



Space research: What happens to soils in weightlessness?

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In the future, astronauts on long missions in space will have to take care of their own farming. But will that even work? An unusual experiment by Eawag researcher was designed to find some of the answers.

Life on our planet has always been under the influence of gravity. But how would soils, plants and other organisms react in a zero-gravity situation? Scientists have been puzzling over this question since last decades until now, and Eawag hydrologist and soil physicist, Joaquin Jimenez-Martinez and his colleagues are also keen to understand how zero gravity affects soil processes. Or, more precisely, how water, gases, and microbiology behave in soils when there is an absence of gravity.

Such questions may sound merely academic, but in the long term they could prove useful for astronauts for instance, because on long space missions, and even for future Mars or moon bases, they will have to take care of their own farming – they will need to grow their own lettuces and radishes! “It will be important in such circumstances to have knowledge of how soil respiration done by plants and soil microbes is in space”, stresses Jimenez.

Outsmarting gravity for a few seconds

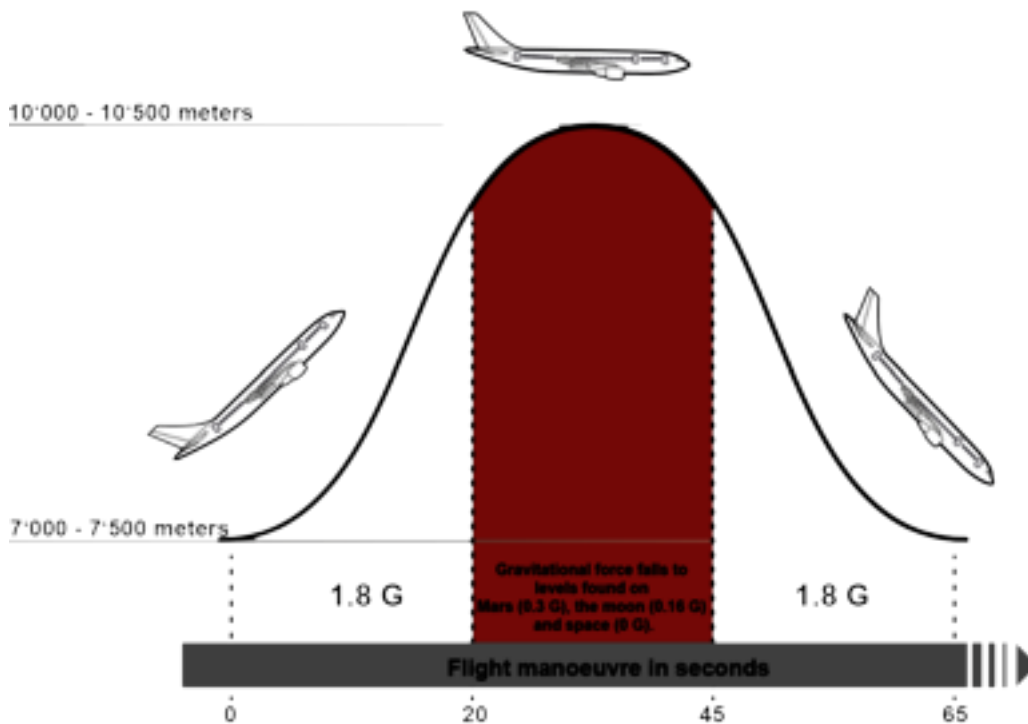
In order to learn more about soils in zero gravity, Jimenez and his colleague Benedict Borer (from ETH Zurich) boarded an Airbus A310 Zero-G in Dübendorf earlier this summer. They took with them soil analogues — porous plates with tiny glass beads inside them that mimic soil structures.



The Airbus which took Joaquin Jimenez-Martinez on several dozen parabolas for his experiment.

(Photo: Joaquin Jimenez-Martinez)

So how does it work? The Airbus made several “parabolas”. This special manoeuvre is designed to create a temporary state of zero gravity. The pilot powers the Airbus steeply upwards at full throttle, which has the effect of almost doubling the gravitational force on a body (1.8 G). He then puts the engines into neutral configuration compensating for drag – and suddenly “there’s nothing above or below, and you’re floating”, as Jimenez says, with a broad grin. This lasts 22 seconds. Then the pilot makes a steep descent and the cycle repeats from the beginning again. The Airbus made 16 parabolas over the Mediterranean on each of the two days of flight. “These manoeuvres enabled us to simulate gravitational conditions in space, on the moon and on Mars”, explains Jimenez.



The gravitational force on earth is 1 G (i.e. 9.81 m/s²). During a parabolic flight, however, gravitational forces of between 0 and 1.8 G can be simulated. (Diagram: Eawag)

Results expected in summer 2019

The aviation antics not only left the scientists with a dizzy feeling, but also a mound of data to wade through. Throughout the duration of the flights, Jimenez and Borer recorded the water and chemical changes in the soil analogues using a special camera. Various instruments also measured temperature, pressure and other parameters. “Now we have to evaluate the data, which will take several months”, says Jimenez. He is looking forward with great anticipation to the results, which should be in by next summer.



The two soil physicists test all of the measuring instruments shortly before take-off to make

*sure they are working.
(Photo: Eawag)*



*Jimenez and his colleague Benedict Borer during a moment of zero gravity.
(Photo: Eawag)*

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<https://www.eawag.ch/en/info/portal/news/news-archive/archive-detail/space-research-what-happens-to-soils-in-weightlessness>