

# Human-in-the-loop: empowering urban environmental monitoring with flexible cloud-based satellite mapping workflows

*Session 9: Innovative downscaling and AI techniques (New emerging technologies -part 1)*

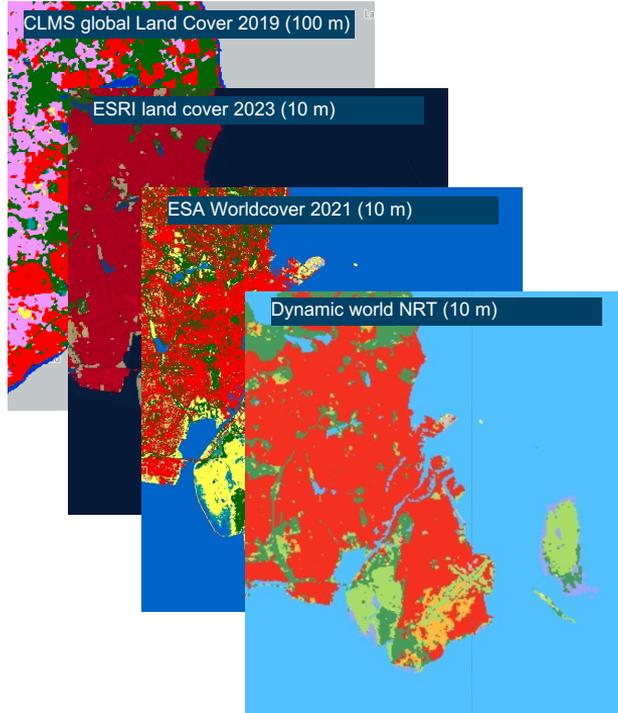
URBIS24, September 18, 2024

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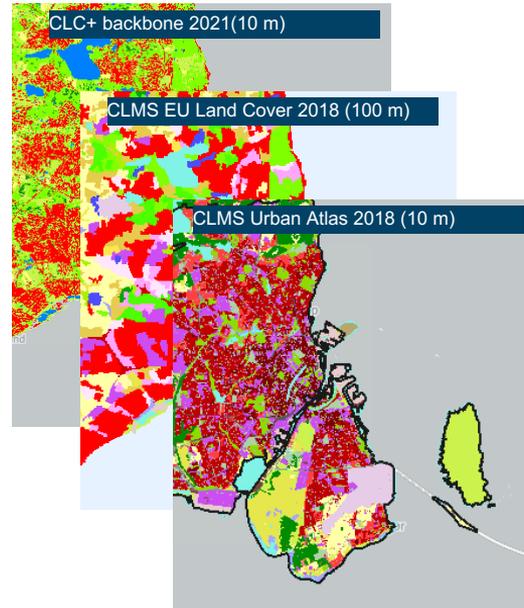


# Myriad of global and regional products

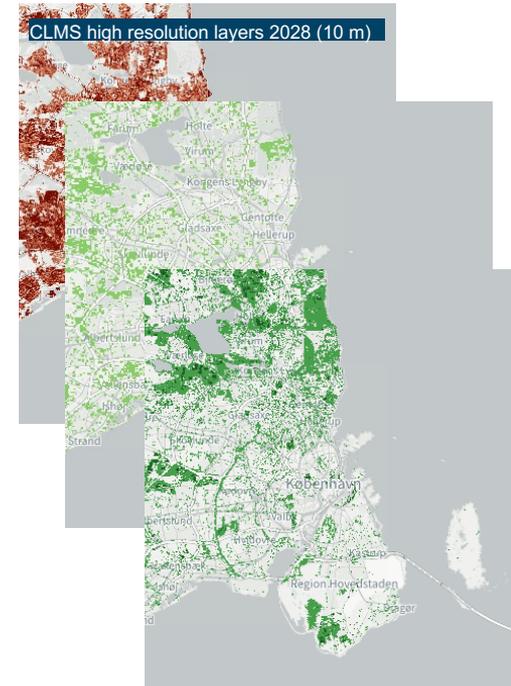
## Global



## European



## Thematic



# Myriad of global and regional products

## Global



## European

## Thematic



CLMS global Land Cover 2019 (100 m)

ESRI land (10 m)

- **Broad Coverage:** Provide extensive geographical coverage, offering a global perspective on environmental dynamics.
- **Standardization:** Data is often standardized, allowing for comparability across different regions and time periods.
- **Accessibility:** Many datasets are freely available and easily accessible, supporting large-scale environmental research and policy-making.

CLC+ backbone 2021(10 m)

CLMS EU Land Cover 2018 (100 m)

CLMS Urban Atlas 2011 (10 m)

### Cons:

- **Low Resolution:** Often lack the fine spatial resolution and disaggregation necessary for detailed urban analysis, missing critical local nuances.
- **Generalization:** May not account for specific local conditions, leading to less accurate or relevant data for urban stakeholders.
- **Latency:** Some products are updated infrequently, which can limit their usefulness in rapidly changing urban environments.

CLMS high resolution layers 2028 (10 m)

# New agile frameworks needed

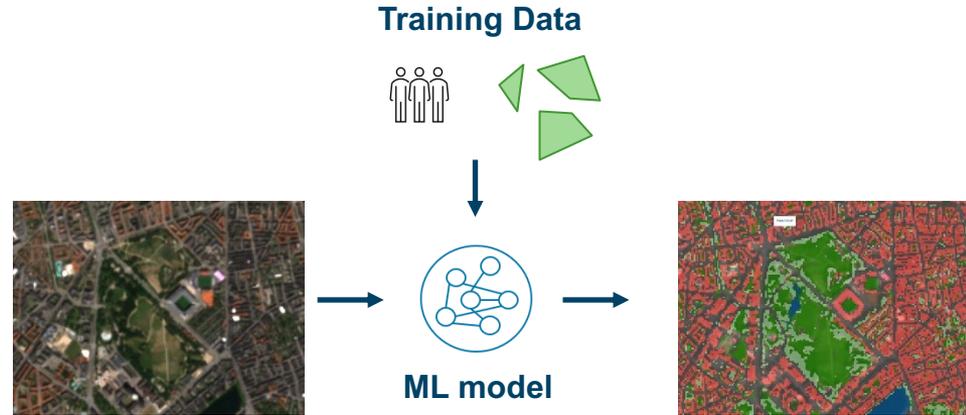
## Manual digitization



High accuracy and flexible classification, but very time consuming and can often be subjective.

vs

## Machine learning



Typically trained using in-situ data or manual annotations.

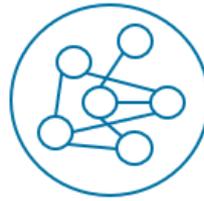
Methods differ in terms of spatial awareness, the amount of training data and training required, the level of transferability and scalability.

# A human in the loop

A Base ML model has learned general land cover features through training on a large set of annotated images

The user annotations/data are used to fine tune the model to local conditions

Input data



ML Model



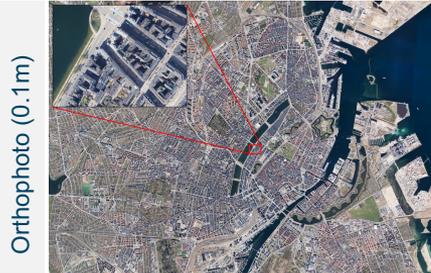
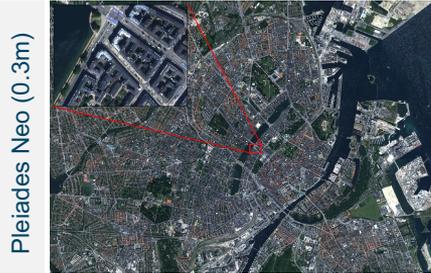
Output map



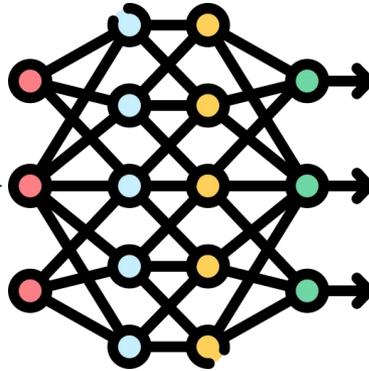
User annotations



# Versatile platform



Pre-trained models



Choose from:

- land cover classification
- roof segmentation
- roof type classification
- tree inventory

Models are trained for various problems at different resolutions

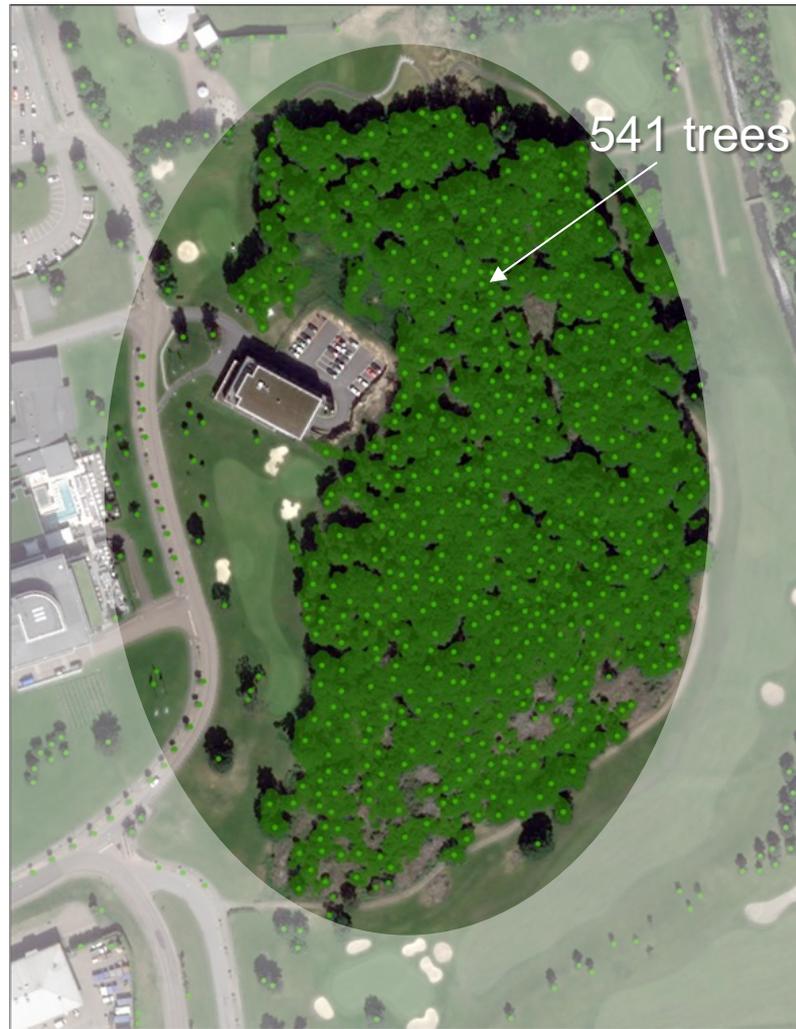
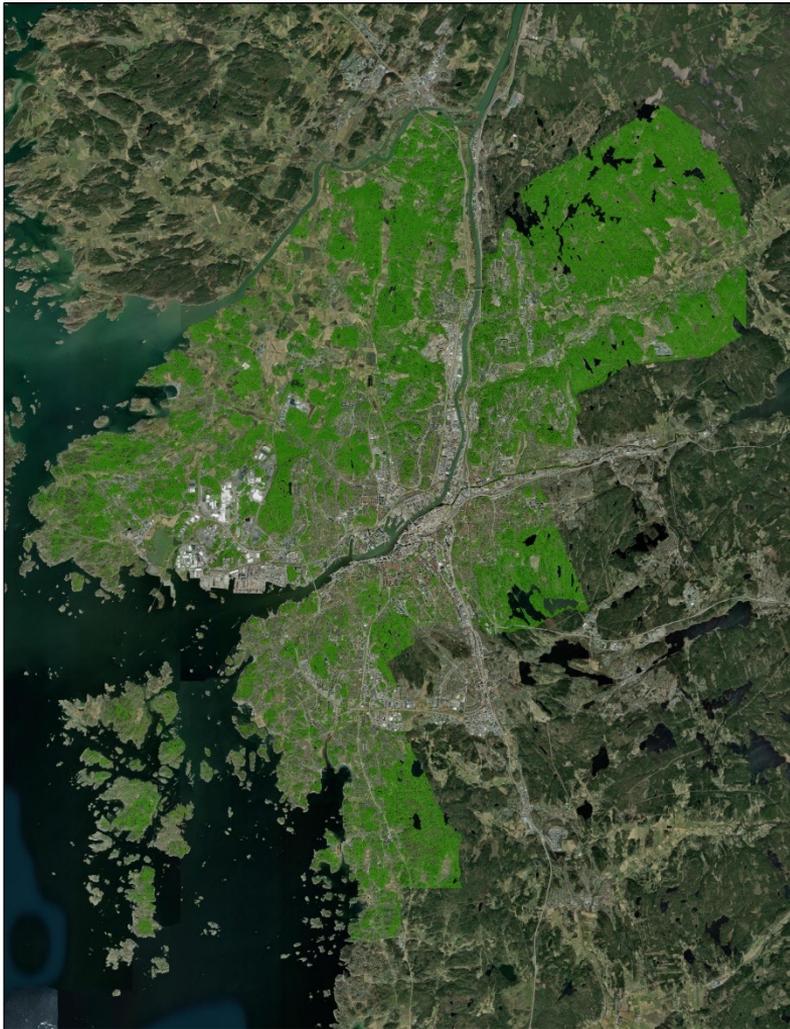
Example: Tree inventory (Pleiades Neo)





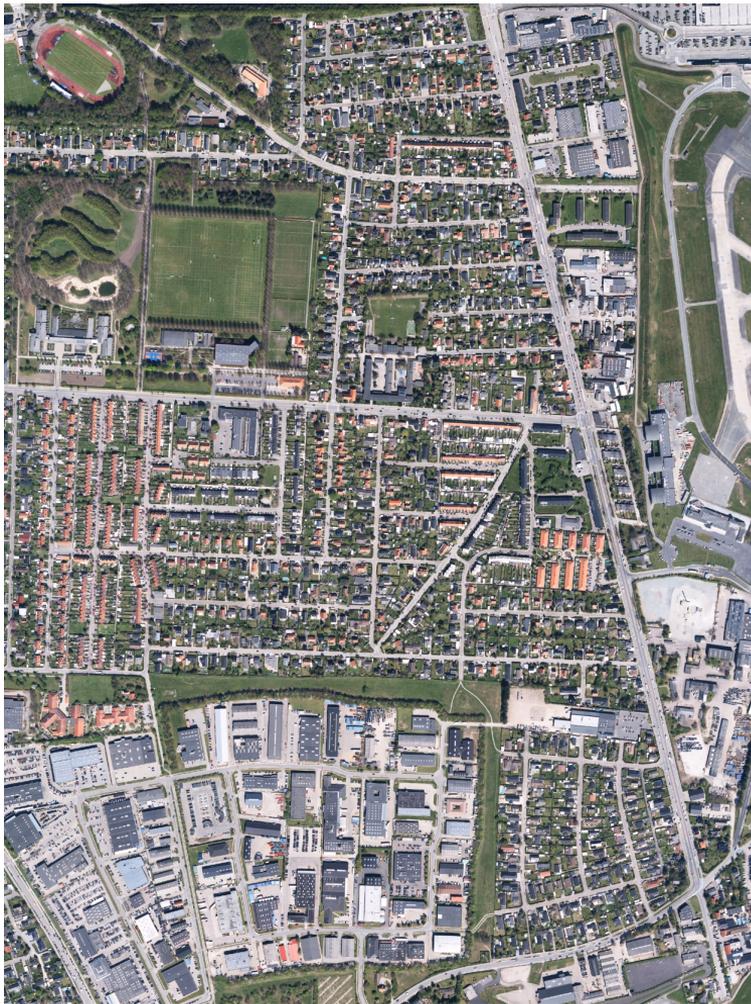
Urban green

© DHI





Urban infrastructure





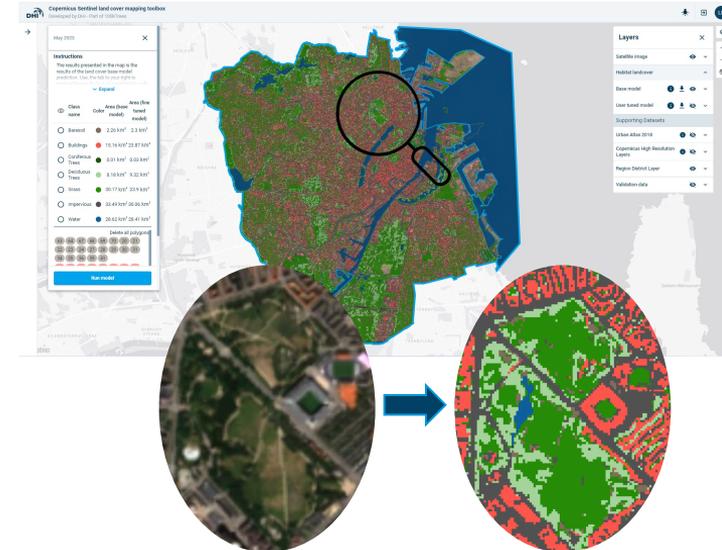
Urban infrastructure

© DHI



# Key Benefits of Human-in-the-Loop approach

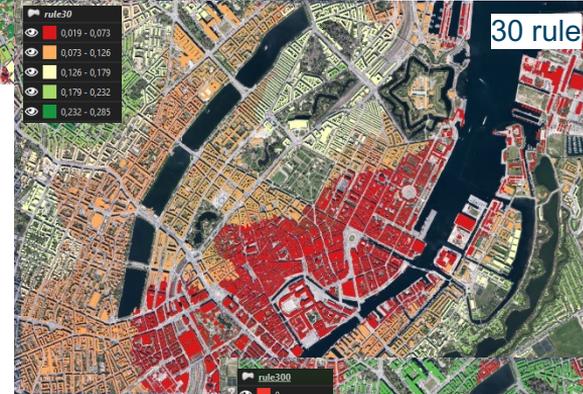
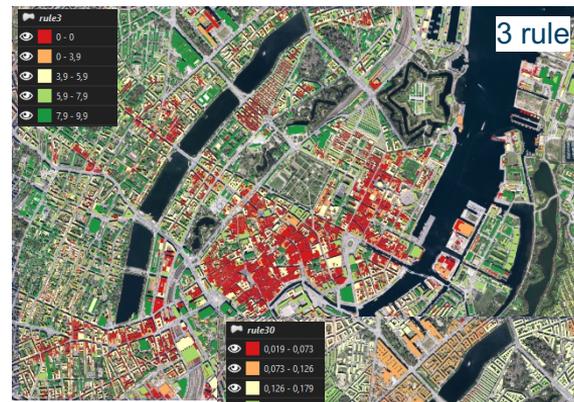
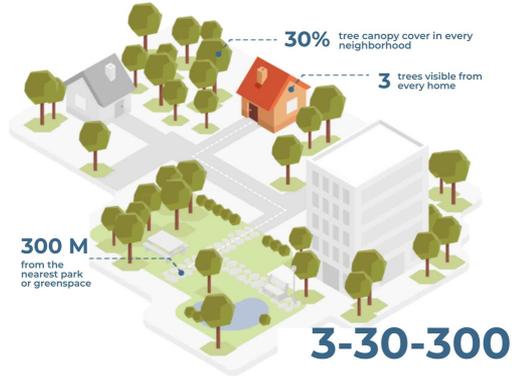
- **Enhanced Data Accuracy:** Combining human expertise with machine learning algorithms ensures more accurate and context-specific results, reducing errors that automated systems alone might overlook.
- **Tailored Solutions:** Stakeholders can customize the analysis and outputs to meet local needs, allowing for more relevant and actionable insights in specific urban environments.
- **Continuous Learning and Adaptation:** The system can improve over time by incorporating feedback from users, making it more adaptive to changing conditions and more aligned with stakeholder requirements.
- **Increased Stakeholder Engagement:** Involving local stakeholders in the data collection and analysis process fosters ownership, increasing the likelihood of the data being used effectively in decision-making.
- **Scalable and Flexible:** The approach is scalable across different cities and regions, with the flexibility to accommodate varying levels of data availability and quality, making it suitable for diverse urban contexts.



An aerial photograph of a river network, likely in a forested area. The water bodies are overlaid with a color-coded map, showing various shades of green, blue, and purple, which likely represent different environmental indicators such as water quality or land use. The text is centered over the image.

# Other EO based initiatives to inform urban decision making

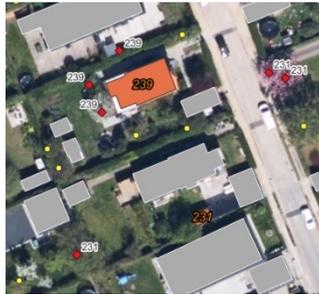
# Mapping the 3-30-300 rule



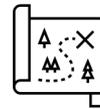
EO tree inventory



Building footprints



ML model



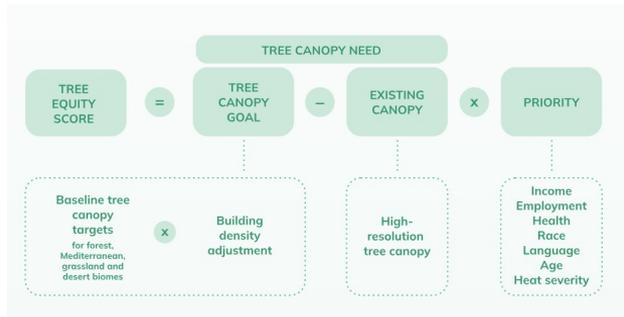
Geospatial operations

# Mapping the tree equity score

The Tree Equity Score is a metric designed to ensure that all communities, especially those in underserved or disadvantaged areas, have equitable access to the benefits of urban trees.

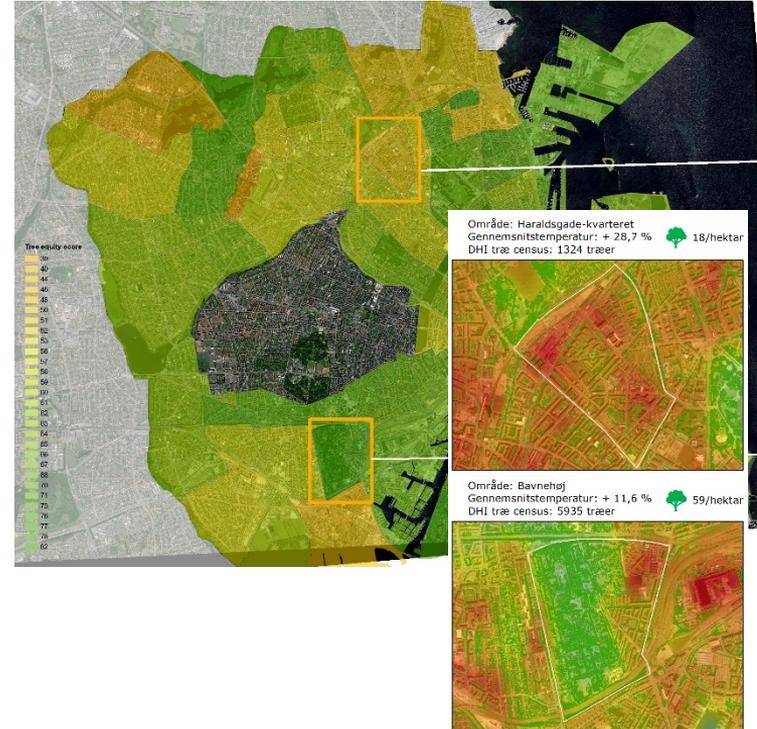
## Components:

- **Tree Canopy Coverage:** Measures the percentage of tree cover in a specific area.
- **Demographic Factors:** Considers factors like income, race, and population density to assess disparities in tree coverage.
- **Environmental Benefits:** Evaluates how tree cover contributes to air quality, cooling, and overall environmental health in different neighborhoods.



<https://www.treeequityscore.org/methodology>

Adapted for Denmark and EU



# In summary: Why should we use EO and AI for urban decision making

## Human-in-the-Loop Approach:

- **Contextual Accuracy:** Incorporating human expertise ensures that AI-generated insights are relevant and tailored to specific local conditions and needs.
- **Stakeholder Engagement:** Actively involving local stakeholders in data collection and analysis fosters better alignment with community needs and enhances the acceptance and effectiveness of policies.
- **Continuous Improvement:** Feedback from users allows the system to evolve and adapt over time, improving accuracy and relevance based on real-world experience and changing conditions.

## AI-Driven Insights:

- **Efficient Data Analysis:** AI processes large volumes of data quickly, providing actionable insights and identifying trends that might not be apparent through manual analysis.
- **Predictive Capabilities:** Machine learning models can forecast future urban challenges, such as traffic congestion or environmental impacts, aiding in proactive decision-making.
- **Data Integration:** AI can synthesize data from multiple sources, offering a comprehensive view of urban dynamics and facilitating holistic policy development (e.g. 3-30-300 and tree equity)

# Resources & Materials

EO and urban NBS

<https://eo-labs.dhigroup.com/eo-clinic-nbs>

<https://urban.satlas.dk/>

DHI Blog

[The Reservoir | Drops of Knowledge | DHI Blog \(dhigroup.com\)](https://theacademybydhi.com/)

DHI YouTube channel

<https://www.youtube.com/@DHIGroup/videos>

DHI's free on-demand webinars

<https://wod.theacademybydhi.com/>

The Academy by DHI website interface. The header includes navigation links: Training Calendar, Training, Publications, University Collaboration, and News & Resources. The main content area is titled 'News & Resources' and features a city skyline background. A sidebar on the right lists: News, Newsletter registration, Blog, Case Stories, and eBooks. A central banner reads 'Subscribe to our newsletters' with benefits: 'Get industry insight, get best ideas, customer stories, keep people and true.' Below this is a section titled 'THE RESERVOIR - DROPS OF KNOWLEDGE' with a search bar and category filter. The main content displays several article cards with images and titles: 'Balancing act: Strategies for sustainable reservoir management', 'Marine ecologists share crucial tips to improve biodiversity quantification', 'Denmark will be busy restoring nature at sea', 'What to consider in a nature-based blue carbon project', 'Five reasons to fight climate change with blue carbon ecosystems', and 'From big data to big information: how Global Hydrological Models ...'.

A satellite view of the Earth, showing the Americas. The text "Thank you" is centered over the Atlantic Ocean.

**Thank you**

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