A hydrological perspective of the February 2000 floods: A case study in the Sabie River Catchment

JC Smithers*, RE Schulze, A Pike and GPW Jewitt
School of Bioresources Engineering and Environmental Hydrology, University of Natal, Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

Abstract

The exceptionally heavy rains which fell over the north-eastern parts of South Africa, Mozambique and Zimbabwe during February 2000 resulted in disastrous flooding, loss of hundreds of lives and severe damage to infrastructure. The objective of the study reported in this paper is to assess the severity, from a probabilistic perspective, and spatial variability of the extreme rainfall and flooding which occurred in the north-eastern part of South Africa during February 2000. This is performed for events ranging from 1 to 7 days in duration using the Sabie River catchment, upstream of the South African/Mozambique border, as an example. The analyses indicate that the floods experienced in the Sabie catchment during February 2000 were the result of rare rainfall with return periods in excess of 200 years in parts of the catchment. The extent of the extreme rainfall increased for longer durations.

The magnitudes of the February 2000 floods were such that many gauging stations did not function and numerous gauging structures were inundated. Hence, a modelling approach was adopted to investigate the spatial variability, magnitudes and probabilities of the floods which occurred during February 2000 in the Sabie catchment. The return periods of simulated runoff depths for durations of 1 to 7 days generally exceeded 50 years for the upper and middle portions of the catchment and 200 years in some parts of the Sabie catchment. Hence, some extremely large and rare flow depths were experienced and the spatial variability of the return periods associated with the simulated runoff depths varied substantially within the catchment.

Introduction

Exceptionally heavy rains fell over the north-eastern parts of South Africa, Mozambique and Zimbabwe during February 2000 which resulted in disastrous flooding, loss of hundreds of lives and severe damage to infrastructure (Dyson, 2000). The extreme rainfall was concentrated in two periods, *viz*. 5 to 10 February and 22 to 25 February 2000, and was caused by tropical weather systems that moved from West to East over the subcontinent (Dyson, 2000). The combination of the two systems and high levels of antecedent soil moisture from an already wet December resulted in the excessive flooding (Van Biljon, 2000).

Alexander (2000) using the South Africa Weather Bureau's (SAWB) monthly district rainfall database, not only showed that the February 2000 rainfall in District 48, situated in the north-eastern part of South Africa, slightly exceeded the 100-year return period event, but also indicated that the severity of the rainfall was highly variable with adjacent districts (49 and 34) associated with return periods of less than two years for the February 2000 rainfall. These analyses were performed on monthly totals of rainfall and do not reflect the variability of daily extreme rainfall that occurred.

Based on the design rainfall depths computed by Adamson (1981), Van Biljon (2000) estimated the return period for 1 and 2 day rainfall depths to be greater than 200 years at certain sites in South Africa. Damage occurred to most river gauging stations in the flood ravaged area (Van Biljon, 2000). However, at a number of sites the magnitudes of the February 2000 flood could be estimated and these indicate that the February 2000 flood was the largest recorded value at some sites, but at other sites the estimated magnitude of the February 2000 flood was exceeded in the historical record. Van Bladeren and Van der Spuy (2000) reached a similar conclusion and reported that the flooding in the Limpopo, Sabie, lower Crocodile and lower Komati Rivers exceeded the 100-year return period event.

The objective of the study reported in this paper was to assess the severity, from a probabilistic perspective, and spatial variability of the extreme rainfall and flooding which occurred in the north-eastern part of South Africa during February 2000. This was performed for events ranging from 1 to 7 days in duration using the Sabie River catchment, upstream of the South African/Mozambique border, as an example. The Sabie catchment is located in South Africa as shown in Fig. 1 and has been the focus of numerous studies (e.g. Jewitt and Görgens, 2000). The Sabie River is important from agricultural and eco-tourism perspectives and is one of the rivers which flows through the Kruger National Park before flowing into Mozambique**.**

Methodology

This assessment was performed for durations ranging from 1 to 7 days for both extreme rainfall and floods. This included the maximum values for the February 2000 floods as well as an assessment of the severity of rainfall on individual days or periods within February 2000.

The exceptional flooding resulted in the failure and, in some cases, the destruction of many river gauging stations (Van Biljon, 2000). Hence, the *ACRU* model (Schulze, 1995) was utilised to assess the extent of the flooding. Some initial hydraulically-based assessments of the flood magnitudes have been made at selected sites by Van Bladeren and Van der Spuy (2000) and these estimates and observations at selected gauging weirs are used to evaluate the peak discharges simulated by the *ACRU* model.

Smithers and Schulze (2000) used a regional index-storm approach based on L-moments to estimate design rainfalls for

* To whom all correspondence should be addressed.
☎ (033) 260-5408; fax: (0 33) 260-5818; e-mail: smithers@nu.ac.za
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