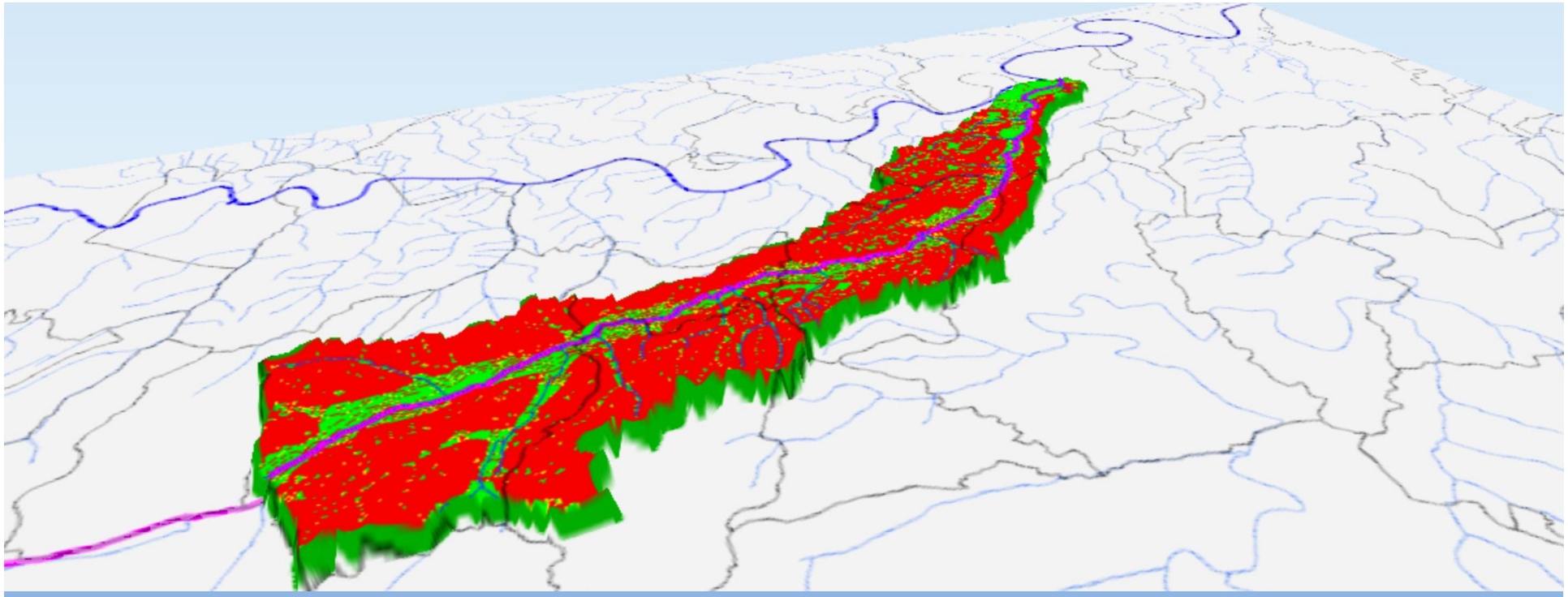
TOPPS
Water Protection

TOPPS ACADEMY
15-18th June 2015
Grugliasco (TO)

DISAFA
Università degli studi di Torino



EXAMPLES OF USE OF SPATIAL DATA FOR RUNOFF RISK DIAGNOSIS – Tiglione Valley

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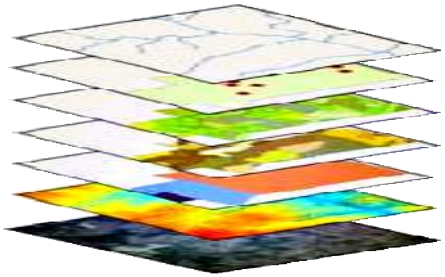
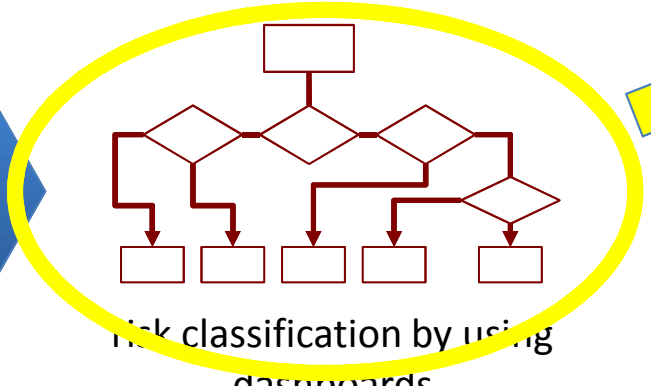
RUNOFF team

DIAGNOSIS



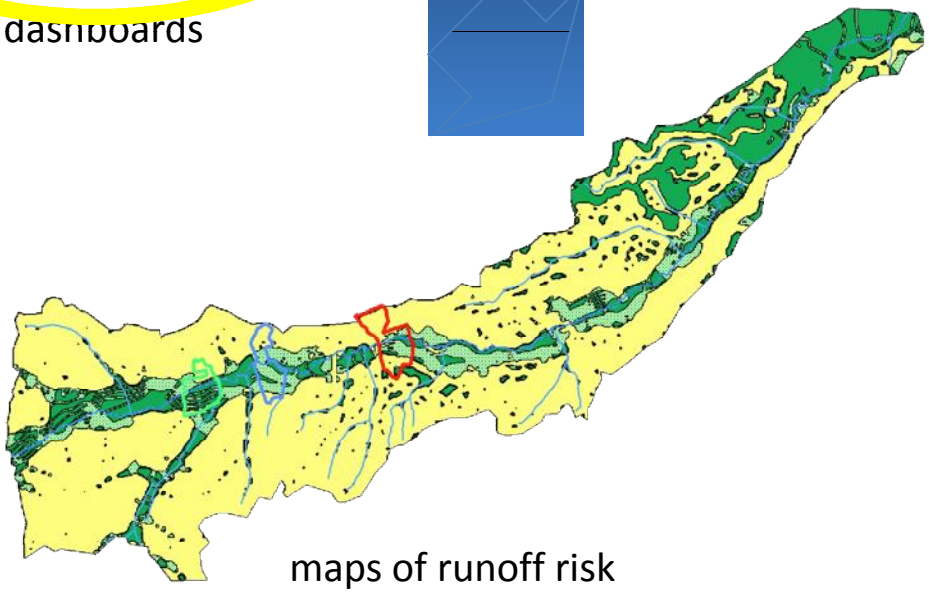
collection of territorial data (soils, elevation, slope, water network, field boundaries, etc.)



what data do we need?

risk classification by using dashboards

field visits to validate classification and collect additional info



maps of runoff risk

Dashboard 1: Infiltration restriction

Proximity to Surface Water	Permeability of the Topsoil	Steepness of Slope	Risk Class & Scenario
Field Adjacent to Water Body	LOW	STEEP (>5%)	I 7
		MODERATE (2-5%)	I 6
		SHALLOW (<2%)	I 5
	MEDIUM	STEEP (>5%)	I 4
		MODERATE (2-5%)	I 3
		SHALLOW (<2%)	I 2
	HIGH	STEEP (>5%)	I 3
		MODERATE (2-5%)	I 2
		SHALLOW (<2%)	I 1

Proximity to Surface Water	Transfer of run-off to downhill		Runoff reaches water body?		Risk Class & Scenario
Field Not Adjacent to Water Body	YES		Runoff reaches water body?	YES	T 3
				NO	T 2
	NO				T 1

HIGH RISK

MEDIUM RISK

LOW RISK

VERY LOW RISK

Dashboard 2: Saturation excess

Proximity to Surface Water	Drainage Status	Topographic Position	Subsoil Permeability		WHC*	Risk Class & Scenario
Field Adjacent to Water Body	Not Artificially Drained	Bottom of slope (con-cave)/Valley bottom (see scenario A)	Plough pan + Permeability disruption		ALL WHCS	S 4
			Plough pan OR Permeability disruption		<120 MM	S 4
					>120 MM	S 3
			No plough pan & Permeability disruption		<120 MM	S 3
					>120 MM	S 2
		Upslope/ Continuous slope	Plough pan + Permeability disruption		ALL WHCS	S 4
			Plough pan OR Permeability disruption		<120 MM	S 3
					>120 MM	S 2
			No plough pan & Permeability disruption		<120 MM	S 2
					>120 MM	S 1
	Artificially Drained	All Positions	Plough pan + Permeability disruption		ALL WHCS	SD 3
			Plough pan OR Permeability disruption		<120 MM	SD 3
					>120 MM	SD 2
			No plough pan & Permeability disruption		<120 MM	SD 2
					>120 MM	SD 1
Field Not Adjacent to Water Body	Not artifically Drained	Transfer of runoff to downhill field?	YES	Runoff reaches wa-ter body?	YES	T 3
					NO	T 2
			NO			T 1

HIGH RISK

MEDIUM RISK

LOW RISK

VERY LOW RISK

* WHC = Waterholding capacity

Runoff

Dashboards: main determining factors

	Digital maps may contain this info?
INFILTRATION RESTRICTION	
soil permeability (cappings)	**yes**
slope	**yes**
SATURATION EXCESS	
plough pan	**no**
water holding capacity	**yes**

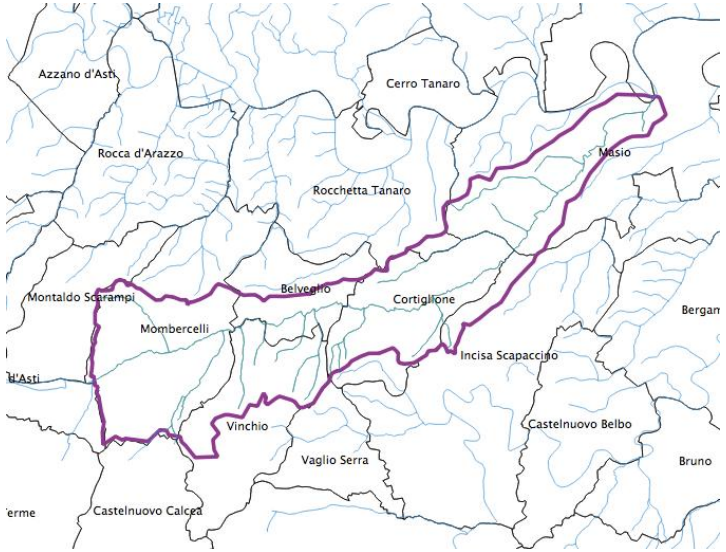
Catchment diagnosis may be performed (at least in part) using GIS

GIS: VECTOR and RASTER maps

VECTOR maps

geographical entities are represented by points, lines or polygons

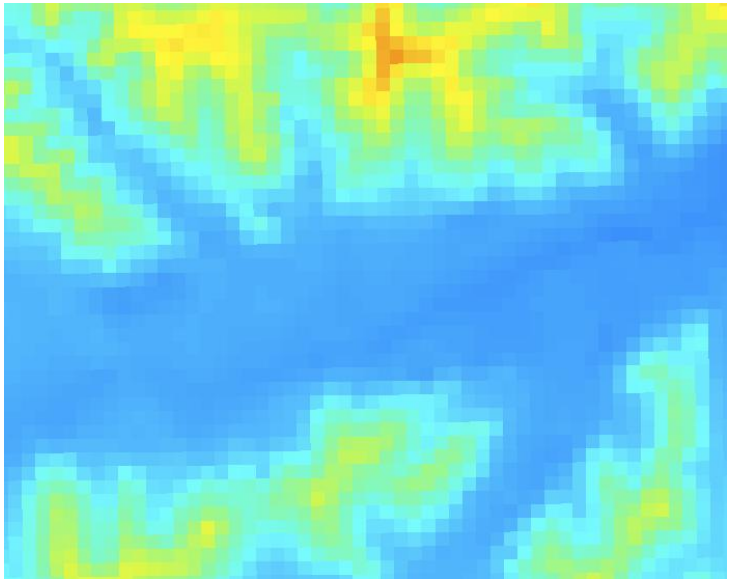
each point/vertex/node is numerically defined in terms of coordinates



water network
administrative boundaries

RASTER maps

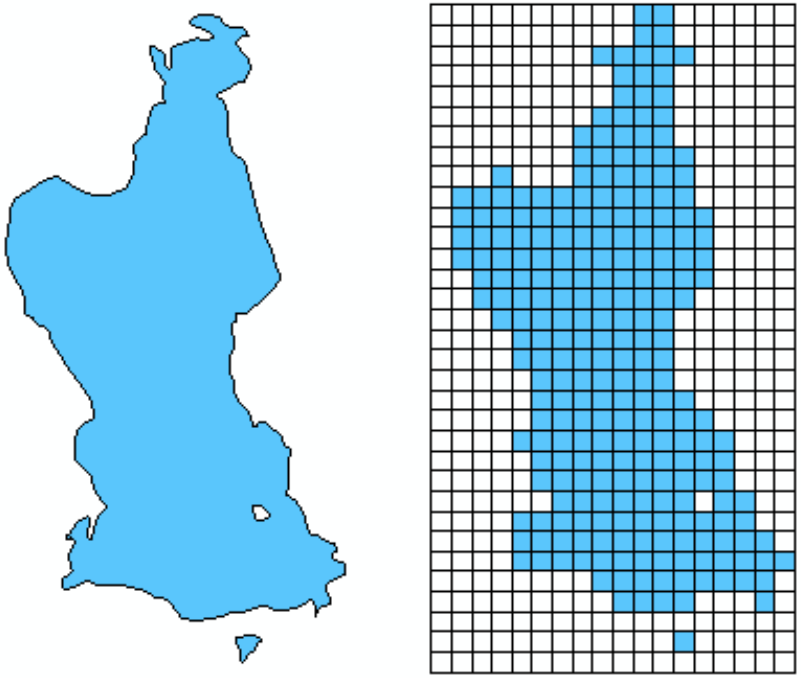
earth surface is divided in to an oriented grid. Each cell of the grid (pixel) is the minimum geographic entity



DTM

GIS: VECTOR and RASTER maps

Vector vs Raster representation of a same geographic entity



Vector
good for capturing and storing spatial details

Raster
good for data that vary continuously from location to location (e.g. elevation, temperature, soil pH, etc.)
Also used for aerial and satellite imagery

GIS: VECTOR and RASTER maps

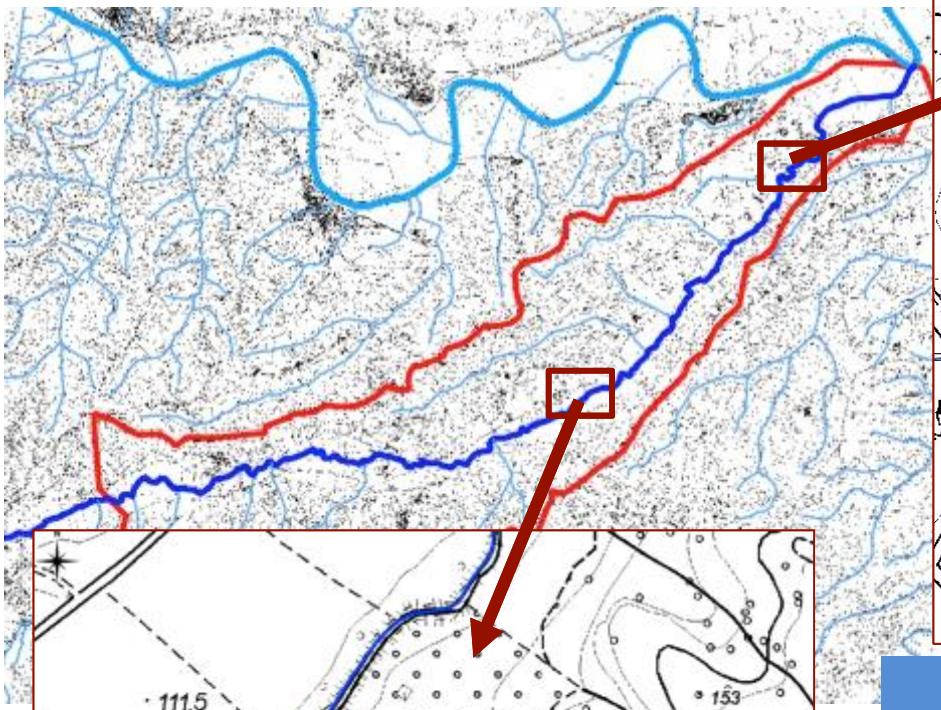
RASTER MAPS

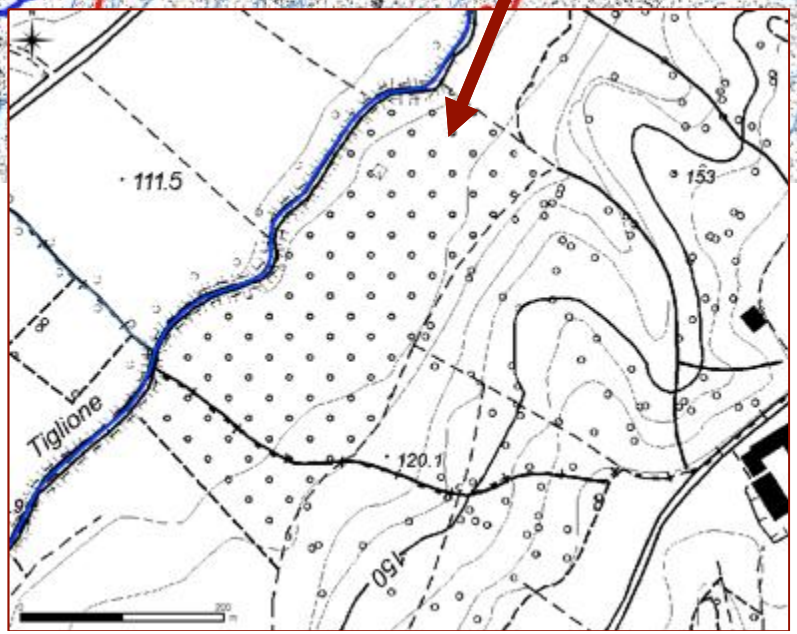
several “image” formats

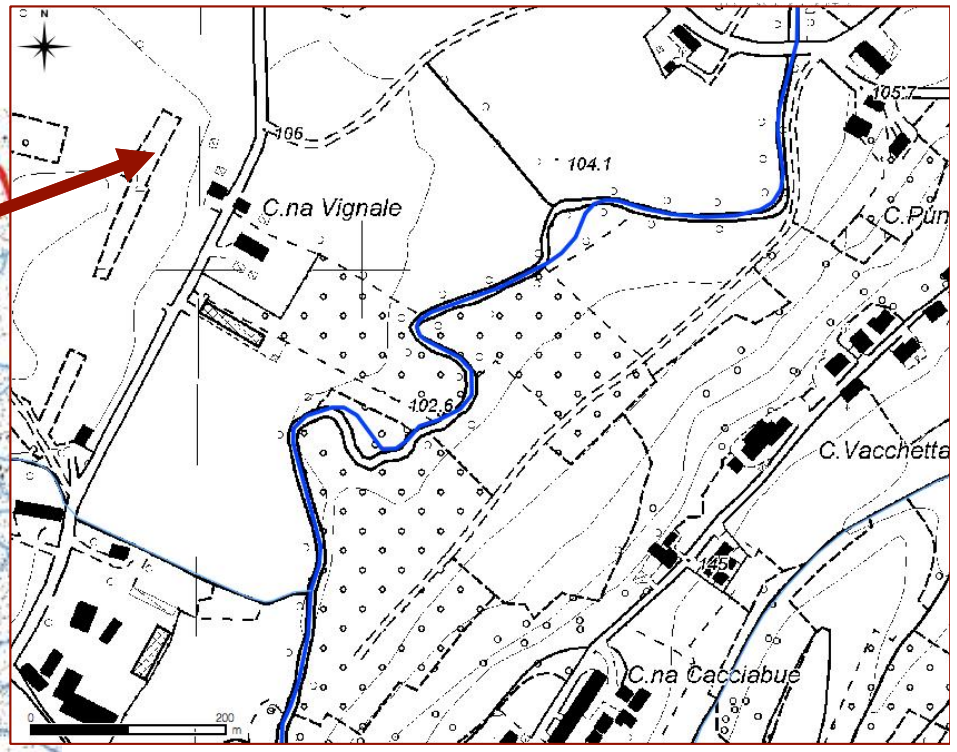
- **tiff**
- **jpg**
- **png**
- **…**

Available maps (Tiglione Valley)

Regional Tecnical Map







Items included (some)

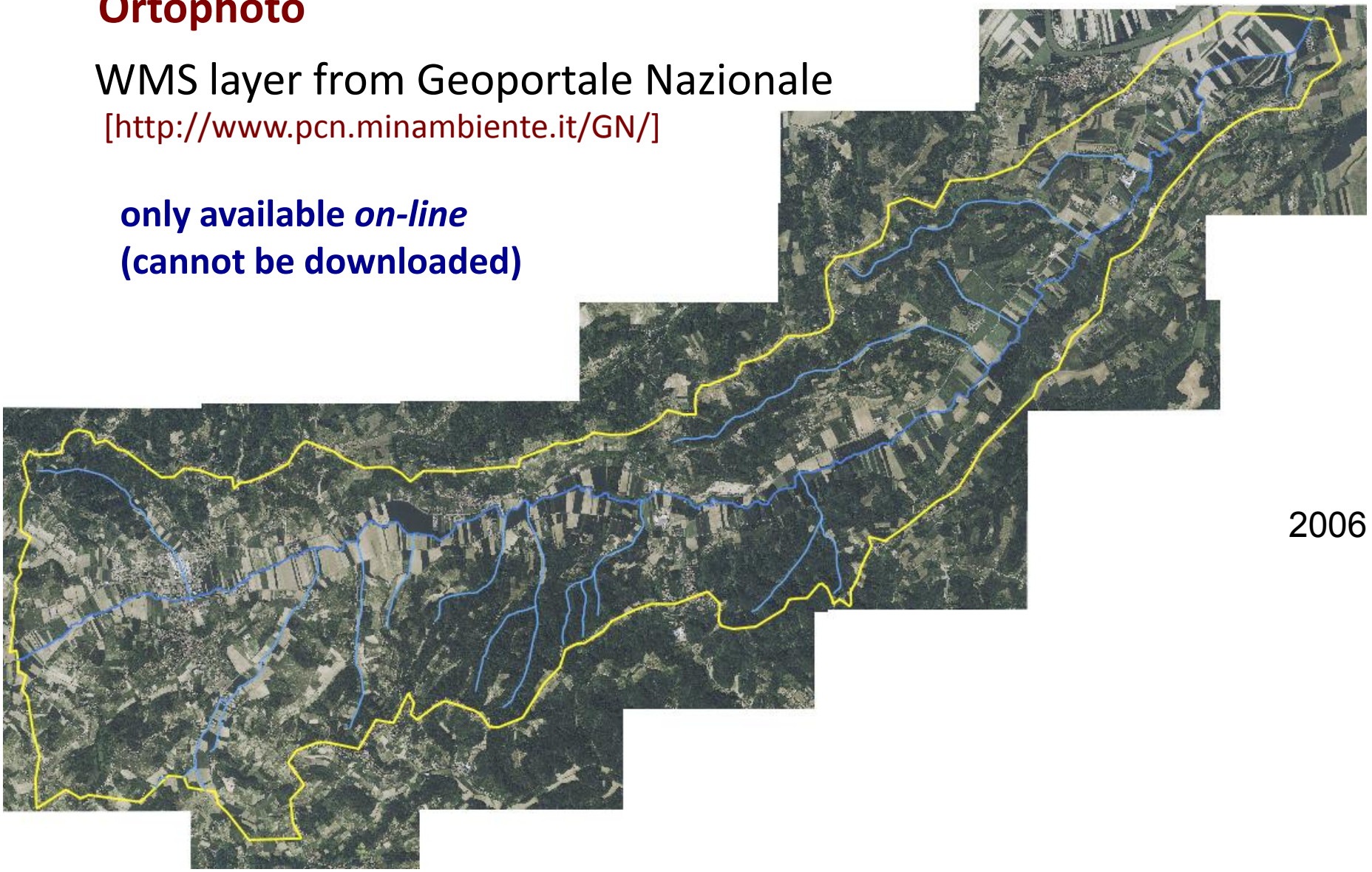
- field limits
- soil use (some)
- raod network
- watercourses
- contour lines (every 10 m)

Available maps (Tiglione Valley)

Ortophoto

WMS layer from Geoportale Nazionale
[http://www.pcn.minambiente.it/GN/]

only available *on-line*
(cannot be downloaded)

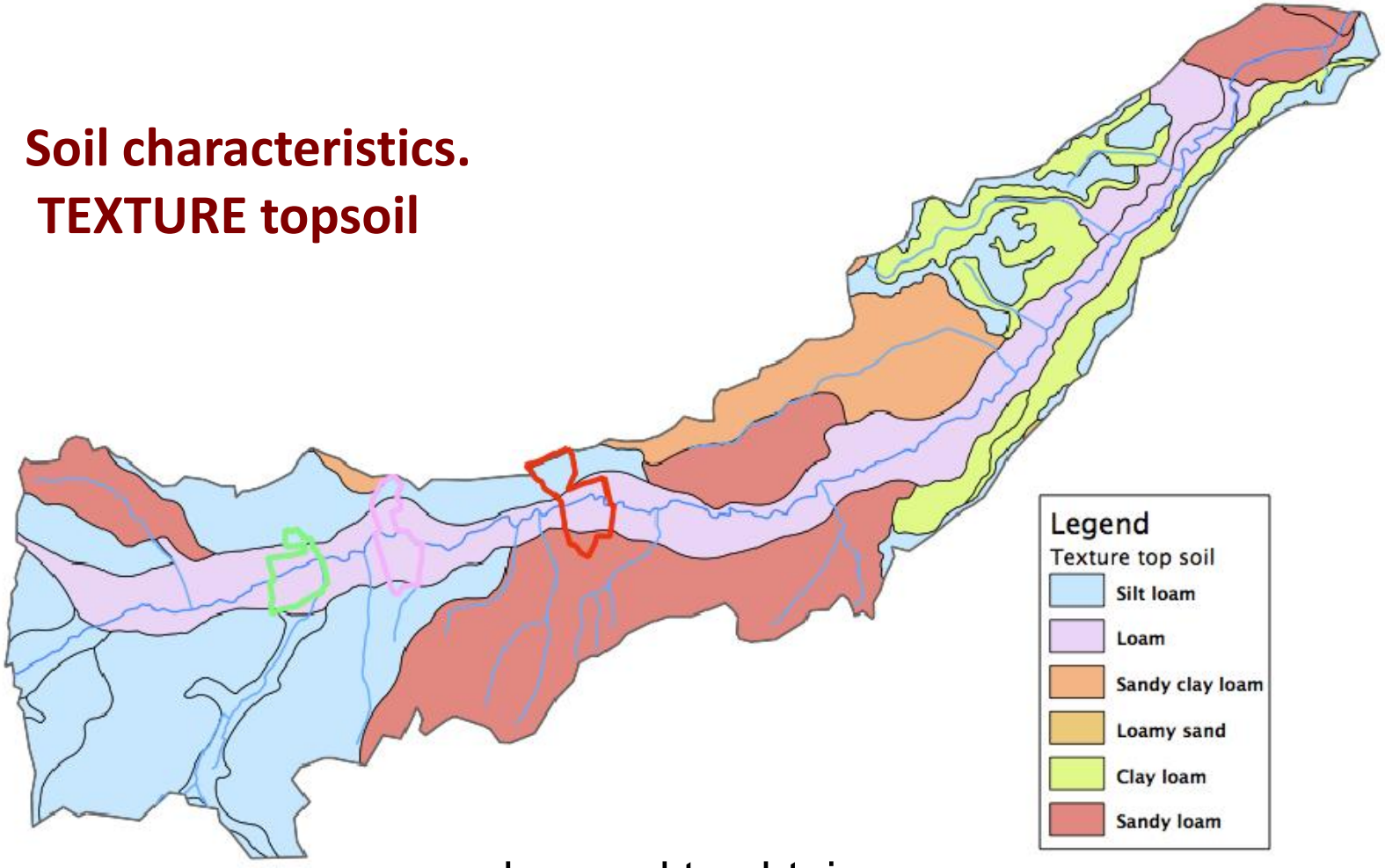


2006

Available maps (Tiglione Valley)

Soil characteristics: PIEMONTE SOIL MAP (1:10000) - vector map

Soil characteristics.
TEXTURE topsoil



can be used to obtain

- **capping risk map (for dashboard 1 application)**
- **WHC map (for dashboard 2 application)**

Dashboard 1: Infiltration restriction

Soil capping

Capping risk is one of the most important indicators or topsoil permeability

- **capping risk maps are often not available**
- **capping risk may be estimated from soil texture**

$$R = \frac{(1.5 \times \text{fine silt \%}) + (0.75 \times \text{coarse silt \%})}{\text{clay \%} + (10 \times \text{organic matter \%})}$$

R	capping risk	permeability of the topsoil*
< 1.2	LOW	HIGH
1.2-1.6	MEDIUM	MEDIUM
> 1.6	HIGH	LOW

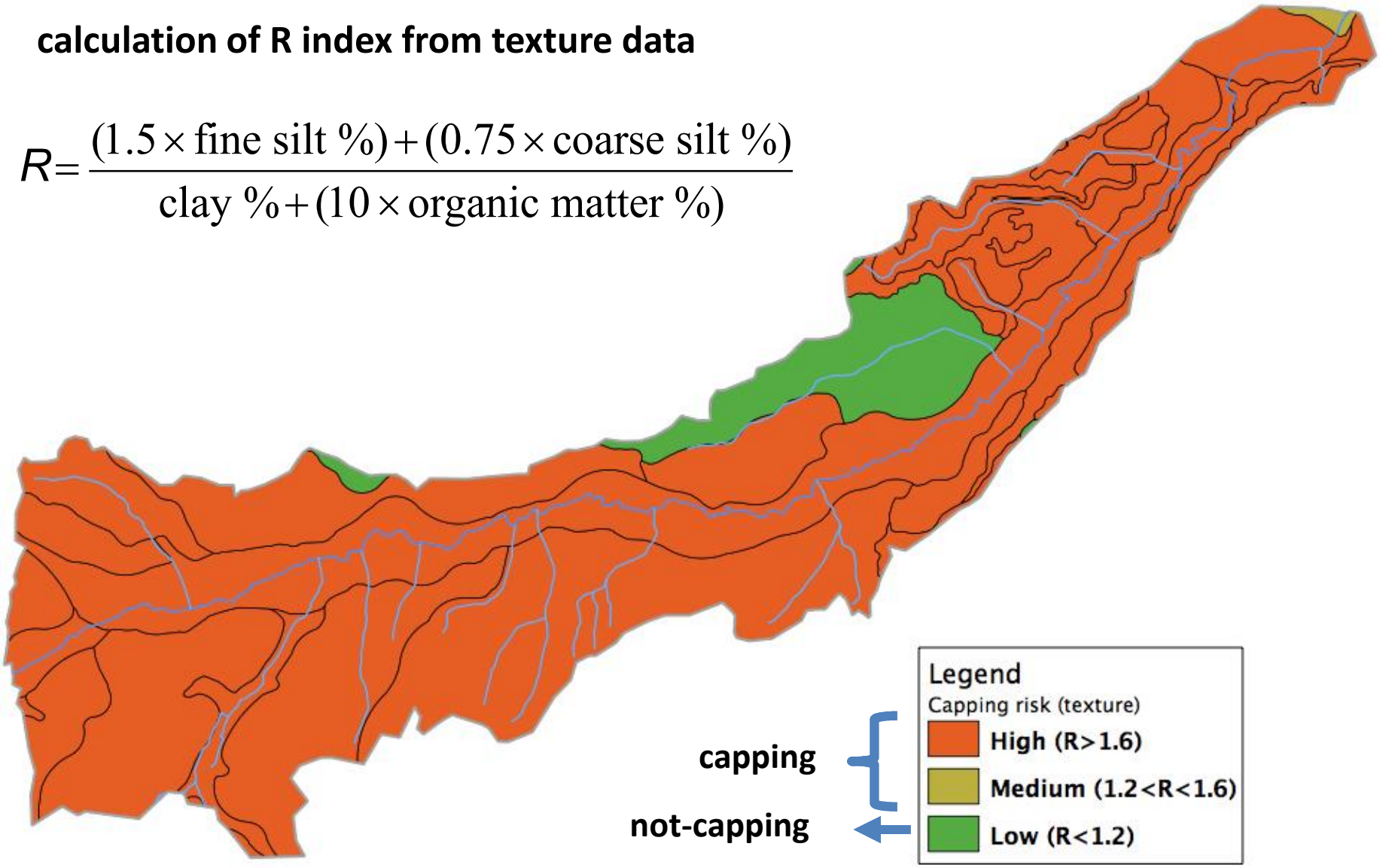
** for the application of dashboard 1 (infiltration restriction)*

Dashboard 1: Infiltration restriction

Soil capping

calculation of R index from texture data

$$R = \frac{(1.5 \times \text{fine silt \%}) + (0.75 \times \text{coarse silt \%})}{\text{clay \%} + (10 \times \text{organic matter \%})}$$



How to know water holding capacity (WHC)

- **some soil maps can already include this info (e.g. PIEMONTE SOIL MAP)**
- **WHC can be estimated from soil texture**

Texture	WHC (mm/cm)
Sand	0.4
Loamy sand (coarse)	0.8
Loamy sand (fine)	1.0
Sandy loam	1.3
Loam Silt loam Sil	1.7
Clay loam Sandy clay loam Silty clay loam	1.8
Sandy clay Silty clay Clay	1.7

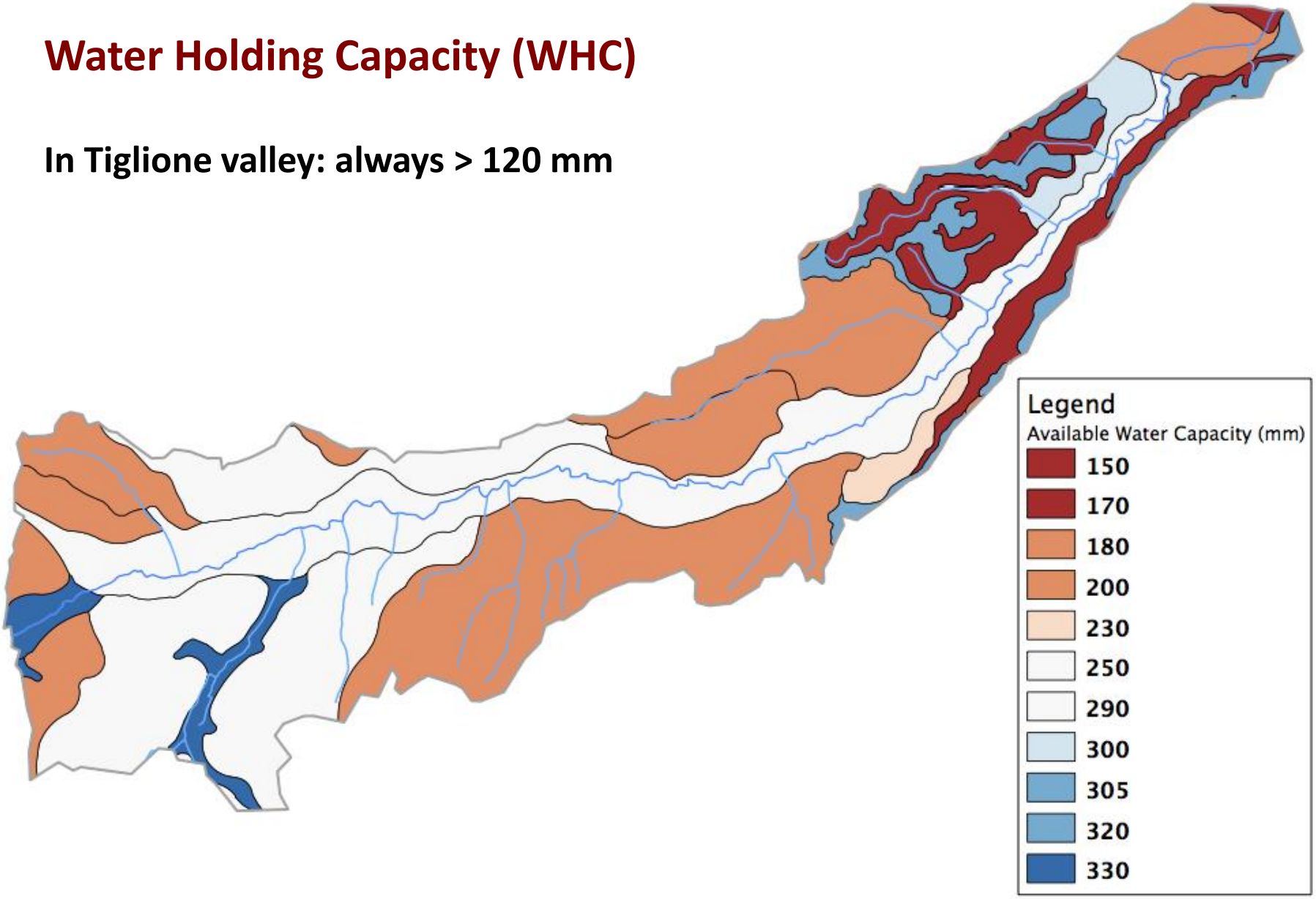
Example:
a) texture: **sandy loam**
b) depth: **100 cm**

Water holding capacity
1,3 mm/cm x 100 cm = 130mm

Dashboard 2: Saturation excess

Water Holding Capacity (WHC)

In Tiglione valley: always > 120 mm

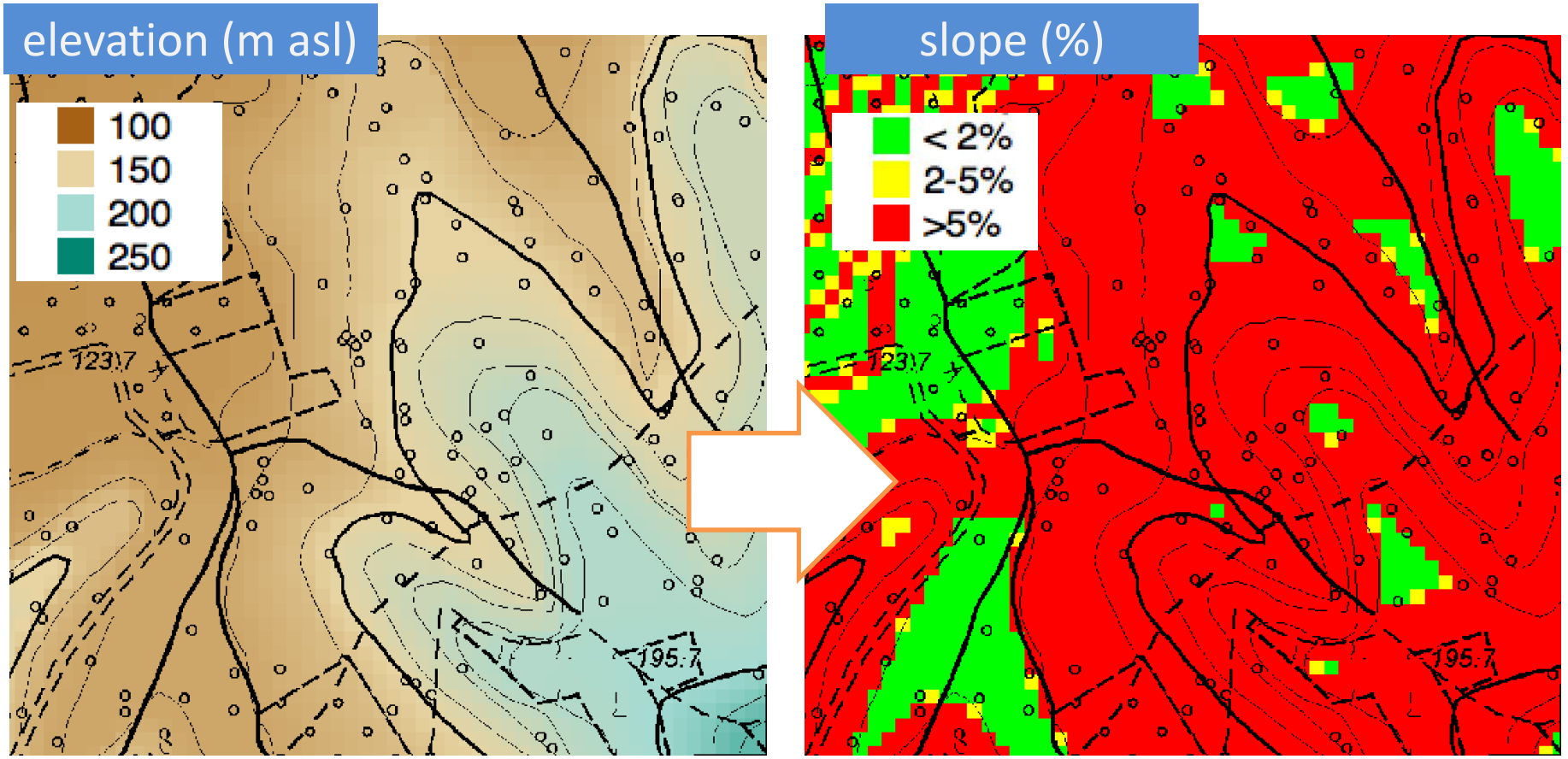


Available maps (Tiglione Valley)

Digital terrain model (DTM)

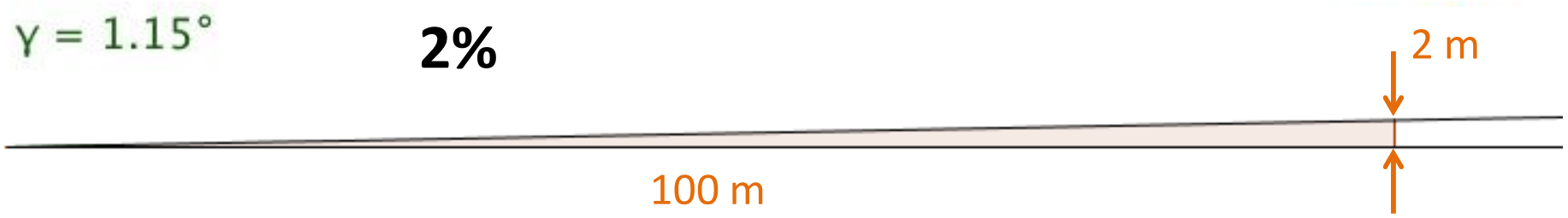
raster map of elevation data

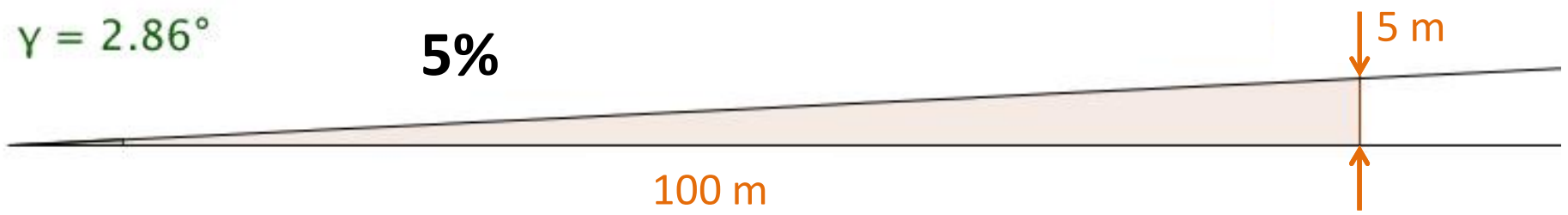
- can be used to obtain **slope map (for dashboard 1 application)**



Slope

in dashboards, slope is measured as percentage!



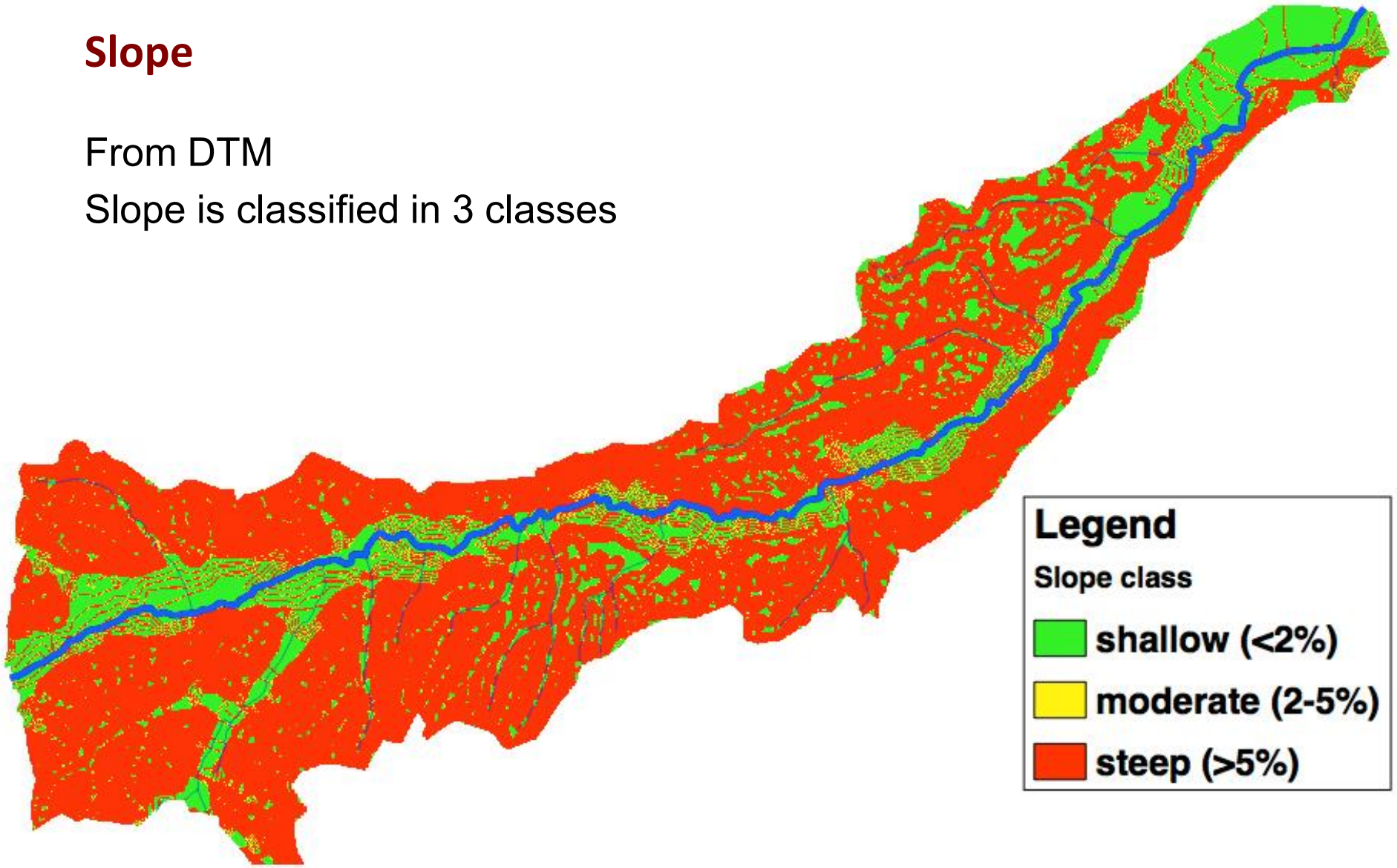


Dashboard 1: Infiltration restriction

Slope

From DTM

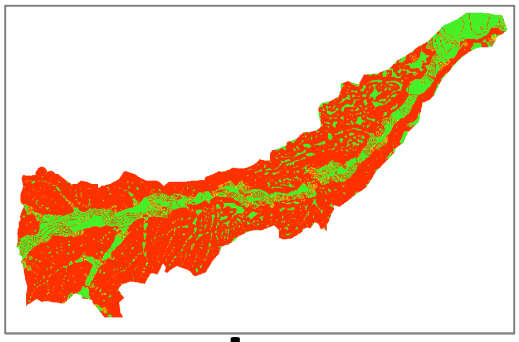
Slope is classified in 3 classes



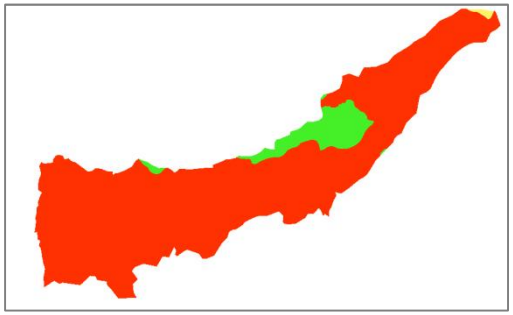
Dashboard 1: Infiltration restriction

Runoff risk estimation

Runoff risk maps is produced by overlapping raster maps of **SLOPE** and **CAPPING RISK** and applying dashboard 1 criteria on a pixel-by-pixel basis



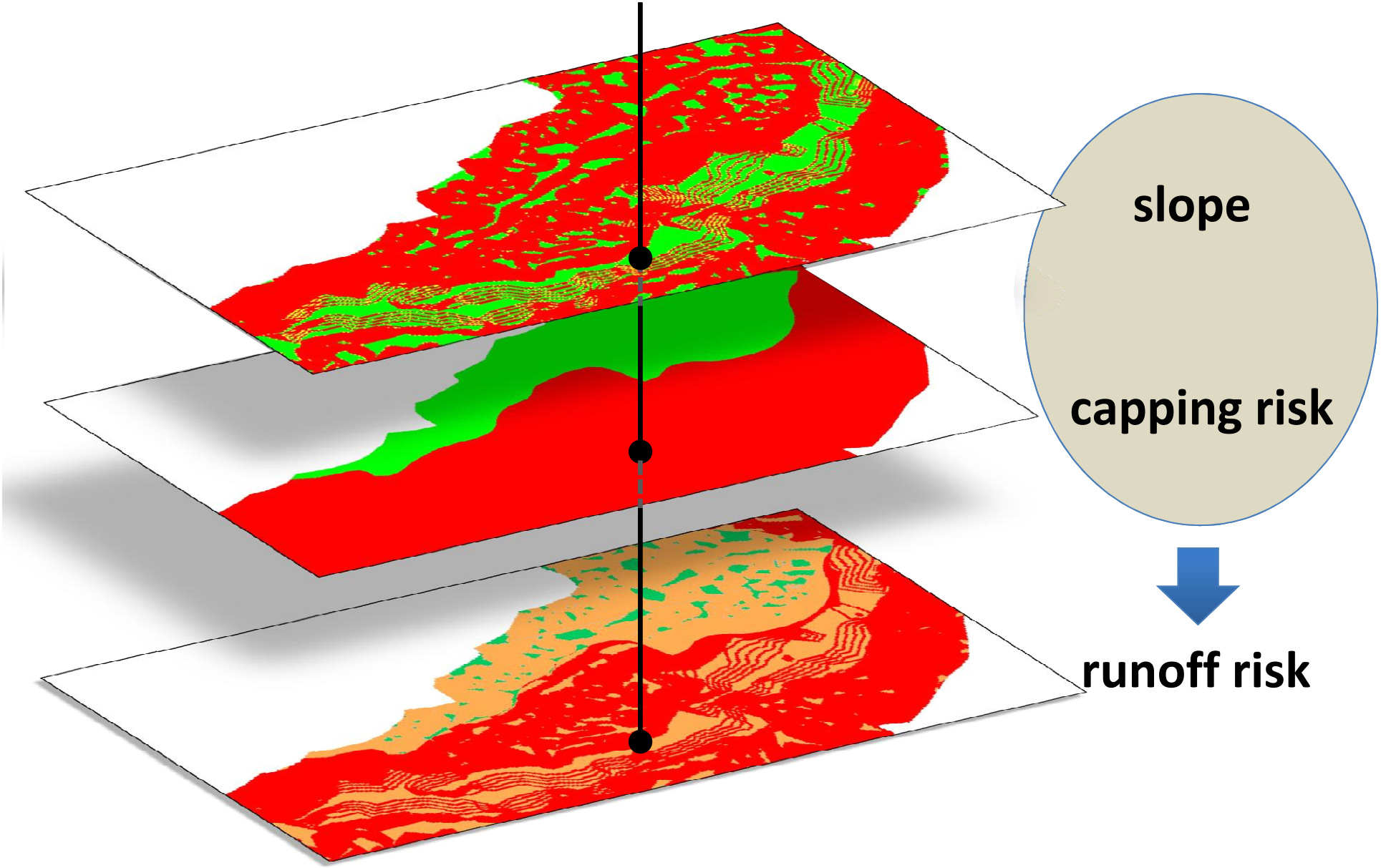
slope



capping risk

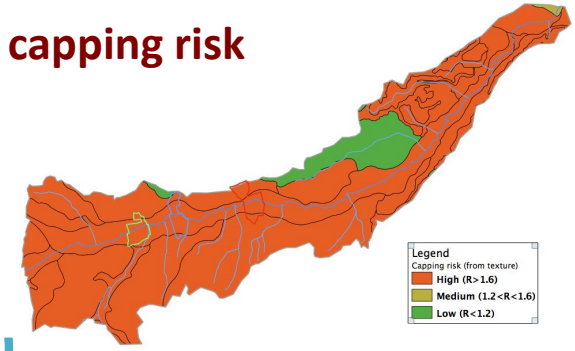
	0-2%	2-5%	>5%
HIGH permeability	very low	low	medium
MEDIUM permeability	low	medium	high
HIGH permeability	medium	high	high

Dashboard 1: Infiltration restriction

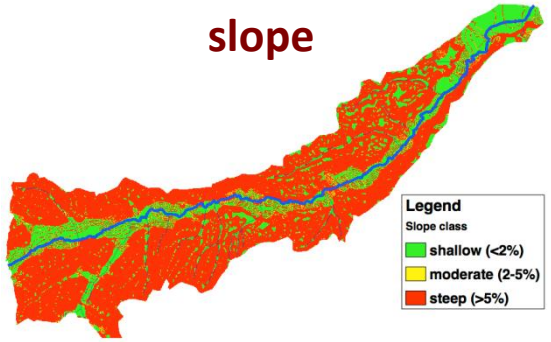


Diagnosi del rischio di ruscellamento: Valle Tiglione (Piemonte)

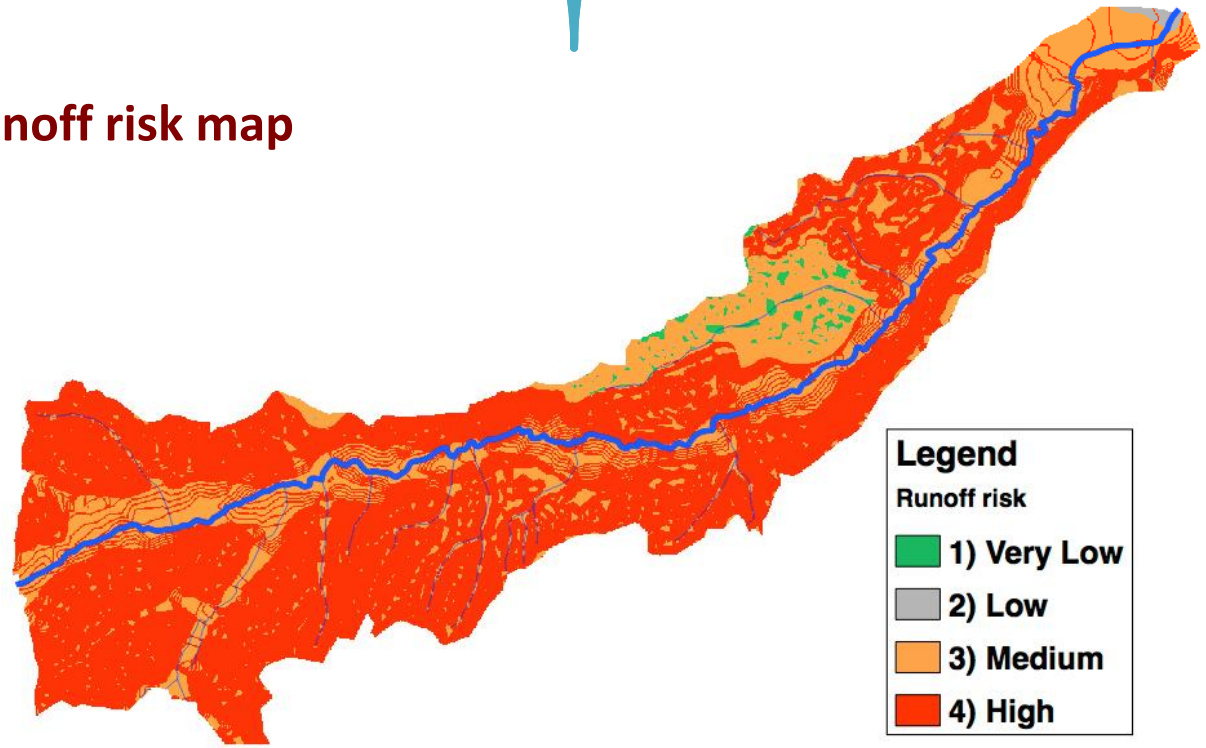
capping risk



slope



runoff risk map

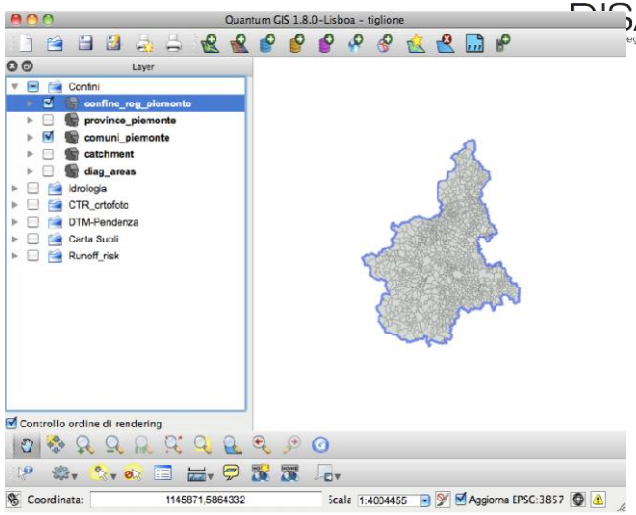


Geographical data visualization/elaboration

software used

QGIS

http://www.qgis.org/



reasons of this choice

- very limited previous experience on GIS
  - need to learn from scratch
  - no previous conditioning to use a specific software
- licence cost elimination: both are free open-source projects
- multi-platform (runs on Windows, MacOSX, Linux)
- very fast increase of users and available plugins
- public authorities largely relying on GIS will use QGIS as future standard productive platform
- largely fexible: new plugins could be developed for specific purposes and distributed as public domain
- technician and stakeholders in general can use a free tool that does not requires (very) expensive licences