Disaster Risk Management: Urban Flooding and heatstress

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Abstract

Natural disasters are a growing concern around the globe. In the Netherlands, water has always played an important role as both friend and enemy. To quickly analyze and visualise possible disaster outcomes has been really difficult.
In collaboration with engineering company Tauw we improved this modelling with an interdisciplinary team of GIS experts, High performance computing and real time visualisation. In a pilot for the city center of Groningen we developed a 3D version of flooding landscape maps (RUG, 2014) after modelling extreme rainfall. With a flooding landscape map you can see at a glance where water is going and where problem areas arise in case of extreme rainfall. Any municipality or county can thus quickly determine which measures are to be taken to prevent for example disruption to traffic or flooding damage to buildings.

Keywords

Water, Flooding, Modelling, Disaster Risk Management, Resilience, 3D visualisation

1 Modelling for climate adaptation

For the pilot we used scenarios of the Royal Dutch Meteorological institute to set up situations which we could both model and visualize. We chose for extreme rainfall and heat stress. This pilot we did for the beautiful city of Groningen. The basis of the model was first developed by engineering company TAUW (Klok, 2012), but hadn’t been used on this scale before. We enhanced the model, increasing performance and making it suitable for cluster computing. The results were visualized in 2d maps and 3d models to give detailed insight into the outcomes of the disaster scenario.

2 Floodrisk

For the urban flooding scenario we used several datasets. The most important one is the AHN2, the Dutch elevation model (which is open data). This raster dataset is extremely accurate, 9 points per square meter. Therefore we know the height for every 50 by 50cm. On top of that we used the TOP10, the open data topographic data for the roads and waterways. We also used the BAG, the

open dataset with all buildings (2d) of the Netherland. Next Groningen was cut up into 25 pieces and 60mm of rain in one hour was simulated. The sewage system was taken into account by removing the first 20mm of water and the rest flowed through the city. The output of this computation is a map which shows the flow of the water and the water that remains at certain places.

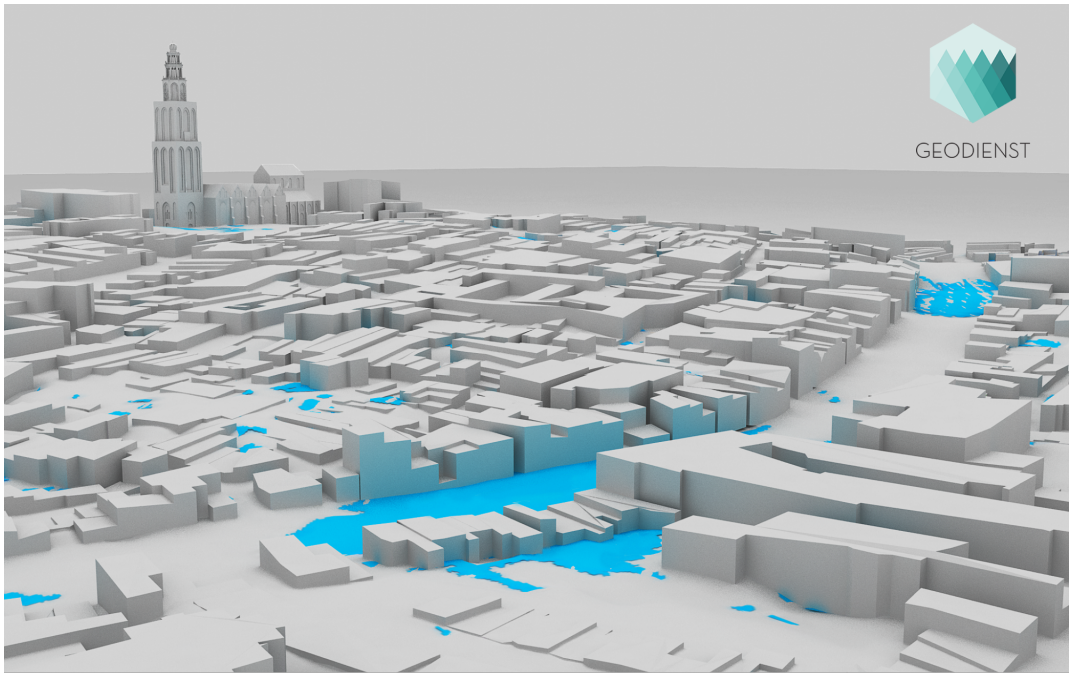

Figure 1: Results visualized in a 3d model.

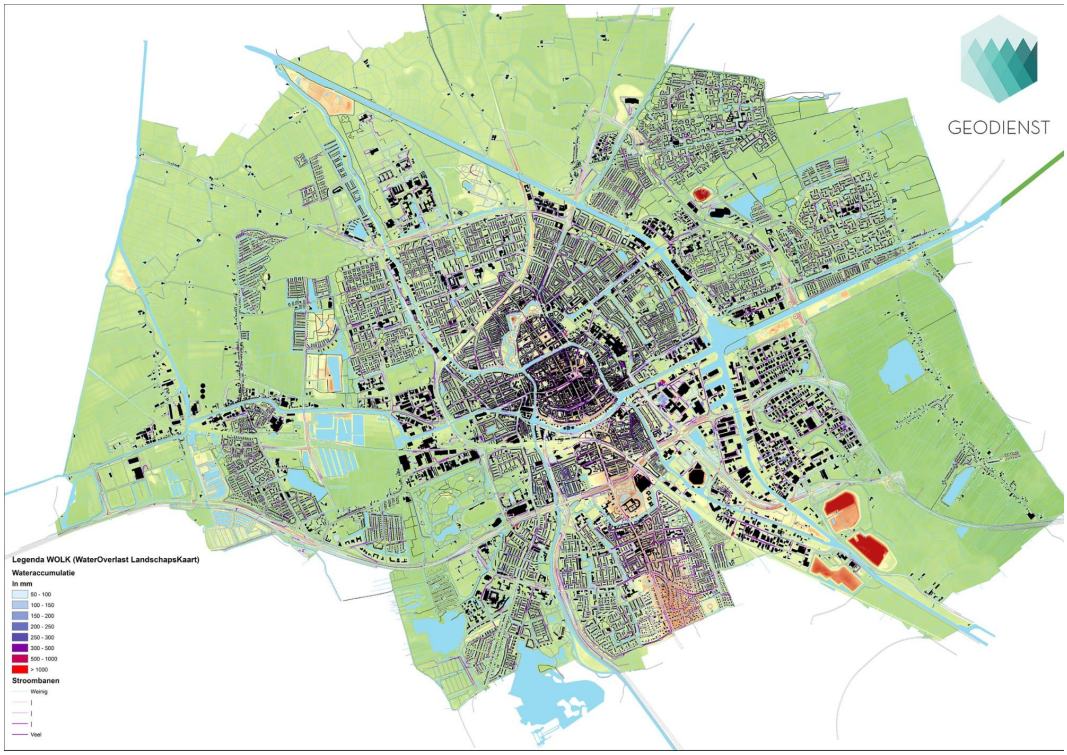

Figure 2: Map showing water flow and accumulation.

Combining the elevation model, the dataset with buildings and aerial photographs we can make a 3d model of the city and get a better overview of the outcomes of the model.
The model was shown in the 3D virtual reality theater on a cylindrical screen using 6 HD projectors to project an image with a resolution of roughly 5000x1800. To display this model on such a big screen a special 3D viewer, based on the open source OpenSceneGraph 3D toolkit, was used. The software was running simultaneously on 7 PC's, one master PC for the control of the model and 6 slave PC's to drive the projectors.

3 Heatstress

The same model as the floodrisk model is applicable to heat stress and drought. In this model we also included an aerial photo with 10cm resolution. And then used a script to the work and make the sun shine above the city.

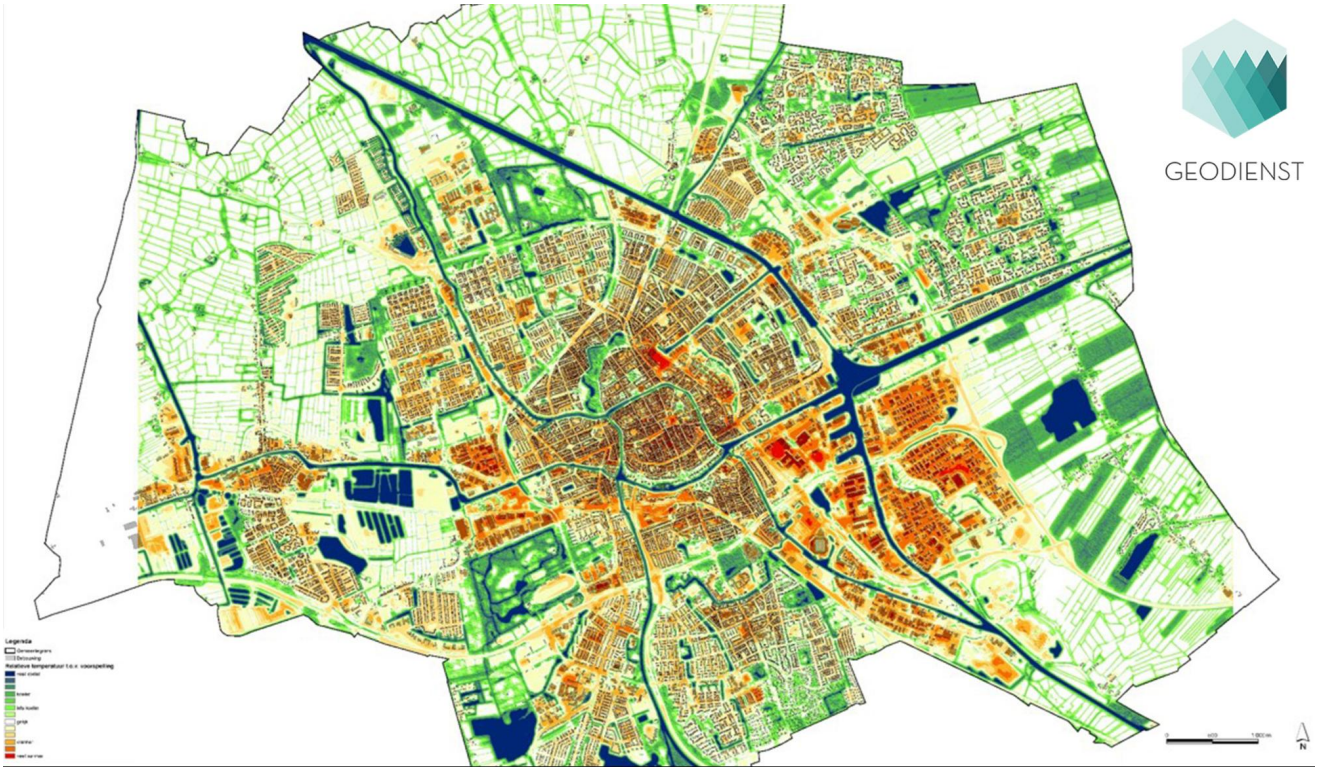

Figure 3: Heat stress map.

4 Challenges and further development

Datasets are getting bigger and bigger, customers get more demanding and want fast and good results. The AHN3 is coming, with an even better resolution, so the model will improve. We can solve the bigger and bigger data problem by using our High Performance computing facilities and 3D visualisations to keep the overview. Currently used other models lack the ability to perform on a large scale.
Currently the high performance and visualisation part is mostly open source based, but the model from TAUW is not. We are working on improvements and building our own parts of the model. By doing this we are working towards an open source model and combining the best tools we can to get the best results

by running the model on the high performance clusters.

References

- ✔ Klok, T.M. (2012). *Modelling of stormwater overland flow in urban areas: Assessment of WOLK as an overland flow modelling tool* (Master Thesis) Retrieved from http://essay.utwente.nl/61450/
- ✔ RUG. (2014). *Disaster Risk Management - urban flooding, heatstress & earthquakes* [video]. Retrieved from https://www.youtube.com/watch?v=mzFahS9RJPA