

Useful to Usable (U2U) End of Project Interviews with Professional Agricultural Advisors

Evaluation of the project and Decision Support
Tools (DSTs)



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I. Executive Summary

A. Background

With substantial input from Midwestern farmers and professional advisors, the Useful to Usable (U2U) project co-produced a suite of online decision support tools (DSTs) to improve the profitability and resilience of cereal crop agriculture—particularly corn. Early in the project, professional advisors emerged as a receptive audience for online DSTs, as well as influential brokers of information for farmers in the U.S. (based on surveys of farmers conducted in 2012). Additionally, the project team recognized the potential to influence more farmers and acres if agricultural advisors utilized the tools in their work with tens to hundreds of farmers each. For these reasons, U2U social science and evaluation efforts focused on both farmers and professional advisors (including public advisors such as Extension agents, and private/paid advisors working for seed companies, fertilizer dealers, cooperatives etc. who are typically Certified Crop Advisors). This report summarizes the results of 20 qualitative interviews with professional advisors conducted towards the end of U2U project funding, in late 2016 and early 2017. The interviews focused on advisors' opinions on the project overall, website and tool usability

B. Evaluation Questions and Key Findings

Evaluation Questions:

1. How do corn advisors view the U2U project, the DSTs the project developed, and co-production of weather and climate tools for agriculture more generally?
2. How are advisors using U2U tools in decision making and advising?
 - i. What are their motivations for using the U2U DSTs?
 - ii. For what types of decisions and situations are they using U2U tools?
3. If advisors are not using one or more of the U2U DSTs, why not?
 - i. Is it because of problems with the tools, or other factors such as just recently hearing about the tools or shifting environmental, social or economic conditions?

Key Findings for Each Question:

1. Professional corn advisors' views on co-production and land-grant science/info
 - Advisors thought U2U's approach (multi-state, land grants, co-production) – was an effective way to deliver improved weather and climate info to farmers and advisors
 - Positive opinions of the website and tools in terms of usability, using them for a variety of decisions and advising situations.

2.
 - i. Motivations include a preference for research based/scientific information to share with farmers, particularly coming from land-grant universities. In addition, several key psycho-social factors (including trust in information, climate change beliefs, and attitudes about incorporating DSTs into their work) appear to diverge among advisors who are users and non-users of U2U tools.
 - ii. Key decisions that advisors use U2U tools for included seed /variety selection, replant decisions after extreme events, explaining yield variability /discrepancies due to weather, identifying disease or frost damage, and predicting the feasibility of split nitrogen applications.

3. If advisors are not using U2U tools, why not?
 - Most common reason was “not knowing enough about it”, and shifting social and economic conditions reduced demand for the information provided.
 - Specifically, low price of corn and bans on drilling in Nebraska meant relatively low use/demand for Irrigation investment tool
 - User and non-user perspectives
 - including some criticisms/barriers to tool use and ideas for future tools/improvements
 - A couple interviewed advisors said the word hasn’t gotten out quite yet
 - Acknowledging the relatively short timeline from creating the tools, promoting, to the corn agricultural industry integrating U2U tools into decisions, and then seeing on the ground or economic results.
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More detailed analyses of the topics summarized here are included in this report.

II. Methods

In late 2016, potential interviewees were selected from advisors who had responded to an online survey between November and December 2016, and indicated that they advise corn farmers in their work. Geographically, the interviews were focused on advisors based in Iowa and Nebraska, though many worked across multiple states. We also focused on two specific types of advisors—Certified Crop Advisors (CCAs) and University Extension agents. Finally, we selected potential interviewees from survey respondents who had previously heard of at least one U2U tool listed on the survey (AgClimateView, Corn GDD, Corn Split N, and ClimatePatternsViewer). One newer tool was not listed on the survey, but was asked about in the interviews—the Irrigation Investment Tool. Interview questions focused primarily on their experiences with the U2U project and tools, how they had or had not

utilized the tools, and general information on their work as an advisor. Advisors were offered a \$20 Amazon credit as an incentive for completing the interview, and 16 men and 4 women agreed. Between late 2016 and January of 2017, the 20 semi-structured phone interviews were completed and subsequently transcribed and analyzed using MaxQDA software. Table 1 below shows the breakdown of interview respondents by advisor type and whether they used U2U tools or not.

Table 1: Advisors interviewed at end of U2U project

Type	Tool users	Tool non-users
Certified Crop Advisors (CCAs)	4	6
Extension Agents	6	4

III. Results

A. How do corn advisors view the U2U project, the DSTs the project developed, and co-production of weather and climate tools for agriculture more generally?

Advisors thought the U2U approach (multi-state, land grants, coproduction) was a good way to deliver better weather and climate information to Midwest farmers and advisors. They highlighted components that were important to them—including getting frequent feedback, bringing together a large diverse team of experts, and developing more usable tools as a result. The following three quotes relate to the approach:

- a. “I think that gives you more of a balanced approach...it's just better when you have grassroots input into the programming...how is it used and how is it useful and getting you feedback...I think that makes a really strong program. And then tools you develop I think are more user-friendly.” Nebraska Extension educator
- b. “I am one, just in terms of planning stuff, that I like to get a lot of people involved because I've always found that the more brains you get involved, the better the product ends up being. And so, I really believe in the concept. You just have to be careful that you don't kind of get -- there's so many people involved that you become paralyzed. But I definitely believe in that concept, and

I think a lot of that, you can see in these [U2U] tools that are here. “ Iowa Extension educator

- c. “...I think it's great to make things easily accessible for the people who will use it on the ground...to get that information out to people in a usable way is awesome. It helps us do our job better.” Iowa Extension educator

Describing how U2U tools compared to other sources of weather and climate information they have used or tried, advisors generally identified the U2U tools and website as more usable, intuitive and user friendly.

- d. “I think the website is definitely far more user friendly for both advisors and for farmers than a lot of other climate websites are.” -Iowa Extension educator
- e. “It's pretty simple and straightforward and it's not complicated...to explain to other folks how to utilize it to their advantage...There's some stuff out there that is good, but...you need three PhDs to work your way through the mess...And I think that the stuff you guys generate is very easy to understand...you don't have to have five years of background yield data ...that some of the other tools I've seen out there ask for.” -Iowa based Certified Crop Advisor (CCA) who also works in Illinois and Indiana
- f. “I like it for a couple of reasons. One is everything is located there, navigation is easy. Graphics are great. Straight numbers are really hard to use. So graphics are excellent, and especially if you're doing a presentation, they're so much better than scrolling through numbers.” Iowa CCA
- g. “The National Weather Service has a ton of information, but they need to clean house. I mean, I can't, sometimes I'll find stuff I like; I'll never find it again. I don't know how I got there. They got a tremendous amount of tools but their site is so tough to navigate a lot of times.” Iowa CCA
- h. “For what I've tried to use on the climate data stuff, I'd say it's [U2U website] been as good or better. It's one of those things I do infrequently enough that it needs to be pretty logical. And I can't say I had any problem finding what I needed when I used the website. So it was set up in a logical manner, for me anyway. I did not struggle with it.” Nebraska CCA

B. How are advisors using U2U tools in decision making and advising?

a. What are their motivations for using the U2U DSTs?

More than half of the advisors interviewed mentioned that they seek out or prefer research or science-based information in their work providing advice to farmers and other advisors. 9 out of 10 private CCAs identified Extension or land grant universities as a source of information they utilize in their job, with many referring to it as “unbiased.” Only one Nebraska based CCA did not utilize Extension information, saying it didn't apply to “the real world.” At least one Extension educator described the often indirect and at times hidden role of Extension in getting science-based information to farmers, “I mention working with the dealer network a lot, you know. And one of the things that we sometimes run into here and I'm sure you run into it in Wisconsin too is people say,

‘well, who really needs universities? We get all of our information from the dealers.’ Well, okay. We’ve done studies at least of Iowa...where do the dealers get their information? About 80% of it comes from the land grant. Yeah, so it's kind of like the person who says, ‘who needs dairy farms? I get my milk from the grocery store.’ And that connection gets lost, and so one of the things that we kind of beat up on the dealers about is, if you guys want us to continue to be around to support you, you've got to support us by telling people where your information's coming from.” Iowa Extension Educator

Figure 1 shows advisors’ perspectives of public (i.e. free from University/government) versus private (Companies, typically charging for the information) weather and climate information sources. This survey question focused on whether advisors’ believe public or private sources are more or less trustworthy, equally trustworthy, or equally untrustworthy. In Figure 1, survey responses are broken down by whether the advisor reported using one or more U2U tools during the interview, and it is apparent that advisors who had used U2U tools were most likely to say public and private sources are equally trustworthy or public sources are more trustworthy. While advisors who had not used U2U tools, were also most likely to say public and private sources are equally trustworthy, the next most common response was “I don’t know”, and none selected “More true for public.” These results are indicative of higher trust in public sources of information among U2U tool users than those who choose not to use the tools.

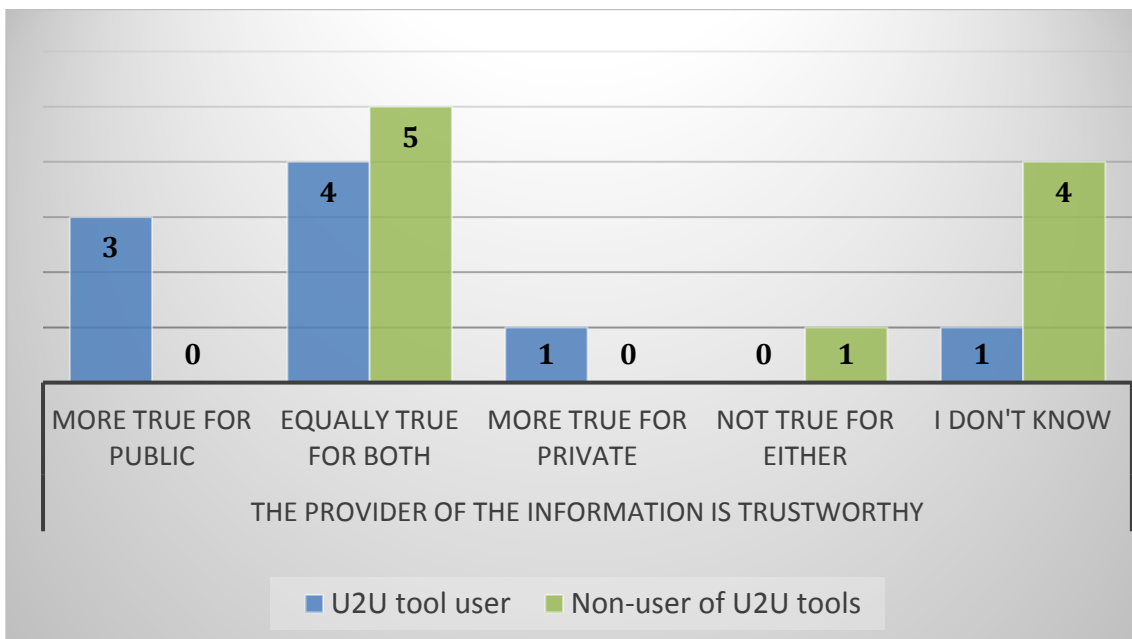


Figure 1: Interviewed advisors’ views on trustworthiness of public vs. private information sources, by use of U2U tools

Several psycho-social factors are likely to influence agricultural advisors’ uptake and utilization of weather and climate DSTs generally and U2U tools specifically. Three factors measured on the 2016 survey were: Advisor attitudes towards using weather or climate DSTs to improve farm outcomes, perceived norms around using DSTs, and extent to which they already use weather or

climate information in their advising. Figure 2 includes the distribution of attitudes, perceived norms and use of information among both users and non-users of U2U tools that were interviewed.

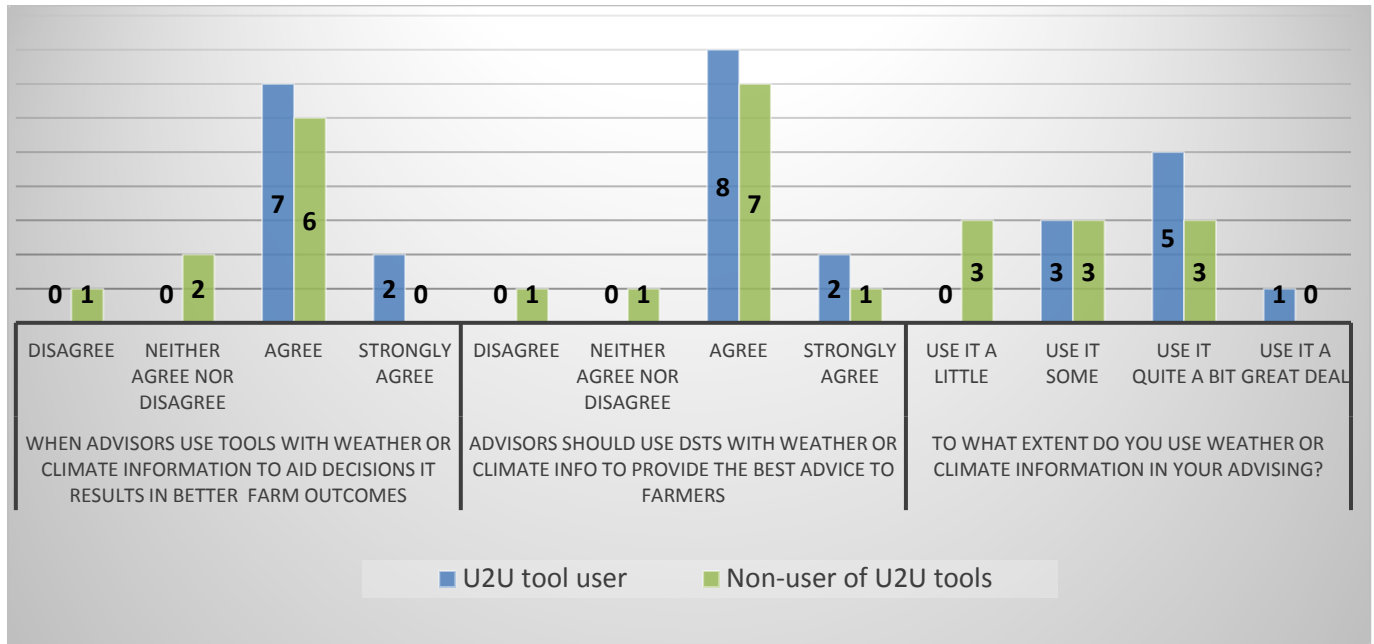


Figure 2: Interviewed advisors’ attitudes toward use of DSTs to improve farm outcomes, norms around advisors using DSTs, and current use of weather or climate information, by U2U tool use

Another background factor, underlying both farmer and advisor decision making and weather and climate DST development is the need for improved information to adapt to and remain resilient under a shifting climate. As one Iowa based Certified Crop Advisor working across several states put it, “...because whether we like to admit it or not-- there is no such thing as normal [weather] anymore...So, utilizing information like that is very useful in convincing guys that, they need to be proactive instead of reactive, and utilizing all the information that they can possibly use.” Figure 3 shows the distribution of responses to four survey questions around the existence of climate change, human contribution, evidence of climate change and whether climate change has affected their advice. As in Figure 2, responses are broken down by users of U2U tools and those who did not use the tools. The general pattern in Figure 3 is that U2U tool users tended to agree more than non-users with all of these statements around climate change and it impacting their work.

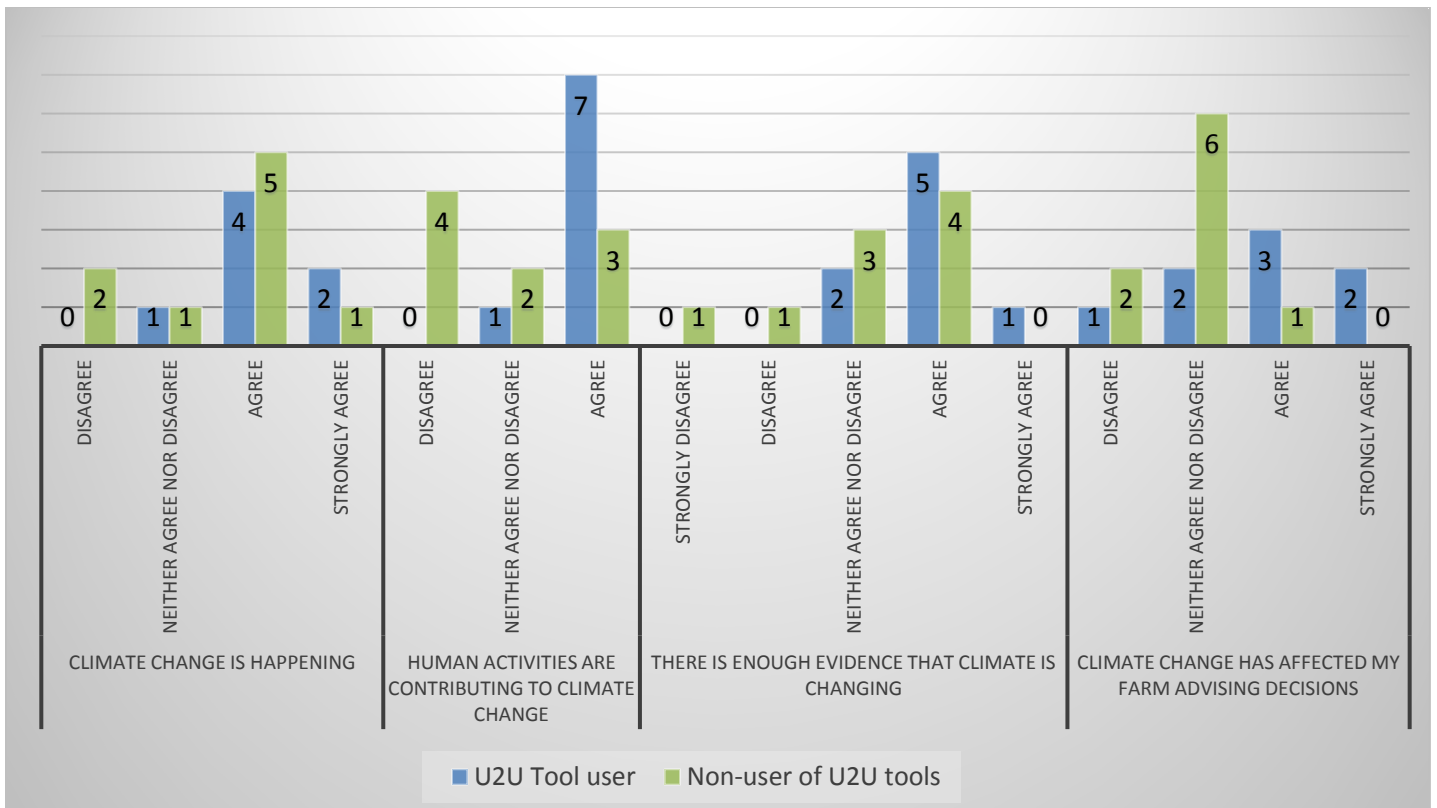


Figure 3: Interviewed advisors' views on climate change from survey responses, by U2U tool use

Nine out of ten tool users interviewed had used the Corn GDD tool, one of the first tools U2U developed, and the most popular to date according to survey and google analytics data. Advisors found the U2U Corn GDD tool to be useful “year in and year out” (Iowa CCA) and liked that it could be tailored specifically to when a farmer had planted their crops, making the results more meaningful. At least 4 advisors had used the ACV, and several used the Corn GDD and ACV hand in hand to explain yield discrepancies between different farms, regions or years. Regarding the Corn Split N tool, advisors tended to be more skeptical that the results could stand alone but did say things like, “It helps me talk to customers about nitrogen” Iowa CCA.

a. For what types of decisions or situations are advisors using the U2U tools?

One Nebraska Extension educator summarized how U2U tools fit into their work, “Well, we've had a couple of training sessions...and I've been able to use it. I have a tendency of using it more so in the spring time because that's usually when people are *needing to make decisions*...and say you have a hail event that comes through...and it's getting a little bit late to plant something else to come in, unless they're going to plant a cover crop. So that's where those tools help me the most, is in that time of year.”

Table 2, below, summarizes the main uses for the U2U DSTs that advisors described during the interviews. As noted above, the Corn GDD tool is one of the “oldest” and most popular tools, so there were more mentions of decisions influenced by that tool than for the other tools. Overall, U2U tools are informing a variety of critical decisions for agricultural advisors and farmers. In addition, several of the interviewees talked about sharing U2U tools and outputs in presentations, electronic newsletters, and in face to face meetings with clients.

Table 2: Key Decisions informed by U2U Tools

U2U Tool	Decision	Sample quote(s)	# of advisors who mentioned
Corn GDD	Seed / variety selection	<p>“In the last several years, where we've had later planting dates and guys questioning whether they need to drastically change relative maturity for whatever crop. Your Corn GDU calculator has been an extremely useful tool. Some guys really want to ‘early up’-- well beyond what they probably need to, to maximize their yield...but...having 30ish years of historical weather data did help...It eases their mind, or maybe even convinces them that they're making too much of a drastic decision or maybe not making a drastic enough decision.” Iowa based Certified Crop Advisor (CCA)</p> <p>“What I use it for, the decision has been made for that season. I used it to help the [seed] sellers understand what each product might be doing. So if we've had ten inches of rain ahead of what normal is, just because a product is not looking too shiny, do you want to throw that product out? or do you realize that it's more of a weather related event. And also, the products that you're seeing that are doing well even in the heavy rainfall, they are good to have in the package so if we have a wet year...But I try to make sure that they don't recommend only things that are successful the previous year. We've got to keep these guys diversified. So, if you can share the weather's influence on product performance it helps them understand why they need to be selling multiple products that have some diversity in the lineup rather than just whatever worked that last year.” Iowa CCA (Also the ACV tool)</p>	4

	<p>Replant decisions after extreme weather events (hail, very wet spring etc.), and negotiating with crop insurance companies</p>	<p>“What probably comes to my mind the most would be the hail event that went through and, people wondering, ‘Okay, what should I be growing?’ I had some cases where the farmer had wanted to raise some sorghum, and then the insurance company was questioning whether he should do that or you'd be better off to go to soybeans. So I was kind of trying to come in as the unbiased, ‘Okay, this is what the research is showing, this is what the research tools show.’ And I shared, I think, U2U as a resource that I have looked at and then shared that with the person, then the insurance industry. And then that helped them know why I made the decision or recommendation.” Nebraska Extension Educator</p> <p>“...we had a storm go through here mid-June last year. So, the guys were wondering, what's the chances of corn if we replanted, what's the chance of that getting matured by the time we get frost? It really did help them make a decision.” Iowa Extension educator</p> <p>“In this past year, this past [2016] growing season we had guys getting corn in the ground in April, and then Mother Nature decided it was time for the monsoon season to start. And some guys that didn't get back out to plant corn until June. So, if you're not going to return seed for shorter season and you're going to your full season hybrid, what's the probability that that hybrid is going to be physiologically mature prior to killing frost? And so, I sent out some of those U2U scenarios. It's part of risk management. Mother Nature blessed us this fall with unbelievably warm weather, so everybody that hung on to their full season hybrid [and] planted in June...it not only reached physiological maturity but it also dried on the vine, so to speak.” Nebraska Extension educator</p>	3
	<p>Timing of pesticide/ fungicide application</p>	<p>“I'd kind of use that if I was seeing a certain pest. If it was a good idea, based on if we're getting close to tassel, and if we should try to hold back on a fungicide application that kind of thing. I would try and use that information to see how far or how close we were to that stage...If we want to apply an insecticide, but if we're close to tassel, if we could wait a little longer ...and we have to make two applications to keep too much damage from occurring.” Nebraska based CCA</p>	2
	<p>Harvest timing</p>	<p>“When you start planning for harvest in the fall and moisture, when it's going to be ready to go, I use then the Growing Degree Day information to try to get a little closer forecast of when they-- I have</p>	2

		producers that work off farm and they need to know when they need to take a week of vacation. So, they're looking at maturity and then trying to figure some of that out too, which is a unique way of using Growing Degree Day information to help clients also." Iowa Extension Educator	
	Timing (and method) of planting cover crops	"Where I think probably it has been most helpful in terms of people making decisions has more been as we get into the season, and you start to see how Growing Degree Days are going, and then you start to see how, what the weather outlooks are in terms of making plans for, okay, about when are we probably going to be starting harvest? What does that mean for putting cover crops in? If we're going to be putting it in after, if we have an early harvest, we have a bigger window to put cover crops in. And if we have a late harvest...do I have a decent shot at drilling [cover crop seed] in after harvest, or should I be thinking about having an airplane come in, about Labor Day and broadcast over the top?" Iowa Extension Educator	1
AgClimateView	Explaining yield discrepancies, verifying rainfall patterns before purchasing land	<p>"And the yield thing is real interesting because everybody wants to know how their area did...but we'll go back and we'll discuss it, why it happened. What was the weather in this area or this area? Why do we see some places everybody is 250 bushels yield and another place is 150? Lot of times that can be explained by weather..." Iowa CCA</p> <p>"The specific instances I can remember using it was I'll get a few customers who will ask well, they'll want rainfall data, as an example, for the past season in two or three different towns. Using them kind of as our standard point but to maybe explain why this area yielded less or this area yielded more and even just some generalized long term rainfall patterns as they're looking to pick up ground [buy land]. Or looking to expand or not expand in a particular area. Like where we sit here, we all feel you go to [x] County and it rains more, with [y] County it rains less and [z] County's kind of in the middle. Well, using that to verify or not verify [existing beliefs]. That's one specific instance I've used it." Nebraska CCA (county names removed to protect anonymity)</p>	5
	Comparing weather across the region, tailoring advice	"I can kind of go county by county and do some comparisons to see what's going on. So, it helped me tailor my answer to which part of the region you're talking to. If I'm talking to somebody from West Central [Iowa] versus in the Northwest corner, there's quite a climate difference there and I can track it better. So that's going to change how I'm going to respond to some questions. It's helpful really from that perspective." Iowa Extension agent	3

	<p>Identifying instances of frost or disease damage to crops</p>	<p>“One thing I had this year was a problem with soybean sudden death. And that thing relates a lot back to weather and planting date. And so one thing I would do is, let's say farmer A didn't have a problem with sudden death in his soybeans but farmer B did. So I look at their planting dates, and I look at soil temperatures and rainfall patterns, if there was cool and wet on a certain date after a guy planted, well, he was probably going to get sudden death. If it was say maybe cool and dry, and he planted on a certain date he wouldn't get it. So it kind of helps explain why one farmer might of had a problem with disease whereas the farmer on the other side of the fence didn't. Guys were always asking that question. So, sudden death is you got to have the right soil temperature for that to really be a problem. And so I can look at planting date and see where things might of been added. I can look at soil temperatures and slam those together, kind of. It's hindsight, but help explain why certain areas had more problems with sudden death syndrome and beans.” Iowa CCA</p> <p>“This year [2016] I had some cases where we had a late frost. And we had exceptionally early planting so I used [the GDD tool] to see how far along that crop might've been. And then I'll [go to the ACV tool to] look at the maximum and minimum temperatures in an area, and I'll also look at soil temps, see how cold we got...who would've had issues with that. And then I'll go back and ground truth frost injury by taking stand counts in some fields. So yeah, we're off X number of plants per acre probably because of the frost ...sometimes a farmer will say 'well, that seed didn't come up very good' or 'it's no good'. And in reality, it might've come up out of the ground and stand was excellent but we got to frost...And just because he wasn't out there to see the frost before sun up, he thinks maybe he didn't get frosted. Well, I can start a conversation with some of this history, record keeping on the weather to explain that. So, I do that kind of stuff quite a bit.” Iowa based CCA</p>	2
<p>Corn Split N tool</p>	<p>Feasibility of split Nitrogen application, or starting a persuasive conversation with the farmer</p>	<p>“A lot of times too, just in terms of making preparations, that kind of background information can help to set the stage for where we would like to see them to go. And what are the implications if it goes this way or that? From time to time I'll maybe get a question from a farmer that basically says, well, I'm thinking about split applying my nitrogen, and I'm concerned about being able to get it on in time. And so, you take a look at some things like field work days and stuff like that, which, again, has weather implications. But we'll kind of take a look at some of that and help them interpret that a little bit in terms of their ability to get the job done, and how frequently they'd be</p>	3

		<p>in trouble.” Iowa Extension Educator</p> <p>“Yeah. I've used that. That can be very useful convincing guys it's never a good idea to put it [Nitrogen] all on in one shot. You know, I've always told guys split applications are probably the best bang for the buck. But that's useful in my opinion, but it's not nearly as useful as some the other tools you guys have in there.” Iowa based CCA who also works in Illinois, Michigan, Indiana etc.</p>	
Irrigation Investment	Investment and lease contract decisions	<p>“I have not seen that but I need to go on and check that out because I just had someone come in here two days ago that was curious about that because-- So I think that would be what I probably need to go to because that is on the forefront. Whether they're coming in with the idea that they're-- they've bought [an irrigation system] and they had to sharecrop with-- and they're wanting to get someone else in the operation or they're trying to work out a fair and equitable lease agreement. Those types of tools could be helpful for deciding, not only on upgrades but also what should I be charging based off of what I've invested in it? So I think that would be good. I would need to check that out because I shared with him the couple of resources we have at UNL 'cause we have the IRRICOST tool but this sure sounds like it might be...I like to get more than one source of information for people.” Nebraska Extension educator</p>	2
Probably Field Work Days	Preparing for fieldwork in the fall and spring, and for splitting Nitrogen applications	<p>“...from time to time, I'll maybe get a question from a farmer that basically says, 'well, you know, I'm thinking about split applying my nitrogen, and I'm concerned about being able to get it on in time.' And so, I mean, you take a look at some things like field work days and stuff like that, which, again, has weather implications. But we'll kind of take a look at some of that and, kind of help them interpret that a little bit in terms of their ability to get the job done, and how frequently they'd be in trouble, and so forth, and so on.” Iowa Extension educator</p>	2

b. If advisors are not using one or more of the U2U DSTs, why not?

- i. Is it because of problems with the tools, or other factors such as just recently hearing about the tools or shifting environmental, social or economic conditions?**

General themes from interviews:

- Skepticism towards weather/climate information, Questions about data applicability /need for transparency

Non-users or light users of U2U tools tended to be less enthusiastic towards weather and climate tools in general, and expressed attitudes that they “can’t control the weather,” but can control soil health and conservation practices:

- “As far as the climate things go, I can't really change anything based on the really variable, I guess, weather events that we have. Because, I mean, at least around us, we're all pretty much strip-till so our fields are pretty protected as far as how we do about everything we can already to prevent weather events from really messing with stuff, so. I don't know if you ever really been over here, but all our soils are pretty low organic matter. We got a lot of sand and things tend to blow during the winter so we're-- we pay a lot of attention to like conservation practices to prevent erosion. Interviewer: So, are you ever advising farmers to maybe adopt more conservation practices or are they mostly-- they're already doing what they need to do? Advisor: Majority of them do it already. One guy I work with, he's not going to change. He's the only one around that really conventional tills anymore.” Nebraska CCA

- Perceptions that some U2U tools are not relevant to their geographic area or specialization (i.e. not specific to conservation or manure management),
- Already have other tools (particularly Iowa State University and University of Nebraska resources),

A few advisors mentioned other tools or sources for weather and climate information that they already used and preferred, some of which they felt were more specific to their location or specialty, and typically provided through their state’s land-grant university (University of Nebraska-Lincoln or Iowa State University for these advisors).

- “One of the things that we have here in the State of Nebraska and it seems to be a product that is the envy of the United States is something called the Nebraska Herbicide Guide. That is one of the primary information sources. Chemical labels are also a critical piece of information.” Nebraska CCA

Some advisors mentioned other tools they used due to familiarity, even if they thought U2U tools were generally more straightforward or usable, such as this quote from an Iowa Extension educator, “So as far as the weather information goes there's a few different sources that I like to use. The Iowa State Mesonet is-- is one of those sources that I use. It's a really good source, but at the same time it can be challenging to find information on that source. So that's one. And usually I work with farmers on that one, like I have my bookmarked sites that I like to go to, so I try to make that as user friendly as possible. Other sites that I like to use, I like your guys' [U2U] growing degree calculator. I like that one when I work with farmers just because you can tailor it specifically to when they planted their crops, make it a little bit more meaningful instead of kind of a general overarching view.”

A common reason that these advisors mentioned for not using the tools in decision making or advising was that they were not familiar enough with a particular tool (Many said they “have it bookmarked” but didn’t dig deeper). This may indicate a need for more promotion and / or testimonials around the U2U DSTs. A couple of Extension based advisors recommended “getting the word out” more on U2U, though it is unclear how feasible that will be as the grant concludes. This could be a role for the Climate centers who will host the U2U DSTs as the grant

concludes. On an encouraging note, several “light users” had recently learned of the tools, and planned to use them more this coming growing season.

ii. Tool specific feedback from non-users and “light” users of U2U tools

- **Irrigation investment tool – In Nebraska, irrigation is generally already in place, and several mentioned bans on drilling more wells. A few mentioned they already have a tool called CornSoyWater out of University of Nebraska Lincoln**

- a. “Interviewer: OK, and are many irrigated?

CCA: Yeah. Almost all-I mean, there's dry lands but we're probably 75% irrigated.

Interviewer: OK. And do you advise them at all about those type of [irrigation investment] decisions?

CCA: No, because we're actually-- in Nebraska you can't drill any more wells. Because there's a moratorium on it, so there is no more irrigation. You just got to move it around if you're trying to, I guess, put up new pivot or--take it to other places.” Nebraska CCA

- b. In Iowa, some areas get enough/too much rain in the spring so most people aren't considering irrigation. Across the region, the price of corn is too low, as demonstrated by this quote, “...I wish this would have been available a few years ago because we also do have some sandy areas...that I work with, and when the price of corn took off here back...about eight or so years ago, and all of the sudden, people started saying, 'I wonder if I should be investing in that?'...and I wish I would've had that available at that time to help people sort through that. Now we're back down to cheap corn again, so I haven't gotten any of those calls for the last couple of years...Yeah, but I think if we get back, into an era of expensive corn, I'm quite sure that that's going to be a useful tool. I've not really looked at it, but just based upon how useful the other stuff has been that I've poked around with, I'm sure this one will be too.” Iowa Extension educator

- c. “I have not seen that, but I need to go check that out because I just had someone come in here two days ago that was curious about that because-- So I think that would be what I probably need to go to because that is on the forefront.” NE Extension

- **Split N-** “I'm still cautious about using that too much...it helps me talk to customers about nitrogen. But that really needs to be ground-truthed, I think, by individuals. So you know, it will spit out an answer for me, but I've got to know so much more than that before I make nitrogen recommendations...things like what's a grower's expectation for yield? What's the soil type? What's the hybrid response to nitrogen? You know, and does he have any overlaying problems that are going to wipe out the benefits of

nitrogen? ...So there's a lot of things that that model doesn't take into account that I have to do 'boots-on-the-ground' type of thing." Iowa CCA

- a. "Year before last, guys that flew on 40 units of nitrogen, post tassel—it really really paid. And, you could not—I don't think you could generate that information from that website...You had to be in the field and looking and doing tissue testing, and making sure that there wasn't any nitrogen there. Or if there was nitrogen there, just be patient." Iowa based CCA, working in several states
- b. "I know they [U2U] have the fertilizer one and I think it looks nice. I haven't used it with producers yet but I do think that one could be one that I may be using a little bit more as we're getting into this next season because we've had higher prices. So I think there may be a little bit more demand on that." Nebraska Extension educator

- **ClimatePatternsViewer (CPV) Some mentioned other tools providing this info (Iowa State University Mesonet and company tools)**

- a. "Yeah. I do [use it] a little bit, but I'm probably not technical enough to be able to interpret just what those always mean...That's probably, I know it's good information, but it's probably not something I use a lot, to be honest with you.

Interviewer: It might be more like background?

Yeah, it is. It's a huge scaled concept and you know, usually like my audience just want to know yes or no; is it La Nina or El Nino?...They don't need to know the size of it...that's good background information for me, but a lot of times I just don't use it on a customer basis." Iowa CCA

- **Corn GDD- Insects/disease and Integrated Pest Management (IPM)**

- "Iowa Extension educator: And to be honest, like, it would be immeasurably more useful, in my opinion, if it was programmable. You know? So like, if you could -- if you could determine the base and the ceiling in terms of -- in terms of temperature. Because then it could be used for insect predictions...But ...you know, that's just my pipe dream.

Interviewer: So, basically, like, being more customizable?

Iowa Ext: Yes, exactly. But, you know, that involves time and money and things like that...And information sources, which is important."

Interviewer: "So it wouldn't necessarily be useful for pest emergence?"

Iowa Ext "Not necessarily. The black cutworm prediction mode is close to the corn growing degree-day model but it's still not exactly the same. So it would be a little bit useful for that but ..."

IV. Conclusions

Overall, these end of project interviews with users and non-users of U2U DSTs helped explain the successes of the project and its tools, but also highlighted some of the inherent and emerging challenges to developing weather and climate DSTs for agriculture. These professional private and public advisors were generally enthusiastic about the usability of U2U tools, particularly compared to other weather and climate information available, and provided many rich examples of how they were using the DSTs in their work (some of which are shown in Table 2 above). The interviews and survey results can point to some of the motivating factors that could drive some advisors to utilize U2U tools more quickly, while others may be more hesitant to integrate these DSTs into their work. A strong connection to research and science-based information was apparent across all the interviews, and a large majority liked to get information from Extension and land grant universities. The survey and interview responses from these advisors suggest that high trust in public sources of information may help increase uptake of U2U DSTs, as well as believing in anthropogenic climate change, having positive attitudes toward using DSTs to improve farm outcomes and perceiving a norm that advisors SHOULD be using these types of tools to provide farmers with the best advice. The extent to which advisors shared U2U tools in newsletters, presentations, and one-on-one meetings with farmers is a strong indicator of their value.

Some of the challenges of integrating new weather and climate DSTs into agriculture highlighted by these interviews included shifting social and economic conditions (falling price of corn, bans on drilling wells for irrigation etc.), and other for-profit tools emerging concurrently as U2U DSTs were being developed. The fact that the “oldest” U2U tools (Corn GDD and ACV) have only been available for about three growing seasons at the time of evaluation somewhat limits the ability to demonstrate impacts. Encouragingly, several interviewees who had recently learned about the U2U tools planned to use at least one of them in the coming growing season, a few advisors were concerned that the tools would be going away as the funding period is ending, and several interviews concluded with statements from advisors such as “Keep up the good work.”