Project Proposal

(Note that this proposal is adapted according to the EPC submission form)

1. Problem Owner (your name)

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2. Project Supervisor for the Problem

Dr. Jenny Jinni Zhou

3.Your Intended Thrust

EOAS (Earth, Ocean and Atmospheric Sciences)

4.Problem Title

Addressing the Economic and Operational Impacts of Adverse Weather on Last-Mile Drone Logistics

5.Problem Background and Expected Impact after Solving the Problem (~100–150 words)

Briefly describe the real-world context where this problem arises. Why is this problem important? What are the key driving factors behind it? (e.g., technological shifts, social challenges, environmental needs)

The field of drone delivery is expanding as a solution for last-mile logistics [1][2]. A significant operational challenge, however, is that current drone systems are highly sensitive to weather [3]. Services are frequently suspended during common conditions like moderate rain or wind, which severely limits their reliability and practical use [4].

Solving this problem is important because it would directly increase the number of operational days, making drone delivery a more dependable and scalable service. The motivation for this research is based on key driving factors: the technological shift towards automated logistics and the environmental goal to increase the use of low-emission electric vehicles.

6.Core Problem Statement (~50–100 words)

Clearly describe the core challenge or pain point to be addressed. Avoid suggesting solutions.

The core problem is the critical mismatch between coarse weather forecasts and the high-resolution data drones need for safe path planning. This data gap raises urgent interdisciplinary challenges. Key questions include: How can we enhance a drone's control stability and anti-interference capabilities to handle unpredictable turbulence and wind gusts? Furthermore, what autonomous emergency solutions can be developed to manage unexpected, weather-induced crashes? Addressing this requires integrating atmospheric science with control systems engineering to ensure reliable, safety-critical decision-making in complex aerodynamic environments.

7. Expected Interdisciplinary Areas

For meteorological knowledge: **EOAS**, SEE
For drone and route planning knowledge: DSA, **INTR**, **IoT**, **ROAS**
For innovative, creative application: **CNCC**, SEE

8.Suggested Stakeholders for Exploration

Suggest types of stakeholder students could interview or research during the exploration phase (e.g., industry professionals, NGOs, hospitals, manufacturers). And highlight available resources.

To understand drone delivery, consider these key groups:

- Academic Researchers: Consult university labs and scholars studying meteorology, robotics, and logistics.
- Industry Professionals: Talk to drone manufacturers and software developers.
- Service Providers: Research companies like Meituan.
- Customers: Interview potential users in healthcare, retail, and food delivery.
- Regulators: Look at government agencies that oversee airspace (like the CAAC).

• Insurance Firms: Explore how companies manage drone-related risks.

9. Additional Notes (Optional)

Any additional comments, cautionary notes, or recommended resources for deeper understanding (e.g., papers, reports, websites).

Additional Comments:

The project scope could be enriched by investigating intersections with related fields. Specifically, exploring quantifiable tools for analyzing the carbon footprint of drone logistics or finding ways to improve energy efficiency during weather-affected flights could add significant value.

Cautionary Notes:

The project must narrowly define the specific size and type of drone being investigated, as environmental impacts vary significantly depending on these factors.

There is an inherent gap between simulation results and real-world conditions; therefore, solutions should not rely exclusively on simulation data for making safety-critical "go/no-go" decisions.

Recommended Resources for deeper understanding:

[1] Giones, F., Brem, A. From toys to tools: The co-evolution of technological and entrepreneurial developments in the drone industry. *Business Horizons* **60**, 875-884 (2017). https://doi.org/10.1016/j.bushor.2017.08.001

[2] Floreano, D., Wood, R. Science, technology and the future of small autonomous drones. *Nature* **521**, 460–466 (2015). https://doi.org/10.1038/nature14542

[3] Gao, M., Hugenholtz, C.H., Fox, T.A. *et al.* Weather constraints on global drone flyability. *Sci Rep* **11**, 12092 (2021). https://doi.org/10.1038/s41598-021-91325-w

[4] Drone Delivery Services: Impact of Weather Conditions - Fly Eye https://www.flyeye.io/drone-delivery-services-impact-of-weather-conditions/

10.Attachment (Optional)

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