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Transport impacts on air quality in a narrow alpine valley

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Alpine space represents a delicate ecosystem with a naturally rich biodiversity, then an area of interest for the whole European Union that, for this reason, has to be preserved according to the current EU environmental policies. Nevertheless, at the same time Alpine Space represents a natural barrier for the north-south transports of goods and people, posing serious constraints to free mobility, which is one of the pillars of European Union. These two aspects of Alpine Space represent a clear trade-off that has to be analysed to find the suited equilibrium among the partially irreconcilable needs.
Facing one of the aspects of this intriguing task, this work analyses the impacts of road transports on air quality in a narrow valley in the Julian Alps (Valcanale-Canaltal), sited in the southern side of the mountain ridge (Friuli Venezia Giulia, Italy), which hosts one of the four main transport corridors of the whole alpine chain (Baltic-Adriatic Corridor).
The study is carried out using the DPSIR conceptual frame, then analysing in detail meteorological determinants (driving forces), pressures represented by transport flows (both heavy duty and private cars) with their emission factors classified according to the EURO concept and by in situ monitoring campaigns. Possible mitigation strategies (measures) are tested as well by way of numerical simulations.
Surprisingly, the results show that, at least in the study area, even if pressures are relatively high in terms of heavy duty flows, the impacts on air quality diminishes quite sharply as a function of the distance from the road and, even thanks to the mountain breeze regime, the pollution values are beneath the threshold fixed to protect human health. In particular, the impacts of road transports are dominant on nitrogen dioxides, while they less relevant on particulate matter. Moreover, according to numerical simulations, carried out with a Gaussian dispersion model, the higher contributions to the pollution average concentration come from the night-time emissions, because of the thermal cold pool that if forming during night-time, nevertheless, in the early morning, mountain breezes contribute to the pollution dilution. Photochemical numerical simulations carried out at a resolution of 2 km, then not sufficient to resolve effectively the road impacts, show that the main impacts on ozone formation are ascribable even to road transports, but mainly to the distant emissions (several tens of kilometres) related to the road system sited in the neighbour plane.
Preliminary conclusions of this work suggest that, at least for air quality (climatic effects are not taken into account in this study), road transports can have a sustainable impact in the study area , in particular thanks to the technological improvements represented by EURO emission classes, and by way of a wise infrastructure design and land use (keep inhabited areas a few tens of kilometres far from main transport axes). Moreover, in some cases, a diminishing of the load pollution load might be achieved through a diurnal redistribution of fluxes.
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