Hello, and welcome to the small farms podcast, a production of the small farms program at Iowa State University Extension and Outreach. Our podcast covers the opportunities and challenges associated with rural life. In this episode, I interview Dr. Justin Glisan state climatologist of Iowa, at the Iowa Department of Agriculture and Land Stewardship. I’m Christa Hartsook, small farms program manager and we hope you enjoy the show. Dr. Glisan, welcome back to the show.

Thanks, Christa. Always nice to be with you.

Alright. So I thought maybe we ought to start and kind of remind our listeners, what your role as the state climatologist entail.

Sure. So it's an extremely interesting job. It's my dream job. So one of the main tasks that I'm responsible for basically the weather archivist or weather historian for the state, we have precipitation and temperature records, going back to 1872. This is the history of Iowa in terms of weather and climate. It shows us where we've been, but also where we're going. And given how important agriculture is to the state of Iowa, knowing the trends that we're seeing, and being able to help farmers and agricultural stakeholders across the state is one of the best parts of my job. And then when you get into the minutiae of state climatologist I certify observations for litigation. So say, for example, there's a slip fall case, I'll pull those weather observations and certify those. And if they're used in litigation, I've been subpoenaed numerous times for expert witness for the state and also other private parties, all kinds of
interesting aspects to my job, weather and data analysis of longer term trends, building out statistical models and statistical tools that tell us and that can show us what types of trends in terms of flooding, droughts, all those extreme events, are we becoming more extreme? And what did those extreme events portend for agriculture or other things across the state? So yes, you could ask me this question tomorrow. And I could give you a completely different answer. But it's a very fulfilling job. And it really encapsulates all the passions that I have getting to work with people, but also studying meteorology and climatology, and then just, you know, getting out and speaking to groups all over the state.

Christa Hartsook 02:33
I know it's always fascinating to hear you speak and to have you on the show and learn a little bit about what we can kind of expect and where we're headed. So I appreciate that. Let's talk first, a little bit about how the state is faring in terms of our drought monitor. You know, we've had a couple of very dry summers. What are our overall soil conditions right now? And maybe how does it compare to our previous year?

Justin Glisan 02:56
Sure. That's an excellent question. I think that's a top of the mind to everybody across the state. We're in the third year of a drought that started in 2020. And now the last pervasive drought that we had was in 2012, across much of the Midwest, this drought is not as pervasive, but it's drought nonetheless. So if we look going back two and a half years, and this sets us up for what conditions on the ground are presently, if we go back two and a half years in that northwest corner, where we currently have that D3 extreme drought category, basically 11% of northwest Iowa. And that's where we see precipitation deficits on the order of 15 to 25 inches, so very dry conditions. In fact, if you look at Sioux City, Sioux City is now surrounded by D4, which is that exceptional drought category. And if we look at a percentile basis for these drought categories, D0, abnormally dry all the way to D4, the driest category, we wouldn't see D4 at a specific location once but 50 to 100 years. So that tells you just how dry things are. Now luckily, Sioux City is on the Missouri River so they do have access to water but still very dry. If you look at Sioux City's period of record, this is the driest year to date going back to the late 1800s, which tells you just how dry conditions are in the northwest corner. If you look at subsoil moisture profiles, given the pervasive precipitation deficits that we're seeing the soil percentiles, if we think of a sponge 100% tile is a soaked sponge. We're on the other end of that anywhere from the fifth to the first percentile. So using that sponge as a proxy, there's anywhere from 95 to 99% capacity for infiltration of soil moisture, so very, very dry conditions. Now luckily last year, as drought was expanding in August in September, we hit the eighth wettest October on record, and when you get into very wet conditions, especially Northwestern Iowa, we actually extinguished D2 and D3 across northwest Iowa. Now you get into a very dry summer the 29th dry summer in 150 years of records, coupled with a very dry fall, one of the top five driest across the northern third of the state. And then you go to the beginning of the growing season in April, top 10 driest growing seasons for Northern Iowa. So you couple all this together very dry conditions. The eighth wettest October last year staved off a rapid expansion of drought through winter into spring, a definitely in the third year of a longer term drought does start to stack those precipitation deficits. Now, luckily, we've had good measurable rainfalls across the south eastern half of the state and even in that northwestern corner, and now we're getting into the driest part of the year, soils will start to freeze and that will cut off
any infiltration that we get. So we would need month after month of above average rainfall and precipitation snowpack, even out to a year to really extinguish those longer term deficits. So one can hope and we'll get into this later with the Fulani in your face shifting that we can get into wet conditions as we approach the next growing season.

Christa Hartsook 06:06

Justin that really kind of leads into the next question, then, you know, what does the remainder of our fall kind of look like here? We're transitioning into some colder temps, obviously, we're getting a little bit of snow today. What do we look like for the rest of our fall?

Justin Glisan 06:19

Yeah, snow is an excellent question here. Because we think about snowpack and the potential that we get in terms of water vapor or water, liquid water out of that snowpack. It's basically 10 to one so 10 inches of snow yields about one inch of water. So while we do see mounds and mounds of snow out there in 2019 2020, we really didn't get a lot of moisture out of that plus the subsoil moisture profiles are frozen, so you're not getting infiltration as we do start to melt. So if we look at the short term all the way out to seasonally, what we're looking at through the end of November is a elevated signal for warmer temperatures. So we've been in a stuck in a cold phase for the last oh 7 to 10 days colder than average temperatures, and we received some snow this morning, it's looking like we're going to transition back to near normal. And then higher probabilities have warmer temperatures, as we move through the end of November, the short term outlooks in terms of precipitation, they are still showing a dry signal, so we're not seeing a lot of potential for rainfall or snowfall in November. And then we get into December, January February, the three driest months for the state, we look at those seasonal outlooks. And you know, they diverge, of course from the Farmers Almanac which is released in early fall. But what we're seeing is that classic la Nina phase sticking around so that we have a greater than 70% chance of that land in your face hanging around for the third winter in a row, which if we go back to 1950, we only have a handful of those events occurring. But so very unique behavior. And for your listeners, that La Nina phase is again a cold sea surface temperature anomaly in the Pacific Ocean, that impacts where thunderstorms set up in the basin. So in that La Nina phase, you get a high pressure that sets off the coast of California, we think of high pressure as stable you have downward motion. Further west in the basin, you have upward motion, you get convection and thunderstorms. Well these two features impact where the jetstream and the storm track setup over the United States. So if we look at analog years in which we've had La Ninas in winter, we see a bullseye for above average precipitation in the Ohio Valley in the Great Lakes and then over into the Pacific Northwest. Drier conditions across the southern states. And then Iowa happens to be right in the middle of those two probabilistic bubbles. So we're right now on the precipitation side for December, January, February, and what's called EC or equal chance of above, below or near average conditions, basically the climatological coin flip with a slight probability bias probability of 34% for what we would expect in winter again, the driest months in the year. On the temperature side, we're actually getting a signal in December, January February, that mimics the LA Nina phase again, where we have elevated probabilities of below average temperatures across the upper Midwest, and that is extending slightly down into Iowa. So we can expect of course cold air outbreaks as we've seen over the last several years. February is actually becoming a very interesting month in terms of cold air outbreaks, increased snowpack, colder temperatures, so
we'll just have to see but again, if we can get a snowpack looking at La Ninas going back to 1950. In general, we expect a near normal snowpack for La Nina years, but if we break those down into the strength of La Nina, so the coldness of that sea surface temperature anomaly, those colder anomalies typically yield below average snowpack for the state of Iowa versus a weak or moderate La Nina which favours above average snowpack. So if that holds in expectations climatologically we should see above average snowpack across the state.

Christa Hartsook  09:57
Okay, Justin, you talked a little bit about what La Nina would mean for Iowa impact in terms of precipitation and temperature. I'm kind of wondering, in general, you know, what are some of those larger climate impacts? If we're going into that third year of aluminium?

Justin Glisan  10:14
That's a great question. And the jury's still out, given that we've only have three year stacks of La Nina, triple stack triple dip La Nina, as we call them. So if we look at precipitation behavior for all La Nina years, going back to 1950, it's all over the place as we move seasonally. So we've had years in which we've seen very dry conditions, and we've seen years where we've had very wet conditions. But if we average all of those out and produce the analog years in which they've been present, again, that feature that we see are the bullseyes for above average precipitation in the Ohio Valley and Pacific Northwest. And it just depends on where that jet stream sets up over the middle of the United States, and hence where the storm track potential is for the state of Iowa. Now, the interesting thing is, is in our probabilistic models and our longer term climate models, we're actually seeing a 57% chance of a shift from La Nina. Again, the cold phase back to what's called enso neutral, enso is the El Nino Southern Oscillation. It's a multi decadal weather oscillation in the Pacific, we can think of oscillation as a pendulum swinging back and forth. So that enso pattern is multi-decadal, as I mentioned, 10 to 20 years, and El Nino and La Nina is a two to seven year cycle within that. So you think of a big wheel, El Nino and La Nina is a smaller wheel that goes around the bigger one. It's all tied into larger scale planetary weather patterns. And now we also have things called the man and Julian oscillation, the Arctic Oscillation, all these different weather patterns that set up on various timescales that also impact how weather sets up across the United States. So overall, with a shift from that La Nina phase into enso neutral, or right in between El Nino and La Nina, that could suggest a shift from this drier weather pattern that we've been in basically seasonally out to several years to a wetter face. And that's what we've seen in some of the model runs but also analog years when we do shift from La Nina to enso Neutral going into the growing season. I think a

Christa Hartsook  12:15
lot of our producers would welcome that overall transition. Should we expect something like that right away in 2023? Are we looking at longer term? What do you think that those models will say?

Justin Glisan  12:27
So we think of La Nina and El Nino as dictating larger scale flow and hence weather patterns that we can see over the state of Iowa getting into several seasons out that's we have climate modeling that we can produce outlooks that go into 2023, and towards the end of 2023, as well. Now we start to lose a numerical certainty as we get further out in those climate outlooks. But a transition from La Nina to enso Neutral is not automatic. It's not like a snap of the fingers. It takes time for the atmosphere to reacquire elebrate or to impose new dynamics. And when we say dynamics, we just talk about the fluid nature of the atmosphere, and how it interacts with the ocean. So for La Nina to transition back to that enso neutral phase, the atmosphere actually decouples from the ocean. So the ocean is not driving a lot of the weather patterns that we see across the United States. But these larger scale weather patterns are what we call teleconnections, because they happen 1000s of miles away, but they have an impact, a good and dominant impact depending on the phase of the weather patterns that we see across the United States. So it might sound like I'm trying to hedge my bets in terms of what we're seeing in those outlooks. But again, coming off the third year of a long term La Nina and then switching back or going through and so neutral, we don't have a lot of data points for that. But when we do look at La Nina is transitioning back to enso neutral, we do see some semblance of a wetter signal start to build in.

Christa Hartsook 13:58
Justin, somebody is really interested in this is there a great bot or region, you know, within those ocean climates and activity that they should really keep an eye on?

Justin Glisan 14:09
Yeah, so we have Nino regions in the Pacific, two or three of those that we look at to sample the sea surface temperature. And in those Nino regions that dictates the strength of the El Nino or La Nina phase and for your listeners, El Nino is the warm sea surface temperature phase that impacts the jetstream as well. So for example, if we were on the flip side of this and an el nino winter, we would typically expect warmer temperatures through December, January, February. So it's very interesting behavior. El Nino and La Nina when they are present are a dominant forcing mechanism in the atmosphere. But we also again have those other oscillations those other thunderstorm driven phases that can impact amplify or deamplify that behavior. That's why climate modeling and forecast ability is so interesting. We mentioned snow storms. You can impact how much snow you get by shifting the track of that low pressure system, anywhere from 10 to 20 miles and the forecast models have a hard time picking up on those things. But overall, those longer term climate models and looking at those Nino regions in the tropical Pacific do give us very good guidance in terms of the strength of the phase, and how long the face is going to stick around. So it gets into the technical weeds in terms of monitoring those regions. But the Climate Prediction Center does put out a good general summary and also technical summaries of those regions.

Christa Hartsook 15:31
Okay, great. What else do we need to think about in terms of our weather in our climate moving into, you know, late fall winter here?
Yep, so we look at our federal record goes back to 1895. I mentioned I have records going back to 1872. From our forts, what we've seen since 1895, is a 1/10 of a degree increase per decade. So we're seeing a warmer atmosphere and via physics, a warmer atmosphere has to hold more water vapor one degree Fahrenheit increase in temperature 4% more water vapor availability in the atmosphere. If we decouple those into seasonal trends, we're actually seeing wetter springs and waterfalls. Now this fall has been the opposite of wet pretty dry conditions, but we look at also snow versus rain, we're seeing less snow and spring, more rainfall events. So take those trends and then look at those short term and seasonal outlooks that we analyze on a monthly basis. And you can kind of see a connection to what we could see generally in terms of expectations, and I mentioned February's a more active month we're seeing more active shoulder months so spring and fall February's are run up into the warm season. So we're starting to shift the large scale weather patterns to thunderstorm driven rainfalls as we get into May, June and July. Another interesting note, if we look at those trends, May and June are still the two wettest months for the state may for the southern third of the state June for the northern two thirds. But we've actually seen a decrease in the amount of July rainfall. And that's over the last 10 years right as crop is maturing hottest part of the year for livestock production, let alone people working outside, when we do see that July is the warmest month of the year coupled with a decrease in rainfall. That's where we can see drought expand more rapidly. So those are those trends that we talked about. And also, the weather patterns that we see is a dominant phase of El Nino or La Nina. So when we look when we look at those seasonal trends, and we couple those with the the climatological outlooks that are produced, the monthly outlooks are produced an initial one in the middle of the month, and then the final monthly outlook at the end of the month. So for example, the final November outlook was issued on October 31. You take all those things together. And, you know talking with farmers that can give you an idea of what hybridization of corn you would like to use, or you know, when you want to plant. Another trend that we've seen is a decrease in frost days. So we've actually increased the growing season by anywhere from 10 to 12 days. So knowing that springs are becoming wetter falls are becoming wetter, a dip in July precipitation and expansion of the growing window by 12 days. We've got buffers that are built in and using these as guidance for your your next growing season or looking back at the previous growing season. I think it informs scientists, but it also informs farmers and ag stakeholders of the tools that we have out there that we can help each other with.

Absolutely. And knowing where to find those is a great important skill for producers. So you mentioned a lot of what you put out and where can our listeners go to find that information?

Well, I've been blessed and very lucky that I work with a set of Iowa State Extension field agronomists that are They're a tremendous group and I learned something from them every day. We have a great working relationship. I do field tours with them. They have great resources on their websites, I always say to extension, Google Iowa climatology bureau that brings you to the Department of Agriculture and Land Stewardship's climatology site has recent reports recent temperature, precipitation behavior, historical reports, soil temperature, soil,
moisture, climate outlooks, anything you would ever want. My contact information is there. If you don't see something that's on that site, send me an email or give me a call. I will find it for you or I will point you in the right direction. But yes, part of my job as state climatologist as being a repository of information but also someone that can guide you to the correct information. Also the Iowa Environmental Mesonet run by Darrell herzman at Iowa State is one of the best websites in terms of data availability. I use it almost on a daily basis. The Midwestern Regional Climate Center also has a great set of tools. All these sites are linked on the climatology Bureau site, but if you can't find it again, I'm your source.

Christa Hartsook  19:59
Awesome. It's all was fascinating to have you on the show, Justin, I really appreciate and value your insight into what we're going to be facing or what could potentially come down the road. So thanks so much for being on.

Justin Glisan  20:10
Thank you, Chris. Always excellent questions.

Christa Hartsook  20:12
All right, take care.

Justin Glisan  20:13
You too. Thank you.

Small Farms  20:15
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