**NASA DEVELOP National Program**

****NASA Jet Propulsion Laboratory

**Fall 2015**

**Short Title: Los Angeles Oceans**

**Subtitle:** Using Remote Sensing to Detect Wastewater Plumes and Assess Their Impact on Public Water Quality in Los Angeles County, California

**VPS Title:** What goes in must come out, but where does it go?

**Project Team & Partners**

**Project Team:**

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**Advisors & Mentors:**

Benjamin Holt (Oceans-Ice Group, NASA Jet Propulsion Laboratory)

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**Past or Other Contributors:**

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**Partner Organizations:**

City of Los Angeles Hyperion Treatment Plant (End-User), POC: Curtis Cash, Ashley Booth, and Mas Dojiri

**Project Details**

**Applied Sciences National Applications Addressed:** Oceans

**Study Area:** Santa Monica Bay, CA

**Study Period:** September 21 – November 27, 2015

**Earth Observations & Parameters:**

Aqua, MODIS – sea surface temperature, chlorophyll-a, remote sensing reflectance

SUOMI NPP, VIIRS- sea surface temperature, chlorophyll-a, remote sensing reflectance

Landsat-8, TIRS – sea surface temperature, chlorophyll-a, remote sensing reflectance

Terra, ASTER – sea surface temperature

ALOS-2, PALSAR-2 – sea surface roughness

Senitnel-1, SAR – sea surface roughness

**Ancillary Datasets Utilized:**

**Models Utilized:**

**Software Utilized:**

ArcGIS - Raster manipulation/analysis, image enhancement & map creation of MODIS, VIIRS, Landsat-8, ASTER, ALOS-2, and Seninel-1

SeaDAS- Data processing and manipulation of MODIS and VIIRS data

SNAP- Sentinel Applications Platform used in the processing of Sentinel-1 & ALOS-2 SAR data

ENVI – ASTER and Landsat-8 processing

**Project Overview**

**80-100 Word Objectives Overview:**

Sewage treatment plants must periodically undergo facility maintenance or upgrades to their current infrastructure of outfall pipes that routinely carry treated effluent into deep, offshore coastal waters. During this maintenance, the outflow is typically diverted to a shorter outfall pipe releasing effluent into shallow coastal waters. By combining NASA Earth observations and *in situ* readings taken during the outflow event at the Hyperion Treatment Plant (HTP) in the City of Los Angeles, we can determine whether the effluent is negatively impacting the marine ecosystem and washing ashore, potentially harming beachgoers.

**Abstract:**

The Hyperion Treatment Plant is one of the largest wastewater treatment plants in the western United States. Treated sewage is generally released at depths of approximately 60 m through 8.05 km outfall pipes into the deep coastal waters of the Santa Monica Bay. In times of repair and maintenance, services on the main outfall pipe are temporarily suspended and require the plant to divert treated sewage to a shorter 1.6 km pipe that extends into shallow coastal zones. These shallow zones make it possible for the buoyant freshwater plumes to reach the surface, potentially contaminating the local environment. This study highlights the use of concurrent satellite data analysis of thermal signature, surface movement, and ecosystem response to the planned wastewater diversion undertaken at HTP from September 21 to November 2, 2015. By combining remotely-sensed observations with GPS-equipped drogue surface drifters and *in situ* readings of temperature, salinity, dissolved oxygen, pH, conductivity, transmissivity, colored dissolved organic matter (CDOM), and chlorophyll-a florescence, an accurate assessment of the full impact and extent at which these effluent plumes affect the Los Angeles Basin is possible.

**Community Concerns:**

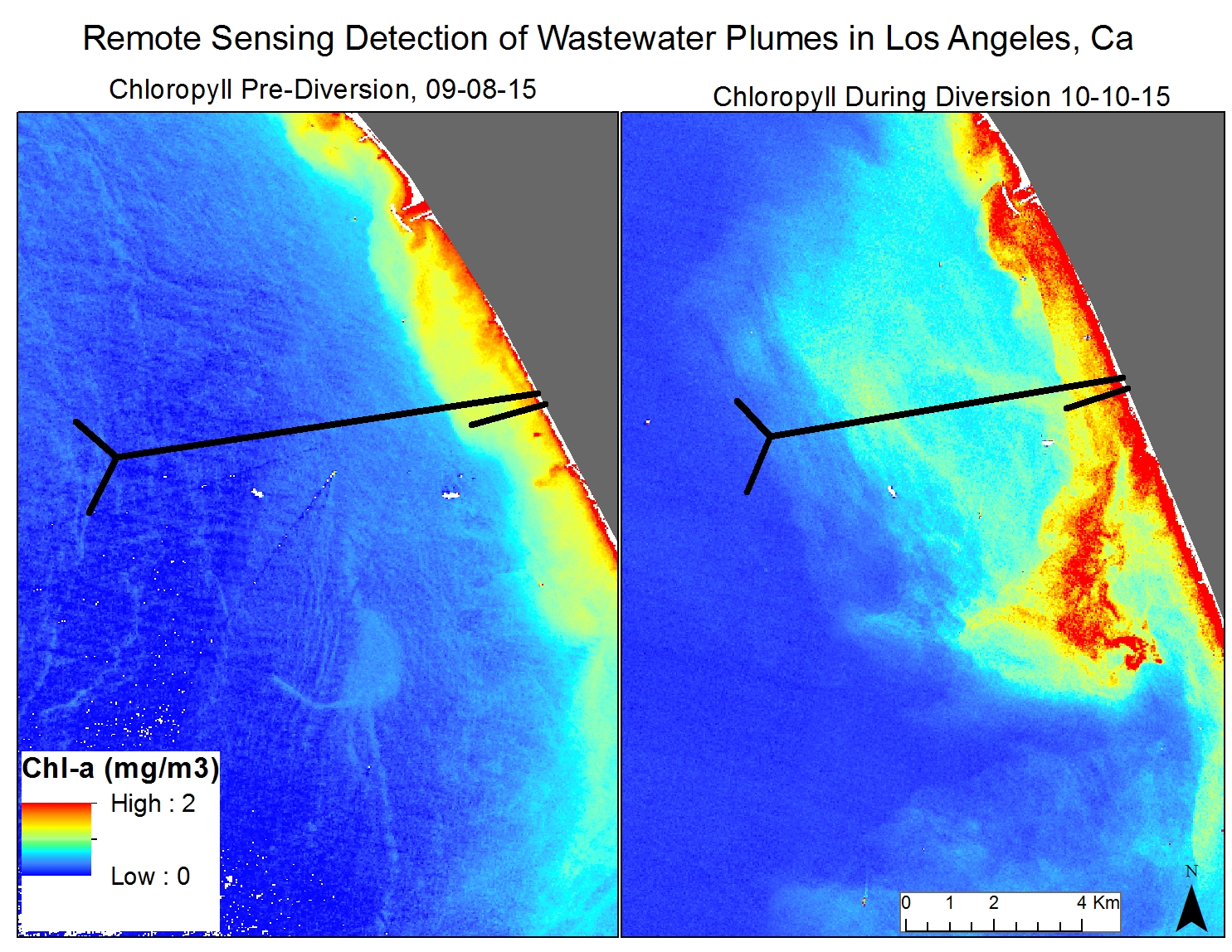
* Treated wastewater is diverted to shorter outfall pipes that extend into shallow coastal zones, where buoyant, freshwater plumes, containing possible containments, may reach the surface and potentially the coastline.
* Contaminants can be harmful to humans who come in contact with the wastewater.
* Excessive nutrients near the surface may also stimulate harmful algal blooms (HABs) that are not only toxic to many marine organisms but also cause health problems to humans.

**Current Management Practices & Policies**:

The City of Los Angeles’ Hyperion Treatment Plant conducts their own internal research operations, both within the plant and in the coastal waters in which they discharge the treated effluent. However, conducting *in situ* operations are very costly, and Hyperion officials typically partner with outside sources to bolster their near real-time observations.

**Decision Support Tools & Benefits:**

|  |  |  |
| --- | --- | --- |
| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Maps of thermal plume signature | Landsat-8, TIRS  Terra, ASTER  Aqua, MODIS  SUOMI NPP, VIIRS | Effluent plume has distinct temperature signature that can be detected via satellite. This makes it easier for HTP to track where the plume is. |
| Maps of ocean color changes | Landsat-8, TIRS  Aqua, MODIS SUOMI NPP, VIIRS | Effluent plume carries high nutrient loads and suspended solids that can be detected via satellite. The biological response in terms of phytoplankton bloom can also be monitored via satellite. This makes it easier for HTP to track where the plume is. |
| Maps of sea surface roughness | Alos-2, PALSAR-2  Sentinel-1, SAR | The buoyant effluent plume is rich in oils and grease that forms a slick on the surface of the water as the plume rises. This can detected using radar and makes it easier for HTP to track where the plume is. |

**Project Imagery**

**Caption:** Landsat-8 images of chlorophyll-a levels off the coast of Los Angeles. Left: Effluent is pumped through a 5-mile long pipe and discharged at depth, minimizing environmental impact. Persistent high levels of chl-a are seen along the coast due to warm waters and shore input. Right: During the diversion, effluent is being discharged at a shallow depth, 1 mile from the coast. Nutrients from the wastewater are able to reach the ocean’s surface, stimulating algal blooms and increasing the amount of chl-a detected. Image Credit: Los Angeles Oceans Team

**Image:** Landsat8\_Chla\_Diversion

**Software Release Requirements**

What category do the tools your project is creating fall within?

Category I