Mark: “Previously on: What Goes In Must Come Out”

“The hyperion water reclamation plant is one of the largest sewage treatment plants in the western United States. It is located in the coast of LA and discharges into Santa Monica bay.”

“About 350 mill gallons a day of effluent is released into the deep ocean through a 5 mile long pipe. However, there are times when this pipe needs to be repaired. In which case, the effluent is temporarily diverted through a shorter 1 mile pipe.”

“During the most recent diversion event, occurring from September 21-November 2 of 2015, the effluent made its way to the water’s surface, bringing with it excess nutrients and bacteria.”

“The NASA DEVELOP JPL team, with support from their mentors, utilized multiple satellite platforms and their instruments to track and monitor the environmental impacts of the effluent. These included the MODIS instrument onboard Aqua, the thermal infrared sensor and OLI instrument on Landsat-8, ASTER on Terra, and VIIRS on Suomi.”

Lindsay: “The satellite data are saying there are large environmental responses to the treated wastewater coming to the surface, but how do we know if they’re right?”

Rebecca: “We need some kind of validation for our satellite data.”

Lindsay: “What about all of those pesky atmospheric aerosols?

How do we know that this phytoplankton bloom is actually happening?”

Rebecca: “I wonder if the temperature signature we’re picking up is real. And if we can say anything about the salinity of the effluent plume.”

Lindsay: “Let’s go find some evidence.”

Mark: “In the field, the investigators used a CTD profiler to measure salinity, temperature, and chlorophyll fluorescence of phytoplankton. The HyperPro was used to determine attenuation of wavelengths across the electromagnectic spectrum, both at the surface of the water and at depth. Water samples were taken to measure chlorophyll concentration and determine the species of the phytoplankton present in the water. They used the Microtops to measure aerosol optical thickness and released GPS-tagged drifters to determine the direction of surface currents.”

Lindsay: “Now what! We have all this in situ data, but how to we use it to validate our satellite data?”

Rebecca: “We need to combine our in situ data and our remote sensing skills to solve this case.”

Mark: “Give me some good news”

Lindsay: “I was able to extract the aerosol optical thickness values from our microtops instrument in order to atmospherically correct the data. Look at the difference all those aerosols had on the satellite data.”

Rebecca: “Look boss, we just had a breakthrough! There seems to be a pattern in the CDT data. It corroborates the story our satellite data is telling.

Look at these temperature values, you can see the distinct cold water signature right at the pipe during the diversion.

And look here, it matches up with the salinity values, which makes sense, since the wastewater coming out of the pipe is fresh.

And then, look at the drifter data. The direction they’re going line up with where we are seeing the plume in the satellite data.”

Lindsay: “Listen, I’ve been having such a hard time with this chlorophyll data, and it’s the last piece of our puzzle. We have chlorophyll data from 3 different sources. How do I know which one to use?”

Rebecca: “Lets pool them all together “

“See how closely the CTD chlorophyll data corresponds to the Landsat chlorophyll data?

That large bloom heading south from the outfall pipe and wrapping around the peninsula is not only detected by the OLI sensor on Landsat-8, but also by the MODIS sensor on Aqua.

Here you can see the difference between the raw CTD chlorophyll data and the adjusted values, obtained by using a linear regression equation, comparing CTD chlorophyll values against discrete surface water sample values.”

Rebecca: “The in situ chlorophyll data correlates well with what we’re seeing in our satellite data:

Lindsay: “Looks like we solved our case”

Rebecca: “This just shows how useful satellite data can be, when combined and corrected with *in situ* measurements”