14. Planetary boundary 8: Increase in aerosols in the atmosphere

Introduction

Aerosols are a collection of fine particles from chemicals suspended in the air. Emitted by human or natural activities (volcanoes, fires), aerosols intervene on a planetary scale in the atmosphere as well as locally in the phenomena of air pollution and allergies.

14.1. Issues related to the use of aerosols

Since the pre-industrial era, human activities have doubled the global atmospheric concentration of most aerosols (Rockström et al., 2009). Moreover, as the IPCC shows in its successive reports, aerosols have a strong influence on the climate system by disturbing the Earth's radiation balance. Indeed, the increased concentration of aerosols in the atmosphere leads to an increase in the level of opacity of the atmosphere and can cause a decrease of 10% to 15% of solar radiation on the surface of the Earth. The impact of aerosols on cloud formation and life is one example of this.

Because of their potentially harmful effects on climate and health, the increase in aerosols in the atmosphere is one of the nine global critical processes. The planetary limit is understood in terms of the overall concentration of particles in the atmosphere, on a regional basis. However, the complexity of aerosols and the spatio-temporal variability of particles, sources and impacts, did not make it possible to define an overall threshold.

14.2. Activities causing fine particle emissions

In France, four main sectors of activity share PM10 particle emissions (fine particles with a diameter of less than 10 µm): the residential and tertiary sector (mainly due to the combustion of wood), industry, agricultural activities (spreading, storage of effluents, resuspension during plowing, burning) and transport. Their emissions have decreased, in total, by 41% over the period 2000-2017 following the progress made in all sectors of activity (improvement of dust removal techniques in industry, improvement of the performance of wood heating installations...)

14.3. Exposure of populations to fine particles

Elie LeMarquis (UTT)

In Europe, outdoor air pollution due to fine particles is the cause of more than 400,000 premature deaths each year, including nearly 40,000 in France (European Environment Agency, 2018). Since October 2013, ambient air particles have been classified as carcinogenic to humans by the International Agency for Research on Cancer on the basis of a sufficient level of evidence of an association between exposure and increased risk of lung cancer.

France is thus regularly confronted with episodes of national pollution. Over the 2013-2016 period, these episodes are mainly due to particles with a diameter of less than 10 µm (PM10). At the start of winter, episodes are marked by a large amount of organic matter linked to combustion phenomena such as wood heating or the burning of green waste. In spring, the episodes observed are distinguished by the influence of emissions linked to agricultural activities (fertilizer spreading) which are added to and interact with the pollutants emitted by industry and transport.