



Components

	NAME	DESCRIPTION	AUDIENCE
	<i>Predicting tropical cyclones</i> teachers guide	This guide describes how students can manipulate data to predict future tropical cyclone activity in Western Australia. Issues relating to validity of scientific prediction are raised.	teachers
	<i>Predicting cyclones 1</i> worksheet	In this open worksheet, students manipulate data on sea surface temperature for towns along the WA coast to predict future tropical cyclone activity.	students
	<i>Predicting cyclones 2</i> worksheet	In this structured worksheet, students manipulate data on sea surface temperature for towns along the WA coast to predict future tropical cyclone activity, then answer specific questions.	students
	<i>Cyclone data</i> spreadsheet	This Excel spreadsheet contains sea surface temperature for Western Australian coastal towns, 1985–2010.	students

Purpose

To use sea surface temperature projections (2010 to 2100) to predict latitudes where tropical cyclones may develop, and hence which Western Australian towns may be affected.

Outcomes

Students understand that:

- historical data can be used to predict future events;
- there are uncertainties in predictions based on historical data;
- climate change may influence the frequency and severity of tropical cyclones; and
- broad scale predictions about climate change may influence predictions about future patterns of tropical cyclone activity.

Students:

- manipulate data to construct models that can be used to predict future events;
- draw inferences from sets of data; and
- communicate their findings to a larger audience.

Activity summary

ACTIVITY	POSSIBLE STRATEGY
Students use the worksheets, <i>Predicting cyclones 1</i> or <i>Predicting cyclones 2</i> , to process data and draw conclusions about the future of tropical cyclones.	students in small groups
Students from each group report their findings to class members. Discussion focuses on the variety of predictions that arise from the same initial set of data.	in groups, whole class

Teacher notes

The emphasis in this activity is upon students processing data and drawing their own conclusions. By working in small groups, students can discuss trends and make inferences about likely future tropical cyclone activity. Each group should present their findings to the rest of the class. Groups of students may make different assumptions and decisions as they process and graph data, thereby producing different interpretations in their reports. Teachers can use this range of opinions to enrich discussion about the predictive process and relate it to current climate change consensus among scientists.

There are two versions of the worksheet, *Predicting cyclones*. An open version (*Predicting cyclones 1*) places greater demands on students to make decisions about how to process and analyse data, make predictions and communicate their findings to an audience. A more structured version (*Predicting cyclones 2*) uses specific questions to guide students through the same processes.

Using the open version students graph data that have been collected over the past 25 years. Students work collaboratively in groups to solve the problem of how to use these data to predict future cyclone activity and consequences for WA coastal towns. A graph showing future projections of global warming, with and without climate policy, has been included in the worksheet. Students can make choices about which global warming scenario to use and the degree to which it affects projected sea surface temperatures for each town, thereby producing a unique interpretation from the initial data set.

The structured version of the worksheet (*Predicting cyclones 2*) guides students stepwise through the activity.

Information in the fact sheet, *How do cyclones work?*, in *Cyclones 2: Exploring cyclones* provides relevant background information for students.

Following students' reports, whole class discussion may focus around the following questions.

- Were there differences between groups' predictions for tropical cyclone activity? If so, why were they different? For example, did groups make different assumptions about global temperature rise?
- Are there any findings that all groups can agree upon?
- What is the likelihood of tropical cyclones forming off the coast near Perth in the future?
- How does this compare to worldwide discussion between scientists about the effects of climate change, when, in this exercise, all students used a relatively small data set?

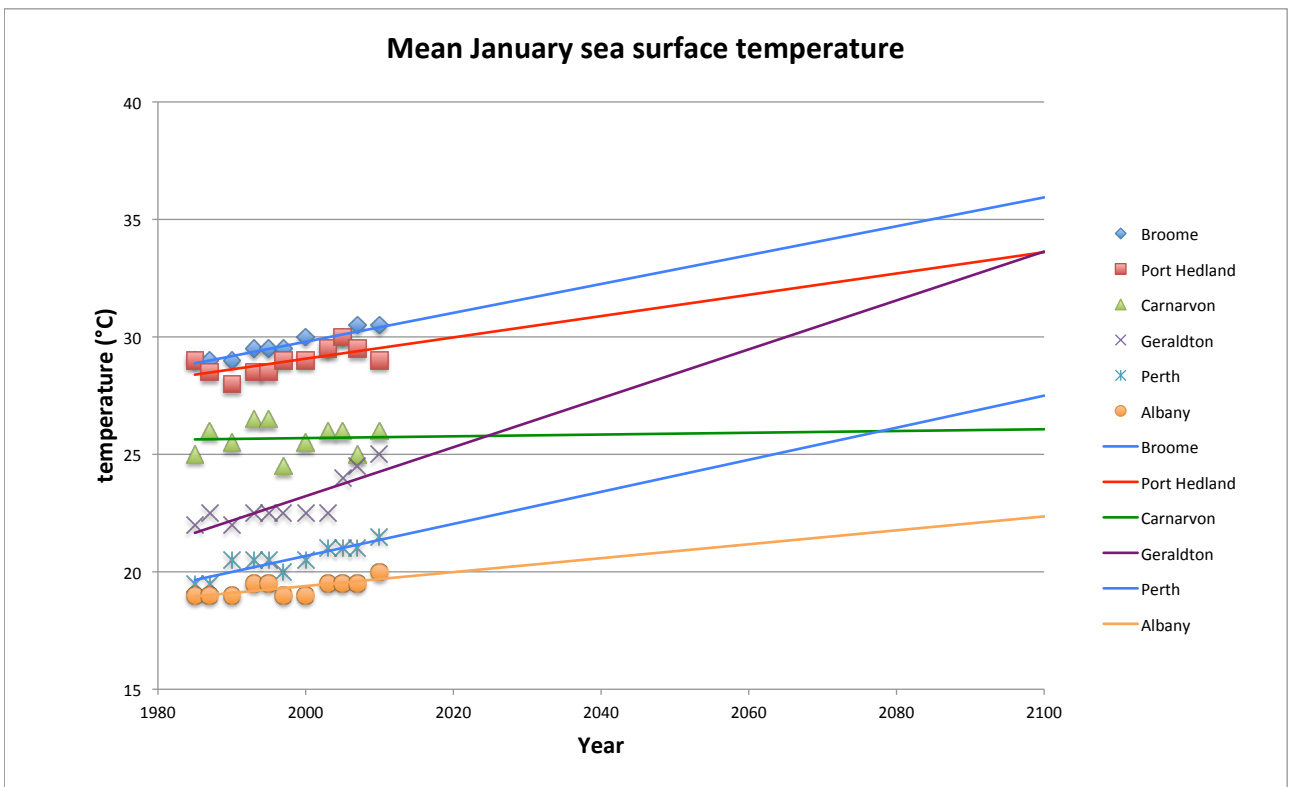
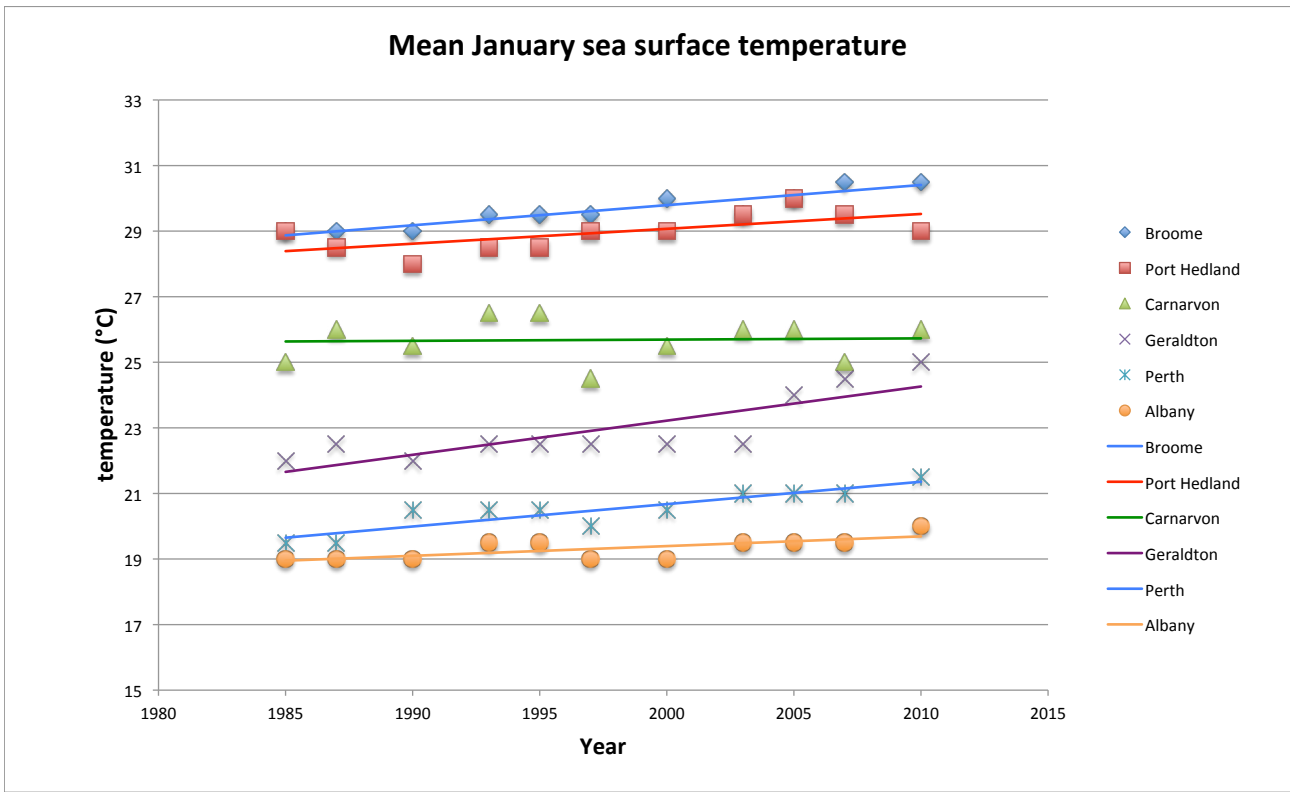
Data from table 1 may be plotted using Microsoft Excel or similar software. The following steps may be used to chart the data and add trend lines.

Microsoft Excel 2010 or 2011

1. Setup an Excel worksheet with the following headings across seven columns: year; Broome; Port Hedland; Carnarvon; Geraldton; Perth; and Albany. Enter data for each year in rows below these headings (11 rows plus header row).
2. Select the block of data A1:G12.
3. (Macintosh) On the ribbon, select **Charts, Scatter, Marked Scatter**.
(Windows) From the menu, select **Insert, Charts, Scatter, Scatter with only markers**.
A default-formatted chart will appear on your worksheet.
4. Select the chart, then from the Chart menu or ribbon select **Move Chart ...** and move it to a new sheet.
5. Adjust the y-axis by selecting it, then (on the ribbon) select **Format** followed by **Format selection**.
6. Select **Scale** in the dialog box and change the axis minimum from 0 to 15.
7. Label chart and axes by selecting **[Chart] Layout** in the ribbon, then selecting **Chart Title** and **Axis Titles**.
Replace default titles with appropriate text and format as required.
8. To add trend lines, select a point on a series (eg one of the Broome data points) and select **Add Trendline...** from the Chart menu. Use the dialog box to change the colour, style or legend for the trend line as required. Repeat for each data series.
9. Students are also asked to extrapolate trend lines to the year 2100. To do this, select the x-axis, then **Format Selection** and set axis maximum to 2100. Select a trend line, **Format selection**, then in 'Options' set forecast forward by 90 periods. Repeat for each trend line.

Use a similar approach with earlier versions of Excel, except most formatting commands are located on the Formatting Palette rather than the ribbon.

If students have used an Excel spreadsheet to extrapolate trend lines then their graphs will resemble the example below. If students have accepted the challenge to use global mean temperatures to predict future trends then their graphs may be different.



Technical requirements

The teachers guide and worksheets require Adobe Reader (version 5 or later), which is a free download from www.adobe.com. The worksheets are also provided in Microsoft Word format.

The data file requires Microsoft Excel.

Acknowledgements

Thanks to Dr Karl-Heinz Wyrwoll, School of Earth and Environment at the University of Western Australia.

Designed and developed by the Centre for Learning Technology, The University of Western Australia.
Production team: Anton Ball, Alwyn Evans, Bob Fitzpatrick, Dan Hutton, Rebecca McKinney, Paul Ricketts, Gary Thomas and Michael Wheatley, with thanks to Pauline Charman, Jan Dook, Jenny Gull and Wendy Sanderson.

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Associated SPICE resources

Cyclones 3: Predicting tropical cyclones may be used in conjunction with related SPICE resources to address the broader topic of how scientists use data to make predictions.

DESCRIPTION	LEARNING PURPOSE
<p><i>Cyclones (overview)</i></p> <p>This learning pathway shows how a number of SPICE resources can be combined to teach the topic of cyclones. The topic is used as a context to investigate modelling of present and future climate.</p>	
<p><i>Cyclones 1: Looking at cyclones</i></p> <p>A presentation that shows effects of some recent cyclones sets the scene for a teacher-led class discussion about origins and conditions for cyclone formation.</p>	Engage
<p><i>Cyclones 2: Exploring tropical cyclones</i></p> <p>The resource explores patterns of cyclone formation associated with sea surface temperature and latitude.</p>	Explore
<p><i>Cyclones 3: Predicting tropical cyclones</i></p> <p>Data on sea surface temperatures are analysed to predict future cyclone activity.</p>	Explain
<p><i>Cyclones 4: Modelling climate</i></p> <p>Students investigate how the world may change if various climate change scenarios, suggested by CSIRO research, are followed.</p>	Elaborate