Tracking urban development with satellite data

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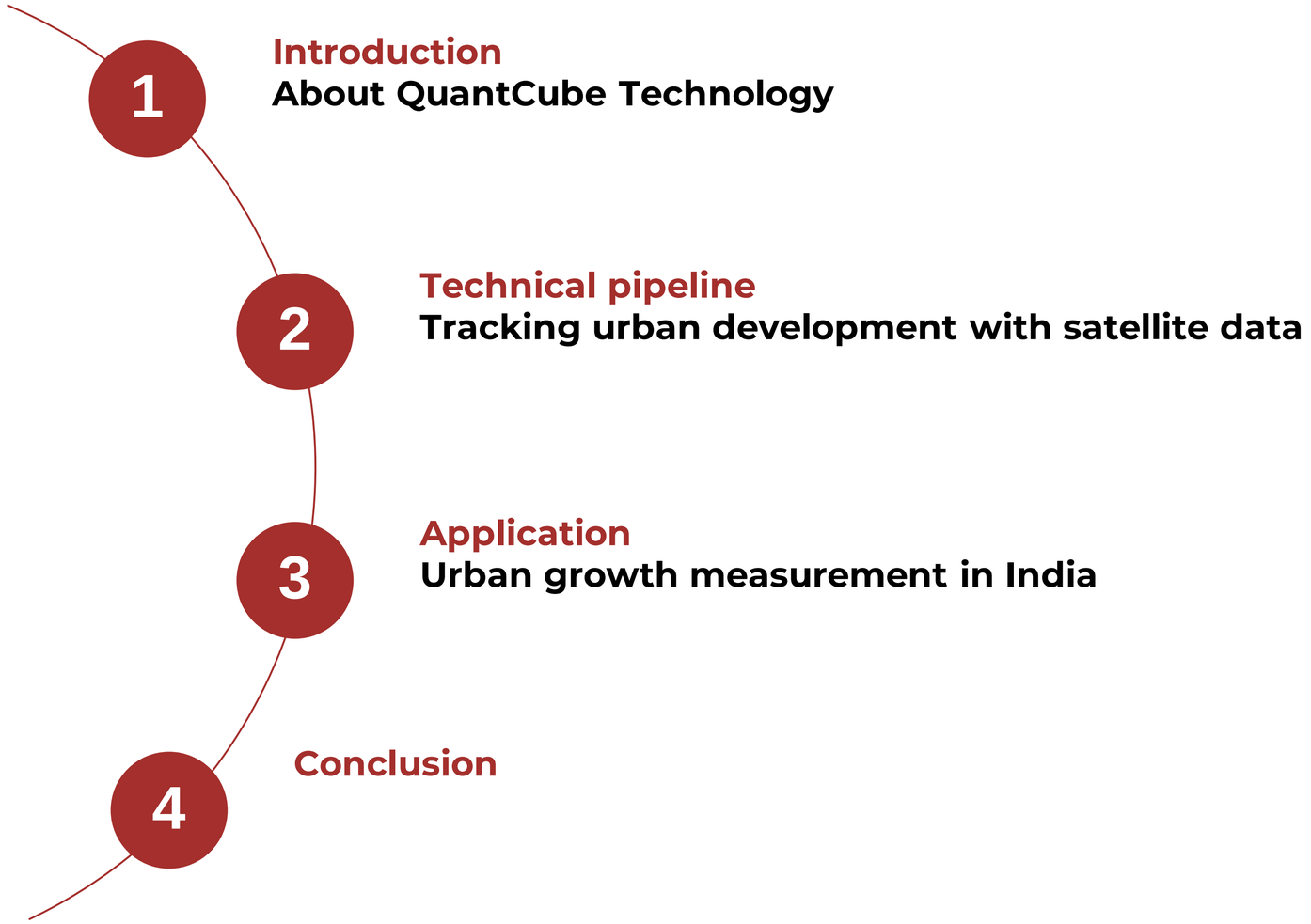
SUMMARY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Urban growth measurement in India
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Conclusion

About QuantCube Technology

QUANTCUBE
TECHNOLOGY

INTRODUCTION

About QuantCube Technology

Overview

QuantCube uses artificial intelligence and big data analytics to deliver real time macroeconomic insights ahead of the Market. We give institutional investors a critical edge in their investment strategies.

Data Coverage

Our Datalake contains over 15 Billion Datapoints including :

TEXT DATA

SOCIAL MEDIA

FINANCIAL BLOGS

NEWS ARTICLES

JOB OPENINGS

HOTEL & RESTAURANTS REVIEWS

GEOSPATIAL DATA

EARTH OBSERVATION SATELLITE

ATMOSPHERIC DATA

RADAR DATA

GEOLOCATION DATA

SHIPPING TRAFFIC

FLIGHT TRAFFIC

HEAVY VEHICLE LOCATION

MOBILITY DATA

STRUCTURED DATA

GOOD PRICES

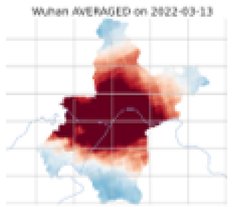
REAL ESTATE PRICES

INTERNET QUERIES

WEB TRAFFIC

AI and Finance Experts

STATE OF THE ART COMPUTER VISION AND NLP TECHNIQUES



City Level Pollution Index

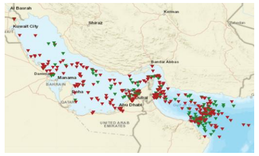
High Resolution Satellite Data

Multilingual Text Analysis

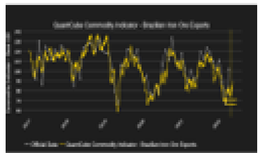
COMPUTER VISION AND NLP R&D PARTNERS

esa cnes Inria

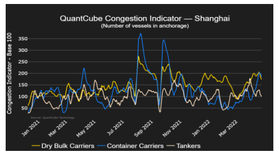
EXPERTS IN FINANCE AND COMMODITY ANALYTICS



Vessels and Cargoes position data processing



Commodity trade AIS data



Ports congestion AIS Data

ECONOMETRICS AND FORECAST MODELING PARTNERS

PSE PARIS SCHOOL OF ECONOMICS INSEE

URBAN GROWTH

A Tool for Innovation and Impact

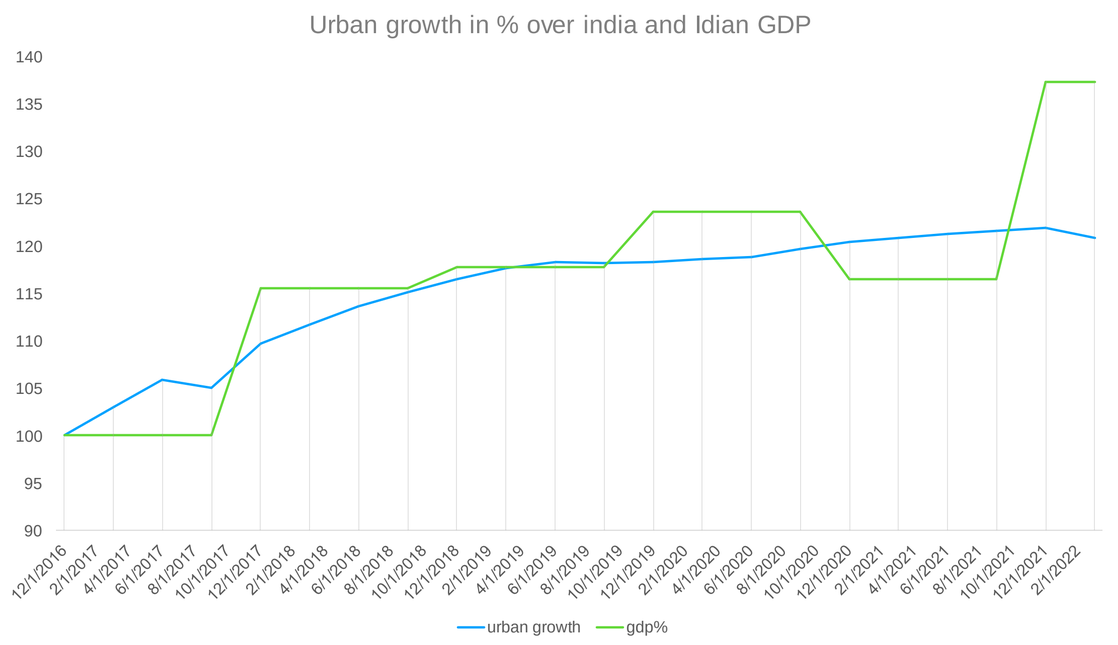
ECONOMIC USE CASES

1. **Measurement of Development**

2. **Growth in sectorial activity for cities strongly linked to a specific industry**

3. **Plan water, electricity and oil supply**

INDIA CASE



- + 18 % of Urban Growth in 7 years
- Urban population increase of 14% during the same period
- Indian GDP correlated with urban growth index for the pre-covid period

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Tracking urban development with satellite data

QUANTCUBE TECHNOLOGY

QUANTCUBE APPROACH

Data Description

Tracking urban development with low and high-resolution satellite data

EXISTING SOLUTION

Traditional Solution

- Land use surveys
- Aerial photography
- Ground-based surveys

NOT SCALABLE

VERY COSTLY

MANUAL WORK

Satellite data solution

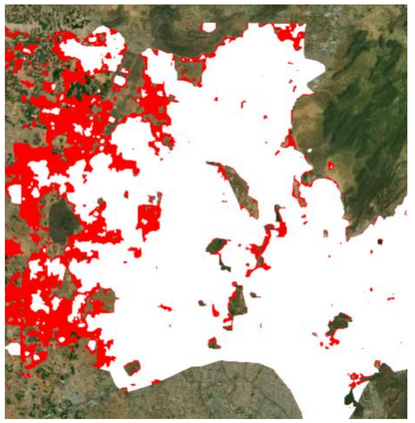
- VIIRS night data, ESRI and ESA Land Cover

ANNUAL UPDATES

10m RESOLUTION

QUANTCUBE APPROACH

	Low Resolution	High Resolution
Data source	Sentinel 1 & 2	Pléiades
Time frequency	Quarterly	-
Data lag	Real Time	On demand
Spatial resolution	10 meter	50 cm
Historical data	2016	2012



Urban surface segmentation mask based on Sentinel imagery

Building segmentation map based on Pléiades imagery

QUANTCUBE TECHNOLOGY

TECHNICAL PIPELINE

Tracking urban development with low- and high-resolution satellite data

STEP 1

Collect low resolution satellite imagery → Estimate the urban growth (Surface – 2D)

Estimation of the urban growth and new urban areas

STEP 2

Collect high resolution satellite imagery → Segment and type classify the buildings → Calculate the volume of the buildings

1. Detection of constructions in a specific area
2. Identification of the type of new buildings: residential, commercial, industrial
3. Volume estimation

QUANTCUBE TECHNOLOGY

TECHNICAL PIPELINE

Step 1 – Sentinel-2 Pipeline

Collect low resolution satellite imagery → Estimate the urban growth (Surface – 2D)

PIPELINE

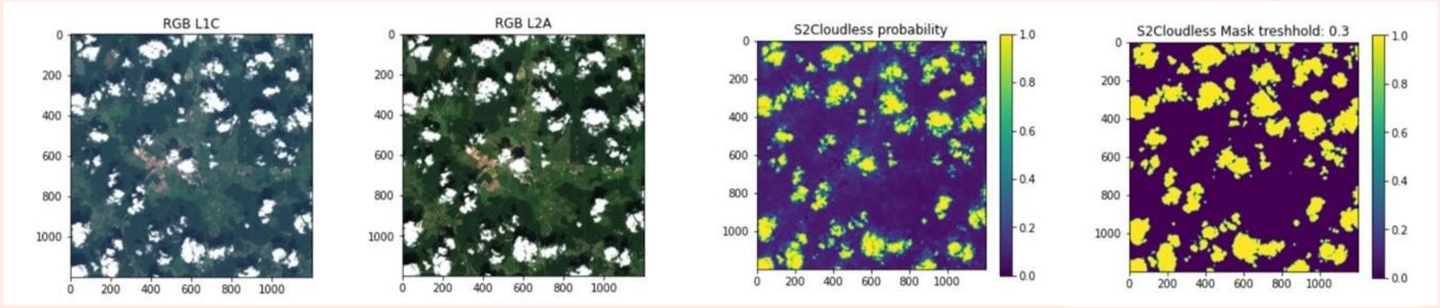
Step 1: Download Sentinel-2 Images

Step 2: Pre-processing: Cloud detection, projection, band ratio

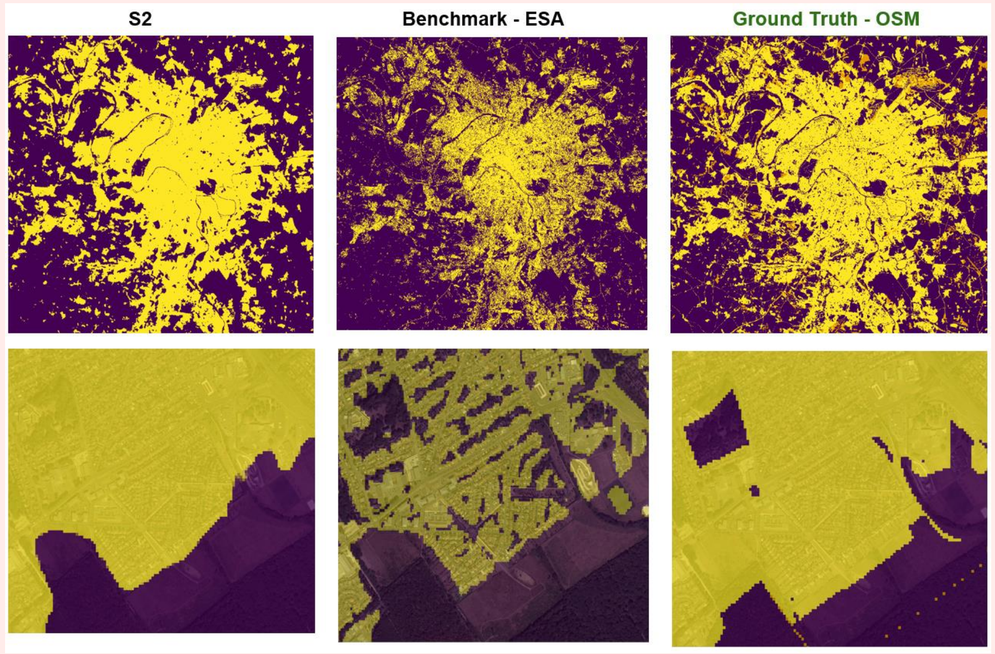
Step 3: Predict using a Deep Learning Model

Step 4: Post Processing to create a probability mask

Probability mask



Step 1 & 2: Download and Pre-processing



Step 3 & 4 : Prediction and Comparison to the Benchmark

QUANTCUBE TECHNOLOGY

TECHNICAL PIPELINE

Step 1 – Sentinel-1 Pipeline

Collect low resolution satellite imagery → Estimate the urban growth (Surface – 2D)

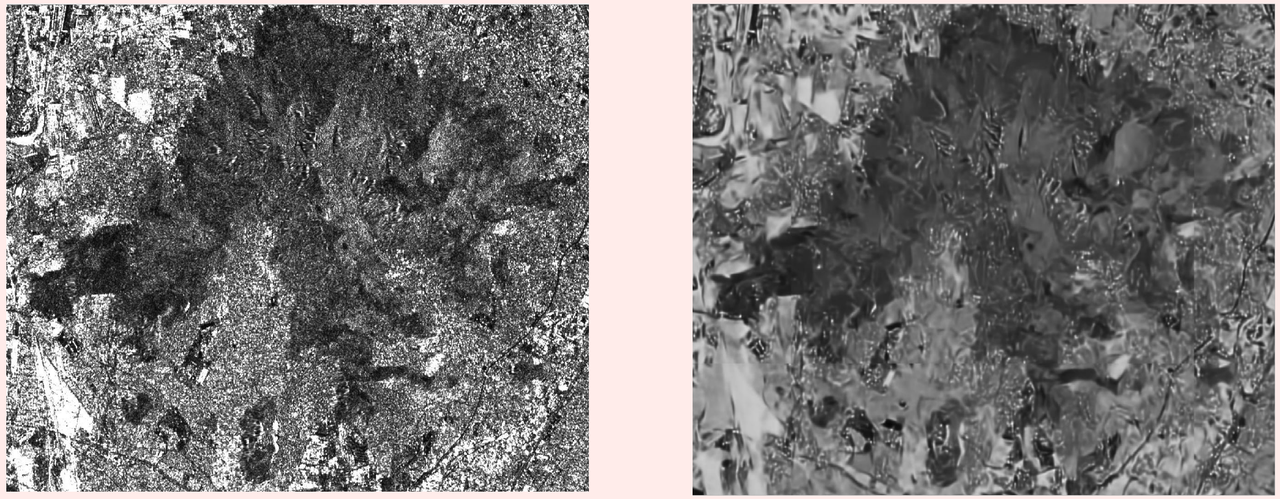
PIPELINE

Step 1: Download Sentinel-1 Images

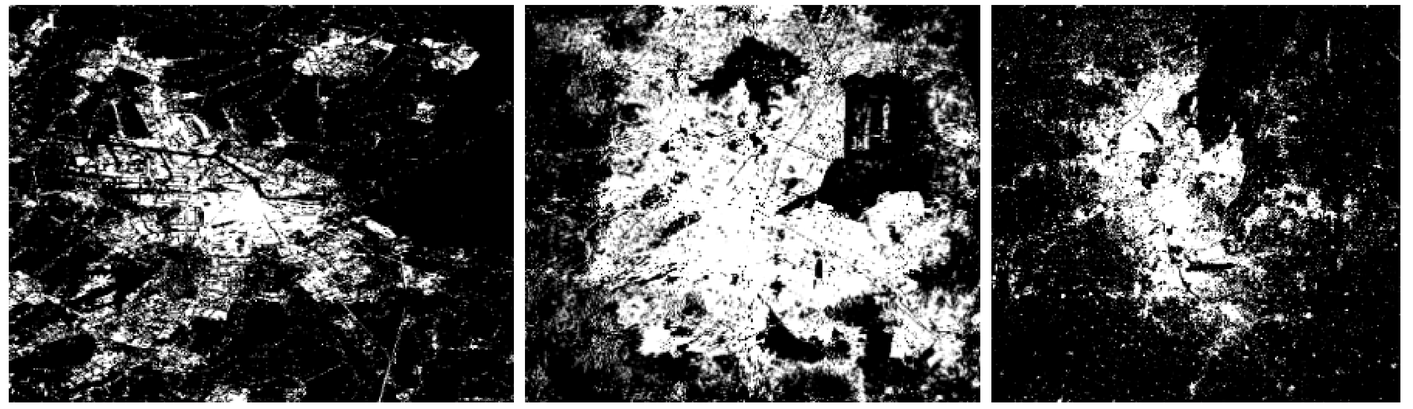
Step 2: Pre-processing using a Deep Learning model (SAR-CNN)

Step 3: Predict using a Machine Learning Model *(Kmean clustering and cluster selection with a score function)*

Step 4: Post Processing to create a probability mask



Step 1 & 2: Denoising of Sentinel-1 images



Step 3 & 4 : Segmentation over Amsterdam (left), Mexico-City (center), Jaipur (right)

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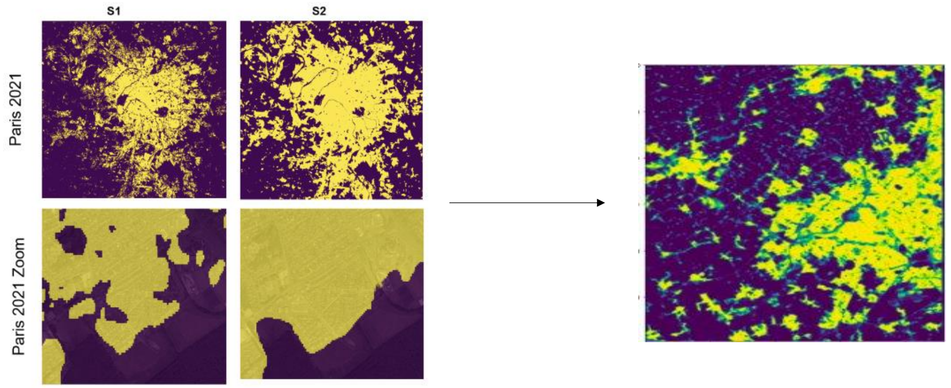
TECHNICAL PIPELINE

Step 1 – Global Pipeline & Results

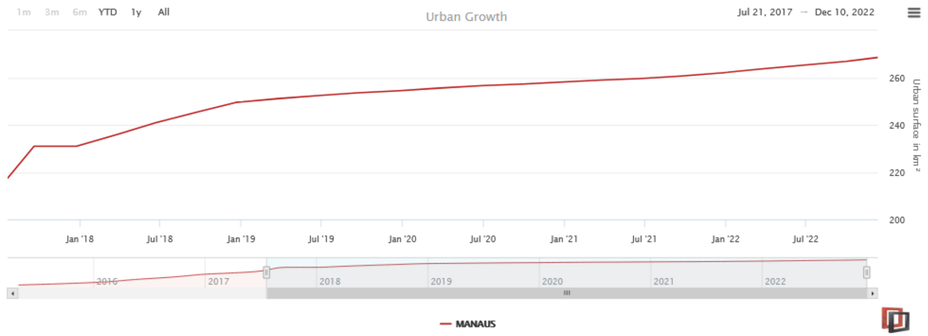
Collect low resolution satellite imagery → Estimate the urban growth (Surface – 2D)

AGREGATION

From probability masks to time series



Aggregation function using the previous states of a pixel and the probabilities to go from a state to another



RESULTS

Per Continent	Europe			Asia			Latin America			North America		
	Recall	Precision	F1	Recall	Precision	F1	Recall	Precision	F1	Recall	Precision	F1
Benchmark ESA	0,79	0,78	0,78	0,77	0,41	0,47	0,82	0,42	0,55	0,70	0,34	0,37
Sentinel 1	0,79	0,80	0,78	0,73	0,38	0,42	0,76	0,39	0,49	0,71	0,24	0,34
Sentinel 2	0,91	0,81	0,85	0,82	0,41	0,49	0,89	0,43	0,57	0,80	0,31	0,43
Merge	0.81	0.81	0.81	0.75	0.42	0.53	0.76	0.39	0.52	0.78	0.26	0.39

- The S2 pipeline yield convincing results against the ESA Worldcover benchmark
- The pipeline F1 score beats the benchmark on most climate and continents
- The results in dry climates could be explained by a lack of training data in those conditions
- The results are less sensible to the presence of vegetation within urban areas than the ESA Worldcover, leading to a better recall for urban labels

Potential Developments:

- Change to recent state of the art DL models for a better robustness and aggregate data from other resources

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TECHNICAL PIPELINE

Step 2 – High Resolution images pipeline

Collect high resolution satellite imagery → Segment and type classify the buildings → Calculate the volume of the buildings

PIPELINE

Step 1: Download stéréo Pléiades Images (50cm resolution RGB + NIR)

Step 2: Pre-processing: image registration, image orthorectification and image calibration

Step 3: Create the Buildings classification map using a Deep Learning Model

Step 4: Digital Surface Model to estimate the volume of each building

Step 5: Create time series to track the volume

Step 6: Building type classification (industrial, residential, commercial) using a proprietary deep learning algorithm

Left: Step 3 - Building Classification Map ; Right: Step 4: Digital Surface Model

RESULTS

- 84% of accuracy for the building segmentation. The validation has been done on a proprietary database labelled manually on Pléiades images. This database comprises cities in all continents.
- 70% of accuracy for the building type classification as industrial

Application: Urban growth measurement in India

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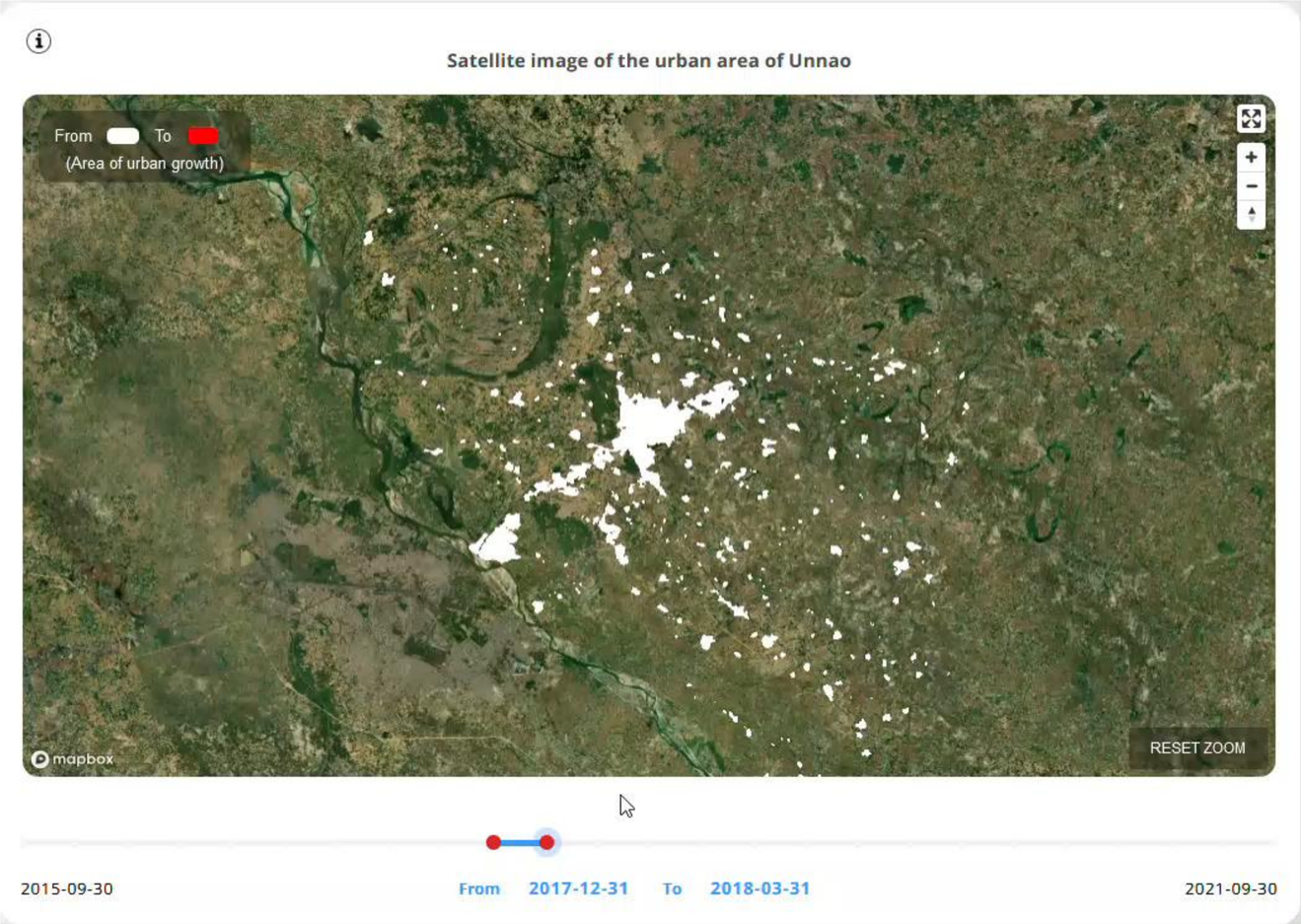
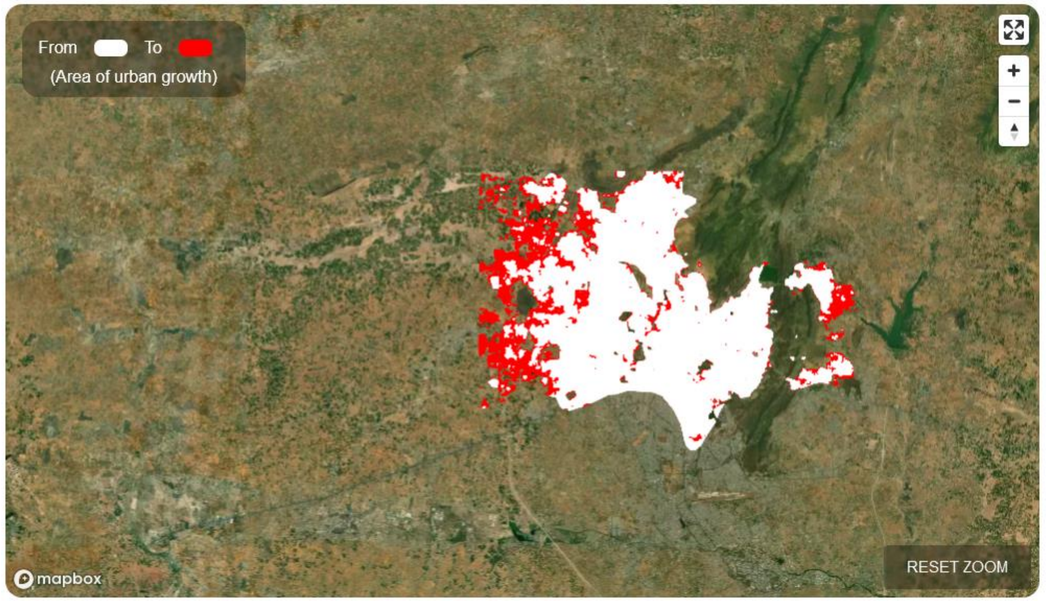
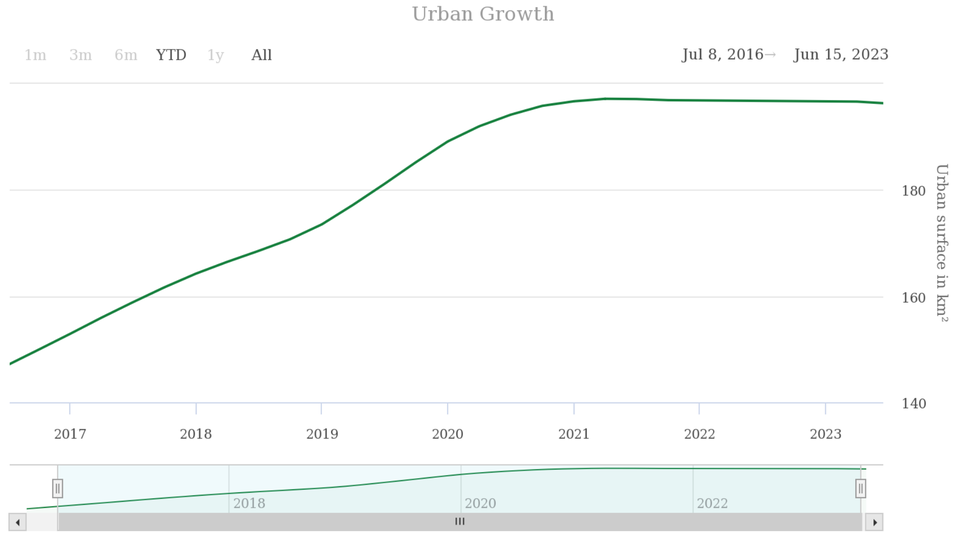
APPLICATION

Focus India

Using the low-resolution pipeline to track Urban Growth





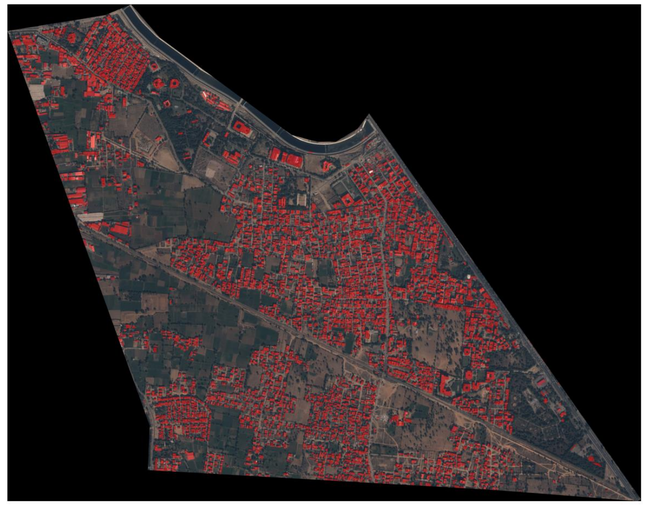


APPLICATION

Focus India

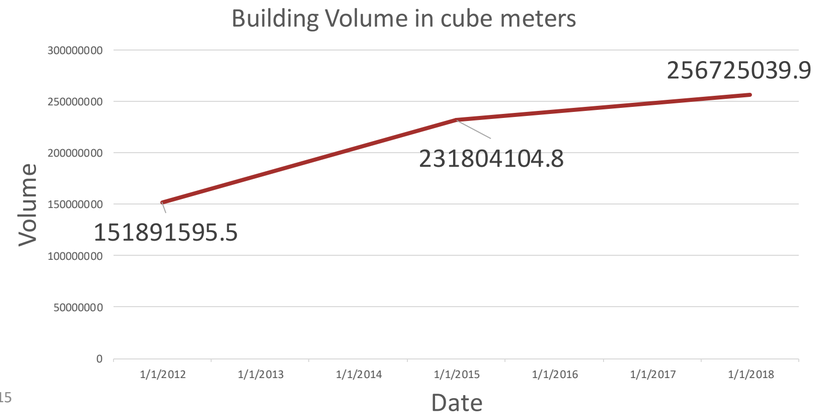
Using the high-resolution pipeline to classify the buildings and track the volumes of the buildings

Area in the outskirts of Jaipur, India



Building classification map

Digital surface model



+ 69% growth from 2012 to 2018

ai4geo Mapping the future

ONERA THE FRENCH AEROSPACE LAB · cnes · IGN · bpifrance · ES GROUP · QUANTCUBE TECHNOLOGY · GEOSAT · AIRBUS · CLS

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APPLICATION

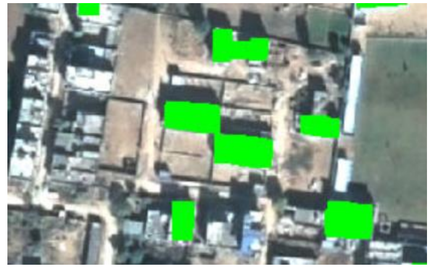
Focus India

Using the high-resolution pipeline to classify the buildings and track the volumes of the buildings

Change map between 2012 and 2018

10/10/2012 ***27/12/2018*** ***Change map***






New buildings in **green**
Destroyed buildings in **blue**

Conclusion

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URBAN GROWTH

A Tool for Innovation and Impact

ECONOMIC USE CASES

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2. **Growth in sectorial activity for cities strongly linked to a specific industry**

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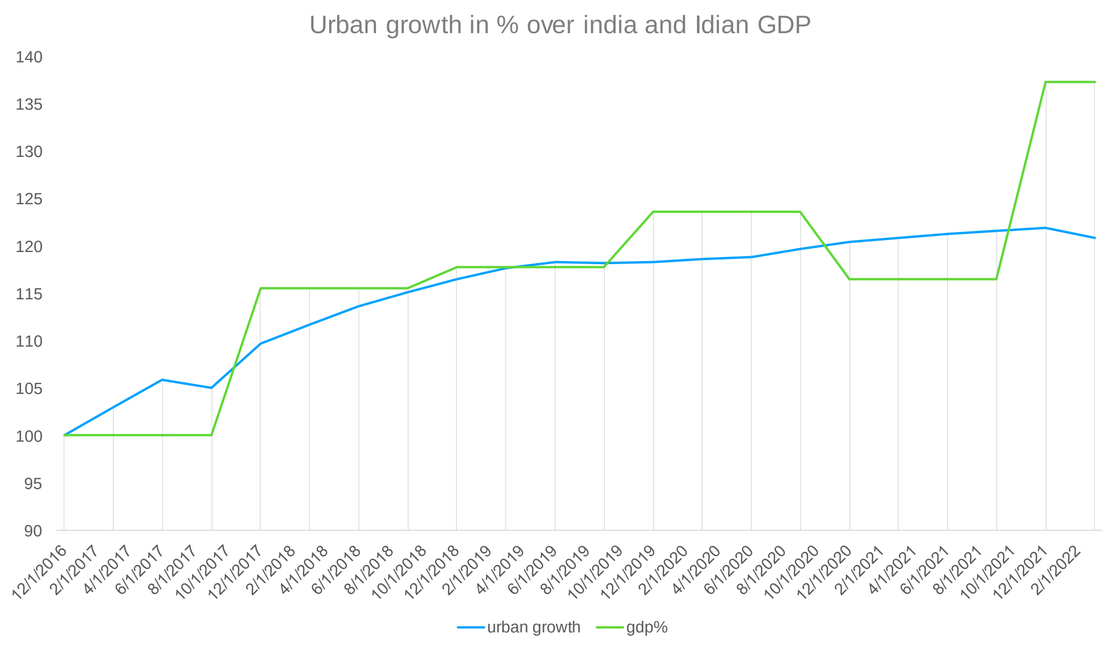
INDIA CASE



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URBAN GROWTH

Real-time monitoring of asset requires the continuous integration of data from multiple sources

ASSET MAPPING USE CASES

4. Real Estate Investment

5. Risk Monitoring at the asset level

STEP 1

Building Classification using proprietary Deep Learning Algorithm

STEP 2

Multisource data aggregation

to find organizations that operate in the building

Activity	Shops & Organisations	SIREN
	AUCHAN CARBURANT	379548001
	COMITE ENTREPRISE AUCHAN MELUN	323962019
	YVES ROCHER FRANCE	808529184

60+ other organisations found

STEP 3

Telecom data

to monitor foot traffic in real-time

THANK YOU FOR YOUR ATTENTION

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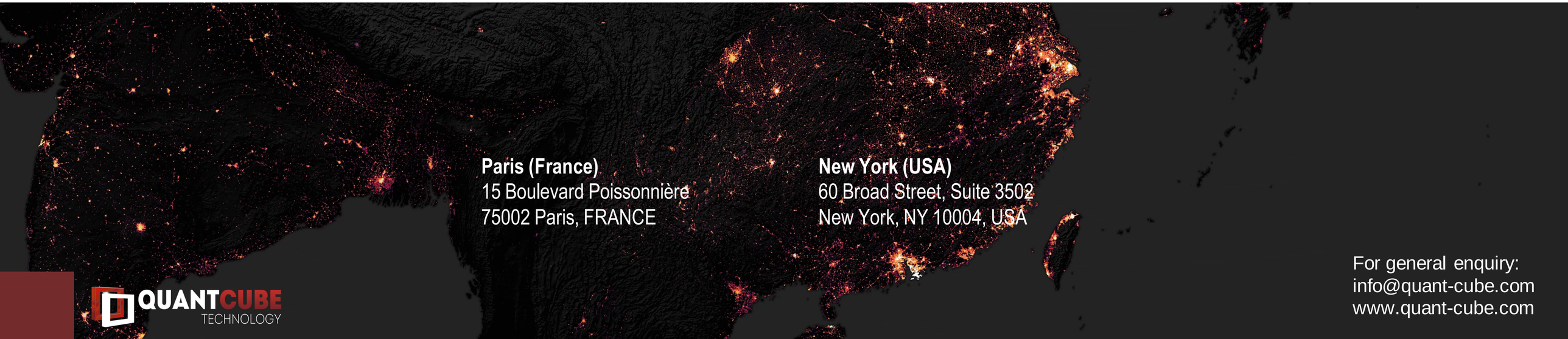

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QUANTCUBE TECHNOLOGY

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