Enhanced Engagement in Research on Kabul River Basin (EKaRB)

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Brief Overview

- A consolidated database on Indus Basin "Indus Basin Knowledge Platform (IBKP)" http//: indusbasin.org (DFID funded)
- Kabul River Basin Knowledge Platform: A decision support tool online launch during the 4-6 July Indus Knowledge Forum in Colombo
- Hec-GeoHMS rainfall runoff model with climate change scenarios focus of today's presentation
- Water Evaluation and Planning Model (WEAP) for the Kabul River Basin under development. Expected completion in Q4
- A comprehensive review of relevant national, sub-national, regional and international laws on water to suggest options for future development of Kabul River Basin
- Research manuscripts under preparation/review

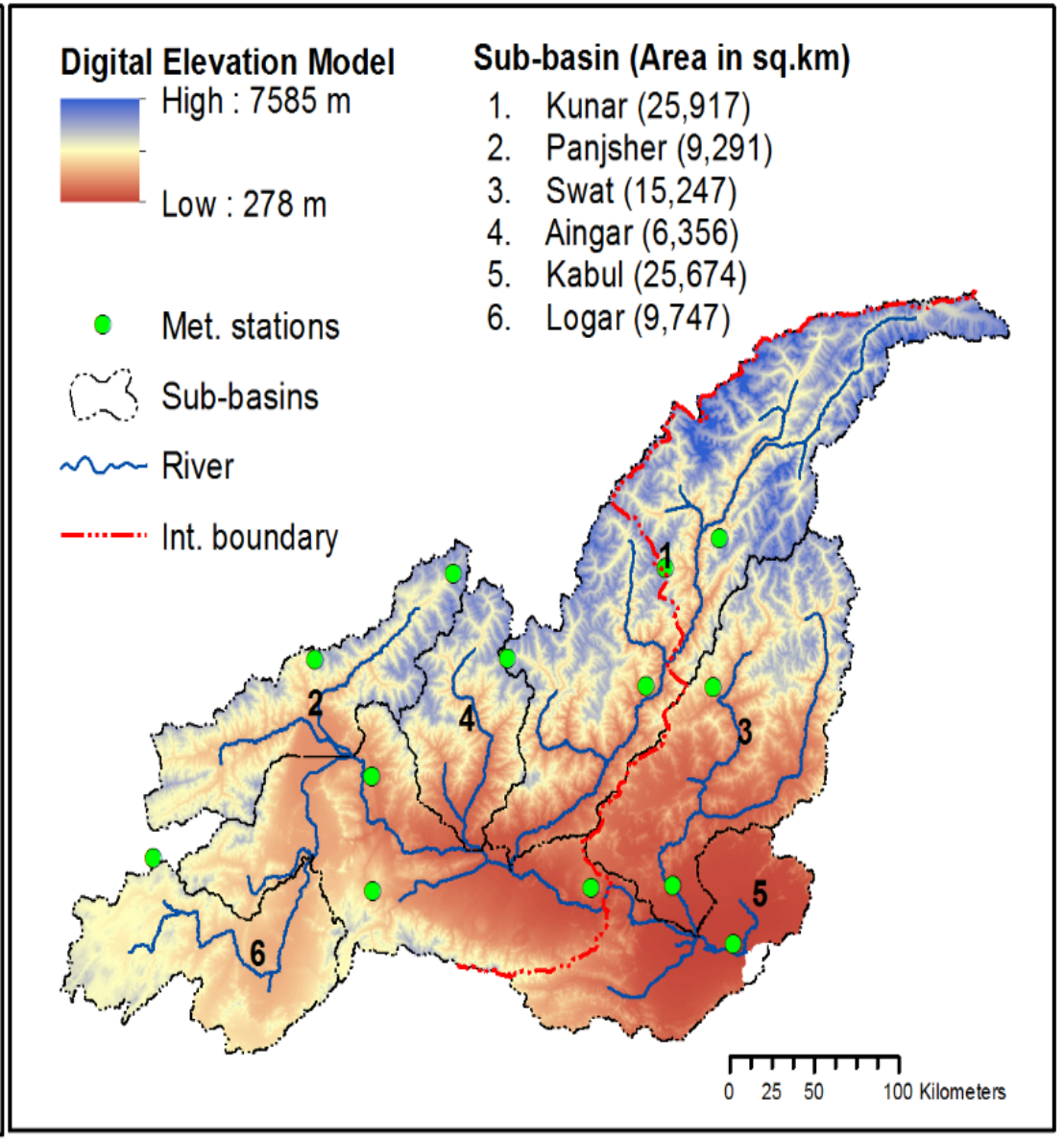
Background

- Both Pakistan and Afghanistan share Kabul River Basin (KRB) becoming upper and lower riparian states respectively. KRB contributes a significant amount of water in the water budget of both countries. However, there has been a considerable decrease in annual flows of Kabul river system based on the historical data (1937 – 2008) which amounts from 28 to 19 MAF (IUCN 2013). The possible reasons could be climatic variability, persistent drought or enhanced use of water in Afghanistan.
- Pakistan is one of the most water-stressed countries. Application of hydrological models has proved to be a good tool to understand the impacts of climate change on mean and peak flows and flood frequencies at catchment scales. The HEC-HMS hydrological modelling aimed at the following two main issues:

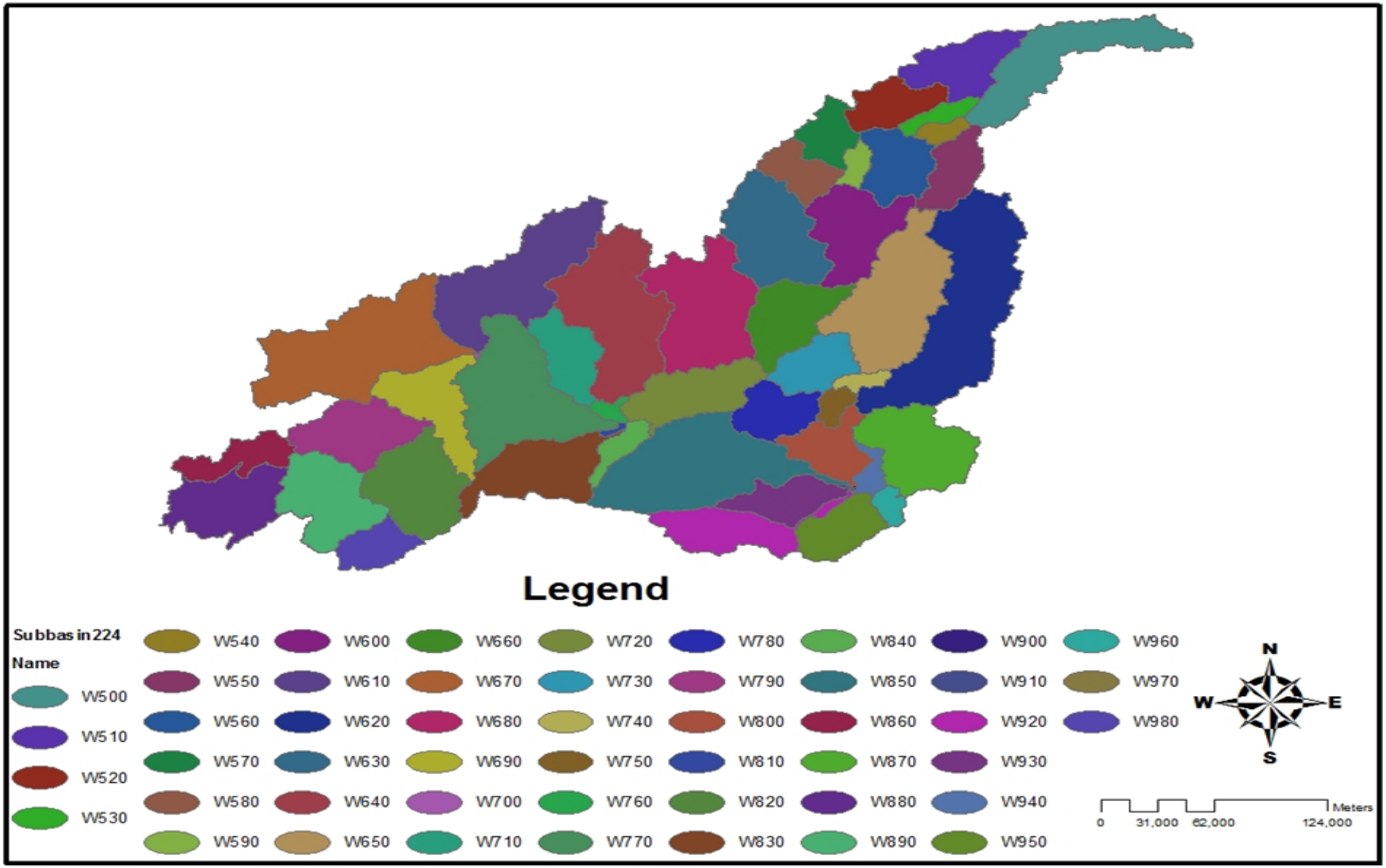
❖Pairing climate data and historical and modern climate data to statistically create a hydrograph

❖Projected climate change impacts on flows

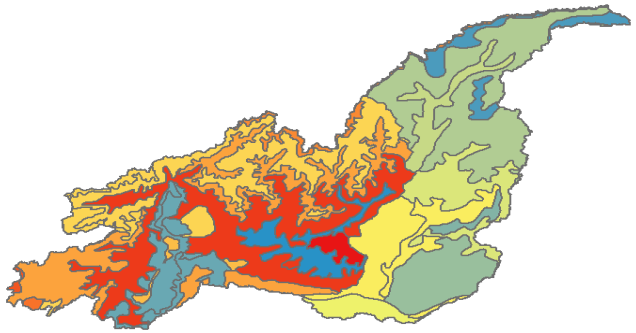
Study Area and DEM of KRB



GIS and HEC-GeoHMS processing (Subbasin delineation)



GIS input to the Model

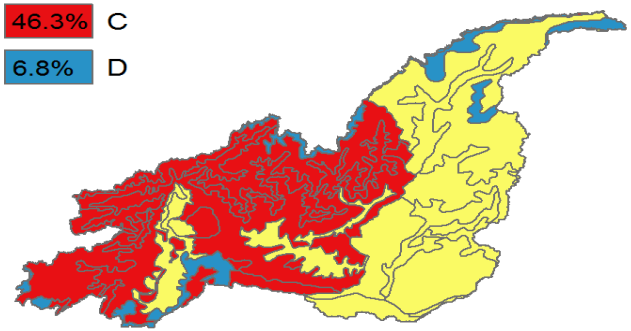


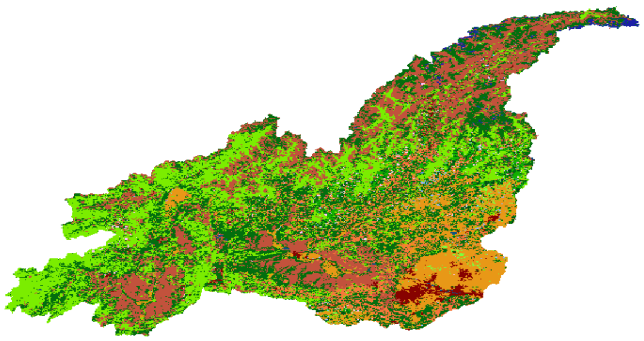
KRB_Soil Classification
USDA-SCS (2011)

- Calcixeralfs with Xerochrepts
- Glaciers and snow caps
- Haplocambids with Torriorthents
- Loamy and clayey mainly noncalcareous soils
- Loamy and clayey part noncalcareous soils
- M rock outcrops with some loamy very shallow soils
- Mainly loamy shallow soils and rock outcrops
- Mountain Mainly Loomy, shallow soils
- Mountains Loamy, Shallow Soils and rock outcrops
- Mountains Rock outcrops and loamy very shallow
- Rocky land with Lithic Cryorthents
- Rocky land with Lithic Haplocambids
- Rocky land with Lithic Haplocryids
- Rocky land with ice-capped bare rock
- Torrifluvents with Torripsamments
- Torriorthents with Torrifluvents
- Xerochrepts with Xerorthents
- Xerorthents with Xeropsamments

KRB_Soils
Hydrological Soil Groups

- 47% B
- 46.3% C
- 6.8% D





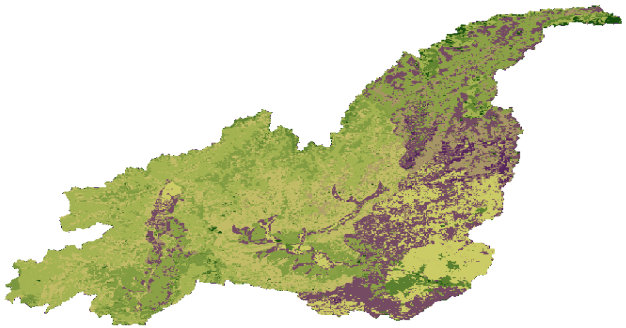
MODIS Land Use

- Barren or Sparsely Vegetated
- Closed Shrublands
- Cropland/Natural Vegetation Mosaic
- Croplands
- Deciduous Broadleaf Forest
- Deciduous Needleleaf Forest
- Evergreen Broadleaf Forest
- Evergreen Needleleaf Forest
- Grasslands
- Mixed Forests
- Open Shrublands
- Permanent Wetlands
- Savannas
- Snow and Ice
- Urban and Built-Up
- Water
- Woody Savannas

Curve Number

High : 98

Low : 55



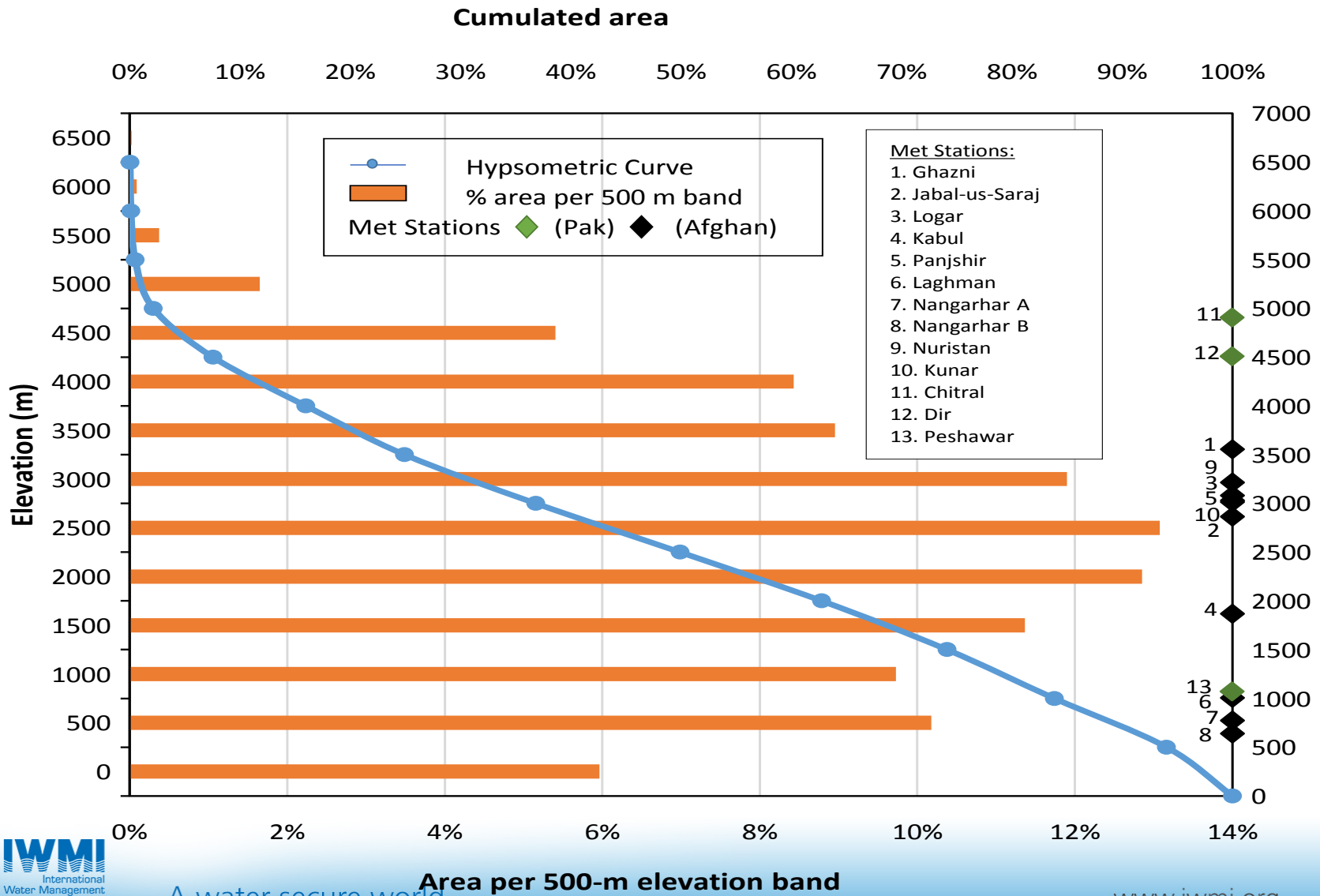
Hydrological Soil Groups

Hydrological Soil Group (HSG)	Soil Textures
A	Sandy, loamy sand, or sandy loam
B	Silt loam or loam
C	Sandy clay loam
D	Clay loam, silty clay loam, sandy clay, silty clay, or clay

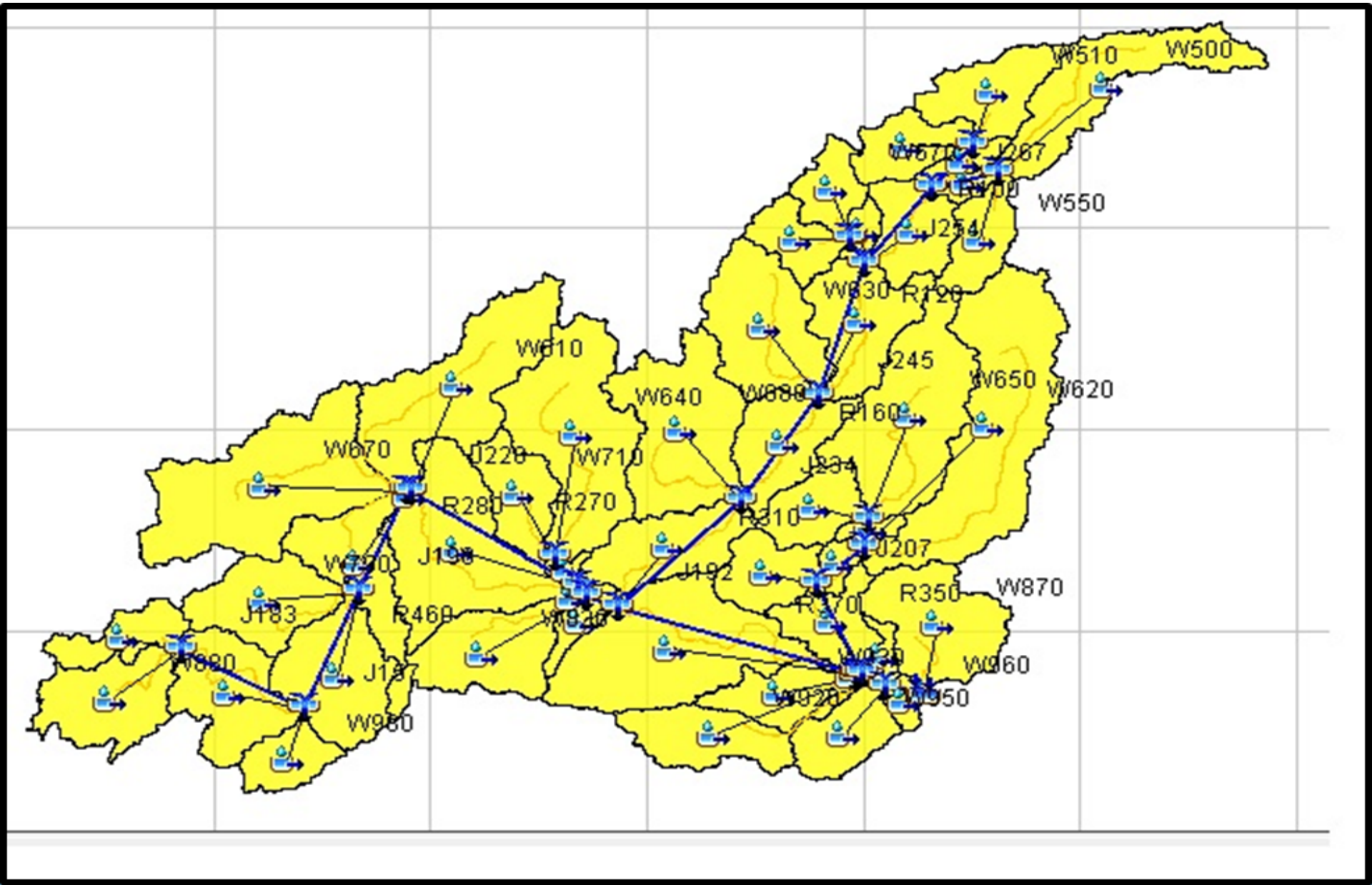
Satellite data

- Digital Elevation Model (DEM) 90m data was retrieved using the Shuttle Radar Topography Mission (SRTM) (http://srtm.csi.cgiar.org/)
- Moderate Resolution Imaging Spectroradiometer (MODIS) land cover data (http://glcf.umd.edu/data/lc/).
- Soil classification within Kabul River basin was retrieved from Unites States Department of Agriculture (USDA) and soil survey of Pakistan soil maps. (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/worldsoils/?cid=nrcs142p2_054000)

Hypsometric curve for KRB



HEC-HMS Project



Hydrologic and climate data

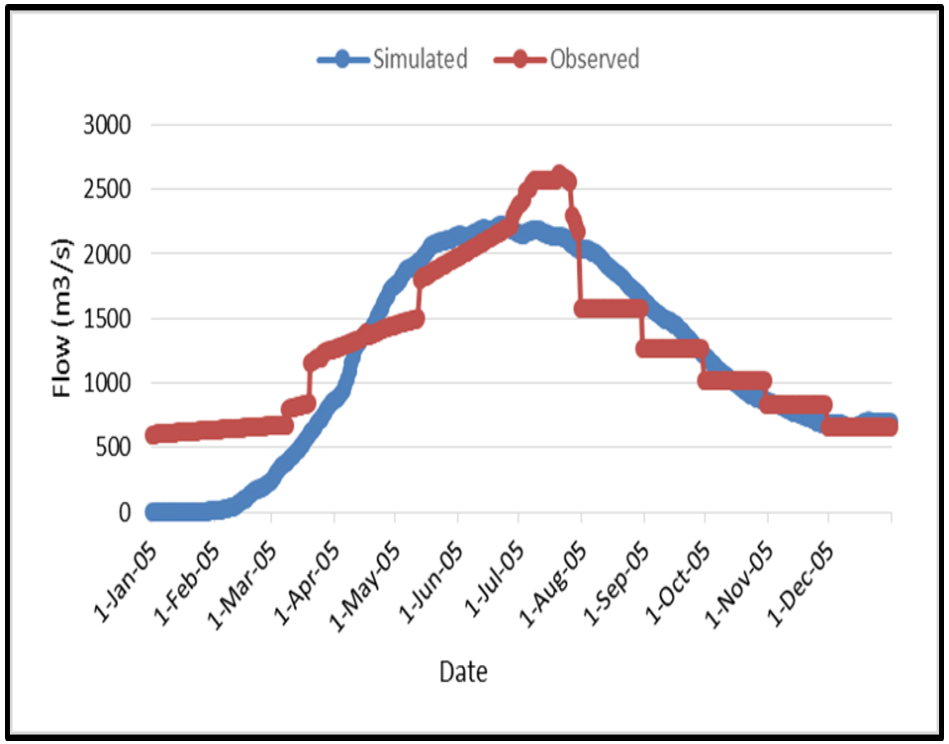
Met Stations	Period of record
Ghazni	2000-2012
Jabal-us-Saraj	2000-2012
Logar	2000-2012
Kabul	2000-2012
Panjshir	2000-2012
Laghman	2000-2012
Nangarhar A	2000-2012
Nangarhar B	2000-2012
Nuristan	2000-2012
Kunar	2000-2012
Chitral	2001-2012
Dir	2001-2012
Peshawar	2001-2012

Flow Stations	Period of Record
Noshehra	2002-2014
Warsak Dam	2004-2014

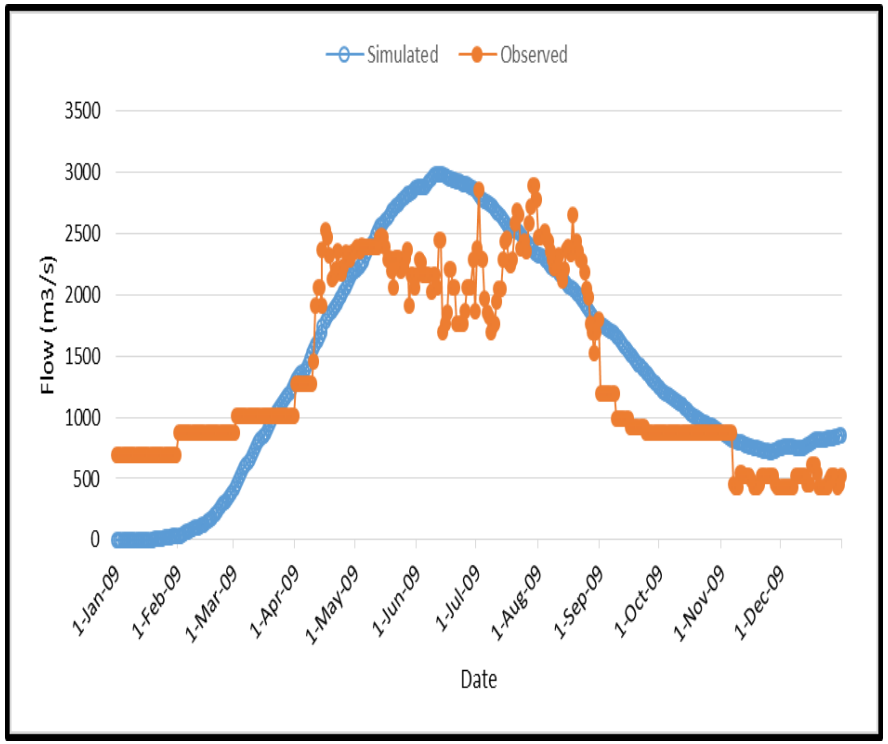
Model Calibrated and validated at downstream of Warsak Dam near Nowshehra

Model Calibration and Validation at Nowshera

- Calibration



- Validation



Model Calibration and Validation at Nowshera

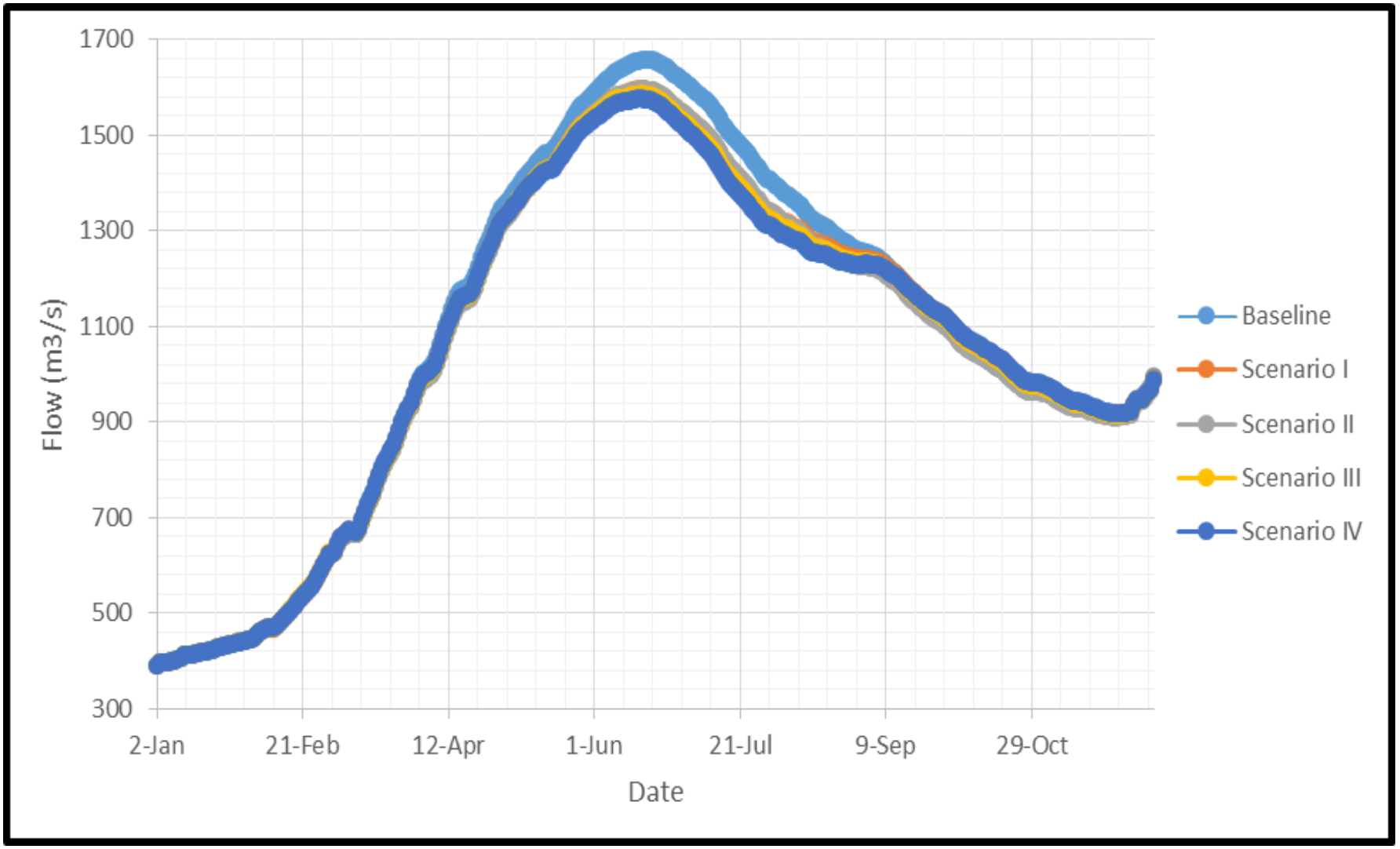
Action	Period	Peak flow			Mean flow			Total volume			R^2	NS
		Observed m^3/s	Simulated m^3/s	RE %	Observed m^3/s	Simulated m^3/s	RE %	Observed Mm^3	Simulated Mm^3	RE %		
Calibration	2005	2620	2224	**15.11**	1271	1176	**7.47**	40	37.1	**7.25**	**0.84**	**0.71**
Validation	2009	2892	2988	**-3.32**	1363	1430	**-4.92**	42.94	45	**-4.80**	**0.74**	**0.56**

Future climate change scenarios

Downscaled climatic data for KRB was used for future scenario analysis:

- Year 2002 – Baseline
- Year 2025 – Scenario I
- Year 2050 – Scenario II
- Year 2075 – Scenario III
- Year 2100 – Scenario IV

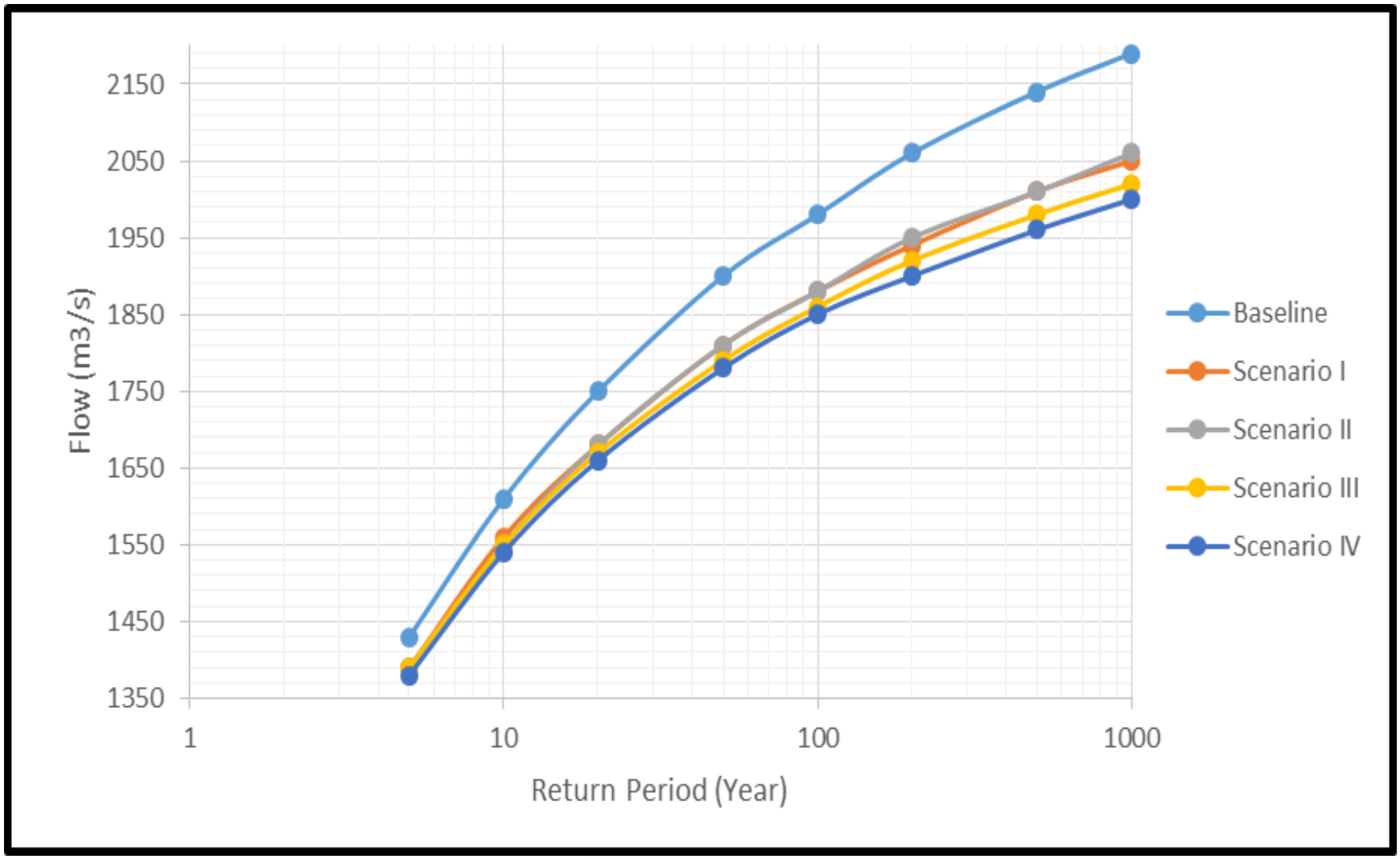
Future discharge cycle at Noshehra



Future discharge cycle at Noshehra

Scenarios	Change in mean discharge (%)	Change in peak discharge (%)
Scenario I	-1.71	-3.83
Scenario II	-2.15	-3.85
Scenario III	-2.00	-4.49
Scenario IV	-2.19	-5.12

Future flood frequency analysis



Summary

- HEC-HMS was used to examine the impacts of climate change on the flood frequencies
- GIS and HEC-GeoHMS was used to process the data in the KRB
- Observed meteorological and flow data were used to calibrate and validate the model for best set of parameters
- Future climate data were downscaled for KRB
- Climate change has nominal effect on the mean and peak flows
- Flood frequency quantiles will reduce under climate change scenarios

THANKS