Monitoring and modelling drainage network dynamics of a Mediterranean catchment

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The active part of the drainage networks, i.e. that characterized by flowing water, is not static but experiences significant expansion/contraction dynamics produced by the interactions between hydrological and climatic variability, morphological features and soil properties in the contributing catchment

The study presents a research activity carried out in the framework of the European project "DyNET: Dynamical River Networks" (http://www.erc-dynet.it/), specifically aimed at analysing in detail the processes and agents overseeing changes in form and in the length of river networks in a Mediterranean environment. The contribution describes the first results achieved in the southernmost of the basins under investigation in the DyNET project, namely the Turbolo creek catchment (Calabria, Southern Italy)

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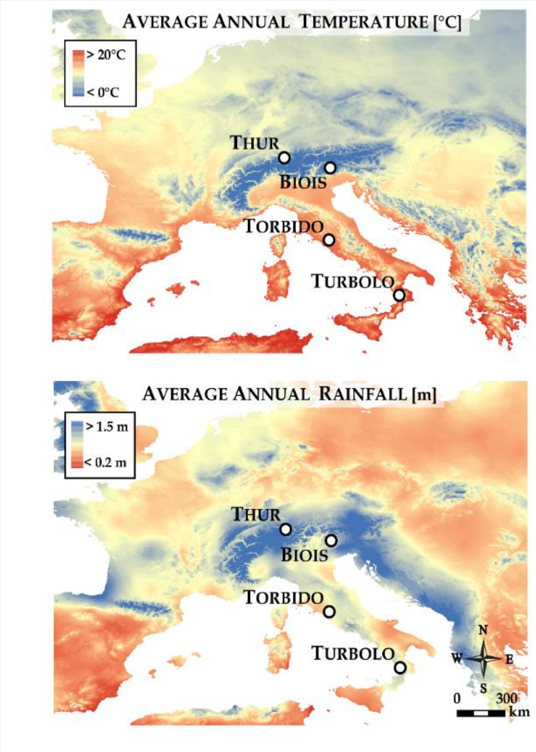
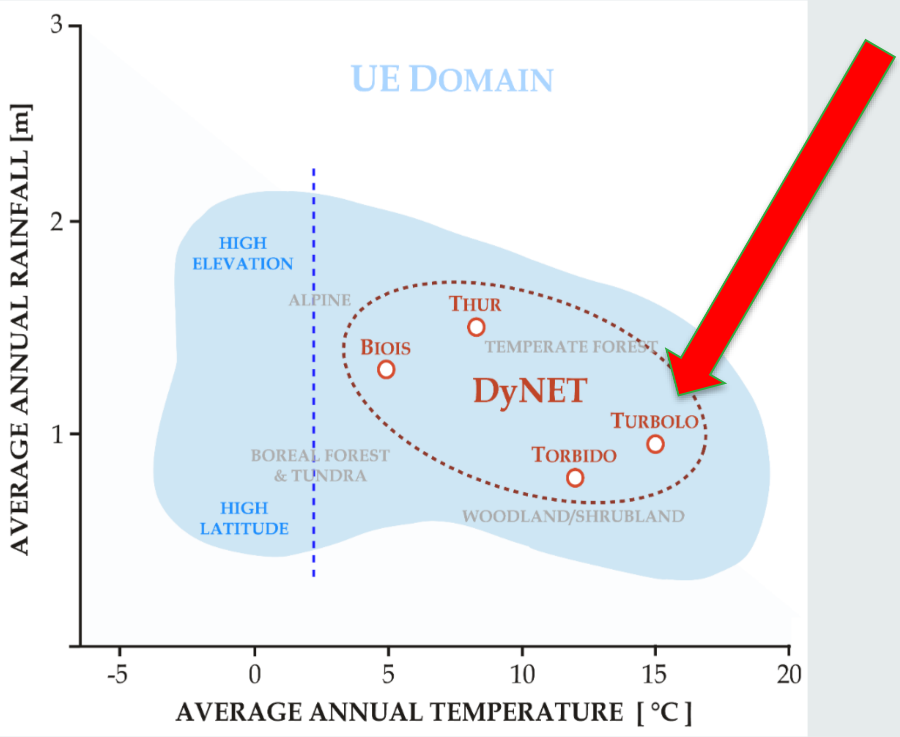
DyNET project

DYNAMICAL RIVER NETWORKS (DyNET)
CLIMATIC CONTROLS AND BIOGEOCHEMICAL FUNCTION

http://www.erc-dynet.it/





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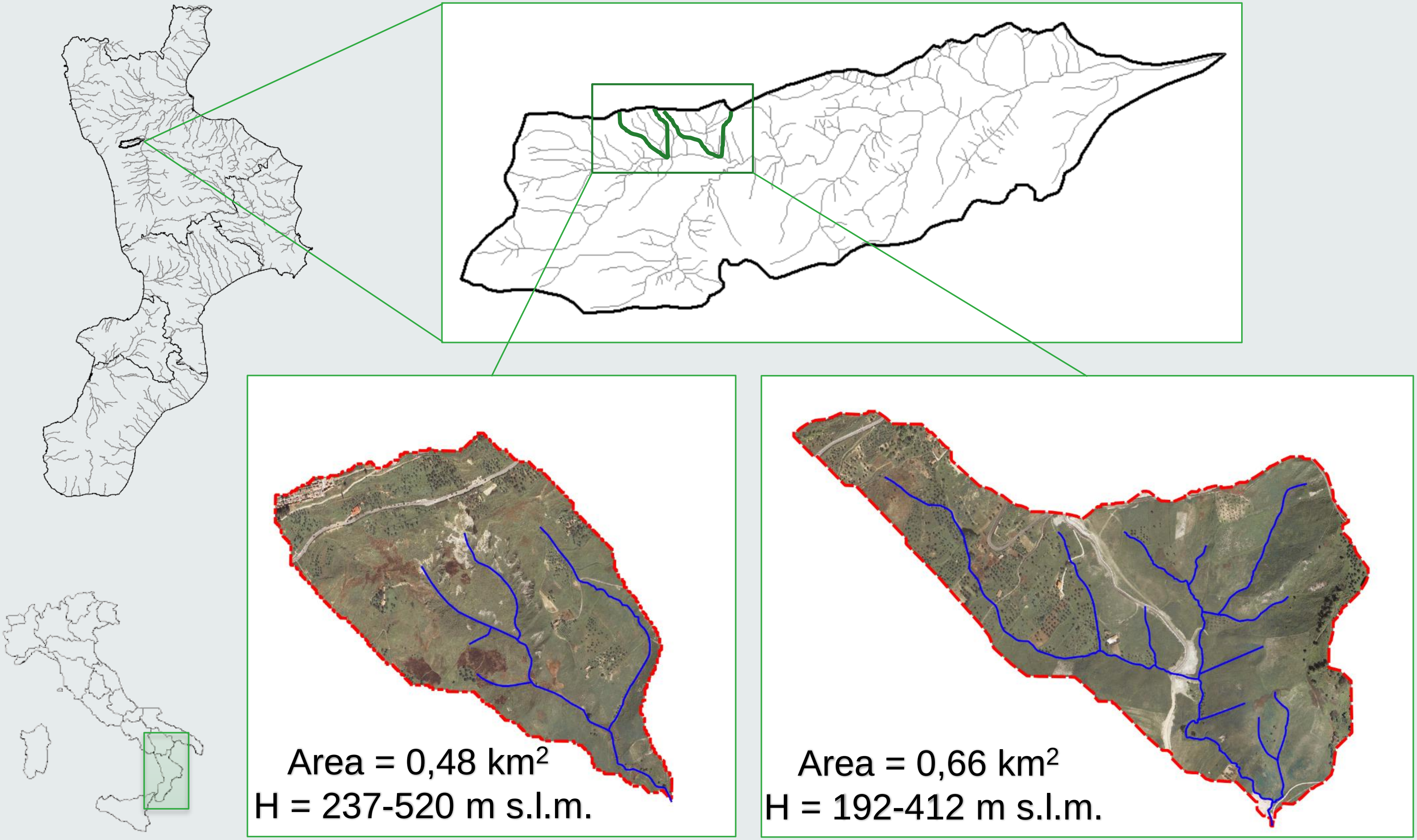
Study area – Turbolo Creek



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Field surveys – eastern catchment

2019

April

mon	tue	wed	thu	fri	sat	sun
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	**18**	19	20	21
22	23	24	25	26	27	28
29	30					

May

mon	tue	wed	thu	fri	sat	sun
		1	2	**3**	4	5
6	**7**	8	9	10	**11**	12
13	14	15	16	**17**	18	19
20	**21**	22	23	**24**	25	26
27	28	29	30	31		

June

mon	tue	wed	thu	fri	sat	sun
					1	2
3	4	**5**	6	**7**	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

Active Drainage Network Length (ADNL) varying from 2736 to 0 m

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Methodology

Modeling the ADNL

Durighetto et al. (WRR, 2020)

$$ET = k_c \cdot ET_0$$

$$EP(t) = h(t) - ET(t)$$

$$EP_T(t) = \int_{t-T}^{t} EP(\tau)d\tau.$$

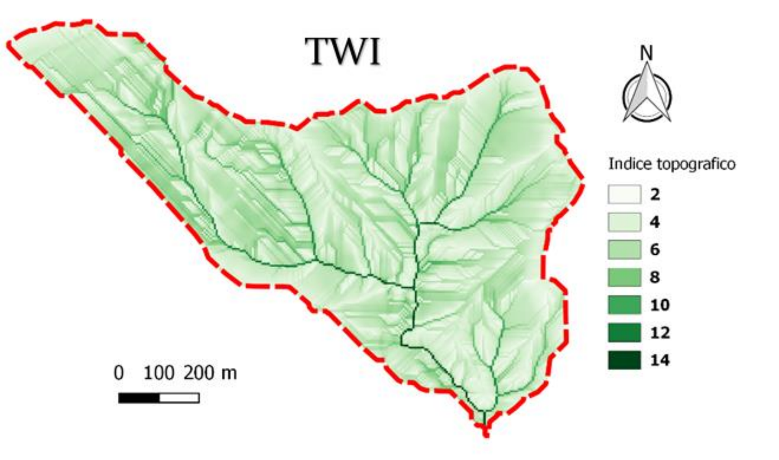
$$ADNL = k_0 + k_1 \cdot EP_T$$

- h_T cumulative rainfall depth
- EP_T cumulative excess precipitation
- k_c, k_0, k_h parameters, but → $\boldsymbol{k_0 = 0}$

ADNL spatial distribution

It can be hypothesized that flow persistence in a cell can be directly linked to the Topographic Wetness Index (TWI, Beven & Kirkby, 1979)

$$TWI = ln\left(\frac{A_s}{tan\beta}\right)$$



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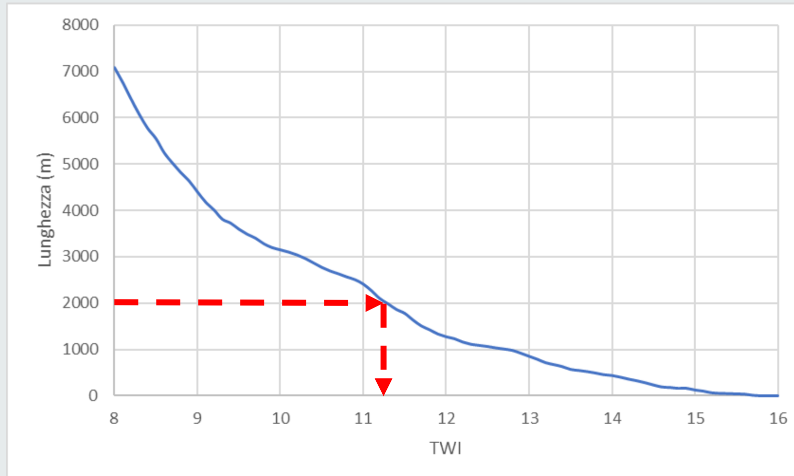
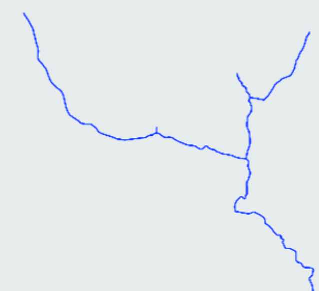
Methodology

Modeled ADNL
(length)



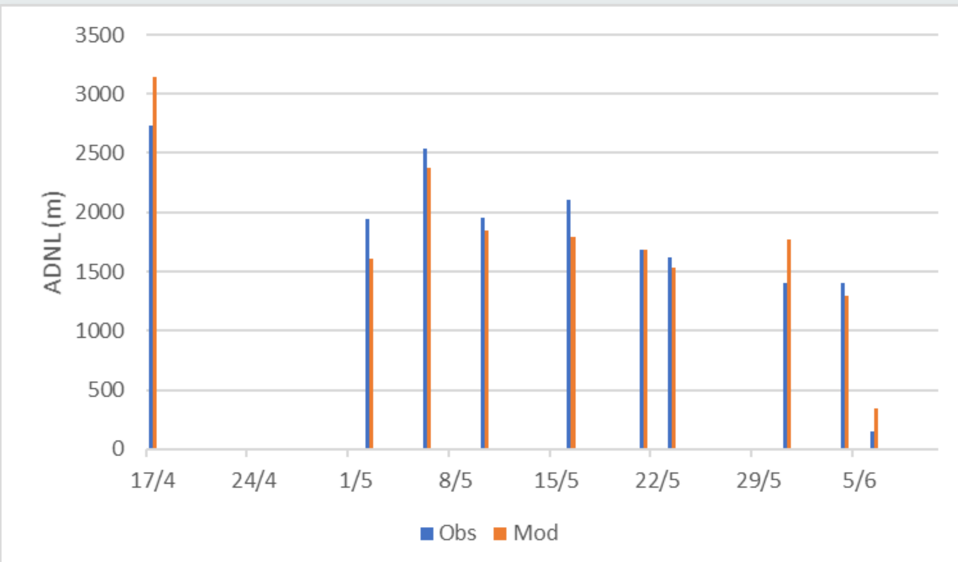
ADNL-TWI relationship

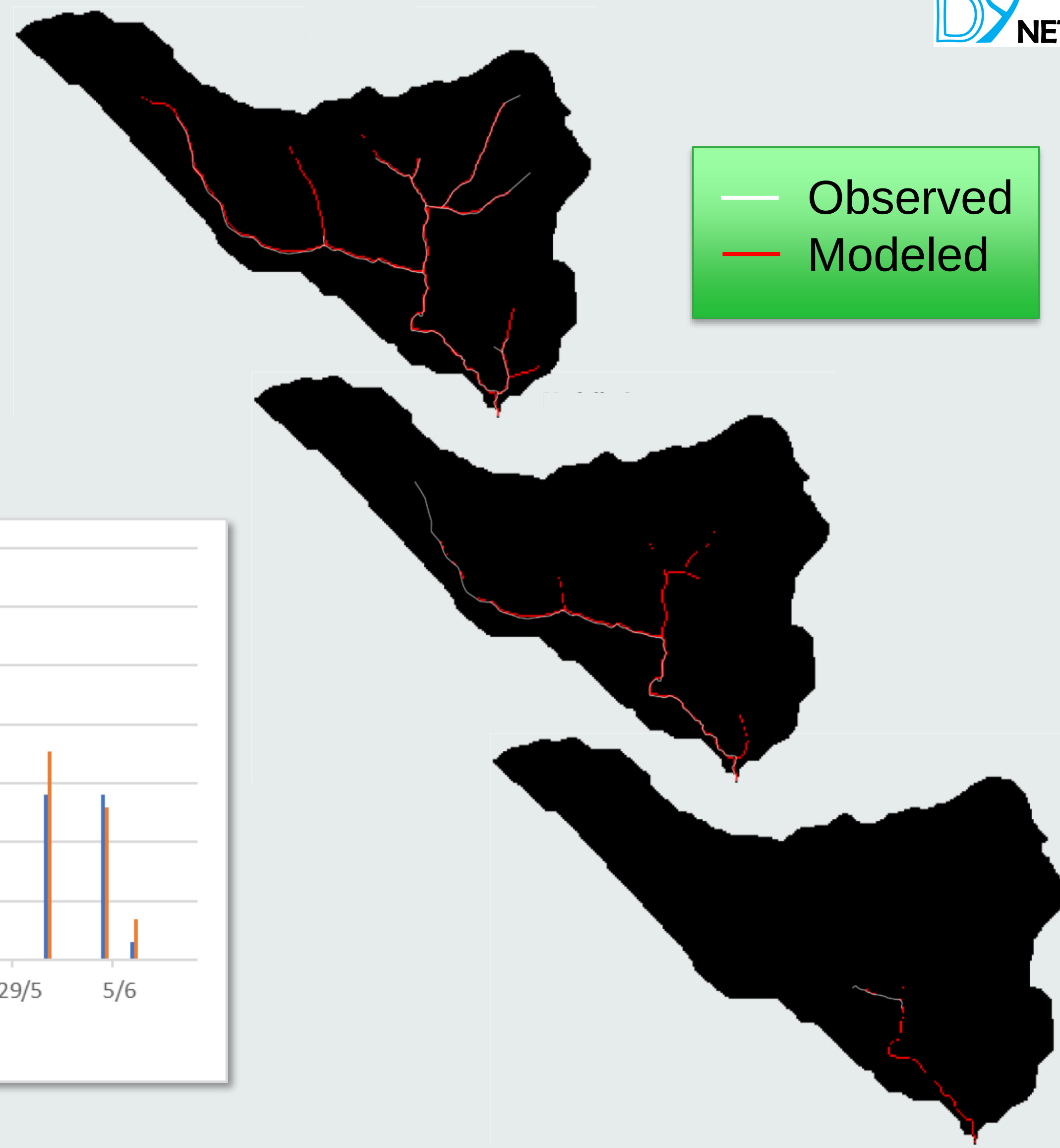


ADNL spatialization

Results

T (days) = 31
k_c = 0.454
k_1 = 0.034 km/mm
RMSE = 234 m
R2 = 0.92
Bias = -1%





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