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Lidar CO_2 profiling in the atmosphere : from ground-based measurements and geophysical applications to spaceborne simulated performances

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In the framework of climate prediction, it is necessary to understand the evolution of carbon cycle and particularly surface-atmosphere exchanges of carbon dioxide (CO_2). In the carbon budget, the CO_2 land sink study is definitively the main interest of CO_2 lidar measurements ultimately from space. There is a need of ground-based, airborne and spaceborne observations that enable to address the patterns and the quantification of CO_2 sources and sinks at local to regional scales (100 m to 100 km) and CO_2 lidar is a well suited instrument to do so. In addition, the current fossil fuel emissions of CO_2, that are only known from statistical data reported by emitting countries themselves, no longer have a small uncertainty. Lidar CO_2 profiling has a role to play to assess how good or not is the current baseline of emissions and how are efficient the measures that are currently taken by cities and regions to reduce emissions. In this paper, we will present the current status of lidar CO_2 profiling in the atmosphere from a ground-based instrument and the potential applications in the carbon cycle studies and we will conclude by the feasibility of a space mission with the recent technological advances.