FACTORS AFFECTING TAKE-OFF AND LANDING FOR A UAV

The most critical portions of any flight, manned or unmanned, are the take-off and landing. For a UAV the take off involves a brisk (but not too brisk take off.

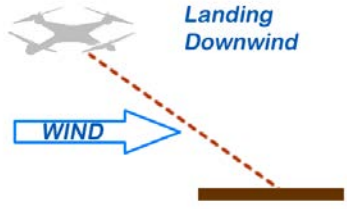
For any aircraft there are "invisible forces" that come into play, like Ground Effect and Vortex Ring Effect. While similar in that they both relate to proximity to the ground they are different and are the result of different forces.

So what is the best method for landing a drone? Why not just bring it down and land? Some models even have an automatic landing function - Push the button and it lands. What's wrong with that? In a calm wind on a mild day, it's fine to run on automatic landing. But let's dig a little further anyway.

As a multi-rotor or a fixed wing UAV descends, VRS and ground effect turbulence cause a change in control Pockets of air turbulence known as "vortexes" are created under or behind each prop as it spins, creating what is known as the Vortex Ring State (VRS). VRS in a helicopter can result in a loss of lift and can occur at any altitude. Added to VRS is Ground Effect, or the reflection of air turbulence from the ground. For a quad-copter this effect is most likely to occur in calm air.

A fixed wing aircraft will encounter "spongie" air on landing while a multi-rotor UAV can seem to "bounce" on a bubble of air near the surface. Welcome to the ground effect zone. Ground effect occurs at approximately one wingspan above the ground for a fixed wing and at an equivalent distance for multi-rotor aircraft. For a small UAV that point is found at about 2 to 3 feet above the landing surface.

To remedy the ground effect turbulence problem for a quad-copter in calm winds, apply a slight angular (side slip) motion in the descent to the landing so as to move into "cleaner" air and then "settle in" for the landing. In other words, it's best to "slide into" a landing rather than coming straight down. In a cross-wind, always land "downwind" starting at a point just above a distance equal to the "wingspan" of the UAV.



(*Droner's Guide* by Tim Trott)

Ground effect for multi-rotors is discussed in some detail in the e-book *Building Multicopter Video Drones by Ty Audronis* (Amazon.com) and Paul Cantrell at www.Copters.com provides a good discussion of ground effect as it applies to helicopters.