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Assessing the usability and potential value of seasonal climate forecasts in land management decisions in the southwest UK: challenges and reflections

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Abstract. The potential usability and benefits of seasonal climate forecasts (SCF) to help inform decision-making processes is widely accepted. However, the practical use of SCF in Europe is still fairly recent and, as such, current knowledge of the added benefits of SCF in supporting and improving decision-making is limited. This study is based on research conducted to co-develop a semi-operational climate service prototype – the Land Management Tool (LMTool) – with farmers in South West regions of the UK. The value of the SCF provided to the farmers was examined to help us understand the usability and (potential) value of these forecasts in farmers' decisions during the winter months of 2015/2016. The findings from the study point to the need to explore and develop (new) research methods capable of addressing the complexity of the decision-making processes, such as those in the farming sector. The farmers who used the SCF perceived it as useful and usable as it helped them change and adapt their decision-making and thus, avoid unnecessary costs. However, to fully grasp the potential value of using SCF, farmers emphasised the need for the provision of SCF for longer periods of time to allow them to build trust and confidence in the information provided. This paper contributes to ongoing discussions about how to assess the use and value of SCF in decision-making processes in a meaningful and effective way.

1 Introduction

The potential benefits of using seasonal climate forecasts (SCF) to help inform and support planning and decision-making is widely recognised across economic sectors (see e.g. Harrison et al., 2008; Rickards et al., 2014; Thomson et al., 2006). However, although SCF have a longer application in certain regions of the world (e.g. Lemos et al., 2002; Patt et al., 2007; Meinke and Stone, 2005; Pulwarty and Redmond, 1997) due to higher predictability in those areas (Doblas-Reyes et al., 2013) their use is still relatively new in Europe (Bruno Soares and Dessai, 2016). As such, current knowledge of the (potential) value and benefits of using SCF in decision-making processes is thus still fairly limited in Europe. Understanding how SCF can be used to address user needs is critical to help us understand how these forecasts can add value to the decisions at hand. In a broader context, such understandings can also help validate and justify public expenditure on climate science as well as evaluate the development of climate services in Europe towards supporting societal progress (EC, 2015).

The concept of value is commonly associated to as something that can bring quantitative and/or qualitative benefits to those involved (cf. Nicholls, 1996). In the context of SCF, such value can be translated into the (potential) benefits of using the forecast to inform and support a specific decision (Bruno Soares et al., 2017; Clements et al., 2013). However, the usability and value of SCF is dependent on aspects beyond the technical quality of the forecast itself such as the characteristics of the end-user and the decision-context within which the information is to be used (ibid; Lemos et al., 2012). Different methods to assess the usability and value of weather and climate information permeate the literature (Clements et al., 2013). These range from more quantitative studies focusing on the technical aspects of forecasts to those more qualitative in nature centred around the end-user (Bruno Soares et al., 2017).

This study is based on research conducted under the EU EUPORIAS project (see www.euporias.eu) where a semi-operational climate service prototype – the Land Management Tool (LMTool) – was co-developed with farmers in the Southwest region of the UK. The SCF were jointly co-developed and provided to the farmers to help us understand the usability and (potential) value of these forecasts in farmers' decisions during the winter months of 2016. This paper aims to contribute to wider discussions on the usability and value of climate information, such as SCF, in decision-making and how to assess it in a meaningful way. The next section briefly describes the LMTool, Sect. 3 explains how the use and value of SCF was studied in the context of the tool developed, and Sect. 4 presents main challenges and reflections from the analysis performed regarding the use and value of SCF to support the farmers' decisions.

2 The Land Management Tool

The LMTool is a semi-operational climate service prototype co-developed with farmers in the Southwest of the UK. It was developed between 2014 and 2016 by a multidisciplinary team led by the UK Met Office together with the University of Leeds, KNMI and Predictia (see Fallon et al., 2017). The aim of the tool was to support land management decisions during winter months given the higher skill of SCF in the UK during winter compared to other seasons (Scaife et al., 2014). The LMTool provided the farmers with SCF (1–3 months ahead) as well as 14-day weather forecasts for specific geographical locations in the three UK regions. The final version of the SCF provided to the farmers (as a result of farmers' feedback and further refinements) included a visualization of the probability of average conditions presented as terciles for the following 3 months for temperature and precipitation (see Figs. 1 and 2). Both types of forecasts (SCF and 14-days forecasts) were accessible to the farmers via a microsite (Figs. 1 and 2) and later on also through an App (Fig. 3).

The development of the tool was underpinned by an agile[1] approach to project management and framed within the principles of climate services development which emerged in the context of the European Coordination of Climate Services Activities[2] (Buontempo et al., 2014). As such, the tool was co-developed in close collaboration with the farmers through the application of different methods (interviews, surveys, workshop) allowing their continuous input and feedback as well as a flexible response by the LMTool team to

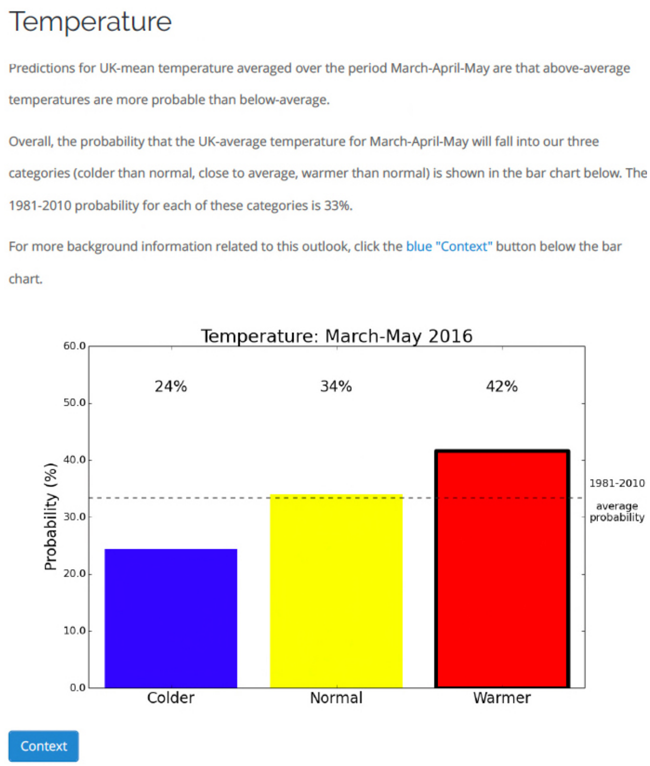

Figure 1. Seasonal climate forecast for temperature for March–May 2016 provided to the farmers through the microsite.

changes in terms of the farmers' requirements which facilitated the development of a technically robust tool specifically tailored to the farmers' needs (e.g. inclusion of other climate parameters of interest to the farmers, provision of the App) (see Fallon et al., 2017).

The farmers involved were based in the Devon Clinton States[3] (CDE) in the Devon region as well as in Dorset and Somerset regions in the UK. An initial set of farmers ($n = 6$) from the CDE were involved based on their expertise on different type of farming enterprises (e.g. organic dairy and crop farming, mixed farming, dairy farming). Following initial interviews with these farmers a second set of farmers ($n = 14$) from Devon, Dorset and Somerset regions were then engaged in order to increase the number of farmers involved ($n = 20$) across a wider geographical area of the of the southwest of the UK. These 20 farmers were then engaged through two surveys, a workshop, and 2 rounds of interviews (a total 11 of interviews) all of which aimed at allowing the co-development of LMTool with the farmers and their ongoing feedback on the advances made in the tool.

The ongoing engagement with the farmers also allowed the opportunity to discuss and provide effective ways of communicating and representing confidence and uncertainty of the SCF provided. This was particularly relevant as "(...)

[1]The Agile approach is an alternative to traditional project management which allows addressing unpredictability through an iterative approach and empirical feedback to the work being developed (see e.g. http://agilemethodology.org).

[2]For more information see: http://www.eu-ecoms.eu.

[3]See www.clintondevon.com.

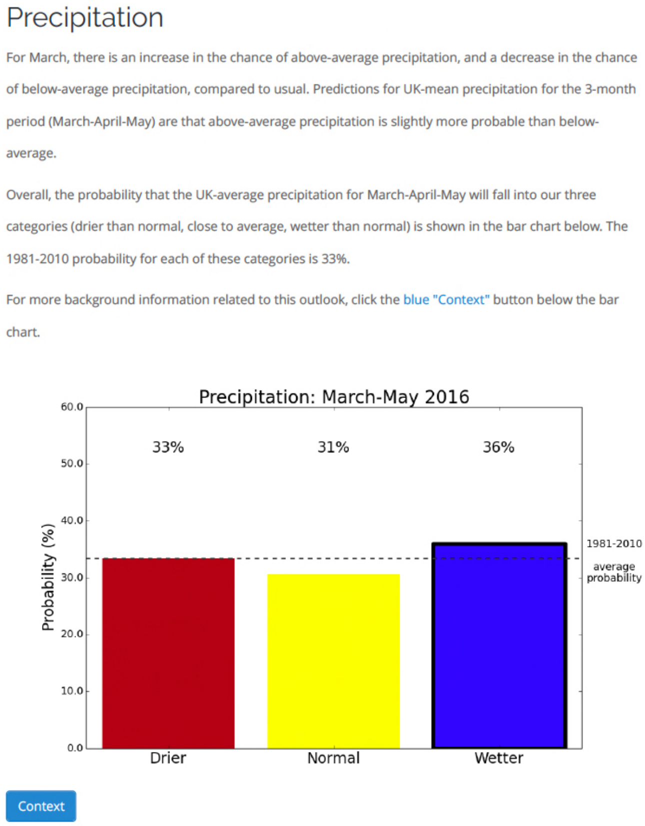

Figure 2. Seasonal climate forecast for precipitation for March–May 2016 provided to the farmers through the microsite.

Figure 3. Seasonal climate forecast for temperature for March–May 2016 provided to the farmers through the App.

while used to dealing with uncertainty in their decision making – [the farmers] do not necessarily have extensive experience of using the kind of complex information that often accompanies seasonal predictions." (Taylor et al., 2016). In the LMTool, whilst some farmers wanted to quickly access and understand the information provided others also wanted to access further background information. As such, the final solution implemented involved using a simple visualization and summary to describe the key messages of the SCF as well as the option for farmer to read more about the context and background of the forecasts provided if they wanted (see Figs. 1 and 2).

2.1 Assessing the use and value of seasonal climate forecasts on farmers' decisions

There are a number of methods and metrics that can be used to help us understand the usability and value of SCF in decision-making (Bruno Soares et al., 2017; Clements et al., 2013). A qualitative approach (i.e. a workshop and in-depth interviews) was adopted to assess the use and value of these forecasts in the farmers' decisions during the winter months of 2015/2016. Given the novelty of applying SCF in Europe and their probabilistic nature allied to the complexity of farming decisions it was thought that, in this case, qualitative methods would allow us a more fruitful interaction with the farmers about the potential use and value of SCF as well as regarding the forecasts' limitations and uncertainty.

The workshop was held in January 2016 and aimed at understanding and determining critical decisions that farmers would face in the following months (March to May 2016). Decision calendars can serve as "(...) an analytical framework for organizing information about a user context, including timing of decisions and climate information needs, and then identifying entry points and opportunities for use of climate information" (Ray and Webb, 2016, p. 40; cf. Haigh et al., 2015; Bert et al., 2006). Decision calendars were therefore used to help identify the two most important forthcoming decisions (e.g. livestock/crop management, commercial aspects, machinery required), establish the weather conditions as well as other factors (e.g. labour required, financial resources) affecting those decision-making processes and the timing of those key decisions (e.g. March).

Farmers were then asked to reflect on the decisions identified during the workshop together with the SCF provided over the coming months. Follow up interviews were then conducted with six farmers in April 2016. The interviews focused on the decisions identified during the workshop, the usability of SCF to inform and support those decision-making processes and the (potential) value and benefits of having the forecast information available during those months. The following section describes the main challenges faced when assessing the usability and value of SCF for the farmers involved in the development of the LMTool.

3 Main challenges and reflections for future research

An immediate challenge noted during the follow-up interviews with the farmers was the limitation of the decision calendar used at the workshop to identify the farmers' decisions. The method proved difficult to implement as, although it helped to somewhat define the farmers' critical decisions (to different extents), it was difficult to subsequently use them in the interviews to explore how decisions were made. This was due to the level of complexity of the land management decisions in terms of their susceptibility and adjustments to change since the workshops (e.g. weather conditions, financial factors) but also due to the difficulty for the farmers in explicitly describing and verbalising their tacit knowledge regarding those decisions (cf. Haigh et al., 2015).

The limitation of the method reflected the intricate complexity of the decisions at hand and raises wider issue about the need to and select (or develop new) methods for assessing the use and value of SCF in complex decision-making such as in the agriculture sector. As a result of this, it was difficult to explicitly relate the decisions identified by the farmers during the workshop with the potential use and value of the forecasts provided. Instead, the follow-up interviews with the farmers focused on the alternative decisions (or adjustments made to the initial decisions identified at the workshop) that were pursued by the farmers and their reflections on the usability and value of the SCF provided.

Of the six farmers interviewed two actively used the SCF provided to support their decision process (in a qualitative way). In one case, the farmer, whose farming enterprise focuses on arable crops (mainly grains), adapted his decision regarding the timing for spraying based on the SCF provided for which indicated a wetter but also higher than normal temperatures (Figs. 1 and 2). According to him "the prediction [from the SCF] was for a wetter but milder winter. It did focus us that (...) if we got a window [for spraying] we needed to take it because there would be less dry spells (...) So we did because the probability was that it was probably rain again". The other farmer pursued a mixed-farming enterprise (crops, cattle) and contracted most of the work in her farm. In this case, the forecast provided led her to delay the decision to contract people to work in the fields: "I've not done any contracts or invoicing for anybody to go on any of my fields because the fields aren't good enough, they're too wet, and I knew that they would be too wet because it was going to be so wet in February and March". Despite both farmers having used and agreed on the value and benefits of using the SCF – in the form of costs that they were able to avoid – they were unable to express those benefits in economic terms: "I don't know, it's hard to actually put a physical value on it really" (...) but "The benefits are that you knew. Like certainly into the autumn and the winter, if it's showing it's going to be particular wet. The benefit was planning, right we'll be as much as we can early, beforehand, sort of thing, knowing it was going to be wet, and as it turned out it was wet".

The other four farmers interviewed did not use the SCF provided but the reasons for that varied. In one case, the farmer was unable to use the information due to the weather conditions (amount of rainfall) that occurred before that winter and which completely conditioned her choice in terms of actions: "Your decision is already made because the rain's there, so actually looking at a forecast it was just giving you an indication that you're not actually going to change plan, because we've had too much rain. So, it's not the fault of the forecast, it's the fault of the relentless rain".

In this situation, the inability to act upon the information provided by the SCF was due to short-term weather conditions (i.e. high levels of rainfall) which affected the land (e.g. difficulty in accessing the land) rather than the seasonal forecast itself (cf. Haigh et al., 2015).

For another farmer, the SCF were of no interest as his activities consisted of renting his land to other farmers. As such, his farming enterprise was not susceptible to weather conditions as the risk lay with the farmers who rented his land.

Another finding of this study was around the need to build trust in the SCF provided. This was mentioned in various of the interviews and related to the time needed to allow farmers to develop confidence in the reliability of these probabilistic forecasts as well as for them to be able translate the SCF information provided in relation to the specificities of their land and similarly to what they do with weather forecasts (i.e. through trial and error over time). This is highlighted in this farmer's quote: "The problem I've got with it [SCF] at the moment is I've not got enough confidence in it because it's not been running long enough to actually overrule my gut feeling". This emphasis on trusting the SCF was also hgihlighted by the farmers who used the SCF: "(...) and it's probably gonna be another year to really trust it. Because the first three months certainly, you're taking it with a bit of pinch of salt, "Well is this gonna work or not?", and then sometimes it absolutely chucks it down or it's randomly ridiculous hot for a week and you forget that this actually over, like you said, it's over three months". The reasons described by the farmers for not using the forecast are not new. In other regions of the world where the applicability of SCF has been pursued for longer, the use of SCF is often limited by conditions such as the timeliness of the forecasts, the lack of saliency and the lack of trust (Lemos et al., 2012; Haigh et al., 2015).

The findings from the LMTool suggests the need to assess the usability and value of SCF together with the farmers over longer periods of time (e.g. one or more years of farming activities) in order to allow the farmers to test and use the forecast information on different decisions, as well as give them time to understand how the SCF information translates in relation to their land (similarly to how they currently use information from weather forecasts). In addition, pursuing ongoing and cyclical assessments of these complex farming systems based on their practices can help facilitate a more efficient assessment of the usability of SCF in their farming decisions and the added value of doing so (cf. Haigh et al., 2015).

4 Conclusions

This study highlights key aspects that need to be further addressed in order to allow the assessment of the use and value of SCF (and other climate information) in complex decision-making contexts (including and beyond the agriculture sector). As such, more attention is required to explore and develop methods that can meaningfully capture the complexity of decisions and how climate information, such as SCF, can help inform those processes as well as manage the susceptibility of those decisions to change and how to meaningfully assess its potential use in such dynamic contexts. In our study, farmers also emphasised the need to be exposed to, and able to use the information provided, over longer periods of time to allow them to gain confidence and trust in the forecasts. This is a critical step to help them understand not only the (potential) usability of these forecasts in their decisions-making processes but also to understand how using SCF can benefit their decisions and activities. Although not necessarily an end in itself, understanding the potential economic value of using SCF (through for for example, improved income, costs avoided, improved production etc.) can be an important step towards encouraging the uptake and use of SCF for decision-making. In a broader context, understanding the use and value of SCF can also help validate the investment allocated for developing this type of forecast for critical sectors in Europe such as in agriculture.

Data availability. The data collected and used to perform this analysis is not publicly available as it was collected under the European data protection act which ensures the anonaminity of the interviewees.

Competing interests. The author declares that she has no conflict of interest.

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