% This script acquires data from a public ThingSpeak channel and uses it to calculate

% a 24-hour averaged Air Quality Index (AQI), which is written back to another Thingspeak channel.

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% Prior to running this MATLAB code template, assign the channel ID to read

% data from to the 'readChannelID' variable. Also, assign the field ID

% within the channel that you want to read data from to plot.

% TODO - Replace the [] with channel ID to read data from:

%%readChannelID = 357142;

readChannelID = 891066;

yourChannel = 839634;

yourChannelWriteKey = '1HF57KEFQYPYM7JJ';

% TODO - Replace the [] with the Field ID to read data from:

fieldID1 = 2;

% Channel Read API Key

% If your channel is private, then enter the read API

% Key between the '' below:

readAPIKey = '';

%% Read Data %%

[rawData, time] = thingSpeakRead(readChannelID, 'Field', fieldID1, 'Numminutes', 770, 'ReadKey', readAPIKey);

localTime = time - hours(7); % adjust for local time in Sunnyvale CA

%% Run custom function that analyzes collected data, computes AQI and plots collected data

returnAQI = analyzeplotAQI(localTime,rawData);

%% Send computed AQI to ThingSpeak Channel (Field 1)

thingSpeakWrite(yourChannel,returnAQI,'WriteKey',yourChannelWriteKey,'Fields',8);

% CUSTOM FUNCTIONS BELOW

% Main function that smoothes collected data and calls other custom functions

function returnAQI = analyzeplotAQI(localTime,rawData)

%% Smooth data

smoothData = movmedian(rawData,10);

% Find max and plot data

smoothDataMax = max(smoothData);

plotfun(localTime,rawData,smoothData,smoothDataMax)

% Combine smoothed data with time as # of elements are the same

smoothParticulateDataTable = table(localTime,smoothData,'VariableNames',{'Time','Particulate\_Conc'});

% Calculate AQI

pmObs = round(mean(smoothParticulateDataTable{:,2}),1); % Calculate 24 hour running average

returnAQI = calculateAQI(pmObs);

end

%% Plot Data

function plotfun(localTime,rawData,smoothData,smoothDataMax)

plot(localTime, rawData);

hold on

plot(localTime,smoothData,'-\*')

% Plot max of smooth data

line(localTime,smoothDataMax \* ones(length(localTime),1),'LineStyle','--')

title('2.5 micron particulate concentration \mug/m^{3}')

xlabel('Time');

ylabel('Concentration \mug/m^{3}');

legend('Collected data','Smoothed data','Max of Smooth Data','Location','best')

axis tight

hold off

end

%% Calculate AQI

function returnAQI = calculateAQI(pmObs)

% Learn about how AQI is calcuated

% https://www.epa.gov/outdoor-air-quality-data

aqiLow = [0;51;101;151;201;301];

aqiHigh = [50;100;150;200;300;500];

concLow = [0;15.5;40.5;65.5;150.5;250.5];

concHigh = [15.4;40.4;65.4;150.4;250.4;500.4];

% Create Look Up Table

lutAQI = table(aqiLow,aqiHigh,concLow,concHigh,...

'VariableNames',{'AQI\_low','AQI\_high','PM\_low','PM\_high'});

% Find the necessary equation parameters

rowIdx = find(pmObs >= lutAQI.PM\_low & pmObs <= lutAQI.PM\_high);

PM\_min = lutAQI.PM\_low(rowIdx);

PM\_max = lutAQI.PM\_high(rowIdx);

AQI\_min = lutAQI.AQI\_low(rowIdx);

AQI\_max = lutAQI.AQI\_high(rowIdx);

returnAQI = round((((pmObs - PM\_min) \* (AQI\_max - AQI\_min))/(PM\_max - PM\_min)) + AQI\_min);

end