International group publishes pioneering study on the effect of solar radiation on the

Conducted by Brazilian researches, higher education professors from UFRGS and UNESP, research shows that some types of soil can help to reduce the NOx contamination, which is injurious to health and contributes to global warming

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The presence of NOx gases (a generic term to define the group of gases formed by nitric oxide and nitrogen dioxide) in the atmosphere affects air quality and contributes to global warming and to the occurrence of acid rain. Derived mainly from the burning of fossil fuels, forest fires, volcanic eruptions and also nitrogen transformations in the soil, NOx gases can be converted into nitrate as a result of soil reactions caused by solar radiation. This transformation has been demonstrated by an international group of researchers and it is published in the scientific article Photochemical emission and fixation of NOx gases in soils, in the journal Science of the Total Environment. The research, coordinated by Professor Vidal Barrón, from the University of Córdoba (Spain), has the participation of two Brazilians: Alberto Vasconcellos Inda Jr., from UFRGS, and José Marques Jr., from UNESP-Jaboticabal.

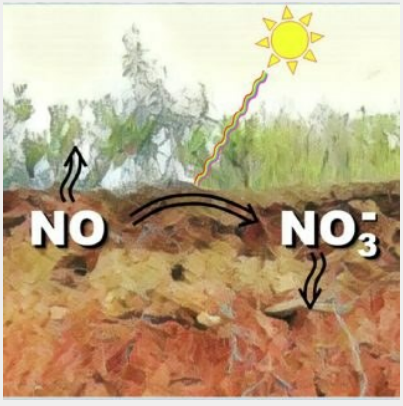

Image: Transformation of nitric oxide into nitrate

The group's discovery is the missing piece in the puzzle of the nitrogen cycle, which, despite being known for over a hundred years, did not include the effect of solar radiation as an operating factor in this process. From this study, it is known that solar radiation is an active agent in the photocatalytic reaction of the soil (chemical reactions caused by the absorption of solar radiation by semiconductor elements present in the soil). "The important thing about this work is that, from now on, there is one more point to be considered in the nitrogen cycle – the abiotic reactions. They had never been considered before, but the study shows that the NOx gas fixation in the soil is possible through abiotic reactions that transform it into nitrate," highlights the researcher from UFRGS.

Privileged Brazilian soil

As the presence of semiconductor minerals capable of generating the gas fixation reaction is variable between different types of soils, the study was based on samples of different soils in terms of granulometry and mineralogical composition. A Brazilian oxisol was one of the soils studied. The other five types were collected in Chile and Spain.

The study confirmed the researchers' expectation that the photocatalytic properties of some minerals would give rise to a kind of soil photosynthesis. Thus, the soil would capture NOx gases from the atmosphere, transforming them into nitrate, which is the way in which plants absorb nitrogen, an essential element for their existence. Compared to sandy soils with large quantities of quartz, clay soils with significant amounts of smectite, iron and titanium oxides have the highest rates of NOx sequestration and nitrate fixation.

"Our expectation was that samples with a higher concentration of semiconductors would have lower gas emissions during the experiment, and that was what happened. On the other hand, in those soils with a predominance of quartz, which is a mineral that reflects more light, the emission was high," says the researcher from UFRGS. Inda Jr. explains that Brazil's tropical and subtropical soils have expressive concentrations of semiconductor minerals. "Our soil belongs to the group of soils that have fixed the most NOx gases. In this respect, we are privileged," he says.

The authors hope that the scientific article will result in new studies in the field of decontamination and new fertilizer management techniques to prevent nitrate loss and mitigate NOx contamination. "It opens up a range of possibilities for other projects; our study is a seed," concludes Inda Jr.

International partnerships

The scientific article, signed by researchers from different institutions and countries, demonstrates the importance of international partnerships for science. According to Inda Jr., "this type of study is made possible only when higher education professors are released from their in-house tasks and authorized, with the aid of financial support, to engage in field research, in their national territories or abroad, for an adequate period of time".

The professor started the cooperation approach with the University of Córdoba in his first post-doctorate in 2007/2008. In 2015, he returned to Spain for his second post-doctorate, this time with the study coordinator Vidal Barrón as supervisor. Since then, Inda Jr. has developed projects and regularly sent doctoral students from the Programa de Pós-Graduação em Ciências do Solo (PPGCS) at UFRGS to the University of Córdoba. The partnership is believed to be further strengthened with new studies and also with the regular stay of research visitors from the University of Córdoba for research periods at UFRGS, Inda Jr. believes.

Translated into English by Juliana da Silva de Melo, under the supervision and translation revision of Elizamari R. Becker (P.h.D.) – IL/UFRGS.