Title: Adverse weather and vulnerable road users' casualty in some European countries

Authors: Ruth Bergel-Hayat, RBH Conseil, France, ruth.bergel@ifsttar.fr
Nathalie Focant, AWSR, Belgium, nathalie.focant@awsr.be

Author keywords: road casualties, road fatalities, adverse weather, trend analysis, vulnerable road users

Background: Weather conditions are known to impact mobility, especially on the roads, and consequently road accident and casualty outcomes. Adverse weather in particular is known not only to reduce exposure but also to increase the level of the road risk. But it is not clear whether the combined effects of a reduced exposure and an increased risk result in a reduction or an increase of the number of road casualties, measured at aggregate level. Vulnerable road users (pedestrians, bicyclists, mopedists and motorcyclists), which are the most weather-sensitive road users, rise up to about half (40 to 60% according to the country) of the total of casualties in Europe and this share continuously increases while on the opposite the respective share of car users, which are very little weather-sensitive, decreases. It is therefore of great interest to measure the impact of inclement weather on VRU’s casualty, and its changes depending on the climatic configurations in Europe.

Aim: This paper aims at presenting a tool for monitoring, on a monthly basis, road casualty short-term trends for VRUs (pedestrians, cyclists, mopedists and motorcyclists) in relationship to a short number of explanatory variables measuring adverse weather. A comparative analysis of the results obtained for a group of European countries (Austria, Belgium, France, Germany, the Netherlands, and UK) is expected to highlight similarities and differences in behaviours of each type of VRU among these 6 countries.

Method: In practice, three steps were achieved. Collecting the casualty data (totals and fatalities alone) from the Care database, building the adverse weather predictors (the number of days in the month with rainy, resp. cold, resp. rainy and cold weather, computed from equidistant meteorological measures taken from the Agri4Cast database), fitting a generic model that could be applied to each dataset of casualties considered. Structural (the so-called "state-space") time series analysis techniques were chosen and applied to the monthly number of casualties, whether totals or fatalities alone, disaggregated per road user type for a number of European countries and for the 16-years period 1999-2014.

Results: Correlations between VRU’s casualty numbers in general and the numbers of days with adverse weather are highly significant with a globally negative sign. The weather sensitiveness of VRUs to adverse weather is much larger for motorcyclists than it is for bicyclists and mopedists. The same result applies regarding the correlations between fatalities alone and adverse weather, but the weather sensitiveness is generally larger.

When analysing the 16-year period in terms of road safety performance, it is clear that some years have been favoured (favourably impacted by adverse weather conditions): 2001, 2010 naturally, and 2013 which had more days with adverse weather than in average, whereas some others have been disfavoured: 2000, 2007, 2011 and 2014 which had more normal days than in average.

Finally, the results of the analysis are coherent among countries, and the size of the adverse weather’s impact is large: when measured at the scale of the year, it may reach 3 to 4% of the total of VRU’s casualty, and even 6% of motorcyclist’s casualty.

Conclusions: This work demonstrates that the number of days with adverse weather measured through rainfall and cold (itself measured through snowfall and frost), in deviation to their seasonal averages, computed from equidistant meteorological measures taken over seven countries’ areas in Europe are significantly correlated to casualty numbers for the 16-year period 1999-2014. These results highlight the demand for an additional source of weather data complementing the
information registered by the police on the spot of the accident. The large size of the adverse weather impact on casualty numbers should lead decision makers, in particular, to analyse trends corrected for this impact. In terms of prevention, a number of actions could be taken or reinforced, at urban level in particular, for reducing the added-risk by rainy and/or cold weather (information and alert, lightning and speed reduction). National authorities and research bodies, municipalities and industry can help addressing this issue.