```
A = importdata('mariana_depth.csv');
lon = importdata('mariana_longitude.csv');
lat = importdata('mariana_latitude.csv');



%2.2.2
wantedEigenSize = 10;
fprintf('OUTPUT: \n');
numOfEignens =
 [1,10,50,100,500];%[1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,22,24,26,28,30,32,
compressedRatings=zeros(1,size(numOfEignens,2));
accurateRatings=zeros(1,size(numOfEignens,2));
temp=zeros(1,size(numOfEignens,2));
for i = 1:size(numOfEignens,2)
    [accurateRating,compressedRating] = main(numOfEignens(i),A,lat,lon);
    fprintf('For ISVD With %i Columns: compression rating %f , accuracy rating
 %f (lower is better)\n',numOfEignens(i),compressedRating,accurateRating);
    compressedRatings(1,i)=compressedRating;
    accurateRatings(1,i)=accurateRating;
end

%figure(100000);
%plot(numOfEignens,compressedRatings,'red');
%title(sprintf('Compression Rating for Different Number of Columns'));
%xlabel('Number of Columns','FontSize',16);
%ylabel('Compression Rating at the Given Number of Columns','FontSize',16);

%figure(100001);
%plot(numOfEignens,accurateRatings,'blue');
%title(sprintf('Accuracy Rating for Different Number of Columns'));
%xlabel('Number of Columns','FontSize',16);
%ylabel('Accuracy Rating at the Given Number of Columns','FontSize',16);

function [accurateRating,compressedRating] = main(wantedEigenSize,A,lat,lon)
    A_t=transpose(A);
    B= A_t*A;

    [V,eigenValues]= betterEigen(B,wantedEigenSize);

    if(wantedEigenSize==50)
        figure(2);
        semilogy(1:wantedEigenSize,eigenValues,'blue');%plot of
        title(sprintf('Semilog Plot Of Eigenvalues From ISVD With %i
 Columns',wantedEigenSize));
        xlabel('Column','FontSize',16);
        ylabel('Eigenvalue at the Given Column','FontSize',16);
    end
    %2.3.1
    sigma = zeros(wantedEigenSize,wantedEigenSize);
    U = zeros(size(A,1),wantedEigenSize);
```

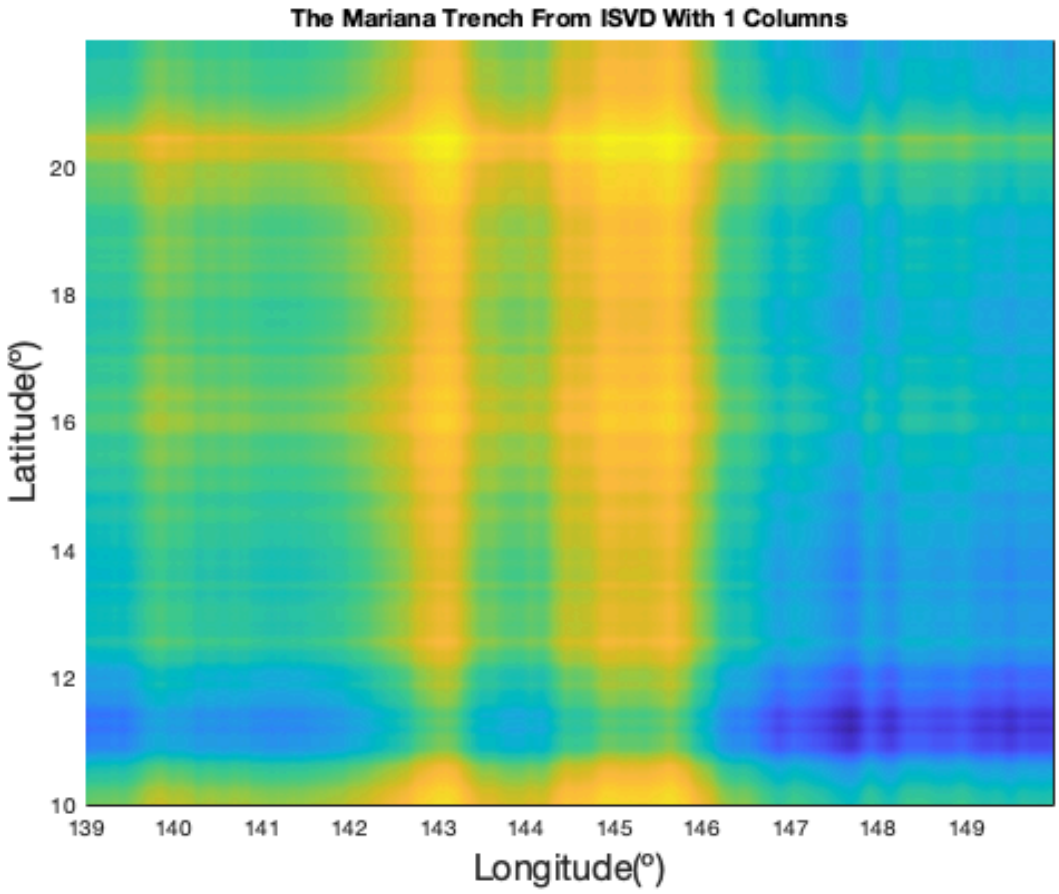
```
    for i = 1:wantedEigenSize
        sigma(i,i)=sqrt(eigenValues(1,i));
        U(:,i) = ( A*V(:,i) ) / sigma(i,i) ;
    end

    %2.3.3
    figure(wantedEigenSize)
    compressedA = U*sigma*transpose(V);
    %grid = meshgrid(lat,lon); %assist 3d plot
    %mesh(lon,lat,compressedA',compressedA'); %3d plot
    s = pcolor(lon,lat,compressedA');%2d plot
    set(s, 'EdgeColor', 'none');%assist 2d plot
    xlabel('Longitude(°)','FontSize',16);
    ylabel('Latitude(°)','FontSize',16);
    zlabel('Depth(m)','FontSize',16);
    title(sprintf('The Mariana Trench From ISVD With %i
 Columns',wantedEigenSize));
    accurateRating = accuracyRating(A,compressedA);
    compressedRating = compressionRating(A, wantedEigenSize);

    %fprintf('compression rating : %f (lower is better), for an eigenspace of
 dimension: %i \n',accuracyRating(A,compressedA), wantedEigenSize);
    count=0; %used to count the number of points below 6km
    currentTotal=0; %used to keep tract of the sum of the depths below 6km
    for i = 1:size(compressedA,1)
       for j = 1:size(compressedA,2)
          if(compressedA(i,j)<-6000) %if the point is deeper than 6km, then
 update our variables that keep track
             count = count+1;
             currentTotal = currentTotal+compressedA(i,j);
          end
       end
    end
    averageDepthUnder6km = currentTotal/count; %arithmetic mean
    fprintf('Average Depth of the Trench For ISVD With %i Columns : %f (km)
 \n',wantedEigenSize,averageDepthUnder6km/1000);%Average Depth of the trench:
 -7204.636665

end

function total = compressionRating(A, numEigens)
    numInA = size(A,1)*size(A,2);
    total= (numEigens*(size(A,1)+numEigens+size(A,2)) )/numInA;
end

function total = accuracyRating(A,compressedA)
    total=0;
    for i = 1:size(A,1)
       for j = 1:size(A,2)
          total = total+ abs( A(i,j)-compressedA(i,j) );
       end
    end
    total=total/100000000;
end
```

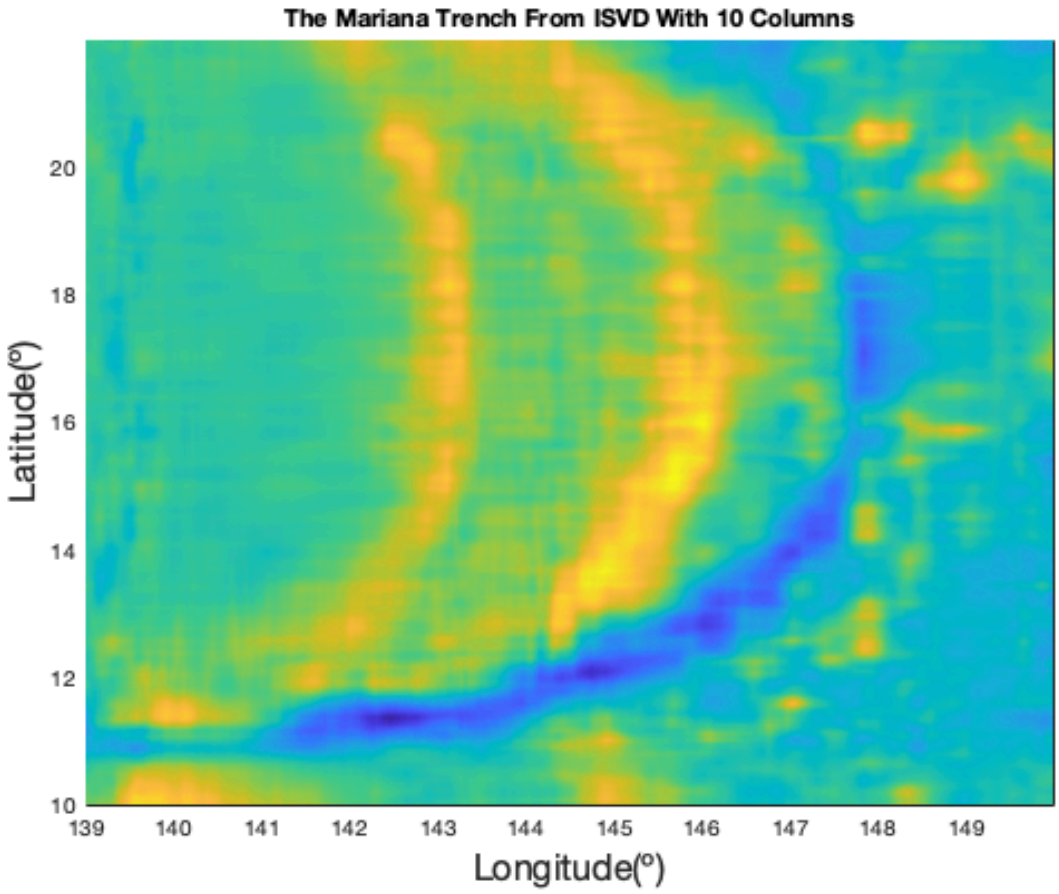
```
function [matrixOfVectors,matrixOfValues] = betterEigen(matrix,numOfEigens)
    %this method uses the second given algorithm to find the first
    %[numOfEigens] amt of eigenvectors adn their associated values.
    matrixOfVectors = zeros(sizeColVect(matrix),numOfEigens);
    matrixOfValues = zeros(1,numOfEigens); %row vectors
    for i = 1:numOfEigens
        u = randomUnitColVector2(sizeColVect(matrix)); %i


        u1star = matrix*u;%ii

        summationResult=0;
        for j = 1:(i-1)
            summationResult=summationResult
+(transpose(u1star)*matrixOfVectors(:,j))*matrixOfVectors(:,j);
        end

        u1=u1star-summationResult;%iii
        u1=unitVect(u1);%iv

        whileCount = 0;
        smallNumber = 1e-3;
        while(mag(u1-u)>smallNumber)
            whileCount=whileCount+1;
            u=u1;
            u1star = matrix*u;%ii

            summationResult=0;
            for j = 1:(i-1)
                summationResult=summationResult
+(transpose(u1star)*matrixOfVectors(:,j))*matrixOfVectors(:,j);
            end

            u1=u1star-summationResult;%iii
            u1=unitVect(u1);%iv
        end
        matrixOfVectors(:,i)=u1;

        %process of getting associated eigenvalue
        scaledV1 = matrix*u1;
        matrixOfValues(1,i) = scaledV1(1,1)/u1(1,1);


        %fprintf('whileCounter: %i \n',whileCount);%

    end
end

function sizeVect = sizeColVect(colVect)
    b=size(colVect);
    sizeVect=b(1);
end
```

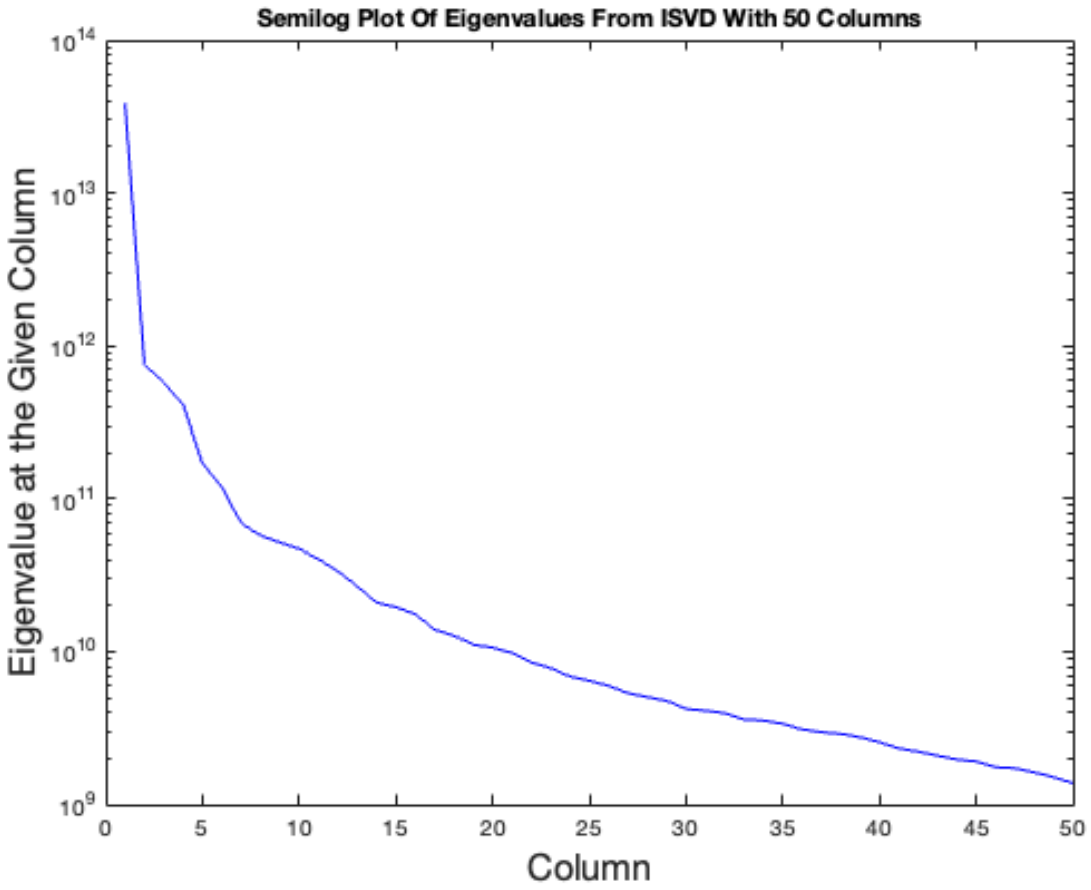
```
function vect = randomUnitColVector1(size,randomUpperBound)
    vect = zeros(size,1);
    for k = 1:size
          vect(k,1)=randi(randomUpperBound,1);%first num in randi is random
 int generator
    end
    vect=unitVect(vect);
end

function vect = randomUnitColVector2(size)
    vect=randomUnitColVector1(size,10);
end

function unitVector = unitVect(array)
    unitVector = array/mag(array);
end

function magnitude = mag(array)
    magnitude = 0;
    for k = 1:sizeColVect(array)
      magnitude=magnitude+(array(k,1))^2;
    end
    magnitude= sqrt(magnitude);
end
```

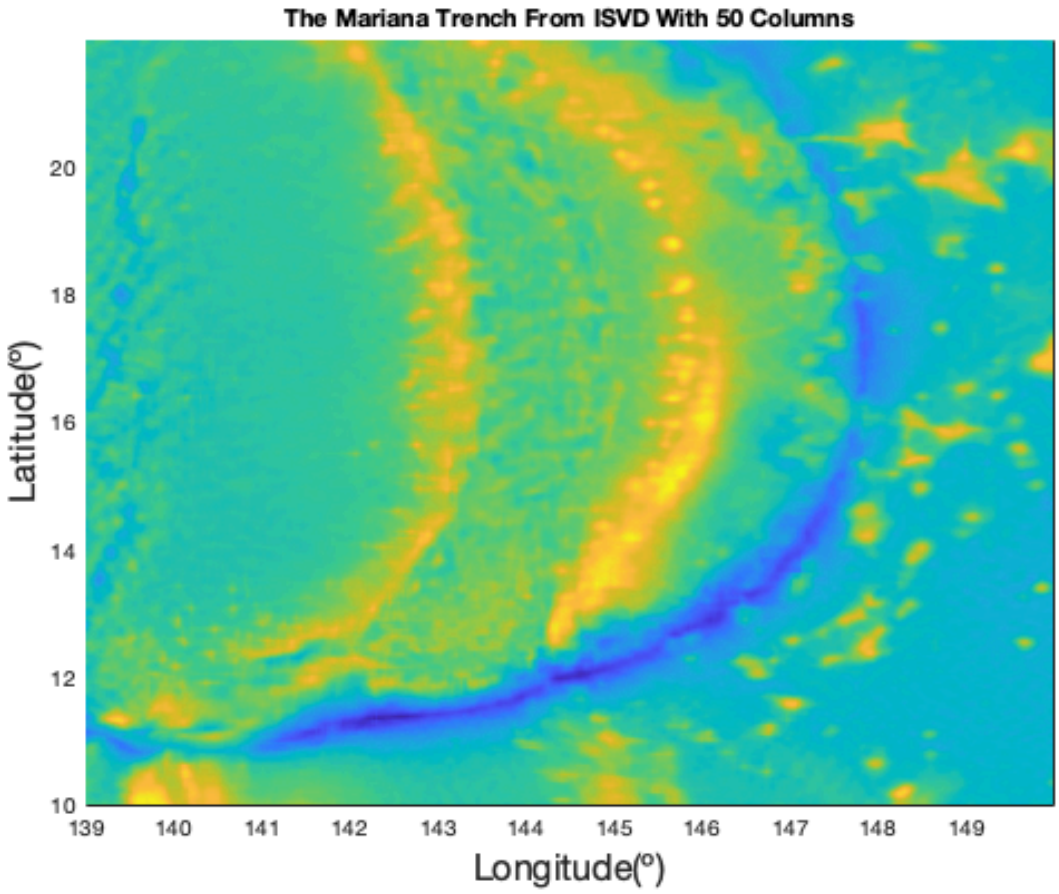
OUTPUT:

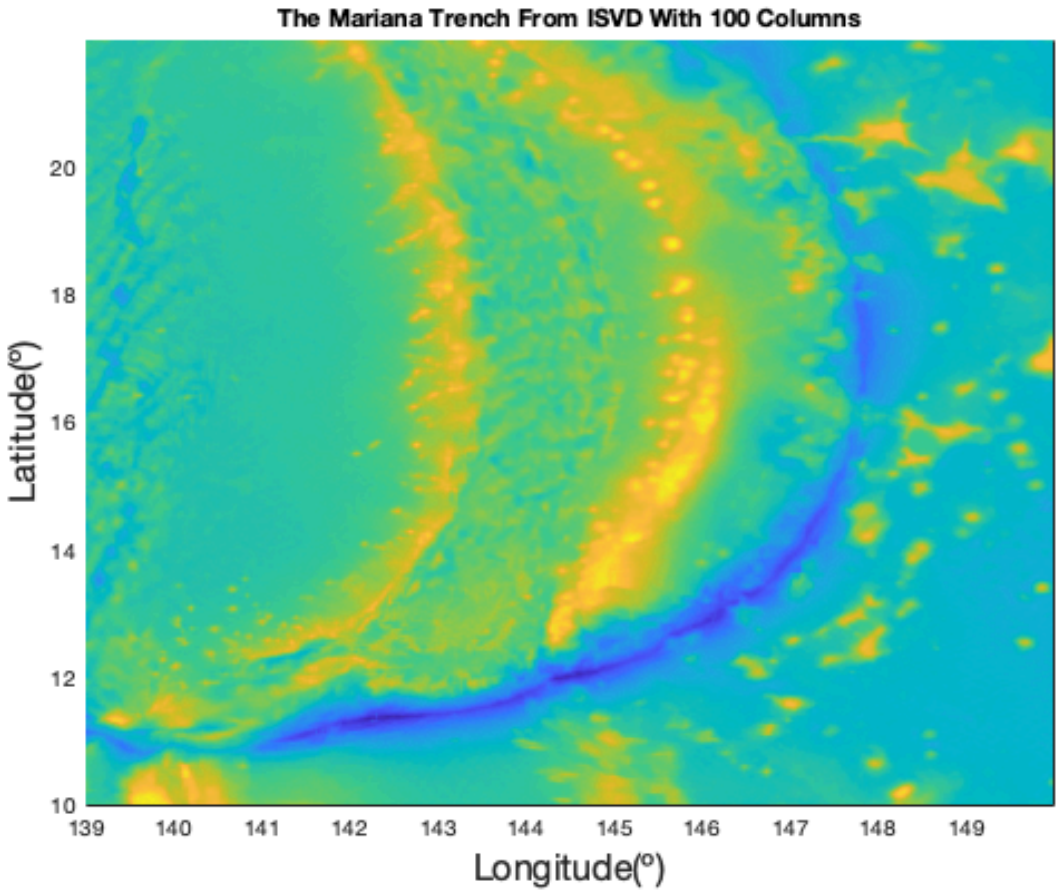
```
Average Depth of the Trench For ISVD With 1 Columns : -6.353018 (km)
For ISVD With 1 Columns: compression rating 0.001453 , accuracy rating
 15.437696 (lower is better)
Average Depth of the Trench For ISVD With 10 Columns : -7.049058 (km)
For ISVD With 10 Columns: compression rating 0.014573 , accuracy rating
 5.946921 (lower is better)
Average Depth of the Trench For ISVD With 50 Columns : -7.174004 (km)
For ISVD With 50 Columns: compression rating 0.073916 , accuracy rating
 1.869204 (lower is better)
Average Depth of the Trench For ISVD With 100 Columns : -7.196723 (km)
For ISVD With 100 Columns: compression rating 0.150463 , accuracy rating
 0.837677 (lower is better)
Average Depth of the Trench For ISVD With 500 Columns : -7.203576 (km)
For ISVD With 500 Columns: compression rating 0.857534 , accuracy rating
 0.134673 (lower is better)
```

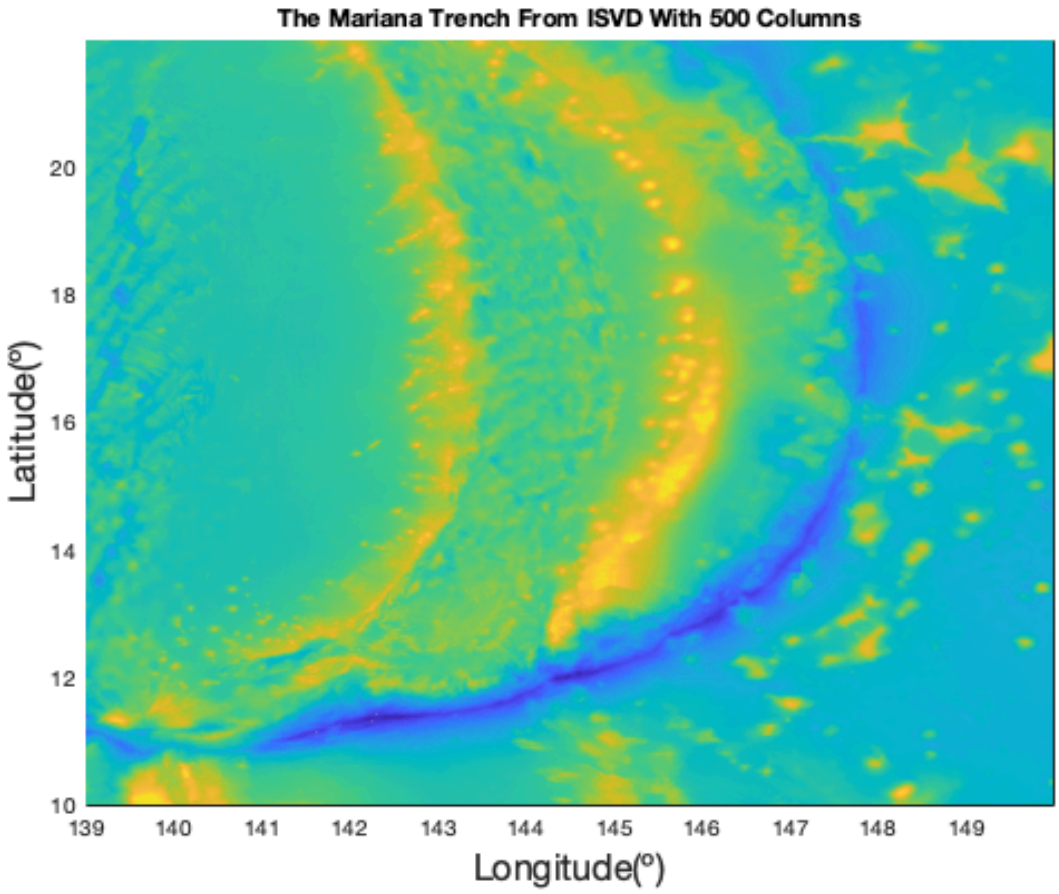

The Mariana Trench From ISVD With 1 Columns
Latitude(°)
20
18
16
14
12
10
139
140
141
142
143
144
145
146
147
148
149
Longitude(°)


The Mariana Trench From ISVD With 10 Columns
Latitude(°)
20
18
16
14
12
10
139
140
141
142
143
144
145
146
147
148
149
Longitude(°)


Semilog Plot Of Eigenvalues From ISVD With 50 Columns
Eigenvalue at the Given Column
Column
10^{14}
10^{13}
10^{12}
10^{11}
10^{10}
10^{9}
0
5
10
15
20
25
30
35
40
45
50


The Mariana Trench From ISVD With 50 Columns
Latitude(°)
20
18
16
14
12
10
139
140
141
142
143
144
145
146
147
148
149
Longitude(°)


The Mariana Trench From ISVD With 100 Columns
Latitude(°)
20
18
16
14
12
10
139
140
141
142
143
144
145
146
147
148
149
Longitude(°)



Published with MATLAB® R2021b