

Reproducing surface road temperature by means of a land surface numerical scheme

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ABSTRACT

Reproducing surface road temperature is a crucial factor for winter road management. In fact, extreme cold winters as well as rain or snow falling on the roads need expensive road management opera in terms of human and technologic resources. To avoid unnecessary and expensive actions, a new parameterization of the porous Asphalt (PAP, Porous Asphalt Parameterization) has been implemented in the UTOPIA model. Porous asphalt represents the most used kind of asphalt for highways construction.

The goal of this numerical study is to reproduce surface temperature and state of the road in several monitored points along the Piedmont highway network. UTOPIA-PAP has been validated against surface road measurements made at six different sites during the period running between January 2007 and January 2011 showing a good estimation of the surface road temperature and state. These good performances of UTOPIA-PAP have a surplus value. In fact, the better estimation of the surface temperature and state leads to a better estimation of the energetic and hydrologic balance.

UTOPIA model PURPOSE Autostrade S.p.a tation with por The University of TOrino land Process Interaction in Atmosphere model ARPA weather station •numerical modelling of the surface road (UTOPIA) is a 1-D multilayer model computing energy, momentum and temperature and state water exchanges between atmosphere and land. The processes in UTOPIA Massino Visconti nord are described in terms of physical fluxes and hydrological state of the better estimation of the PBL Courmayeur Ponte Yall land. magnano Sesia ·early warning system for road winter The physical processes: The hydrological processes: management



RESULTS

SENSITIVITY TEST : Romagnano Sesia highway station, 2.5 km from Ghemme ARPA station





Fig. 6,7: Surface temperature time series

release due to ice formation keeps the asphalt layer warmer compared to the same with a lower freezing point. • Another possible -prediction bounds

fitted curve fitted curve influence of the traffic on the asphalt thermal balance, not implemented in Fig. 10,11 scatter plot: maximum and the Utopia model. minimum temperatures

-prediction bounds

Figure a) shows the simulated asphalt surface state in the winter period 2008/2009 at Massino Visconti highway station. Blue line represents the surface water fraction, the red one the ice fraction that occurs when the surface temperature drops below the freezing point (see figure b). In presence of snow cover (figure c), the ice fraction decreases and disappears when the asphalt surface is totally covered by snow.

Conclusions and future developments

In this work we implemented and tested the UTOPIA-PAP (Porous Asphalt Parameterization) to simulate the porous asphalt surface temperature and state (water or ice fraction). Statistical analysis with Romagnano Sesia highway station data shows that UTOPIA-PAP simulates in a very good way the asphalt surface temperature.

Statistical analysis at the other sites shows even satisfactory results, but less good than those of Romagnano Sesia. This is mainly due to the greater distance between the highway station and the correspondent ARPA weather station in all the other sites considered. Another possible cause may be also some little differences in thermal and hydrological properties between the Romagnano Sesia asphalt (the one used to do the sensitivity test) and the one of other sites (especially for those located in a different highway).

A future development can be the implementation and testing of the traditional asphalt parameterization. Another future goal is to implement an operative chain able to forecast the asphalt conditions (temperature, surface state,

presence of snow cover...) in different points of the Piedmont highway network.

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