

UKCP18 Guidance: How to use joint probability plots

Land Projections:

What do joint probability plots show?

Joint probability plots show the absolute or relative change for two different variables on one plot for a range of probability levels. The information is usually presented for one location for one month or season at a future time period. They are available for the probabilistic projections only.

In the examples provided (Figure 1), future changes in two variables – temperature and precipitation – are compared on the plot (temperature as an absolute change in degrees Celsius and precipitation as a percentage change with respect to 1981-2000). The plot represents the average change for the 3-month summer season July-August towards the end of the 21st Century.

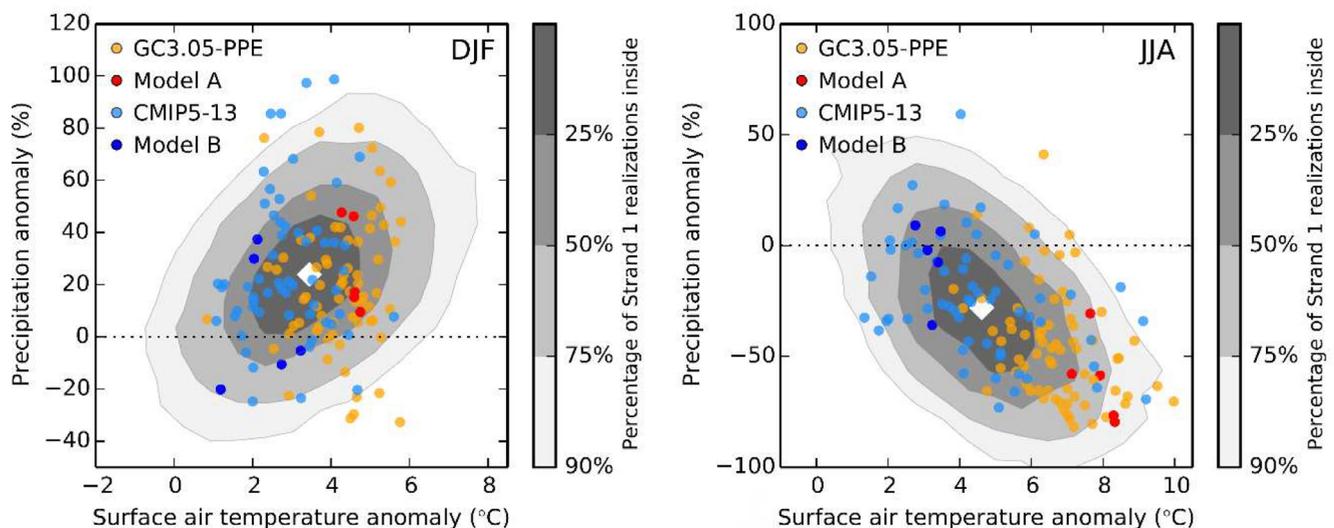


Figure 1 Projected temperature (bottom scale, °C) and precipitation (left hand scale, %) changes to the end of the 21st century for December to February (left hand panel) and June to August (right hand panel). Shading shows results from the probabilistic projections (%) probability, right hand scale). The dots show global climate model projections, there is one dot for each model for each of the 5 years considered, and all results are for RCP8.5. The orange dots and light blue dots represent the sets of GC3.05 and CMIP5 projections respectively. Two example models selected from the set of 28 global projections are shown in red and dark blue. From figure 2.14 of Lowe et al (2018).

How to use joint probability plots: examples

Examples of the way in which the information in joint probability plots can be used include:

- The shape of the area in Figure 1(a) is skewed diagonally from the bottom left to the top right of the plot area. This indicates that the probability of the two variables changing in the same direction, i.e. lower

temperature and reduced rainfall (colder and drier) as well as higher temperature and increased rainfall (warmer and wetter) are more likely than the two variables changing in opposite directions.

- The position of the individual simulations and the shaded area, displaced up and to the right relative to the temperature and precipitation zero lines (no change), indicates that there is a higher likelihood of the future climate being warmer and wetter.
- If you compare joint probability plots at the beginning of the 21st century with the end of the 21st century (not shown), you will find that the shaded area becomes larger for variables such as temperature. This indicates how the uncertainty increases as we progress through the 21st century.

What to be aware of when using joint probability plots

Joint probability plots reflect the probability ranges obtained using the UKCP18 method. This range captures the important known uncertainties associated with climate projections. For the probabilistic projections, emissions uncertainty is explored through the use of different sets of climate projections reflecting different scenarios of future greenhouse gas emissions. A single joint probability plot (see Figure 1) shows projections associated with a single emissions scenario. Multiple joint probability plots are therefore needed to illustrate emissions uncertainty.

Further information on the caveats and limitations for the probabilistic projections are available from the [UKCP18 website](#).

Where to find joint probability plots?

Joint probability plots are used in the UKCP18 Science Reports available at the [UKCP18 website](#).

You can create your own joint probability plots for the UK on the [UKCP18 User Interface](#).

References

JLowe JA, Bernie D, Bett PE, Bricheno L, Brown S, Calvert D, Clark RT, Eagle KE, Edwards T, Fosser G, Fung F, Gohar L, Good P, Gregory J, Harris GR, Howard T, Kaye N, Kendon EJ, Krijnen J, Maisey P, McDonald RE, McInnes RN, McSweeney CF, Mitchell JFB, Murphy JM, Palmer M, Roberts C, Rostron JW, Sexton DMH, Thornton HE, Tinker J, Tucker S, Yamazaki K, and Belcher S (2018). UKCP18 Science Overview report. Met Office.