Seasonal variations in satellite data and charting changes over time

## 1. Introduction

Apart from observations taken by buoys in set locations, satellite data is the most suitable means of gathering time series data, such as sea surface temperature, about specific points of the ocean. Here we will examine how to make a chart using Excel to depict the seasonal and interannual changes for sea surface temperature and chlorophyll images using MODIS data, which is capable of taking multiple daily measurements. These instructions assume the user has a basic working knowledge of Excel as well as how to input data into Excel spreadsheets.

## 2. Processing flow

The process for creating a time series chart using Excel is depicted in Figure 1. Below the processing steps are covered in greater detail.

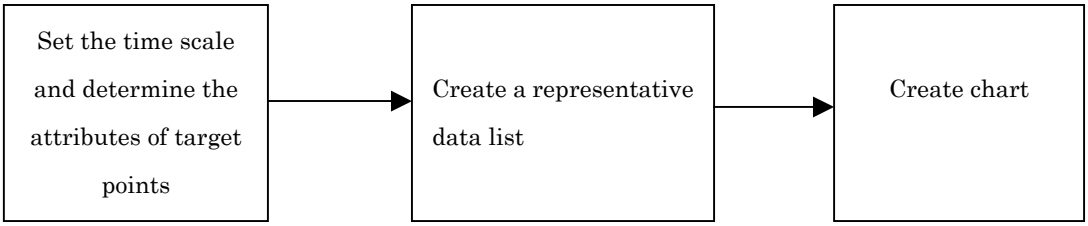



Figure 1. Data processing flow through creating a time series chart.

### (1) Determine the characteristics and time scale for sampling points

For the purpose of demonstrating how to make a time series chart, here we will make a chart based on the 2001 to 2003 chlorophyll a concentration data for the area around Sta.6 in central Toyama Bay as indicated in Figure 2.

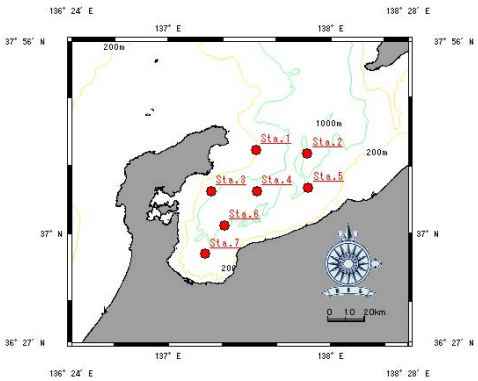



Figure 2. Observation points.

In general, the weather along the Japan Sea is often cloudy during the year, and the number of days of data which can be taken without a negative impact from cloud cover is relatively few compared to the area of Japan facing the Pacific Ocean. As indicated in Figure 3, satellite data for the points around Sta.6 are few, with an average of only five days per month, except for during autumn. In cases like this where the number of usable data days are few or limited, there are ways to estimate actual data by overlaying data or interpolating intervals, however, in this manual only the original satellite data is used.

Also, in creating a time series chart, it is conceivable that charts will be created using daily, weekly and monthly data. In instances where there is little valid day data, it may make sense and be more appropriate to make weekly or monthly charts, but here we have elected to demonstrate how to create a chart using daily data.

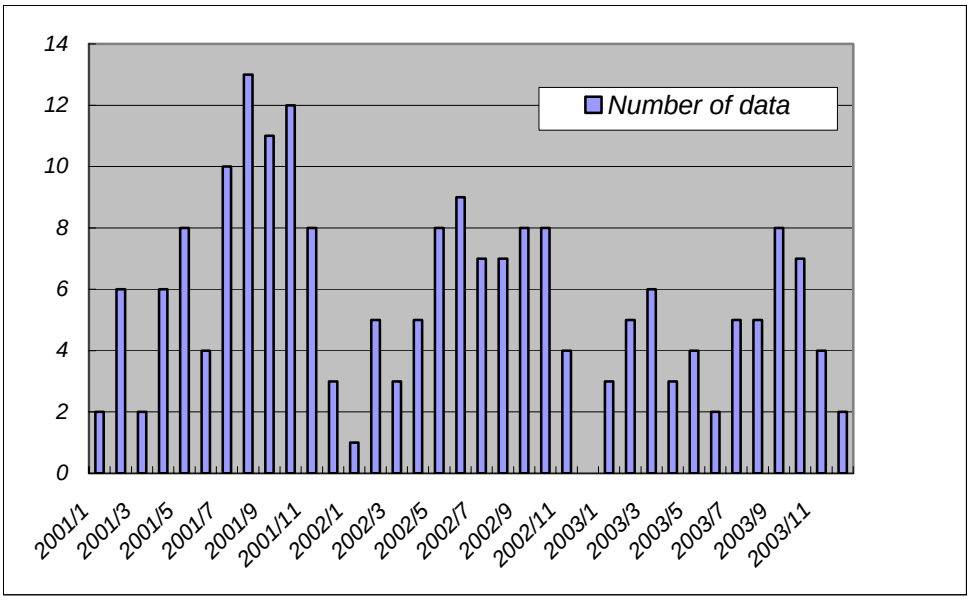



Figure 3. Number of valid satellite data days per month for sampling points.

(2) Create a list of representative values

MODIS satellite imagery is a collection of pixels each displaying a kilometer of surface imagery. In general, when seeking representative values for areas in which there are significant spatial variations and a low frequency of data for sampling points, it is typically better to take an average value calculated based on data from surrounding area pixels than to use the 1 pixel value. In this case, as indicated by Figure 4, a representative value is calculated using the monitoring point pixel as the center and taking the average of pixels in a 3 x 3 matrix. Chlorophyll a data for each pixel can be acquired by referencing the instructions listed elsewhere entitled: Acquiring the physical values from ASCII data format. The latitude for Sta.6 is 36.9035 North Latitude and 137.2213 East Longitude. In terms of grid numbers this would be rendered as below.

Sta.6 grid line number = (38.7181 - 36.9035)/0.0098816 +1 = 184
Sta.6 grid sample number = (137.2213 - 136.1324)/0.012494 + 1 = 88

Therefore, the grid number for the eight pixels surrounding the number Sta.6 will be calculated as ± 1 grid number line or sample.

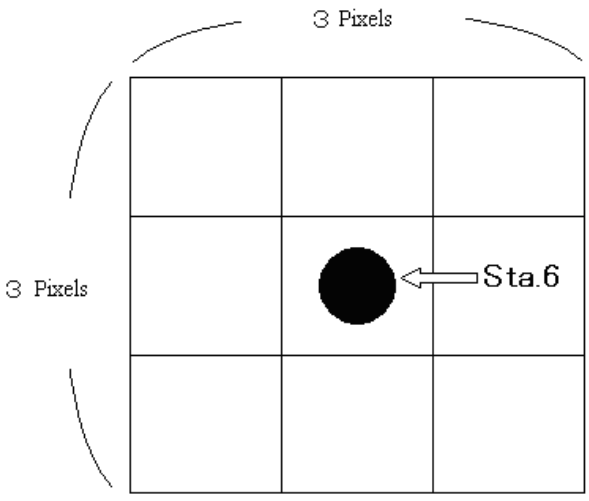



Figure 4. Matrix for seeking representative values.

(3) Creating a chart

Creating a time series chart using Excel is done using the process outlined in Figure. 5.

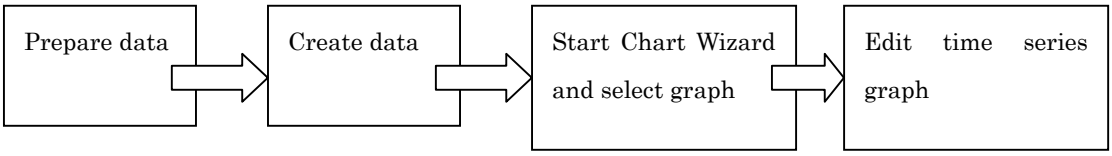



Figure 5. Processing flow for creating a time series chart using Excel.

**I.** Preparing data

Using an Excel spreadsheet, input the date and chlorophyll a concentration (Chl 3 x 3) data so that the information forms two rows of data. Input #N/A for the value for missing data. By filling in cells for unavailable data with #N/A, data lines can be drawn and connected in a way that ignores missing data. If having gaps in the chart lines does not pose a problem, then leave the cells blank as they are.

| | A | B |
|---|---|---|
| 1 | Date | Chl (3x3) |
| 2 | 2001/1/3 | 0.158617 |
| 3 | 2001/1/21 | 0.119448954 |
| 4 | 2001/2/15 | 0.348448222 |
| 5 | 2001/2/17 | 0.368377778 |
| 6 | 2001/2/18 | #N/A |
| 7 | 2001/2/19 | #N/A |
| 8 | 2001/2/20 | 0.510423111 |
| 9 | 2001/2/22 | 0.847899444 |
| 10 | 2001/2/23 | 1.175604444 |
| 11 | 2001/2/27 | 0.525248556 |

Figure 6. Preparing data.

**II.** Selecting data

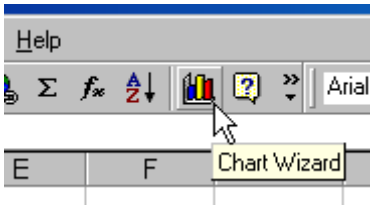
Use the mouse to select all of the data from the line 1 header to sample 2.

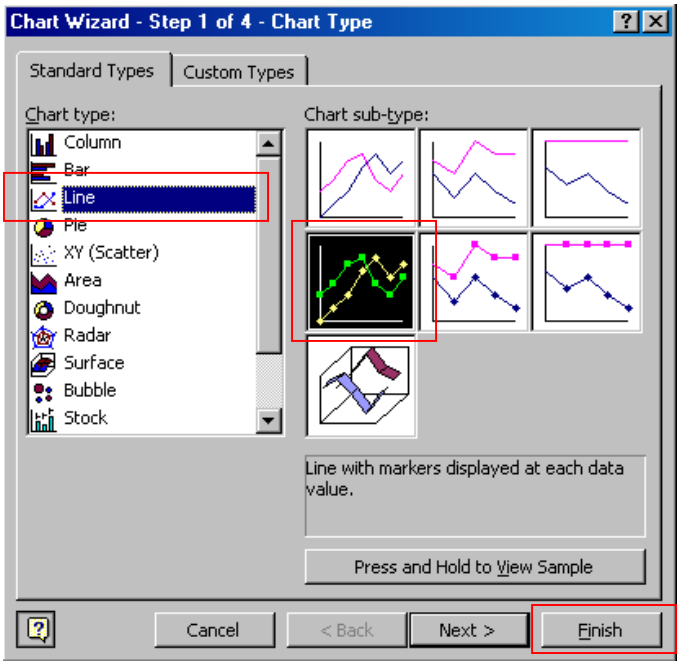
| | | |
|---|---|---|
| 195 | 2003/10/9 | 0.318687333 |
| 196 | 2003/10/17 | 0.304684444 |
| 197 | 2003/10/19 | 0.350573444 |
| 198 | 2003/10/25 | 0.356060667 |
| 199 | 2003/10/26 | 0.509375222 |
| 200 | 2003/10/27 | 1.282723167 |
| 201 | 2003/10/30 | 0.899114667 |
| 202 | 2003/11/4 | 0.425961667 |
| 203 | 2003/11/14 | 0.549959667 |
| 204 | 2003/11/15 | 0.511150889 |
| 205 | 2003/11/19 | 0.605589222 |
| 206 | 2003/12/25 | 0.542306 |
| 207 | 2003/12/28 | 0.528512 |
| 208 | | |
| 209 | | |

Figure 7. Selecting data.

**III.** Start Chart Wizard

Start Chart Wizard with all of the data selected. For chart type, select Line. For format select from the left center Line chart with mark.




▪Clicking on the Finish button will result in the automatic creation of a chart like that below.

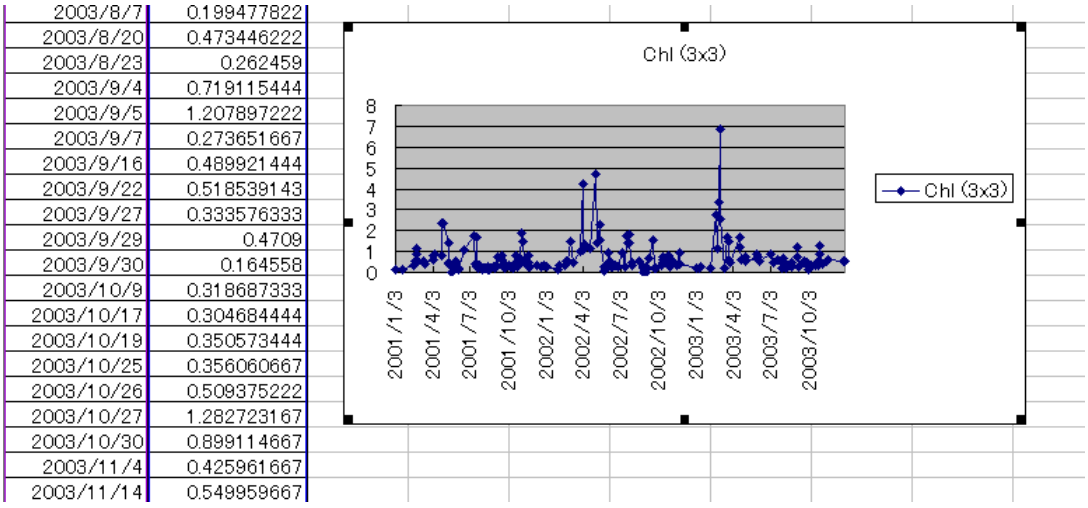


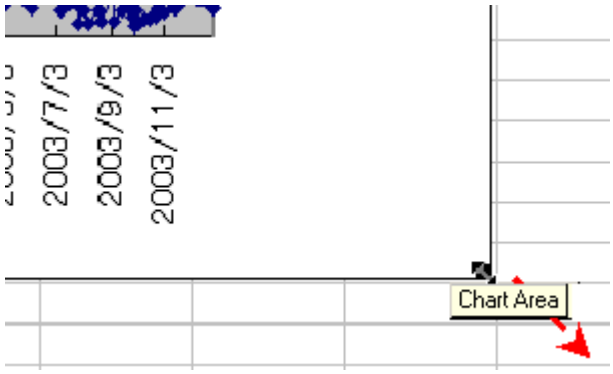

Figure 8. Start Chart Wizard.

## IV. Chart editing

Edit the chart size and other elements to make it more visually appealing and easier to understand. A number of editing examples are shown below.

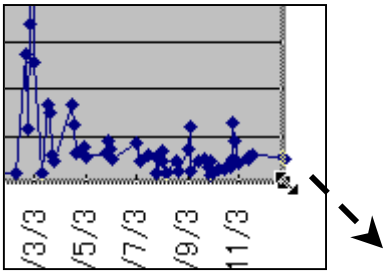
▪ Change the size of chart area

Click on the chart area, put the cursor on the ■ and the size can be altered by dragging and releasing with the mouse.




▪ Altering plot area size

Click on the chart object, put the cursor on the ■ and the size can be altered by dragging and releasing with the mouse.




▪ Setting data series format

Set the cursor on the line, right click, select Format Data Series, then settings for the chart can be altered.

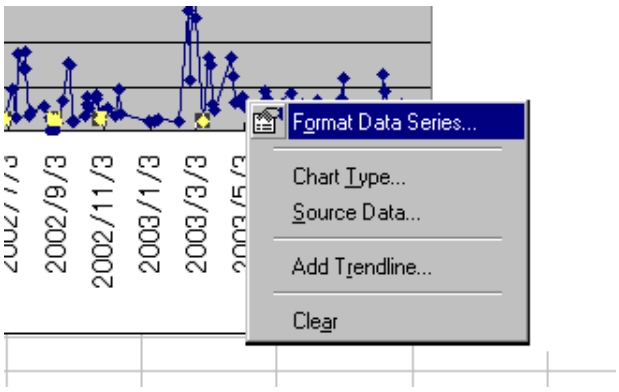



Figure 9. Chart editing.

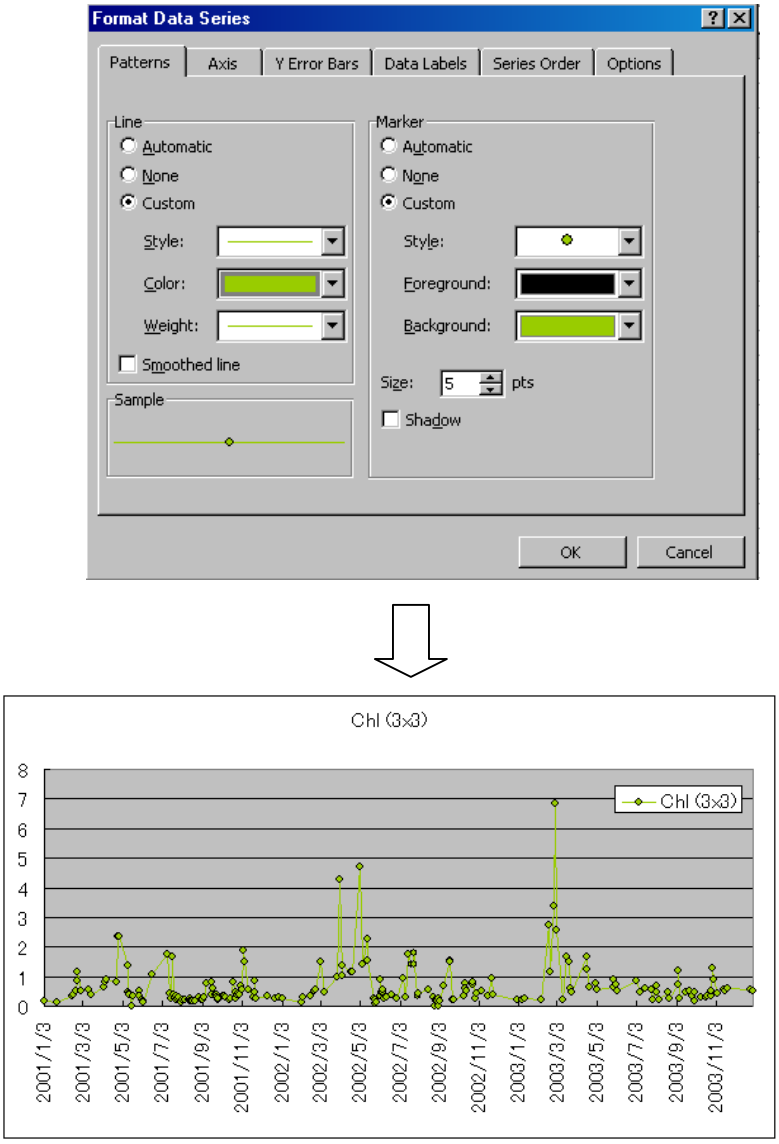



Figure 10. Sample time series chart.