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Effectiveness of Laser Weapons in the Environment of Southeast Asia (SEA)

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Objective

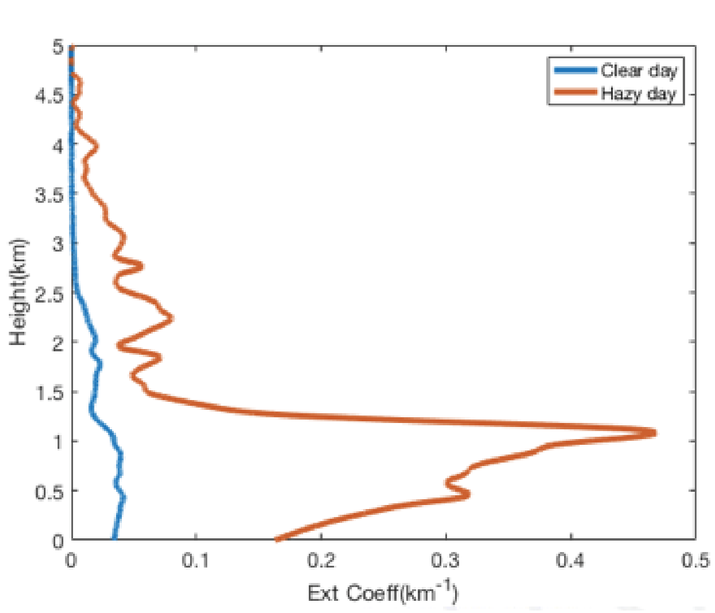
The objective of this thesis is investigate the effects of haze and rain in SEA on the peak intensity and dwell time required to melt a 100 cm^2 target area of varying thickness. The targets are (1) a UAS made of Aluminum with a thickness of 0.1 cm (e.g. DJI Matrice 600), and (2) a 122mm Rocket Artillery (RA) warhead shell made of steel with a thickness of 1 cm.

Approach

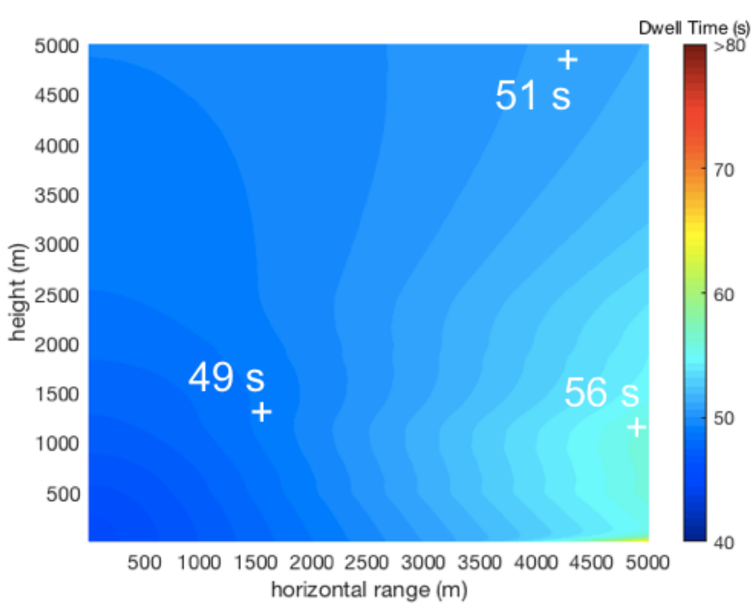
The propagation of laser through the atmosphere will be simulated using MATLAB based on the Fresnel Diffraction Model and the Scaling Law Model. The models will be using extinction coefficient data from (1) MODTRAN, a radiative transfer code, and (2) Micropulse Lidar Network (MPLNET), a network of Lidar systems that measures the actual aerosol content in the atmosphere.

Results

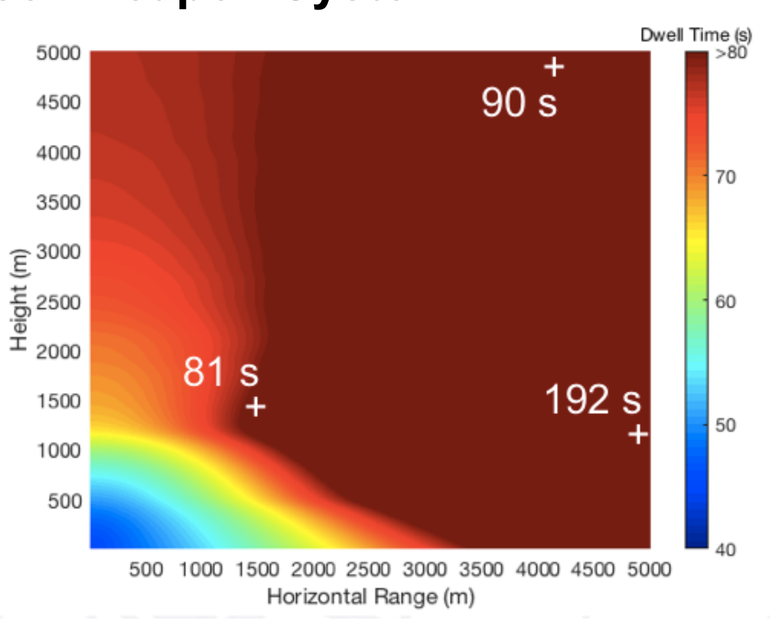
Effects of Haze on Dwell Time against 122mm RA based on 50 kW Laser Weapon System



Actual Aerosol Extinction Coefficient obtained from Lidar stationed in Singapore

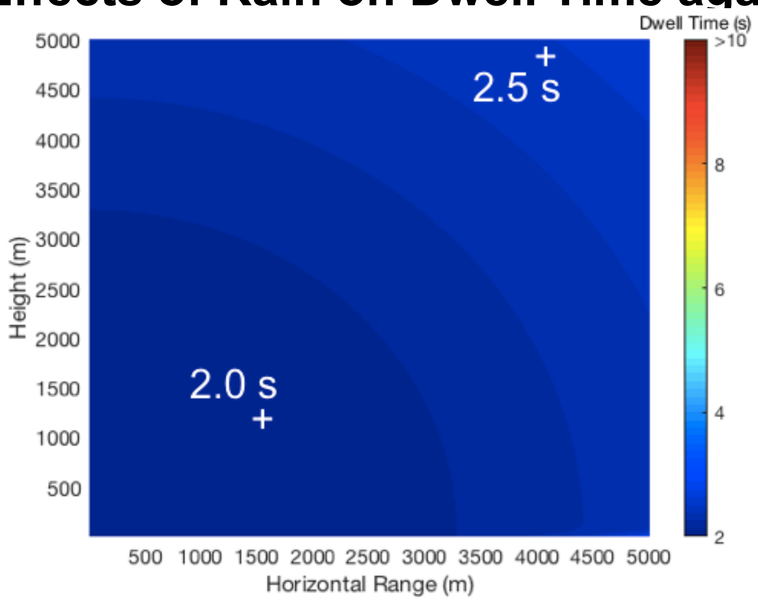


Dwell Time required to melt 100 cm^2 target area on a clear day (15 Oct 2010 : PSI 36-41)

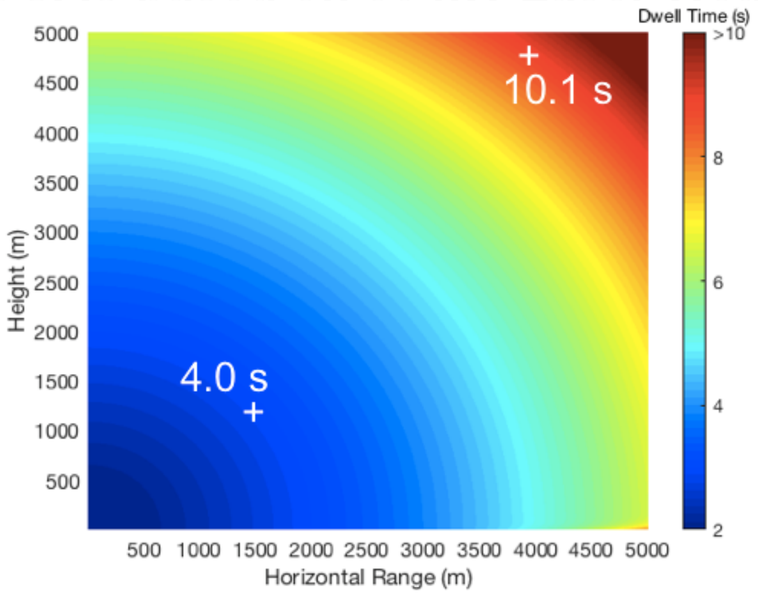


Dwell Time required to melt 100 cm^2 target area on a clear day (22 Oct 2010 : PSI 87-96)

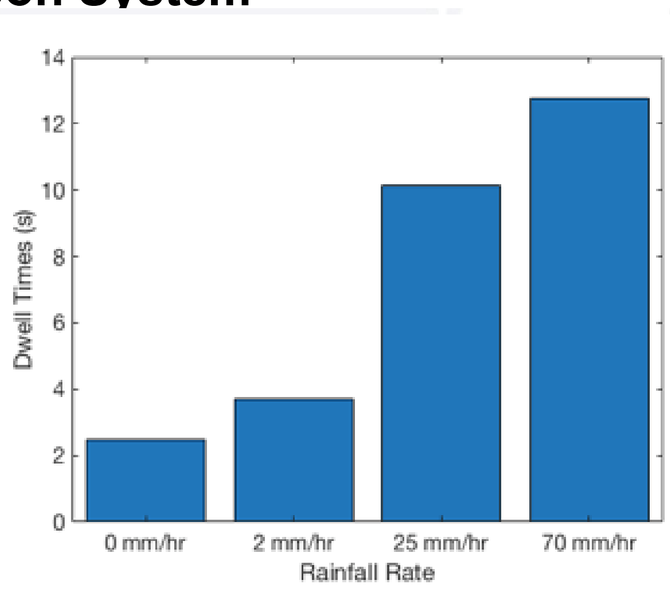
Effects of Rain on Dwell Time against UAS based on 50 kW Laser Weapon System



Dwell Time required to melt 100 cm^2 target area on a clear day



Dwell Time required to melt 100 cm^2 target area on a rainy day (25 mm/hr)



Effect of Increasing Rainfall Rate on Dwell Time required to melt 100 cm^2 target area

Conclusion

Haze and rain causes a significant increase in dwell time required. A 50 kW Laser Weapon System is sufficient to melt 100 cm^2 target area for a UAS with reasonable dwell times but higher power required to be effective against RA.

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