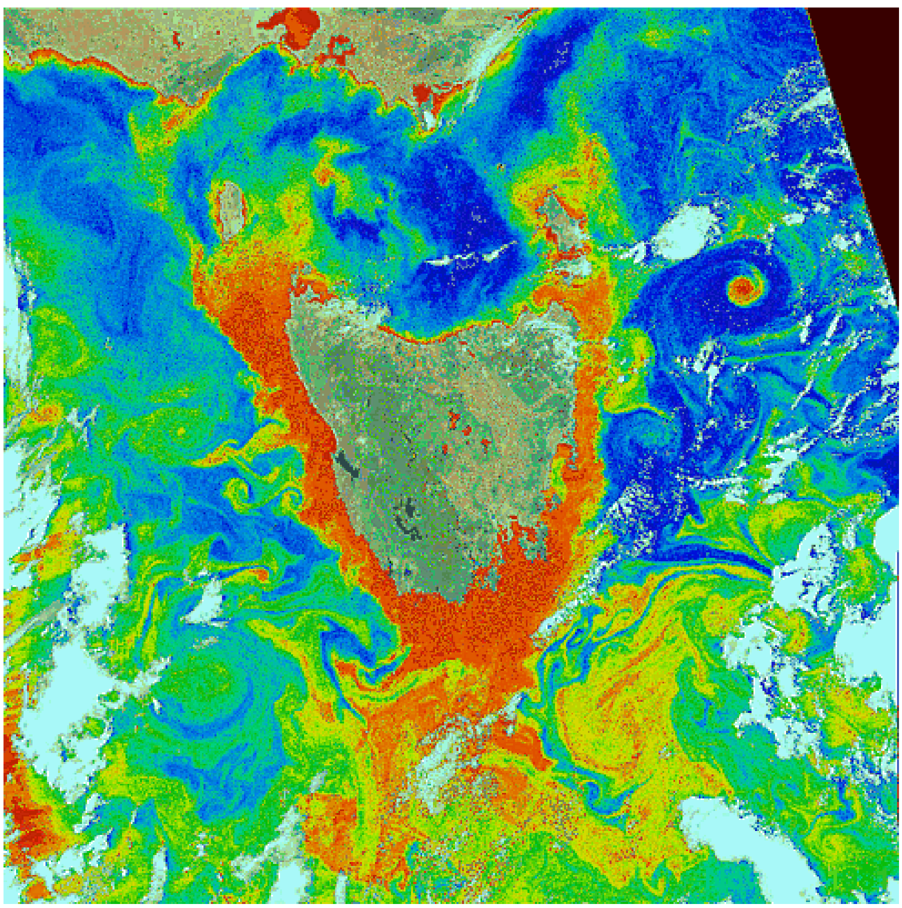
Classic CZCS Scenes

Chapter 1: Interactions of ocean currents and biology

The scene shown below is an image from the Coastal Zone Color Scanner (CZCS) archive, centered on the island of Tasmania. Tasmania is a large island located south of the eastern coast of the Australian continent. The currents in this oceanic region are particularly strong, and as they interact with the topography of the ocean bottom and the land mass of the island, a complex pattern of swirling motion (which oceanographers term eddies, rings, and vortices) is the result.



CZCS image of Tasmania and surrounding waters, obtained on November 27, 1981. The southern coast of Australia is at the top of the image, separated from Tasmania by the Bass Strait.

The CZCS was an instrument carried on the NIMBUS-7 satellite. It was designed to make precise measurements of the intensity of radiation in different portions (bands) of the color spectrum. These measurements indicated how much sunlight was being absorbed and how much was being reflected at (and from some depth beneath) the ocean's surface. The small living plant cells that exist near the ocean surface--called *phytoplankton*--contain *chlorophyll*, the pigment that allows them to convert sunlight and carbon dioxide into the organic matter of their cellular structure. The more chlorophyll that is present at the surface, the "greener" the reflected light will be. At the same time, more red light will be absorbed. Thus, the measurements made by the CZCS allow a view of the patterns of phytoplankton in the ocean.

The image of the oceans around Tasmania is a "false color" image. False color means a color scale is used to indicate the approximate concentrations of phytoplankton in the water. In this color scale, yellows and reds indicate more phytoplankton, and greens and blues indicate less. Dark blue and purple indicate very low concentrations of phytoplankton in very clear ocean water.

It is obvious that the current interactions around Tasmania are very complex, and they shape the phytoplankton growing near the island into patterns that are constantly changing. The complexity of the patterns and the fact that they are always in motion makes it very difficult for the traditional methods of oceanography, conducted from a stationary ship, to make accurate estimates of the amount of phytoplankton in a given oceanic region. It is also difficult to determine how rapidly the phytoplankton in an entire region are growing. The process of photosynthesis in plants converts light and carbon dioxide to carbon in the cell. The rate at which carbon is produced by plants is called *primary productivity*, and it is one of the fundamental variables measured by biological oceanographers.

If scientists on a ship were trying to survey the waters around Tasmania, they could travel in a certain direction for days in clear water, and only a few kilometers away there might be a patch of higher primary productivity that the ship never encountered. On the other hand, a ship could travel in high productivity waters and not encounter any areas of low productivity. In either case the scientists' picture of the biology around the island would be inaccurate. It is only by taking a view from space that the biological patterns in the whole region can be observed and measured, presumably allowing more accurate estimates of primary productivity.

There are many different processes that influence the growth and movement of phytoplankton in the ocean. In subsequent sections, some of the most important processes will be discussed and illustrated with other images from the CZCS archive.