

The use of Biral Forward Scatter Visibility Meters in the presence of haze, smoke and sandstorms

The performance of forward scatter meters (FSM) in the presence of haze, smoke and dust is sometimes questioned as the fundamental operation of such devices is defined for hydrometeors (mist and fog) rather than for lithometeors (haze, sand, dust and smoke). This note explains why forward scatter meters are suitable in such conditions and gives some references to independent studies that have addressed the issue.

With respect to haze and smoke forward scatter meters can be expected to operate correctly as the very small particles appear to behave in a similar way to mist and fog particles at the infrared wavelengths used by Biral forward scatter meters. With these small particles, which generally appear as a blue/white haze, the scattering mechanisms allow forward scatter meters to respond correctly, as discussed in ICAO document 9328, Manual of RVR Observing and Reporting Practices, section 8.1.3, paragraph d. There will always be some discrepancy between a forward scatter meter and a transmissometer in anything other than pure water mist or fog but the discrepancy is unlikely to be significant for haze and most smoke.

A number of studies have been undertaken that address the performance of forward scatter meters in the presence of smoke and haze, examples are referenced below:

Poirot, R., & Husar, R. B. (2004). Chemical and physical characteristics of wood smoke in the northeastern US during July 2002 impacts from Quebec forest fires. Regional and Global Perspectives on Haze: Causes, Consequences and Controversies, Pap, (3).

Wendler, G., Conner, J., Moore, B., Shulski, M., & Stuefer, M. (2011). Climatology of Alaskan wildfires with special emphasis on the

extreme year of 2004. Theoretical and applied climatology, 104(3-4), 459-472.

The performance of a forward scatter meter in the presence of larger sand or dust particles will be dependent to some extent on the particles' scattering properties. Theoretical studies are generally of little use in this case as the particle characteristics are likely to vary significantly from location to location and from event to event. Biral forward scatter sensors have been compared to transmissometers in locations prone to sand and dust storms by a number of customers with positive results. Being customer funded trials detailed results cannot be published, however independent investigations of the use of forward scatter meters in sand and dust have been undertaken. A reference to one such study is provided below:

Fu, P., Huang, J., Li, C., & Zhong, S. (2008). The properties of dust aerosol and reducing tendency of the dust storms in northwest China. Atmospheric Environment, 42(23), 5896-5904.

In conclusion, it can be shown the forward scatter sensor in general and Biral forward scatter sensors in particular provide reliable estimations of visibility in the presence of haze, smoke, dust and sandstorms.