4.6B RELATIONSHIP OF STRENGTH OF TURBULENCE TO RECEIVED POWER

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Because of contributions due to reflection, the determination of the turbulence refractive index structure constant $C_n{}^2$ may be affected (e.g., ROTTGER, 1980). For pure scattering from turbulence in the inertial subrange the radar echo power can be used to calculate $C_n{}^2$, as applied in several investigations (e.g., GREEN et al., 1978; VANZANDT et al., 1978). The radar power is determined by the convolution

$$P \propto \int E^m(\psi_T - \psi,\ \theta_T - \theta)\ A(\psi_A - \psi,\ \theta_A - \theta) \cdot \sin\theta\ d\theta\ d\psi \qquad (1)$$

where ψ is the elevation angle and θ the azimuth angle. The term E^m is the pattern of the radar antenna pointing into the direction given by ψ_T and θ_T. The angular distribution $A(\psi_A - \psi, \theta_A - \theta)$ expresses the aspect sensitivity of the radar target, where the angles ψ_A and θ_A determine a tilt of the target. Height variations of these parameters are not considered here for simplification. If the radar target is a scattering medium, $m = 1$. The distribution A determines the anisotropy of the scattering irregularities. If the radar target is an ideal reflector, $m = 2$, and A is given by the Dirac delta function. It is found from experiments that $1 < m < 2$, providing evidence that the radar echo power is given by a composition of scattering and reflection or by diffuse reflection.

It was assumed by VINCENT and ROTTGER (1980) that in a two-dimensional approach (θ = const), the aspect sensitivity can be expressed by a Gaussian angular distribution with its maximum near the zenith.

If one swings the antenna beam to sufficiently large off-zenith angles (>12.5°, e.g., Figure 9 in ROTTGER, 1980) so that a quasi-isotropic response from the tail ends of the Gaussian angular distribution can be anticipated, the evaluation of the integral (1) depends only on the known antenna pattern of the radar. This procedure, swinging the radar beam to attenuate the reflected component, may be called "angular or directional filtering". Under this condition of volume scattering, $m = 1$, and A = const for isotropic scatterers. It has to be assumed, on the other hand, that the outer part of the angular distribution really is due to pure turbulence scattering and not due to diffuse reflection. The tilted antenna also may pick up reflected components from near the zenith through the sidelobes. This can be tested by the evaluation of the correlation function (e.g., RASTOGI and ROTTGER, 1982). This method applies a "time domain filtering" of the intensity time series but needs a very careful selection of the high pass filters. Provided that these two methods of angular and time domain filtering can be properly applied to separate the contribution from reflection and scattering and that VHF radars can determine if a volume is filled with homogeneous turbulence, it is accepted that reliable estimates of the refractive index structure constant and eddy dissipation rate due to turbulence can be deduced.

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