ASSESSMENT OF SUPERFLUX RELATIVE

TO REMOTE SENSING

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One of the objectives of Superflux was to advance the state of the art in remote sensor technology, thereby hastening the day when remote sensing can be used operationally for fisheries research and monitoring. This goal has certainly been achieved, both in terms of individual sensors as well as in the design of remote sensor systems.

There were three major individual sensor technologies that benefited from the program: laser fluorosensors, optical-range scanners, and passive microwave sensors. Under Superflux, the first convincing evidence was obtained that the AOL fluorosensor can map chlorophyll, i.e., is linear, over a wide range from less than 0.5 to 5.0 mg/m^3. The ALOPE dual-excitation concept for addressing phytoplankton color group composition was also demonstrated convincingly. The result has been that NASA's support for laser fluorosensor technology has increased significantly (comparing 1981 to 1980 research funds) and the AOL will acquire a second laser, thus adopting the dual-frequency excitation technique of the ALOPE.

In the area of optical-range scanners (MOCS, TBAMS, and AOL), 1980 was the year that the 3-band MOCS algorithm came to our attention. It appears to be an extremely successful algorithm for eliminating extraneous effects (e.g., atmospheric and other variations) while retaining the water color information. Superflux provided many hours of flight verification for the MOCS algorithm at altitudes ranging from 150 to 6000 m and with the best and most comprehensive sea truth MOCS has ever had. This added significantly to empirical evidence that the MOCS algorithm works, but there still needs to be analytical ("first principles") and laboratory validation. The MOCS algorithm was applied to TBAMS data and was highly successful in eliminating off-nadir asymmetries.

Advances in the area of passive microwave sensors were not as dramatic because that technology had already been well established before 1980. Superflux did provide the opportunity, however, to demonstrate that a single microwave band could be used with a modified commercially-available infrared radiometer (PRT-5) to map salinity and temperature. This decreases the complexity of the microwave sensor compared to the 2-band microwave systems used before Superflux.

The real-time capability of several of the sensors is worthy of mention. The analog displays of the AOL, MOCS, L-Band, and OCS, which were generated in real time onboard the aircraft or near real time (in the case of the OCS which has a 5-minute lag time) at a ground station, made aircraft-boat interactions highly successful. The location of fronts and patches could be relayed to the boats to enable better in situ sampling of these features.

The most significant accomplishment of Superflux was its initiation of the systems approach, that is, the integration of sensors into systems and the synergism that resulted. Regarding the validity or "proof" of individual sensors, there is nothing more convincing than witnessing the synchrony of two or more sensors. For example, when all the sensors onboard the P-3 detect a front with simultaneous increases in chlorophyll a, turbidity, and temperature, the validity of each sensor is enhanced.

The remote-sensing technology that was advanced by Superflux is still a long way from being ready for operational use in fisheries research and monitoring. To this end, the design for a more operational airborne remote sensor system is beginning to emerge. It would be comprised of sensors of the same type as those used in the low-altitude system during Superflux, but it would be a true system in the sense that it would have common electronics (e.g., data acquisition and display hardware, etc.) and be linking to a common time code generator and Loran C tracker. Thus, the so-called "registration" of the data would be made simpler and more operational. In addition, the sensor system would be made as compact and light as possible so that it could be flown on a smaller and operationally less expensive aircraft than the P-3.

In conclusion, the effort that went into the Superflux experiments has resulted in a stronger scientific underpinning of the technologies in this area. The high degree of interaction between NASA technologists and the scientists, who will ultimately be the beneficiaries of the technology development, contributed immeasurably to that scientific underpinning. By supporting Superflux, the National Marine Fisheries Service has enabled the pursuit of some remote-sensing technology development which otherwise would have been postponed or even cancelled. The many successes that resulted have put this technology in a much better position to compete for limited financial resources in the future.