

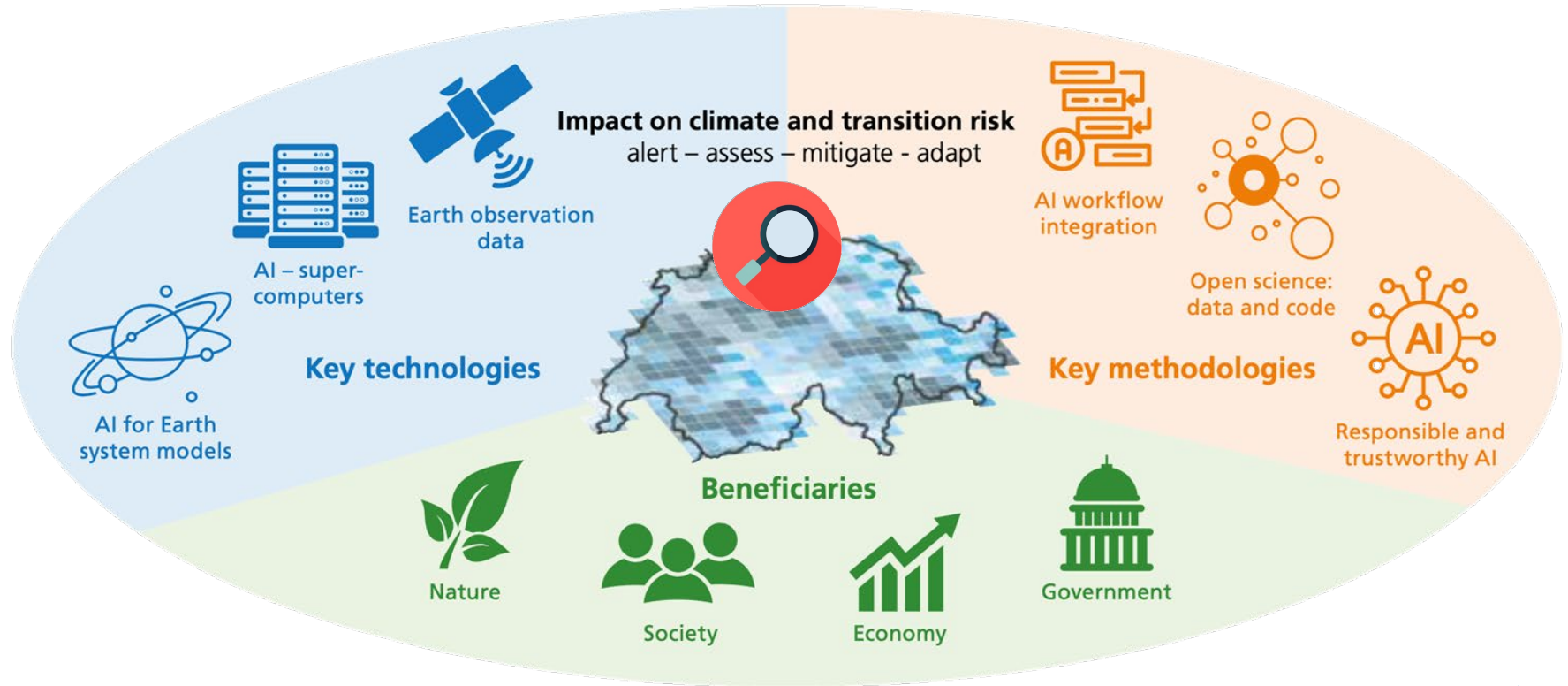
# How to use the power of AI to reduce the impact of climate change on Switzerland

Recommendations for the Swiss society and economy to become more resilient against the impact from a radically changing climate

Thomas Brunschwiler  
IBM Research - Europe

**satw** technology  
for society

# Enabling Technologies & Methodologies for a Sustainable Society



# A Point-of-View from 50 Experts in Switzerland

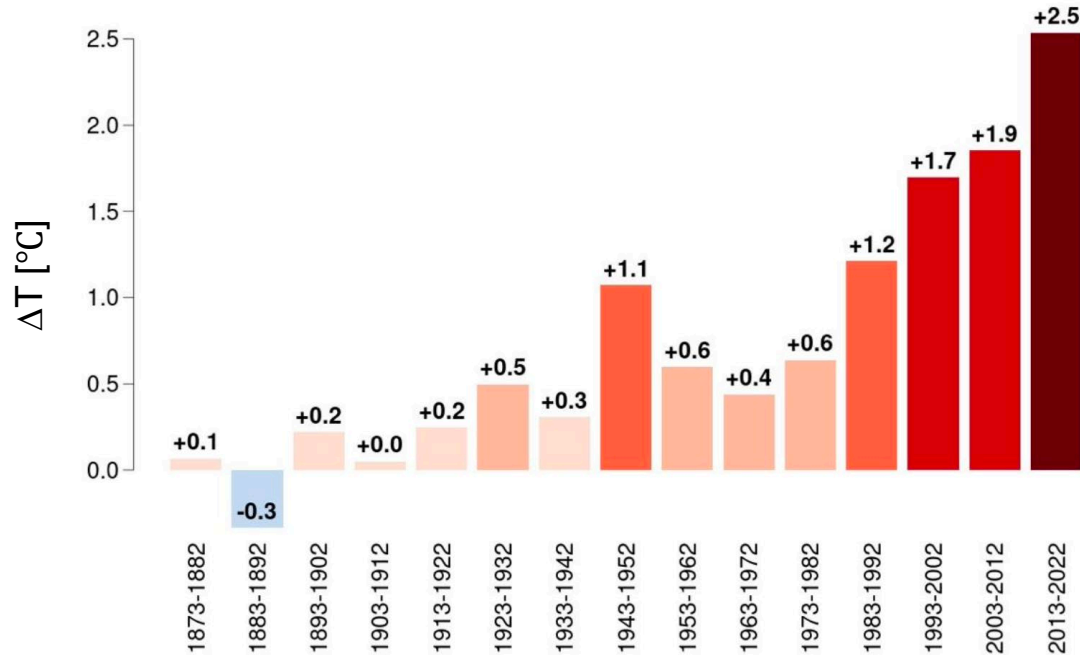


The Climate Network and the Whitepaper Study were initiated by IBM Research and carried out in collaboration with the Swiss Academy of Engineering Sciences SATW.

This study was kicked off with a Climate Network Workshop on June 15<sup>th</sup>, 2023 with about 50 experts from academia, administration, and industry.

The editorial board would like to thank all the workshop participants and authors for their valuable contributions which made this broad work possible!

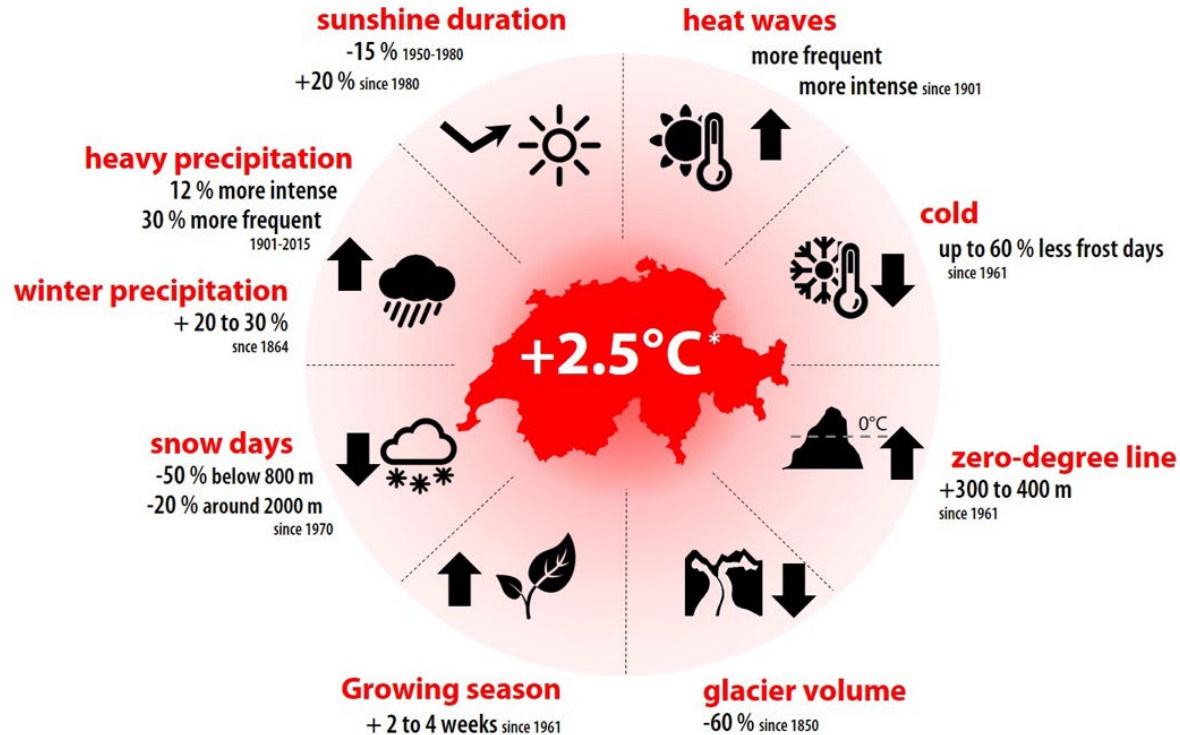
# Current State of Global Warming in Switzerland



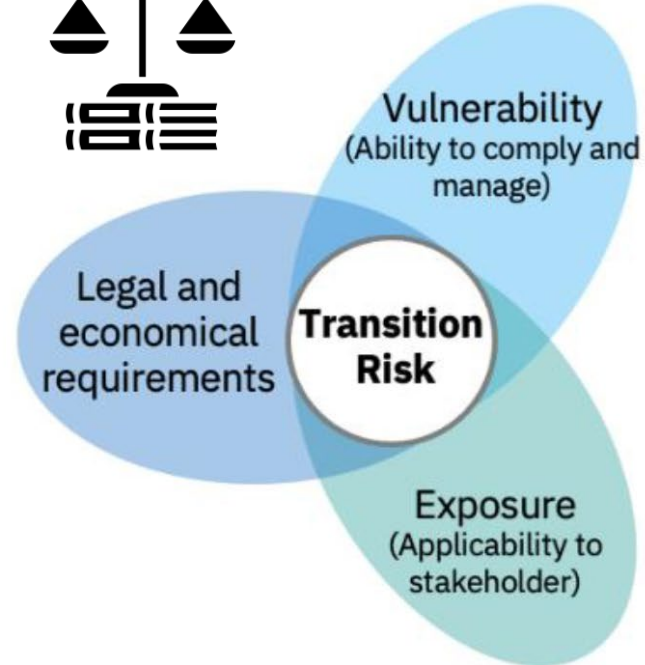
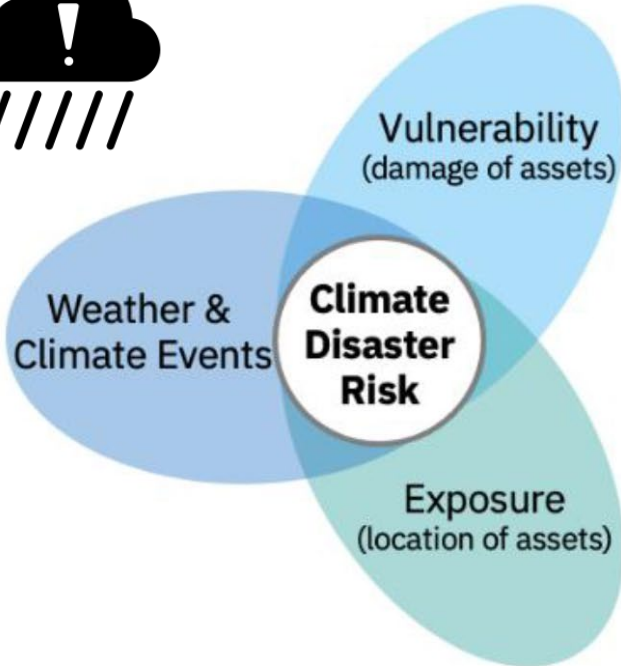
Deviation (in °C) of nationwide mean temperature relative to 1871–1900 for the 15 decades since records began. (MeteoSchweiz 2023)



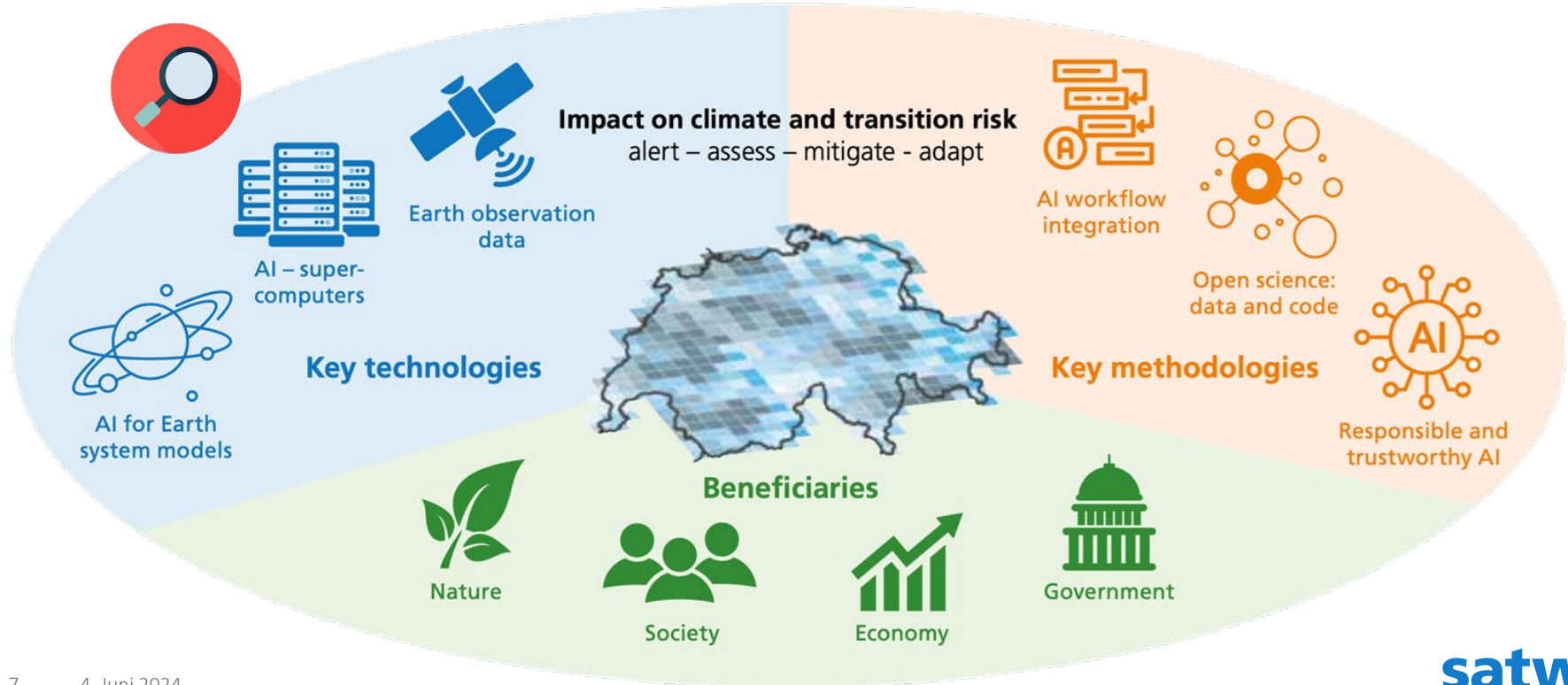
# Climate Impact affects us all!



# Stress Test for all of us: Climate Disaster Risk and Transition Risk

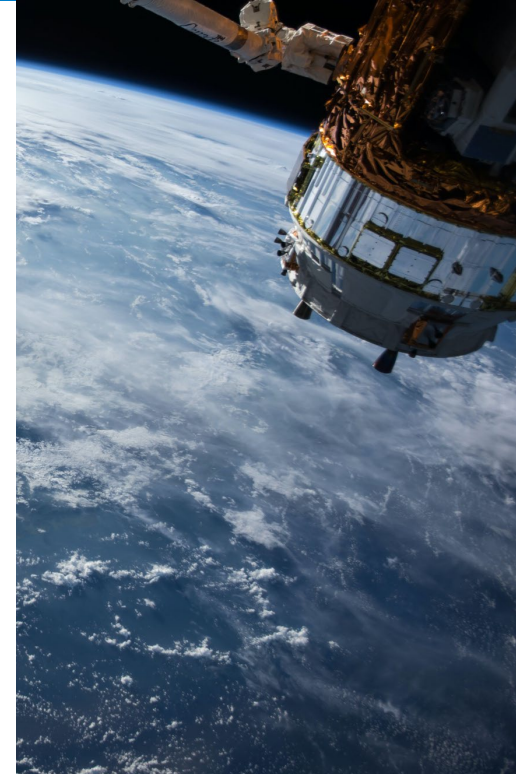
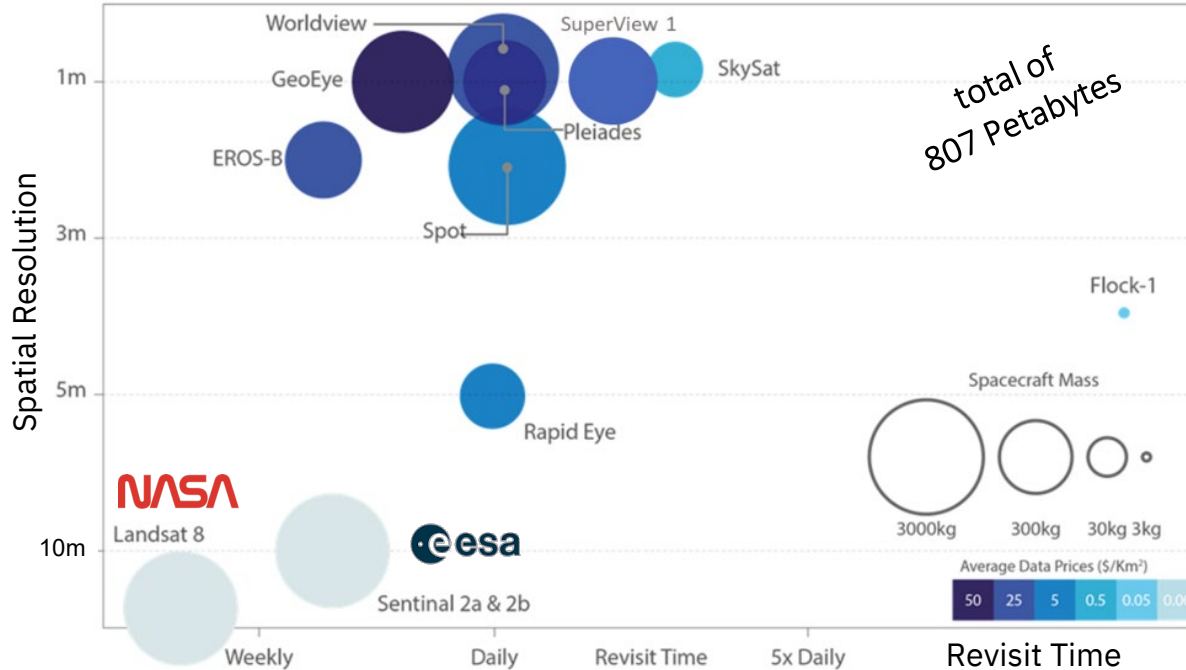


# Enabling Technologies & Methodologies for a Sustainable Society



# 1) Earth Observations by Satellite Constellations

Spatial Resolution vs. Revisit Time for Various Satellites

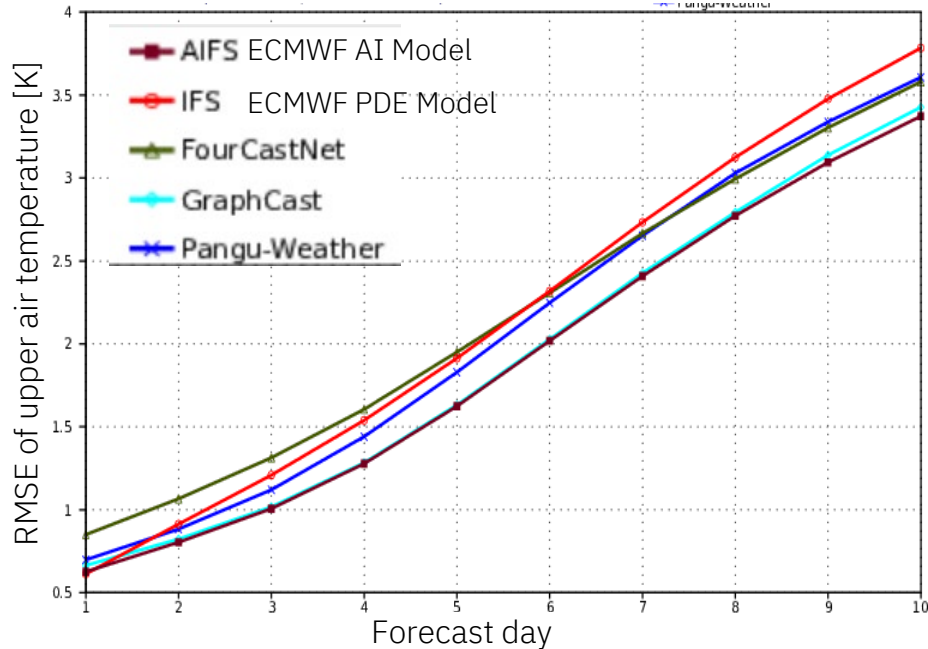


Source: Satellite Applications Catapult from EO21 Project

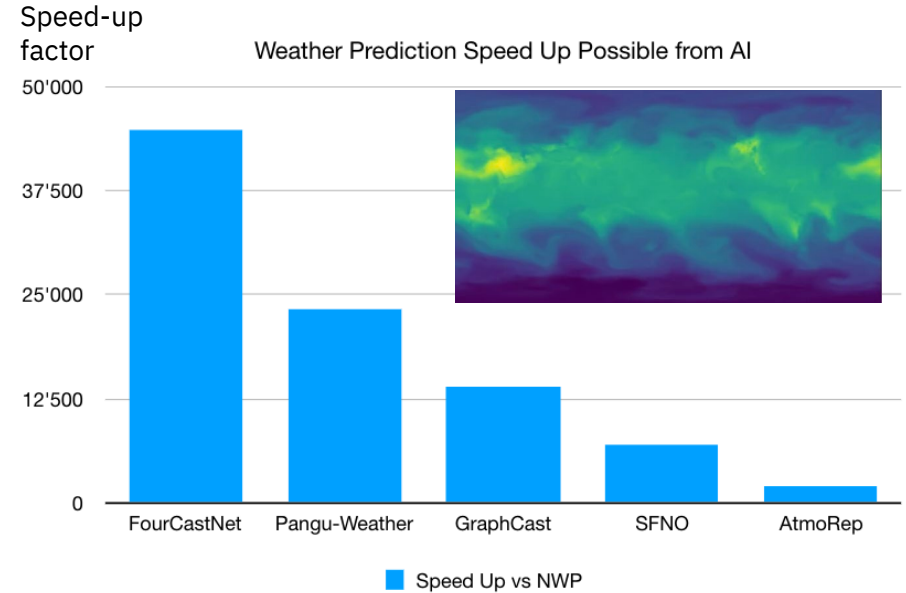


## 2) AI-Emulators: ChatGPT Moment in Weather Forecasting

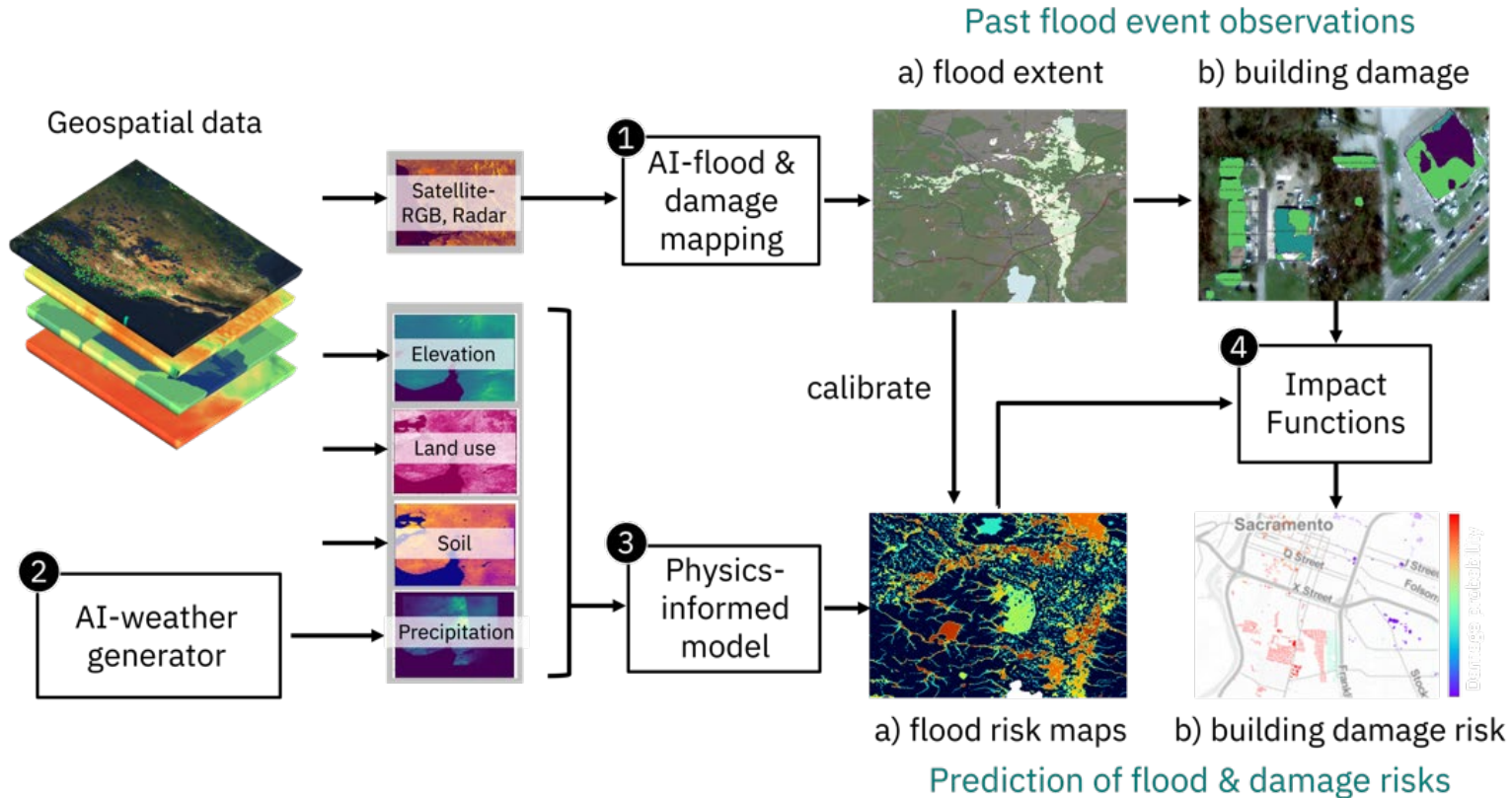
### AI Emulators with similar skills as Numerical Forecasting Models



... at four orders of magnitude reduced compute!



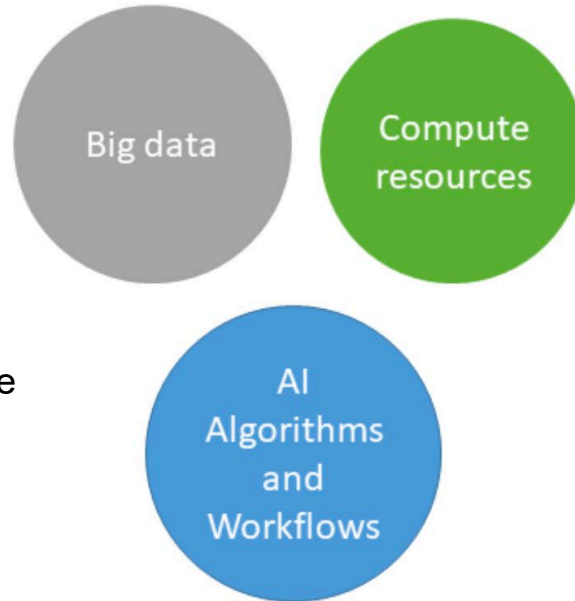
# AI Assisted Flood Risk Estimation - Example Workflow



# So we have the latest and greatest AI – Is anybody using it at scale?

## Current situation

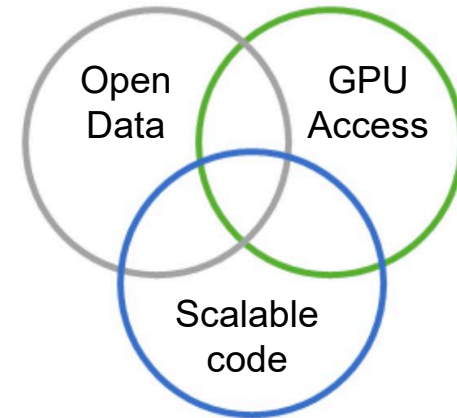
“pick-up the pieces”



The Swiss geo and climate ICT infrastructure seen from the perspective of Swiss economic and innovation actors.

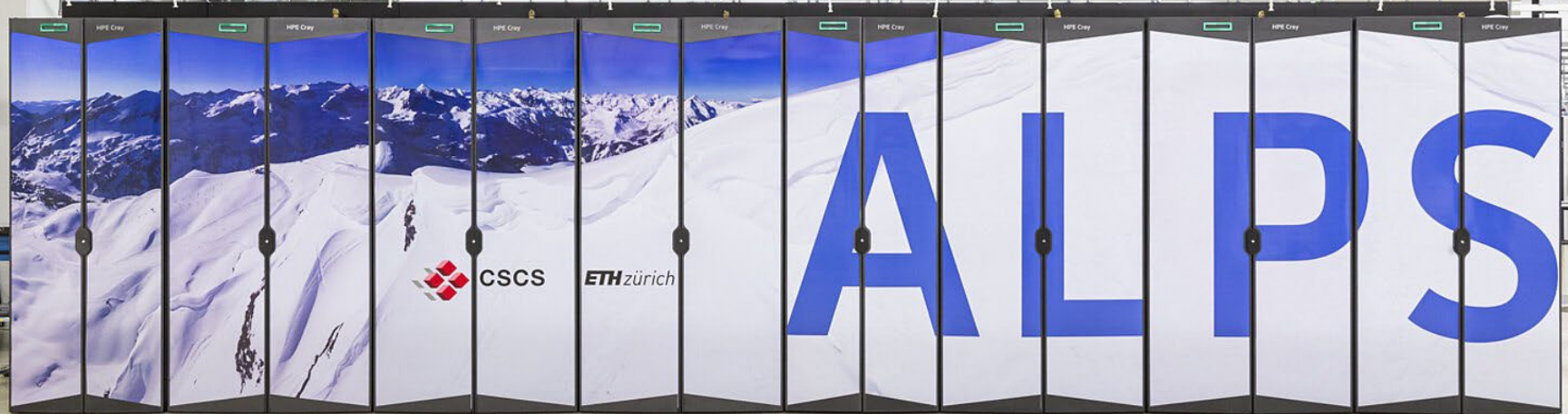
## Objective

“all-in-one service”



- ✓ Remove barriers
- ✓ Enable innovation

# Switzerland runs the 6<sup>th</sup> fastest Compute Cluster World Wide!



10,752 NVIDIA Grace-Hopper  
110 PB hard disk, 6 PB SSD  
0.27 ExaFLOPS at 5.2 MW

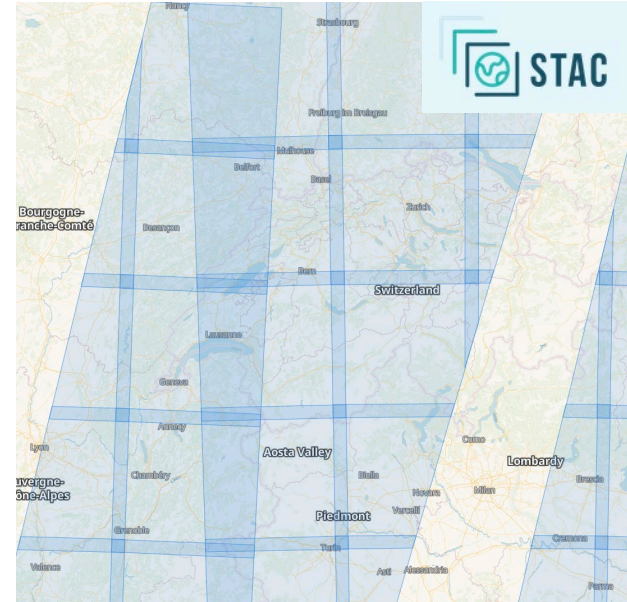
Access to Swiss Stakeholders  
from Academia, Governmental  
Organizations and Industry



# Data Exploration through Unified Geospatial API and Meta Data

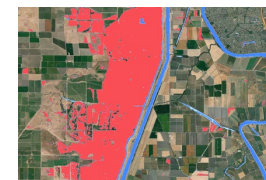
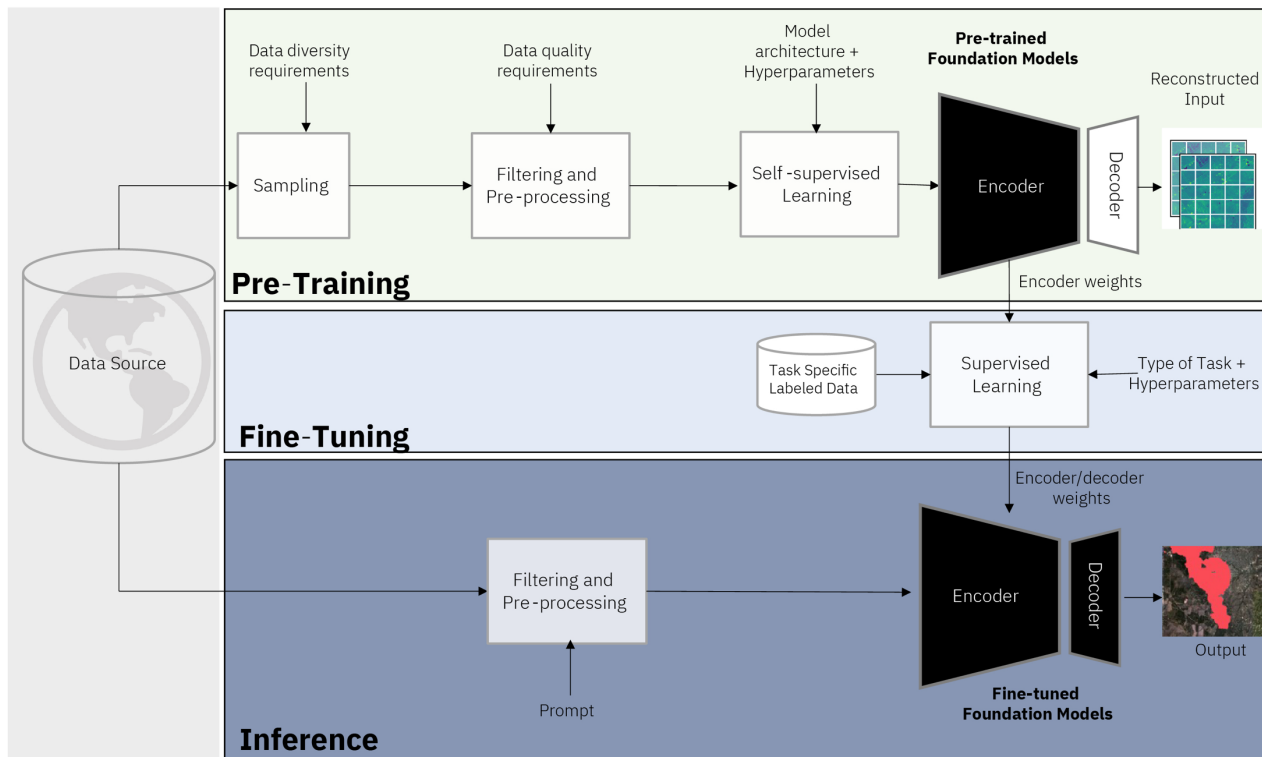


openEO platform **provides intuitive programming libraries to process a wide variety of earth observation datasets**. This large-scale data access and processing is performed on multiple infrastructures, which all support the openEO API.



**SpatioTemporal Data Catalogue**, representing a single spatiotemporal asset as a GeoJSON feature plus datetime and links.

# Earth Observation Foundation Models by Global Self-Supervision



Detecting floods

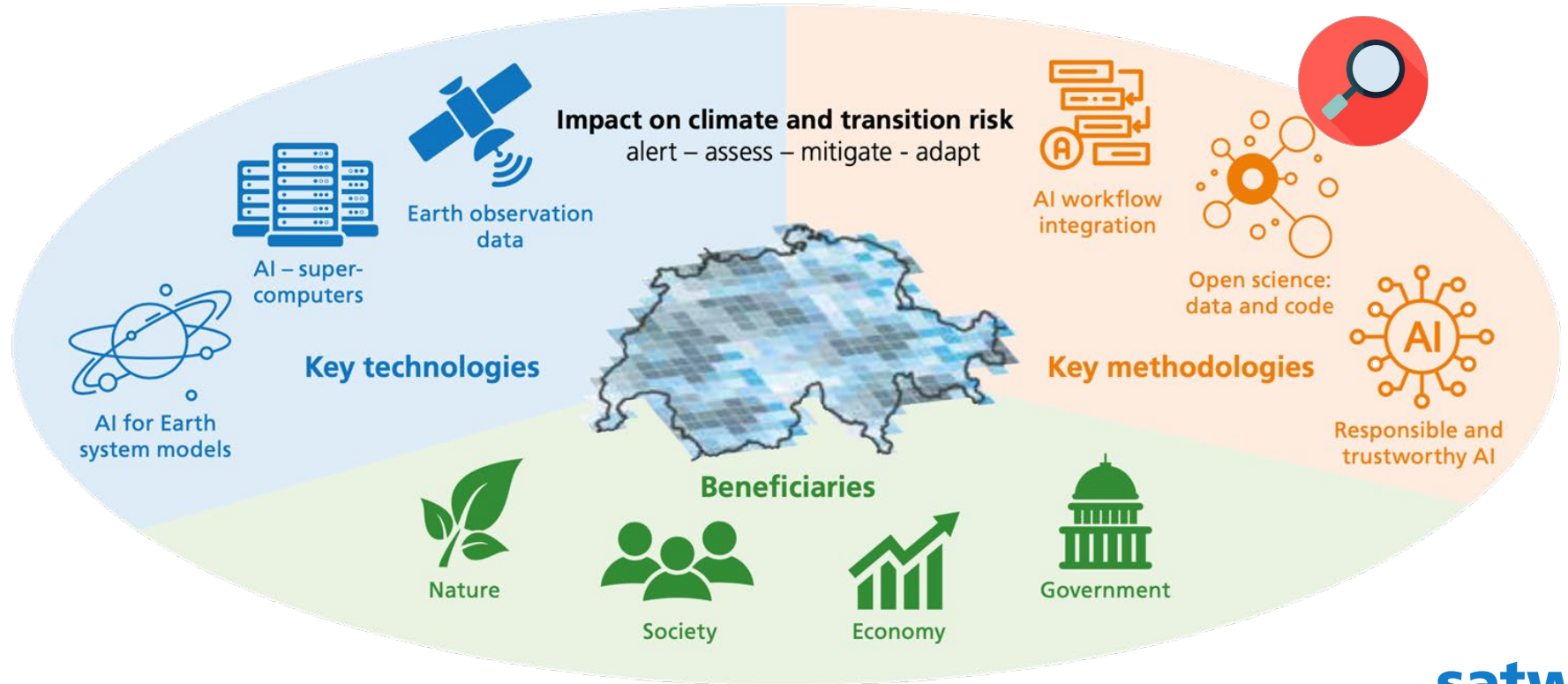


Classifying crop species



Observing urban heat

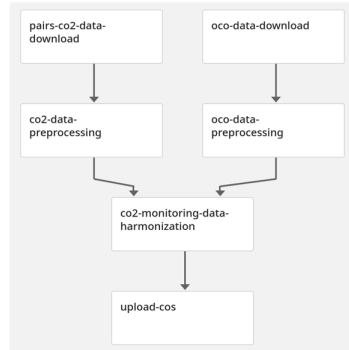
# Enabling Technologies & Methodologies for a Sustainable Society



# Methodologies – Best Practice Recommendations

## Software Engineering Principles

Sustainability Researchers often Lack SW Engineering Skills on:  
**Data and model versioning**  
**Containerization of workflows**  
**Documentation and testing**



## Responsible & Trustworthy AI



**Inclusivity:** access for communities most affected  
**Trust:** by interpretability & responsible communication  
**AI Model Efficiency:** mitigating Greenhouse Gas Emissions from model training, reporting of carbon footprint

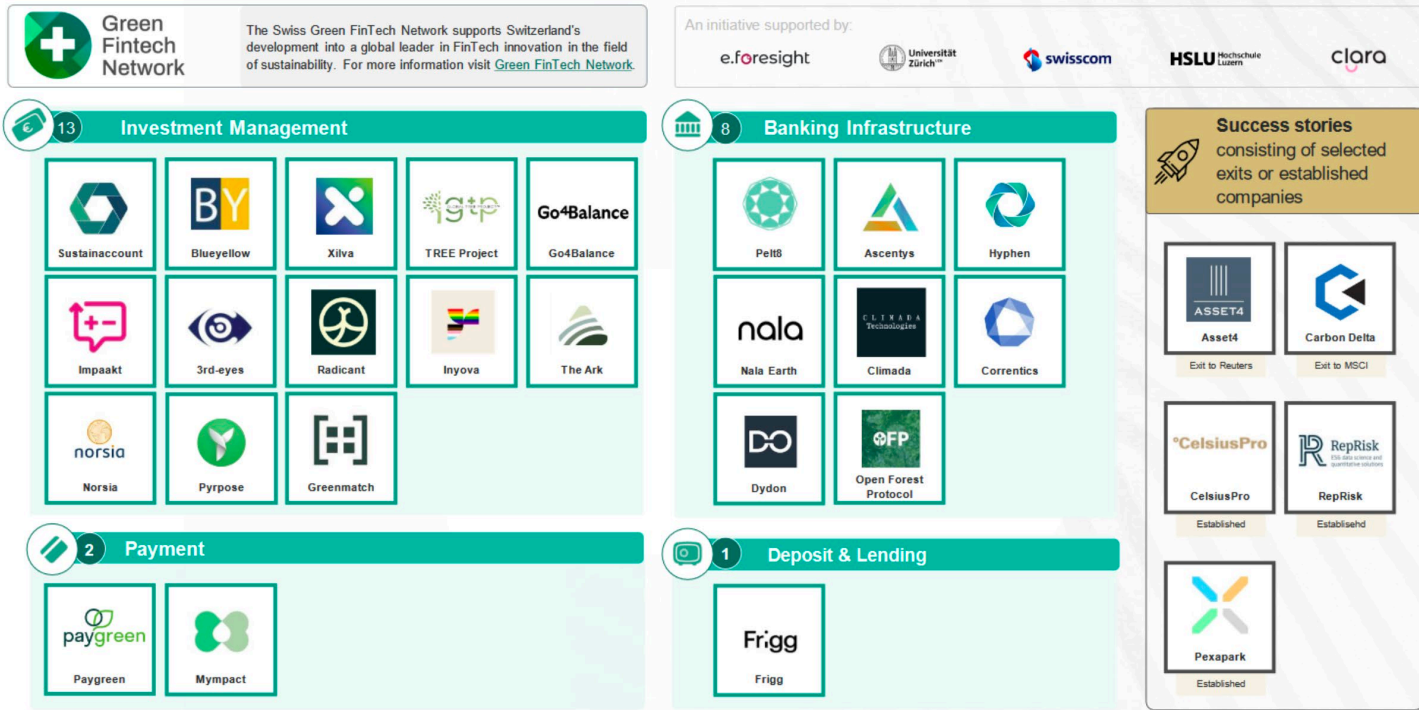
## Open Science Principles

Open source and open science ecosystems help accelerate research.  
**FAIR data principle**  
(Findable, Accessible, Interoperable, and Reusable)





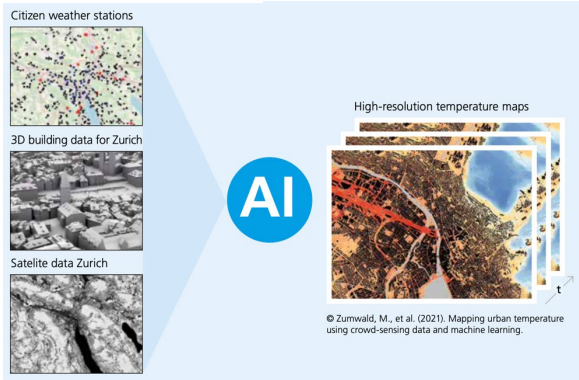
# Let's become Sustainable and leverage Sustainability Opportunities



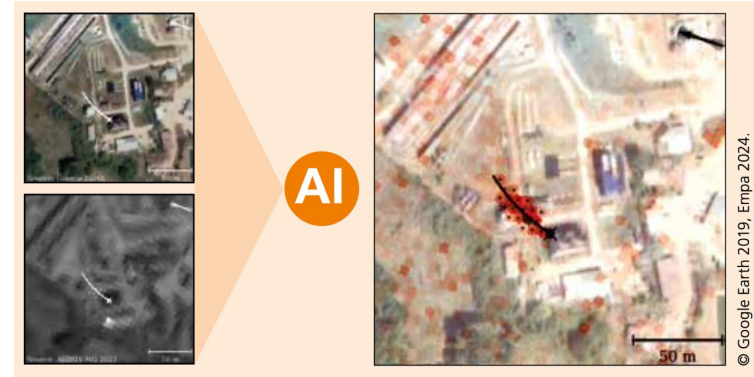
Swiss Green Fintech map as of July 2023. (Source: Fintechmap<sup>94</sup>)

# AI Case Studies to tackle Climate and Transition Risks

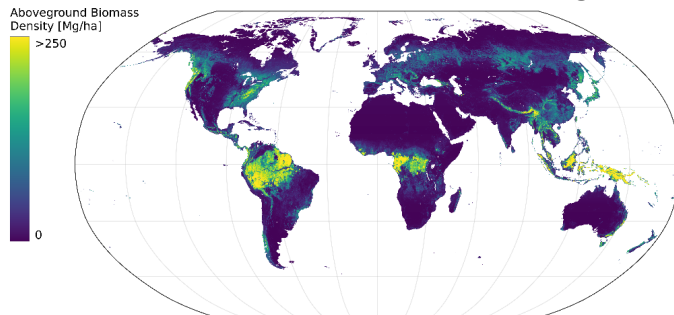
## Urban Heat Island Prediction



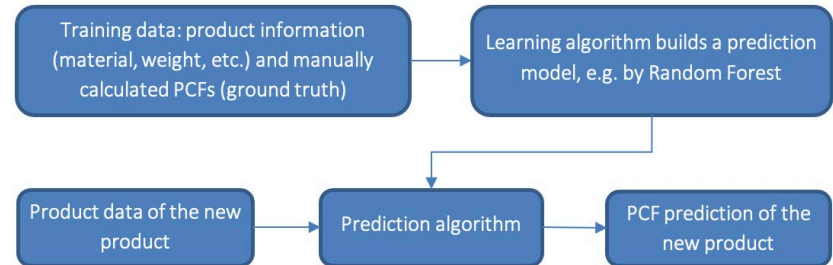
## Greenhouse Gas Emission Monitoring



## Above Ground Biomass Monitoring



## Product Carbon Footprint Reporting



# Recommendations for Decision Makers



Academia



Government



Funding Orgs.



Private Sektor



## Build capacity for Swiss actors in the field of AI for climate and sustainability

Reinforce the capacity of national competence centres and research bodies to support AI for climate and sustainability.



## Implement the principles of open science

Reinforce open data and open source principles (e.g. EMBAG), including data parsimony.



## Ensure access to and involvement in international programmes

Negotiate participation in European and international initiatives supporting AI for climate and sustainability.



## Promote scalable and reusable code and ML model base

Provide resources to enable collaboration between environmental scientists and software engineers.

# Recommendations for Decision Makers



Academia



Government



Funding Orgs.



Private Sektor

5



## Accelerate the translation of research results in market impact

Strengthen and establish interdisciplinary and transdisciplinary collaborations as well as Public-Private Partnerships (PPPs).

7



## Foster a quantitative understanding of the implications of climate change

Conduct data-driven studies on climate-related impacts on all Swiss stakeholders.

6



## Implement responsible AI applications

Conduct technology impact assessments based on the UN SDG Agenda.



# Recommendations for Data Scientists, Engineers and Developers

Desired state	Action	Targeted stake holder
<b>FAIR</b> (find, access, interoperate, and reuse data) data principles implemented	Adopt <b>open standards</b> for data discovery and access (e.g. OGC) as well as for <b>model interchange</b> (e.g. ONNX). Publish research data on trusted <b>public digital repositories</b> (like Zenodo). Provide <b>documentation</b> for data schema, management, discovery, access and model integration.	Researchers, data scientist, data engineer
<b>Sustainable applications</b> by federation principles	Implement data and model <b>federation principles</b> to minimize data transfer related emissions and latencies.	Researchers, data scientist, data engineer
<b>Re-usable</b> and scalable code base	<b>Apply data, code, and model versioning principles</b> . Include tests and validation into your pipeline. Use <b>state-of-the-art software architecture</b> like Cloud-native and development concepts, such as DevOps, CI/CD and MLOps.	Researchers, data scientist, data engineer
<b>Responsible ML</b> models	Be <b>transparent about the data</b> used to train ML models, including licenses, lineage and generalization of the data set and consider social fairness, i.e. potential negative impacts on vulnerable groups in the society (based on communication, classification, value assignment etc.)	Researchers, data scientist
<b>Sustainable AI</b>	Reduce and benchmark the <b>energy usage and carbon emissions</b> of your AI applications by model optimization and deployment strategies.	Data engineer

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