



ROYAL CENTRE
FOR REMOTE SENSING

Products & Services



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Earth Observation for Development

Morocco has been involved for many years in a series of national sector-based strategies and programs to accelerate its development and enhance its international competitiveness.

The implementation of these strategies and projects in the fields of infrastructure, agriculture and water resources management, environment protection as well as climate change adaptation, is based thorough on an understanding of territories and resources.

Indeed, be they to oceans, forests, climate phenomena, water resources, food security, land planning, their management requires technical means and tools to measure them, map their geographical distribution, and assess their evolution in time and space.

In this perspective, satellite Earth observation technologies have become an essential tool for the implementation of these strategies, in particular when there is a need to regularly observe territory, monitor spatial and temporal evolutions, assess impacts and provide recurrent and relevant information to assist management and sector-based decision-making.

Between 2007 and 2016, 181 Earth Observation satellites were launched (excluding meteorological satellites). Over the next decade, more than 600 EO satellites (50 kg +, non-meteorological) should be launched to support space remote sensing applications. Nearly fifty countries are expected to launch a satellite capacity and more than half of the satellite in orbit will be privately owned.

Moreover, accuracy of the images acquired by these systems is constantly improving. It has currently attained 30 cm resolutions with a daily revisit capability, thanks to the development of constellations.

Since its creation, CRTS has implemented several projects integrating remote sensing and GIS to answers to users' needs in the fields of inventory and management of natural resources, environment protection and territorial development. These projects and activities aim to:

- Boost the development of EO products and services related to environment, resources, land use, and risks management.
- Facilitate access to EO data to all national users from the public and private sectors
- Strengthen national capacities in satellite data use through ongoing training programs and research and development studies.

The developed applications and the works carried out provide strategic assistance to decision-makers in several fields: Agriculture, water resources, territorial development, risk management and urban development....

Royal Center for Remote Sensing



Pleiade satellite image, Tanger Med Port, 2016

The Royal Center for Remote Sensing (CRTS) is a government institution in charge of the promotion of remote sensing applications and related technologies. Its major customers are the different ministerial departments and operational agencies which strive for more effective management of socio-economic development projects and programs.

To achieve these goals, the CRTS actions are structured around four strategic axes :

- To assist and support users to make effective use of satellite imagery and space remote sensing derived products;
- To provide all users with optimal access to Earth Observation data and Geospatial Information;
- To strengthen national and regional capacities and to develop skills through workshops and training programs;
- To develop a thorough understanding of EO applications and promote them through research and development activities.

International cooperation is a key factor to CRTS activities which include, among other things, cooperation and partnership programs with international institutions, operators of earth observation systems and space agencies.



Agriculture

Agriculture is a key sector for Morocco's economic, social and environmental development.

Increasing production and improving agricultural productivity are the strategic objectives of the national agricultural policy. They face many challenges such as climate change impacts, water resources scarcity, soil degradation, and pressure of urbanization...

In this context, the use of new technologies and techniques, including geospatial information, derived from satellite remote sensing, are an effective means to manage agricultural resources, plan and implement strategies to achieve efficiency and sustainability.

The combination of satellite images, together with field information, meteorological data, land surveying, allows operators of the agricultural sector (ministerial departments, agricultural development offices, large agricultural enterprises, cooperatives, farmers...) to have access depending on their specific needs and on their temporal frequency, to:

- **Dynamic maps of land use;**
- **Crop monitoring indicators and production statistics;**
- **Agricultural campaign monitoring bulletin and cereal production forecasts;**
- **Information on irrigated lands;**
- **Water consumption and productivity parameters and indicators;**
- **Maps to follow-up on major agricultural investment projects;**
- **Geospatial, dynamic and updated information to feed GISs;**
- **Information to assess the risks and disasters management: drought, flood, locust...**

Users

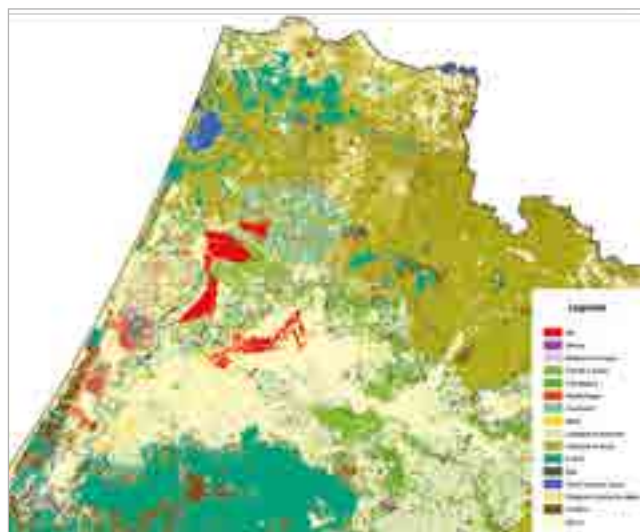
- Central Directorates of the Ministry of Agriculture, Maritime Fishing, Rural Development and Water and Forests,
- Regional Offices for the Development of Agriculture,
- Hydraulic watersheds Agencies
- Department in charge of Territorial Planning,
- Department of the Environment,...

MAPPING IRRIGATED CROPS

Information on agriculture is becoming an increasingly important parameter in the assessment and monitoring of land use. The use of satellite images, combined with auxiliary data, provides decision-makers and managers with accurate and useful information for agricultural development at different levels: local, regional and national. Thanks to its increasingly fine spatial and temporal resolutions, spatial remote sensing has become an essential tool for characterizing ecosystems in terms of land use at different levels from 100,000 to 10,000, and generating statistics per every administrative entity (municipality, province).



Extract from the Gharb ORMVA area of intervention, covered by a Spot6 image, 2016

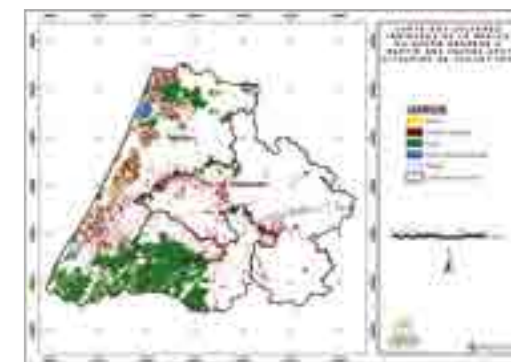


Land use map in the Gharb region (provinces of Kenitra and Sidi Kacem) at 1/10,000 scale, produced from satellite images April-May-August 2010, for the Regional Agricultural Development Office of the Gharb (ORMVAG).

MAPPING IRRIGATED CROPS

Information on irrigation is becoming an increasingly important parameter in the assessment and monitoring of water consumption and water use efficiency by crops.

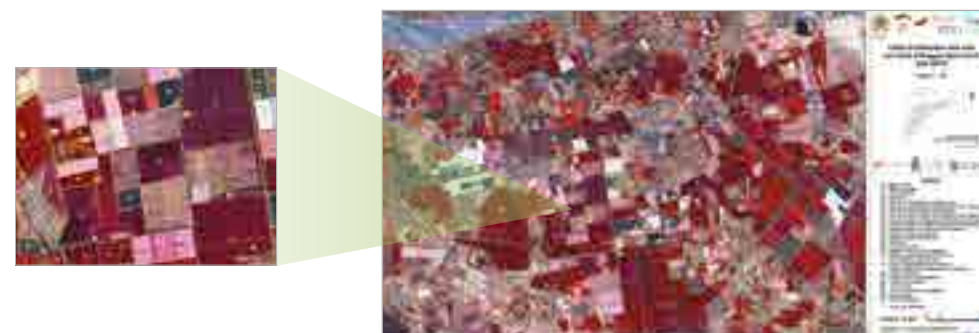
Accurate information on irrigated areas location, in particular irrigated crop maps, extracted from remote sensing data, can be used as input data for the different water balance models used in water management decision-making. Maps can be established at different national, regional and local scales.



Irrigated crops map on the Gharb region established from satellite images SPOT6 and 7 taken in July-August 2016, for the Regional Agricultural Development Office of the Gharb (ORMVAG).

With the help of AGIRE Program and in partnership with GIZ, the Royal Centre for Remote Sensing carried out two land-use mapping projects that covered areas of great interest for the Souss Massa Watershed Agency and Oum Errabii Watershed Agency. This effort yielded a set of documents, which include:

- A baseline land use map at 1/10,000 scale for the Sous Massa plain for the year 2013 (derived from Spot5 images);
- Maps to monitor changes in irrigated areas between 2002 and 2013 in the Sous Massa plain (produced from Spots5 images);
- A baseline land use map at 1/10,000 scale for Tadra aquifer for the year 2015 (produced from Spot6 and 7 Images).



Land use map at 1/10,000 scale, elaborated from Spot images at the level of Massa plain as part of a study carried out by CRTS on behalf of the Souss Massa Watershed Agency with a GIZ support.

OPERATIONAL MANAGEMENT

OF IRRIGATION BASED ON SATELLITE MEASUREMENTS

The optimization of water supplies for irrigation is of crucial importance for Morocco, especially in arid and semi-arid regions, that are characterized by water resources scarcity and adverse weather conditions. The IRRISAT-Maroc platform, based on the combination of satellite data-generated parameters and modeling, provides users (farmers, agricultural development offices, watershed agencies and the Ministry of Agriculture) with decision-making information for irrigation management depending on their needs, in particular:

- irrigated crop water consumption;
- assessment of irrigation pattern impact and water productivity;
- Water resources balance.



Daily water quantity consumed by crops at each parcel in the Tadla irrigated perimeter (IRRISAT-Maroc Project)



Annual water consumption per block in mm/yr, Tadla irrigated perimeter (IRRISAT-Maroc Project)

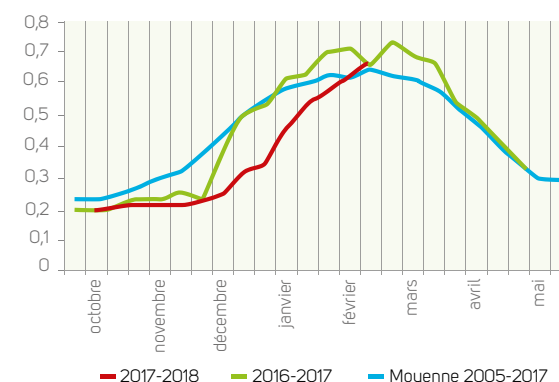
INDICATORS

FOR THE AGRICULTURAL CAMPAIGN

The availability of a set of indicators on the agricultural campaign is important in assessing the evaluation of the cropping progress season. These indicators are extracted from a sample of very high-resolution images covering areas of cereals and acquired, key phases of crop growth:

- Area of cultivated lands at the beginning of the crop year;
- Tillering stage via the generation of the recovery rate;
- Area obtained from the image classification;
- Estimation of autumn cereal production (durum wheat, soft wheat and barley).

The implementation of this system contributes significantly to crops monitoring, mainly the autumn cereals and allows the Ministry of Agriculture to assess the state of cereals at different growth stages and to estimate the autumn cereals production at regional and national scales.



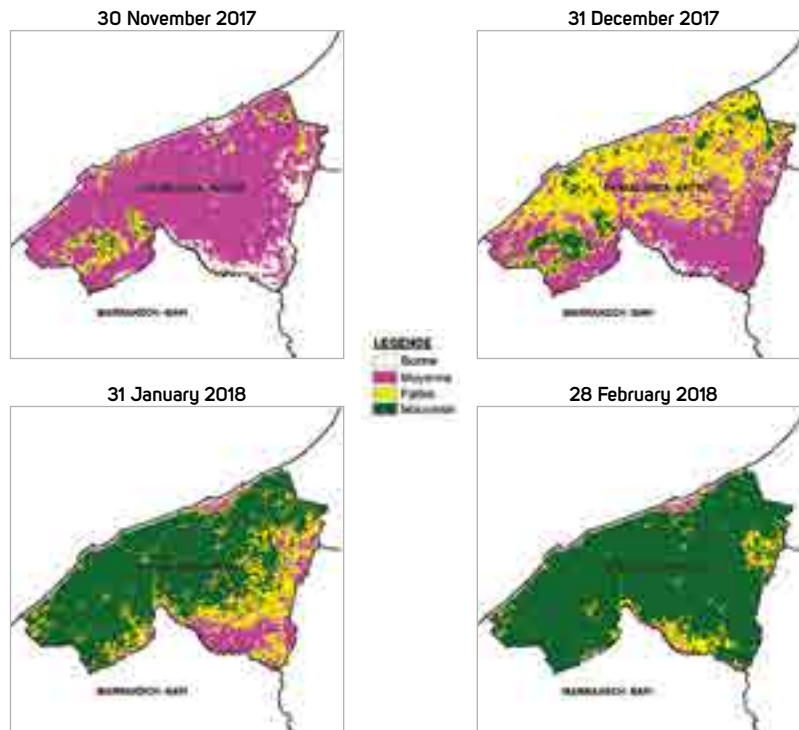
province	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
Ben Slimane	2 176,17	2 103,27	3 640,81	2 659,25	3 056,97	799,71	2 698,88
Casablanca	1 000,10	219,21	858,17	546,05	648,02	185,99	663,24
El Jadida	8 526,03	2 830,92	8 032,93	3 919,69	8 420,44	2 745,39	6 786,52
Settat	10 922,38	4 199,17	11 092,55	6 887,26	10 072,45	3 756,22	8 935,95
Total	22 624,68	9 352,57	23 624,45	14 012,26	22 197,88	7 487,31	19 084,60

Profile of average vegetation index of rainfed crops and estimation of autumn cereal production in 1000 quintals in the Region of Casablanca-Settat (2010 to 2017)

IMPACT OF URBANIZATION ON AGRICULTURAL LANDS

Since 2001, CRTS has been publishing a **monthly bulletin for the overall monitoring of the agricultural season at national** and regional levels. This bulletin is based on the exploitation of low-resolution data, and produces decadal syntheses of the vegetation index. It is distributed to all national stakeholders involved in the follow-up of the agricultural campaign, including:

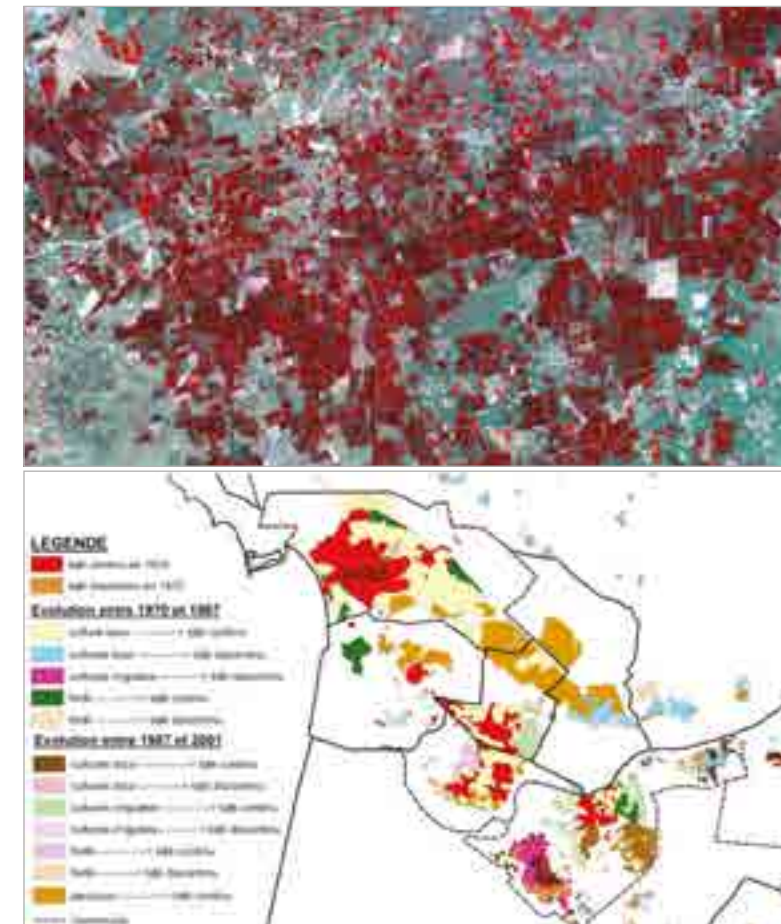
- The Ministry of Agriculture, Maritime Fisheries, Rural Development and Water and Forestry- Directorate of Strategy and Statistics;
- Credit Agricole Bank - Directorate of Studies and Rural Development;
- National Institute of Agronomic Research;
- General Council of Agricultural Development;
- Bank Al Maghrib - Directorate of Studies and International Relations;
- Mutuelle Agricole Marocaine d'Assurances (MAMDA);
- Directorate of National Weather Forecasts;
- Ministry of Interior- Directorate of Rural Affairs;
- Etc.



Characterization of the vegetation, based on the evolution of the vegetation index throughout the agricultural season in the Region of Casablanca-Settat - Extract from the Monthly Bulletin of 2017-2018 Agricultural Campaign monitoring.

The mapping of urbanization evolution and its impact on agricultural lands allows managers to better appreciate urban development trends as well as the shifting dynamics from agricultural land use to urbanization, both at qualitative and quantitative levels. The maps of various scales (1/5,000 to 1/50,000) and the statistical data obtained should allow users to make projections and design future planning scenarios. Their integration into a wider information system, such as an Urban Information System, incorporating development plans, regulatory zoning limits, master plans... constitutes a support tool to plan and develop urban and peri-urban areas.

The project carried out for the Ministry of Agriculture on the impact of urbanization on agricultural lands covered three urban centers (Khemisset, Ksar El Kebir and Beni Mellal) and two irrigated perimeters (Souss Massa and Doukkala). This study was based on aerial photos, topographic maps and Spot images at 20 m resolution.



Evolution of land use over 30 years (1970, 1987 and 2001) of the irrigated perimeter of Souss Massa, showing the different changes in land cover.



Forest Resources

Morocco is characterized by a great bio-ecological diversity and a large number of natural environments. Forests constitute the very basis of this ecological wealth and play an important role both in economic activity and in the national strategy for sustainable development. The management, valorization and protection of this heritage, as well as the strategic support of these resources to the decision-makers and managers, rely heavily on satellite imagery. Thanks to their high resolution (accuracy) and the very high revisit frequency (daily), data from space remote sensing provide products and services to:

- **Conduct forest inventories and evaluate pastoral resources;**
- **Design development programs;**
- **Manage and control forest activities;**
- **Establish maps of sensitive systems and monitor their evolutions:**
Wetlands, biological interest sites, protected areas.. ;
- **Manage the risks and degradation of forest cover:** forest fires, degradation... ;
- **Produce indicators and reports in line with international conventions:**
bio-diversity, climate change, carbon footprint.

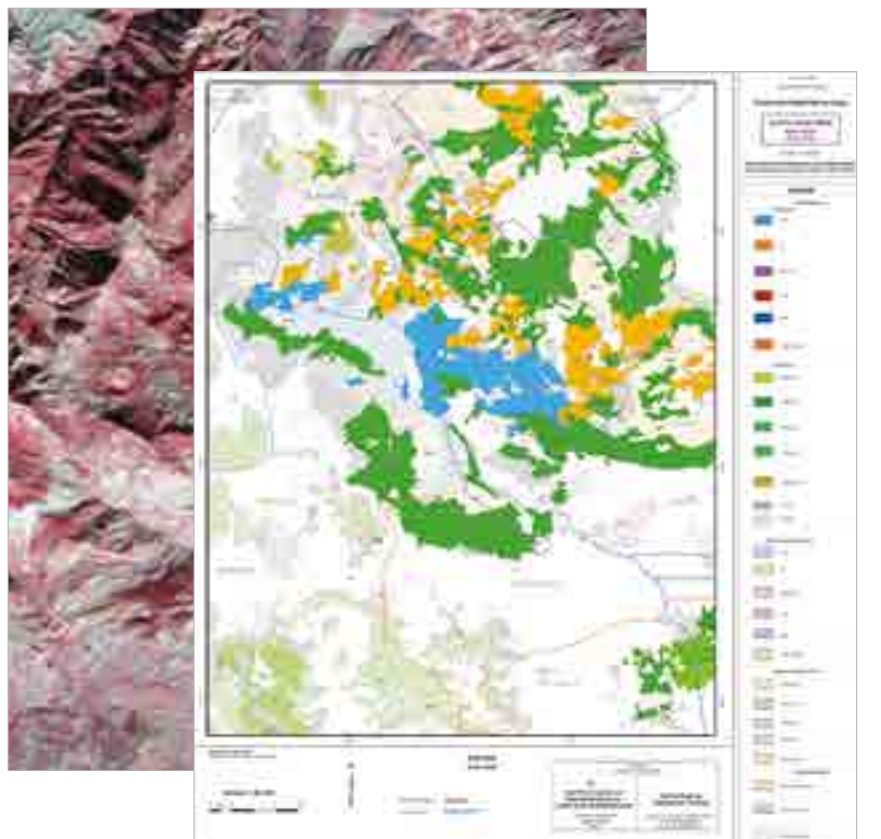
Users

- High Commission for Water and Forestry and Fight against Desertification (HCEFLCD).
- Ministry of Interior
- Ministry of Territorial Development
- Regional Councils and Regional Agencies of Project Implementation

MAPPING AND INVENTORY OF FOREST RESOURCES

Forest mapping provides a tool to plan and manage forest resources both at the national and local levels. The national forest inventory map (IFN) is used by both the internal services of the HCEFLCD for the development of forest resources and monitoring purposes and by the various departments involved in the territorial management.

Revision of the national forest inventory maps relies currently on high spatial resolution satellite images to generate maps at 1/100000 scale. Approximately 77% of the national territory was covered by satellite images (37 Landsat-TM images and 15 Spot-XS images) to develop 146 forest maps at 1/100,000, 30 maps at 1/250,000 in the southern Provinces and 3 maps at 1/500,000. The work carried out allowed to complete the existing national forest inventory maps and produce new maps for the areas not covered by the first IFN. These maps made it possible to accurately locate and distinguish between forest areas and alfa cover in the eastern provinces and to assess forest resources (Saharan Acacia and Tamarix) in the Southern provinces on the other hand.



Forest map (Bab Taza) developed as part of the revision of the IFN of the Rif area for the Office of the High Commission for Water, Forests and Fight against Desertification (HCEFLCD)

MONITORING OF FORESTRY ACTIVITIES AND RISKS, CUTTING, REFORESTATIONS, FOREST FIRES...

The monitoring of forest dynamics via spatial remote sensing is a necessary tool for a better management of this natural habitat, in particular the identification and planning of cuts and reforestation, follow-up of forest evolution and assessment of the areas of the different forest species.

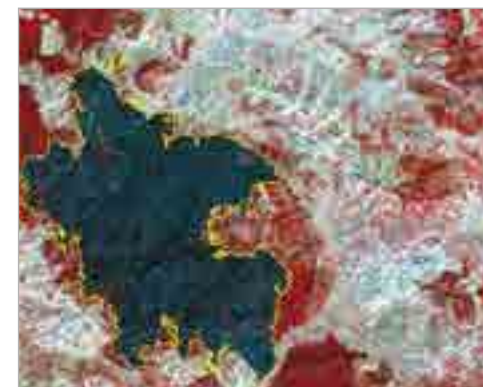
The desired accuracy in terms of forest dynamics follow-up requires a larger-scale mapping of the forest cover (between 1/25,000 and 1/100,000) that uses high resolution satellite images (between 50 cm and 20 m).



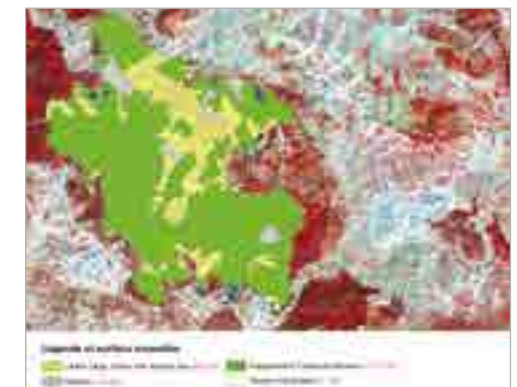
Evolution map of Maamora forest between 2001 and 2012, developed from multitemporal satellite images showing unchanged, reforested and deforested areas.

As for forest fires, remote sensing images allow:

- **the development of risk maps** at the local level (from 1/100,000 to 1/50,000) from the crossing of thematic and meteorological data,
- **the mapping of burned areas** based on satellite images with high spatial resolution (between 50 cm and 20 m), and assessment of damage,
- **a high temporal frequency monitoring** of burned areas at a national scale using low resolution spatial satellite data (between 250 m and 1 km).



Spot image acquired in August 2004, showing the extent of Izaren forest fire (Provinces of Ouazzane and Sidi Kacem)



Estimation of the burned areas of Izaren forest by species in September 2004.



Territory Management

Territory planning and the efficient management of territorial resources, be they economic, social or environmental, are at the heart of the overall development process. The tools for planning and coordination of sectoral actions (National Territorial Development Plan SNAT, Regional Territorial Development Plans SRAT), as well as the local reference documents, are largely based in their development and implementation on geospatial information obtained from satellite imagery.

Satellite data constitute strategic tools for a relevant territorial management. They provide a good understanding of the available resources in terms of their distribution, evolution and the dynamics of interaction between different actors, options and conflicts of use.

The use of remote sensing images and their derived products allows to:

- **Produce maps of territorial land uses and their evolution;**
- **Characterize the urbanized areas:** Residential areas, industrial areas, green spaces,... ;
- **Monitor and control construction dynamics in peri-urban areas.**
- **Develop and update master plans and territorial development plans.**

Users

- Ministry of National Territory Development, Urban Planning, Housing and City Policy.
- Ministry of the Interior
- Urban Planning Agencies and local authorities.
- Autonomous Agencies and consulting and Consultancy Companies.
- Regional Councils and Regional Agencies of Projects Implementation.

MAPPING

FOR THE PLANNING AND MONITORING OF URBAN AND COASTAL DEVELOPMENT PROJECTS

This is a basic mapping product which is used at different levels of territorial intervention (1/5,000 to 1/20,000), and is developed from very high-resolution spatial imagery (50 cm to 2.5 m). It provides updated information on urban fabrics and other related themes as well as their spatial distribution. This product can be used as auxiliary data for:

- **The development of urban planning documents** (Development Plan, Zoning Plan and Master Plan of Urban Development).
- **Geospatial follow-up on the implementation of the planning documents provisions.**
- **Works related to operational urban planning** (network management, planning studies, etc.) and as a supplement to other business lines.



Plan at 1/5,000 scale, based on Quickbird imagery at 60cm resolution (Marrakech Autonomous Authority of Water and Electricity Distribution)



Plan at 1/20,000 scale, based on a SPOT5 imagery at 5m resolution (Agency for the Urban Planning and Safeguarding of Fez)

As to coastal development, the study carried out on behalf of TMSA allowed the analysis of the evolution of land use between 2003 and 2016 to assess the impact of Tangier Med Port on its environment.



Land Use Map (2016) of the region Tangier Med

MONITORING

OF URBAN AND ITS SUBURBAN EXTENSIONS

This product provides a better control of the occupation of space in urban and suburban areas thanks to an updated information on the urban structure and its evolution over time.

This involves very large scale maps (1/5,000), derived from multitemporal satellite images (50cm to 1m). This product can be used to:

- **Monitor areas with a highly growing informal housing** at regular intervals (quarterly, semi-annually or annually).
- **Monitor slums** in terms of proliferation or eradication.
- **Assess the impact of urbanization** on lands at the urban level.
- Assess the impact of urbanization on agricultural land.

The project, initiated with Casablanca Agency for Urban Development in 2007, aims at acquiring very high resolution recent image coverage (50cm) of its intervention area that will allow a quarterly monitoring of the suburban areas. Each quarter, around 20 plans at 1/5000 scale are produced from Pleiades ortho-images at 50 cm to provide a mapping of the built areas, hangars, slums and roadways.

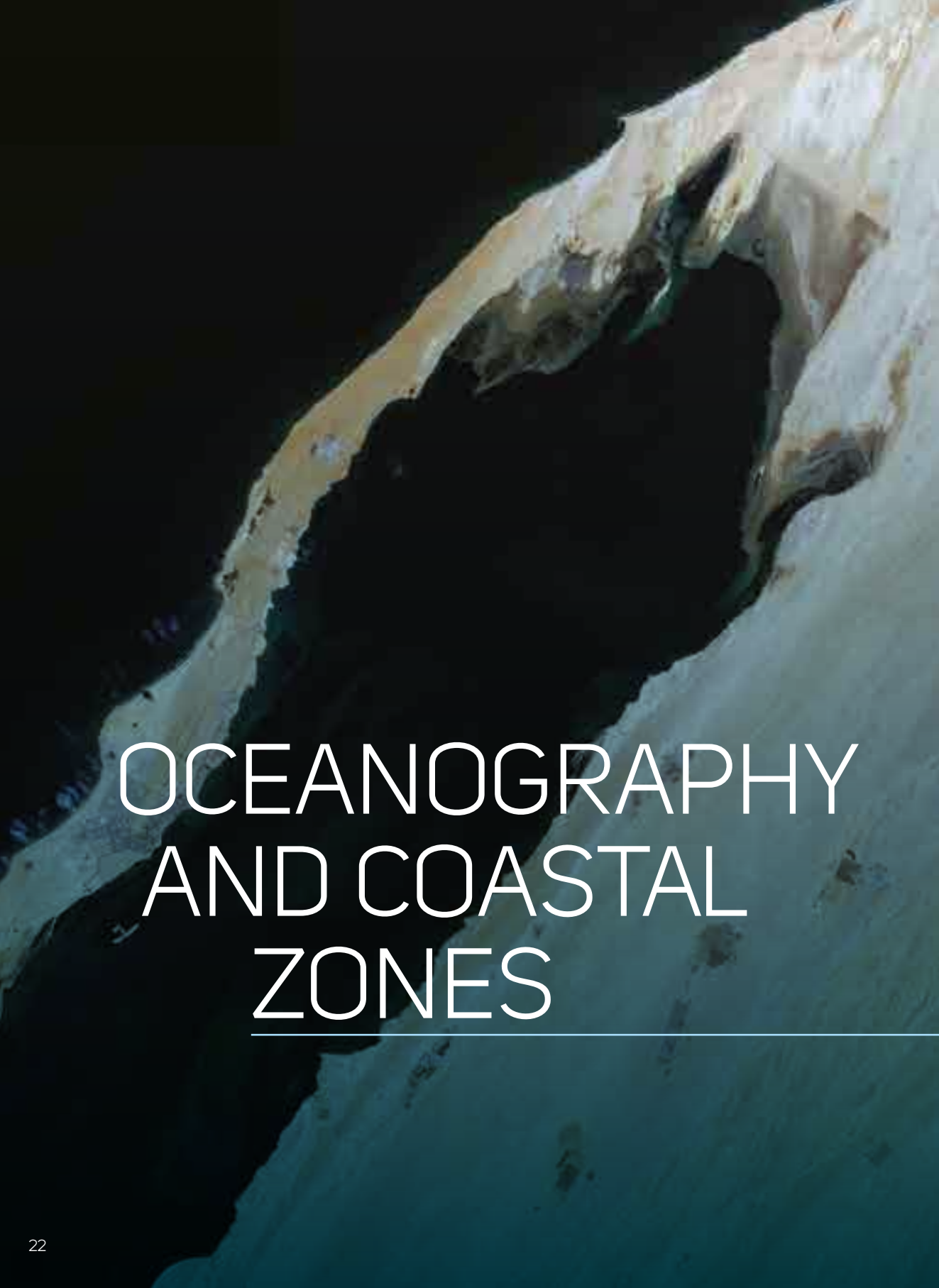


Plan at scale 1/5,000 produced from multitemporal Pleiades images at 50 cm (Casablanca Agency for Urban Development)



Plan at scale 1/5,000 produced from multitemporal GeoEye images at 50 cm (Wilaya of Fez)

As far as the monitoring of slums is concerned, the CRTS implemented a project on behalf of the Ministry of Housing for the mapping and the annual monitoring of slums in 34 cities of the country between 2005 and 2011. The coverage of the cities concerned by the «Cities without slums» initiative was done from very high resolution images (resolution 50 cm).



OCEANOGRAPHY AND COASTAL ZONES

The 3500 km long Moroccan Atlantic coast is among the richest coasts in marine resources. The Moroccan Exclusive Economic Zone is characterized by a great diversity of fish resources, including about 500 species, 60 of which are currently being harvested.

Moreover, the coastal area witnesses a great population dynamic and a concentration of economic and industrial activities which generate a high pressure on an already vulnerable ecosystem.

The exploitation, development and integrated management of oceanographic areas, marine and littoral environments and coastal zones rely heavily on a good understanding of the biophysical parameters of these areas as well as on the specific information describing the status of the resources and their evolutions in space and time.

Satellite observation offers a wide range of applications related to these fields and constitutes an essential source of knowledge for the monitoring of marine parameters at various spatial scales and temporal frequencies, like sea surface temperature and the indicators derived from waters colors data (chlorophyll, algal blooms, primary production, MES, waters transparency...) in addition to marine pollution, namely the hydrocarbons.

Satellite images are also used for the valorization of sea resources and monitoring of their evolution in time and space through the follow-up of indicators describing the environment conditions (upwelling index, thermal fronts, chlorophyll concentration...) and the selection and management of aquaculture sites or the integrated management of coastal areas.

Users

- Maritime Fisheries Department.
- Equipment Department
- Ministry of the Interior
- Department of the Environment
- Department in charge of Territorial Planning (Urban agencies ...)
- National Institute of Fisheries Research.
- National Agency for the Development of Aquaculture.
- Civil Protection.

IDENTIFICATION OF AQUACULTURE POTENTIAL OF THE COASTAL ZONES

As part of the APPUIT project, co-financed by the European Union and in partnership with the National Institute of Fishery Research, the Royal Center of Remote Sensing developed operational systems and tools for the valorization and management of potential aquaculture sites, to support the development of aquaculture in Morocco. Products, designed from satellite images and in-situ measurements are combined to delimit and characterize the optimal zones for aquaculture farming.

A database of maps of various scales, indicators and parameters contributing to the success of an aquaculture farm are initially produced for three coastal sites with different characteristics (the semi-closed lagoon of Nador, M'diq offshore site, and Dakhla semi-open bay). These indicators are combined according to a multi-criteria approach which takes into consideration the species needs and the farming techniques to delimitate the suitable areas for aquaculture in each site. The goal of this system is to help decision makers in:

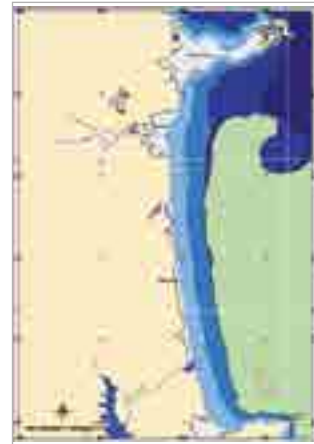
- **Assessing the aquaculture potential of the country ;**
- **Locating the coastal sectors suitable to aquaculture ;**
- **Regularly monitoring the different parameters** to spot any possible changes and assess the risks likely to hinder aquaculture projects in each identified site.



Satellite image of M'diq coastal zone



Risk of turbidity



Determination of the area suitable to aquaculture

CARTOGRAPHY AND MONITORING OF COASTAL ECOSYSTEMS

To assess satellite images potential in the coastal field, the CRTS analyses the elements and components of the coastal zones and produces cartographic information related to land use, intertidal vegetation, coastline, and to follow-up on their temporal dynamics. The aim of this work is to conduct an objective diagnosis of these fragile sites and to identify the changes that affect them, particularly the vulnerable coastal sites (SIBE, wetlands, lagoons, bays...). This information is exclusively extracted from very high-resolution satellite data and are produced in cartographic and statistical forms with variable spatio temporal scales, depending on the needs and covered themes:

- **The integrated management of the coastal zones;**
- **The development of master plans and appropriate coastal development plans**
- **The valorization of coastal areas** (fishing and aquaculture, agriculture, tourism, sand exploitation...);
- **The conservation of fragile ecosystems** (SIBE, lagoons, wetlands...);
- **The prevention of coastal risks:** receding coastlines, silting, erosion...



*Map of Moulay Bouselham lagoon ecosystem between 2008 and 2016
(Spot 2.5m from 2008 and Pleiades images from 2016)*



*Coastline evolution of Tahaddart region between 2003 and 2016
(Quickbird from 2003 and Pleiades images from 2016)*

COASTAL AND MARINE RISK MANAGEMENT

CASE OF TSUNAMI

Within the framework of the European Commission program called SCHEMA, a generic approach, based on modeling scenarios, satellite data and in situ data, was developed to assess tsunami risk in 5 different sites along the Mediterranean and Atlantic coasts, including Rabat-Sale.

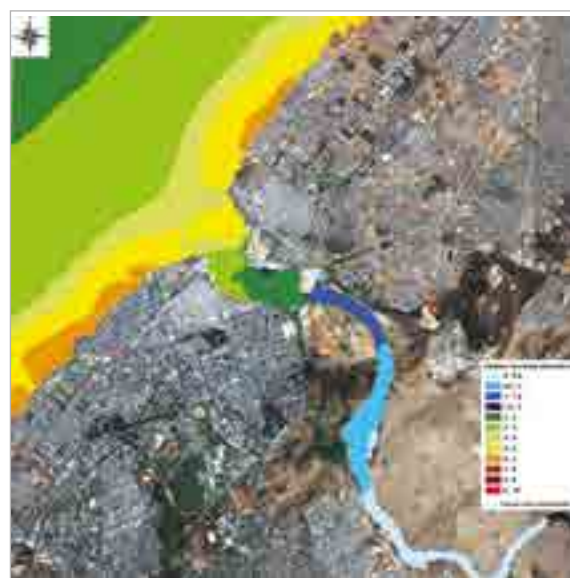
The THR satellite data were extensively used to produce a precise map of the coastline, used for the modeling of the types of buildings located in the flood-risk areas and the evaluation of their vulnerability degree.

An Atlas covering all Moroccan coasts is under preparation. It includes the following maps at 1/5,000 scale that may be useful for all national entities in charge of risks management:

- **Tsunami risk maps that provide** information on potential flood-risk zones, submersion depth and waves heights.
- **Maps of vulnerability classes** of buildings in flood-risk areas that describe the level of resistance of each building considering wave height.
- **Maps of damage levels** suffered by each flooded building based on an approach that combines the degree of vulnerability, the type of building and the wave height.



Vulnerability levels of buildings in Rabat-Sale coastal area exposed to tsunami risks



hazard Map of tsunami risks threatening the coastal area of Rabat-Sale (aggregation of all scenarios)



Map of the damage levels suffered by the buildings flooded by the Tsunami in the Rabat-Sale coastal area.



WATER RESOURCES

Water resources management has become a global concern, and is central in all development policies at local, regional and international levels. In fact, water is a key factor for food security, poverty reduction, improvement of populations' health, and the preservation of ecosystems, balances and biodiversity.

In Morocco, water resources undergo the double pressure of an increasingly high demographic and economic demand and an accelerated rarefaction due to the impacts of climate change.

The design of development policies and strategies of action in the field of water resources management depends largely on the availability of relevant and qualitative information as well as on adequate tools for the a better evaluation of needs and an efficient monitoring and implementation.

Satellite technologies, and particularly the information obtained via Earth observation programs, have reached a degree of maturity and efficiency and offer vital tools to users in all processes of water resources management. Thanks to synoptic and continuous data, that cover long periods of observation and thanks also to the development of communication and information exchange through Geo information infrastructures, satellite data and the resulting decision-support tools are gaining in accuracy and efficiency. The challenge is to facilitate access to satellite technology services to decision-makers and promote its full use.

Many practical applications of these tools help managers and decision-makers in various fields:

- Mapping and monitoring of surface waters;
- Prospection of underground water resources in dry environments;
- Production of parameters and indicators for the development of water balances;
- Control and optimization of water use in agriculture.

Users

- Department of Water and Watersheds Agencies.
- Department of the Environment
- Department in charge of Territorial Planning,
- Directorate of Ports and the Maritime Public domain.
- Regional Council

MONITORING OF SURFACE WATER RESOURCES

This product involves the mapping of natural water bodies and dam reservoirs. In certain cases, the delimitation of these water bodies can be very important for the assessment of the state of surface water reserves. Satellite images can also be used to analyze the evolution over time of these water bodies and their relation to time and space variability of rainfalls. The products are maps of different scales from 1/5,000 to 1/100,000 ; depending on the size of the zone and the type of sensor used (resolution from 50 cm to 10 m).



Spot image with 1.5 m resolution taken in May 2010 of El Massira dam for the Department of Water

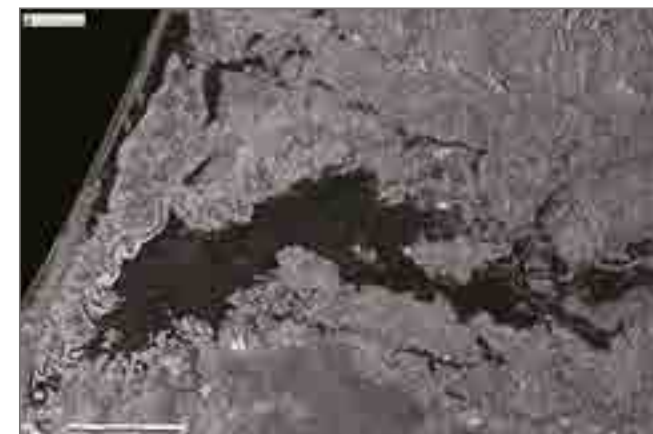


An evolution map of water body in El Massira dam reservoir between September 2007 (light blue) and May 2010 (dark blue) irrigated crops (green)

MAPPING AND MONITORING OF FLOODS

This product provides useful information for the management and assessment of flood impact. In general, as far as flood risk management is concerned, satellite imagery is vital for an accurate mapping of water bodies and consequently for the delimitation of disaster-stricken areas in crisis periods. In addition to optical satellites, synthetic aperture radar satellites are heavily used to monitor plain flooding in rainy periods that are often accompanied by an important cloud cover.

These mapping products also offer a better spatial characterization of flood hazard in view of its integration in the hydraulic modeling for prevention and prediction. These products are designed by the CRTS in times of crisis in order to assist national stakeholders to better direct their field actions through a better understanding of the situation of the flooded zones and their evolution over time.



Evolution map for the monitoring of the Gharb area floods, designed from Spot and Radar images



Mapping of the crops affected by floods in the Gharb region on 11 February 2009



GEOLOGY AND MINING RESOURCES

The operational applications of Earth Observation in the field of earth sciences cover:

- Geological mapping and analysis of geological structures.
- Mining prospection and development of mineral resources
- Management of geological risks (landslides) and support to territorial development.
- Extraction of construction minerals and management of careers.

The diversity of Morocco's geological landscapes, as well as the potential mining reserves of the country's subsoil are strategic resources. The development of these resources requires an appropriate geological infrastructure, an essential tool for the mining and oil research development, the evaluation of water resources, territorial development, environment protection as well as natural risks prevention.

The geological mapping and its applications are among the first sectors that use spatial imagery. Indeed, image data generated by spatial remote sensing allow the extraction of relevant information on geological structures, delineation, identifications of facies ...

Moreover, the combination of radar data, hyper-spectral images and elevation digital models provides accurate information for mining prospection and analysis of geological risks, such as landslides. Very high-resolution images, not only allow the generation of maps at detailed scales, but also provide information to follow-up and monitor open-pit mining and selection and the geological and geomorphologic study of the sites for large infrastructure works.

Users

- Geology Directorate
- Mining Directorate
- National Office of Hydrocarbons and Mining
- Cherifien Phosphates Office- OCP
- Mining companies

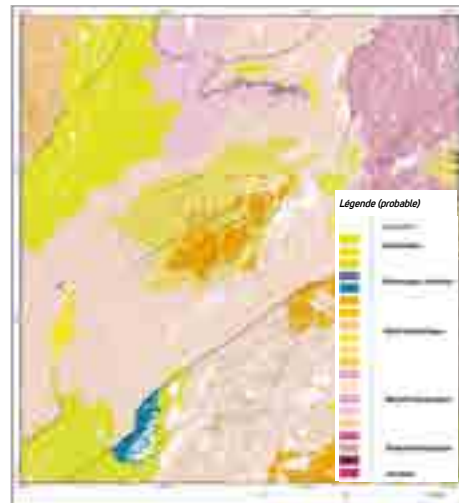
GEOLOGICAL CARTOGRAPHY

The reliance on satellite imagery for the investigation of geological formations and outcrops lithology has always constituted a major factor in the production process of geologic maps at all scales. Due to the diversity of geologic contexts from one region to another, and the spatial variability of the appearance of geological lithology and geological structures on the images, the mapping products retained for each zone are often determined by their power of enhancement and discrimination between the studied geological units.

The spectral resolution and the geometrical quality of satellite data are increasingly reinforced by the advent of new high resolution spatial and spectral sensors. The processing techniques are often based on the combination of different sensors for a better exploitation of the spectral capacities of some and the geometrical capacities of the others.



A space Spatio-map produced from the spectral fusion of SWIR image of the ASTER sensor and SPOT at 1.5 m.



A geological sketch on the south-eastern front of the Mauritanides produced from the satellite data processing (map of OuidianRkayez).



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