Dynamic stage-discharge relations of the Dutch Rhine branches

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Reliable discharge time series for rivers are fundamental components within effective river management: e.g. flood (risks) management, navigation, environmental redevelopment. Although the measuring techniques for continuous discharge time series are constantly evolving, the technique for continuous water level measurements is more frequently applied and more straight forward. Dutch discharge time series were therefore mainly derived from water level time series by use of a static rating curve, which presents a direct relationship between the discharge and water level stage.

The development of a rating curve does require discharge data. Discharge measurements are executed during various water level stages, but collected with irregular time intervals. The stage-discharge relation needs to be checked frequently against these discharge measurements due to constant changes in the river system. Analysis of the historical static rating curves (1901-2001) of Lobith showed the temporal variation of the stage-discharge relation and its liaison with autonomous subsidence of the river bed (Van Vuuren, 2004; Figure 1). On a shorter timescale, hysteresis causes temporal variation in the stage-discharge relation. Whereas rating curves reflect steady-state conditions, unsteady flow conditions as hysteresis lead to a looped rating curve.

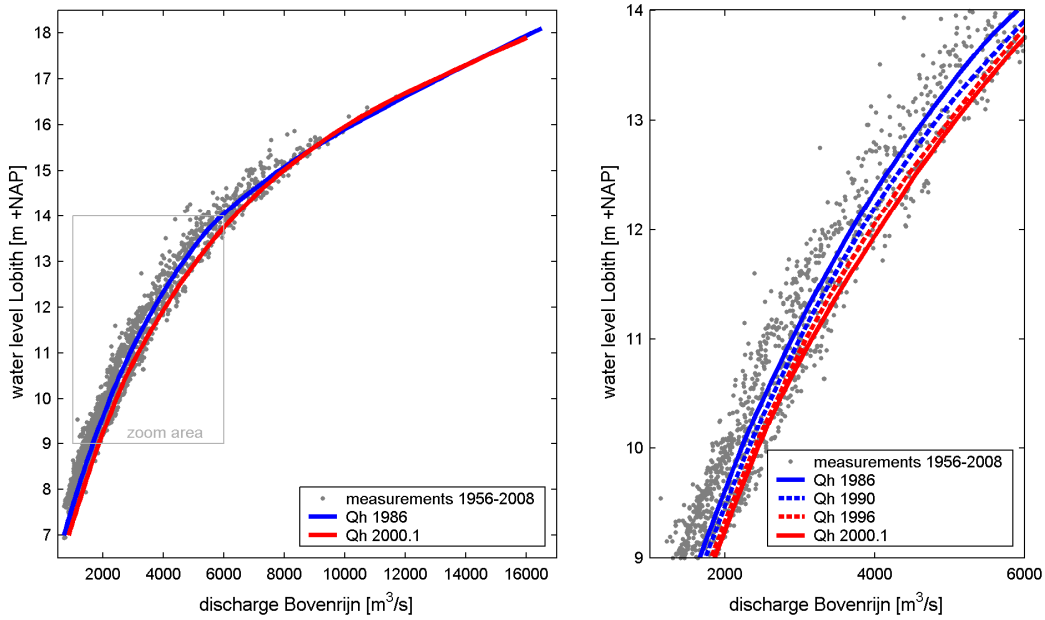

Figure 1. Different rating curves (Qh 1986, 1990, 1996 and 2000.1) together with the discharge measurements from 1956 - 2008 show the temporal change of the stage-discharge relation of Lobith

In need to incorporate temporal variations, dynamic stage-discharge relations were developed for several locations along the Dutch Rhine (Ogink & Stolker, 2004; HKV, 2010). The relation also takes into account the effect of weirs and changes made to the river system due to large projects as Room for the River. The methodology comprises physical backgrounds (e.g. Jones correction) and statistical techniques to optimise the result.

This presentation will clarify the methodology of this dynamic stage-discharge relation and the improvement of the derived discharge time series. Additionally, it will discuss the impact of this relation for Dutch river management.

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