Using climate*prediction*.net to produce a climate forecast

These 3 half hour sessions will explore climate model results and lead to students producing their own unique climate forecast for a specific place in the world. If there is time, the pupils could give the presentation to the rest of the class.

What you will need:
You need to either:

1) Install the climate*prediction*.net model for schools from http://www.climateprediction.net/download/index_ou.php and leave it running for at least 3 weeks until an experiment has been completed. This will generate a unique data set which could be copied from C:/Program Files/Climate Prediction/archive/experiment_1 to all the computers to be used in the exercise. Download the student visualisation interface from http://www.climateprediction.net/client/help/vis2.php.
2) Download one or more sample data sets from http://www.climateprediction.net/schools/materials_main.php and download the student visualisation interface from http://www.climateprediction.net/client/help/vis2.php. The SVI will not work in ‘timestep’ mode unless a climate*prediction*.net model is actually running on the same computer, but this should not prevent the sessions below from being used.

You will also need a world atlas available for session 2.

Background Information

Climate model data
The data that you will be investigating is the output of a climate model. It is not data that is based on the observed weather in any way, but is data that was generated by a computer, solving hundreds of thousands of equations for each point on the Earth’s surface.
We will mainly be looking at phases 2 and 3. Phase 2 (given the dates 1825-1840) is a hindcast (literally a forecast done as if it were 1825 and we had no knowledge about the future) of typical pre-industrial conditions (so Greenhouse Gases etc. are as if there were no industrial activity on the Earth). Phase 3 (given the dates 2050-2065) is a forecast based on a doubling of carbon dioxide levels in the atmosphere. This is set to happen in about 2050.

The Student Visualisation Interface
(http://www.climateprediction.net/science/expt/vis/vis2_guide.php)

- When you first open the package (by double clicking on the SVI icon), the default field plotted is the surface temperature field of your current model run in 'timestep' mode. This updates as your run progresses.
- After making any change, click on the 'plot' button on the bottom right of the screen to update the plot.
- The **View** button (top left) lets you change the type of plot which is produced:

Surface Fields there are 4 menus available:

1. **General**

-Timescale: *timestep* updates the field as your model runs, *season* lets you select one or more season in one or more year - so you could plot the average December/ January/ February surface temperature for 1810-1820 (use control left click to select multiple years) and *year* lets you plot the average surface temperature over one or more year. Note that, to be able to view fields in *season* or *year* mode, you need to have completed at least one phase of the experiment, and you can only view fields from completed phases of the experiment (this is because of the data processing that happens at the end of each phase).

-Field: *Surface temperature*, (surface) *pressure*, *total precipitation* (rain & snow), *rainfall*, *snowfall,* Top Of Atmosphere *infrared brightness temperature* (a measure of how much heat the Earth is losing to space), *total cloud amount* and *plot memory* (used in conjunction with the memory button on the top left of the screen).

-Plot Type: allows you to select whether you see the plot in colour or black and white etc.

2. **Projection**

This may be either **cylindrical** or satellite. If you choose to view a *cylindrical* projection, you can control the boundaries of the plot, either by specifying them explicitly, or by left clicking on the plot itself to zoom in. If you choose to view a *satellite* projection, you can control which bit of the Earth the satellite is hovering over.

3. **My Scale**

This menu allows you to choose an appropriate contour scale for your plot - so if your world is particularly warm, you can extend the colour scale upwards (the *extend scale* options add one more colour to the end of the scale, for more drastic changes you have to specify a complete new scale).

4. **Overlay**

This menu allows you to overlay (with line contours) one field over another - so you could overlay pressure onto surface temperature, or precipitation onto cloud, to get a feel for how these fields interrelate. You can also overlay *wind vectors* (not on timestep fields) which are arrows showing the direction and strength of the wind. V*ector skip* controls how many vectors are plotted (e.g. if vector skip=1, vectors are plotted at every other grid point) and *vector length* allows you to control the scale of the vectors.

- **Zonal Fields**

These are fields which have been averaged in longitude i.e. you make the Earth 2-Dimensional by averaging all the values on each latitude circle - so you can see how the fields change with height. The main new option here is that you can chose whether the height scale is linear in *height* (as it is in the real world, with pressure dropping off exponentially with distance from the Earth's surface) or *pressure* (related to the mass of air), which lets you see what most of the air molecules in the atmosphere are doing.

- **Time height Fields**
  This lets you see how the vertical structure of the atmosphere varies with time at a given latitude (again is has been averaged in longitude). No new options here.

- **Surface Average Fields**
  These are fields which have been averaged both in longitude and latitude. You can either plot these in *timestep* mode, in which case you see the fields evolving over 1/ 2/ 7 days in the model you have running currently. In *year* mode, you can see the results for all the completed phases of the experiment. The default is to plot *global mean* data, but you can deselect this and instead choose to plot the evolution of the field at a given latitude and longitude. *Long degs* and *Lat degs* allow you to specify the size of the box you are looking at - so a 1° by 1° box centred on 52° N, 0°W would approximately cover London. You can choose to plot 2 fields simultaneously (field 2 appears with a dashed line). The **my scale** menu allows you to choose an appropriate y axis for the plot (look at the numbers appearing in the box on the bottom of the window to see what scale is appropriate). If you choose to set a scale for one of the fields, you have to set a scale for the other too.
  The **memory** button allows you to save a *season/ year surface field* which you have plotted into memory. If you then create another *season/ year surface field*, you can use the *memory* menu options to *add* or *difference* (subtract) the new field from the old one. Using the *field* menu in the *general* menu, you can then *plot memory*. So, for example, you could plot 1825-1840 year mean surface temperature, add the field to memory, then plot 2050-2065 year mean surface temperature, difference from memory, and then plot memory to see how average surface temperatures changed when carbon dioxide was doubled.

  The **file** menu gives the following options:

- **Change Experiment**: If you have already completed one or more climate*prediction*.net experiments, this option allows you to select which set of results you look at. N.B. timestep fields will always show the experiment which is running currently.

- **Print**: This will print the current figure (including scale bar and logos).

- **Save as an image**: This will let you save the current plot as a .pgn, .jpg or .bmp image. These will be saved in the C:/Program Files/ Climate

Prediction/vis directory. You can choose to reverse the colours of the figure to save on black ink. You can also choose to *autosave* every image you create.

- **Output date**: This will output the data used to produce the last figure to a file which you specify - very useful if you want to import it into, e.g. Excel and do further analysis. You can choose to *autosave* all the data you produce.

Session 1 Investigating the Visualisation Interface

1) Choose ‘Surface Field’ from the ‘View’ menu and ‘season’ from the ‘timescale’ menu.

Using the right mouse button and ‘control shift’, select all the years from 1825-1840

- **Now choose the surface temperature field–**

⇒What time of year is it?
⇒What’s the season in Great Britain? Australia?
⇒Where is it warmest? What are the approx. high temperatures?
⇒Where is it Coldest? What are the approx. lowest temperatures?
⇒Is the sea warmer or cooler than the air?
⇒What’s the temperature in England?

- **Switch to the total precipitation field -**

⇒ Where is the wettest place on earth?
⇒ Where is the driest place?

- **Switch to the total cloud amount field -**

⇒ Are all the clouds producing rain?

Investigate all the options in the ‘projection’, ‘general’, ‘my scale’ and ‘overlay’ menus.

2) Choose ‘Surface average field’ from the view menu and ‘year’ from the ‘timescale’ menu.

- **Plot global data surface temperature -**

⇒ What happens to the average temperature of the Earth during phase 3 (red)? Try and describe when it changes most as well as what the difference is between 2065 and 2050.
⇒ Now uncheck ‘global data’ and enter the latitude and longitude for your school (hint: London would be Lon 0, Lat 52) and plot that. Does the temperature change in the same way as it did for the average of the whole world? You may need to change the scale of the graph to be able to see all the lines.
⇒ Now change the field to precipitation – can you say whether it will it get wetter or drier? Does the rainfall vary a lot from year to year?

Session 2 Investigating climate change at one location on the Earth

Choose a place, anywhere in the World, that you are going to investigate. You will need to know the location (latitude and longitude) of that place.
You now need to produce 5 graphs for that place. For each graph, think carefully about the scale, and any other options you have. Save each graph you produce as a .jpg using the 'file', 'save as an image' menu option. Try and give each graph a name which will help you identify it – who produced it and what does it show?

1) A satellite view surface field (any field, any timescale) with that location in the centre of the graph.
2) Cylindrical projection surface field- use the right mouse button to zoom in on the continent your location is in. Plot the DJF surface temperature for 2050-2065.
3) With the same view and, importantly, the same scale, as plot 4, plot the JJA surface temperature surface temperature for 2050-2065.
4) Surface average field temperature for all the years available at that location (hint: keep lon degs and lat degs as 1)
5) Surface average field precipitation for all the years available at that location (hint: keep lon degs and lat degs as 1)

Session 3 Producing and Delivering a Climate Forecast
Open the sample PowerPoint presentation climate_forecast.ppt. Each slide has a space for you to insert the 5 jpgs you created in session 2, which you should be able to find in C:/Program Files/ Climate Prediction/vis
Now imagine that you are presenting the climate in your location to the rest of your class. For each slide you will have to think about

1) What uniquely describes the location you chose – what continent/ country is it in, is it by the sea or inland, is it quite far North or South, or is it close to the Equator?
2) Is DJF winter or summer for your location? What are typical DJF temperatures?
3) Is JJA winter or summer for your location? What are typical JJA temperatures? Are they very different to the DJF temperatures? Does the location you chose have bigger or small seasonal changes in temperature than you are used to at home?
4) How does the temperature change during phase 3? Is the change bigger than the year-to-year variations that you see in the data? When does the temperature change most? Does the temperature end up being more or less pleasant for human life?
5) How does the precipitation change during phase 3? Given the temperatures you saw in graph 2, do you think this precipitation is rain or snow? Do you think this is a fairly wet place, or a fairly dry place? Is the change bigger than the year-to-year variations that you see in the data? When does the precipitation change most?