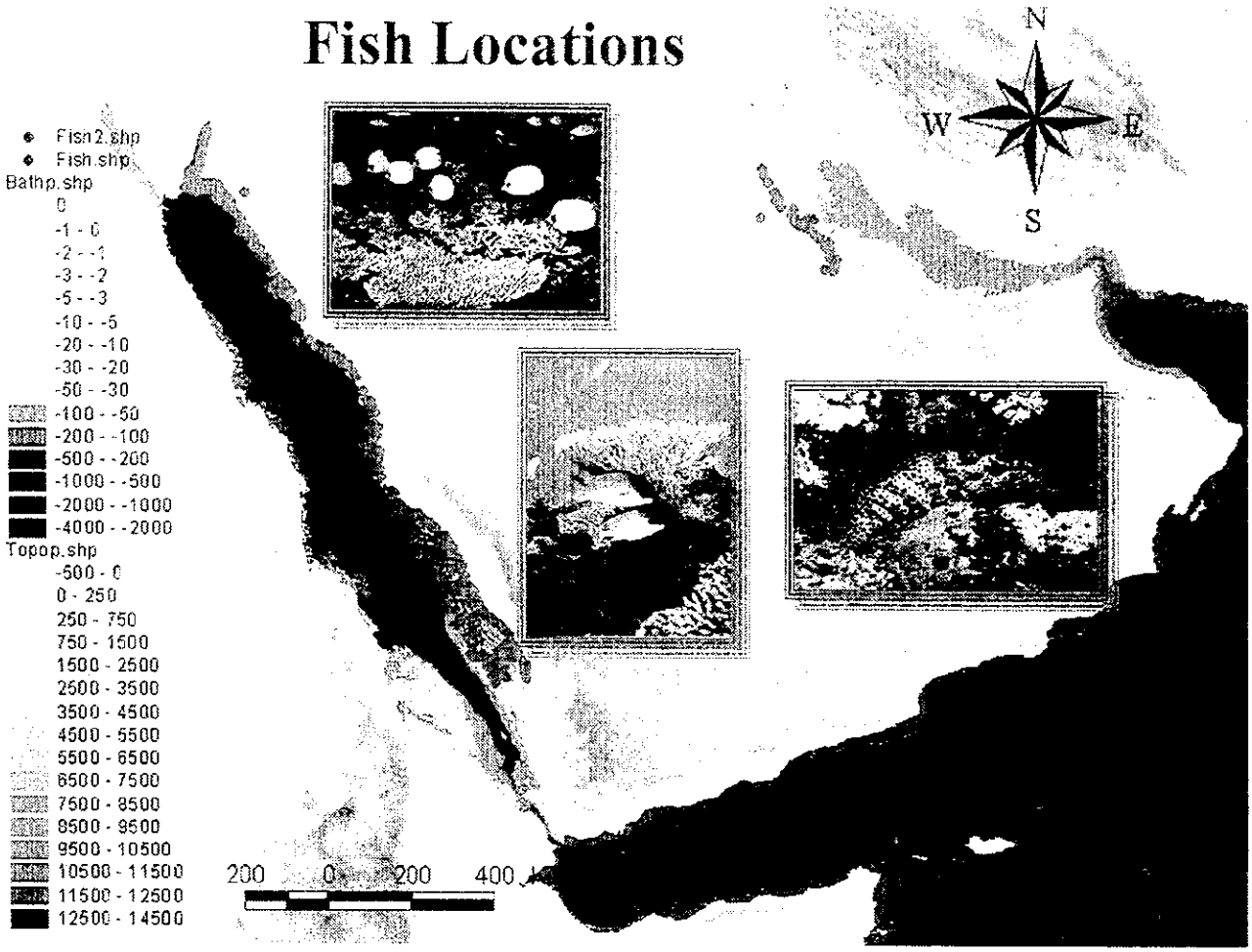
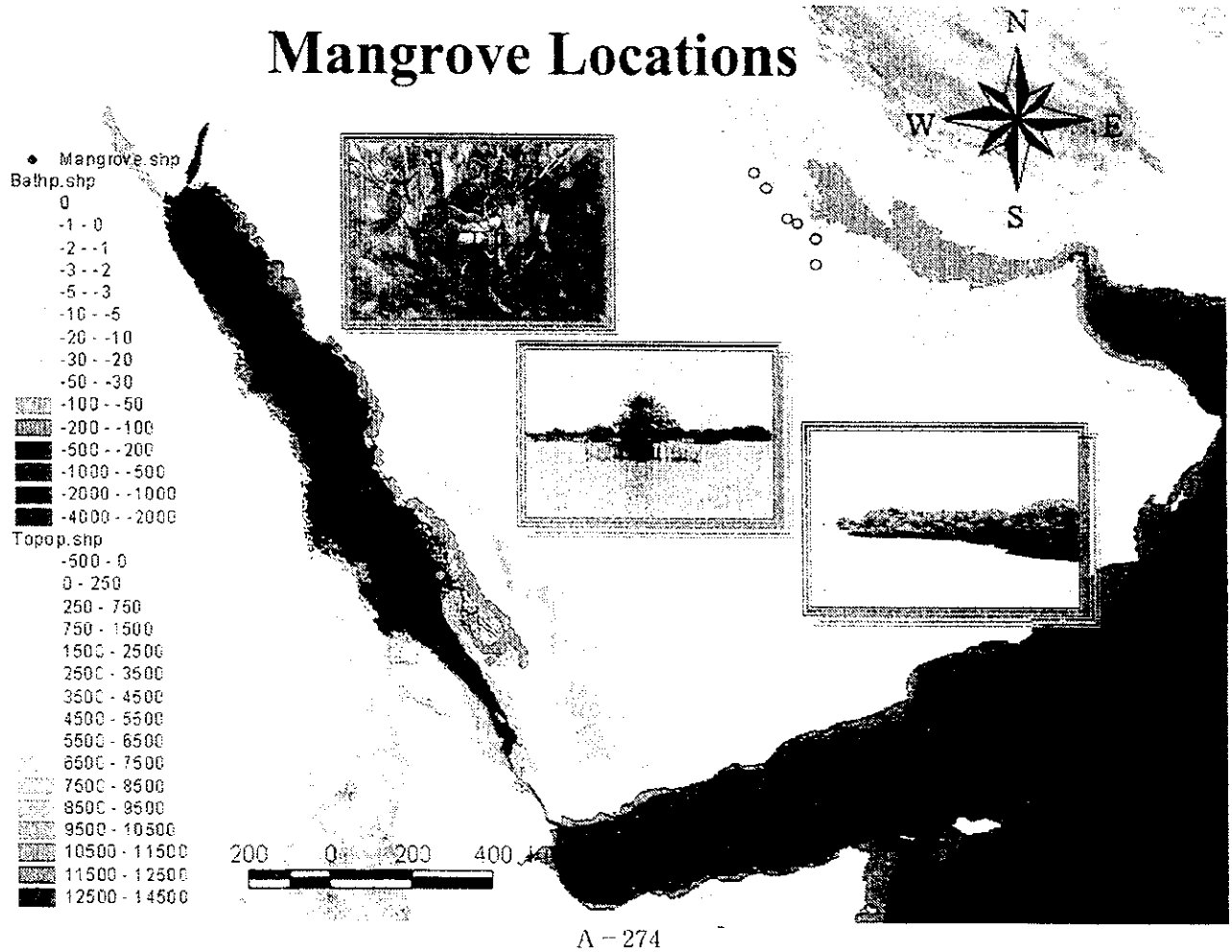
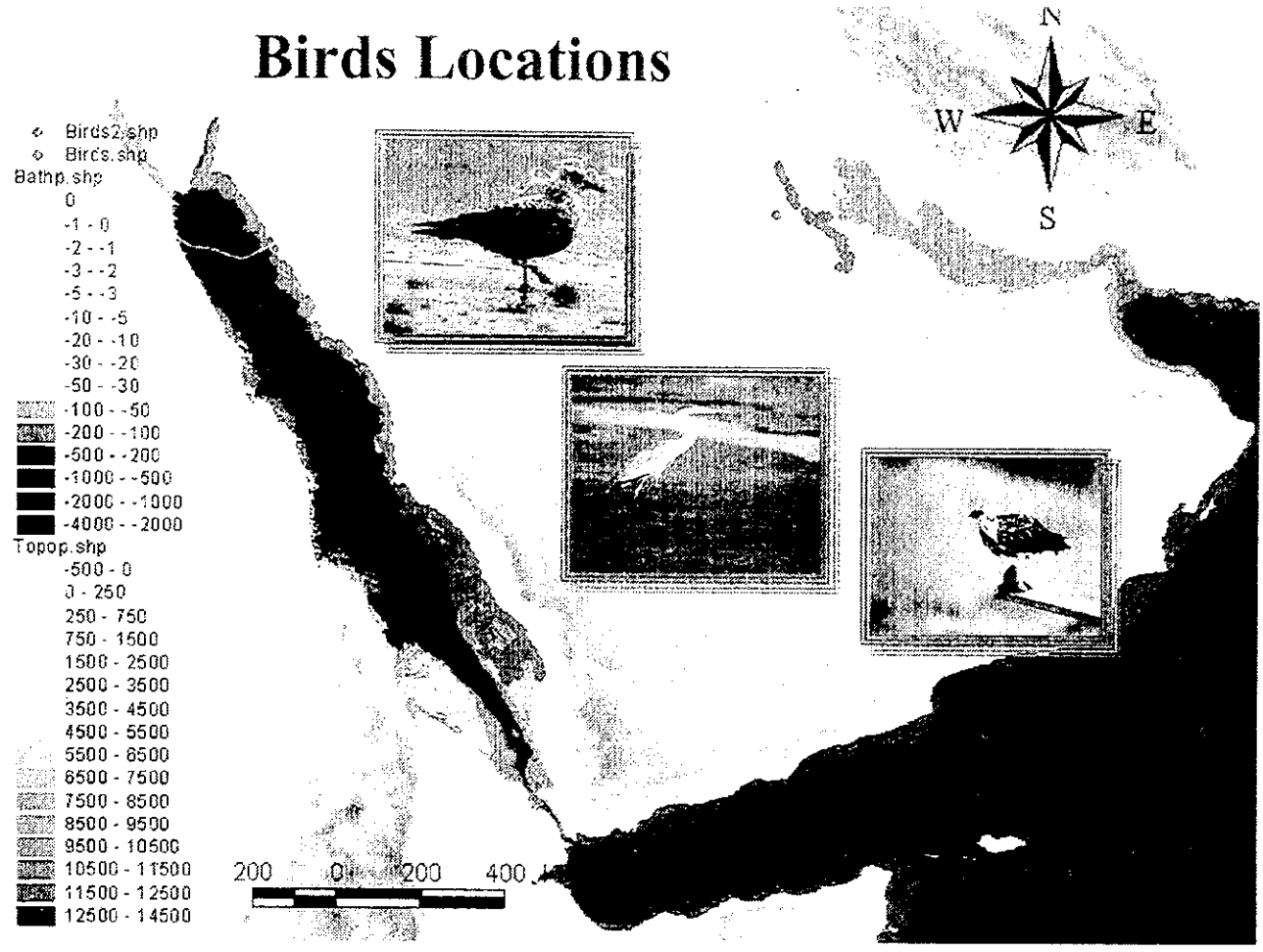
Fish Locations

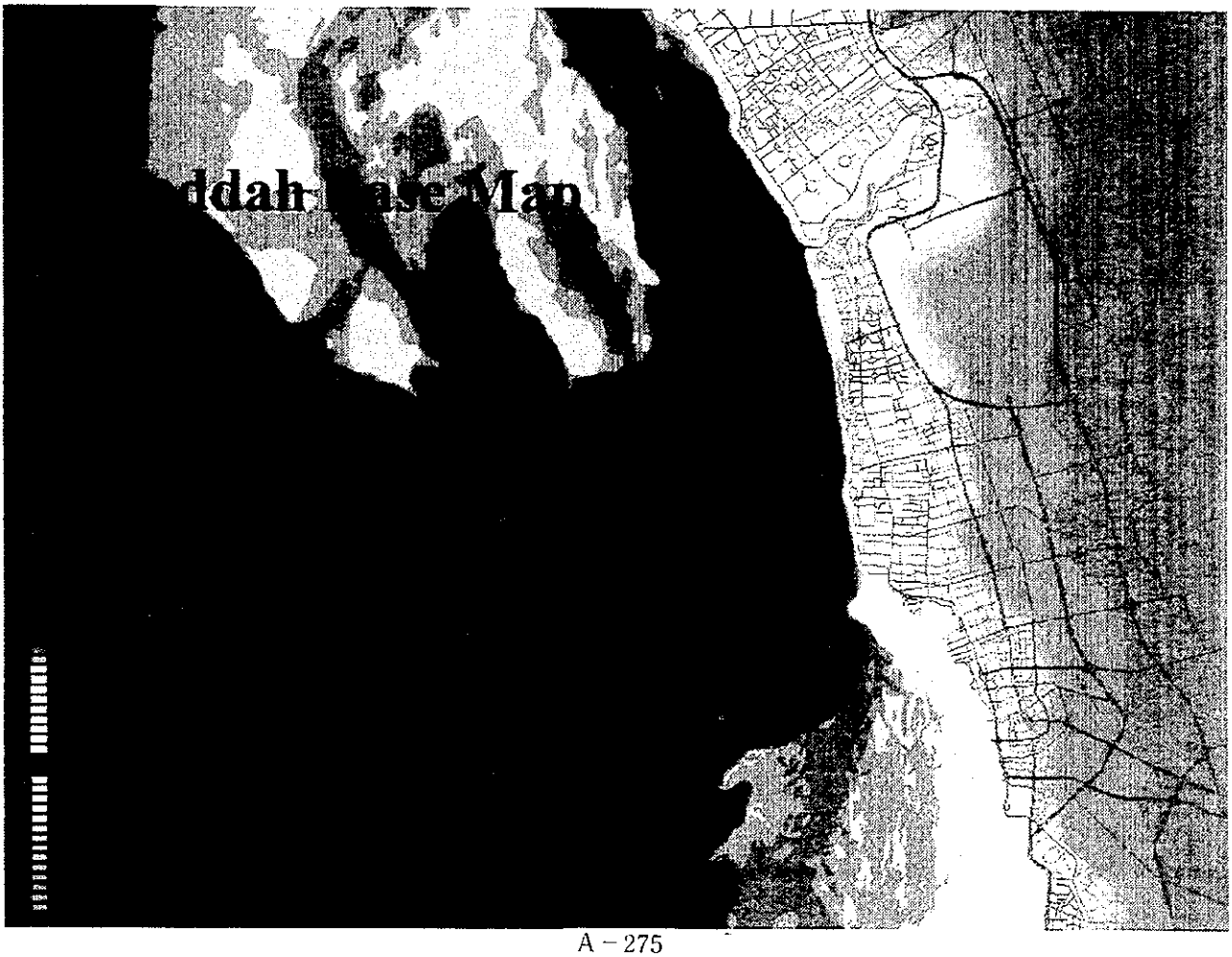


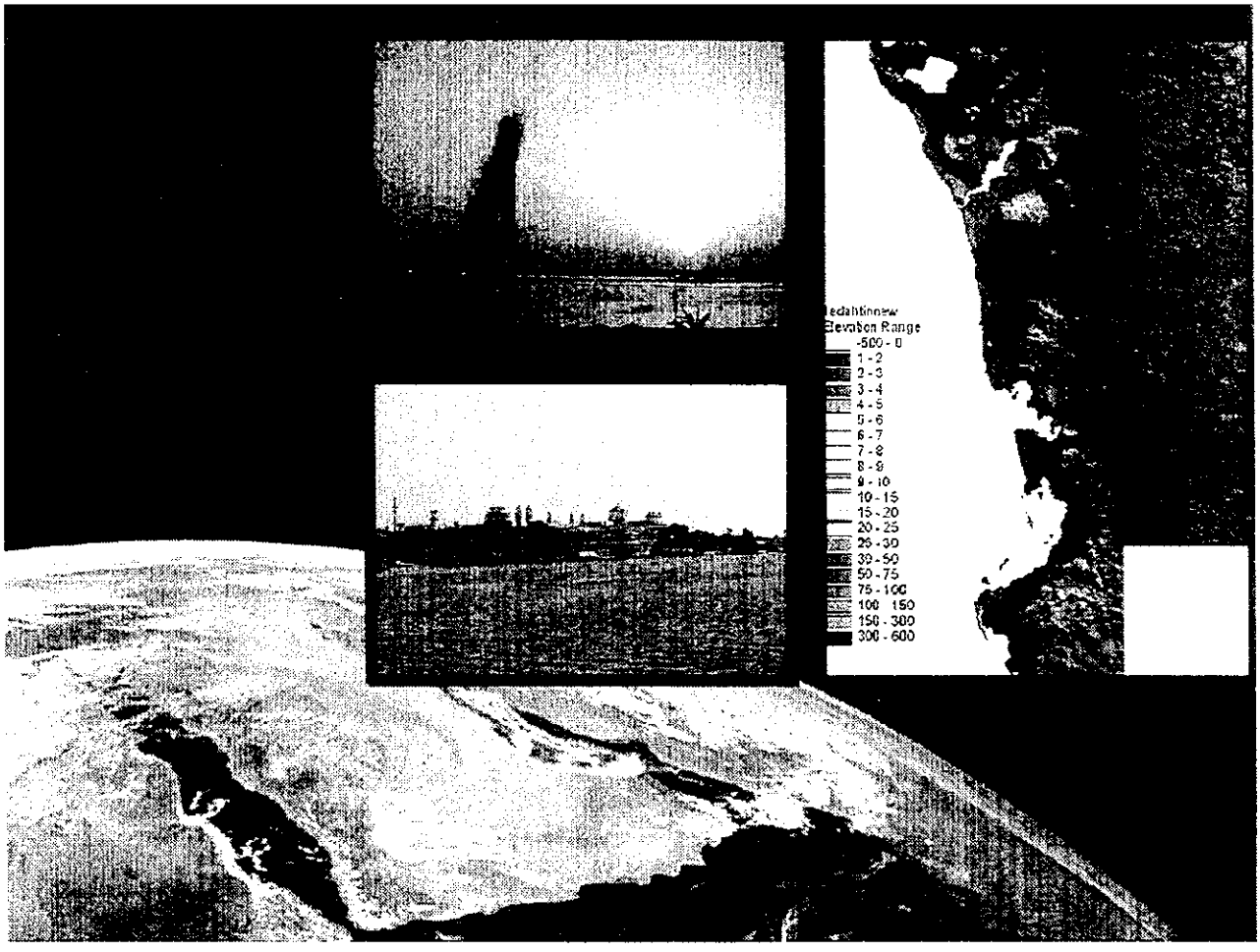
Mangrove Locations

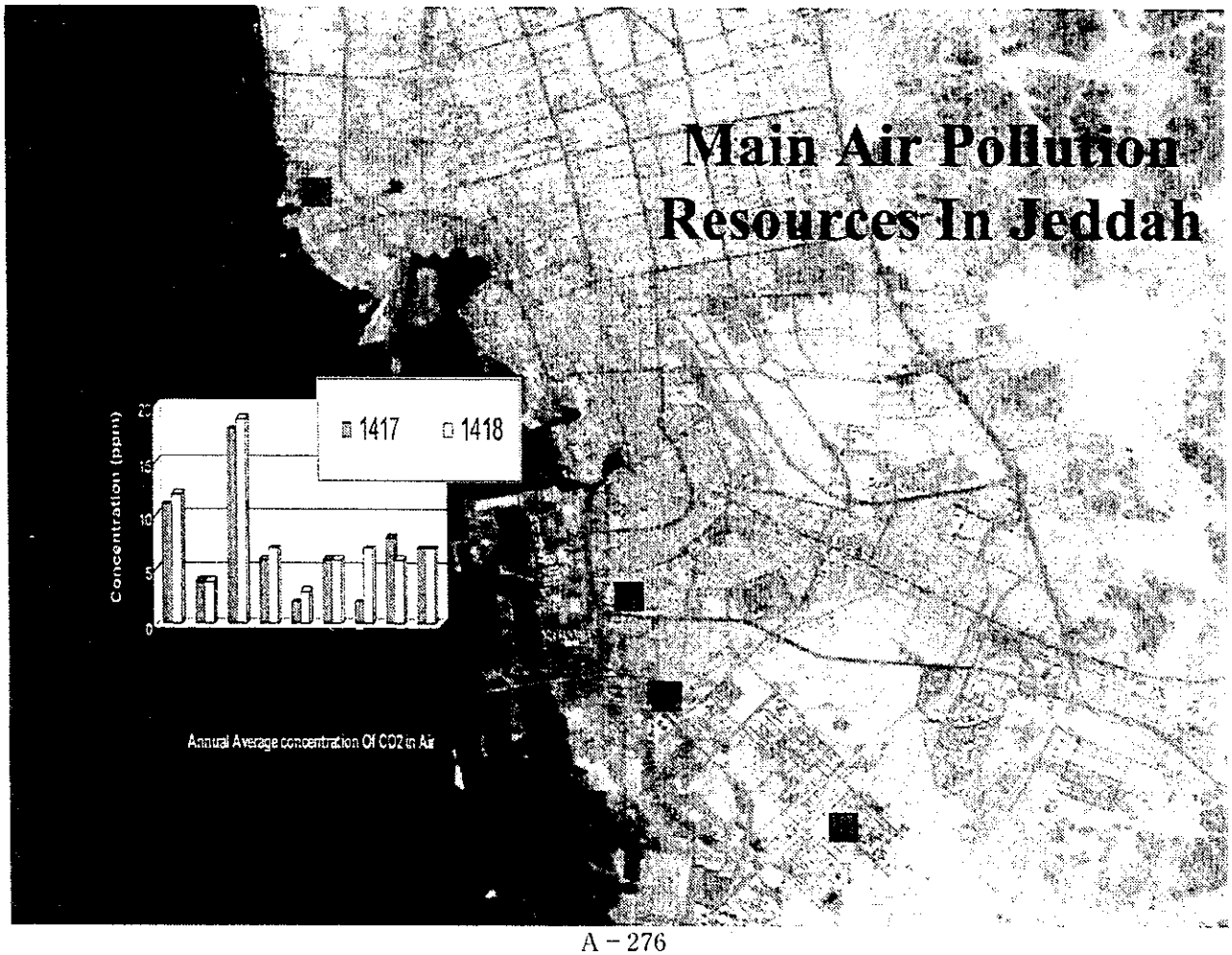


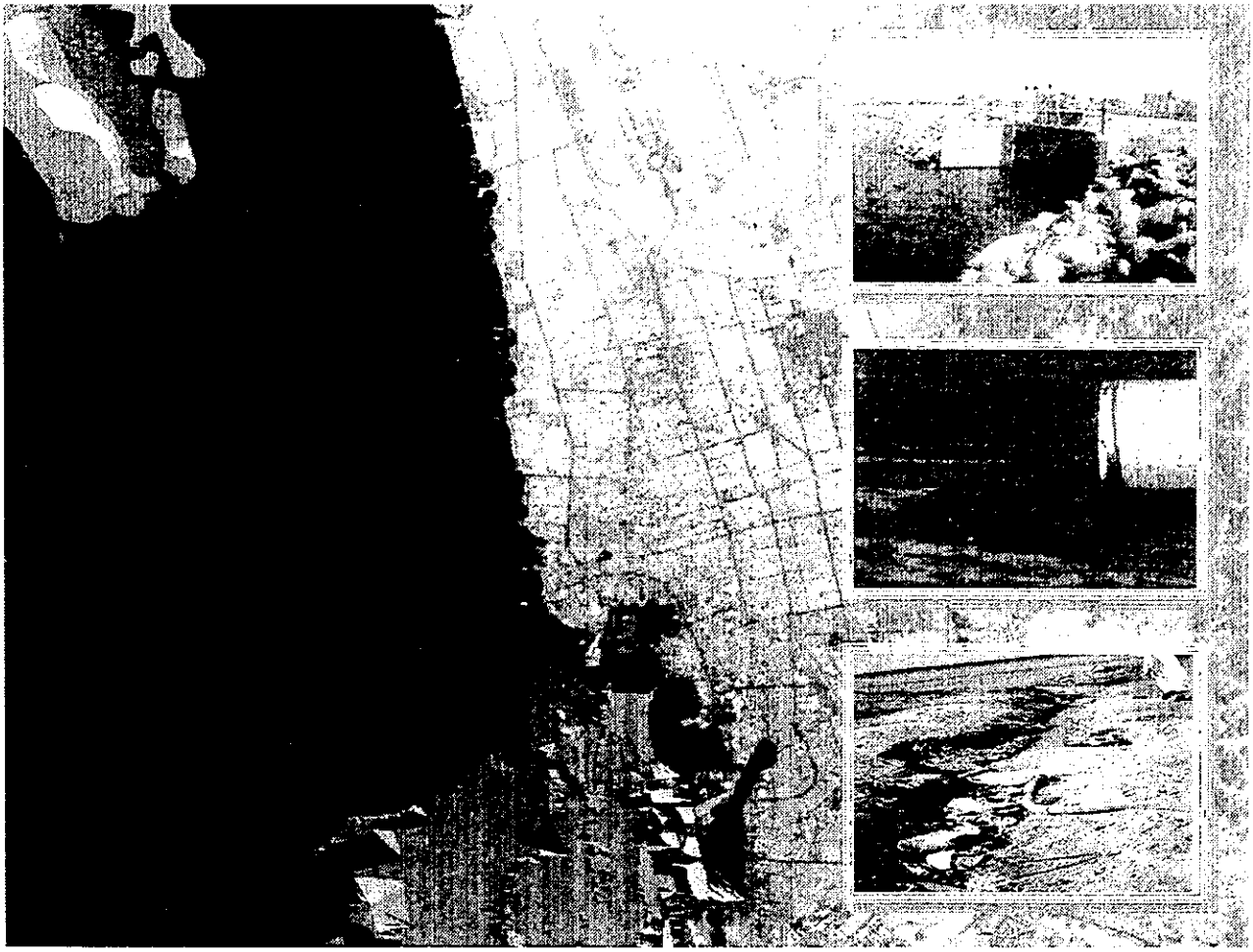
Birds Locations



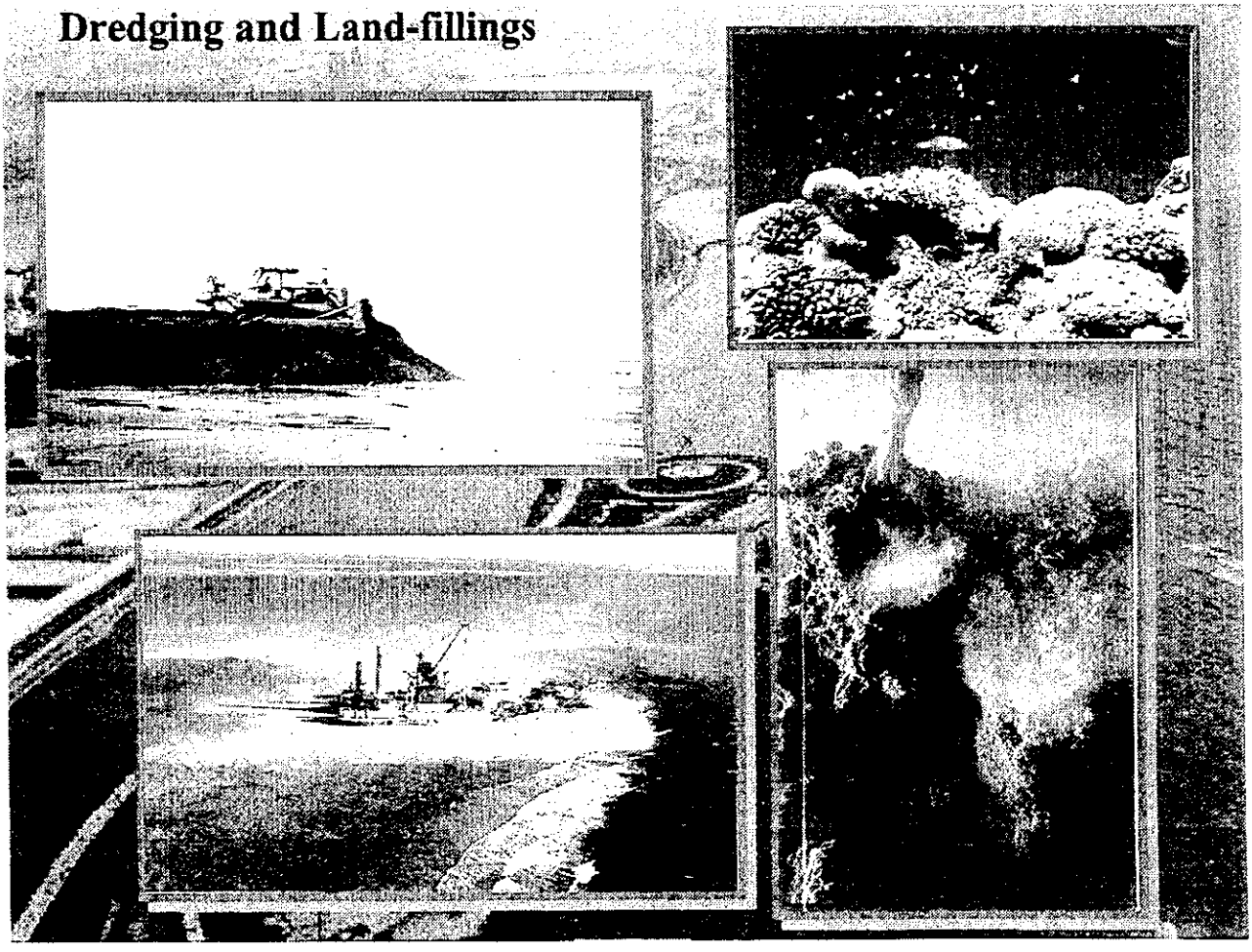



Elevation Range
-500 - 0
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10
10 - 15
15 - 20
20 - 25
25 - 30
30 - 50
50 - 75
75 - 100
100 - 150
150 - 300
300 - 600


Main Air Pollution Resources In Jeddah
1417
1418
Concentration (ppm)
Annual Average concentration Of CO2 in Air



Dredging and Land-fillings



JICA/MEPA Workshop III

"Seawater Quality Evaluated by Satellite Data Analysis"

Krishna Mishra

Sea Water Quality Evaluation by Satellite Data Analysis

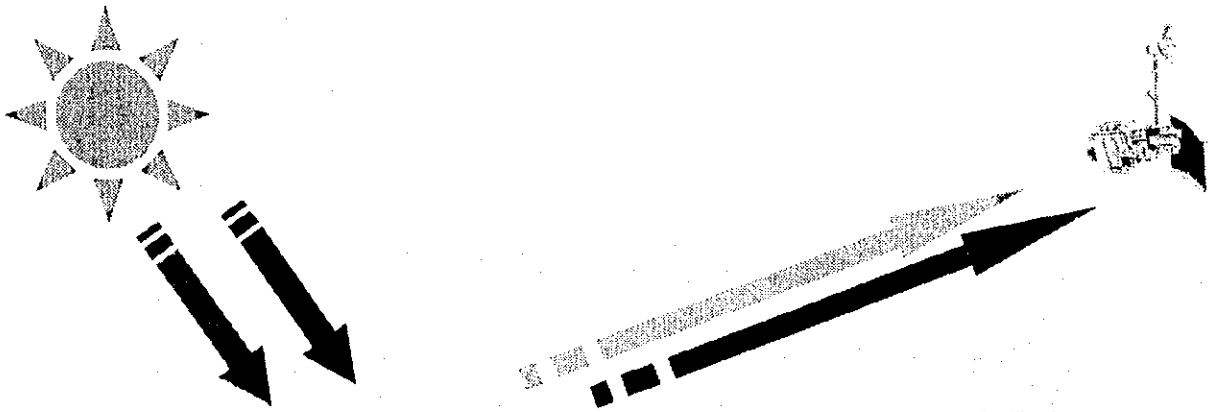
Dr. Krishna Kumar MISHRA

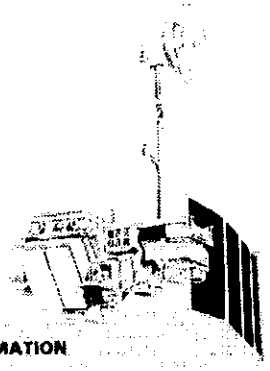
Japan International Cooperation Agency

Member, JICA Team

The marine environment covers 70% of the Earth's surface & is a vital element of the planet's life support system.

Monitoring of Sea Environment is one of the most common applications of the satellites.





TECHNICAL INFORMATION

Spacecraft	–	Landsat 4 (launched 16.07.82)
	–	Landsat 5 (launched 01.03.84)
Orbit	–	Near polar sun-synchronous
	–	98.2° inclination (coverage up to 81° north and south)
	–	Complete orbit every 99 minutes
Altitude	–	705 km, 438 miles
Re-visit	–	16 days
Payload	–	MSS (4 channels)
	–	TM (7 channels)
Spatial Resolution	–	MSS – 80 m
	–	TM – 30 m (except band 6 – 120 m)
Swath	–	185 km x 185 km

The LANDSAT satellite has ability to explore, characterize, monitor, and help protect and manage our earth resources.

LANDSAT TM Sensors

TM Bands	Wavelength (μm)	Resolution (m)	Coverage (km)
1.	0.45 - 0.52 (Blue)	30	185
2.	0.52 - 0.60 (Green)	30	185
3.	0.63 - 0.69 (Red)	30	185
4.	0.76 - 0.90 (NIR)	30	185
5.	1.55 - 1.75 (Int_NIR)	30	185
6.	10.4 - 12.5 (TIR)	120	185
7.	2.08 - 2.35 (MIR)	30	185

Utilized TM Data

	Path/Row	Date	Scene	
1.	165/040-041	Jan 20 1999	Full	3rd Stage
2.	164/041	Dec 12 1998	Full	
3.	164/042	Dec 12 1998	Sub	
4.	163/042	Dec 21 1998	Full	
5.	163/043	Nov 03 1998	Full	

1.	164/041	Oct 12 1999	Full	4th Stage
2,	164/042	Oct 21 1999	Sub	
3.	163/042	Oct 12 1999	Full	

Objectives

Stage 3

Generation of Sea surface Temperature Distribution

Utilization of water quality sampling data for the distributions of

Suspended Solids

Chlorophyll *a*

Coastal Area Distribution

Analysis Procedures

LANDSAT/TM Data searching, selection & acquisition

⇩

Geo-referencing, re-sampling, spectral enhancements, preparation of Mosaic Image

⇩

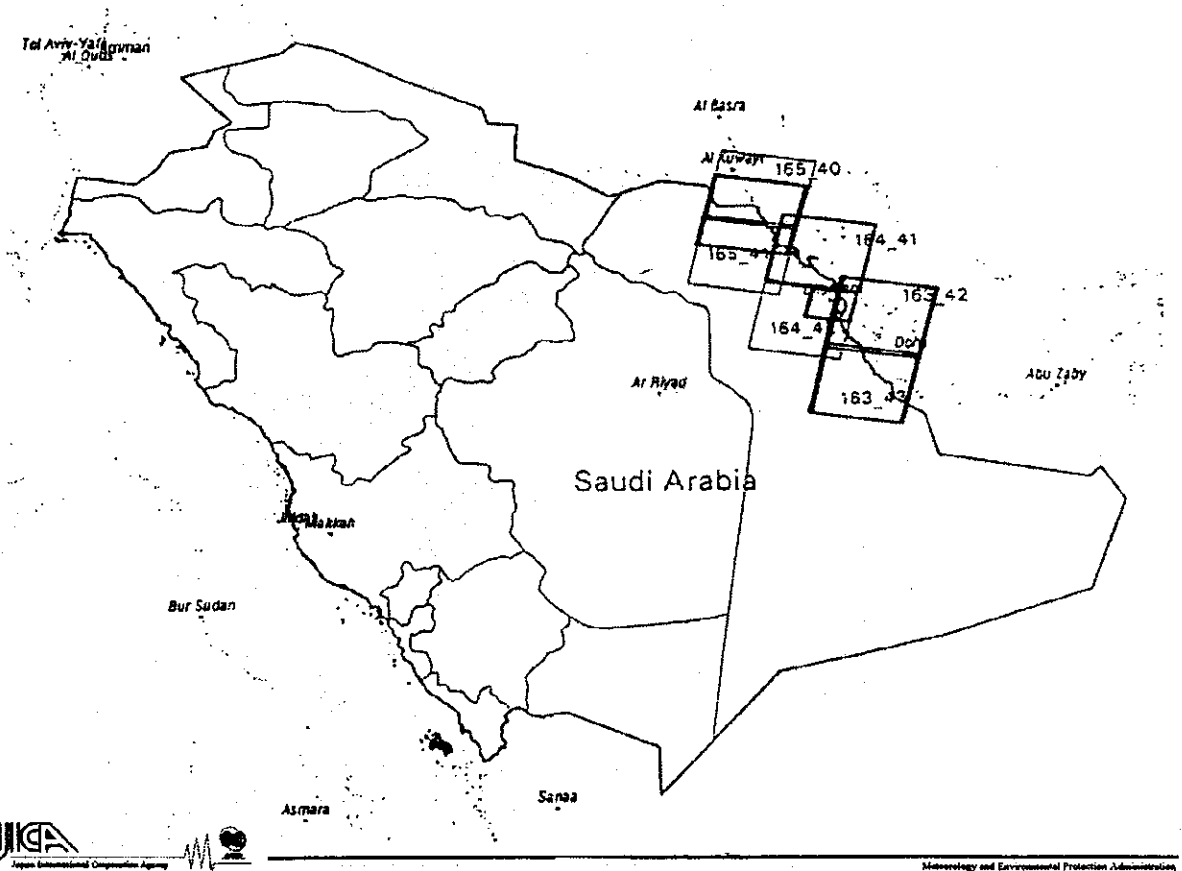
Analysis and distribution map preparation

- Sea surface Temperature Distribution
- Suspended Solids Distribution
- Chlorophyll Distribution
- Coastal Area Distribution

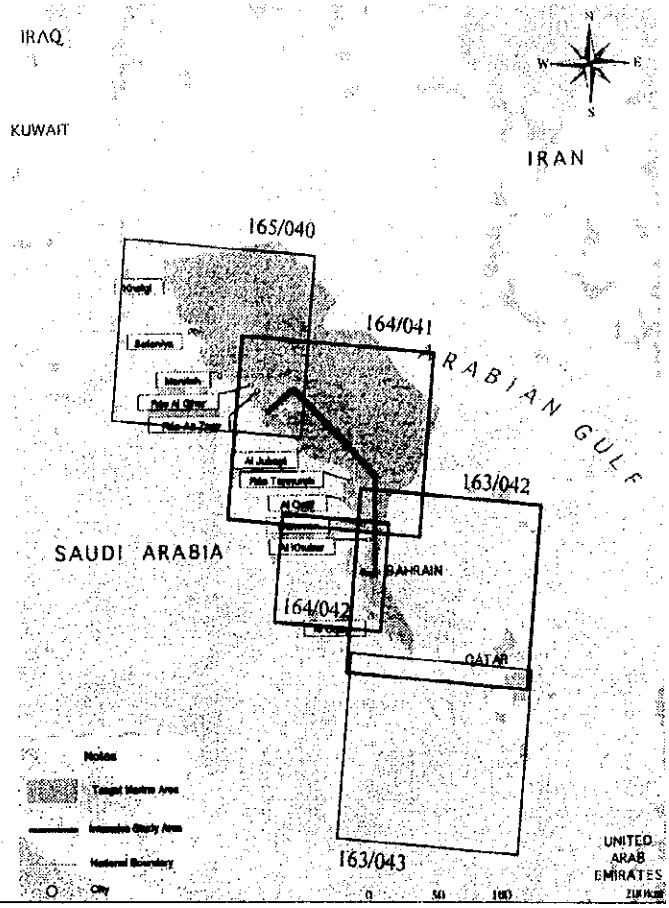
⇩

Reporting

LANDSAT/TM Coverage

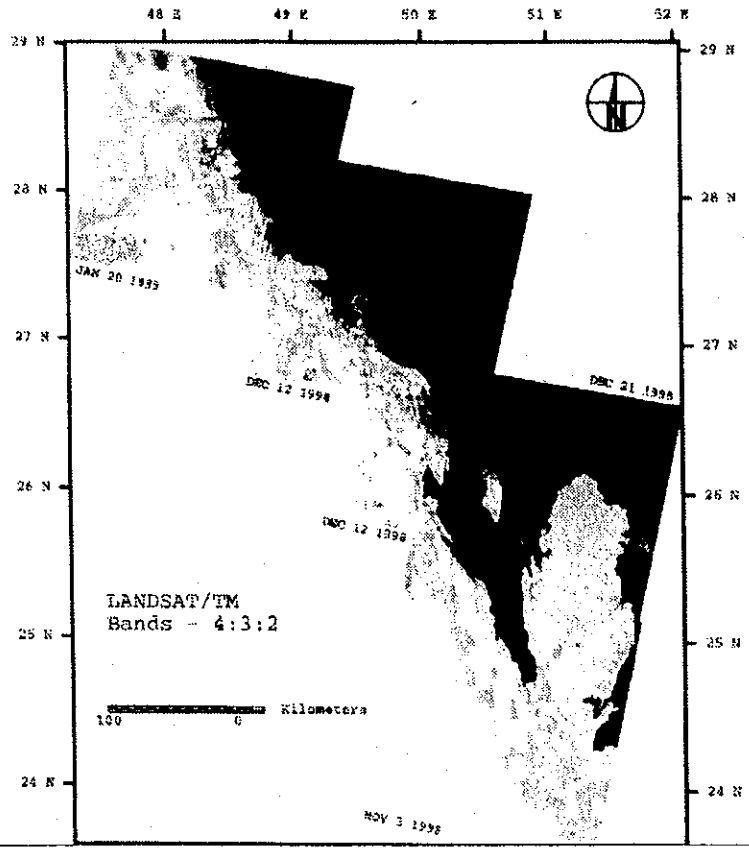


TM Coverage of the Target Marine and Intensive Study Area

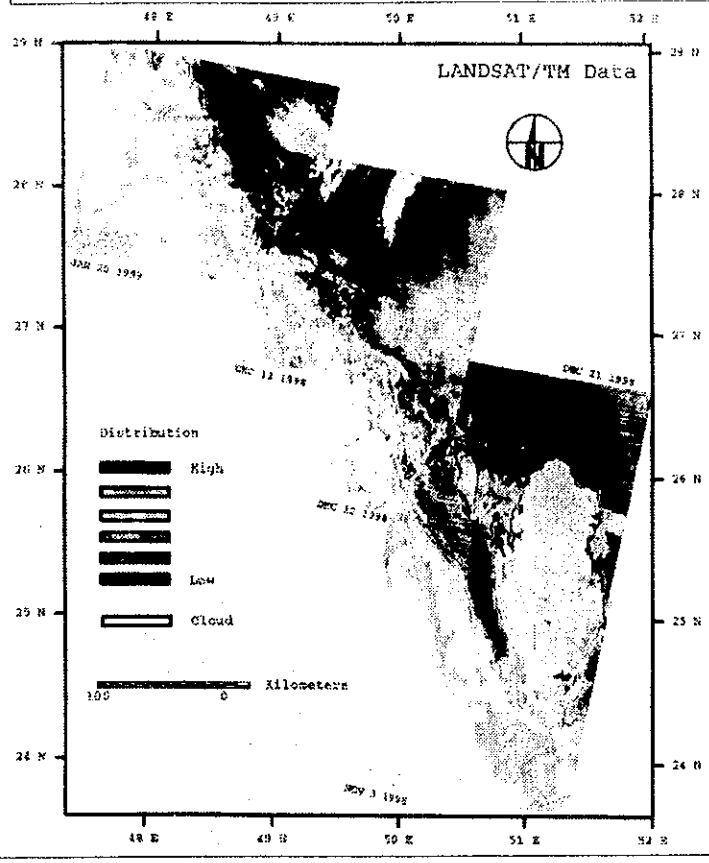


False Color Composite Image – Arabian Gulf, Saudi Arabia

Stage 3

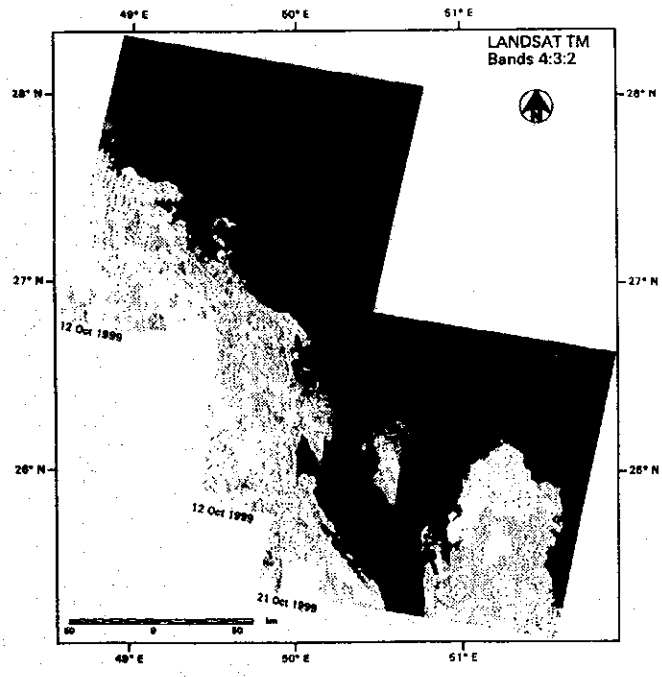


Suspended Solids Distribution – Arabian Gulf, Saudi Arabia



Stage 3

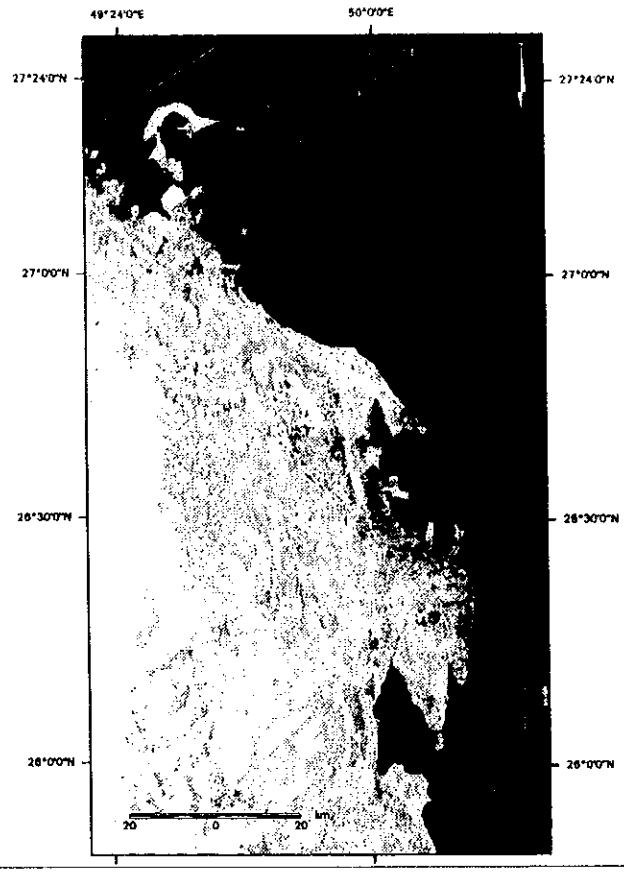
Arabian Gulf, Saudi Arabia



Stage 4

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
METEOROLOGY AND ENVIRONMENTAL PROTECTION ADMINISTRATION (MEPA)

Intensive Study Area - Arabian Gulf, Saudi Arabia



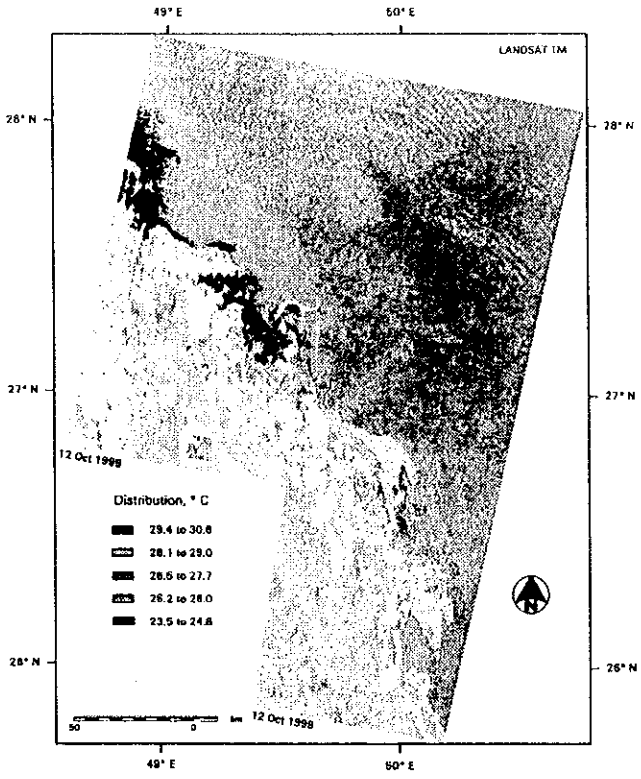
JICA Japan International Cooperation Agency

Meteorology and Environmental Protection Administration

Sampling Locations

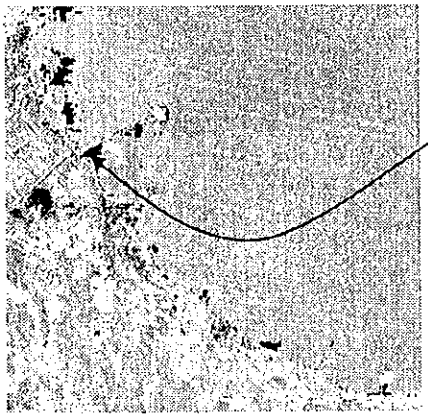
Utilization of GPS Observations

Temperature Distribution - Arabian Gulf, Saudi Arabia



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
METEOROLOGY AND ENVIRONMENTAL PROTECTION ADMINISTRATION (MEPA)

Meteorology and Environmental Protection Administration



Site Code J5

Lat (N): 27° 07.6', Long.: (E) 49° 38.2'

Water Quality of shared industrial outfall – point of discharge

Distribution, ° C

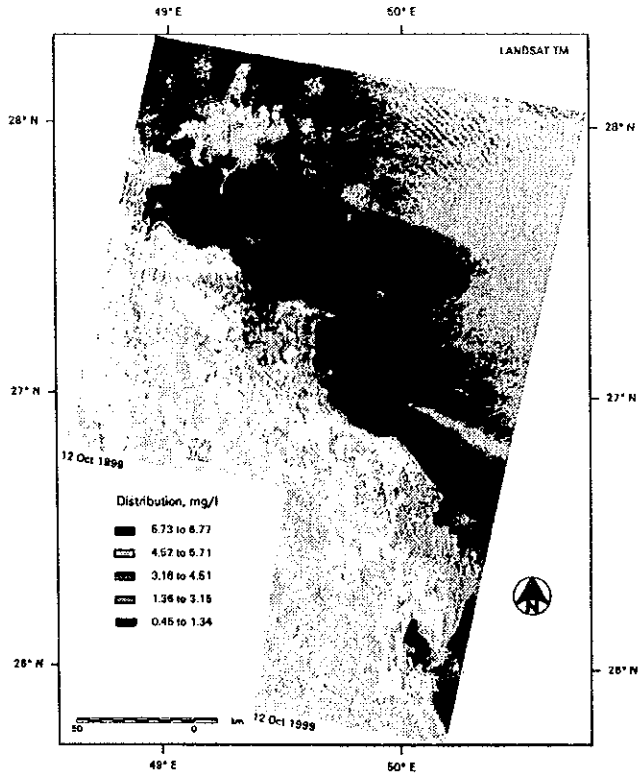
- 29.4 to 30.6
- 28.1 to 29.0
- 26.5 to 27.7
- 25.2 to 26.0
- 23.5 to 24.8

Site Code K2

Lat (N): 26° 24.0, Long.: (E) 50° 11.0'

Small patches of higher temperatures were distributed primarily in shallow areas & along the vicinities of the coastal regions where more industrial & residential activities are located.

Suspended Solids Distribution - Arabian Gulf, Saudi Arabia



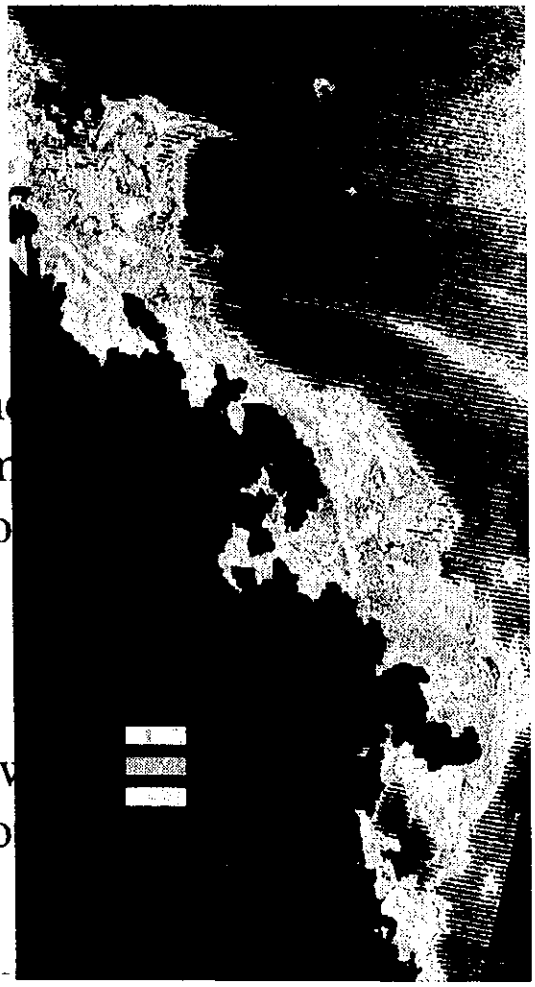
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
METEOROLOGY AND ENVIRONMENTAL PROTECTION ADMINISTRATION (MEPA)

Meteorology and Environmental Protection Administration

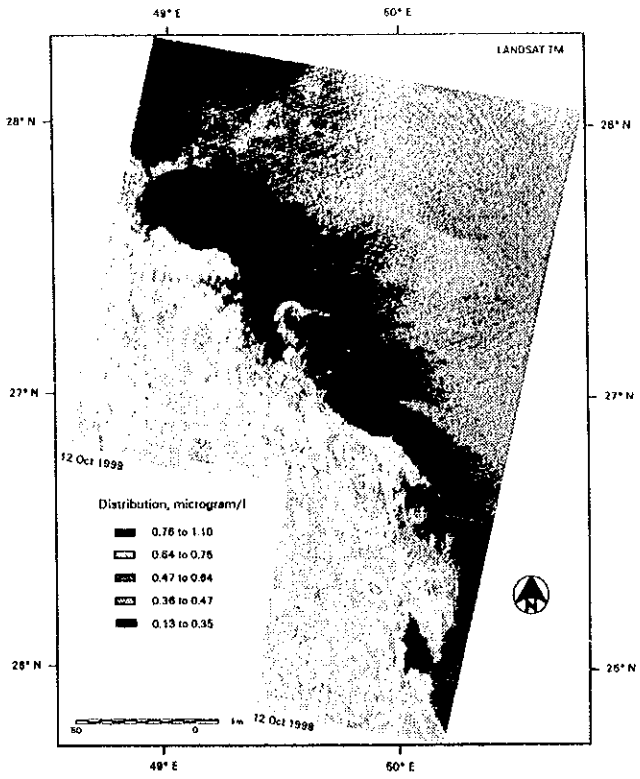
ed Solids
on

ribution values along th
ons (e.g., 3.16 to 4.51 m
st common in the shallo
re areas).

on of 1.36 to 3.15 mg/l v
ributed in mostly offsho



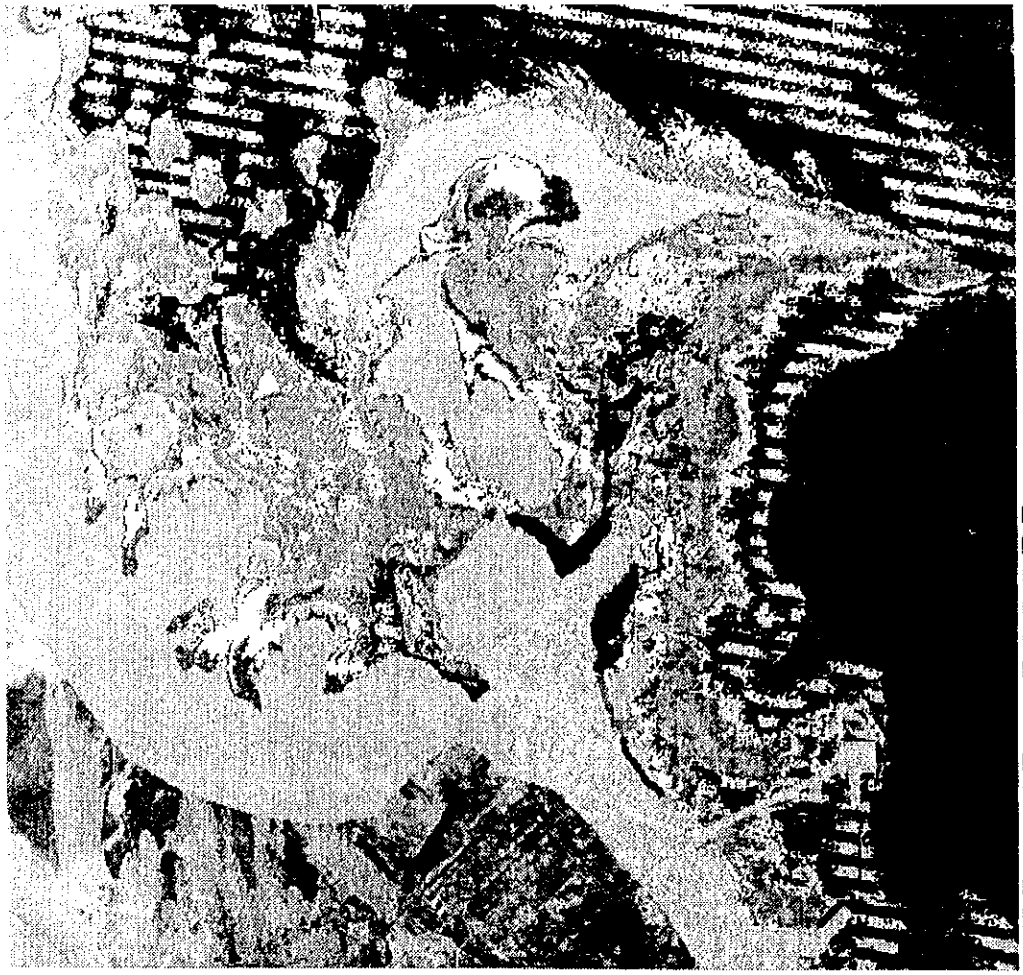
Chlorophyll Distribution - Arabian Gulf, Saudi Arabia



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
METEOROLOGY AND ENVIRONMENTAL PROTECTION ADMINISTRATION (MEPA)

Meteorology and Environmental Protection Administration

Spectral Enhancement & Information extraction

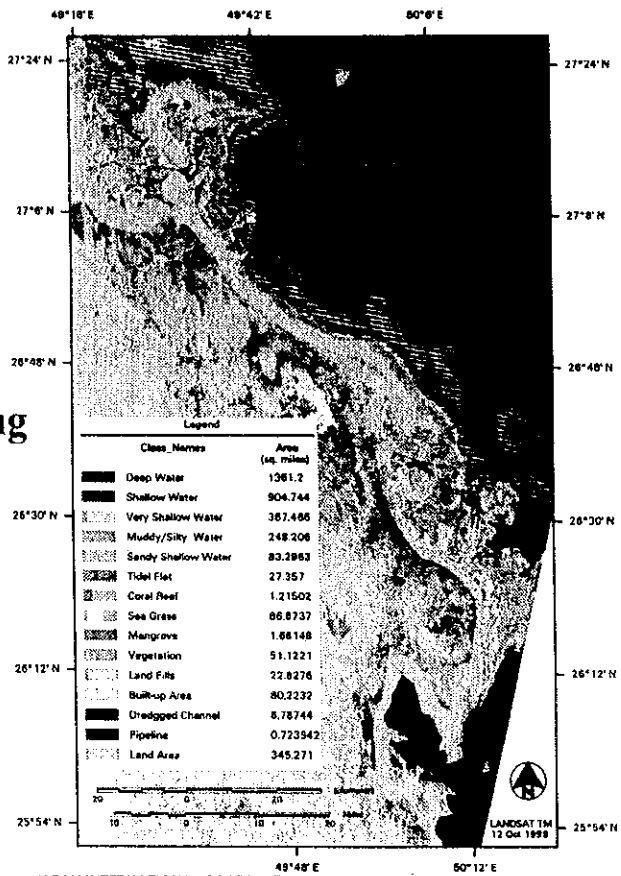


Existing Situation

- Deep Water
- Shallow Water
- Very Shallow Water
- Muddy/Silty Water
- Sandy Shallow Water
- Tidal Flat
- Coral Reef
- Sea Grass
- Mangrove
- Vegetation
- Land Fills
- Built-up Area
- Dredgged Channel
- Pipeline
- Land Area

Coastal Mapping

Coastal Mapping - Intensive Study Area, Arabian Gulf, Saudi Arabia



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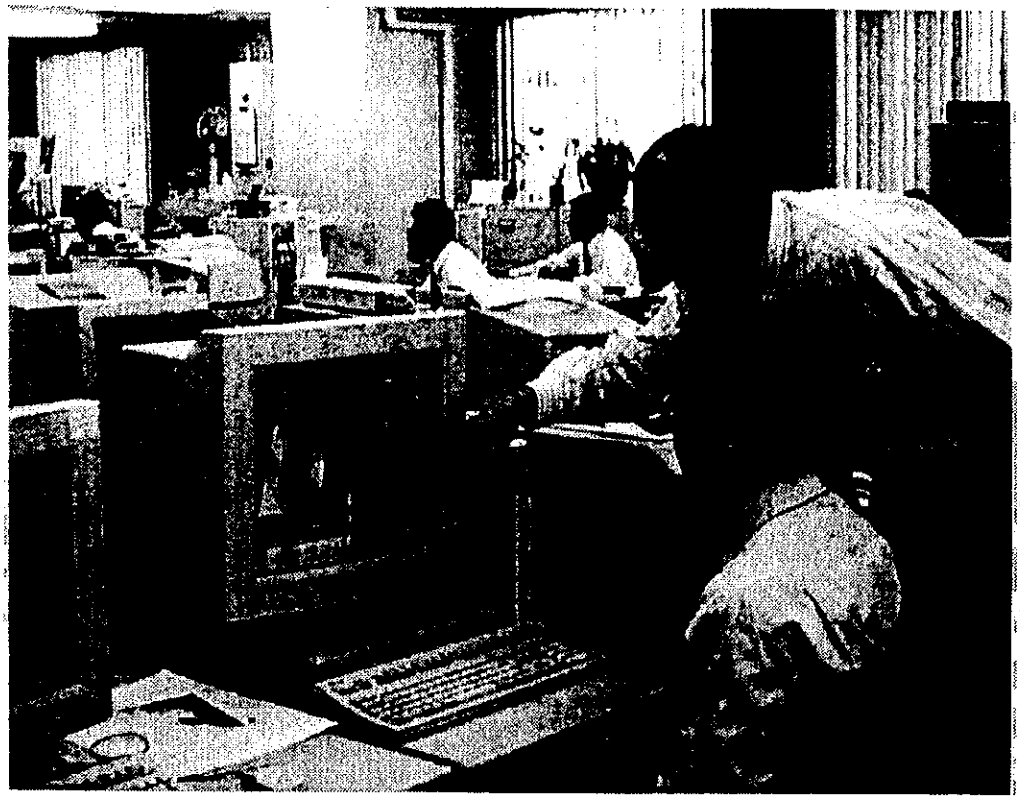
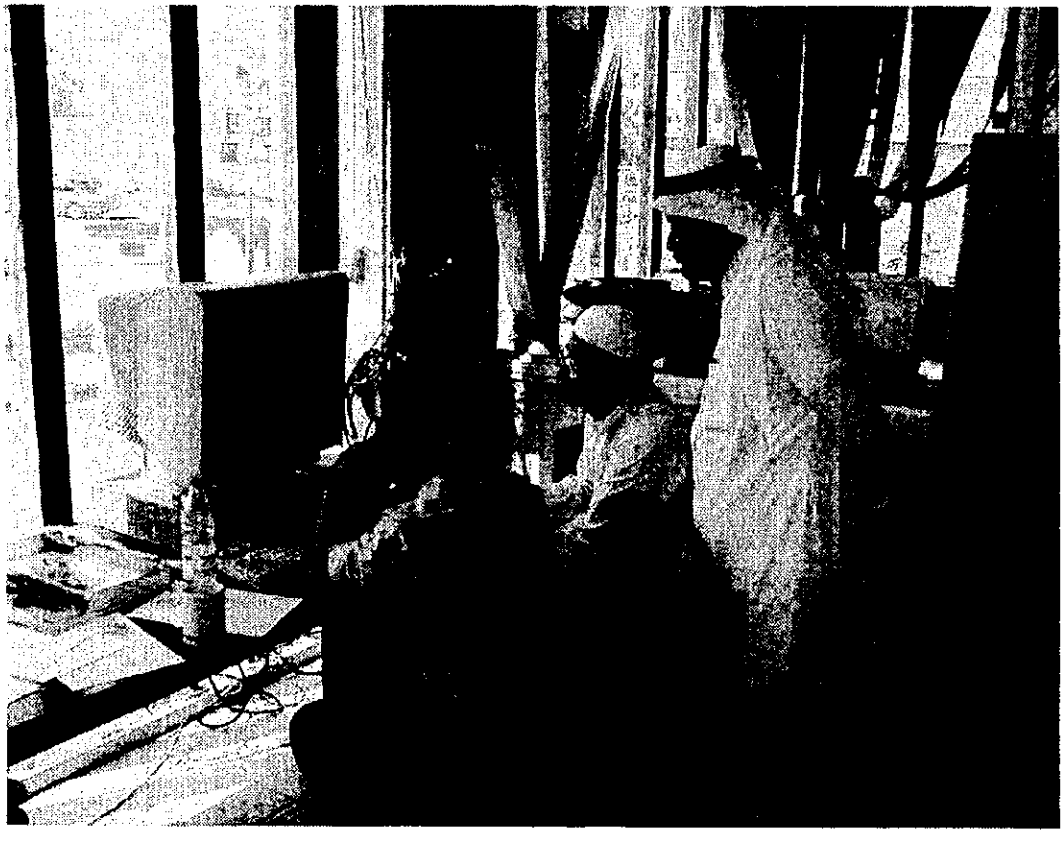
Meteorology and Environmental Protection Administration

Data Processing in Japan



3rd STAGE

Data Processing in MEPA, Jeddah

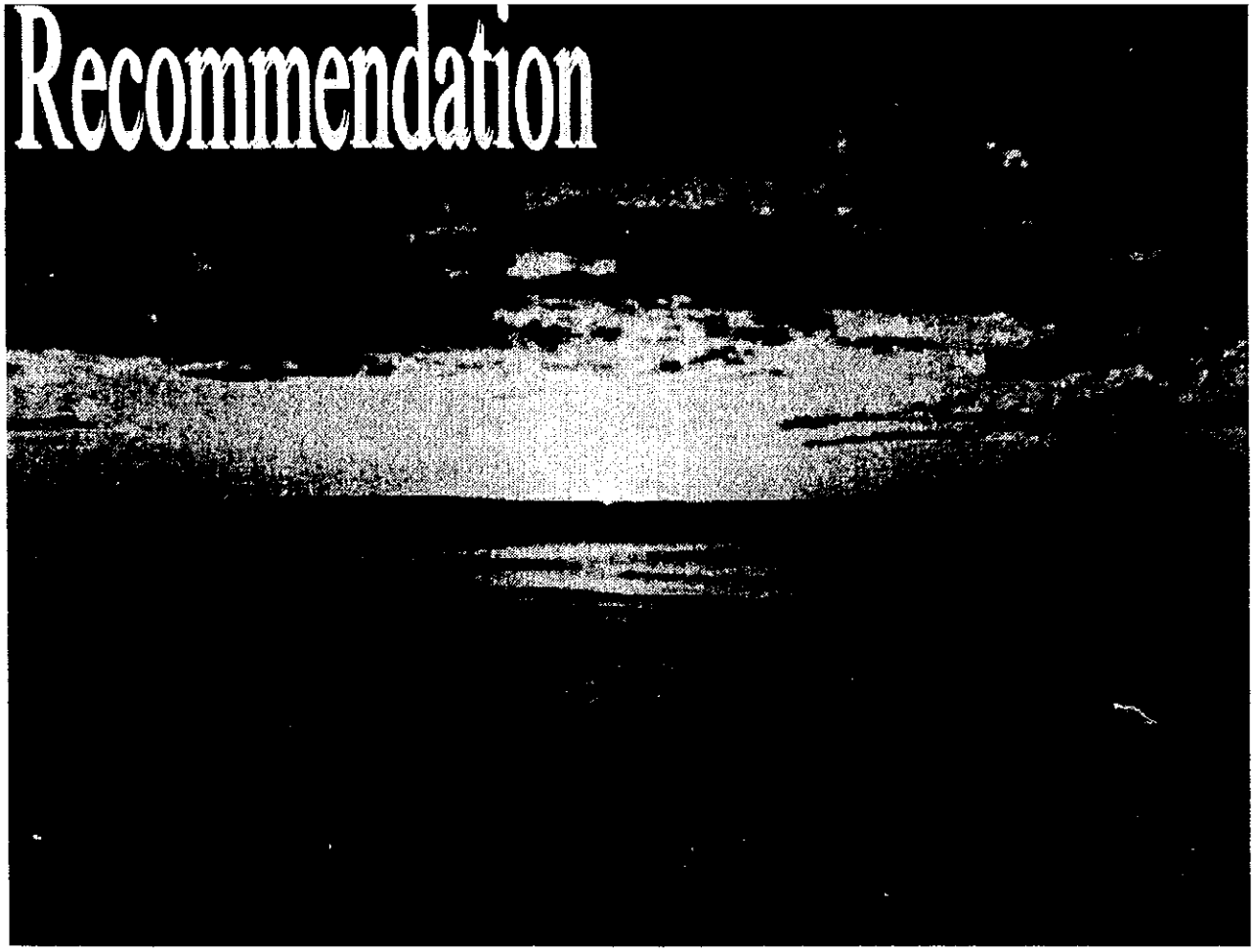


4th STAGE

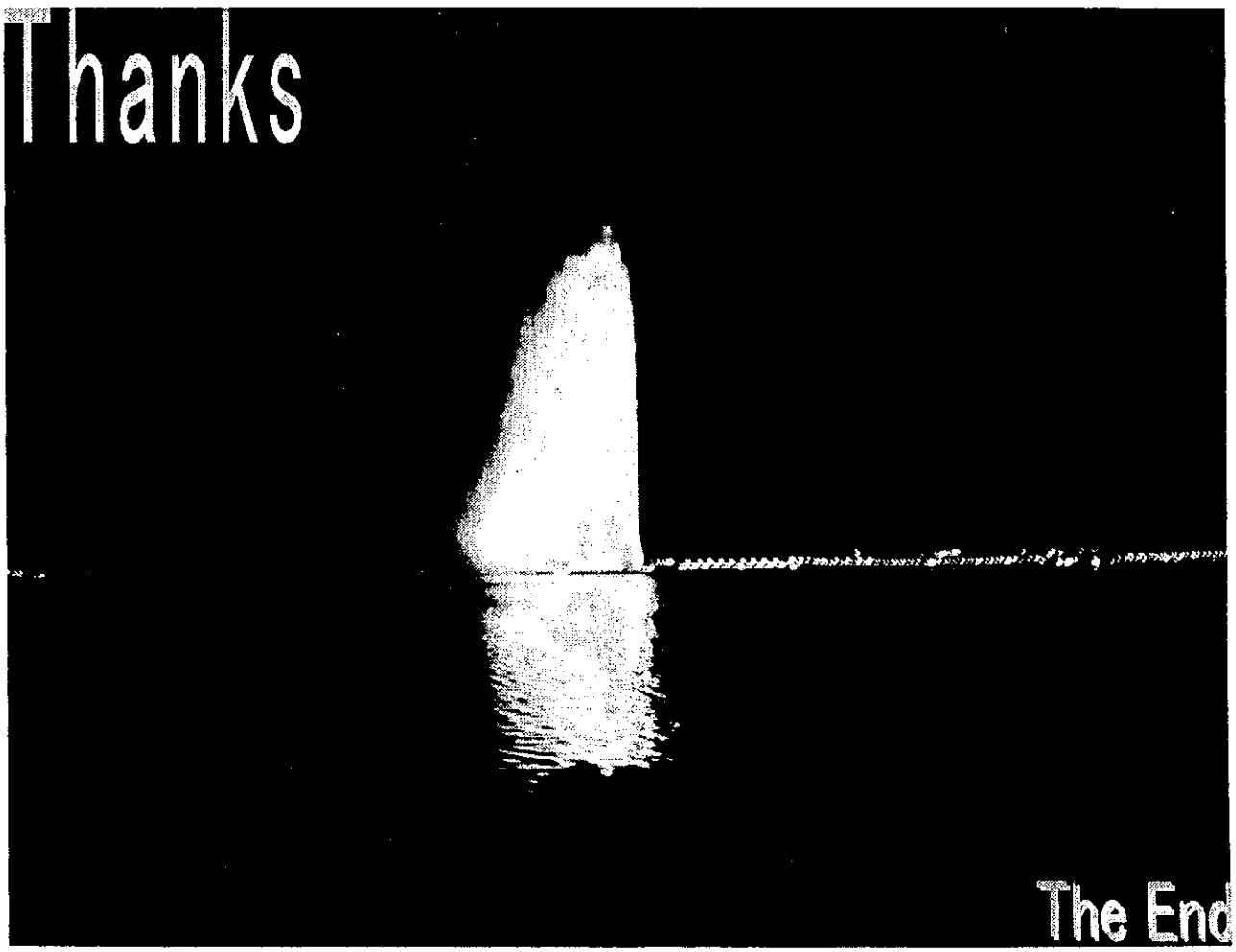
Conclusions

- TM images showed the variability of the selected water quality parameters
- Analyzed results provided useful information for identifying regional pattern in the temperature, suspended solids, chlorophyll & coastal areas distribution
- Effectiveness of the satellite data for providing a synoptic & quantitative overview of the water quality in the intensive study area
- Utilization of satellite remote sensing can be a feasible means for regular monitoring on seasonal or temporal basis. Moreover, increased spatial & spectral resolution of sensors of different satellites should be tried to help expand the opportunities for monitoring the Arabian Gulf Environment

Recommendation



Thanks



JICA/MEPA Workshop III

"Phased Approach to Future Seawater Monitoring Plan"

Tomohiko Ike