A QUANTITATIVE APPROACH TO THE OCEAN COLOR REMOTE SENSING STUDIES

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Pour abordér le probléme de la teledetection des certains parametres d'intérêt ecologique dans la mer, on a conduit un étude sur l'Adriatique du Nord utilizant un capteur en vol à grande hauter capable de simuler la réponse du Coastal Zone Color Scanner, satellisé sur le Nimbus-G.

It is well known that the upwelling light field above the marine water is proportional to the total cross section of the suspended particles in the sea water as phytoplankton populations, sediments and gelbstoffe (1).

The absorption spectrum of the sea water shows a window in the electromagnetic spectrum (2), that allows subsurface water properties to be determined in the visible region.

The phytoplankton, the first link in the marine food chain, posses chlorophyll-a as one of the chromophore, that absorbs solar energy just in the visible region with two absorbing peaks at 440nm and at 680nm, with a relatively trasparent region between 530nm and 650nm (3).

These specific absorption characteristics modify the upwelling sunlight at characteristic wavelenghts and it allows to detect phytoplankton.

The rate of phytoplankton photosyntesis is governed by the availability of inorganic nutrients such as nitrogen and phosphorus (4).

High nutrient concentrations resulting from various types of pollulants can cause anomalus high levels in bottom waters.

Anomalous levels of phytoplankton can also indicate the presence of specific toxic compounds (5).

As chlorophyll-a concentration is a measure of the nutrient load and an indicator of current state of health of a water, in the last time it has been considered the opportunity to utilize the upsurge remote sensing technology to monitor in real time and in large scale the distribution and the dynamic of this enviromental parameter.

With this goal the National Aeronautics and Space Administration (NASA) of the USA has lauched the Nimbus-G satellite with 8 sensor.

One of these sensor, the Coastal Zone Color Scanner (C.Z.C.S.), will be dedicated to obtain informations on the quality of marine coastal waters, as 4 of its channels were selected to coincide with absorption maxima and minima of clorophyll-a and sediments.

In order to define the problems associated with the back-scattered light above the sea water, to prepare the processing and the interpretation of the satellite data, a prototype sensor, with 10 channels in the visible region of the spectrum, the Ocean Color Scanner (O.C.S.) on loan from NASA, was flown at 11000 m in the North Adriatic Sea.

Contemporary a set of sea truth measurements have been carried out in the same test site.

As the O.C.S. data is only available on high density digital tapes and not in a computer compatible format, a long preprocessing work is needed.

In this phase of conversion, a correction for the rolling angle of the aircraft is made.

To have a rapid quick look of the imagery data a serie of computer programs has been developped in FORTRAN and APL languages.

The O.C.S. records data with the same istantaneous field of view (IFOV), for all the directions of view, within the field of view (FOV). So all the pixels do not have the same spatial distribution.

To have a linear spatial distribution of the pixels on all scanlines a geometric correction is needed.

This correction gives to all the pixels the same spatial resolution.

In this way it is possible to identify on the imagery the exact position of the sea truth stations, as their geographycal coordinates are known, and then to correlate the sea truth with the remote sensing ocean color data.

A serious limitation to a rapid analysis of the spectra in terms of surface water characteristics is given by the atmospheric scattering.

The measured spectra are composed of components of direct and diffuse sunlight reflected from the surface on the water, scattered sunlight from the atmosphere, and scattered sunlight from the water.

Only the last component contains the information signal.

The atmospheric bakscatter, consisting of reasonably predictable Rayleigh scattering and unpredictable Mie scattering, constitues the majority of the signal seen by a high altitude sensor.

A model of radiation beaviour in the atmosphere, leaving from some atmospheric measurable parameters has been developped to correct the spectra from the atmospheric effects.

The correlation method being developped to detect phytoplankton is based on the use of differential spectroscopy (6).

The intensity at a reference wavelenght outside the absorption region is compared to the intensity at a sample wavelenght located at the absorption maxima.

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