GLOBE Observer:
Locally-Based Global Citizen Science
By Holli Riebeek Kohl,
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Moderator: Amelia Chapman
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3:00 pm CT

Coordinator: Excuse me. This is the conference operator and I just wanted to let everyone know that the call is being recorded at this time. If you do have any objections, you may disconnect. Thank you. You may begin.

Amelia Chapman: Welcome everybody. This is Amelia Chapman. Thank you so much for joining us today for the Museum Alliance Successional Development Conversation Globe Observer for Locally-Based Global Citizen Science.

I'm reminding everyone to please mute their phone, not just put us on hold and I've already had a question about the presentation. It is on the Museum Alliance Website. If you're a member of the Museum Alliance, please go to that website and you'll find it under conversations and it's also on the Solar System Ambassador site.

If you are not able to see it there, in just a minute, please tell me your email address and I'll send you the information or you can email me at amelia.j.chapman@jpl.nasa.gov. But I want to go ahead and introduce our speaker today – Holli Kohl. She's been working at Education and Communication in the Earth Sciences Division at NASA Goddard Space Flight Center since 2003.

Prior to becoming the Project Coordinator for Globe Observer, she wrote for the award-winning Earth Observatory Website and led education and communication efforts for the Terra and Landsat missions. She has a degree in

physics and science communication and she's also made it clear that she's happy to take questions as we go.

So with that I'm going to just turn it on over to Holli.

Holli Kohl: All right, thanks, Amelia and thank you so much for having me today. I think somebody had asked if there was a video combo and it's to the call and it is just audio but the slides themselves which are on the website or Amelia sent you do have little videos embedded in them and if they don't play, I also give you the YouTube URL so you can go look at them later. So that's what we were talking about when we were talking about a video component.

Slide1: So I'm just going to start up my opening slide and I will try to remember to tell you which slide I'm on. As Amelia said – I'm coordinating a new program called Globe Observer. It is a citizen science program and it's based on the Globe Program.

So you may be familiar with the Globe Program. It's a 20-year-old program for students to involve them in taking environmental observations that are useful to Earth scientists – particularly NASA Earth scientists. And so all of the observations that Globe takes are meant to help students gain a view of the planet as a system to understand Earth system science in some way or another and it's a really great program and it's a rather mature program having grown over the last 20 years and developed into a strong and really vibrant community.

And so as we were looking at the Globe program we were thinking about what's the next step for developing this program and also for getting more data. There are a lot of options and opportunities for students to click lots of different kinds of data and as a result you get lots of individual data

collections but maybe not as deep a record as you would like or as consistent of a record as you might like.

And so in terms of getting more data for scientists and also for student researchers, we begin to wonder what's the next step. And we've concluded that opening this up to everybody – to citizen scientists – is where we wanted to go next and so Globe Observer is a result of that effort.

So Globe Observer is taking some of the protocols that were developed for Globe – some of those environmental observation protocols – selecting a handful of them and then providing them to the public in the form of a smartphone app that requires very little training to use.

And so we're trying to take some of the complexity of taking some of those observations and measurements and removing that by using technology. So what I'm going to do today is give you an overview of the program. I'm going to tell you about an opportunity you have to participate in a challenge with the Association of Science and Technology Centers in October and then I'm going to show you a few resources that we've put together for people working in museums and libraries and I'm going to assume they're going to be useful to solar system ambassadors as well.

So my contact information is on that first slide. My email address is there and please feel free to get in touch with me at any point.

Amelia Chapman: And Holli I'm just going to break in just for a minute. It does sound like we still have some open lines so once again anyone on this call, please make sure you mute your phone. Thank you very much.

Holli Kohl: Thank you. All right, so I'm on Slide 2 now. So as we began to develop this program, we had the opportunity to partner with the Association of Science and Technology Centers. They're holding an International Science Center and Science Museum Day on November 10th and this is done in collaboration with the United Nations and the UN sustainability goals is really the focus and so the day is the International Science Center Day and they're trying to raise awareness about the importance of science centers and museums to bringing environmental awareness to the planet.

So as part of this day they wanted to do a Global Experiment and they contacted us and asked if they could use Globe Observer as the platform for this experiment. So of course we said yes, that sounds like a really great opportunity. And the challenge is that we invite every participating museum or associate – libraries, solar system ambassadors are welcome to join in- to invite the public to take cloud observations for a two week period from October 1st to October 15th and that period of time includes three weekends. So that includes plenty of time for events and large public presence at museums and science centers.

That period of time also coincides with the amount of time it takes to get a full global composite of the Earth from some of our cloud observing satellites. So we will be able to get – we're hoping – the first full international view of the globe from the ground looking up into the sky while we simultaneously get a full view of the globe looking down from space. That's kind of exciting being able to pair those two up and I don't know that that's been done before so it'll be exciting to see how much of the globe we can fill in in that period.

So as I said before, I'm going to suggest some hands on activities and some programming ideas you can use for an important event if you decide to hold one and then at the end of that two-week period we're going to release a data

animation that we will share with museums and science centers and I'll be happy to share it out to the Museum Alliance as well on the 10th so that you have a sense of the impact of the event. So moving on – any questions about that before I move on?

Okay. So again this is an event that's sponsored by ASTC– the Association of Science and Technology Centers – and I'm sure that if you go to their website especially if you're a member of the organization, you can get more information about this.

Okay so next slide, Slide 3, is just an introduction – What is the experiment? – and so I'm going to provide an overview of the app and what you can do with it and I hope that you consider using it with audiences outside of the challenge. I mean the challenge is a really great opportunity to dive in and be a part of a bigger event but I think it's useful beyond that.

I'm going onto the next slide, Slide 4, called "How does it work?" And the image I'm showing you here is the opening screen of the app. The app is currently available on Google Play and in the app store so we have it for Android and iPhone so we do not have a Windows version of it. So it's available now. You can go download it. It's free of charge. Once you download it, you will be asked to register.

To register you just need an active email address and we just want to verify that you are an actual person and actually using the app. So you will submit an email address. It will send you an automated email – with a URL and a password and then you enter that password into the app and then that registers you and will recognize you as a citizen scientist from that point forward.

When we share out this data – and I'll show you in a little while how we do that – but when we share out the data you collect with other people – particularly students and scientists – your email address which is the only way we have to identify you – will not show up. You will simply show up as a citizen scientist at a particular location. So there's no identifying information for any public view.

So I'm going to the next screen, Slide 5. It's also titled "How does it work?" It's kind of a follow-on. We are creating a new feature for – specifically for informal educators. It says Museum Registration at the top because this is focused on that event which was targeted at museums however this will work for anybody.

What you will do if you are sponsoring an event and you want to create a group of citizen scientists that are affiliated with you as an organization, you're going to create a referral code and you will send it to us. You can send it to my email address directly. There's also some Contact Us buttons in the app and you can just use that and it will reach me just the same.

So you're going to provide and just tell us hey, I'm working at this museum. I'm organizing a Citizen Science Club and we're going to organize everybody under this particular referral code and the referral code can be the name of your museum. It can be something just easy to remember. It doesn't have to be a code per say.

So users – when they register for the app they will have your code. And if my code is natural history museum or natural history or something like that and I'm registering, I enter my email, my country and then my referral code – natural history – and click create an account. And that means that my account is now directly affiliated with that museum and all of my observations will be

something I can see but will also show up under that museum. Is there a question? Okay, I thought I heard somebody asking a question.

We don't have – so this is a new capability. It will be added to the app and it will be updated in the near future – probably in the next few days but certainly by the end of next week. It isn't in the app currently but it will be very soon. This is a brand new thing that our developers just started to work on yesterday. Are there any questions about that before I move on?

Jeff Nee: Yes, hi Holli. This is Jeff. For the referral code, it's just whatever the museum makes up for themselves. Is that right?

Holli Kohl: Yes and just register it with us. So just send – yes you can make it up yourself but then send it to us so that we have – we know what it is. And then – and we can start grouping people under it.

Jeff Nee: Oh, great. Okay.

Holli Kohl: So we don't have these random codes.

Jeff Nee: Okay, thanks.

Holli Kohl: Yes. If somebody just puts one out there that they've made up and it's not anything we recognize, we probably won't do much with it. We'll probably just toss it.

Jeff Nee: Okay, thanks.

Holli Kohl: All right, so once you have an active account – oh I forgot the other point I was making. This is for new users. So if you already have an account and

you've already basically been affiliated with your country is what happens and so we can't affiliate you with somebody else and so unfortunately just in the development process the way the database is working, you would have to delete that account and then create a different account if you wanted or just create a totally different account which you can do with that referral code.

They'd have one ID with the referral code and one ID which would be another email address with the other code or just affiliated with your country.

Okay so next slide, Slide 6 – still titled how does it work because this is all about how the app works.

So after you register, you will be – and you go back and you confirm that you're real and you enter your password then you will be brought to a tutorial screen and this is something that only pops up the first time you use the app. You can get at it again by clicking on the question mark button down in the lower right corner but it doesn't come up for you at that time.

So the tutorial is very short. This particular one is four screens long. It orients you through the Globe program to what Globe Observer is and to the protocol to the – what you'll be doing as you make an observation. So I've only included the three screens here but I just wanted to include these to show you that it really is not extensive training. It's very, very quick and we wanted it to be just a basic orientation simply because we want the barrier to entry to be very low.

So the next slide, Slide 7 – once you complete the orientation this is your – sorry. Once you complete the orientation and you click on "Clouds" from the home screen, this is where you go.

We currently just have cloud observations in the app though the plan is in the coming months to add other observations so people can help us observe things like land cover, what's growing on the surface of the land. Is it forest? Is it a parking lot? Is it mixed use? What is it? And then we'll be adding some other things as well but right now we're looking at clouds.

So this is the screen and to orient you if I wanted to start a new cloud observation, well I'm going to start at the top. So you have Globe Cloud tells you what you're observing. Observations tells you how many observations you've taken so when I took this screenshot several months ago, I had taken 13 observations at the time.

The next button down – the blue one – this is where you go if you're going to start a New Cloud Observation and that's where I'll go – what I'll talk about mostly but I wanted to let you know what else is here.

The third one – Review/Send My Cloud Observations. Because we want people to be able to take observations while they're offline once you take an observation, it's actually stored on your phone and you do have to go back and review it and actually send it and that's an active step. So this is where that happens and I'll go over that at the end of the process.

The third button down allows you to Check Satellite Flyovers so when you read the orientation at the beginning, one of the things that it tells you is that the observations we want most are those that happen simultaneous with a satellite flyover so that we get that double view from the top and the bottom occurring at the same time.

And other observations are useful to us as well, you know. We would like to know what clouds are doing because they change throughout the day when

our satellites aren't looking but the most useful ones are when the satellites are there. So we give you a way to check and see when the next time the satellite will be directly over you as using…

Man: I've got a quick question.

Holli Kohl: Yes.

Man: Quickly on the cloud satellite flyovers – I looked at that and there were times. Are those local times for me or are they international universal time?

Holli Kohl: No, those are local times to you. Let me just – I'm starting to second guess myself. Last time I looked at it, I remember thinking they were local times to me. Let me just open it on the fly here. Yes, yes, they're local times to you.

So what we're doing is we're using the location – so if you click on that you'll see at the top of the screen – it'll say here's your latitude and longitude and for that latitude and longitude here's the schedule for the satellite. So it's looking at the satellite schedule and grabbing the time based on where you are and your time zone.

So the fourth button down is See My Data. So yes, I'm curious to know if there's a trend or I just want to review what I've done. So I can click there and just see all of the observations that I have made. And then the button underneath that which is kind of hidden under the Nav. stuff, that one is see everybody else's measurements from today. So if I clicked on that, I would get to a map which I'll show you in a little bit where I can see everybody else's cloud observations and I can compare what I'm seeing to what other people have seen.

And then quickly at the bottom we have some Navigation Tools and on the left – the darker blue ones – that home button brings you back to the opening screen that you – that I first showed you and then the bar graph button brings you to your data. It's basically the same thing as CMI data.

The navigation button on the left side – you have a pair home button that brings you to the home for the protocol that you're on so it'll bring me to this screen if I'm doing clouds.

The satellite outline next to it will bring me to the check satellite flyovers page. So if I'm somewhere else in the middle of the process and I want to double check and see if this is really the right time to be taking an observation, I can click there and pull up the satellite servers without having to come back to the home screen.

The third button is a cloud key. I'll show you why that matters in a little bit and then the fourth one is a help screen and if you click on the help, it will bring you to a list of options that includes the initial tutorial, other places to go for help like frequently asked questions and then a way to contact us.

So moving onto the next slide, Slide 8 – you should be seeing a title how does it work and then three screenshots. The first says time and location. The middle one is cloud coverage and then the other one is types of clouds. So these are the next screens you'll be seeing.

So you say I want to do a new cloud observation. You click on New Cloud Observation. It'll open up a time and location and that currently auto fills so it'll take the current date, the time from your phone, your current location. Now you do have the ability to change that if you think that your phone is

wrong that the location isn't accurate for whatever reason. You can change that and we will be adding very soon a map interface.

So some people have had trouble with their location services not working properly or not auto filling and so we will have a map interface pretty soon where you can zoom in and you can tap on a map to indicate where you are as a backup. But that should auto fill and you should just be able to click the big green Next button and move on.

In the middle screen the next thing you'll do is you'll just say well are there clouds outside? Is it clear, cloudy or are there things in my way that make it so that I can't see the sky? And by obscured that means is there smoke from a wild fire or blowing dust or heavy rain or snow or fog but it's making it such that I can't see more than 25% of the sky. And if that's the case, you just select obscured and it will ask you well what is obscuring your view and you'll select dust or smoke or pollution or precipitation – something from the list of options there.

And then if you select step outside and there are no clouds, you select care. You're done. Your observation's finished and thank you very much. That's all we needed and that's an important observation to be making. No clouds are as important as some clouds but I'm going to assume that there are some clouds visible because that's the case most of the time.

So I would select clouds visible and that takes me to the next screen which says well okay, what kind of clouds do you see. And the first thing we want to know is well how many – what is the percentage of the sky covered by clouds? This is actually kind of a hard thing to estimate and so we provide a range.

So is it 10 to 25% of the sky, 25 to 50, 50 to 75 or 75 to 100 and things in that range seems to be a little bit more realistic for people to estimate.

So after you provide an estimate of the percentage of cloud cover, you're going to tell us the cloud types and I'm going to click to the next slides, Slide 9, because I have a more complete view there. So again you should be seeing how does it work and three screenshots showing types of clouds.

And the type of clouds – we have the basic cloud types. We don't have some of the rarer cloud types but we have the basic cloud types that you will see in the sky and we have photos that you can compare the photo to what you're seeing and give your best guess as to the cloud types that you see in the sky and there is probably more than one type of cloud visible. And so you check whatever is applicable to what you see.

Now we realize this is probably the hardest part of the process and the part that people feel the most uncomfortable with. So we have a little key and that's that key shaped button in the navigation on the lower right. If you click on that, it will pop up a cloud key and it has more pictures and it has a more detailed description of the cloud types and some tips on observing that cloud type – for example it'll have tips on telling the difference between zero cumulus, also cumulus and cumulus. So it'll give you some clues about how to differentiate those.

So if you're not sure what a cloud is, click on that key and use that as a tool to help you differentiate. The other thing I like to tell people is this is an art almost more than a science. I've been outside with people who are really familiar with clouds and classifying clouds and had those experts disagreeing about a particular cloud – what type it is – and my point in saying that is even the people who are most familiar with clouds may disagree and so it's okay if

you classify something and somebody else classifies that cloud as something else. It’s just do your best to estimate what it is and that’s okay.

So after you select your cloud types, we ask if there are contrails in the sky. That tells us something about the atmospheric conditions at the time. And so if there are contrails, you say yes there are contrails or you say no, there are no contrails if there aren't. And if you see contrails are visible – this is not a screen I grabbed – but you’ll get another picture guide similar to the cloud types and it will ask you what kind of contrails do you see. Is it a new contrail where you see the plane and you see a short contrail behind it but the contrail’s kind of disappearing pretty quickly.

Is it one of those? is it a contrail that’s been there for a while but the plane’s long gone but you can still see the contrail and it’s still fairly distinct or is it a spreading contrail where you can see that it’s kind of spread out and puffy and it’s also been there for a little while. So you select one of those and then you tell us how many of those – of each type you see. So I see two fresh ones and three persistent contrails in my sky.

The next step then for the next screen, Slide 10, also says “How does it work?” and I have two screenshots and it should say photos at the top. We are asking people to take pictures of the sky and we’re asking for photos facing north, south, east, west, up and down.

By doing north, south, east, west we get kind of the 360 view and then straight up obviously we get the clouds above us but down is something we ask for because that’s something that a satellite sees. When you’re looking at clouds from space, you’re seeing the earth from the top down and sometimes it’s really difficult to differentiate between what’s on the ground and what’s a cloud. Some of those things are similarly colored or have similar properties

and so it's helpful to us if we have a photo of the ground so we can see okay, this is a giant snow field or this whole area is covered in snow so I get why we can't tell the difference between white clouds and the ground.

So as part of the photo process when you say collect a photo, it will have you turn your phone to landscape mode. There will be a little bubble and it will say north, south, east, west – a little circle – and so you rotate until that circle is aligned with a – there's another circle in the middle – and then you tilt the phone until it's aligned up and down. It's kind of like using a level if you've ever used one of those – a level to like hang a picture or build something. You're just lining those bubbles up.

And once the bubbles are lined up, side to side and vertically – you have your angle right and your direction right – it will automatically take a picture for you.

So since this is really difficult to describe, I actually have a video of it. So that's the next screen, Slide 11, and hopefully it plays for you. So if you are able to play it, I would recommend hitting play on your computer and I'll give you a few minutes to watch it. It's a really short video.

Jeff Nee: And Holli for those who don't have the PowerPoint, I uploaded the MP4's onto the Museum Alliance site so if you just click on those, you'll get it.

Holli Kohl: Great.

Kay Ferrari: And those videos are also on the NASA nationwide website. So if you got in before they were posted, refresh that page and the videos will appear.

Holli Kohl: Fantastic. We also have them on our YouTube channel. So if you look under YouTube – NASA Globe Observer – you will find the videos there. So it's just a quick little I think 20 second video but it shows you that process – that photo taking process.

So I'm going to assume everybody's had a chance to look at that and I'm going to move on and again it's available so you can look at it again later if you didn't get to watch it. So the next slide, Slide 12 – you again have your three screenshots and the first says Observation Complete. The second one has my name at the top and the third one says The Globe Program at the top.

So starting on the left again – after you take your pictures, it will say great, you're done. We have everything we need from you. And you now have the option of going back home, reviewing your observations. Actually I don't know what the share button does. I should go play around with that but so you can go review – so like I said before. If you are somewhere where you don't have a good data connection or you don't particularly want to use your cellular data to send the pictures in which is probably the most data intensive part of our process – you want to be on a Wi-Fi network – you can go do that later. You don't have to do that immediately.

I like to, you take the observations outside. I like to go inside to review them because a lot of times when you're outside, there's enough glare that it's hard to see your screen and to know that you actually entered what you thought you did.

So once you're to a place where you're actually ready to send your observations in, you click that green Review/Send My Cloud Observations and you'll get something like the middle screen. It will show you – it'll step you through and you can look at all of the fields you entered and if you find

that there's something that you didn't intend – like you said that there were five contrails and you really didn't mean that – you only saw one – you can go click that, edit it and then come back and finish reviewing.

You can also review your photos to make sure that they are what you – what you had thought they were. Sometimes with the auto photo, where you're lining it up with the picture and the circles, it automatically takes your photo – the photos don't necessarily always take if you're in a hurry and you think it took. Sometimes it didn't. So it's nice to be able to go back and review and make sure that they really are all there.

And then you click Submit Observation and it says I'm sending your photos in because that's the part that takes the longest and then it gives you a screen that says okay well here's – here are your observations then. Here are the observations you took recently and you'll notice that on mine, you know, I went to that immediately after this and my photos aren't there. It says no photos uploaded but I know I sent them.

What's happening is we take a little bit of time and we hold your photos and we review them. So somebody on our team is looking at every single photo that is submitted through the app just to insure that it actually is a cloud, that we're not getting something else. The data you collect in the photos are available to globe students who are doing student research and those students are elementary age to high school age and some college. So because it's available to kids, we just wanted to make sure that nothing inappropriate made its way into that database. And so we review everything.

And so if there's a recognizable face in the photo or text, we just remove that photo. We're trying to protect peoples' privacy and also to eliminate

opportunities for offense. So anyway, once you see your data it might take like a day for the photos to show up.

All right, next screen, Slide 13, is another video that I think I'm going to skip because I've already talked about it but that video shows you some of the navigation tools and how to use them. So the next screen, Slide 14, after that is our YouTube page and I provide the URL for all of our videos. So I have each step of the data collection and submission process shown in these videos and broken down into four separate videos and then we also have – if you click on the little arrow to see other videos on our channel – we also have a video explaining the science behind the cloud observations – why we actually want them and how we – is everyone still there?

Man: Yes.

Kat Ferrari: Yes, we are.

Holli Kohl: Okay, I just heard a beep and I didn't know if that meant I was disconnected. Okay so, one is the science video and one is a basic orientation invitation to participate in the program. You're welcome to take them and use any of those however you like. They are Public Domain.

Okay, next slide, Slide 15. Questions about the process before I move onto the science? Okay. So next, Slide 16, Seeing the Data. So this is how you are going to be able to find your observations and other peoples' observations on our webpage. So next screen, Slide 17, it shows you the Globe Observer webpage. It's a very simple design because we are just assuming that most people are going to be looking at it on a mobile device since this is a smartphone app based program. We're just going to assume that you're

looking at our website on your mobile device so it's fairly straight forward simple navigation.

So if you scroll down that page, this is our homepage – observer.glob.gov – you scroll down that page and that's the next slide, Slide 18. In the middle of our homepage is a section called our data and you see on that slide there's a map of observed today. You click on that map and go to the next slide, Slide 19. You should see a global map with a bunch of dots on it.

Each of those dots represents a cloud observation made by a citizen scientist on that day – whatever day you're on. So I grabbed this on the 11th of September and you see all of the observations made that day. And if I wanted to look at other days, I could go – there's a slider bar up in that top left corner there – I could go to that slider bar and move it and see other days or I could type into the little box to see other days.

For us – for clouds we've been in existence and public since the 30th of August so we can't go back too, too far but you can go back a couple of weeks.

So each of these dots represent an observation and you see the color actually is an indicator of what the observation is. So the solid blue dots, you see in New Zealand there are two solid blue dots. It tells you that there were no clouds over New Zealand that day.

If you go to solid grey – the lighter solid grey like the one in Kazakhstan or there's one in India –those indicate that it was 100% cloudy that day and the partial dots are an indication of partial cloud cover. So anywhere from 25 to 50 to 75% depending on how much blue versus grey you have.

The dark grey – there's one in Alaska – that tells you that the sky was obscured by something that precluded the observer from actually seeing the clouds.

We're finding that the people don't necessarily understand that that's what we mean and so not all of those are actually obscured skies and so if you clicked on that dot, you could see what the person actually observed and then you could say okay, they just misunderstood or truly there was volcanic ash blowing around in the sky which is something that you get there in Alaska.

The legend- so if you wanted to know more about what the blue dots are, there's a little legend at the bottom in Antarctica on the lower right side of the map and there's a little blue arrow you can click on and that will pop up and show you the legend.

And then if you are a museum or library or an ambassador wanting to lead a citizen science club or something – an event – and you have a group of people affiliated with you through that registration code, we're going to provide you a URL or a way to modify this URL so that you can see just the observations from your group.

And since this is something that our development team dreamed up last night, I can't tell you where that URL is yet but we do have a page on our website and I give you the URL here that where we provide information for museums and libraries and I will post on that website how to get to the observations that are affiliated with you. So I'll give you that URL and you can provide those directions there or you can contact me and I will send that to you as soon as that feature is ready hopefully in the next few days. Any questions before I move on?

Okay. So why do we want these – all of these cloud observations from everybody – How do your observations support science? Next slide, Slide 20. I'm actually – and then the next slide, Slide 21, again. You should see something that says what are clouds at the top.

So this is just giving you a basic definition. Clouds are when a large number of water droplets or ice crystals are present, they block light enough for us to see them and they become visible clouds. So at any given time over half the earth's surface is shadowed by clouds which I thought was an interesting statistic – also something we didn't know until the satellite era. We didn't know how cloudy earth was until we were able to go into space which was kind of cool.

Next slide, Slide 22 – What can clouds tell us? They tell us something about the conditions of the atmosphere, is it really dry? Is it moist? Where are the winds blowing? How they also tell us how much sunlight and energy is reaching the ground and escaping back into space and this is the core of why we study clouds at NASA. It helps us to understand climate and understand the transfer of energy throughout the Earth's system.

So as you see in the photos, those high thin clouds allow sunlight to come through to the ground but the low thick clouds block the sunlight. And they – they both effect the amount of energy that reaches the surface of the earth.

Slide 23. So some science questions that depend on cloud observations, how much does cloud cover affect the surface temperature and the surface air temperature? So the temperature of the ground if you touch the ground how hot is it to the touch and the air temperature – what you feel around you. How much do clouds affect that?

Next slide, Slide 24 – What is the relationship between clouds and rainfall? If you get more really dense clouds, you get more rain and what is that relationship? And that may seem kind of obvious but it's actually a really important question especially if you start talking about how clouds are changing in a changing climate and what that means for changes to the water cycle and the availability of fresh water in communities. Next slide.

Slide 25. This is the meaty slide. So how will clouds respond to a changing climate? And this is – this is a huge, huge and important question. So in essence high clouds enhance warming. Low clouds enhance cooling. So as we get a warming climate, you have more energy because you have more energy kind of staying at the surface and in the system. You have higher temperatures. You get more water evaporated into the atmosphere so higher energy, more water. What does that do to clouds?

So you get more of those low clouds that are going to have a cooling affect or do you get more of the high thin clouds that actually have a warming affect? You see the diagram there on the right. You see that those high thin clouds – they let the sunlight through and some of it is reflected off of the surface of the earth and some of it actually heats the Earth up and the red diagram is an indicator of the heat leaving Earth's surface and going up to those high clouds and some of that heat does escape through those clouds back into space but those clouds are actually really good at retaining that heat and pushing it back down to the surface. So you see more energy coming back to us than is actually leaving.

On the other hand, the low fluffy clouds – they're really bright and thick so they reflect a lot of sunlight. So you've been outside on a hot summer day and had a cloud move in front of the son and you felt the temperature drop. Well that's this type of cloud in action. It's blocking that energy from the sun.

So when you have a cloud like that, less actually gets through so you have this thin yellow area going beneath that cloud, indicating the less direct light from the energy from the sun is actually reaching the surface of the earth. At the same time, you still have heat coming up from the earth and that heat is trying to go back out into space and some of it – and it looks like it might be about half of it – makes it through those clouds but half actually comes back down to the surface.

So if clouds never formed in oure atmosphere, our planet would be more than 20 degrees warmer on average because of this cooling effect of the fluffy clouds but as clouds change, how does that change the way our planet works? Do we get more of an increase in heating? Do we get an increase in cooling or is it going to balance out? Does it amplify global warming or does it dampen global warming? This is why it's so important that we study clouds that we see them from satellites and also from the ground and when we're looking at them from satellite, we're looking at the tops of the clouds and how things are functioning from that perspective.

When we're looking from the ground, we're seeing the lower layers. And so, the atmosphere is very complex. You get those high clouds and you get the low clouds and if you're just looking from the top, you may not even know what is happening in terms of the low clouds closer to the ground. You don't have a full picture. Other than from the ground, you don't see everything. So we really need the combined view of citizen scientists and satellites to get a full picture of what's happening here.

So this is a really critical question and I know I talked about precipitation a minute ago but if you're getting cloud types changing – if you're getting more of those high thin clouds, they don't carry a lot of water and they don't rain –

so you're getting more of those. That means you're getting more droughts. If you're getting more of the low fluffy clouds in some areas, you're getting more rain and maybe it's a little bit of both. It's just a change in the intensity of the cycle.

So all of those are really important questions and they have a direct impact on our day to day life and they influence the precipitation that we do get and the severity of precipitation.

So you think you're outside just taking pictures of clouds but it actually is answering some pretty important science questions that are very relevant to our well-being.

All right, next slide, Slide 26, is about contrails. We care about contrails. It tells us about the atmosphere and we ask is there a relationship between contrails and cloud cover and when you have contrails, does that mean certain kinds of clouds and so – next slide.

Slide 27. How your measurements help us understand how cloud climatology may be changing – I think I talked about that already so I'm going to move on but we can see – just to make a point there – on the right we can see small features like short lived contrails or small clouds or the edges of clouds that may be hard for us to detect from space but they're actually easier to see from the ground. And so there are things that you can observe and report that we may not otherwise be able to see. Next slide, Slide 28 – more ways your measurements can help.

Your measurements help us verify and improve automate remote sensing. So, when we have our satellites looking at clouds, we have automated algorithms and they're calculating cloud cover, energy and things like that and your

observations help us improve those algorithms so that we actually have a better understanding of what the satellites are telling us. It also helps us improve our interpretation of satellite observations.

Like I was talking about before, sometimes it's really hard to see the difference between the ground and the cloud and looking down from space but you looking up into the sky – it's a lot easier to tell the difference between sky and cloud – so the combination is really, really useful. Next slide.

Slide 29. Okay, we've got 10 minutes. Implementing the Challenge – so this is for museums if you're participating in that ASTC Global Experiment, I wanted to provide some ideas for hands-on activities and explainers – things that you could use in an informal education environment to introduce clouds and provide some context for these observations.

Again this is something you can use any time. You don't need to wait or you don't need to just use it for this event or even do the event at all. You can use this at any time. So if you go to the next slide, Slide 30, I provided an example of one of the activities we have on this page. This is something that I think a lot of people have done before. It's a cloud in the bottle but I suggested it because it's one that I have done in a large public event before and it's something that generates a lot of attention. People are really curious and it's a great conversation starter.

It doesn't take long. It's something that you can involve the crowd in doing the actual experiment and it's a short experiment and it makes noise and it's really flashy so it draws attention then allows you to start a conversation.

I just provided and showed this particular experiment. Basically you have rubbing alcohol that you put in the bottle and you swish it around and you

don't need much. You just need a little tiny bit and then you tap the bottle with a rubber stopper that has a needle from like a bicycle pump, the needles that you use to inflate balls, put that needle through the rubber stopper, attach it to the pump and then you're going to pump the air into the bottle.

Basically you're going to create a high pressure environment inside that bottle and then give it a good 10-12 pumps and that's something that's fun to involve kids doing because it gets hard at the end. And then you pull the stopper out of the bottle and the difference in pressure will actually cause the alcohol to evaporate and condense into a cloud.

And if you use this particular method, there are lots of ways to do a cloud in a bottle. I've seen smoke and water and a match – you put a burned match in a water bottle or a bottle with a little bit of water in the bottom and that works and then you just use pressure from your hands to create a cloud and I've seen a few other approaches to creating it but this alcohol one works every time and it's pretty dramatic.

So I included the URL for the alcohol one which is for the sticky spaces one but there's another one on the school URL that I included – the second one. And then I included a list – we just have a list of activities with links off to where you can find them at the observer.globe.gov website in our section for museums and libraries – really for informal educators. Anybody can use it but these are just activities that we felt would be most useful in those settings.

So that's the conclusion of my presentation. The last slide, Slide 31, provides my email address – as well as the team's email address. So if you email that team address, you'll get our small team. There's 10 or 15 of us. And so I'm including these so we'll all see the requests and they will mostly be answered

quickly and then I have a URL there for our tips and help page for additional questions. Any questions?

Amelia Chapman: Sometimes it takes people a while to unmute their phones so I'll just ask the first question. I know that the cloud protocol is the first thing you have planned for Globe Observer. Do you want to give us a sneak peek of what other options are going to be coming up in the future?

Holli Kohl: Sure. So the first thing that will be happening in the very near future is we'll be adding some stuff to the cloud protocol and so we'll be asking maybe similar detailed questions about things like sky color and temperature and that will get additional things like air quality and the temperature one is one that we hope to use. Temperature and cloud is something we hope to use together as a suggested activity to do during the 2017 solar eclipse next August because those conditions would be your temperature and your cloud cover may be changing as your solar radiation changes during the course of that eclipse.

So it's an environmental experiment that we're putting together so that will be available fairly soon. The next thing we'll be doing after that is we're adding another protocol – another kind of observation that you can take – and that one will be mosquitos. It will be looking at mosquito larva and to identify the three species that are the major disease carriers.

So those three species are the ones that carry the Zika virus and the malaria and dengue and some of those nasty, nasty diseases. And really those three are the big ones. Other species are not quite as dangerous so and they're actually fairly distinct – fairly easy to identify at the larva stage. So we'll have a protocol in helping people identify those mosquito larvae and also suggest

ways to eliminate places where mosquitos are breeding so where are you finding those things.

So that'll be our next one and we're planning on putting that out by the spring of next year and then after that we'll have land cover that will be summer of next year.

Amelia Chapman: Cool, thank you.

Holli Kohl: And we'll add additional ones in out years but we haven't agreed on what those will be yet. So…

Jeff Nee: Yes Holli I had a question about the obscured – actually just so I'm clear you don't mean building sort of trees or anything like that, right? You mean atmospheric obscures?

Holli Kohl: Yes, we mean atmospheric things and that's a really great point because I think a lot of people get confused and say well I don't have a great view of the sky because I'm in a city and I have skyscrapers or lots of trees around me. So no, we just mean things in the atmosphere that'll prevent you from seeing the sky.

Jeff Nee: Okay and I just want to tell you that I really love the website. I'm looking through it right now and I especially love the top photos. That's always nice. Is that curated by a person?

Holli Kohl: Yes. Yes, that's our team choosing some of the more interesting things we get. Now that's actually a – I feel it's fun to have but we need to develop the way that it's presented a little bit more so that will be changing but we're trying to feature peoples' observations because we feel like Citizen Science is most

effective when it's a conversation and we want to encourage that community development and conversation.

So we do have that section of the website but we also encourage people to submit stuff to us on Facebook and Twitter and we comment on their observations. We've shared a number of citizen observations through those meetings. So we're trying to use social media as a conversation space and the website is kind of the archive space.

Jeff Nee: And I know that museums will really appreciate that you let them brand with their own reference code. That's really helpful so thank you for doing that.

Holli Kohl: Of course, yes. And I think it's useful to Citizen Scientists as well because you have another community that you belong to.

Amelia Chapman: Do we have any more questions? All right well if not, I would just like to be the first to thank Holli for joining us today and to thank you for joining us. I invite everybody back next Tuesday, September 20th at 12 noon Pacific. We'll be learning about Curiosity's Martian discoveries and future exploration plans.

So once again thanks for joining us today and have a great weekend.

Group: Thank you.

Jeff Nee: That was a great presentation.

Holli Kohl: Thanks. Bye.

END