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## Hydrological Modeling of Large Drainage Basins Using a GIS-based Hybrid Atmospheric and Terrestrial Water Balance (HATWAB) Model

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### Author(s)

Berhanu F. Alemaw

### ABSTRACT

A Hydrological model is proposed to study the spatial and temporal variability of the water budget components of large drainage basin systems from atmospheric and terrestrial water balances. In order to understand the water balances that include, surface runoff, actual evapotranspiration and soil moisture, a GIS-based simple water balance model which is referred as Hydrological Model from Hybrid Atmospheric and Terrestrial Water Balances with acronym HATWAB is presented. The spatio-temporal climatology database was created from a network of climate stations from CLIMWAT data base to reconstruct the monthly primary inputs to HATWAB model, rainfall and potential evapotranspiration. The modeling principles and HATWAB model are demonstrated using the Limpopo and Congo basins in Africa. The model was used to simulate water balance components by taking rainfall-runoff processes in the basin including soil-texture controlled moisture in the terrestrial system, and the vertical integrated moisture convergence that accounts for the net water vapor flux from the basins in order to close the hydrologic water budget.

### KEYWORDS

HATWAB; Water Budget; Large Drainage Basin; Soil Moisture; Vertical Integrated Moisture Convergence; Water Flux; GIS

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### References

- [1] M. R. Knebl, Z. L. Yang, K. Hutchison and D. R. Maidment, " Regional Scale Flood Modeling Using NEXRAD Rainfall, GIS, and HEC-HMS/RAS: A Case Study for the San Antonio River Basin Summer 2002 storm event," *Journal of Environmental Management*, Vol. 75, 2005, pp. 325-336. doi:10.1016/j.jenvman.2004.11.024
- [2] G. H. Leavesley, S. L. Markstrom and R. J. Viger, " USGS Modular Modeling (MMS)-Precipitation-Runoff Modeling System (PRMS)," In: V. P. Singh and D. K. Frevert, Eds., *Watershed Models*, Boca Raton, Taylor and Francis, 2006.
- [3] W. T. Lin, W. C. Chou, C. Y. Lin, P. H. Huang and J. S. Tsai, " WinBasin: Using Improved Algorithms and the GIS Technique for Automated Watershed Modelling Analysis from Digital Elevation Models," *International Journal of Geographical Information Science*, Vol. 22, No. 1, 2008, pp. 47-69. doi:10.1080/13658810701300121
- [4] C. W. Thornthwaite and J. R. Mather, " Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance." Drexel Institute of Technology, Publications in Climatology, X(3), USA, 1957.
- [5] G. J. McCabe and S. L. Markstrom, " A Monthly Water-Balance Model Driven by a Graphical User Interface," U.S. Geological Survey Open-File Report 1088, 2007, pp. 1-6.

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- [6] C. J. Vorosmarty, B. More, A. L. Grace, M. P. Gildea, J. M. Melillo, B. J. Peterson, E. B. Rasteller and P. A. Steudler, " A Continental Scale Models of Water Balance and Fluvial Transport: An Application to South America," *Global Biogeochemical Cycles*, Vol. 3, No. 3, 1989, pp. 241-265. doi:10.1029/GB003i003p00241
- [7] N. Zeng, " Seasonal Cycle and Interannual Variability in the Amazon Hydrologic Cycle," *Journal of Geophysical Research*, Vol. 104, 1999, pp. 9097-9106. doi:10.1029/1998JD200088
- [8] J. A. Marengo, " Characteristics and Spatio-Temporal Variability of the Amazon River Basin Water Budget," *Climate Dynamics*, Vol. 24, 2005, pp. 11-22. doi: 10.1007/s00382-004-0461-6
- [9] B. F. Alemaw and T. R. Chaoka, " A Continental Scale Water Balance Model: A GIS-approach for Southern Africa," *Journal of Physics and Chemistry of the Earth*, Vol. 28, No. 20-27, 2003, pp. 957-966.
- [10] W. P. A. Van Deursch and J. C. J. Kwadijk, " An Integrated GIS Water Balance Model for the River Rhine," *Proceeding of Viena Conference, IAHS Publ., the Netherlands*, No. 211, 1993, pp. 507-518.
- [11] D. Conway, " A Water Balance Model of the Upper Blue Nile in Ethiopia," *Hydrological Science Journal*, Vol. 42, No. 2, 1997, pp. 265-286. doi:10.1080/02626669709492024
- [12] DWAF, Department of Water Affairs and Forestry, Republic of South Africa, " Water Balance Situation Assessment Model (WSAM)," 2007. <http://www.usersupport.co.za/>
- [13] USGS, " Interactive Stream Flow Model, Flood Risk Map and Hydrographs," [http://edcw2ks40.cr.usgs.gov/sa\\_floods/article.asp?sid=37&comm=yes](http://edcw2ks40.cr.usgs.gov/sa_floods/article.asp?sid=37&comm=yes)
- [14] B. F. Alemaw, " A Hybrid Atmospheric and Terre-Strial Water Balance Model. A GIS Based Approach for Large Drainage Basins," *Internal Research Report. University of Botswana*, 2006, p. 32.
- [15] B. F. Alemaw, T. R. Chaoka and O. Matenge, " Spatial and Temporal Variability of the Limpopo River Basin Water Budget from a GIS-based Limpopo water balance model," In: Savenije, et al., Eds., CD-ROM Proceedings of Water-Net/Warfsa/GWP-SA Annual Symposium, Lilongwe, Malawi, 1-3 November 2006.
- [16] J. B. Chishugi and B. F. Alemaw, " The Hydrology of the Congo River Basin: A GIS-Based Hydrological Water Balance Model," In: S. Starrett, Ed., *Proceedings of World Environmental and Water Resources Congress 2009 (American Society of Civil Engineers): Great Rivers*, Kansas City, 17-21 May 2009, pp. 1-16.
- [17] B. F. Alemaw, " Development and Application of a GIS-Based Regional Hydrological Variability and Impact Assessment System for the Southern African Region," *PhD Thesis (unpub.)*, University of Dar es Salaam, 1999, pp. 1-282.
- [18] Food and Agriculture Organisation (FAO), *FAO CLIMWAT for CROPWAT*, CD-ROM. *Agroclimatic Database. Rainfall and Evaporation Figures*, United Nations Food and Agriculture Organisation (FAO), *World Reference Base for Soils*, Rome, 2003.