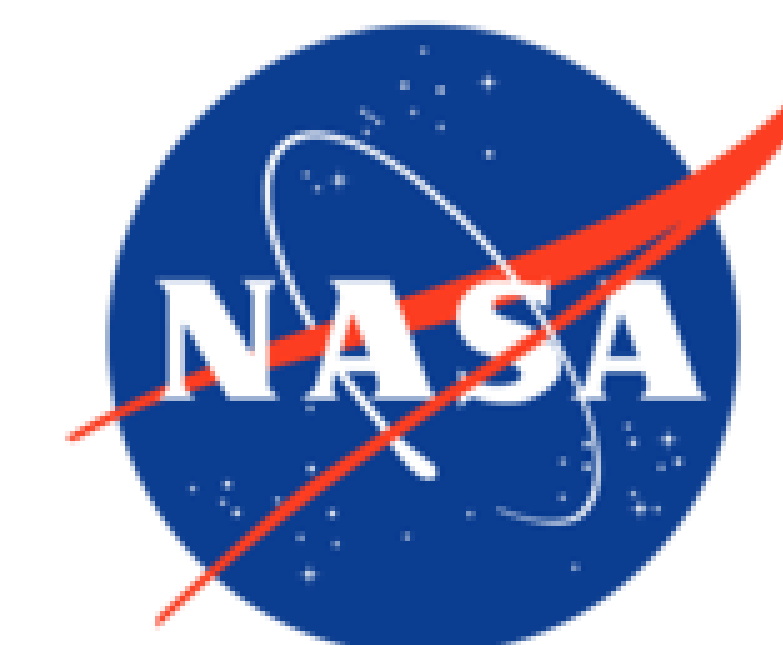




An Auditable Framework for Fugitive Gas Leak Surveys using an Unmanned Aerial Vehicle



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Main Objective

To enable researchers and gas companies expedite the identification and repair of fugitive gas leaks, our research proposes an explainable and auditable statistical framework to perform gas-leak surveys using an Unmanned Aerial Vehicle (UAV).

Results to Date

- Method to estimate USR dimensions developed.
- Explainable and Auditable Statistical method to map and fuse USRs developed.
 - Information flow clearly defined. Reproducible results.
- Framework evaluated with simulation tools (QUIC) and real UAV measurements.
- Objective performance metrics (probability of finding leaks; size of clear region).

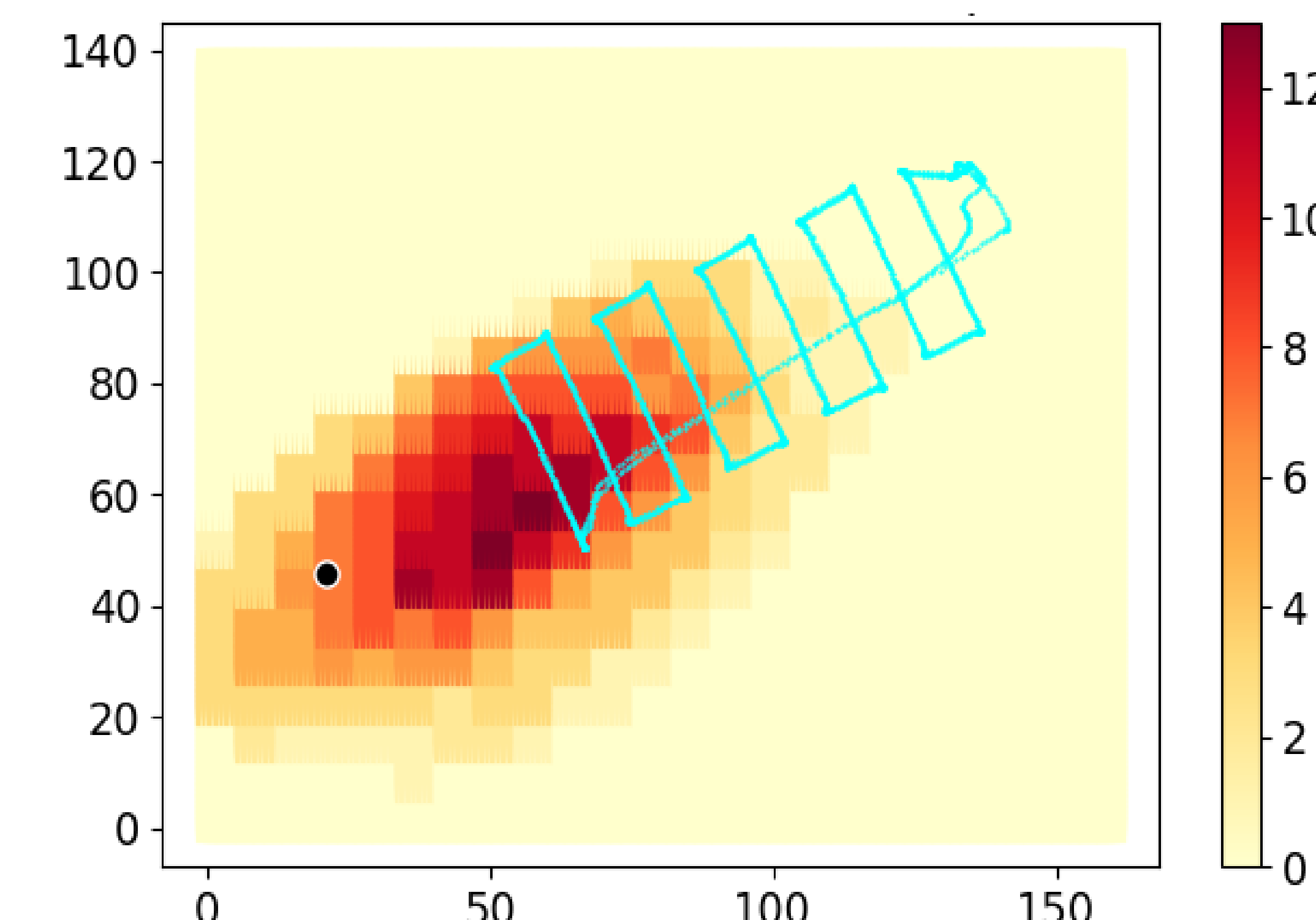
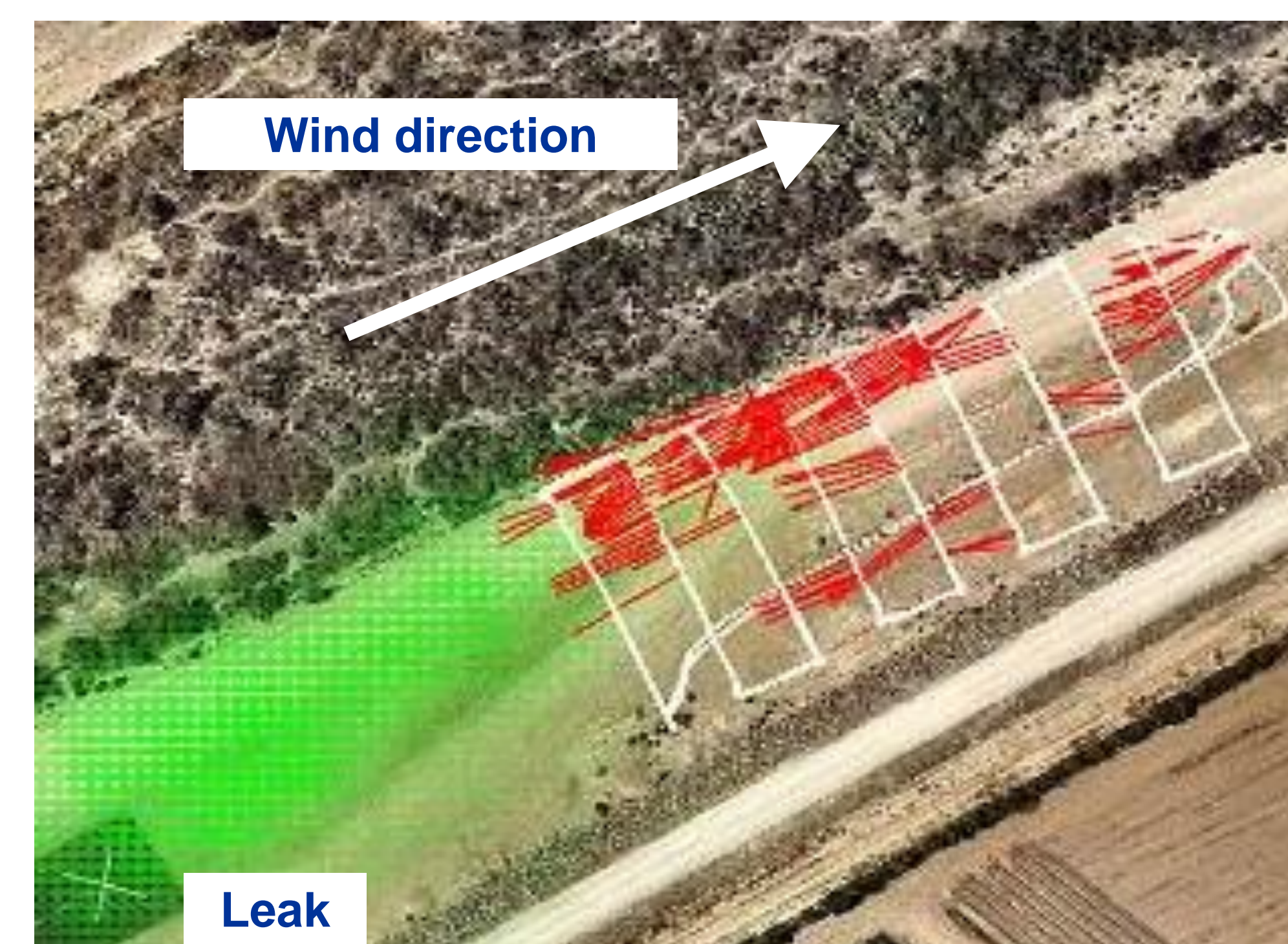
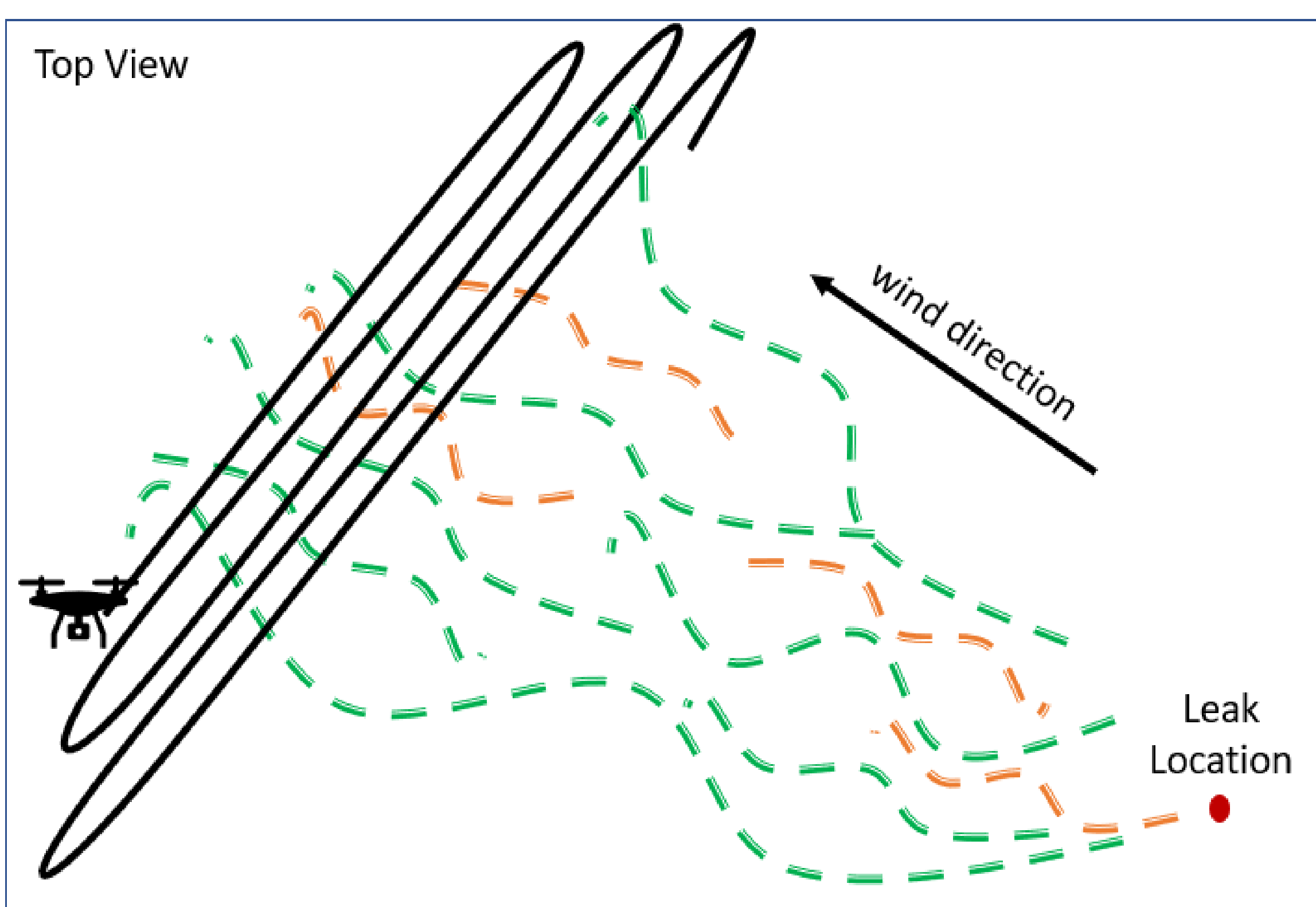


Figure 1. UAV crossing gas plume and collecting methane gas concentration measurements to produce survey map.

Figure 2. UAV and OPLS sensor used in experiments

Figure 4. Aerial photograph of experiment. White lines indicate UAV path. Red lines indicate detections by OPLS sensor.

Figure 5. Number of USRs with high concentration covering each grid point.

Project Approach/Scope

- Upwind Survey Regions (USR) mapping measurements into regions on the ground.
- Information from multiple USRs fused to classify each grid point.
- Statistical decision framework used to produce Survey Map.
- Survey map indicates areas clear of gas leaks with a certain reliability.
- Survey map indicates areas requiring further evaluation.

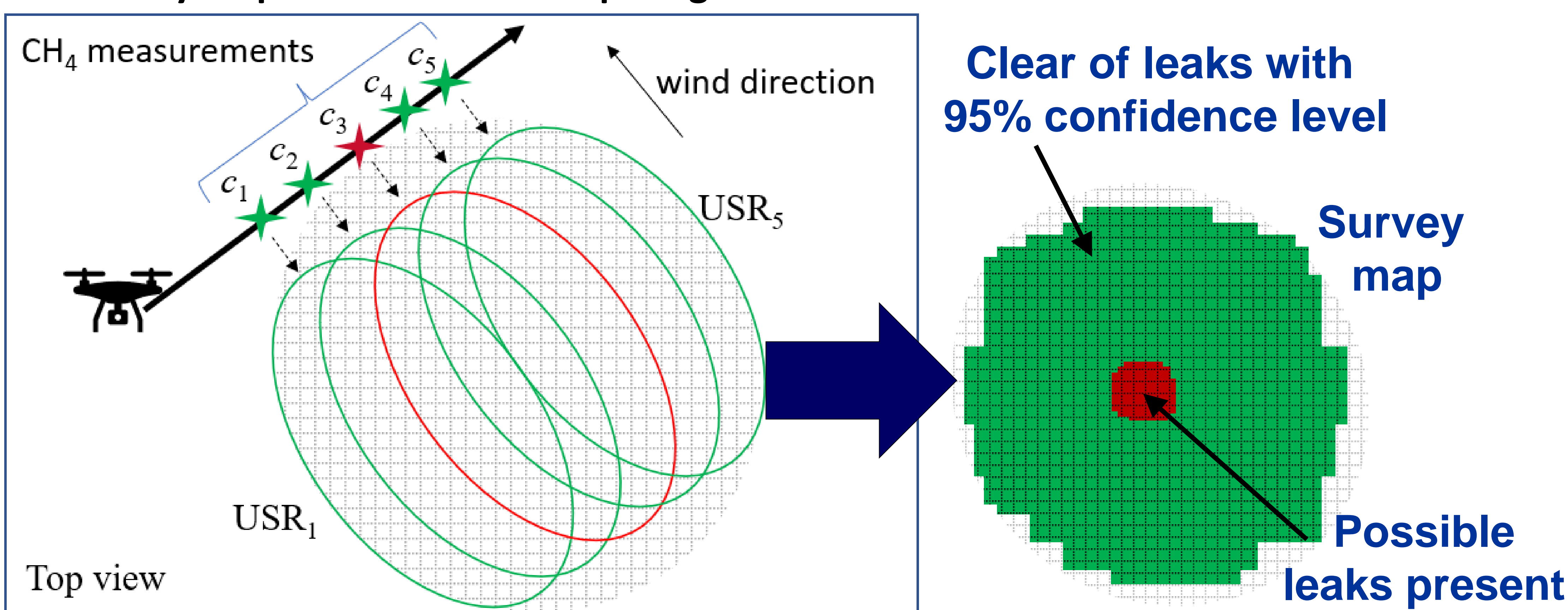


Figure 3. USRs from low concentration measurements providing evidence to clear grid points. USRs from high concentration measurements providing evidence that grid points may contain leaks. Multiple USRs cover each grid point. Fusion procedure produces survey map.

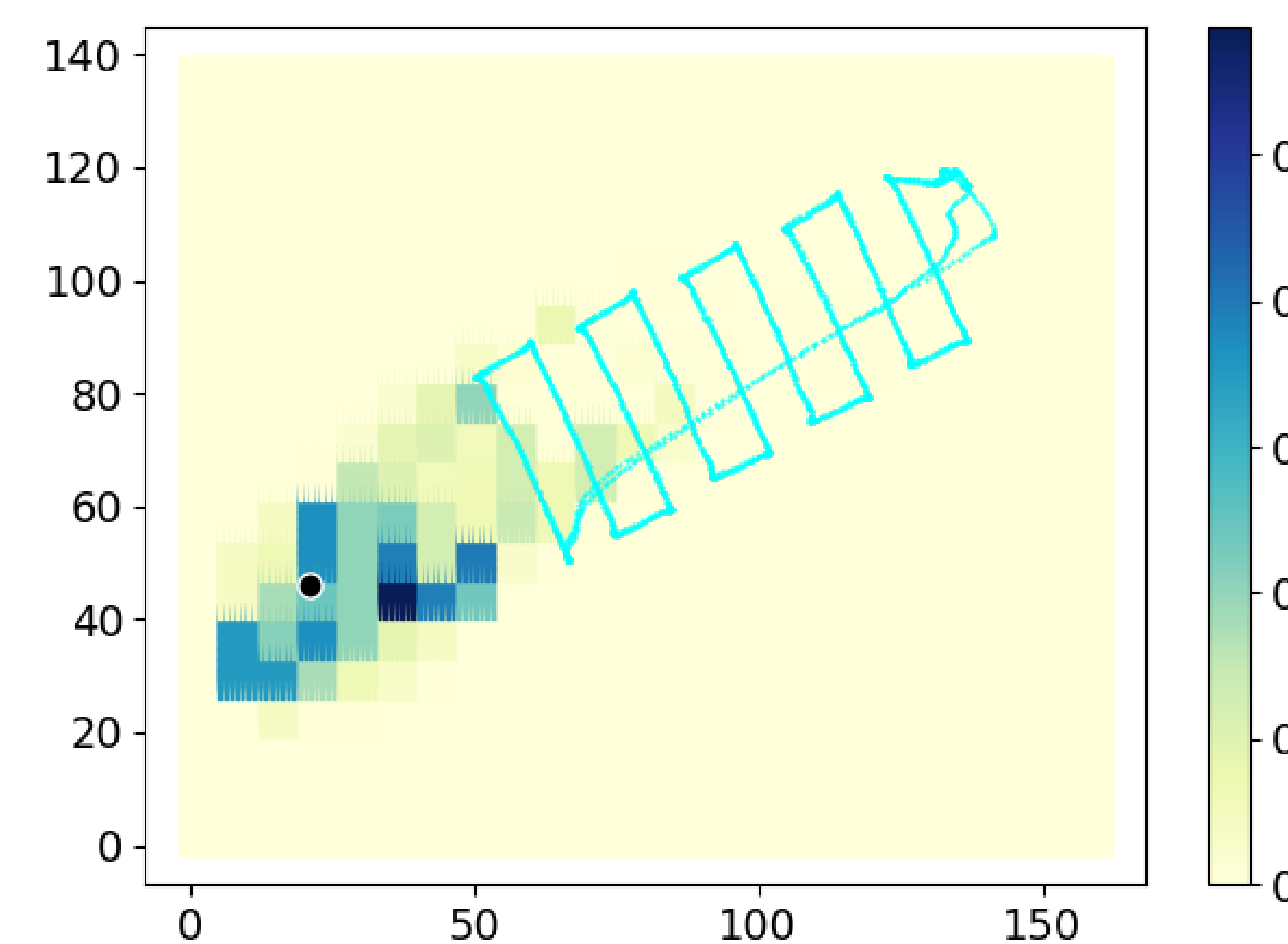


Figure 6. p-value of hypothesis test that grid point contains leak.

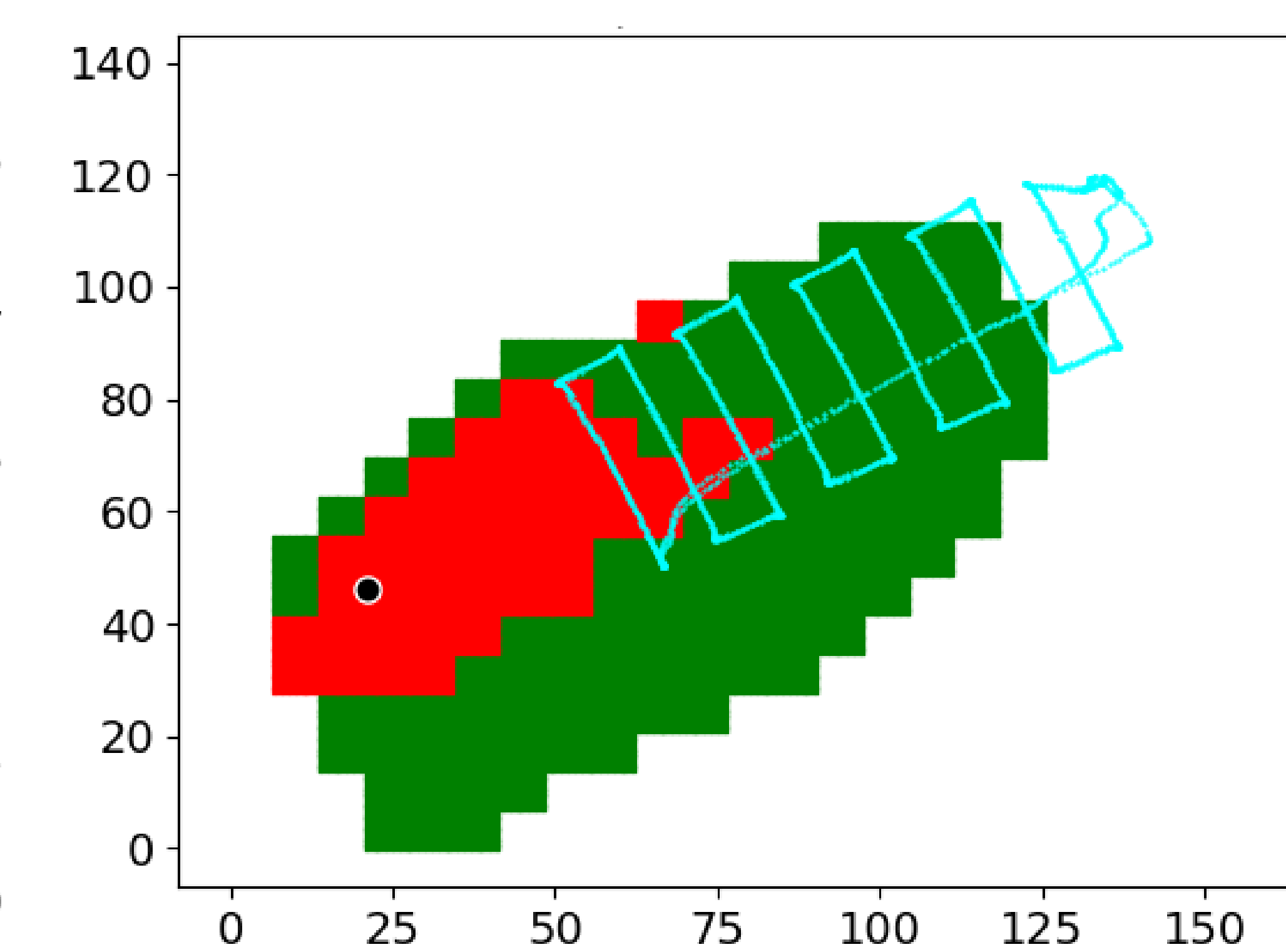


Figure 7. Final Survey map indicating areas clear of leaks with 95% confidence level and areas where possible leaks may be present.

Acknowledgments

This project was supported by the Jet Propulsion Laboratory and NYSEARCH under subcontracts 1656873 and 1677705, and by the NASA Space Act Agreement 82-19609.

Disclaimer: Any opinions, findings, conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of NASA, Jet Propulsion Lab, or NYSEARCH.

References

Souza, W.; Hart, A.; Fonseca Jr., B. J. B.; Tahernezehadi, M.; Christensen, L. E.; "A Framework to Survey a Region for Gas Leaks Using an Unmanned Aerial Vehicle"; *Submitted to the IEEE Access journal.*