Cycling up Col d'Izoard is as cycling into Near Gale winds
By Sjoerd Groeskamp.

The last climb of the Tour de France of 2017, is up the Col d'Izoard. With an average gradient of 7.3% and a length of 14 km, this is a climb of the toughest category. However, how tough would that actually be?

Some people (like the Dutch) live in a country so flat, that a dike is considered a climb. However, in case of the Dutch landscape, what makes cycling tough are not the dikes, but the wind. For the Dutch and others in a similar situation, it makes more sense to express the climb of the Col d'Izoard as an equivalent wind speed rather than an incline, because that they understand…

Since this study[1], it is now possible to calculate an incline as an "Incline Equivalent" wind speed. This resulted in the following formula,

$$v_\alpha \approx \frac{2mg}{\rho C_d A}\sqrt{\alpha}.$$

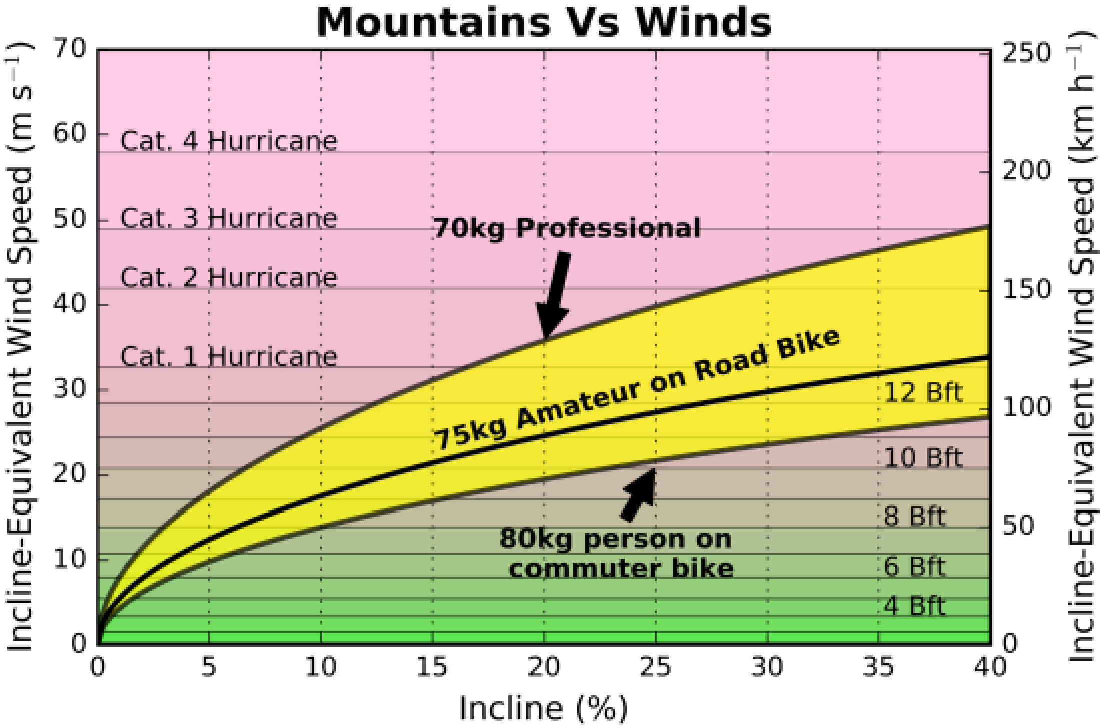
This formula approximates an incline (α) as an equivalent wind speed (v_α), and depends on the mass (m, in kg) of the biker + bike, the density of air (ρ, in kg/m^3), the gravitational acceleration (g, m/s^2), the frontal area (A, in m^2) of the bike and biker, and of the air-drag coefficient (C_d). The incline equivalent wind speed that results has the following interpretation:

It is the force with the wind needs to blow in order to bring a cyclist that is rolling down a hill with incline α, to an exact stand still.

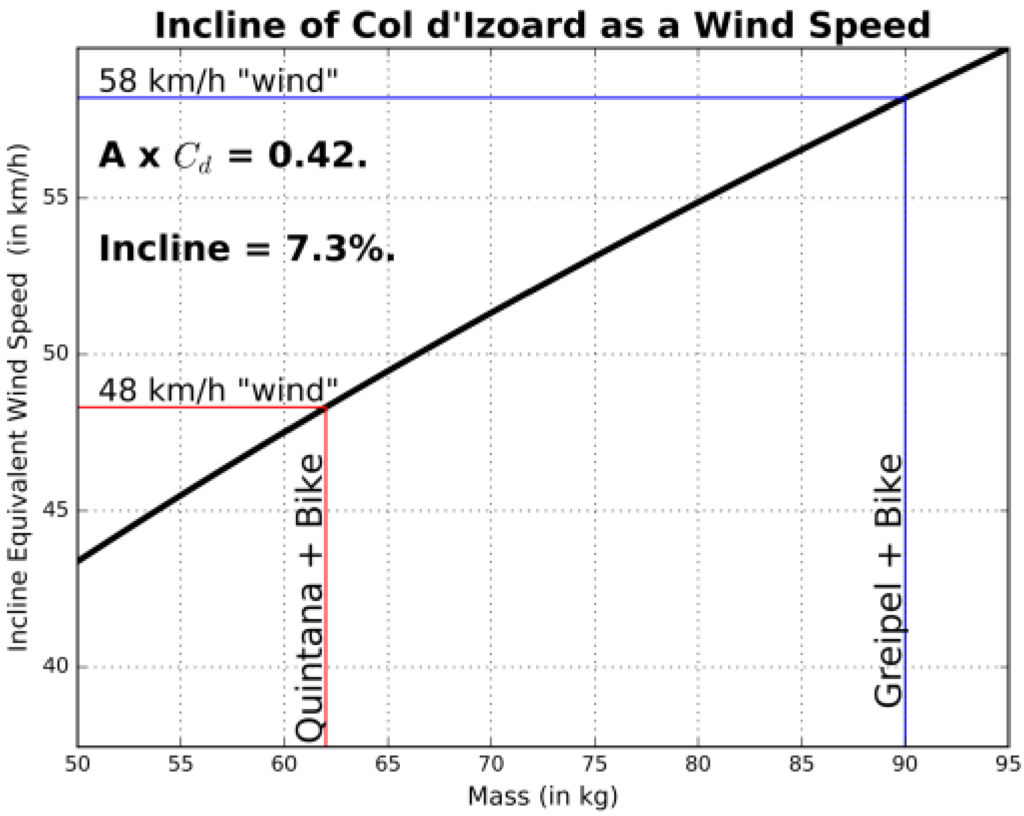
Or in other words, it is the power a cyclist requires to produce to not ride up the hill or roll backwards, but be at an exact balance with zero velocity. We then find the wind speed that we need in order to push that same biker to an exact stand still, if it would cycle on a flat road with the same power.

It turns out that the heavier the person, the more power it requires to cycle up the hill, resulting in a higher Incline-Equivalent wind speed. However, the more aerodynamic the cyclist is, i.e. the lower the area (A) x drag (C_d), the faster the wind has to blow in order to get the biker to a standstill. This is because the wind has less grip to push the rider back when the rider is more aerodynamic.

The results therefore depend on the weight of the biker and the bike and on aerodynamics (A x C_d). The latter depends on how you are positioned on the bike (are you doing a time trial or doing groceries). The result is the following diagram in which we recalculate the incline into an incline equivalent wind speed, for different type of bikers. These are a professional time trial athlete, an amateur on a road bike and a commuter sitting "straight up" on a typical Dutch commuter bike.



Now, let us get back to the Tour de France and use an aerodynamic coefficient typical for pro's on a roadbike (A x C_d = 0.42), a bike of 6.8 kg and see how the climb of the Col d'Izoard (with an incline of 7.3%) depends on the mass of the rider:



Here we can see that a climber such as Nairo Quintana (about 55 kg) who cycles up the Col d'Izoard, can be interpreted as him cycling into 48 km/h incline equivalent (head) wind speed. Andre Greipel on the other hand (83 kg) is cycling into an incline equivalent wind speed of 58 km/h. Even though heavier riders may be able to produce more power, this is a difference between a Strong Breeze or Near Gale force, and that won't go unnoticed!

Reference:

[1]GROESKAMP, S.. Translating Uphill Cycling into a Head-Wind and Vice Versa. **Journal of Science and Cycling**, North America, 6, jun. 2017. Available at: <http://www.jsc-journal.com/ojs/index.php?journal=JSC&page=article&op=view&path%5B%5D=296>.