

Improvement the Conditions in Urban Areas by Plant Based Surface Treatment Technology

Model, Nikolaus, Berlin, Germany, NikolausModel@aol.com,
Felipe Omar Tapia Silva, Centro de Investigación en Geografía y Geomática "Ing. Jorge L. Tamayo" A.C., Mexico, otapia@centrogeo.org.mx
Anne Wehrmann, Berlin, Germany, annewehrmann@hotmail.com
Hans-Joachim Henze, Berlin, Germany, hans-joachim.henze@agrar.hu-berlin.de

Abstract:

Extensive naturation of building surfaces and particularly naturation of tram track (TBN) can contribute considerably for an alternative rain water management, for a reduction of noise and for an improvement Mesoclimate in Urban Areas. It can be shown, that TBN leads to noise reduction, improves the mesoclimate (especially important for climate conditions with low exchange) and can contribute to an alternative rain water management in a remarkable way. We especially investigated a urban location in the German town Berlin.

The rain water cycle in towns is influenced negatively by sealing, traffic, number of inhabitants and industry. The way of using the available spaces in the urban areas has a decisive influence on the distribution of precipitation, evaporation and drain and can therefore allow rain water retention at a location. A model for the calculation of actual evapotranspiration and superficial flow was developed and tested. The combined use of the formula from FAO-Grass reference evapotranspiration (Wendling 1995) and the development of a reduction function for the calculation of actual evapotranspiration – taking into account the change of the soil water reserve (Tapia 2002) - have demonstrated their applicability. Its transferability for other places was confirmed by means of examination of the computation results with the measured values. Correlation coefficients between measured and computed values are between 0,83 and 0,91 for daily and 0.9 and 0.99 for monthly computations. The model worked better in summertime. In this measuring period largest amounts of precipitation and evaporation did occur and the positive effect of naturation on the water regime and on the mesoclimate mostly took place. On this basis, a computer-assisted model for water regime computation for the naturation of railways range could be developed. An alternative rainwater management strategy has been designed.

The noise reduction calculations with the forecast model ANIRAIL yielded a diminution of up to 8dB(A). It can be presented the frequency dependent representation of the Noise Coefficient of absorption in dependence of the plant formation. The comparison of the noise coefficient of absorption and Gravel Track (Gravel High: 0,50 m) shows very good properties of the extensive naturation of tram track.

The improvement of the urban climate by naturation of tram track has been computed. The results show that the relative air humidity [%] is growing from 30 until 70 % (distance 100 m; height 2 m). By means of the geographical information system ArcView detailed estimations are made.

1. Introduction



Fig. 1: Grass Track (Berlin 1905)



Fig. 2: without TBN (1997)

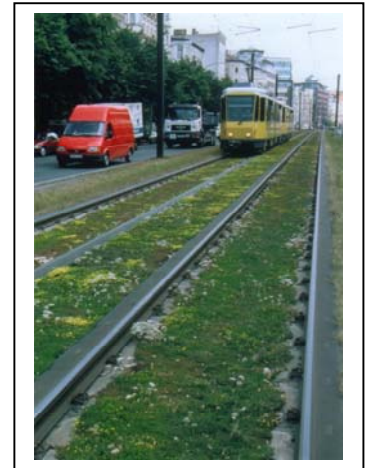


Fig. 3: with TBN (1998)

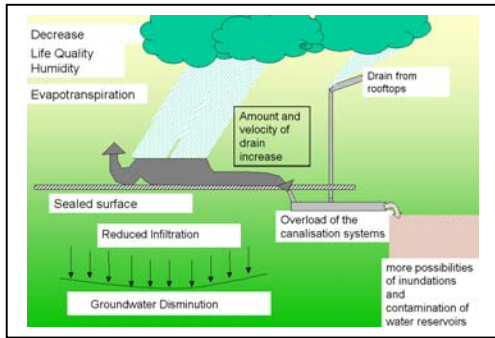


Fig. 4: Water cycle

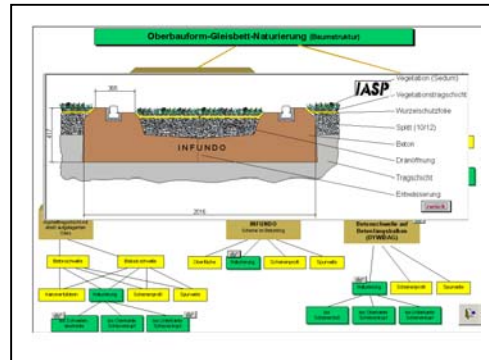


Fig. 5: Example for a Naturation System "INFUNDO"

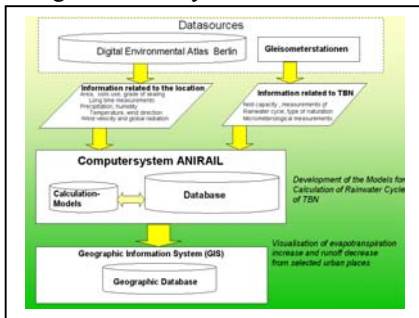


Fig. 6: Calculation scheme

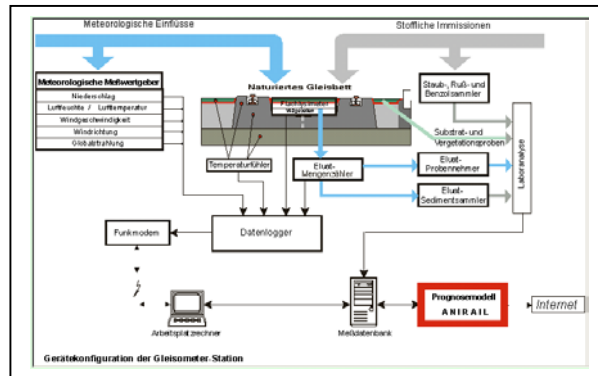


Fig. 7: Measurement system

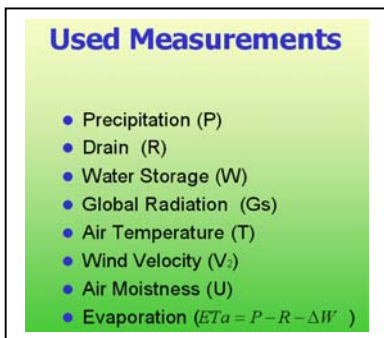


Fig. 8 : used measurements

2. Computing the improvement of the air humidity

- For the calculations are used the data of 8-15-2 (a day with low radiation exchange), which where determined on the IASP-measuring station in the Berlin street 'Torstraße'.
- Due to the high air temperatures are such high summer's days a very high stress for the man.
- The temperature was 34.5° C and the relative atmospheric humidity was at 32%.
- The wind velocity is low and the air is dry.
- The wind velocity is low and the air is dry.
- assuming a adiabatic system,
- then we can compute the air condition change as a result of the evaporation over the plant based surface by means of the Mollier-h,x-diagram for damp air

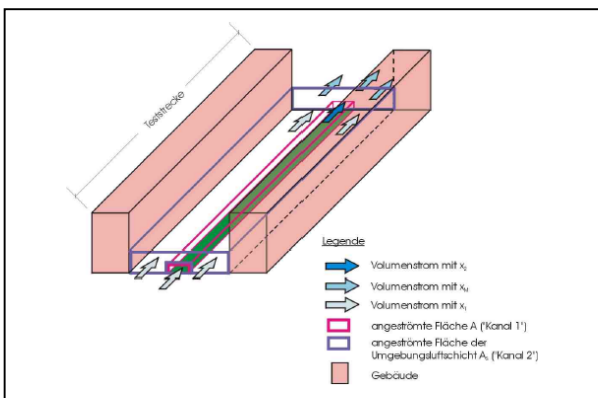


Fig. 9 : Schematic representation the street ravine as an air duct system.

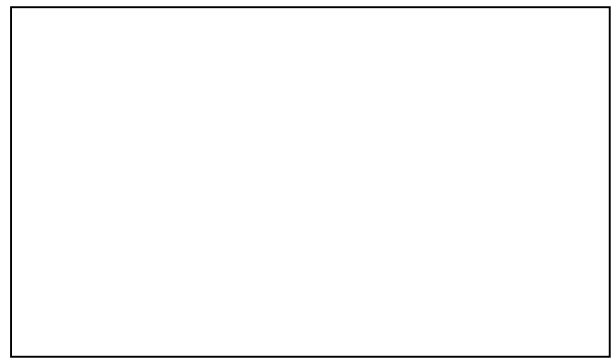


Fig. 10 : Berlin-Torstraße

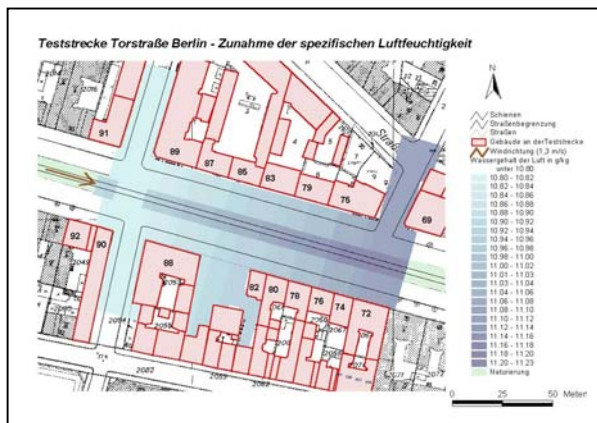


Fig. 11 : GIS presentation (Increase the specific air humidity by evaporation over the naturation up to 3 m of height on 8-15-2001 16.00 clock (climate conditions with low exchange) in Berlin-Torstraße [cf. Wehrman 2002])

3. Noise Reduction

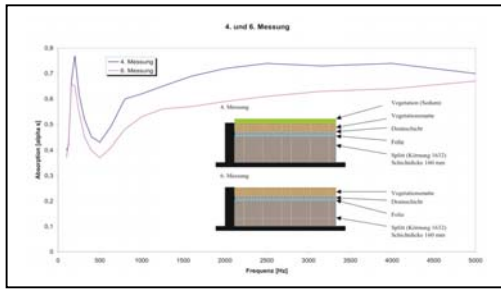


Fig. 12 : frequency dependent Representation of the Noise Coefficient of absorption in Dependence of the Plant formation

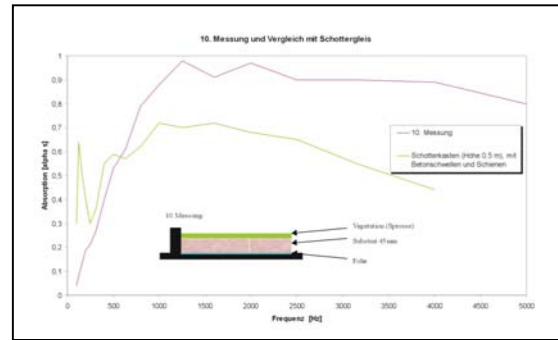


Fig. 13 : Comparison of the Noise Coefficient of absorption with Gravel Track (Gravel High: 0,50 m)

4. Alternative Rain Water-Management

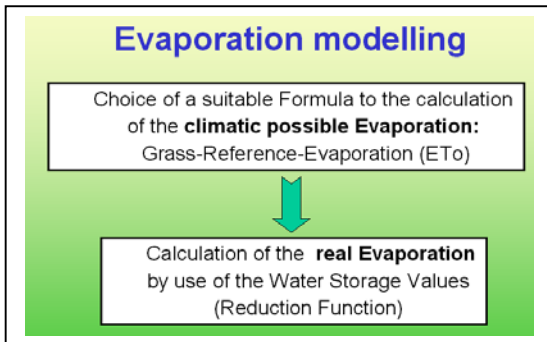


Fig. 13 : Overview

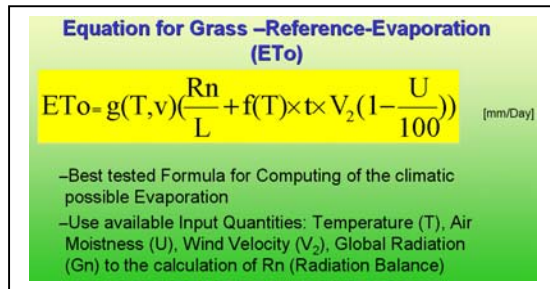


Fig. 14 : Modelling

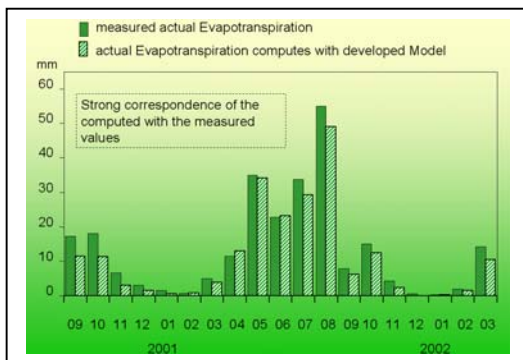


Fig. 15 : Comparison measurement and model

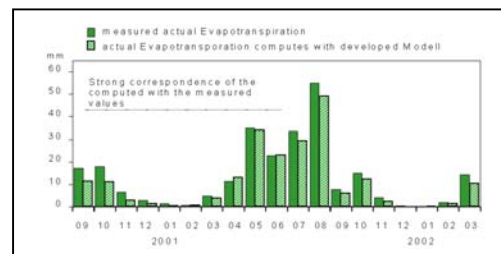


Fig. 16 : Results of the computer-assisted model for the actual evapotranspiration calculation of the TBN area pro month at the measurement station Berlin Malchow.

Conclusion – Rain Water Management

- substantial runoff reduction and evaporation increase by the thin-layered naturation-system on the railways takes place.
- A water retention of at least 50 percent of the total precipitation for one year was proven.
- A model for the calculation of actual evapotranspiration and superficial flow was developed and tested.
- Its transferability for other places was confirmed by means of the examination of the computation results with the measured values.

5. Pollutant Filter and - Depot

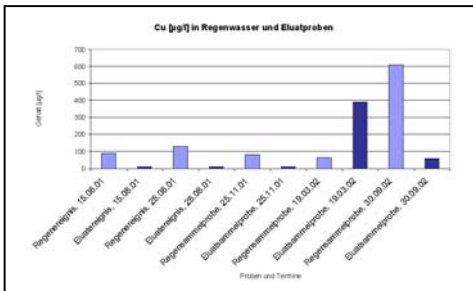


Fig. 17 :The Vegetation System as Pollutantfilter and Pollutantdepot

6. Conclusion

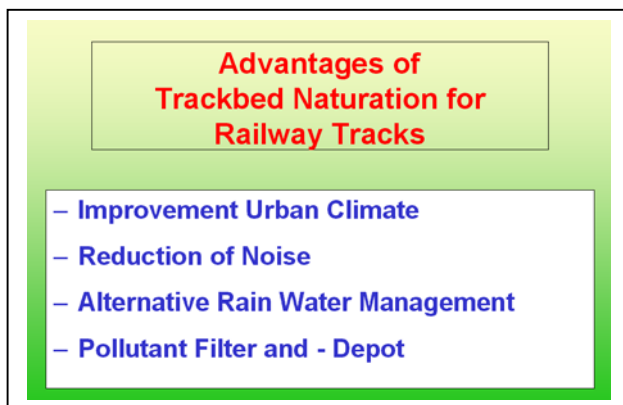


Fig. 18 : Advantages