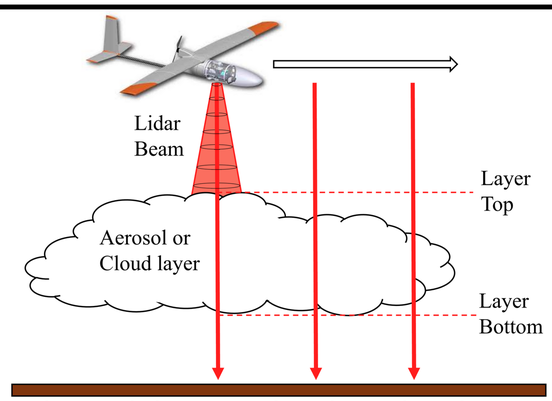
# Development of a Miniature Lidar Instrument for Plume Detection

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## Motivation and Objectives

- Measure the vertical location and structure of clouds and aerosols with high resolution (10's m)
- Provide detailed information on the diurnal nature of aerosol properties relevant to air quality
- Enable rapid plume profiling using one or more of the instrument platform
- Demonstrate the airborne technology concept before scaling to spaceborne



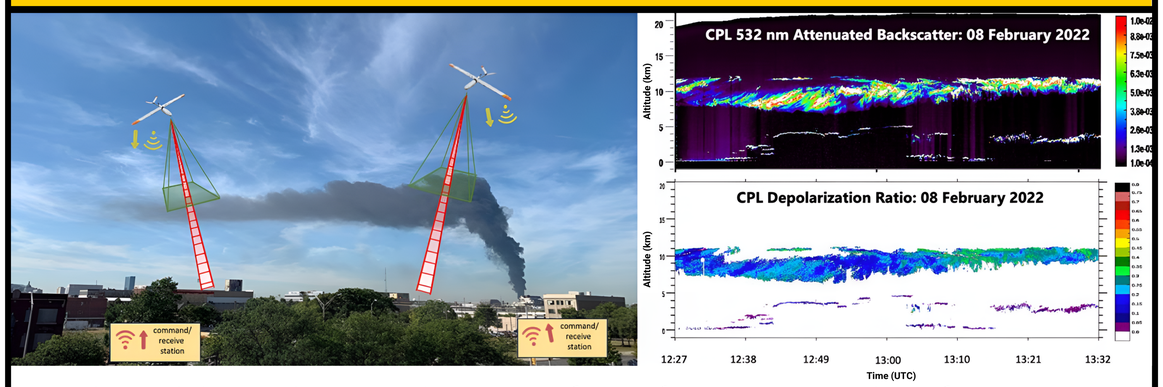

Airborne lidar providing layer heights and vertical profiles of cloud-aerosol layers

## Background

- Scientists, policy makers, and forecast models require real time data products
- Many instruments cannot provide height information accurately enough (10's m) to provide reliable aerosol and cloud detection, nor do they supply data in real time (< 3 hrs)
- Lidar can provide accurate height registration and optical depth of cloud and aerosol layers in addition to differentiating clouds from aerosols
- We combine lidar and polarimetry to get advanced real time data products and enhance aerosol typing

**Couple lidar data with multispectral and multiangle polarimetry** → **Provide additional information on aerosols** → **Supply scientists, policy makers, and air quality forecast models with real-time data**

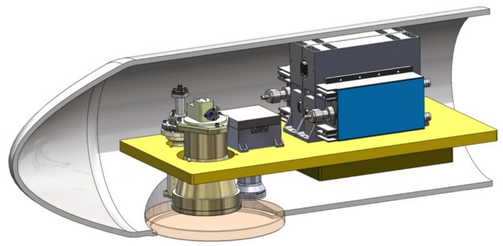
**Our compact UAS-deployable lidar instrument coupled with multi-spectral and multi-angle polarimetry will deliver real time data products on cloud and aerosol distributions**




Multiple miniature lidar-polarimeter platforms for remote sensing of aerosols and plume monitoring. The lidar provides vertical profiles while the polarimeter provides scene context. Instrument integration into target UAS platform and low cost enhances accessibility. Sample Cloud Physics Lidar (CPL) data products much like those of the novel lidar [1]. Adapted from [2]

## Current Work

- Developing the instrument forward model to simulate the expected instrument performance
- Designing and optimizing the optical system
- Minimizing the Size, Weight, and Power (SWaP)
- Drafting component layout and mounts



Compact UAS-deployable lidar+polarimeter concept

## Future Work

- Perform Finite Element Analysis (FEA) and modify 3D model as needed
- Assemble and optically align instrument in the Iowa Atmospheric Sensor Development Laboratory (IASDL)
- In-house vibration and thermal-vacuum testing
- Assess instrument performance on the ground prior to test flights
- Tailor the design to a target UAS platform




The IASDL facility and the University of Iowa's L-39ZA research aircraft

## References

**[1]** McGill, M.J., et al. (2002): Applied Optics, 41(18), 3725-3734, doi: 10.1364/AO.41.003725

**[2]** McGill, M.J., et al. (2024). Laser Radar Technology and Applications, XXIX, 13049, doi: 10.1117/12.3013563