

Re-graphing temperature data

Getting the most from your data

Some temperature loggers provide automatically generated graphs, usually in a PDF format. This process caters to data formats from a range of loggers including Emerson, Cryopak, DeltaTrak and Xsense. In some instances, there is value in re-graphing temperature monitoring data, such as to:

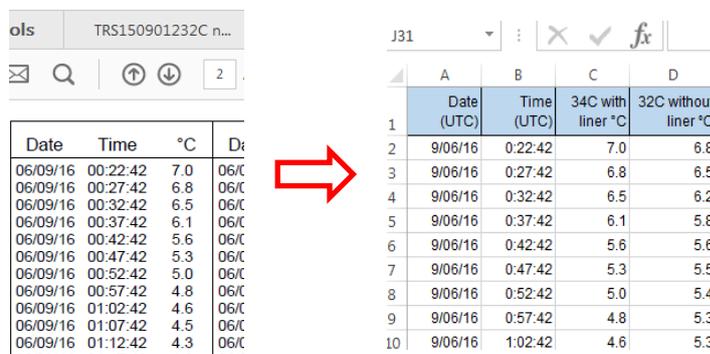
- Identify where temperature breaches occurred. Most automatically generated graphs do not indicate the steps or location at which temperature breaches occurred. Re-graphing allows you to insert comments on critical logistics steps in the supply chain.
- Compare temperatures between loggers. Most automatically generated graphs display the data from only one logger. Including multiple plots on the one graph (e.g. data from loggers in different locations in the consignment) can help compare temperature differences across the container and between consignments.
- Graph only the relevant data. PDF graphs sometimes include data before logger insertion and after logger removal from the consignment. This often makes graph interpretation difficult, making it harder to see the details of the actual consignment conditions.
- Provide better date and time information. PDF graphs can sometimes present the date/time data in an unfamiliar time zone or with odd date and time points e.g. 17/7/2017 02:17, making it hard to identify a specific time on the graph between gridlines. Re-graphing the data allows you to set the major time intervals to a more recognisable and local format e.g. 17/7/2017 12:00.

Graphing your temperature data using Excel (2013)

1. Importing and organising data

Date, time and temperature data can be best prepared in an Excel file. Data presented as a PDF file can be converted to Excel format by purchasing specialist PDF converter software or getting it free from the internet (e.g. search 'PDF to Excel converter free' in Google search) to transfer data to an Excel file.

Realign relevant data (often in multiple columns into single columns on single sheets in Excel for simpler graphing.



Date	Time	°C	Dt
06/09/16	00:22:42	7.0	06/C
06/09/16	00:27:42	6.8	06/C
06/09/16	00:32:42	6.5	06/C
06/09/16	00:37:42	6.1	06/C
06/09/16	00:42:42	5.6	06/C
06/09/16	00:47:42	5.3	06/C
06/09/16	00:52:42	5.0	06/C
06/09/16	00:57:42	4.8	06/C
06/09/16	01:02:42	4.6	06/C
06/09/16	01:07:42	4.5	06/C
06/09/16	01:12:42	4.3	06/C
06/09/16	01:17:42	4.2	06/C

Date (UTC)	Time (UTC)	34C with liner °C	32C without liner °C
9/06/16	0:22:42	7.0	6.8
9/06/16	0:27:42	6.8	6.5
9/06/16	0:32:42	6.5	6.2
9/06/16	0:37:42	6.1	5.8
9/06/16	0:42:42	5.6	5.6
9/06/16	0:47:42	5.3	5.5
9/06/16	0:52:42	5.0	5.4
9/06/16	0:57:42	4.8	5.3
9/06/16	1:02:42	4.6	5.3

2. Modify the 'DateTime' column format

2.1 Ensure that the date and time data displays in one column

If the date and time data are presented in separate columns, then:

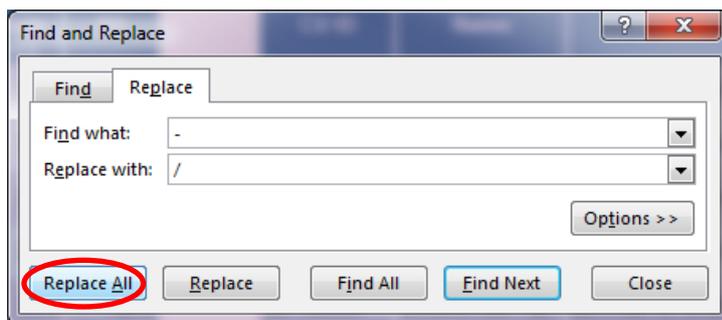
- i. Create a new 'DateTime' column (column C in the example).
- ii. Type in the equation '= A2+B2' into the first relevant cell, e.g. into C2.
- iii. Copy the formula to all relevant cells in column C.

	A	B	C
1	Date (UTC)	Time (UTC)	DateTime (UTC)
2	9/06/16	0:22:42	9/06/2016 0:22
3	9/06/16	0:27:42	
4	9/06/16	0:32:42	
5	9/06/16	0:37:42	
6	9/06/16	0:42:42	
7	9/06/16	0:47:42	
8	9/06/16	0:52:42	
9	9/06/16	0:57:42	

2.2 Check the DateTime separators

Make sure the '/' rather than a '-' symbol is used as the separator in the 'DateTime' column.

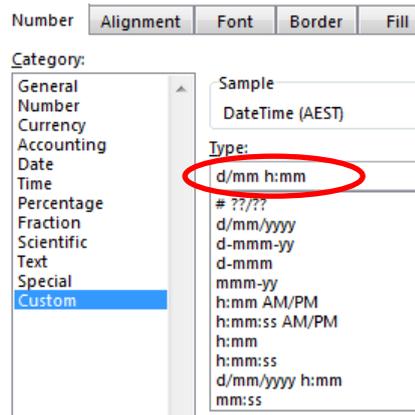
- i. Use 'Find and Replace' function by pressing 'CTRL + F'.
- ii. Click 'Replace'.
- iii. Enter the symbol you want to replace in the 'Find what' line (e.g. -).
- iv. Enter the symbol you want to replace with in the 'Replace with' line (e.g. /).
- v. Click 'Replace All'.



2017-06-13 13:24	13/06/2017 13:24
2017-06-13 13:54	13/06/2017 13:54
2017-06-13 14:24	13/06/2017 14:24
2017-06-13 14:55	13/06/2017 14:55
2017-06-13 15:25	13/06/2017 15:25
2017-06-13 15:54	13/06/2017 15:54
2017-06-13 16:25	13/06/2017 16:25
2017-06-13 16:55	13/06/2017 16:55
2017-06-13 17:24	13/06/2017 17:24
2017-06-13 17:55	13/06/2017 17:55

2.3 Ensure that Excel recognises the DateTime format

- i. Right click on the 'DateTime' column and choose 'Format cells'.
- ii. Select 'Custom' on the left under 'Category'.
- iii. Select 'd/mm/yyyy h:mm' under 'Type', delete '/yyyy'.
- iv. Click 'OK'.



2.4 Convert DateTime to your time zone

In most cases, the recorded time is set as Universal Time Clock (UTC). Australian Eastern Standard Time (AEST) is UTC plus 10 hours.

- i. Insert a new column, e.g. column D.
- ii. If you are in AEST, type '10:00:00' in a new cell in new column (e.g. G1).
- iii. Insert the formula '=C2+\$G\$1' into the first relevant cell in column D, e.g. D2.
- iv. Copy the formula to all relevant cells in D column

	A	B	C	D	E	F	G
1	Date (UTC)	Time (UTC)	DateTime (UTC)	DateTime (AEST)	34C with liner °C	32C without liner °C	10:00:00
2	9/06/16	0:22:42	9/06/2016 0:22	9/06/2016 10:22	7.0	6.8	
3	9/06/16	0:27:42	9/06/2016 0:27	9/06/2016 10:27	6.8	6.5	
4	9/06/16	0:32:42	9/06/2016 0:32	9/06/2016 10:32	6.5	6.2	
5	9/06/16	0:37:42	9/06/2016 0:37	9/06/2016 10:37	6.1	5.8	
6	9/06/16	0:42:42	9/06/2016 0:42	9/06/2016 10:42	5.6	5.6	

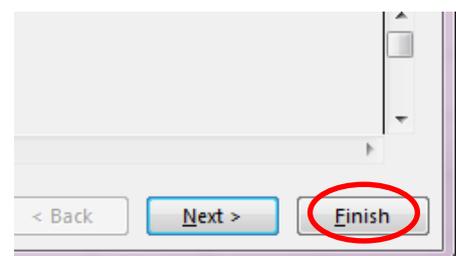
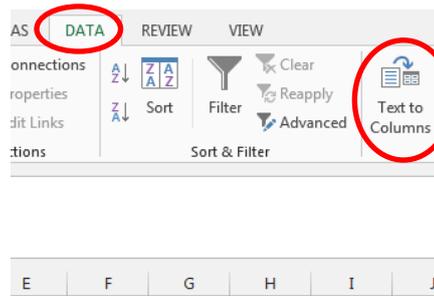
3. Modify the 'Temperature' column format

3.1 Ensure temperature numbers are recognised as 'number' format

If 'Green Triangle' appears on top left of data cell, it means temperature data are not sorted in the correct format.

- i. Select the column with this problem.
- ii. Click 'Text to Columns' under 'DATA' menu of Excel.
- iii. Click on 'Finish' to correct format for data in a column.

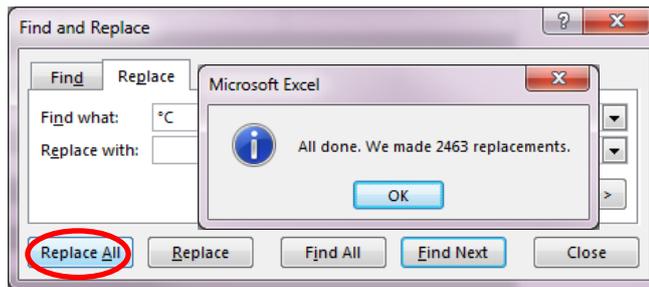
22.5
22.5
22.5
21.2
20.2
19.5
18.8



3.2 Eliminate unwanted symbols

If your data has '°C' on the end of the temperature, Excel will think it is a text entry and won't graph it properly.

- i. Use 'Find and Replace' function by pressing 'CTRL + F'.
- ii. Click 'Replace'.
- iii. Enter the '°C' symbol in the 'Find what' line.
- iv. Leave the 'Replace with' blank.
- v. Click 'Replace All'.



28°C	28
27.4°C	27.4
26.8°C	26.8
26.8°C	26.8
27.4°C	27.4
28.2°C	28.2
29.1°C	29.1
30.1°C	30.1
30.1°C	30.1
30.2°C	30.2
30.6°C	30.6
30.6°C	30.6
30.6°C	30.6

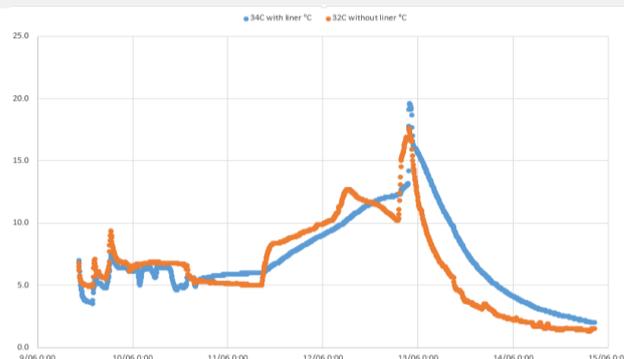
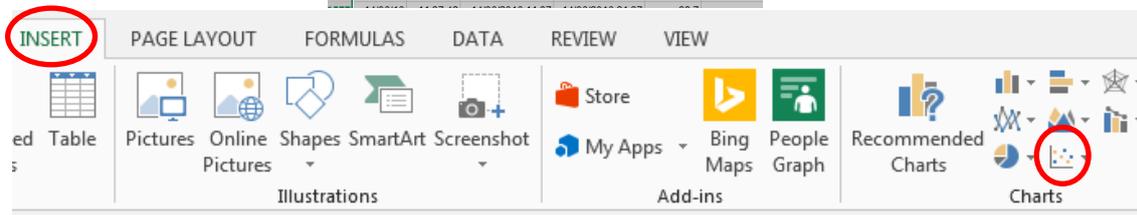


4. Re-graph relevant data

- i. Delete data that recorded prior to when the logger was inserted and after the logger was removed from the produce. You will need to find out when these steps happened from whoever inserted and removed the loggers.
- ii. Select the relevant data in 'DateTime' and 'Temperature' columns.
- iii. Click on 'INSERT' on top menu and select 'scatter' chart.

1559	14/06/16	10:07:42	14/06/2016 10:07	14/06/2016 20:07	2.0	1.5
1560	14/06/16	10:12:42	14/06/2016 10:12	14/06/2016 20:12	2.0	1.5
1561	14/06/16	10:17:42	14/06/2016 10:17	14/06/2016 20:17	2.0	1.5
1562	14/06/16	10:22:42	14/06/2016 10:22	14/06/2016 20:22	2.0	1.5
1563	14/06/16	10:27:42	14/06/2016 10:27	14/06/2016 20:27	2.0	1.5
1564	14/06/16	10:32:42	14/06/2016 10:32	14/06/2016 20:32	2.8	9.7
1565	14/06/16	10:37:42	14/06/2016 10:37	14/06/2016 20:37	5.4	20.0
1566	14/06/16	10:42:42	14/06/2016 10:42	14/06/2016 20:42	20.0	24.4
1567	14/06/16	10:47:42	14/06/2016 10:47	14/06/2016 20:47	26.8	
1568	14/06/16	10:52:42	14/06/2016 10:52	14/06/2016 20:52	30.3	
1569	14/06/16	10:57:42	14/06/2016 10:57	14/06/2016 20:57	32.0	
1570	14/06/16	11:02:42	14/06/2016 11:02	14/06/2016 21:02	33.7	
1571	14/06/16	11:07:42	14/06/2016 11:07	14/06/2016 21:07	33.8	
1572	14/06/16	11:12:42	14/06/2016 11:12	14/06/2016 21:12	33.1	
1573	14/06/16	11:17:42	14/06/2016 11:17	14/06/2016 21:17	32.4	
1574	14/06/16	11:22:42	14/06/2016 11:22	14/06/2016 21:22	31.6	
1575	14/06/16	11:27:42	14/06/2016 11:27	14/06/2016 21:27	31.2	
1576	14/06/16	11:32:42	14/06/2016 11:32	14/06/2016 21:32	33.9	

Delete



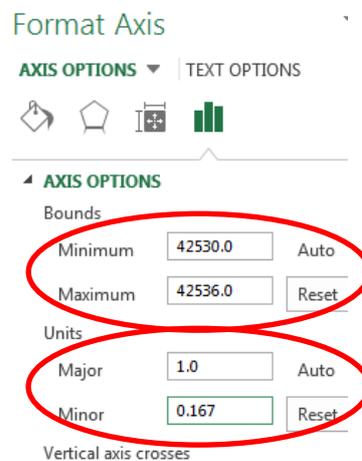
5. Clearly present the graph, adjusting the axes and axis labels

5.1 Trim the start, end and axis intervals for DateTime

- Double click on graph's horizontal axis.
- 'Format Axis' appears on the right → AXIS OPTIONS → , adjust maximum and minimum 'Bounds' value to trim horizontal axis.
- Set major horizontal unit as '1.0', this means one day.
- Set minor horizontal unit at 0.167 (1/6), this means minor intervals are indicated every 4 hours for easier interpretation.

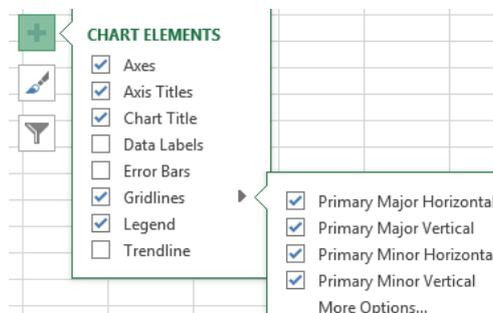
Note:

- 'Auto' values in 'Maximum/Minimum' mean numbers of days from 01/01/1900 to recording dates.
- 'Auto' value in 'Major' means the number of days for DateTime interval for horizontal axis.
- 'Auto' value in 'Minor' means the number of days for minor vertical gridlines.



5.2 Make minor units, chart and axis titles visible

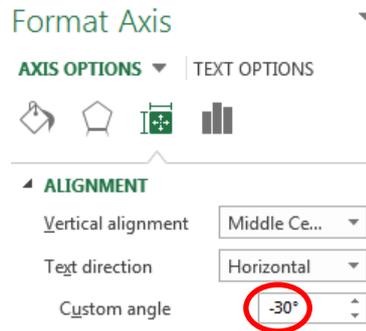
- Click on the graph, there is a '+' symbol on top right corner.
- Tick 'Axis Titles' and 'Chart Title'.
- Click on it and choose 'Gridlines'.
- Tick 'Primary Minor Horizontal' and 'Primary Minor Vertical'.



5.3 Angle the DateTime label to space them out making them easier to read if needed

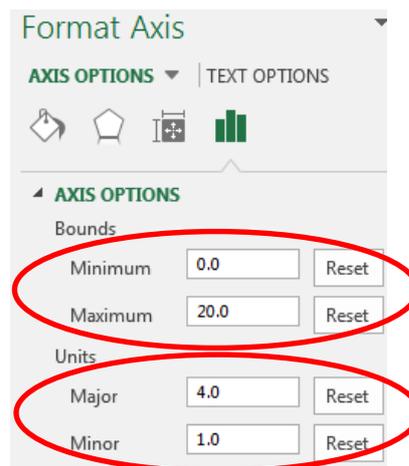
- Click on graph's horizontal axis.

- ii. 'Format Axis' → AXIS OPTIONS → .
- iii. Set -30° for 'Custom angle' for clearer reading.



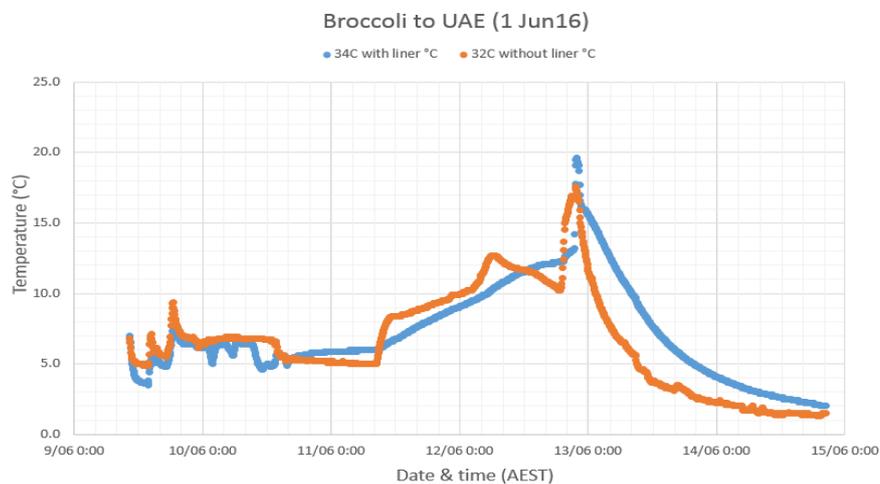
5.4 Modify temperature range

- i. Click on graph's vertical axis.
- ii. 'Format Axis' appears on the right → AXIS OPTIONS → , adjust 'Bounds' values to trim vertical axis.
- iii. Set appropriate major vertical unit, e.g. 4.0.
- iv. Set major horizontal unit as '1.0', this means one Celsius degree.



5.5 Include chart and axis titles

Insert appropriate chart and axis titles for effective record keeping and interpretation at a later time.



6. Set upper and lower limits for recommended storage temperature for your produce

- Set up a range with X and Y values in a blank area on the same excel sheet.
- The X value ranges from start to end date of recording; the Y value correspond to your lower and upper temperature limit.
- Then right click on the graph, choose 'Select Data...' and 'Add', type series name and choose X, Y values, click 'OK'.
- Same steps as above for adding upper temperature limit.

X	Y	X	Y
9/06/2016 10:22	4.0	9/06/2016 10:22	8.0
14/06/2016 22:52	4.0	14/06/2016 22:52	8.0

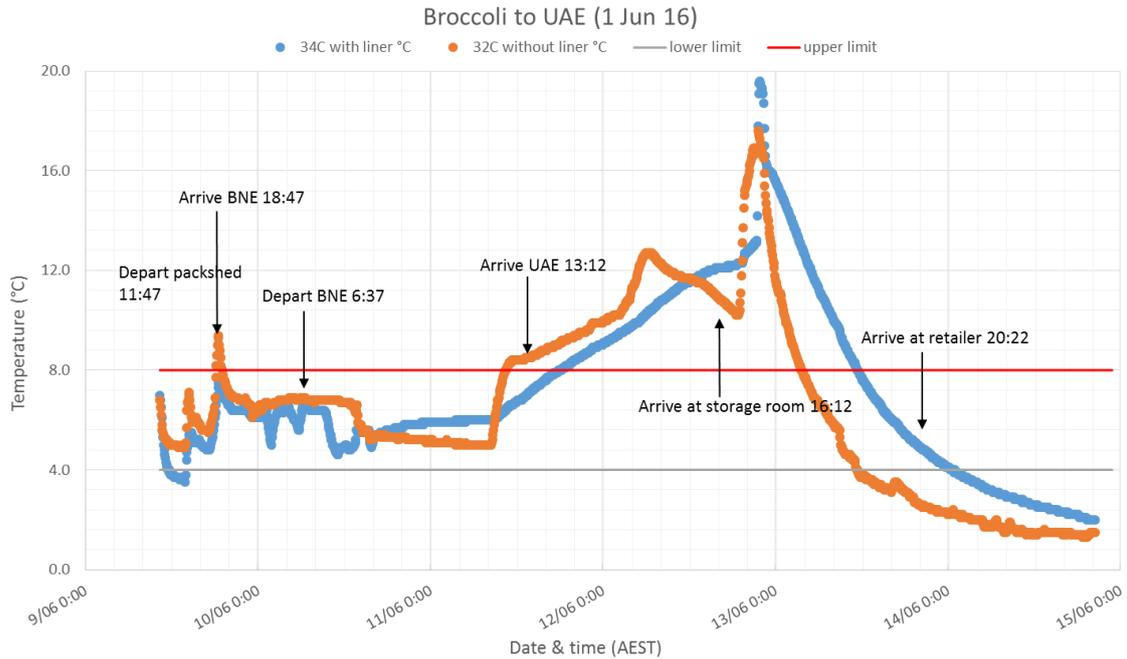
- You'll see two points in the graph.
- Right click on the graph, choose 'change chart type'.
- Select 'Combo' on the left and change chart type for 'lower limit' and 'upper limit' as 'Scatter with smooth lines' chart.



7. Insert data labels

Contact responsible supply chain members at each stage for detailed information on when consignments arrived, were they were stored and departed.

- Find critical time points in data series.
- Select 'Shapes' under 'INSERT' top menu.
- Insert arrow symbols at critical time points.
- Select 'Text Box' function under 'INSERT' top menu.
- Type critical information in each text box to keep record.



Summary

Re-graphing is an effective way to record information on temperature, time and location of your consignments along the supply chain. You are then able to clearly understand when and where any temperature breaches happened. This valuable information can help you to make decisions on improvements, risks and further action required for your consignments.

Most users of temperature monitoring will repeatedly use the same loggers. This will make it possible to create a template that automates a number of the steps described above into an excel file template, making significant time savings in the middle of what usually are busy harvest seasons.

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The Serviced Supply Chains project is funded by the Hort Frontiers Asian Markets Fund, part of the Hort Frontiers strategic partnership initiative developed by Hort Innovation, with co-investment from the Department of Agriculture and Fisheries (Qld), Department of Economic Development, Jobs, Transport & Resources (Victoria), The University of Southern Queensland, Manbulloo (mangoes), Montague Fresh (summerfruit), Glen Grove (citrus) and contributions from the Australian Government.