

Firenze
16 Febbraio 2024



Associazione Italiana
Società Scientifiche Agrarie



Smart agriculture
per l'adattamento ai cambiamenti

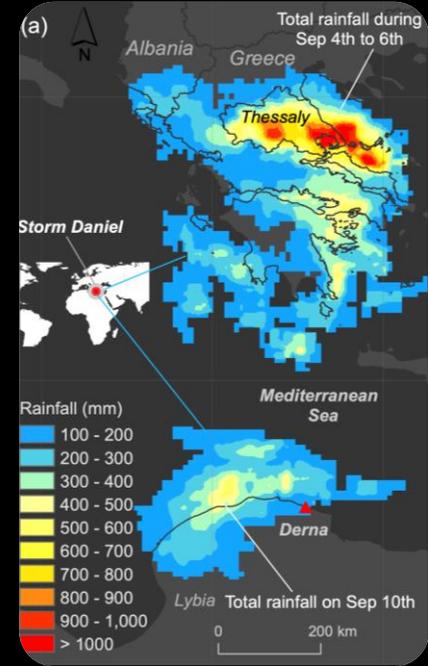
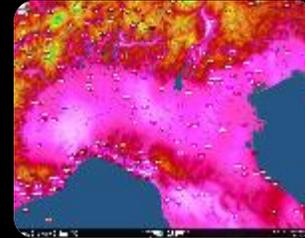
Paolo Tarolli
Dip. TESAF
Università di Padova

grandi
cambiamenti

REMOTE SENSING, BIG DATA, OPEN DATA, ARTIFICIAL INTELLIGENCE



Il **2023** si è confermato **l'anno più caldo dal 1850**, con l'aumento della temperatura media globale di **+1.48 °C** rispetto al livello preindustriale 1850-1900. Il bacino del Mediterraneo nel **2023** è stato caratterizzato da eventi meteo estremi: **siccità** (iniziata nel 2022) persistente sino ad aprile, **alluvione** in Emilia-Romagna, temperature che hanno superato per più giorni consecutivi i **40 °C** in **Sicilia**, **grandine** di grandi dimensioni in pianura padana, **temperatura del mare** più calda della media di **oltre 5 °C**, ed infine il **ciclone Daniel** che ha portato alluvioni catastrofiche in Grecia (con quasi 1000 mm di pioggia cumulata) e in Libia (dove più di **11,000 persone** risultano disperse).

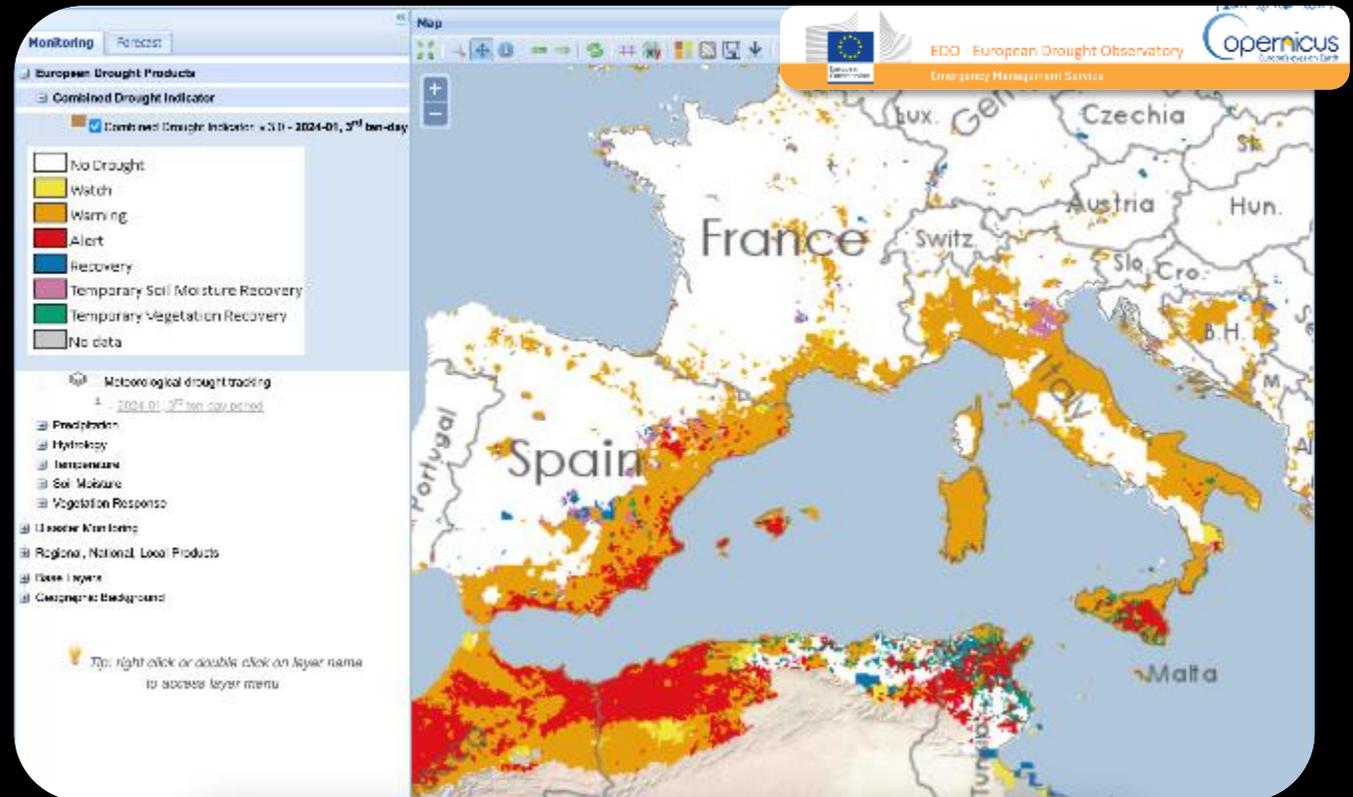
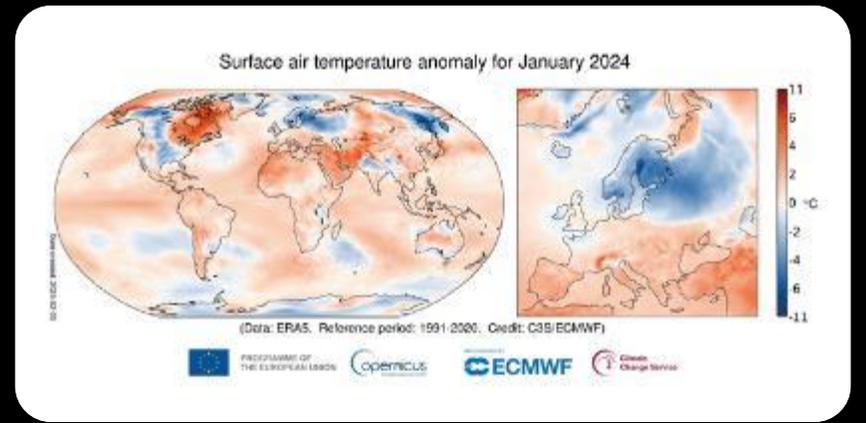


2022



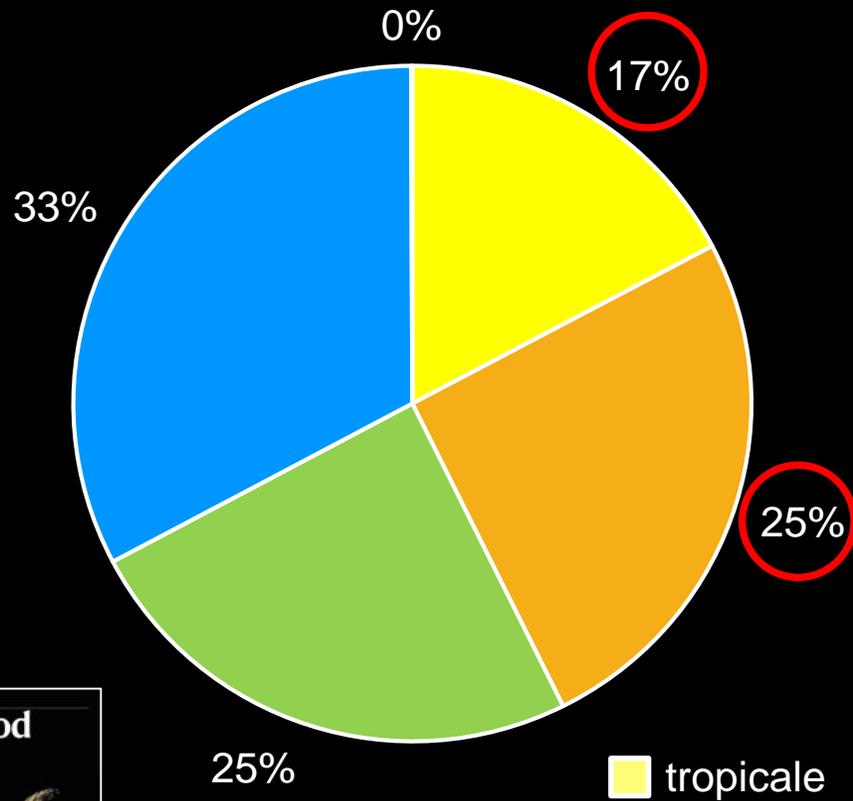
2023

2024

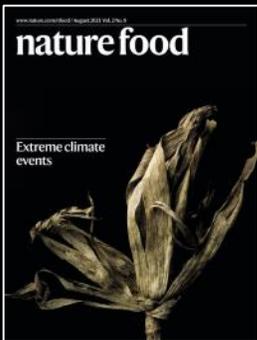
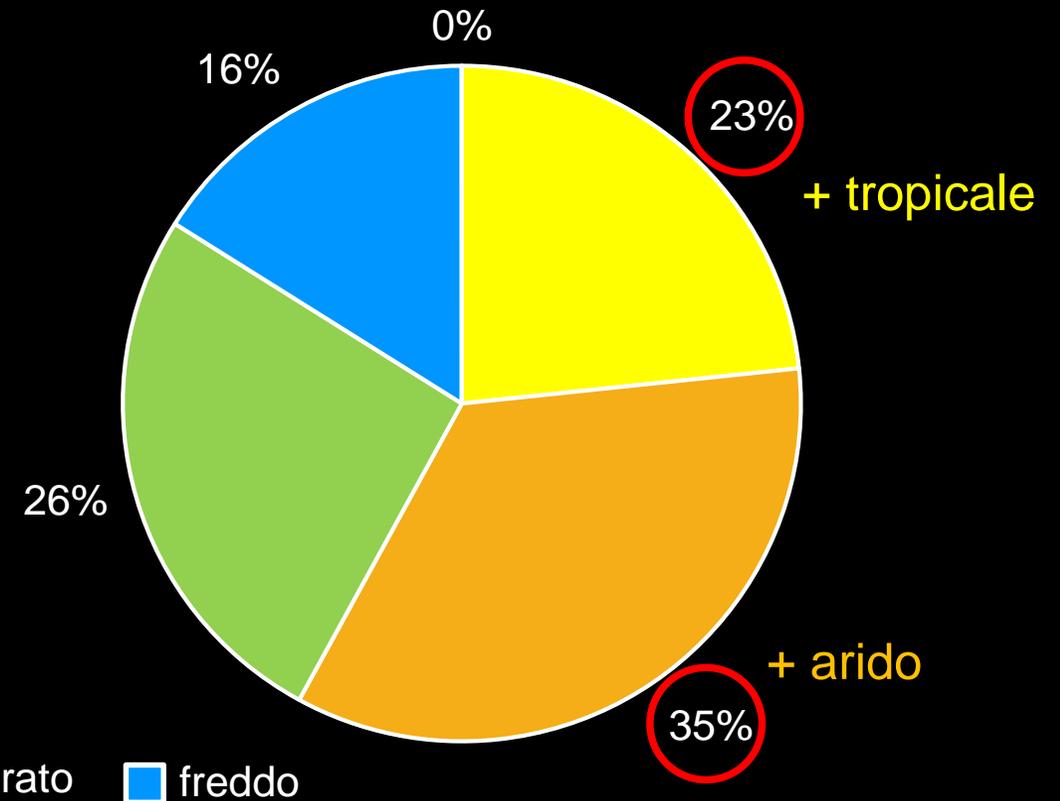


superficie agricola globale

clima attuale



clima futuro
(proiezione fine secolo, scenario IPCC RCP8.5)



Wang W, Pijl A, Tarolli P (2022). Future climate-zone shifts are threatening steep-slope agriculture. *Nature Food*

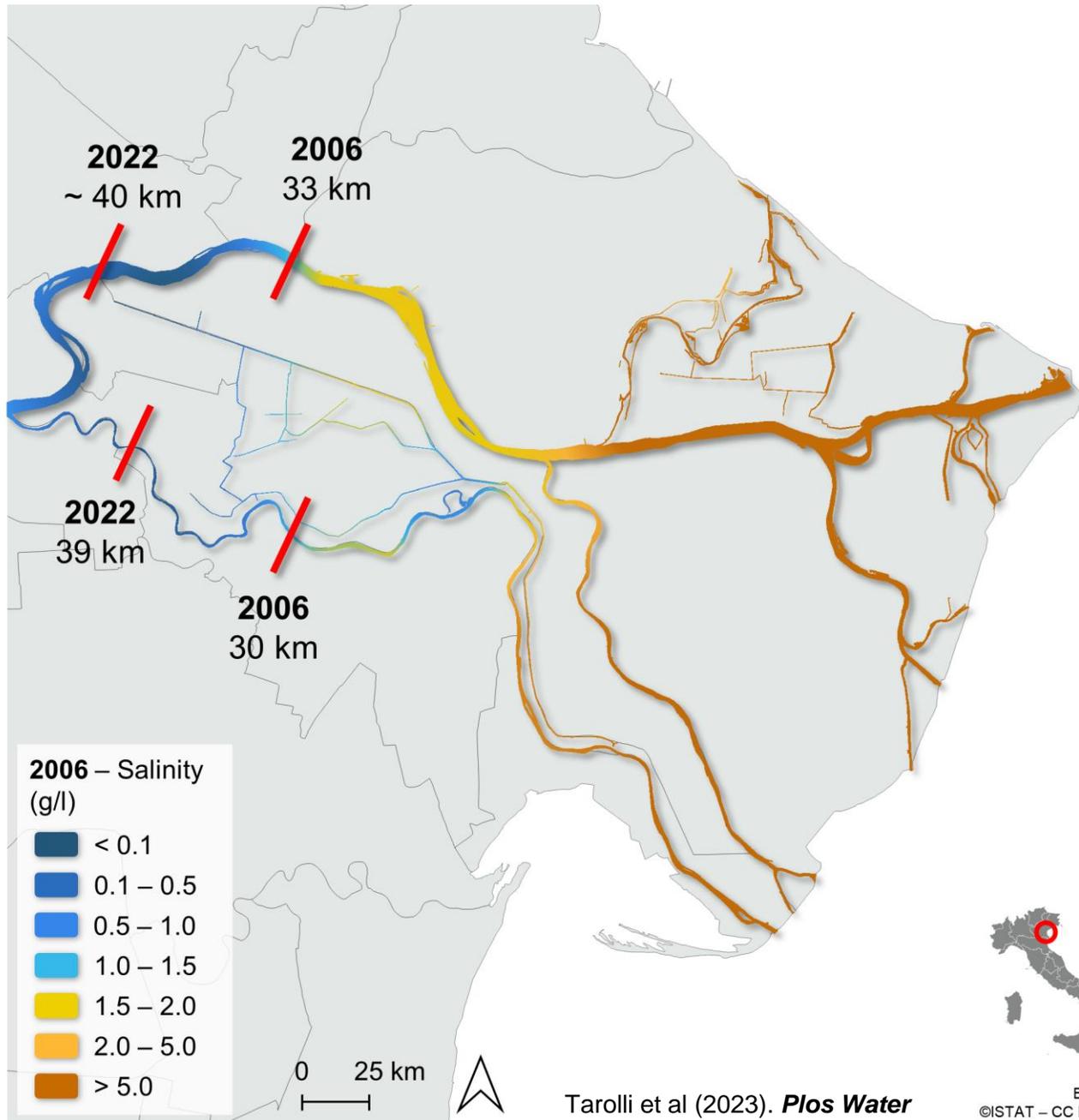
An aerial collage of four images showing coastal agricultural landscapes. The top-left image shows a large body of water next to a field with a small pond. The top-right image shows a complex network of canals and fields. The bottom-left image shows a coastal area with a large green field and a body of water. The bottom-right image shows a vast green field with a small pond. The text 'agricoltura costiera' is overlaid in white on a semi-transparent grey background.

agricoltura costiera

An aerial photograph of the Delta del Po region in Italy during the summer of 2022. The image shows a large expanse of agricultural fields. A significant portion of these fields is brown and appears to be fallow or suffering from drought. There are distinct, irregular patches of green vegetation scattered throughout the brown areas, indicating areas where crops are still growing or where the soil is less affected. A paved road with a white dashed center line runs diagonally from the bottom right towards the top right, with a white car visible on it. To the right of the road is a dense line of green trees and shrubs. In the background, a wide river (the Po) flows through the landscape, with more agricultural fields and some buildings visible on the far bank. The overall scene depicts the impact of drought and saline water intrusion on agricultural productivity.

Delta del Po - estate 2022

siccità + intrusione cuneo salino

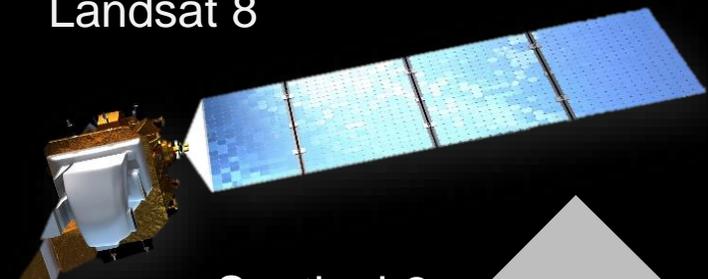


Tarolli et al (2023). *Plos Water*

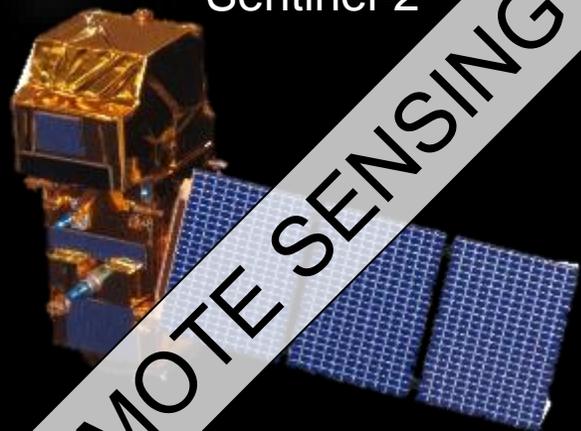
Basemap:
©ISTAT – CC BY 3.0 IT



Landsat 8



Sentinel-2

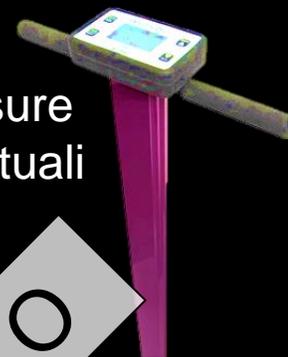


REMOTE SENSING

drone multispettrale



Misure puntuali



SENSORI AL SUOLO



Misure in continuo



Misure puntuali

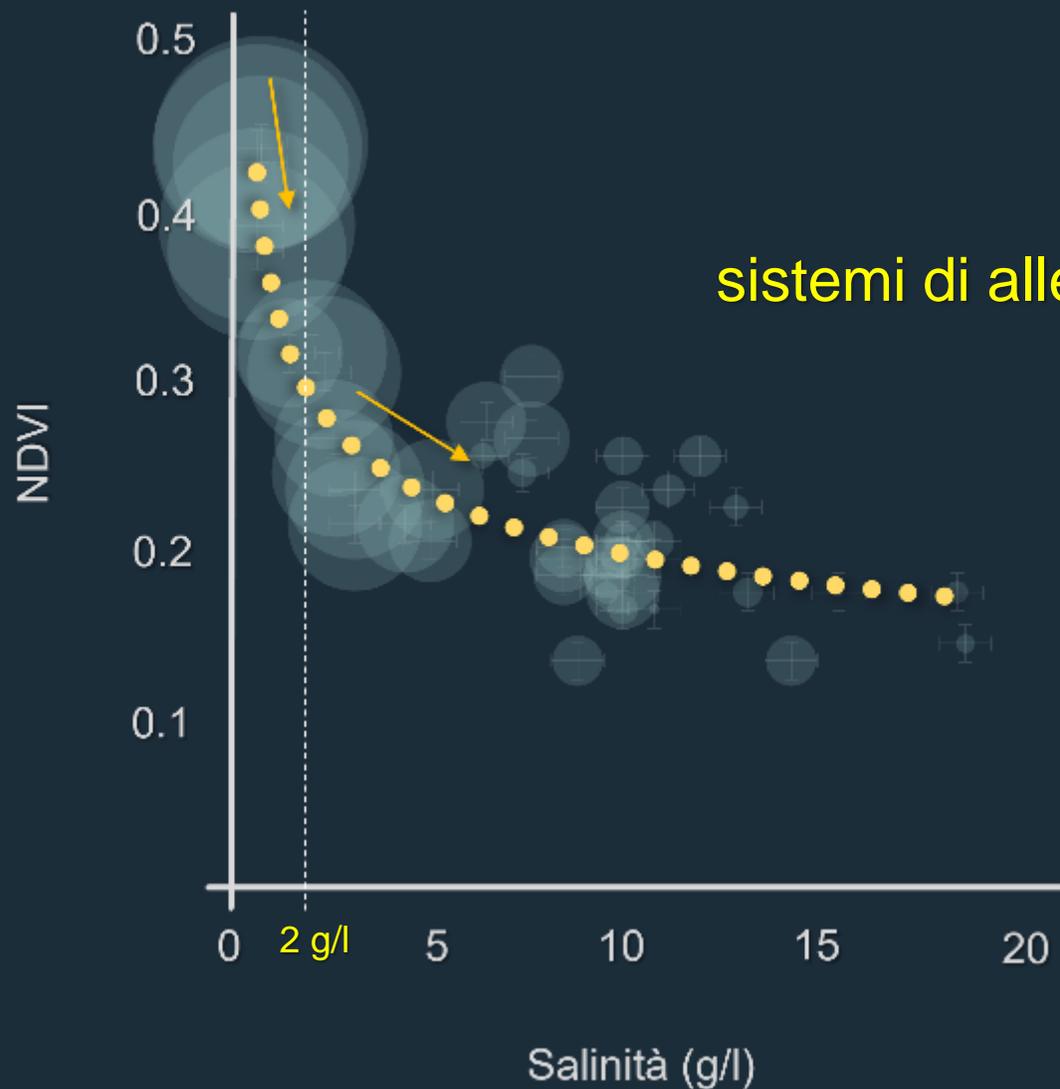


Misure in continuo

SENSORI IN ACQUA



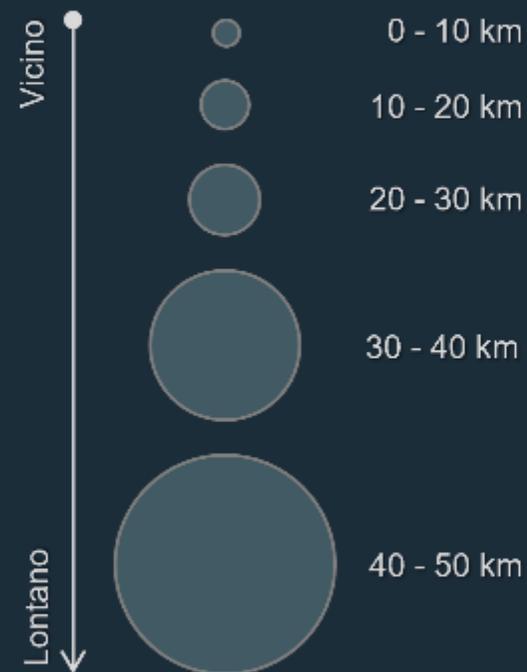
satellite + misure in acqua (50 punti distribuiti in tutto il Delta)



sistemi di allerta



Prossimità dal mare

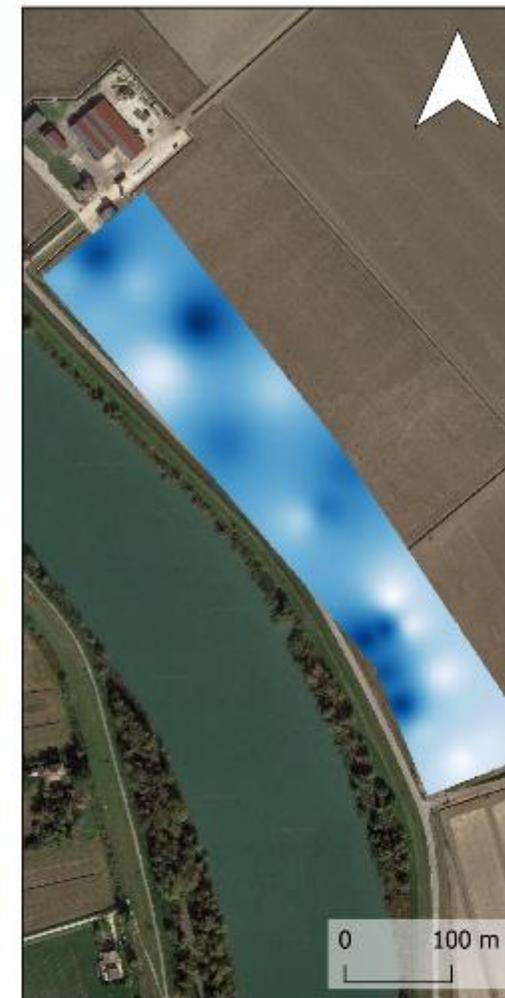
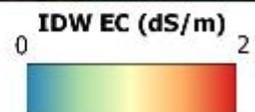
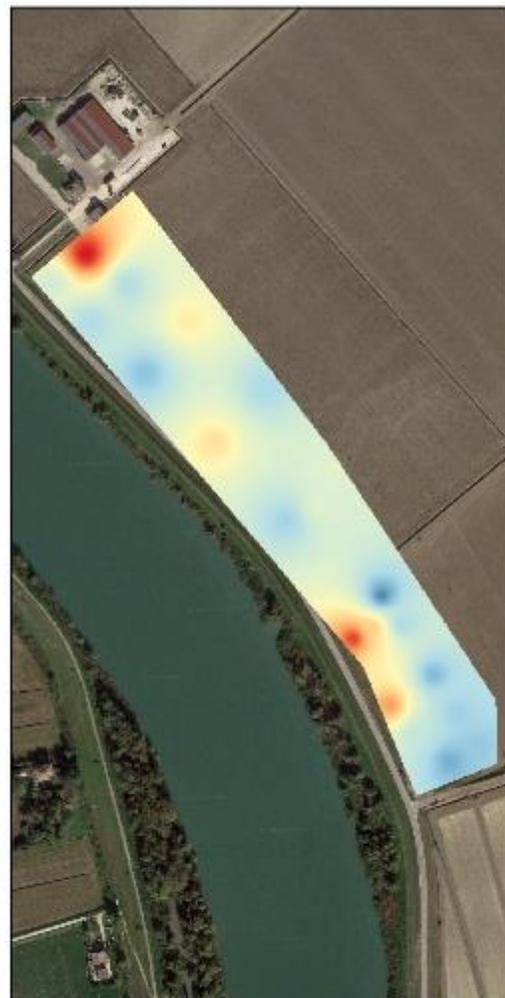


Luo et al (2024). *International Soil and Water Conservation Research*



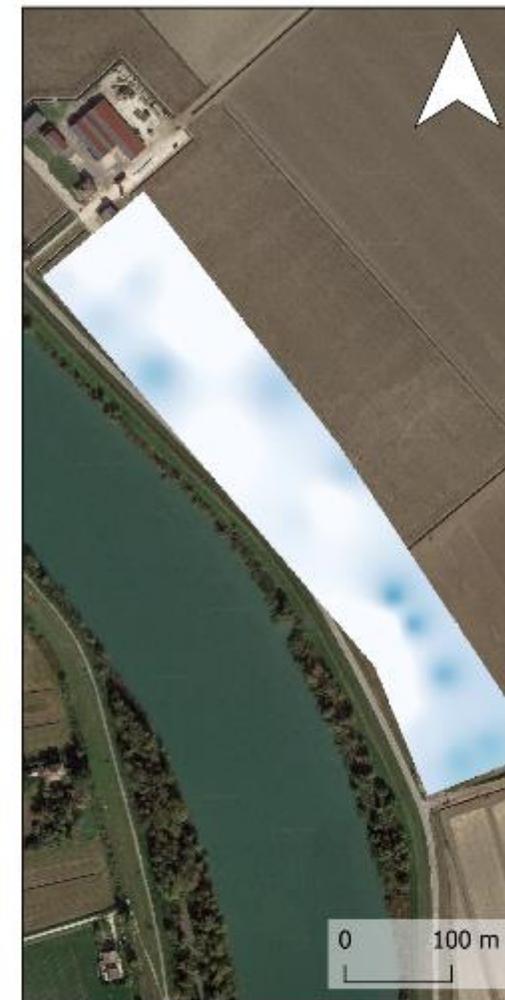
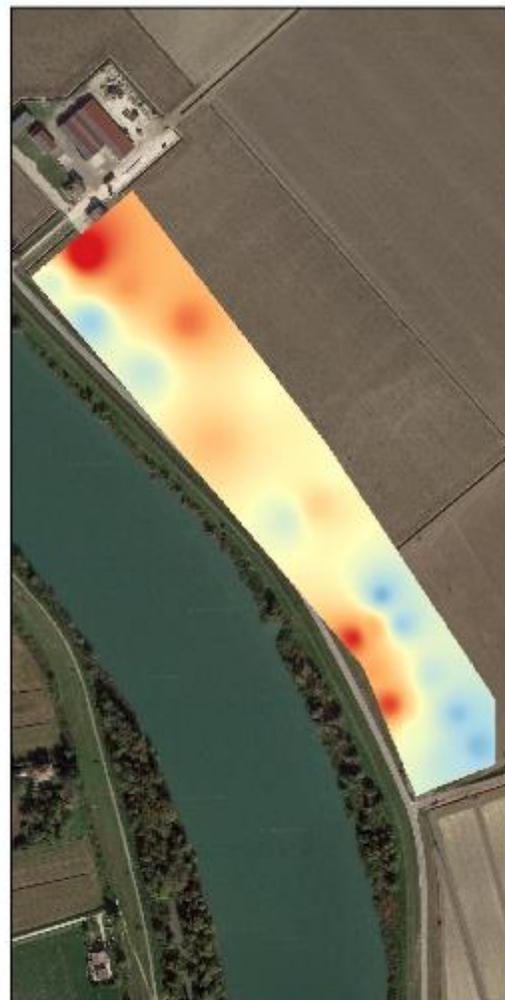
salinizzazione superficiale nel periodo estivo

Inizio luglio 2023



salinizzazione superficiale nel periodo estivo

fine agosto 2023



STRATEGIE DI MITIGAZIONE E ADATTAMENTO

uso efficiente risorse idriche

- Irrigazione di precisione (micro-irrigazione, sub-irrigazione, modellistica)
- Invasi per stoccaggio di acqua piovana
- Riutilizzo di acque reflue trattate
- Barriere mobili anti-risalita cuneo



meccanizzazione e lavorazione suolo

- No-tillage e minimum-tillage per preservare SO
- Riduzione del compattamento del suolo

nature-based solutions

- Ripristino di barriere naturali (barene e wetland)
- Fasce tampone lungo canali e scoline





agricoltura



eroica



pioggia estrema

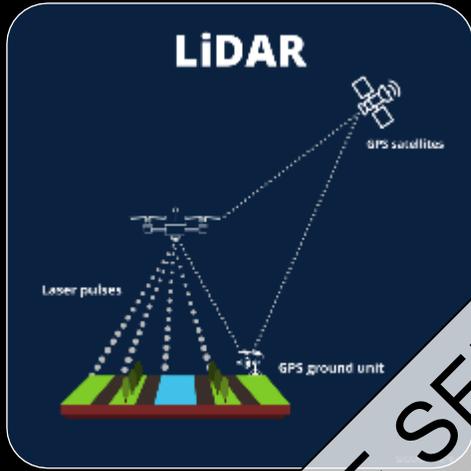
82 mm/hr

settembre 2018 (Valpolicella)



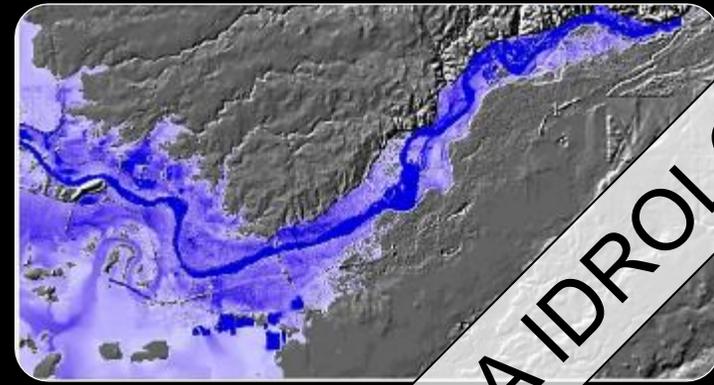
siccità

luglio 2022 (colline lago di Garda)

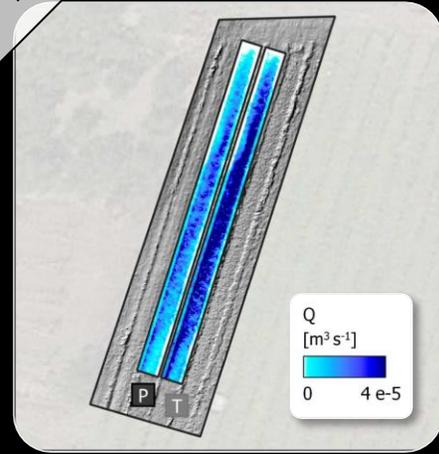


REMOTE SENSING

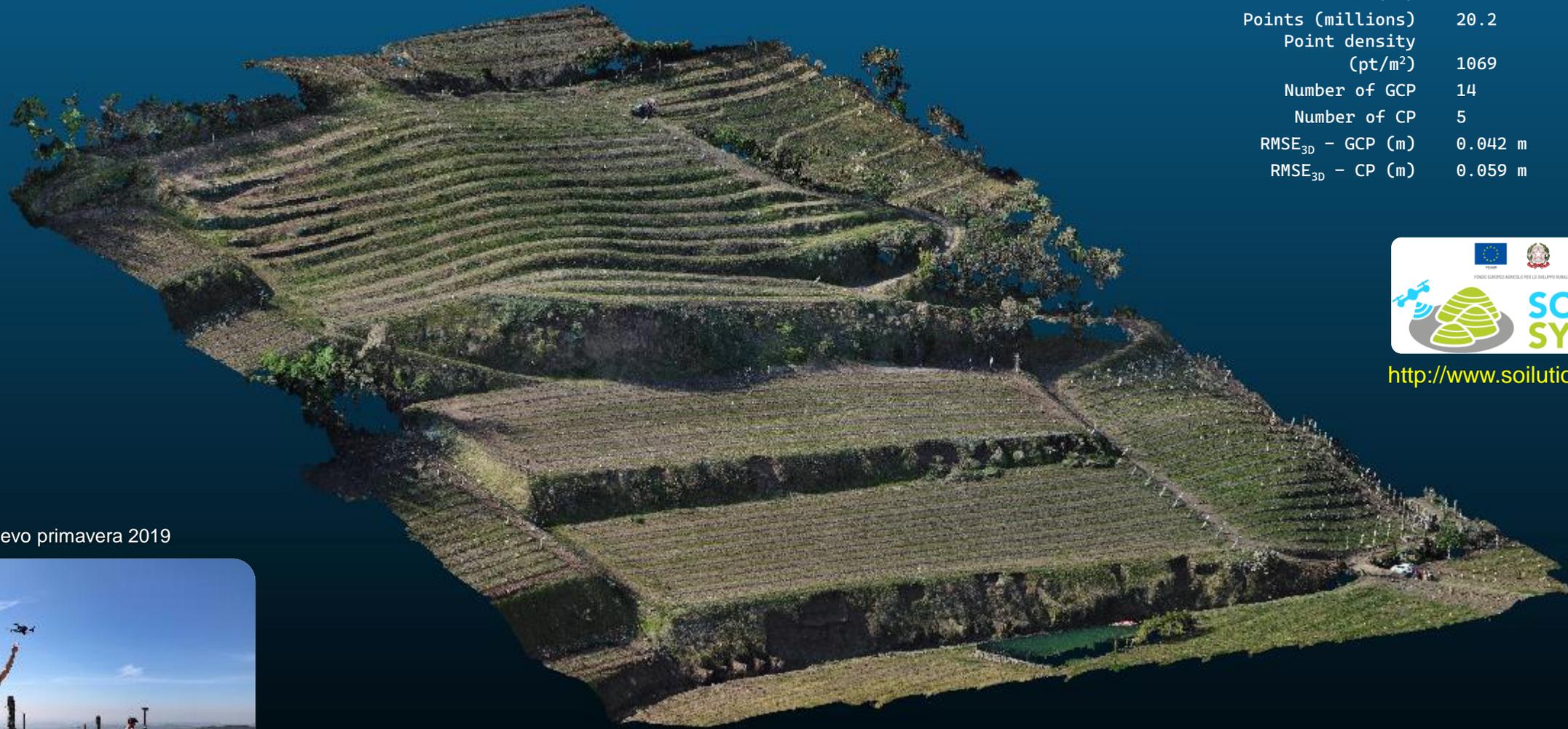
droni



MODELLISTICA IDROLOGICA



Structure from Motion photogrammetry using drones



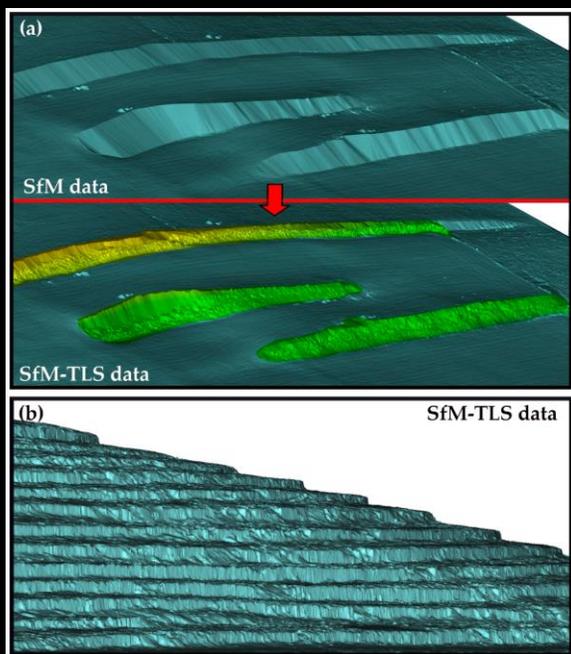
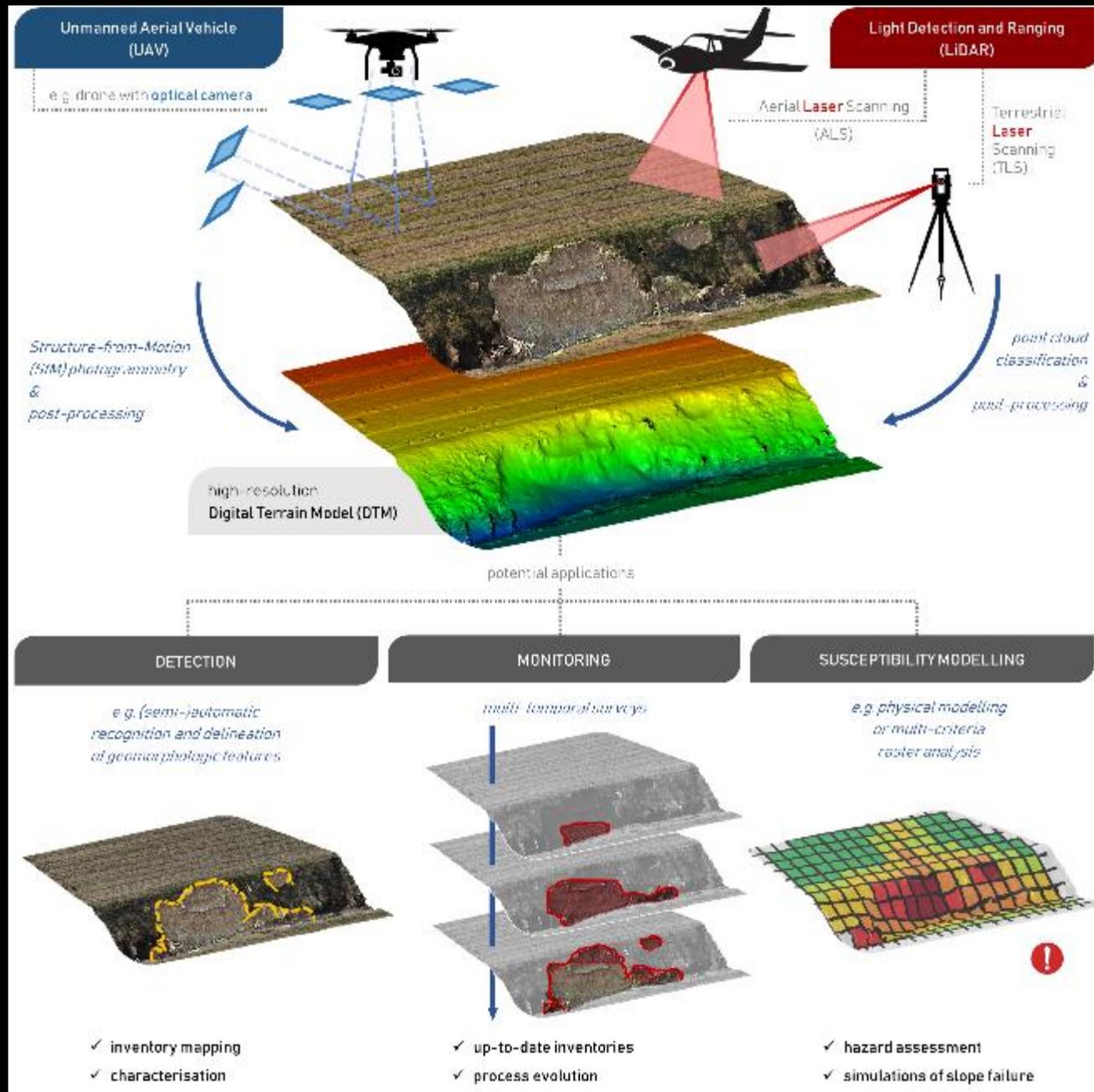
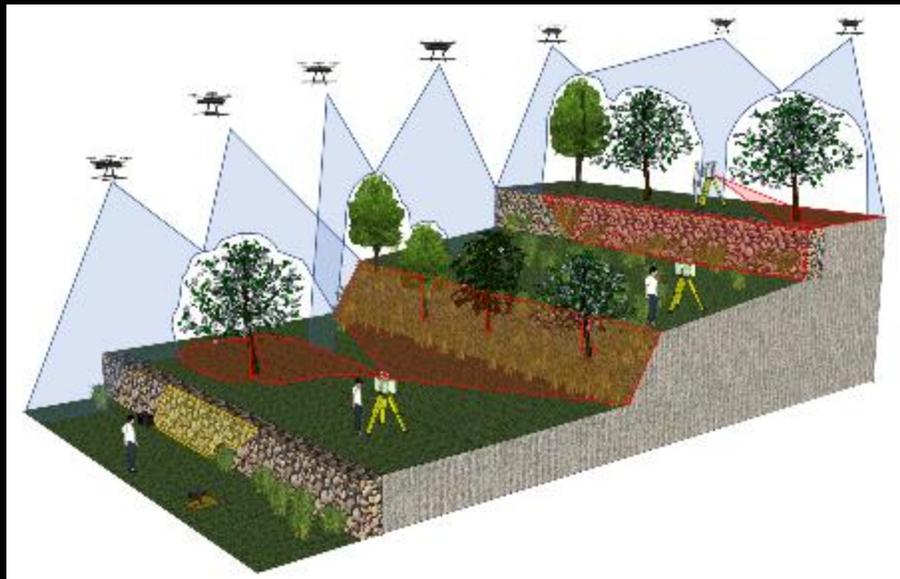
DRONE	DJI Mavic Pro
Camera	1/2.3" (CMOS), pixel: 12 MP
Flight height (m)	50
Surface (ha)	1.89
Points (millions)	20.2
Point density (pt/m ²)	1069
Number of GCP	14
Number of CP	5
RMSE _{3D} - GCP (m)	0.042 m
RMSE _{3D} - CP (m)	0.059 m



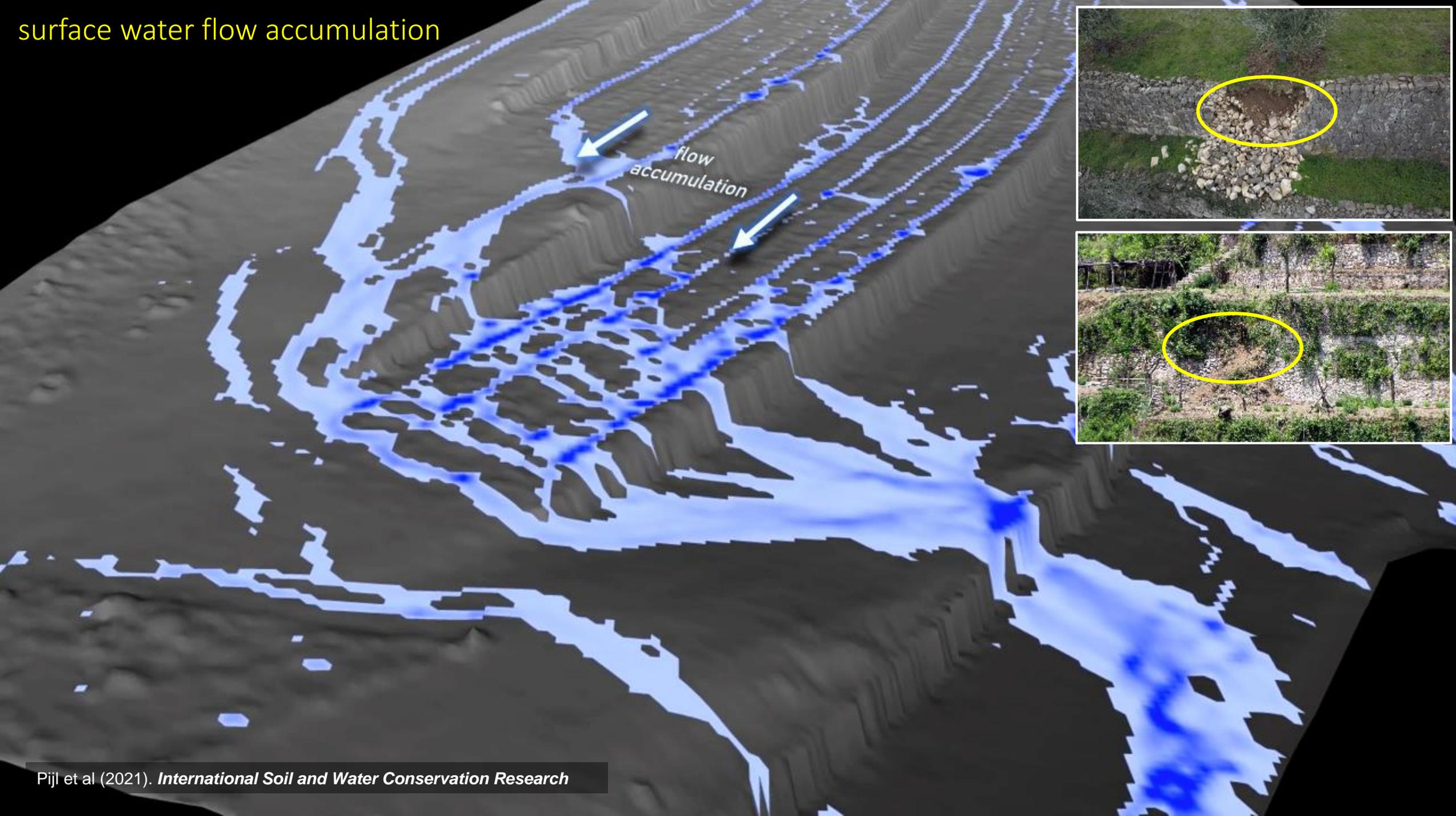
<http://www.soilutionsystem.com>

rilievo primavera 2019

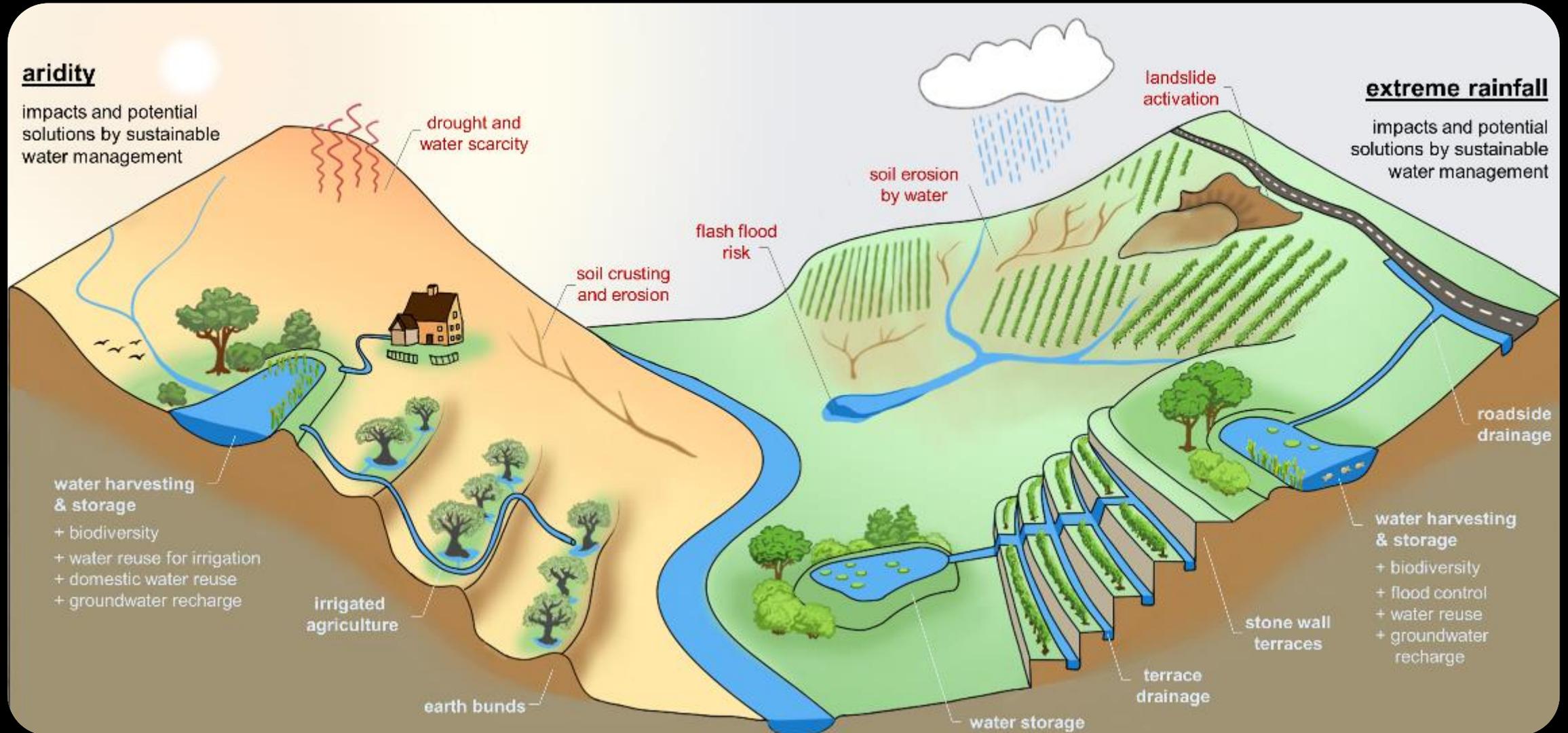




surface water flow accumulation



STRATEGIE DI MITIGAZIONE E ADATTAMENTO



gestione risorse idriche in condizioni estreme

Nepal



raccolta durante monsoni, riuso durante stagione secca

Myanmar



Italia (Soave, VR)



India



photo: Jennie Barron

Cina



Kenya





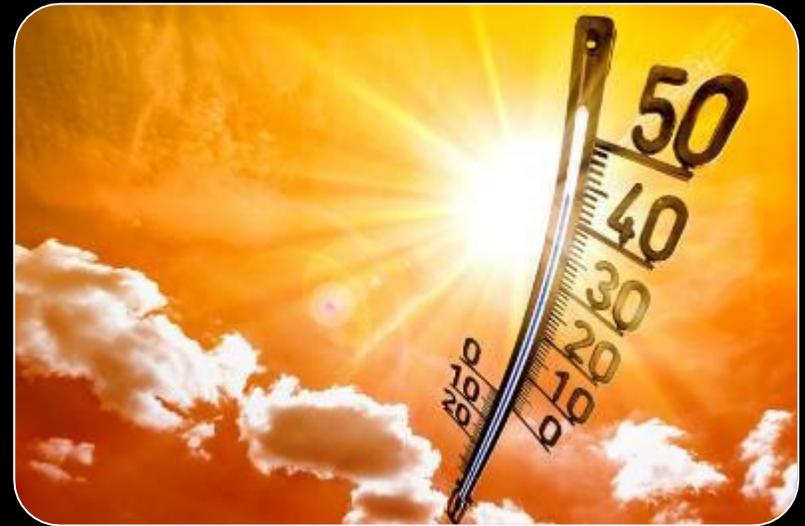
- mitigazione siccità (riuso per irrigazione)
- laminazione deflusso (specie su pendii), quindi mitigazione dissesto idrogeologico
- + biodiversità, habitat per anfibi, uccelli migratori
- finalità della nuova politica EU della **land restoration** (recupero funzionalità di ecosistemi degradati). La messa in opera di una rete di invasi potrebbe portare al ripristino dell'equilibrio ecologico e recupero di servizi ecosistemici.
- mantenimento del valore paesaggistico e culturale (recupero e mantenimento di antichi saperi per la gestione dell'acqua) e della produttività (sostenibilità socioeconomica)
- basso impatto ambientale e sostenibili

STRATEGIE DI MITIGAZIONE E ADATTAMENTO

meccanizzazione leggera
con mezzi elettrici



prospettive future



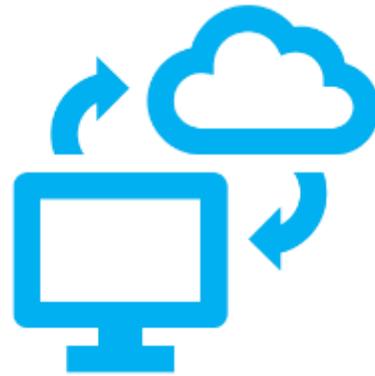
Intelligenza Artificiale

Supportare la **gestione delle emergenze in agricoltura** con l'intelligenza artificiale



L'emergenza climatica ha reso sempre più complesso per gli stake-holders prendere decisioni

Intelligenza Artificiale



Artificial intelligence in the agri-food sector

Applications, risks and impacts



Fabbisogno Idrico



Scelte Colturali



Gestione Finanziaria



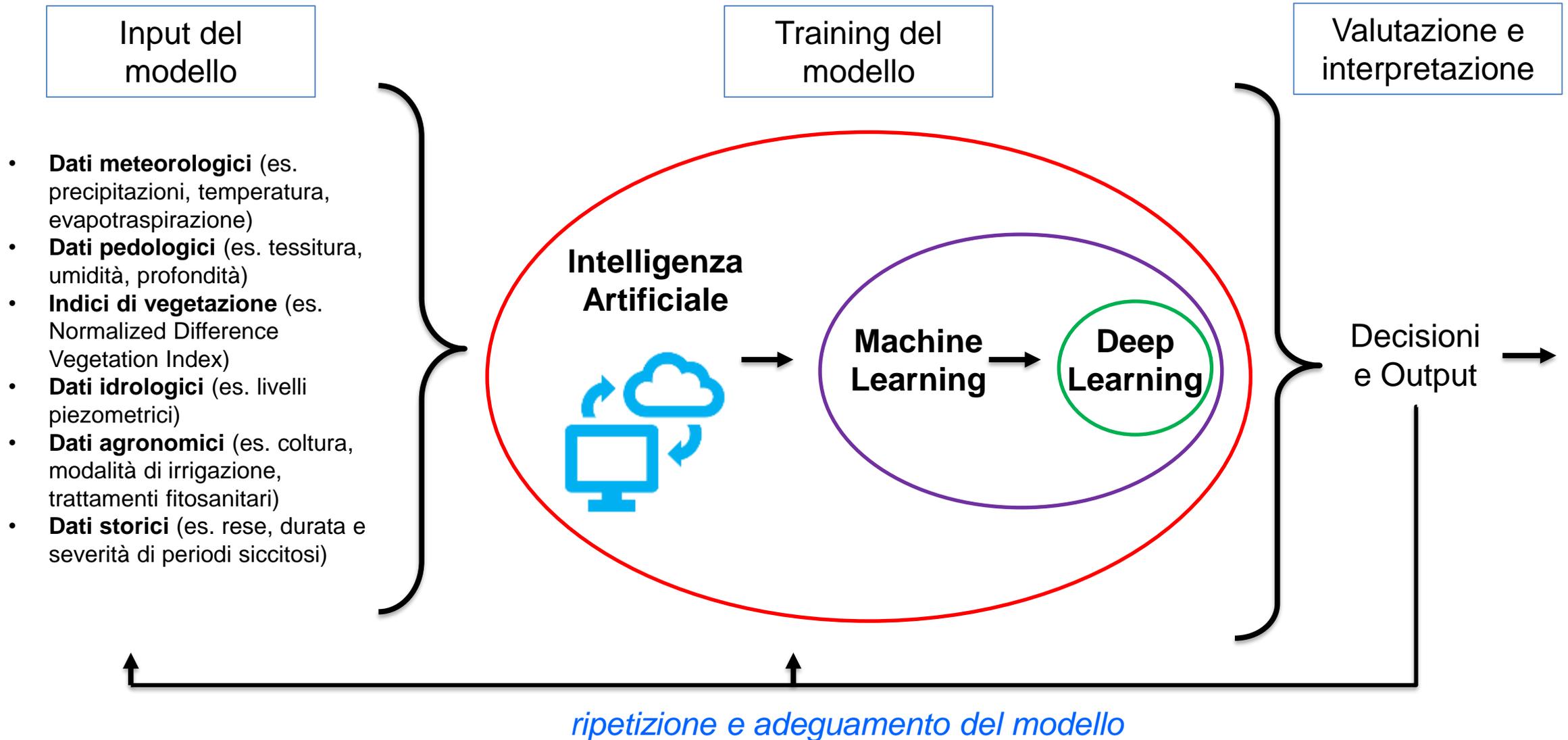
Manutenzione e Riparazioni



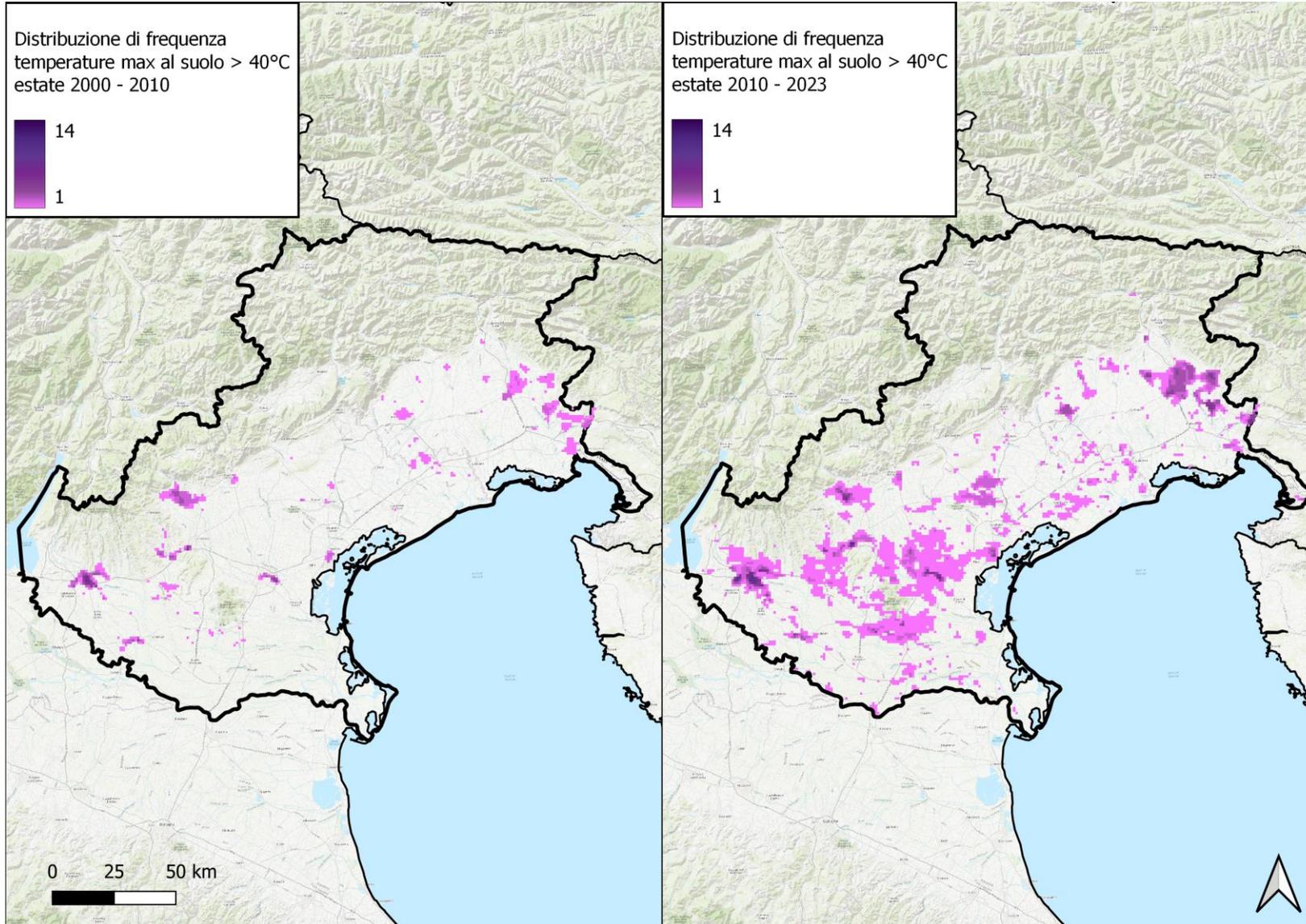
Patogeni e Specie Nocive

esempi decisionali

Sviluppo di sistemi di pre-allerta per la siccità agricola con l'intelligenza artificiale



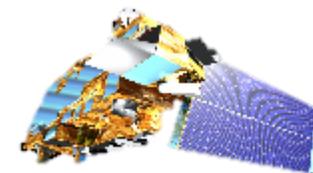
ondate di calore



NEGLI ULTIMI 10 ANNI SI REGISTRANO
TEMPERATURE ESTREME NON SOLO
NEI CENTRI URBANI

> 40°C

2000 – 2010
VS
2010 - 2023



MODIS
1 km cella



Bordeaux (Francia)
vendemmia notturna



Francia: copertura per proteggere sole



The solar panels produce enough

beneficial arrangements.

FRANCE (1/24/21)

France probes deaths of Champagne workers in heatwave

The Guardian (01/21) - French authorities were on Thursday investigating the deaths of four people who were harvesting grapes in the famed Champagne region, as locals suspected they suffered sunstroke in unusually high outdoor temperatures.

Issued on 13/01/2020 - 19:04 - 1 min



Italia: pergola





grazie per l'attenzione!

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