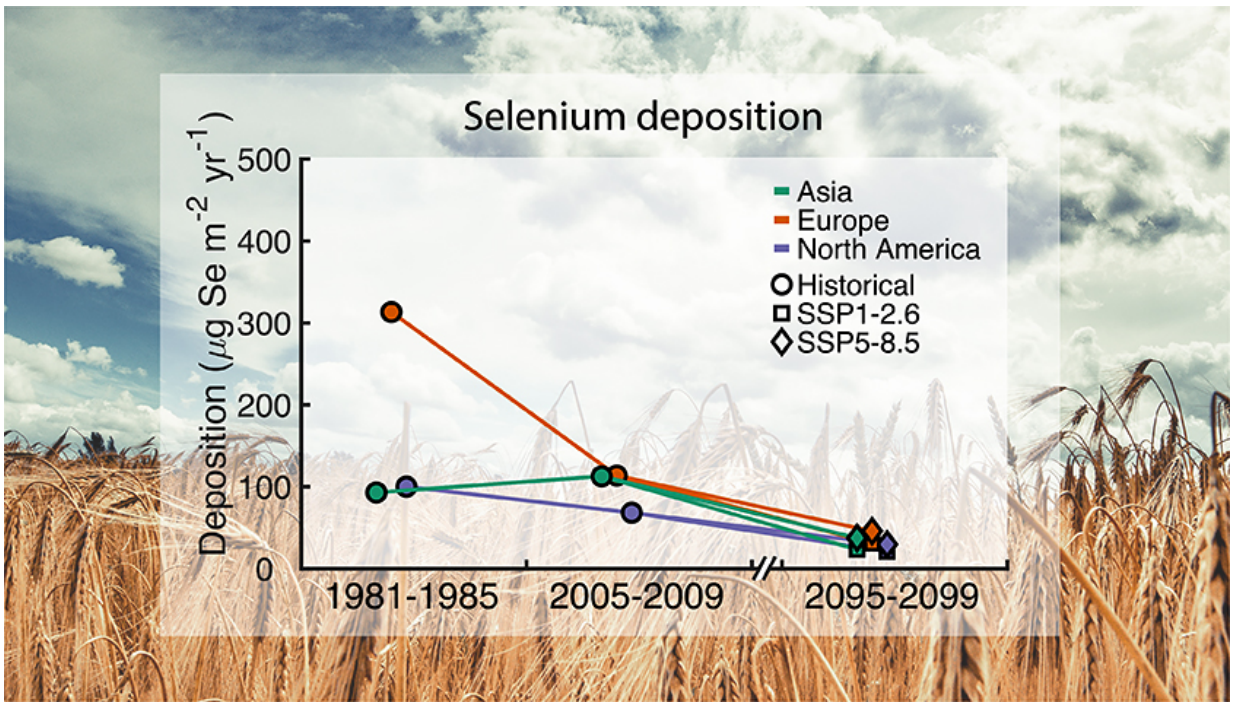

Atmospheric inputs of nutrients to soil to decrease in the future

May 26, 2021 | Bärbel Zierl
Topics: Ecosystems | Pollutants | Water & Development

The shift from fossil to renewable energy sources is essential for climate mitigation but will also significantly reduce the atmospheric input of the nutrients sulphur and selenium into soils. Sustainable solutions are therefore needed to supply intensively used agricultural soils with sufficient nutrients and to ensure a safe and healthy diet for the world's population.

The energy turnaround - the switch from fossil fuels to renewable energy sources - is being driven forward worldwide. "Reductions in fossil fuel emissions have been crucial in combating air pollution, and are essential for meeting climate change mitigation goals," says Lenny Winkel, ETH professor and group leader at the aquatic research institute Eawag. "But they also have unexpected consequences for nutrient input into soils and thus for crop production."

Unexpected side effect of fossil fuels

When fossil fuels such as coal, natural gas or oil are burned, CO2 and other pollutants, such as the toxic element mercury, are released into the atmosphere. However, for two of these pollutants — selenium and sulphur — the story is more complicated. Although both of these elements can have harmful effects at high concentrations, they play a critical role as nutrients in agricultural systems when they enter the soil through rain.

Sulphur is an essential nutrient for the health and growth of plants and thus of key importance in safeguarding crop yields. Deficiencies in sulphur have been reported in crops worldwide, with increasing prevalence in recent decades threatening food security.

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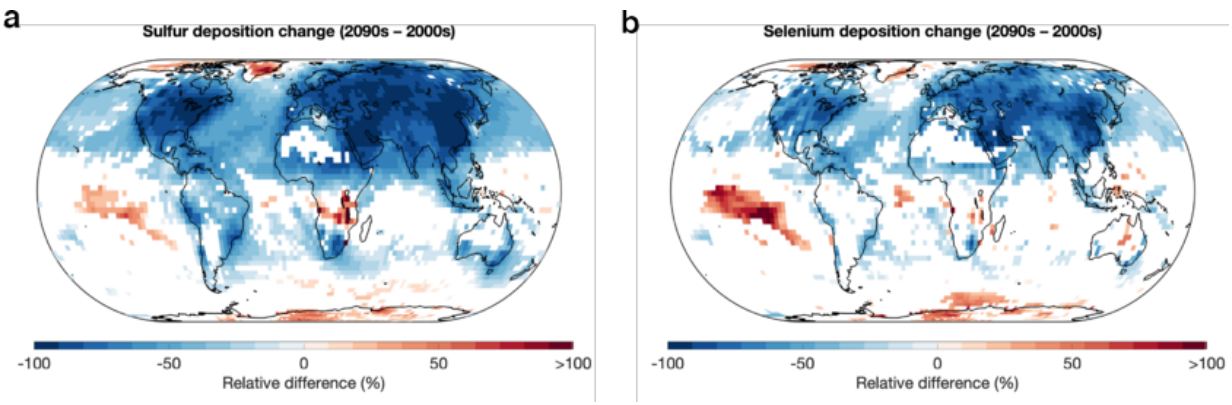

Projected changes to sulphur (a) and selenium (b) deposition between 2005-2009 and 2095–2099 under a sustainable development socioeconomic scenario (SSP1–2.6). Blue colours indicate smaller inputs and red colours larger inputs in future times compared to near-current times. (Graphic: Ari Feinberg & Lenny Winkel)

Low selenium supply poses risk for nutritional deficiency

Selenium is also taken up by plants from the soil, and while it is not essential for plant growth, it is a vital trace element for the health of humans and livestock, especially for their immune systems. A high content of plant-available selenium in the soil is therefore of great interest for the production of healthy, selenium-rich food. Between half a billion and a billion people have been estimated to have inadequate dietary intakes of selenium today.

A team of researchers from Eawag, ETH Zurich and the US, led by Lenny Winkel and her former doctoral student Ari Feinberg, has now studied the global deposition of sulphur and selenium in a combined modelling approach. They published their findings in today's article Reductions in the deposition of sulphur and selenium to agricultural soils pose risk of future nutrient deficiencies in the Nature Journal "Communications Earth & Environment". The research team used a global aerosol chemistry-climate model to map deposition worldwide in recent years (2005 - 2009) and predict future changes (2095 - 2099) under two socio-economic scenarios.

Decline in sulphur and selenium depositions threatens food production

"Our model calculations show a substantially decreased deposition to agricultural soils," says Feinberg, the study's lead author and currently a postdoctoral fellow at MIT in the US. "Inputs of sulphur could decline by 70 to 90 percent by the end of the 21st century, and those of selenium by 55 to 80 percent." Especially for agricultural land, which is stripped of large amounts of sulphur and selenium through intensive crop harvest, the sufficient supply of nutrients will become a challenge.

In their article, the researchers therefore call for further monitoring of changing nutrient supply to agricultural systems and the further development of sustainable solutions to manage the declines in nutrient inputs. "These actions can help ensure the supply of healthy and nutrient-rich food for the world's population," says Winkel.

Cover picture: Ari Feinberg & Lenny Winkel

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Original publication

Aryeh Feinberg, Andrea Stenke, Thomas Peter, Eve-Lyn S. Hinckley, Charles T. Driscoll & Lenny H. E. Winkel (2021) Reductions in the deposition of sulfur and selenium to agricultural soils pose risk of future nutrient deficiencies
https://doi.org/10.1038/s43247-021-00172-0

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