 3 700 m. It is employed with other weather monitoring equipment such as visibility, precipitation, and temperature and dew point sensors for support of aviation operations and weather forecast activities.

System A determines cloud height by emitting a pulsed laser into the atmosphere and measuring the time required for backscattered returns from particles in the atmosphere, if present, to reach

2.2.1 Transmitter assembly

2.2.2 Receiver assembly

2.3 Representative Ceilometer System B

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