and J. Stevenson-Hinde (MRC Unit on the Development and Integration of Behaviour, Cambridge) demonstrated correlations between children's temperament and their interactions with and feelings about their mothers and other family members. Such effects also operate outside the home, for temperamental characteristics are related to interactions in the pre-school period.

Although studies of temperament in the development of personality are only just beginning, they have already been widely used by clinicians. W. Carey (University of Pennsylvania, Philadelphia), who himself developed several widely used temperament scales, discussed how temperament assessments could assist paediatric practice both in facilitating the identification of potentially difficult children and in fostering parental understanding of difficulties. Furthermore, B. Keogh (UCLA) showed that teachers' assessments of children are affected by temperamental differences between them, indicating that an understanding of temperament is important also for educationalists.

Seasat: space-age oceanography

from George H. Born

SEASAT, the first satellite designed to assess the valve of microwave sensors for remote sensing of the world's oceans, was launched on 27 June, 1978. The satellite operated successfully until 10 October, 1978, when a power failure brought transmission to a stop. Despite its short lifetime, Seasat acquired a wealth of data on sea-surface winds and temperatures, ocean wave heights, internal waves, atmospheric water content, sea ice, topography of the ocean surface and shape of the marine geoid. Analysis of these data has demonstrated the success of Seasat in accurately measuring, on a global scale, important oceanographic parameters from space.

Five sensors were carried on-board the satellite: (1) a radar altimeter to measure sea-surface topography, ocean wave height, and wind speed; (2) a scanning, multi-channel, microwave radiometer (SMMR) to measure sea-surface temperatures (SST), wind speed, and atmospheric water content; (3) a wind-field Seasat-A satellite scatterometer (SASS) to measure both the magnitude and direction of the wind speed; (4) a synthetic aperature radar (SAR) for imaging the ocean's surface at radio frequency to measure wave heights and wave directions, and to recognize sea-ice features; and (5) a visible and infrared radiometer (VIRR) to provide information on cloud conditions.

For the past three years, an international team of scientists and engineers has been evaluating the performance of the Seasat sensors and analysing the data they produced. At the 1981 spring meeting of the American Geophysical Union, about 50 presentations employed Seasat data and here some of the highlights of that meeting as well as other recent research involving the altimeter, SMMR, and SASS will be discussed.

Understanding the general circulation, which governs the ocean's contribution to the global heat transport, is a fundamental problem facing oceanographers and here satellite altimetry can be of great value. The radar altimeter on Seasat measured the distance to the ocean's surface with a precision of 5–7 cm (compared with the 1-2 m on Skylab and 30-40 cm on GEOS-3). With appropriate corrections the elevation of the ocean's surface relative to the geoid can be computed. After removing tidal effects, this topography is a manifestation of the surface pressure field from which the absolute value of the surface geostrophic velocities can be computed. Knowledge of the surface pressure field, combined with conventional in-water measurements of conductivity and temperature as a function of pressure, allows calculation of velocity profiles with depth.

Inaccuracies in our knowledge of the marine geoid currently prevent the determination of mean (time-averaged) circulation on a global basis. However, the time-variable component of ocean circulation on a global basis. However, the time-variable component of ocean circulation is being studied successfully by using Seasat altimeter data. Surface topography variations, as defined by differenced altimeter data from Seasat orbits with repeated ground tracks, depict mesoscale variability in ocean circulation patterns. Also, the combination of ocean circulation of ocean circulation measurements and wind fields such as those from the SASS will allow hypotheses of the linkages between the ocean circulation and the wind stress curl to be tested.

Synoptic SST maps have been obtained using data taken by the Seasat SMMR. With certain restrictions, temperatures from these maps have been proved accurate to ±1°C over a range of 10 to 30°C when compared with ship, buoy, and bathythermograph data. At present, this accuracy is obtained by excluding data when continental boundaries are within 600 km of the instrument swath, or when the 6.6 GHz channel is contaminated by radio-frequency interference, or in conditions of rain or sunglint. These restrictions may be eliminated in future missions by improved instrument design and data processing.

Monthly averages of SMMR SSTs are within 0.6°C of monthly averages of ship data. SMMR provided SST monthly averages more accurate than of conventional data because of the greater density of coverage. By sampling most of the world's oceans at least twice every 3 days for 3 months, the Seasat SMMR made almost a million SST measurements — a number comparable to all of the conventional SST measurements made during the past 50 years.

Wind fields from the Seasat scatterometer, have been demonstrated to be accurate to ±2 ms^{-1} in magnitude and ±20° in direction for winds from 2 to 24 ms^{-1}. However, the SASS wind measurements are obtained with as many as four wind speed directions, only one of which can be correct. Additional man-in-the-loop meteorological interpretation and processing will be required to remove the direction ambiguity. This problem can be eliminated at least 95 per cent of the time by including two additonal antennas on future instruments.

Because of the lack of conventional observations, critical weather phenomena frequently pass undetected or are mislocated. The wind fields derived from scatterometer data give accurate location of weather features such as highs, lows, fronts, and tropical storms and hurricanes can be located to within 25 to 50 km.

Use of Seasat scatterometer data may also improve storm prediction. In several instances scatterometer windfields indentified low-pressure areas that developed into destructive storms as much as 12 to 24h before they were detected by conventional observations. In September 1978, a rapidly developing storm in the North Atlantic was responsible for the destruction of the fishing trawler *Captain Cosmo* and the loss of its crew. In the same storm the *Queen Elizabeth II* suffered considerable damage and about twenty passengers and two crew members were injured. This storm intensified by a factor of 16 in just 24 hours. Although the conventional weather forecast predicted 2 to 3-m waves, the *Queen Elizabeth II* was pounded by 10 to 12-m waves, with occasional waves up to 16 m. Subsequent analyses suggest that Seasat data could have given advance warning of the development of the storm.

Comparison of Seasat data with *in situ* observations demonstrates that, with relatively minor exceptions, pre-launch accuracy specifications have been met or exceeded. Some problems with sensors and data products have been discovered, but these have either been solved in the course of the data analysis, or could be resolved by modifications to the sensors. As a mission to test microwave surveilance of the oceans, Seasat was an outstanding success.

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