



Kuwait Institute for Scientific Research

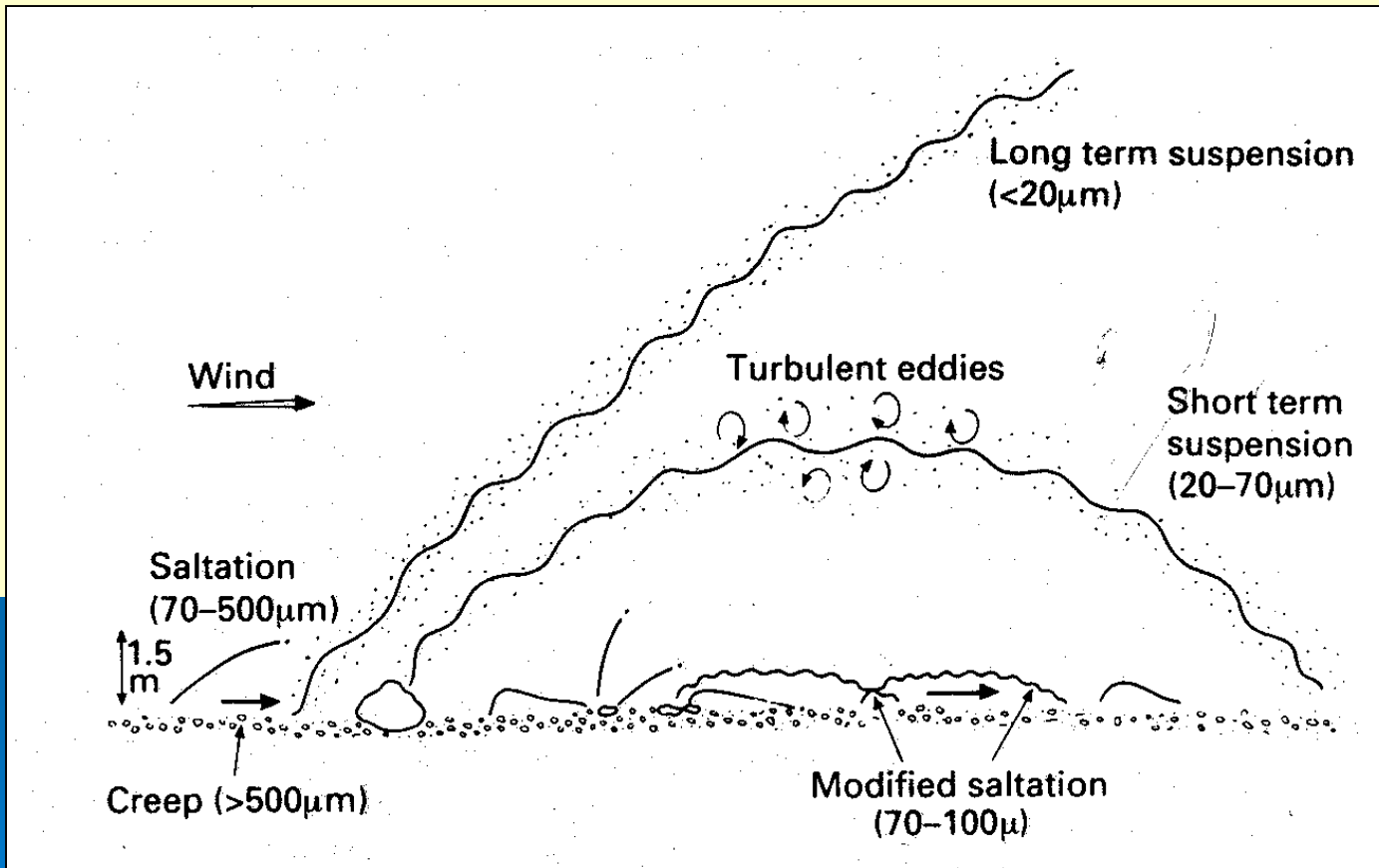
**MONITORING AND ASSESSMENT OF DUST FALLOUT
AND ASSOCIATED POLLENS WITHIN THE STATE OF
KUWAIT**

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Coastal and Air Pollution Department
Environmental and Urban development Division

21 May 2007

Grains transportation by wind



الزحف والدرجة

Rolling

الوثب

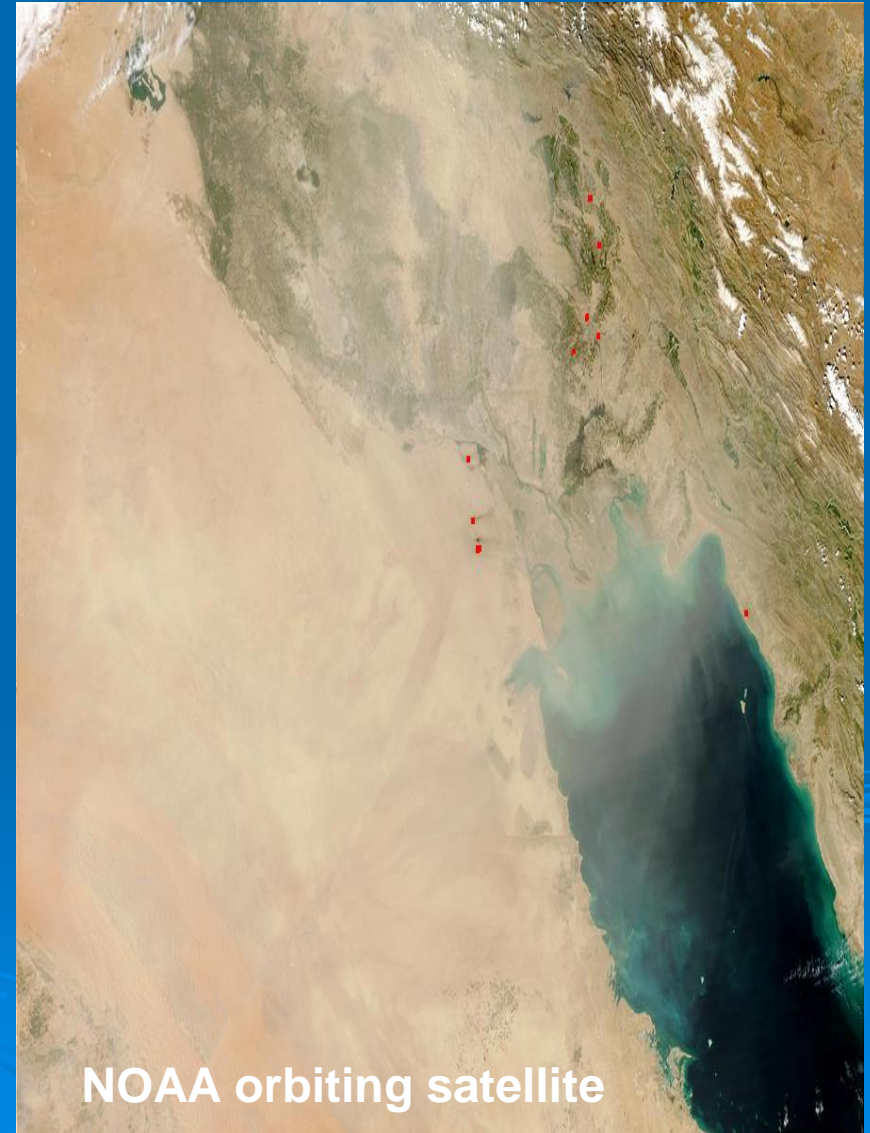
Saltation

التعلق

Suspension

Benefits to Kuwait

- Recent data and information regarding the dust fallout and pollen in Kuwait (rate of deposition and mineralogical composition).
- **Baseline data on local sources of dust and pollens within Kuwait.**
- Providing essential information on pollen distribution for future planning of Health Ministry and expanding in new housing projects and to link it with different types of allergic diseases for present and future planning.
- **The effective and efficient control measures of reducing dust that can later be applied in a wider case study.**
- Dust generally promotes the desertification processes through the deflation of the fine particles via suspension and saltation of the desert sediments over urban and agricultural areas. As a result studying this phenomenon is a major step towards understanding the desertification problem.
- **Assist the decision-makers in Kuwait to evaluate the environmental impact assessment of the area, and help them in recommending a proper environmental control measure to reduce the hazards of dust and suspended particles.**



April 1984





Nikon

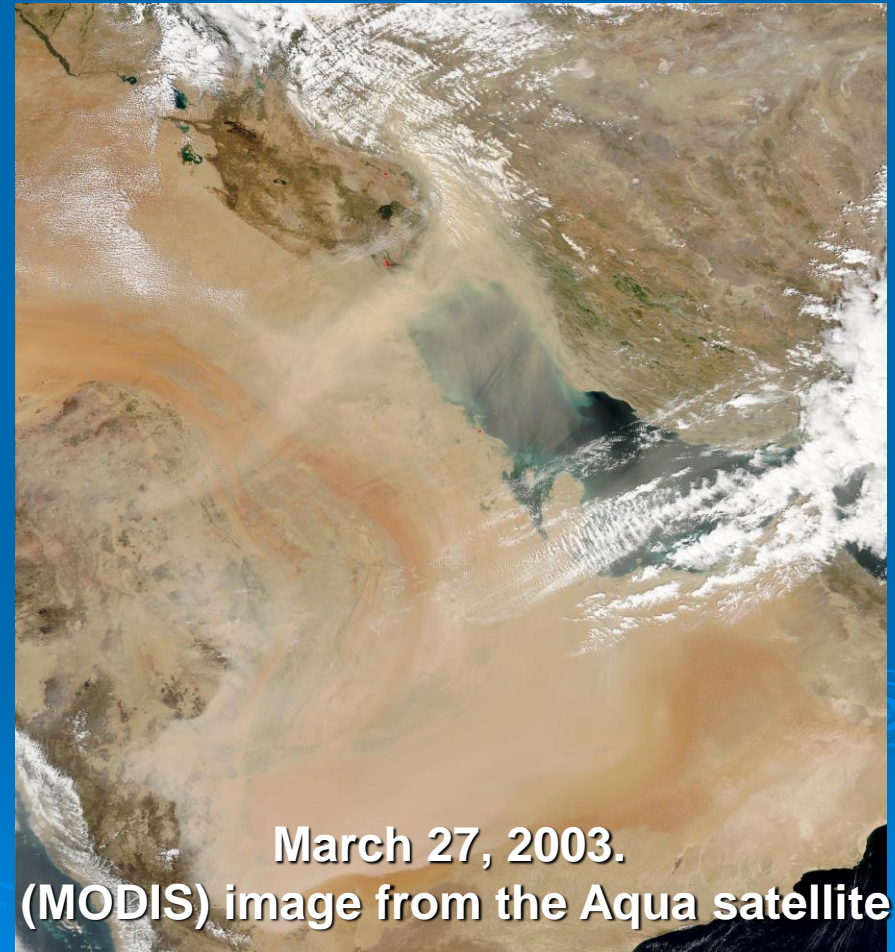




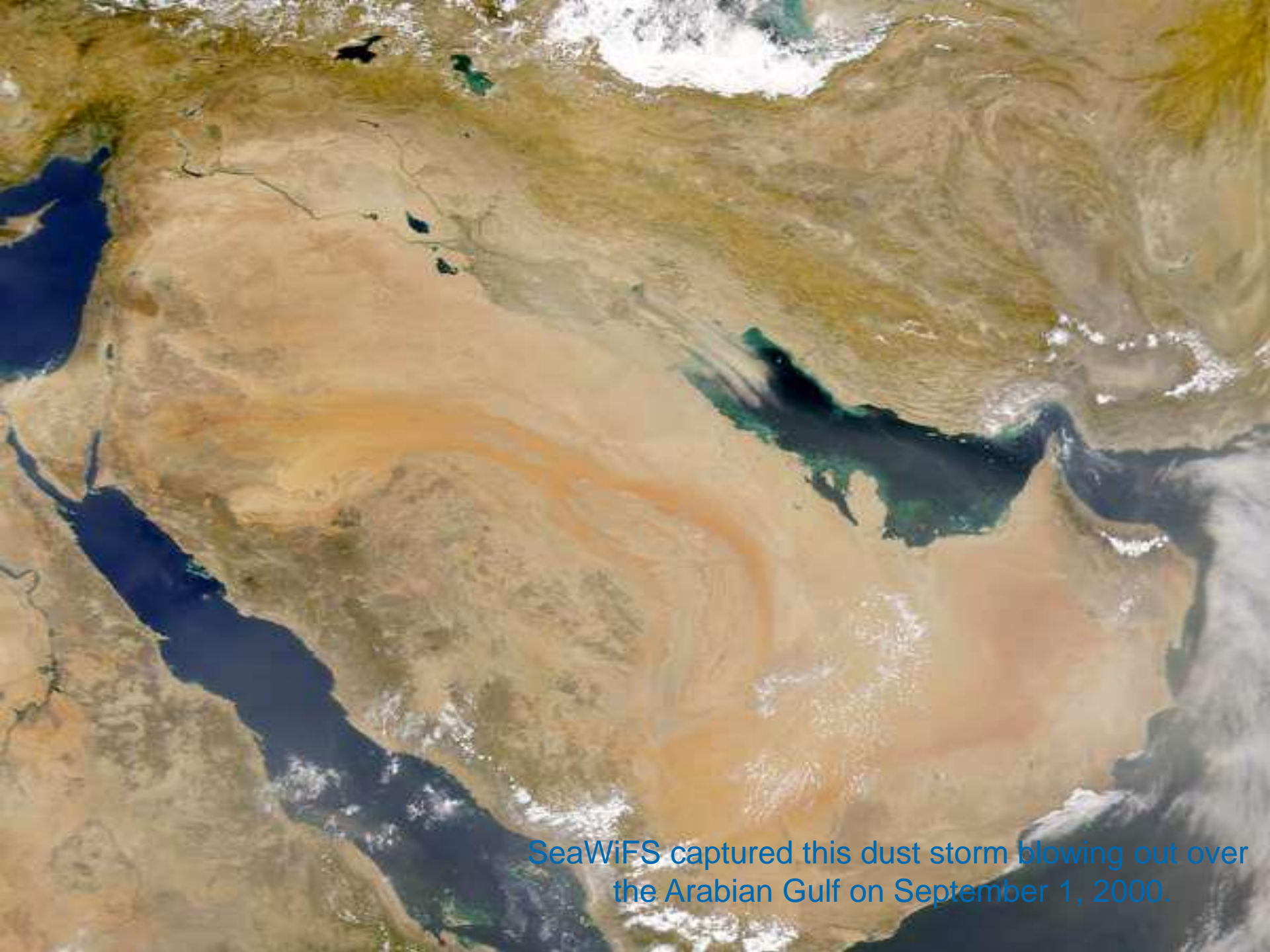
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Definitions

- **Airborne Dusts.** Airborne dusts are small particles produced from parent materials by deliberate or adventitious processes of breakage, that have become dispersed into the air by projection from fast moving machines or by winnowing action of air current (Walton, 1991).
- **Toze.** Toze is a local name for dust storms in Kuwait (Khalaf, 1979); like **haboub** in Sudan and, western Sahara, **khamasian** in Egypt and Palestine, **shaief** in southern Arabia.
- **Palynology.** Palynology is the study of pollen and spores, from both living and fossil plants and protists.



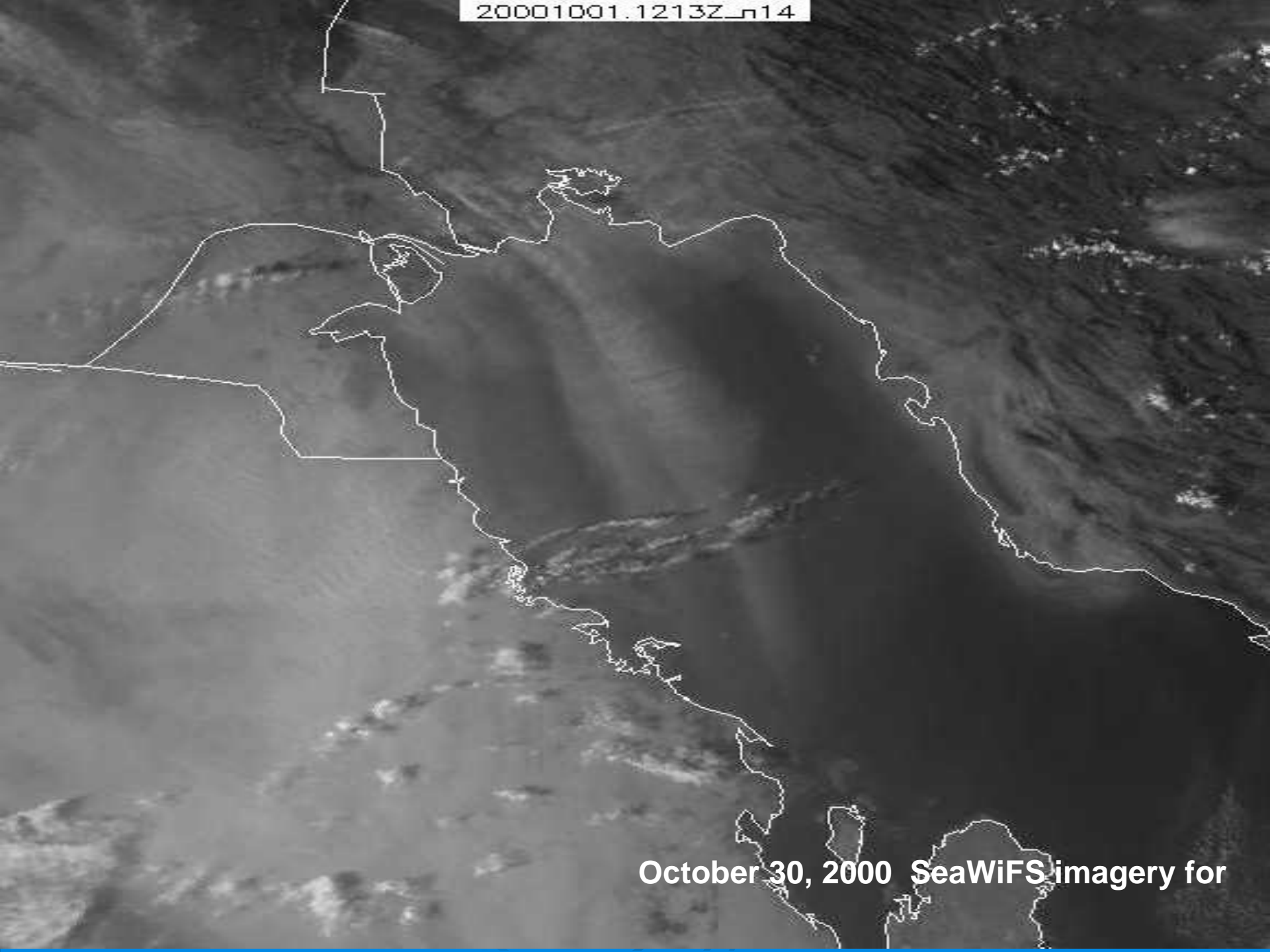
March 27, 2003.
(MODIS) image from the Aqua satellite



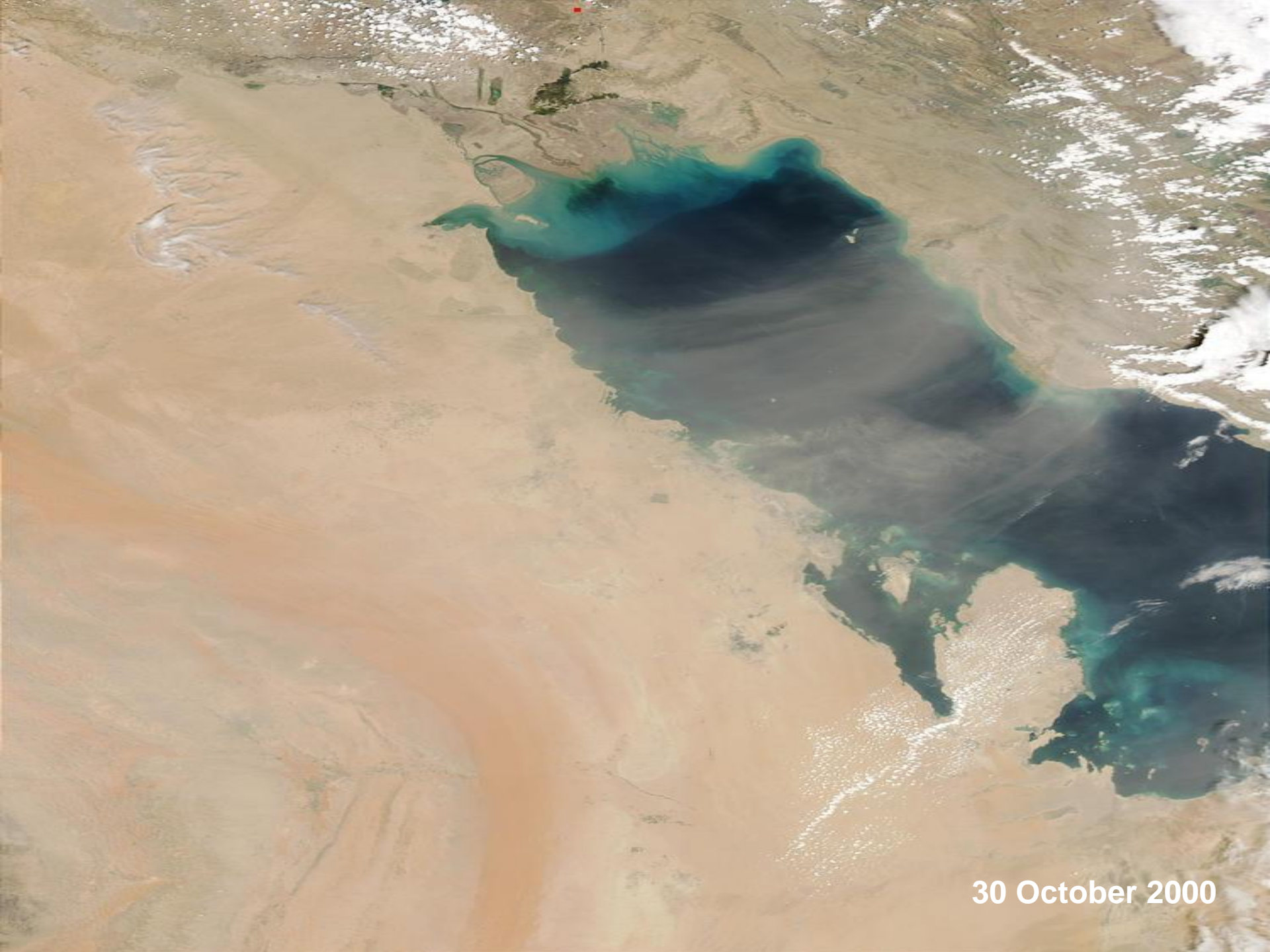
SeaWiFS captured this dust storm blowing out over the Arabian Gulf on September 1, 2000.



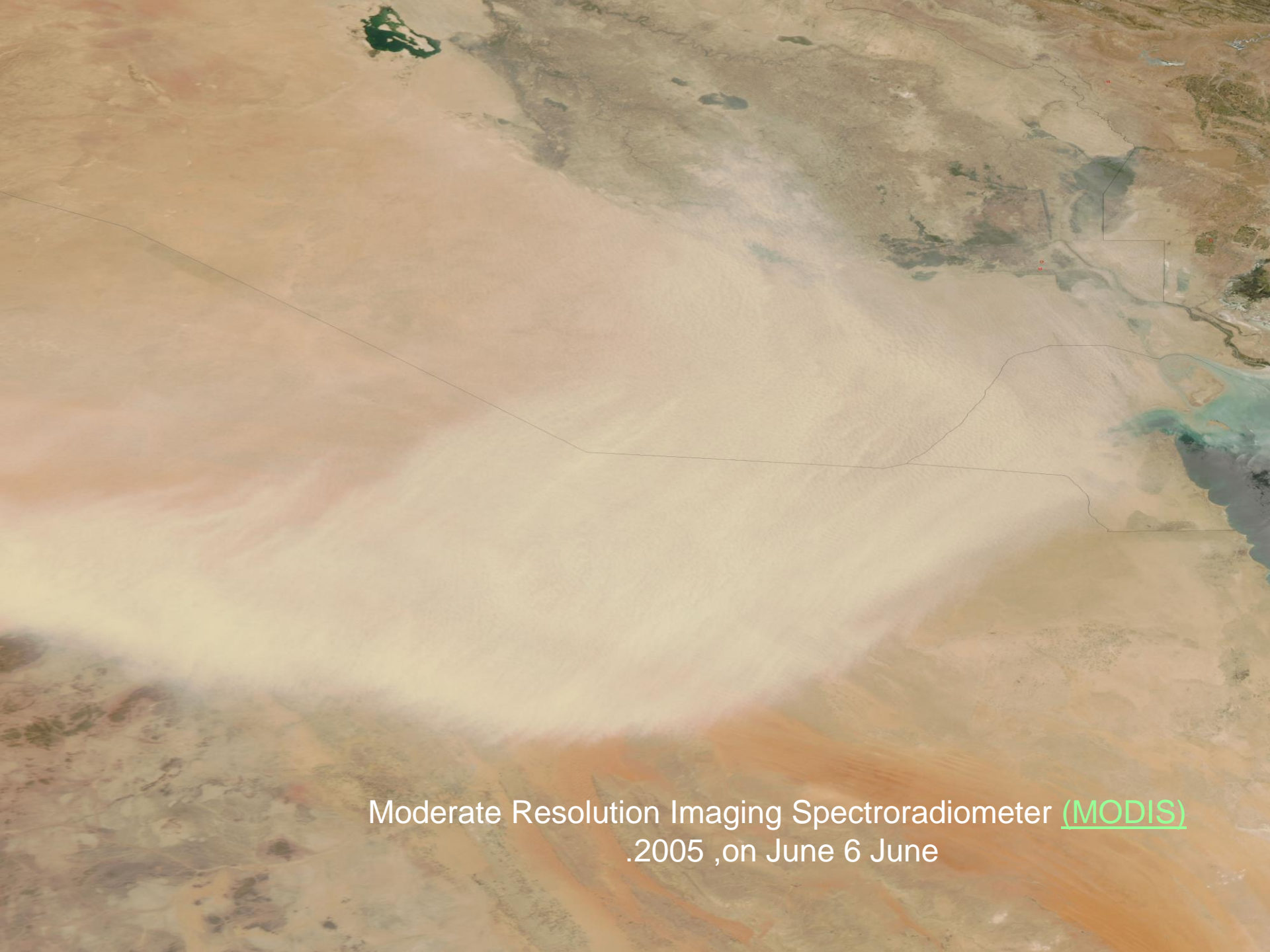
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October 30, 2000 SeaWiFS imagery for



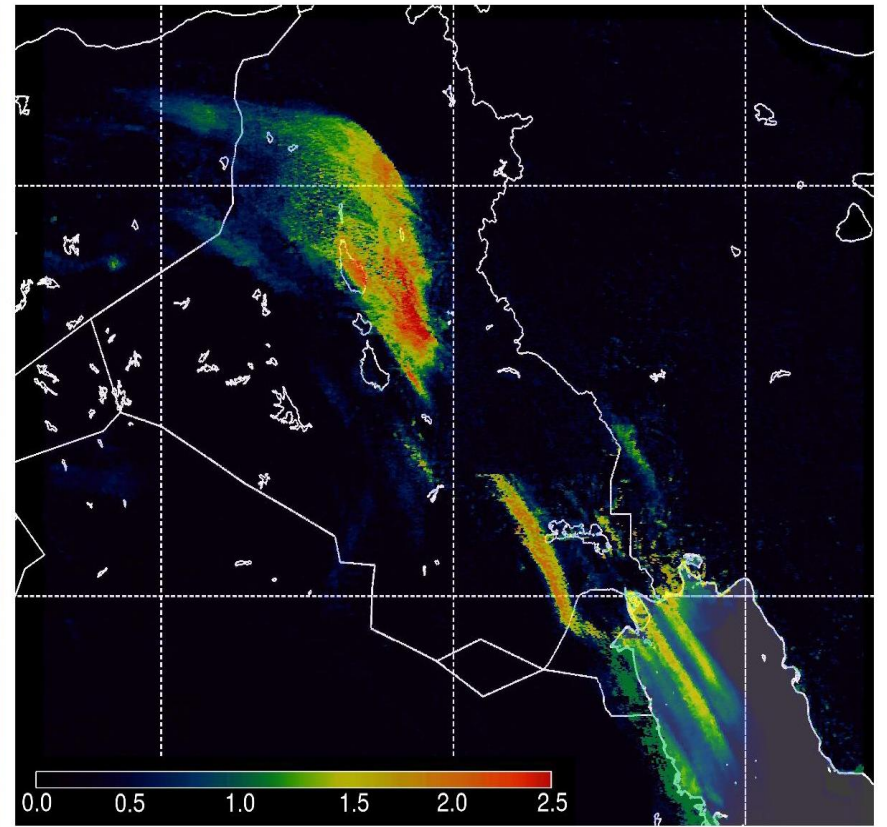
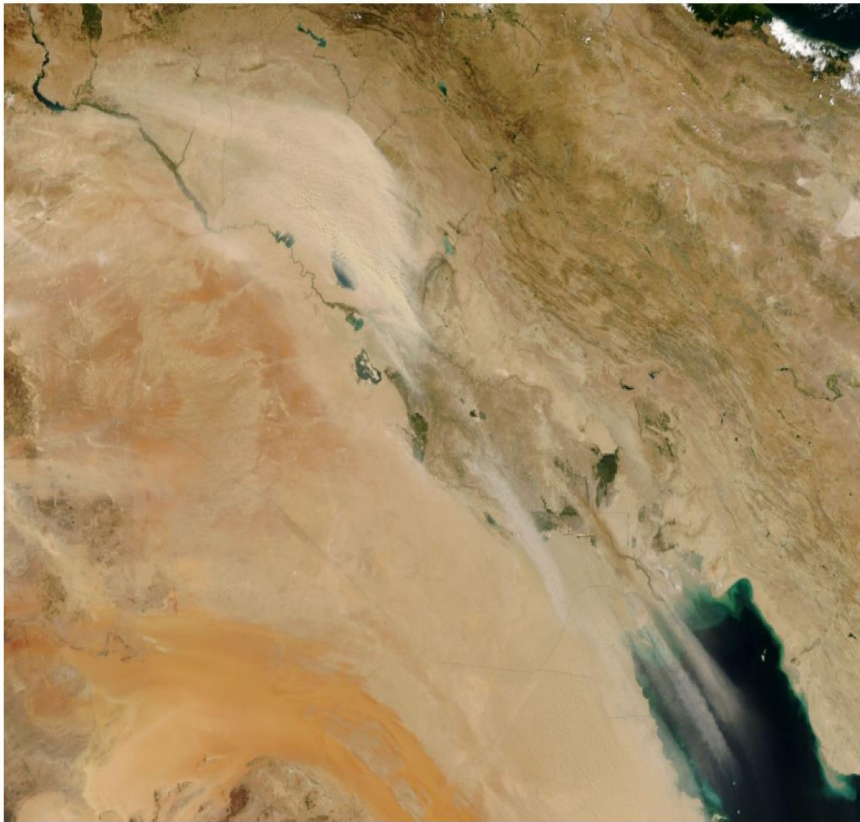
30 October 2000

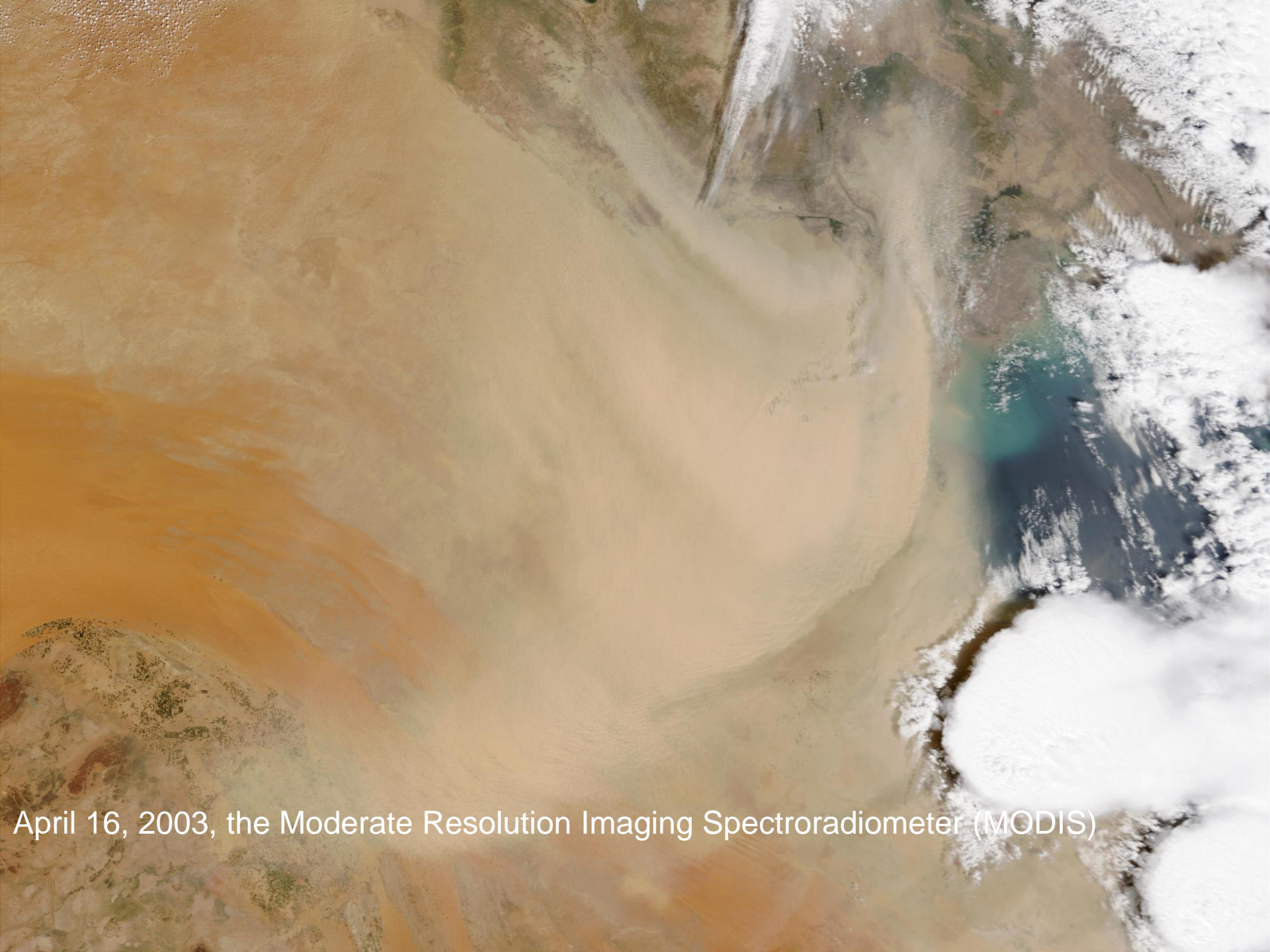


Moderate Resolution Imaging Spectroradiometer ([MODIS](#))
.2005 ,on June 6 June

MODIS aerosols distribution map

August 7, 2005

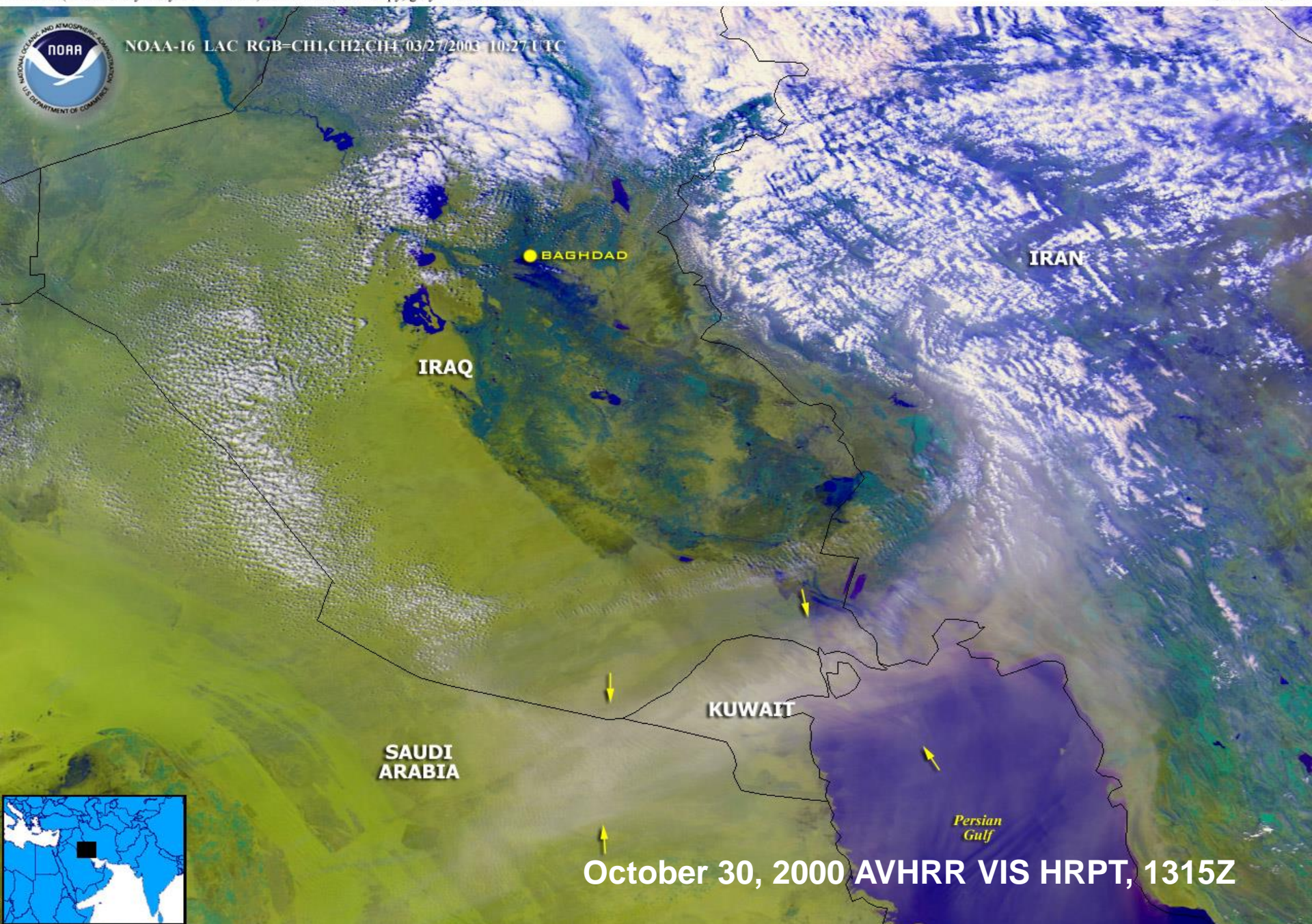




April 16, 2003, the Moderate Resolution Imaging Spectroradiometer (MODIS)

This NOAA-16 image depicts a sandstorm that extends across northern Saudi Arabia through Kuwait and into parts of southern Iraq. The dust (indicated by the yellow arrows) is visible as the lumpy, gray mass of cloud.

CREDIT: NOAA

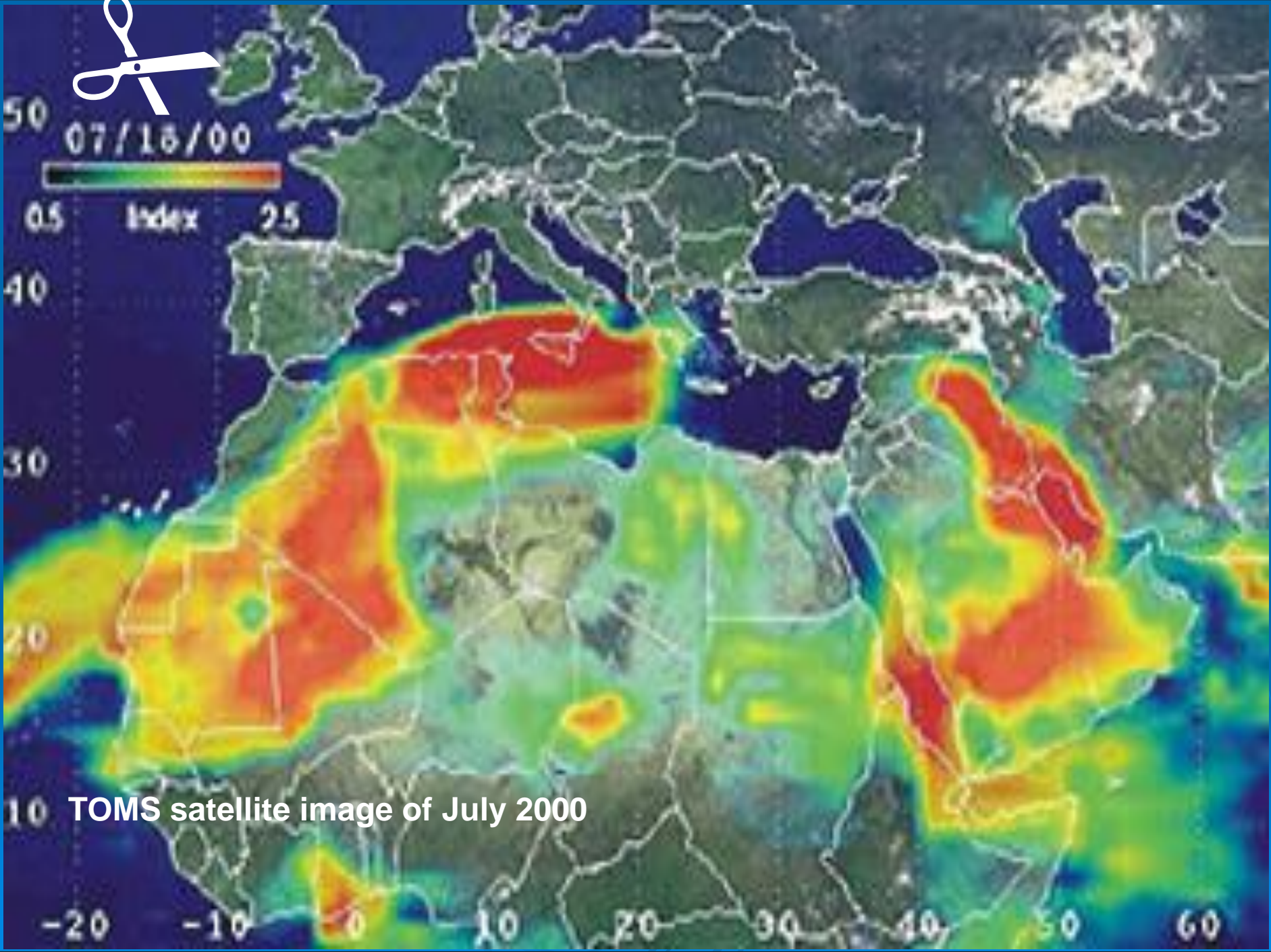




07/16/00

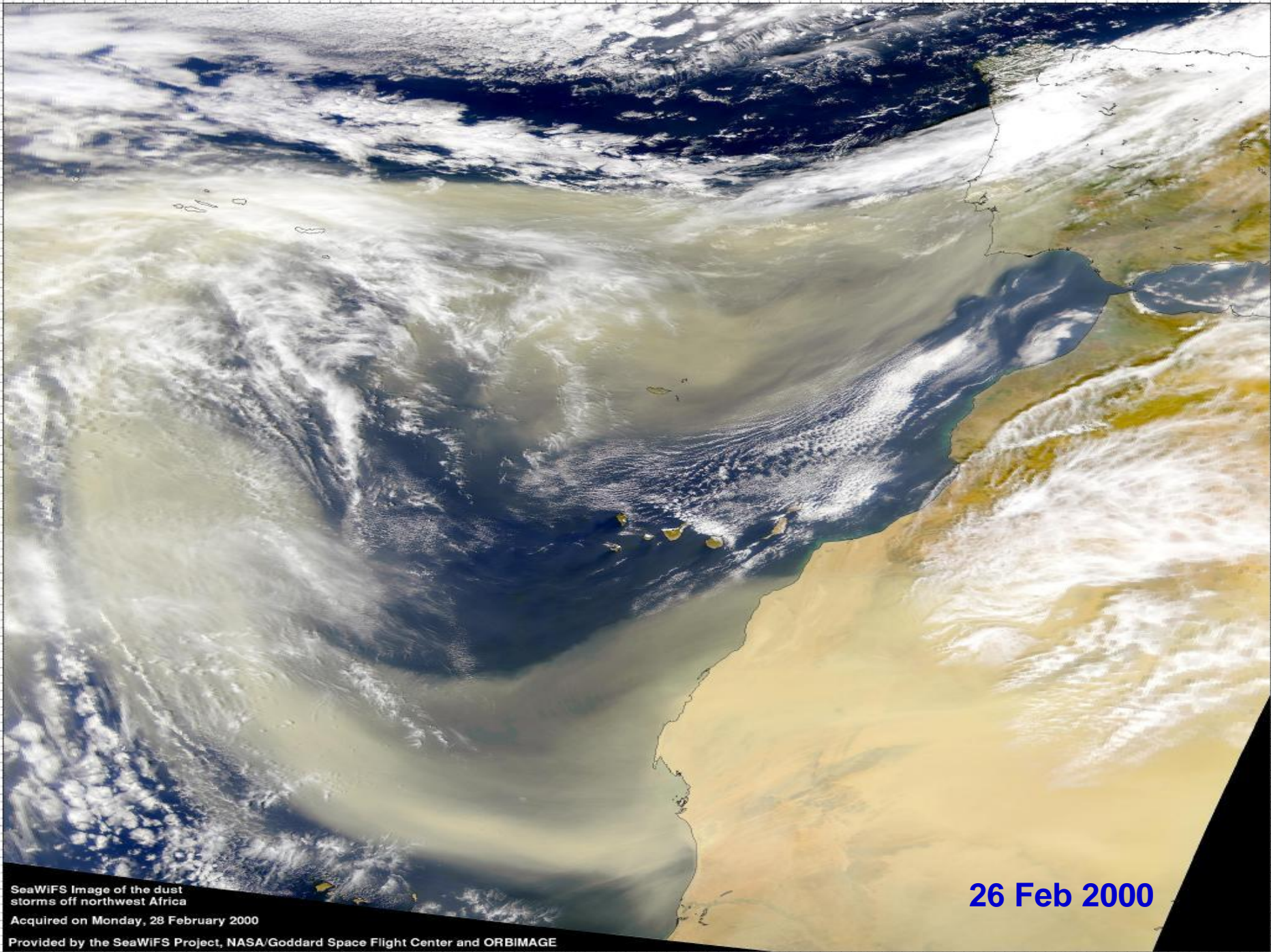


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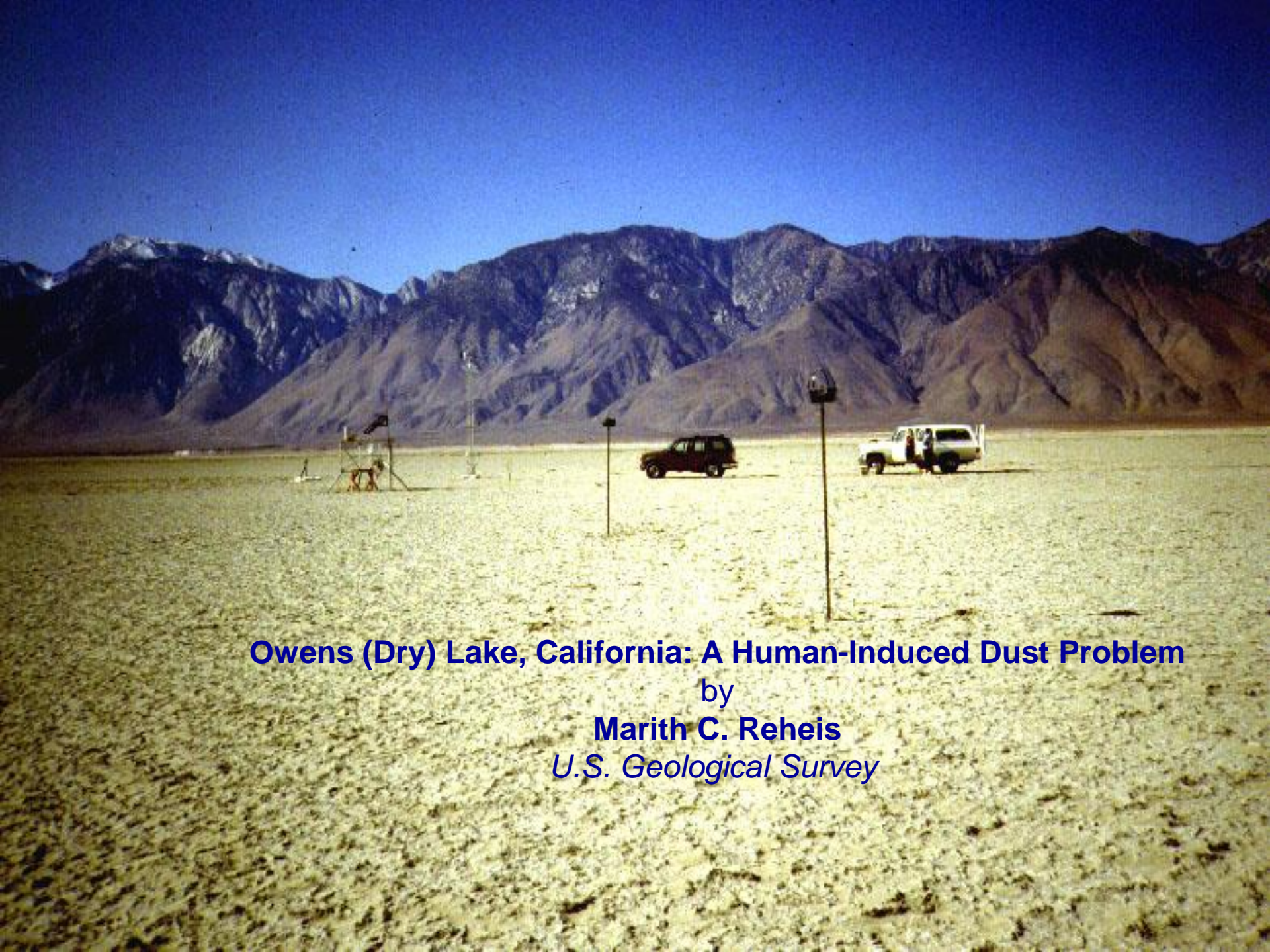
TOMS satellite image of July 2000

-20 -10 0 10 20 30 40 50 60



SeaWiFS Image of the dust storms off northwest Africa
Acquired on Monday, 28 February 2000

26 Feb 2000



Owens (Dry) Lake, California: A Human-Induced Dust Problem
by
Marith C. Reheis
U.S. Geological Survey

U.S. Survey Geological

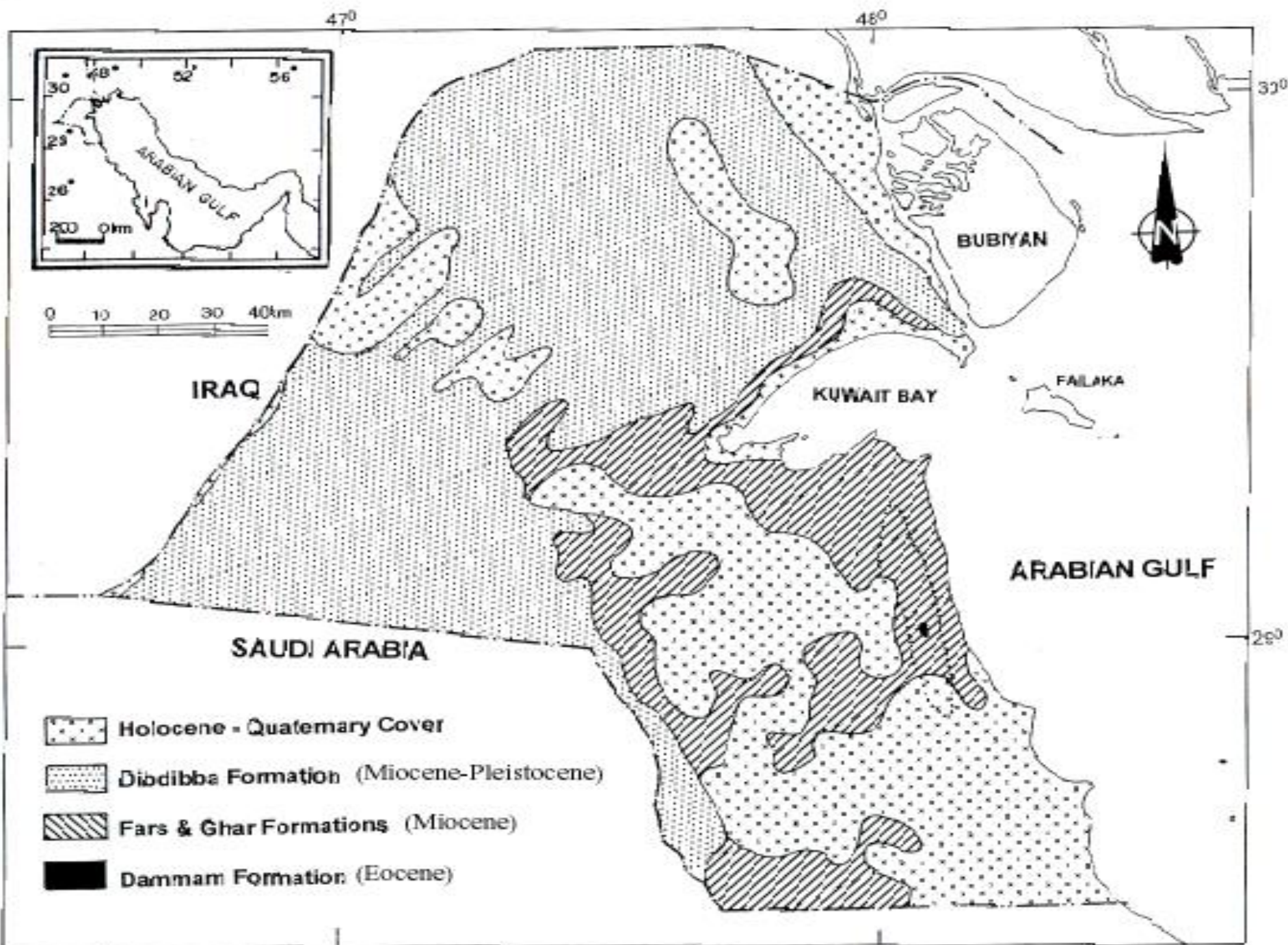


Objectives

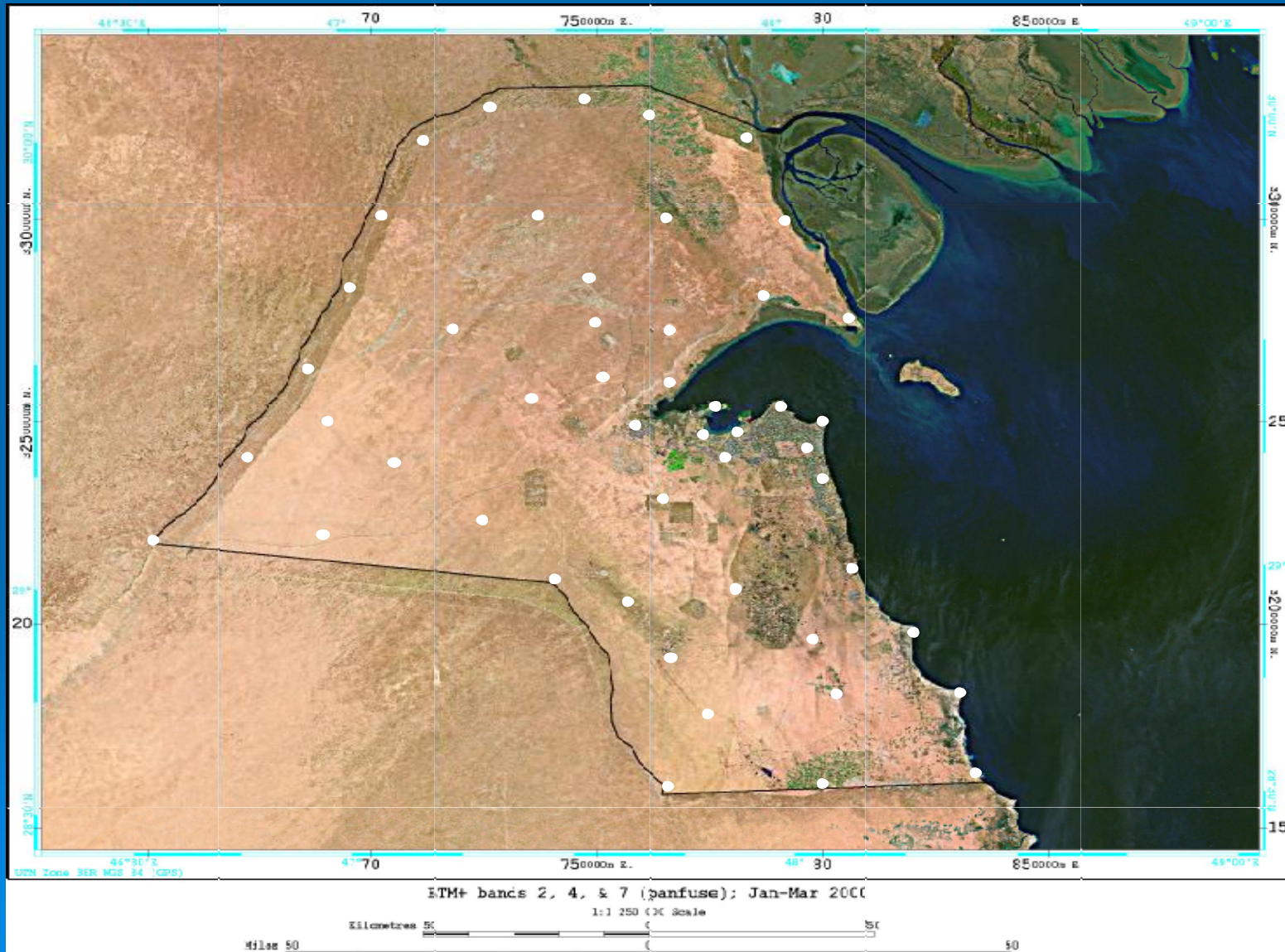
- To provide basic information on the qualitative and quantitative mineralogical composition and grain size distribution of the dust fallout in Kuwait.
- To identify the new local potential sources and distribution pattern of the dust fallout in Kuwait.
- To test and environmentally evaluate many varieties of effective control measures, whereby we can identify the efficiency of each control measure in controlling the mobile dust.
- To assess the physical (morphometry of the grains) and chemical (trace elements percentages) characteristics of dust fallout in order to identify its origin.
- To identify the pollen distribution in dust samples.

Previous Related Projects

- **EES-12: Mineralogy, granulometry and distribution pattern of dust fallout in Kuwait.**
- **EES-27: Study of sand and dust storm sediment - Phase II.**
- **EES-66: Dust fallout in the northern part of ROPME sea area.**
- **VD001C: Assessing the impact of volatile organic compounds emitted from anthropogenic sources on the ambient air quality (completed).**
- **EC006S: Testing and evaluating the post certification activities for radionuclide station, RN-40, Kuwait City, Kuwait (completed).**
- **EC007S: Testing and evaluating the post certification activities for radionuclide station, RN-40, Kuwait City, Kuwait- phase II (completed).**
- **EC015C: Assessment of chemical and radiation pollution in the working environment at Amghara Industrial Area (completed).**
- **EC019C: Field environmental measurements in Bubiyan Island monitoring climatic conditions and movement of aeolian sediments (sand & dust) (completed).**
- **EC041K: Dust fallout monitoring and analysis in Jahra City and surroundings (completed).**



Proposed dust collectors



Benefits to Kuwait

- Recent data and information regarding the dust fallout and pollen in Kuwait (rate of deposition and mineralogical composition).
- Baseline data on local sources of dust and pollens within Kuwait.
- Providing essential information on pollen distribution for future planning of Health Ministry and expanding in new housing projects and to link it with different types of allergic diseases for present and future planning.
- The effective and efficient control measures of reducing dust that can later be applied in a wider case study.
- Dust generally promotes the desertification processes through the deflation of the fine particles via suspension and saltation of the desert sediments over urban and agricultural areas. As a result studying this phenomenon is a major step towards understanding the desertification problem.
- Assist the decision-makers in Kuwait to evaluate the environmental impact assessment of the area, and help them in recommending a proper environmental control measure to reduce the hazards of dust and suspended particles.

Task I: Mobilization

- Within this task, a literature survey will be conducted in order to compile existing data and information on the geology, geomorphology, hydrogeology, vegetation cover, environmental conditions, status of aeolian processes and climatic conditions of the study area.
- **Purchasing and manufacturing of the field equipment (on-site weather station accessories, dust fallout collectors, etc.).**
- Designing and manufacturing of dust collectors in order to monitor the amount of dust for 24 months.
- **Preparing of topographic maps of different scales, aerial photos and satellite images.**
- Establishment of base maps for the study area.
- **Design field sheets for data collection and sampling.**
- Communication and coordination with concerned organizations, e.g., Ministry of Defense, Ministry of Interior, Kuwait Oil Company, Ministry of Health and others.
- **Allergic diseases can be monthly monitored for one year time period to correlate with dust and pollens type and concentrations.**
- Preparation of detailed work plan.

Task II: Field Monitoring

2-1: Site Selection

- Reconnaissance field survey using recent images, aerial photographs and Personal Digital Assistant (PDA) to collect data and information on the general relief, land forms, soil characteristics, and road accessibility of the study area.
- Representative stations will be selected for the whole area. Designed or manufactured dust fallout samplers will be placed at proposed sites, at a height of 2.40 m from the surface. These sites will cover a vast area of Kuwait.
- Based on the results of the reconnaissance field survey and interpretation of remote sensing information (besides previous experience) the best locations of the field monitoring stations and sample collectors will be selected. The coordinates of the monitoring field stations will be registered and downloaded on the PDA.

Task II: Field Monitoring

2-2: Sampling and Data Collection

- Recording of wind data from the fixed wind station. These data include wind speed and direction.
- Collect dust fallout samples on monthly basis from 50 stations distributed all over the study area for a maximum period of 24 months.
- Collecting samples from different aeolian land forms and geological formations within Kuwait for comparison with dust.
- The monthly dust fallout samples will be collected simultaneously from all sampling stations for an approximate period of 24 months. The monthly amount of dust fallout at each sampling station will be calculated (in Tons/km²) by dividing the total weight of the collected sample by the area of sampler's opening. A contour map will be produced from the available data through which we can allocate the main local sources of dust blowing towards Kuwait.

Task III: Analysis of Gamma-emitting Radionuclides, Data Processing, and Evaluation

- Collection of dust samples from five selected sites will be analyzed.
- **To process collected samples of dust for gamma laboratory analysis by applying standardized and reproducible chemical procedures recommended and used by internationally recognized institutions.**
- Special attention will be paid to traceability of the samples by maintaining a “Chain of Custody” record for each sample. A catalogue will be set up of processed samples.
- **To perform gamma spectrometry analysis of processed samples by using a laboratory system equipped with an HPGe detector and an ultra-low background shielding.**
- To optimize the measurements with respect to its duration and uncertainty. To determine mass and radioactivity concentrations of selected radionuclides.
- **To maintain validity of the results and to carry out specified quality assurance procedures.**
- To set up the Naturally Occurring Radioactive Materials (NORM) data as the database for the current radiological situation in the fields and as a baseline for future studies.

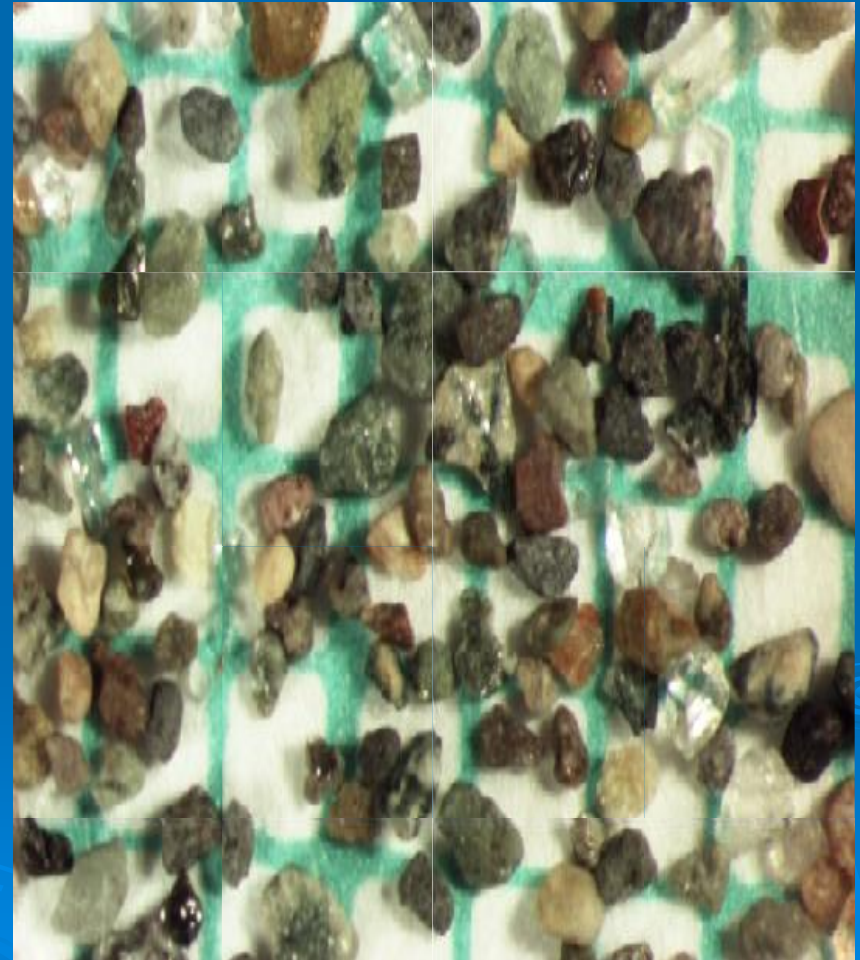
Task IV: Laboratory Investigation

- **Sample Preparation.** The dust samples will be washed in a 10-mesh sieve (0.063 mm) to remove insects and bird's feathers, and then treated chemically by soaking in hydrogen peroxide at 400oC to remove the organic materials. The samples will then be dried and weighed.

Task IV: Laboratory Investigation

Grain Size Analysis.

All samples, most of which weighed a few grams, will be analyzed for grain size distribution using a Laser granulometric analyzer. The analyzer can measure the weight percentage for each size under 2 mm. Grain size parameters will be determined for dust fallout. Both Moment and Folk and Ward (1974) method will be employed to determine the statistical parameters of the sediments with GRADSTAT software developed by (Blott and Pye, 2001).



Task IV: Laboratory Investigation

➤ **Mineralogical Analysis.**

The two main textural components (very fine sand, silt and clay) of the dust samples will be subjected to mineralogical analysis to identify the mineral constituents and determine their frequency percentage in each textural class. The clay size fraction will be separated from the whole sediments of the samples by sedimentation method (Folk, 1974) for X-ray diffraction (XRD) analysis and the rest of the sample (silt) will be taken for heavy mineral analysis using Carver (1971) technique.

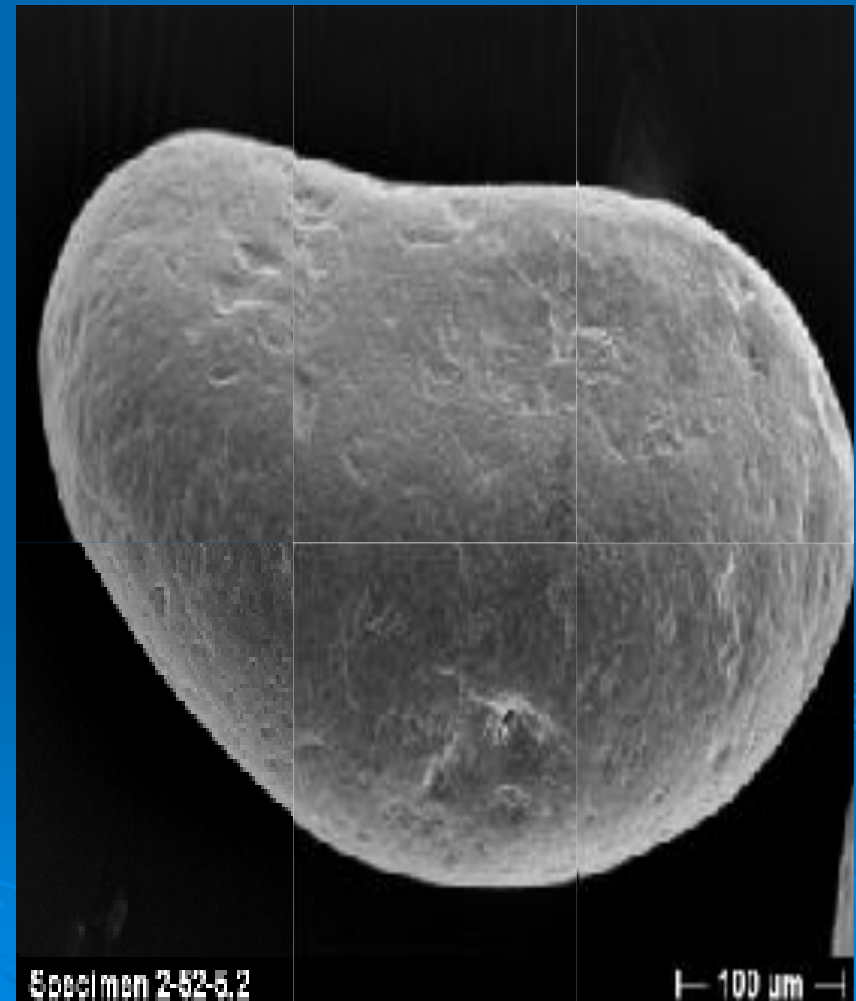
Task IV: Laboratory Investigation

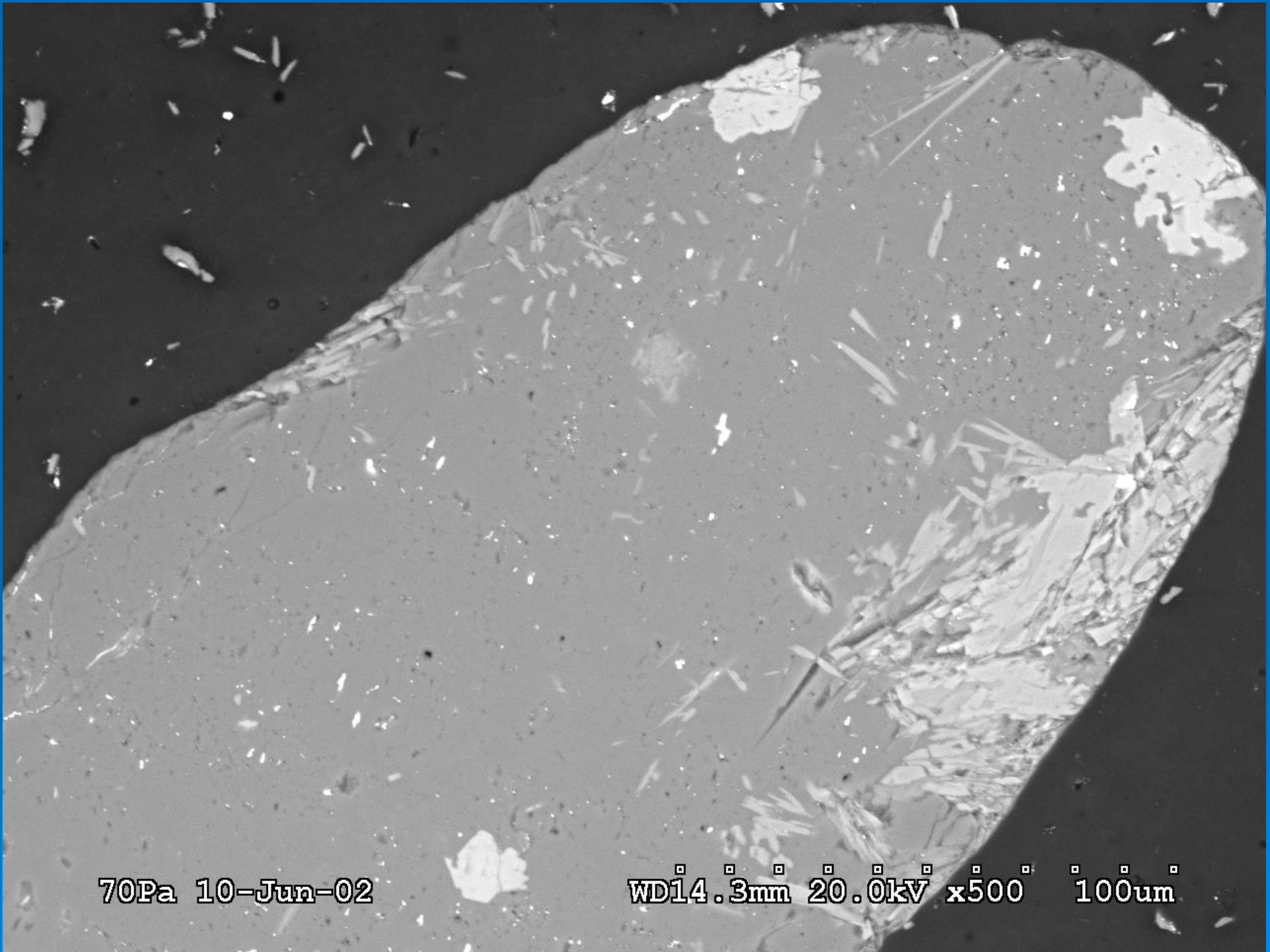
Chemical Analysis.

The origin of dust particles can be deduced from the mineralogical and geochemical analysis in a pilot study. Possible sources of air born contaminants can be oil lakes, dried-out river catchments and quarries. Using ICP.OES and/or XRF will be used to trace the following main concern elements: Ni, Cr, V, Pb and others.

Physical Properties:

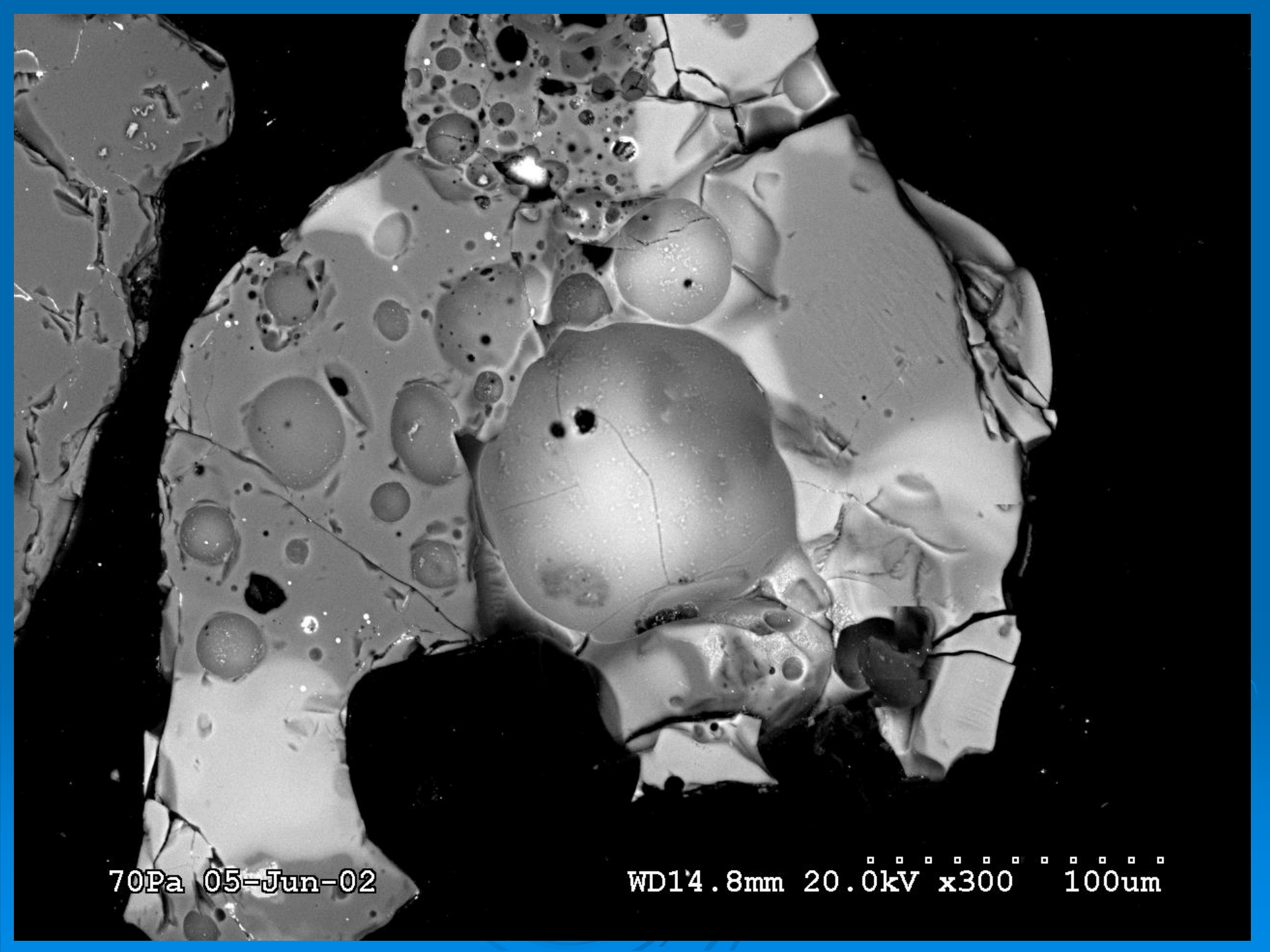
The physical properties of the two dominant size fractions of dust and sand samples collected will be analyzed. These properties are the textural characteristics through SEM in addition to the BET surface area, and particle areas and perimeter.





70Pa 10-Jun-02

WD14.3mm 20.0kV x500 100um



70Pa 05-Jun-02

WD14.8mm 20.0kV x300 100um

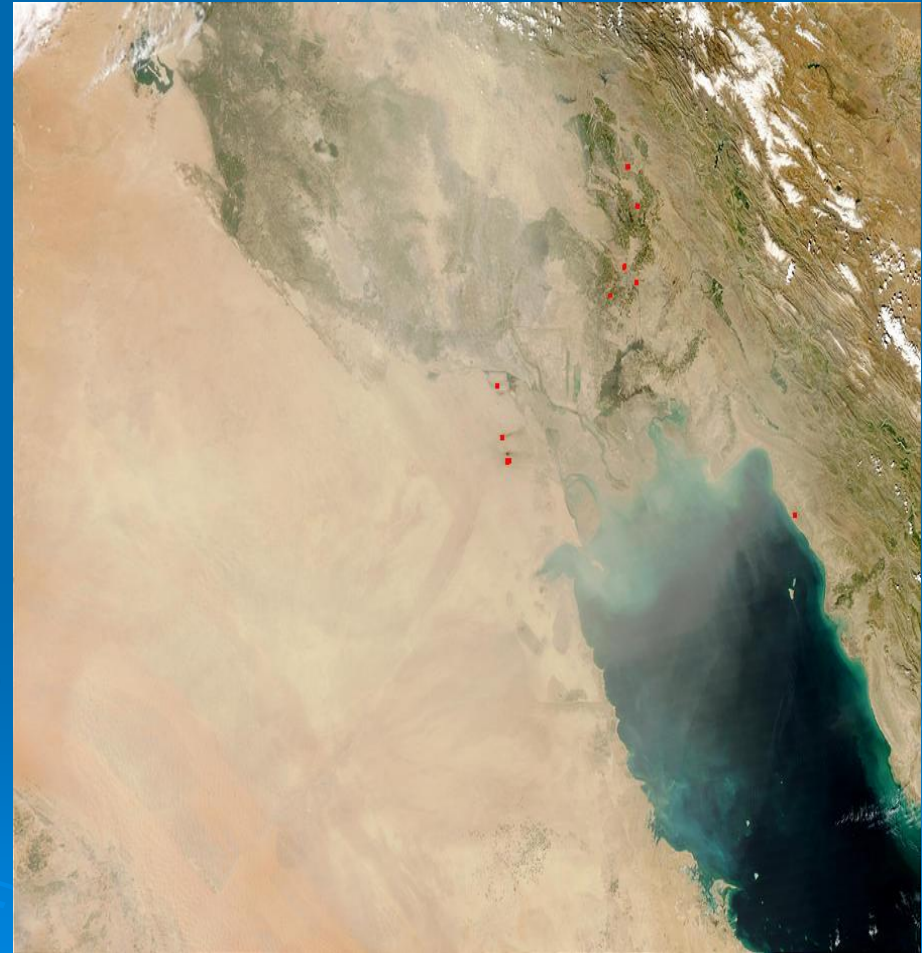
Task V: Pollen Collection and Identification

- Thirty dust collection sites will contain several slides for trapping pollens from the air.
- Pollen will be characterized by:
 - 1-Resistant to decay.
 - 2-Morphological characteristics specific to plant groups.
 - 3-Produced in vast quantities.
 - 4-Reflect the natural vegetation of a location.
 - 5-Size (10-150 μm).
- A monthly map for one year monitoring, for each pollen distribution in Kuwait, will be prepared.

Task VI: Dust and Pollens Mapping and Monitoring via GIS and Remote Sensing

Two sets of images will be acquired.

- First set is low resolution regional images (TOMS, AVHRR, SeaWiFS) to understand the regional dust dynamics and distribution.
- The second set of images will be medium and high resolution scene (Landsat ETM, ASTER, Quickbird), which will help in identification of changes in dust pattern and accumulation, size of dust body and shape to make quantitative estimates of sand added or removed from a site.
- Layers of dust and pollens concentrations will be presented through geographical information system (GIS).



Task VII: Reporting

A progress report and a comprehensive final report containing data generated from all tasks with interpretation will be compiled and submitted at the specified reporting dates as per the task schedule of the project.

Whats new in this proposal- Expected Output

- Qualitative monthly and annual rates of pollens and dust fallout over the State of Kuwait with information on grain size distribution and mineralogical composition of dust.
- **Monthly maps illustrating the main local sources and distribution of dust and pollens within Kuwait.**
- Monthly graphs presenting dust and pollen rate variability around different control measures such as green belts, cultivated areas and preserved areas, and effect of morphology (cliffs, depressions, and quarries) on dust and pollen distribution.
- **Physical and chemical analysis data of dust fallout and comparable local geological formations in Kuwait's sediment sources in order to identify its origin.**
- There will be monthly maps and figures measuring the dust fallout amount for a period of 24 months to show potential sources of dust fallout and their relative importance in the study area in addition to maximum 12 extra maps illustrating pollen distribution every month.

Staff Salaries	07-08	08-09	09/10	Total
Researchers	15,042 (6.9mm)	8,502(3.9mm)	5,014 (2.3 mm)	28,558
Professionals	2,688(2.8mm)	1,440(1.5mm)		4,128
Technicians	5,610(8.5mm)	2,970(4.5mm)	330(0.5mm)	8,910
Administrators	1,400(2.5mm)	840(1.5mm)	1,400 (2.5mm)	3,640
		Sub-total		45,236
Operation Expenses				
Pick-up vehicle (on rent)	2,400	2,400	0	4,800
Temporary field labors	8,000	2,000	1000	11,000
Travel	3,000	3,000	1,500	7,500
Fabricating/making dust collectors	1,000	0	0	1,000
Dust fallout collectors	4,000	0	0	4,000
Raw materials	1600	0	0	1600
Satellite images	6,000	4,000	0	10,000
Temporary staff	5,000	5,000	1,500	11,500
Consultants	5,000	5,000	0	10,000
Softwares	2,000	2,500	0	4,500
Pollen analysis	5,000	10,000	0	15,000
Experimenting lab supplies	1500	500	0	2,000
Charges for sending samples to overseas for analysis	0	1,500	1000	2,500
Publication Cost	400	1,000	1,400	2,800
Petty Cash	500	500	300	1,300
Sub-total				89,500

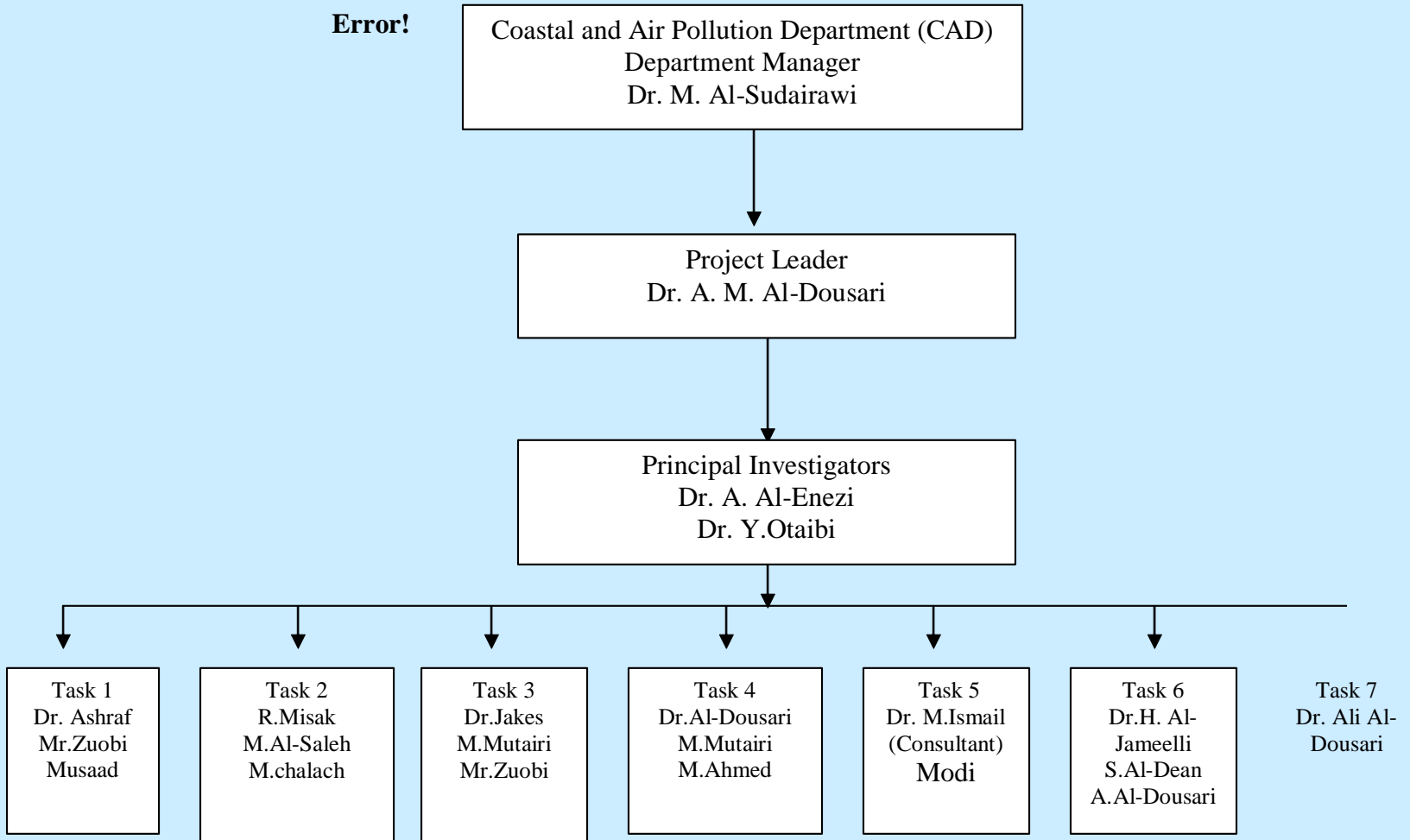
The total budget is estimated to be KD.146,736/= with a duration of 27 months. The following breakdown lists the anticipated cost of the project

Capital Cost	07-08	08-09	09-10	Total
Wind station networking Accessories	3,000	0	0	3,000
Digital camera	3,000	0	0	3,000
Laptop for data collection	1,000	0	0	1,000
Balances	1,000	0	0	1,000
Oven	1,500	0	0	1,500
Seive Shakers with sieves	2,500	0	0	2,500
Sub-total				12,000
Grand Total				146,736

Organization Chart

The project organization plan shown in the following organization chart

Error!



Project Schedule

Tasks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
I. Mobilization																											
II. Field Monitoring																											
Site Selection																											
Sampling and Data Collection																											
III. Radionuclide																											
IV. Laboratory analysis																											
Physical and Grain Size Analyses																											
Mineralogical Analyses																											
Chemical Analyses																											
V. Pollen analysis																											
VI. Surface Mapping																											
VII. Reporting																											

Acknowledgement

- We express our sincere gratitude and thanks to the management of Kuwait Institute for Scientific Research for positive comments and suggestions. We wish to extend our sincere thanks to Dr. Nader Al-Awadhi (Acting DG and DDG, Research), Dr. Dhari Al-Ajmi (DD, EUD) and Dr. Mane Al-Sudairawi (DM, CAD).
- Administrative support provided by Mr. Thomas Mathew, Ms. Nahed Al-Sayed and Mr. Jacob Chacko is also highly appreciated.

