Air Quality Management along the Brenner Corridor in the Italian Alps: the BrennerLEC Project

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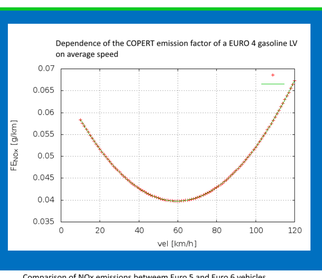
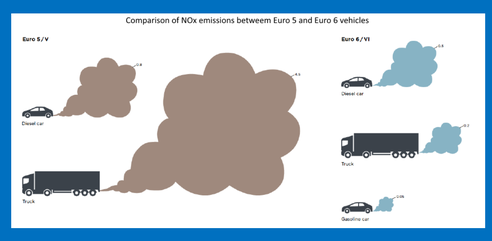
Background

Trentino-Alto Adige/Südtirol is an Italian region that is crossed by the Brenner corridor, a strategic route for Europe, connecting Italy with Austria and Germany. Road traffic is responsible for 60% of nitrogen oxides (NO_x) emissions in this area. On the Italian side, the A22 highway generates 41% of NO_x emissions from road traffic. The peculiar meteo-climatic conditions occurring in Alpine valleys and the proximity of the highway to populated urban areas enhance the problem of nitrogen dioxide (NO_2) concentrations, which generally exceed the limit value of 40 µg/m^3 on annual mean, set by the 2008/50/EC Directive. In the light of this issue, it is strategic to reduce emissions from road traffic. Traffic jams induce the so-called "stop & go" events, which produce higher emissions than constant speed conditions. In addition, emissions show a dependence on speed, being at their maximum when close to the speed limit for light vehicles (LVs). Heavy-duty vehicles (HDVs) complying with their speed limit ensure the minimum NO_x emissions. Furthermore, the technological advances made on HDVs have significantly reduced their NO_x emissions compared to LVs. As a result, EURO 6 HDVs emit about 60% less NO_x than EURO 6 LVs. In this framework, innovative policies aiming at pursuing improved environmental quality objectives should consider LVs as the main target.





Aims of the Project

The "Brenner Lower Emissions Corridor" (BrennerLEC, BLEC) project aims at implementing and demonstrating the benefits expected from three types of dynamic policies to improve air quality (AQ), climate protection and noise:

- dynamic road capacity management, to reduce speed limits and temporarily introduce an additional third lane during highly saturated traffic conditions on the base of current and predicted traffic flows;
- dynamic speed limits management, to be applied to LVs as a function of the current (reactive approach) and predicted (proactive approach) AQ conditions;
- dynamic integrated traffic management, to improve the management of highway traffic in correspondence of urban areas, following the principle of "low emissions zones" (LEZs).

Study Area

Three pilot-test areas were selected for applying the proposed environmental policies:

- **BLEC-ENV**: a stretch of about 90 km hosting the field verification of the dynamic road capacity management strategies.
- **BLEC-AQ**: a stretch of about 20 km hosting the tests of the dynamic speed limits management strategies.
- **BLEC-LEZ**: three stretches, in the correspondence of the urban areas of Bolzano, Trento and Rovereto, which host the tests on the strategies for urban-highway integrated traffic management.

Field Measurements

Air quality and meteorological monitoring

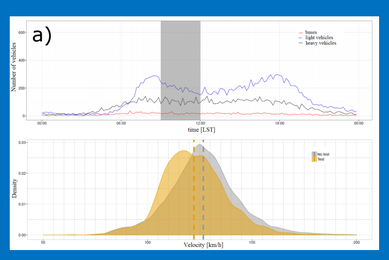
In order to support the policies implemented in the project, a dense network of AQ and meteorological sensors is going to be deployed along the Brenner highway. Three air quality stations were installed to monitor NO_x, NO_2 and other pollutants, including black carbon (BC). Air quality monitoring will be performed using both conventional and innovative resistive and electrochemical sensors, in particular for measuring NO_2 and NO concentrations. Evaluation of the performance of these instruments is still limited and mainly based on laboratory experiments. During the project the performance of this kind of sensors under true ambient conditions will be continuously monitored, by comparing their measurements against the conventional stations. BC measurements will be performed using aethalometers working at different wavelengths, in order to discriminate between BC emitted from traffic and from wood combustion, extensively used in the region during the winter period.

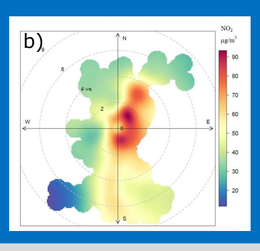
Air quality station installed along the Brenner highway.

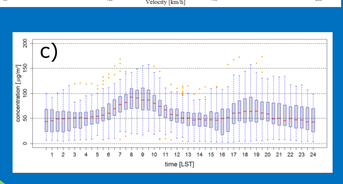
Innovative sensors for measuring nitrogen oxides.

Traffic-induced turbulence

Two Gill HS-100 ultrasonic anemometers will be deployed along the highway in order to evaluate traffic-induced turbulence and to improve knowledge about the influence of traffic-related parameters on turbulence. Results will be used to improve pollutants dispersion simulations.







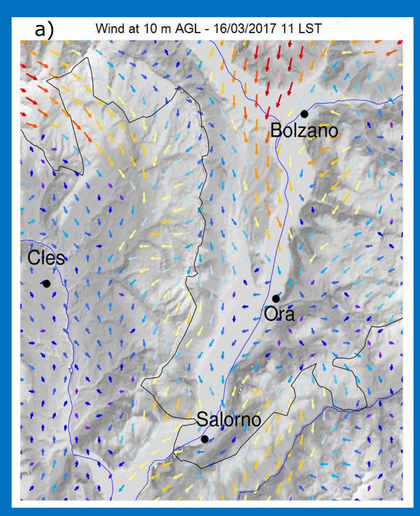
a) Vehicular fluxes and velocities during the first tests; b) correlation between wind speed and direction and NO_2 concentrations; c) typical daily cycle of NO_2 close to the highway.

Monitoring of improvements and impacts

An integrated approach will be set up to study correlations between AQ, noise, meteorological, traffic and emission data, to analyze the differences between the ex-ante and ex-post situations, to evaluate external pollutant contributions and assess the health risk for residents.

Modelling activities

During the project an advanced modelling chain, composed of integrated meteorological, air quality and traffic models, will be developed to support the extensive testing and application of temporary reduction of speed limits connected to critical air quality situations. High-resolution meteorological forecasts will be performed using the Weather Research and Forecasting (WRF) model. Operational meteorological forecasts will take advantage of data assimilated by a dense network of surface stations, both installed specifically for the project and operated by the local meteorological offices, including a thermal profiler and a wind profiler. Air quality forecasts, performed using the CALPUFF and AUSTAL2000 dispersion models, will provide the decision support tool for the application of reduced speed limits on the highway, in order to maximize the benefits of the policies implemented limiting negative impacts for the highway users, by putting in action measures only when necessary and anticipating environmental issues.



Examples of maps obtained from the WRF and the CALPUFF models. a) Forecast of wind speed at 10 m AGL in the study area; b) NO_2 concentrations along the Brenner highway.

ACKNOWLEDGEMENTS

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