Estimation of discharge using temperature index melt model in Modi River basin, Kaski, Nepal

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OUTLINE

- Introduction
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- Conclusion
- Acknowledgements

Graduate Course-Surface water and Ground water interaction, 2016
INTRODUCTION

- Changing precipitation or melting of snow and ice altering hydrological systems (Jimenez Cisneros et al., 2014)
- As glaciers shrink their relative contribution decreases (Huss, 2010)
- Hydrological models; framework to investigate relationship of climatic variables (Maurer et al., 2009)
- Temperature index melt model, widely used in data scarce Himalayan region
- Knowledge gap about relevance of snow and glacier melt in Asian river hydrology (Immerzeel, 2010)
- Efficient management of water resource; wise decision making

MATERIALS AND METHODS

Study area
- Modi River basin: Kaski district-Gandaki zone
- Modi River originates from Annapurna massif, the main tributary of the Kaligandaki River of Gandaki basin
- Catchment area: 643.2 km²
- Elevation range: 748 m to 8000 m
- Glaciers: 12 % (77.5 km²)
- Rock and vegetation: 88 % (565.6 km²)
- Diverse climate with highest precipitation at Lumle agro-meteorological station
### MATERIALS AND METHODS...

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<th>Data collection</th>
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<td>Daily temperature and precipitation</td>
<td>(1980-2013) Lumle AMS (1740 m)</td>
<td>DHM (GoN)</td>
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<td>(1991-2010) Kushma MS (891 m)</td>
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<td>Mann-Kendall test (Mann, 1945; Kendall, 1975)</td>
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<td>Daily discharge</td>
<td>(1988-2013) Nayapul HS (748 m)</td>
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<td>RCM-WRF (2016-2050) daily temperature and precipitation for RCP4.5 and RCP8.5 emission scenarios</td>
<td>BCCR, University of Bergen, Norway</td>
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<td>ASTER DEM (2011), Landsat 4, 5 Thematic mapper images (Oct, 2010)</td>
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<td>Glacier outlines (2010)</td>
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Location map of Modi River basin, Kaski, Nepal.
MATERIALS AND METHODS...

Hypsograph of the Modi River basin

Flow chart of MPDDM approach
RESULT AND DISCUSSION

Observed climatic data analysis

Observed temperature and precipitation at base station (Lumle)

Observed discharge at base station (Lumle)
RESULT AND DISCUSSION...

MPDDM discharge simulation

Calibration year (1991-2000)

- NSE = 0.75
- VD = 1.23 %
- R² = 0.77

Validation year (2001-2013)

- NSE = 0.76
- VD = -9.43 %
- R² = 0.79

Observed discharge

Simulated discharge

RESULT AND DISCUSSION...

Contribution of snow and ice melt in river discharge

Calibration year (1991-2000)

- 5.29 %
- 94.71 %

Validation year (2001-2013)

- 5.71 %
- 94.29 %

11 Nov 2016
RESULT AND DISCUSSION...

Projection of future discharge (2016-2050) of basin

Decadal hydrograph analysis

RCP4.5

- 1991-2013
- 2016-2020
- 2021-2030
- 2031-2040
- 2041-2050

RCP8.5

- 1991-2013
- 2016-2020
- 2021-2030
- 2031-2040
- 2041-2050

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CONCLUSION

- Temperature index melt model - a good hydrological model
- Model applicable in data scarce Himalayan region
- Modeling approach aids in impact studies
- Emission scenarios; future water availability
- Real scenario - groundtruthing??

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Modified Positive Degree Day Model for the Estimation of River Discharge
Version 1.0

Fig: Sink hole at Armala VDC, Pokhara