UNIVERSITÀ DEGLI STUDI FIRENZE

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DTVT: a GIS tool for the automatic validation of physically based landslide models and the identification of the optimal warning criterium

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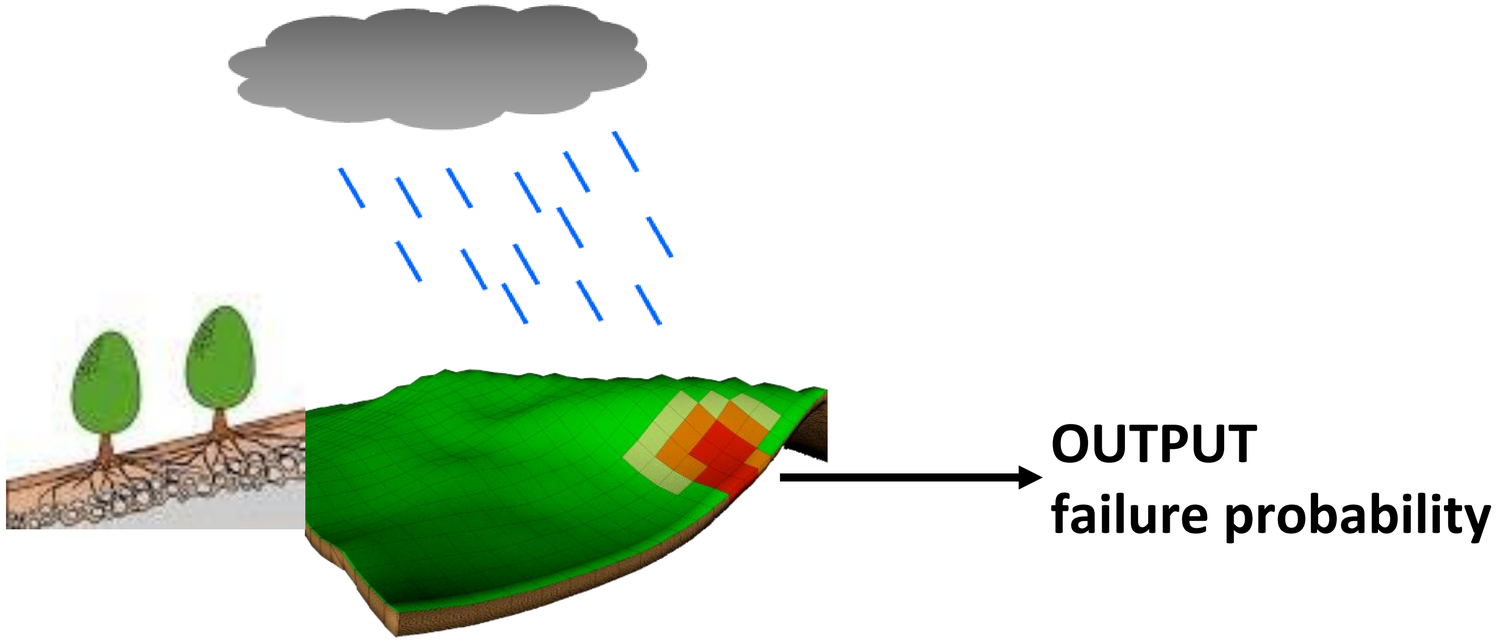
Distributed physically based models

Basic principles

- Complex process-based equations
- Many input parameters (morphology, geotechnics, hydrology, rainfall, roots…)
- Probabilistic approach

Examples:
TRIGRS
HIRESSS
…



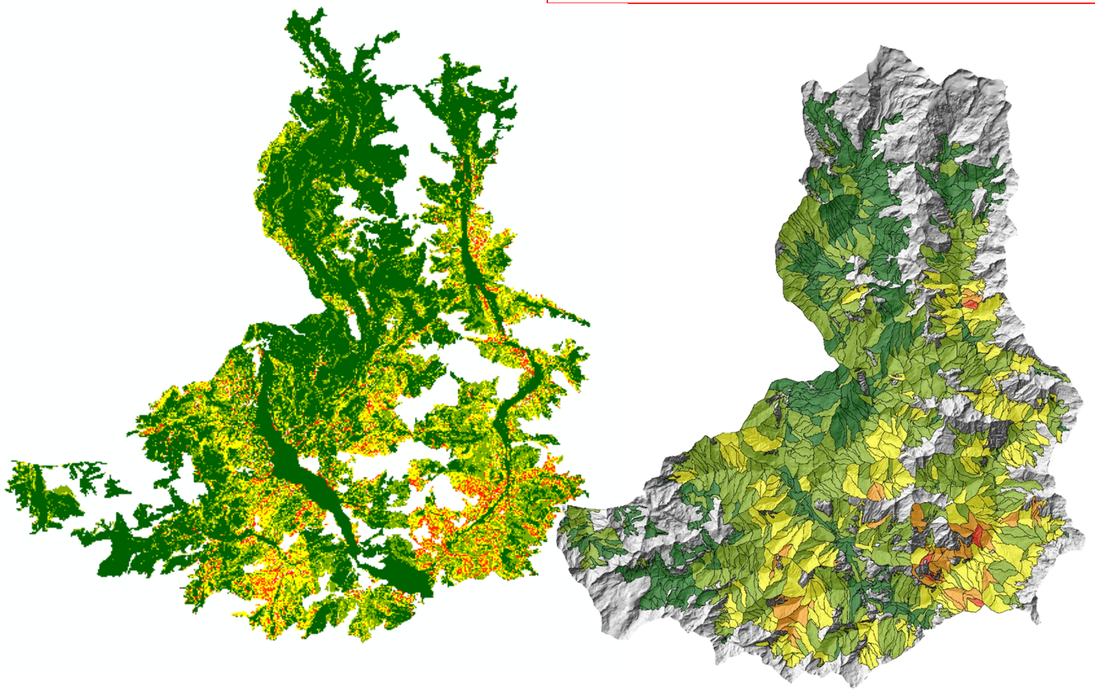
Distributed physically based models

Can be used for LEWS?

LIMITATIONS:

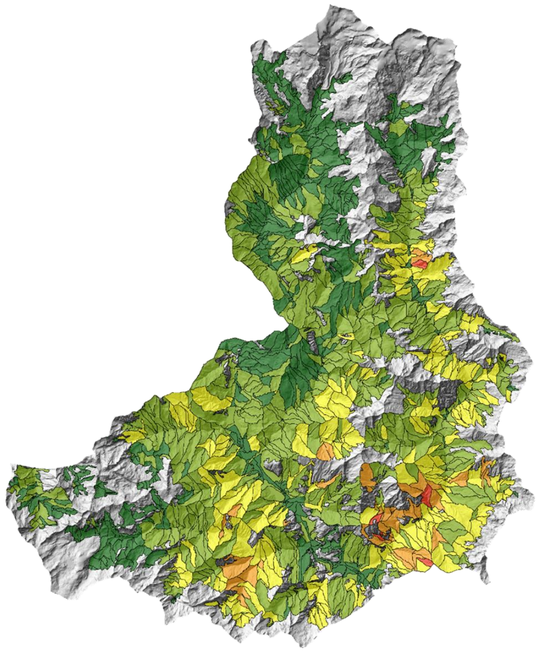
- Complexity (difficult to implement, computational resources)
- Static input data: many, with very high spatial variability
- Difficult validation, difficult interpretation

Contribution of this work



Rationale

Spatial unit:
pixels → small watersheds



Warning criterium:
A watershed is considered unstable
(and receives a warning)
if

X% of the area has a probability of landslide triggering > Y%

X% → Instability diffusion threshold (IDT)

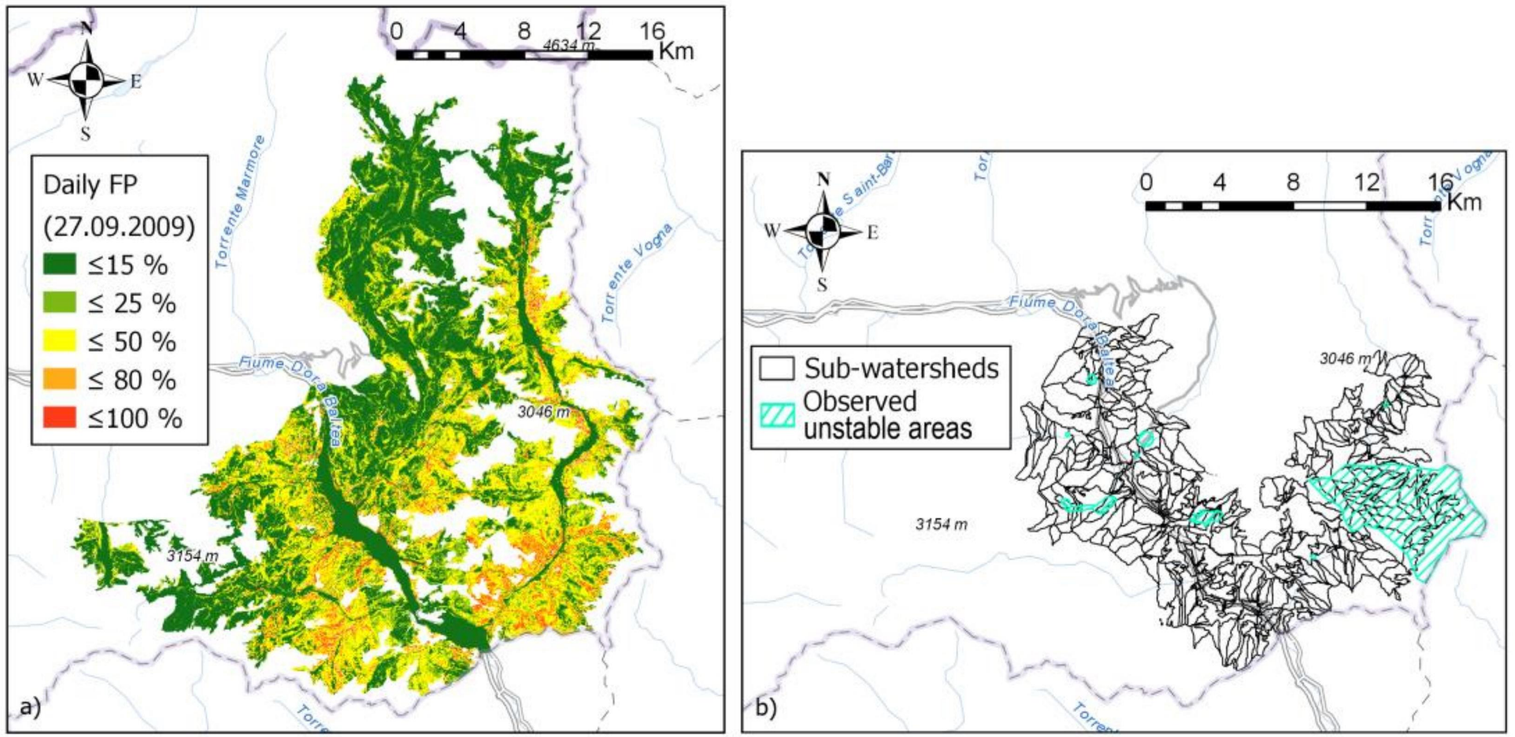
Y% → Failure Probability Threshold (FPT)

Double Threshold Validation Tool (DTVT)

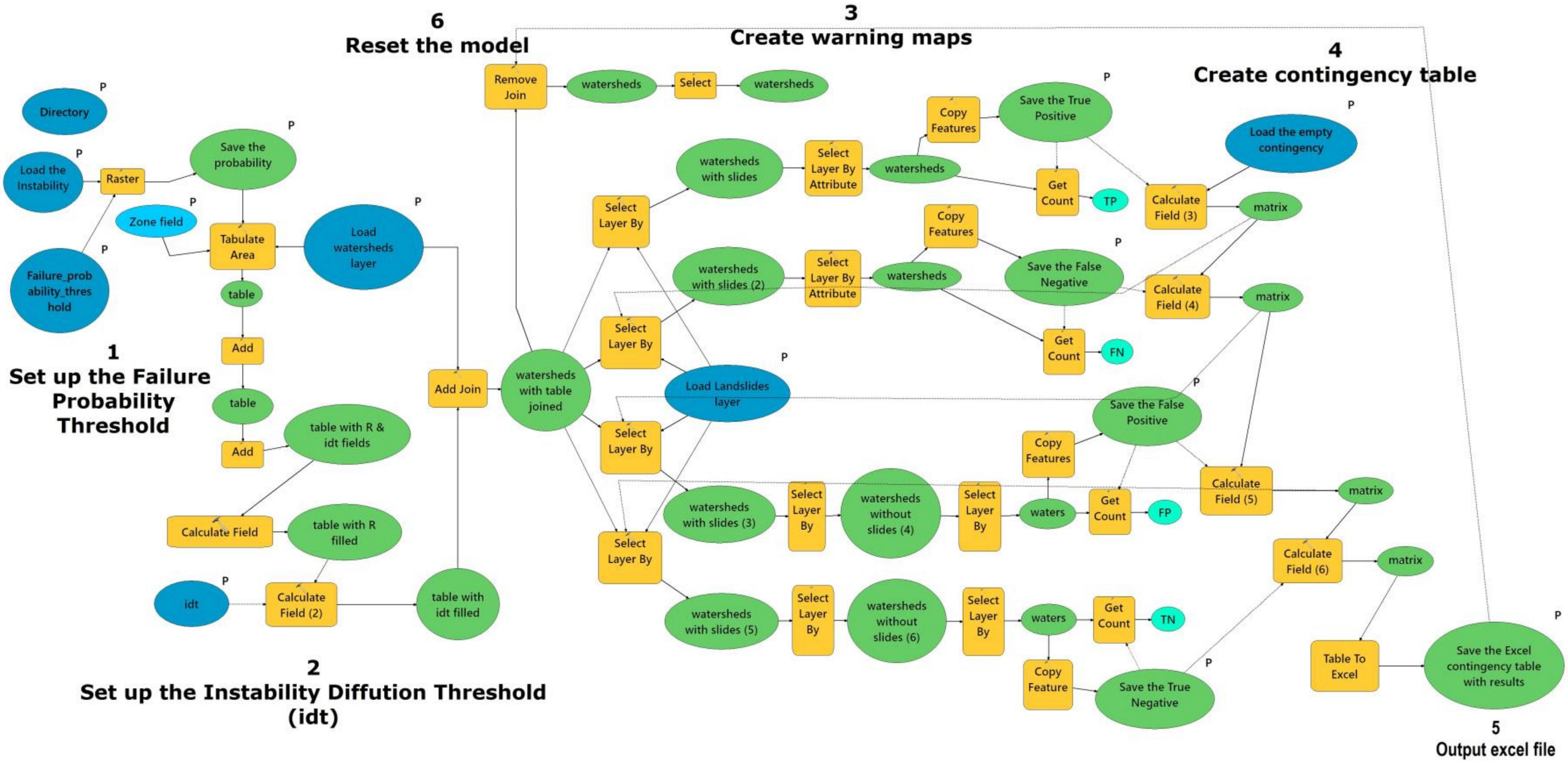
DTVT tool for GIS

INPUT DATA

- Slope failure probability maps (output of other models e.g. TRIGRS, HIRESSS…)
- Shapefile of reaggregation units (warning units)
- Validation dataset (inventory of observed landslides)



DTVT tool – ArcGIS model builder

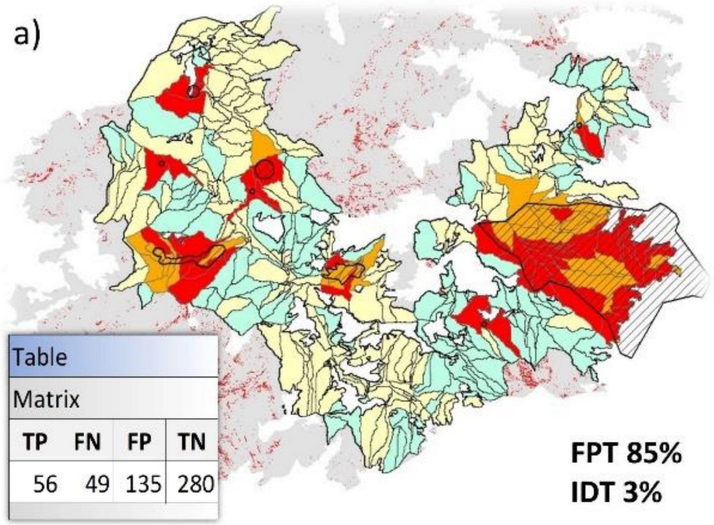


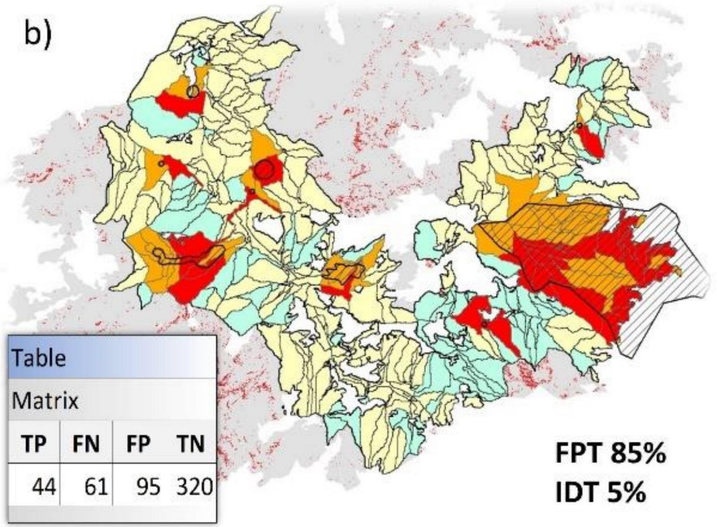
DTVT tool – RESULTS

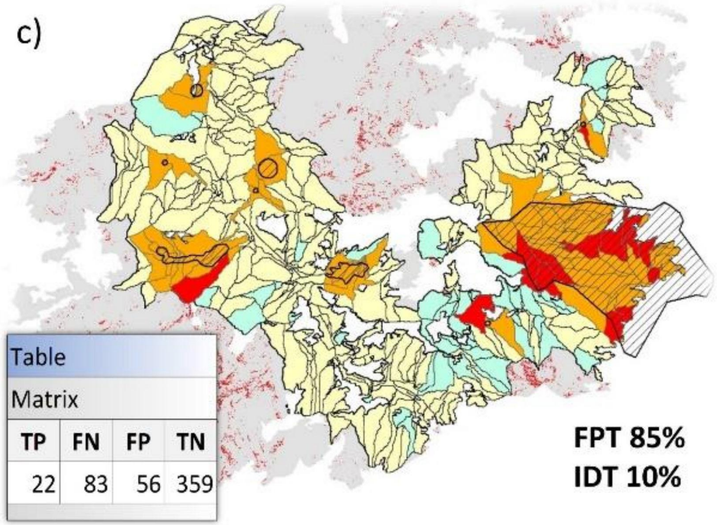
AUTOMATIC VALIDATION OUTPUTS

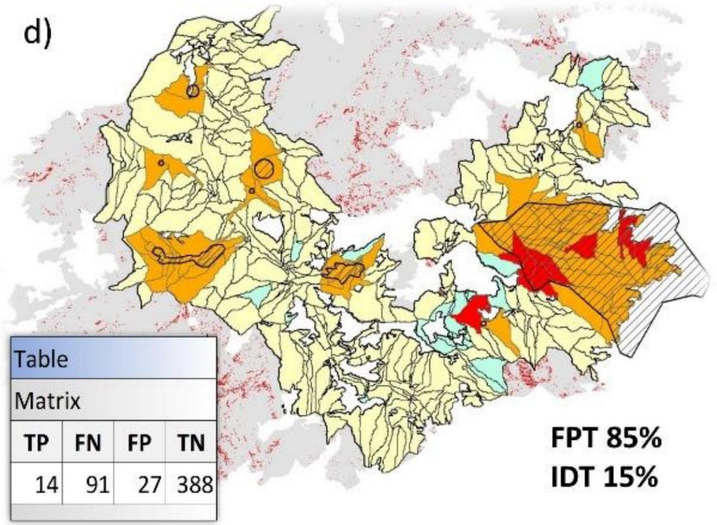
- Validation map
- Contingency matrix

LANDSLIDE		OBSERVED	
		YES	NO
PREDICTED	YES	TRUE POSITIVE	FALSE POSITIVE
	NO	FALSE NEGATIVE	TRUE NEGATIVE









Additional results

Selection of the optimal outcome based on skill scores

Example:
Efficiency = (TP + TN) / (TP + TN + FP + FN)

Efficiency		FPT					
		60%	70%	75%	**80%**	85%	90%
IDT	3%	0,650	0,673	0,696	0,725	0,740	0,767
	5%	0,708	0,735	0,754	0,788	0,817	0,823
	10%	0,804	0,821	0,837	0,852	0,858	0,873
	15%	0,850	0,875	0,871	**0,890**	0,877	0,888

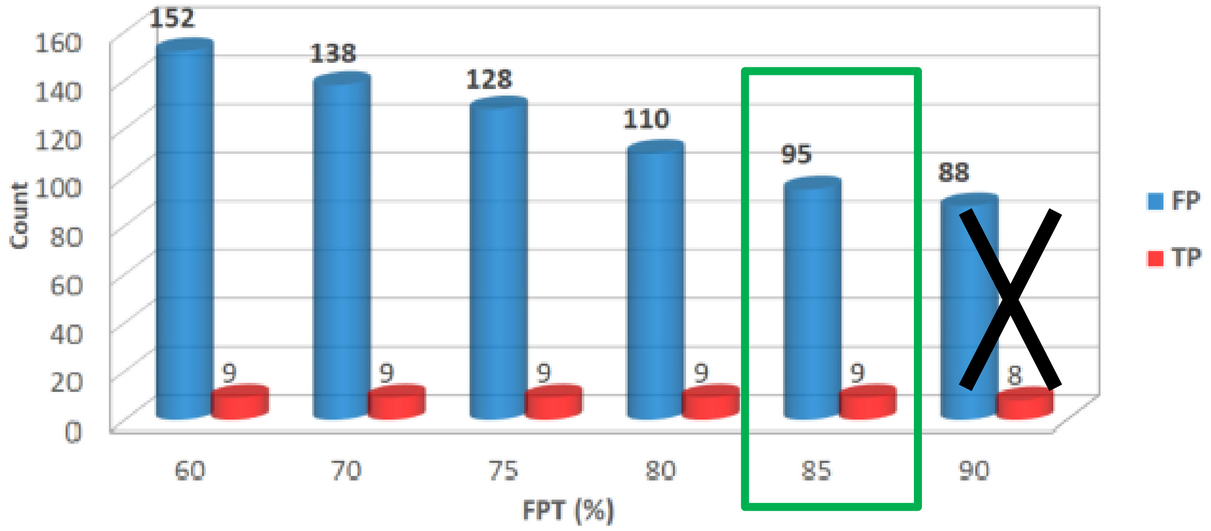
Implications for LEWS

Selection of the optimal configuration to be used to issue warnings in a prototype LEWS

Example = avoiding missed alarms is the priority

1- Identification of all configurations that maximize True Positives (thus minimizing FN)

2- Among them, selection of the configuration with less false alarms (FP)



General vs particular

The identified double-threshold criteria are stable if DTVT is applied to other rainfall events in the same test site.

BUT

Different test sites may have very different optimal double thresholds:

Valle d'Aosta Alert Zone B – 900 km2 – DTVT= 85/5

Urbino area – 100 km2 – DTVT = 35/1

Firenze province – 3514 km2 – DTVT = 57/1

Site specific costumization needed before use in LEWS!

Conclusions

- DTVT is a tool that **automates and speeds up** the process of **validation** for distributed phisically based models
- DTVT can be used to identify possible **warning criteria for LEWS**
- DTVT can be requested to the author or downloaded with the related paper (see next slide)

Thank you for your attention

Based on:

water

MDPI

Technical Note

A Tool for the Automatic Aggregation and Validation of the Results of Physically Based Distributed Slope Stability Models

Maria Alexandra Bulzinetti [1], Samuele Segoni [1,*], Giulio Pappafico [2], Elena Benedetta Masi [1], Guglielmo Rossi [3] and Veronica Tofani [1]

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