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NATURAL RESOURCES
MANAGEMENT GROUP



DIPARTIMENTO
DI GEOSCIENZE

1222-2022
800
ANNI



UNIVERSITÀ
DEGLI STUDI
DI PADOVA

“La pianificazione strategica delle dighe nel bacino del Mekong mitiga l’impatto dell’idroelettrico sul trasporto dei sedimenti”

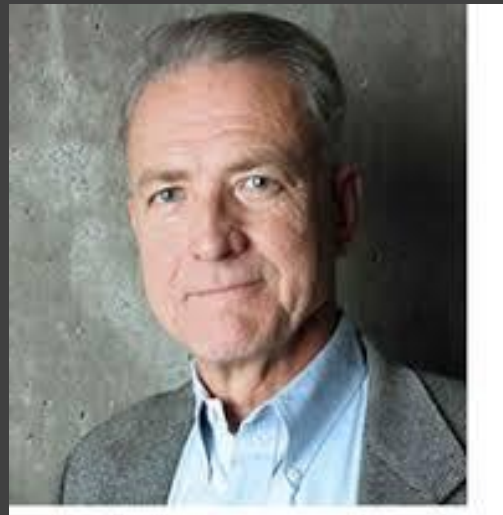
Presentazione della ricerca
Premio ASPEN Institute Italia 2021,
24 Gennaio 2022

Dr. Simone Bizzi
Department of Geosciences

The team



RAFAEL SCHMITT



MATT KONDOLF



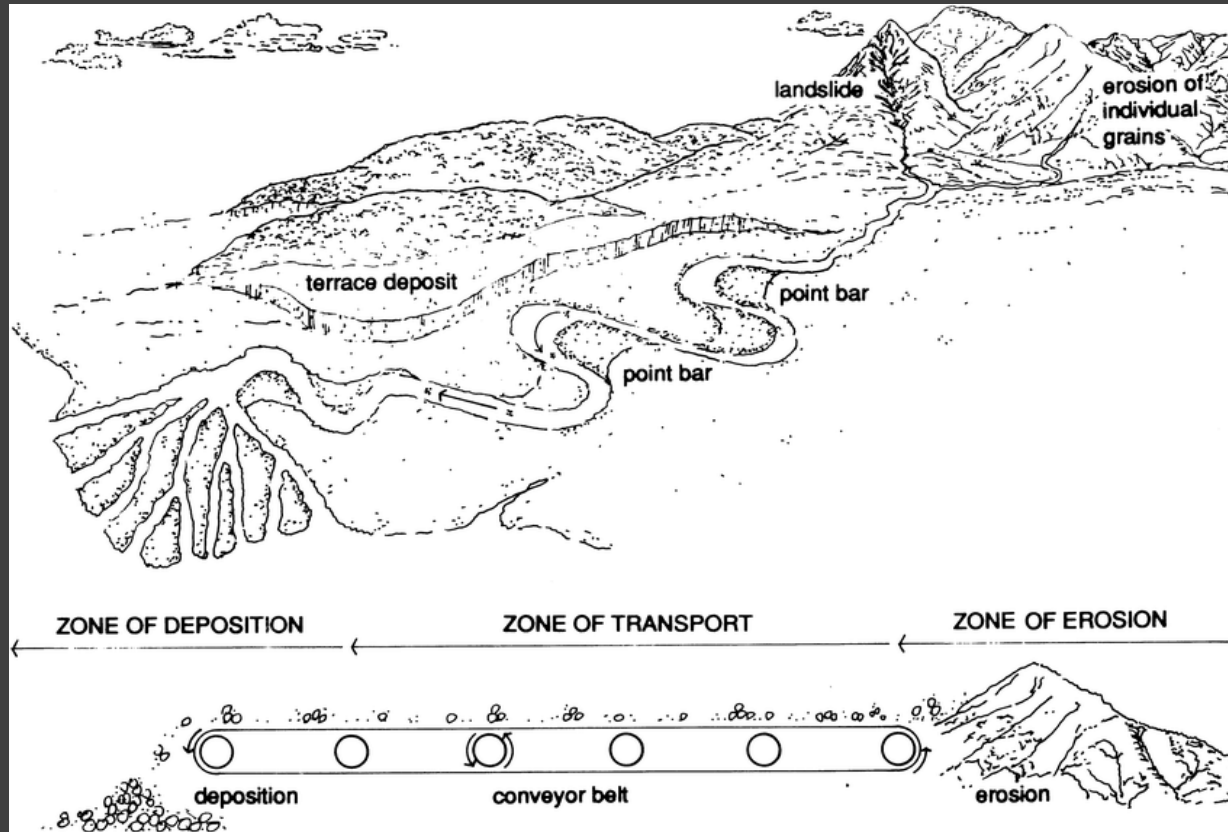
ANDREA CASTELLETTI



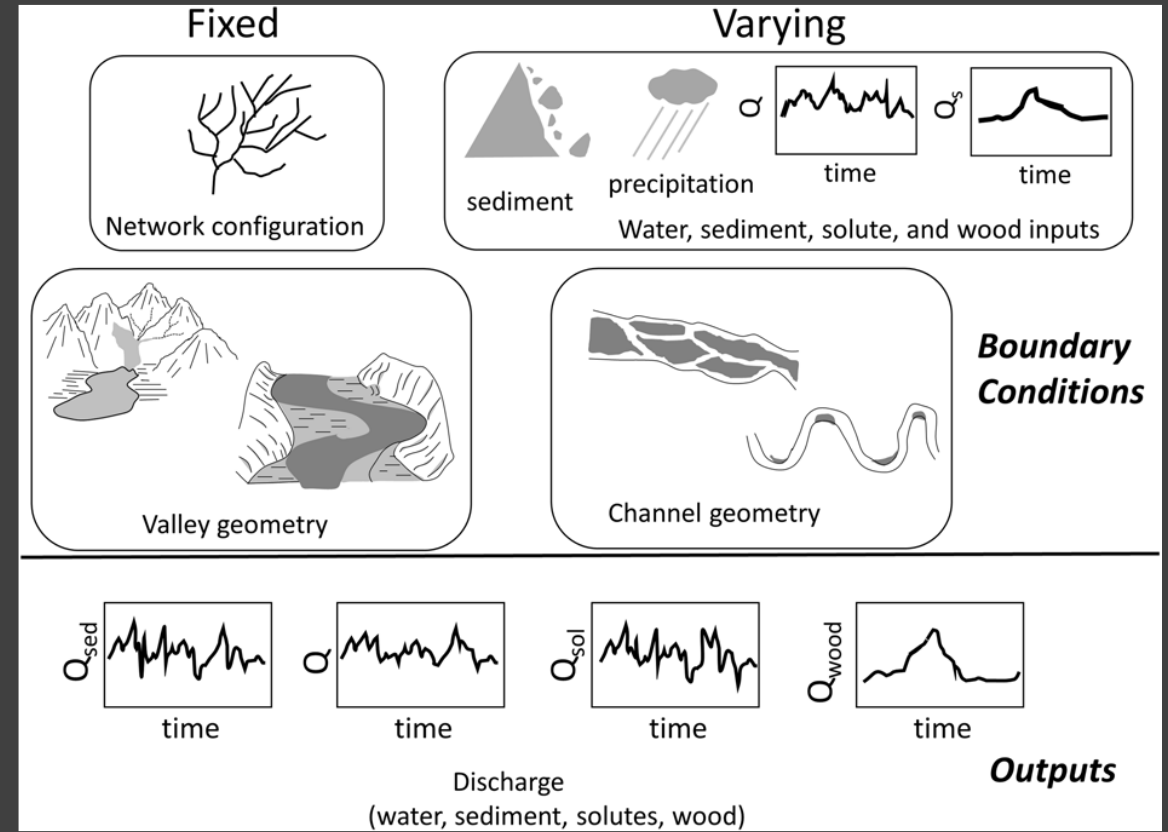
SIMONE BIZZI



Il funzionamento dei sistemi fluviali

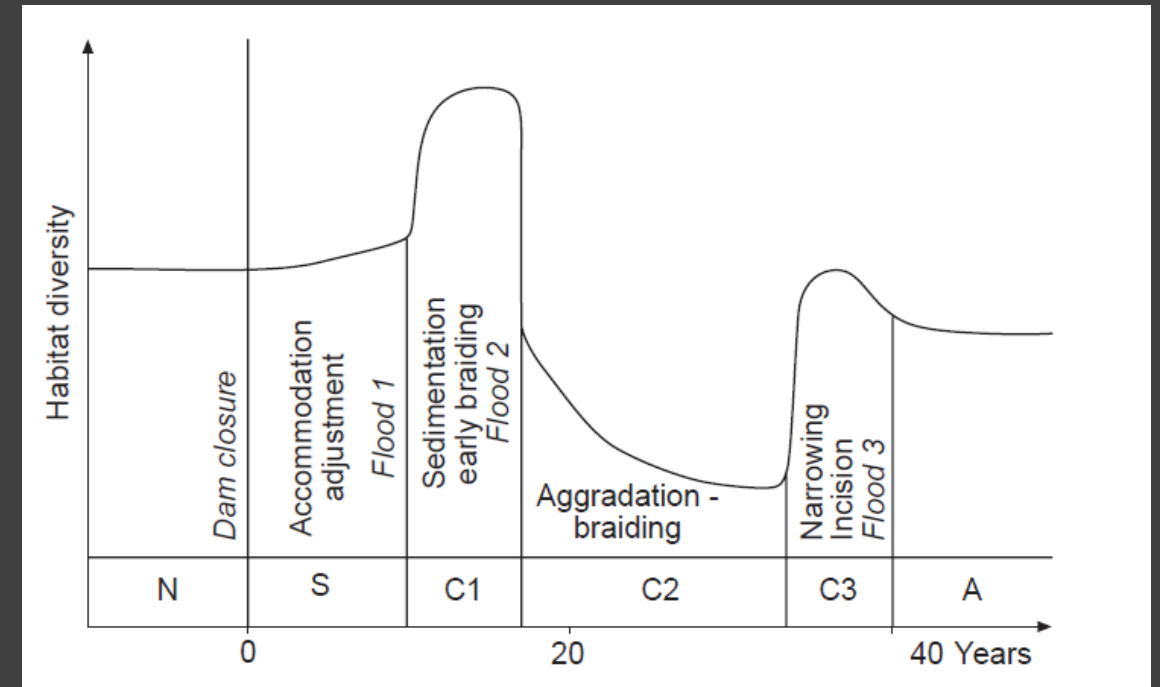
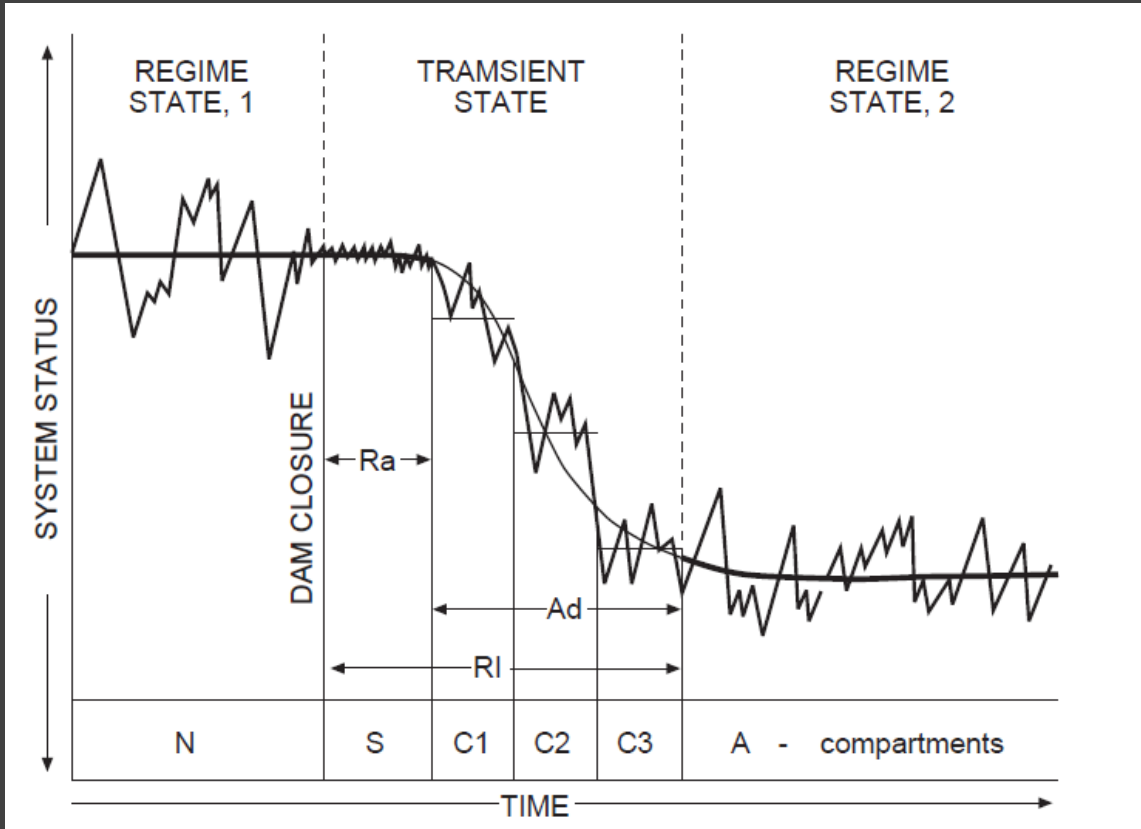


Kondolf, G.M., 1997



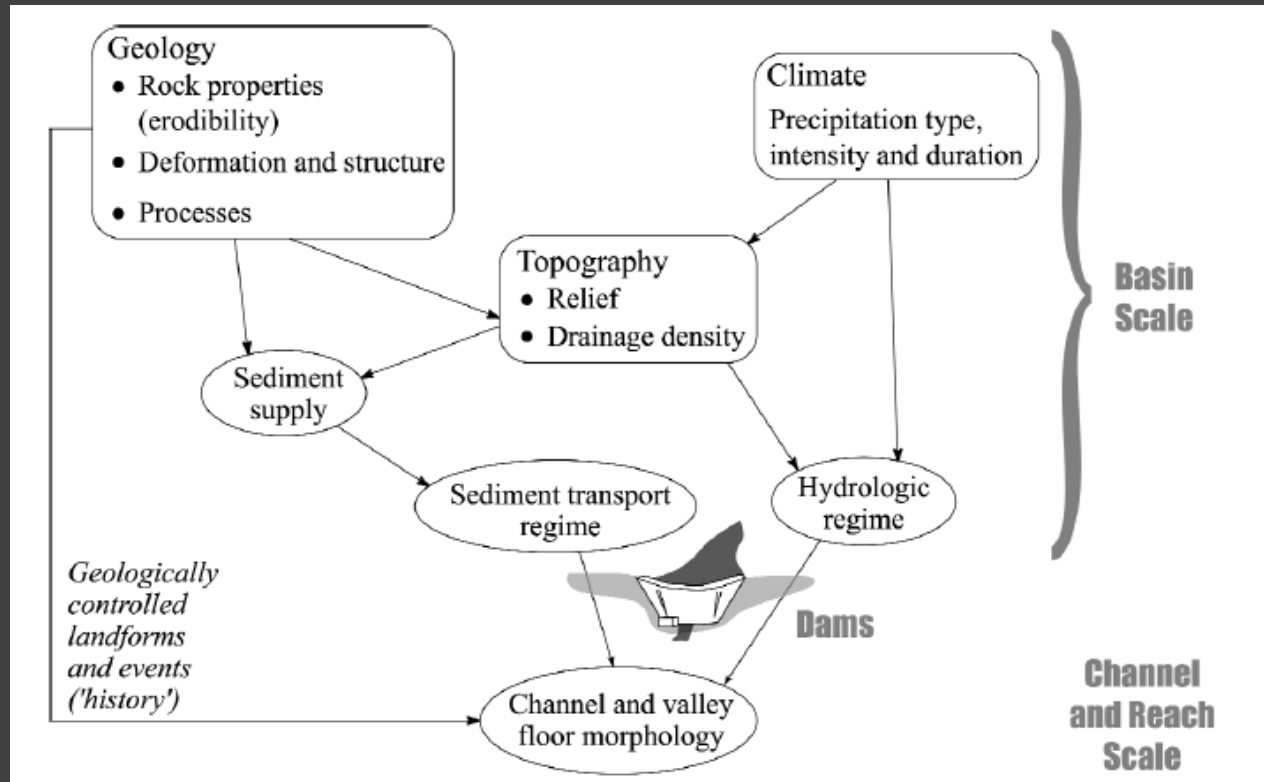
Wohl et al., 2018

Come le dighe interagiscono con il sistema fluviale

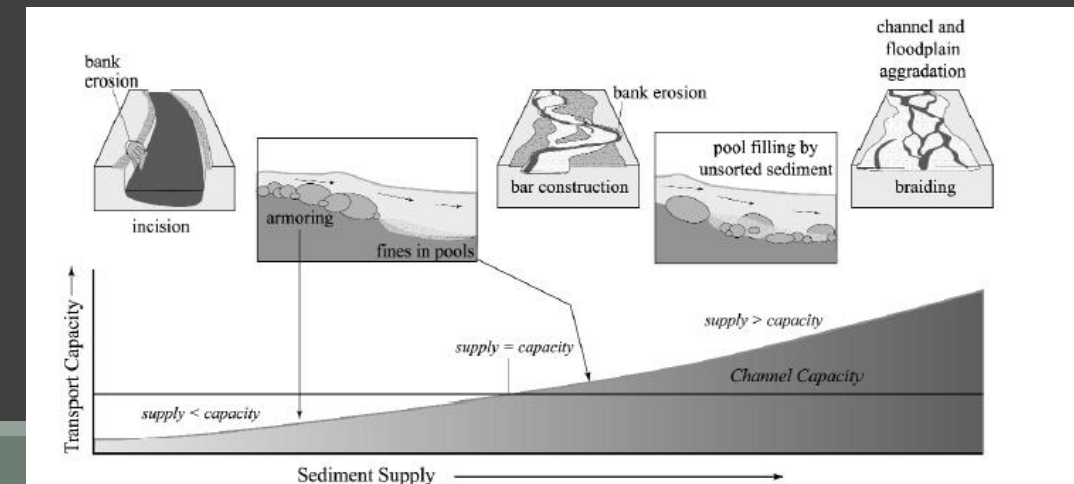
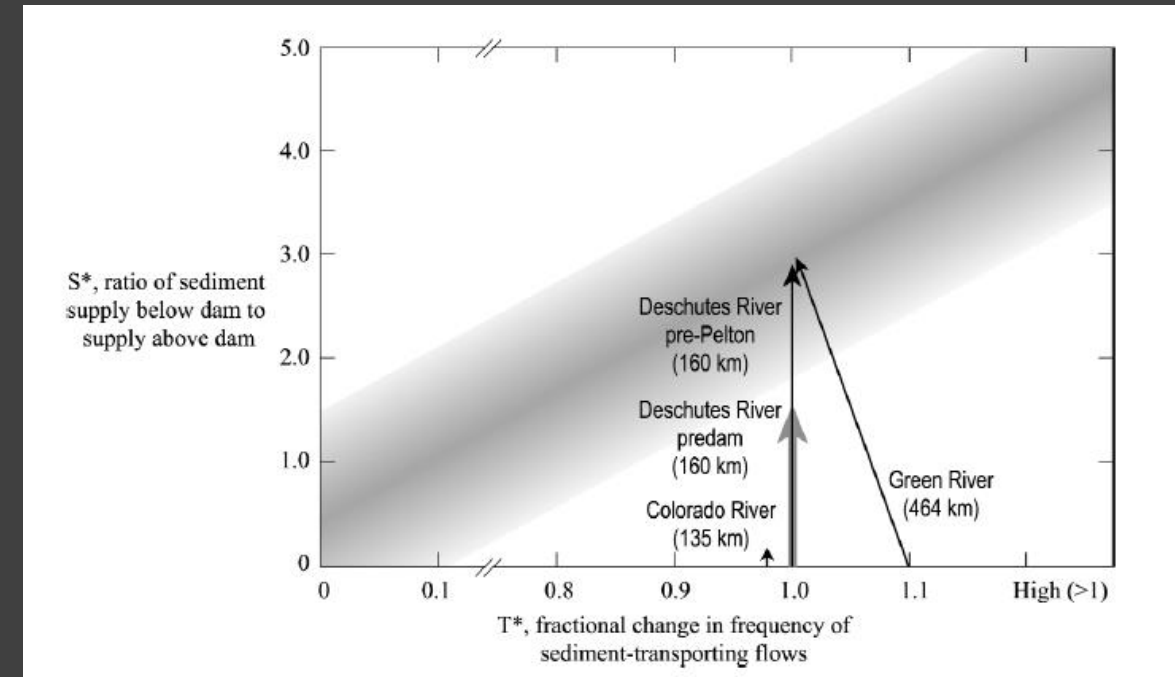


“The recently published report of the World Commission on Dams (WCD,2000) makes no reference to geomorphology” (Petts and Gurnell 2005)

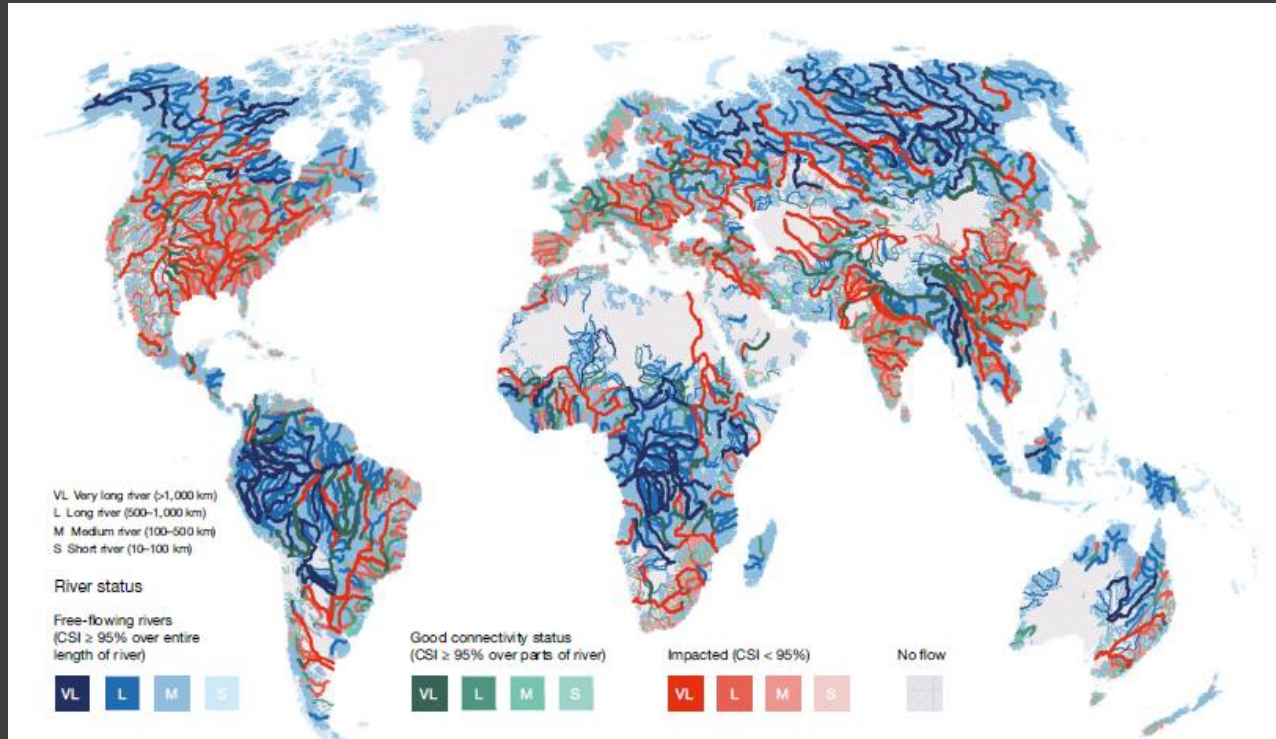
Non tutte le dighe sono uguali



Grant et al., 2003



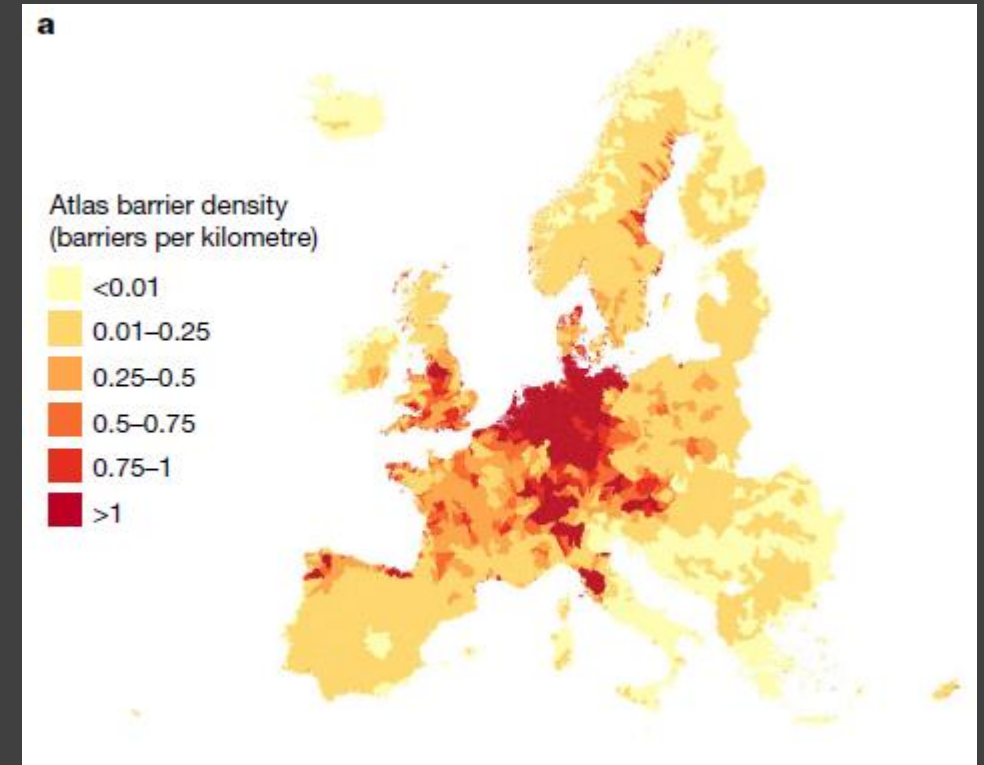
La presenza di dighe nei fiumi oggi



ARTICLE 9 MAY 2019 | VOL 569 | NATURE | 215

Mapping the world's free-flowing rivers

G. Grill^{1*}, B. Lehner^{1*}, M. Thieme², B. Geenen³, D. Tickner⁴, F. Antonelli⁵, S. Babu⁶, P. Borrelli^{7,8}, L. Cheng⁹, H. Crochetiere¹⁰, H. Ehalt Macedo¹, R. Filgueiras^{11,16}, M. Goichot¹², J. Higgins¹³, Z. Hogan¹⁴, B. Lip¹⁵, M. E. McClain^{16,17}, J. Meng^{18,19}, M. Mulligan²⁰, C. Nilsson^{21,22}, J. D. Olden²³, J. I. Opperman²⁴, P. Petry^{25,26}, C. Reldy Liermann²⁶, L. Saenz^{27,28}, S. Salinas-Rodriguez²⁹, P. Schelle³⁰, R. J. P. Schmitt³¹, J. Snider³², F. Tan³³, K. Tickner^{32,33,37}, P. H. Valdujo³⁴, A. van Soesbergen³⁵ & C. Zarri³⁵



Article | Nature | Vol 588 | 17 December 2020

More than one million barriers fragment Europe's rivers

<https://doi.org/10.1038/s41586-020-3005-2>

Received: 28 June 2020

Accepted: 26 October 2020

Published online: 16 December 2020

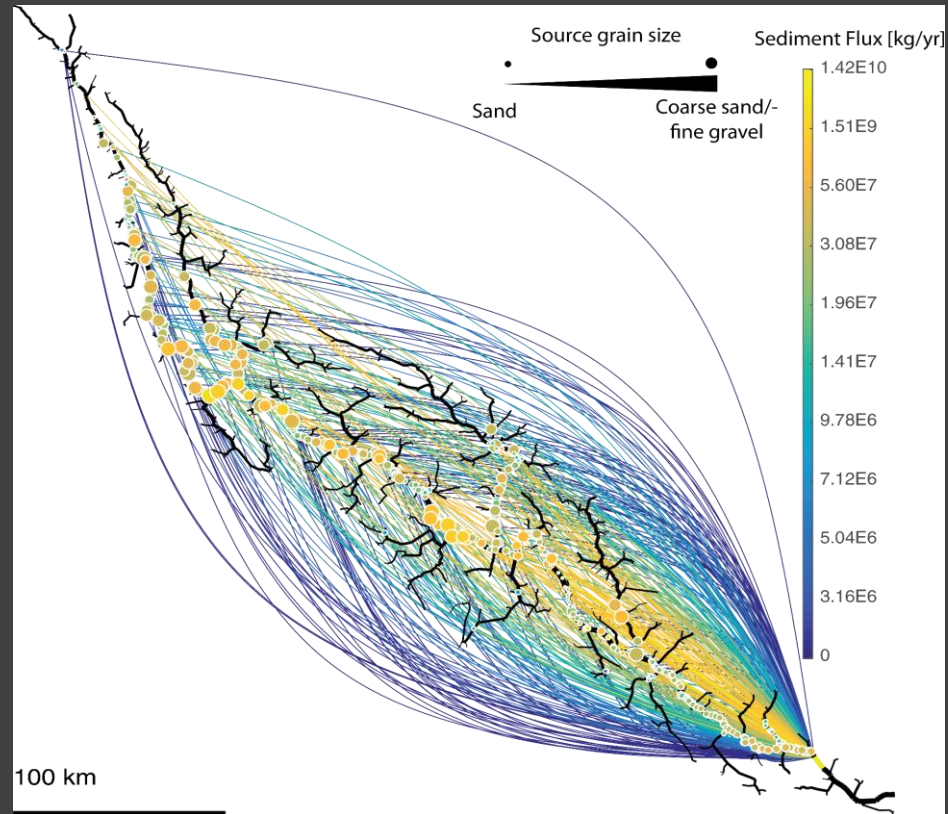
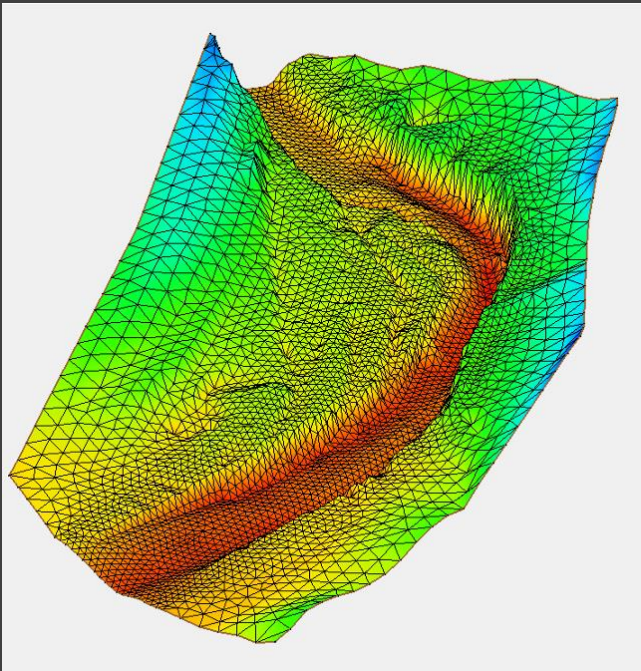
Check for updates

Barbara Bellefleur^{1,29}, Carlos Garcia de Leaniz³², Joshua Jones³, Simone Bizzzi¹⁰, Luca Börger³, Gilles Segura³⁴, Andrea Castelletti³, Wouter van de Bund³², Kim Aarestrup³, James Barry³, Kamila Belka³, Arjan Berkhuysen³, Kim Birnie-Gauvin³, Martina Busetto³⁵, Mauro Caroli³, Sofia Consuegra³, Eduardo Dopico³⁵, Tim Faierfell³⁵, Sara Fernandez³⁵, Paco Fernandez Garrido³, Eva Garcia-Vazquez³⁵, Sara Garrido³⁵, Guillermo Giannico³⁵, Peter Gough³, Niels Jepsen³, Peter E. Jones³, Paul Kemp³⁵, Jim Kerr³⁵, James King³, Malgorzata Lapinska³⁶, Gloria Lázaro³⁶, Martyn C. Lucas³⁵, Lucio Marcello³⁵, Patrick Martin³, Phillip McGivern^{35,37}, Jesse O'Malley³⁵, Rosa Olivo del Amo³⁵, Piotr Parsiewicz³⁵, Martin Pusch³, Gonzalo Rincón³⁴, Cesar Rodriguez³⁴, Joshua Royte³⁵, Claus Tili Schneider³⁵, Jeroen S. Tummers³⁵, Sergio Valles^{35,38}, Andrew Vowles³⁵, Eric Verspoor³⁵, Herman Wanningen³, Karl M. Wantzen^{33,39}, Laura Wildman³⁸ & Maciej Zalewski³

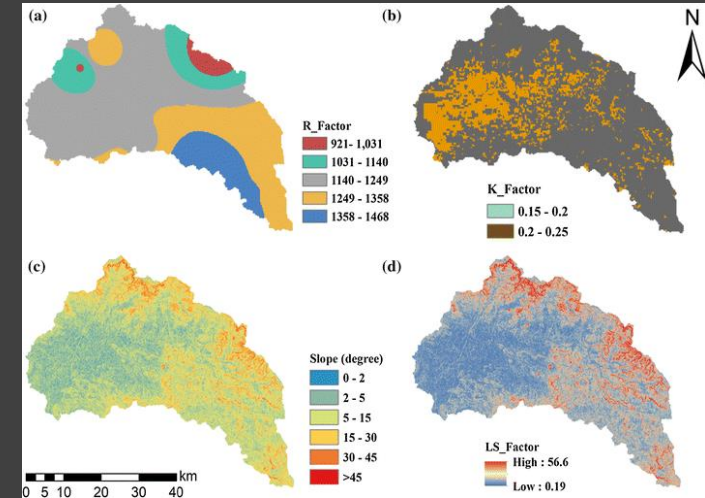
Da dove viene CASCADE

CASCADE (Network Scale Sediment Transport Model)

CFD 1-2-3 D



Soil Erosion Model



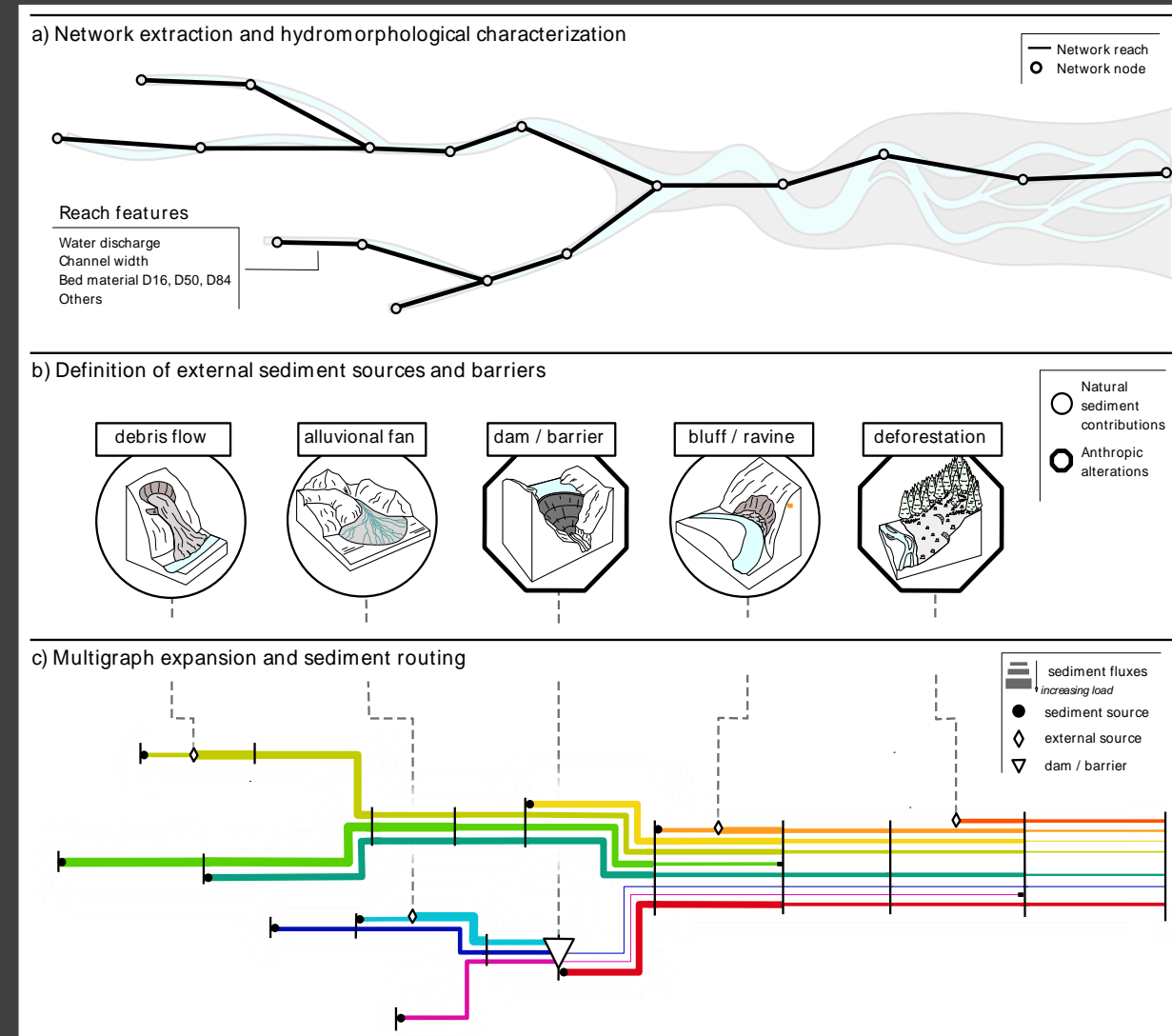
Modelli per il trasporto solido a scale di reticolo

Conceptual and numerical models

- These **exploratory models** present a typically 1D structure combined with **empirical formulas** specifically derived to represent river sediment transport.
- Focus on **characterizing and quantifying network-scale sediment routing patterns** and **highlight (dis)connectivity pathways** across the network.

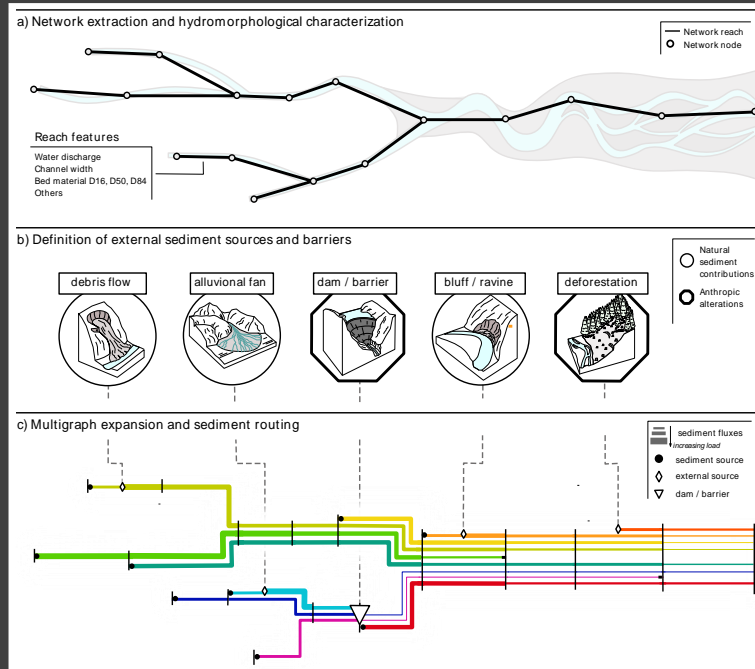
Examples:

- SedSim (Wild and Loucks, 2012)
- NetworkSedimentTransporter (Czuba and Foufoula-Georgiou, 2014, Czuba et al. 2017, Pfeiffer et al. 2020)
- SeRFE (Gilbert and Wilcox, 2020)
- CASCADE (Schmitt, 2017)





CASCADe toolbox: www.cascademodel.org

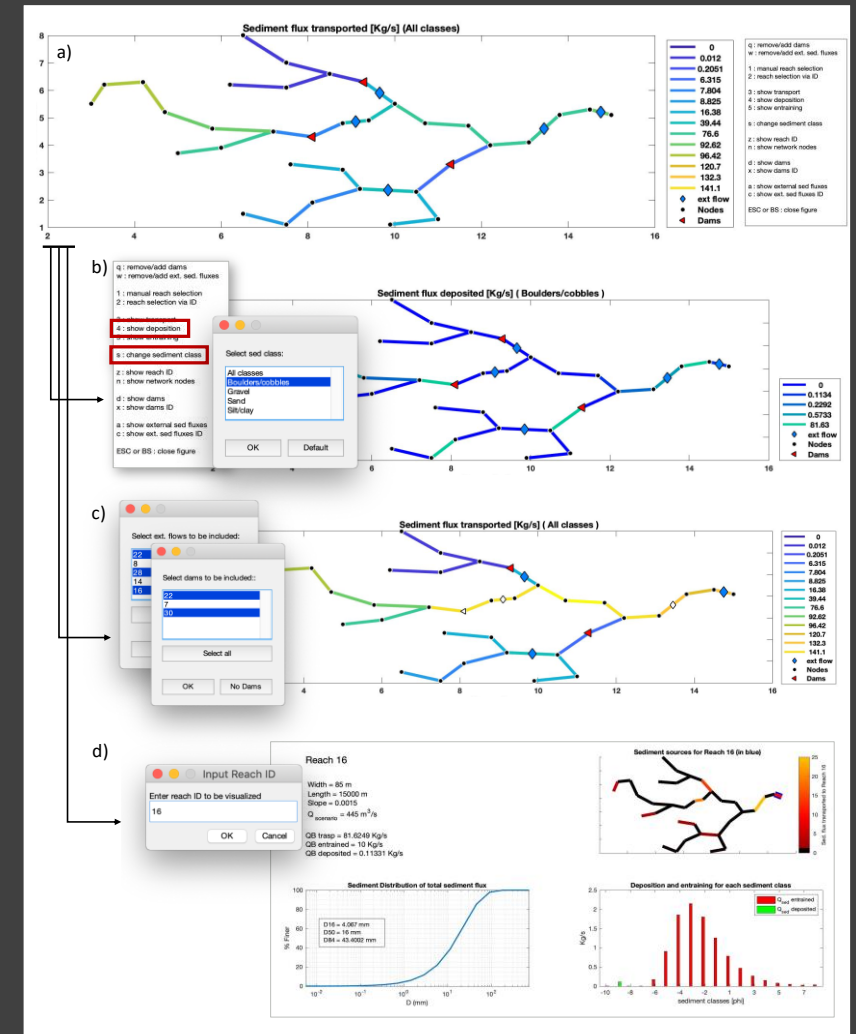


Sediment Fluxes

Sediment Eroded/Deposited

Sediment Fluxes for alternative management options

Sediment sizes and sources for a specific reach



Environmental Modelling and Software 119 (2019) 400–406

Contents lists available at ScienceDirect

Environmental Modelling & Software

journal homepage: www.elsevier.com/locate/envsoft

The CASCADe toolbox for analyzing river sediment connectivity and management

Marco Tangi^a, Rafael Schmitt^b, Simone Bizzi^a, Andrea Castelletti^{a,*}

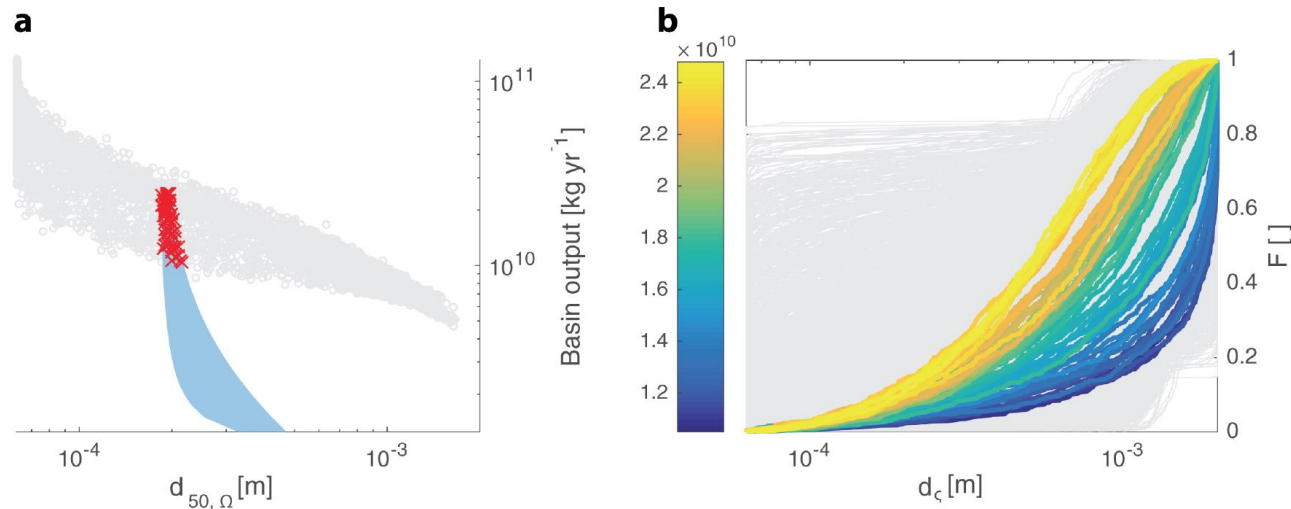
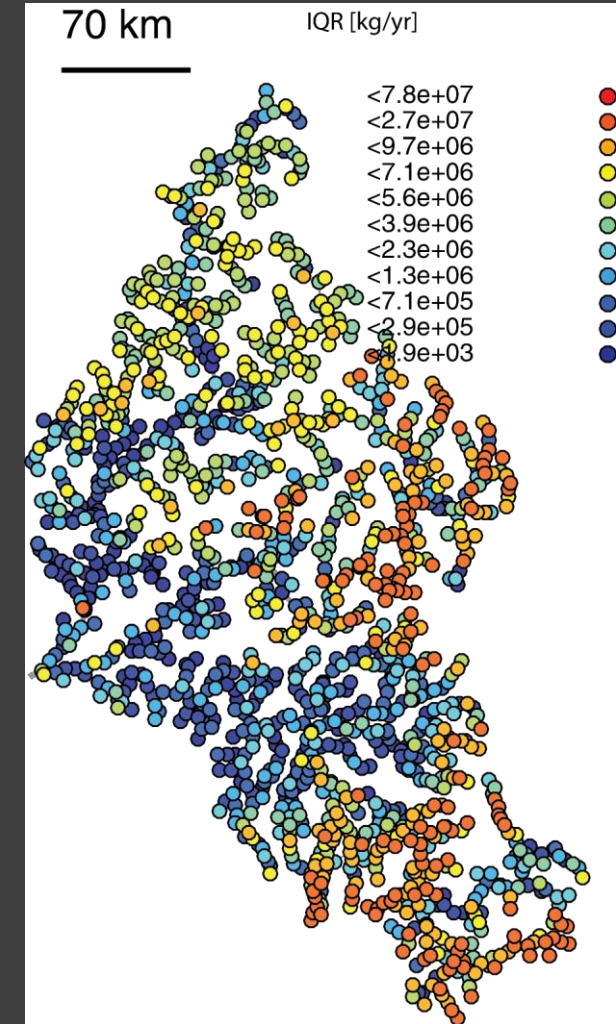
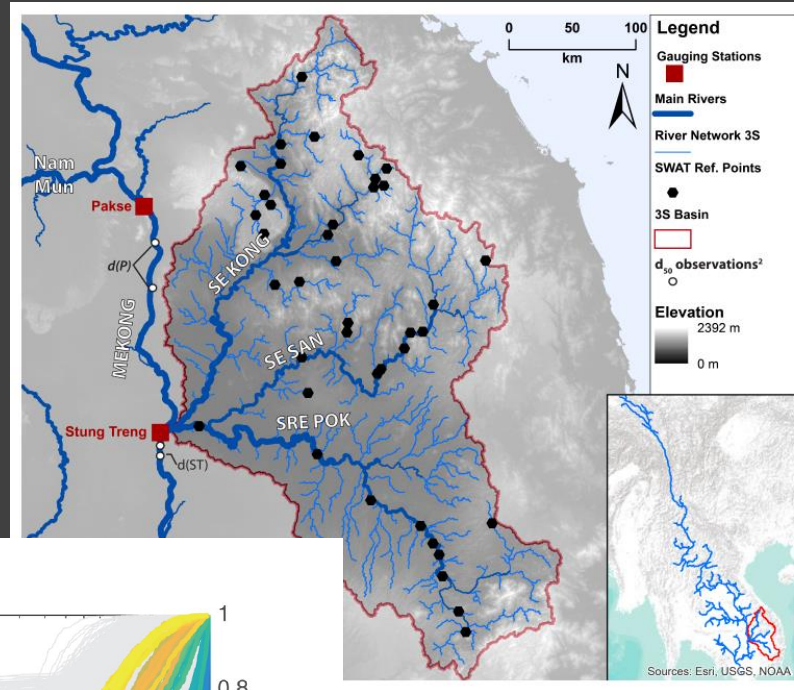
^a Politecnico di Milano, Dipartimento di Elettronica, Informazione e Biogeografia, Italy

^b The Natural Capital Project and Woods Institute for the Environment, Stanford University, United States

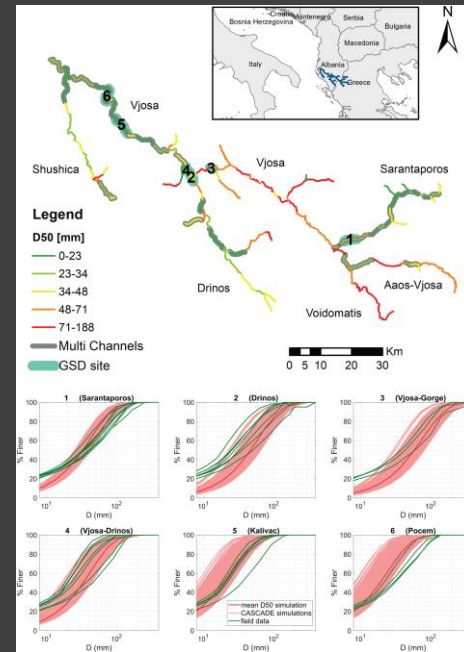
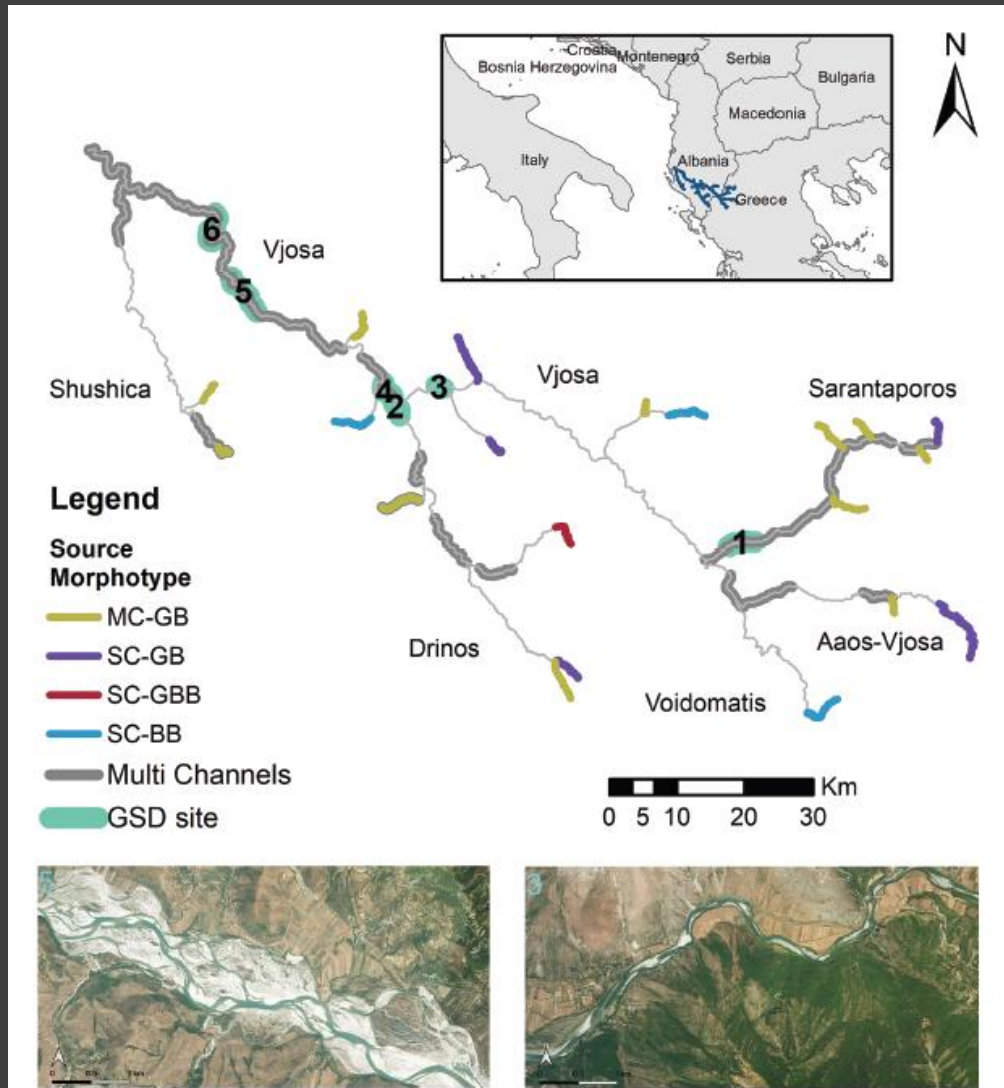
E' possible fare certe stime? Validazione

Stochastic Modeling of Sediment Connectivity for Reconstructing Sand Fluxes and Origins in the Unmonitored 3S Basin

Schmitt, Bizzi et al., 2017, JGR, DOI
10.1002/2016JF004105

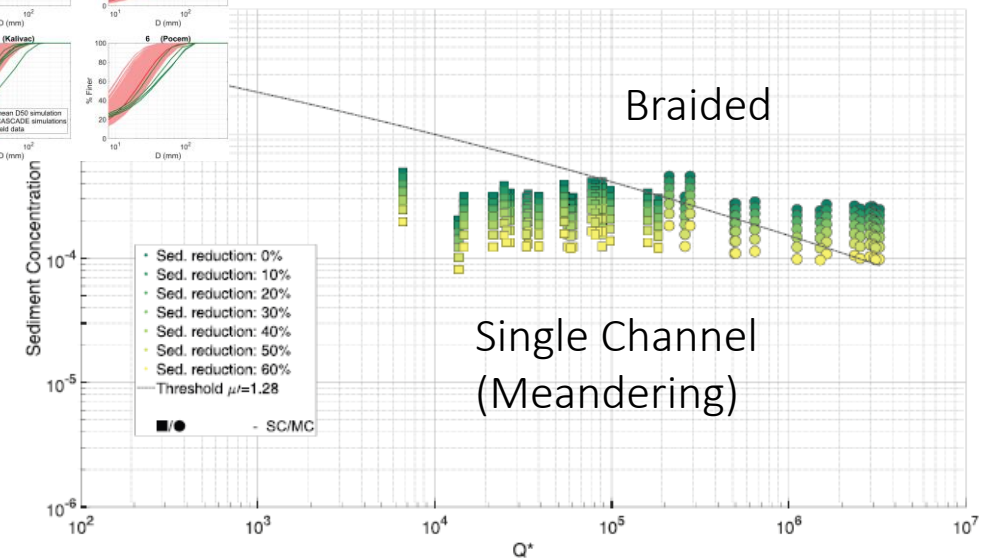


Il caso del Vjosa

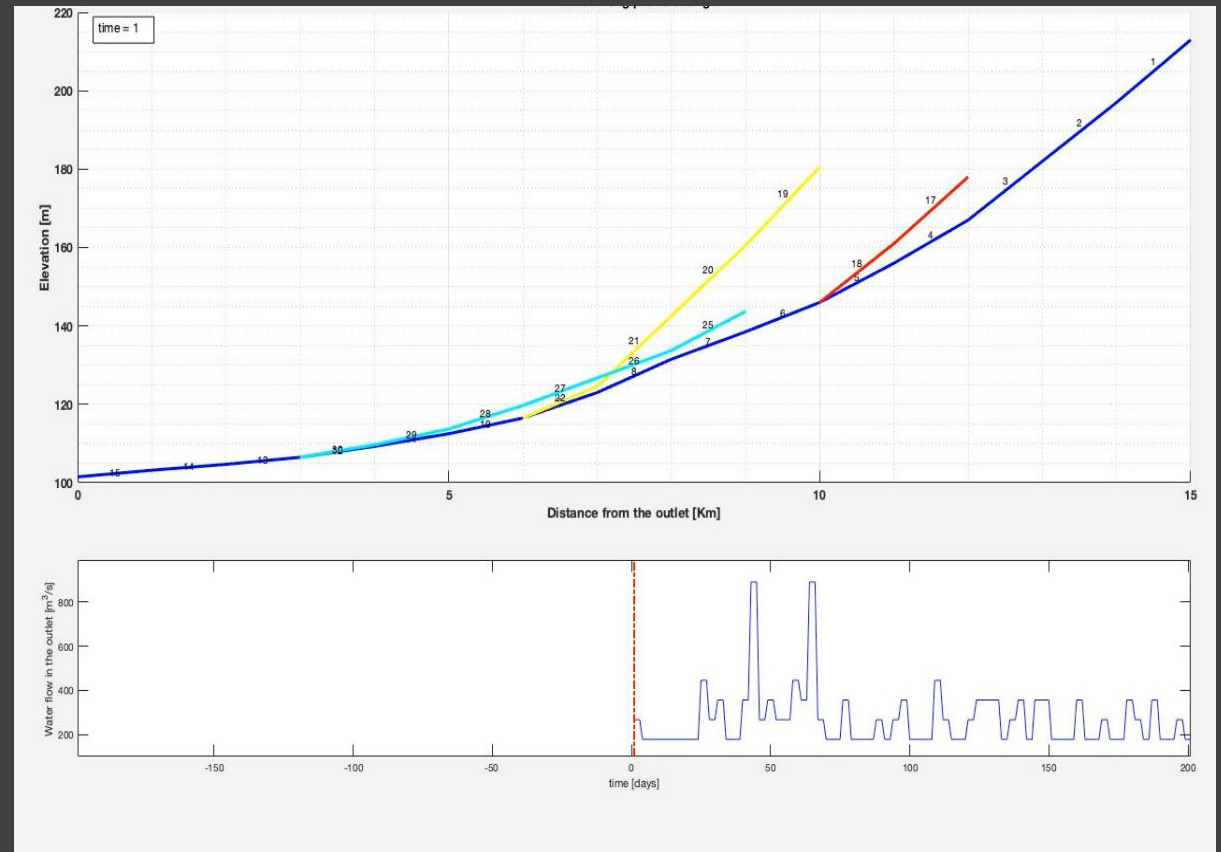
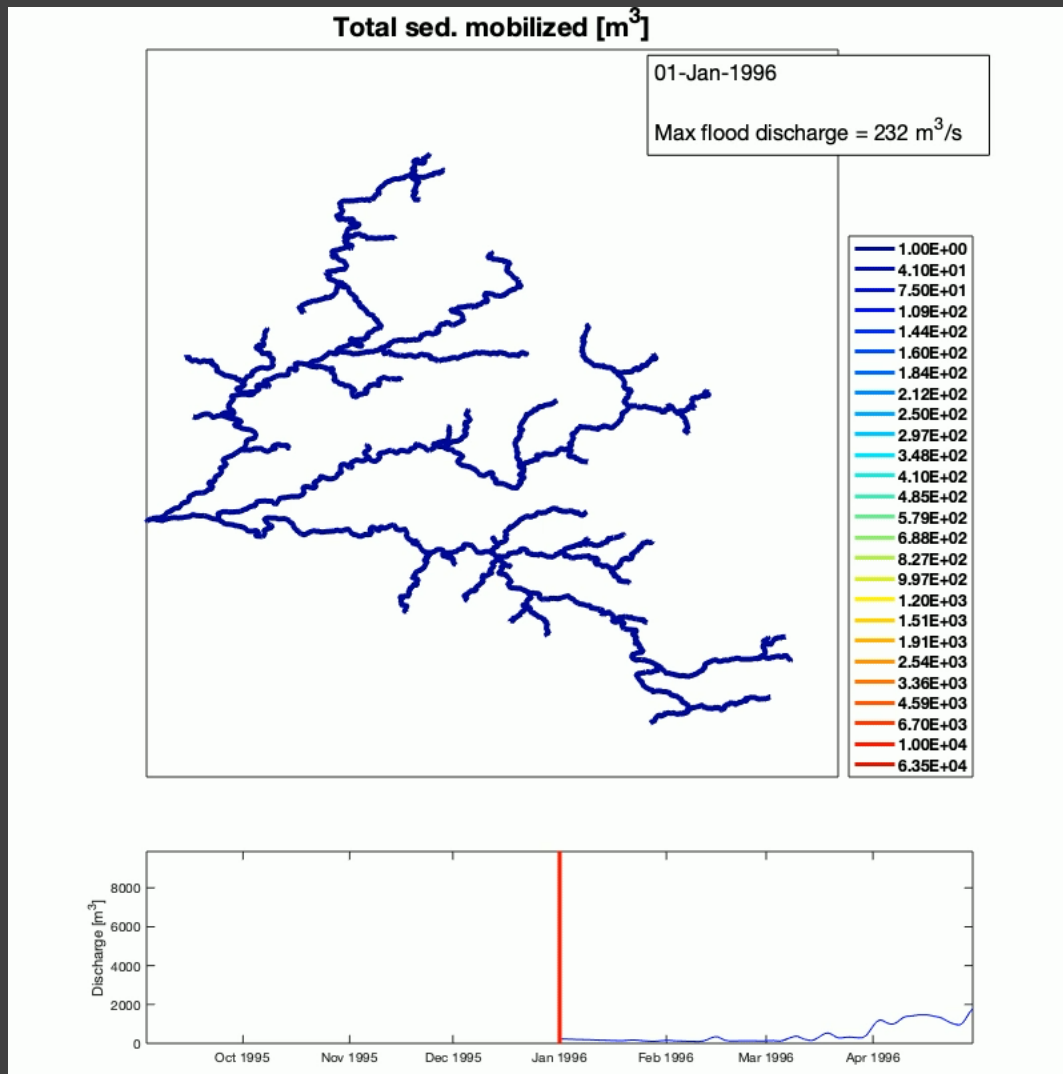


Stima della probabilità di cambi morfologici

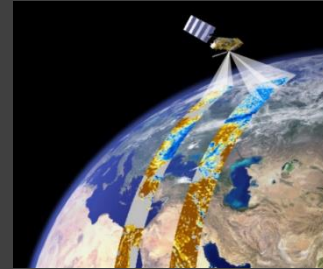
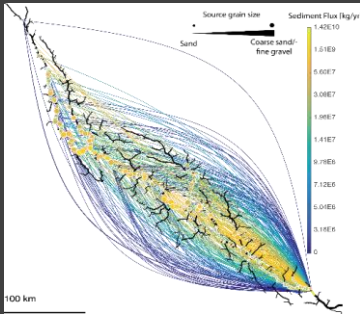
Bizzi et al. 2020



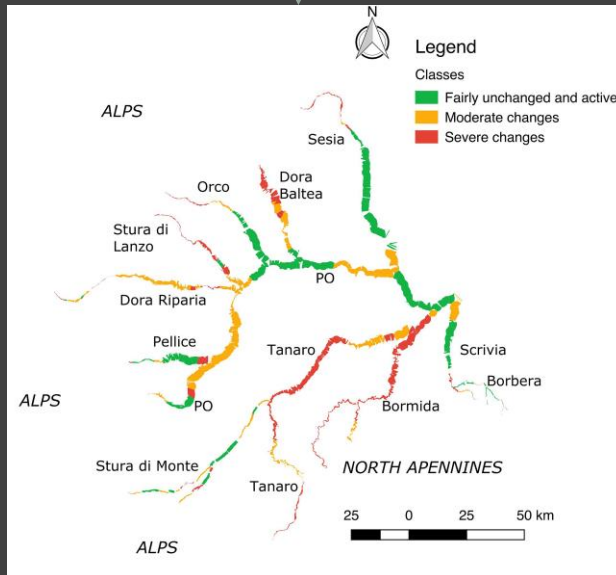
Presente e Futuro: Dynamic CASCADE



Presente e Futuro: Telerilevamento e validazione



- Sentinels plus Drone is a cost effective-solutions for a multi-scale hydromorphological monitoring framework for medium-large river systems: pilot basins can be designed with limited efforts (it is an opportunity!)
- Large scale monitoring and assessment frameworks needs to integrate different sources of remotely sensed data
- The new layers of information allow a exhaustive characterization of fluvial forms and process: geomorphic units, water channels mapping, and then habitat evaluation, monitoring channel evolution trajectories, characterizing grain size and predicting discharges. And on selected sites we can integrated this information with field data on sediment budgets and sediment transport.
- Network scale harmonized databases needs ot be shared (globally) and feed network-scale models (e.g., CASCADE)



Bizzi, Piegay et al. 2018 ESPL, doi:10.1002/esp.4509
Demarchi, Bizzi et al. 2017, ESPL, doi: 10.1002/esp.4092

We are on a cusp of something in river science and management... but it still has not happened

Grazie!

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<https://www.linkedin.com/in/simone-bizzi/?originalSubdomain=it>