



## Communicating uncertainty to agricultural scientists and professionals

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Models of agricultural systems often aim to predict the impacts of weather and soil nutrients on crop yields and the environment. These models are used to inform scientists, policy makers and farmers on the likely effects of management. For example, a farmer might be interested in the effect of nitrogen fertilizer on his yield, whilst policy makers might be concerned with the possible polluting effects of fertilizer. There are of course uncertainties related to any model predictions and these must be communicated effectively if the end user is to draw proper conclusions and so make sound decisions. We searched the literature and found several methods for expressing the uncertainty in the predictions produced by models. We tested six of these in a formal trial. The methods we considered were: calibrated phrases, such as 'very uncertain' and 'likely', similar to those used by the IPCC; probabilities that the true value of the uncertain quantity lay within a defined range of values; confidence intervals for the expected value; histograms; box plots; and shaded arrays that depict the probability density of the uncertain quantity.

We held a series of three workshops at which the participants were invited to assess the six different methods of communicating the uncertainty. In total 64 individuals took part in our study. These individuals were either scientists, policy makers or those who worked in the agricultural industry. The test material comprised four sets of results from models. These results were displayed using each of the six methods described above. The participants were asked to evaluate the methods by filling in a questionnaire. The questions were intended to test how straightforward the content was to interpret and whether each method displayed sufficient information.

Our results showed differences in the efficacy of the methods of communication, and interactions with the nature of the target audience. We found that, although the verbal scale was thought to be a good method of communication it did not convey enough information and was open to misinterpretation. Shaded arrays were similarly open to misinterpretation, but proved to give the best impression of uncertainty when individuals were asked to interpret results from the models. Box plots were most favoured by those who had a stronger mathematical background. We propose a combination of methods should be used to convey uncertainty in emissions and that this combination should be tailored to the professional group.