Atmospheric Link Calculations

Using Air Force Measured Korean Turbulence Data

Approved for Public Release, Distribution Unlimited Case 9693 3 Jul 07

AGENDA

- **Korean Turbulence Data Base:**
  - √ Air Force Combat Climatology Center, Strategic Climatic Information Service
    - Processed To Provide Benign (15%), Average (50%), & Degraded (85%) Turbulence Strengths
  - √ Compared To Multiples Of Huffnagle Valley 5/7 Model
- **Link Calculations Limited By Turbulence:**
  - √ Ground to Aircraft At 25,000 ft
    - Zenith Angles From 0° to 85°
  - √ Aircraft at 25,000 ft to Aircraft at 25,000 ft
    - Cross Link Ranges From 10 km to 300 km
  - √ Aircraft At 25,000 ft to Ground
    - Nadir Angles From 0° to 85°
- **References**

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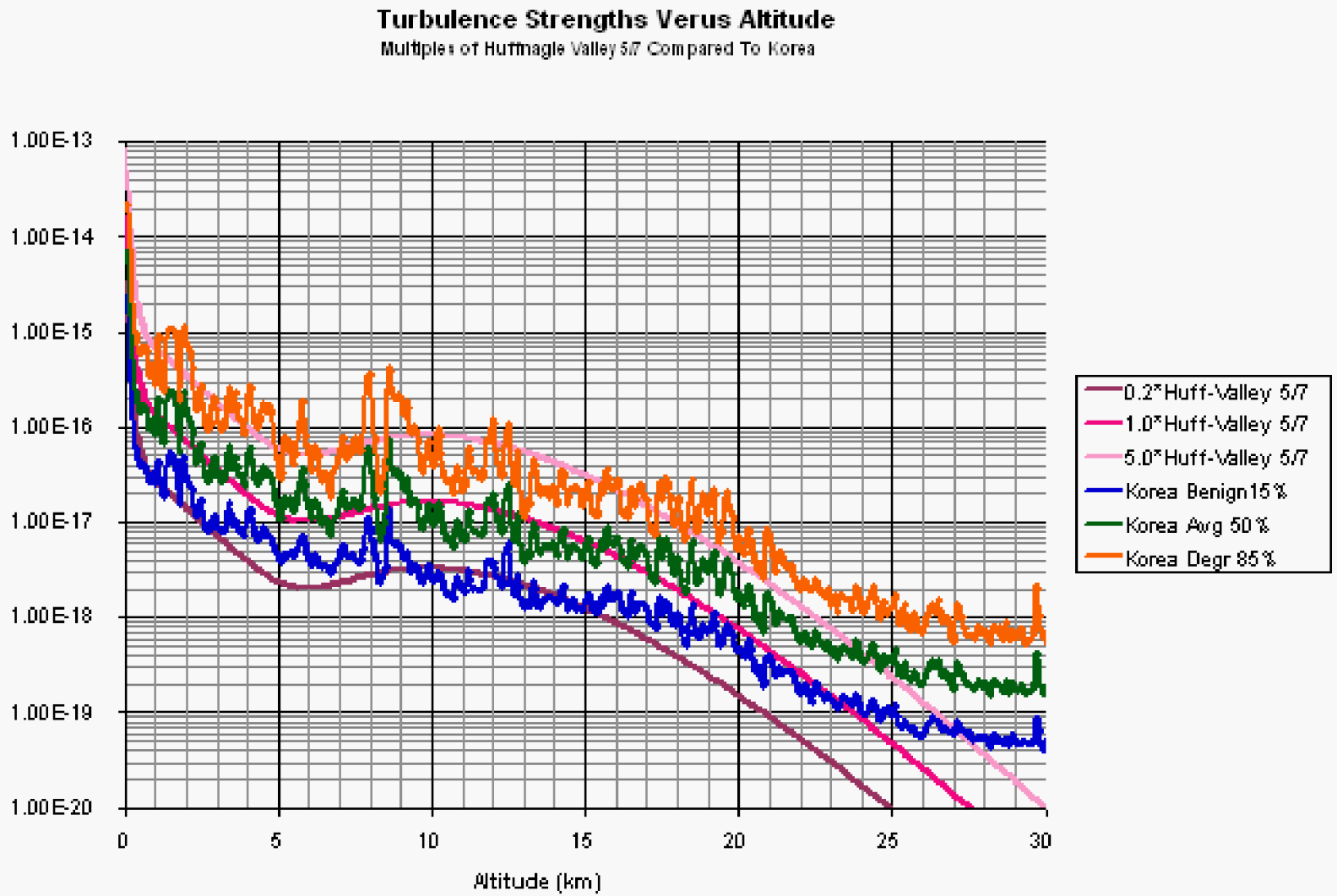
Korean Data From AF Balloon Flights

Derived From Air Force Combat Climatology Center Data Compared To Multiples Of Huffnagle-Valley 5/7 Model



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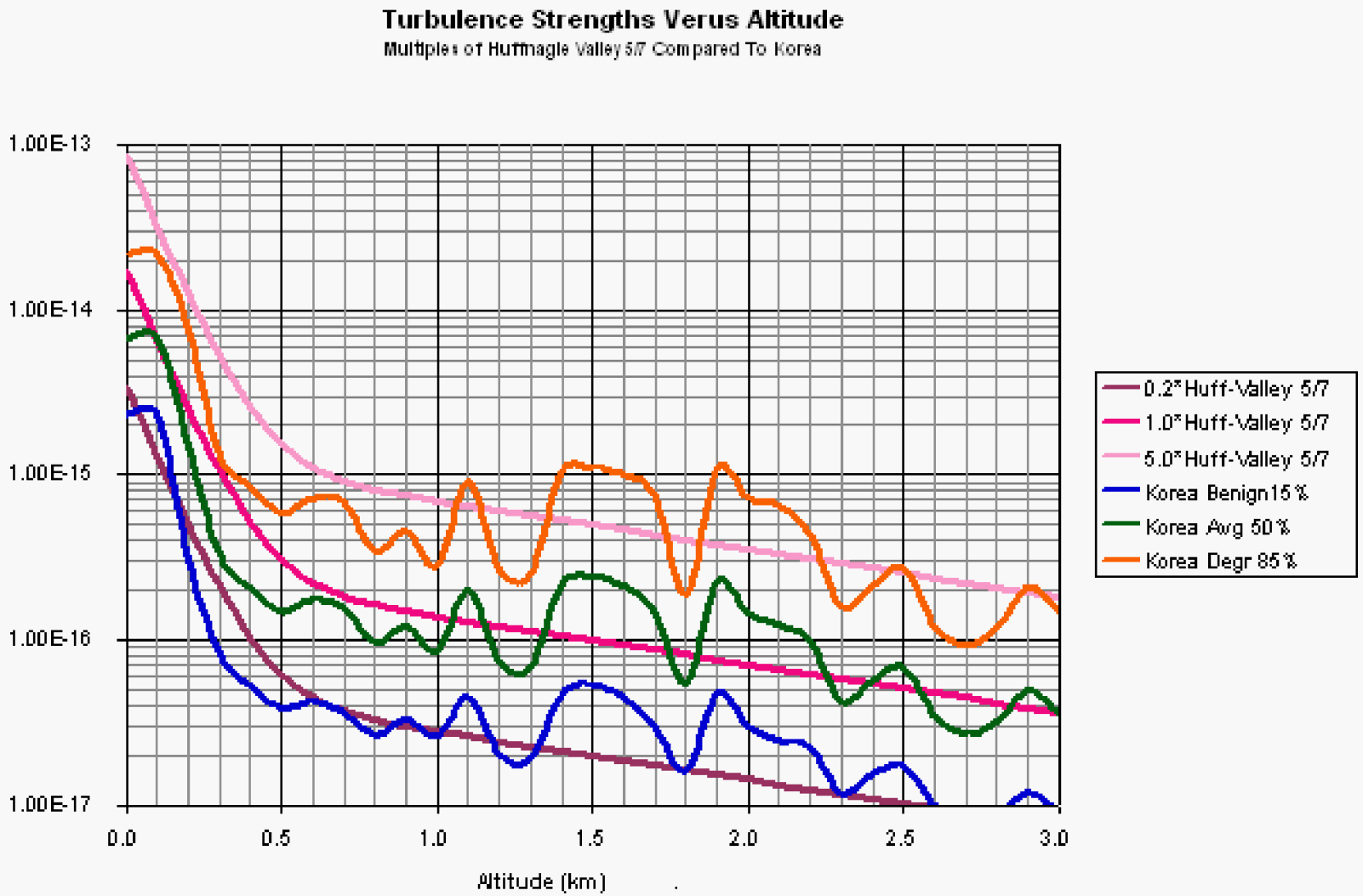


Equations Used To Calculate Coherence Diameter & Rytov Number

Armed with measurements <u>or</u> models of turbulence strength versus altitude, we can calculate basic turbulence driven parameters such as the coherence diameter and the Rytov Number, using the standard equations as shown:

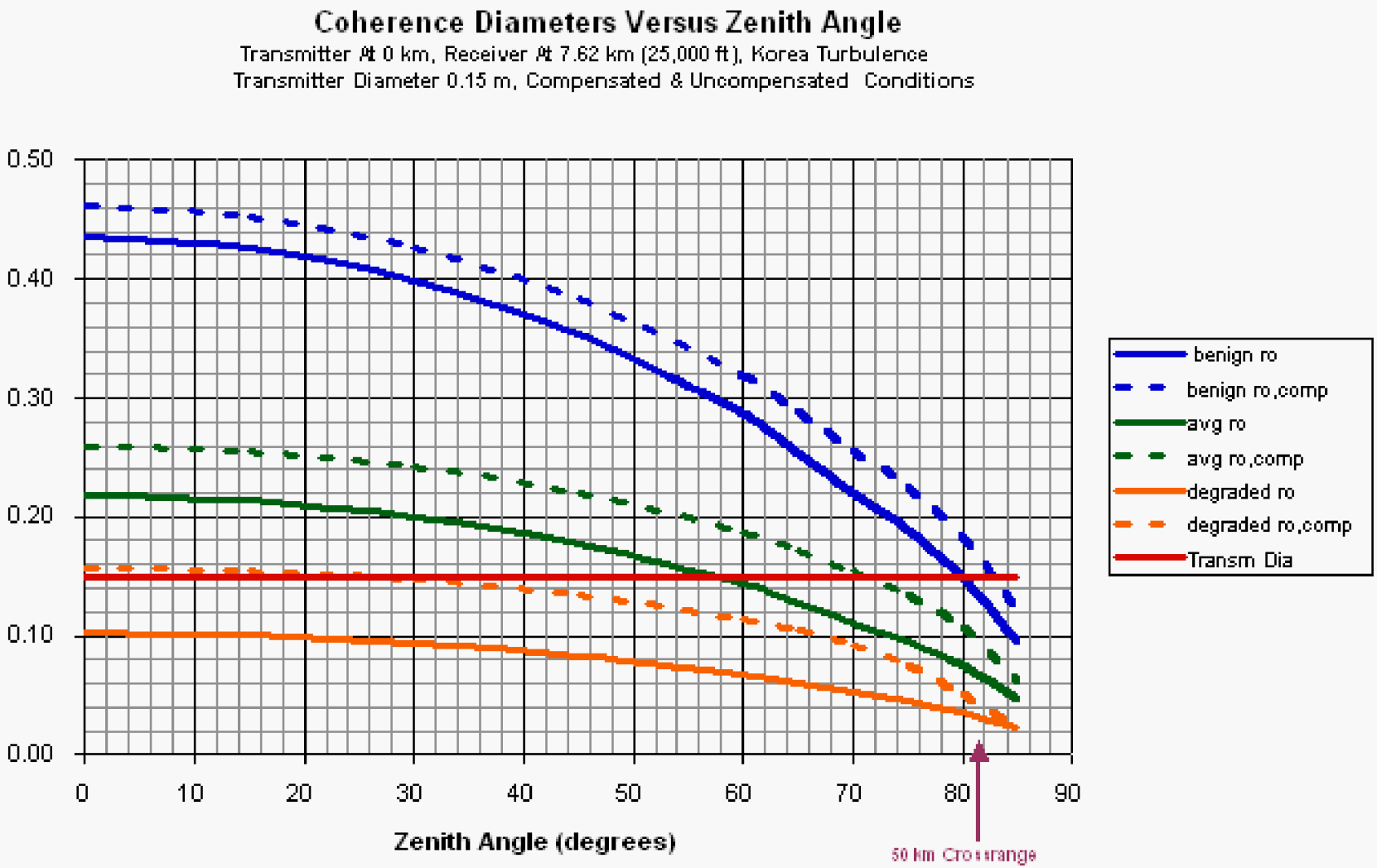
Coherence Diameter, $r_0 = [16.71 \int_0^R C_n^2(r)(1-r/R)^{5/3} / \lambda^2]^{-3/5}$

Rytov Number, $\sigma_r^2 = 4.78 \int_0^R C_n^2(r) r^{5/6} (1-r/R)^{5/6} / \lambda^{7/6}$

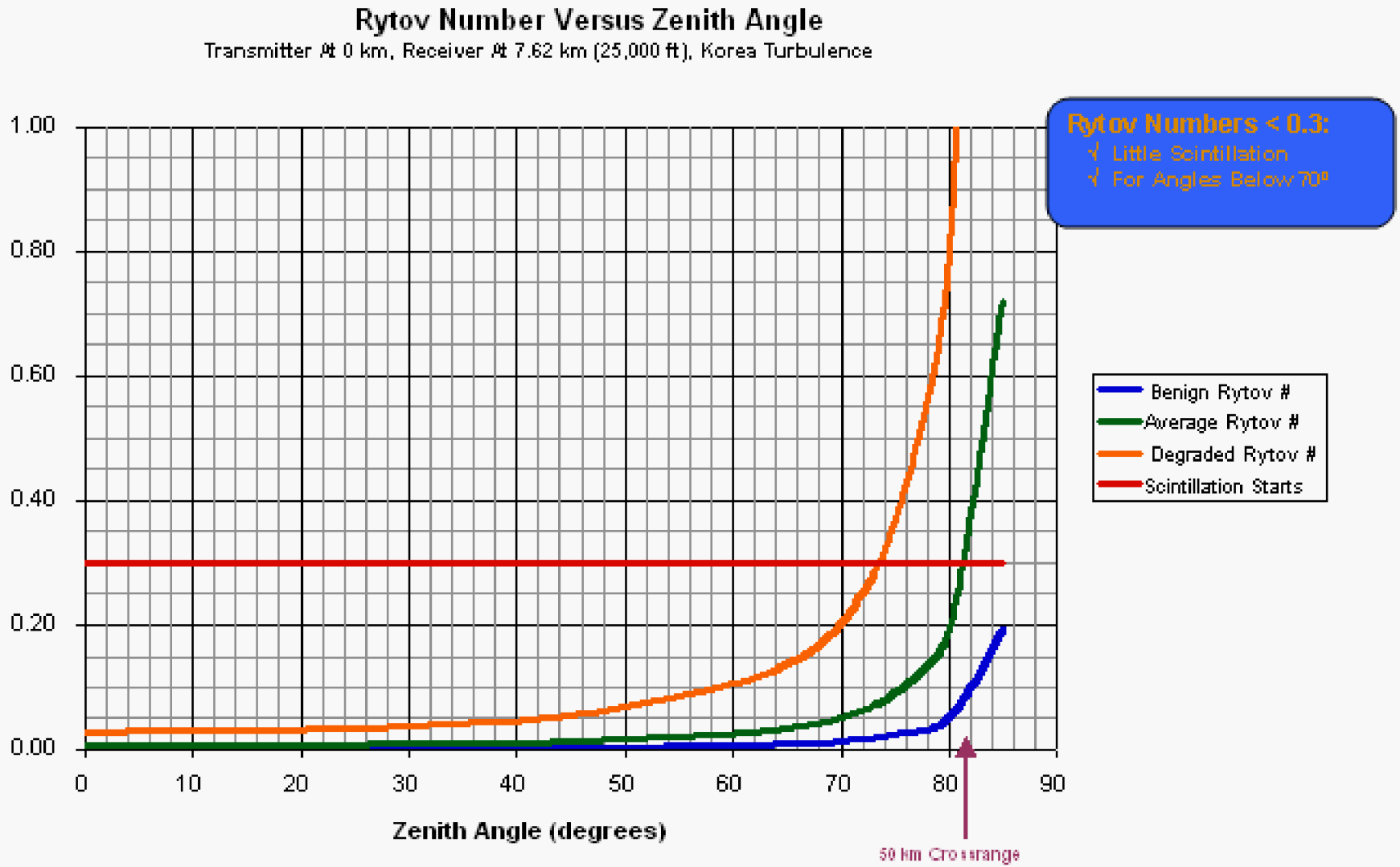
Coherence Diameters

Ground To Aircraft At 25 kft, 15 cm Transmit Diameter

With & Without Adaptive Optic Compensation

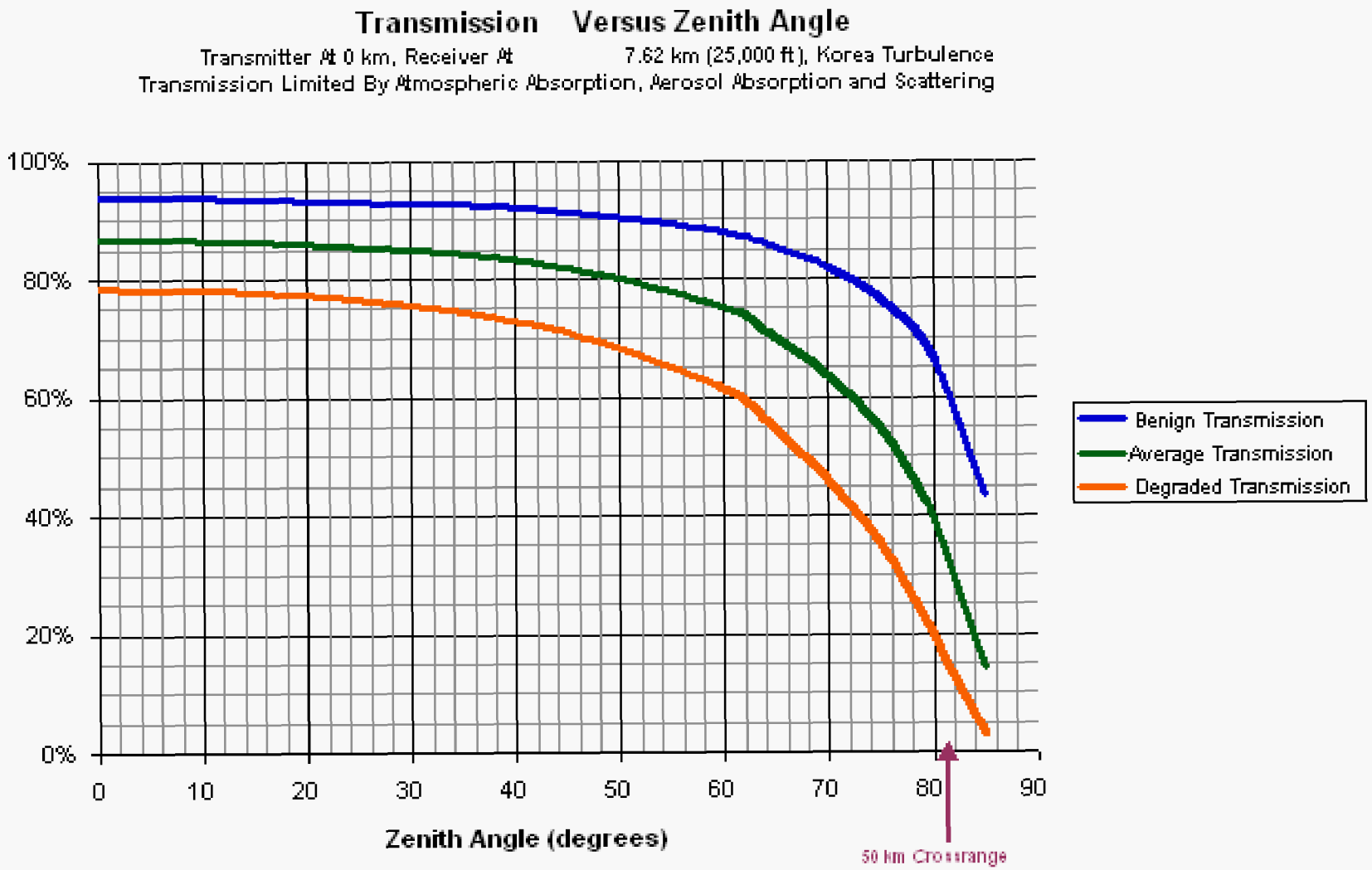


Rytov Numbers
Ground To Aircraft At 25 kft



Estimated Transmission Loss

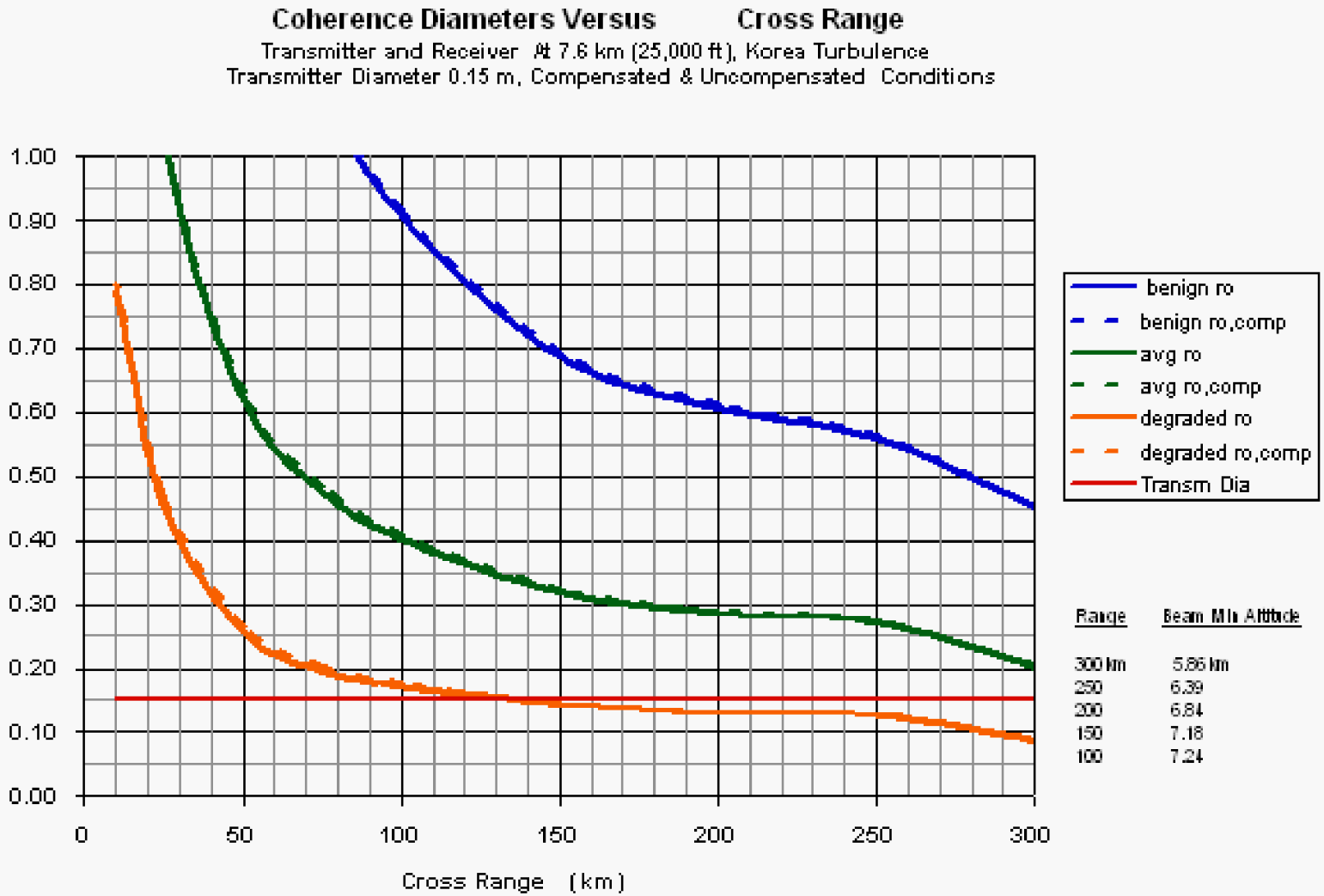
Due To Atmospheric Absorption, Aerosol Absorption & Scattering



Coherence Diameters

Aircraft To Aircraft, Both At 25 kft

With & Without Adaptive Optic Compensation



Rytov Numbers
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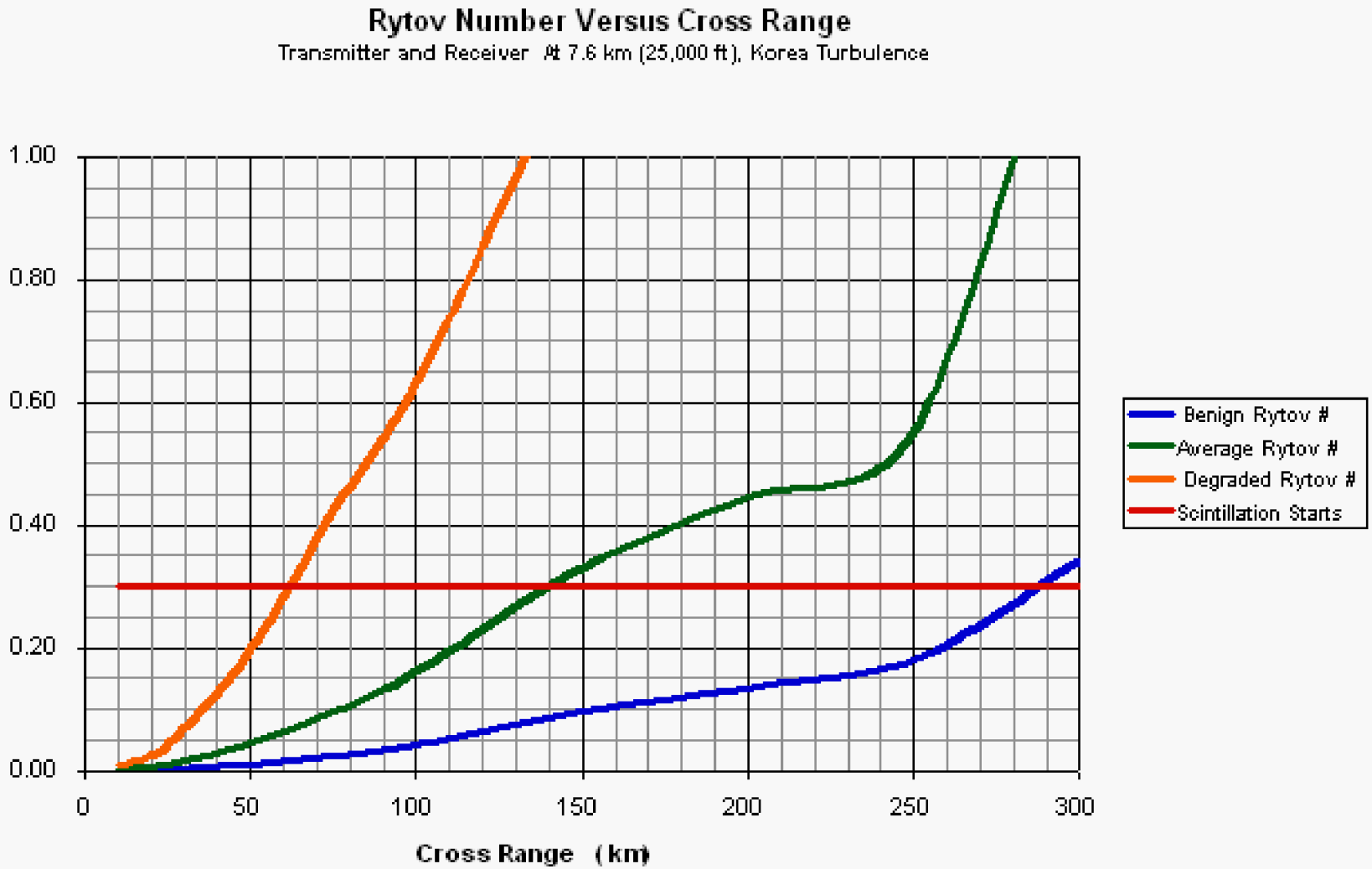
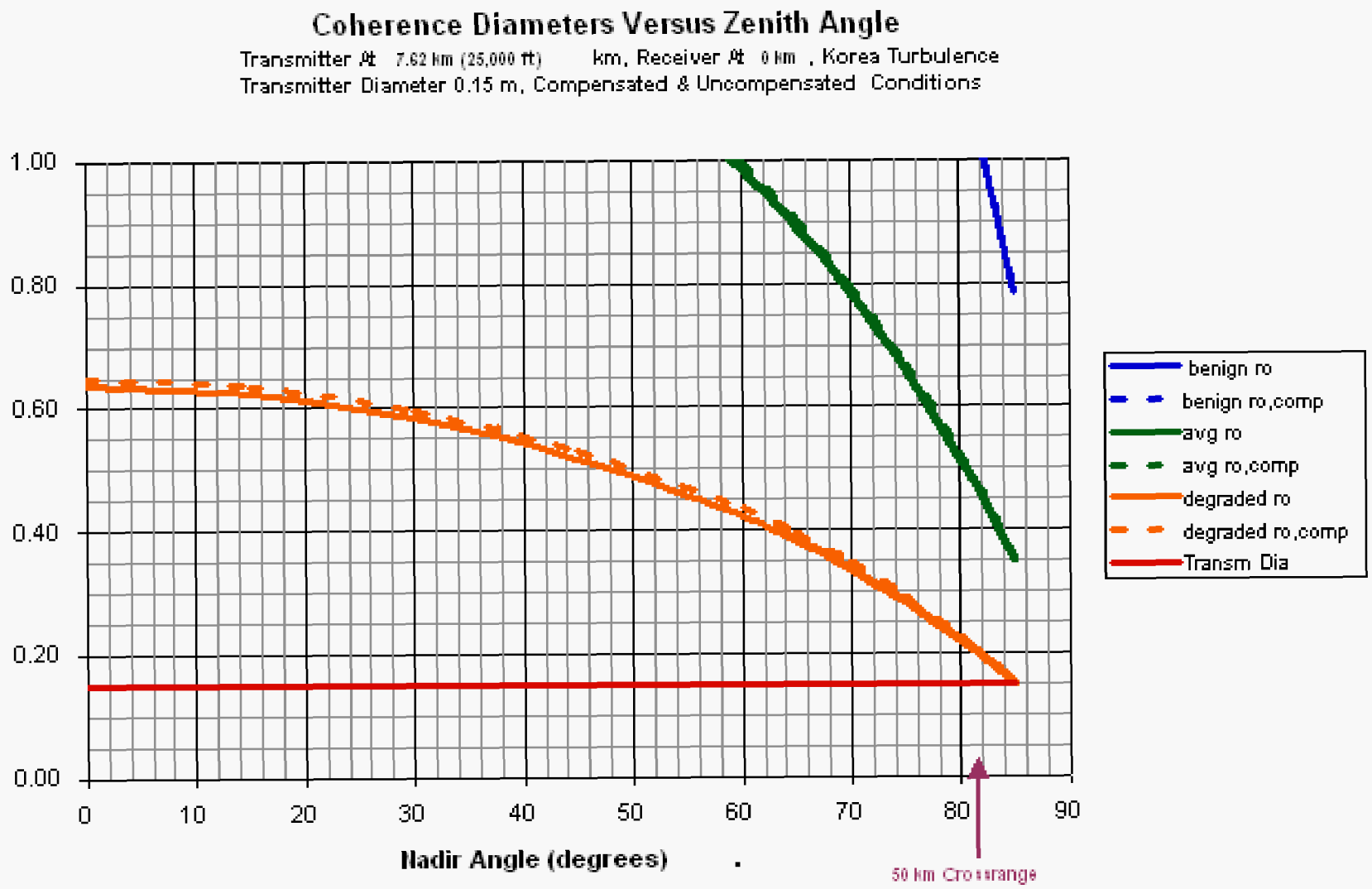


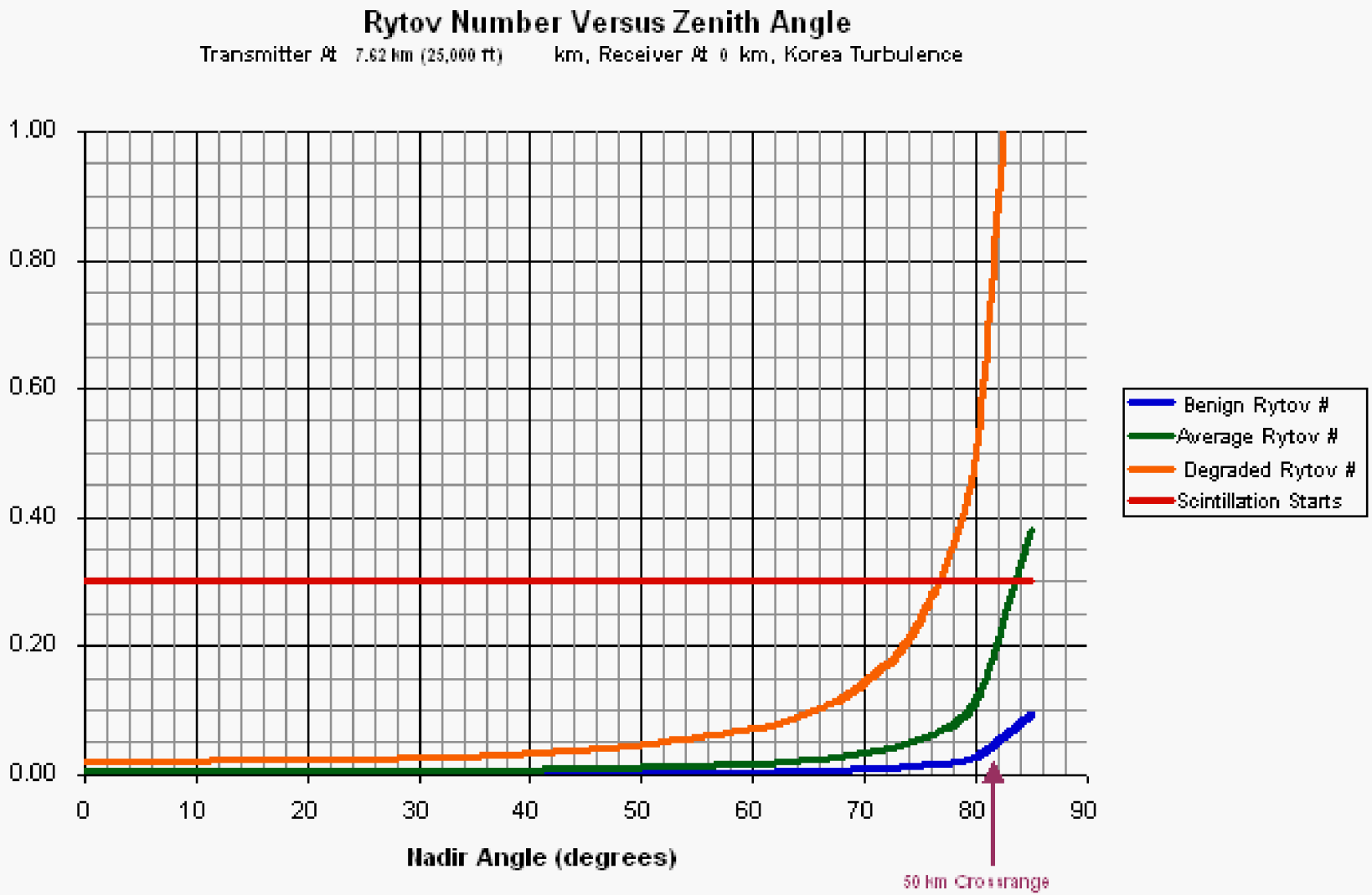
Coherence Diameters

Aircraft At 25 kft To Ground

With & Without Adaptive Optic Compensation



Rytov Numbers
Aircraft At 25 kft To Ground



References

(1) "Principles of Adaptive Optics, 2nd Ed," Robert K. Tyson, Academic Press, 1991

(2) Air Force Combat Climatology Center, Strategic Climatic Information Service:

https://notus2.afccc.af.mil/SCISPublic/