Mississippi River (H.Fisk, 1944)

Politecnico di Torino

Department of Environment, Land and Infrastructure Engineering

1859

Dimensional analysis and intercomparison of the basin time of concentration formulas

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Sharing is encouraged

This presentation participates in OSPP

EGU

Outstanding Student & PhD candidate Presentation contest

Design Flood peak estimates are highly sensitive to the critical basin travel time

> But there is no agreement on the conceptual and operational definitions of **the time of concentration** and the **lag time**

> and upper and lower bounds of these parameters can not be predicted *a priori*

A history of the concept of time of concentration

Keith J Beven

Looking for a robust formulation to be used in hydrological modelling...

47 empirical and semi-empirical formulas selected

STARTING POINT

Azizian (2018)
Yoo et al. (2019)

1° PRUNING

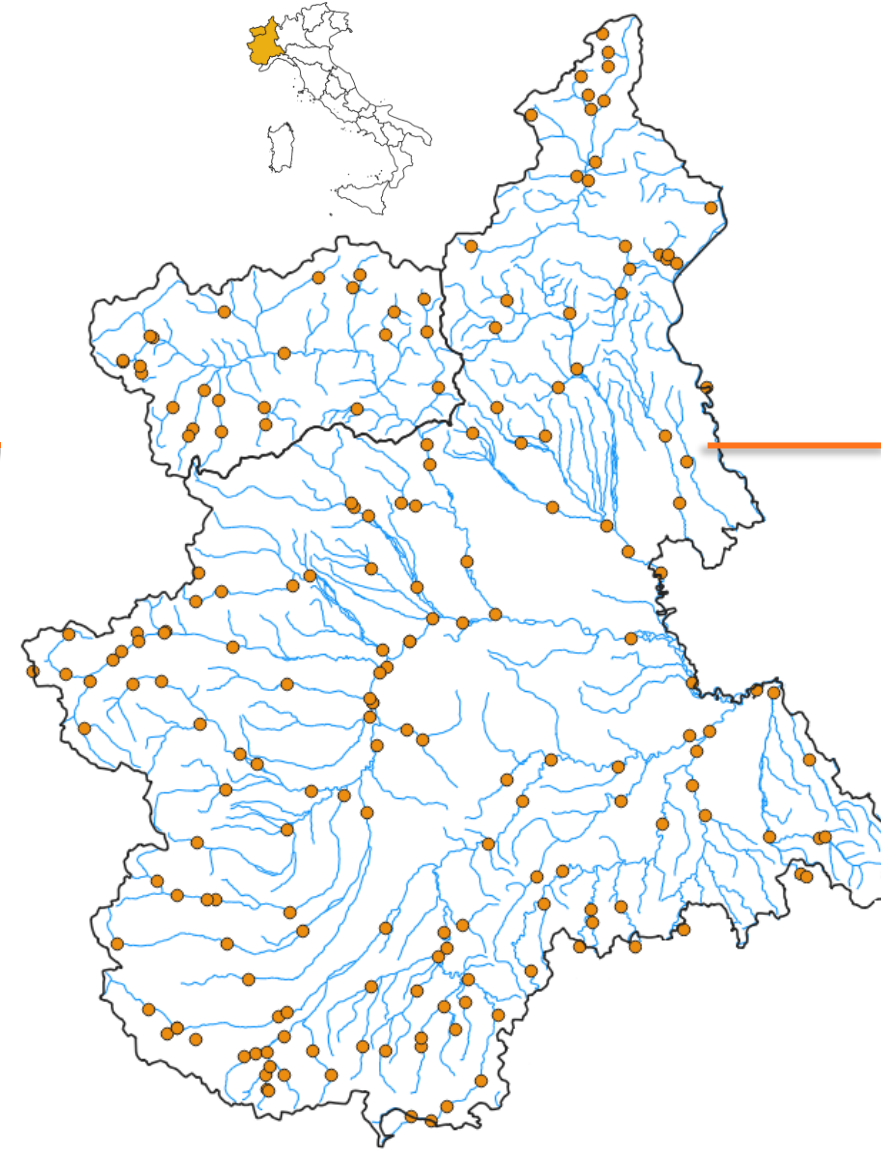**11** formulas consistent with the Chezy hydraulic formula

$$v = C \sqrt{R\,S}$$

$$t = \frac{L}{v} = k\,\frac{L^m}{S^n}, \quad n = \frac{m}{2} \rightarrow t = k\left(\frac{L}{\sqrt{S}}\right)^m$$

C = Chezy coefficient
R = Hydraulic radius
S = Flow path slope

L = Flow path length
t = time (hours)

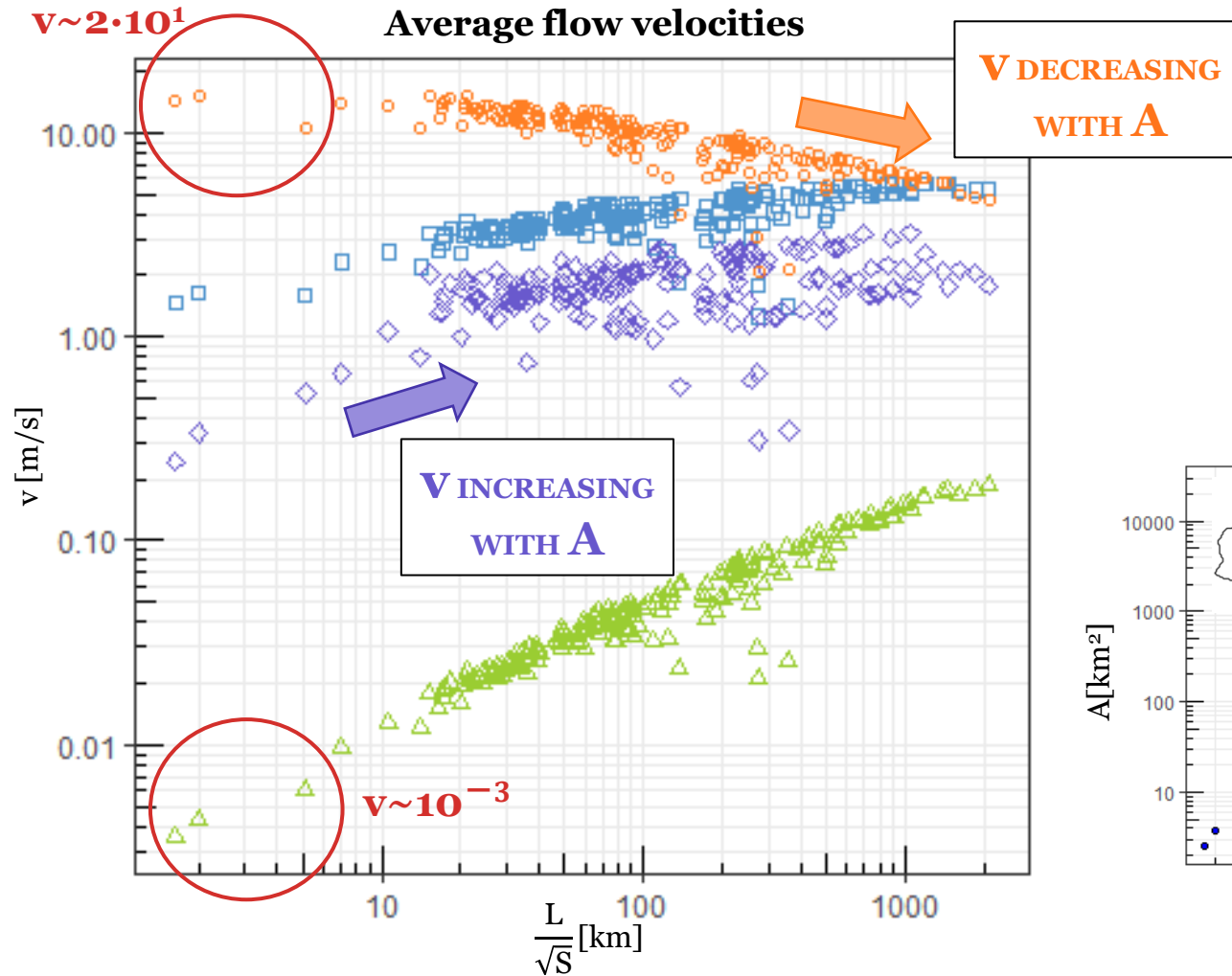Average flow velocities estimated on 197 basins

2° PRUNING

Azizian A. - Uncertainty Analysis of Time of Concentration Equations based on First Order-Analysis (FOA) Method. American Journal of Engineering and Applied Sciences, 11, 327-341,2018

Yoo C., Lee J., Cho E. - Theoretical evaluation of concentration time and storage coefficient with their application to major dam basins in Korea. Water Supply, 19.2, 644-651, 2019

Are there formulas suitable for use outside their **range of calibration**?

47 empirical and semi-empirical formulas selected

5 selected formulas

Average flow velocities

$v \sim 2 \cdot 10^1$

V DECREASING WITH A

V INCREASING WITH A

$v \sim 10^{-3}$

v [m/s]

$\frac{L}{\sqrt{S}}$[km]

A[km²]

$\frac{L}{\sqrt{S}}$[km]

A
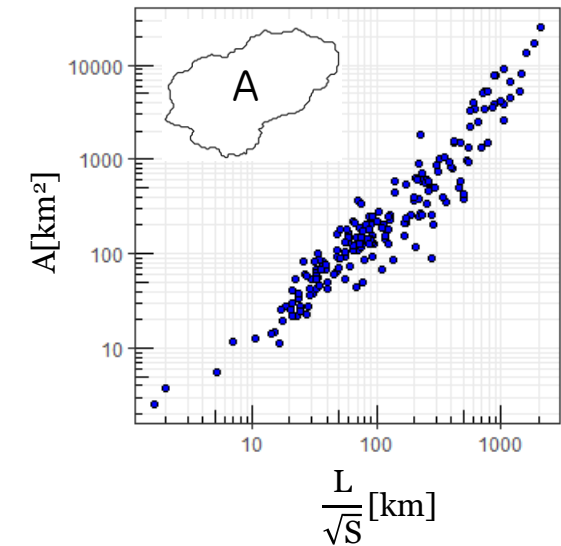
✓ $\frac{L}{\sqrt{S}}$ can be used as a «**reference time**»

✓ Representation in the v - $\frac{L}{\sqrt{S}}$ plane can provide some **guidance in the choice** of appropriate formulations

To be continued..
Thank you!

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