



Report ITU-R RS.2184
(10/2010)

**Arrival time difference lightning detection
systems in the meteorological aids
service in operation below 20 kHz**

RS Series
Remote sensing systems



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***Note:** This ITU-R Report was approved in English by the Study Group under the procedure detailed in Resolution ITU-R 1.*

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1 Summary

This Report describes the general operational and technical characteristics of the arrival time difference (ATD) system of the meteorological aids services operating in the frequency range below 20 kHz.

2 Introduction

This ITU-R Report characterizes the technical properties and operational characteristics of the ATD system operating in the meteorological aids service in the frequency range below 20 kHz.

3 ATD network basics

The purpose of this section is to address the use by the meteorological aids services of frequencies below 20 kHz.

Long-range lightning detection using observations near 10 kHz has been performed since 1939, originally with a very manpower-intensive system measuring the direction from which signals were received, but since 1987 detection has been carried out with an automated Arrival time difference system (ATD) using the time differences of signals received to derive strike locations.

The ATD system utilizes a network of “detector” out-stations to monitor spectral emissions of cloud to ground lightning strikes centred between about 5 and 20 kHz. At these frequencies the sky waves, reflected off the ionosphere, propagate for very large distances with relatively little attenuation and are preceded by a ground wave at shorter ranges. Thus, it is possible to receive the emissions from the cloud to ground strokes at thousands of kilometres from the stroke location. A distributed network of ground based sensors can locate the origin of the lightning stroke, using the time differences between the arrivals of the lightning emission at the individual sensor sites.

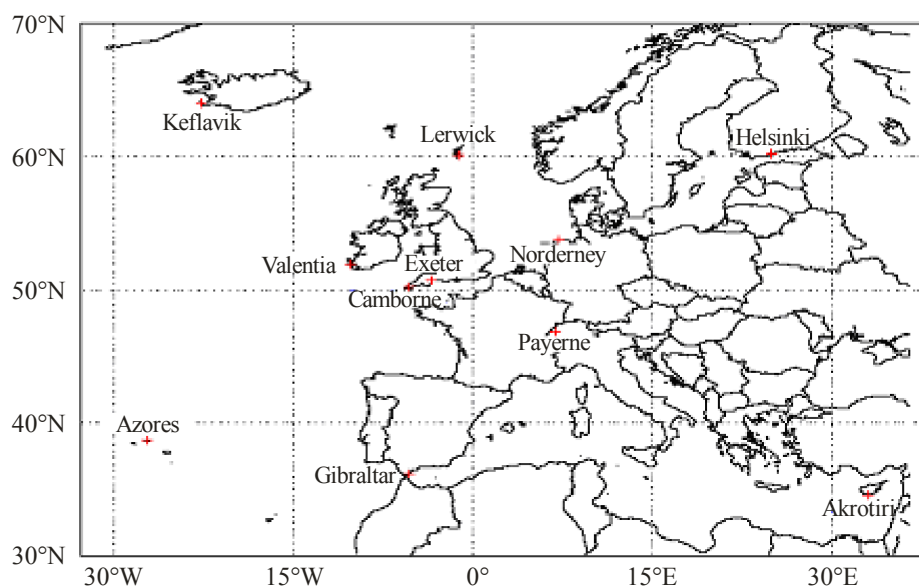
At June 2010, the network comprised 11 sensors distributed across Europe from Iceland to Cyprus, operating in collaboration with Finland, France, Germany, Iceland, Ireland, Portugal and Switzerland.

The network configuration is shown in Fig. 1.

A further sensor has been placed in La Reunion (in the Indian Ocean to the east of Madagascar) to evaluate improvements in location for Africa, but this is not yet processed as part of the operational system. In the immediate future new sensors are to be installed in Croatia, at some sites in Africa, South America, the Middle East and in western Asia, and in the long term there should be opportunities to extend the system to provide global coverage.

This and other intended sensor locations are shown in Fig. 2.

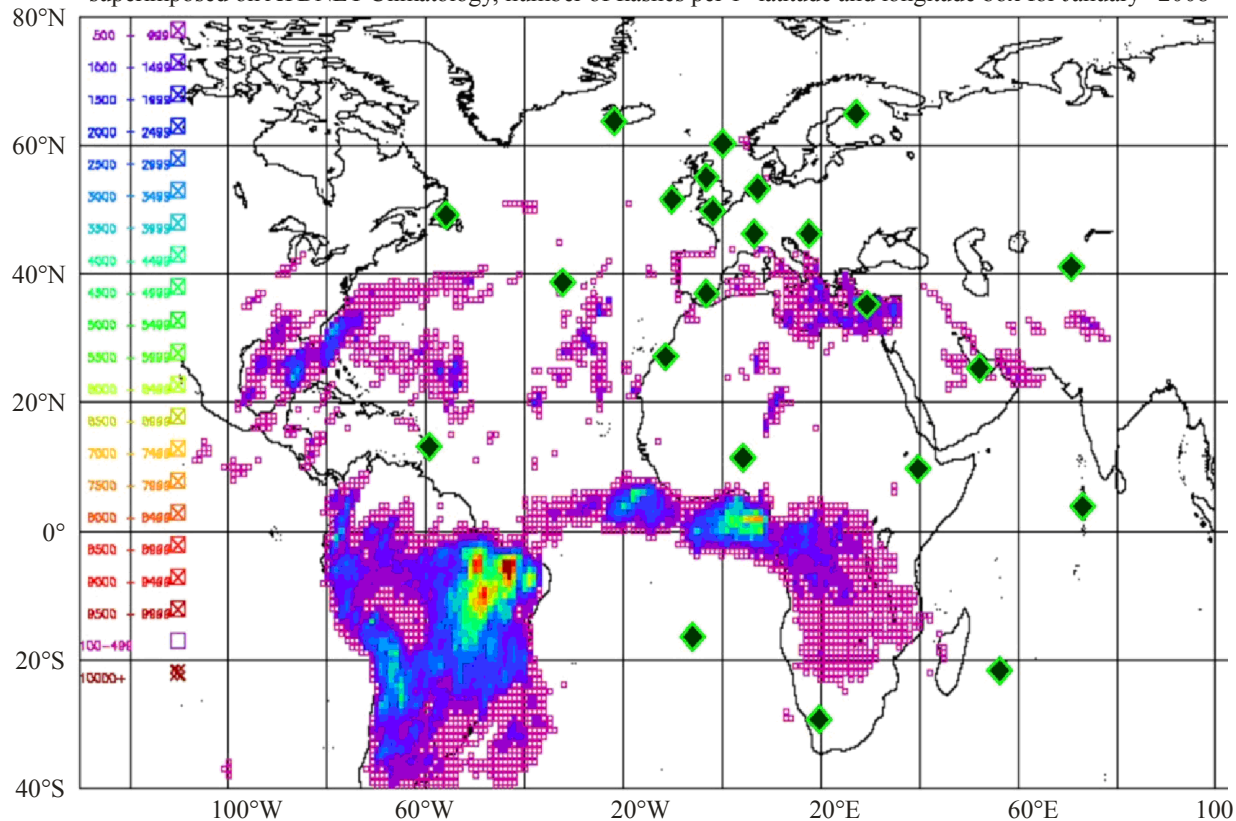
FIGURE 1
The current ATD system sensor network



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FIGURE 2
New and proposed locations of ATD system

Possible ATDNET sensor locations in 2011, 
superimposed on ATDNET Climatology, number of flashes per 1° latitude and longitude box for January 2008



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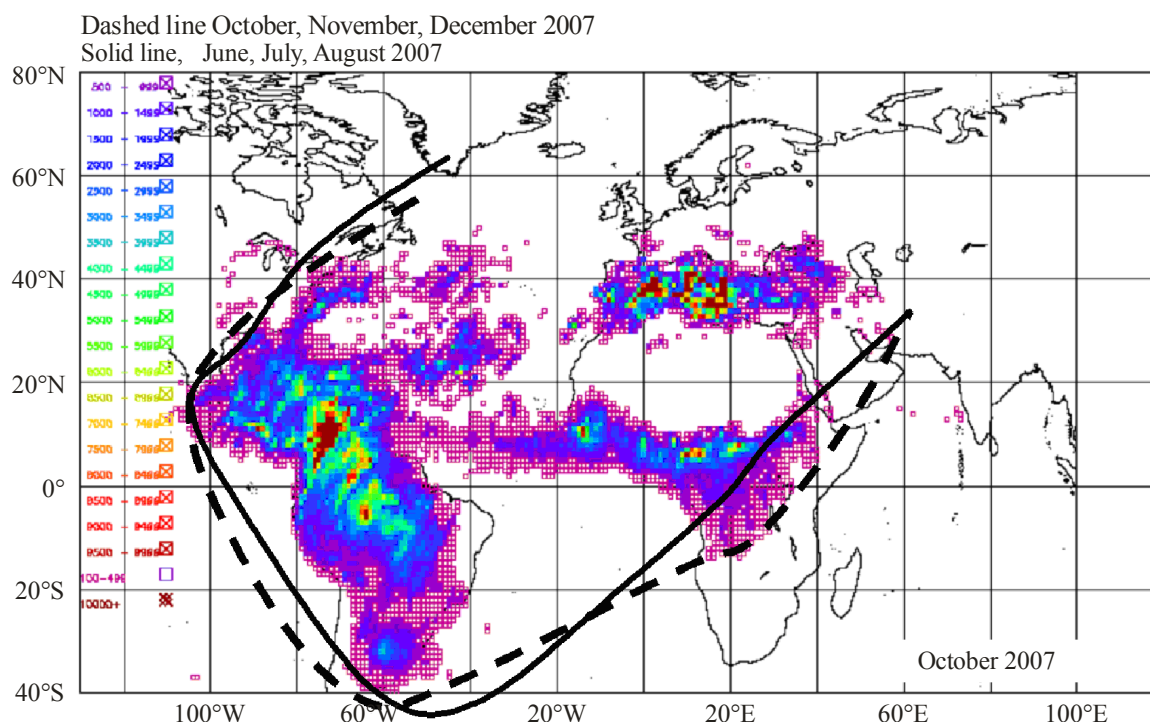
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3.1 ATD network service area

The ATD network can provide a 24-hour thunderstorm detection service over the areas shown in Fig. 3. The area of coverage is governed by the properties of sferic¹ propagation, with least loss of sensitivity with distance travelled occurring along sea tracks. In South America, Central America the Caribbean and North and West Africa the system provides useful thunderstorm detection throughout the day. South Africa is well outside of the Service Area covered throughout the day, but work is under way in extending the ATD service area to cover the whole of Africa.

FIGURE 3

ATD system network coverage



Estimated area of useful detection for ATDNET compared to LIS satellite climatology superimposed on ATDNET lightning climatology for October 2007

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3.2 ATD network detection output data

The typical output from the system is illustrated in Fig. 4, where the lightning locations have been detected at a time of year when there are few thunderstorms in Europe, with intense activity in Central Africa, the Caribbean and parts of South America.

¹ Sferic: A lightning generated electromagnetic signal (abbreviation for radio-atmospheric).