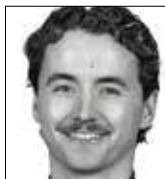


Stormwater hydraulic modeling – a comparative study of Mike+ and Infodrainage

Hydraulisk dagvattenmodellering – en jämförande studie av Mike+ och Infodrainage



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Abstract

Effective stormwater management is important in urban environments to mitigate flooding, manage peak flows, and support resilient infrastructure planning. Hydraulic modeling tools play a critical role in the design and analysis of drainage networks, yet different software tools often rely on different assumptions, numerical methods, and model structures, which raise questions about comparability and reliability. This study compares two widely used stormwater modeling tools, MIKE+ and InfoDrainage. Identical drainage systems were simulated under identical input conditions, including synthetic rainfall events, Chicago Design Storms and block rain with 10- and 30-year return periods. Results show that despite identical inputs, the two models produced notable differences in peak flow rates, timing of runoff, surcharging behavior, and flood extents, particularly under high-intensity rainfall events. These differences are largely attributed to differences in numerical solvers, surcharge handling and handling of node interactions. While MIKE+ typically produced higher peaks, InfoDrainage exhibited more numerical instability in the hydrographs and fewer instances of surcharging. The study also highlights the implications of uncertainty in model structure and solver design, especially in the absence of field calibration. The findings demonstrate that MIKE+ and InfoDrainage are not functionally interchangeable, and model results must be interpreted in the context of each software's assumptions. This comparison contributes to a more informed selection of modeling tools in stormwater design and planning and emphasizes the need for calibration, sensitivity analysis, and model transparency in future applications

Keywords: Stormwater modeling, hydraulic modeling, 1D modeling, model structure uncertainty, hydraulic software

Sammanfattning

Effektiv hantering av dagvatten är avgörande i urbana miljöer för att minska översvämningsrisker, hantera flödestoppar och stödja hållbar infrastrukturplanering. Hydrauliska modelleringsverktyg spelar en central roll vid dimensionering och analys av dagvattensystem, men olika programvaror bygger ofta på skilda antaganden, numeriska metoder och modellstrukturer, vilket väcker frågor om jämförbarhet och tillförlitlighet. I denna

studie jämförs två vanligt förekommande modelleringsverktyg, MIKE+ och InfoDrainage, genom att simulera identiska dagvattensystem med harmoniserade indata, inklusive syntetiska regn (10- och 30-årsregn enligt Chicago Design Storm och blockregn). Resultaten visar att modellerna trots identiska indata ger märkbara skillnader i flödestoppar, tidpunkt för avrinning, överbelastningar och översvämning, särskilt vid intensiva regn. Dessa skillnader kan i huvudsak förklaras av olikheter i numeriska lösningsmetoder, hanteringen av överbelastade rör och hanteringen av brunnar. MIKE+ tenderar att ge högre flödestoppar, medan InfoDrainage genererar flödeskurvor med fler svängningar och färre överbelastningar. Studien belyser betydelsen av modellstrukturell osäkerhet, särskilt när kalibrering mot uppmätta data saknas. Slutsatsen är att MIKE+ och InfoDrainage inte är direkt utbytbara, och att resultaten bör tolkas med hänsyn till respektive programvaras bakomliggande antaganden. Denna jämförelse bidrar till en mer informerad modellvalprocess vid dagvattenplanering och betonar behovet av kalibrering, känslighetsanalyser och ökad transparens.

Introduction

Proper management of stormwater in urban environments is one of the cornerstones of sustainable city planning. The amount of impermeable surfaces increases as cities are built and expanded, leading to a reduction of natural infiltration of rainfall and thus an increased surface runoff. Without proper planning and control, this increased runoff can result in increased flood risks, infrastructural damage, and increased pollutant transport to the receiving water bodies (Fletcher et al., 2014). Designing stormwater networks that are both cost-efficient and reliable requires detailed hydrologic and hydraulic analysis to ensure sufficient capacity during more extreme rainfall events while avoiding non-cost-efficient overdimensioning. Urban drainage systems should also be designed to be able to handle future climate changes that can potentially increase the frequency and intensity of future rainfall events. Studies have shown that traditional design storms may underestimate future extreme events, which creates a need for adaptable modeling approaches which take long-term reliability into consideration (Arnbjerg-Nielsen et al., 2012). Tools that use numerical simulations to quantify runoff volumes, flow rates, flooding, and network capacity are increasingly used in the stormwater design and evaluation stage to solve these challenges. Different modeling programs often use different assumptions, algorithms, and governing equations, and thus they can vary in their respective simulation outputs and results.

Differences in how software handles processes such as infiltration, surface runoff and flow distribution can therefore give different results between different modeling softwares under identical conditions (Deltic et al., 2012). There is a wide range of tools available for professional practices, among them are MIKE+ by DHI and InfoDrainage by Autodesk. MIKE+ integrates hydrodynamic simulation capabilities for complex stormwater, wastewater and river systems using the MIKE 1D engine to model open and closed conduits. InfoDrainage focuses more on Sustainable Drainage Systems (SuDS) and design-friendly workflows. Despite the wide usage of both softwares, there is a notable lack of peer-reviewed studies comparing the two platforms directly under identical conditions.

This article is a summary of a thesis carried out in 2025 at Luleå University of Technology. For more detailed description of this work, please refer to Agnér (2026).

Aim

The aim of this study was to compare the hydraulic modeling softwares MIKE+ and InfoDrainage. The parameters compared are water pressure levels (flooding & surcharging), discharge, velocity and depth in a stormwater sewer network. The underlying equations and numerical solutions were examined to identify which assumptions might have produced the differences between the two programs. Thus, the main objective of this study was to evaluate the differences

between the two modeling tools in order to increase understanding of their respective strengths, limitations and areas of applicability.

Software hydraulics

MIKE+ and InfoDrainage share similarities but also differences in their hydraulic engines, as presented in Table 1. Both software hydraulics are based on the one-dimensional Saint-Venant equations, but they are solved using different numerical schemes. MIKE+ handles pressurized flow with the Preissmann-slot method to ensure the validity of the Saint-Venant equations during such conditions. Node head losses in MIKE+ are calculated using Weighted Inlet Energy which takes the energy level of a node as a flow-weighted average of all incoming flows and accounts for velocity head contributions from multiple inlets. InfoDrainage uses the velocity head formulation to account for losses in node entries, exits and bends. Both MIKE+ and InfoDrainage utilize Manning’s equation to calculate hydraulic resistance in this study (DHI , 2021 ; EPA, 2017).

Table 1: Comparison of hydraulic calculations

Aspect	MIKE+	InfoDrainage
Governing equations	Saint-Venant	Saint-Venant
Numerical scheme	Abbott-Lonescu, implicit staggered grid	Dynamic wave, semi-implicit
Pressurized flow	Preissmann slot method	Continuity, damping factors
Node interactions	Weighted Inlet Energy (nodes)	Velocity head formulation (entries, exits, bends)
Resistance	Manning’s equation	Manning’s equation

Method

The models were set up with identical input values to ensure that any differences observed could be attributed to differences in the hydraulic aspects of the models. The attributes of the stormwater network, including node type, diameter, ground level, bottom level, location and pipe length, diameter, material (including hydraulic resistance), up- and down-stream level were matched in both softwares. The catchments, their properties, connections, and rainfall events were also matched to ensure the validity of the comparison.

10- and 30-year Chicago Design Storm- and Block rainfall events with a duration of six hours were simulated (Figure 1 & 2), based on the Dahlström equation.

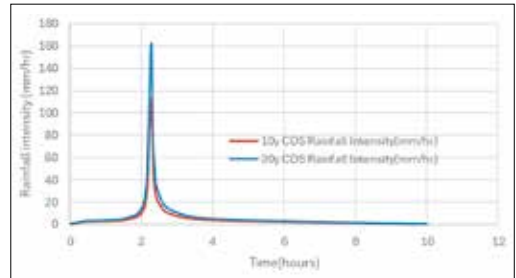


Figure 1: Hyetograph for the 10-year (red) and 30-year (blue) Chicago Design Storms (CDS).

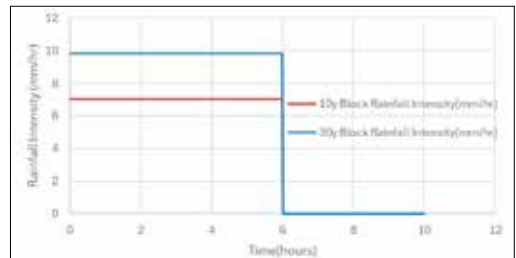


Figure 2: Hyetograph for the 10-year (red) and 30-year (blue) block rainfall.

Results

In this section, the simulations with 30y CDS rainfall are selected as it presents more distinct differences in the hydraulic response.

Mass balance error

Table 2 presents the mass balance error for the simulations. Overall, all events satisfy the “very good” criteria (<1% error) according to an SVU report by Blomquist et al. (2016), indicating sufficient numerical stability. Furthermore, both models have a higher error for CDS rainfall compared to block rainfall, indicating greater difficulties with higher peak intensities.

Table 2: Mass balance error for each simulation in MIKE+ and InfoDrainage

Simulation	Mass balance error MIKE+ (%)	Mass balance error InfoDrainage (%)
10-year CDS	0.25	-0.01
30-year CDS	0.26	-0.01
10-year block	-0.06	0.003
30-year block	-0.03	0.002

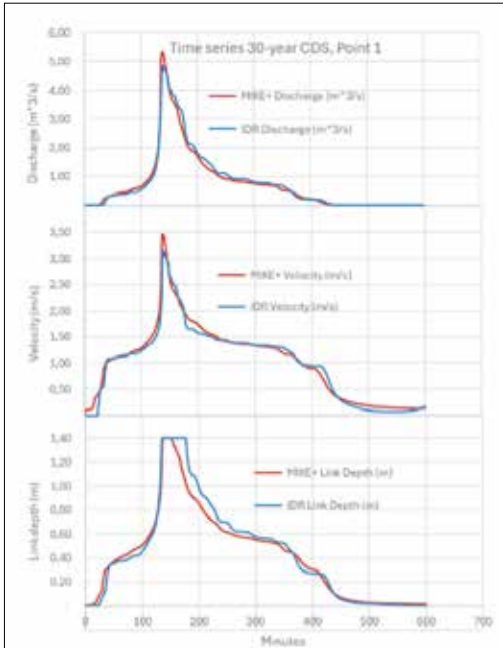


Figure 3: Time series graph for discharge velocity & link depth for the 30-year Chicago Design Storm (CDS) event.

Hydrographs

The hydrographs for discharge from both models follow a similar shape and timing (Figure 3). MIKE+ produces a slightly higher discharge peak compared to InfoDrainage, pointing to a more concentrated runoff routing. MIKE+ also produces a higher peak for flow velocity compared to InfoDrainage, but still with a similar pattern in shape and timing. For link depth, both models show similar rising limbs with filled pipes at 1.4 m, but InfoDrainage shows a longer time span with water levels exceeding the pipe crown as the link depths decrease earlier in MIKE+. This indicates that MIKE+ contains more of the specific energy as velocity, while InfoDrainage translates it into higher water levels within the pipe with a slower runoff. InfoDrainage expressed more frequent oscillations in the hydrograph for all events, indicating more numerical instability in Infodrainage or overstabilization in Mike+.

Discussion

Overall, the results were very similar, but with one common key difference showcased from each result

type – The MIKE+ model generated higher pressure levels generally. This study revealed differences in model outputs, even though identical inputs were applied. But what are the contributing factors? One primary factor is the underlying mathematical formulations and numerical solvers used in the softwares. Both software bases their hydraulics on the Saint-Venant equations but compute them using different numerical schemes and they use different approaches when accounting for surcharging and node energy distributions and losses. These results are in line with the findings of Wistfors (2024) who showcased that differences in solvers and internal structures led to differences in timing and flood prediction, when comparing MIKE+ and Fluidit Storm with identical inputs. Similarly in the study made in Kärgruvan (Bengtsson, 2018), MIKE Urban and SWMM produced different peak flow and flood extents despite equal input data, pointing to differences in the solving engines and how surcharging is represented as key factors.

The comparison of MIKE+ and InfoDrainage confirms that structural uncertainties, even in simpler one-dimensional models, can produce different outputs and provides new insight on how different solvers alone can affect model performance assessment, without added complexity of, for example, surface flow.

Conclusions

This study has investigated the hydraulic modeling capabilities of the two widely used stormwater modeling tools MIKE+ by DHI and InfoDrainage by Autodesk. Their simulation outputs have been compared during identical input conditions, including four different identical rainfall events, identical network structure, catchments and other identical parameters. The primary objective of this study was not to determine which software is superior, but rather to understand how and why model outputs differ, i.e. what structural differences there are and what they mean practically for urban stormwater planning and design.

The results showed that even when the input values were aligned, notable differences occurred between the models in peak flow rates, total in- & out-flow and the spatial distribution of surcharging and flooding, i.e. pressure levels, even though the results were somewhat

similar. The differences were most evident for the more highly intensive CDS-rainfall events where MIKE+ showed higher peak flows, velocities and pressure levels, suggesting that the numerical solvers, structural assumptions and hydraulic routing differ in the handling of fast flow dynamics and pressure transitions. The hydrograph peak timing was identical though for the CDS-events, but InfoDrainage showcased slightly more numerical instability.

These variations in results can have direct implications if the models are used as base for decision-making regarding pipe-dimensioning and flood risk evaluation, especially if used directly without acknowledging the models' assumptions and limitations.

The study also highlights that uncertainties in model structure, solver calculations, and a lack of calibration can undermine confidence in model outputs. Uncertainty was minimized by excluding certain parameters and using identical synthetic rainfall. However, the lack of calibration remains a limitation when evaluating the respective models' accuracy and performance.

This study demonstrates that, while MIKE+ and InfoDrainage produce somewhat similar results, they are not interchangeable. Outputs should be interpreted with each software's underlying modeling philosophy in mind.

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