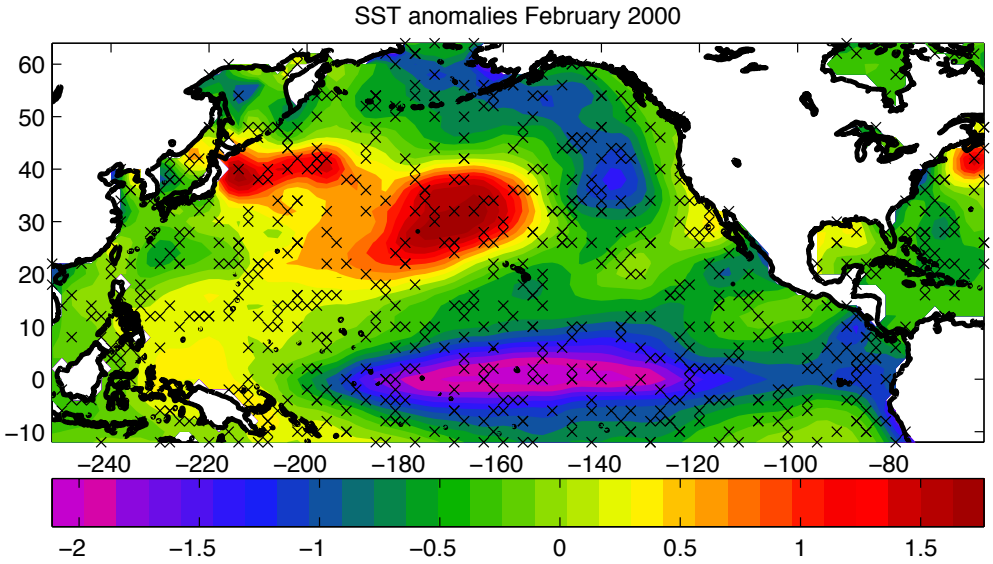
ADVANCED ENVIRONMENTAL DATA ANALYSIS
HOMEWORK #5

1) Objective Mapping/Krigging (e.g. Mapping Sea Surface Temperature data)

You are given a set of sea surface temperature anomalies (SSTa) observations over the North Pacific during the month of February 2000 at the locations of the black x (figure below). You are asked to objectively interpolate this data on a regular grid shown in the map below. At the end of the objective mapping procedure you should be able to recover the SSTa pattern below.



(a) Use this set of observations to estimate the spatial de-correlation length-scale in the data (make a plot).

(b) Use the de-correlation length-scale information to build a Gaussian spatial statistics covariance model to use in the your objective mapping of the SSTa.

(c) Compute the non-dimensional error map and discuss how the error map changes if you increase of decrease the de-correlation length-scale in your spatial statistics.

The data is in the MATLAB file: `SST_NP.mat`. In this file you will find two structure arrays containing the vector of the observations and their locations (`obs25`) and the coordinates (lon/lat) of the grid where you need to map the data (`grd`).

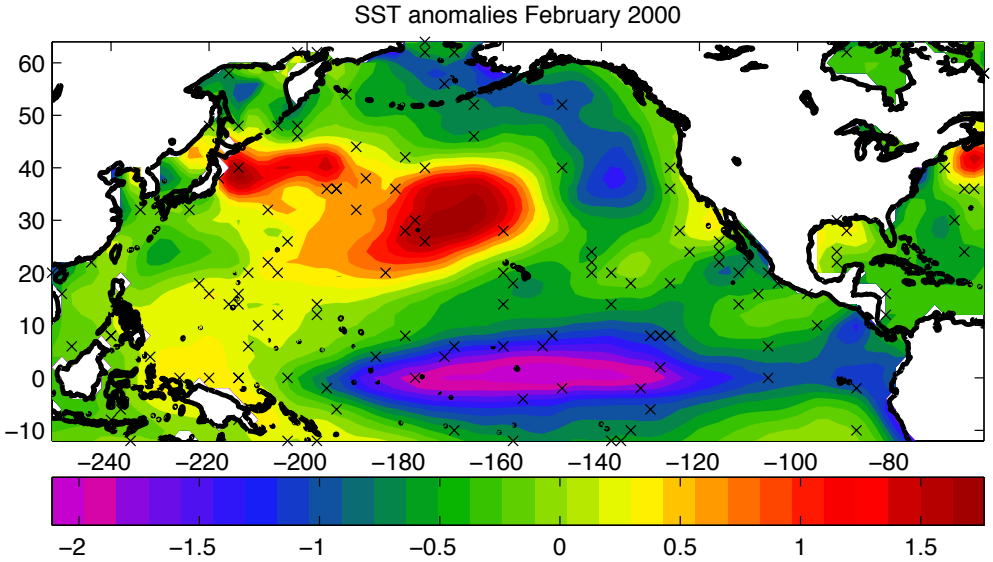
2) Empirical Orthogonal Functions (EOFs)

The data you loaded in the previous exercise contains also the SSTa space/time dependent anomalies from 1950-1999 in the structure array `grd`.

(a) Compute the first two empirical orthogonal functions and plot their spatial and temporal patterns. Please use the lon/lat information when plotting the spatial maps and the year/month information when plotting the timeseries of the modes.
(b) Make a plot of the eigenvalue spectra of the modes normalized so that the y-axis contains the amount of explained variance.

3) Mapping data using EOFs

Now suppose that you had a reduced set of observations contained in the structure array `obs5` (see map below) along with the EOF information you have computed in the previous exercise.



(a) Map the data using the objective mapping procedure you developed as in exercise #1. Can you recover the SSTa pattern? Show and discuss the error map.
(b) Now use the EOFs from exercise #2 to map the data and compute the error map. Are you able to recover this pattern? (NOTE: the EOFs are derived from the spatial covariance of the SSTa so they contain the full spatial statistics information you need for the objective mapping.)
(c) Discuss and show how you derived the EOF mapping model. Did you use all the EOF modes or only a subset?