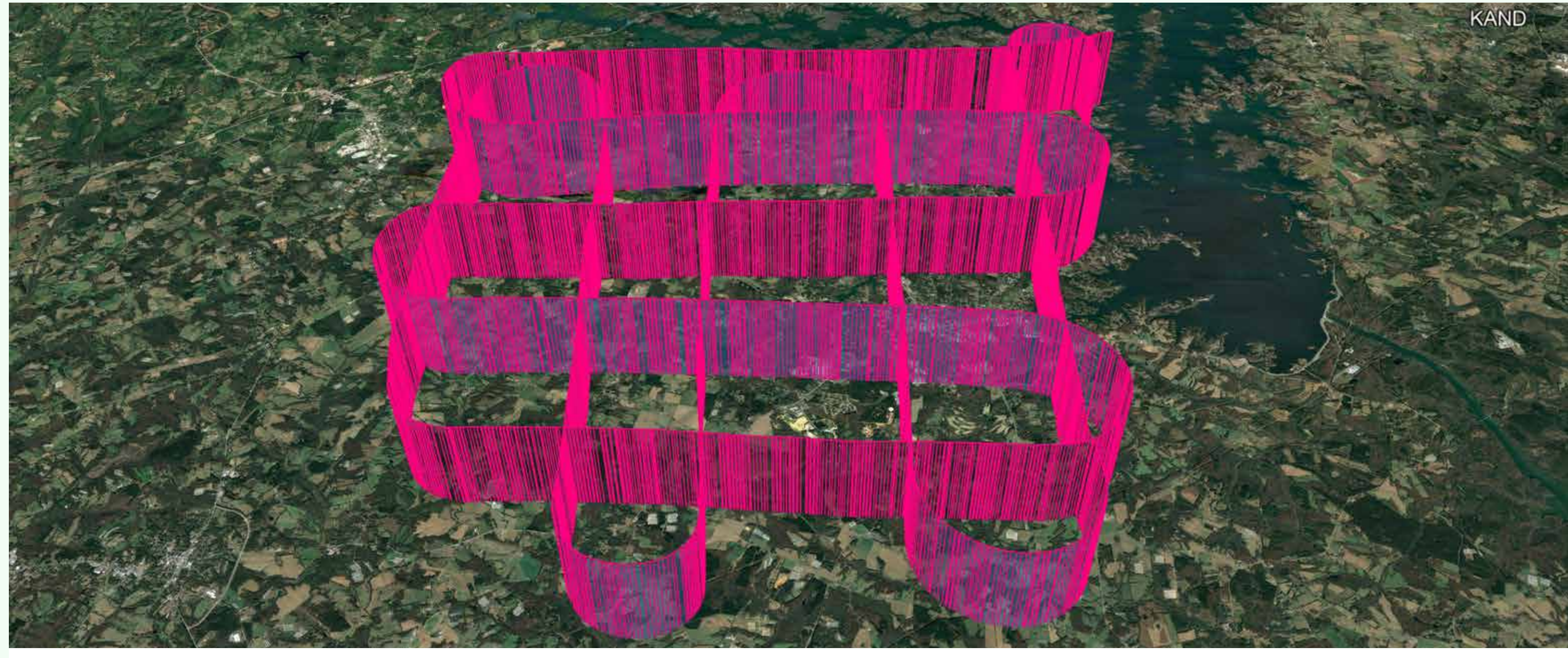


Aircraft surveys for air eDNA: probing biodiversity in the sky

We designed a tool to capture airborne DNA that can be mounted on an aircraft. This device can filter air to collect genetic material (e.g., eDNA) directly from the atmosphere.



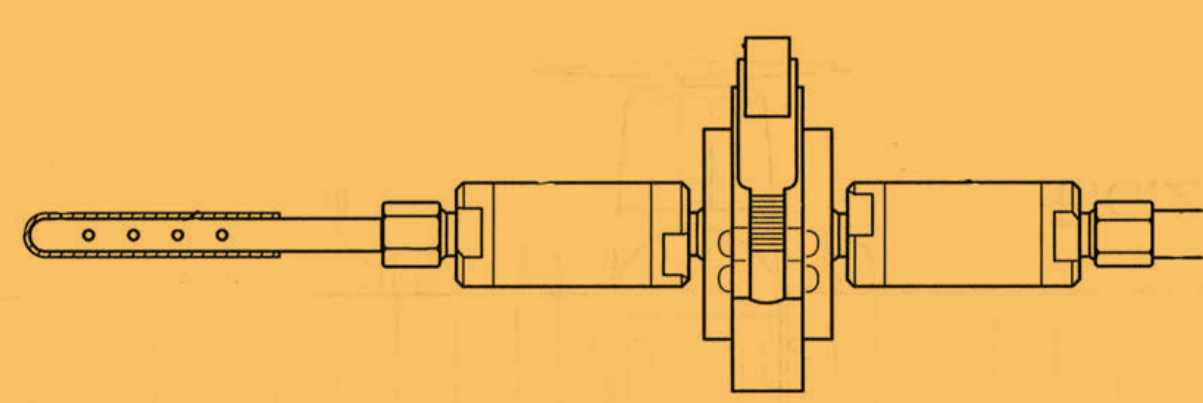
We pioneer airborne surveys to map biodiversity using metagenomics.



GENETIC AERIAL MAPPING

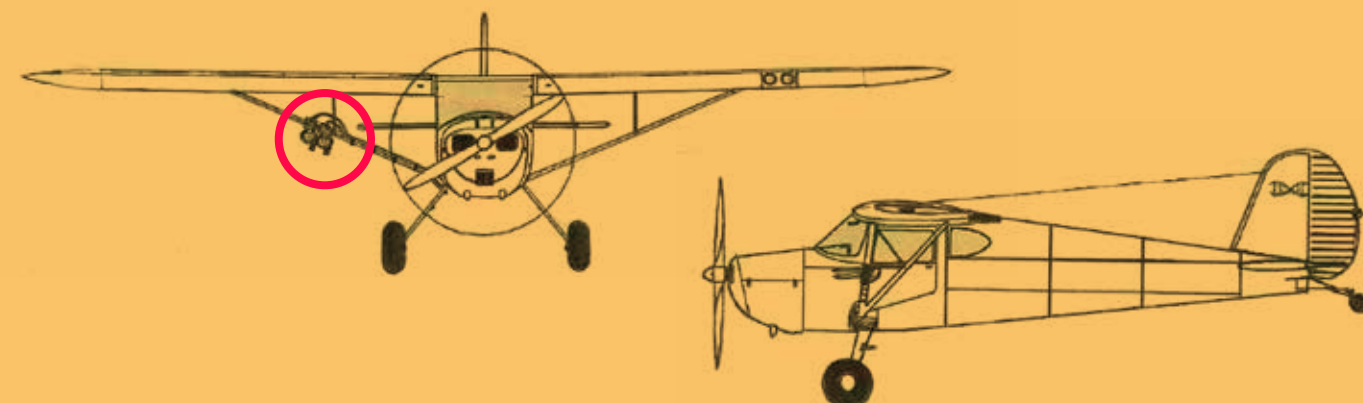
We conducted research flights with a **light aircraft** in a defined three-dimensional area over major aerosolization sources. We developed a **gridded flight pattern** to sample several altitudes up to 2,500 m through air masses with different transport histories. We used high-throughput sequencing to analyze genetic data from bacteria, plants, birds, and mammals with **multi-marker metagenomics**.

What we do is **scalable**—we can do large scale mapping.



INSTRUMENTATION (PROBE)

Our lightweight sampling probe is sterile until sampling is initiated, and features precise regulation and control of sampling. When sampling is terminated, the sample is protected from loss and contamination in an isolation chamber until it is returned to a sterile lab environment.



AIRCRAFT RESEARCH PLATFORM

We used an economical and practical light aircraft to probe the depth of the planetary boundary layer at 300 m, 1200 m, and 2500 m above ground level.

1

Collect environmental nucleic acids

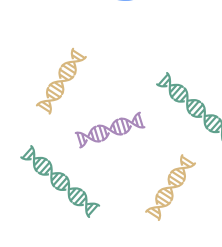
2

DNA extraction



3

Multi-marker DNA amplification



4

High-throughput sequencing (metabarcoding)



ATCACRACCAT
CCTACGGGGGG
ATCGGATACTTG
ATCACRACCAT
CCTACGGGGGG
ATCGGATACTTG

5

Bioinformatics + species identification



bacteria
CCTACGGGGGG

plants
ATCGGATACTTG

vertebrates
ATCACRACCAT

Airborne DNA from bacteria, plants, and vertebrates is detectable up to high altitude using our sampling probe.

Our work also reveals previously unreported species from air sampling. Airborne DNA profiles in the atmosphere can reflect **ground emissions, allergens, and potential ice and cloud condensation nuclei.**

We show that the atmosphere contains large amounts of new, untapped genetic data. Aerobiology data offer unlimited opportunities for **allergen mapping, animal and plant-crop pathogen detection, as well as biodefense and industry applications.**