

Pictures of ocean systems & methods of observation

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The images I make for ocean science groups are as realistic and as accurate as I can produce. They typically show overviews of observation programmes with many details of the instruments and ecosystems at varying depths and locations. I use a size scale so the large scale ocean to planet edge can be represented in the same picture as cell and molecular scale. My design for a GOOS poster in 2008 best illustrates this approach. A booklet was produced to describe 22 features of the poster using text. I propose that animated graphics may do a better job of communicating how measurements are taken and how organisms function. For example, the virus infection of *Emiliania huxleyii* shown in the centre of the image is further visualized by animation which I made for the UK's NERC, the action of acoustic observation was animated for Norway's IMR, the action of CTD sampling and sea bed corers was animated for Germany's HZG coastal group.

The underlying theme of the GOOS poster is my idea of how science operates. The image shows ocean temperature data streaming to researchers who construct models which are used to make predictions of future changes, and then new data is collected to test and improve the models. I suggest that our brains do something similar when we observe, act, and improve our brain models of how to operate in a complex environment. We learn very quickly when presented with well designed graphics and similarly we may well understand processes in nature when shown animated visuals that have been tested with viewers, modified, and evolved into neat communication tools.

In 2015 I gave a talk on graphical communication to an audience of physicists at a conference entitled 'Microscale Ocean Biophysics' in Aspen USA. I showed a published still image of marine bacteria swimming in varying shear forces of water currents, followed by the animated version of the image. Even though the audience could calculate the forces and predict the pathway of the cells, they enjoyed the sight of my animated models moving as predicted. I continue to make images for this group as it helps communicate in their research papers an instant snapshot of their investigations. The scientists provide me with very precise fine tuning of the graphics and we email to and fro up to 20 version changes until we get a final best result.

My ambition at the advanced age of 70 is to make movies to describe ideas such as how first life started in the oceans, how photosynthesis evolved in marine cells, the role of marine bacteria and viruses, and the more familiar marine ecosystem interactions. I am interested in finding out just how far you can go in explaining fundamental processes using animation, with the result that the key messages are remembered. As a former teacher of science in high schools this question has always exercised my imagination.