PACKAGE DROP PREDICTION MODEL ATTEMPT

Assumption 1: The aircraft height, velocity, and air density are perfectly known

Assumption 2: The ground is flat near delivery sites.

Assumption 3: package is a point mass

wind estimate is typically off by ~1m/s.

The time delay for the package release is less than 1 second

To solve this problem using classical physics, consider the dynamics of the package (point mass) as it falls through the air, influenced by gravity, drag and wind. The challenge is to predict the final landing position (North-East coordinates) relative to the point of release of the aircraft.

Initial conditions : when released, the package initially has the aircraft's position and velocity.

Forces acting on the package:
1. gravity pulls the package downwards.
2. drag force opposes the motion of the package.
3. wind effect: wind adds or subtract from the package's velocity in each direction (north, east and down)

Equations of motion: the motion of the package can be described using the equations of motion under constant acceleration, modified for drag and wind.

To tackle the final complication of delayed package ejection, the problem can be simulated using a parametric piecewise differential equation with a constant initial history function that can be solved numerically, by including a parameter representing the
delay time between the release command and the actual release of the package in the ode solver.

This parameter will influence the initial conditions of your package's trajectory.
An optimization technique can be applied to solver and the collected data to estimate the delay parameter along with the other parameters of the model.