We are Margaret Kosmala, Koen Hufkens, and Josh Gray, climate change researchers at Harvard and Boston University who are using automated cameras, satellites, and citizen science to learn more about how future climate change will impact plants across North America. AMA!

Seasonspotter [1] and r/Science AMAs[1]

[1]Affiliation not available

April 17, 2023

Abstract

Hi Reddit, We're Margaret Kosmala and Koen Hufkens at Harvard University and Josh Gray at Boston University. We're part of a research group that has been putting automated cameras on weather towers and other elevated platforms to study the the seasonal timing of changes in plants, shrubs, and trees – called 'phenology'. Because this timing of when plants leaf, flower, and fruit is very sensitive to changes in weather, plant phenology alerts us to changing climate patterns. Our network of about 300 cameras ('PhenoCams') take pictures of vegetated landscapes every half hour, every day, all year round. (That's a lot of pictures!) With the data from these images we can figure the relationships between plant phenology and local weather and then predict the effects of future climate using models. We also use images from satellites to broaden the extent of our analyses beyond the 300 specific sites where we have cameras. And we use citizen science to help turn our PhenoCam images into usable data, through our Season Spotter project. Anyone can go to Season Spotter and answer a few short questions about an image to help us better interpret the image. Right now we are running a "spring challenge" to classify 9,500 images of springtime. With the results, we will be able to pinpoint the first and last days of spring, which will help calibrate climate change models. UPDATE: We're done with our Season Spotter spring images, thanks! Since it's fall in half the world, we've loaded up our fall images. We have another 9,700 of those to classify, as well. We'll be back at 1 pm EDT (10 am PDT, 6 pm UTC) to answer your questions; we're looking forward to talking to you about climate change, plants, and public participation in science! UPDATE 1 pm Eastern: We're now answering questions! UPDATE 3 pm Eastern: Josh has to leave for a meeting. But Koen and Margaret will stick around and answer some more questions. Ask away if you have more of them. UPDATE 5 pm Eastern: Koen and I are done for the day, and we've had a lot of fun. Thank you all for so many insightful and interesting questions! We'll try to get to more of the ones we missed tomorrow.

the WINNOWER

REDDIT

Science AMA Series: We are Margaret Kosmala, Koen Hufkens, and Josh Gray, climate change researchers at Harvard and Boston University who are using automated cameras, satellites, and citizen science to

SEASONSPOTTER R/SCIENCE

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CORRESPONDENCE:

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Also, another question.. What do you guys think of the recently published "dire" report by James Hansen and his group at Atmospheric Chemistry and Physics?

You can read a newsreport on it here: http://m.nzherald.co.nz/world/news/article.cfm?c_id=2&objectid=11611840

Braitopy

Margaret: My take is that the science appears sound. James Hansen has a good track record with his science. Ice melt estimates have tended to underestimate ice melt, so it's reasonable that ice will melt

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faster than we have thought. Colleagues who work in paleo-climate (not my area of expertise) point to previous episodes in earth's history when the world was ice free and carbon dioxide levels are similar to today's levels.

Generally, when we think about climate forecasts, we know there's a range of uncertainty. We tend to think about and drive policy towards the average or center of the climate estimates. But climate change may not follow the average estimate; it may follow the upper limit of what's predicted. And there are reasons to think that climate change forecasts lean conservative, such as necessary simplifications for climate modeling of a very, very complex system (earth).

I did not follow the dissemination of the paper at the time, so I don't have much to comment on that process. I will say that the way academic publishing is currently structured, it can take a very long time to get finished results published. So if someone wants to be heard on a time-sensitive topic, it might make sense to pursue other avenues of dissemination in addition to academic publishing. (But yes, doing so has complications.)

I have a garden around my home in the California Central Valley. I've lived here for almost 20 years.

According to the USDA Plant Hardiness Zone Map, this is a "9b" growing zone, but according to my own measurements over the last 5 years, I treat my garden as a 10a zone, and plant accordingly.

From what I can tell, 20 years ago this area would have rated solidly in the 9a growing zone range.

My questions:

1. The last zone map was updated in 2012. Is your work going to be considered by the USDA in order to update their hardiness zone map?
2. In what ways do you think this map will change in 10, 20, and 50 years?
3. Are farmers reacting to climate change by relocating their crops to more suitable zones?

Thanks for your work!

calladus

Margaret: Yeah, my mom is an avid gardener (in Maine) and she's been telling me about how the USDA has to keep updating its hardiness zone map.

1. I just checked out the USDA's Plant Hardiness Zone webpage (http://planthardiness.ars.usda.gov/PHZMWeb/ in case anyone else is interested). They only use temperature, elevation, and distance to water as their input data. So they haven't ever used plant data at all. But it's a really good question. Maybe it would make sense for them to use some plant data. The tricky thing will be that different plant species respond to changing temperature at different rates. So I'm not exactly sure how we'd integrate data about lots of different species into one map. (But it probably can be done.)

2. The 2012 map uses data from 1976-2005! We know that average temperatures are quite a bit higher than they were for the average of 1976-2005. So you're totally right when you treat your garden as a different zone than what is on the map. I imagine that in 10, 20, and 50 years into the future, they'll use as much up-to-date weather info as possible, and hopefully they'll start discarding the "old" data. A 2012 map might have been more accurate using 1986-2005 data, for example. And, as I'm sure you imagine, all those zones are going to move ever northwards.

3. Farmers are definitely paying attention to changing climate. Since farmers are typically tied to their land, not their crop, they are doing things like switching to new cultivars -- and in some cases to new crops entirely.

Thanks for your work. QUESTION: i have a friend who denies climate change and cites all the money being spent as the reason this "myth" is being perpetuated. what would you three cite as definitive evidence to convince him? (please provide links to studies if possible!). thanks for doing this AMA!

floatonalrite

Josh Gray: the fact that there's no rich climate scientists would be a good start ;)

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floatonalrite

Margaret: I would also add that many people who deny climate change will not be persuaded by facts or evidence. People develop their world views through raw information, yes, but also through emotions, beliefs, and desires to belong to various communities. Climate change has, unfortunately, become politicized in the U.S. So, I think if someone has feelings about it that are not seated in scientific thought that you can't change their opinion by throwing facts at them. You have to understand what bothers them about the idea of climate change. It might be because it's scary. Or that the person feels helpless to do anything about it. Generally, I approach such issues by narrowing down to something concrete that the person knows or cares about. Do they live near the ocean? You can talk about how sea-level has risen without having to talk directly about Climate Change. Do they garden? You can talk about the changes they see in the timing of their plants or the insects they see without having to talk directly about Climate Change. Things like that. Find a hook for something to talk about and avoid the term "Climate Change," which has so many connotations. And don't forget: no one likes to be wrong. So if someone has said they don't believe in climate change, it's going to be hard for them to say, "oops, I changed my mind. Maybe I was wrong." And even harder if they've been arguing it against others for a long time. Find a way for them to save face.

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floatonalrite

Koen: A good source of information to discuss these topics can be found here: http://www.skepticalscience.com

It lists the most common climate myths and the scientific answer to these myths.

Is the food production increasing or decreasing because of climate change?

Hyperx1313

Josh Gray: just to expand a bit on Margaret's excellent response, the degree to which climate variability increases could be more important to agricultural production than long-term trends in hotter/drier/etc. For example, in 2012 a very intense but localized drought reduced US corn production by 20%. This is really big compared to the normal year-to-year variability. If that sort of event becomes more rare, then we could have a much more volatile food production system.

Is the food production increasing or decreasing because of climate change?

Hyperx1313

Is the food production increasing or decreasing because of climate change?

Margaret: How climate change affects food production is very complicated. Science-wise, at any given agricultural location, climate is changing in a particular way -- maybe higher average annual temperature, maybe higher winter temperatures, maybe much drier, or in some places wetter. And so farmers at any particular location need to change what they're doing if they want to maximize their yields. In many cases it might be hard or expensive -- for example, increase irrigation in peak summer months. In others, it might be easier or cheaper -- for example, use less fungicide because warmer and drier temperatures discourage certain plant diseases. Some farmers may look to more heat-tolerant cultivars of their crop. Others may switch crops entirely. Some areas that were not previously suitable for farming will become suitable. And likewise, some areas that were good for farming may become marginal.

I was talking a few weeks ago with a wine grape scientist who works in Europe. It was fascinating to look at what's been going on there in just the past few decades and with future forecasts. What seems apparent is that places in the south of Europe, such as in Italy and some parts of France will become less and less usable for wine grapes. And portions of central and more northerly Europe are going to become better and better for wine grapes.

That's just the science. When you then look at the societal implications... well, it's hard and expensive to change. So, if you're a farmer somewhere and you have to figure out how to change and what to change, there's going to be some time in there that you lose some production. If you think about the established culture of wine grapes in Italy and France, it's going to be enormously painful for people to have to give up growing grapes that their families have grown for many generations. Likewise, in newly useful agricultural areas, many land-owners may not realize that they can grow new crops and it may take a while for them to learn and adopt these crops. So in the short-term, there will almost certainly be a decrease.

And I've really only been talking about commodity crops. If you think about the large number of people who do sustenance agriculture, food production will likely become more erratic due to increases in droughts and other anomalous events. So more famines, I think, unfortunately.

Hey guys! Thanks for doing this AMA.

Is there anything that someone, living in the suburbs of a first world country, can do which is really simple and cheap that would help to either negate or reverse the impact we are having on our planet?

OurNightFall

Koen: Conserve energy, consume less!

Insulate your home properly (against heat and cold). Use high efficiency LED light bulbs and boilers. As mentioned, eat less meat, fly less, drive less. All these things will also save you a lot of money.

Good reading on an alternative greener economic model can also be found here: http://www.nature.com/news/the-circular-economy-1.19594

Being that we are currently near the end of the typical interglacial warm spell of about 12000 years, do

you think we will have another ice age soon? Is a longer winter coming?

Professor_Pecan

Koen: Chances of this happening are slim, in part due to a mismatch in rate of change (timing).

For a detailed answer I suggest reading:http://www.skepticalscience.com/heading-into-new-little-ice-age.htm

What software do you use, if any, to deal with the data? Particularly interest re: predictive analytics but curious about everything.

seobrien

Koen: R (statistics) python (when it has to be a bit faster) Fortran (when it has to be really fast / efficient - bigger model exercises) Perl and bash for juggling files

What software do you use, if any, to deal with the data? Particularly interest re: predictive analytics but curious about everything.

seobrien

Josh: I use R for almost everything, and like Koen, Python when it has to be a bit faster. Generally I just throw more processors at the problem, though. That said, I do occasionally resort to C/C++ for certain problems, and some legacy codes that we use are in Fortran, Pascal, etc. If there's an OSS alternative, I'll usually choose that.

How is the flora and fauna adapting to climate change differently in different regions and at what rate?

mr_genetics

Margaret: Really good question. There are scientists devoting their entire careers to answering this question! For trees and other plants alone, we know that different species respond to different changes (that we call "drivers"). So, for example, many trees leaf out earlier in earlier springs. Some will leaf out earlier if the winter previous was colder. But some won't. Some plants really only pay attention to the sun and start to leaf out when days are long enough.

As for adapting, it's equally complicated. Some plants have a lot of plasticity, which means that they can change in response to changing environments. Some have less. Some species are moving their ranges pole-wards or up mountains to find the sort of environment that they're most adapted to. For animals, some animal species change their behavior. Some migrate to new areas. Some change the food they eat.

But not all plant and animal species can adapt as much as others. So it's a real question to exactly what the future of natural (and managed) ecosystems will look like.

Hello! Thank you for the opportunity to learn more about your project.

I'm curious, what areas of the world are your PhenoCams located in?

Also, once you establish the level of change that our ecosystems are undergoing, how do you plan on addressing the issues to the public? In my experience, the public doesn't really care all too much if "a

couple plants die".

tsunami845

Koen:

You can find a map of all PhenoCams here:https://phenocam.sr.unh.edu/webcam/network/map/

We cover quite some ground, mostly in the US but some are located in Europe as well.

Science communication is becoming very important, in part to make people care. As scientists, using tax dollars, we need to make our work public (in all kinds of ways). This AMA for example is a way to make people care, and tip the veil on science and how it is done.

How do you see our societies adapting to climate change in regards to our relationships with wildlife? Will we focus on our own adaptations and less on wildlife/vegetation or more of an umbrella approach?

WheezyTurtle

Margaret: I would love to see a more holistic approach. Especially when it comes to many diseases, we really need to figure out the whole ecology to nail down solutions. For example, Lyme disease has become more and more common. It's a terrible disease that if not caught, can cause life-changing symptoms and even death. Lyme is spread by deer ticks, which like to spend part of their lives on deer. Because of a combination of several types of human-caused environmental change, deer populations are growing, especially in areas where people live. And so more ticks. More Lyme. A good solution to reducing Lyme disease in people probably requires understanding the whole system of ticks-deer-people-habitat. There is a growing awareness of this, and socio-environmental science has become a hot topic in recent years. So I'm hopeful.

What do you say to those people that seem to appreciate information and education in almost every aspect of their lives, but still deny climate change?

missionbeach

Margaret: Climate change has, unfortunately, become politicized in the U.S. So, I think if someone has feelings about it that are not seated in scientific thought that you can't change their opinion by throwing facts at them. You have to understand what bothers them about the idea of climate change. It might be because it's scary. Or that the person feels helpless to do anything about it. Generally, I approach such issues by narrowing down to something concrete that the person knows or cares about. Do they live near the ocean? You can talk about how sea-level has risen without having to talk directly about Climate Change. Do they garden? You can talk about the changes they see in the timing of their plants or the insects they see without having to talk directly about Climate Change. Things like that. Find a hook for something to talk about and avoid the term "Climate Change," which has so many connotations. And don't forget: no one likes to be wrong. So if someone has said they don't believe in climate change, it's going to be hard for them to say, "oops, I changed my mind. Maybe I was wrong." And even harder if they've been arguing it against others for a long time. Find a way for them to save face.

General question: could your team estimate your collective certainty regarding different aspects of climate change?

1) How certain are you that the Earth is getting warmer? (100%=very certain)

2) How certain are you that human activity is the primary cause of this warming?

3) How certain are you that the warming changes to the climate will be apocalyptic in nature?

g_threepwood

Margaret:

1. The earth is getting warmer *on average* (but there will be variations from day-to-day, week-to-week, year-to-year, and not every place on earth will get warmer): 100%
2. Humans as the primary cause: 100%
3. Apocalyptic: well... I guess it depends on what you mean by this. Some species of animals and plants will go extinct. So it will be apocalyptic for them. In the next few generations things may change quite a bit, and it may take a lot of wealth and resources to address those changes. So those of us who are relatively wealthy, globally, will probably feel the least effects. Those on the margins will feel the brunt of climate change. For them, yes probably apocalyptic in the sense that famines, wars, and plagues are apocalyptic. (Sorry, I don't have a number here...)

redditWinnower

Margaret: How long after an AMA do you archive? (Just curious.)

Does the scientific community studying climate change have any kind of comprehensive plan to address the denial of climate change taking place in government?

edumacations

Koen: Science informs, but can't enforce policy. The only way scientists can try to sway policy is by informing people. The same people that vote politicians into office. This chain is often slow however. Consequently, policy mostly lags behind the current scientific consensus.

What region is the least affected by climate change?

koniboni

Margaret: It's hard to say. Climate change will affect different regions differently. So some places may have droughts. Others may have flooding. Some may have increased disease. Others may have agricultural impacts. And so forth. I don't know how to weigh these different things against each other to decide which is "least" affected.

What is the most carbon-locking plant or process we can do individually?

I live in East Tennessee, could I plant anything to reduce my carbon footprint?

EvilVegan

Margaret: The fraction of carbon in plants and trees doesn't vary too widely, so the more vegetation, the better for locking in carbon. Trees. Tall perennial plants with big root systems. Fast-growing plants will take carbon up faster, but often die faster, too, and then release the carbon back to the atmosphere as they decompose or are burned. So go big (or dense) and perennial.

My favorite small-scale long-term carbon sequestration method is to grow hardwood trees and then cut them down and make furniture and other items out of as much wood as possible. Pass these heirlooms down to younger generations to keep the carbon out of the air. (Note that I don't think that this is a practical large-scale solution. Better is to reduce the output of carbon.)

Do you think that the plants will migrate to cooler climates (northern regions) because they are unable to tolerate the warmer temperatures or will the plants most likely go extinct first? What sorts of implications do your findings have on biodiversity, are you seeing plants being selected for traits pertaining to being more tolerant to warmer temperatures or is the species composition changing in areas?

Meowsandpurrs

Margaret: Yes, and many are already doing so! They are moving pole-wards (north in the northern hemisphere) and up mountains. Whether they successfully migrate or go extinct depends on how quickly they reproduce, how quickly their local environment changes, whether there are other plants "in the way", how well their seeds disperse, and whether their populations are big or small.

Because of all these dependencies, I don't think there's a general rule for how climate change will affect biodiversity. Species composition is definitely changing in some places where it's being closely monitored. And I don't know much about research into natural selection for heat-tolerance, but I would be surprised if it isn't happening.

At what point will it be undeniable that human actions contribute to climate change? (it arguably is now, but is still up for "debate")

What is the most effective way to reverse climate change? How long will it take to halt or reverse climate change?

yolonda_swagmore

Margaret: 1990, when the IPCC released its first assessment report. It's only up for debate in political circles, not scientific ones. So I have no idea when politicians will decide to stop debating.

To reverse climate change, there is no magic bullet. We need a wide range of activities to stabilize the climate. Steve Pacala and Robert Socolow came up with the concept of "stabilization wedges" in 2004 to help think about how to approach the necessity of multiple simultaneous approaches. It helps me think about it, anyway. You can explore the idea here: http://cmi.princeton.edu/wedges/

And it will likely take multiple decades at this point to halt and reverse climate change.

Are there some types of plants that can deal with such changes more easily than others? I am wondering whether plants like crocuses or tulips adapt to climate change because each year can be so

different.

wicked-dog

Margaret: I think so. Plants that generally grow quickly after a disturbance are quite plastic and good at a wide range of environmental conditions. And yes, plants that grow in places with seasons that can vary widely will probably do fairly well, too.

I know mushrooms aren't plants. But, do you include them in your studies? What's the trend or prediction to the future of this species?

Thanks for your time and for helping the planet.

Trauma2

Josh Gray, here: I have never seen a fungi phenological dataset, though I'm sure something like that exists. Most of our Phenocams would not be good at finding mushrooms because they're usually above the forest canopy.

I know mushrooms aren't plants. But, do you include them in your studies? What's the trend or prediction to the future of this species?

Thanks for your time and for helping the planet.

Trauma2

Margaret: Great question! Mushrooms are only starting to be studied in the context of climate change. Check out Jeff Diez's research page and scroll down to where it says "Fungal responses to climate change." This is the only research I know of in this field...

What do you think has been the most important finding(s) in climate change science in the past several years and how has this affected our understanding of the causes and/or consequences of climate change?

ChaucerianFraud

Koen: For me the influence of oceans (as a buffer, mediator) in the climate system. Furthermore, our increased understanding in the coupling between atmosphere and biosphere.

What do you think has been the most important finding(s) in climate change science in the past several years and how has this affected our understanding of the causes and/or consequences of climate change?

ChaucerianFraud

Josh Gray, here: I don't keep up with the climate change literature as much as remote sensing, crops, and phenology, but I think it's fair to say that there haven't been any singular breakthroughs or anything like that: more evolution than revolution. The models get incrementally better, the observational data archives get bigger and our ability to draw inference from them gets better, computers get faster and cheaper which allow us to run more analyses at finer resoltuions, etc. One thing that seems fairly recent is an appreciation for the role that greenhouse gases other than CO2 are playing, particularly

methane.

What programming language do you use the most? Python? C#? C++?

pteroso

Koen: mosty R for statistics, python when it has to be a bit faster, and Fortran when it has to move quickly (bigger models, or those that crunch a ton of data). I use bash and various command line tools to manage my data.

Thanks for doing this!

As a Uni student, what are ways we can actively and meaningfully contribute in our day to day lives to help fight climate change and make a tangible difference without the big investments in solar power or electric cars because Student budget only allows for packet noodles and instant coffee even while still working 30+ hours a week.

Also as we graduate and start to earn a decent income, where is a good place to start fighting climate change in our day to day lives with a bit more of a budget? Should we start looking at solar? Are there better more effective things we could be doing?

mrwhippy102

Koen: As I mentioned elsewhere: conserve energy, consume less! Use high efficiency LED light bulbs (you can take those with you and probably last you a lifetime, e.g. I cut the energy bill in my apartment by >25% by doing so, it's a shared place but the bulbs have already payed for themselves). Eat less meat, fly less, drive less. Very practically and in the short term, as a student not buying into consumer culture will save the planet some and a pretty penny.

What, if any, is going the biggest change to the average North American's life regarding climate change's effect on NA flora? I'm 17 years old and very interested in climate change and how it's going to affect our future, so thank you for taking the time to answer these questions.

The_Real_Twisted

Josh Gray, here: I believe that climate change's effects on vegetation are going to be most readily experienced through its impacts on crop production. In this regard, increased climate variability is probably the largest concern. For example, a drought in 2012 reduced US corn yields by 20%, this is a HUGE reduction relative to the normal year-to-year variability. What if that sort of event becomes less rare?

Climate change is of course affecting natural ecosystems in a variety of ways as well. These effects include changing what species can grow where, how productive the ecosystems are, and how they are ecologically structured. With regards to phenology, we have seen a general trend towards earlier springs and longer growing seasons across much of NA's temperate forests, especially in the NE.

First, thank you for doing this! Second, thanks for working on something I believe to be beneficial to our planet, animal friends, and selves. Third, my question is, if you could get the group of politicians together* who claim climate change is either over emphasized, or just a lie, what would you tell them? Edit: *

ThurstyAlpaca

Josh Gray, here: there's probably nothing that I could say that they haven't already heard. I'd probably just show them this cartoon. In all seriousness, a productive path forward with people that may not trust climate science/scientists is to focus on the economic and health benefits of adopting sustainable technologies: a "Green Revolution" across energy, food, water, etc. would be beneficial to human wellbeing and national interests regardless of the reason you undertake it.

What do you think of Senator Sheldon Whitehouse's efforts to use the RICO law against climate change deniers?

GreatGriff

Koen: A judge has to decide on what side of free speech or fraud some of these actions fall - probably motivated by to what degree these actions were motivated by monetary gain, and potential damages.

How do you deal with people who deny that climate change exists? Do you have friends or family who don't believe in climate change? Is there any initiatives in the climate change world to make people see and understand that it really exists? Much like how Apple has simplified technology so that everyone and their grandma can use their products, what is or can be done to help those who don't believe in it, change their minds, so that we can all make the planet a better place. I don't want to eat bugs for protein in the future, but if it means its cheaper than other food, then I will.

snakemonkey

Margaret: I don't have immediate family or close friends who don't believe in climate change. But I do run into people who deny climate change (or evolution or the utility of vaccines...) as acquaintances and extended family. I generally try to listen first. People develop their way of thinking about the world through facts, yes, but also through emotions, values, and a desire to belong to communities. I realize that I'm very likely not going to change their world-view, and so I try to understand what's important to them. And then I try to talk about some small tangible effect of climate change. If they're older and have lived in one area their whole life, they've almost certainly experienced climate change. Do they remember what winters were like when they were a kid? How is it different now? What do they think has changed and why? Things like that. I try to avoid the politically charged term "climate change" and just talk about something the person can relate to. And I just leave it there. Once conversation is not going to change their whole outlook on climate change. I just try to gently nudge in the right direction without being dogmatic.

I'm sure there are some organizations that are working on making climate change more understandable and palatable to people. But it seems like a hard task and is probably underfunded. I could search the web for some, but you could, too. I don't think any org has emerged as the leader in this regard.

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snakemonkey

Josh: I have family that aren't sure about anthropogenic climate change and what we should do about it. My personal challenge is to try and understand their perspective rather than assuming they're wrong, ignorant, whatever. It is a very complex topic and there are seemingly contradictory things going on. My favorite is hearing about how in the late 70's there were "Global Cooling" conferences (and it's true!), so I can appreciate a bit about why someone would be skeptical. It's hard enough to keep up with the bleeding edge when you do this stuff all day, everyday, much less if you do something completely different. Koen had a nice link to the skeptical science website that should give you all the "ammunition" you need to have a fact-based conversation. My point is that it's as much, or more, about the presentation of these facts rather than the facts themselves.

What has been the most interesting aspect/finding so far?

pooh159

Josh: one surprising thing that came out of my own work was realizing that increased agricultural production plays a large role in driving increased CO2 seasonality. We had observed that the Earth was taking deeper "carbon breaths" for a while now, but without a real understanding of what was driving it.

Thanks for doing the work you do! I'm from Australia, and I was wondering if you were aware of any citizen science efforts here? Is there a database where one could find out about these things?

Braitopy

Margaret: Yes! Climate Watch is a good one. And they have apage listing some others.

Are there any promising technologies being developed that might possibly remediate/reverse global warming?

strangeattractors

Koen: I would say sustainable energy sources (wind, solar, hydro) all contribute to offsetting the burning of coal for our energy needs (which is a big contributor to climate change). Yields on all these system go up with time. Reversing global warming through geo-engineering is feasible but not advisable as consequences are even less predictable than climate change itself.

What are the greatest shortcomings of your research?

wehiird

Koen: Limited time, too many ideas. You have to pick something, by doing so you neglect other interesting ideas (for a while, if not for good). The latter is a shame. Limited time also leads to limited documentation, which doesn't favour reproducibility. However, most of my projects are now kept on github for this same reason.

How great is the uncertainty in the first and last days of spring calculated from the Season Spotter project?

Also, has such results been calculated before using other methods? If so, why do you choose this

method which involves the public?

EDIT: Reworded a little bit.

Basidiomycota30

Josh Gray, here: The uncertainty of the spring/fall dates varies from camera-to-camera because of differing levels of image quality (signal/noise, missing data, shifts in field of view, bugs landing on the lens, etc). Thus, some greenness time series are better behaved and the models we fit to those data have lower uncertainty. There are many ways to get a date from the time series, and they all imply a different sort of ecological meaning. For example, you can fit logistic functions to the greenup and greendown portions of the time series and calculate the date at which the logistic function's curvature is changing most rapidly, or when it reaches some percentage of its overall amplitude, or something else. There is some uncertainty in that date that is determined on the model's parameters: how well does it fit the data and how noisy are the data? Typically, these are quite low (~2-5 days). But, what good is that specific metric? Usually, we want to know something like: when did photosynthesis start? or, when did NPP cross zero? So, the larger portion of uncertainty comes from relating these metrics to something we do want to know, and those errors are a bit larger. We've employed citizen scientists to help in a number of ways: to find snow that our algorithms failed to detect, to identify "odd" things in the images (like a bug landing on the camera), to identify shifts in the camera's field of view, and to pick out vegetation in images that come from non-Phenocam cameras.

I live in Idaho and I just recently read that our wine industry has been benefiting from climate change because the winter frost hasn't been as severe. Are there other examples of industries or areas that climate change will have a positive effect on?

dizzyizzie

Josh: Yes, there are probably many such examples of where a changing climate may benefit a particular industry. However, it's important to keep in mind that this may be accompanied by many other less desirable changes across ecosystems more broadly. You could end up with landscapes that are great for growing grapes, but horrible for sequestering carbon, providing wildlife habitat, buffering water supplies, etc.

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dizzyizzie

Margaret: Interesting about Idaho! I just talked with a wine grape researcher from Europe a few weeks ago. Same thing happening there. Central parts of Europe (e.g. Germany) are getting a better climate for grape growing. But southerly parts are becoming less good because it gets too hot in summer. So hard to say if it's good *overall* for the wine grape industry.

So yes, there will be winners and losers with climate change. That's part of why it's so hard to address.

This is to all of you:

As a 25-year-old Environmental Geography student, I've been rather obsessed with climate change (and other environmental issues) for a number of years. In the past and present, it has caused and is causing me a great deal of depression, occasionally making things seem hopeless. Have any of you

also experienced something similar, and if so, what have you done to cope/help?

EnviroguyTy

Koen: Consider that all small efforts help. Focus on things you can achieve which have a local impact but matter globally e.g. reduce your carbon footprint, inform other people. Act locally, think globally.

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EnviroguyTy

Margaret: Exactly what Koen said. I'll add talk to people about it. Friends, others in your field. There are a lot of people who care out there. I've occasionally felt down about it -- mainly because the main barrier to address climate change at a large level is political and societal, not scientific. And if you're feeling depressed, please go see a doctor (even though it may be hard to do).

What do you have to say to the people who do not believe climate change is real?

DatOneGuy-69

Josh: this is what i want to say, but what I strive to do is to listen rather than speak, and try and understand how they've arrived at their conclusions. The last thing I want to do is to appear to condescend, speak from the "ivory tower" or otherwise lose an opportunity to educate and learn myself.

How do you sleep at night, knowing the observations, the models and the possible outcomes? Do you have trouble sleeping because there is so much to be done or because you know the outcomes are dire (I presume the former)?

goo_lagoon

Koen: I do sleep at night. I do worry about how we neglect the climate change issue, but I'm trying to do my part (in all kinds of ways) to work towards a more sustainable future. Shouldn't everyone?

How do you sleep at night, knowing the observations, the models and the possible outcomes? Do you have trouble sleeping because there is so much to be done or because you know the outcomes are dire (I presume the former)?

goo_lagoon

Margaret: I am generally optimistic, actually. The thing is that the political will to *do* something will be found once things get bad enough. I do what I can within my limited sphere of power in the world and cede the rest to powerlessness.

Hello, Boston University alumni checking in, thanks for the AMA! I live in Michigan, and am wondering

what your opinion is in regards to plants such as wild hyacinth, wild lilac, and clematis being sold at gardening places like Home Depot. If they are on the endangered list, why and how do companies like this have a generous supply, and what makes them endangered if we can grow them for mass production?

Thanks again!

berthejew

Koen: *wild* is key here! Plants can go extinct due to pressure on their home ranges (either direct due to development or due to climate change). This does not preclude them from being grown in greenhouses.

Since when does BU have a climate research program? When I was there I was trying to do a specialized Climate Policy tract but no one seemed to know anything about it.

akornblatt

Margaret: Josh works in the Earth & Environment department. Not sure when it began.

Do you plan to work in Europe?

YamnuanEmpire

Koen: The PhenoCam network is currently focused on the US, but we are open to contributors from around the world. Europe has a similar network, but it is currently less well centralized and consequently has a lower online visibility. Also, as a Belgian citizen I hope to return to the EU to continue my research at some point.

There is a FRC robotics competition at Boston University this weekend - Will any of you be attending this? They are always very fun with lots of music, and you all should definitely check it out. It's at Agganis Arena. You might even be able to find a lot of kids who are interested in your autonomous cameras!

8__o

Margaret: Sounds like fun, but I don't think I'll be attending. My six-year-old would probably be interested. But I don't think my one-year-old will sit still long enough for any of us to enjoy it.

I'm gonna ask the big question:

Is Climate Change real?

MagicBreadRoll

Koen: Yes, all the answer to arguments against it are listed here: http://www.skepticalscience.com/argument.php

Do you have a Boston accent?

SeaHogTV

Koen: No, I'm Belgian.

How did you guys end up in a research project together despite being from different Universities? This stuff always seems to happen in with Boston Universities and I've always wondered this.

SynesthesiaBruh

Koen: The lab at BU tackles global scale phenology from remote sensing (overlap in theme) and is a partner in the NSF project that funds the PhenoCam network at Harvard.