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مركز محمد بن راشد
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MOHAMMED BIN RASHID SPACE CENTRE

We enable organizations with insights

Mustafa Alhashmi

+971506627541

m.musawa@smartrnavigation.ae

6th April 2021

“Use Cases of GIS and Remote Sensing Projects: From Concepts to Applications”

Agenda

Introduction

- Smart Navigation Systems
- Eagle.i71
- MBRSC Partnership

Space Remote Sensing (SRS)

- Basic Concepts
- Use Cases Overview
- Application Development

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**THE EMIRATI SOCIETY OF GIS AND
REMOTE SENSING (ESGRS)**

INVITES YOU TO THE 1ST BI-WEEKLY WEBINER TITLED:
*“Use Cases of GIS and Remote Sensing Projects:
From Concepts to Applications”*

**TUESDAY, APRIL 6, 2021
10:00 AM TO 11:00 AM**

PRESENTED BY:

MARCIN KUNKA
Product Specialist
Smart Navigation Systems

**MUSTAFA
ALHASHEMI**
CEO and Founder
Smart Navigation Systems

REGISTER NOW!



Local Authorities



Municipalities

in ADM, AAM, DRM Sections:

- Agriculture
- Land
- Building Permit

Customers' Sectors



Environment



Municipalities



Health



Housing



Transportation



Utilities



Agriculture



Marine



Economy



Civil Defense



Federal Authorities



NCEMA



UAE Ministries



DOT



Environmental Agency

Partnership

Programs

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MAXAR
TECHNOLOGIES



Clients



UNITED ARAB EMIRATES
MINISTRY OF INFRASTRUCTURE
DEVELOPMENT

بلدية دبي

DUBAI MUNICIPALITY



UNITED ARAB EMIRATES
THE SUPREME COUNCIL FOR NATIONAL SECURITY
National Emergency Crisis and Disasters
Management Authority

دائرة البلديات والنقل
DEPARTMENT OF MUNICIPALITIES
AND TRANSPORT

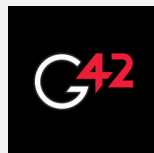
بلدية مدينة العين
AL AIN CITY MUNICIPALITY

أدنوك
ADNOC

Integrators



هيئة أبوظبي للرقمية
ABU DHABI DIGITAL AUTHORITY



EDGE
إيدج

Analysis

Picterra



Cloud Computing



amazon.com

Google

Academy



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جامعة خليفة
Khalifa University

جامعة نيويورك أبوظبي

NYU | ABU DHABI

UAEU



كليات التقنية العليا
HIGHER COLLEGES OF TECHNOLOGY

Remote Sensing



Satellite Imagery

RGB, MS, SAR, NDVI, NIR

Aerial Photo & Drones

INTEGRATION
WITH GIS



AI

SaaS

Cloud

SDI

MATURITY

EAGLE-I 71

OUR PRODUCT
For Analytical Services



Team

+70 Experience
Partnership

Applications

AI – Deep Learning



Insights

Government Authorities



Agriculture



Transportation



Municipalities



Marine



Civil Defense



Environment



Economy Development

Use Cases (Samples)

Change
Detection



Mapping of
Vegetation
Health



Base Map
Updating



U
S
A
G
E



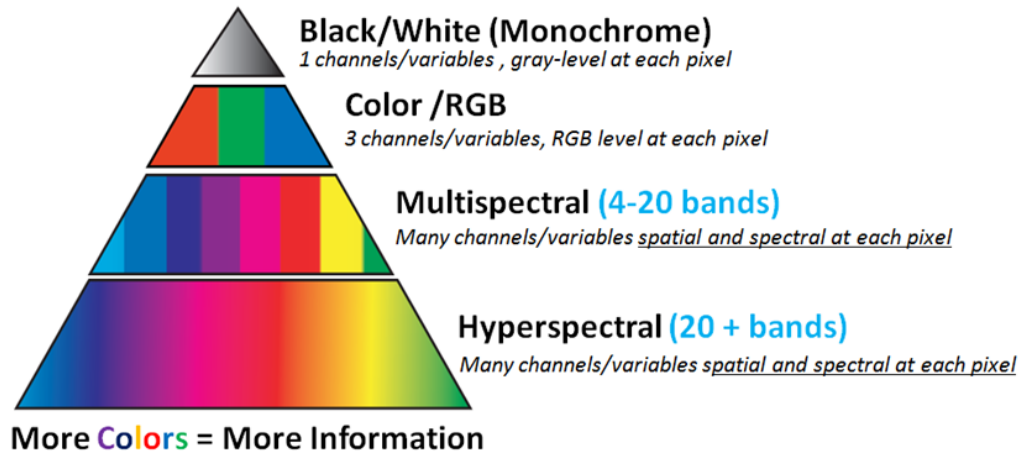
SNS Activities Summary



1. Receiving MBRSC satellite images of Abu Dhabi Capital Region (mosaic 0.70 m); we do appreciate
2. 17 use cases verified
3. Customers approached
 - NCEMA (disaster mitigation and recovery)
 - Al Ain Municipality (LU/LC, Rain Flooded areas)
 - ADNOC (on-shore oil pipeline leakage detection)
 - Construction progress monitoring.
 - Municipalities (green areas maintenance monitoring)
3. Platforms tested
4. Fourth set of interns from HCT accepted to SNS

We are having good links to potential customers; many meetings have been performed with positive response.

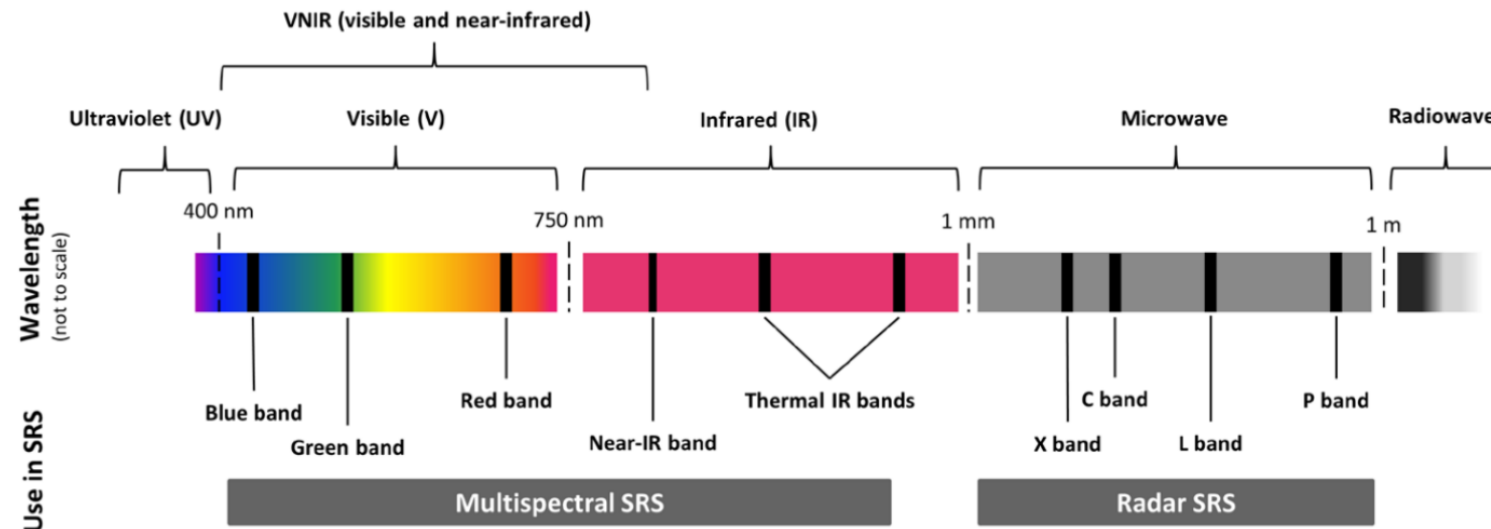
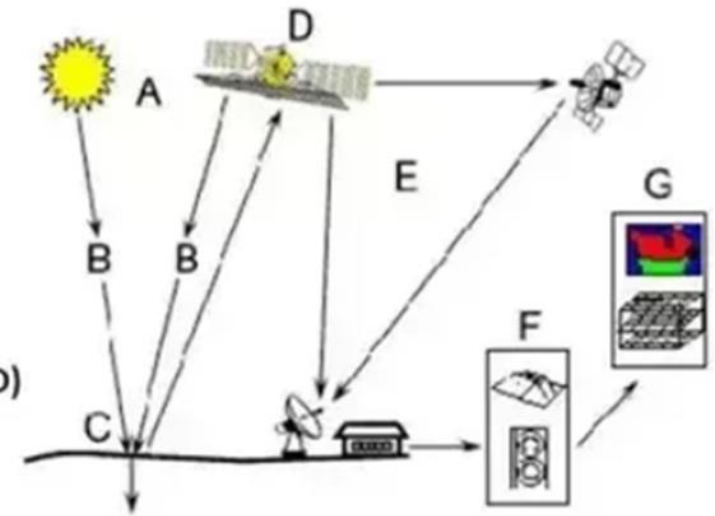
Components of Remote Sensing



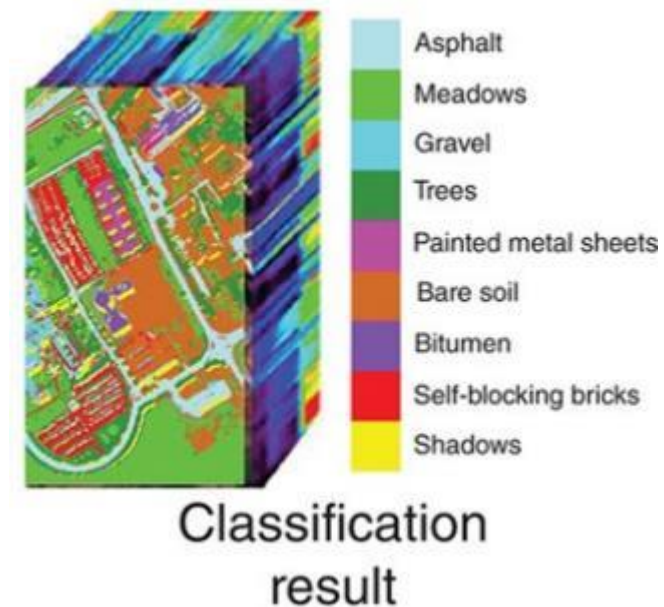
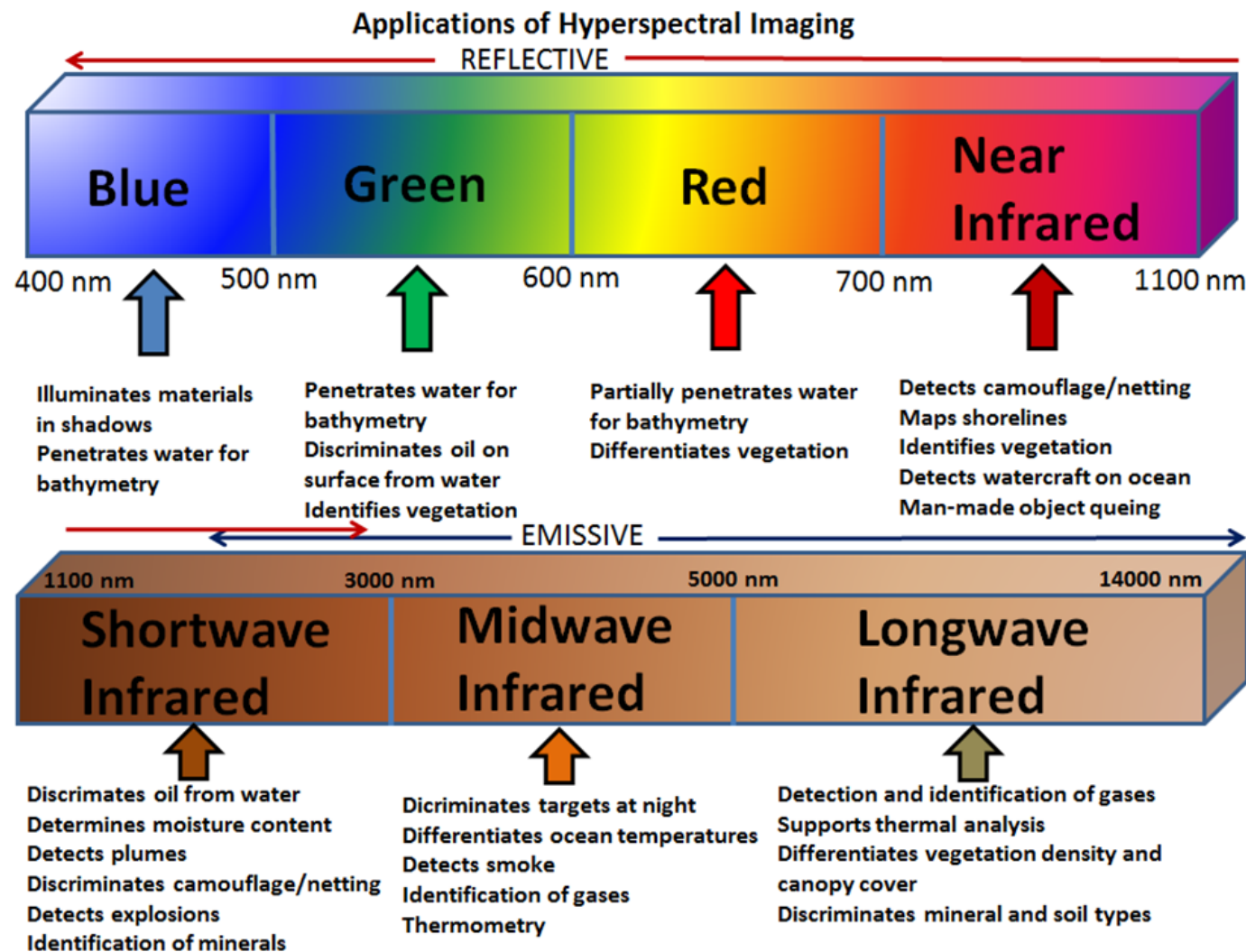
Spectral Imaging is a combination of:

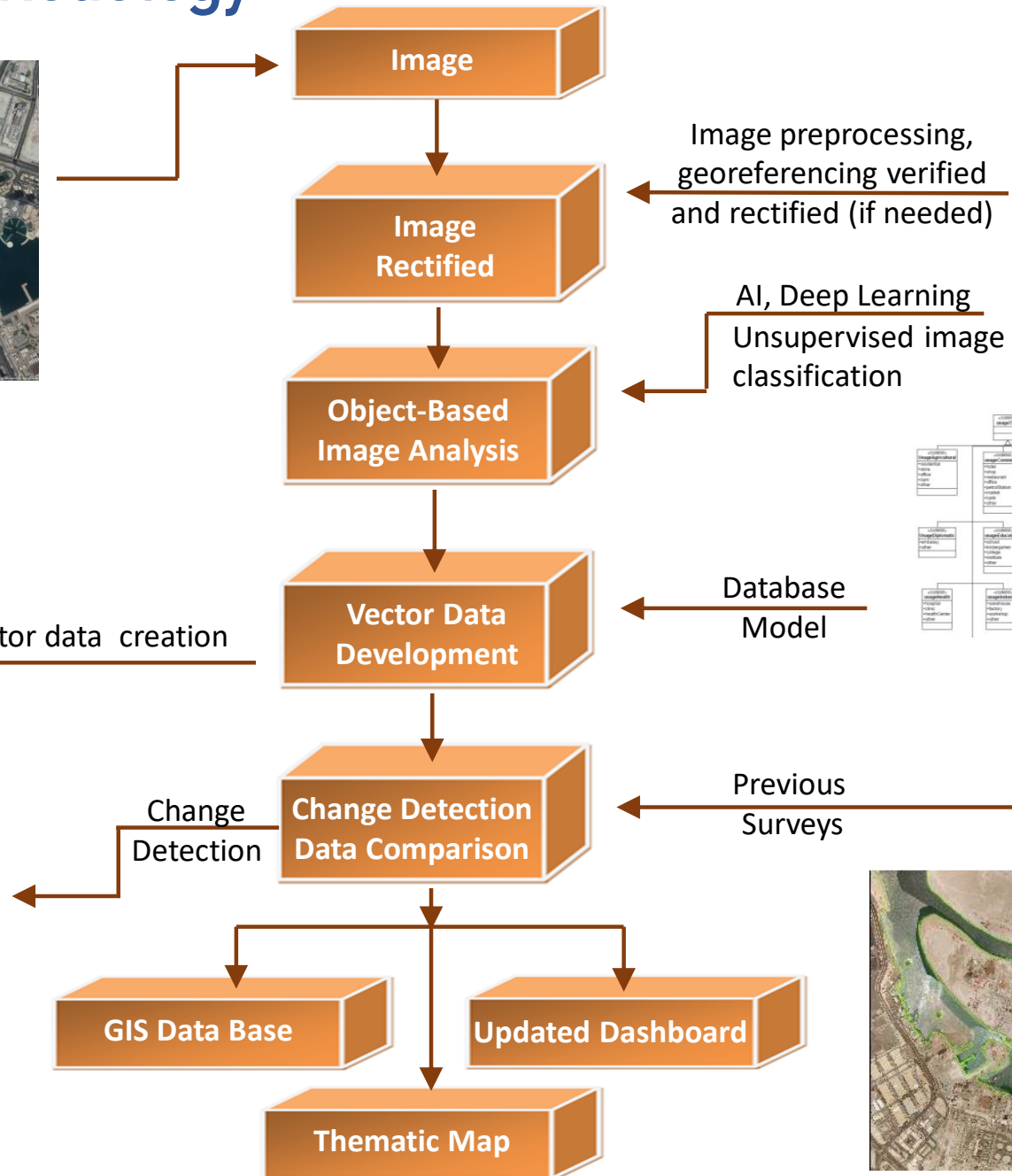
- Imaging: two dimensional spatial sampling
- Spectroscopy: measurement of color light

1. Energy Source or Illumination (A)
2. Radiation and the Atmosphere (B)
3. Interaction with the Target (C)
4. Recording of Energy by the Sensor (D)
5. Transmission, Reception, and Processing (E)
6. Interpretation and Analysis (F)
7. Application (G)



Components of Remote Sensing 2





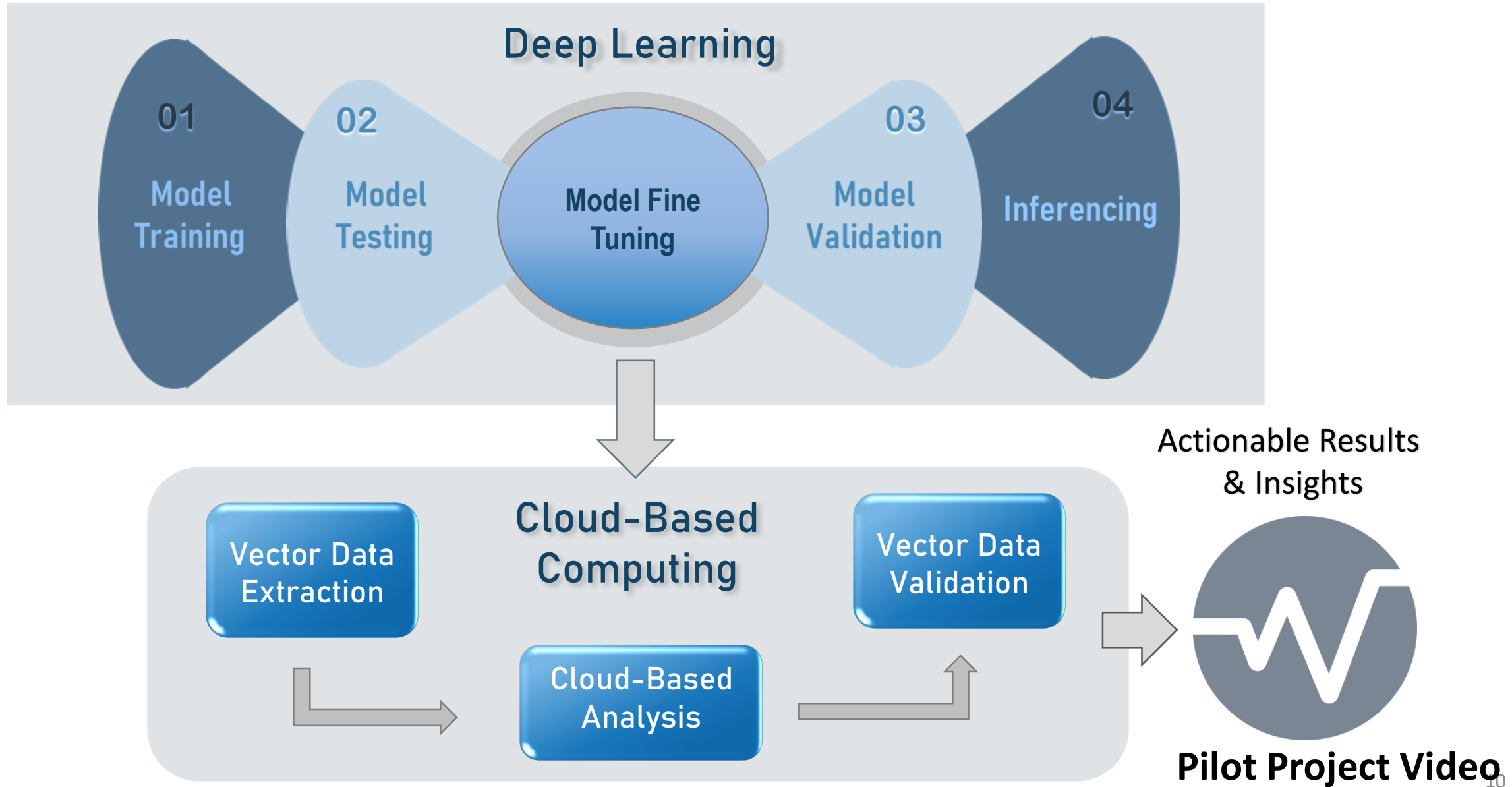
The diagram illustrates the georeferencing process. It shows a satellite image being aligned with a reference map using control points and transformation lines. The top part shows the initial state where the image is skewed and misaligned. The bottom part shows the result after georeferencing, where the image is straightened and correctly positioned relative to the reference map's grid.

[illegible]

2008

2012

Previous Classified Images





Use Cases



Agriculture

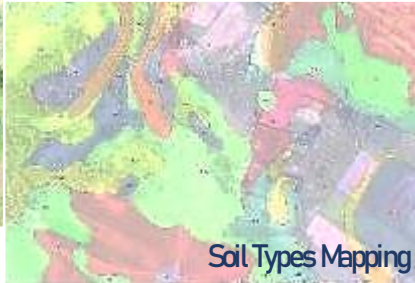
Farms Dune Mapping



Vegetation
Health
Monitoring



Soil Types Mapping



Economy Development

Development of
Built-Up Areas



Civil Defense

Disaster
Mitigation
Planning



Transportation

Highway Dune
Mapping



Railway Dune
Mapping



Municipalities

Base Map
Updating



Building
License
Verification

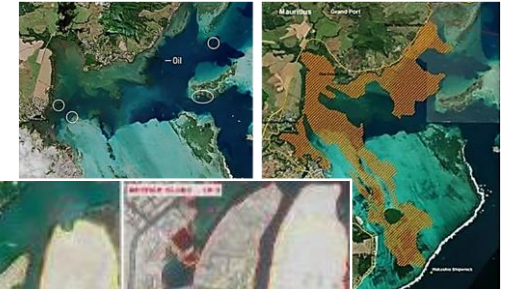


Building
Usage
Control



Marine

Oil Spills Monitoring

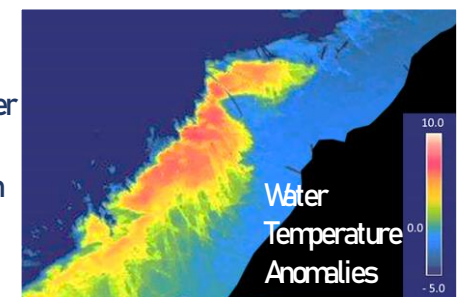


Costal Change Monitoring



Environment

Sea Water
Thermal
Pollution



Mapping of Dune Movements

Rationale

Proposed application discovers moved dunes affecting farms and their crops (calculates impacted areas), indicates highways and railways covered by sand.

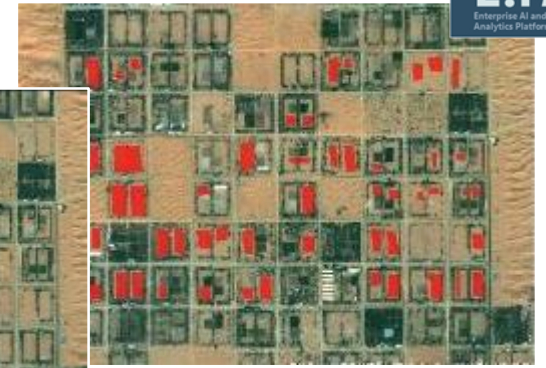
Beneficiaries

- Agriculture Agencies
- Department of Transport
- Etihad Railways
- Municipality Planners
- Affected Citizens
- Insurance Companies

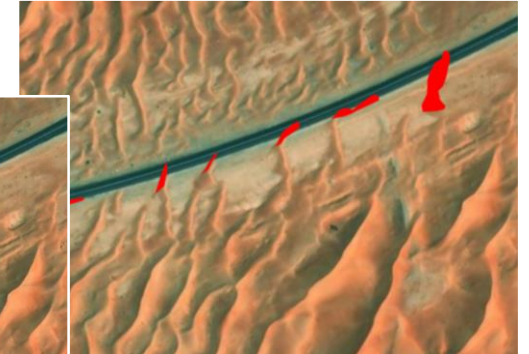
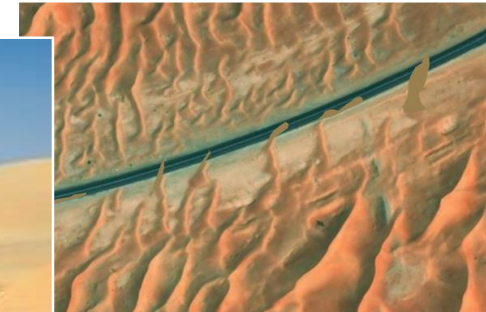
Result

Thematic map presenting detected vegetation covered by dunes, places of railways and highways affected.

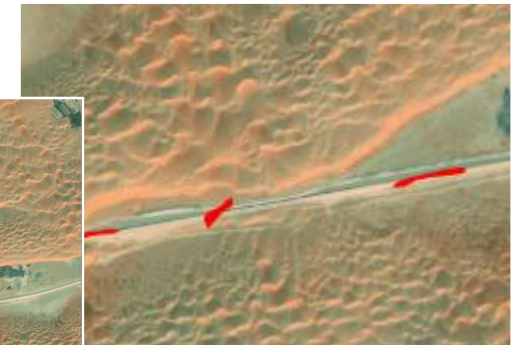
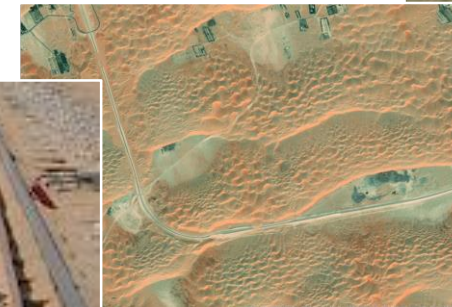
Farms



Highways



Railways



Rationale

Infrared wavelength is absorbed by water and is strongly reflected by vegetation and soil which is ideal solution for mapping coastal lines.

Beneficiaries

- Environmental Agency
- Municipality Planners, Developers
- NCEMA

Result

Thematic maps utilizing change detection methods enabling multiple outcome presentations.



Monitoring Sea Water Temperature

Rationale

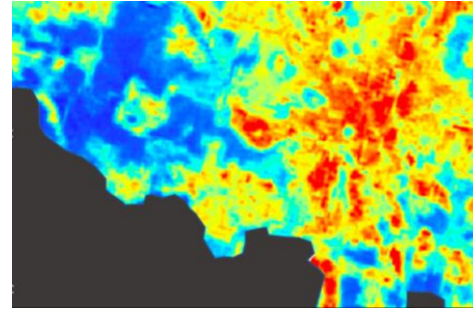
Retrieval sea surface temperature to monitor and detect the thermal anomalies of cooling-water discharged from the nuclear power plant.

Beneficiaries

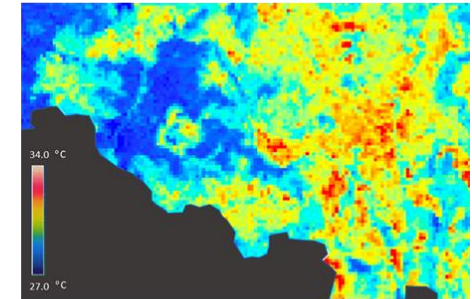
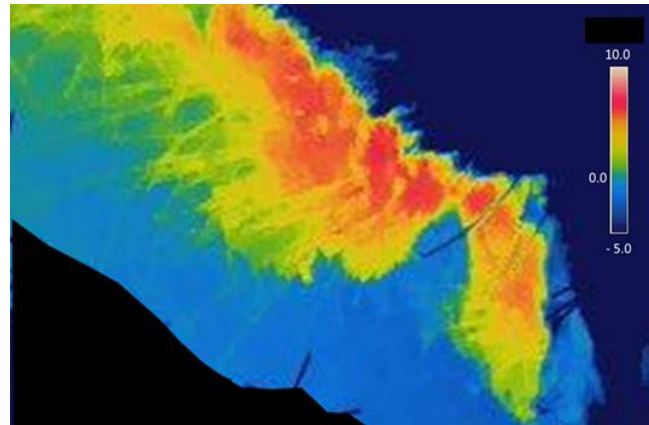
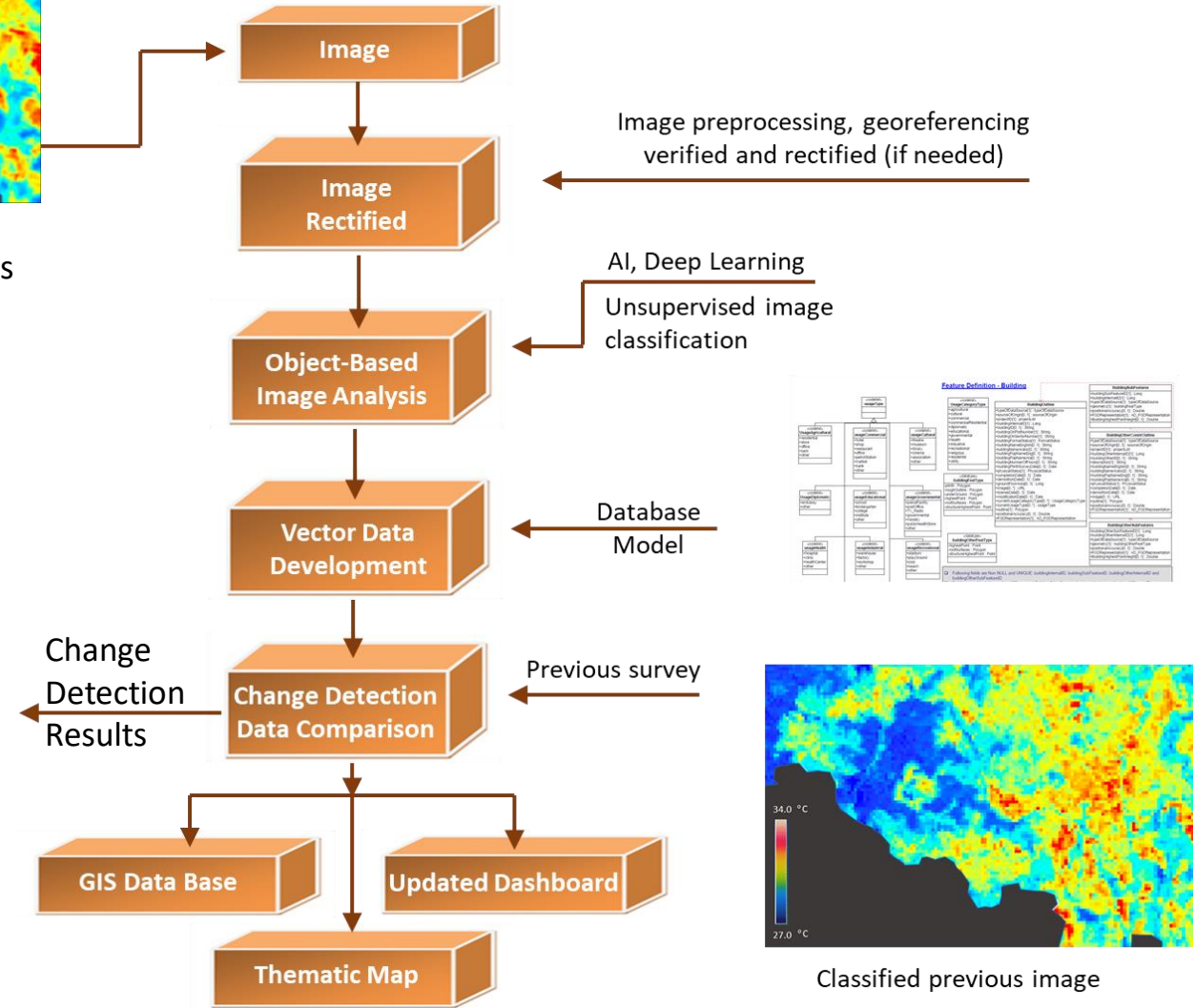
- ✓ Nawah Energy Company (ENEC)
- ✓ NCEMA
- ✓ Municipalities

Result

Image showing changes in water temperature compared with the previous survey



Satellite Image -
thermal infrared bands
(raw data)



Classified previous image

Rationale

Using remote sensing this application extracts from satellite images current and historical data for built-up areas.

Change detection techniques of GIS creates maps of this area development within defined time.

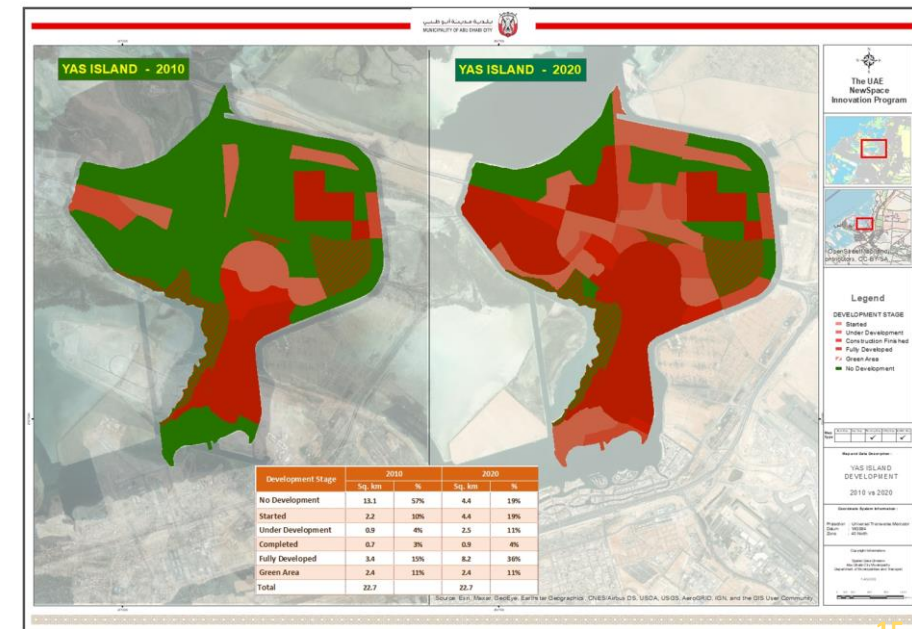
Beneficiaries

- Environmental Agency
- City Planners
- Depart. of Economic Development
- Governmental and Non-Governmental Agencies

Result

Our application provides multiple outcome presentations in the format of thematic maps (change detection) and reports.

Yas Island Development



Rationale

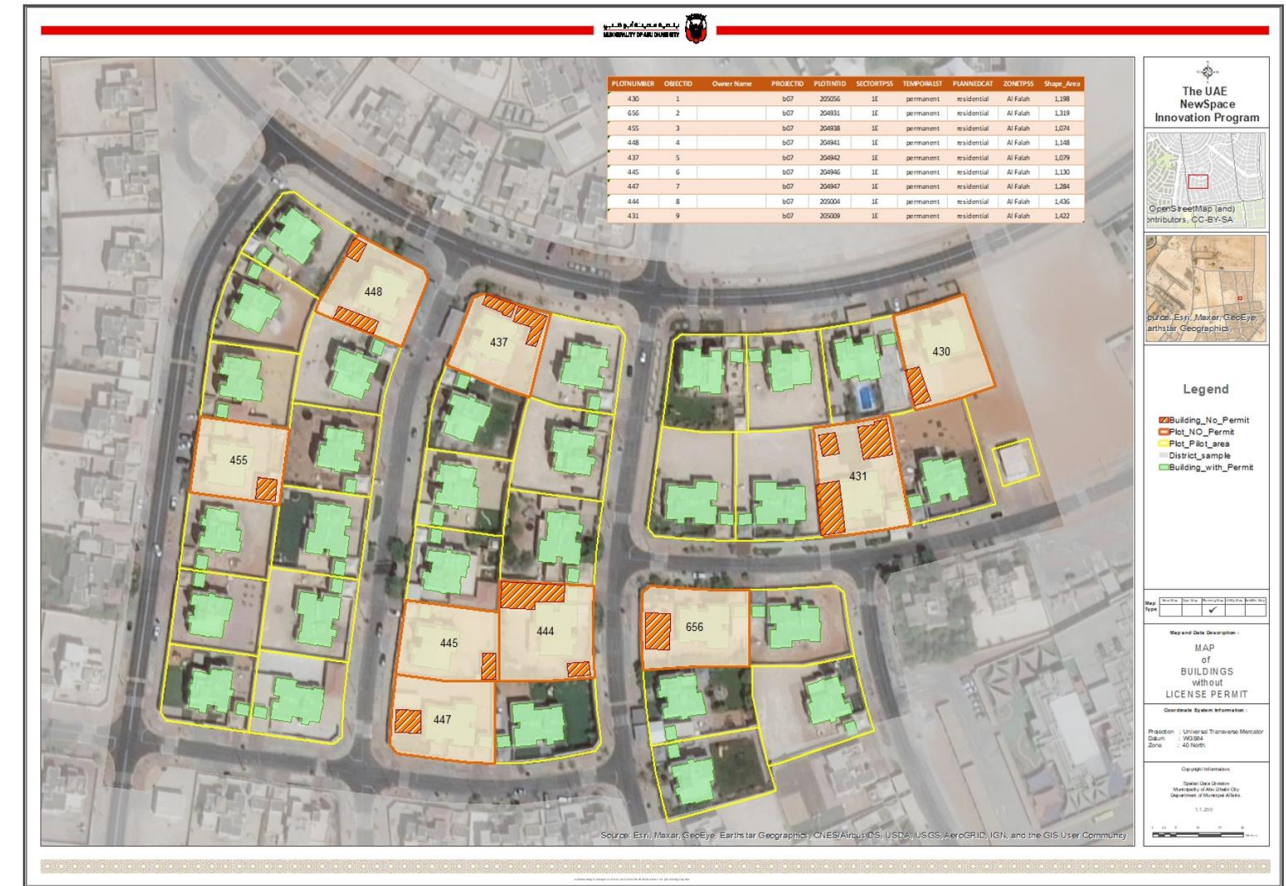
Proposed application identifies potential residential buildings constructed without appropriated documentation.




Beneficiaries

- ✓ Municipality Building Sections
- ✓ NCEMA
- ✓ Affected Citizens

Result

Thematic map highlighting properties for further field visit by municipality inspectors to verify existence of building permits.



-  Building extracted from satellite image
-  Building with existing construction permit
-  Suspected building without permit



Oil Spill Monitoring

Rationale

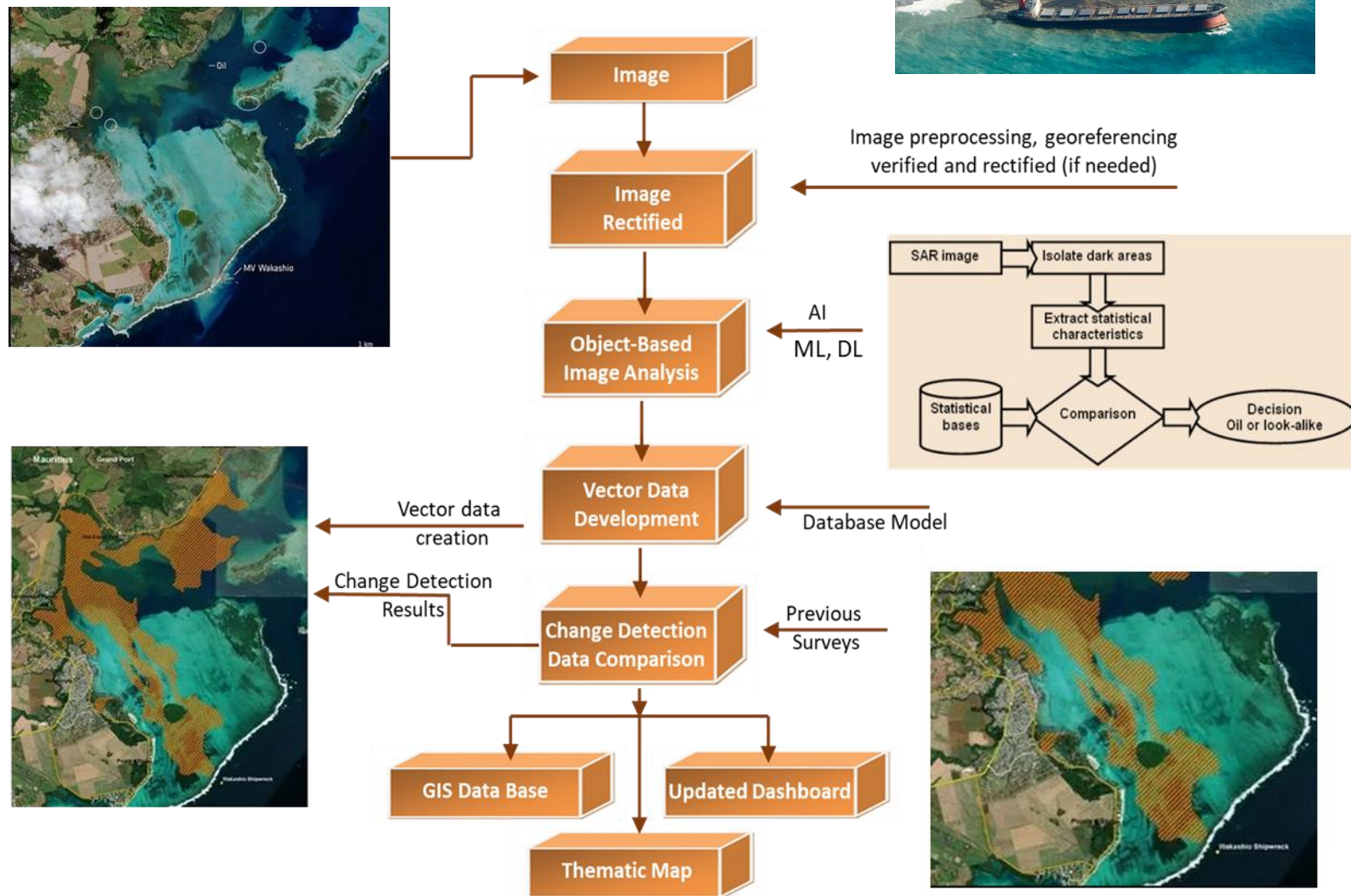
Using SAR (Synthetic Aperture Radar) methodology propose application can extract from satellite images the extent of the oil spills and identify the direction and rate of oil movement.

Beneficiaries

- Environmental Agency
- NCEMA
- Municipalities, ADNOC
- Governmental and Non-Governmental Agencies

Result

Our application provides multiple outcome presentations in the format of thematic maps (change detection) and reports.



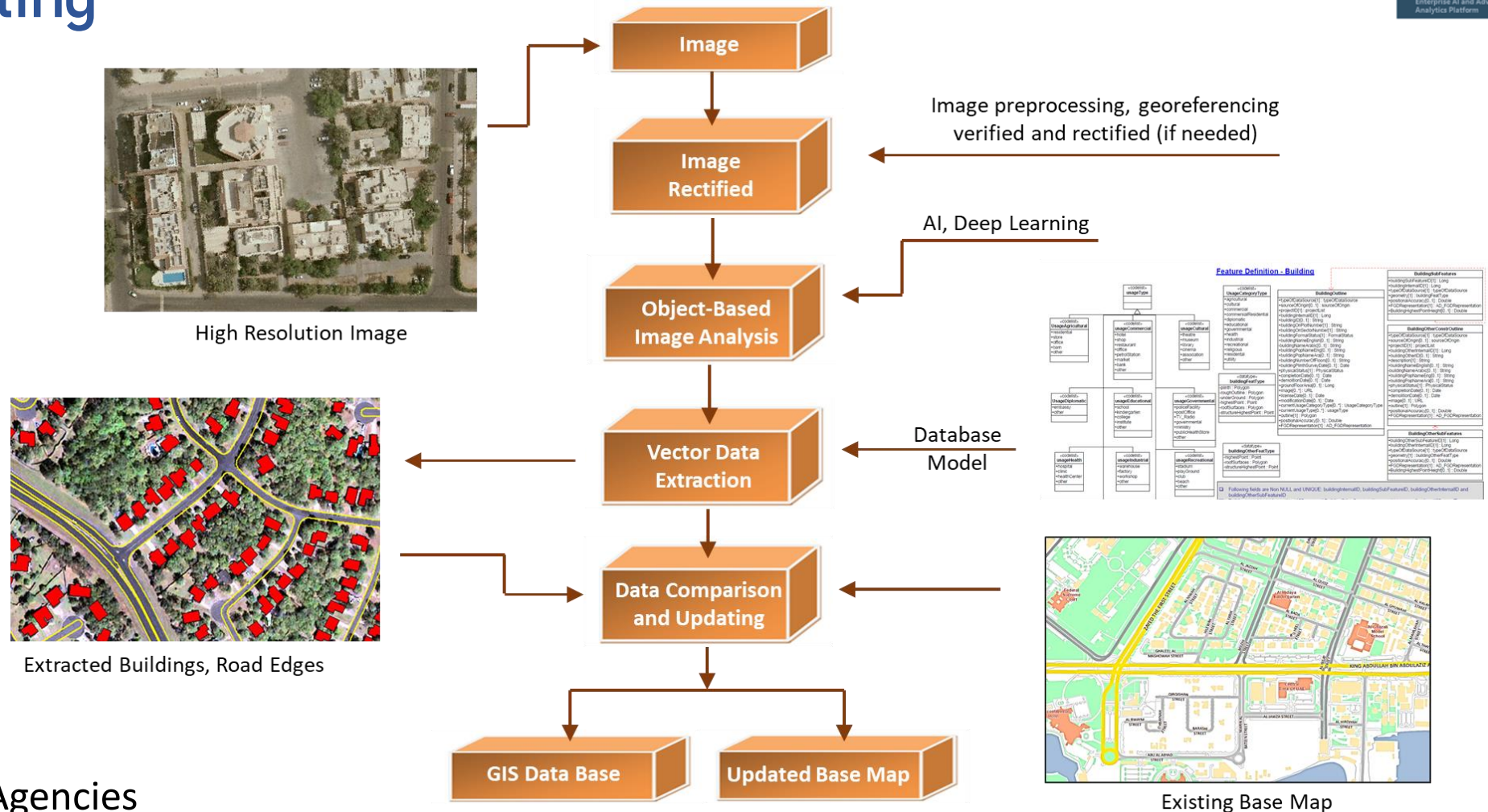


Rationale

Proposed application uses different bands to retrieve from satellite images built-up areas, especially buildings and roads to bring Base Map up to date.

Beneficiaries

- ✓ Municipalities
- ✓ Other Governmental Agencies
- ✓ City Planners, Developers
- ✓ GIS Community



Result

Backbone of GIS city data base, i.e. Base Map, becomes updated for medium to small scale elaboration in very short time.

Rationale

Proposed application utilizes combination of different bands to retrieve from satellite images Normalized Difference Vegetation Index (NDVI) indicating vegetation health.

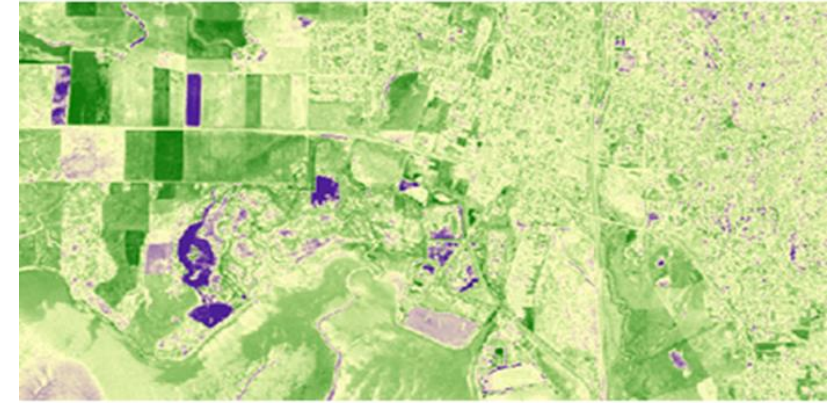
Beneficiaries

- ✓ AD Agriculture & Food Safety Authority
- ✓ Environmental Agency
- ✓ Farmers
- ✓ Global Farming Investment
- ✓ Parks and Green Areas Maintenance Co.

Result

Thematic map highlighting changes of NDVI index within established interval of time.

Change in NDM from 2016 to 2020



Decrease in NDVI Increase in NDVI



 Vegetation Health Improved

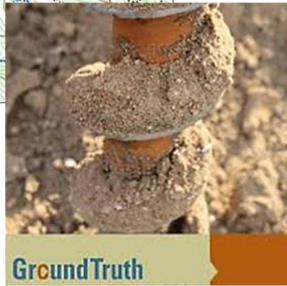
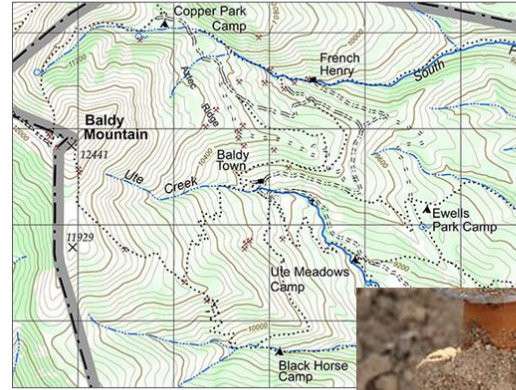
 Vegetation Health Deteriorated

Rationale

Proposed application utilizes combination of different bands (1–5 and 7) to retrieve from satellite images soil types and its spatial position for agriculture purpose.

Beneficiaries

- Environmental Agency
- City Planners
- Farmers
- AD Agriculture & Food Safety Authority



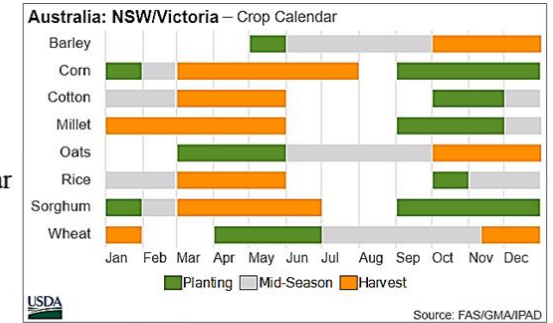
topographic maps

ground truth

administrative boundaries



crop calendar



original image

preprocessing

Object interpretation,
classification
and vectorization

AI, DL

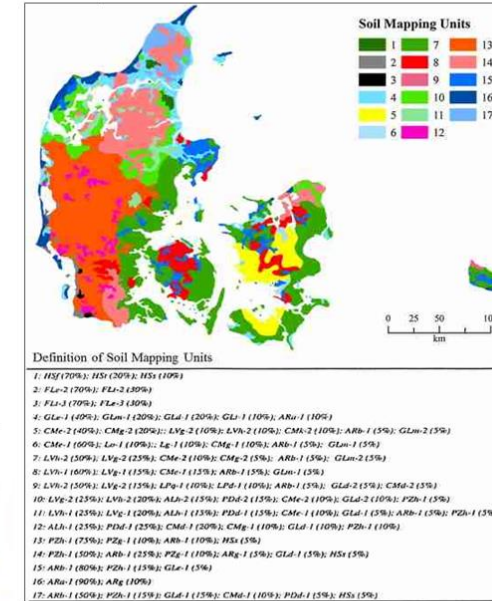
LCCS

Solid units and
erosion features

GIS database

Land Cover Map

LCCS - Land Cover Classification System



Result

Thematic map with current distribution of soil types (with eventual changes happening within the time).

Rationale

Proposed application identifies potential calamities (Earthquake, Flood, Hurricane, Tsunami, Fire) and establishes procedure to mitigate if happen.

Quick disaster assessment is necessary for rescue workers.

Beneficiaries

- National Crisis & Emergency Management Authority (NCEMA) and others
- Municipalities
- Affected Citizens

Result

Custom-made applications for particular disaster combined with set of procedures to be implemented in very short time.

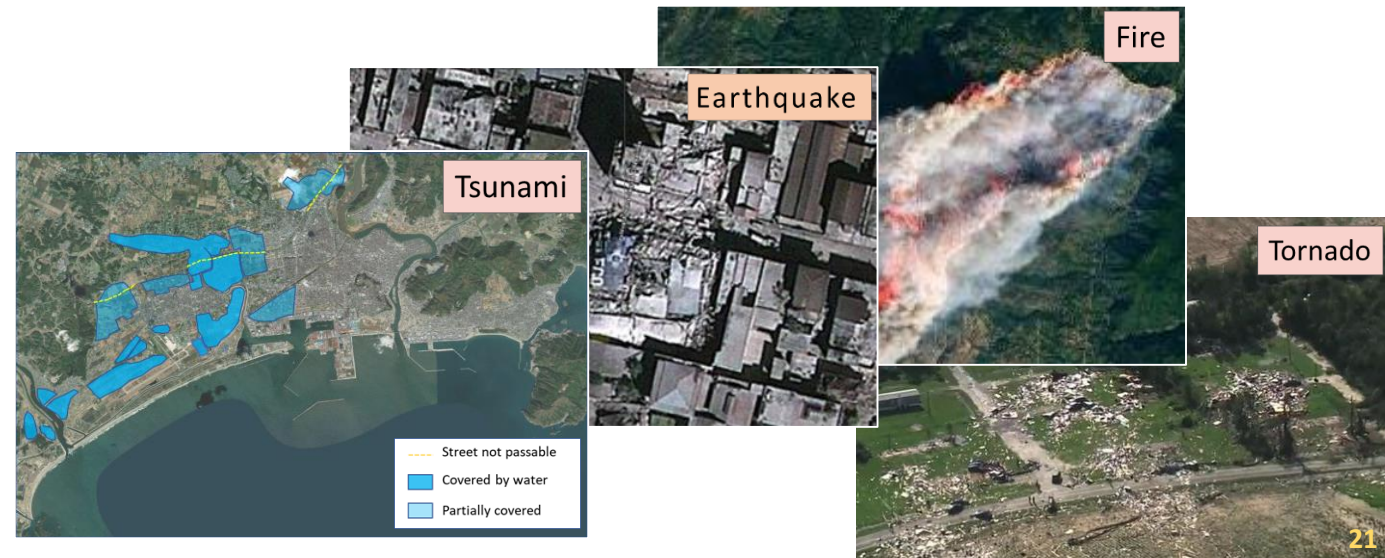
Disaster Mitigation Planning



MoU signed with remote sensing company(s) for quick image supply on daily basis.
Image pre-processing

Developed application retrieves data (according to predefined library) using AI (DL, ML) and integrates with GIS

Thematic map is published according to predefined templates on daily basis and distributed to rescue teams





Counting Cars

Rationale

Counting the number of cars is needed to improve the traffic in large cities, to avoid congestion and predicting vehicle behavior.

Currently ground surveillance cameras and sensors are employed. It is useful to collect composite information regarding the number of vehicles on the roads, their positions, directions, etc.

DoT gets updated information about imposing paid parking areas wherever it is reasonable.

Beneficiaries

- Department of Transport
- Environmental Agency, Municipality
- Department of Economic Development

Result

GIS database presenting detected cars extracted from intelligent machine learning models. Can be collected in any time of the day and any day of the week to perform complex analysis (e.g. change detection).



By analyzing the results obtained by developed model, we show that it has a very good vehicle detection accuracy maintaining a very low detection time. Above image is part of Khalifa City with resolution of 0.50 m.



Counting Cars



Monitoring Property Sizes

Rationale

Proposed application discovers differences of residential property built-up sizes (Plots) comparing to cadastral data base of municipalities.




Beneficiaries

- ✓ Municipality Building Sections
- ✓ City Planners
- ✓ Affected Citizens

Result

Thematic map highlighting existing properties where fenced/walled area exceeds by 10% the legal cadastral figure. The result (maps, reports) gives tools to municipality inspectors (for further field visit) to verify correctness of plot occupancy.



-  Property extracted from satellite image
-  Property (Plot) from Cadastral db
-  Property area exceeds >10% of legal volume

Statistics

S.N.	PLOTNUMBER	CALCULATED	ORIGINAL	SIZE DIFF	%
67	174	2863	2090	773	37.0
66	176	2870	2090	779	37.3
64	178	2872	2090	782	37.4
69	185	2854	2090	764	36.6
71	192	2873	2090	782	37.4
29	193	3014	2090	923	44.2
70	194	2875	2090	785	37.6
10	195	2983	2090	892	42.7
50	201	3156	2090	1066	51.0
49	188	2682	2090	592	28.3
32	204	3527	2090	1437	68.7
68	209	2864	2090	774	37.0

Monitoring Construction Progress

Rationale

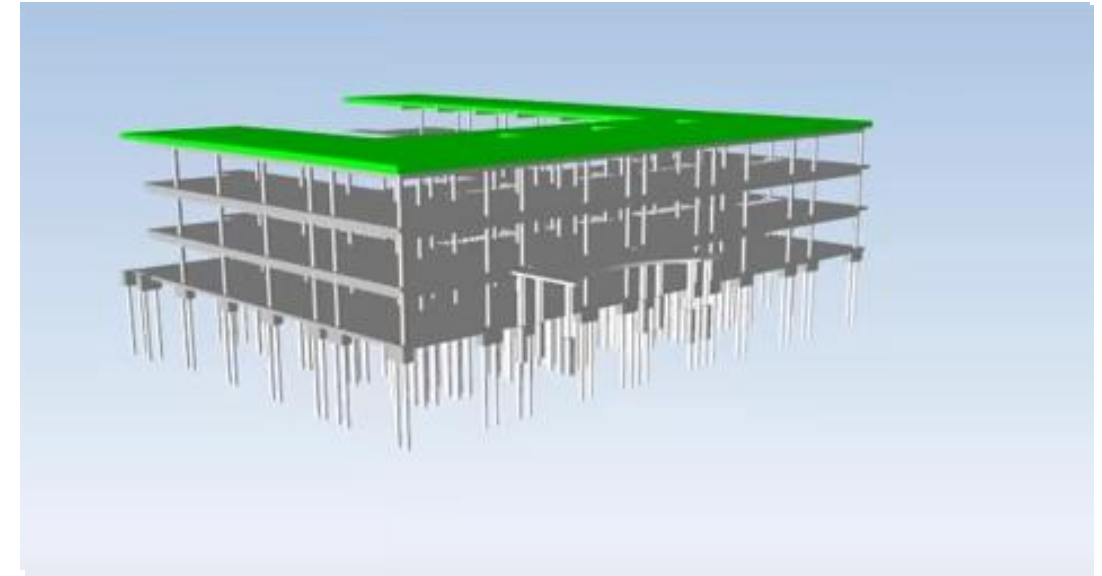
Proposed application monitors work progress based on temporal images and engaging AI science with model Deep Learning. As the data source are aerial (drones) and satellite imageries driven by analytical algorithms and supported by 3D modelling, change detection and classification of constructed objects.

Beneficiaries

- ✓ Municipality Building Sections
- ✓ Developers, Investors

Result

The main benefit of the proposed solution includes the automated measurement, enhanced visualization, documentation of planned vs. actual progress along with 4D Project Management Workflow optimizing project schedule and performance.



<https://www.youtube.com/watch?v=nr6l18FW718>

4D Construction Visualization

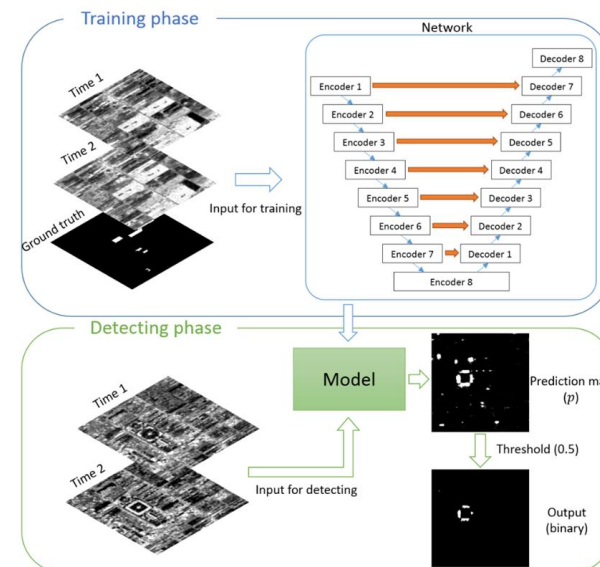


Figure 3. Process of detecting newly built constructions.



Land Use/Land Cover

Rationale

LULC changes have become a key subjects for study of the global environmental variations. Proposed application monitors this phenomena based on temporal satellite images (multispectral with seven visible and near-infrared bands) and engaging AI science.

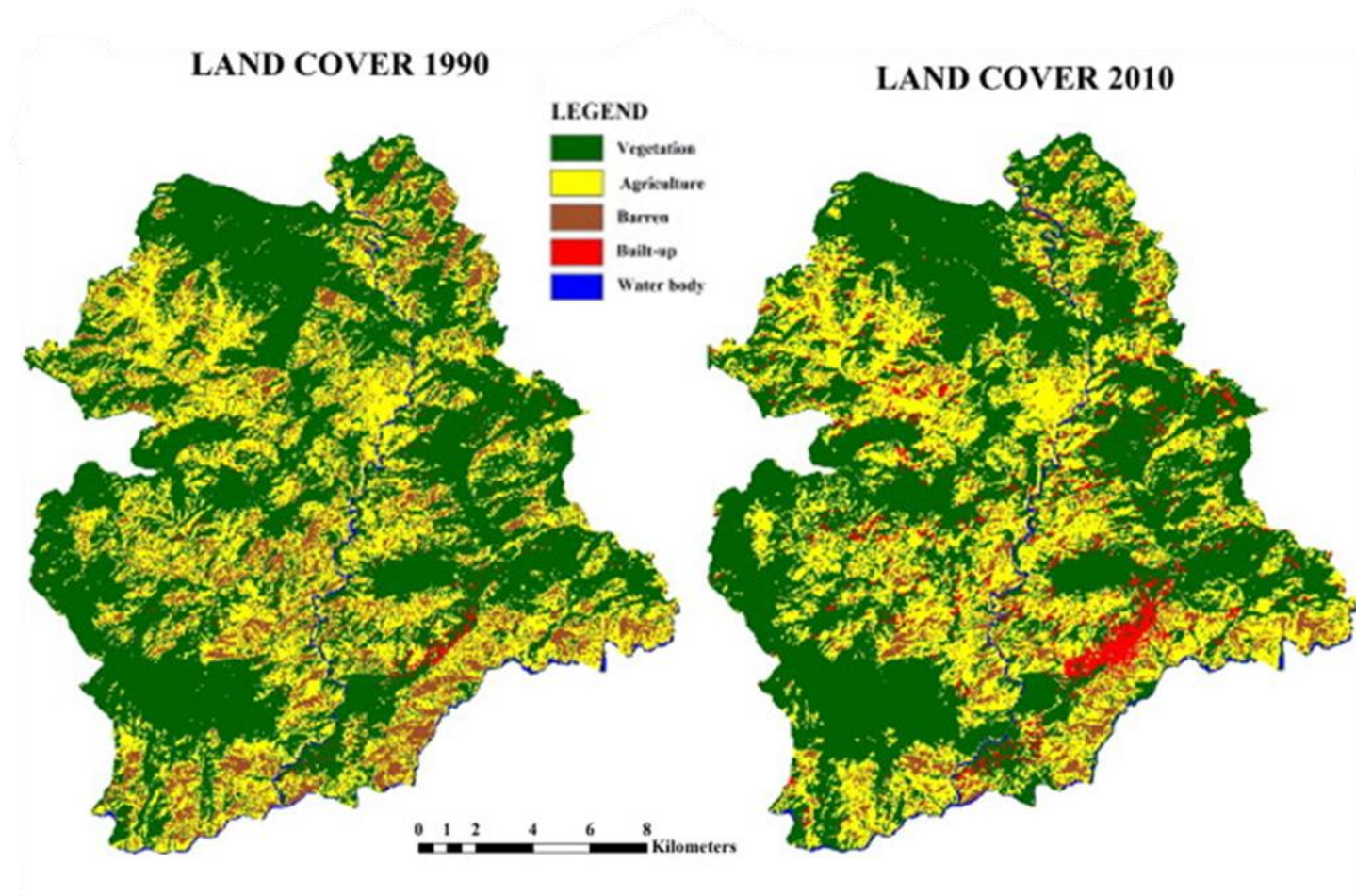
Beneficiaries

- Environmental Agency, City Planners
- Department of Economic Development
- Investors

Result

Usually this type of study shows that vegetation areas are decreased while urban areas expanded. In some cases forest land is increased due to government effort restoring rural ecosystem by forestation moves (depends on countries and their policies).

The results are presented in thematic maps supported by detailed reports quantifying areas for particular usage types as well as forecasting the future trends. Independently GIS database is distributed to potential customers and serves for updating of their dashboards and enabling further investigation.





Counting Palm Trees

Rationale

Counting the number of palm trees can be very useful for commercial, agricultural or environmental purposes.

Deep Learning of AI offers the possibility to automatically identify the positions of individual palm trees in large areas in a reasonable time, indicating palm health conditions also.

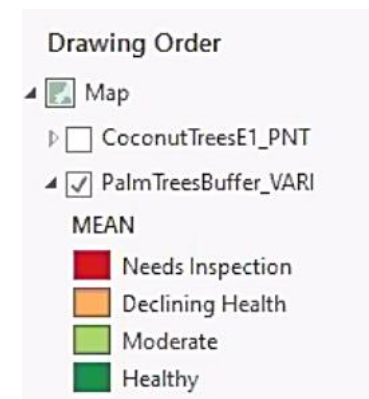
The palm trees are visible and distinguished on satellite images with 50 cm spatial resolution using four spectral bands (R, G, B, NIR).

Beneficiaries

- Agriculture & Food Safety Authority
- Environmental Agency, Municipality
- Department of Economic Development

Result

GIS database presenting all detected palms and their health conditions with optional mapping publishing. Independently, change detection technique enables to monitor their health alterations or existence within given time frame.



https://www.youtube.com/watch?v=wzQTBPG-Q_M

<https://www.mdpi.com/2072-4292/11/3/312/htm>

Monitoring City Night Lights

Rationale

Monitoring of city night lights provides new insights about inhabited places, their infrastructure development, and their growth patterns.

Researchers can investigate how cities expand, monitor light intensity, source and type of lights to estimate energy use and economic activity, and aid in disaster response.

Data for the images shall be acquired with the Visible Infrared Imaging Radiometer Suite (VIIRS) having a low-light sensor, the day/night band that measures light emissions and reflections.

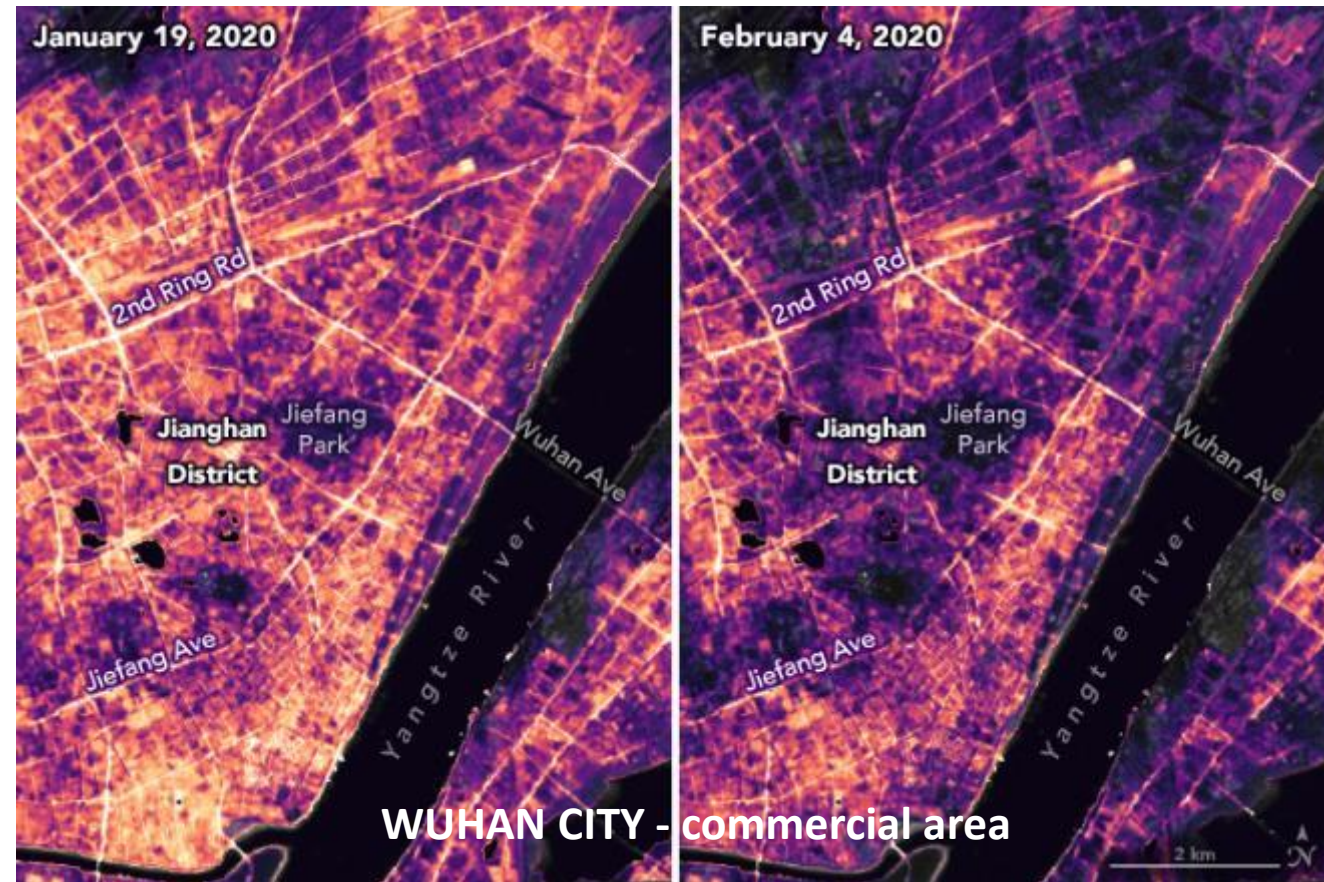
The main challenge are the phases of the moon, which constantly varies the amount of light shining on Earth.

Beneficiaries

- Environmental Agency, City Planners
- Department of Economic Development
- NCEMA, Municipality

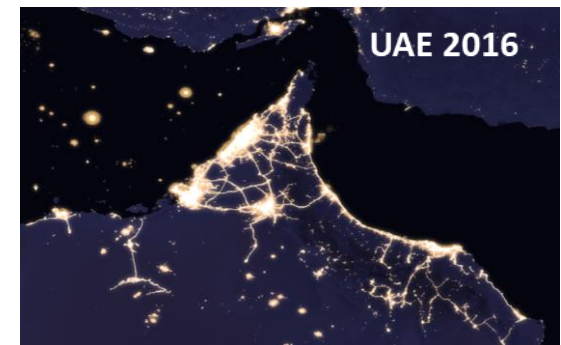
Results

Database or maps presenting the changes of the city lights in indicated period of time.



<https://earthobservatory.nasa.gov/images/146481/nighttime-images-capture-change-in-china>

<https://www.nasa.gov/feature/goddard/2017/new-night-lights-maps-open-up-possible-real-time-applications>



Monitoring City Night Lights

Flourish

By MarkKun on 26 Nov 2020



 Duplicate and edit



Image
2012

Image
2016

Source: <https://public.flourish.studio/visualisation/4472913/>

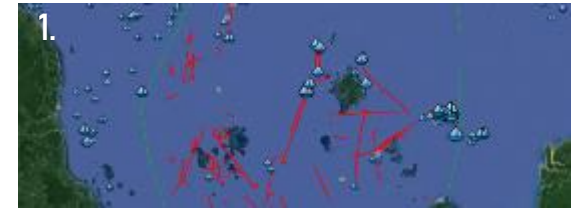
Web Viewer [Terms](#) | [Privacy & Cookies](#)

Edit



Other Potential Use Cases

1. Fishery Industry
 - Detecting illegal activities,
 - Monitoring sea surface temperature and ocean colors to indicate of specific fish species
2. Archeology – finding ancient sites
3. Real Estate – current view of the property and surrounding area; schools, shopping districts, parks, existing road network, etc.
4. Criminal Investigation – locating lost bodies
5. Other Disaster Predicting landslides
6. Tracking birds migration, location (e.g. houbara)
7. Habitat suitability models to predict the presence of mosquitoes
8. Planning an optimal telecom networks by understanding distribution of population
9. Assessing the environmental changes (not coastline only)
10. Getting oblique city view for better visualization e.g. construction progress monitoring
11. Monitoring above the ground high voltage network for surveillance and maintenance work (drone based)
12. Hydrology – locating groundwater zone maps to locate well sites
13. Insurance industry – detective work to verify crop insurance claims



Thank you