



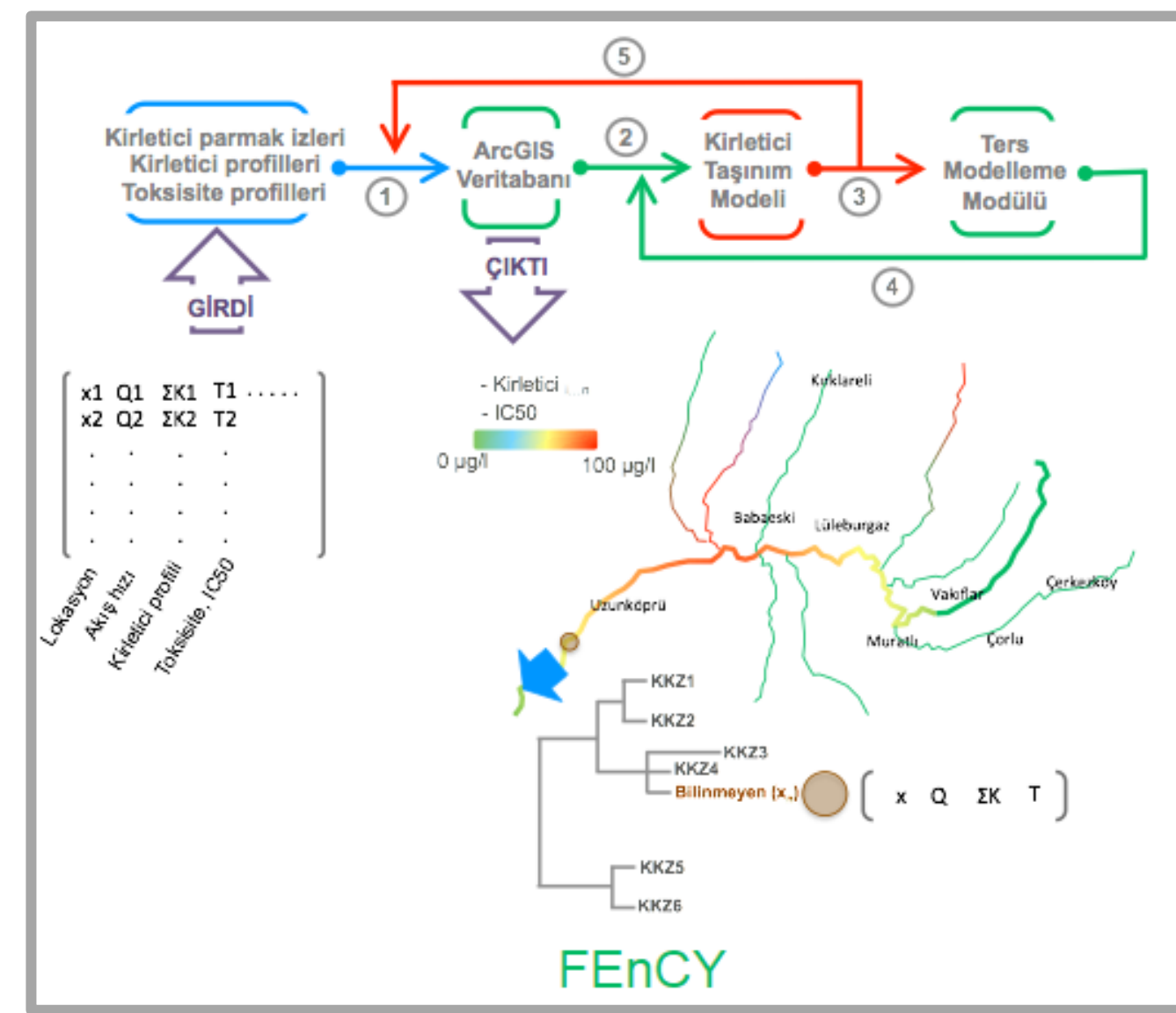
Effect of Land Surface Elevation Data Availability on River Hydraulic Model Output

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INTRODUCTION

River hydraulic models are useful tools in watershed management. They are critical components of flood planning studies, and are prerequisites for pollution transport modeling. One of the critical parameters in modeling river hydraulics is the river channel slope.

When the river system of a large watershed is of concern, the land surface elevation data can be used to create the river network and to determine the slopes of the river channels.

Digital elevation maps (DEMs) created by using remote observations, together with GIS tools provide an easy way to delineate the river network and to determine the river channel slopes. However, the validity of the resultant model parameterization is very much dependent on the resolution and the accuracy of the DEM data.

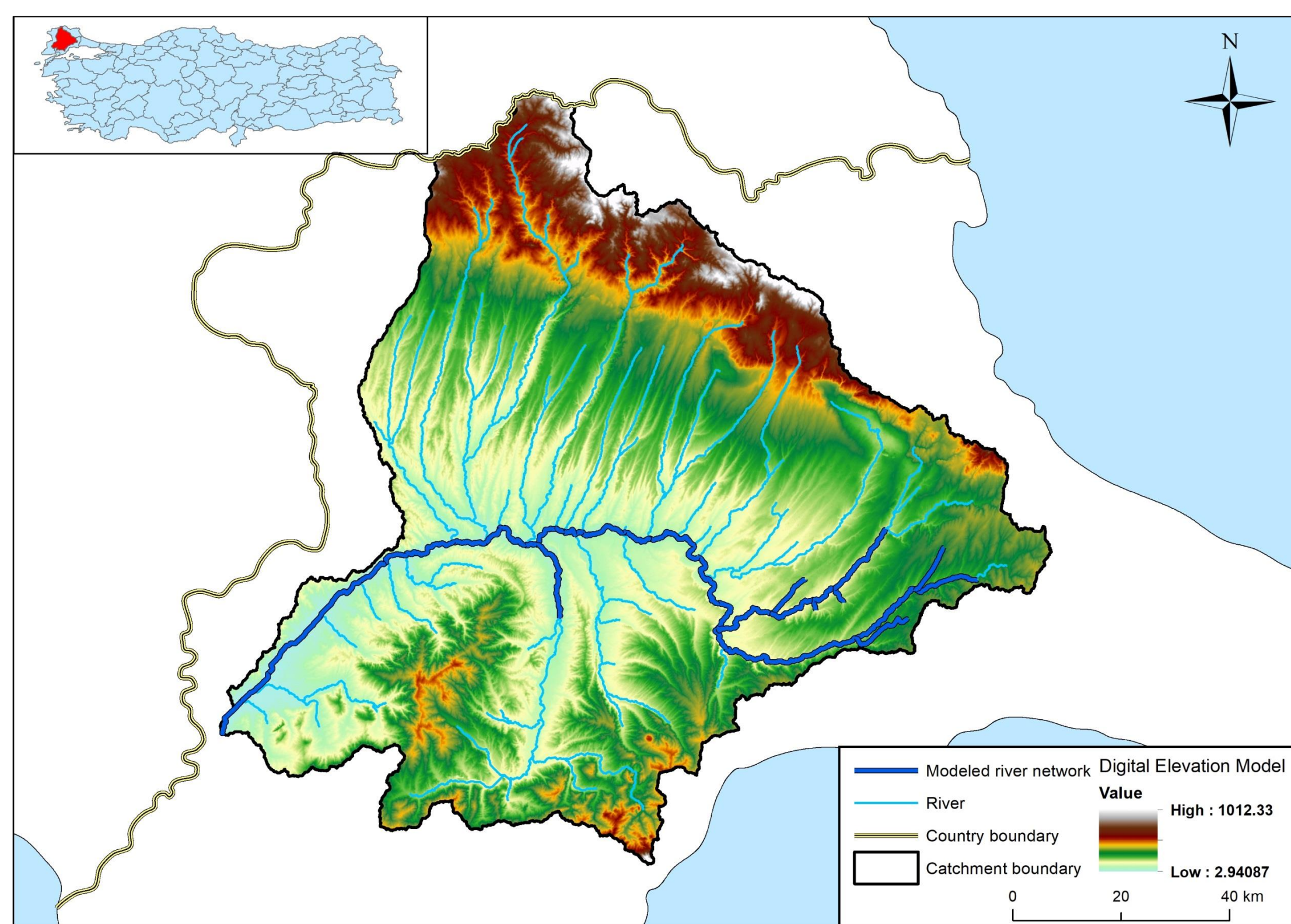
The alternative to using DEM data based on remote sensing is to use actual site elevation measurements throughout the river network. Although this alternative has the potential to provide more accurate results, collecting and compiling measurement data in the adequate resolution may not be economically feasible if the data is not already available, especially in case of developing countries.

STUDY AREA

ERGENE WATERSHED

This study is part of a research project titled “Development of a geographical information system based decision-making tool for water quality management of Ergene Watershed using pollutant fingerprints” funded by Turkish Scientific and Technological Research Council (TUBITAK).

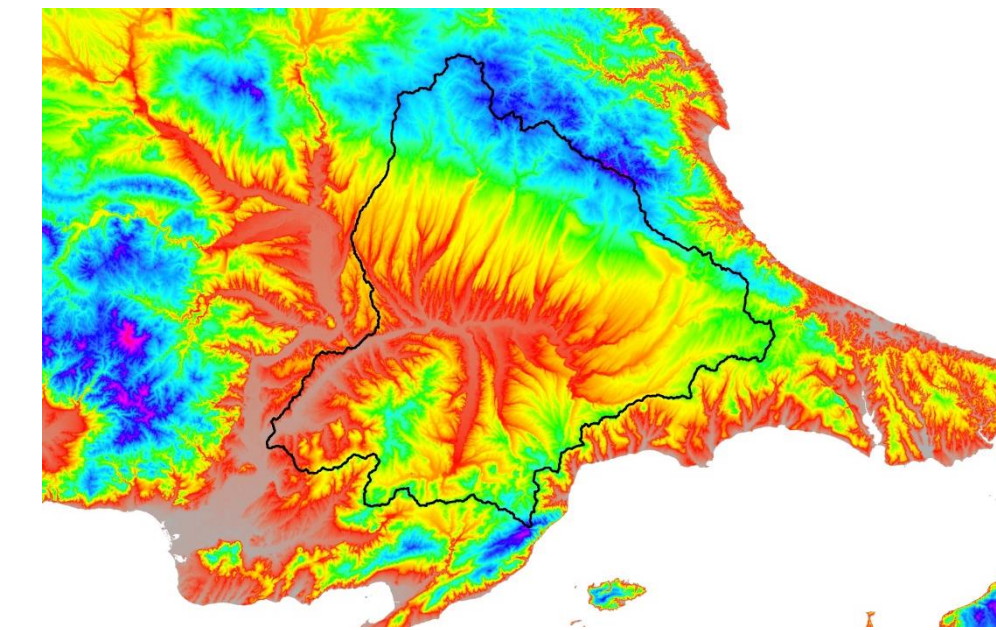
- A hydraulic model is being developed to be used in water quality management of the Ergene Watershed, which has a drainage area of 10,952 km².
- The hydraulic model will cover the main branches of Ergene River with a total length of more than 300 km.



DESCRIBING THE RIVER NETWORK AND RIVER CHANNEL SLOPES

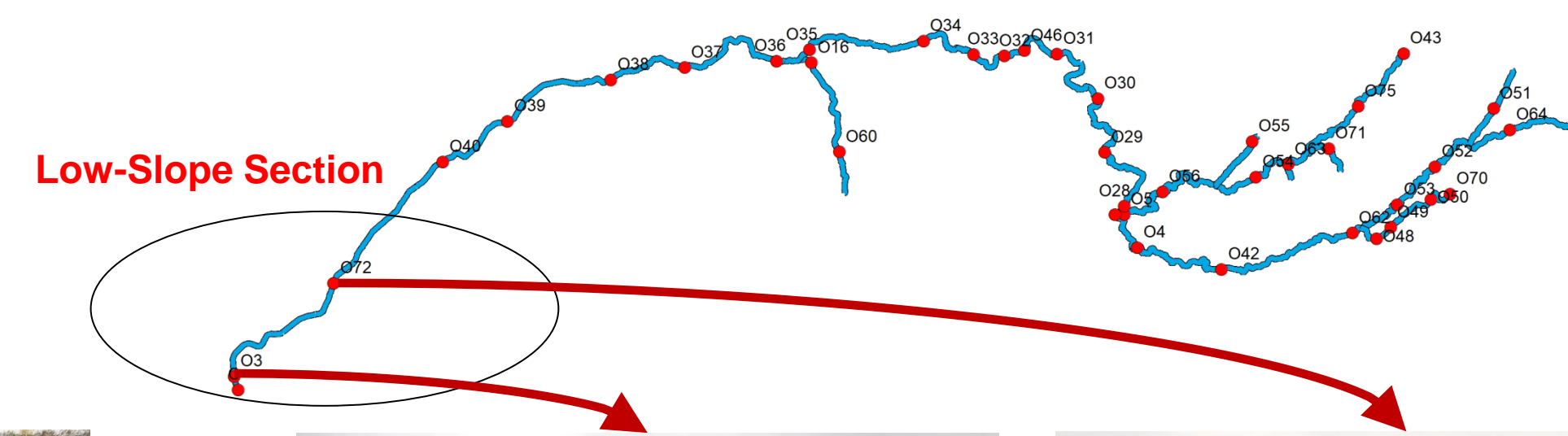
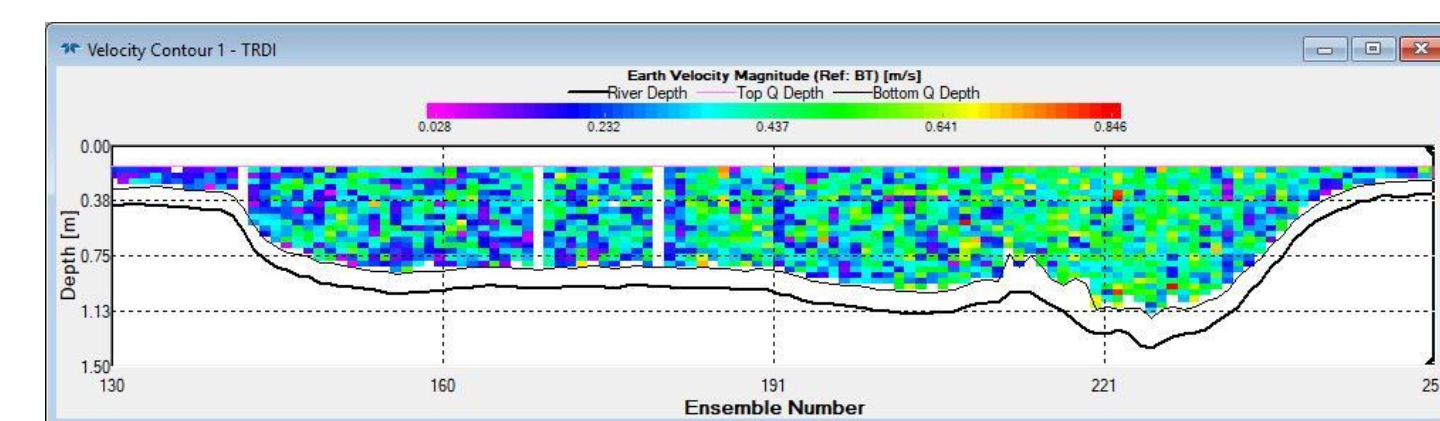
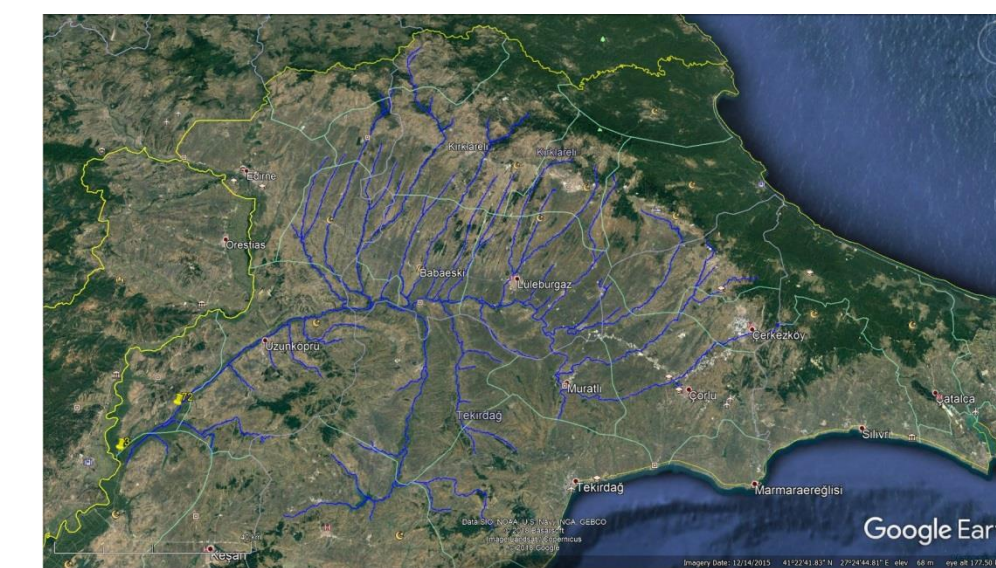
Approach 1: Using DEM

- EU-DEM: Publicly available through the European Environment Agency
- Resolution: 1 arc second ~ 30 m
- Watershed delineation and flow network generation using GIS tools
- **Elevations at river nodes read from DEM**

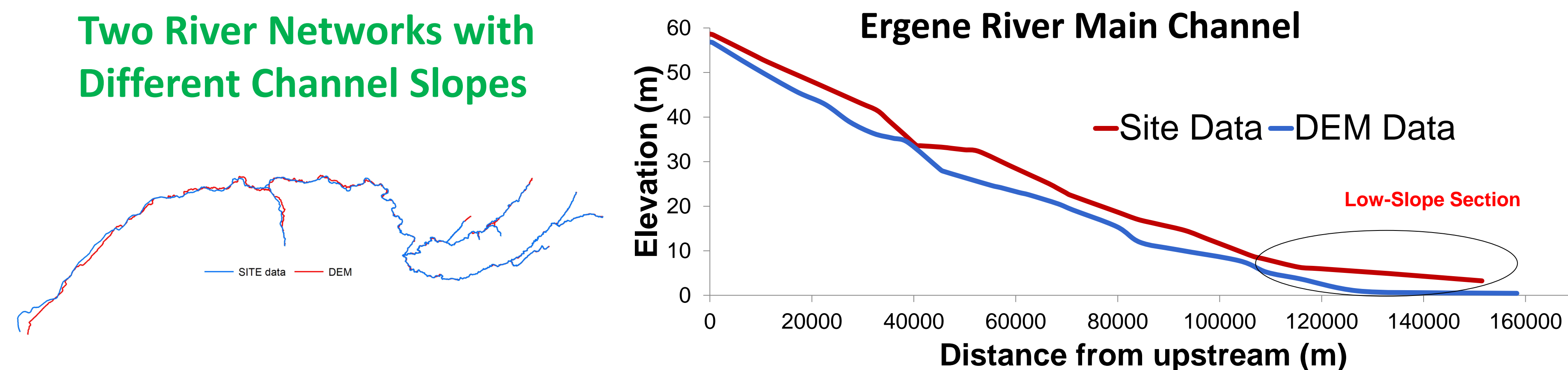


Approach 2: Using SITE DATA

- Measurements at 38 locations throughout the river
 - Water surface elevations
 - Channel cross sections
 - Flowrate and velocity
- Using satellite images obtained through Google Earth to generate river network by manual tracing
- **Elevations at river nodes obtained from site measurements**



Two River Networks with Different Channel Slopes



HYDRAULIC MODEL

U.S. Environmental Protection Agency's Storm Water Management Model (SWMM)

- Channel cross-sections obtained from site data
- Roughness coefficients by back-calculation from measured flow, slope and cross-section data
- Distributed flow inputs to channels deduced from site measurements.
- **Steady-flow simulations conducted for two different river networks with different channel slopes**

ACKNOWLEDGEMENT

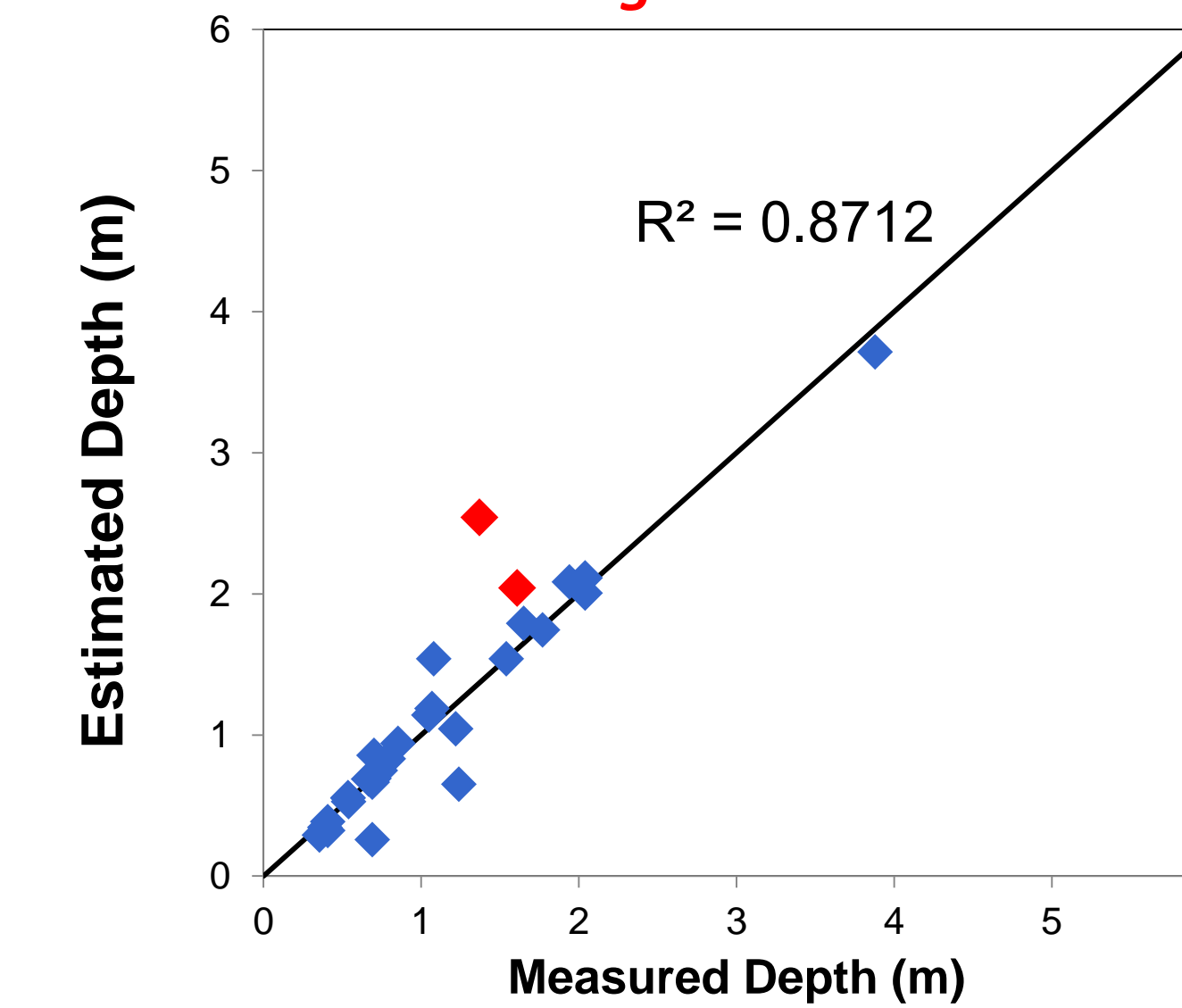
This study is funded by The Scientific and Technological Research Council of Turkey (TUBITAK) under Project Number 115Y064. We would like to thank Ezgi Yildirim for generating the river network from Google Earth images.

RESULTS

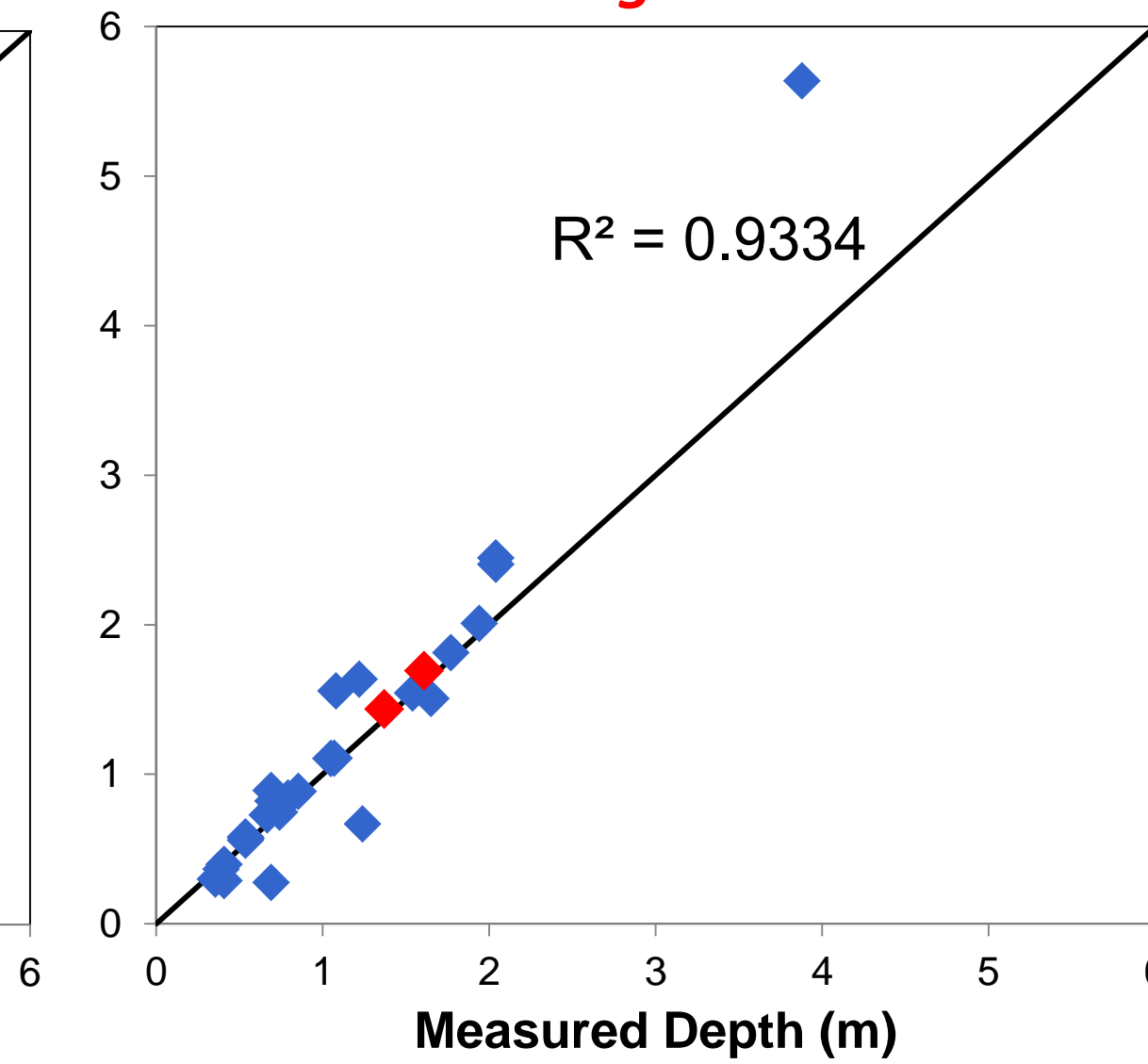
COMPARISON OF THE TWO APPROACHES

cross-sections obtained from site data
back-calculated roughness coefficients

Using SITE DATA



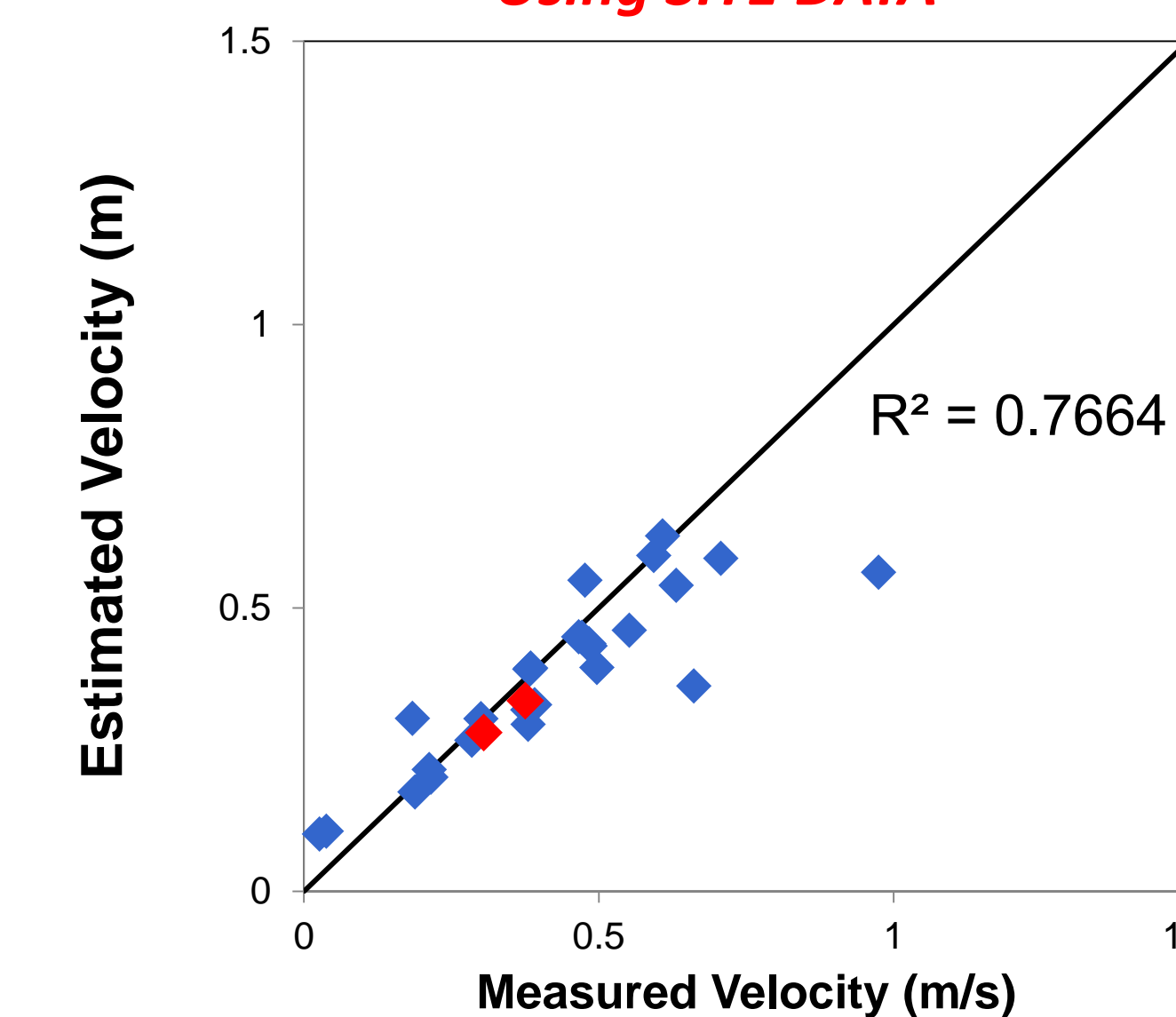
Using DEM



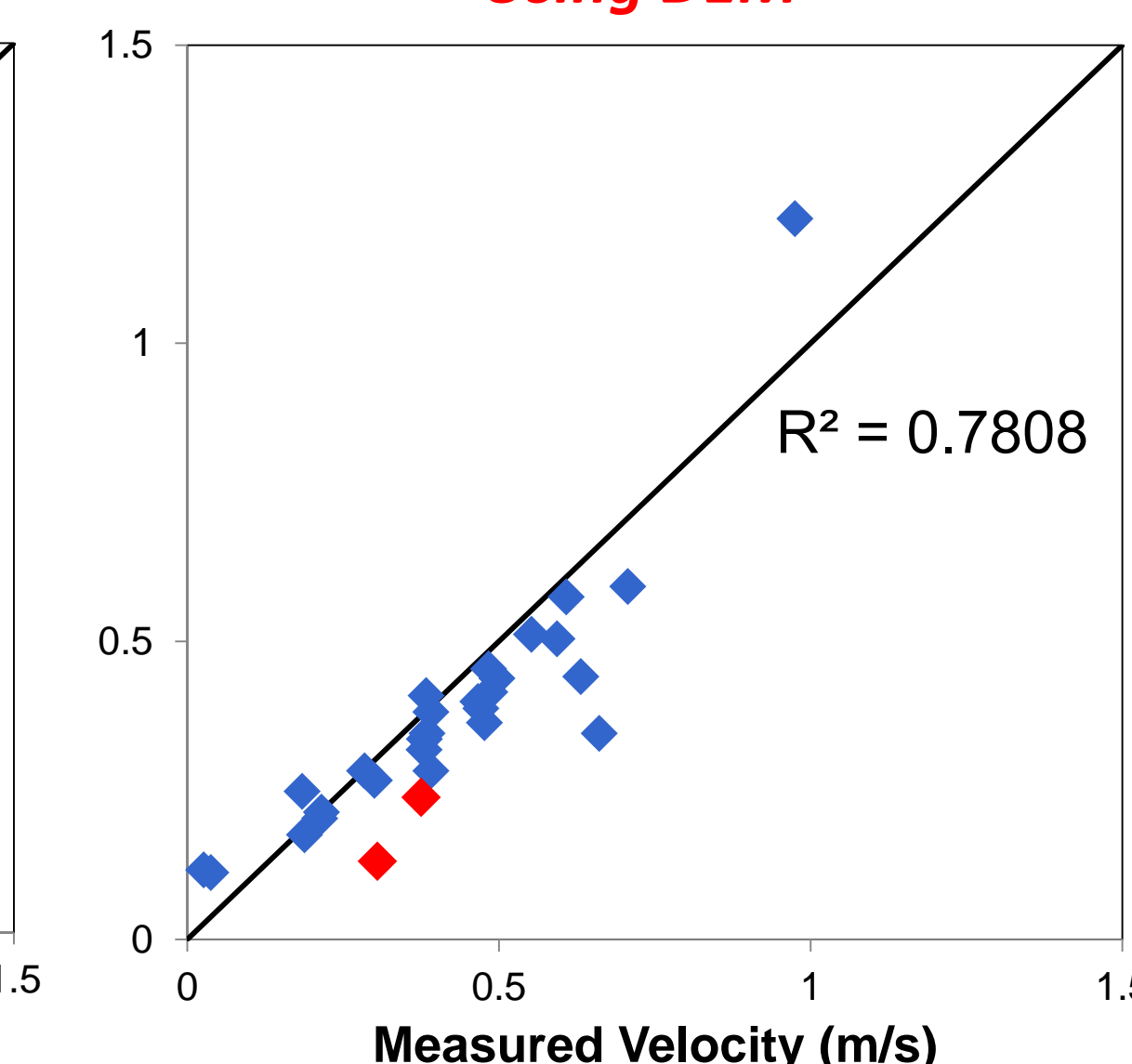
◆ Low-Slope Measurement Locations

R² is the square of the Pearson Correlation Coefficient.

Using SITE DATA



Using DEM

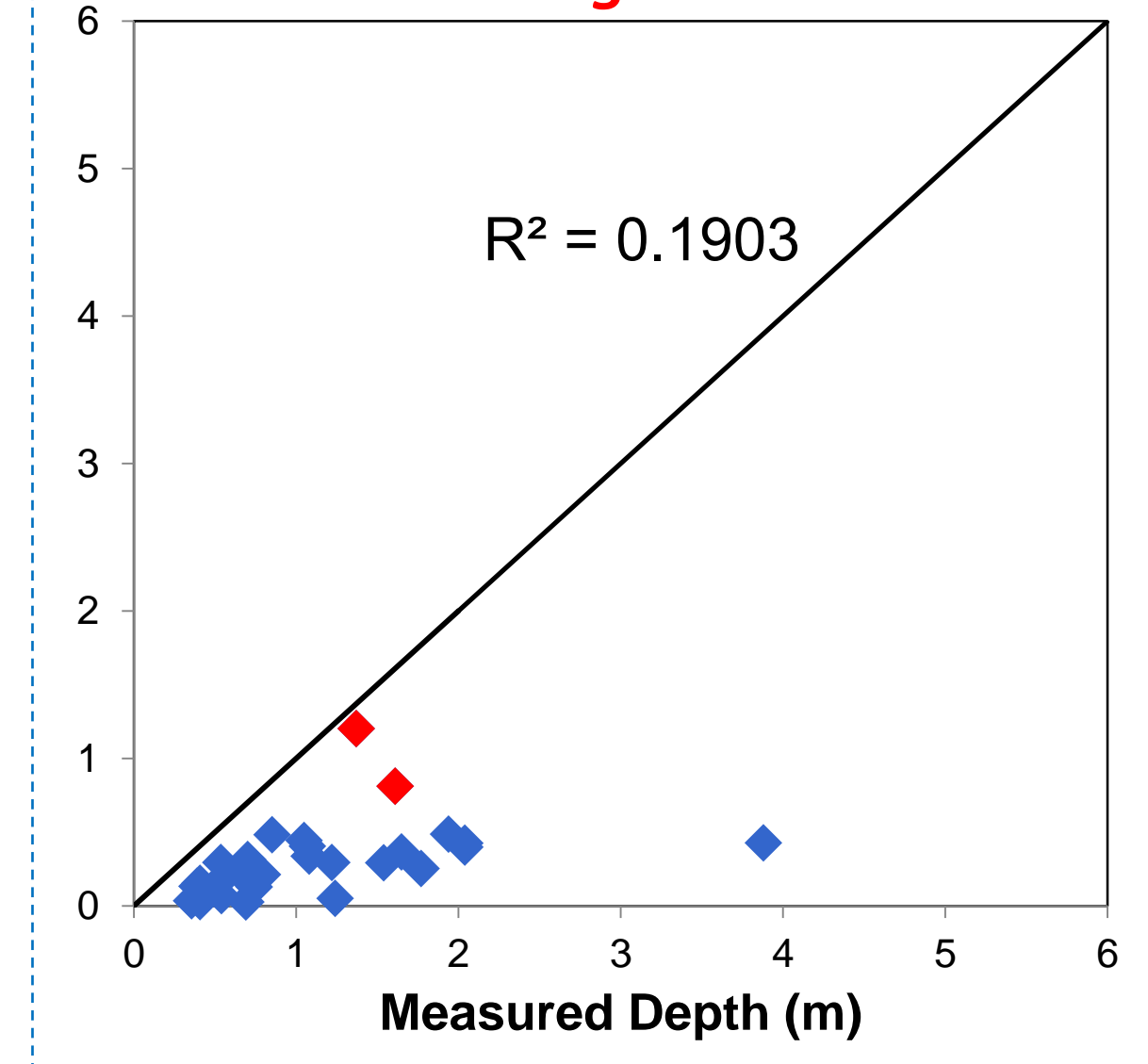


WHAT IF

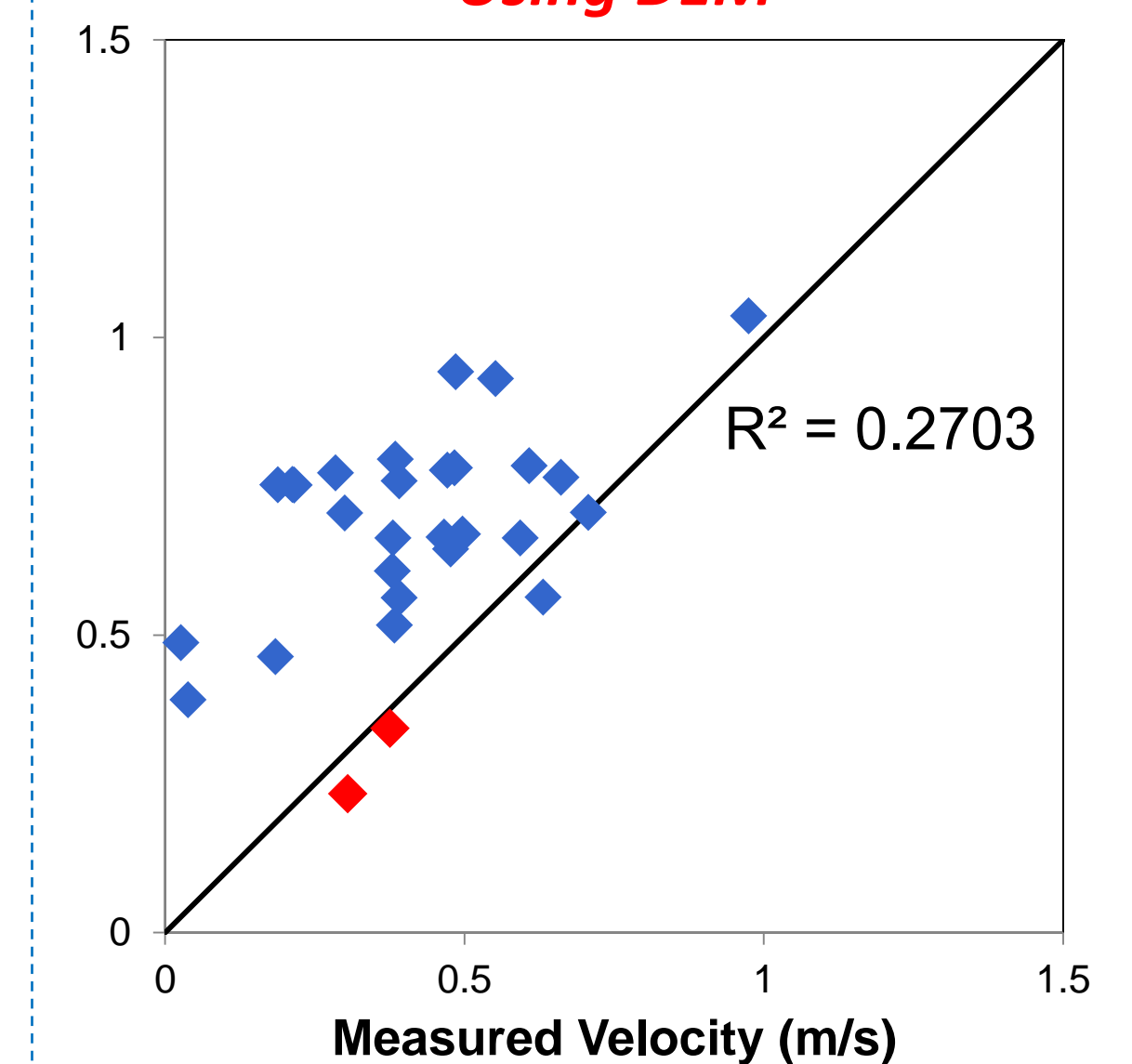
NO CROSS-SECTION DATA
WAS AVAILABLE ?

trapezoidal cross-sections
generic roughness coefficients
(n = 0.013)

Using DEM



Using DEM



SUMMARY & CONCLUSIONS

- Ergene River's channel hydraulics was modeled for the steady-flow case.
- Two different approaches were used to determine river network and river channel slopes that used:
 - (i) DEM data; (ii) Site data.
- When every other model input was the same, both approaches produced comparable model outputs.
- When the hydraulic model that used DEM data was run with trapezoidal cross-sections and generic roughness coefficients, the model outputs significantly deteriorated.
- Using site-specific cross-section data and accurate roughness coefficients seem to be more important than using accurate site elevation data when river hydraulic model outputs are concerned.
- Further studies needed to provide specific guidance on developing cost-effective site data collection schemes.
- Future work includes integrating the hydraulic model with a hydrological model for conducting dynamic simulations.