Regional dimension for GEO and capacity building priorities

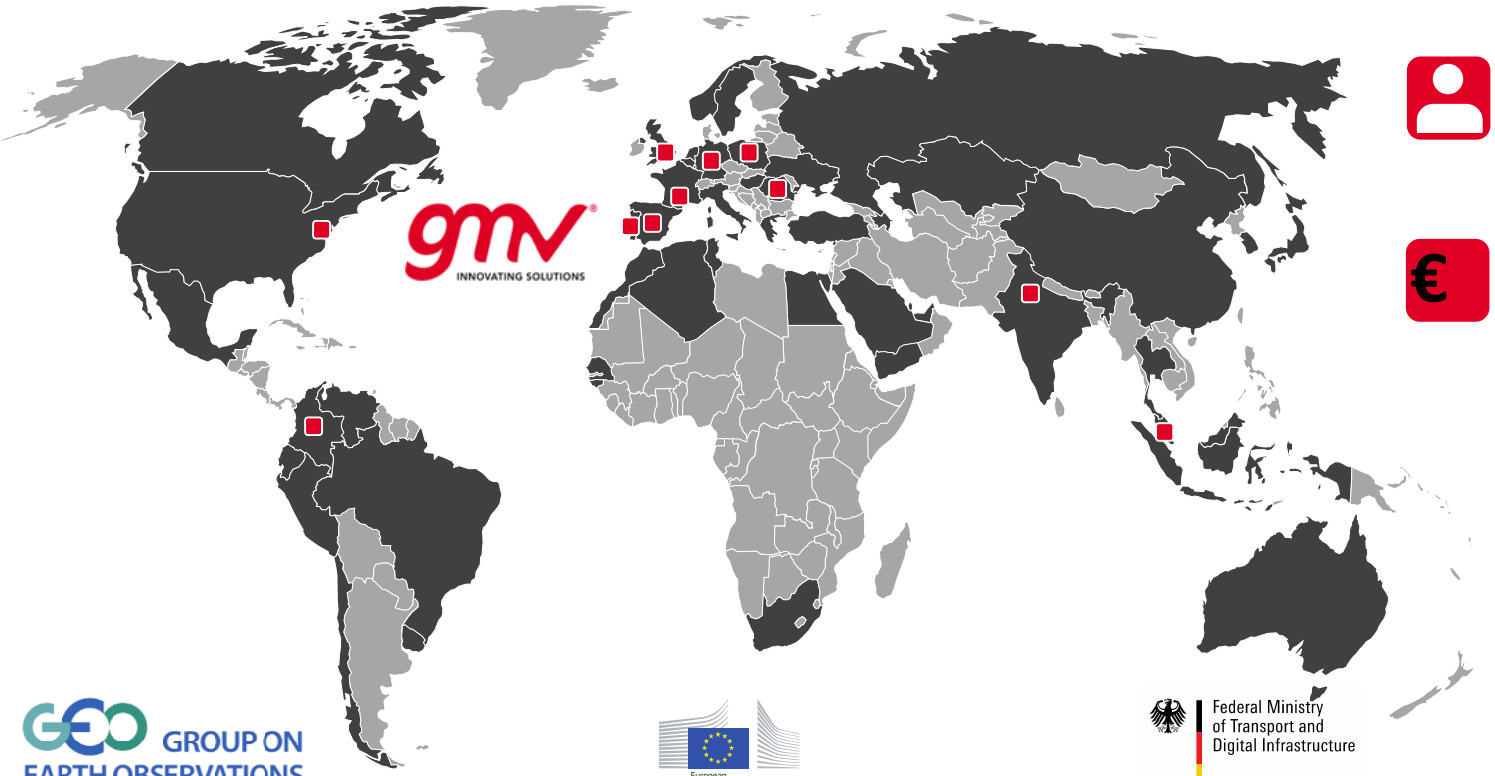
Wall-to-wall Environmental Habitat Mapping in the Emirate of Abu Dhabi

Ana Sebastián

gmv INNOVATING SOLUTIONS

GMV

A high-tech multinational corporation, founded in 1984, with presence in Spain, Portugal, Germany, France, Romania, Poland, UK, USA, Colombia, India and Malaysia.



1,160 employees worldwide

120M€ (total revenue)
85M€ (space-related)

GEO GROUP ON EARTH OBSERVATIONS

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GMV TODAY

#1 Worldwide Satellite Control Center provider to commercial telecom operators (+300 Satellite missions worldwide)

Healthcare

Responsible for critical safety systems of European GNSS systems (EGNOS and Galileo)

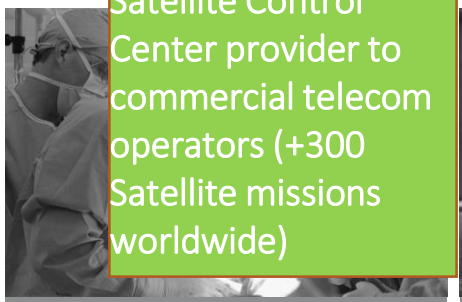
Transportation

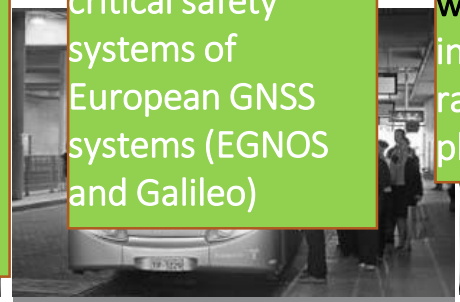
First ever worldwide intraoperative radiotherapy planning system

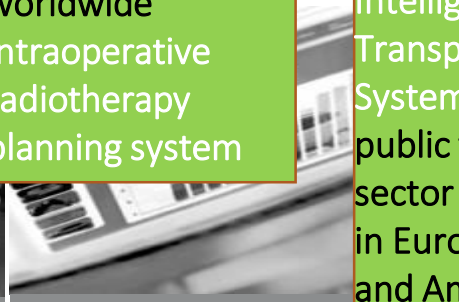
IT

Leader of Intelligent Transportation Systems for the public transport sector (+100 cities in Europe, Asia and America)

ecurity



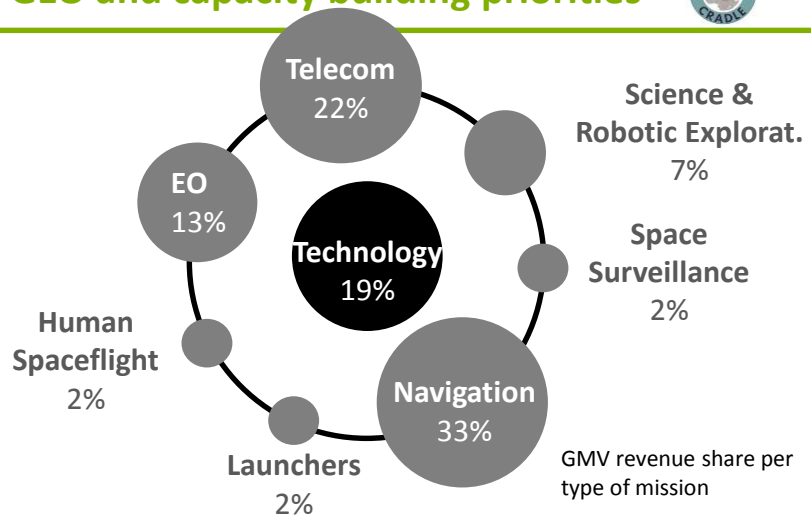




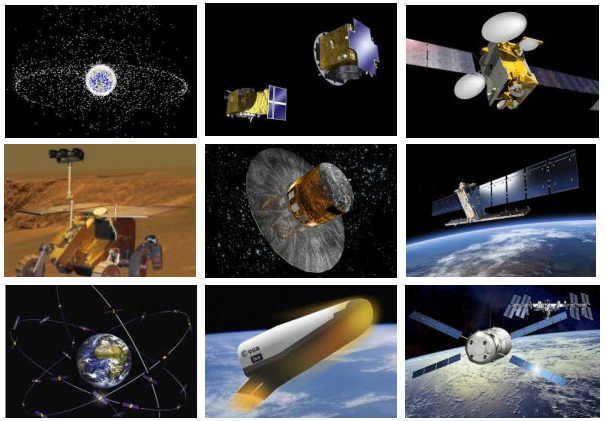
GMV IN SPACE

- **30** years of experience
- **500** highly skilled and experienced engineers
- Active in **ground** & **space segment**, **operations** and **space applications**
- GMV **systems deployed across main Space Agencies** worldwide
- Quality

CMMI DEV /5 SM
Exp. 2016-09-16 / Appraisal #20109



GMV revenue share per type of mission



Wall-to-wall Environmental Habitat Mapping in the Emirate of Abu Dhabi at 1/10.000 scale, to serve, first and foremost, as a baseline for ecological studies

- **Habitat, Land use and Land Cover maps**
- **Abu Dhabi Land INFO Geodatabase**
- **WV2 Mosaic**
- **WV2 orthos and CGPs**

Environment Agency – Abu Dhabi

PROTEUS

DigitalGlobe

gmv

EOMAP

NAUTICA

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European Commission

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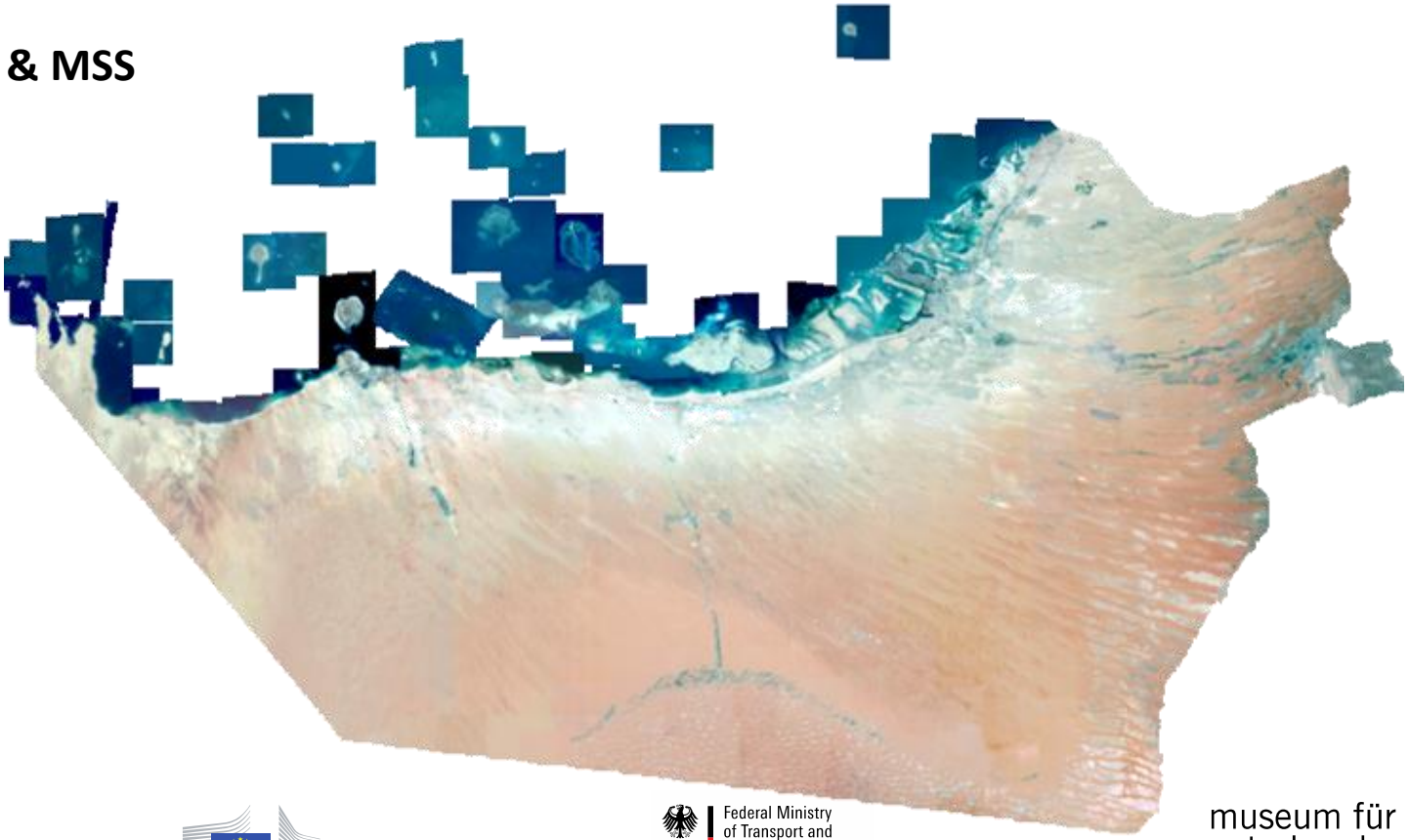
ORTHO-PHOTOS & RGB MOSAIC

- ❑ **WorldView 2 PAN & MSS**
- ❑ **600 IMAGES**
- ❑ **PAN: 697 Gb**
- ❑ **RGB: 130 Gb**



THE TERRESTRIAL DOSSIER

- **Cartographic rules, MMU and other technical specifications per class**
- **Nomenclature: Based on Brown and Boer's *"Interpretation Manual of the Major Terrestrial Natural and Semi-Natural Habitat Types of Abu Dhabi Emirate"***

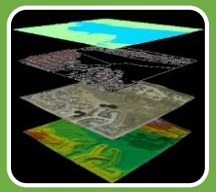
Type no.	Sub-type no.	Habitat type	MMUs (ha)	Land Cover (Land form) No.	Landcover type	Land Use No.	LandUse Type
1000		Intertidal habitats					
	1010	Mudflats and sand exposed at low tide	5	22211	Bottom	4000	Vacant
	1020	Sheltered tidal flats with cyanobacterial mats	5	12220	Algae	4000	Vacant
	1030	Saltmarsh	5	12240	Salt Marsh	4000	Vacant
	1040	Mangroves	5	12230	Mangrove	4000	Vacant
	1050	Storm beach ridges	5	21311	Beach	4000	Vacant
	1060	Sandy beaches	5	21311	Beach	4000	Vacant
	1070	Beach rock and gravelly beaches	5	21324	Beach	4000	Vacant
2000		Coastal plains, sand sheets and low dunes					
	2011	Coastal plains on well-drained sandy ground	25	21312	Sand Dune/Sheet	1400	Vacant
	2012	Coastal plains on well-drained rocky or gravelly terrain	25	21331	Gravel Plain	1400	Vacant
	2020	Coastal sand sheets and low dunes	5	21312	Sand Dune/Sheet	4000	Vacant
	2030	Coastal cliffs, headlands, rocky slopes and wadis in coastal situations	5	21322	Hills	4000	Vacant
3000		Coastal sabkha, including Sabkha Matti	25				
3100		Coastal sabkha, including Sabkha Matti	25	21342	Coastal Sabkha	1400	Vacant
4000		Sand sheets and dunes					
	4110	Sand sheets and dunes with tree cover	25	21312-11210	Sand Dune/Sheet with Trees	4000	Vacant
	4120	Sand sheets and dunes with shrub cover	25	21312-11220	Sand Dune/Sheet with Shrubs	4000	Vacant
	4130	Sand sheets and dunes with dwarf shrub cover	25	21312-11220	Sand Dune/Sheet with Shrubs	4000	Vacant
	4140	Sand sheets and dunes with perennial herbs and graminoids	25	21312-11230	Sand Dune/Sheet with Herbaceous	4000	Vacant
	4200	Mega-dunes	25	21312	Sand Dune/Sheet	4000	Vacant
5000		Gravel plains (alluvial and interdunal)					
	5110	Gravel plains with distinct tree vegetation	25	21331-11210	Gravel plain with Trees	4000	Vacant

WORK LOGIC

Base data

- Study area analysis
- Base data: WV2 ortho-ready

Data compilation and pre-processing



- Ancillary data (Field data, DEM, Topographic maps, Landsat images)
- WV2 Orthorectification
- WV2 Atmospheric corrections
- WV2 Pan-Sharpening
- WV2 Mosaicking

Map production

- Feature extraction

Accuracy assessment

- Stratified random sampling
- >85% overall accuracy
- 95% confidence level
- 5% error margin

PRODUCTS

- Raw imagery selection

- WV2 Ortho images
- WV2 Mosaic (RGB)

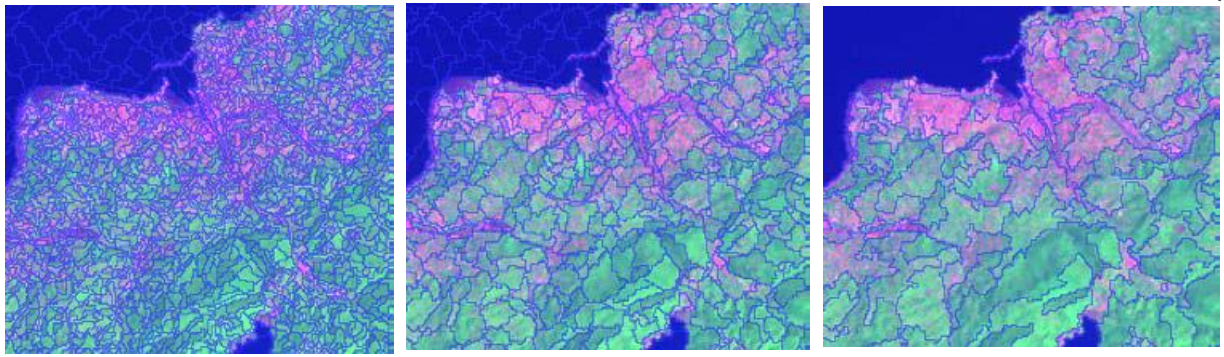
- Land Cover Map
- Geodatabase model
- Ground survey

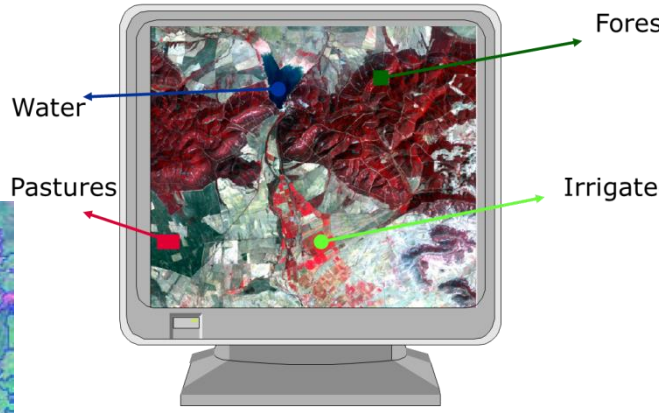
- Ground survey

CLASSIFICATION

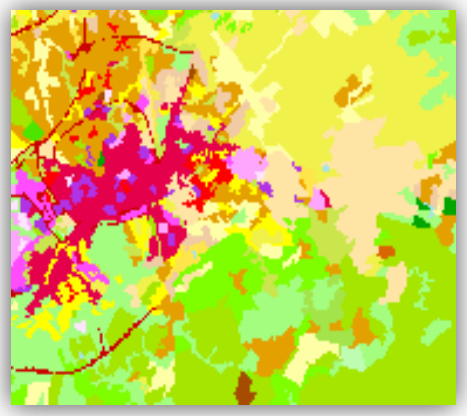
Semi-automatic classification for map production

- ❑ Multi scale image segmentation



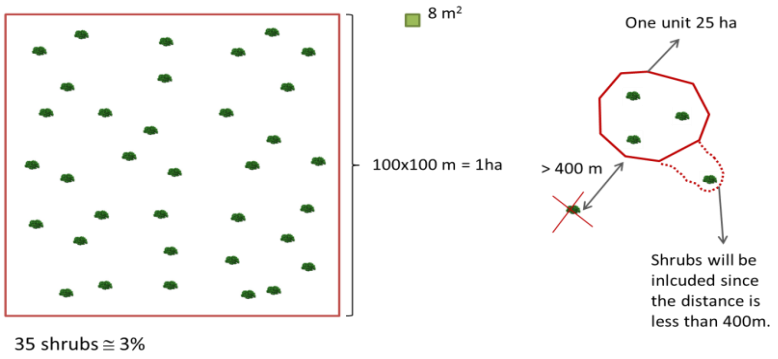


Select training areas in the image

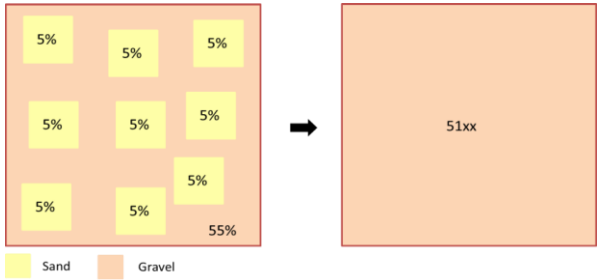


- ❑ Supervised spectral classification (field campaign)
- ❑ Visual interpretation and manual editing
- ❑ Post-classification processing

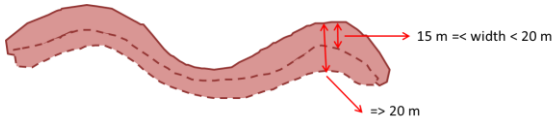
GENERALIZATION AND MAPPING RULES

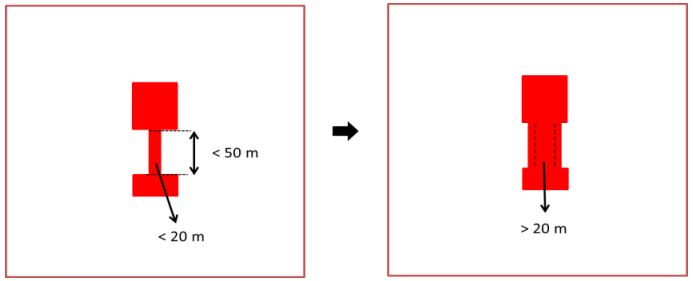


Amalgamation



Exageration

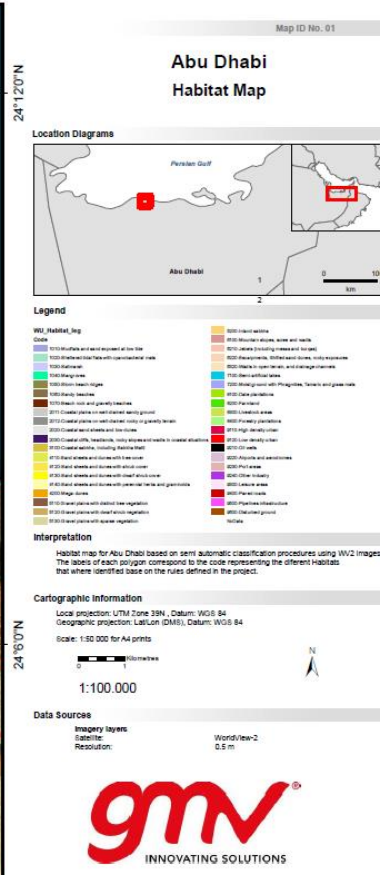




Cartographic rules

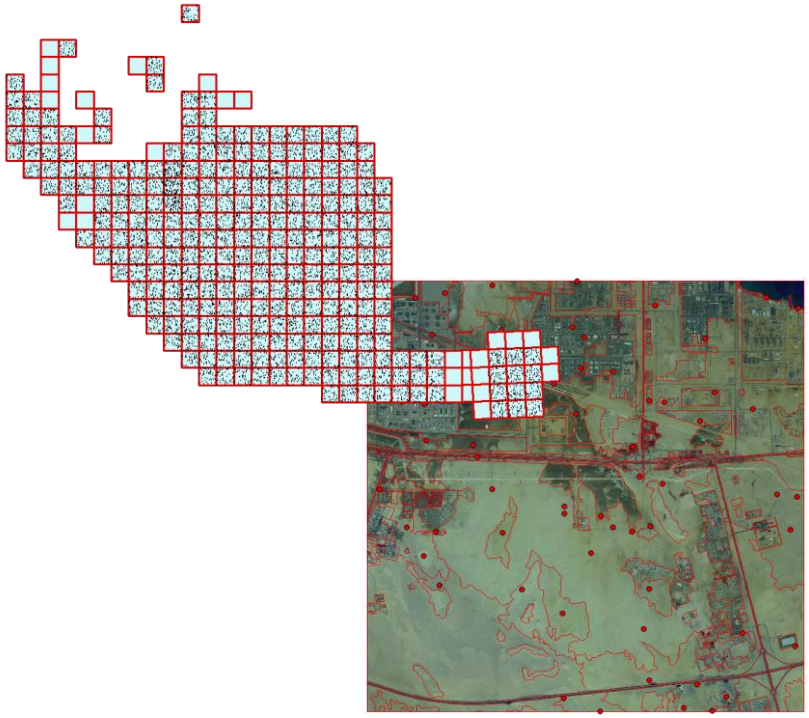
HABITAT AND LULC MAPPING

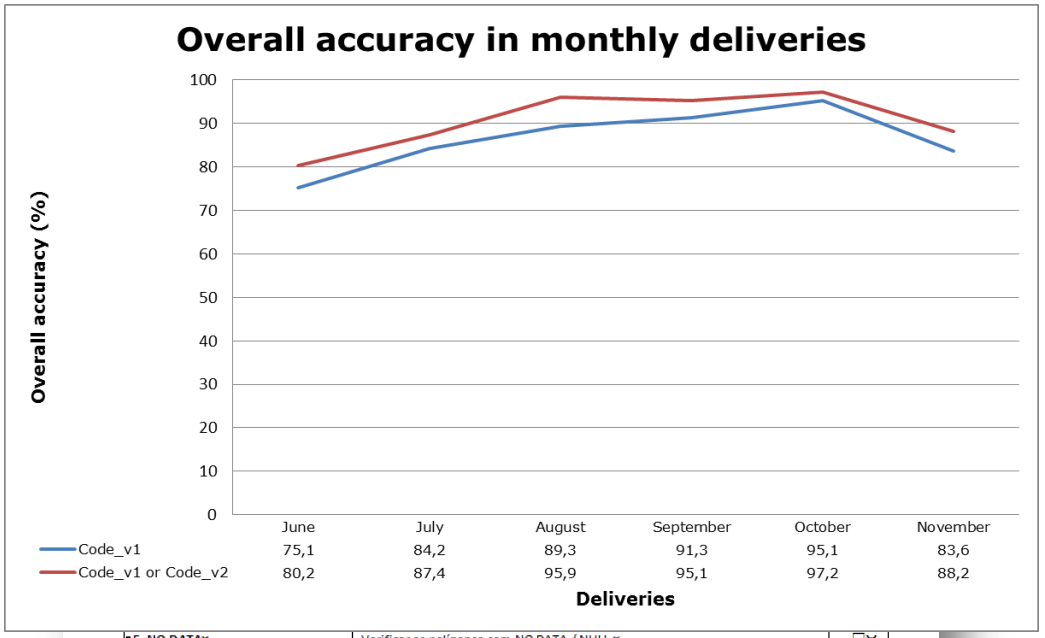
- More than 60.000 km2
- 3 Info layers:
  - 42 Habitats
  - 31 Land Cover
  - 13 Land Use
- 0,5m spatial resolution
- MMU: 1 – 25 ha



INTERNAL QUALITY CONTROL

Thematic, geometric and structural





5. NO-DATA	Verificar os polígonos com NO-DATA / NULL	☐
6. Topology	Definir as regras de topologia para a feature dataset (revision). Definir para cada feature as seguintes regras: • No gaps • No overlaps	☐
7. Dissolve	Verificar que o numero de polígonos do dissolve é igual ao da feature original.	☐
8. Verificar áreas	Fazer join à tabela de correspondência e verificar que a área de cada polígono é >= que o valor da tabela. Excluir os polígonos de fronteira (spatial query com a quadricula).	☐
9. Verificar distâncias	Not implemented.	☐
10. Erros de fronteiras	Not Implemented	☐

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European Commission

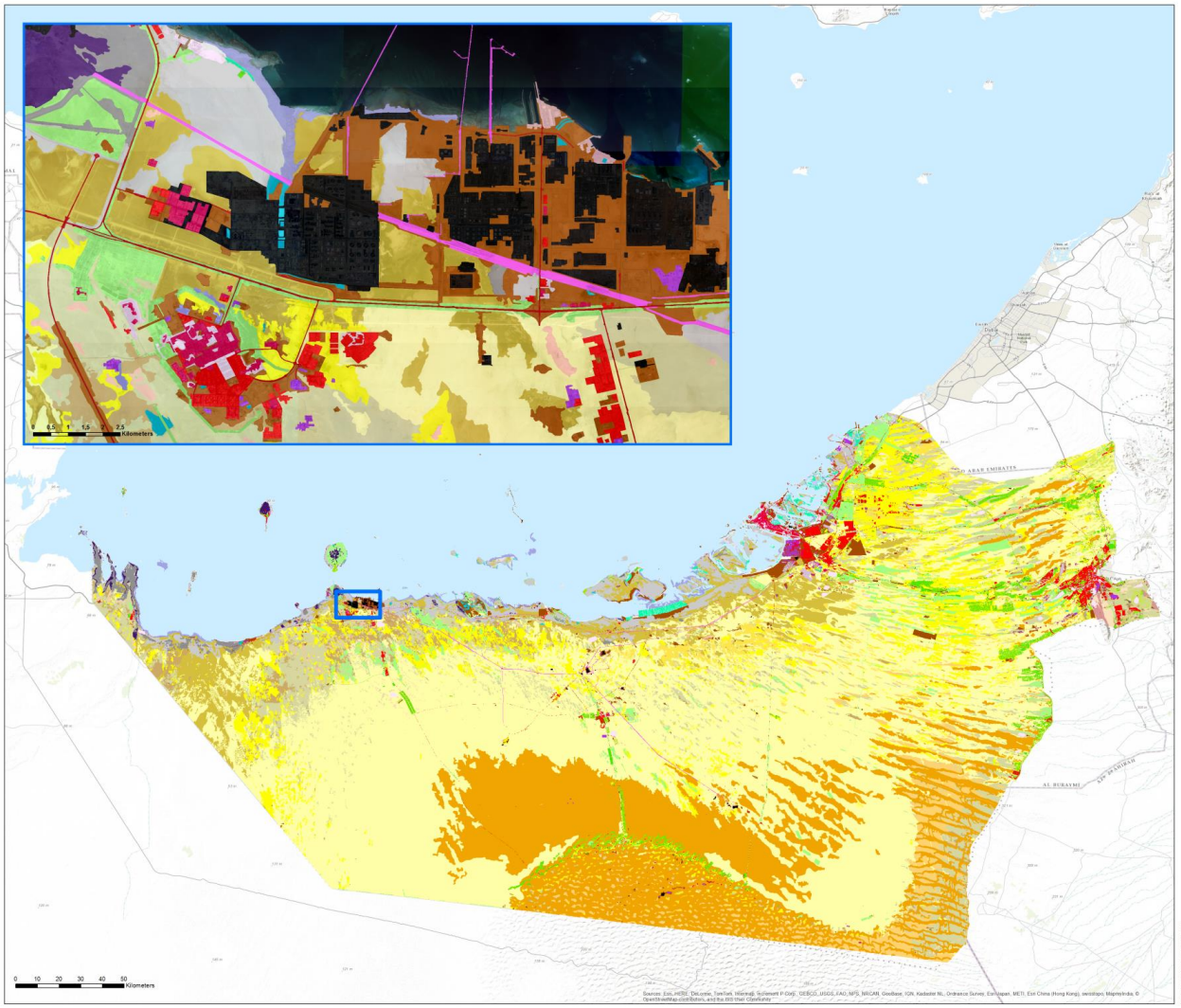
Digital Infrastructure

naturkunde berlin

Regional dimension for GEO and capacity building priorities

RESULT:

- Unprecedent level of detail and coverage.
- Highest cartographic quality
- EXTERNAL OVERALL ACCURACY 90,5%
  - 385 field samples




Code
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1020-Sheltered tidal flats v
1030-Saltmarsh
1040-Mangroves
1050-Storm beach ridges
1060-Sandy beaches
1070-Beach rock and grav
2011-Coastal plains on we
2012-Coastal plains on we
2020-Coastal sand sheets
2030-Coastal cliffs, headla
3100-Coastal sabkha, inclu
4110-Sand sheets and dun
4120-Sand sheets and dun
4130-Sand sheets and dun
4140-Sand sheets and dun
4200-Mega-dunes
5110-Gravel plains with di
5120-Gravel plains with dv
5130-Gravel plains with sp
5200-Inland sabkha
6100-Mountain slopes, scr
6210-Jebels (including me
6220-Escarpments, lithifie
6320-Wadis in open terrair
7100-Semi-artificial lakes
7200-Moist ground with P
8100-Date plantations
8200-Farmland
8300-Livestock areas
8400-Forestry plantations
9110-High density urban
9120-Low density urban
9210-Oil wells
9220-Airports and aerodro
9230-Port areas
9240-Other industry
9300-Leisure areas
9400-Paved roads


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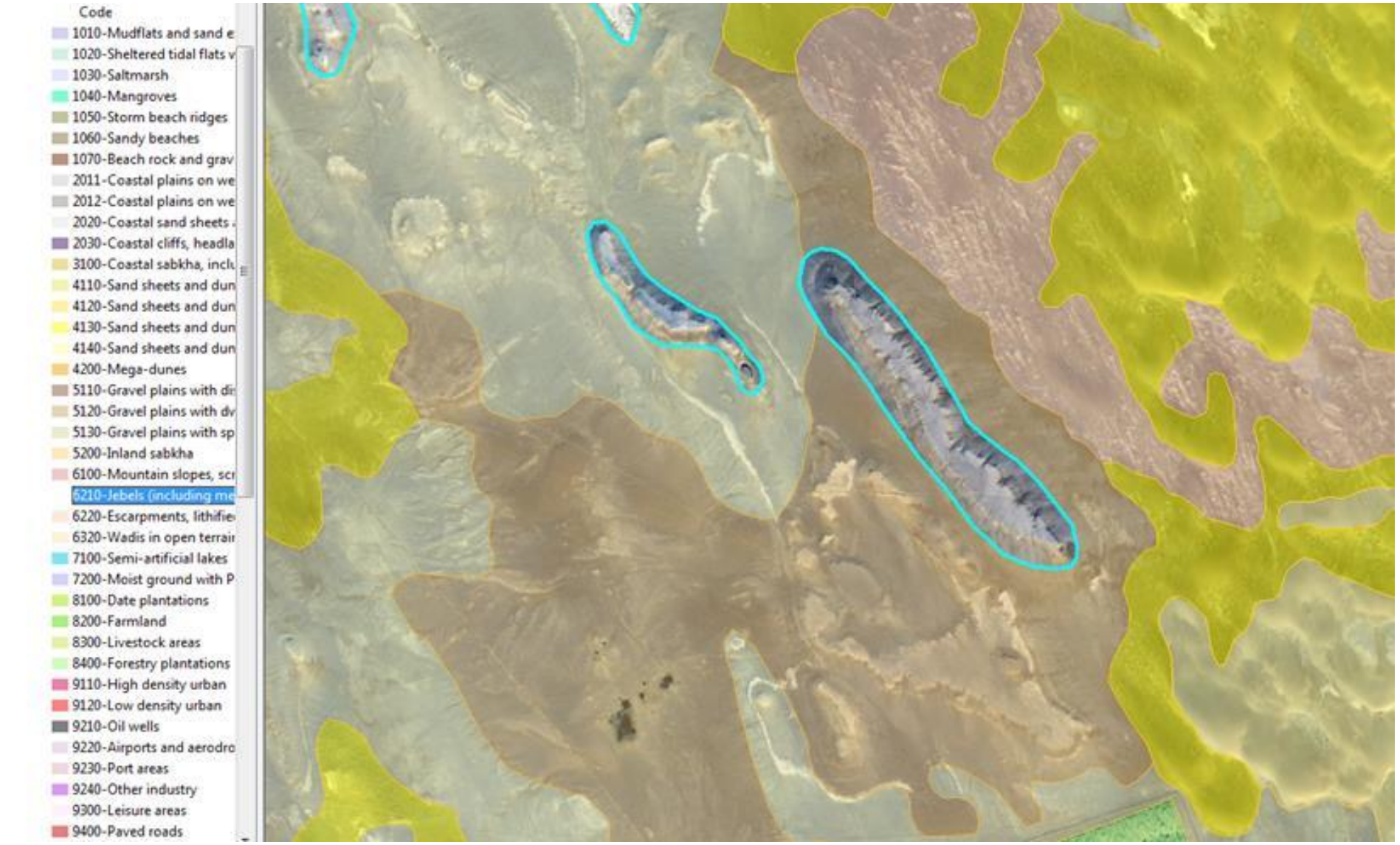
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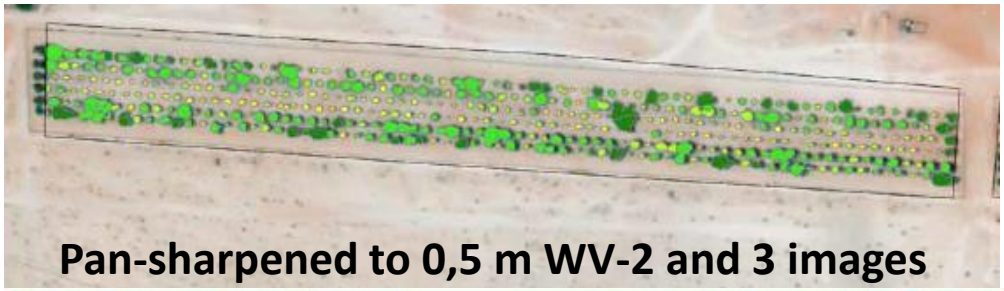
FORESTRY MAPPING

- ❑ Over 25 mill trees in plantations
- ❑ Maintain them while reducing costs of:
  - √ Irrigation (i.e. ground water)
  - √ Monitoring (i.e. traditional practices)
- ❑ **Automatic extraction of tree crowns**

+ Manual refinement in certain areas

- ❑ **Gedatabase:**
  - Above 21,000 ha
  - 2500 plantations, c. 5 mill trees:
    - → **Crown parameters**
    - → **Vegetation health**
    - → **Species identification (acc. 74%)**



Pan-sharpened to 0,5 m WV-2 and 3 images

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FOSTERING OPEN EARTH OBSERVATION FOR EUROPE

10TH GEO EUROPEAN PROJECTS WORKSHOP | 31 MAY - 2 JUNE 2016, BERLIN

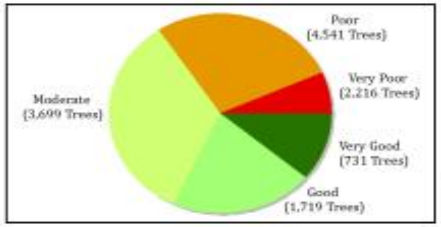
Regional dimension for GEO and capacity building priorities

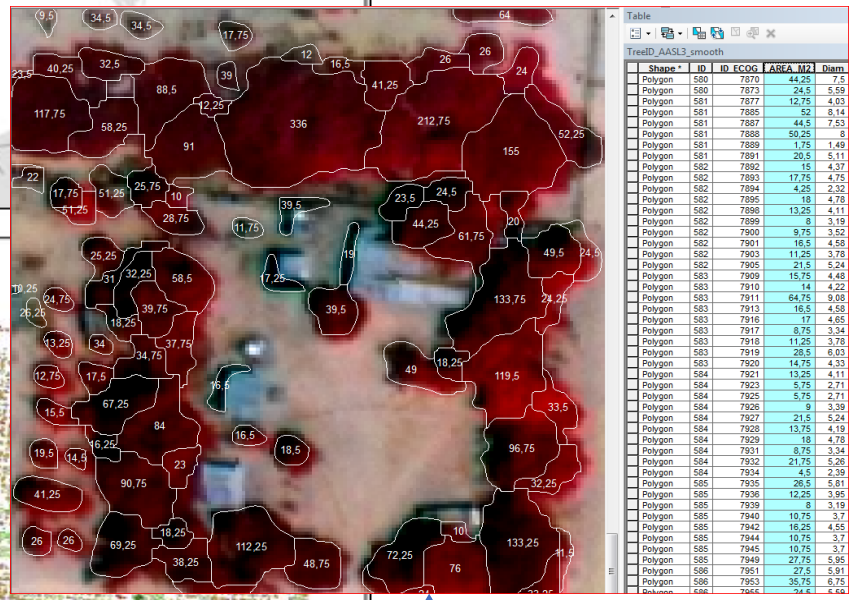
PROTEUS gmv

EAD Forestry: Vegetation Condition

based on Normalised Difference Vegetation Index (NDVI)

NOTE: NDVI is directly related to photosynthetic activity. Thus, higher NDVI indicates more vigorous vegetation.





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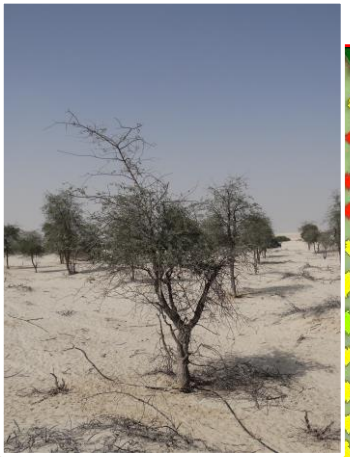
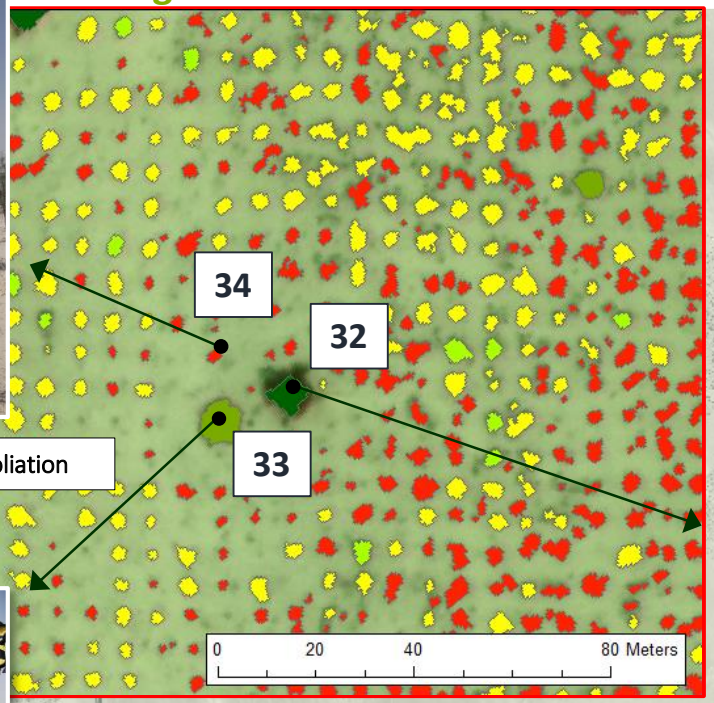


34 - *Prosopis cineraria* – Severe Defoliation



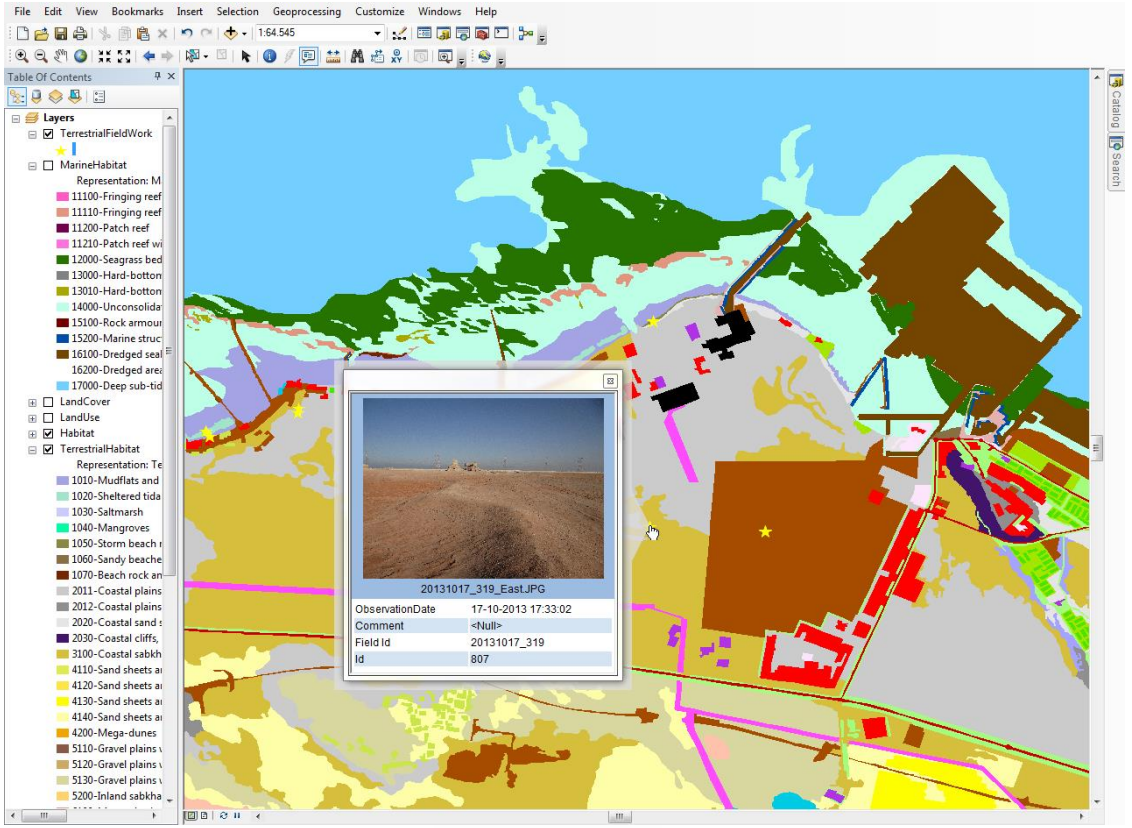
Defoliation level

33 - *Salvadora persica* – Null Defoliation

32 - *Prosopis juliflora* – Null Defoliation

ArcGIS GDB with relational DBMS including

- ❑ **Land use/cover terrestrial habitat map**
- ❑ **Fauna and Flora species**
- ❑ **Photographs**
- ❑ **Categories descriptions**
- ❑ **Other field data**
- ❑ **Metadata**
- ❑ **Etc etc**



CHALLENGES

Show we could produce a groundbreaking baseline, and DO IT FAST!!!

→ **implement a robust and sophisticated WORKFLOW**

→ **ensure QUALITY along the production chain (thematic, structure, geometric)**

→ **stick to a very tight CALENDAR, with monthly deliveries**

→ **Different technical specifications per class**

→ **Requirement for overall accuracy above 85%**

→ handle very large datasets

LESSONS LEARNT

Factors explaining the successful implementation of a sophisticated workflow:

→ **Previous experience**

→ **Local partners: daily contact with client, bring in regional knowledge**

→ **Input (satellite) data**

→ **Bottom-up approach in the definition of the technical specifications**

→ **Technological level of the client**

IMPACT & FUTURE WORK

Abu Dhabi's Habitats Map

→ **New and improved modeling capacity for environmental decision-making, e.g.:**

- ❑ **Identify new areas needing protection**
- ❑ **Refine current protection boundaries**
- ❑ **Perform assessments, e.g.:**
  - ❑ **Environmental Impact**
  - ❑ **Monitoring evolution and changes**
  - ❑ **Ecosystem services**
  - ❑ **CO2 stocks (blue carbon)**

THANK YOU FOR YOUR ATTENTION!!

Photo credits:
- **Nautica**
- **GMV**
- **EAD**

Ana Sebastián AND António Araujo
Payload Data Processing and Applications Business Unit /Remote Sensing Services and Applications Division
asebastian@gmv.com
www.gmv.com

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