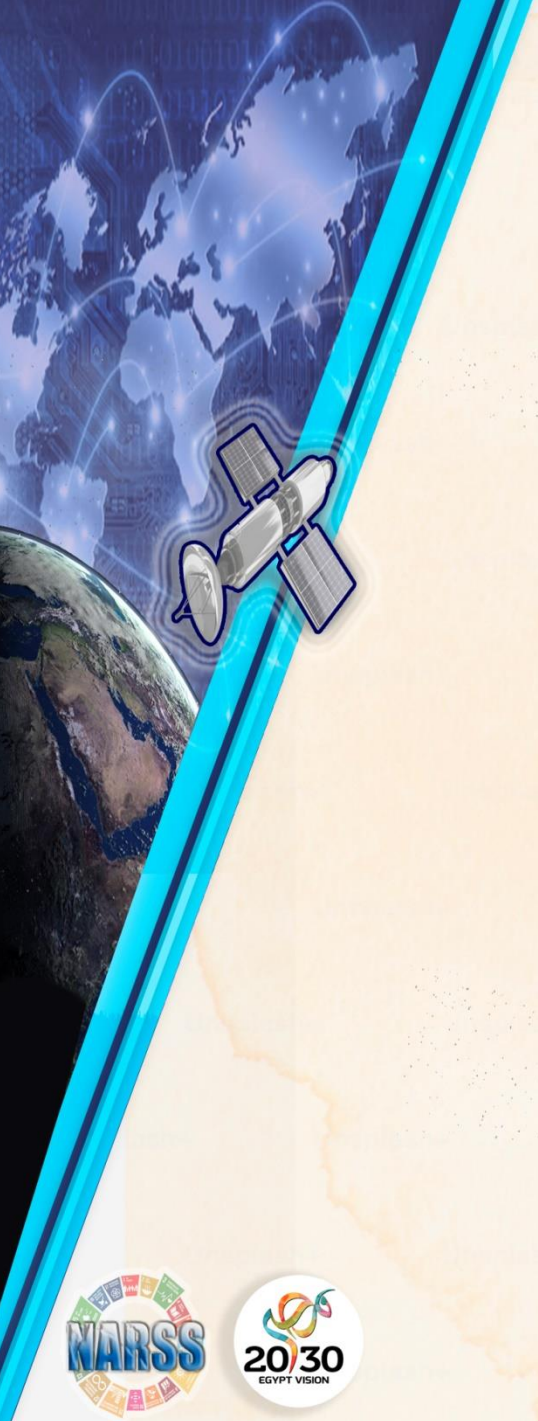
جمهورية مصر العربية
وزارة التعليم العالي والبحث العلمي
الهيئة القومية للاستشعار من البعد وعلوم الفضاء
National Authority for Remote Sensing and Space Sciences

استخدام تقنيات الاستشعار من البعد في مراقبة وحماية النظم البيئية الساحلية والبحرية ومخاطر التغير المناخي

إلهام محمود علي
أستاذ البيئة وعلوم البحار

شعبة الدراسات البيئية واستخدامات الأراضي
الهيئة القومية للإستشعار من البعد وعلوم الفضاء



Outlines

- خصوصية البيئة الساحلية والبحرية واهم مواردها
- النظم البيئة الفريدة بالبيئة البحرية والساحلية
- طرق مراقبة البيئات البحرية والساحلية
- سبل الحماية
- التغير المناخي واثاره
- تطبيقات فعلية من مشروعات وابحاث الهيئة

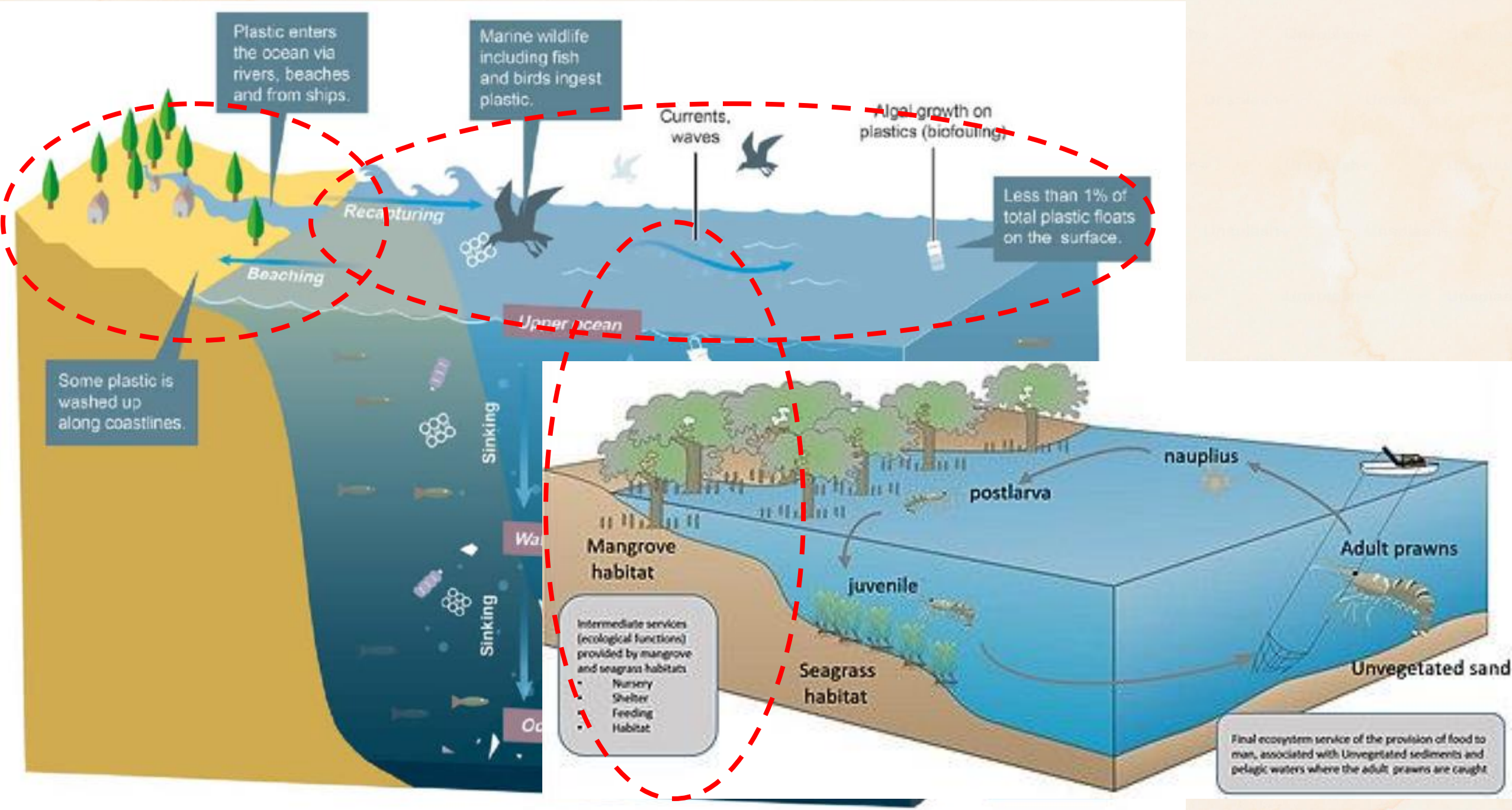
البيئة الساحلية والبحرية

يقصد **بالبيئة البحرية** كل مساحات المياه المالحة وما تشتمل عليه هذه الكتلة من أوجه الحياة البحرية ،
اما **البيئة الساحلية** فهي منطقة تلاقي الكتل الأرضية بالبحر.

أهمية البيئة البحرية :

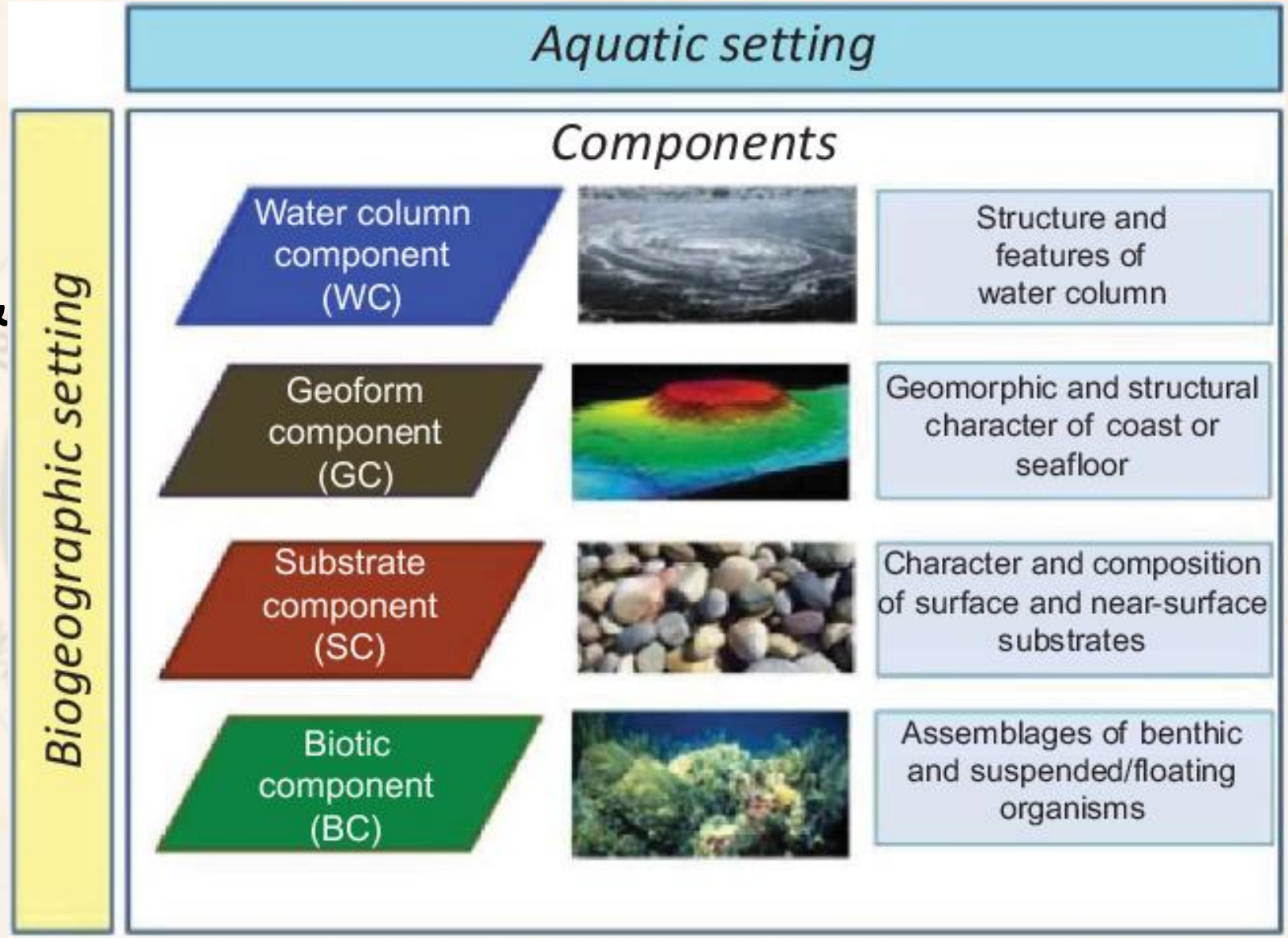
- تغطي أكثر من 70% من سطح الأرض ،
- تسهم بنصيب وافر في المحافظة علي التوازن البيولوجي للكرة الأرضية

تتمتع بأهمية كبرى للإنسان ، فهي مصـدر لغذائه ومصدر للطاقة والميـاه
ومصدر للعديد من الثروات المعـدنية والنباتيـة المختلفة
وسبيلاً للنقـل والمواصلات
ومجالاً للترفيه والسياحة


Plastic enters the ocean via rivers, beaches and from ships.
Marine wildlife including fish and birds ingest plastic.
Currents, waves
Algal growth on plastics (biofouling)
Less than 1% of total plastic floats on the surface.
Recapturing
Beaching
Upper ocean
Some plastic is washed up along coastlines.
Sinking
Sinking
nauplius
postlarva
Mangrove habitat
juvenile
Adult prawns
Seagrass habitat
Unvegetated sand
Intermediate services (ecological functions) provided by mangrove and seagrass habitats
Nursery
Shelter
Feeding
Habitat
Final ecosystem service of the provision of food to man, associated with Unvegetated sediments and pelagic waters where the adult prawns are caught

Oceanography
Environment &
Land uses
Geology
Water
Agriculture

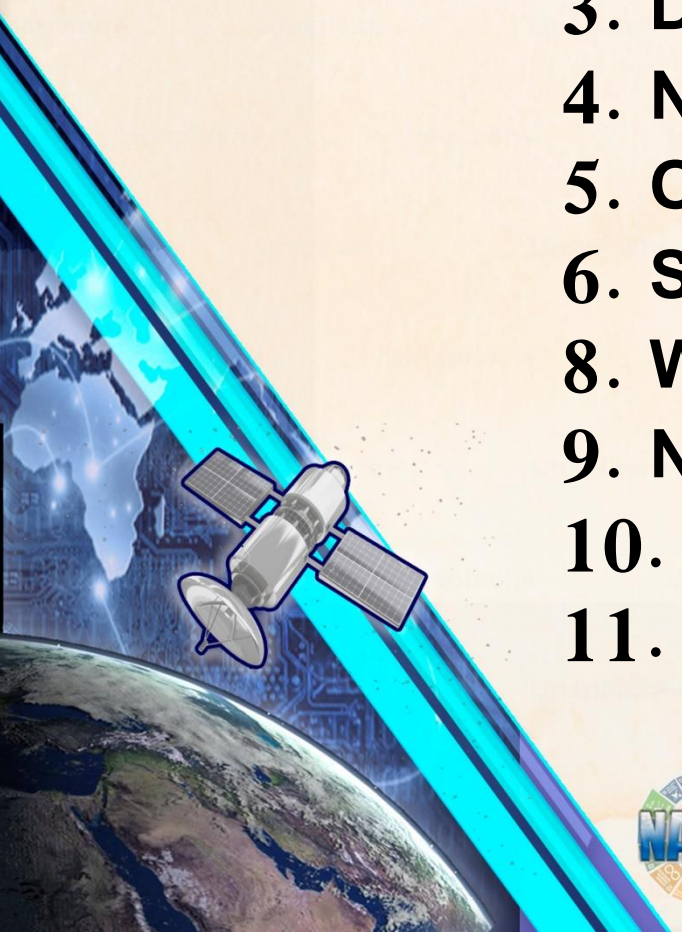
Training



Major 10 Challenges

1. **Ocean Dumping:** (only mining dump 220 MT waste/ year)
2. **Land Runoff**
3. **Dredging:**
4. **NOx and Sox**
5. **Ocean Acidification**
6. **Sea Water Level Rising**
8. **Waste Pollution from Ships**
9. **Noise Pollution from Ships**
10. **Oil Spills**
11. **Plastic Pollution**

Climate Change



NARSS potentialities to save the Egyptian coasts and marine ecosystems

NARSS

Potentiality

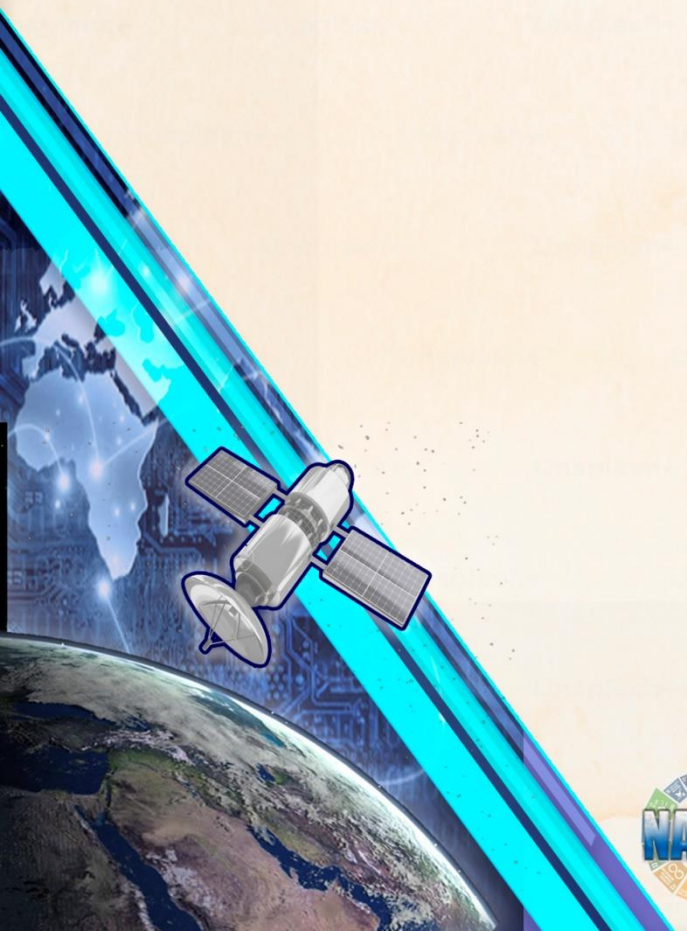
1. **Monitoring & Assessment**
    1. Pollutants
    2. Oil pollution
    3. Chl-a
    4. Salinity
    5. Irradiance/light
    6. Turbidity
    7. Electric conductivity

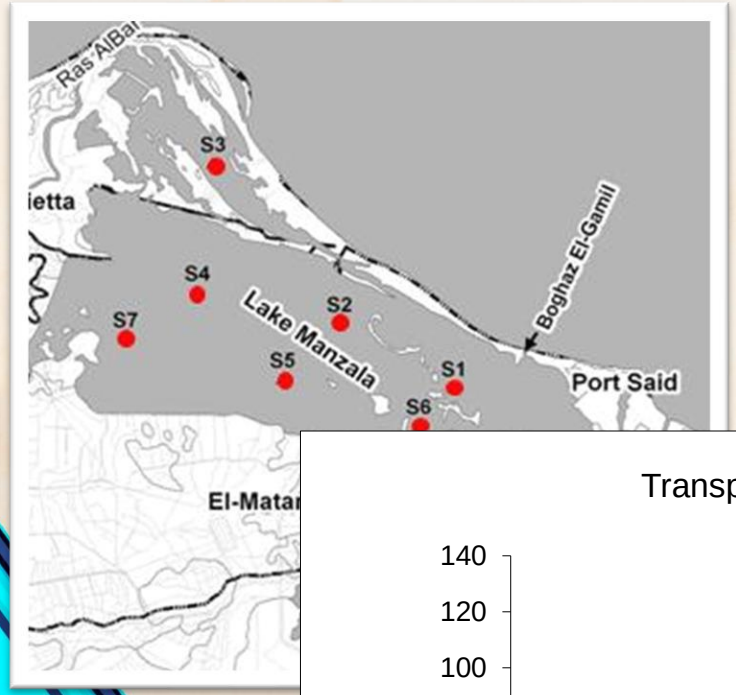
2. **Integration** & **Forecasting**
    1. Pollution capacity
    2. causes and sources
    3. Sources of oils spill (ships)
    4. , phytoplankton community (quantitative)
    5. Food chain
    6. Light profile
    7. Water column biota

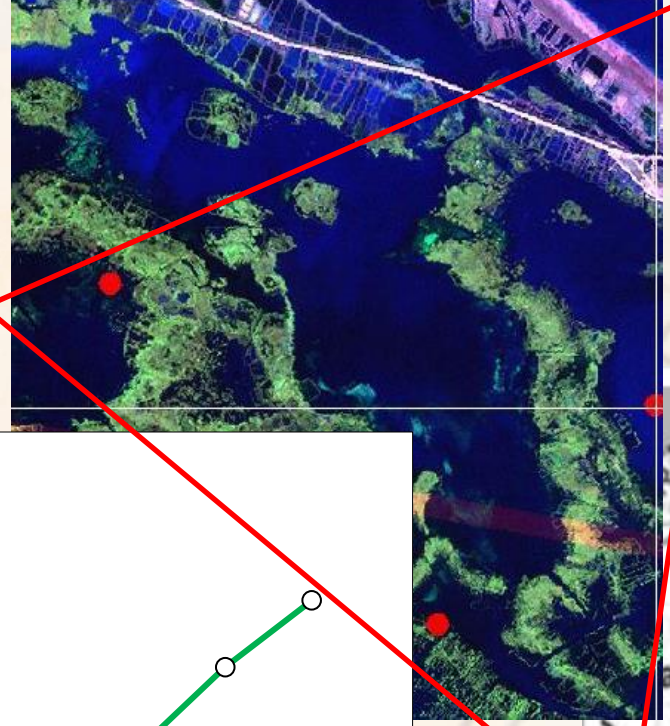
1. Management
2. Sustainability

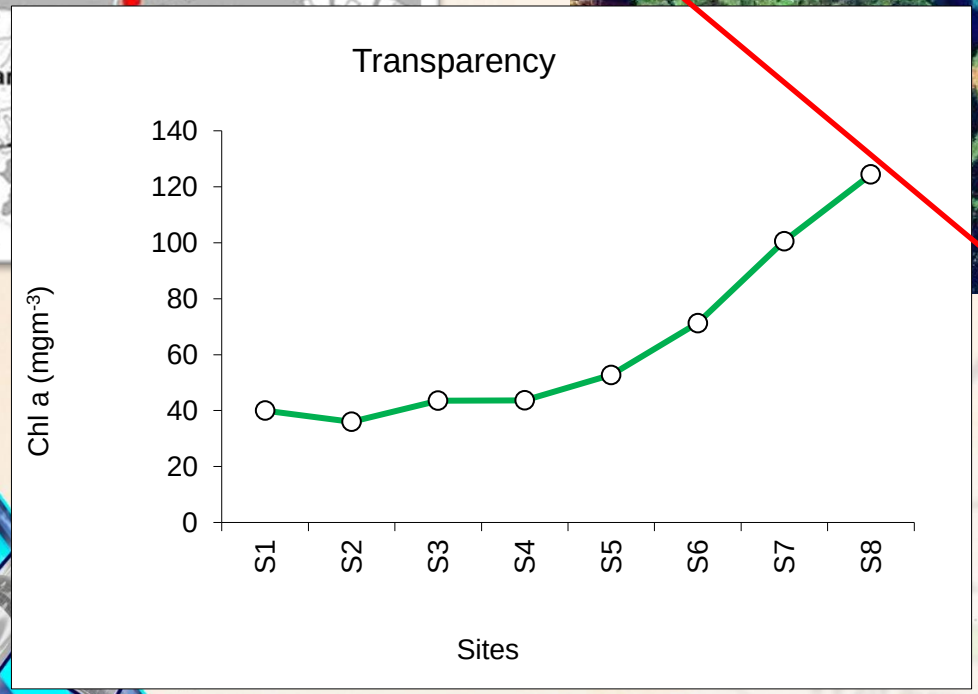
Examples

Monitoring Chl-a and develop coefficient to determine Chl-a remotely

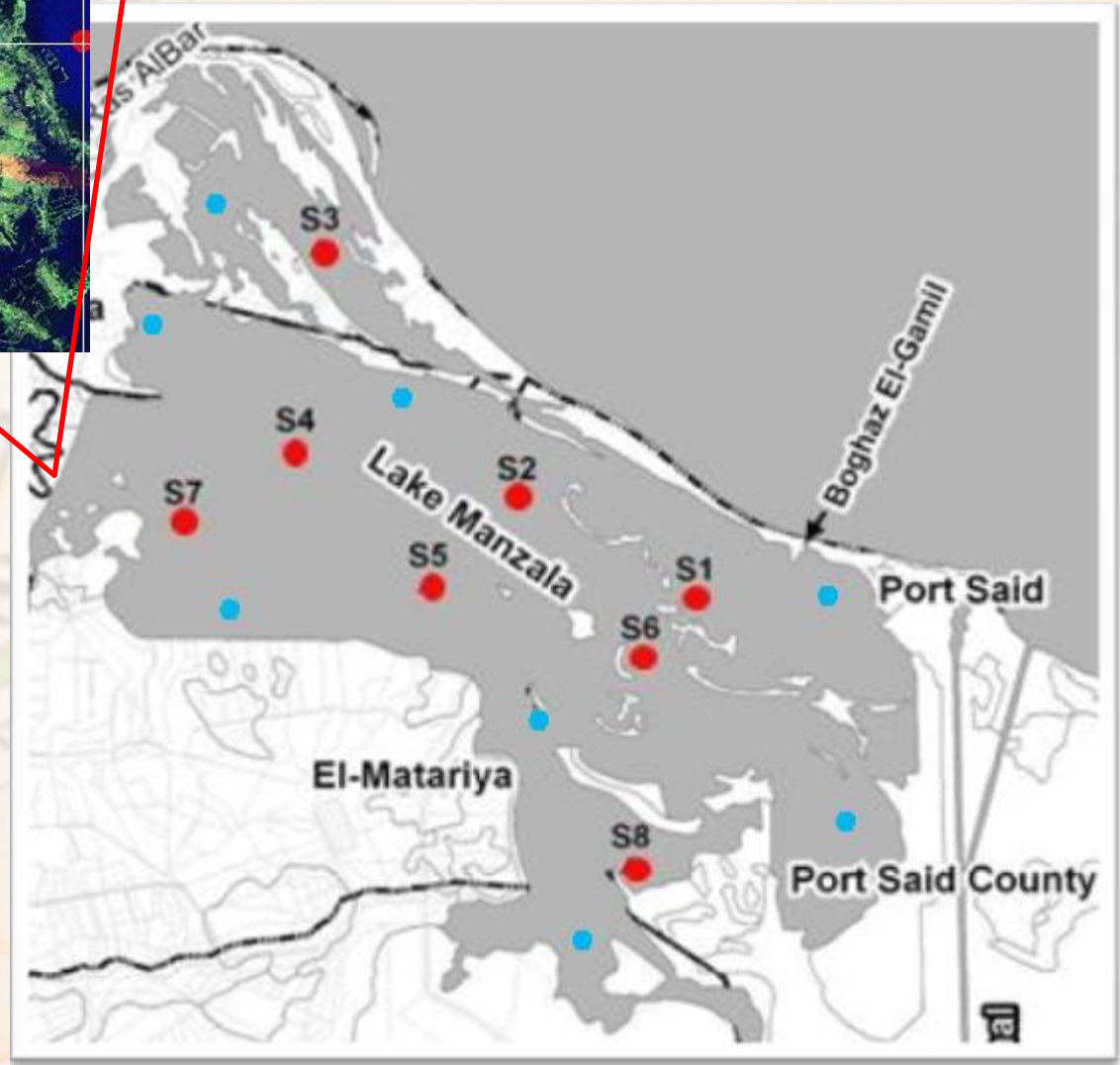






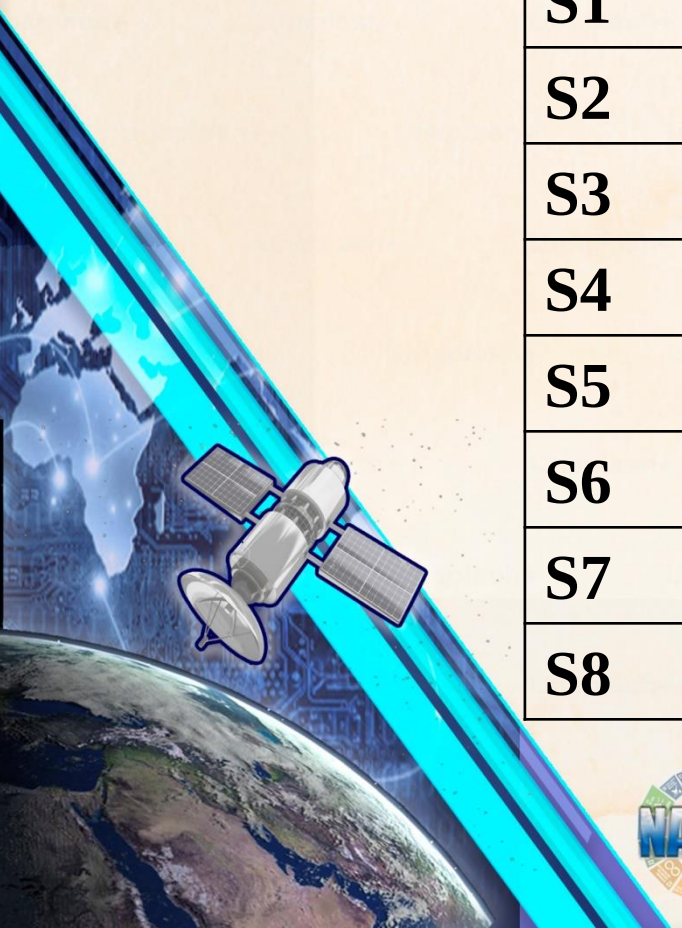


Lake Manzalla

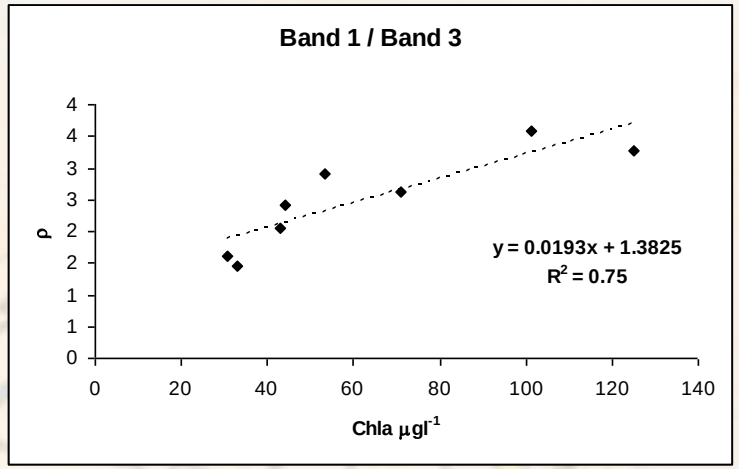


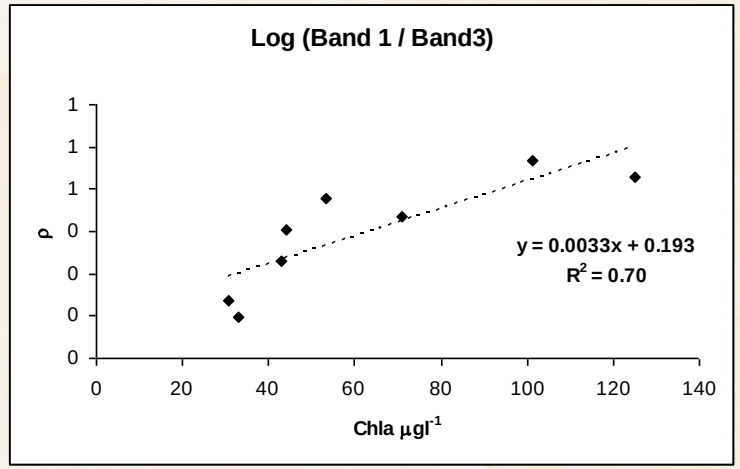
Statistical Correlation

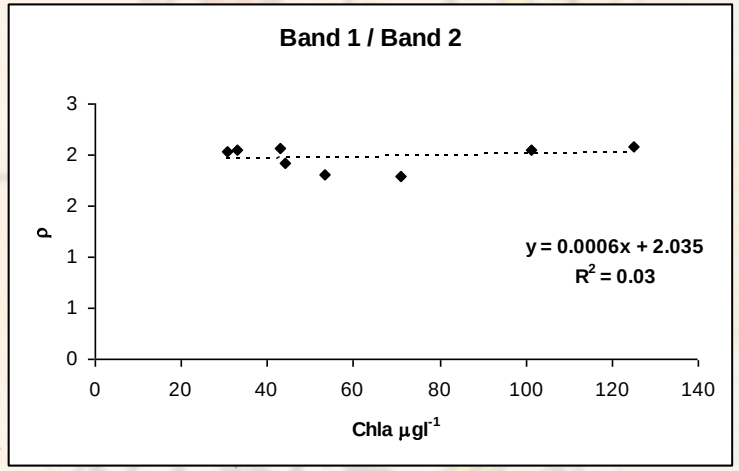
Station	Average Chl *a* (mgm^{-3})	Satellite irradiance		
		Band1	Band2	Band3
S1	30.5	0.173	0.081	0.101
S2	33	0.189	0.088	0.121
S3	43.1	0.197	0.091	0.092
S4	44.3	0.212	0.105	0.084
S5	53.3	0.213	0.112	0.071
S6	70.9	0.239	0.126	0.088
S7	125	0.267	0.122	0.079
S8	101.1	0.243	0.113	0.066

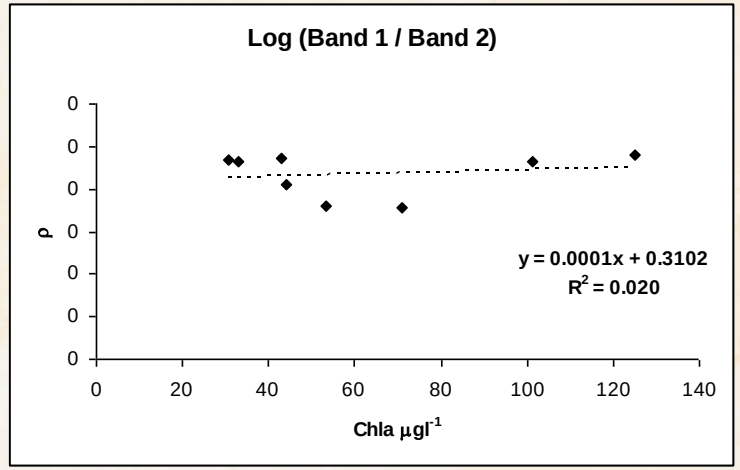


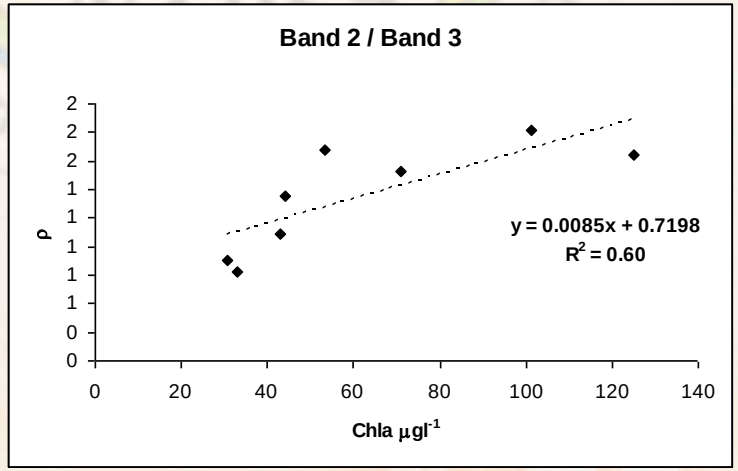
Establish correlation between these values in the different band ratios based on the previous behaves

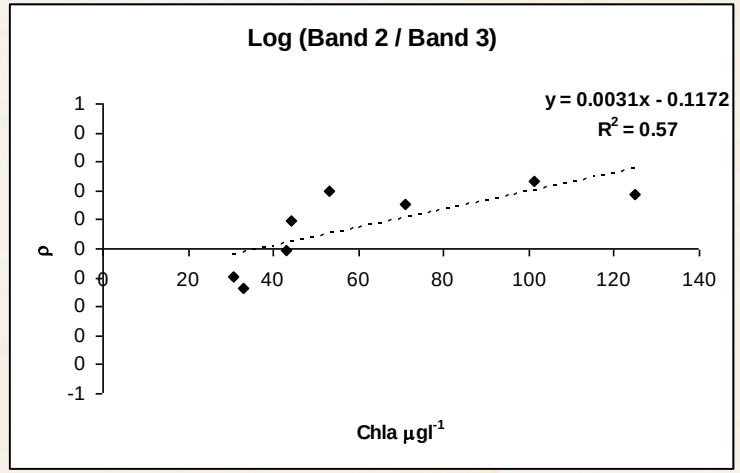








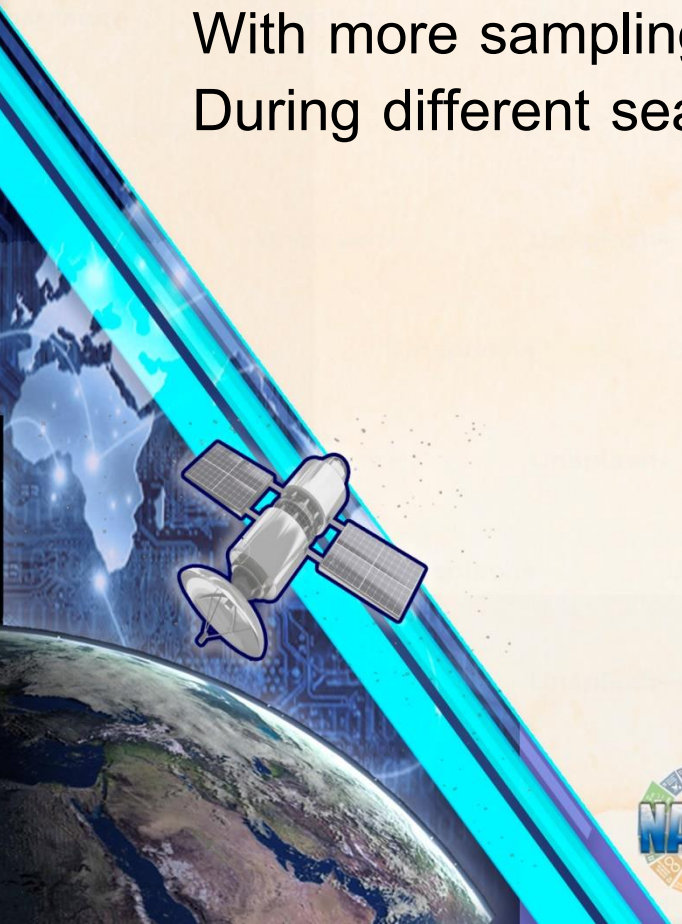


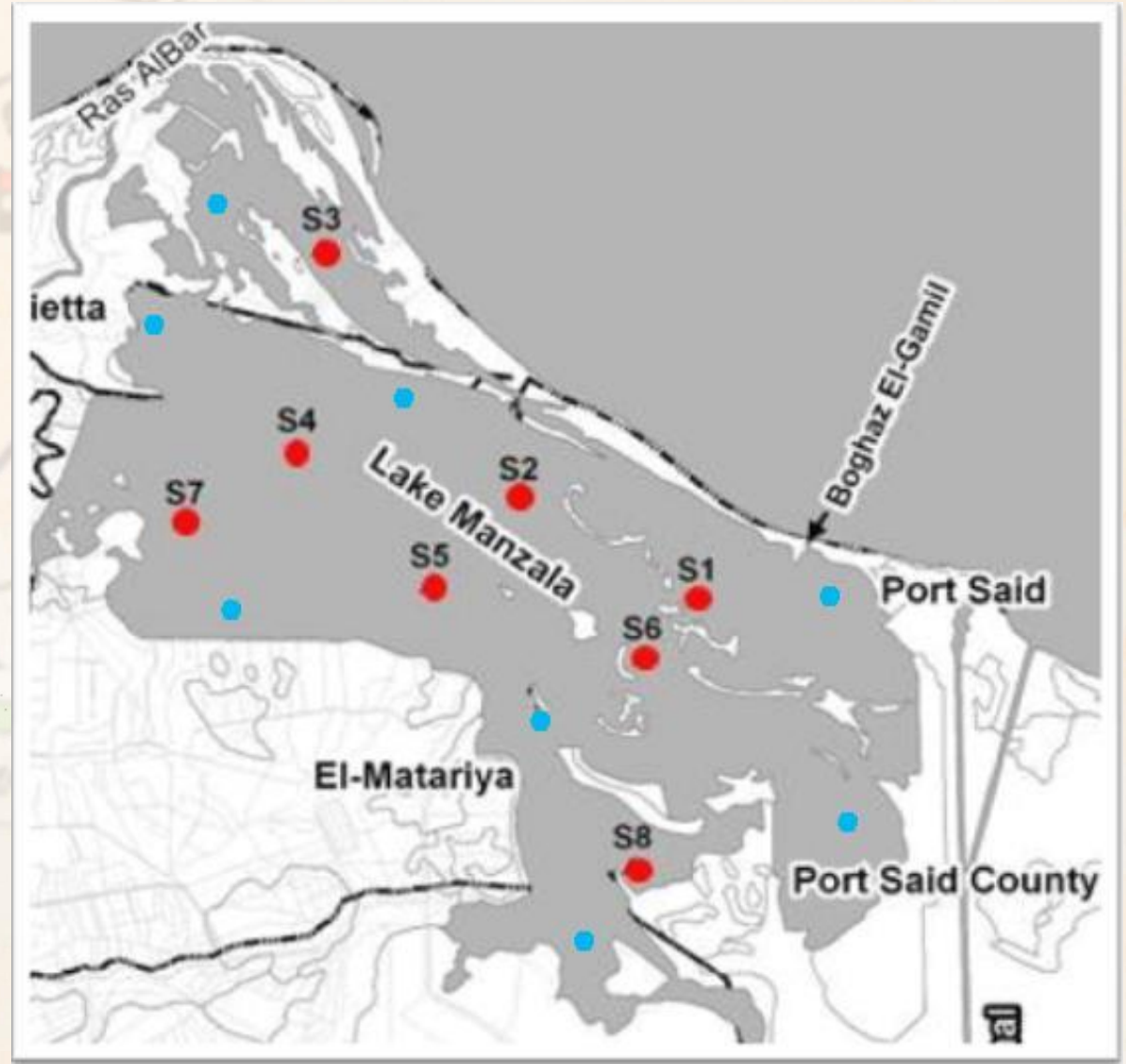


Valid approach BUT

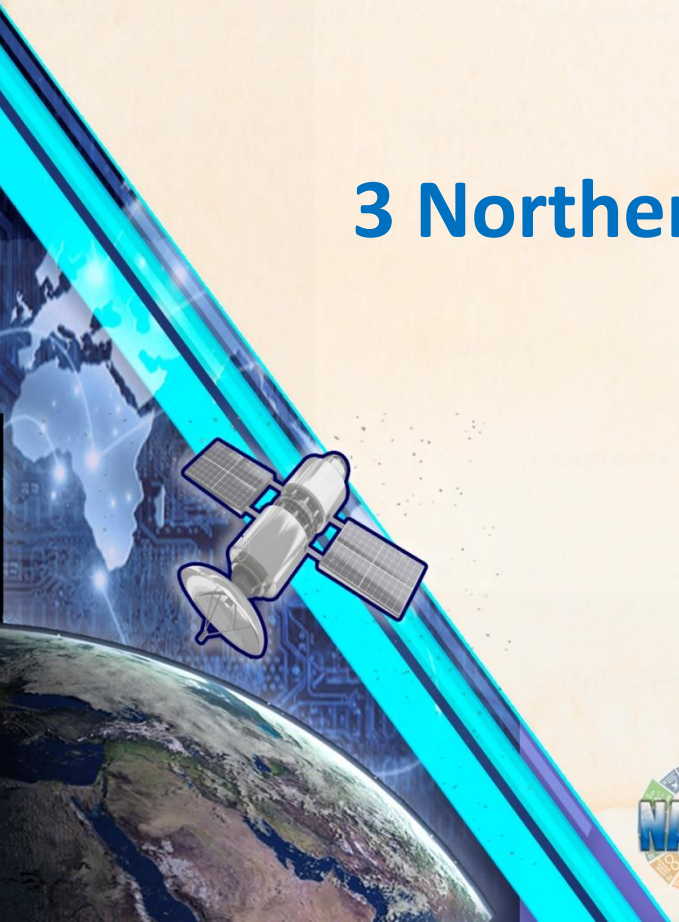
The correlation model need to be applied:

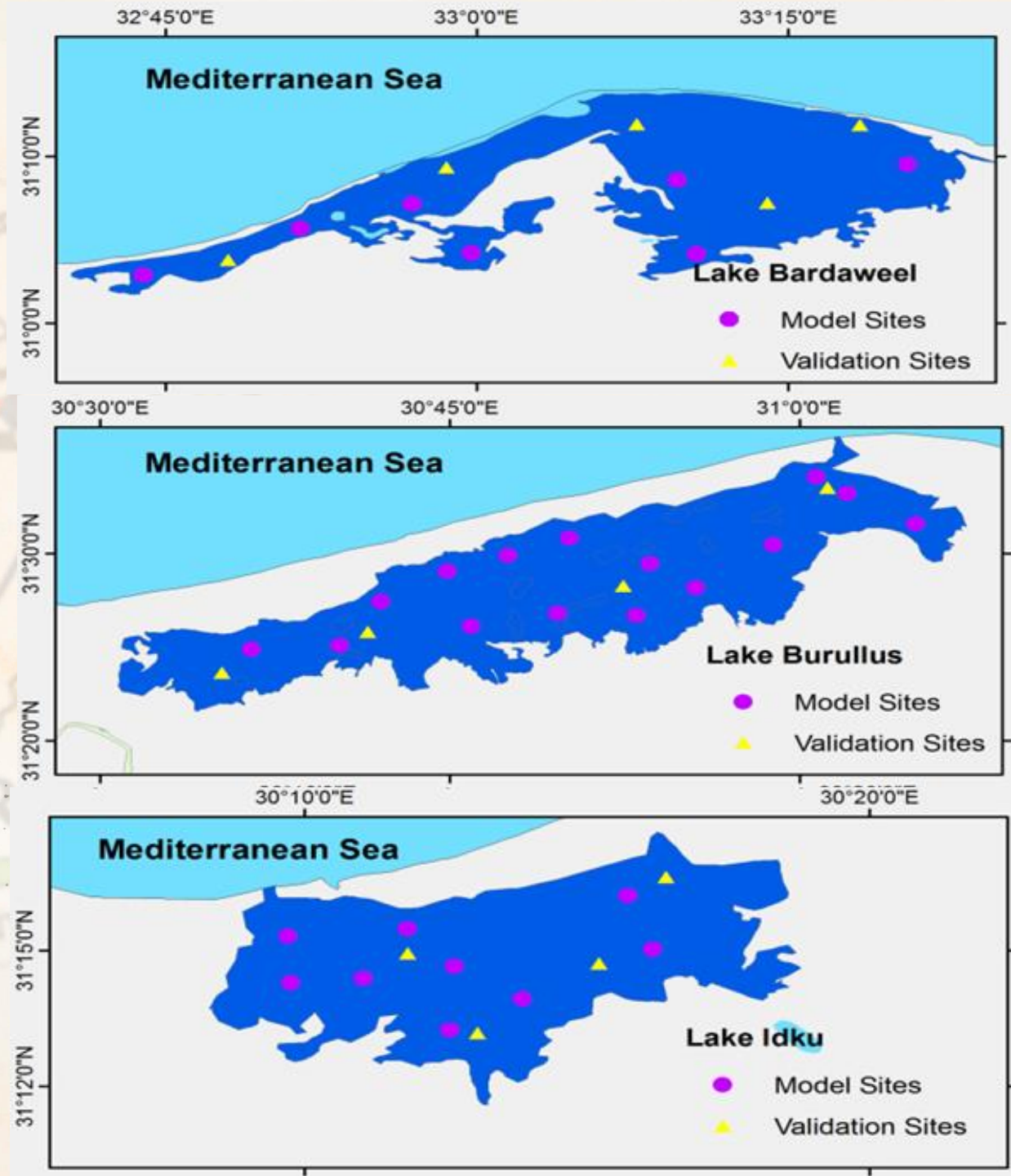
- Onto other similar/different water bodies
- With more sampling locations
- During different seasons





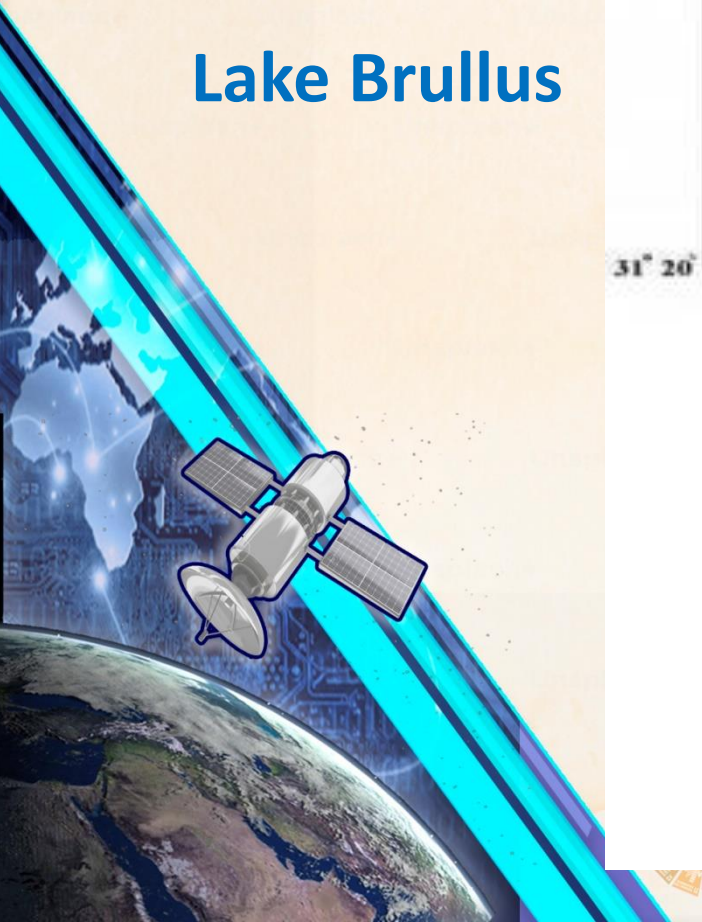
3 Northern Lakes

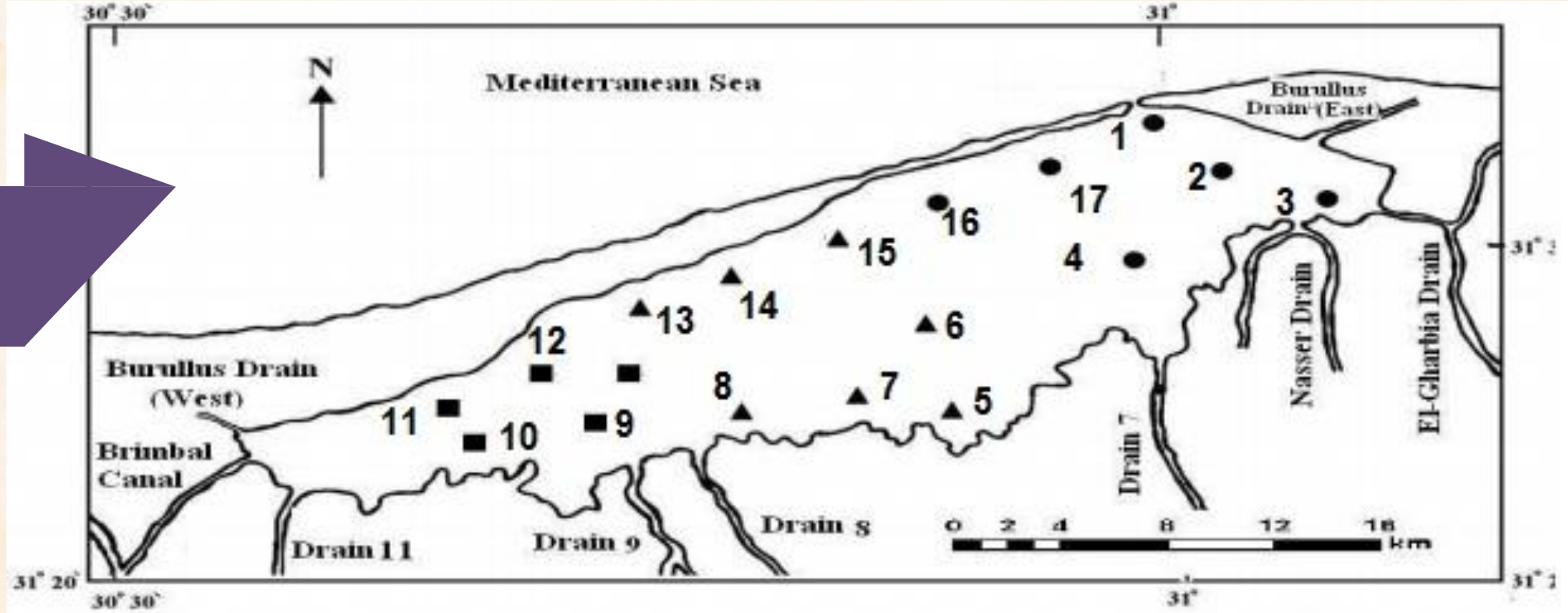




Examples

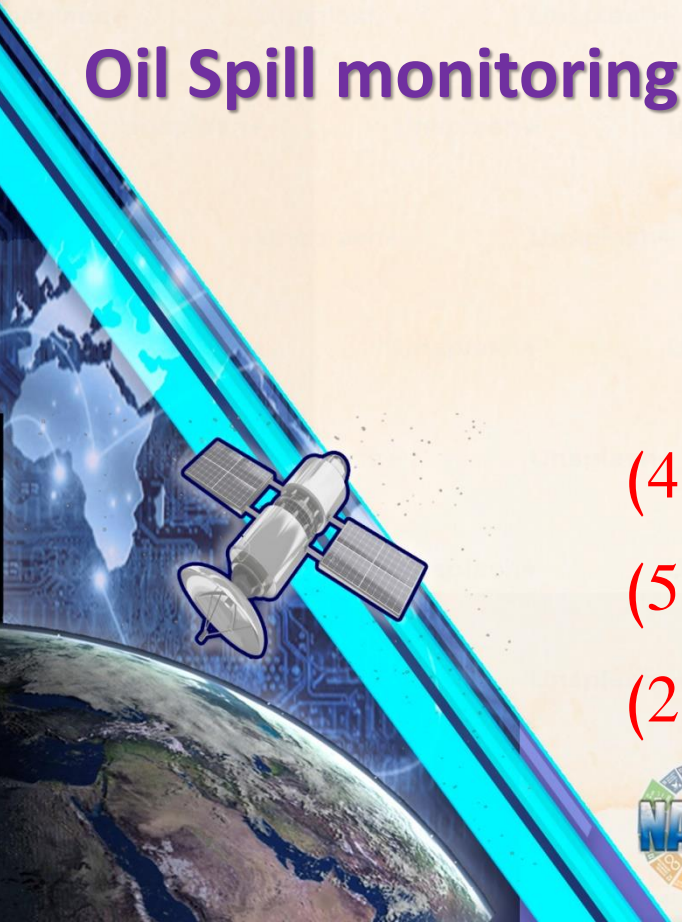
Lake Brullus





Examples

Oil Spill monitoring



Sources:

(45%) • Ship operative discharges

(5%) • Tanker accidents

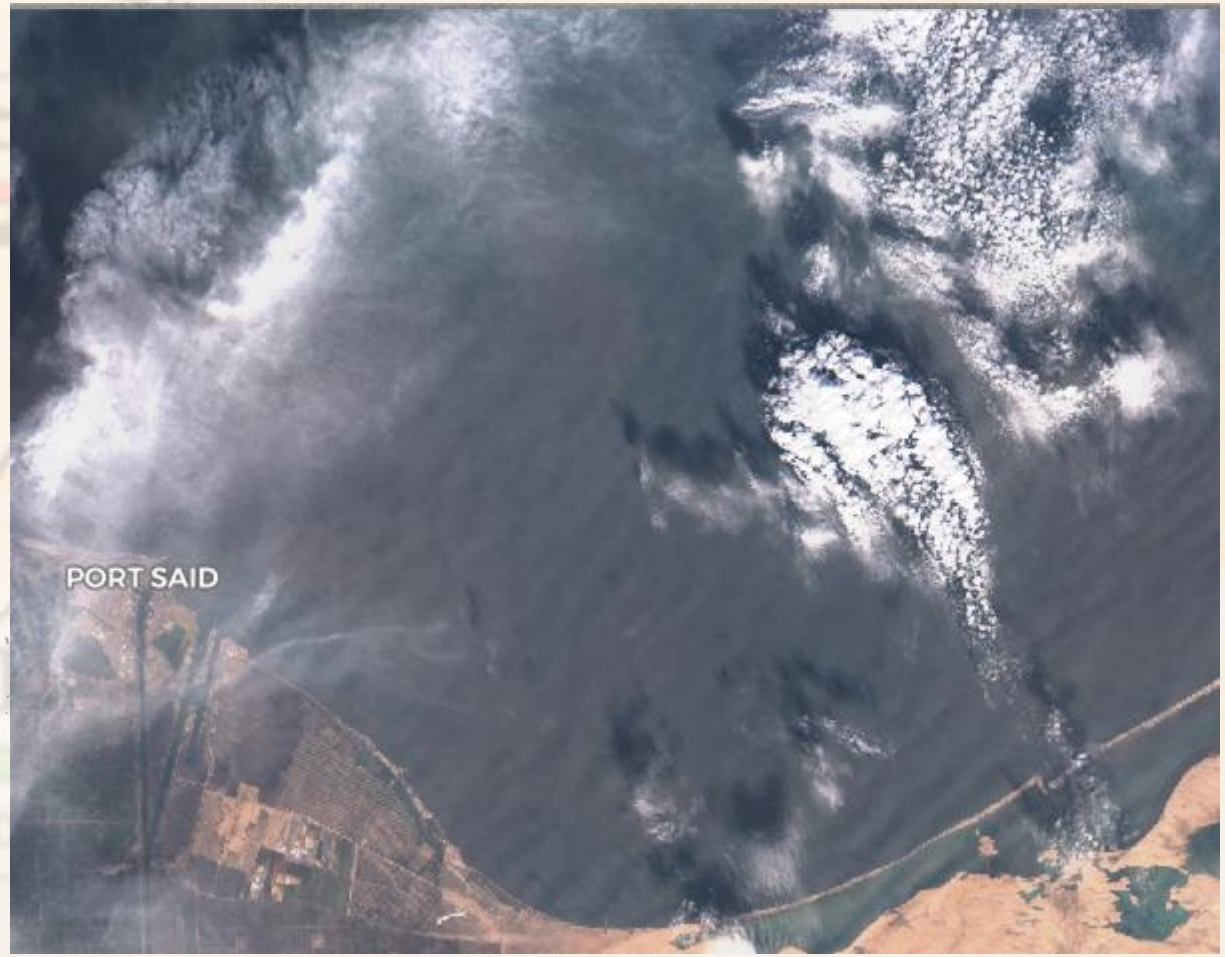
(2%) • Accidents on Platforms

Optimum for Oil Spill Detection

Optical Sensors

Vs

Synthetic Aperture Radar (SAR)



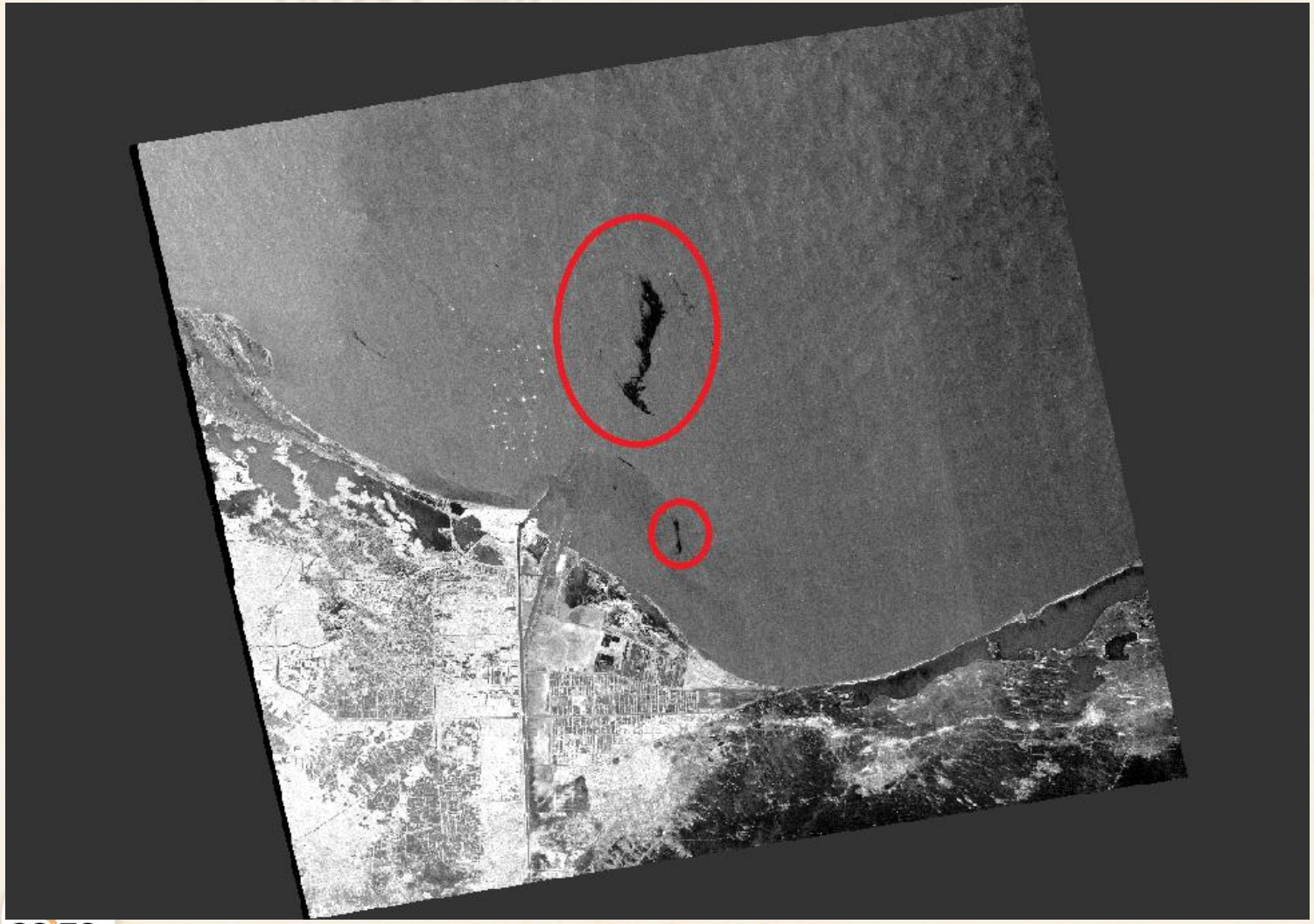
Satellite: Sentinel 1 Date: 25-12-2019

Synthetic Aperture Radar (SAR)

An Oil Slick Example

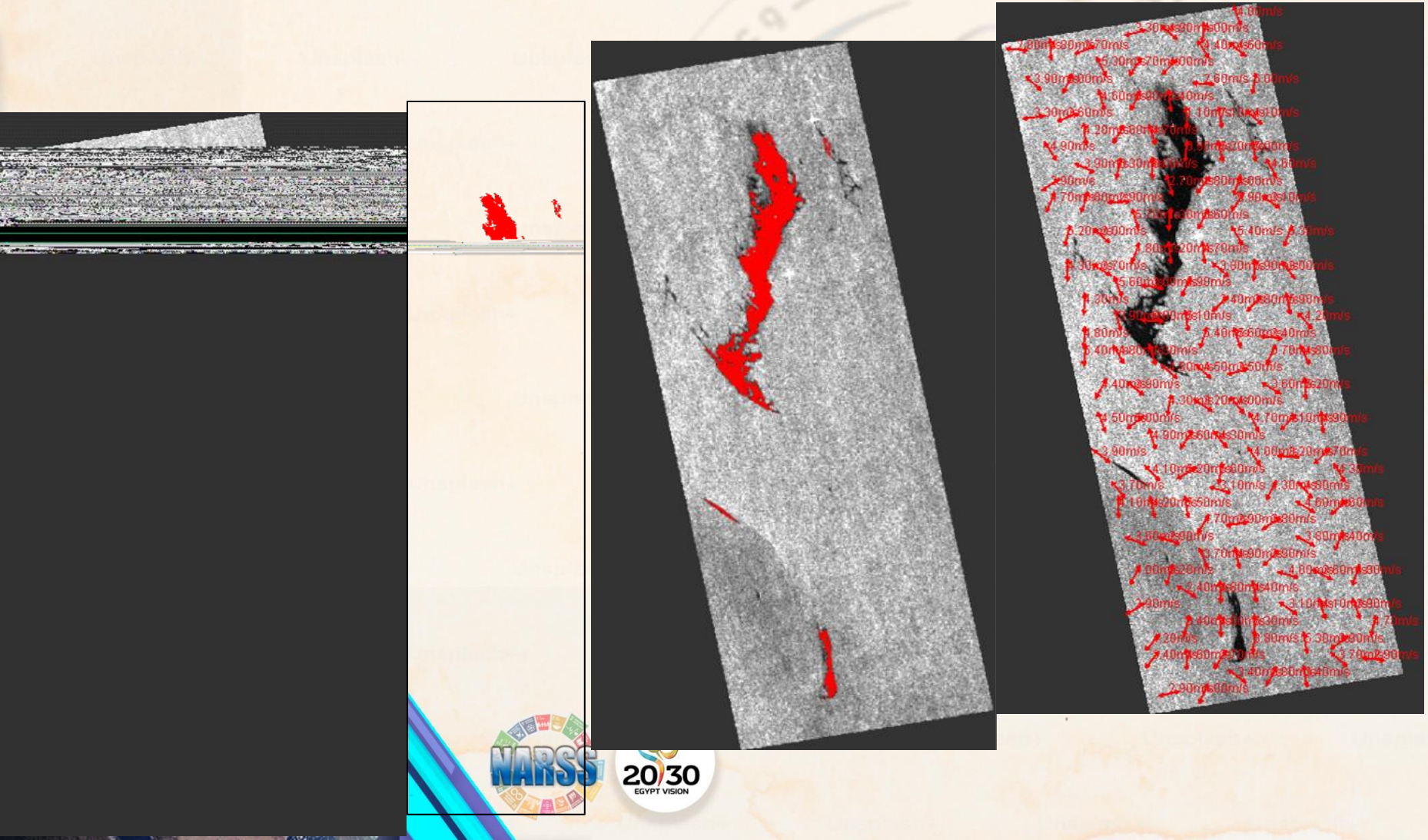
Satellite: Sentinel 1

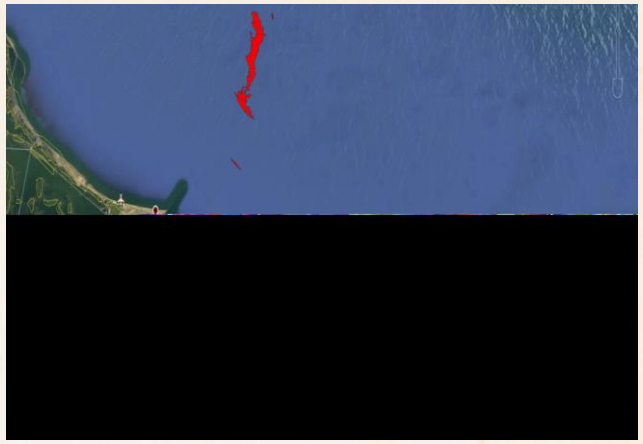
Date: 04-10-2014



Processing

Oil spill clustering using a background window size of 500 pixels and a threshold shift of 3.5 dB and wind vector calculations.



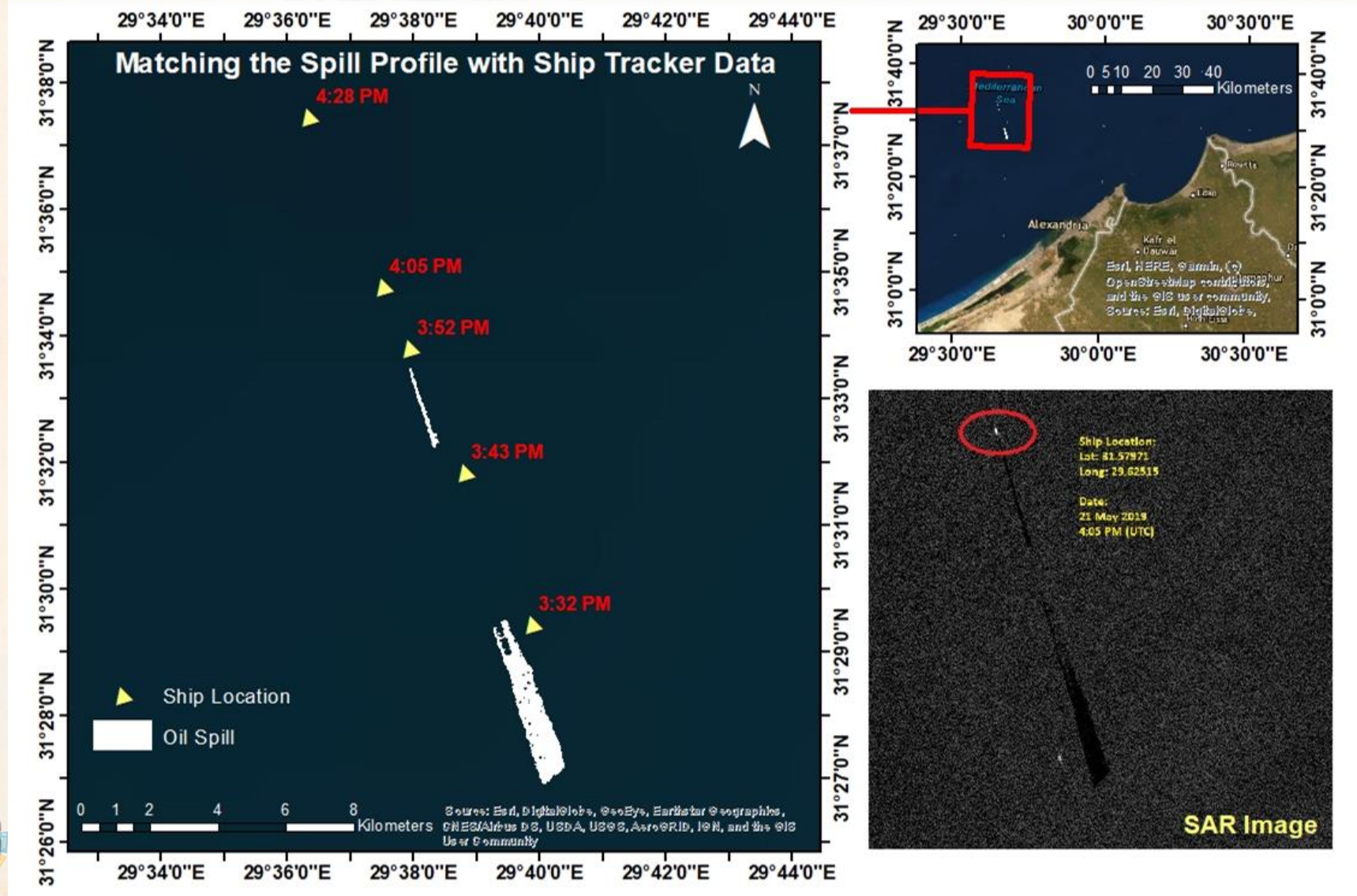


Oil spill clustering using a background window size of 500 pixels and a threshold shift of 3.5 dB and wind vector calculations.

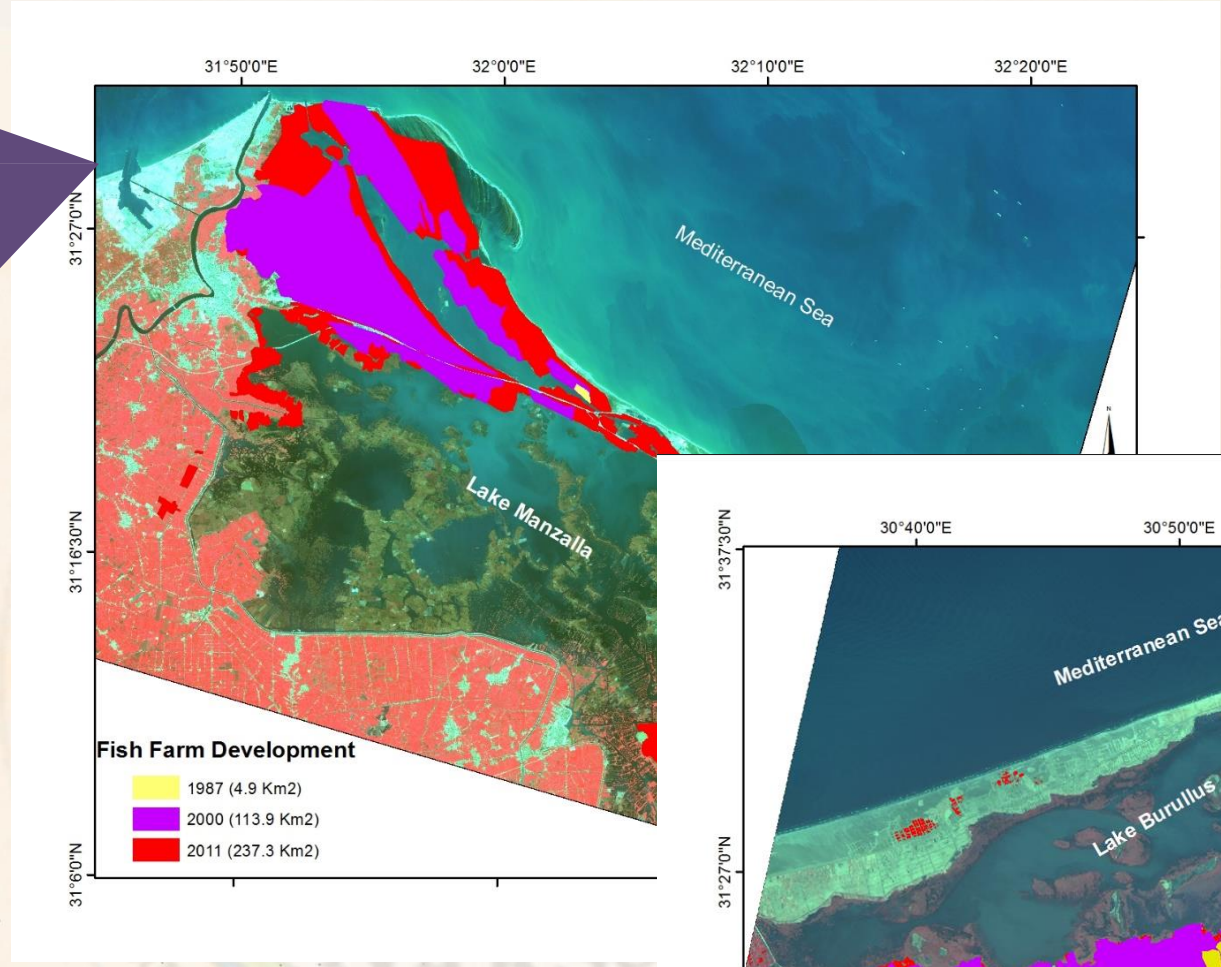
Product

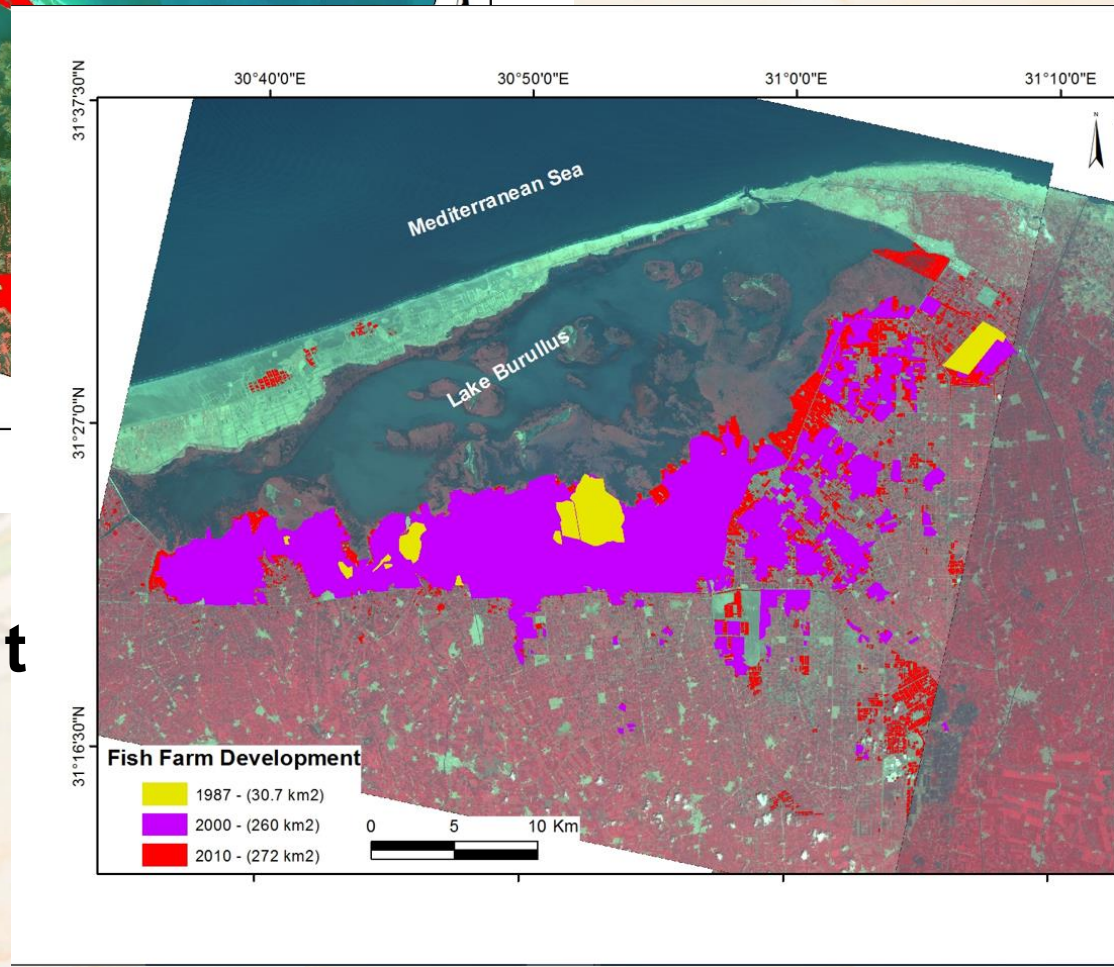
Moving Ship

Excellent Match

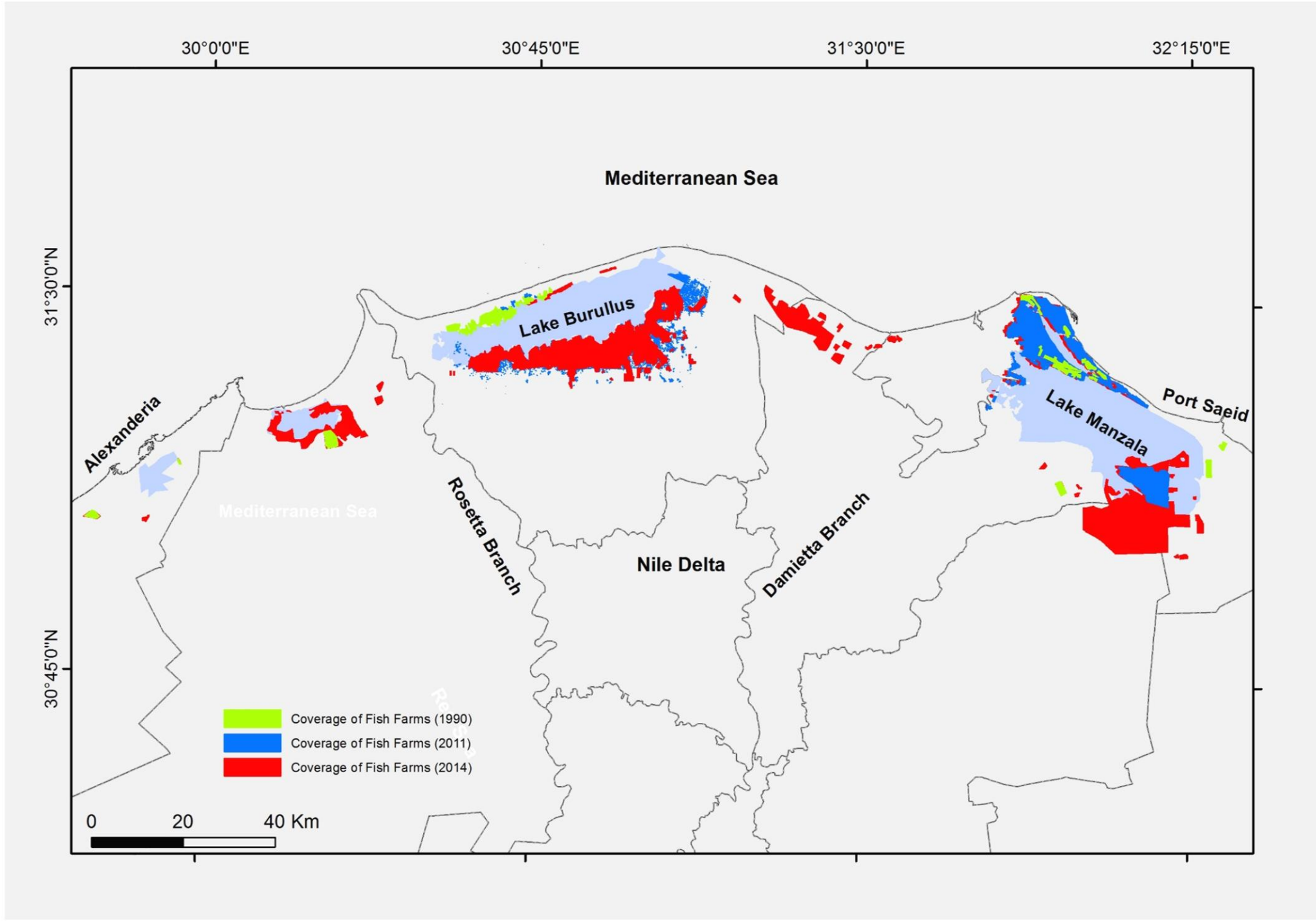


Examples



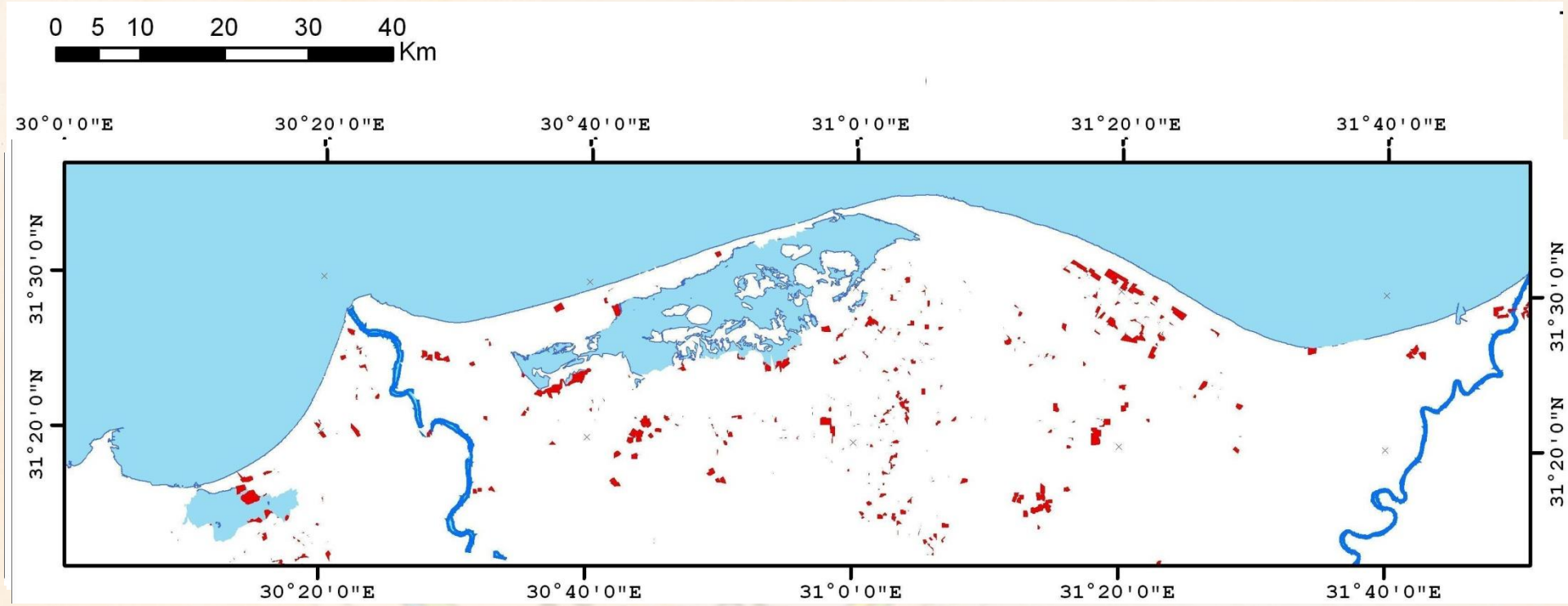


Monitoring coastal activities;
e.g., Fish farming development


30°0'0"E
30°45'0"E
31°30'0"E
32°15'0"E
31°30'0"N
30°45'0"N
Mediterranean Sea
Lake Burullus
Alexanderia
Mediterranean Sea
Rosetta Branch
Nile Delta
Damietta Branch
Lake Manzala
Port Saeid
Coverage of Fish Farms (1990)
Coverage of Fish Farms (2011)
Coverage of Fish Farms (2014)
0
20
40 Km

Results –

Fish farms

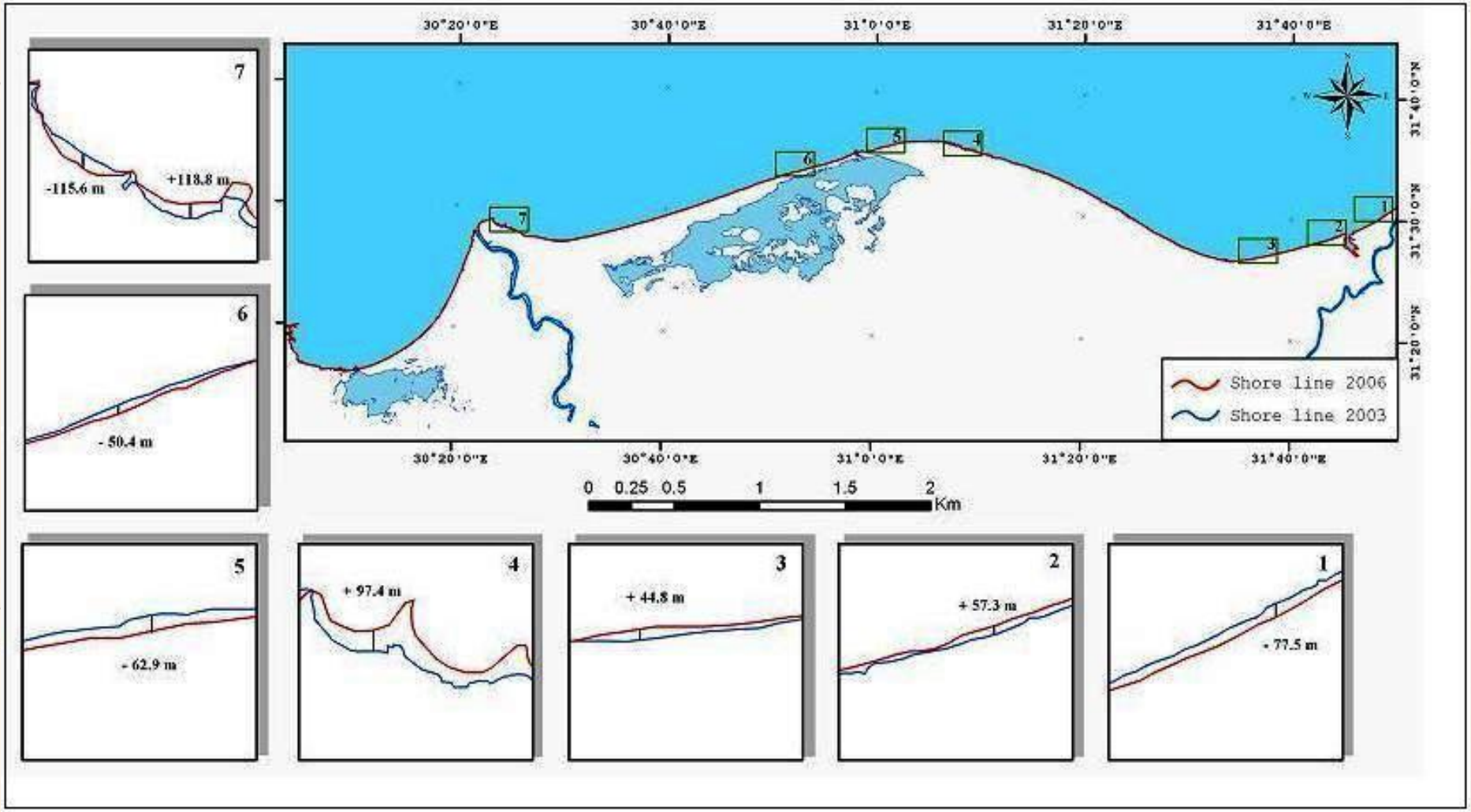


- 5.5% increments in Fishfarms' area in 2006
- 6.9 km2 per year during the period of study.
- 1.8 km2 were determined from 1990-1995 (El-Asmar, 2000)
- 1.4 km2 during the period between 1984-2006 (El. Magd & Hermas, 2009)

Examples

Coastal Erosion (CE)

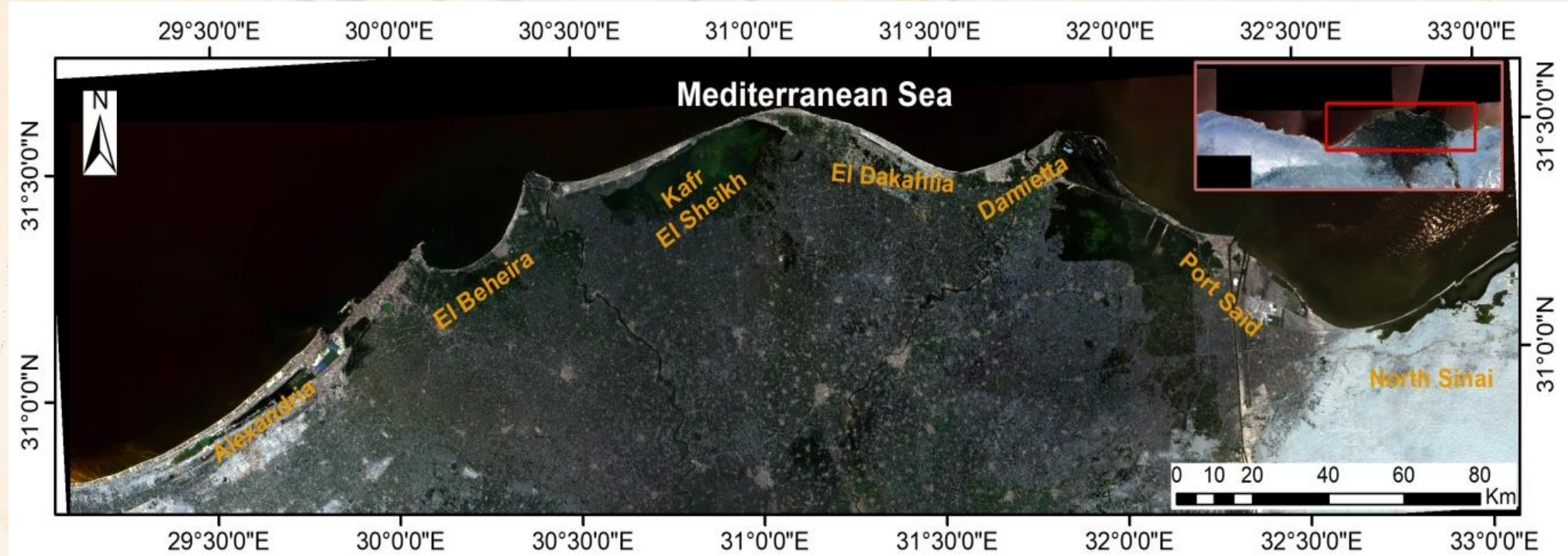
Shoreline changes



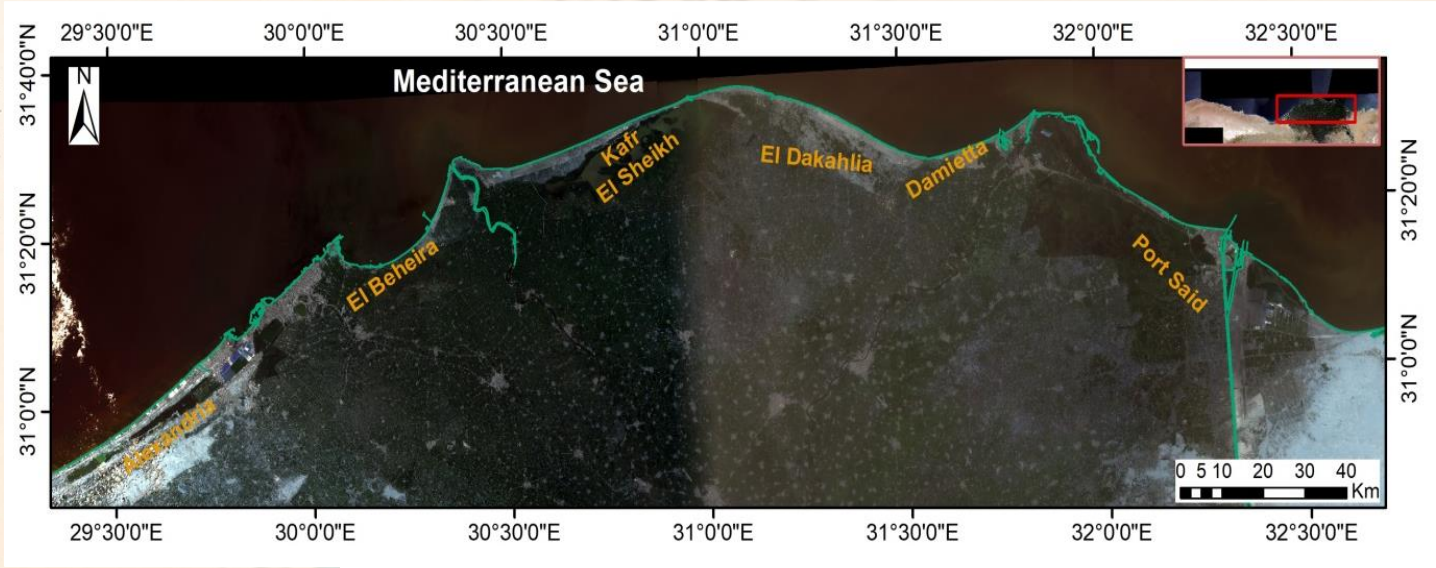
Coastal Erosion (CE)

– Nile Delta

- It comprises the coastal strip which extends for about 60 km between the Damietta promontory at Ras El-Bar and Port-Said along the inlet of the Suez Canal and extends southward for about 40 km from the Mediterranean coast.

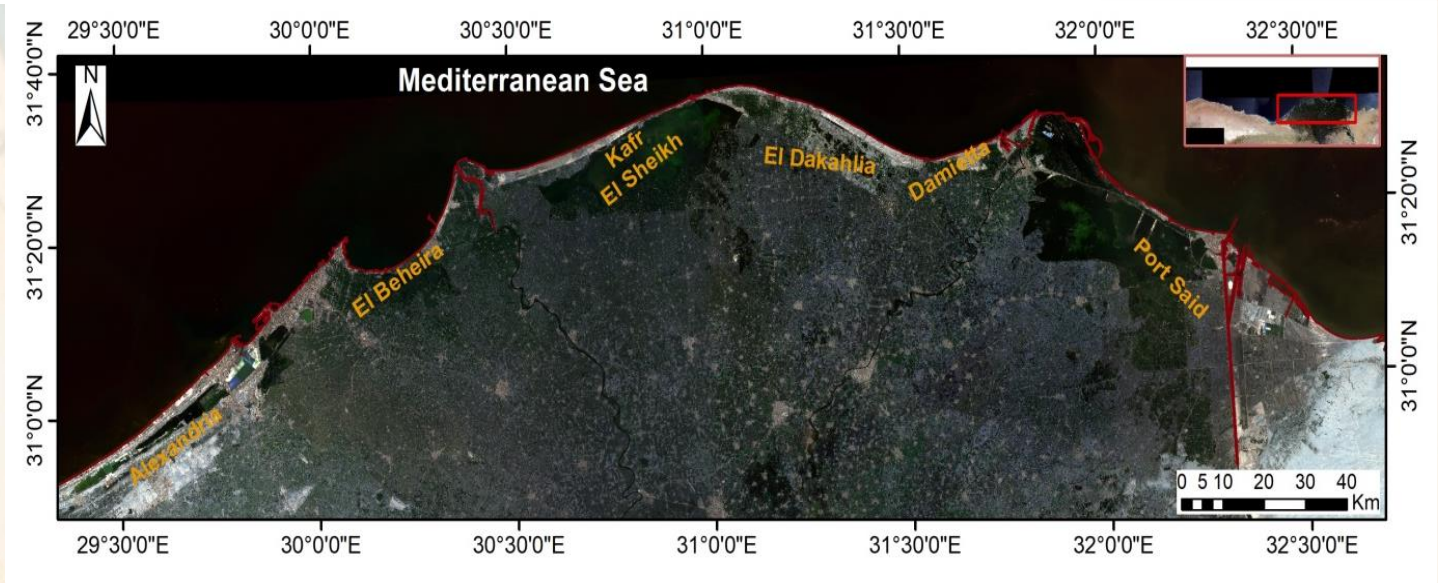


- Shore line over −5 years – **Sentinel 2– 10 m Res**. (short time detection)



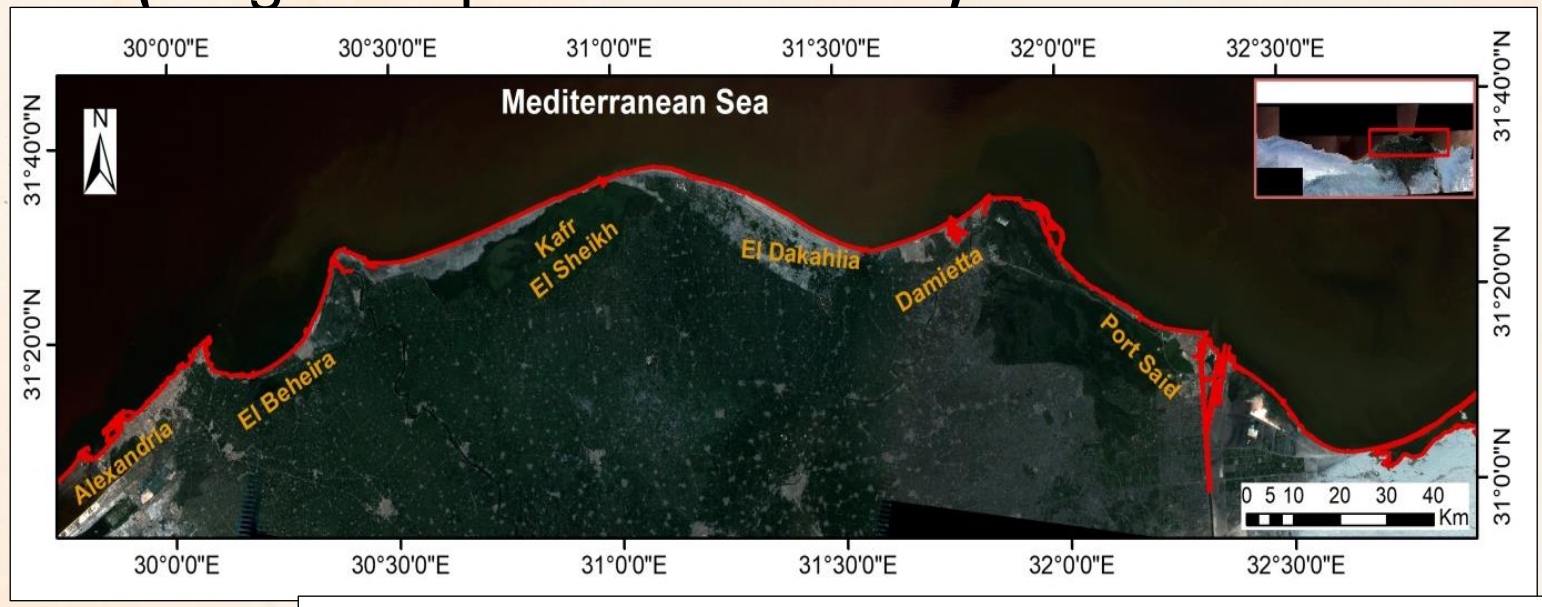
2015

Results

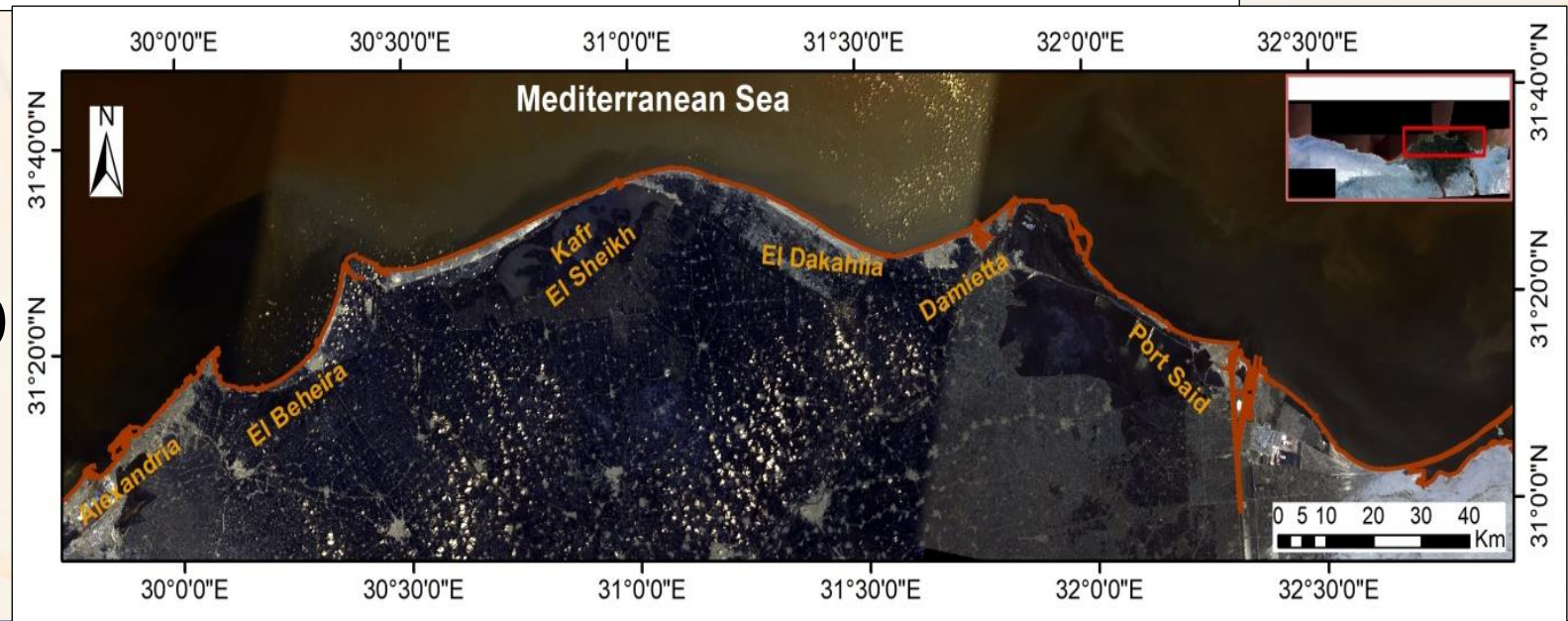


2020

- Shore line over 10 years – **landsat 8 – Res. 30 m** (long time period detection)



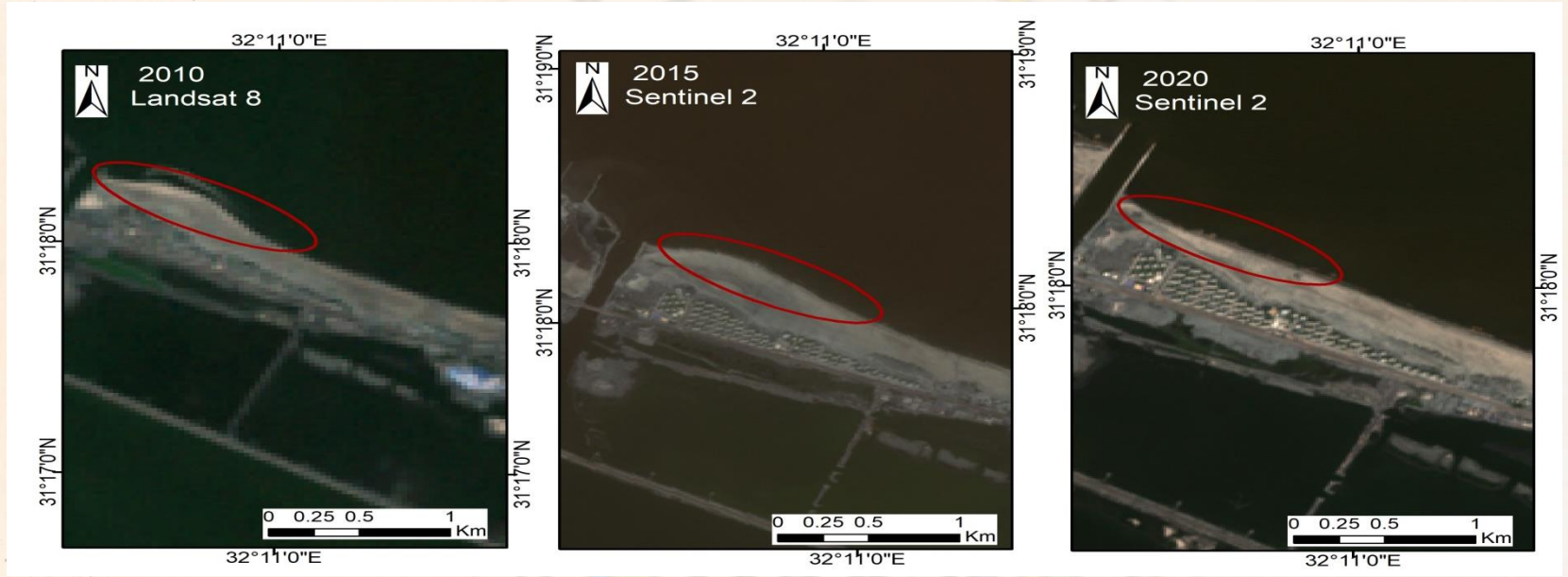
2010



2020

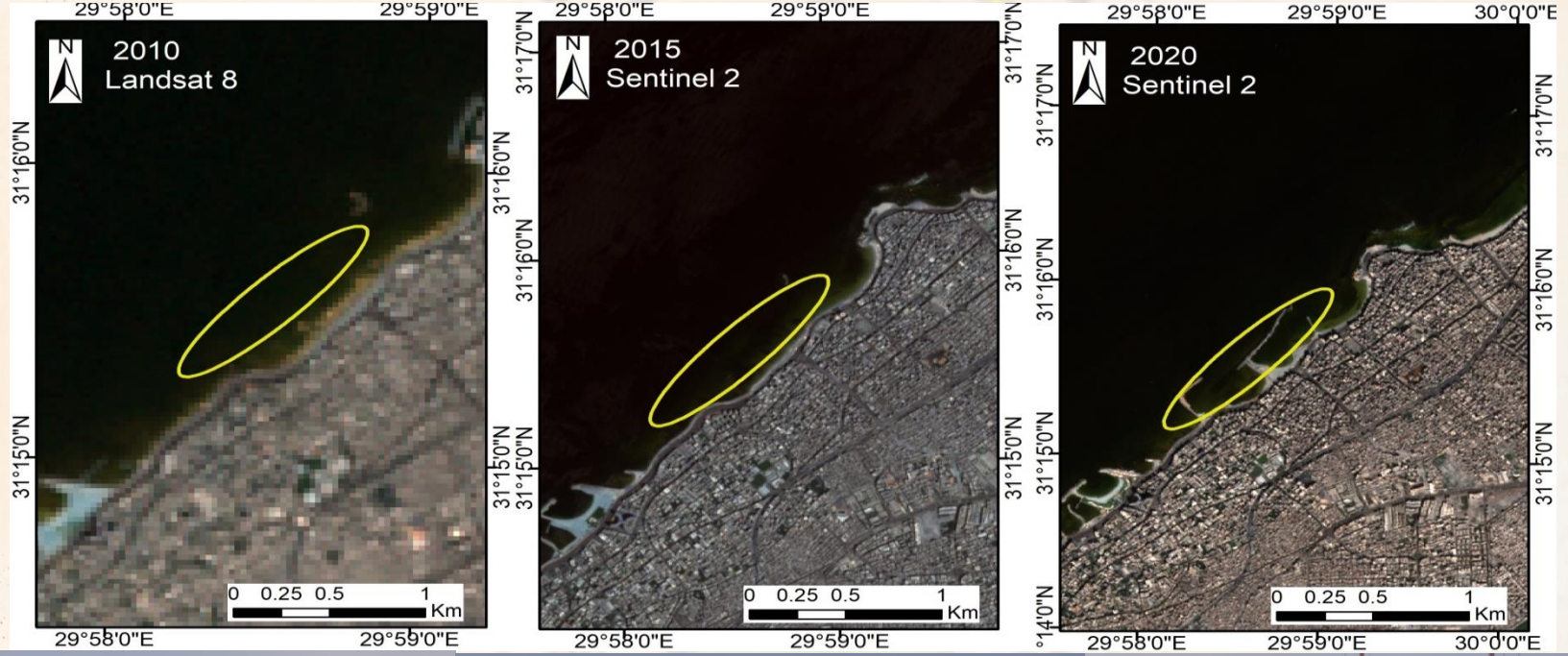
Location 23 – Port Said

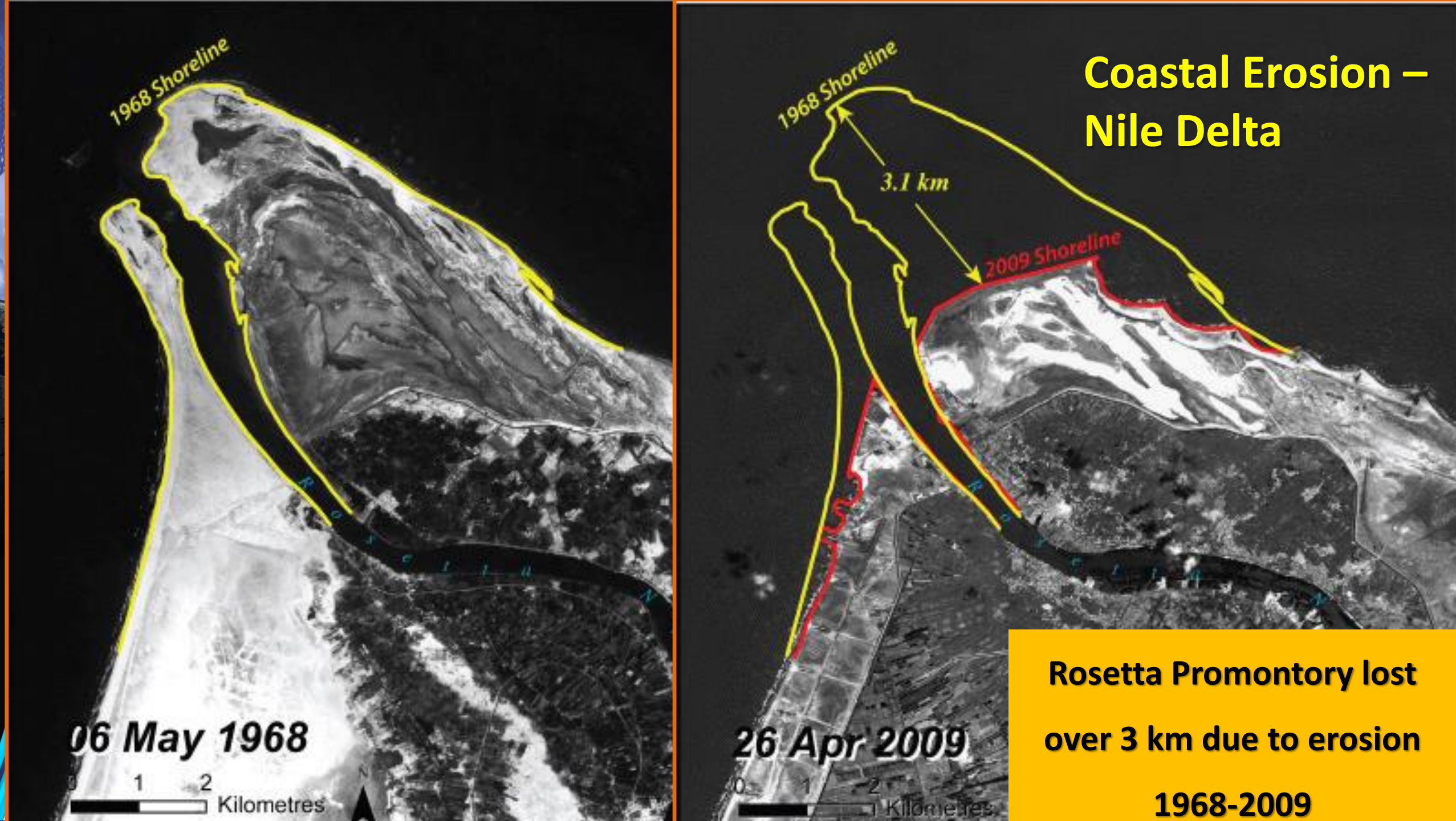
✓Erosion (**Red circle**) was about $0.14\ km^2$ within 5 years .



Location 3 – Sidi Besher–Alexandria

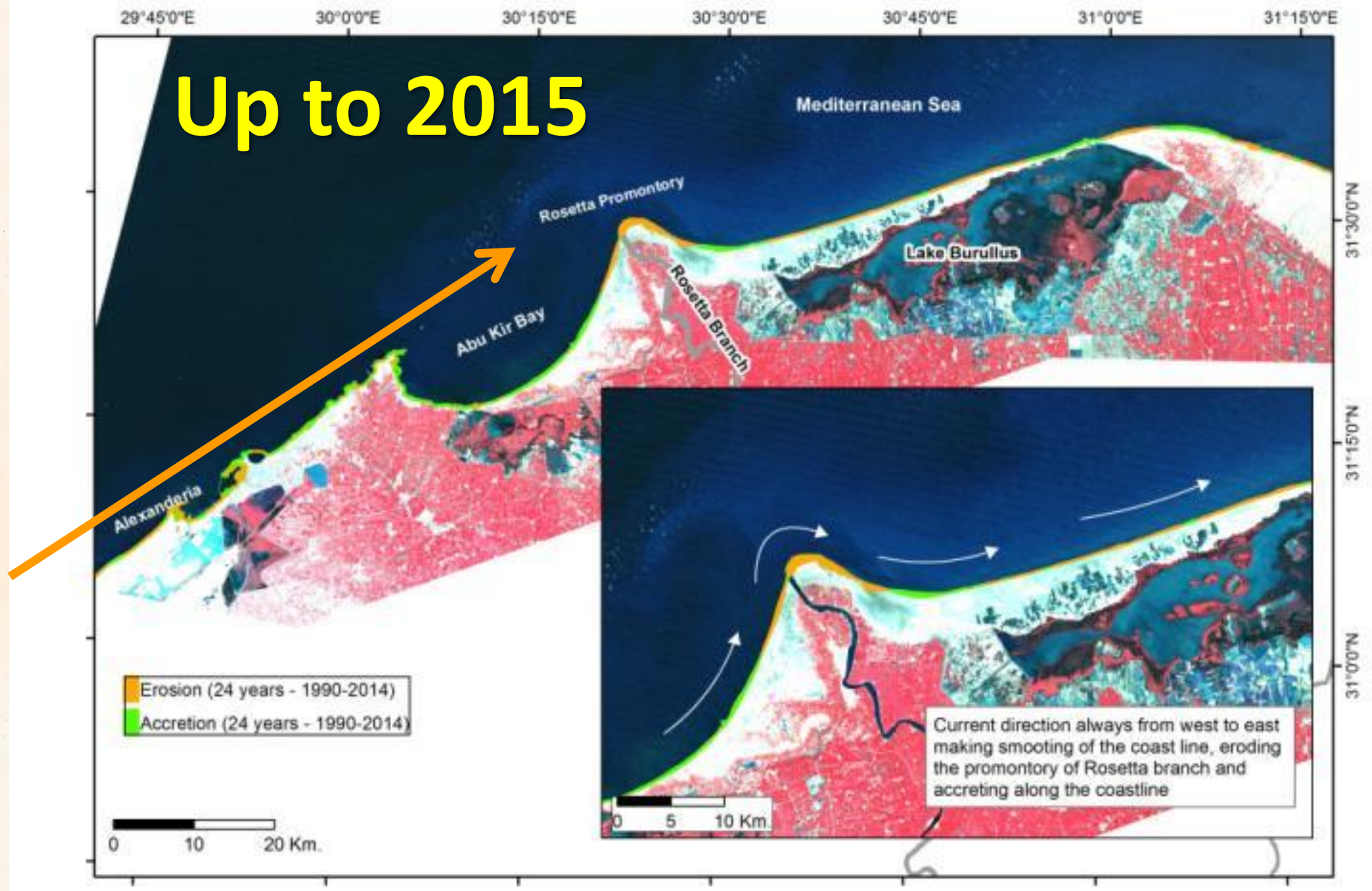
✓Protection constructions (**yellow circle**) were built to protect beaches and residential areas

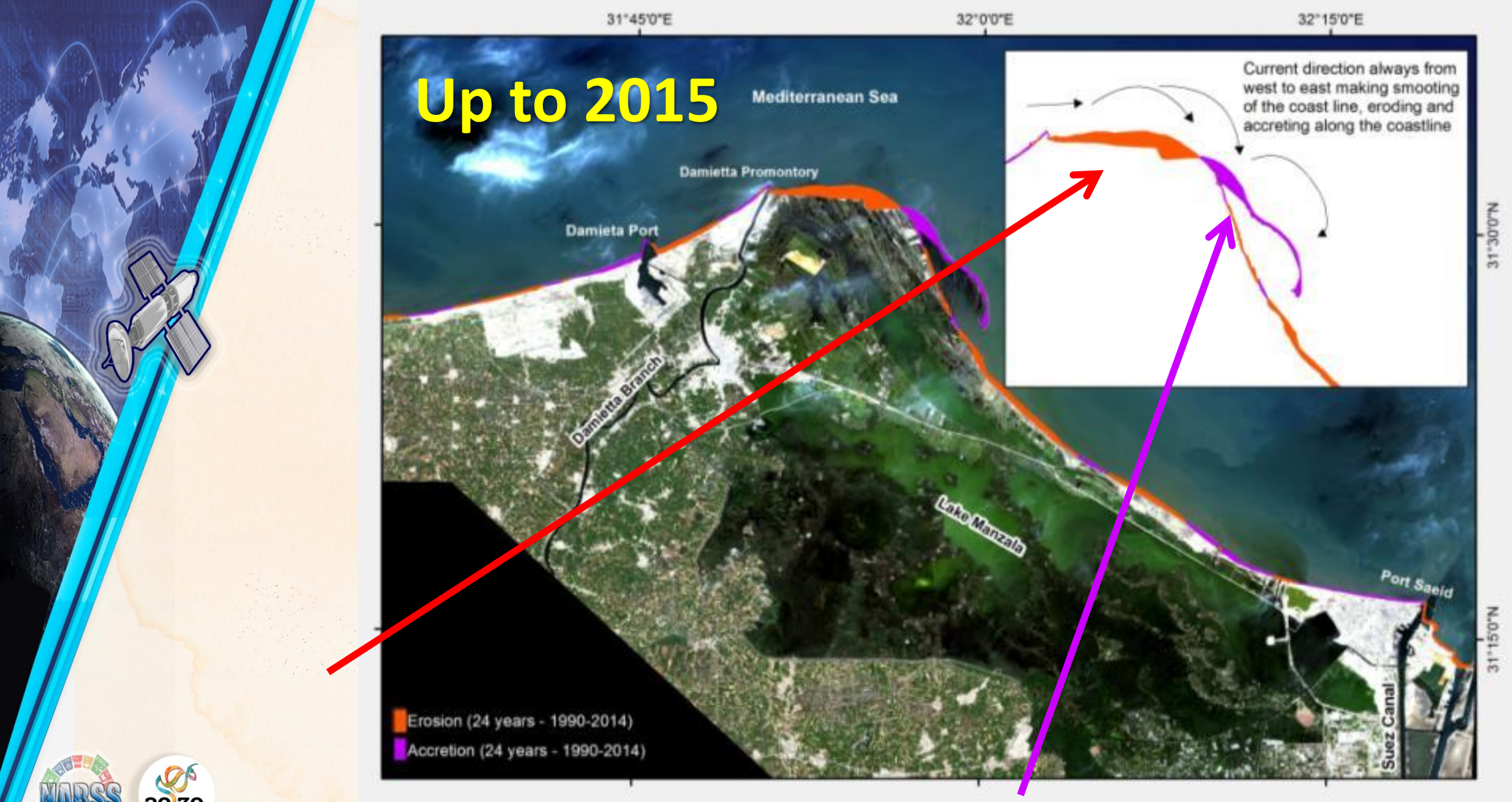




Coastal Erosion – Nile Delta

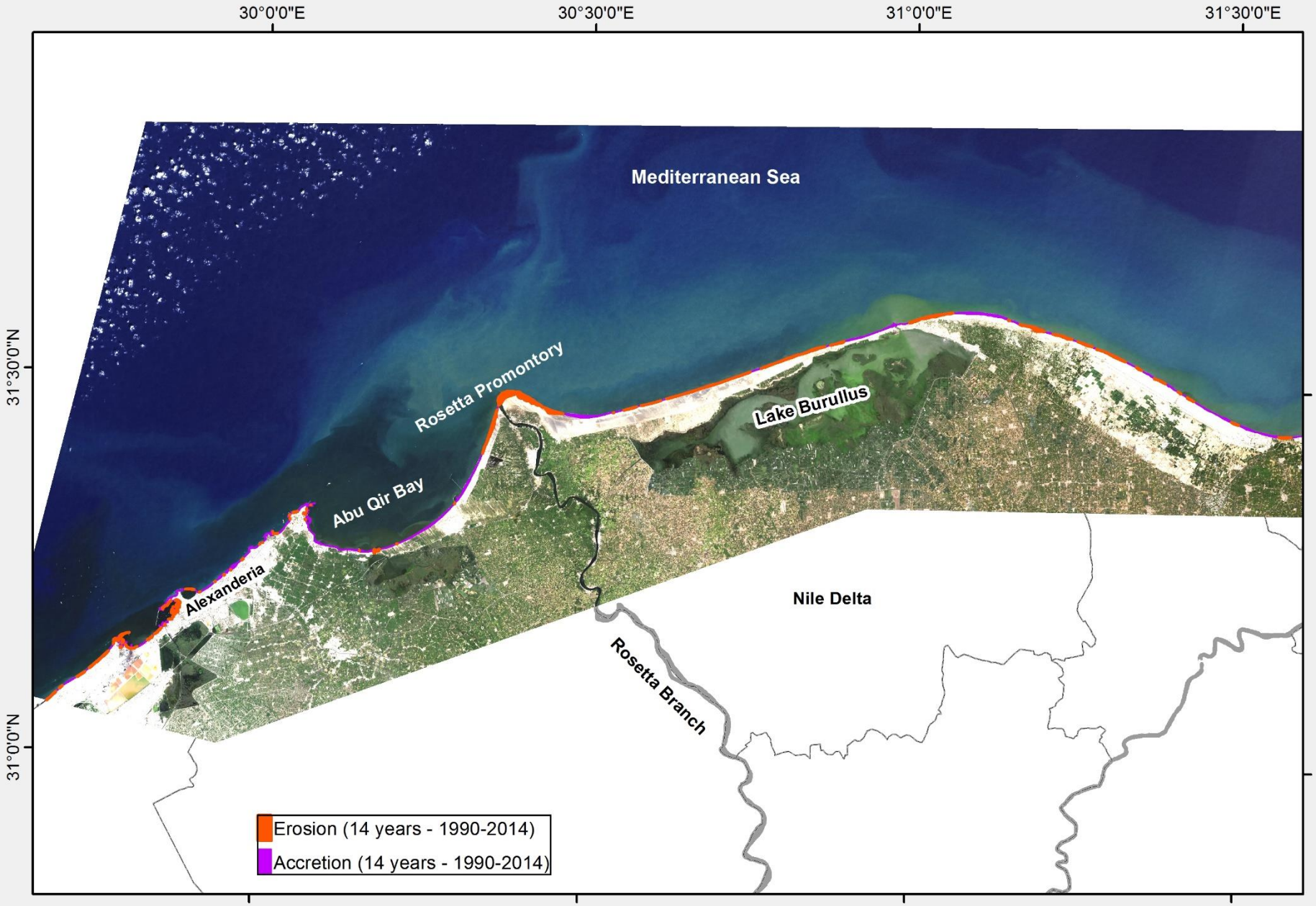
Rosetta Promontory lost over 3 km due to erosion 1968-2009

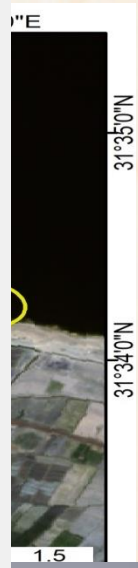

Up to 2015
29°45'0"E
30°0'0"E
30°15'0"E
30°30'0"E
30°45'0"E
31°0'0"E
31°15'0"E
31°30'0"N
31°15'0"N
31°0'0"N
Mediterranean Sea
Rosetta Promontory
Lake Burullus
Rosetta Branch
Abu Kir Bay
Alexandria
Erosion (24 years - 1990-2014)
Accretion (24 years - 1990-2014)
0 10 20 Km.
0 5 10 Km
Current direction always from west to east making smooting of the coast line, eroding the promontory of Rosetta branch and accreting along the coastline

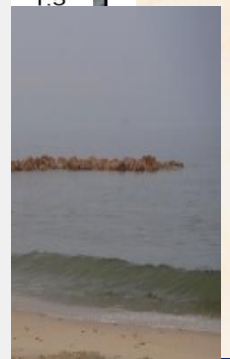


- The total area deposited in the last 25 years is 3.14 Km^2

0.65 km²


30°0'0"E
30°30'0"E
31°0'0"E
31°30'0"E
31°30'0"N
31°0'0"N
Mediterranean Sea
Rosetta Promontory
Abu Qir Bay
Lake Burullus
Alexanderia
Nile Delta
Rosetta Branch
Erosion (14 years - 1990-2014)
Accretion (14 years - 1990-2014)

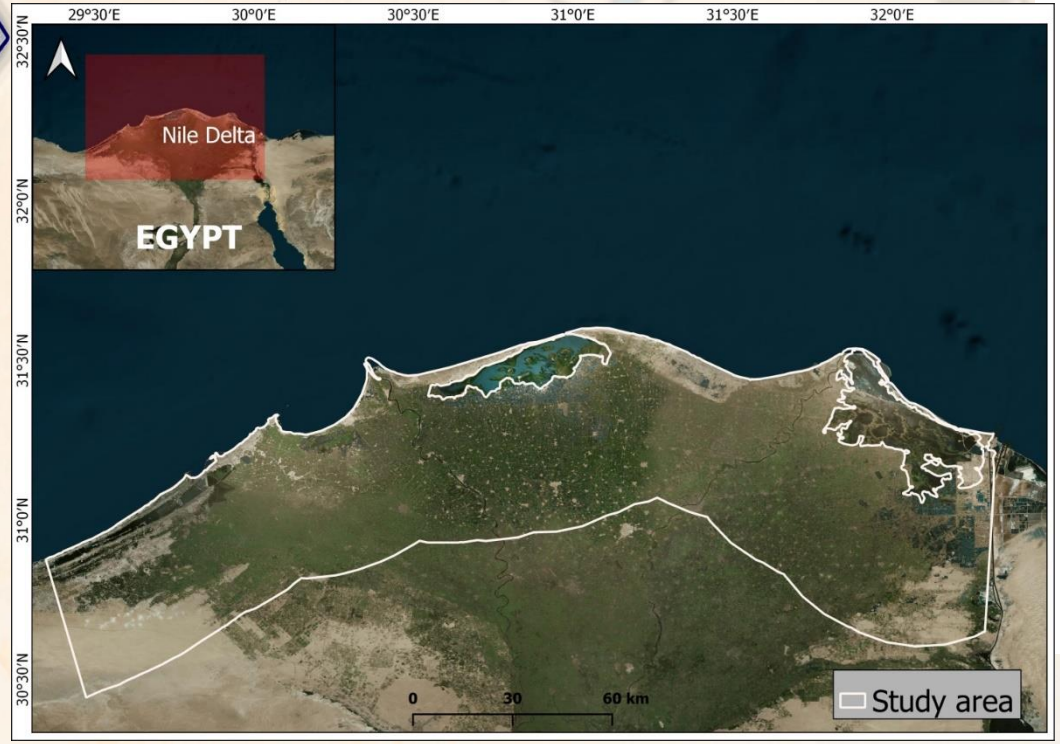

31°35'0"N
31°34'0"N
1.5

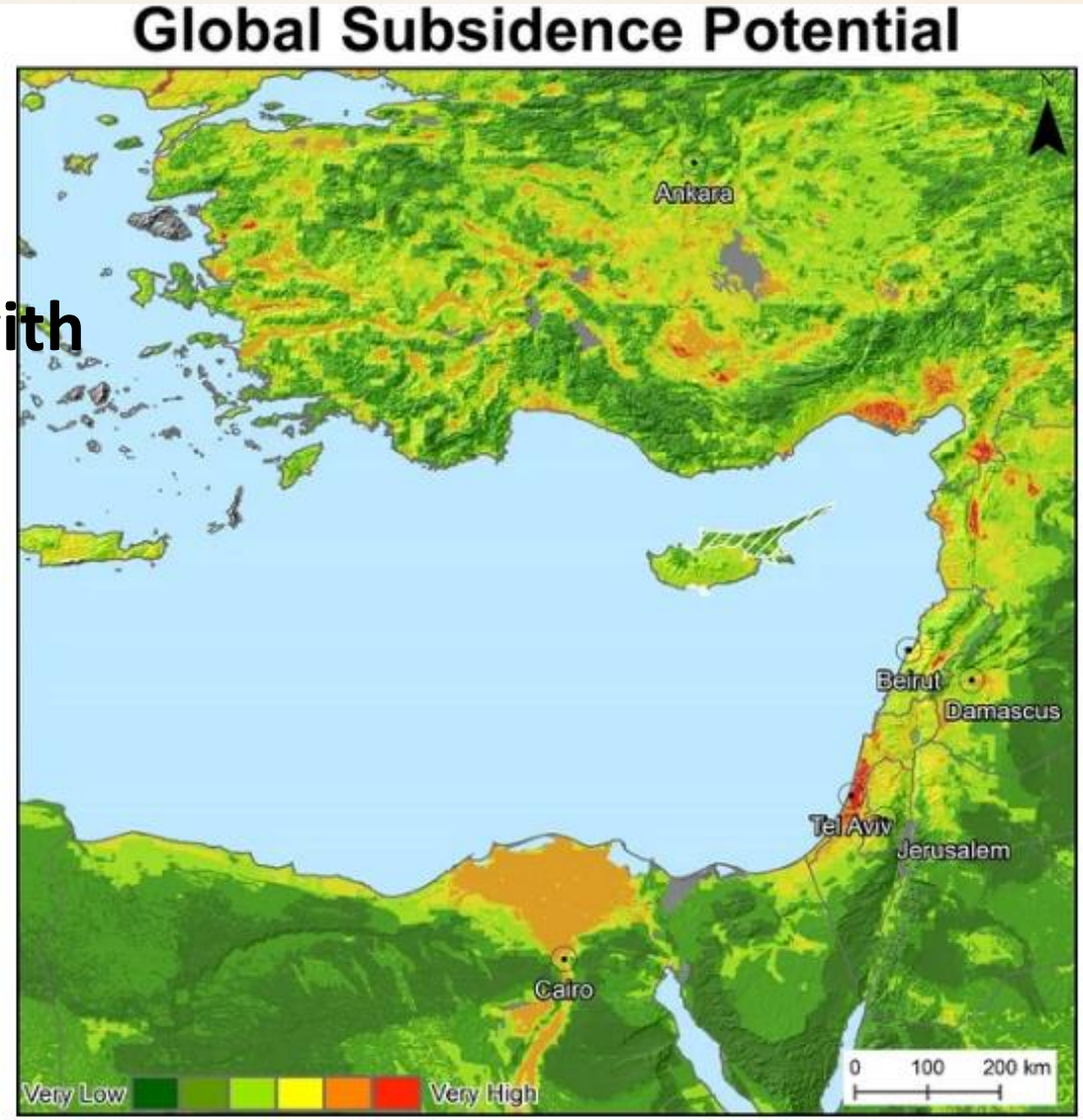


Examples

Land Subsidence (LS)

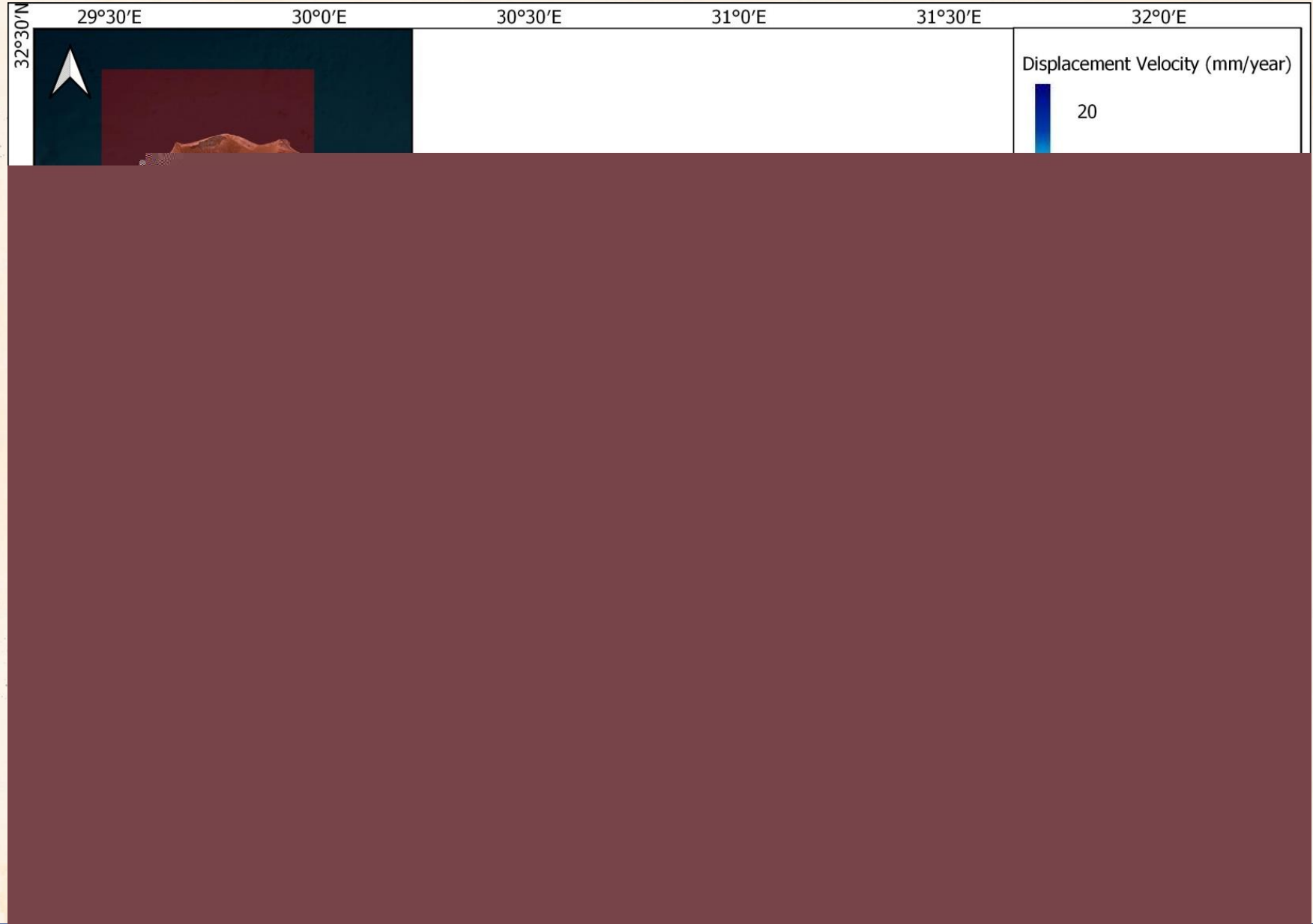
Nile Delta is among the areas with potential to land subsidence





Credit: Gerardo Herrera أبرز مناطق الهبوط في دلتا النيل وشرق المتوسط

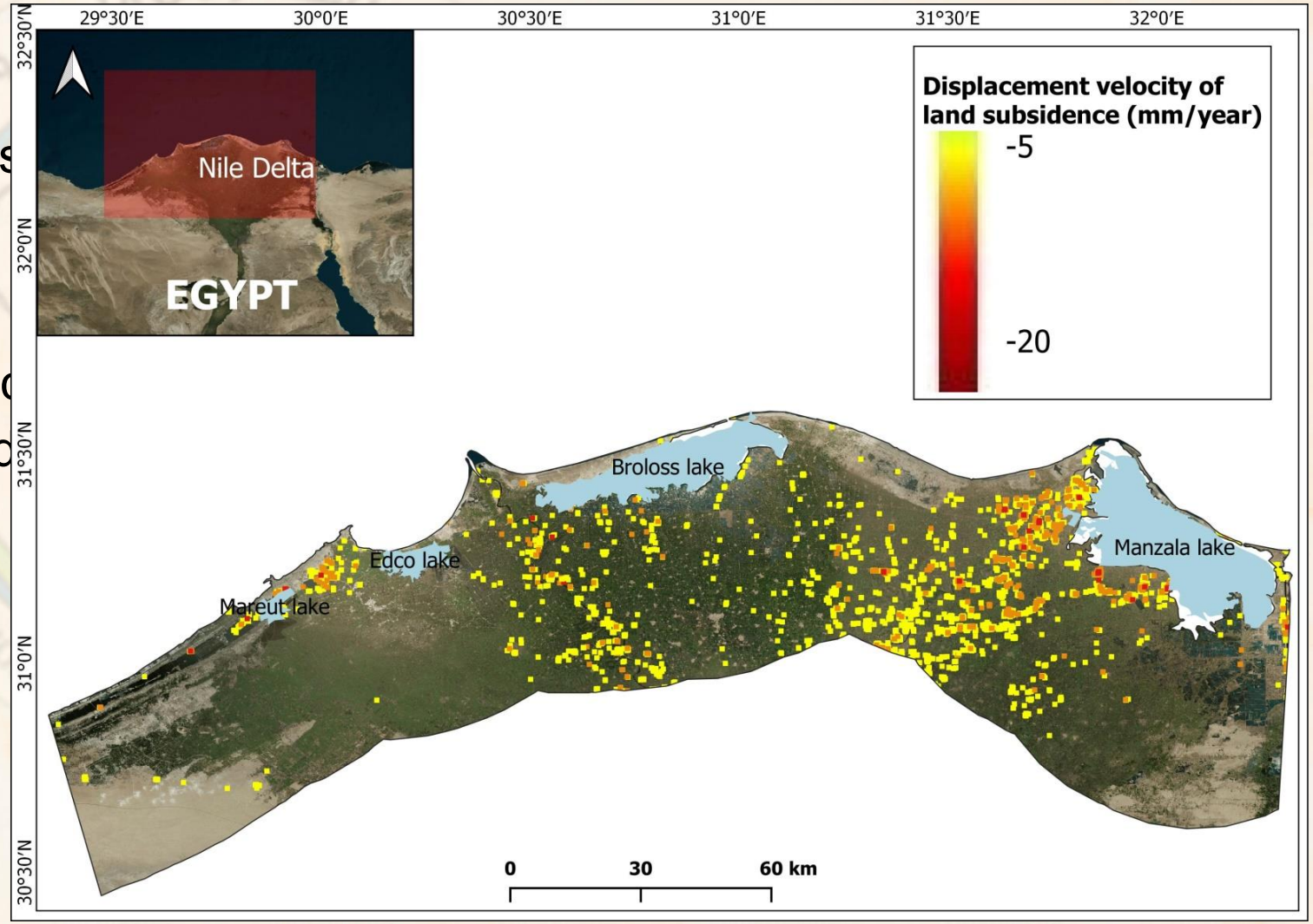
- 60 Km of the Mediterranean cost


29°30′E
30°0′E
30°30′E
31°0′E
31°30′E
32°0′E
32°30′N
Displacement Velocity (mm/year)
20

The of 110 Sentinel-1 Single look complex (SLC) products for the Nile Delta from 2015-2020 using Permanent Scatters Interferometry (PInSAR).

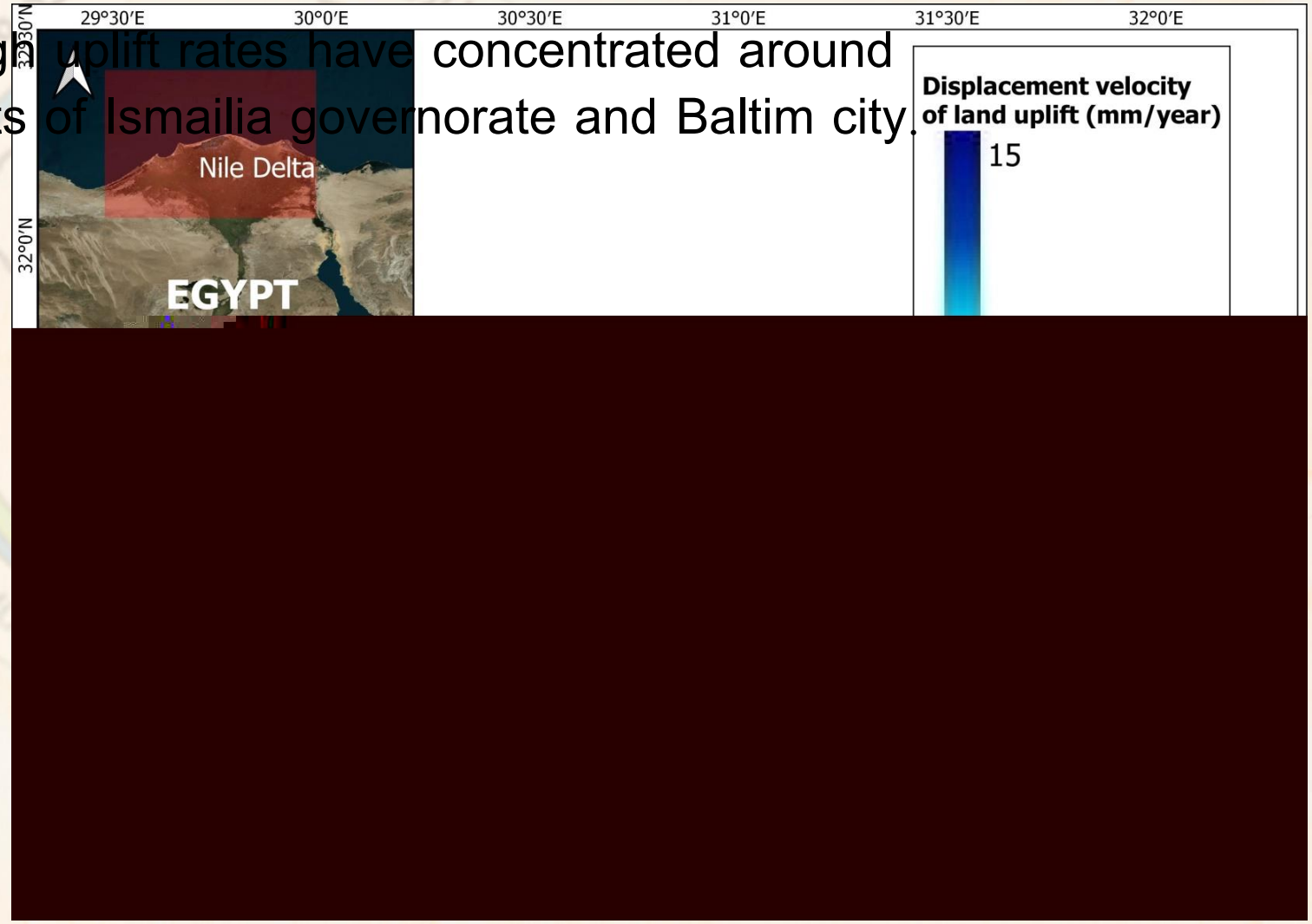
1- Subsidence

- SNAPPING service has
  period
- High rates of subsidenc
  Damietta, Dakahlia and
-



2) Uplift

On the other side, high uplift rates have concentrated around Bardaweel Lake, Parts of Ismailia governorate and Baltim city.



Examples

Monitoring
Climate– related factors

Universal attention

IPCC/UN

WG I AR6

WG II

WG III

COP 1 - COP26

COP27

MedECC

UfM

CC

@ the Global context

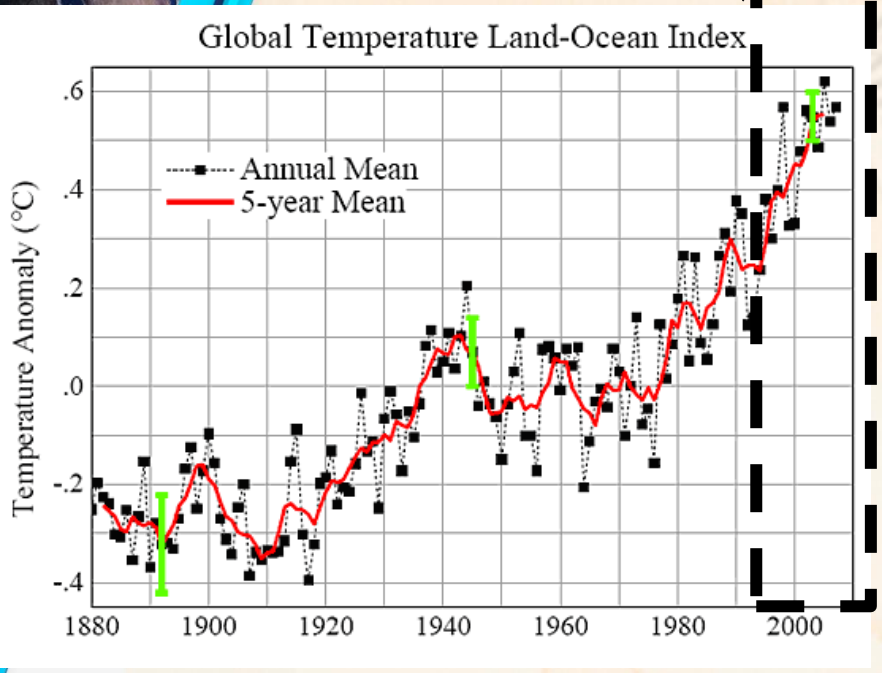
Warming means:

–Increases in global sea and air temperatures

–Rising global sea level

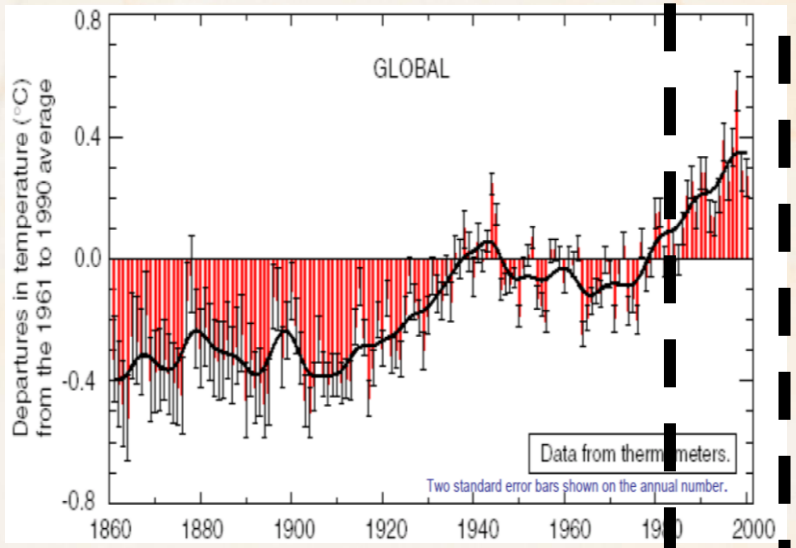
The land–ocean temperature index:

Source: NASA (January 2008)



Annual land–surface air temperature/sea surface temperature (combined data)

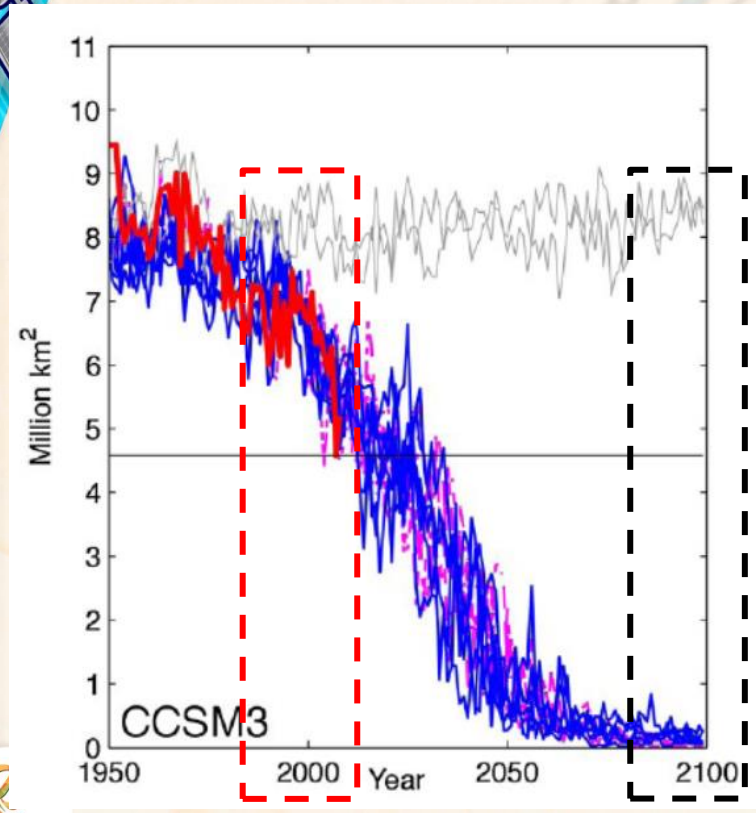
1860 – 2000



Source: AR3, IPCC, 2001

@ the Global context

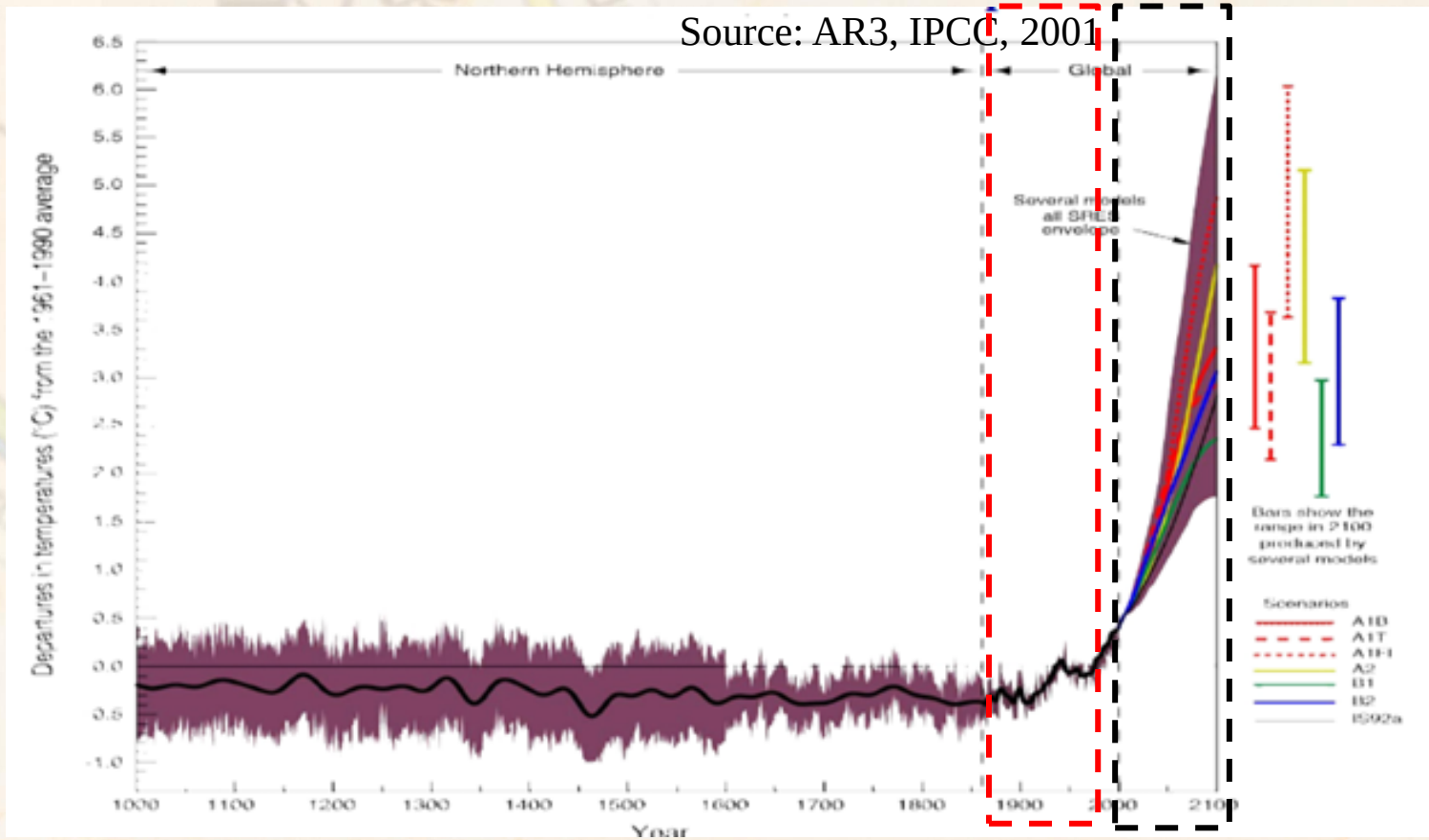
Rabid loss of Arctic sea



Source: AR4, IPCC, 2004

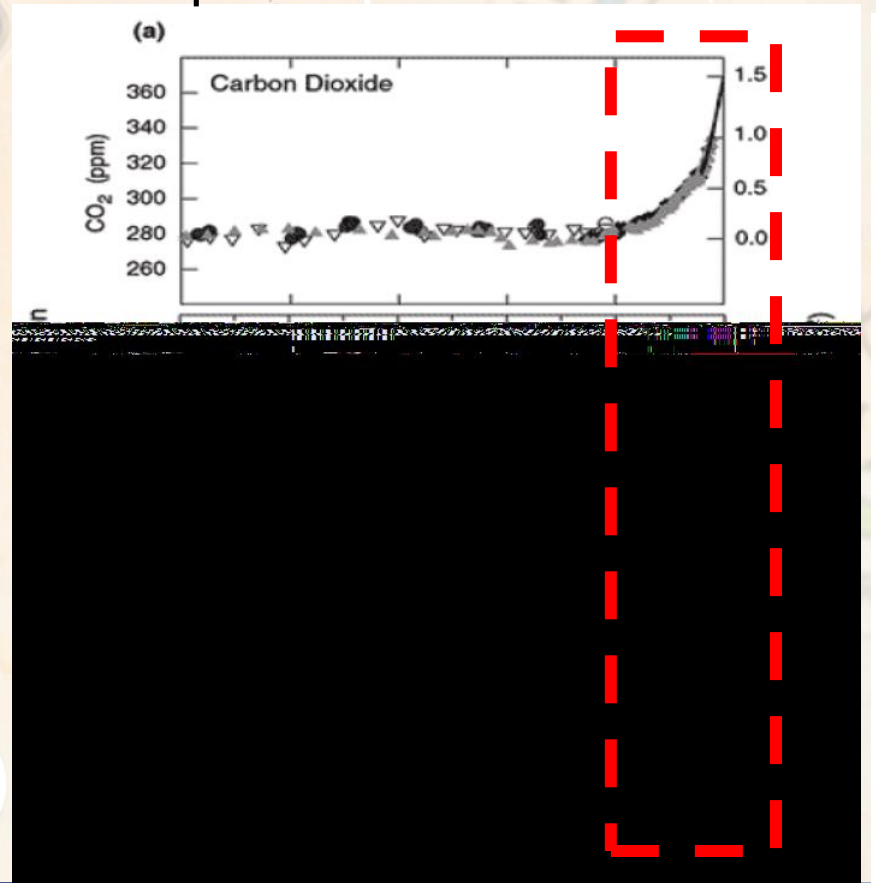
Variations of mean Earth's surface temperature from 1000 to 2100 - **Modelled data**

Source: AR3, IPCC, 2001

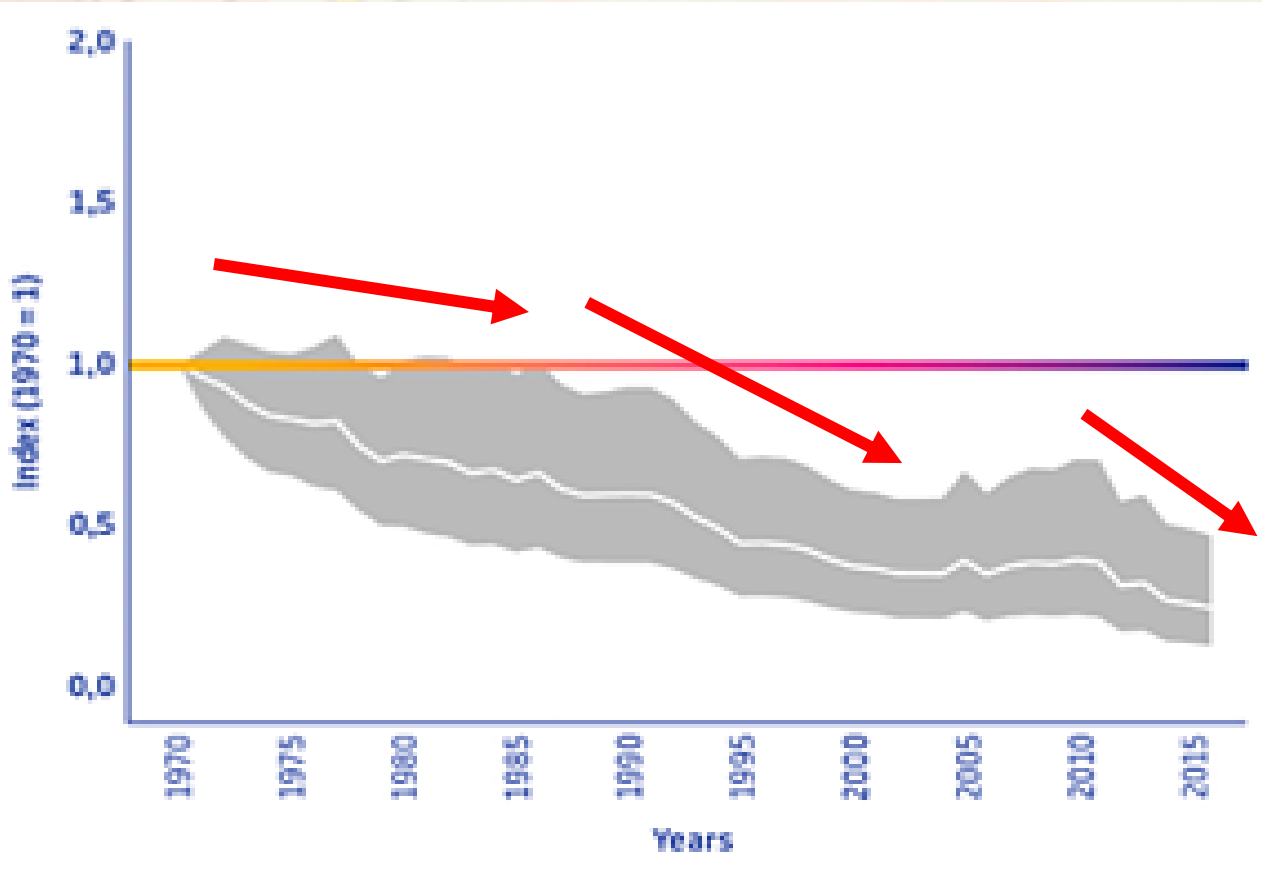


@ the Global context

Greenhouse gasses in the atmosphere (AR3 – IPCC, 2001)



Living planet index: showed 75% average decline in populations for the period of 1970 to 2016



Major vulnerability to Climate change

1. Increased air temperature
2. Increased sea surface temperature
3. Change in ocean salinity/acidity
4. SLR
5. Coastline changes
6. Salt intrusion
7. Agricultural shift
8. Biodiversity loss
9. Changed precipitation distribution map
10. Flooding and Hurricanes
11. others

Vulnerability of Economic Sectors

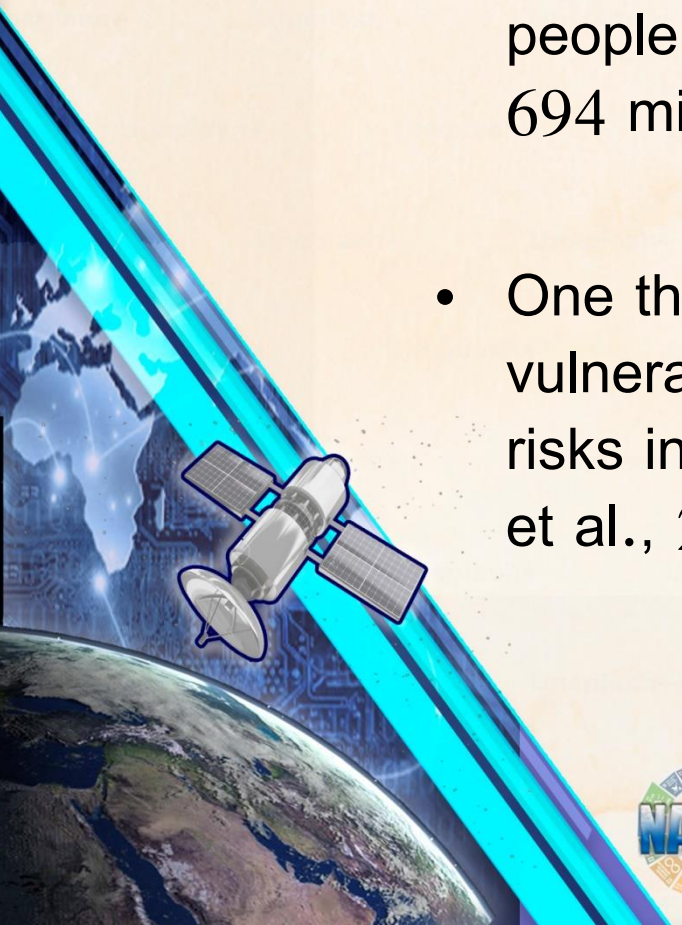
- Freshwater resources
- Agricultural sector
- Fish stocks
- Food security
- Mediterranean forests
- Regional tourism

Effect on Economy
Effects on Social behavior
Affect the Nationsl GDP

Human Vulnerability

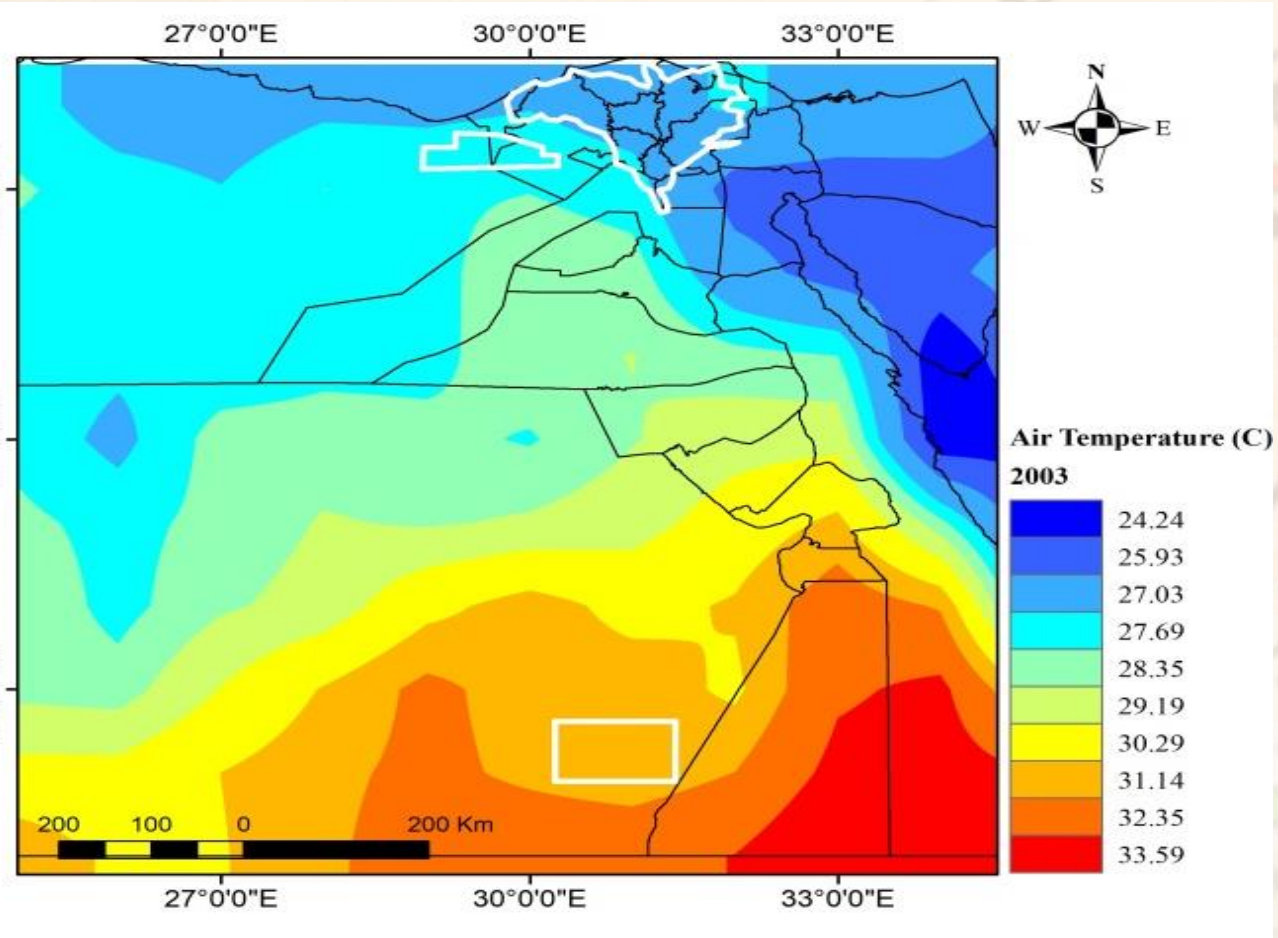
- Based on 2020 estimates, The Mediterranean Basin host about 542 million people and this number is exposed to increase to 657 million by 2050 and 694 million by 2100. (UN DESA, 2019).

- One third of the Mediterranean population (about 150 million people) are vulnerable to sea-level rise with countries that most vulnerable to coastal risks in the southeast part (e.g. Syria, Lebanon, Egypt, and Palestine (Satta et al., 2017).



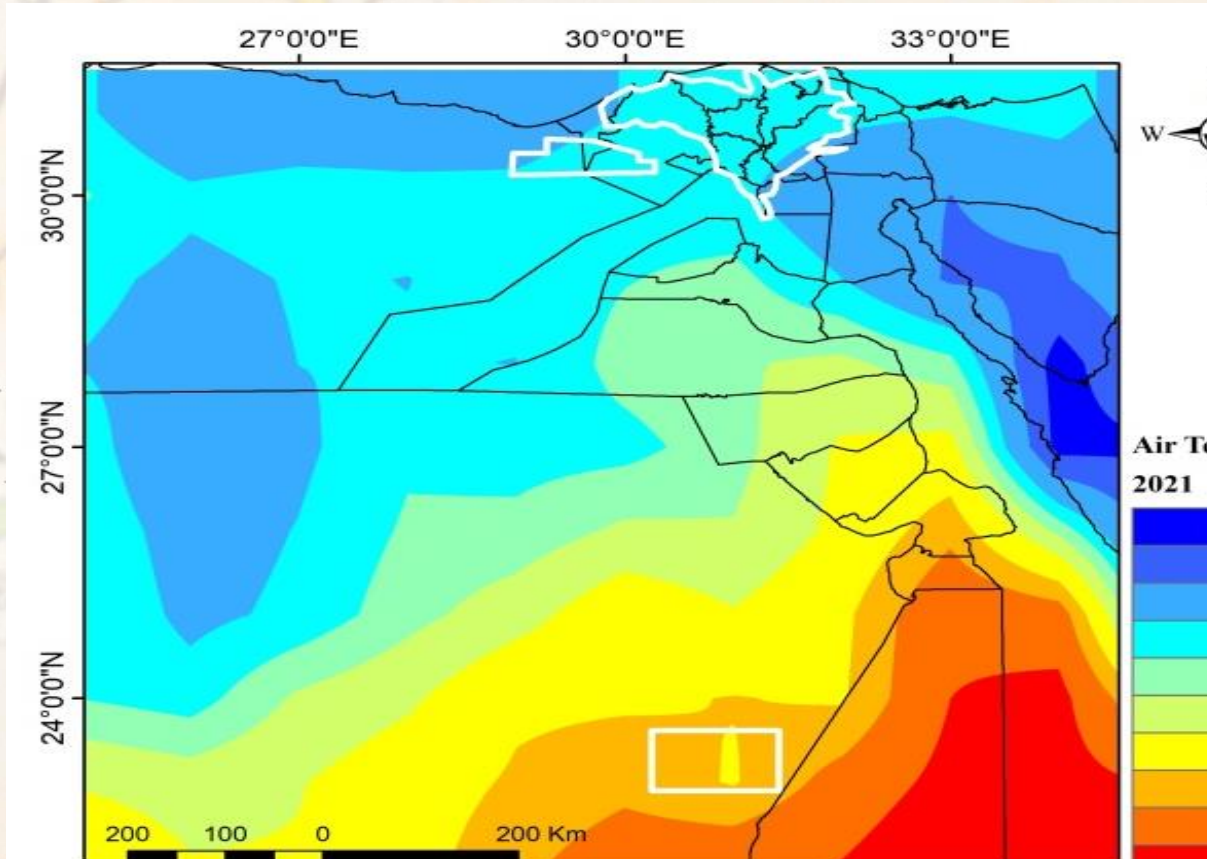
eStation Data

Air Temperature



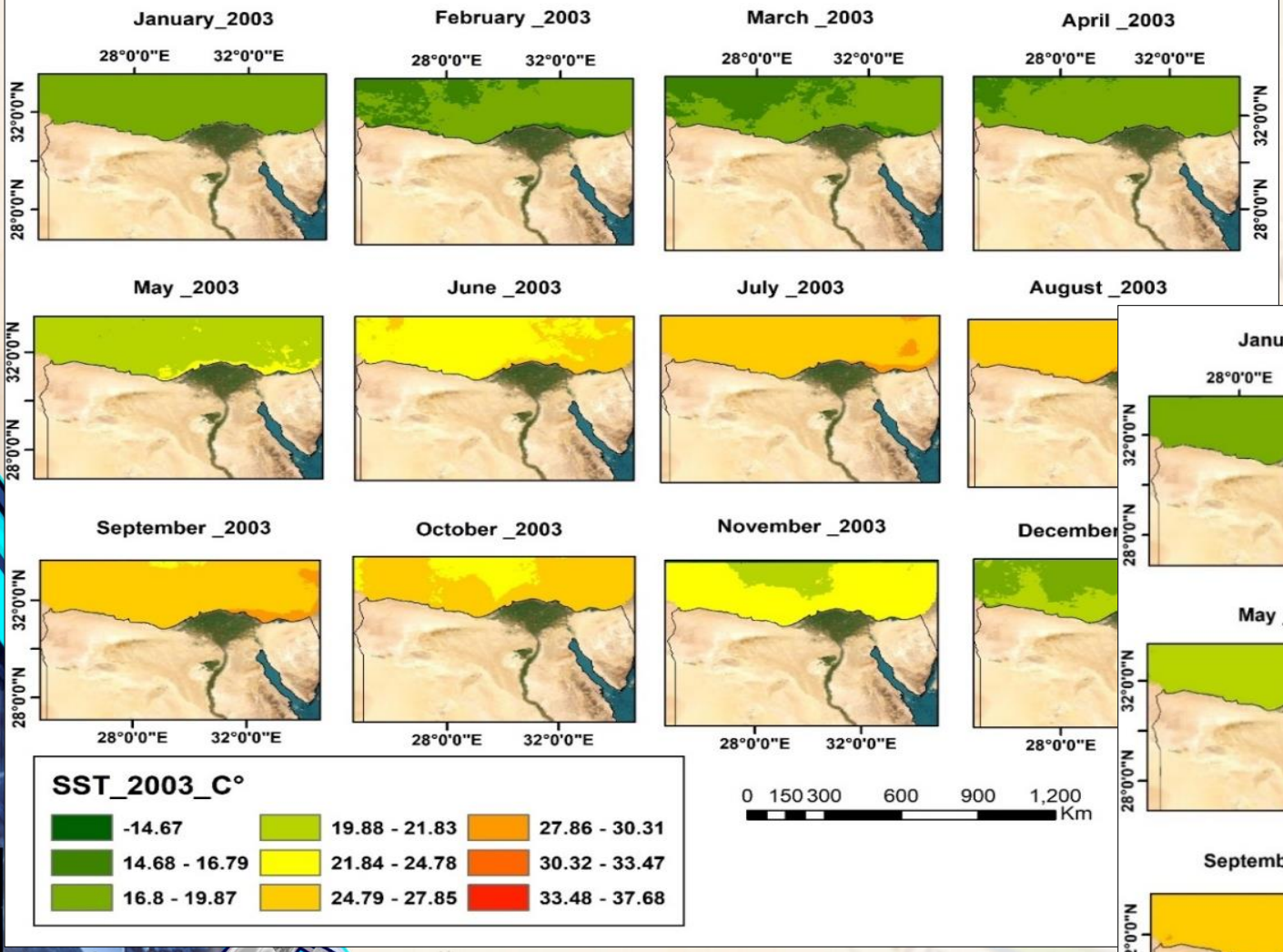
Difference in monitored Air Temperature near the surf

from 2002–2020 and in 2021

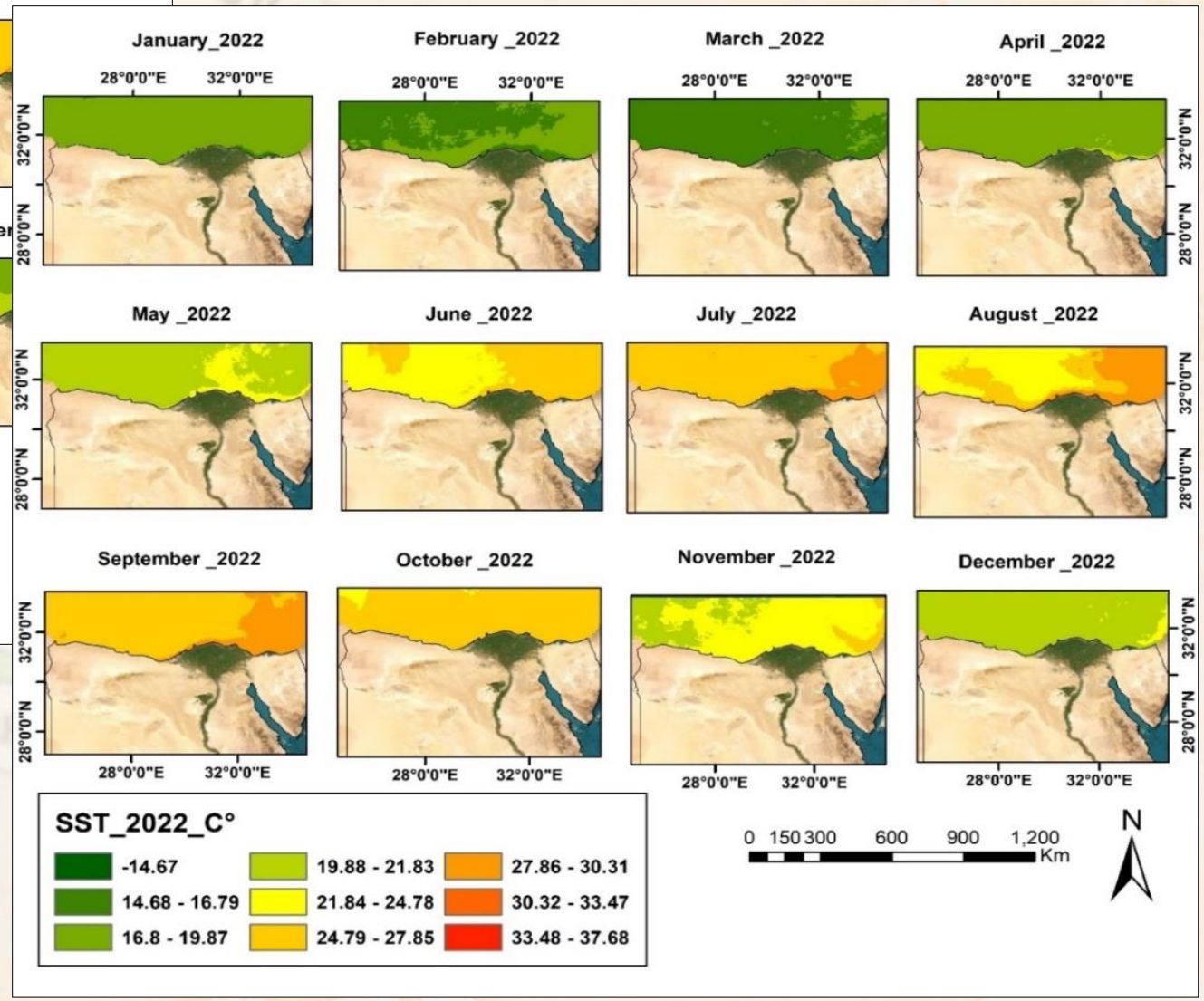


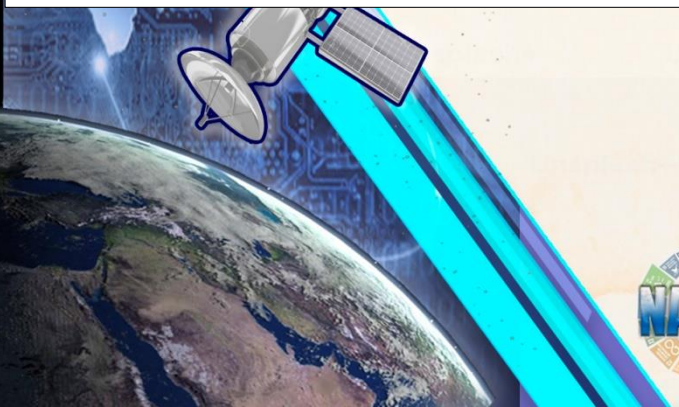
The Mediterranean Sea

2003



2022



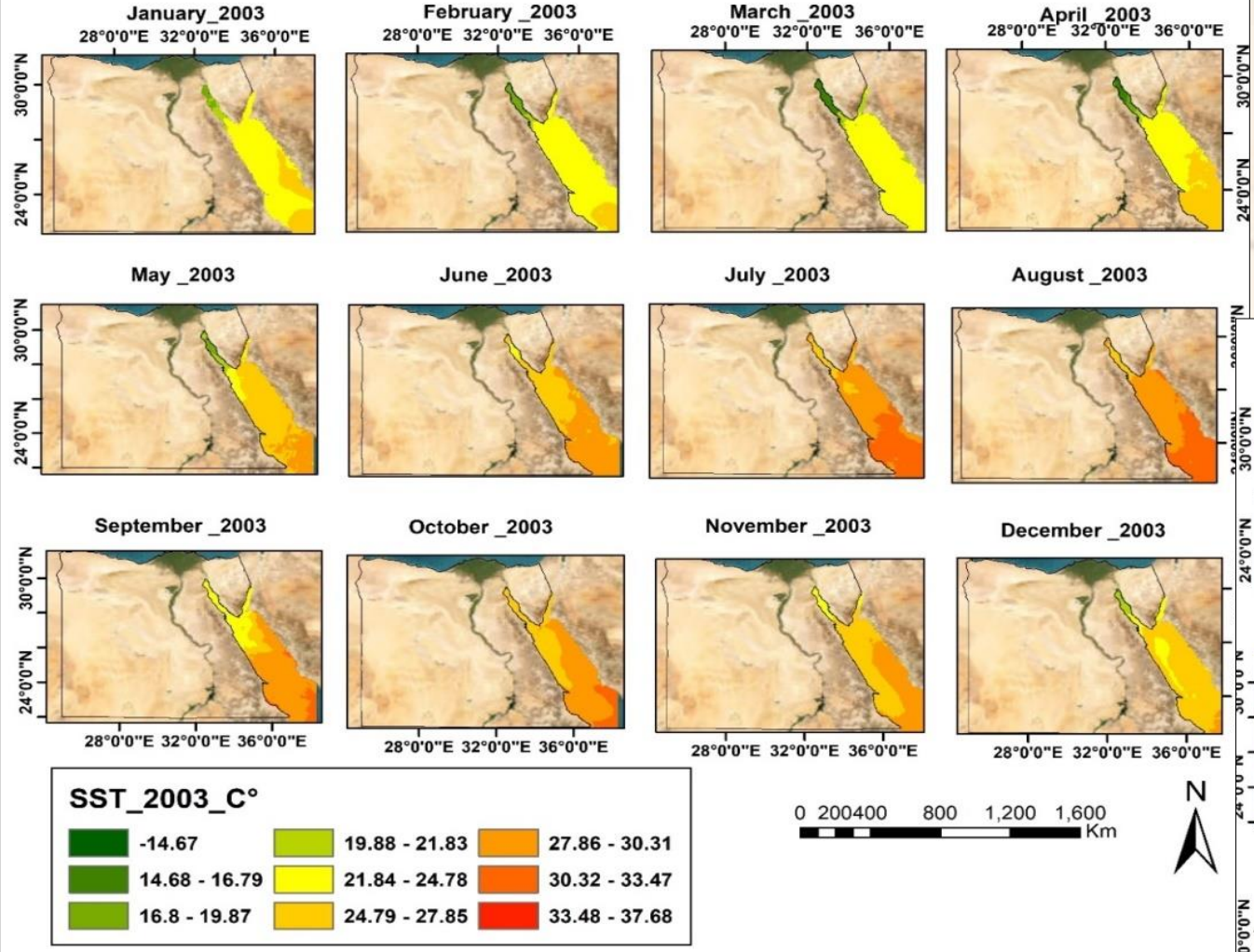


NARSS

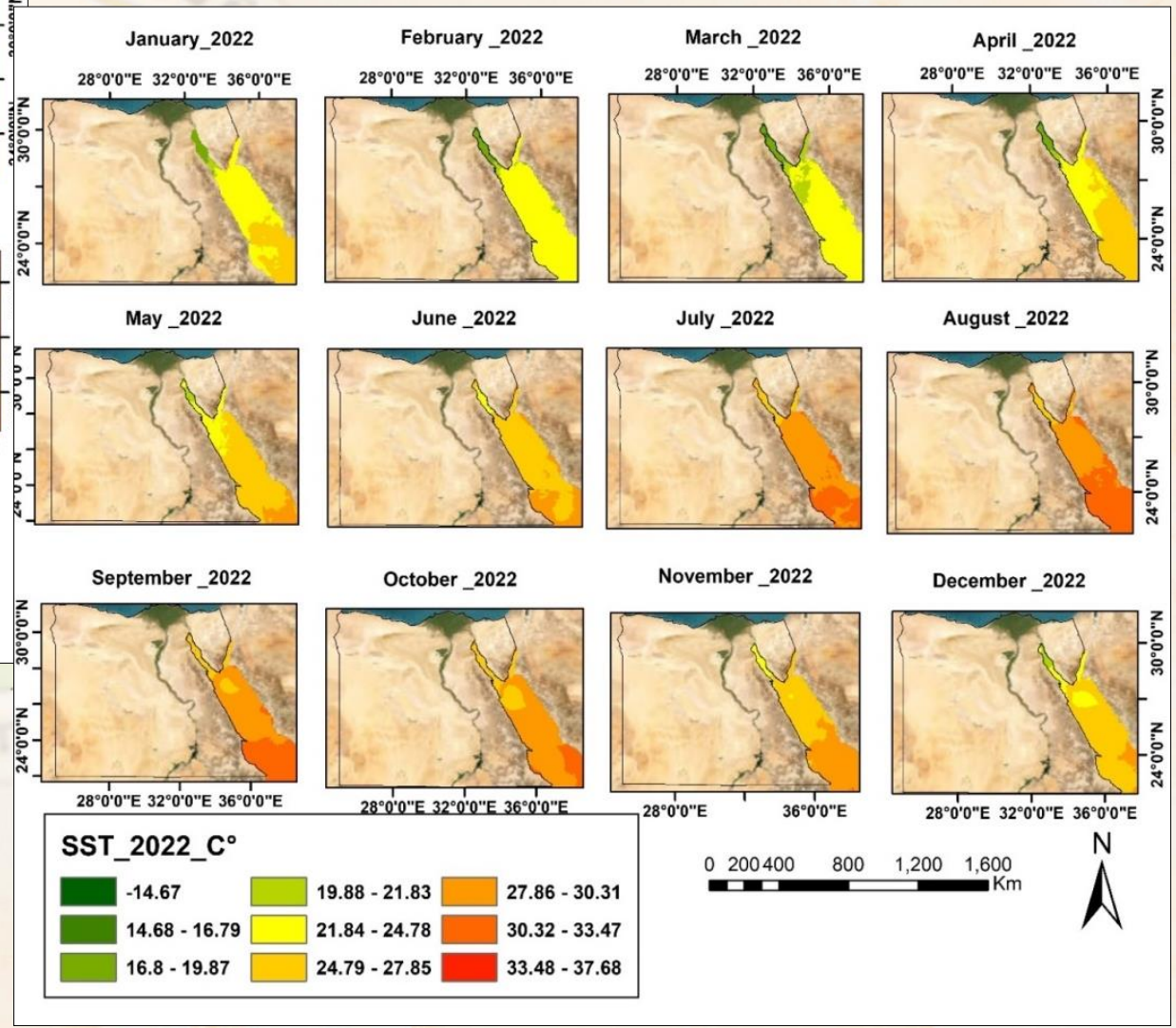
20/30 EGYPT VISION

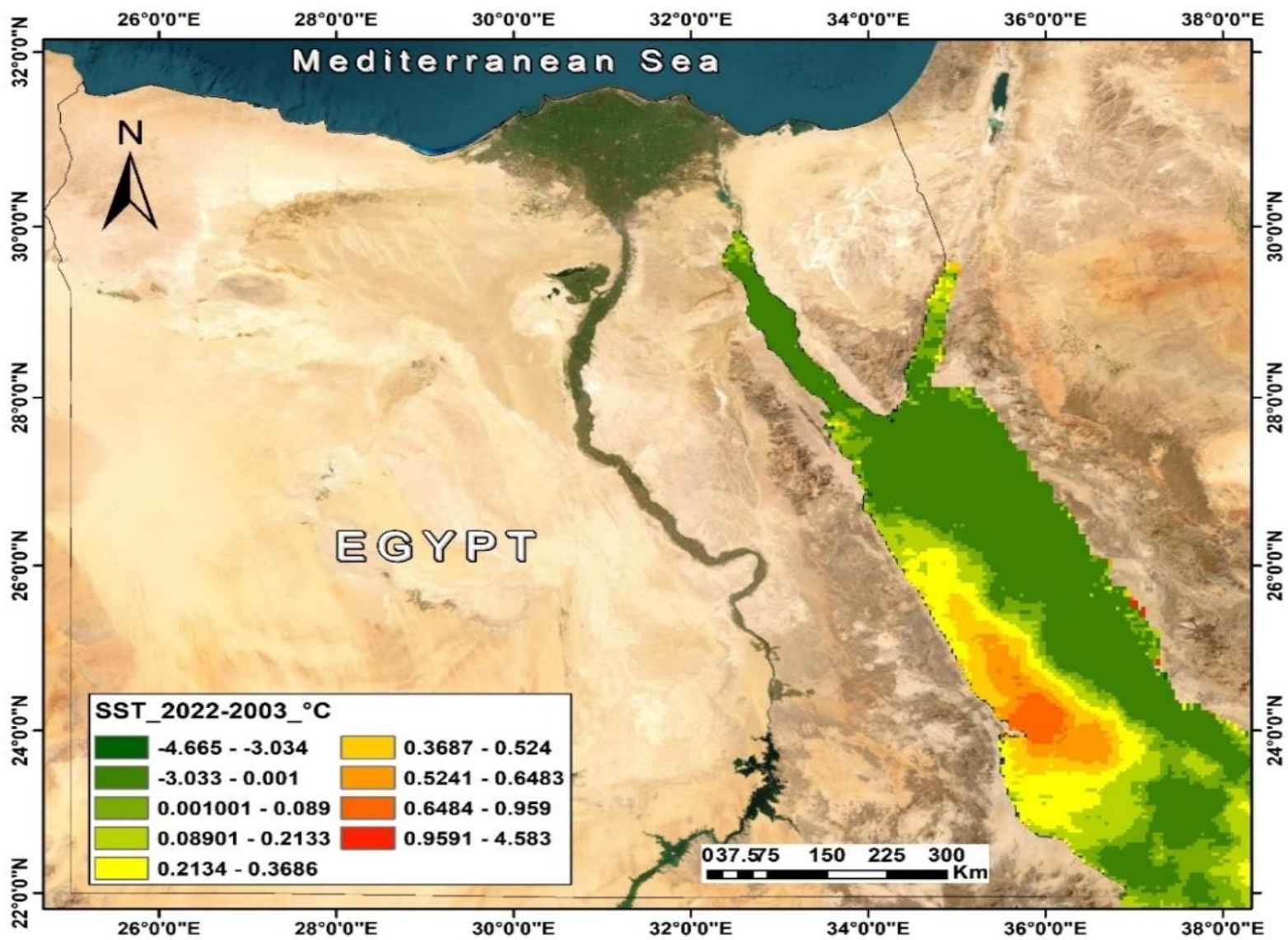
The Red Sea

2003



2022

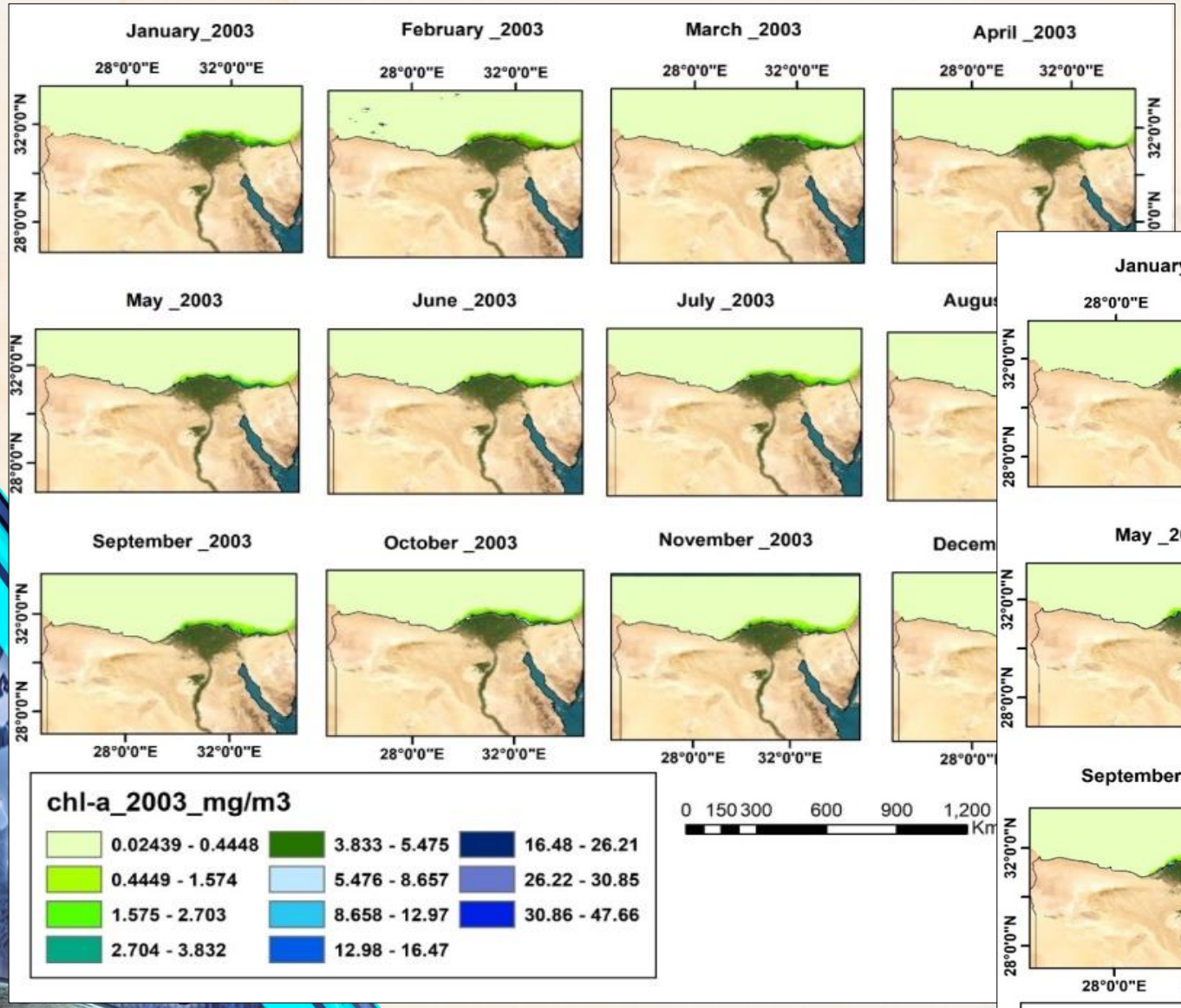


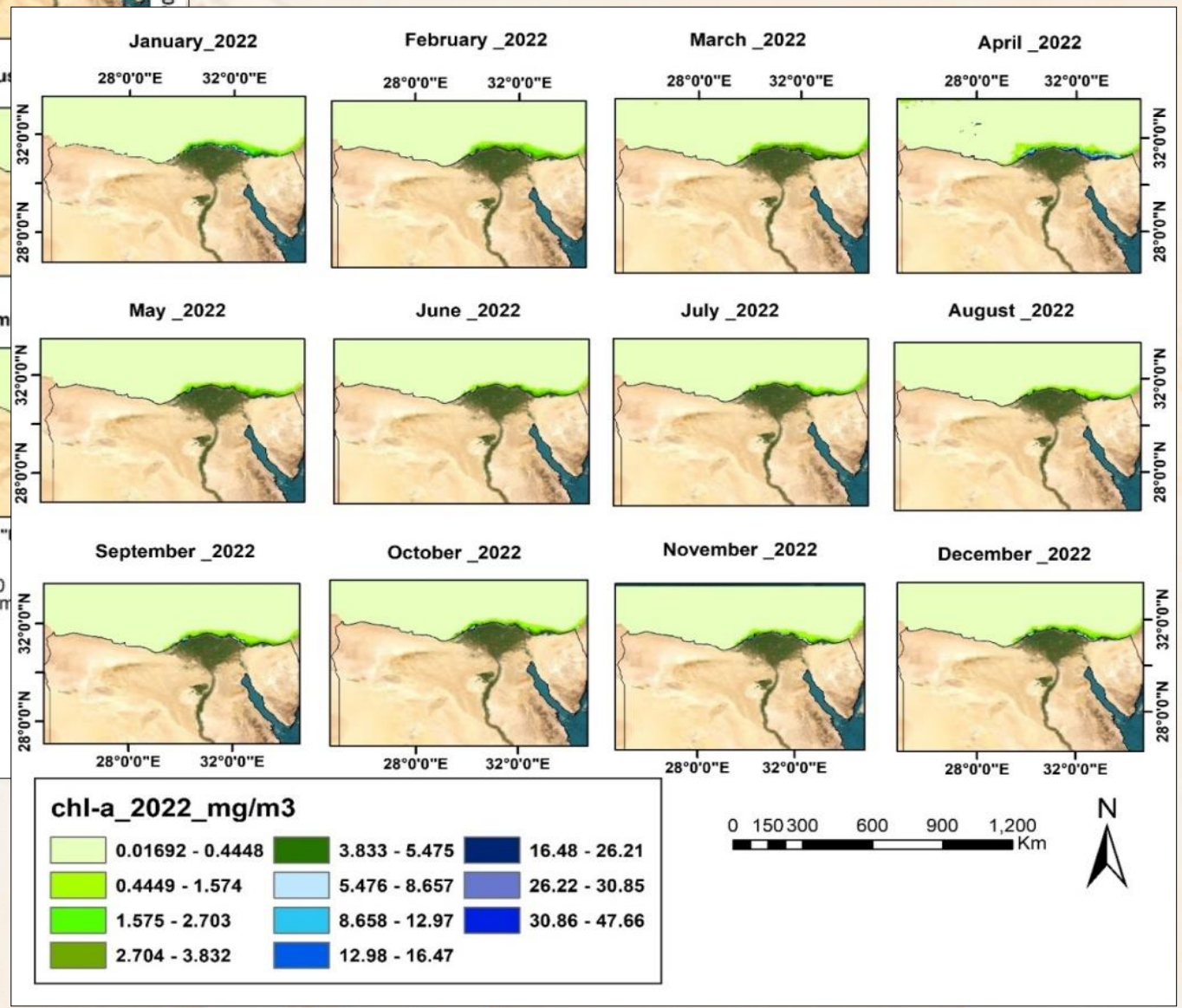


Rate of SST changes of Red Sea from 2022 −2003

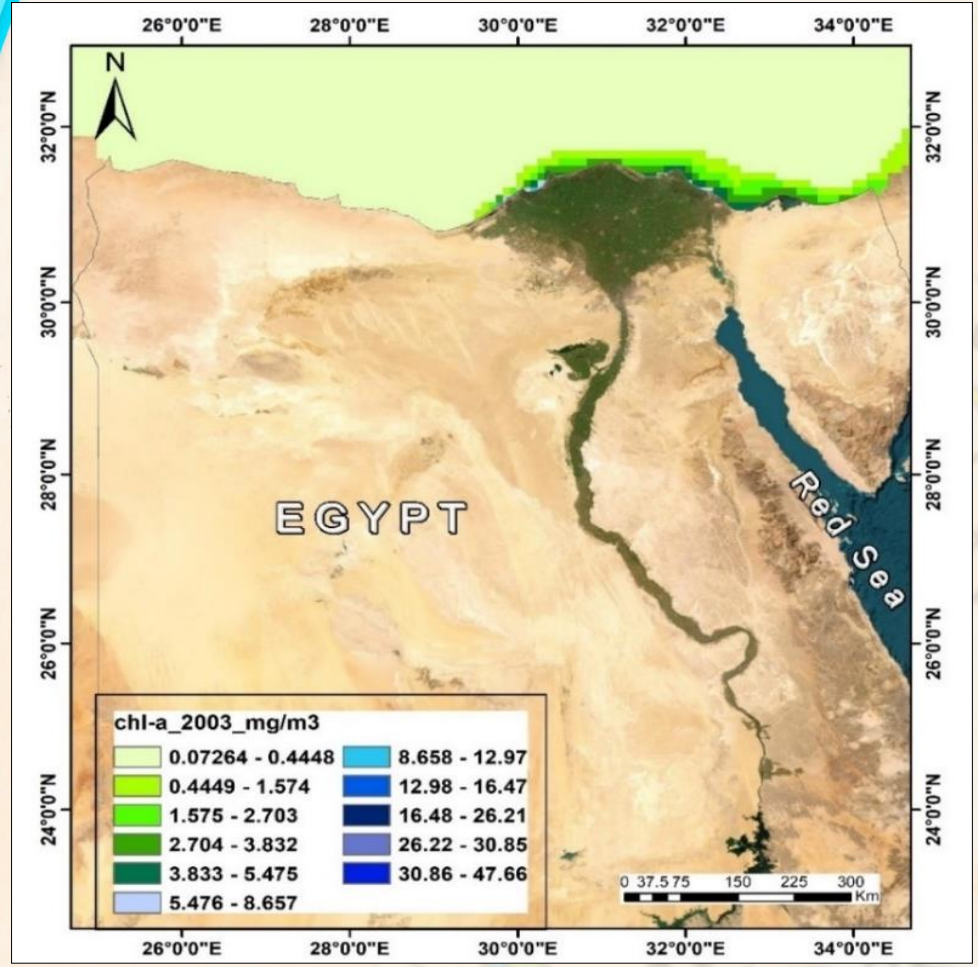
The Mediterranean Sea

2022



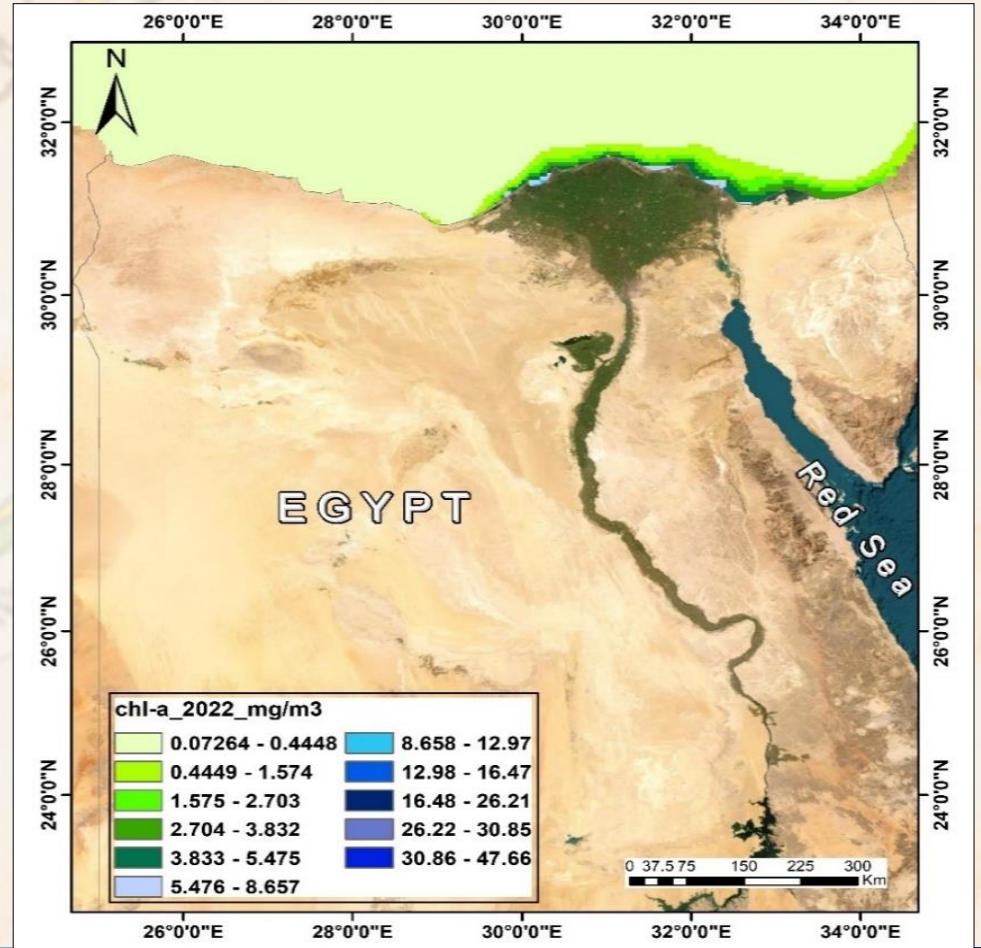


2003

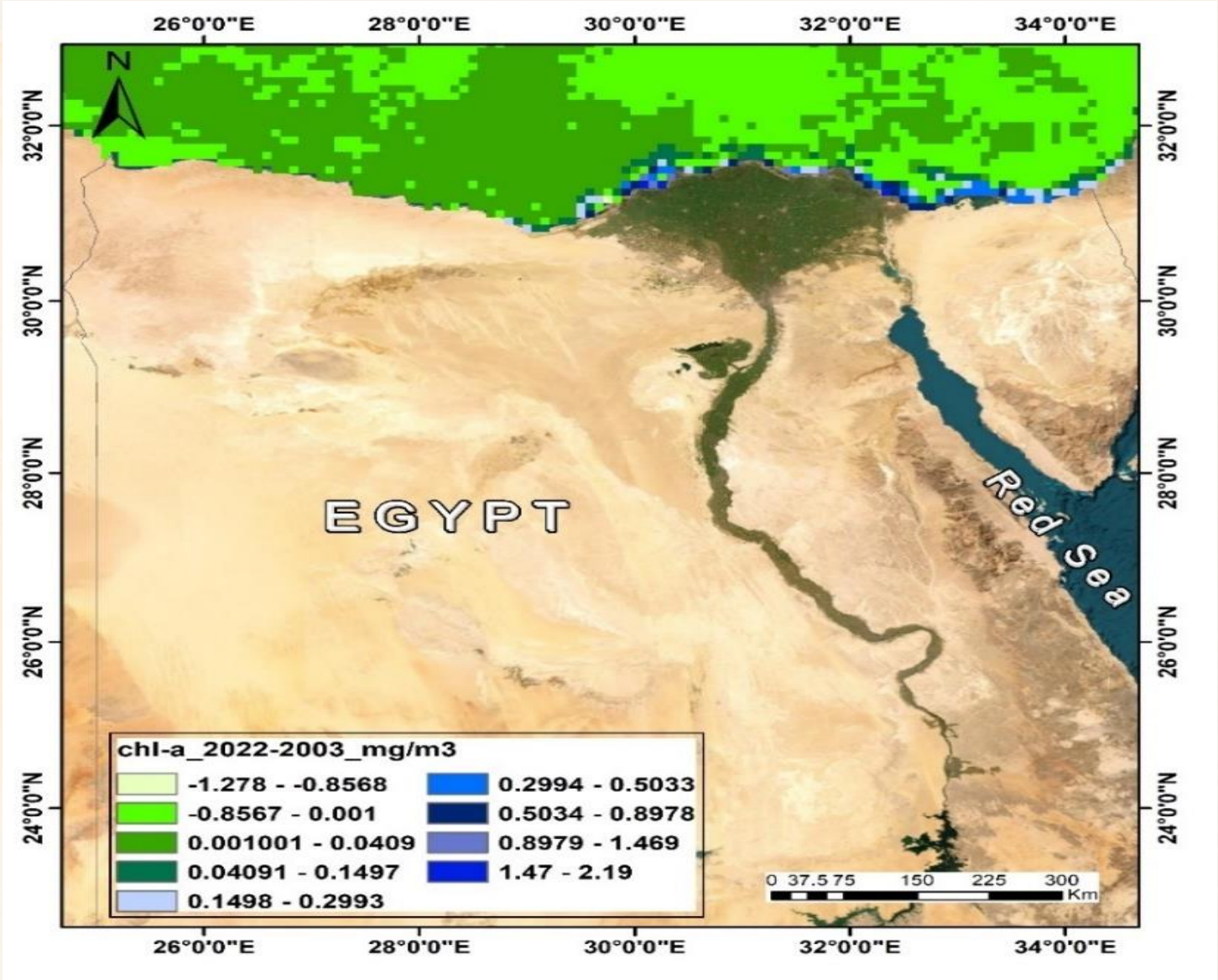


2003

Annual Chl-A of Mediterranean Sea

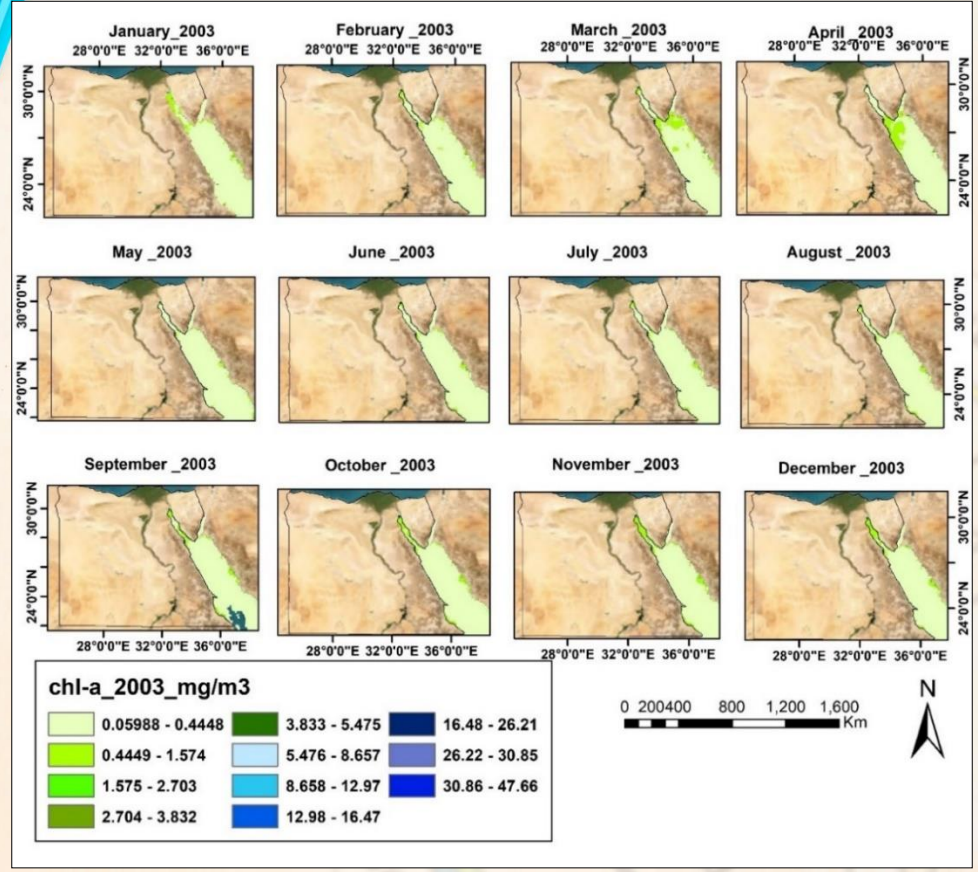


2022

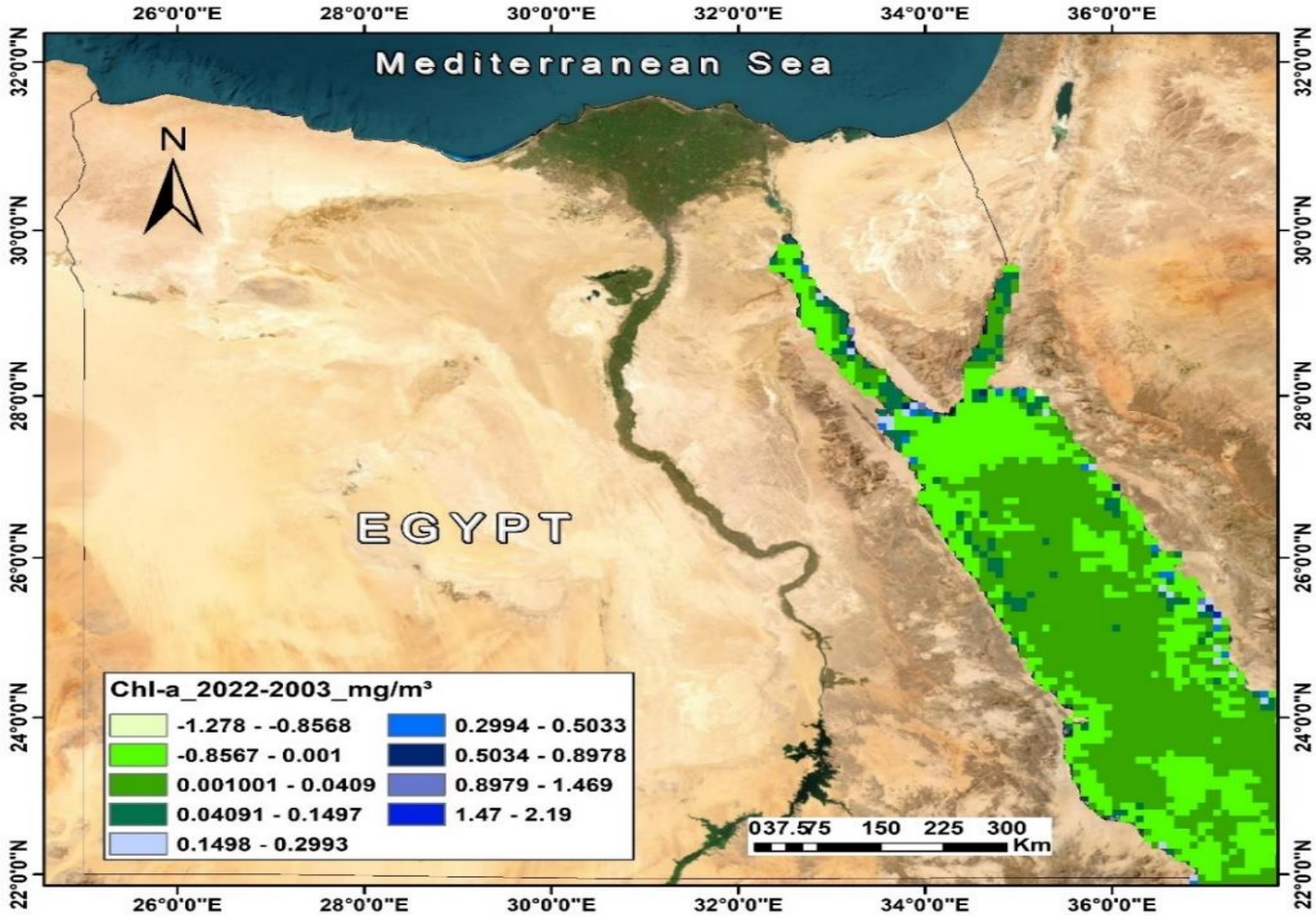


20 years changes in Chl-a along the Mediterranean Egyptian coast

The Red Sea

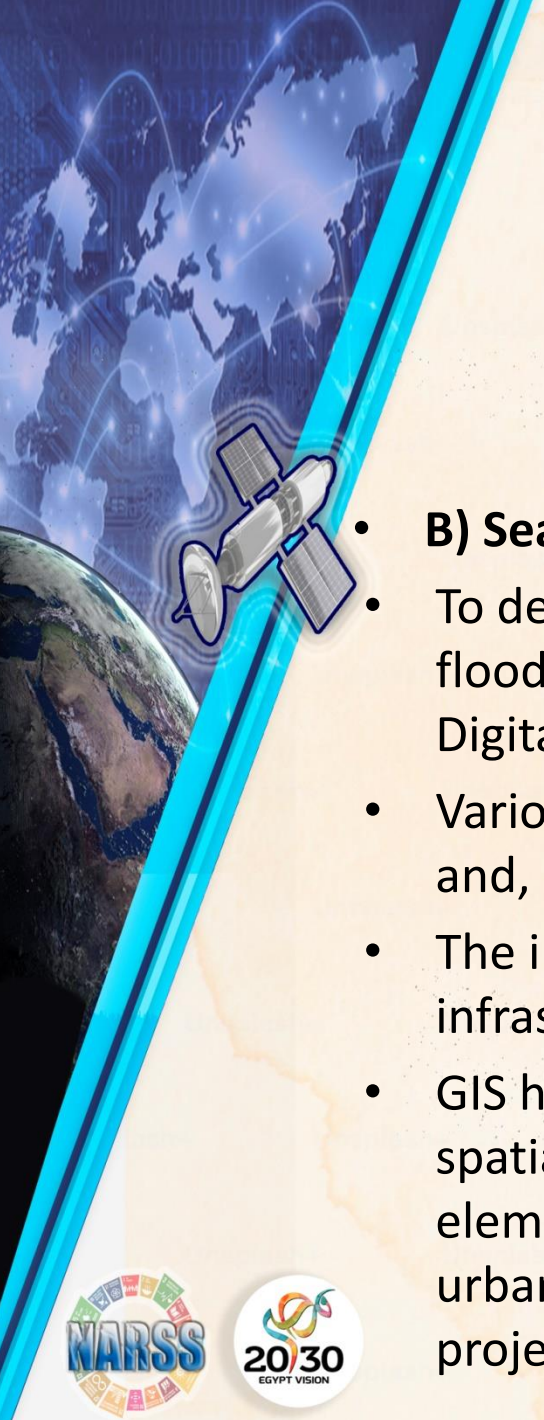

January_2003
February _2003
March _2003
April _2003
May _2003
June _2003
July _2003
August _2003
September _2003
October _2003
November _2003
December _2003
28°0'0"E 32°0'0"E 36°0'0"E
30°0'0"N
24°0'0"N
chl-a_2003_mg/m3
0.05988 - 0.4448
0.4449 - 1.574
1.575 - 2.703
2.704 - 3.832
3.833 - 5.475
5.476 - 8.657
8.658 - 12.97
12.98 - 16.47
16.48 - 26.21
26.22 - 30.85
30.86 - 47.66
0 200400 800 1,200 1,600
Km
N


January_2022
February _2022
March _2022
April _2022
28°0'0"E 32°0'0"E 36°0'0"E
30°0'0"N



20 years changes in Chl-a along the Red Sea coast

Sea Level Rise (SLR)



A) Sea Level changes

- The sea level anomaly (SLA) data were obtained on 1st June 2015-2020 from the Copernicus Marine Environment Monitoring Service (CMEMS) and the Copernicus Climate Change Service (C3S).

This data set for estimates the sea level anomaly based on satellite altimetry measurements.

- **B) Sea level rise scenarios**
- To define the areas exposed to sea water flooding rise along the Egyptian coastal zone, the Digital Elevation Model (DEM) data was used.
- Various scenarios were applied including the 1, 2, and, 3 meters' rise.
- The impacts of SLR on population and infrastructure were studied.
- GIS has been used to overlay the best available, spatially-disaggregated data on critical impact elements (land, population, agriculture, and urban extent), with the inundation zones projected for 1-3m SLR.

Sea Level Rise Scenario at 1–3 m along the coastal zone of Egypt.

6584.9

1 m

9508.8

2 m

12221.5

3 m

Natural System vulnerability

Human System vulnerability

1 m

11097571

2 m

15050363

3 m

18215775

Sea level rise scenarios	Area (Km^2)	Population count
Scenario 1 (1m SLR)	6584.9	11097571
Scenario 2 (1m SLR)	9508.8	15050363
Scenario 3 (1m SLR)	12221.5	18215775

The Coast of Egypt

- Due to low elevation in the Nile delta region, Egypt is considered one of the top five countries expected to be mostly impacted with sea level rise.

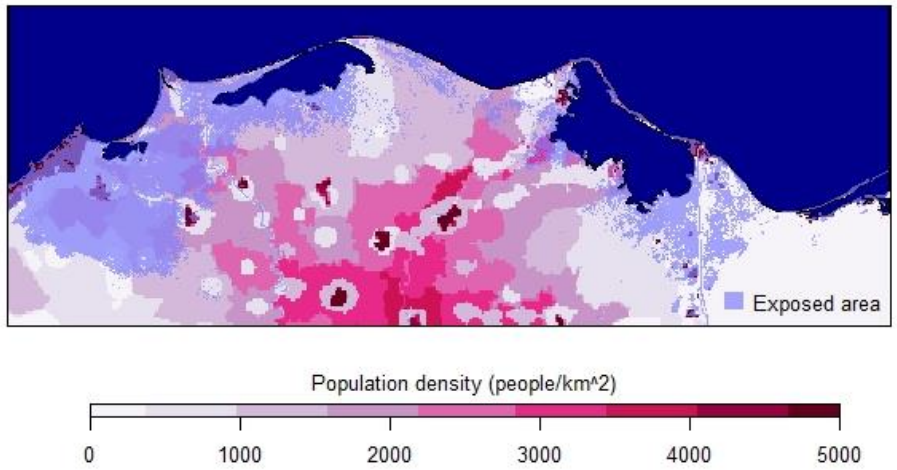
- *Alexandria and Port Said are vulnerable to sea level rise (low elevation of adjacent land) followed by, Beheira, and Damietta governorates.*

-

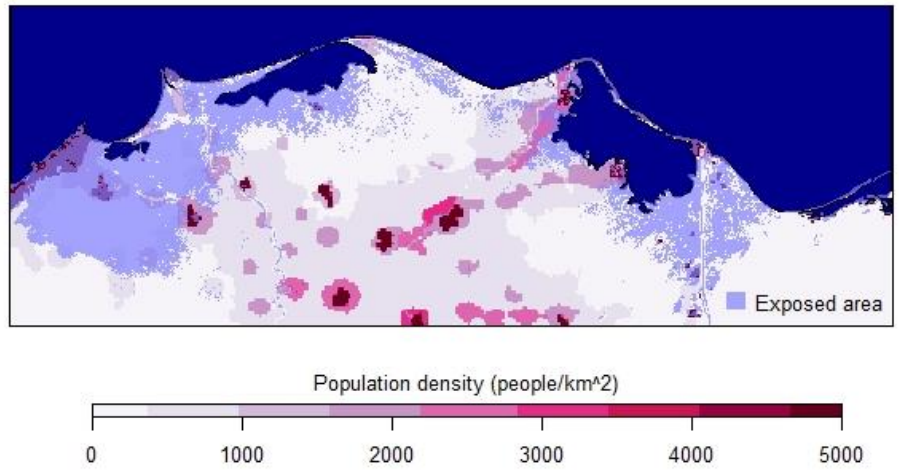
IPCC scenarios

Based on our research + others

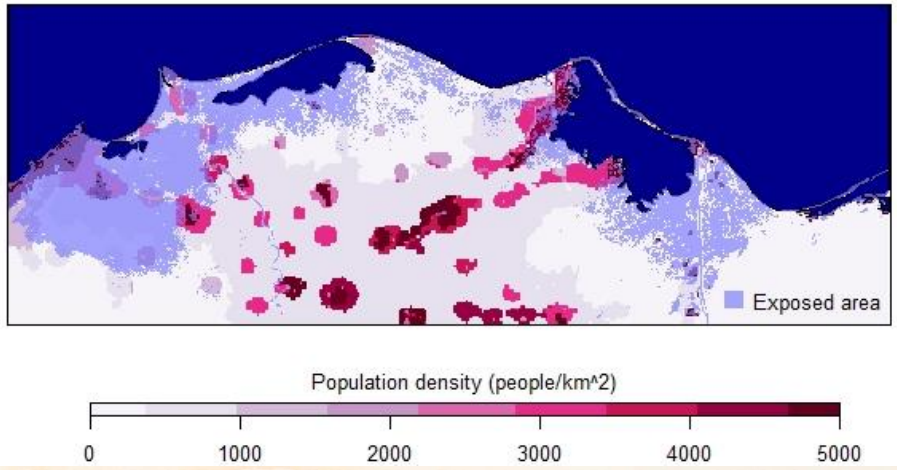
Today's exposure (current sea levels)



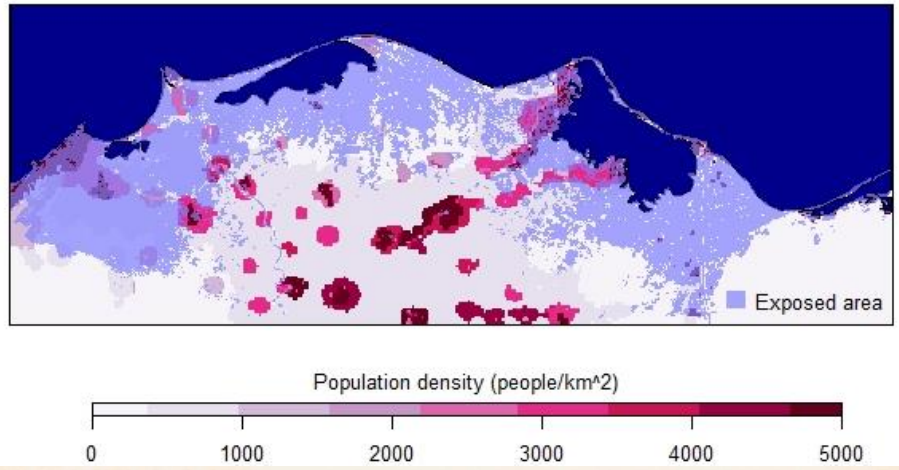
2100 exposure, with 0.43m sea-level rise (SSP1-26)



2100 exposure, with 0.75m sea-level rise (SSP5-85)



2100 exposure, with 1.7m sea-level rise (SSP5 - high-end)



Actions– for protection, development & sustainability of Coastal & Marine systems

NEEDS

1. Monitoring and Assessment
2. Evaluation
3. Forecasting
4. Management
5. Mitigation scenarios
6. Adaptation partway

7. Decision support &

8. Management plans

Vs.

NARSS
RESOURCES & Capabilities

1. Satellite data
2. Different sources
3. eStation (free data)
4. Numerical Models
5. Forecasting Models
6. Historical record of data
7. Thematic maps
8. Good Ranked Publications
9. Competent Scientists
10. **8 divisions with different disciplines**

11. Decision support &
12. Management plans

Thank you for attention

Elham Ali

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