



EARTH COMMISSION EXPLAINER BRIEF

AEROSOLS

STEMMING THE EFFECTS OF AEROSOLS TO ENSURE PLANETARY AND HUMAN HEALTH

As you take your next breath, consider what you and the rest of the world are breathing in. Air pollution – or aerosol concentration – comes from many different sources, both natural and from human activities, such as volcanic ash and traffic emissions. Particulate matter (one type of aerosol) is associated with respiratory illnesses and premature deaths. No level of air pollution can be called absolutely safe from a health perspective. *Our planet and its people are at risk from air pollution. We must act now to stop aerosol concentration from increasing.*

WHAT ARE EARTH SYSTEM BOUNDARIES?

The groundbreaking Earth System Boundaries (ESBs), identified by the Earth Commission, are scientifically quantified safe and just limits for climate, freshwater, biodiversity, nutrient cycles and aerosol pollutants.

They delineate a long-term corridor for humanity on a global scale – *a safe and just zone for people and planet*. By operating within these limits, we can maintain a stable and resilient planet and ensure access for everyone to the resources necessary for a dignified life.

Earth System Boundaries are hard limits. Even temporary overshooting of some of the boundaries can permanently damage the planet's critical systems, causing irreparable harm to life.

Earth System Boundaries can guide action towards a safe and just future for every human and the planetary web of life we rely on.

- *Safe boundaries ensure stable and resilient conditions on Earth, within the Holocene range of variability, that we know can support human development.*

- *Just boundaries minimize human and nature's exposure to significant harm. In addition, the Earth Commission quantified minimum levels for access to resources for a dignified life and freedom from poverty for everyone.*

WHAT DOES THE EARTH COMMISSION SAY ABOUT AEROSOLS?

Aerosols from natural sources dominate air pollution concentration in wild areas but anthropogenic (human made) sources are prevalent in areas where most people live. In the Northern hemisphere, there is more land mass and higher population, thus more polluting activities. If air pollution in the Northern hemisphere increases further, this could lead potentially to an imbalance of aerosol concentrations between the two hemispheres, which can potentially disrupt rain patterns, such as the monsoon system.

The Commission proposes a novel boundary for aerosols that links the Earth system to human systems to prevent millions of premature deaths annually and prevent altering of the monsoons.

WHAT ARE THE KEY INSIGHTS WE CAN DRAW FROM THE AEROSOLS ESB?

- The level of polluting aerosols in the atmosphere can have a disruptive effect on how the Earth system functions.
- A rising North/South hemispheric difference in aerosols can cause substantial adverse effects on regional rain patterns.
- The Earth Commission has set safe and just boundaries aimed to stem the negative effects of aerosols on both planetary health and human health.
- The safe and just boundary aims to avoid imbalances between Northern and Southern hemisphere aerosol loading to stabilise global rain patterns. The goal is *to prevent adverse health impacts causing millions of premature deaths annually and to prevent negative impacts from changed precipitation patterns.*

WHAT EVIDENCE HAS INFORMED THE EARTH SYSTEM BOUNDARY FOR AEROSOLS?

- The safe Earth System Boundary is defined by the interhemispheric difference in aerosol optical depth based on observational evidence from volcanic eruptions and modeling studies that show a rising North/South hemisphere difference in aerosol concentration can trigger regional-scale tipping points, which could lead to shifts in monsoonal patterns. This difference can cause substantial adverse effects on weather cycles that influence flooding and drought risk.
- *A more stringent just ESB is based on local air pollution standards since exposure to particulate matter (PM) poses significant harm to human health. The just boundary is set at 15 $\mu\text{g}/\text{m}^3$ mean annual exposure to $\text{PM}_{2.5}$ to avoid a high likelihood of significant harm from aerosols. This boundary is based on interim targets from WHO 2021 guidelines and EU and US EPA air quality standards.*

- *The just boundary aligns with the safe boundary at the global level. The global boundary is set on pollutants that could alter the monsoons, such as in West Africa and India. These pollutants could disrupt wet and dry seasons and rainfall in multiple regions.*

WHAT CAN YOU DO?

Although they are tiny and virtually unseen, aerosols have major impacts on our Earth system and health. While most aerosols are natural, 10% of aerosols found in our atmosphere are human made and can alter rainfall patterns, while also having led to millions of premature deaths from pollution related health issues.

Meeting basic needs for all while living within safe and just boundaries requires innovation and redistribution.

We must find ways to reduce fossil fuel use. We must eliminate deforestation, overgrazing and any activities that increase the rate at which aerosols enter the air. We must urge our lawmakers to follow clean air guidelines.

The Earth Commission is part of a bigger system of changemakers: the Global Commons Alliance, which created the Science Based Targets Network (SBTN) to translate scientific boundaries into science-based-targets (SBTs). Businesses and decision makers can work with SBTs for Nature as part of their commitment to stay within the safe and just boundaries, across all sectors of the economy.

The ambition of the first phase of science-based targets for nature, just released by SBTN, is aligned with the Earth Commissions scientific findings. Building on existing environmental knowledge and aligned with local ambitions, these targets, including science-based targets for climate, will put businesses, cities and policy-makers on the right path so that we move towards a safe and just space for people and the planet.

Read more at earthcommission.org