

ANNEX E

Swath Width Limitations

The extent of the swath that can be surveyed from a moving sensor may be constrained by difficulties which depend on the sensor, as well as on considerations of line of sight.

The upper layers of the atmosphere allow good propagation of visible light in the absence of clouds, fog, rain, and dust, allow some wavelengths in the infrared band to propagate as well as or sometimes better than visible light, and are nearly transparent to the longer wavelengths used by radar. However, some absorption and blurring occurs at all of these wavelengths when the radiation has to penetrate a long distance, nearly horizontally, through the lowest and densest layers of the atmosphere.

Because of this fact, surveillance of targets at long ranges will be unsatisfactory when the line of sight from an airborne or satellite-borne sensor makes a very small angle with the surface of the earth. The practical limit is usually taken to be 3° . This limits the surveyed swath to a maximum range less than that established by the horizon.

Radar sensors suffer from another limitation, due to the enormous reflections returned by the earth itself. These are at their greatest when the line of sight from the radar makes a large angle with the surface of the earth, and fall off significantly when the radiation can glance off in a forward direction instead of being reflected back towards the transmitter. Consequently it is usually not useful to try to observe the ground (or objects flying over the ground) in the cone directly below the vehicle. The critical angle depends on the nature of the surface and on the clutter rejection mechanisms of the radar signal processing system, but is usually between 50° and 80° . This limitation provides a "nadir hole" underneath the vehicle, in which surveillance cannot be conducted. It does not apply to electro-optical sensors.

These two limitations are illustrated in Figure 4 for three satellite altitudes.