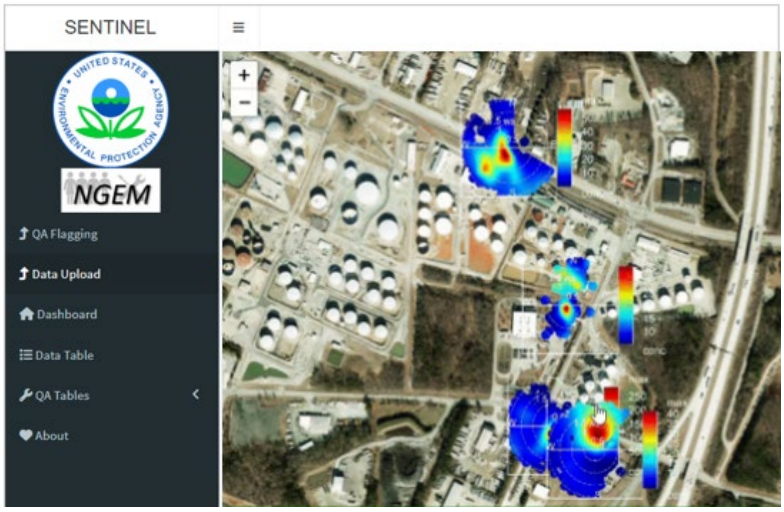
SENTINEL: An application for fenceline sensor data analysis

Purpose:

There is growing interest in fenceline monitoring around chemical facilities[1-5]. Fenceline sensors used in these monitoring applications can collect large amounts of concentration and meteorological data for extended time periods[6-8]. The **SEN**sor In**T**ell**I**ge**N**t **E**missions **L**ocator (SENTINEL) application helps users compile, process, and analyze data from a specific commercial fenceline sensor that was based on the EPA open-source SPod (sensor pod) design[9-12]. This application delivers these capabilities in a user-friendly interface that can combine and process daily data files from multi-sensor deployments, allowing users to gain insights from compiled sensor data over time. The SENTINEL app is one of the technologies developed under the Next Generation Emissions Measurements (NGEM) program.

Features:



The SENTINEL application is developed within the R Shiny framework and features are supported by several common R packages[13-15]. Version 1.0 of SENTINEL prompts the user to upload any number of raw daily sensor files. The user has the option to apply user-specified quality assurance (QA) flags (i.e., calibrations, maintenance) to the raw data in the QA screen. All uploaded data is then processed to a standard 5-minute form and automatic QA flags are applied by the software. A dashboard is generated for the user that contains interactive times series plots and geospatial representations that incorporate sensor signal data, meteorological data, user-input calibration information, and automatic canister trigger recordings. This dashboard can be output to a HTML page for printing as a record. The user can also view the data in tabular form and perform basic search and sort operations on the processed 5-minute data. Quality assurance for this type of data is particularly useful to the user to confirm that sensors are working as expected over time. SENTINEL can populate QA tables for a single sensor or a collocated pair of sensors that contain summary statistics on operational, meteorological and concentration data indicators. Any values that are outside of a determined range will be flagged to alert the user. The user can output the processed data as a .csv file and the QA tables as HTML files. Finally, the app contains a page with useful links and resources to SPod research for the user.

Access:

Currently, SENTINEL is accessible as raw code in a Github repository (https://github.com/USEPA/SENTINEL). This repository contains supporting information, such as the user manual, as well as primary app code and customized function code. The user can download the folder from the repository and deploy the app in an instance of R Studio on their machine. In the future, it is possible that SENTINEL will be accessible as a web app via a simple shareable link.

Future Research:

There is a possibility of applying a sensor-agnostic interface to the SENTINEL application, so data files from other types of air sensors can be analyzed through this framework (e.g., methane sensors). An inverse modeling program could also be added to the application, allowing the user to generate back trajectory models of particles detected by the sensors. A rudimentary emissions estimation could be made from this sort of model.

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