Tea is colored, and we know why. But what causes ocean color, and what can be learned by observing it? Whether ocean, rivers, lakes, ponds, or even drinking water, all waters contain organic matter. In the world’s oceans, the vast majority is dissolved, and individual substances are found at very dilute concentrations. Nevertheless, the many thousand compounds make a pool that is as abundant as atmospheric carbon dioxide. In fact, the two are connected through photosynthesis. Plankton, found at the surface of the ocean, takes up carbon dioxide and uses the sun’s energy to form organic substances. When they die, the leftover substances become available to bacteria, who themselves seek to gain energy by utilizing them. However, not all substances are equal. Some are consumed within hours, but the vast majority survives multiple ocean circulations (that is more than 16,000 years). Since the global climate is changing, scientists are using remote sensors to monitor organic substances to evaluate how atmospheric carbon dioxide is permanently transformed into organic substances and stored in the ocean. However, such sensors rely on measurement principles that are poorly understood. Sensors measure the absorbance of light caused by organic substances (similar to the color of tea caused by polyphenolic substances), or detect the emission of fluorescent light as a response to stimulation with ultraviolet and visible light. Since not all substances absorb or fluoresce, the challenge is to decipher these signals, and learn how much remote sensors can tell us about all other organic substances in the water. In this project, new methods were developed that facilitate a better chemical understanding of absorbance and fluorescence observations of dissolved organic substances. This was done by simultaneously performing optical measurements along with chemical characterizations of dissolved substances, such as molecule size, or molecule composition. Through this combination of techniques, we learned how selectively measuring substances emitting different light allows us to extrapolate and follow changes in the concentration of other compounds. Measuring the concentration of these compounds, along with determining their detailed chemical composition, normally requires expensive analytical instrumentation, whereas the knowledge gained with our approach can be applied to data gathered with more cost-efficient instruments. This allows the usage of remote sensors to track a vast number of organic substances by simply measuring water color and fluorescence. New remote sensors that utilize this knowledge can be built to selectively target multiple fluorescing substances emitting different light, and thus follow the dynamics of different parts of the vastly complex pool of organic substances in all waters. This can help to determine the safety of drinking water, monitor the health of fish in aquaculture, or monitor shifts in organic substance composition in the ocean as consequence of climate change.