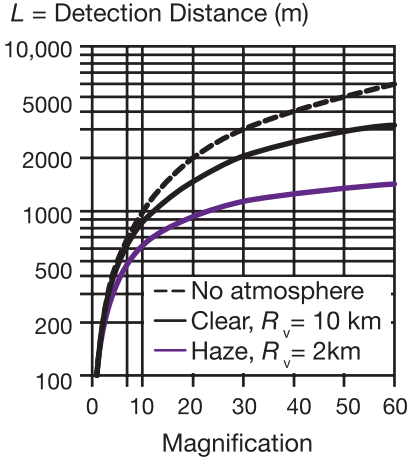
Atmospheric Scatter Effects

Light scatter by atmospheric haze reduces contrast and degrades resolution of distant objects seen vertically or horizontally through a scope or binocular. These effects depend on the **visual range** R_V, which is defined as the distance at which the unaided eye can detect an extended dark object having 2% contrast against the horizon sky. In clear daylight, R_V is >10 km. In light haze, it is 5 to 10 km and, in moderate haze, it is 2 to 5 km.

Ricco's Law states that the product of target angular size and its contrast is constant at the detection limit. Additional magnification compensates for contrast loss.

Detection of a target at distance L through a binocular or scope requires a minimum magnification of $M = (L/r)(e^x)$ where e is the Napierian logarithm base, r is the distance at which that same target can be detected with the unaided eye, and $x = 1.956(L - r)/R_V$.



This graph shows the maximum values of L as functions of M and R_V for three atmospheric conditions when the same target can be detected at 100 m with the unaided eye. Note that a given change in M has less effect on L when the target is at a long distance.

For example, if R_V is 10 km (clear day) and r = 100 m, L = ~2500 m at 40× and ~ 2900 m at 50× (~16% change). For R_V of 2 km (moderate haze), L = ~1270 m at 40× and ~1400 m at 50× (~10% change).