

THE NIMBUS-7 COASTAL ZONE COLOR SCANNER (CZCS) PROGRAM

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1. ABSTRACT

A summary is given of Nimbus-7 CZCS history, characteristics, data collection and processing. Examples of Level 1 and Level 2 photographic data products are shown. Finally, a brief description is included of the CZCS II instrument to be flown on the National Oceanic Satellite System (NOSS).

2. INTRODUCTION

The Nimbus-7 Coastal Zone Color Scanner (CZCS) evolved from a series of measurements made from the years 1969 through 1973 to determine if ocean color could be sensed through the intervening atmosphere of earth, and if sufficient information could be determined from that color to be useful to oceanographers. Pioneering work by Clarke, Ewing and Lorenzen (1970) showed that color measured from low altitude could, indeed, indicate the chlorophyll content of the ocean, and also indicated the problems that one would encounter with intervening atmosphere. During the same time frame, and beginning somewhat earlier, Yentsch (1959, 1962, 1970) carried out laboratory measurements on the absorption and fluorescence characteristics of biochemical substances which gave weight to the measurements of Clarke et al, and showed that remote sensing could be a useful tool in determining the content of the ocean waters.

In order to determine if remote measurements could be made through the entire atmosphere of the earth, as would be required from a spacecraft, Hovis, Forman and Blaine (1973) carried out experiments utilizing high altitude aircraft, wherein approximately 95% of the atmosphere was below the aircraft during the course of

the measurements. These measurements indicated that ocean color could be sensed through most of the atmosphere, and it was felt that the remaining 5% would present no significant problems.

Following the original measurements by Hovis, Forman and Blaine, a prototype ocean color scanner was made for flights on a NASA U-2 aircraft at an altitude of approximately 20 kilometers. The scanner provided both spectral information, as had been provided by the spectrometers flown previously, and also spatial information on the effects of such things as limb brightening when scanning was done at an angle away from the nadir of the viewing aircraft. Although the aircraft information indicated that atmospheric correction would be a formidable problem, especially the correction for the highly spatially variable aerosols in the atmosphere, the data was encouraging enough that it was felt that such corrections could be carried out with spacecraft data, and the Nimbus-7 CZCS was conceived and proposed to NASA for flight.

3. THE COASTAL ZONE COLOR SCANNER (CZCS)

The Nimbus-7 CZCS, whose characteristics are shown in Table 1, is a conventional 45° rotating mirror scanner with one axis of scan provided by the rotating mirror, and the other by the motion of the spacecraft with the velocity of approximately 7 kilometers per second.

Table 1
Coastal Zone Color Scanner Characteristics

Spectral Bands
443 \pm 10 nanometers
520 \pm 10 nanometers
550 \pm 10 nanometers
670 \pm 10 nanometers
750 \pm 50 nanometers
10.5 to 12.5 micrometers
Spatial Resolution
0.825 milliradians, 800 meters at nadir
Operation - Day and Night
Day - All channels
Night - 10.5 to 12.5 micrometer only
Glint Avoidance
Tilt of scan mirror $\pm 10^\circ$ along track for $\pm 20^\circ$ pointing
Swath Width
1636 km