Tiny particles high up in the sky give insight into climate change

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Credit: Ryutaro Tsukata from Pexels

Scientists have observed extremely high concentrations of aerosol particles at 8- to 14-km altitudes over the Amazon Basin. This finding could have significant implications for climate change.

Aerosols, tiny particles that are suspended in the atmosphere, contribute significantly towards climate change. However, despite their consequential role, aerosol interactions aren't very well understood.

To address this knowledge gap, a team of scientists, some of whom received funding through the EU's A-LIFE project, conducted airborne observations of aerosols in the upper troposphere (UT) over the Amazon Basin. Their findings have been published in the journal *Atmospheric Chemistry and Physics*.

The energy that the sun sends to Earth doesn't all reach the planet's surface. Some of that energy is reflected back into space by aerosols and the clouds they create. Although most aerosols reflect sunlight and have a cooling effect on Earth's atmosphere, some also absorb it. Mineral dust and black carbon are two examples of absorbing aerosols whose action warms the atmosphere.

Prof. Bernadett Weinzier, the lead researcher for A-LIFE, explains in an interview posted on the European Research Council website: "**lack carbon (BC) is the second or third contributor to current global warming after CO2. Due to the short lifetime of BC – weeks, compared to hundreds of years for CO2 – controlling BC emissions has been suggested to provide significant** climate **benefits, but the uncertainties are high and it is even possible that part of the absorption attributed to BC comes from mineral dust, in particular in mixtures."**

The observations conducted over the Amazon Basin provided further insight into aerosol interactions in the atmosphere. The scientists discovered high concentrations of aerosol particles in the UT, in some regions numbering in the tens of thousands per cm3. In contrast, the average particle concentration **in the lower troposphere (LT) was 1 650 per cm3.**

The UT's high aerosol concentrations provide a reservoir of particles that can move downward into the lowest part of the troposphere known as the planetary boundary layer (PBL). Because these particles have a long lifetime in the UT, they can travel large distances and affect the composition of low-level clouds when they eventually descend into the PBL. The UT may therefore be a major source of tropospheric aerosol particles **in regions that aren't strongly affected by man-made or natural aerosols.**

The scientists' observations also reveal an enormous difference between today's polluted atmosphere and that of pre-industrial times. Aerosol concentrations in the pristine pre-industrial atmosphere resemble their Amazonian findings: high UT and low LT aerosol levels. However, in polluted continental regions, aerosol concentrations are generally much higher at ground level than in the UT. In an era where humans are the dominant influence on climate and the environment, the aerosol concentration profile has "been turned upside down," say the journal paper authors. The consequences for Earth's climate are significant. "By their radiative and microphysical effects on convection dynamics, aerosols are also able to increase upper tropospheric humidity, which plays an important role in the Earth's radiation budget and may also affect the potential for aerosol nucleation in the UT, thus providing an additional feedback," the authors conclude.

During the next two years, A-LIFE (Absorbing aerosol **layers in a changing climate: aging, lifetime and dynamics) will be further investigating the properties of absorbing aerosols to gather new data on their impact on climate change.**

More information: For more information, see www.a-life.at/

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