



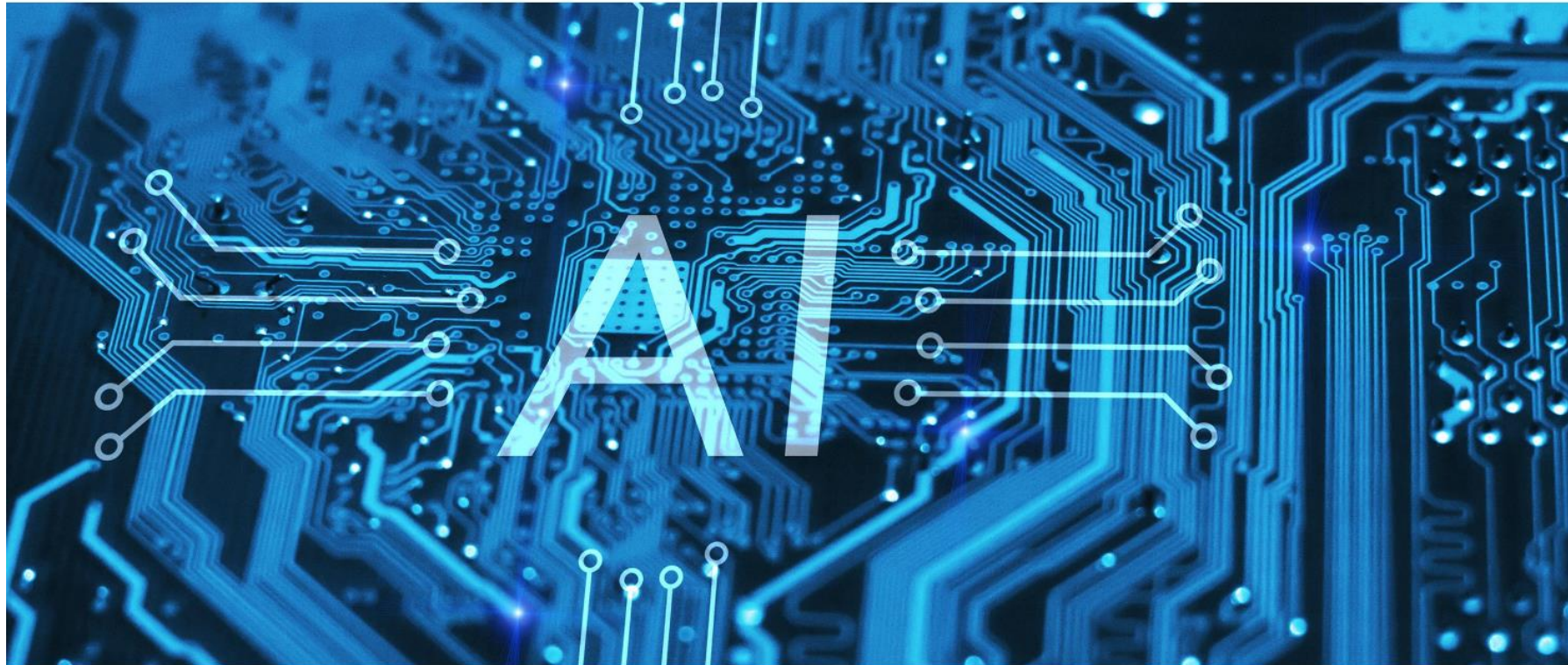
# Space-Level AI for Safer Infrastructure Lines

**Prof. Reza Arghandeh**

Leader, HVL Data Science and AI Group

Western Norway University of Applied  
Sciences

IMC, 12.Sep.2023



## Data Science and Artificial Intelligence Group

The researchers in this group are focused on theoretical aspects of data science and its applications in various domains such as energy, biology, and physics.

[www.hvl.no/ai](http://www.hvl.no/ai)

# Connectivity, Information & Intelligence Lab

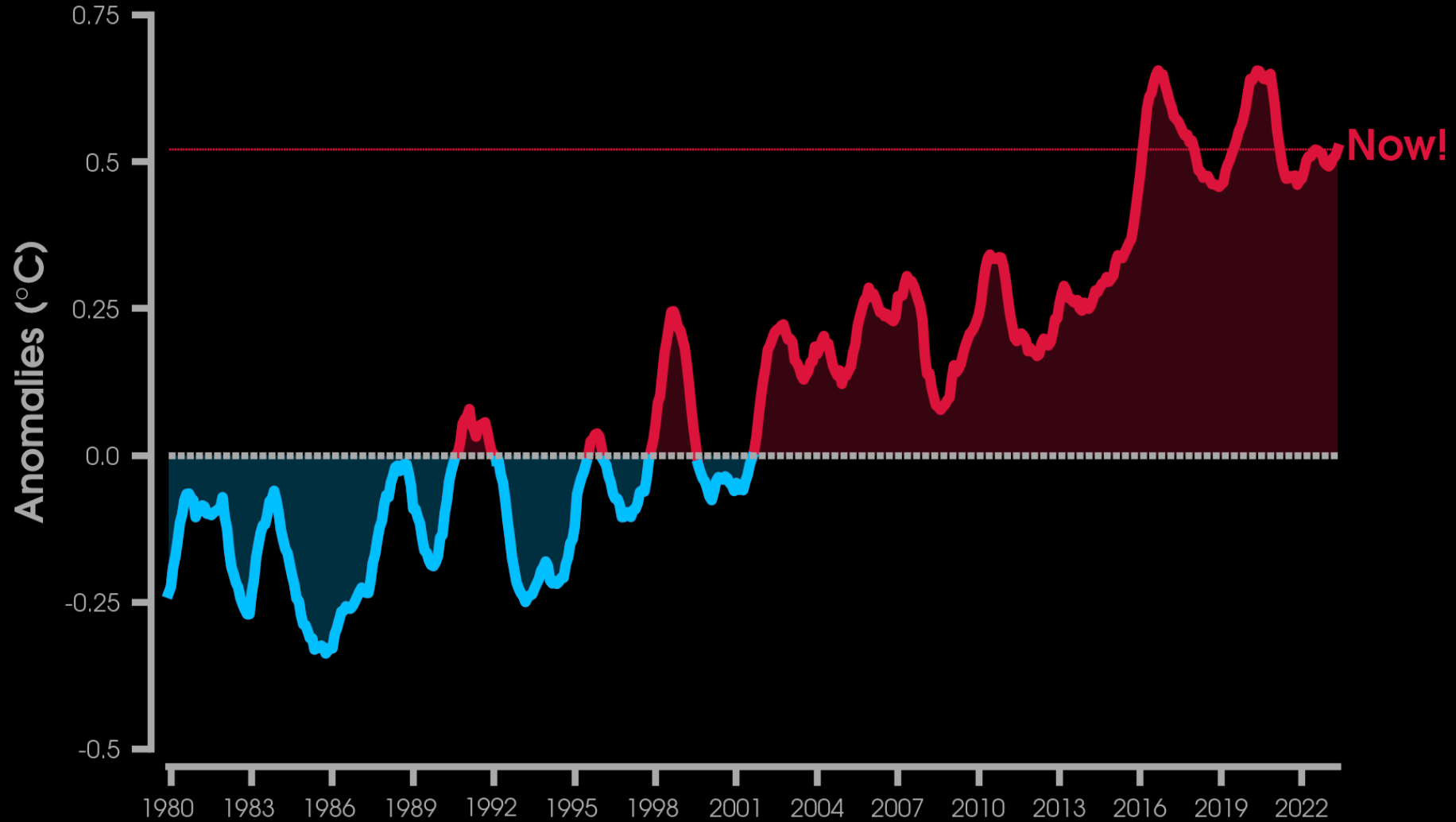


# ci2

We use AI to understand how infrastructure networks shape our lives and impact our environment.

[www.ci2lab.com](http://www.ci2lab.com)

# GLOBAL TEMPERATURE : 12-MONTH RUNNING MEAN



DATA: Copernicus Climate Change Service/ECMWF (ERA5 : 2-m T)  
SOURCE: <https://climate.copernicus.eu/>

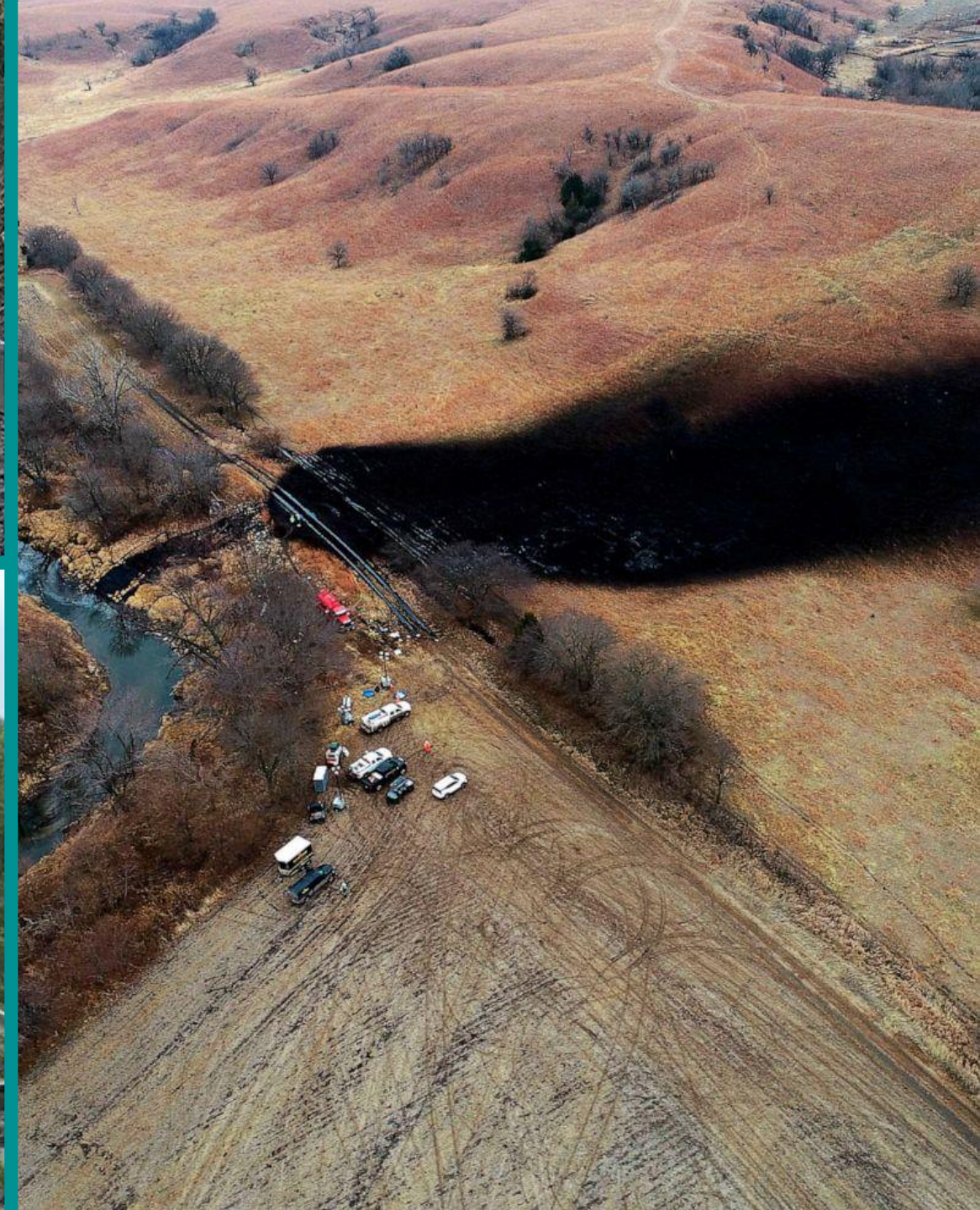
BASELINE: 1981-2010, Climatology  
GRAPHIC: Zachary Labe (@ZLabe)



Norway, June 2020



Våler, Norway, Aug 2020



- **86% of power outages in Norway are due to vegetation<sup>1</sup>**
- **Vegetation-induced power outages in the US cost up to 33 billion USD annually<sup>2</sup>**

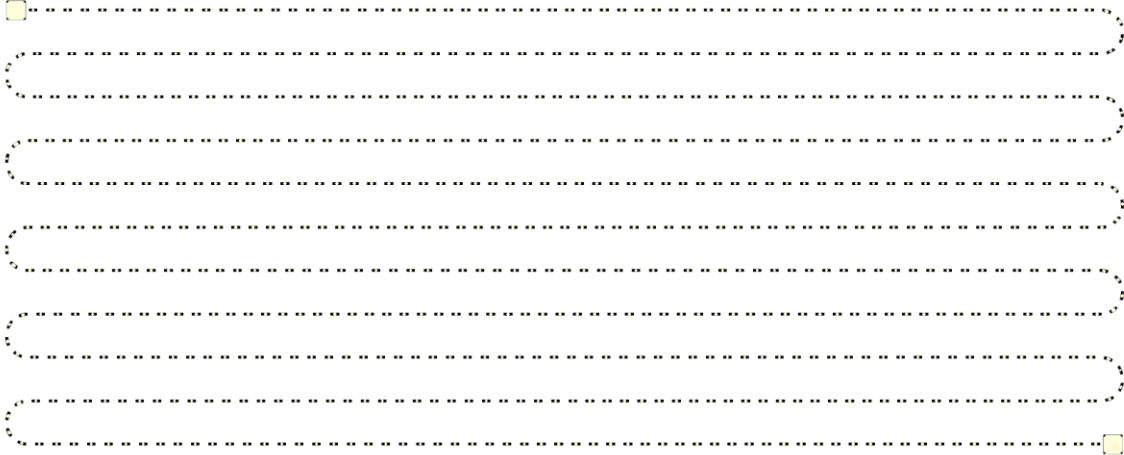
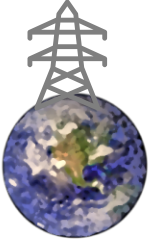
<sup>1</sup>Norway's Quality of electricity supply, NVE, Norwegian Energy Regulatory Authority (NVE-RME), <https://www.nve.no/>

<sup>2</sup>The Economic Impact of Extreme Weather, Bloom Energy, April 2022

Picture: Courtesy of Linja



# Keeping Eye on Electric Grid is hard!



**Length of European power lines:**

- **384.400 Km**
- **25 x to the moon**



# Monitoring Dilemma

## Classic

Manual inspections, drones, helicopters

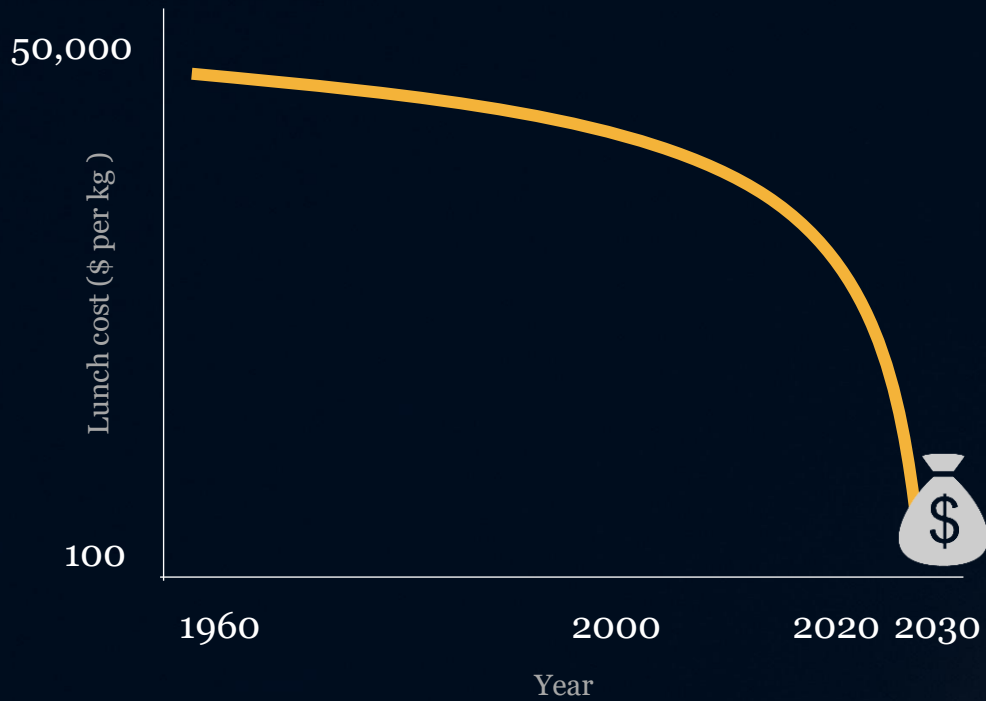
- ✓ Very high resolution
- ✓ Possibility to check grid components
- ❖ Time-consuming
- ❖ Costly
- ❖ High CO<sub>2</sub> footprint

## Modern

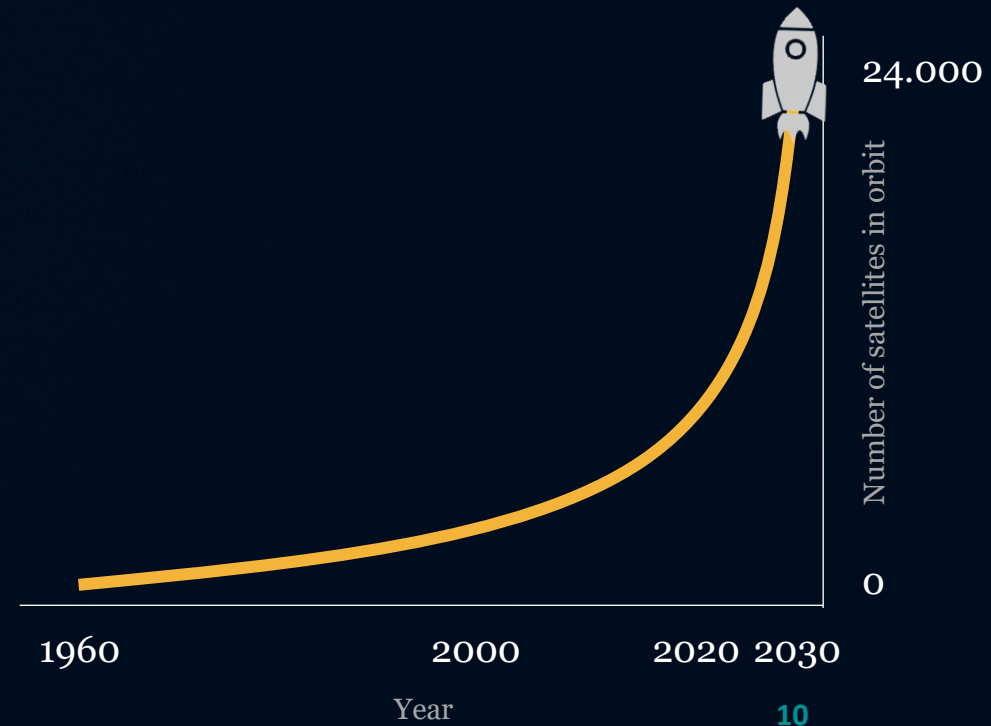
Satellite imagery

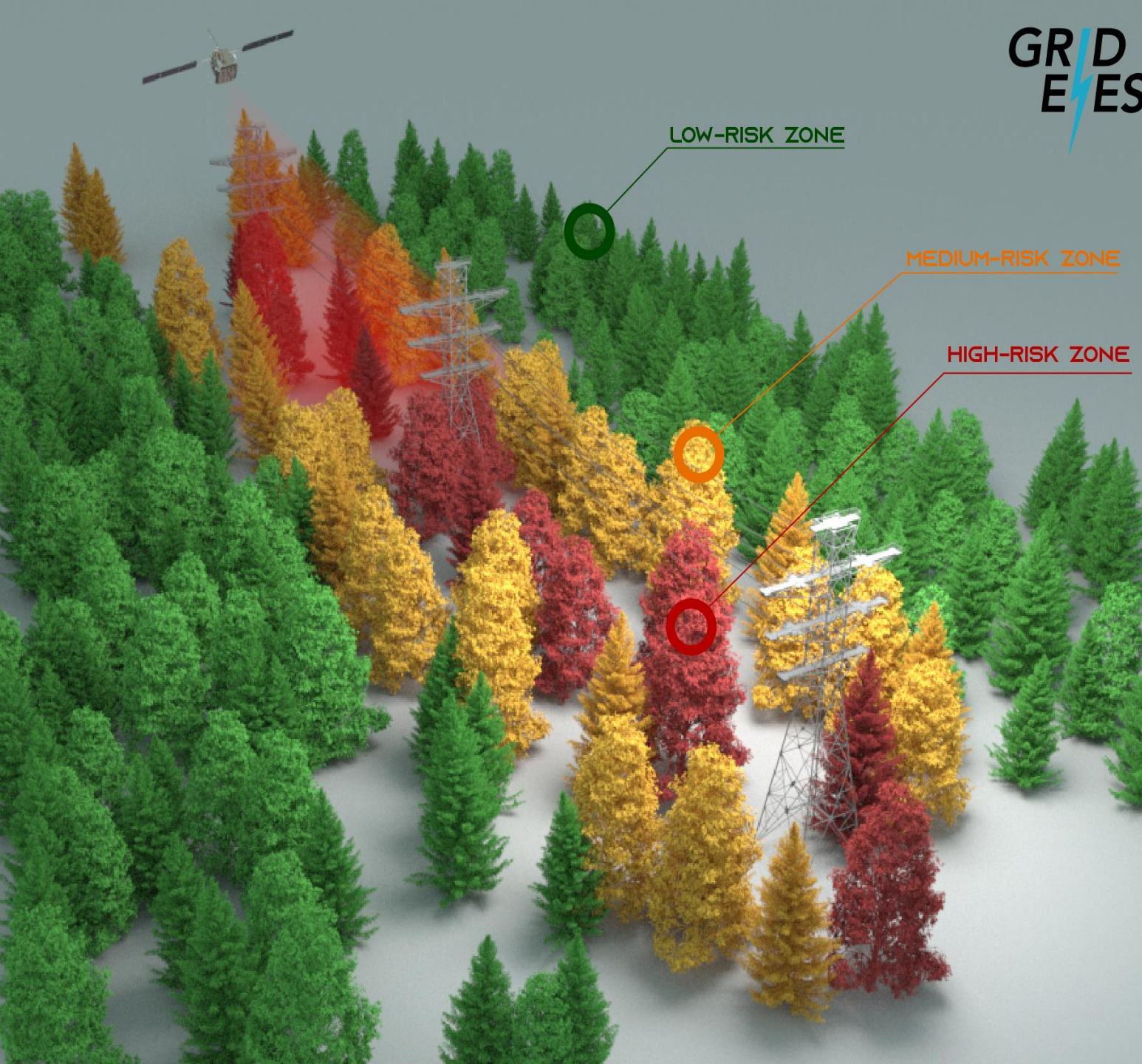
- ✓ Cheap
- ✓ Fast
- ✓ Frequent revisiting time
- ✓ Much less CO<sub>2</sub> footprint
- ❖ Limited resolution (0.3 m/px at most)\*





# The space revolution is taking off





The GridEyeS solution supports electricity companies by providing situational awareness regarding vegetation near power lines **faster**, **cheaper**, and with **less CO<sub>2</sub> footprint** through **Space-level Artificial Intelligence** powered by **Weather Intelligence**.

# GridEyeS Project Team



*StormGeo*

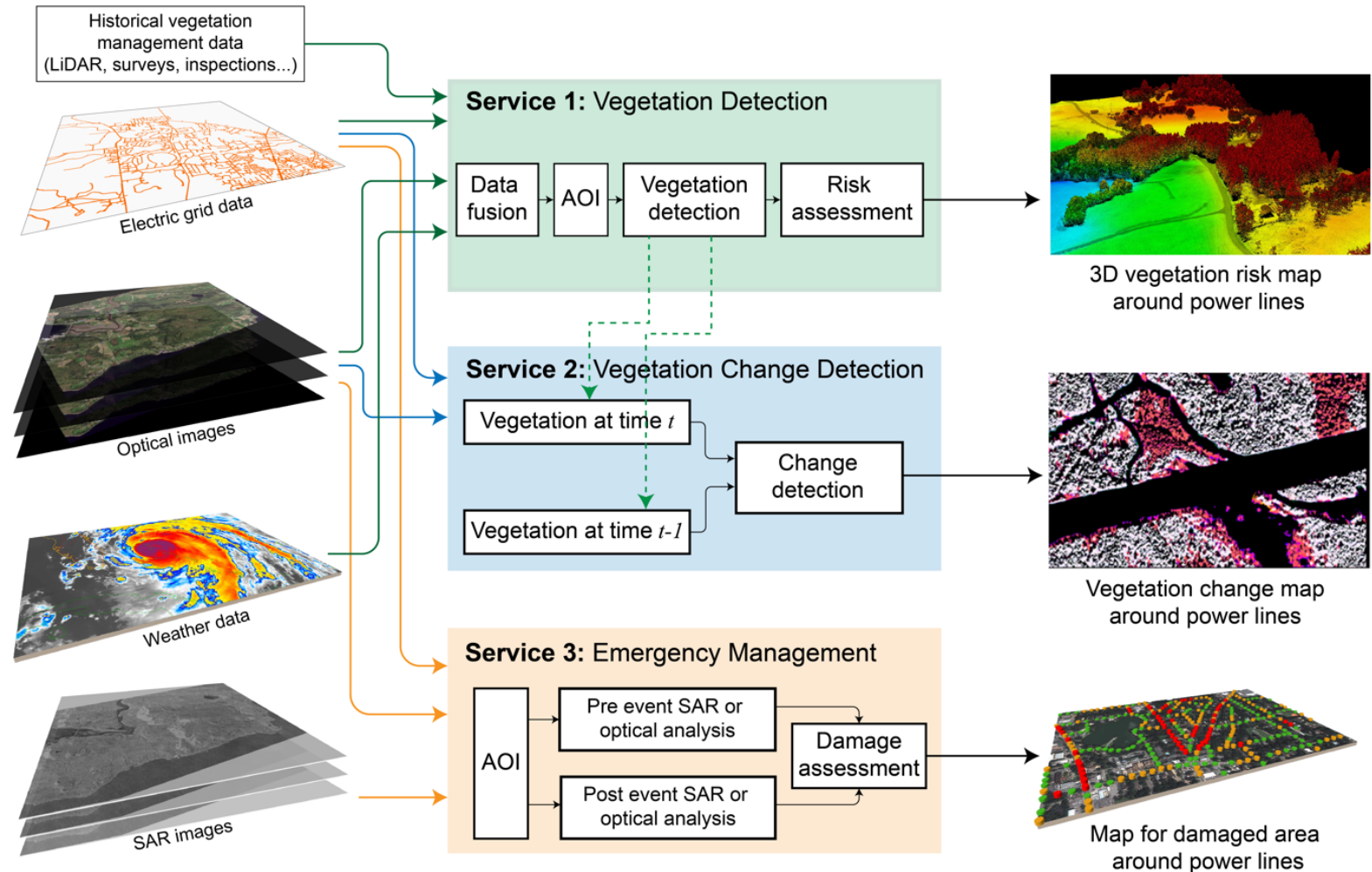


End-Users



# GridEyeS Solution

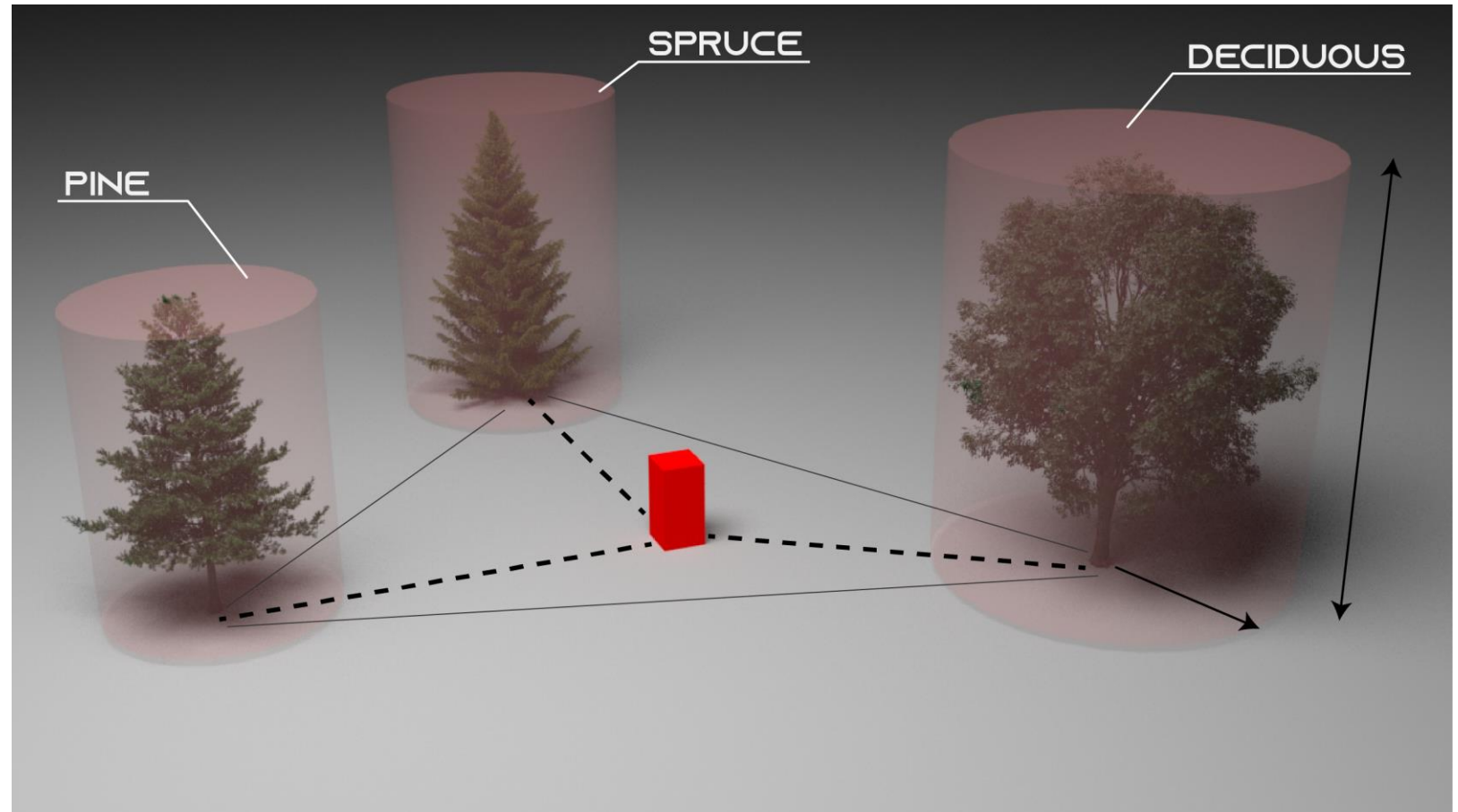
- **Vegetation Detection:** to the vegetation encroachment into power lines' rights-of-way
- **Change Detection:** to monitor both authorized and unauthorized constructional and agricultural/forestry activities within power lines' rights-of-way
- **Emergency management:** to provide fast satellite-based insights to electric companies after extreme weather events



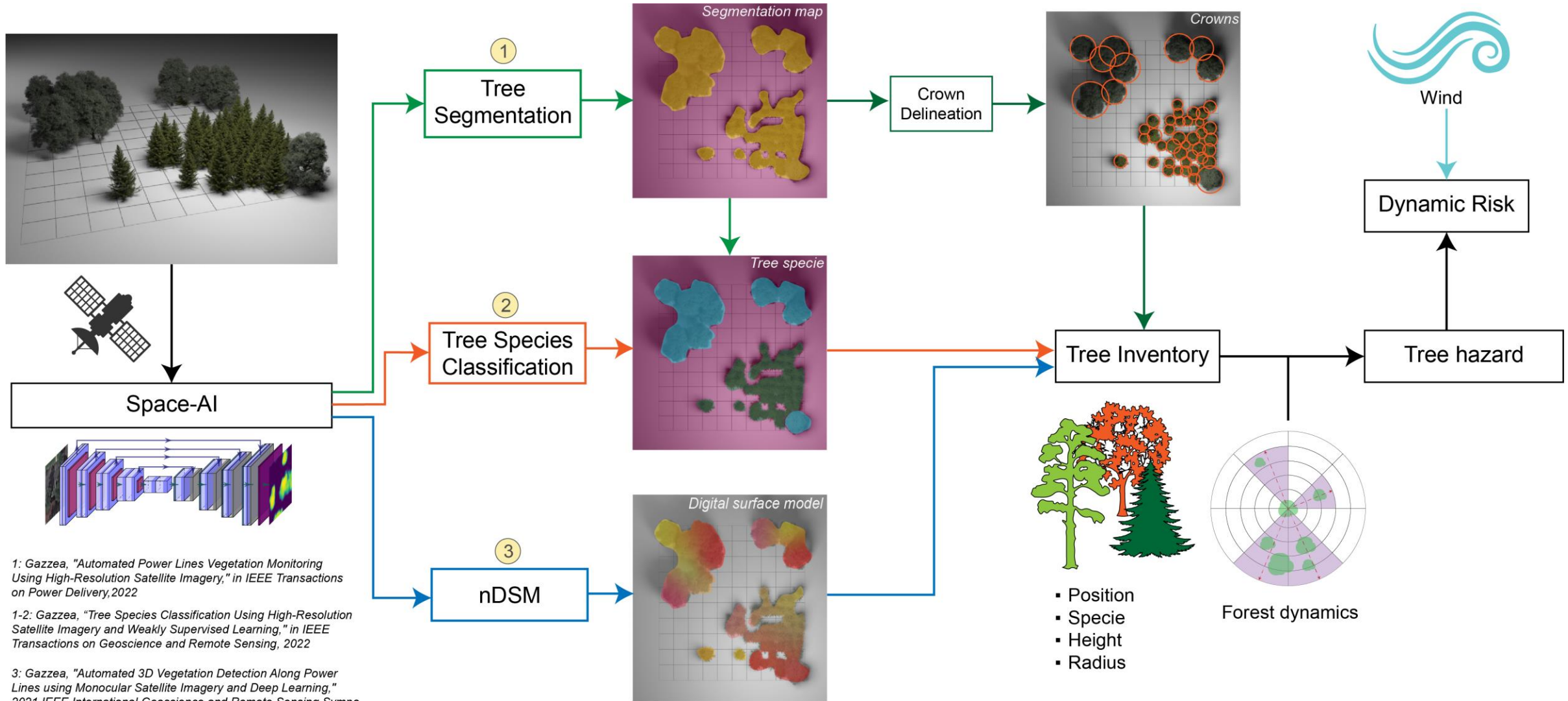
# Methodology

Key elements to model vegetation risk

- Position w.r.t. the power line
- Size
- Species
- Height
- Position of trees w.r.t. other trees



# Methodology



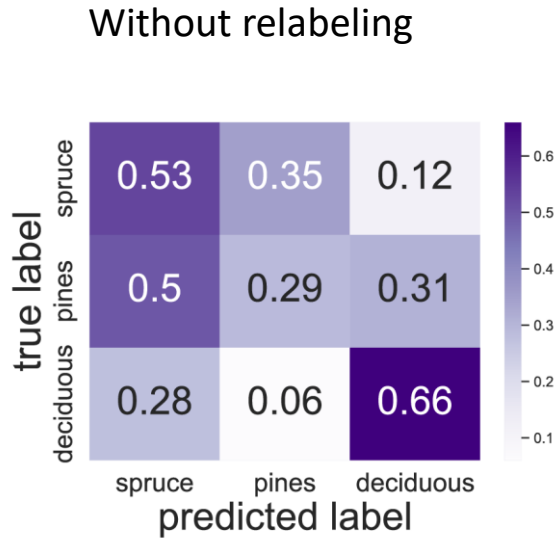
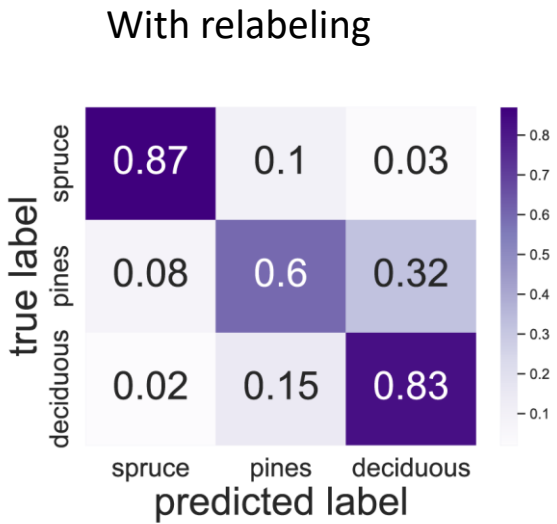
1: Gazzea, "Automated Power Lines Vegetation Monitoring Using High-Resolution Satellite Imagery," in IEEE Transactions on Power Delivery, 2022

1-2: Gazzea, "Tree Species Classification Using High-Resolution Satellite Imagery and Weakly Supervised Learning," in IEEE Transactions on Geoscience and Remote Sensing, 2022

3: Gazzea, "Automated 3D Vegetation Detection Along Power Lines using Monocular Satellite Imagery and Deep Learning," 2021 IEEE International Geoscience and Remote Sensing Symposium IGARSS

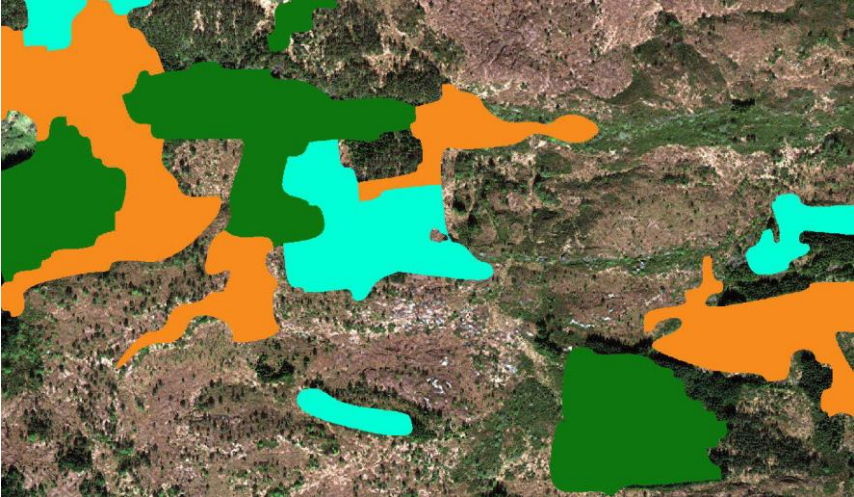
# Tree Type Detection

Confusion matrices between predicted (by Tree Species Detector) and true tree type (from ground truth)

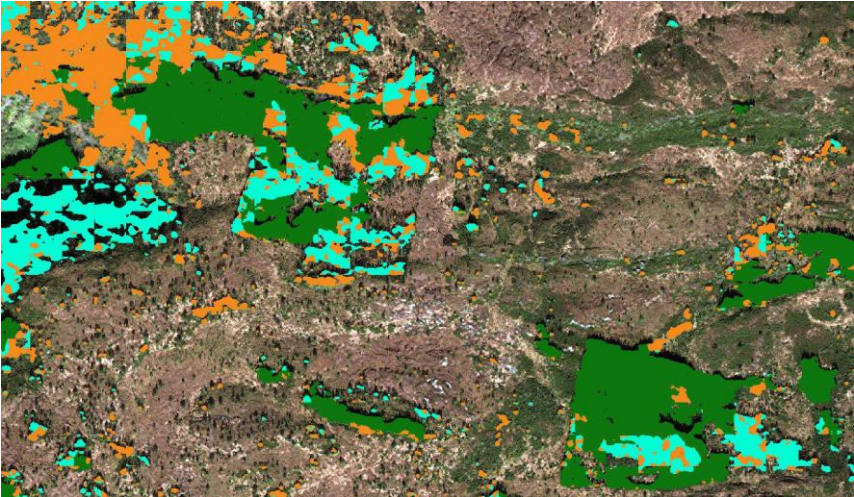


Legend: spruces pines deciduous

Original tree inventory



Generated tree inventory with our approach

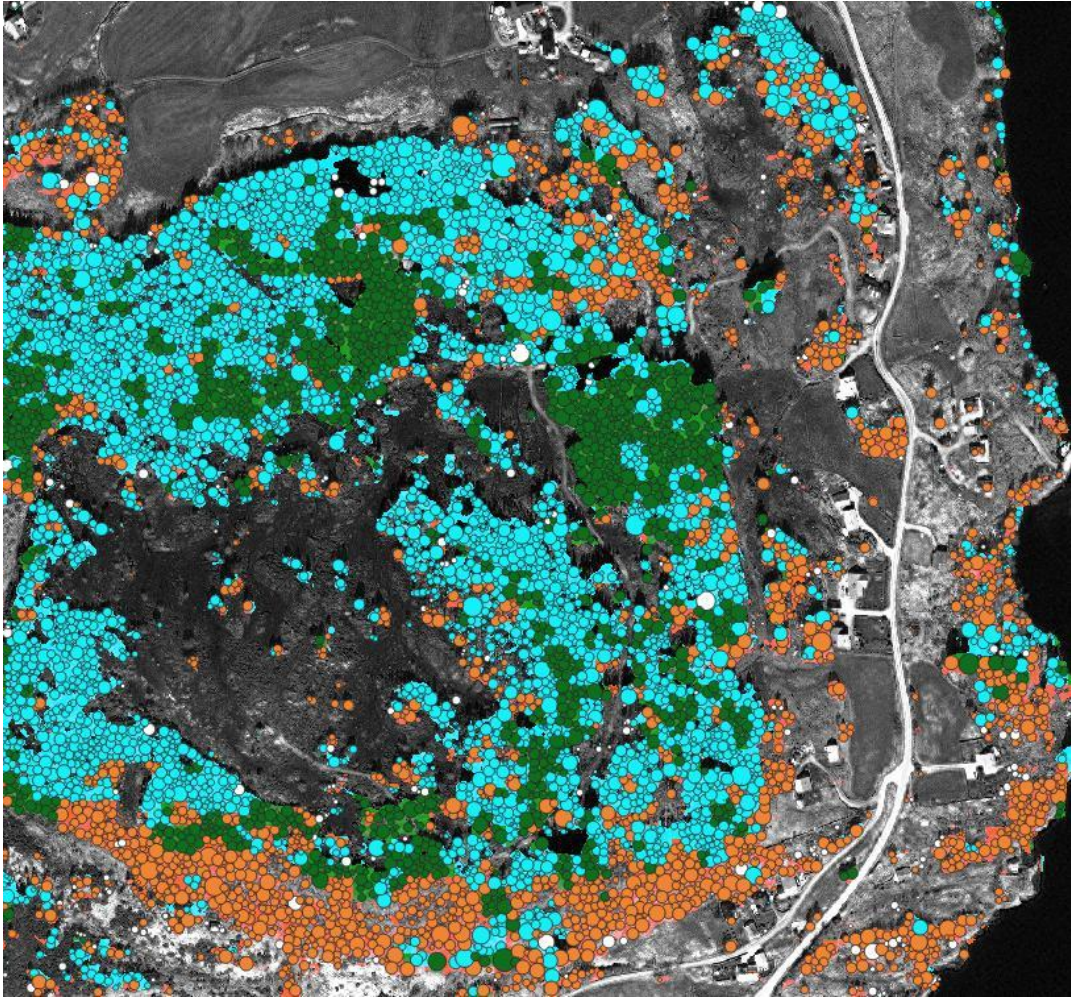
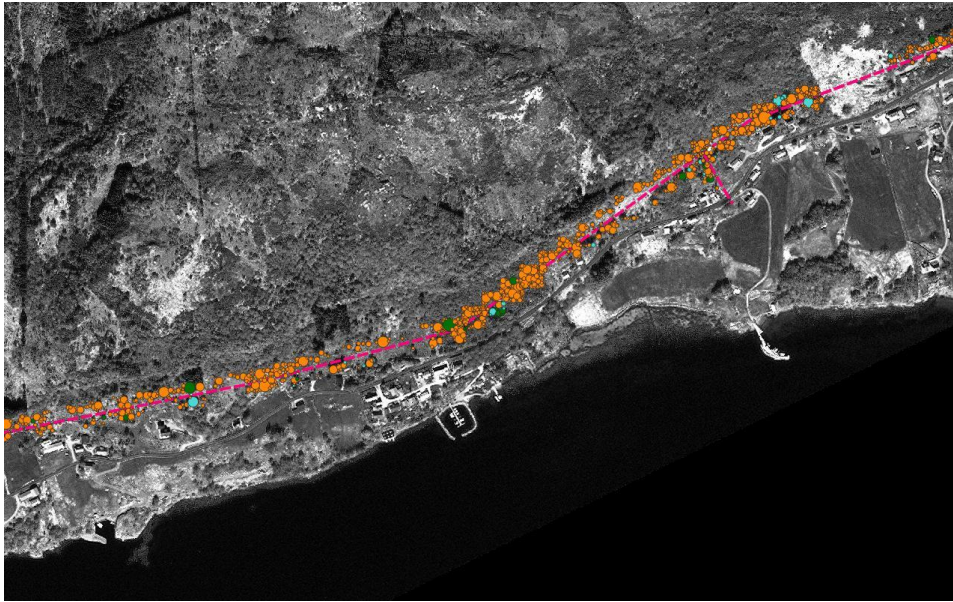




# Tree Crown Delineation

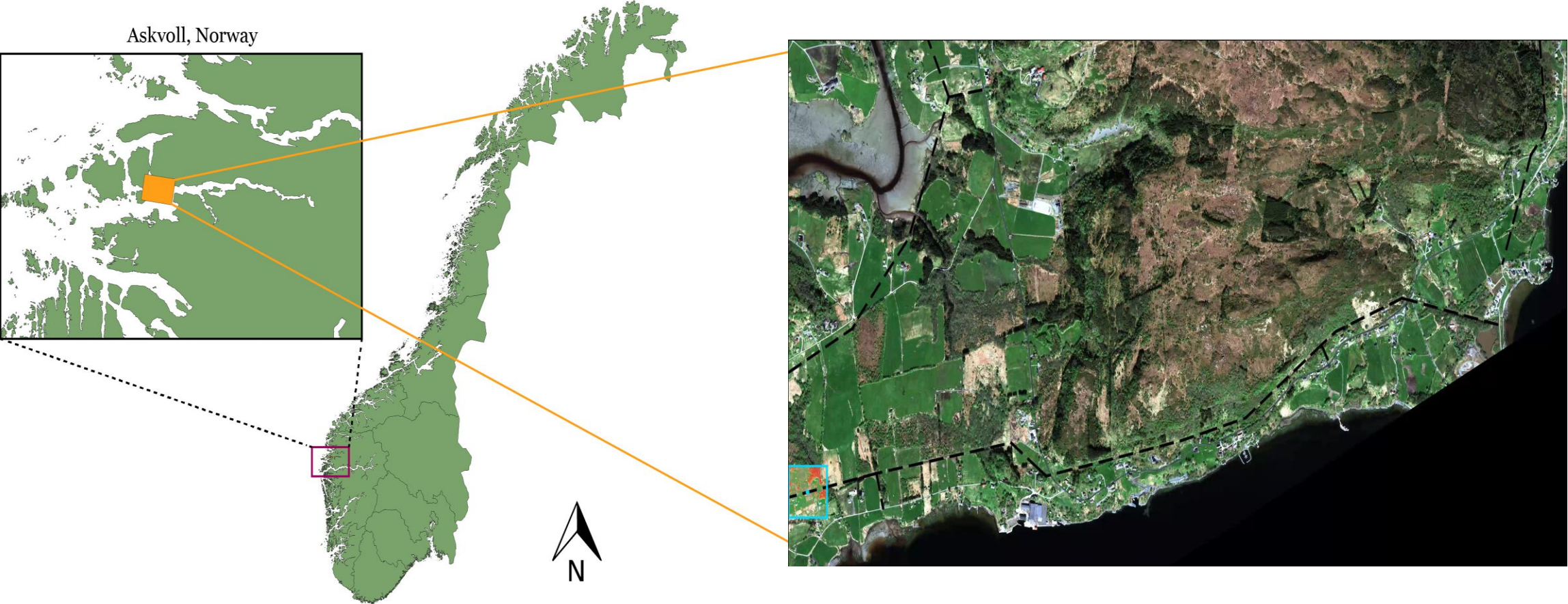
Crown delineation for a portion of the Askvoll area →

↓ Crown delineation for a portion of the power line

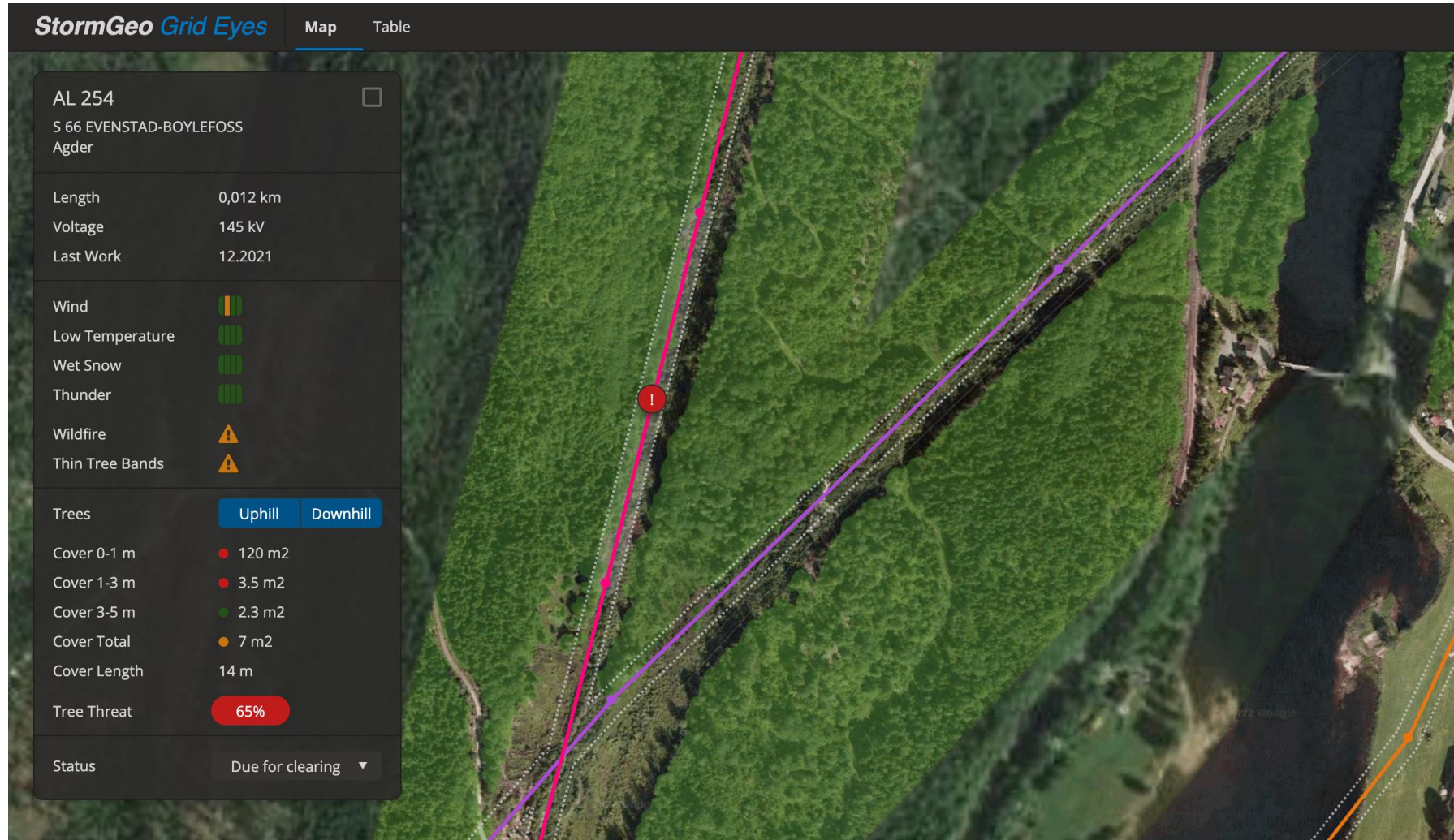


Legend: spruces pines deciduous

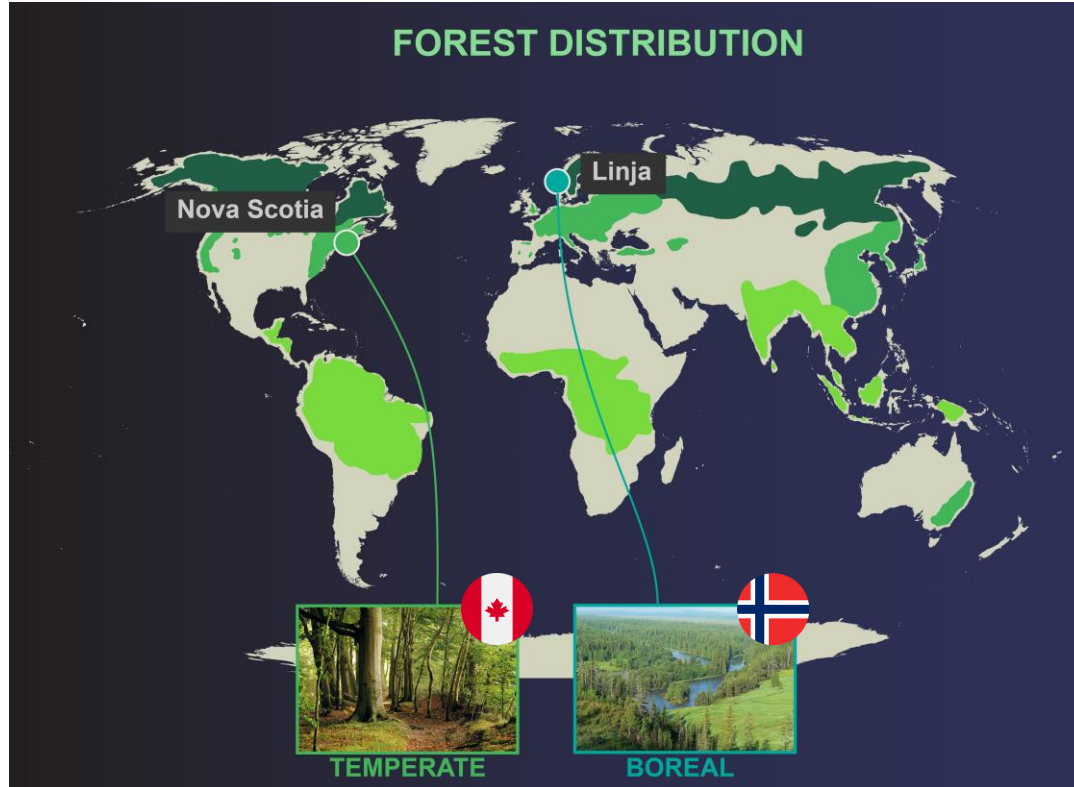
# How it works



# API:



# Scalability & Transferability



The project includes pilot sites in **Norway** and **Canada**, which represent **different ecological, weather, climate, and electrical network conditions**.

These sites are crucial for testing and validating the solution's **scalability** and **transferability**.


# In Media

**NRK** Logg inn

Vestland Snakk med oss Vestlandsrevyen P1 SF P1 H

## Kunstig intelligens kan hindra straumbrot

Tre som veltar er ein viktig grunn til mange straumbrot, men no kan forskarar i Bergen ha funne løysinga på problemet. Pilotprosjektet deira vekkjer internasjonal merksemd.



Åge Alger  
Journalist

Publisert 1

VELTA OVER STRAUMLINJE: Slik kan det gå når straumlinjene går rett gjennom skogen. Biletet er frå Kongsberg i mai 2022.  
FOTO: GLITRE ENERGI

**forskning.no**



Et pilotprosjekt skal føre frem til en produkt demonstrasjon av tjenester for overvåking av strømledninger i Norge og Canada. (Foto: GridEyes)

## Forskere skal bruke satellitter for å se hvor trær kan falle ned på strømledninger

Satellittbilder kan vise både type og høyde på vegetasjonen og hvor nær den er strømledningene.

**Norsk Romsenter**  
Norwegian Space Agency

BLOGG KONTAKT OSS ENGLISH

ELPER MED FAGOMRÅDER BRUK AV ROMMET LÆR OM ROMMET AKTUELT OM OSS

HJEM / AKTUELT / SISTE NYTT / SKAL OVERVÅKE STRØMLINJENE VED HJELP AV SATELLITT



GridEyes

## Skal overvåke strømledningene ved hjelp av satellitt

GridEyes skal bruke satellittdata til å se hvor trær kan falle ned på strømledninger.

# Thank You



European Space Agency



Prof. Reza Arghandeh  
reza.arghandeh@hvl.no