```matlab
% Written by Vineet Yadav and Subhomoy Ghosh 3/25/2022
% To go with paper
% Metrics for assessing Linear Inverse Problems: A case study of a Trace
% Gas Inversion

% Load All The Relavant Data
% Please Change Paths Accordingly
% Senstivity with respect to observations
clc % clear console
clear all % clear all variables from the workspace
% Note windows kind of paths
% loads a matrix that contains prior and lat lon domain of inversion
dataPath = uigetdir(path);
% Addpath for code files
addpath(genpath(dataPath))
% repeat covariate as we only have annual
% covariate that is like invariant prior
% Load forward  operator, observations and parameters for Q and R
load([dataPath,'\','data_section_3.1.mat'])
```

Coordinates of Sites that Measure Methane and other details about observations

```matlab
towerNames={'ONT', 'FUL', 'CMP', 'GRA','USC', 'UCI','PSA','BND'};
timePeriods=2;
% Observation time is stored in amap variable
obsTime=[amap_ONT(:,1) 1*ones(size(amap_ONT,1),1);...% 1 represents ONT
    amap_FUL(:,1) 2*ones(size(amap_FUL,1),1);...% 2 represents FUL
    amap_CMP(:,1) 3*ones(size(amap_CMP,1),1);...
    amap_GRA(:,1) 4*ones(size(amap_GRA,1),1);...
    amap_USC(:,1) 5*ones(size(amap_USC,1),1);...
    amap_UCI(:,1) 6*ones(size(amap_UCI,1),1);...
    amap_PSA(:,1) 7*ones(size(amap_PSA,1),1);...
    amap_BND(:,1) 8*ones(size(amap_BND,1),1)];
% Number of observations available from each tower
towerSize=[size(amap_ONT,1) size(amap_FUL,1) size(amap_CMP,1) ...
    size(amap_GRA,1) size(amap_USC,1) size(amap_UCI,1) size(amap_PSA,1) ...
    size(amap_BND,1)];
% tower coordinates that measures Methane CH4
towerCoord = [34.064167 -117.583611 % Ontario
    33.880417 -117.884122 % Fullerton
    33.873792 -118.276806 % Compton
    34.283889 -118.4725 % Granada Hills
    34.021447 -118.288844 % University of Souther California
    33.644422 -117.844181 % University of California Irvine
    34.1366 -118.12641 % Pasadena
    34.087686 -117.310167]; % San Bernardino
% Time When Observations Were Taken
obsTimePre=[linspace(1,size(H,1),size(H,1))' ...
    obsTime datevec(obsTime(:,1))];
obsTowers=num2cell(obsTime(:,2));
% This is just list tower name with each observation time
```

```matlab
obsTowers(obsTime(:,2)==1)={'ONT'}; % Ontario
obsTowers(obsTime(:,2)==2)={'FUL'}; % Fullerton
obsTowers(obsTime(:,2)==3)={'CMP'}; % Compton
obsTowers(obsTime(:,2)==4)={'GRA'}; % Granada Hills
obsTowers(obsTime(:,2)==5)={'USC'}; % University of Souther California
obsTowers(obsTime(:,2)==6)={'UCI'}; % University of California Irvine
obsTowers(obsTime(:,2)==7)={'PSA'}; % Pasadena
obsTowers(obsTime(:,2)==8)={'BND'}; % San Bernardino
```

Plot Spatial Domain or the region of The Study

```matlab
% DOMAIN OF THE STUDY VARIABLES [PLOTTING: NOTHING RELATED TO EQUATIONS]
fluxD=size(H,2)/2;% total no of flux grid cells. Two 4 day time periods
% Create grid of latitude and longitude
% Unique latitudes
uniqueLat=unique(latlon(:,2));
% Unique Longitudes
uniqueLon=[unique(latlon(:,1))]';
% Grid of Latitude and Longitudes
gridlon1=repmat(uniqueLon,length(uniqueLat),1);
gridlat1=repmat(uniqueLat,1, length(uniqueLon));
% Now we get indices where data would be plotted
% This is the mask
index=zeros(fluxD,2);
for i = 1:fluxD
    [~,col]=min(abs(latlon(i,1)-gridlon1(1,:)));
    [~,row]=min(abs(latlon(i,2)-gridlat1(:,1)));
    index(i,1) = row;
    index(i,2) = col;
end
% This is our plotting grid
mapgrid=ones(size(gridlat1,1),size(gridlon1,2))*NaN;
for i = 1: fluxD
    mapgrid(index(i,1),index(i,2))=1;
end
titles ='Domain of Study';
h=pcolor(gridlon1,gridlat1,mapgrid);
set(h, 'EdgeColor', 'none');
shading flat; % do not interpolate pixels
axis on;      % display axis
axis tight;   % no white borders
axis image;   % real x,y scaling
set(gca,'fontsize',14)
ylabel('Latitude')
xlabel('Longitude')
title(titles,'FontSize', 14,'Fontname','Arial')
hold on
plot(towerCoord(:,2), towerCoord(:,1),'o','MarkerEdgeColor',[0 .5 .5],...
    'MarkerFaceColor','red' );
text(towerCoord(:,2),towerCoord(:,1),towerNames,'VerticalAlignment',...
    'top','FontSize', 12,'Fontname','Arial','Color','blue')
hold off
```
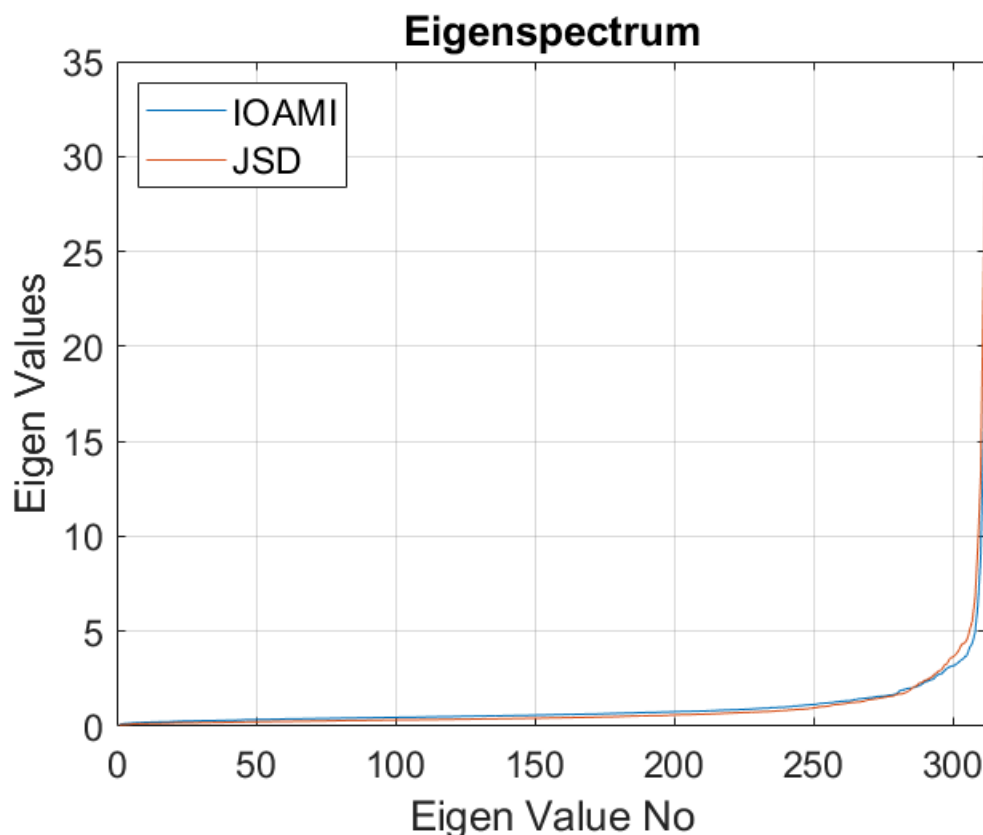
Domain of Study
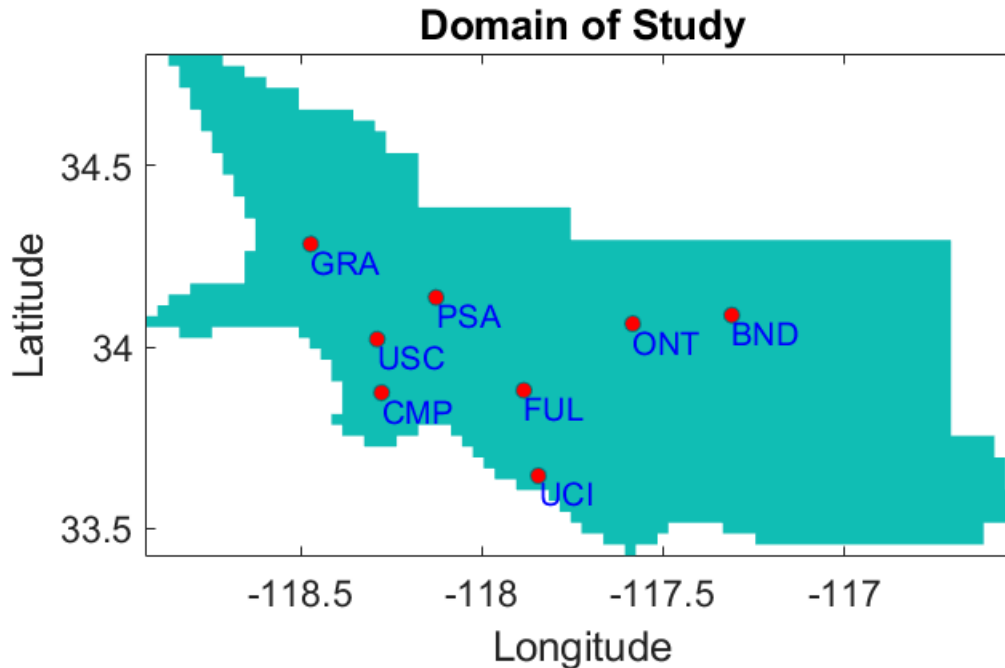
Compute IOAMI or Jaccard Index and Jensen-Shannon Matrices for Each Observation

```
% See variables areaCover and jenShannon
% note we convert sparse matrix to full matrix to speed up computation. do
% not do this for large matrices
% This is not optimized code for computing IOAMI or JSD.
% construct H;
H=[H_ONT;H_FUL;H_CMP;H_GRA;H_USC;H_UCI;H_PSA;H_BND];
H=full(H);
IOAMI_CORR=NaN*ones(size(H,1)); % Empty IOAMI CORRELATION Matrix to Fill it with Values
IOAMI_COV=NaN*ones(size(H,1)); % Empty IOAMI Covariance Matrix to Fill it with Values
JSD=NaN*ones(size(H,1)); % Empty Jensen Shannon DISTANCE Matrix to Fill it with Values
for i=1:size(H,1) % Go through footprint matrix row by row. Footprint of each observati
    for j=1:size(H,1)
        [IOAMI_CORR(i,j),~,~,~]=ioami_jaccard(H(i,:),H(j,:),'normalized'); % IOAMI
        [IOAMI_COV(i,j),~,~,~]=ioami_jaccard(H(i,:),H(j,:),'nonnormalized'); % IOAMI
        normlazed_H_1=H(i,:)./sum(H(i,:),2); % We have to normalize H for JSD so that i
        normlazed_H_2=H(j,:)./sum(H(j,:),2);
        JSD(i,j)=jsd(normlazed_H_1,normlazed_H_2,'log_2'); % Jensen Shannon using log w
        %[,JSD(i,j)=ioami_jaccard(normlazed_H_1,normlazed_H_2,'nonnormalized');
    end
end
% Note IOAMI is correlation matrix
JSD=1-JSD; %convert JSD distance matrix to correlation matrix
% Note to get IOAMI correlation matrix to distance matrix do
% IOAMI = 1- IOAMI % Note this is also ((A-B)+(B-A))/(AUB)
```

```
% Eigen Spectrum of IOAMI & JSD. It is check for positive semidefiniteness
eigen_IOAMI_CORR=eig(IOAMI_CORR);
eigen_IOAMI_COV=eig(IOAMI_COV);
eigen_JSD=eig(JSD);
% Test for correlation matrix
% (1) Symmetric
% (2) Ranges between -1 to 1. JSD only ranges between 0 and 1 and IOAMI by
% Definition should also be between 0 and 1 for footprints or Jacobian
% (3) It should be positive semidefinite
```

Plot Eigenvalues of the IOAMI and JSD Correlation Matrices of H to see they are Positive Definite

```
close all % close all existing figures
% Note All Eigenvalues should be >=0 which shows that it is Positive
% Definite Matrix
plot(eigen_IOAMI_CORR); % line plot of eigen values of IOAMI
hold on % hold to plot another line
plot (eigen_JSD); % line plot of eigen values of IOAMI
% Labels and Title for Plots
ylabel('Eigen Values',"FontSize",14)
xlabel('Eigen Value No',"FontSize",14)
legend({'IOAMI','JSD'},'Location','northwest',"FontSize",14)
title('Eigenspectrum','FontSize',14)
grid on % show grid on the plot
set(gca,'FontSize',14)
hold off
```

Plot IOAMI Correlation Matrix of the Jacobian (H) to see its Structure

```matlab
% Empty display to create Gap between Figures and Tables of Matrices
disp(' ');
```

```matlab
disp(' ');
```

```matlab
disp(' ');
```

```matlab
% Image Display of Correlation Matrix
imagesc(IOAMI_CORR)
ylabel('Col No',"FontSize",14)
xlabel('Row No',"FontSize",14)
axis off;
title('IOAMI Correlation Matrix','FontSize',14)
color=colorbar; color.Label.String = 'Correlation';
colormap Jet;
set(gca,'FontSize',14)
```
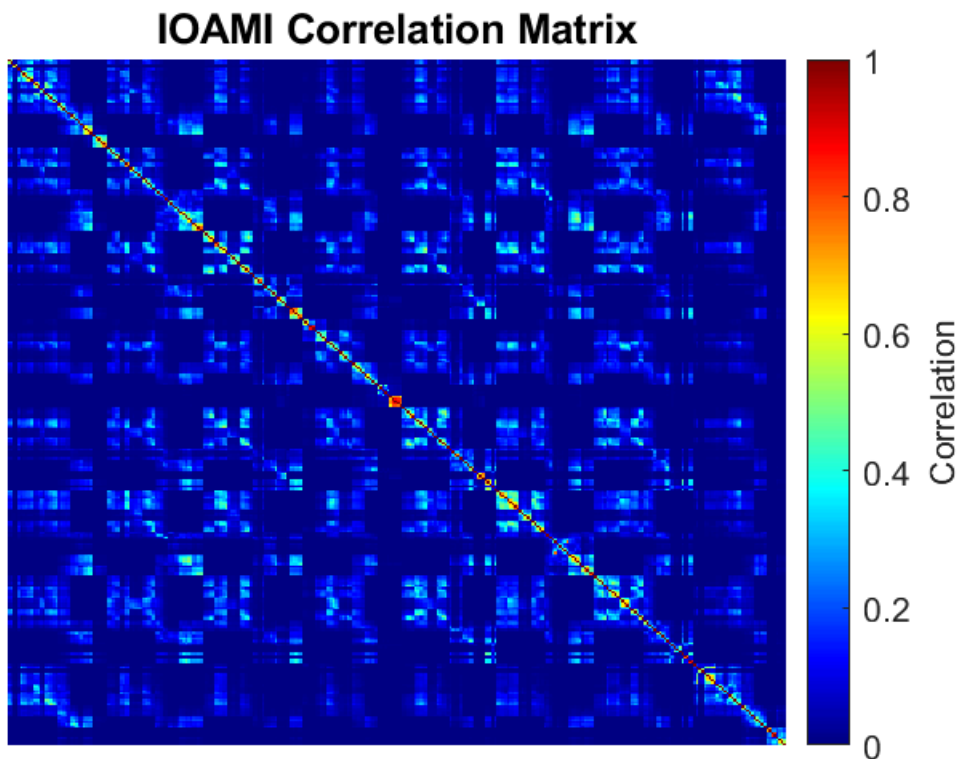

PLOT JSD Correlation Matrix of the Jacobian (H) to see its Structure

```
% Empty display to create Gap between Figures and Tables of Matrices
disp(' ');
```

```
disp(' ');
```

```
disp(' ');
```

```
% Image Display of Correlation Matrix
imagesc(JSD)
ylabel('Col No',"FontSize",14)
xlabel('Row No',"FontSize",14)
title('JSD Correlation Matrix','FontSize',14)
color=colorbar; color.Label.String = 'Correlation'; color.FontSize=14;
colormap Jet;
set(gca,'FontSize',14)
```
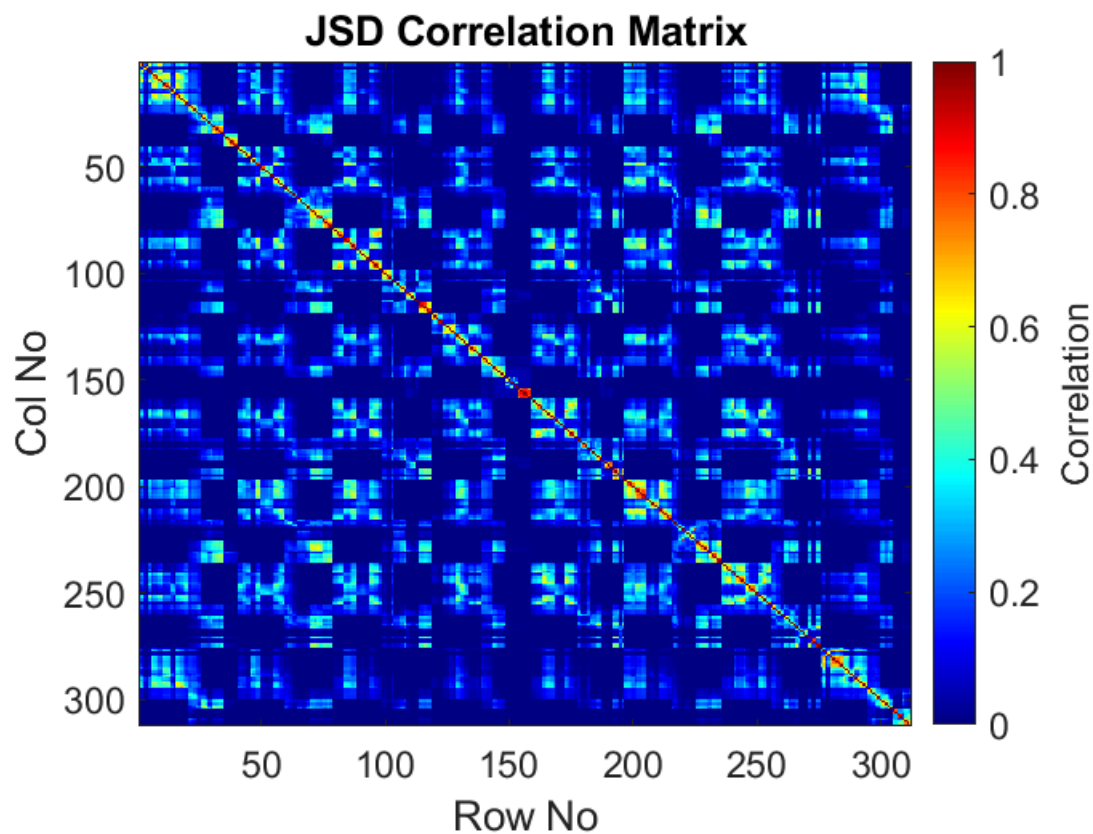

Compare IOAMI and JSD Correlation Matrices

```
% The matrix with lower condition number is better and same goes with
% respect to the Norm. Especially, if it is used as representative of spatio-temporal o
```

```
% variations
cond_IOAMI=cond(IOAMI_CORR);
cond_JSD=cond(JSD);
% compute frobenius norm
norm_IOAMI=norm(IOAMI_CORR,'fro');
norm_JSD=norm(JSD,'fro');
% compute distance between two correlation matrices formula from
% Correlation Matrix Distance, a Meaningful Measurefor Evaluation of Non-Stationary MIM
correlation_distance=1-(trace(IOAMI_CORR*JSD)/(norm_IOAMI*norm_JSD));
% note range of correlation distance is between 0 - 1 with 0 being same and
% 1 being completely dissimilar. For details see:
% See: Herdin, Markus, et al. "Correlation matrix distance, a meaningful measure
% for evaluation of non-stationary MIMO channels." 2005 IEEE 61st Vehicular
% Technology Conference. Vol. 1. IEEE, 2005.
% Smaller condition number means better behaved matrix for constructing a
% coveriance matrix
disp(['****************************************************'])
```

```
****************************************************
```

```
disp(['Distance between IOAMI and JSD Correlation Matrix is ::', num2str(correlation_di
```

```
Distance between IOAMI and JSD Correlation Matrix is ::0.036056
```

```
disp(['****************************************************'])
```

```
****************************************************
```

```
disp(['condition Number of IOAMI Correlation Matrix is ::', num2str(cond_IOAMI)])
```

```
condition Number of IOAMI Correlation Matrix is ::197.2447
```

```
disp(['condition Number of JSD Correlation Matrix is ::', num2str(cond_JSD)])
```

```
condition Number of JSD Correlation Matrix is ::446.3145
```

```
disp(['****************************************************'])
```

```
****************************************************
```

```
disp(['Frobenius Norm of IOAMI Matrix is ::', num2str(norm_IOAMI)])
```

```
Frobenius Norm of IOAMI Matrix is ::34.2742
```

```
disp(['Frobenius NORM of JSD Matrix is ::', num2str(norm_JSD)])
```

```
Frobenius NORM of JSD Matrix is ::49.5054
```

```
disp(['****************************************************'])
```

```
****************************************************
```

Plot Small Sub-Matrix of IOAMI in the units of Jacobian and Check full IOAMI in the units of the Jacobian is Positive Definite

```
% Empty display to create Gap between Figures and Tables of Matrices
```

```matlab
disp(' ');
```

```matlab
disp(' ');
```

```matlab
disp(' ');
```

```matlab
disp(['Outputting first 5 rows and Columns of IOAMI in Units of ppm/micromoles m-2 sec-
```

Outputting first 5 rows and Columns of IOAMI in Units of ppm/micromoles m-2 sec-1 ::

```matlab
IOAMI_COV(1:5,1:5)
```

```
ans = 5×5
    2.0760    1.2838    0.0838    0.0720    0.3530
    1.2838    1.6608    0.0762    0.0615    0.3931
    0.0838    0.0762    0.0899    0.0632    0.0321
    0.0720    0.0615    0.0632    0.0851    0.0151
    0.3530    0.3931    0.0321    0.0151    0.5208
```

```matlab
% Check if whole IOAMI SubMatrix is Positive Definite by Plotting its Eigen
% Values
close all % close all existing figures
% Note All Eigenvalues should be >=0 which shows that it is Positive
% Definite Matrix
% Empty display to create Gap between Figures and Tables of Matrices
disp(' ');
```

```matlab
disp(' ');
```

```matlab
disp(' ');
```

```matlab
plot(eigen_IOAMI_COV); % line plot of eigen values of IOAMI
ylabel('Eigen Values',"FontSize",14)
xlabel('Eigen Value No',"FontSize",14)
legend({'IOAMI in units of Jacobian'},'Location','northwest',"FontSize",14)
title({'Eigenspectrum of IOAMI', 'in the units of Jacobian'},'FontSize',14)
grid on % show grid on the plot
set(gca,'FontSize',14)
hold off
```

Eigenspectrum of IOAMI in the units of Jacobian
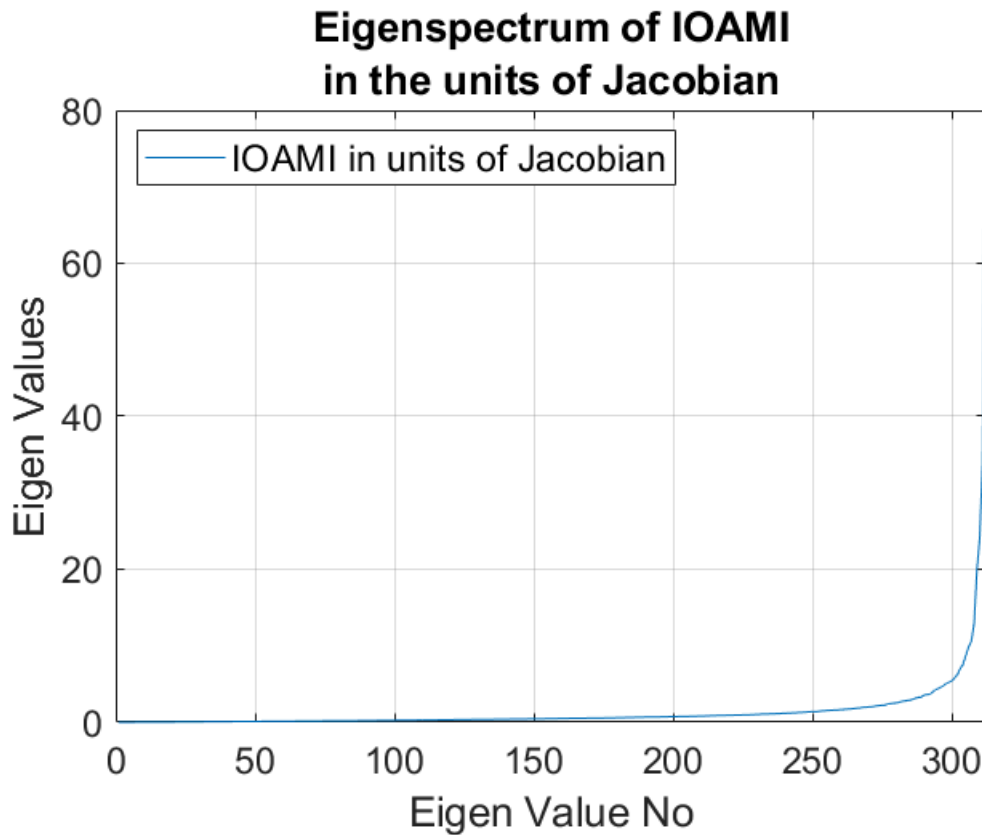
How to contruct covariance from IOAMI & JSD correlation Matrix

Note this is just a hypothetical case of knowing sigma2

Build NonStationary R covariance

```
sigma2=2;
nonParamteric_ioami_covariance=sigma2*IOAMI_COV; % convert correlation to covariance fo
```

Put IOAMI and Jaccard Index Matrix in Cell Array for Checking Time of Observation

```
% Put Area Stat in Cell Array With Tower Names
tempAreaCover=NaN*ones(size(IOAMI_CORR,1)+2, size(IOAMI_CORR,2)+2);
tempAreaCover(3:end,3:end)=IOAMI_CORR;
tempAreaCover=num2cell(tempAreaCover);
for i=1:size(H,1)
    tempAreaCover{i+2,2}=datestr(obsTimePre(i,2),'yyyymmddHHMM');
    tempAreaCover{2,i+2}=datestr(obsTimePre(i,2),'yyyymmddHHMM');
end
tempAreaCover(3:end,1)=obsTowers(:,1);
tempAreaCover(1,3:end)=obsTowers(:,1)';
tempAreaCover{1,1}='TOWERS';
tempAreaCover{2,2}='TIME';
tempAreaCover{1,2}=[];
tempAreaCover{2,1}=[];
% Empty display to create Gap between Figures and Tables of Matrices
```

```
disp(' ');
```

```
disp(' ');
```

```
disp(' ');
```

```
disp('IOAMI CORRELATION MATRIX SEE VARIABLE TEMP AREA COVER')
```

IOAMI CORRELATION MATRIX SEE VARIABLE TEMP AREA COVER

```
disp(tempAreaCover);
```

```
  Columns 1 through 9

    {'TOWERS'  }    {0×0 double    }    {'ONT'         }    {'ONT'         }    {'ONT'         }    {'ONT'
    {0×0 double}    {'TIME'        }    {'201510231900'}    {'201510232000'}    {'201510232100'}    {'2015
    {'ONT'     }    {'201510231900'}    {[          1]}    {[     0.5234]}    {[     0.0403]}    {[
    {'ONT'     }    {'201510232000'}    {[     0.5234]}    {[          1]}    {[     0.0455]}    {[
    {'ONT'     }    {'201510232100'}    {[     0.0403]}    {[     0.0455]}    {[          1]}    {[
    {'ONT'     }    {'201510232200'}    {[     0.0344]}    {[     0.0365]}    {[     0.5647]}    {[
    {'ONT'     }    {'201510232300'}    {[     0.1573]}    {[     0.2198]}    {[     0.0554]}    {[
    {'ONT'     }    {'201510241900'}    {[     0.1949]}    {[     0.1649]}    {[     0.0330]}    {[
    {'ONT'     }    {'201510242000'}    {[     0.2066]}    {[     0.2131]}    {[     0.0450]}    {[
    {'ONT'     }    {'201510242100'}    {[     0.2462]}    {[     0.2475]}    {[     0.0419]}    {[
    {'ONT'     }    {'201510242200'}    {[     0.2486]}    {[     0.3244]}    {[     0.0558]}    {[
    {'ONT'     }    {'201510242300'}    {[     0.2733]}    {[     0.3752]}    {[     0.0361]}    {[
    {'ONT'     }    {'201510251900'}    {[     0.1947]}    {[     0.1108]}    {[     0.0121]}    {[
    {'ONT'     }    {'201510252000'}    {[     0.2460]}    {[     0.1487]}    {[     0.0141]}    {[
    {'ONT'     }    {'201510252100'}    {[     0.2978]}    {[     0.1656]}    {[     0.0127]}    {[
    {'ONT'     }    {'201510252200'}    {[     0.1068]}    {[     0.1073]}    {[     0.0071]}    {[
    {'ONT'     }    {'201510252300'}    {[     0.0712]}    {[     0.0666]}    {[     0.0054]}    {[  3.
    {'ONT'     }    {'201510261900'}    {[     0.2978]}    {[     0.1853]}    {[     0.0171]}    {[
    {'ONT'     }    {'201510262000'}    {[     0.3320]}    {[     0.2113]}    {[     0.0200]}    {[
    {'ONT'     }    {'201510262100'}    {[     0.3998]}    {[     0.2595]}    {[     0.0180]}    {[
    {'ONT'     }    {'201510262200'}    {[     0.2118]}    {[     0.2124]}    {[     0.0186]}    {[
    {'ONT'     }    {'201510262300'}    {[     0.1742]}    {[     0.2145]}    {[     0.0132]}    {[
    {'ONT'     }    {'201510271900'}    {[     0.0884]}    {[     0.0603]}    {[     0.0039]}    {[
    {'ONT'     }    {'201510272000'}    {[     0.1277]}    {[     0.0957]}    {[     0.0059]}    {[
    {'ONT'     }    {'201510272100'}    {[     0.1234]}    {[     0.0862]}    {[     0.0056]}    {[
    {'ONT'     }    {'201510272200'}    {[     0.1131]}    {[     0.0895]}    {[     0.0081]}    {[
    {'ONT'     }    {'201510272300'}    {[     0.0861]}    {[     0.0809]}    {[     0.0044]}    {[  8.
    {'ONT'     }    {'201510281900'}    {[          0]}    {[          0]}    {[          0]}    {[
    {'ONT'     }    {'201510282000'}    {[          0]}    {[          0]}    {[          0]}    {[
    {'ONT'     }    {'201510282100'}    {[          0]}    {[          0]}    {[          0]}    {[
    {'ONT'     }    {'201510282200'}    {[          0]}    {[          0]}    {[          0]}    {[
    {'ONT'     }    {'201510282300'}    {[          0]}    {[          0]}    {[          0]}    {[
    {'ONT'     }    {'201510291900'}    {[          0]}    {[          0]}    {[          0]}    {[
    {'ONT'     }    {'201510292000'}    {[          0]}    {[          0]}    {[          0]}    {[
    {'ONT'     }    {'201510292100'}    {[          0]}    {[          0]}    {[          0]}    {[
    {'ONT'     }    {'201510292200'}    {[          0]}    {[          0]}    {[          0]}    {[
    {'ONT'     }    {'201510292300'}    {[          0]}    {[          0]}    {[          0]}    {[
    {'ONT'     }    {'201510301900'}    {[          0]}    {[          0]}    {[          0]}    {[
    {'ONT'     }    {'201510302000'}    {[          0]}    {[          0]}    {[          0]}    {[
    {'ONT'     }    {'201510302100'}    {[          0]}    {[          0]}    {[          0]}    {[
    {'ONT'     }    {'201510302200'}    {[          0]}    {[          0]}    {[          0]}    {[
    {'ONT'     }    {'201510302300'}    {[          0]}    {[          0]}    {[          0]}    {[
    {'FUL'     }    {'201510231900'}    {[     0.1041]}    {[     0.1621]}    {[     0.0143]}    {[
```

```
{'FUL'    }    {'201510232000'}    {[    0.1074]}    {[    0.1333]}    {[    0.0181]}    {[
{'FUL'    }    {'201510232100'}    {[    0.0746]}    {[    0.0885]}    {[    0.0210]}    {[
{'FUL'    }    {'201510232200'}    {[    0.0281]}    {[    0.0341]}    {[    0.0159]}    {[
{'FUL'    }    {'201510232300'}    {[    0.0306]}    {[    0.0372]}    {[    0.0147]}    {[
{'FUL'    }    {'201510241900'}    {[    0.0643]}    {[    0.0560]}    {[    0.0067]}    {[
{'FUL'    }    {'201510242000'}    {[    0.0559]}    {[    0.0624]}    {[    0.0193]}    {[
{'FUL'    }    {'201510242200'}    {[    0.1306]}    {[    0.1543]}    {[    0.0155]}    {[
{'FUL'    }    {'201510242300'}    {[    0.1405]}    {[    0.1706]}    {[    0.0165]}    {[
{'FUL'    }    {'201510251900'}    {[    0.0061]}    {[    0.0099]}    {[    0.0030]}    {[  1.
{'FUL'    }    {'201510252000'}    {[    0.0062]}    {[    0.0106]}    {[    0.0040]}    {[  1.
{'FUL'    }    {'201510252100'}    {[    0.0027]}    {[    0.0068]}    {[    0.0030]}    {[  5.
{'FUL'    }    {'201510252200'}    {[    0.0031]}    {[    0.0078]}    {[    0.0040]}    {[  3.
{'FUL'    }    {'201510252300'}    {[    0.0045]}    {[    0.0104]}    {[    0.0059]}    {[  3.
{'FUL'    }    {'201510261900'}    {[    0.1538]}    {[    0.1067]}    {[    0.0039]}    {[
{'FUL'    }    {'201510262000'}    {[    0.1760]}    {[    0.1387]}    {[    0.0052]}    {[
{'FUL'    }    {'201510262100'}    {[    0.1515]}    {[    0.1516]}    {[    0.0053]}    {[
{'FUL'    }    {'201510262200'}    {[    0.0915]}    {[    0.1149]}    {[    0.0053]}    {[
{'FUL'    }    {'201510262300'}    {[    0.0459]}    {[    0.0608]}    {[    0.0067]}    {[
{'FUL'    }    {'201510271900'}    {[    0.0345]}    {[    0.0419]}    {[    0.0022]}    {[  1.
{'FUL'    }    {'201510272000'}    {[    0.0385]}    {[    0.0482]}    {[    0.0031]}    {[  3.
{'FUL'    }    {'201510272100'}    {[    0.0165]}    {[    0.0202]}    {[    0.0028]}    {[  6.
{'FUL'    }    {'201510272200'}    {[    0.0012]}    {[    0.0018]}    {[ 8.7271e-04]}    {[
{'FUL'    }    {'201510272300'}    {[    0.0026]}    {[    0.0037]}    {[    0.0014]}    {[
{'FUL'    }    {'201510281900'}    {[         0]}    {[         0]}    {[         0]}    {[
{'FUL'    }    {'201510282000'}    {[         0]}    {[         0]}    {[         0]}    {[
{'FUL'    }    {'201510282100'}    {[         0]}    {[         0]}    {[         0]}    {[
{'FUL'    }    {'201510282200'}    {[         0]}    {[         0]}    {[         0]}    {[
{'FUL'    }    {'201510282300'}    {[         0]}    {[         0]}    {[         0]}    {[
{'FUL'    }    {'201510291900'}    {[         0]}    {[         0]}    {[         0]}    {[
{'FUL'    }    {'201510292000'}    {[         0]}    {[         0]}    {[         0]}    {[
{'FUL'    }    {'201510292100'}    {[         0]}    {[         0]}    {[         0]}    {[
{'FUL'    }    {'201510292200'}    {[         0]}    {[         0]}    {[         0]}    {[
{'FUL'    }    {'201510292300'}    {[         0]}    {[         0]}    {[         0]}    {[
{'FUL'    }    {'201510301900'}    {[         0]}    {[         0]}    {[         0]}    {[
{'FUL'    }    {'201510302000'}    {[         0]}    {[         0]}    {[         0]}    {[
{'FUL'    }    {'201510302200'}    {[         0]}    {[         0]}    {[         0]}    {[
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{'BND'　　}	{'201510262000'}	{[　　0.2133]}	{[　　0.1618]}	{[　　0.0395]}	{[
{'BND'　　}	{'201510262100'}	{[　　0.2531]}	{[　　0.1625]}	{[　　0.0209]}	{[
{'BND'　　}	{'201510262200'}	{[　　0.2804]}	{[　　0.1989]}	{[　　0.0201]}	{[
{'BND'　　}	{'201510262300'}	{[　　0.2962]}	{[　　0.2331]}	{[　　0.0204]}	{[
{'BND'　　}	{'201510271900'}	{[　　0.0517]}	{[　　0.0449]}	{[　　0.0030]}	{[　4.
{'BND'　　}	{'201510272000'}	{[　　0.0392]}	{[　　0.0412]}	{[　　0.0034]}	{[　5.
{'BND'　　}	{'201510272100'}	{[　　0.0398]}	{[　　0.0471]}	{[　　0.0058]}	{[　9.
{'BND'　　}	{'201510272200'}	{[　　0.0629]}	{[　　0.0448]}	{[　　0.0040]}	{[　2.
{'BND'　　}	{'201510272300'}	{[　　0.0387]}	{[　　0.0422]}	{[　　0.0055]}	{[　2.
{'BND'　　}	{'201510281900'}	{[　　　　0]}	{[　　　　0]}	{[　　　　0]}	{[
{'BND'　　}	{'201510282000'}	{[　　　　0]}	{[　　　　0]}	{[　　　　0]}	{[

```
{'BND'      }    {'201510282100'}    {[         0]}    {[         0]}    {[         0]}    {[
{'BND'      }    {'201510282200'}    {[         0]}    {[         0]}    {[         0]}    {[
{'BND'      }    {'201510282300'}    {[         0]}    {[         0]}    {[         0]}    {[
{'BND'      }    {'201510291900'}    {[         0]}    {[         0]}    {[         0]}    {[
{'BND'      }    {'201510292000'}    {[         0]}    {[         0]}    {[         0]}    {[
{'BND'      }    {'201510292100'}    {[         0]}    {[         0]}    {[         0]}    {[
{'BND'      }    {'201510292200'}    {[         0]}    {[         0]}    {[         0]}    {[
{'BND'      }    {'201510301900'}    {[         0]}    {[         0]}    {[         0]}    {[
{'BND'      }    {'201510302000'}    {[         0]}    {[         0]}    {[         0]}    {[
{'BND'      }    {'201510302100'}    {[         0]}    {[         0]}    {[         0]}    {[
{'BND'      }    {'201510302200'}    {[         0]}    {[         0]}    {[         0]}    {[

  Columns 10 through 18

    {'ONT'          }    {'ONT'          }    {'ONT'          }    {'ONT'          }    {'ONT'          }    {'
    {'201510242100'}    {'201510242200'}    {'201510242300'}    {'201510251900'}    {'201510252000'}    {'
    {[      0.2462]}    {[      0.2486]}    {[      0.2733]}    {[      0.1947]}    {[      0.2460]}    {[
    {[      0.2475]}    {[      0.3244]}    {[      0.3752]}    {[      0.1108]}    {[      0.1487]}    {[
    {[      0.0419]}    {[      0.0558]}    {[      0.0361]}    {[      0.0121]}    {[      0.0141]}    {[
    {[      0.0212]}    {[      0.0330]}    {[      0.0196]}    {[      0.0076]}    {[      0.0086]}    {[
    {[      0.2034]}    {[      0.4247]}    {[      0.3691]}    {[      0.0480]}    {[      0.0548]}    {[
    {[      0.3773]}    {[      0.2513]}    {[      0.2480]}    {[      0.1534]}    {[      0.1772]}    {[
    {[      0.6805]}    {[      0.4025]}    {[      0.3824]}    {[      0.1227]}    {[      0.1421]}    {[
    {[         1]}    {[      0.4583]}    {[      0.4740]}    {[      0.1285]}    {[      0.1485]}    {[
    {[      0.4583]}    {[         1]}    {[      0.5826]}    {[      0.0822]}    {[      0.0988]}    {[
    {[      0.4740]}    {[      0.5826]}    {[         1]}    {[      0.0978]}    {[      0.1112]}    {[
    {[      0.1285]}    {[      0.0822]}    {[      0.0978]}    {[         1]}    {[      0.6506]}    {[
    {[      0.1485]}    {[      0.0988]}    {[      0.1112]}    {[      0.6506]}    {[         1]}    {[
    {[      0.2269]}    {[      0.1405]}    {[      0.1729]}    {[      0.3877]}    {[      0.5530]}    {[
    {[      0.0917]}    {[      0.0755]}    {[      0.0861]}    {[      0.0719]}    {[      0.0983]}    {[
    {[      0.0630]}    {[      0.0358]}    {[      0.0488]}    {[      0.0462]}    {[      0.0574]}    {[
    {[      0.1778]}    {[      0.1394]}    {[      0.1520]}    {[      0.4628]}    {[      0.5010]}    {[
    {[      0.2916]}    {[      0.2084]}    {[      0.2320]}    {[      0.2663]}    {[      0.3312]}    {[
    {[      0.3125]}    {[      0.2149]}    {[      0.2799]}    {[      0.2187]}    {[      0.2665]}    {[
    {[      0.2991]}    {[      0.2644]}    {[      0.3328]}    {[      0.1099]}    {[      0.1279]}    {[
    {[      0.2249]}    {[      0.2368]}    {[      0.3132]}    {[      0.0844]}    {[      0.0936]}    {[
    {[      0.0668]}    {[      0.0573]}    {[      0.0705]}    {[      0.1449]}    {[      0.1442]}    {[
    {[      0.1015]}    {[      0.0923]}    {[      0.1150]}    {[      0.1188]}    {[      0.1350]}    {[
    {[      0.0962]}    {[    ...
```

Plot footprint Ioami and JSD correlation of observation from ONT site colleceted 2015-10-23::1900 with all other observations

See varable tempAreaCover for observation time with IOAMI correlation matrix

Observation time is same for both JSD and IOAMI correlation matrix

```
close all % close all existing figures
% Note All correlation is between 0 and 1
% Note Correlation with Itself is one;
% Empty display to create Gap between Figures
disp(' ');
```

```
disp(' ');
```

```
disp(' ');
```

```
plot(IOAMI_CORR(1:end,1)); % line plot of IOAMI correlation of ONT obs with all other o
hold on % hold to plot another line
plot (JSD(1:end,1)); % line plot of IOAMI correlation of ONT obs with all other obs
% Labels and Title for Plots
ylim([0 1])
ylabel('Correlation',"FontSize",14)
xlabel({'Observation (see first column of','variable tempAreaCover for time and towers'
legend({'IOAMI','JSD'},'Location','northwest',"FontSize",14)
title({'Correlation between footprint of an ONT Observation',' (2015-10-23::1900) with
grid on % show grid on the plot
set(gca,'FontSize',14)
hold off
```

Correlation between footprint of an ONT Observation (2015-10-23::1900) with other footprints

Observation (see first column of
variable tempAreaCover for time and towers
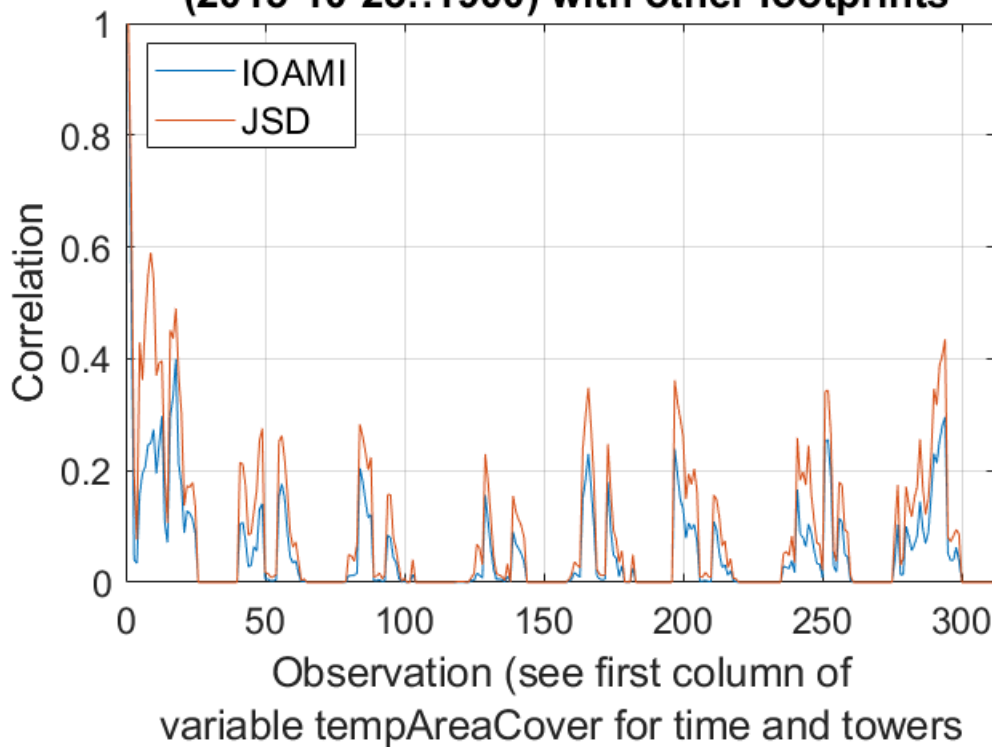
COMPUTE SPATIO-TEMPORAL AREA OF DOMINANCE (STAD)

```
% STAD: We WILL APPLY STAD ON MEAN SENSTIVITY DUE TO TOTAL NO OF
% OBSERVATIONS THAT VARIES BY SITE
% Compute Mean Senstivity
obsTowers(obsTime(:,2)==1)={'ONT'}; % Ontario
obsTowers(obsTime(:,2)==2)={'FUL'}; % Fullerton
obsTowers(obsTime(:,2)==3)={'CMP'}; % Compton
obsTowers(obsTime(:,2)==4)={'GRA'}; % Granada Hills
obsTowers(obsTime(:,2)==5)={'USC'}; % University of Souther California
obsTowers(obsTime(:,2)==6)={'UCI'}; % University of California Irvine
```

```matlab
obsTowers(obsTime(:,2)==7)={'PSA'}; % Pasadena
obsTowers(obsTime(:,2)==8)={'BND'}; % San Bernardino
% Mean H Column Wise
H_Mean_Senstivity=[mean(H_ONT)' mean(H_FUL)' mean(H_CMP)' mean(H_GRA)' mean(H_USC)' ...
    mean(H_UCI)' mean(H_PSA)' mean(H_BND)'];
% we have two time period for which we are computing fluxes therefore we
% sum senstivities to get it for one time-period that would cover a 4-day
% overlapping time period
H_Mean_Senstivity=full(H_Mean_Senstivity(1:fluxD,:)+H_Mean_Senstivity(fluxD+1:end,:));
% Find Gridcells of Dominance
loopLimit=size(H_Mean_Senstivity,2);
storeDominanceIndex=NaN*ones(fluxD,1);
maxH=full(max(H_Mean_Senstivity,[],2));
for i=1:loopLimit
    zeroH=maxH-H_Mean_Senstivity(:,i);
    iR=find(zeroH==0);
    storeDominanceIndex(iR,1)=i;
end
```
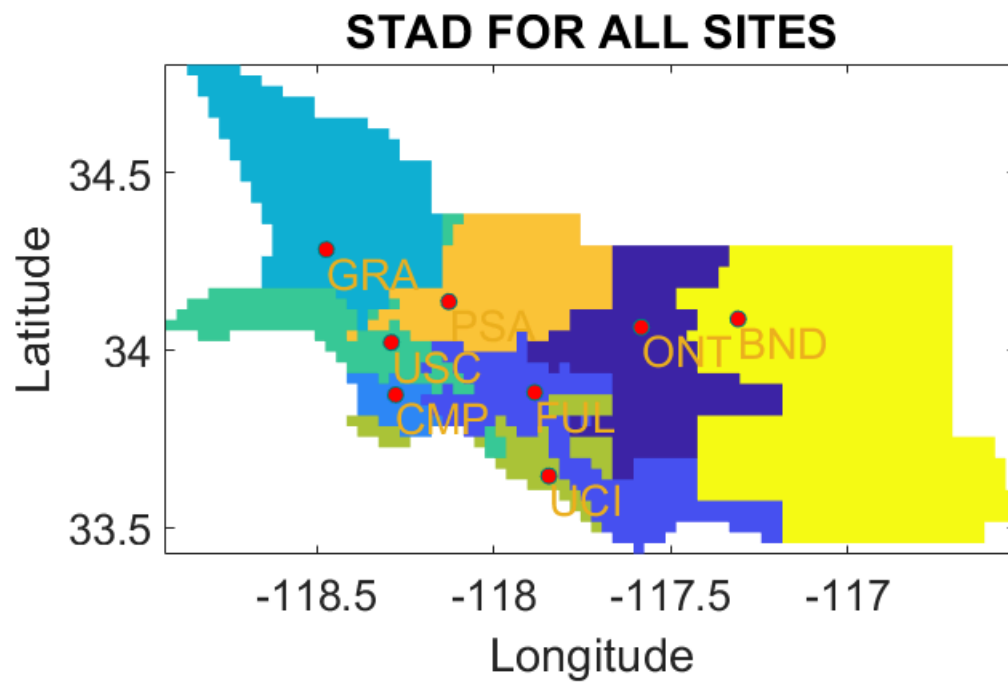
PLOT STAD

```matlab
% This is our plotting grid
mapgrid=ones(size(gridlat1,1),size(gridlon1,2))*NaN;
for i = 1: fluxD
    mapgrid(index(i,1),index(i,2))=storeDominanceIndex(i);
end
titles ='STAD FOR ALL SITES';
h=pcolor(gridlon1,gridlat1,mapgrid);
set(h, 'EdgeColor', 'none');
shading flat; % do not interpolate pixels
axis on;      % display axis
axis tight;   % no white borders
axis image;   % real x,y scaling
set(gca,'fontsize',16)
ylabel('Latitude')
xlabel('Longitude')
title(titles,'FontSize', 16,'Fontname','Arial')
hold on
plot(towerCoord(:,2), towerCoord(:,1),'o','MarkerEdgeColor',[0 .5 .5],...
    'MarkerFaceColor','red' );
text(towerCoord(:,2),towerCoord(:,1),towerNames,'VerticalAlignment',...
    'top','FontSize', 16,'Fontname','Arial','Color','#EDB120')
hold off
```

STAD FOR ALL SITES

GRA
PSA
USC
CMP FUL
ONT BND
UCI

Latitude

34.5

34

33.5

-118.5 -118 -117.5 -117

Longitude

```
% clear grid* IOAMI* index i j JSD* eig* correlatio* dataPath* normalized* mapgrid norm
%     H_Mean_Senstivity latlon loopLimit titles store* temp* time* no h max* unique* ze
%     noTowers row X obs* tower*
```