

Lab 8

Non-Linear Fitting Review and Animated Visualization

Marine Modelling March 4, 2019

Non-Linear Fitting
Review and
Animated
Visualization

Katja Fennel



Outline

Non-Linear Least
Squares Regression

MODIS Surface
Chlorophyll Data

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We will work through two examples:

- Review non-linear fitting
- Plot surface chlorophyll measured by satellite over time and create an animation

Non-Linear Least Squares Regression



Same approach, but needs to be solved iteratively, i.e. search coefficient space by repeatedly calculating χ^2 .

There are many different techniques of searching for the minimum:

- Grid search
- Gradient descent/search
- Expansion methods

See, for example, Bevington and Robinson, Chapter 8.

Steepest Descent Gradient Search

This is vaguely analogous to rolling a marble on the χ^2 surface: it will roll down hill until it reaches the lowest point. Sometimes it will oscillate around the minimum.

Mathematical routines typically required:

- an initial guess of the coefficient values
- how small of a $\Delta\chi^2$ you consider convergence
- the name of an m-file that codes your model
- sometimes the maximum number of iterations
- sometimes the name of an m-file that calculates the model gradient

Note: It's always good to have a "good first guess".

Cautionary note: Be aware of local minima.



MODIS Surface Chlorophyll Data

Data: Ocean colour satellite (MODIS) 8-day composite

Objective: Plot pseudocolour of image and coastline over 1-year of data, and use to create an animation



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```
% load chlorophyll data, resolved in lon/lat/time  
load chl_mm2018
```

MODIS Surface Chlorophyll Data



```
% loop through third index - time dimension
for i=1:size(CHL,3)
    pcolor(LON,LAT,log10(CHL(:, :, i)))
    shading interp, caxis([log10(0.1),log10(20)])
    % function that plots new england coastline
    plotnewengland
```

MODIS Surface Chlorophyll Data



```
% loop through third index - time dimension
for i=1:size(CHL,3)
% plot chlorophyll on a log colorscale
  pcolor(LON,LAT,log10(CHL(:, :, i)))
  shading interp, caxis([log10(0.1),log10(20)])
% function that plots new england coastline
  plotnewengland
% set colormap to nice cmocean green map
  colormap(cmocean('algae',21))
  cb = colorbar; % create colorbar
```


MODIS Surface Chlorophyll Data

```
% loop through third index - time dimension
for i=1:size(CHL,3)
% plot chlorophyll on a log colorscale
    pcolor(LON,LAT,log10(CHL(:,:,i)))
    shading interp, caxis([log10(0.1),log10(20)])
% function that plots new england coastline
plotnewengland
% set colormap to nice cmocean green map
colormap(cmocean('algae',21))
cb = colorbar; % create colorbar
% set ticks and tick labels for logscale
set(cb,'ticks',[log10(0.1),log10(0.2),...
log10(0.5),log10(1),log10(2),log10(5),...
log10(10),log10(20)])
set(cb,'ticklabels',{'0.1','0.2','0.5',...
'1','2','5','10','20'})
title([sprintf('Chl (mg/m3)\n'),...
datestr(doy2date(JDAY(i),2012))])
```



MODIS Surface Chlorophyll Data

```
for i=1:size(CHL,3)
% plot chlorophyll on a log colorscale
  pcolor(LON,LAT,log10(CHL(:, :, i)))
  shading interp, caxis([log10(0.1),log10(20)])
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log10(10),log10(20)])
  set(cb,'ticklabels',{'0.1','0.2','0.5',...
'1','2','5','10','20'})
  title([sprintf('Chl (mg/m3)\n'),...
datestr(doy2date(JDAY(i),2012))])
% pause for animation effect
  pause(0.2)
end
```



MODIS Surface Chlorophyll Data

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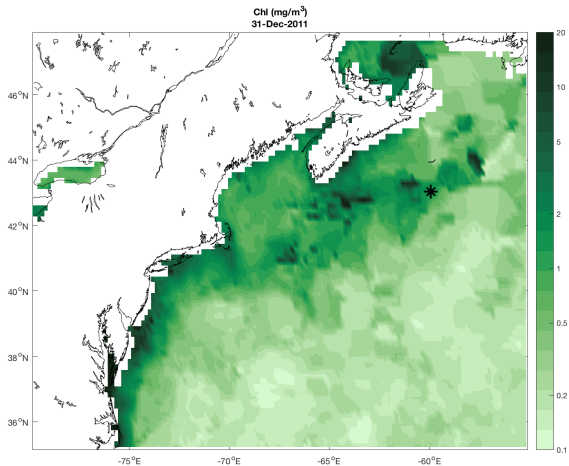
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Non-Linear Least
Squares Regression

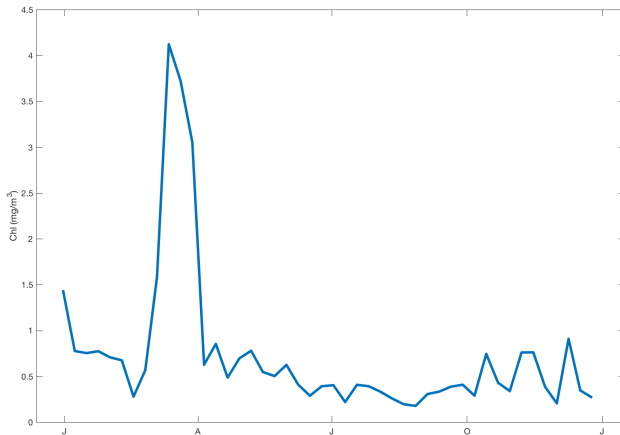
MODIS Surface
Chlorophyll Data



MODIS Surface Chlorophyll Data



Timeseries shows spring bloom in North Atlantic



Creating videos/animations with MatLab



Open the script: `images2video.m`

It can create a video from the files provided in a defined directory.

Explain the code ...