Remote Sensing from the Air and Space

PRESENT AND NEAR-FUTURE CAPABILITIES

Humankind's views, perceptions, and understanding of the Earth and its oceans have been dramatically affected first through images obtained from aircraft and more recently from space. The thinness of the atmosphere and the vastness of the oceans as well as the beauty and complexity of the atmosphere and oceans are only a few of the impressions provided in photographs by space explorers (e.g., Apt et al. 1996). While the visual impacts of space-based images are profound and in themselves informative, the next difficult step has been to extract quantitative information.

Satellite-based sensors are now capable of providing nearly global and, in some cases, "snapshot" or synoptic views—and, importantly, data—over much larger areas of the ocean surface (and ice) than possible from any other platforms (see figure 9.4 in the color section). The data are typically empirical inferences of surface signals (e.g., either passive or active electromagnetic radiation) and are often based on groundtruth data sets obtained from ocean-based platforms (e.g., Koblinsky and Smith 2001). Because electromagnetic radiation only penetrates to very shallow ocean depths (e.g., infrared to millimeters and visible to meters), satellite information must be complemented with in situ observations to characterize important subsurface ocean properties. Considerable research effort is being devoted to extracting subsurface data using remote sensing, in situ data sets and models.

Some of today's oceanographically important remotely sensed variables include solar radiation, wind stress and direction, rainfall, surface heat fluxes, sea surface temperature, ocean color (e.g., pigment concentrations) (IOCCG 1999), and sea surface height (several references in Koblinsky and Smith 2001).

A few of the interesting applications of remote sensing have included studies of mesoscale features, seasonal evolution of temperature and phytoplankton (via ocean color), El Niño and La Niña, equatorial waves, planetary scale waves (Kelvin and Rossby waves), wakes of ships, hurricanes and typhoons, coastal upwelling, storm runoff, surface and internal gravity waves, bottom topography, island wakes, and ice age, extent, thickness, and motion.

TOWARD THE FUTURE

Aircraft-based systems will be able to provide very high spatial resolution data for altimetry, color, temperature, salinity, and other variables. Aircraft-