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Spatiotemporal Evaluation of Climate Bulk Materials Production in Atmospheric Aerosol Loading

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Abstract : Atmospheric aerosol loading (AAL) from anthropogenic sources is an evidence in industrial development. The accelerated trends in material consumption at the global scale in recent years demonstrate consumption paradigms sensible to the planetary boundaries (PB). This paper is a statistical approach on recognizing the path of climate-relevant bulk materials production (CBMP) of steel, cement and plastics to AAL via an updated and validated spatiotemporal distribution. The methodology of statistical analysis used the most updated regional or global databases or instrumental technologies. This corresponded to a selection of processes and areas capable for tracking AAL within the last decade, analyzing the most validated data while leading to explore the behavior functions or models. The results also represented a correlation within socio economic metabolism idea between the materials specified as macronutrients of society and AAL as a PB with an unknown threshold. The selected country contributors of China, India, US and the sample country of Iran show comparable cumulative AAL values vs to the bulk materials domestic extraction and production rate in the study period of 2012 to 2022. Generally, there is a tendency towards gradual descend in the worldwide and regional aerosol concentration after 2015. As of our evaluation, a considerable share of human role, equivalent 20% from CBMP, is for the main anthropogenic species of aerosols, including sulfate, black carbon and organic particulate matters too. This study, in an innovative approach, also explores the potential role of AAL control mechanisms from the economy sectors where ordered and smoothing loading trends are accredited through the disordered phenomena of CBMP and aerosol precursor emissions. The equilibrium states envisioned is an approval to the well-established theory of Spin Glasses applicable in physical system like the Earth and here to AAL.

Keywords : atmospheric aeroso loading, material flows, climate bulk materials, industrial ecology
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