PLEASE NOTE: This transcript has been auto-generated and has not been fully proofed by ISEOF. If you have any questions please reach out to us at info@thegreatsimplification.com.

[00:00:00] **Anastassia Makarieva:** We are calibrating the models using the most disturbed ecosystems. It is like we go to the hospital where there are very ill people suffering from disease and we calibrate an average human being based on their capacity to do things. But all that they can do is at best survive till the next meeting with the doctor.

[00:00:27] And this is not how natural forest functions. So our vision of forest is totally distorted and we don't study the most important forest that actually stabilize the climate.

[00:00:46] **Nate Hagens:** Today I'm pleased to be joined by physicist Anastasia Eva to discuss her work, researching and educating on the biotic pump, Dr. Anastasia Eva is a Russian atmospheric physicist and senior researcher at the Petersburg Nuclear Physics Institute. Anastasia is best known for co-developing the biotic pump theory alongside the late professor Victor Goroff.

[00:01:13] This theory proposes that forests play a crucial role in driving atmospheric moisture, transport effectively influencing rainfall patterns over land. Her work emphasizes the importance of intact forests in maintaining climate stability and has challenged conventional climate models to incorporate the dynamic role of vegetation in atmospheric processes.

[00:01:40] She's Russian. the language is a little difficult. I encourage you to watch the intro video, which will link right here on biotic pumps before you watch this, what I consider to be an excellent video. Near the end, I asked my traditional, closing questions and just thinking of her as a scientist, forgetting that she lives in Russia, with the United States being at war.

[00:02:13] And, it kind of stopped me cold. the lack of empathy that I had in the moment asking her about those questions when people in her country are dying. my personal view is I have long thought. The biotic pump theory is extremely valid and important, and I'm so glad to host her, on the platform and hopefully have her back on some sort of a round table.

[00:02:44] I hope you, can, learn from and enjoy this wide ranging conversation with Dr. Anastasia. Eva. Anastasia. Eva, welcome to the program.

[00:03:01] **Anastassia Makarieva:** Thank you, Nate.

[00:03:06] **Nate Hagens:** I have known of you and your work for a long time, never fully understood it, but always had a curiosity about it. So I'm, glad that we have some mutual, science colleagues that introduced us. I've invited you on the show 'cause of your groundbreaking research on forest systems and their relevance to modeling and understanding planetary dynamics, including climate change.

[00:03:33] so I expect we're gonna take a deep dive into the main tenets of your work. But before we do that, maybe you could share with us how you got involved in this field. and first of all, where are you right now?

[00:03:47] **Anastassia Makarieva:** I am in St. Petersburg in Russia. Okay. And, everything started from my teacher, professor Victor Goroff.

[00:03:58] He was a prominent physicist, theist, Ian, who worked in the theoretical physics division in Petersburg Nuclear Physics Institute, where I also work. And so he was really a prominent physicist, like I'm sure you know, I and Leitz in theoretical physics. So it references some of his. That were really high level.

[00:04:28] But, at the same time, he always had a keen interest in wild nature in how nature works. So it was something innate. So he traveled a lot, in Russia, in wilderness areas, in Siberia, but his research was purely like physics. Then in the seventies, several things happened. First he saw some that perspectives in the field that he was doing, his research were becoming quite foggy, and the time has shown he was correct in his perception.

[00:05:18] So he changed his field radically, and his passion for nature, began to dominate. So he began to study how the biosphere stabilizes itself and the environment. And, it so happened, that in this, like.

[00:05:47] He also experienced an extraordinary event when he was a passenger of a flight that was, there was a terrorist who explored the bomb. So yes, it was a very unusual, one of the first terrorist attacks. It was in St in Leningrad. And at a certain point he was absolutely sure that he'll die. So it was so like for him, everything on fire.

[00:06:22] And I think he was denying that. But if you remember Doki before his trial, when he was, he knew that he was going to be hanged and after it was a different right and a different, like personality. So I think this was also what contributed, and so, really he changed very radically his successful career as a theoretical physicist to something entirely different.

[00:06:57] How natural ca systems, stabilize themselves. First of all, it's not, we as a civilization has not yet mastered how to stabilize ourselves.

[00:07:15] By doing that, they also stabilize the environment and climate, which is, like, an inseparable, part of, persistence of the biosphere itself. And, so he began this research, which was totally alien to anything that was being done in our theoretical physicist division. But his authority and level was very high, even though he never occupied any, like, leading positions.

[00:07:48] He never directed anybody what to do. He was just, people were saying a cat who was, who is walking by himself. And so, he established this direction and formulated the concept of the biotech regulation of the environment, which quantifies how ecosystem stabilize, our environment and climate. And so, he also lectured in, Polytechnical Institute in the Rad, where I was a student.

[00:08:21] And so I was involved and we beca, became, long-term, collaborators. And this totally changed my life. so that's how I was involved. I'm so detailed because it's very important that the ground base for everything I've been doing lies in theoretical physics, which is. very comprehensive and unique approach, and actually the highest level of, intellectual, achievements that our civilization can, be proud of.

[00:09:00] **Nate Hagens:** So you have, developed a passion for this topic, even though you, personally didn't have a near death experience like Victor Gors did.

[00:09:10] **Anastassia Makarieva:** No, I didn't have a such an experience, but, I was asking myself, even when, like a teenager still, what I am looking for in the world. And, there were two things like, I perceived the world as an, mystery.

[00:09:36] As an enigma. I didn't know how the ends meet. It didn't make a, like a picture for me. It was all, I didn't see patents like in history. I'm totally ignorant because I can't see patents. It's all for me, like a mess of, unconnected pieces of evidence. So I wanted to understand the world. And another thing which I formulated that I wanna bear the burden.

[00:10:11] Burden I didn't specify for myself, but I understood that something is there that is not well, and I wanna partake. So I wanna

[00:10:27] know what is this and contribute to help.

[00:10:30] **Nate Hagens:** That actually seems so benign of a statement. But the fact that you are a Russian scientist, and I am an American scientist, and we're having this conversation about something that feels wrong with the natural world, is actually a fundamental tenet of the best side of humanity.

[00:10:55] I, mean, this is, I'm like you, I'm curious. I know something is wrong and I want to figure it out. And that's what this platform is, trying to do.

[00:11:04] **Anastassia Makarieva:** That's why I thought that this will be very important interview for me. so precisely because I figured it out that you're seeking, something that it is also, I'm also seeking, Victor used to teach me that, everything good in humans is the same.

[00:11:26] So it, it's not a mystery that there are people who feel the same thing. So yeah.

[00:11:35] **Nate Hagens:** So you have argued, and thank you for, doing the backdrop of, Victor Gors off's work and, how you collaborated together. You, and Victor originally have argued that the mainstream climate narrative ignores the importance of forest ecosystems in the climate models and research and maybe underestimating forest damage as a climate change risk.

[00:12:06] So let's start there. Can you briefly explain what role forests play in mitigating climate risk or in the homeostasis of the planetary system?

[00:12:18] **Anastassia Makarieva:** So if you look at the forests, we need to understand that these are dynamic systems, not just static objects. So they do things so they are working based on the genetic information of the speeches that compose the forest.

[00:12:37] And so the main thing, that, in our opinion is missing from the models is the information, processing by forest and what they can do for climate. For example, the most uncertain aspect of climate arc clouds. So why arc clouds such. A difficult, ingredient of climate because they can both cool and warm.

[00:13:10] They reflect sunlight and so they cool and they, trap, thermal radiation from the surface, redirecting back to the surface to they warm, they're part of the greenhouse effect. And these effects are, for example, in the tropics of similar magnitude. So by, for example, as we know that forests are active in generating cloud cover.

[00:13:37] So by generating clouds of different types and using these levers, forests can, impose significant impact on temperatures, on regional temperatures and in consequence on global temperatures. And when the forest is just represented as a, surface with a number of parameters, which can be counted on like on one hand or two hand.

[00:14:07] So, it doesn't just doesn't work.

[00:14:12] **Nate Hagens:** I have lots of questions now. Okay. and these are on top of the original questions I had. So how do climate models that look back historically. At CO2 and temperature and things like that, how do they account for the different forest cover that we had a thousand years ago, 10,000 years ago, a million years ago?

[00:14:35] Because we don't, really know what the forest cover was. or do we,

[00:14:39] **Anastassia Makarieva:** we don't know. But this is, the, this is a high level question, which climate models just can't address.

[00:14:52] **Nate Hagens:** For instance, I, my understanding is we have around 3 trillion trees today. And historically, for much of the pre Holocene period, there were 6 trillion trees.

[00:15:04] So that has to have a big impact. Yes,

[00:15:07] **Anastassia Makarieva:** that's have a big impact. But with the clouds. With the clouds, lemme tell you that currently the situation is such that even if we don't, speak about forests, but just about the ocean, global climate models completely disagree with each other about the clouds in the last three decades of satellite measurements.

[00:15:35] Even that, and if you have heard about these, hot models, you know that. All centers. There are big centers in the world that develop these big climate models with increasingly, better resolution and more computing power and all that. And they wanna, naturally people wanna represent the earth as good as to the best of the capacity.

[00:16:08] So they continuously collect data, incorporate into models based on parameterizations. So what is a parameterization? We don't know the physical law behind say the dependence of the cloud cohort on temperature. So we collect data, like draw a line, assume that it's more or less okay, and put this line into the model instead of a law of a physical law.

[00:16:36] So that's it. And so people have been working and suddenly in the late, in the recent generation of these models, it turned out that certain models, which especially do well with clouds. They begin to predict, about six degrees of warming for doubling of CO2.

[00:17:00] **Nate Hagens:** Oh, the hot models are, you're referring to the, climate sensitivity that is with a doubling of CO2, there will be a very high, reaction in temperature.

[00:17:14] **Anastassia Makarieva:** yes, So among all models, so there, there was a fifth generation, now there is six generation. So in this six generation, comparison of all models, suddenly certain models went quite high. Yeah. And because of, mainly because of clouds. And they do, describe clouds better than others. And what did the community do?

[00:17:45] They downgraded these models. They said, no, that can't be because you show such a high, like, projection for increase, but in the past it wasn't like that. So you can't describe the past. So, and so there is this clash. They kind of describe the present, the cloud cover, but do worse than others describing the past.

[00:18:14] So in this all about 40 years, just 40 years in such a discrepancy. Among different models. Some predict two Kelvin, warming pursue to doubling and others six Kelvin. So there is three times discrepancy between models and this is just no forest involved. It's just, you know, the simplest, system.

[00:18:43] **Nate Hagens:** How do those climate models, treat the role of forests? Or don't they at all?

[00:18:48] **Anastassia Makarieva:** no, They do, you know, if we come out and say climate models don't like consider forests, many people will get offended because there are, yeah, drew, because there are like lots of people trying to incorporate forest and publishing papers, with forest in forest out.

[00:19:10] But you can see, forests are much more complicated systems that say the ocean, even though ocean also complicated due to the biotic effects. But,

and we simply dunno, as you said, we not only dunno what was in, like you say, thousands years ago, but we dunno what's going on now because if you look at the data which used to calibrate models, they're.

[00:19:48] There are more scientists, so in the most populated regions of the world, like Europe is very well covered, you know, but they don't have natural forests at all.

[00:20:00] **Nate Hagens:** So there, there's not thousands of climate scientists in Kamchatka doing research.

[00:20:06] **Anastassia Makarieva:** Exactly. Exactly. Or in Siberia or even the Amazon.

[00:20:12] The Amazon is like fortunate because it's such a mighty thing that people understand that it's important. So it gets more research, but no Kong, Papa know. So basically we're calibrating the models using the most, disturbed ecosystems. So it's like, as a, I wrote in my book and people found it like an app, comparison.

[00:20:45] It's like we go to the hospital where there are very ill people suffering from disease and we calibrate an average human being based on their capacity to do things. So, but all that they can do is that best, like take food and, survive till the next like meeting with the doctor. And this is not what, how natural forest function.

[00:21:13] So our vision of forest is totally distorted. And, we project these distortions, into like, include it into climate projections. So, so, so, first thing that we dunno because they're very complex. And second thing that we don't study, the most important, forest that actually stabilize the climate. And this is, I can give you an example how it should be, such an approach should be a failure. And the

failure. It's like you may, have heard about this CO fertilization, C2 fertilization, like more c2, more, biological productivity.

[00:22:06] And, C2 is being taken from the atmosphere. And based on this, lots of researchers were building models, how the, biomass of trees is increasing globally and taking C2 from the atmosphere. And as long as the uncertainty of measurements was low. It was okay. So we couldn't, like we have about 400 or 300 gigatons of carbon of, three biomass.

[00:22:43] And when the increment is still below the uncertainty of measurements, you can fantasize what is happening. But as year time goes, at a certain point, you must see it. And so this year or last year, there was a publication in science, which actually looked at that and they found that there is no increment of three bio.

[00:23:08] So all those models got that wrong. Steel carbons is disappearing. It goes somewhere and we just, and you won't find a single scientist who will come out like me because I don't have a hand there in this business. I'm not say, guys, this is a failure, a spectacular failure of all our, it doesn't work. We don't know how the biosphere works, let us admit that won't happen.

[00:23:45] **Nate Hagens:** I have like hundreds of questions, but I, think we need to start at, ground zero. and then go out from there. So you and your late colleague, Victor Goov, observed a phenomenon in the forest that you called the Biotic pump Theory. So, for our viewers and listeners around the world who may never have heard of this at all, can you explain this theory and why it is significant to the current climate science and climate situation?

[00:24:20] **Anastassia Makarieva:** so the biotic pump theory or concept, is, has two, can be summarized with two statements. One statement is that the natural forest regulates its own water cycle by regulating the atmospheric moisture

transport. So the forest draws in enough moisture to support itself. And the second statement is how it's doing the physical mechanism.

[00:24:51] And the physical mechanism is, based on fresh ingredients generated by, condensation of water vapor. So this is what we later called condensation induced atmospheric dynamics. So two things that the forest plays this active role. And the second thing, how, does that, so you can, prove or disprove the biotic pump, concept along these two lines of evidence.

[00:25:21] So it can still be that forest regulates the water cycle, but by some other mechanism or, so that's it. and I actually can show you, I prepared this, noise that you were hearing. This is basically, I want to show you how it works. Okay? Yeah. Because it's important that it's not something abstract, but this is a toy, which is called drinking bird.

[00:25:52] And what it has in common with the biotic pump, that it's also driven by condensation and gravity. So what's happening, actually, it is like an imitation of a perpetual mobilly. As long as there is water here, it'll be moving. You can see, there is, the liquid inside, and now it's going up this liquid.

[00:26:20] And when it goes up there is like, it flips. You can see this liquid, a green one. It's coming up, but why is it coming up? It's coming up because the head of the bird is wet and it evaporates and

[00:26:43] vapor inside its head condenses as it cools and as it condenses, the pressure drops and that is why the liquid go goes up. So you can see the head cools, the vapor inside it, in the head, in the sealed, vessel condenses. We don't see it, but we can understand that it's happening because the pressure is dropping and the liquid goes up.

[00:27:17] And so. It goes up, then it flips and it gets more water such that it is always wet and the emotion repeats itself.

[00:27:27] **Nate Hagens:** So is the corollary to that. When it gets wet, it rains in natural ecosystems and forests.

[00:27:34] **Anastassia Makarieva:** The point is that by the forest, when it transpires moisture, so when the leaves o this tomato open and there is water vapor going to the atmosphere, it moistures the atmosphere.

[00:27:51] Then in the colder levels, it condenses like in the bird's head, and it creates mono equilibrium pressure, gradients. So the air goes up and there is a, shortage of air at the surface, and this creates inflow of moist air from the ocean.

[00:28:16] **Nate Hagens:** What if it's very far from the ocean?

[00:28:19] **Anastassia Makarieva:** Oh, well, if it's, if the there is only one tree, it won't do that.

[00:28:26] But the ocean should start the forest should start from the ocean. And so, EE every tree, so to speak, draws moisture from the adjacent area. And if we cut the inner forest from the ocean, the process stops.

[00:28:48] **Nate Hagens:** I'm really curious about the scaling of this. So I live in, Minnesota, Wisconsin area, the upper Midwest in the United States.

[00:28:57] And there's a lot of, land here that's been, the forests have been cut down for, crops, but there still are some forests left. where I live, there might be 10 hectares of forest and then a lot of farmland. So does even 10 hectares have some impact on a biotic pump or does it need to be much, much more contiguous forest?

[00:29:23] **Anastassia Makarieva:** When we, first started to, investigate this, we compared, precipitation patterns, forested in non forested regions all across the world. And what we found that in non forested regions, the pre precipitation declines exponentially with the scale of a few hundred kilometers, like 500 to 600.

[00:29:51] There is an exponential decline like by three times. Meanwhile, in, big forests like Siberian forests and Amazon and conga precipitation doesn't decline as we move inland. regarding very small for, very small forest to.

[00:30:18] Since condensation occurs in the atmosphere and the atmosphere, scale height is 10 kilometers. So the horizontal dimension should be at least the same order of magnitude. So very tiny sports, they don't contribute to this, process. What's the problem of proof? Okay. We can see that there is a correlation between forest and like, penetration of rainfall inland, but we can see that it is just forest grow there because for some reason rainfall and rain and there is such a moisture transport and they're just grow where this happens.

[00:31:06] **Nate Hagens:** So, so the conventional thinking is the forests are the byproduct of rain and soil and not the origin of the water cycle. Yes.

[00:31:17] **Anastassia Makarieva:** So, so the conventional view is that there are geophysical flows of water and wind, and they're indeed because we live on a planet, where most part of which is occupied by the ocean, which has its own condensation and things.

[00:31:35] So there are geophysical flows somewhere, moisture goes far inland and there, there are forests. So we need, to find to somehow disentangle these geophysical flows and biotic impact. And, it so happens, that, the Amazon Forest gives such an opportunity because if we look at the, like at the globe, which I can see behind you there is yes.

[00:32:14] **Nate Hagens:** Out of respect. Yeah.

[00:32:15] **Anastassia Makarieva:** And in, in the tropics, there is this, rain band called into the tropical convergence zones, which migrate, seasonally go going the northern and to the thousand, hemisphere. And it brings rain to corresponding regions. So the alternation of dry and wet seasons in the pics is related to this migration of the, precipitation peak, which is, goes along the parallel.

[00:32:50] But it so happens that in the Amazon, the season begins much earlier than the arrival of this geo geophysical thing.

[00:33:08] It was an enigma. When we formulated the biotic pump, we didn't know anything about that. So we knew only, afterwards, but there were researchers who were motivated by this enigma, how this happens. And this was research by wrongful. They did a lot of dedicated work, and they found out that this is related to, evaporation, to the flux of moisture from the forest itself.

[00:33:44] And later it was confirmed that indeed this moisture comes from leaves because this can be, decided based on as atopic analysis. And so, and also it was discovered that at the end of the dry season, the Amazon makes new leaves. So imagine the forest is making new leaves, the new leaves transpire a lot, moisture the atmosphere and kickstart the whole process of condensation, precipitation, load pressure, and moisture, import from the ocean.

[00:34:22] **Nate Hagens:** What are the differences in rainfall on earth, and drought, between forested areas and deforested areas?

[00:34:30] **Anastassia Makarieva:** Of course we can't see, like compare deforested average, areas on average, which forested on average, for example,

we can, if we concentrate on, the Amazon again, then what was found is that on the deforested areas locally, a rainfall may increase locally.

[00:34:54] If you look, like increase with increasing proportion of deforestation, and this is understandable because deforestation creates very sharp, horizontal temperature gradients.

[00:35:10] **Nate Hagens:** Explain what a temperature gradient is a above a forest.

[00:35:14] **Anastassia Makarieva:** When sun, the forest receives sunshine, it goes to Eva transpiration.

[00:35:22] So basically to evaporate water vapor from the wet inside of the leaf. And for that reason, because it goes to evaporation, it's not converted to heat immediately. And that's why if you, like also the surface of a lake, it's cooler than the sand near the lake. At the same, sunshine because when the sunshine heat, the, sand, it's converted to sensible heat, so immediately goes to warm the surface.

[00:36:07] And so when we deforest, we basically convert reduce of va transpiration and make more sensible heat. So for example, on a deforested area, in Europe, in a European forest, even in, autumn, on a sunny day, the temperature can be 70 of the surface can be 70 degrees Celsius. And so when. a forest patch nearby and, deforested patch nearby.

[00:36:45] We may have like a 50 degrees Kelvin, which is international Kelvin. It's okay, between them on a horizontal, dimension.

[00:36:55] **Nate Hagens:** And that's at the surface. What about above it into the sky?

[00:36:59] **Anastassia Makarieva:** Well, what happens in the sky will depend on the circulation that will develop. So it's at the surface what matters.

[00:37:07] And so when we have such a big difference, so there will be more rigorous, circulation and there will be moisture rising and a lot of precipitation, and this is what is found. But if we look at bigger regions on a bigger scale, then what was found is that rainfall declines with the degree, of, deforestation.

[00:37:36] So it all goes into this, local, intense rains, but there is no increase in, large scale moisture transport.

[00:37:48] **Nate Hagens:** Let me ask you some hypothetical difficult questions, and maybe I will learn and understand this through these questions. Hypothetically, what if all the forests in the world were, cut down?

[00:38:00] what, what would happen to our rainfall and climate? Everything else being equal.

[00:38:05] **Anastassia Makarieva:** Well, we think that, there will be a drastic reduction in inland precipitation, like we'll convert to this, pattern that characterizes deforested areas with a steep decline of precipitation inland.

[00:38:23] **Nate Hagens:** What would happen if we were able to double the forest cover generally on the earth?

[00:38:28] What would happen to rainfall and climate? just what, how could you speculate about that?

[00:38:34] **Anastassia Makarieva:** This is very important because, if we just stop, this, the destruction that we are doing now, especially, but not limited to the tropics, we can, stop the acceleration of climate change

[00:38:56] **Nate Hagens:** even with more CO2 coming from emissions and industry.

[00:39:00] **Anastassia Makarieva:** Yes. Even with more CO2, because now what is happening, we can see that this acceleration, this uptick in recent uptick in temperature increase is not related to more c2, to a spike in CO2 emissions. It's related to changes in the cloud cover. And the cloud cover is related also to changes in atmospheric, and we can see that.

[00:39:33] The Amazon, like in 2023, it experienced a major drought. So it was a big hotspot of lost cloud cover.

[00:39:45] **Nate Hagens:** And last year too, I think in 2024.

[00:39:49] **Anastassia Makarieva:** yes. So, so, and this happened after the, the years during which Bolsonaro and his team were doing everything against the Amazon, because in the Amazon there were some successes in cut in bringing deforestation down.

[00:40:14] But this was all overruled, recently I think that forest will can recover. So like a person, it can be ill, but it can be having hard times, but it has enormous, capacity to self recover. But if we continue to directly destroy it, it won't recover and that it'll be worse.

[00:40:37] **Nate Hagens:** I am so fascinated by this. I, literally, like have a hundred questions for you right now,

[00:40:43] **Anastassia Makarieva:** but lemme mention because we're talking, there is a lot of talk about the Amazon and much less about other, major forests.

[00:40:52] **Nate Hagens:** Yeah. Right. I agree. The, African central African rainforest hardly. Yeah.

[00:40:58] **Anastassia Makarieva:** Like, it's like I feel that everybody just are scared about talking about that because the of the very difficult social situation that is there. So, but there is also Indonesia, we're in Indonesia right now. They're planning massive, deforestation.

[00:41:17] Massive for the sake of growing biofuels.

[00:41:23] **Nate Hagens:** okay, here's some of my questions. Where the forests are in the, tropics or the north or the south, does that matter on its impact on the water cycle and on climate?

[00:41:36] **Anastassia Makarieva:** Yes. it matters in different ways. Is in ways and it's a very complicated, and I can't claim that I know all the answers because it is really a huge topic which, many institutes should be researching.

[00:41:54] yeah. But what is important, in the tropics, we're receiving most of our sunlight. So, so what is being done with that Sunlight like matters directly, therefore, these. Critical forest that are tropical, that the Amazon Congo in Indonesia and Papua New Guinea, these are very important.

[00:42:24] **Nate Hagens:** It's the highest amount of net primary productivity because of the sun cycle and everything else.

[00:42:30] **Anastassia Makarieva:** Yes. also the prime productivity, but then we also have boal forests that are still like a natural state. how we define it, it a different question In Canada and in Russia, like Russia has enormous areas with forests and these are also very important because we know the Arctic is a hotspot of, global warming.

[00:43:08] We don't quite know what's the reasons are, but it's related definitely to the heat transport, to the region. So it's not, just, local effect. And here forest

play an enormous role in cloud cover regulation, in moisture transport regulation. And so, they're also very important.

[00:43:36] **Nate Hagens:** You outlined earlier the importance of the biotic pump and forest to the water cycle and precipitation, but I'm unclear on why more for why stopping deforestation would actually solve, well not solve, but limit the temperature rise.

[00:44:01] What is the link there? with global, heating?

[00:44:06] **Anastassia Makarieva:** Yes. this is a different, story. It is not directly related to atmospheric moisture transport, but what, what is the culprit here? When forests transpire, this energy is captured at the surface. and then what the vapor goes up and condenses at a certain mean height, which is in the tropics, is about five kilomet ki kilometers.

[00:44:40] And so what happens if it's not captured as water vapor, this energy but is converted to heat at the surface, then it's a thermal radiation. It goes up and this captured by greenhouse substances. And so it participates in creating the greenhouse effect, but when it goes up. And only is released at five kilometers, for example, on average, and turns to heat there, then it can, this energy can be emitted thermals, escaping the interaction with greenhouse gases beneath this height.

[00:45:27] **Nate Hagens:** What percentage of greenhouse gases are above and below that height, roughly?

[00:45:32] **Anastassia Makarieva:** Oh, actually all water vapor. All water vapor is, is below that. Height is below because of water is, ah, I see actually five kilometers. About five kilometers is the height from which the earth radiates directly to space. It's the, upper radiating lay layer.

[00:45:58] So if we go, if we emit from there, it goes almost un impeded to space because the thickness, the optical thickness of the atmosphere is not very large.

[00:46:11] **Nate Hagens:** What you're saying is the forests, Change where the heat is created, the forest versus a deforest, if it's all of a sudden there was a forest and it was cut down,

[00:46:24] **Anastassia Makarieva:** yes,

[00:46:25] **Nate Hagens:** it's gonna be like the sand next to a lake.

[00:46:27] The sun's rays are gonna hit it and it's gonna instantly heat. And that heat is underneath this five kilometers of greenhouse forcing gases, including clouds. Therefore, it adds to the trapped heat as opposed to if the forest is intact, it will have this evapotranspiration biotic pump and the it, gets, evaporated and the heat transfer happens much higher in the sky, and therefore that heat doesn't get wrapped into the greenhouse gas functions the way it would in a deforested situation.

[00:47:08] **Anastassia Makarieva:** Yes.

[00:47:08] **Nate Hagens:** And how is it possible that global climate models don't include what I just said?

[00:47:15] **Anastassia Makarieva:** You know, this is, what also, was my question. so the, it's really, not very straightforward. They, why they don't, why they don't, I tell you, because you see.

[00:47:40] Energy to heat at the surface, and then it goes up through the, interaction with greenhouse cases. It's one vertical gradient of temperature. So we'll have high temperature here and lower temperature high in the atmosphere.

But now imagine that we take some heat from here and go up and release it there.

[00:48:09] Now we'll have a small difference. Okay? Then in the case when all heat is here, so this means that the temperature gradient, the vertical temperature gradient, decreased temperature will be more uniform because we just spread heat from the, we just take heat from the earth, which is the hottest layer and brought it up.

[00:48:36] So up we reduce the vertical temperature difference. So it's all about, the vertical temperature gradient and, in global climate models, this vertical temperature gradient is a subject to what is called parameterization, which keeps it more or less, not fixed, but changes with temperature. A priority specified manner.

[00:49:10] So it's, something that people like figured out, like should be, and they keep it, fixed. Why? I also, it's not because they're stupid or don't know, but the idea is that if the, temperature laps right, like is steeper, steeper, then any parcel of air that goes up becomes warmer than this.

[00:49:42] and it'll go up and it'll like, smoothen it. So it's unstable. Very steep gradient is unstable. It's difficult. I understand. So, but, the idea is that it's all about this vertical temperature gradient, and if the bundles don't get it right, it's an indication that something in what I am saying can make sense.

[00:50:13] You know, you know,

[00:50:14] **Nate Hagens:** but this is, if someone had the resources and the time and the dedication, what you're saying could be proven or disproven, about what you just described, right? You could have a model that would predict, the

temperature gradient, above a forest somewhere and make some predictions on this.

[00:50:33] **Anastassia Makarieva:** But actually we do have, we do have observations. we do have observations and we compare. We can compare them with model predictions. So, and these observations show that indeed the, this vertical temperature ellipse rate is becoming steeper

[00:50:57] **Nate Hagens:** all around the world.

[00:50:59] **Anastassia Makarieva:** Well, mostly, most the effect is pronounced overland.

[00:51:04] Overland. You can't just locate it. Like I cut two trees and I measure above it because it circulates. So it spreads, the effect. So it's not as local, but we can see, from large amounts of data that this is what is happening. And, this is one of the, very persistent, discrepancies between model predictions, and general understanding and, evidence.

[00:51:44] And it, it's already like three decades that it's in exist existence. And there I read a.

[00:52:02] How models view the water cycle should be seriously reconsidered. Now, 20 years later, it's not resolved, but nobody's gonna reconsider.

[00:52:11] **Nate Hagens:** What you're basically saying is, in you. You agree that we face a global heating, crisis that this century and beyond. but you think that the focus on CO2, maybe not misplaced, but it's ignoring the central importance of forests.

[00:52:34] And forests are actually something that we in theory, could have more human agency to improve or at least stabilize. And therefore a lot more effort and

research needs to go into the importance of forests and their role as a biotic pump, in reducing this temperature gradient so that it would have less deleterious impact on, global heating and the higher standard deviation of droughts and floods.

[00:53:07] **Anastassia Makarieva:** yes, yes, this is a very correct summary. but also we need just to stop, what is already in the making. Like I can name projects that are unfolding like in the Our Forest Act, which is.

[00:53:30] A disaster, basically. So I'm waiting when there is a country or somebody who will become a leader in that,

[00:53:41] **Nate Hagens:** I'm not even aware of that. Fix our forest. What is that?

[00:53:44] **Anastassia Makarieva:** Fix? Our forest Act or bill? I don't, I'm not a, an expert on the legal system, that you have. But from my colleagues in the US who are really immensely concerned, this fix, our force act is what, now was already, passed through the Congress, I think, or somehow last week almost that, and this, was made in the wake of, forest fires, which, were like recently.

[00:54:20] And this, says that we need to cut forests more, to prevent, to

[00:54:26] **Nate Hagens:** eliminate fires. To

[00:54:27] **Anastassia Makarieva:** eliminate fires. And this is, very destructive because under this umbrella you can cut everything.

[00:54:36] **Nate Hagens:** So tell me why this is a bad idea. I, mean, I can guess why, but explain why from your perspective, why this is a disaster.

[00:54:45] **Anastassia Makarieva:** This is a very good question. This is a very good question because if we look how bio the pump works, the crucial things

that. Is needed is condensation. Like condensation drives everything, all the dynamics. And for condensation to happen, the moist air must reach a de the dew point, right?

[00:55:11] **Nate Hagens:** What is the dew point?

[00:55:12] Briefly,

[00:55:13] **Anastassia Makarieva:** dew point when relative humidity is 100% and you can't add more moisture, becomes, begins, to condense, to precipitate. And what is important, for example, if we have a forest canopy, a close canopy, we have the temperature version beneath the canopy because the canopy absorbs sunlight and it is warm and there is shadow, and the earth is cool.

[00:55:44] And this cool, surface, cool air doesn't rise. So there is no rise of and loss of moist air. It's like sealed in the forest. The forest, keeps moisture and all moisture that is lost or better to say invested. It's through roots. So the for the surface remains wet, but moisture comes from the soil, from the roots via leaves.

[00:56:18] And this, moisture the atmosphere. Now imagine, so this, temperature version is important. The surface, moist surface is important and dead logs on the surface are important. They're not fuel load, they keep moisture actually. So, so, and there was a study, by American ecologists who compared rates of, fire in protected forests with a lot of fuel load and managed forest without this load.

[00:57:03] And those managed forest burned more burned, not less. And this is also because when you have thin, thinned forest, there is more wind beneath the canopy. It takes moisture away. So it totally disrupts, the capacity of the forest to store moisture. And I must tell you that the biotic pump is our own thing, and we can be wrong, but other people arrived at this independently and Australian researchers going the term landscape trap.

[00:57:41] Which is what it's, when you, there is a forest which has its own natural fire cycle, like maybe 100, 200 years a fire, natural fire, which doesn't destroy it. And then you begin to cut this forest. And this showed how this new, newly grown forest is more fire prone and you cut again and it's even more fire prone.

[00:58:10] And so there is this dead loop, which ultimately brings the forest to complete degradation. It no longer can restore itself. And this was, established on, empirical data. So landscape trap. So basically this fix, our forest act is aimed to turn this forest to, to trap you land into this desert state.

[00:58:41] **Nate Hagens:** Is it true? I.

[00:58:46] The Sahara Desert was created by hand, axes and goats back in the day, like the deforestation that led to that. And then there was a positive feedback and it was created into a desert. is that valid?

[00:59:01] **Anastassia Makarieva:** Well, regarding Sahara, of course there is a lot of evidence that it used to be much, much, weather.

[00:59:10] But this is, like we always have this, uncertainty. And there is the ge physical view, which relates it to, changes in the Earth's orbit, which are also very real. But nobody has ever demonstrated, quantitatively that a given change in Earth's orbit will turn a forest into a desert. So we can always ask if there were no human impact, maybe the same orbit.

[00:59:48] change wouldn't create anything, any harm to the forest. But there is another res example, it's the, it's Australia. Australia used to be a green. A green continent.

[01:00:04] **Nate Hagens:** How long ago?

[01:00:05] **Anastassia Makarieva:** Like, about like, 50,000 years ago. And they're finding now in the, desert, like in the dry desert, they're finding remnants of three kangaroos, three kangaroos.

[01:00:22] It's, very cute things. 20 kilograms or something I may not remember correctly, which now the relatives lives live in, the tiny remnants of tropical, rainy forest in Australia. there they were across the entire continent. Three congos.

[01:00:43] **Nate Hagens:** What happened to the forest?

[01:00:45] **Anastassia Makarieva:** Yeah. Yeah. What happened to the forest?

[01:00:47] There is research showing that approximately when the first humans arrived after that, like 40, thousand years ago, there was a drastic change in the composition of, vegetation towards the, this dry state. And this is not parallel to geophysical catastrophes that somehow happened around just, they say the moon soon ceased to penetrate inland and never recovered ever since.

[01:01:22] **Nate Hagens:** So this is because the humans that arrived there chopped down the forest for timber and fuel and building?

[01:01:28] **Anastassia Makarieva:** No, they, didn't chop it down. They were burning. So you burn and you, catch the wildlife that is escaping. This is one thing and another thing is that you burn for there to be early successional vegetation, which is often, more, palatable for and invites more wildlife and you catch them so burning and if they were living at the coast, fishing and all that and burning at the coast.

[01:02:05] So they cut the biotic pump of the inner forest from the moisture, source, and it was over in no time. In no time. So, and you can't find even traces of

this, why this happened. It was almost instantaneous when a tipping point was crossed.

[01:02:27] **Nate Hagens:** I mean, one of, one of my fears is that, and you don't know a lot about my work, is that this abundance and moonshot of economic growth that, our species has experienced the last 150 years is because we're mining this ancient sunlight in coal, oil, and gas, and it's supporting, this lifestyle and expectations.

[01:02:53] But this stuff is finite. It's, non-renewable. And when we run low on fossil hydrocarbons, and that it takes more energy and resources to get them out of the ground, we will then turn again to forests as fuel and timber. like we did in the 2009 financial crisis where the country of Greece had to pro, had to hire army members to protect the northern forest for people that would cut them down for firewood.

[01:03:28] So I worry, I, I'm, when you're telling me the story about how things are working, now in my head, I'm thinking, unless we have some change in consciousness, and you suggested some countries take the lead, I'm hoping it could be the whole world. The maintenance and even growing of our forest cover, because the default is we're gonna do the fix our forests globally.

[01:03:55] That's not ecologically informed, that's not systems informed, and we're gonna turn the whole world into a desert. Not so metaphorically. What, are your thoughts on all that?

[01:04:07] **Anastassia Makarieva:** first of all, there, it's not, just, like, your perspective, but there are very good data showing how the decline of forests in the US and in Russia we're stopped.

[01:04:24] when, the fossil fuel consumption went up, you were 50 years ahead of us. It was 19, like 70 or something, and we had it in the beginning of the 20 century. So literally. As controversial as it might sound, fossil fuels did a lot to save what we still have. So yes, I totally share your concerns.

[01:04:56] **Nate Hagens:** I really like you as a person, as a human, as a scientist, it, this is a hard topic to understand, but I can tell that you're so passionate about it and it's so important, in your life, but in all of our lives.

[01:05:09] So, I am, I'm gonna just, I hope you don't have a, a deadline on this conversation. I want to, I wanna keep going 'cause I have a bunch of, small questions that will build to the larger questions. So when we take a forest and it's just X number of hectares, how does the biotic pump function differently depending on the type of forest?

[01:05:35] So an old growth forest compared to a young forest or even a monoculture that they use, like in Spain, there's a lot of heavily forested areas, but they're all monoculture plantations. Does how the biotic pump function does that change? Depending on the type of forest,

[01:05:56] **Anastassia Makarieva:** the biotic pump has evolved. Like it is an evolved feature of natural forests.

[01:06:02] So like by definition, natural forests. That a native to a certain region run the biotic pump, most efficiently. Now, when we begin to change the ecosystem, habitually, like replacing one species with another, we can't expect anything good from such a, rearrangement, and we can, pinpoint very specifically what can go wrong.

[01:06:36] As I said, it's crucial that the forest transpires the right amount of moisture in the right time. Like for the Amazon Forest for example, there is a dry

season and the forest doesn't transpire a lot. It's dry season. It only begins to transpire in the late when the dry season ends. Why? Because when it is too dry, the forest transpires into this dry atmosphere.

[01:07:07] No condensation occurs because it's still too dry and all this, moisture is just ventilated away and it's a lost, like so to speak, lost money. The forest transpired, but there is no condensation and no return of moisture. So natural forest geophysical conditions and.

[01:07:35] The situation is such that this added moisture can trigger additional condensation and moisture impact. When we just go to a dry place like modern Spain and, place some trees or arbitrary species, they just transpire everything they have into the dry atmosphere and they just, waste out, waste away soil moisture.

[01:08:11] So, and that's why many people are convinced that if you plant the forest, you'll have less moisture, you'll have less river runoff. It'll like take your moisture, especially from the field, especially if there is irrigation. So there is this competition be between trees and people. And so, and this is indeed when you are in this landscape trap and you're trapped in the, dry regime, then, just planting trees will make the situation worse, not better.

[01:08:51] So when you kill the ecosystem to resurrect it. May not be, very easy or even possible at all.

[01:09:02] **Nate Hagens:** So, so the point is to not kill it in the first place?

[01:09:04] **Anastassia Makarieva:** Absolutely. This is, the first point. The and I'm very cautious every time I have many friends in regeneration field, like lettuce regenerate the earth and all that.

[01:09:20] But when we say lettuce, regenerate it, like produce that we can degenerate, degrade and then we'll regenerate. It's okay, but it's not okay. So we didn't degrade for no reason we degraded these lands because it was very cheap. It was cheap just to take from them until they were dead. But to regenerate is extremely costly and may not be even possible in many places.

[01:09:53] Like when a person is dead, he's dead.

[01:09:57] **Nate Hagens:** Right? You can't, there's no regeneration.

[01:09:59] **Anastassia Makarieva:** Yeah, there's no regeneration. fortunately with the ca systems could be better, but, like that. And so by the way, in, in your country, there was this term coined

[01:10:16] ation notation, not reforestation, but pro, by Susan Massino and colleagues. What is pro forestation? It is when you see that the forest can self recover and you keep it, just keep it because it's a live source. Like every population, of any species, you can see that there are sinks, population sinks, and population sources.

[01:10:49] So there are places where their population reproduces abundantly. So it's has all the resources and there are sinks, which is only sustained by migration from the sources. Like cities have always been population sinks. As I recently learned. The people didn't reproduce well there. So we need to keep those life sources.

[01:11:15] They're our utmost treasure. It's not just about biotic pump, it's life itself. We, if we lose this metrics, which still works, it's still there, it's alive, but we, if we lose this metrics, we're done. No hope.

[01:11:35] **Nate Hagens:** I'm a little speechless after that, which doesn't often happen. let me ask you a question I plan to ask you, and I'm gonna come back to, the implications of what you're suggesting.

[01:11:45] So I don't know if you know Carlos Nore, but he was on the show a few months ago and he spoke about the Amazon rainforest is approaching a tipping point where it could turn into a self-driving savanna due to the deforestation disrupting the moisture recycling kind of what you're describing here.

[01:12:09] So how does your biotic pump theory, support or extend what Carlos warned about on this show?

[01:12:18] **Anastassia Makarieva:** Of course, I know this work because it is, like a very famous work and, it's, based on a different mechanism of, changing albedo, the reflectivity of the surface. So when there is, less, sunlight, coming, so there is, less energy available for a vapa transpiration and this coal, causes drying.

[01:12:45] If we put it simple. So less energy available due to forest is darker. The forest plant is brighter, it reflects more sunlight, less is available for rapid transpiration. And there is drying.

[01:12:58] **Nate Hagens:** So that's, only based on sun's reflexivity? mostly, yeah. Yes. Yes.

[01:13:04] **Anastassia Makarieva:** and not, on, not on moisture transport,

[01:13:07] **Nate Hagens:** but Carlos talks about the flying rivers, in the Amazon, which are the water vapor flowing through the air.

[01:13:14] So it has something to do with moisture.

[01:13:16] **Anastassia Makarieva:** You know, actually I am very close to this story of flying Rivers because Carlos brother, a younger brother, Antonio Nore, is my very close friend and colleagues since, 2004. And they're two brothers who have diametrically opposite views on the biotic pump, which Carls being strongly, Opposing from the beginning. And Antonio is like a actual, Antonio, was the one who wrote to us in 2004 saying that you guys are developing nice theories about biotech regulation of the environment, that the systems control their own environment. But here we have the Amazon and its water cycle, and please do something to show that it regulates its own cycle.

[01:14:05] So it was a challenge from him, which, which, we took, and which, set us on this way of investigating the motorcycle because we were doing other things, at the time. So Antonio, he's an extremely, dedicated, person to the task of saving the Amazon. But originally the, it was Antonio, who was, doing a lot and back the scenes.

[01:14:41] So he didn't, get any, public recognition, for that. But Flying Rivers. What, how is it related to the biotic pump? Flying rivers is a very, like, strong, symbol or concept or notion that draws attention to the fact that there is a lot of what the vapor flying above our heads and above the forest.

[01:15:11] And so, so it's like an artistic message flying rivers above the Amazon while the biotic pump explains how these flying rivers actually, why they are the air and why they, are above the Amazon forest. And also what is important when the forest, the forest has evolved to, to maintain, to sustain itself with water.

[01:15:44] So it draws in mo air takes as much as it has it needs, but it doesn't care where the rest of the water goes. So apparently the air can't stop just because the air circulate. So it goes further, for example. And and since it goes from the moist forest moisture. Areas downwind and there is research and Antonio, is involved in that.

[01:16:18] And he has prepared now a new paper on that, showing that, basically the Amazon Forest serves as a notion on land and the regions adjacent to it receive moisture from it, which facilitates agriculture. And where there is flow from the forest, you may get two harvests instead of one. If you are outside of this like river and also rivers themselves, it's also like what forest disposes of.

[01:16:54] So rivers are not important for the forest as forest is important for the rivers. So without forest there would be no, or much smaller rivers, but for the forest, it's just the excess of, or inevitable loss due to gravity. So, and as the Amazon goes, to the ocean, so are those flying rivers that pass over the Amazon to the agricultural regions in Brazil?

[01:17:26] They're just what, the excess of forest, functioning or in terms of water?

[01:17:32] **Nate Hagens:** Are there atmospheric rivers, in Siberia and in Central Africa

[01:17:40] **Anastassia Makarieva:** of course, And this is also not our own research, but there was a famous study which showed that, for example, China also receives a lot of mo that recirculates, and goes through Siberia and goes then to China.

[01:18:00] So not just from the Pacific Ocean, but from the East.

[01:18:05] **Nate Hagens:** I am hearing and feeling from you that, Humans and human scientists, misunderstand and underappreciate the role of forests in the stability of our ecosystems and in the climate models themselves. earlier in this conversation, you mentioned the concept or the phenomenon of climate sensitivity, which is how much earth's surface temperature would rise if atmospheric greenhouse gases, would double.

[01:18:43] you and your research, I believe, have proposed what you call a three-legged model for understanding this, which is not just CO2 and albedo or reflectivity, but this vertical, temperature gradient above the forest. So can you walk us through the framework on how the forest influence these three variables and what this implies for the climate sensitivity that is in, the literature, today?

[01:19:16] **Anastassia Makarieva:** Yes, I, don't think that this, three legged, something schemer, can be accepted. This is just, refer to a diagram which shows indeed three lines that you can conceptualize climate change. But, we have already mentioned that, first of all, there are greenhouse substances that trap, thermal radiation, and increase, surface temperature.

[01:19:48] So the more we have greenhouse substances, the higher the surface temperature. Then there is how much sunlight the planet absorbs and how much it sends away, back to the space. This is what is called reflectivity or albedo. So climate research focuses on that. But another thing is that, is this temperature, a vertical temperature gradient.

[01:20:16] And this vertical temperature gradient, actually describes what happens at the surface because, the balance, the balance is, between how much, energy, the planet always in a steady state. It'll receive as much sun, is, it'll emit as much radiation, as much thermal radiation as it receives sunlight just from meta conservation.

[01:20:47] But what will be at the surface depends on this vertical temperature gradient.

[01:20:54] **Nate Hagens:** What are the implications on the, four C to six c climate sensitivity numbers? If we incorporate, the work of biotic pump theory?

[01:21:07] **Anastassia Makarieva:** I can tell you what I think that including, generally not just biotic pump, but generally the idea that, natural systems contribute to climate stability.

[01:21:24] It can explain this hot models paradox. How, because hot models, they describe the current climate using the most recent data, satellite data on, clouds and the models that have lower climate sensitivity, they better fit it to the past. So if we take these results at face value, we can see that past climate.

[01:21:56] Was less sensitive to CO2 than current climate, and there was a sharp increase in sensitivity during the last decades and what happened in these decades, massive destruction of natural forests. So we, and this explains that all the models keep it lower sensitivity and more advanced models fit it to more recent data already reflect this more destroyed biosphere.

[01:22:32] And if this is so, and this is as I know, this is the only explanation, because, current, climate community just doesn't, as my understanding is they don't have any explanation and the idea what to do with those, hot models and how to explain this discrepancy. But the idea is that we're losing natural care systems.

[01:22:58] We're losing stability. We dunno how we can figure it out. Of course, like with the 2023, we lost a lot of cloud cover over them. But generally 10 hectares here, th hundreds of kilometers in Siberia, our forest. the US now plans for self-sustainable forestry in Canada. Big plans for bioway fuel in Indonesia.

[01:23:35] So we're eating away these pillars of our climate stability, and then we're surprised that indeed there is an uptick and there is an uptick in temperature and the models begin become violent, and, climate sensitivity, will rise soon to 10 degrees to doubling.

[01:23:59] **Nate Hagens:** Possibly it could, but not for the reasons that the models say it's possibly, it could be 10 C if we denuded, if we do a 21st century version of Easter island, after fossil fuels decline, like we talked about earlier.

[01:24:15] like I'm reading between the lines of what you're saying and I'm a little depressed right now 'cause I didn't really fully understand this.

[01:24:23] **Anastassia Makarieva:** In fact, we had a conference, in Munich, last year embracing nature's complexity, about this stuff. And people, who participated, noted, on the contrary that this is a positive message.

[01:24:52] Success in fighting with CO2 emissions are exactly zero,

[01:24:57] **Nate Hagens:** but our success on forests might not be zero,

[01:24:59] **Anastassia Makarieva:** might not be zero, and it's still there and they're alive.

[01:25:04] **Nate Hagens:** So let me take a aerial view here. what would accepting the biotic pump theory and the central importance of forests, if the general thrust of yours and Victor Gors Goff's work was integrated and accepted, what would that mean for current climate models and climate activism generally?

[01:25:31] **Anastassia Makarieva:** There are two questions, you, that you ask for climate models and for climate activism. In my view, climate models currently have a major problem that they try to describe what is possible like, but indeed many things are possible. And, you know, if, the, there are like official models that are accepted by IPCC predict from two to six Kelvin's, such a big, discrepancy,

[01:26:11] actually, what has not been tested is what can't be modeled by these models. Nobody tried. Like there is a model which predicts just two Kelvin. Is there a model? At least, they all agree in the sign that most CO2 means warming.

But probably we could, come up with other models that pre predicts something different.

[01:26:42] And with respect to the water cycle, which is not their focus, I must tell you that when these models deforest the world and they did make such experiments, they predict totally different answers. So no robust response. Some say there will be more moisture transfer to land, more precipitation. Some say there will be less moisture transfer, less precipitation.

[01:27:10] And there is so, and it means that there are no constraints. They're totally, blind on this matter. And, so, what I think it, and this is my idea that I been entertaining for a couple of years already, what could be done? They like to compare us with the space, spaceship Earth. Like we are all on the spaceship.

[01:27:41] We, we need to take care of it. But when people construct spaceships, they plan for the worst scenario. So they try to expand the range of things that can happen not to, like, let us concentrate on the most probable scenario and discard the least problem. No. Expand what is at all possible.

[01:28:08] So instead of trying to make models that mimic the reality and confirm the major role of c2, let us build a different model. Just forget about C2 and which assigns the main role to forest and let us parameterize as much as we can and try to see with such a model is possible. Because if it's possible, then we're on the equal grounds, but it has never been made.

[01:28:46] **Nate Hagens:** You're saying the climate of earth is incredibly important, but maybe if instead of optimizing for CO2 as the driver, we should just set that aside for the moment and redo it, build it from scratch, focusing on forest as the main driver and see what is the output of that.

[01:29:06] **Anastassia Makarieva:** Yes. Yes.

[01:29:08] **Nate Hagens:** And, CO2 would be one of the variables, but not, but forest would be the central one.

[01:29:13] **Anastassia Makarieva:** Yes. just ask a group of scientists with that, the problem. I would say, that, scientists, I think, and it's a global problem, especially when you call for something like don't don't destroy, it goes against economic, interest of many people. Yeah, of course. So it's not like, you can, you are free to say what you are saying, but, who will listen And this is the problem, but not only in my country, but everywhere.

[01:29:44] I think

[01:29:45] **Nate Hagens:** of course, because the science is good until there are recommendations and implications from it, and then it's suddenly questioned. So what do we do about that? what, is your hope for science, and humanity in coming decades?

[01:30:03] **Anastassia Makarieva:** We were very much, concentrated on our research, and Victor died in 2019.

[01:30:12] After a long, like he was ill for about year and a half, and it was very tough time. And in 2019, I was like, I just, opened my eyes and I saw that the world has changed something I felt very acutely. And I remember writing to UGA bar about that, what's happened. it was, I, like, I was totally, disconnected with my other, with this dramatic things and something happened.

[01:30:50] So I felt it. I saw it. So I'm trying now to figure out, and still when I look into the future, I don't get any signals I has confessed. But at the same time, more recently, like something I feel that there is an opportunity, like, maybe there is an opportunity because changes are so strange. What's going on?

[01:31:20] Many things are going, really strange. So I really hope for a face transition when suddenly the priority in, a competitive interaction that drives our society will change. We need to have something preserved by that time.

[01:31:42] **Nate Hagens:** I agree. So is there anything that, people around the world listening to this show can do with respect to the protection and the maintenance of existing forests?

[01:31:58] Like what sort of recommendations do you give on that front?

[01:32:02] **Anastassia Makarieva:** There are, in every country, there are people on the ground that, fight for each particular place. So if you have an opportunity, just support those local efforts. Besides that, I think that we need, we really need a global, movement, for this and we need, to energize governments to lead because it's a very, it's a field where it's easy, to lead and to be seen as a very good, like a real leader.

[01:32:46] And in this sense, when I, see it, this, what you are having now, like this make America great again, it's good, but you destroy.

[01:33:07] It won't make America great again. Maybe this could be communicated, to people.

[01:33:13] **Nate Hagens:** You're the first guest I've ever had from Russia. Do they teach basic ecology to 10 year olds in grade school? In high school, in, in Russia?

[01:33:24] **Anastassia Makarieva:** Yes. there is of course, it's not, ecology. It's, I think on the biology course.

[01:33:32] **Nate Hagens:** cause most people in this country don't. Are never required to take ecology unless it's an elective in college. So we really are ecosystems blind generally, like fix our forests is like an Orwellian term because

it's gonna do the opposite, like, like you said. so I think there's an ecological education and awareness that is a, foundational step first.

[01:33:59] **Anastassia Makarieva:** Unfortunately, the situation is worse that you are saying because there are, as I'm a little bit acquainted with the literature, there are many scientists paid directly by, industry and they are scientists and they are teaching this that forest should be cut of to reduce fuel, load. So this is the situation is more gra like more grave in Russia.

[01:34:29] we have a different, thing that, basically nobody cares, what you are saying. Oh, so, so it is like,

[01:34:39] **Nate Hagens:** no. What do they care about?

[01:34:41] **Anastassia Makarieva:** no. I mean, in, the US what I see as I see the industry is paying scientists that they right, are saying something that

[01:34:52] **Nate Hagens:** they're,

[01:34:52] giving conclusions that are friendly to the industry

[01:34:55] **Anastassia Makarieva:** to continue to cut.

[01:34:57] In Russia, it's like not needed because the industry has, its. Like can't do that. So in this sense, the industry, and this is what I in the West, is more like advanced in doing these tricks,

[01:35:14] **Nate Hagens:** you know, to be honest. your world famous on your work on the biotic pump, and all the implications that has on climate and the other systems.

[01:35:27] Part of me wishes I could have just had this two hours with you to talk about Russia. Tell me about a favorite forest that you have in Russia. I'm sure there's lots of them and can you just describe it for a bit?

[01:35:43] **Anastassia Makarieva:** I, traveled, for many years to the White Sea. White Sea is about 700 kilometers, north from St.

[01:35:54] Petersburg. It has a very high tide, like about one meter and a half, which makes it difficult to develop the coast and that's why it's, more or less wild. And so I spent a lot of time, like I calculated six years, like 70 months between forest and sea. And this is absolutely transforming. this is, like you come there and in three weeks, not immediately.

[01:36:31] In three weeks, you become a different person, but you're rebalanced retuned somehow. And you see, Victor was saying that it's exceptionally important for a theorist to be, immersed into the forest because a lot of things you estimate by order of magnitude. So you just have an idea how things, fit together, like productivity, like rainfall, like soil moisture, and you see it all.

[01:37:13] And you see the complexity of things. What we're missing, the main thing is the complexity of nature, complexity. It's, more complex than our civilization, which is just a big thing. concentrated resources,

[01:37:33] **Nate Hagens:** which is also complex. But I agree with you on nature.

[01:37:36] **Anastassia Makarieva:** Yes. So we're underestimating that.

[01:37:39] And, since, 2000, 2020, with, and my partner collaborator we're, traveling to Siberia, to the NC River. Which is where the biotic pump actually started. Because when Antonio told us that we should develop something about

the Amazon, the first thing Victor thought about was the Yea river where he traveled a lot.

[01:38:15] And he said, how is that, that this river being, so many thousands of kilometers from any of the ocean is such a big river, how all this rain gets there? So that was our starting point, how we began, to think about that. And indeed, the n Sea River is, very mighty, entity, very mighty, phenomenon.

[01:38:44] When you see it

[01:38:45] **Nate Hagens:** in the north of Russia.

[01:38:47] **Anastassia Makarieva:** Yes. mostly we're in the, on approximately the same latitude as, St. Petersburg's there.

[01:38:54] **Nate Hagens:** It's just outta curiosity, what sort of megafauna are there? What sort of animals or fish or birds might you see?

[01:39:03] **Anastassia Makarieva:** Oh, yes. well, first of all, bears Moose. These are the biggest and, Also, regarding fish, in the yea there is like very precious fish, which is prohibited fish. but there is a lot of very good fish also there, it's called the white fish.

[01:39:28] **Nate Hagens:** So I'm sorry to get so, esoteric, but it's beyond dinnertime, where you are. Have you had dinner yet tonight?

[01:39:37] **Anastassia Makarieva:** yes.

[01:39:38] Yes.

[01:39:38] **Nate Hagens:** What did you have?

[01:39:40] **Anastassia Makarieva:** I have a cabbage soup.

[01:39:44] **Nate Hagens:** Cabbage soup?

[01:39:46] **Anastassia Makarieva:** Yes.

[01:39:47] **Nate Hagens:** Well, that's very

[01:39:48] **Anastassia Makarieva:** delicious. Very delicious. soup. She Excellent. It's called She in Russia.

[01:39:55] **Nate Hagens:** Okay. so I, I don't know that you've watched any of my episodes, but I usually close the interview by asking, some of the same questions to all my guests.

[01:40:07] So, I work on something that we call the metris, which is not only climate change, but inequality and energy depletion and artificial intelligence and economic growth, and how all those things, fit together, the unfolding of our times. Do you have any personal advice? Well, first of all, did is, metris, is that a thing in Russia?

[01:40:33] Do people talk about the metris or the poly crisis?

[01:40:38] **Anastassia Makarieva:** People are dying. So this is now overshare those, other, discussions. But, generally in Russia, people are more optimistic about global warming. I must tell you because we're not so many people think the warmer the be, the better,

[01:41:03] **Nate Hagens:** the warmer the better.

[01:41:04] For Russia.

[01:41:04] **Anastassia Makarieva:** Yeah, for Russia. So there is a lot of like, I would say, a lot of, skepticism regarding the, the, danger,

[01:41:20] **Nate Hagens:** well plus the most of the country is a forest. So it's not like you're deforesting Russia at a rapid pace.

[01:41:29] **Anastassia Makarieva:** no. We're, are deforesting Russia at a rapid pace. Really.

[01:41:32] It's, I didn't

[01:41:32] **Nate Hagens:** know that.

[01:41:33] **Anastassia Makarieva:** No, you should know that. the rates of deforestation are really, very high. And also as we have discussed, when you log, it is followed by fires because what does the weather cycle is disrupted and there are also more people can come because there are roads, so there is more ignition.

[01:41:55] So there, I'm sure you heard about huge fires in Siberia. So it is all interconnected. So basically there is, Forests are on the threat in Russia, and this will matter for the world also. So it, that's why I'm talking about, international effort. just let us bring up a new culture because you know, forests, okay, I agree.

[01:42:27] Fa pharma industry is very powerful. They're taking money from everybody, killing people. Very difficult to do something. But forestry industry is not that powerful. it's not, fossil fuel industry. It is. So it should be possible to overcome this relatively minor segment of economics, which makes a disproportional destruction for all.

[01:43:01] And people are just not seeing that because even for the farm, even for the fossil fuel, this baron or whoever, or for everybody, these people who are

cutting forests, who are promoting building skyscrapers from wood or whatever. Also, I must tell you this topic about plastic package is very suspicious because if we replace plastic package with paper, it'll be a global disaster.

[01:43:34] **Nate Hagens:** Because we will have to chop down so many forests

[01:43:37] **Anastassia Makarieva:** because we'll chop down everything. So what we're proposing, we actually, we are proposing here the notion of climate regulating forests. Let us protect the climate regulating forest, the self regenerating forests, and let do, forestry on plantations.

[01:44:01] Don't pretend these forest, don't pretend.

[01:44:05] **Nate Hagens:** Call them something else.

[01:44:07] **Anastassia Makarieva:** Call them something else. And you have grown. Don't go to nature. Don't. So they couldn't even be paid. So the state could even like, contribute some investments for these plantations. Like my crazy dream would be like the Chinese. They are, we were in December in China on the Echo Summit about eco civilization of the future.

[01:44:36] And the Chinese are really very serious about ecology, about trying to do something because their situation is very diff difficult in ecological terms. But while they are trying to restore something in China, they're cutting everything in, Russia, in the forest. All growth forests. And by doing so, they're disrupting the moisture flow and disrupting regional water cycle.

[01:45:05] So to China? To China, yes to China. So maybe to cooperate with China, let us do a plantation, because on a plantation you can forget about ecology and you can just grow as we grow on the field.

[01:45:21] **Nate Hagens:** So there would be a tree forest or a tree plantation, and they're run by different rules. And what Yes, the summary of this podcast conversation with you and thank you for your time, is one of the biggest no regret strategies that we humans have as a species going forward, is to protect the existing remaining forests on earth for their ecological functioning and services that they stabilize all sorts of things.

[01:45:53] **Anastassia Makarieva:** Yes. It's a climate regulating, for the climate regulating function and for what we discussed less, also for the function, for providing us with a reference that makes, the sense of life. The meaning of life.

[01:46:09] **Nate Hagens:** Are there activists who aren't scientists like you, but are there entities in Russia that, Champion the causes that you are discussing here.

[01:46:23] **Anastassia Makarieva:** You know, that indeed, Russian people are, there are many people who are concerned about forests. They are a minority as in any other population, but it is normal. I think it's normal, but they're less concerned about climate, like big climate, but they're concerned about forests and, their argument.

[01:46:52] I very, I would say you would love them because are multi-dimensional, multi-perspective from all perspectives, from the perspective of health, of, knowledge of, like, from everything including, including, local climatic benefits. Also, like everybody understands that forest smooth and smoothes, temperature extremes.

[01:47:25] **Nate Hagens:** So just from a marketing standpoint, it would be much easier for the world to adopt, protect and save our existing forest than it would to save climate change. It's just way too complex. the latter is way too complex and counter to industry and everything else. I actually think, forest and, what they do

for climate regulation and other things is a better story, for people to actually respond to.

[01:48:00] Because in my work, I call the economic Superorganism is going to want more and more, emissions and fossil fuels. The problem is once growth stops, what do we do then about forests? And that's something that is a, big question on my mind.

[01:48:19] **Anastassia Makarieva:** It's actually an existential question, because, and in the bio regulation concept, it refers to the, problem or the curse of abundance.

[01:48:32] Because when you have an abundance resource, you don't, you can't arrange competitive interactions such that those who preserve, outcompete, those who, take, take away. It's like the tragedy of commons. And, but it's, very fundamental problem. And I've been thinking how to overcome that. And, the only thing I, think it's a taboo.

[01:49:07] There should be a taboo. But not superstitious, like something, which is, it used to be in indigenous, some indigenous societies, like Antonio was saying, that the indigenous peoples of the Amazon, they know that if you destroy forests, there will be no rain. How do they know? They know from the spirits. We don't know that.

[01:49:30] But we can formulate this global taboo, based on science because it's for the first time in human history that we have been able to look at the globe as a whole. We know global precipitation, we know what forests are doing. We can measure it. We know river runoff and all that. So based on this, we can forever just set them aside and return to this green corridor way we can do whatever we want, developing our civilization.

[01:50:07] Further, when the population level stabilizes at the, like, below 1 billion, there won't be any problems if we also preserve electricity. And, so, so there are chances, I think, and unique chances for the first time, maybe this global crisis is our, you know, global chance. It's so boring. and Nate, it's so boring.

[01:50:37] Every time, one and the same big civilization call, have we learned something? Can we stop this or minimize these, very silly things. And all the time, for the same reason, for the same reason, stupid people go up and destroy everything, then everything is destroyed. Clever people come up, repair and or nature grows itself.

[01:51:08] And this is all the same. and now when this is global, maybe we can stop it.

[01:51:15] **Nate Hagens:** Well, that's my hope and why I have this platform here. Here's a question I ask all my guests. I don't know that you've heard this, but if you had a magic wand and you could wave it and there was one thing you could do, there was no personal risk to you or your decision, what is one thing you would do to improve the future for humanity and the biosphere?

[01:51:41] **Anastassia Makarieva:** Well, I would of course ban, any further forest exploitation everywhere just from tomorrow or from today. So it's, pretty clear. and it's also personally. People are so wounded. You know, you were asking about, my travel, what I learned in that travel. What is the, feeling of your territory that you, it's the territory of yours.

[01:52:13] You own, it's your home. But with this wish we don't, actually experience in such a cute manner when we are living the urban environment because we're sharing with many people whom we dunno. But when you see it's like yours, like, you are part of it. But with this comes this acute, tragedy, responsibility of no, no,

very, acute suffering of, when it's destroyed, when it's when somebody comes and you lose a control.

[01:52:55] So, so when I thought it, it made me rethink and understand the sufferings of people who were, colonized when our civilization was, it's something that people don't understand who didn't experience it. It's an immense suffering.

[01:53:23] Like total, co-ops, of something.

[01:53:26] **Nate Hagens:** Yeah, it's like a violation of, something sacred. I, feel what you're trying to articulate.

[01:53:34] **Anastassia Makarieva:** Yeah. Yeah. So, so, so, so lots of people are wounded when forests are being cut. Of course, it doesn't matter for many people are also being killed and nobody cares.

[01:53:48] But this is, something that we need to preserve.

[01:53:53] **Nate Hagens:** Thank you. I agree with that. I'm gonna give you a chance to make a closing appeal to our listeners, but let me ask you this. you are obviously, a polymath of sorts. you have a scientific mind and a curiosity. If you were to come back on this show next year, say, what is one topic and it might or might not have to do with forest?

[01:54:15] What is one topic that you personally are very interested and passionate about that is relevant to human or planetary futures that you would be willing to take a deep dive and, unpack?

[01:54:30] **Anastassia Makarieva:** You know, I have lots of, scientific interest, which I can't pursue because this, my research that I'm now doing, I think is most important.

[01:54:44] But, Early in my career, I did some genetic, research on the genetic variability in mammals. And I think, a very important problem of our species is the increasing mutation load so that we, don't have a proper, natural selection operating, and we are continuously, genetically degrading basically.

[01:55:14] And this is not, properly, we're not, we don't have even a discussion about that. but this is important and this also relates to a normal environment. So this is, a very complicated topic. Yeah. Yeah. that's fine. I mean, I'm also interested in that. And another, topic, which is, also very interesting from my point of view is how, what would be, the right, how can we arrange a good life on the planet for the humanity in terms of ecology?

[01:55:59] So how many should we be or how should we behave to, to be in balance? And are there any natural guidance on how many. On, on, on our numbers, which we could use because if you look at the distribution of energy consumption in natural forests, you'll see that the biggest animals consume the smallest proportion of energy.

[01:56:30] All animals, all big animals, meaning all mammals, beginning from mice, consume less than 1% of primary productivity. 10% goes to inverting birds, like including insects. And 90% is what is decomposed by bacteria and fungi who are the pillar of the stability.

[01:56:54] **Nate Hagens:** I didn't know that. So all 6,000 mammal species together consume 1% of NPP

[01:57:03] **Anastassia Makarieva:** in, in, natural forest.

[01:57:04] If you have in natural forest degraded, you can, like in somewhere in Savannah, which is very unstable, you may have a higher, much higher, population density, which is by the way, why Savannah is unstable. But for stable ecosystems,

we have this. and Victor was the first person who established that. And this is basically the, what he formulated as a limit, as a, what you would say.

[01:57:40] for our species. And, that's it. And that's important because this has to do, why is this so, and this has to do with the size. When you have a big size, the vol size, surface and volume ratio, the diminishes and you are mostly concentrated on your inner side, and your impact on the environment is reduced to very simple things.

[01:58:11] You take and you return, excrete. And this is, has many parallels in World. Like when a firm, a company is small, it's very competitive. It's, like doing good things. And then it undergoes what is now coin, the term it's ification or something like that, when it grows big and it begins to absorb in its own, internal problems and doesn't care about external consumers.

[01:58:45] So it's a very, and that's why because they're so inefficient, these big things, including us nature, strictly suppresses their share of consumption such that they don't, are not allowed to make a big impact. And this picture stands in sharp contrast with the idea that some people. Anthropocentric idea that big animals are engineers of ecosystem, that this is not, so,

[01:59:15] **Nate Hagens:** yeah.

[01:59:16] Yeah. that's fascinating. So, yeah. So, so, thank you so much for your important work, your lifetime of dedication to this work and, your time today. Do you have any closing comments for the viewers around the world watching and, trying to, understand the importance of, the biotic pump and, the earth's forest?

[01:59:40] Do you have any, closing words of advice to the humans, following this story?

[01:59:46] **Anastassia Makarieva:** yes. I would say that, we need to, listen to each other and to try to overcome this, disruptions, that are coming our way. Because really, there is a more connection between the good in, many countries and in all countries.

[02:00:10] There is the evil near the good. So we need to connect rather than be disrupted on the formal, ground that somebody is from the wrong country. So think you, Nate, for listening.

[02:00:26] **Nate Hagens:** Thank you, sva Anastasia, Eva, thank you. And to be continued, my friend. If you enjoyed or learned from this episode of The Great Simplification, please follow us on your favorite podcast platform.

[02:00:40] You can also visit The Great Simplification dot com for references and show notes from today's conversation. And to connect with fellow listeners of this podcast, check out our Discord channel. This show is hosted by me, Nate Hagens, edited by No Troublemakers Media, and produced by Misty Stint, Leslie Balu, Brady Hayan.

[02:01:04] And, Lizzie Sirianni.