

Atmospheric Scientists Show Resilience in the Face of Lockdowns

By Jane Palmer, Freelance Science Journalist

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For the past few weeks, Jen Morse and a colleague have had to ski 6 kilometers to a snow-buried shack on Niwot Ridge to collect data. Once at this remote, windswept spot on the Front Range of the southern Rocky Mountains of Colorado, Morse, a climate technician at the University of Colorado Boulder, fills four heavy flasks of mountain air, which she carries down in her backpack. Skiing the full distance isn't the norm, "but it's hard to social distance in the cab of a snowcat," Morse said. Hundreds of such carefully collected flasks get shipped to the National Oceanic and Atmospheric Administration's (NOAA) Global Monitoring Laboratory in Boulder each week from such remote locations as Hawaii, Mongolia, and Antarctica. In Boulder, scientists analyze the flasks' contents to determine how the levels of trace and greenhouse gases, such as carbon dioxide and methane, are fluctuating or increasing. "There are some very specific things that we can learn right now that are going to turn out to be valuable in the long run." But over the past few weeks, many countries have implemented strict measures to curb the spread of the coronavirus disease (COVID-19), placing cities and even entire countries on lockdown, and NOAA researchers have scrambled to keep the flask collection going. "We've never had a situation where we've had the potential to lose the flask data from so many sites at the same time," said Arlyn Andrews, who manages NOAA's Global Greenhouse Gas Reference Network. So far, more than 90% of the flask sites are still sampling, and automated measurements made at in situ sites continue to provide data for carbon dioxide and methane. Doing whatever is safely possible during the pandemic to sustain monitoring is important, not least for maintaining records, scientists assert. "There are some very specific things that we can learn right now that are going to turn out to be valuable in the long run," said Prof. Joost de Gouw at the University of Colorado Boulder.

Going Local. When news of the impending lockdown reached de Gouw on 11 March, he knew he had to act fast. With his group, he physically moved a mass spectrometer to a prime site on the university campus where it could measure the changing levels of organic gas compounds in the background ambient air. "It was hectic, but we got it done in time," de Gouw said. "And now our instrument is happily chugging away." The instrument measures organic compounds, in the form of gases, that emanate from transportation, agriculture, vegetation, oil and gas production, and personal care products such as cleaning materials. De Gouw hopes that the measurements will help researchers discriminate how much air pollution comes from individual sources. "In normal times, all of these compounds are emitted where people live and where they drive, so they come from similar locations at the same times, and it is difficult to decide what the relative contributions are," de Gouw said. "Now we are taking one important source away—cars—so then what do we see?" Already, de Gouw's data have revealed several improved air quality

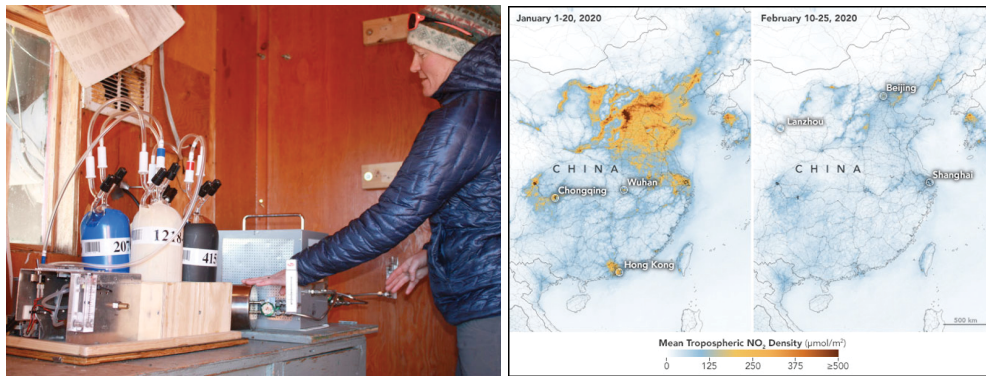


Figure 1. (Left) Jen Morse fills flasks full of mountain air for NOAA's Global Greenhouse Gas Reference Network (by Jane Palmer); (Right) Sentinel-5 TROPOMI satellite images show a sharp reduction in nitrogen dioxide concentrations over China in February 2020 (by NASA).

days in the Boulder region. “There is a wow factor of the level of pollution that all of us combined put into the atmosphere, and that is now no longer present,” de Gouw said (Figure 1).

A Big-Picture Perspective. While de Gouw’s mass spectrometer is revealing changes in local air quality, the Dutch/European Space Agency (ESA) Tropospheric Monitoring Instrument (TROPOMI), which is on the ESA’s Copernicus Sentinel-5P satellite, has enabled researchers to observe the changes in air pollution at a global level. “It is something that we have never seen before, such a big change in air pollution levels in such a short time frame.” Observations from TROPOMI have shown that on average, across China, levels of nitrogen dioxide have dropped by 35% from the day that lockdown measures went into effect, compared with the same time period in 2019. The TROPOMI data also reveal reduced concentrations of nitrogen dioxide in the major cities of Europe, such as Milan, Paris, and Madrid, in the past couple of weeks. “It is something that we have never seen before, such a big change in air pollution levels in such a short time frame,” said Pieternel Levelt from the Royal Netherlands Meteorological Institute and Delft University of Technology in the Netherlands. To fully understand the impacts of the lockdowns on nitrogen dioxide concentrations, scientists are starting to investigate a combination of satellite, meteorological, and ground data. “We are testing our knowledge in the extremes,” Levelt said.

Challenging Times. Unlike the scenario with nitrogen dioxide, it will take some time before scientists begin to see changes in the rate of greenhouse gas emissions, Andrews said. Their network, which includes in situ monitoring and flask samples taken on planes in addition to the ground-based flask data, was designed to look at changes on continental to global scales, and large reductions in emissions will register only a small signal at remote sites, such as the long-running Mauna Loa Observatory in Hawaii. “But if we have a slowdown that lasts for 5 or 6 months, the signal will start to stand out even at these remote sites,” Andrews said. Regional signals over the United States and Europe will likely be larger, but it’s too early to see anything yet, Andrews said. “Signals of the economic slowdown will be larger than what we see at remote sites, but the economic impacts are only just starting.” Factors such as photosynthesis and respiration play a larger role in emissions at the continental sites, meaning that it can be even more difficult to find a clear signal of reduced emissions in the data, Andrews said. The scientific questions that the lockdowns present are interesting but are secondary to concerns about global health and the economic impacts of coronavirus and the safety of colleagues locally and around the world. The logistics of trying to manage the network via telework while also homeschooling children are challenging, Andrews said. Levelt concurs. Despite the scientific possibilities, it’s still a difficult situation for scientists, Levelt said. “Everyone has someone in their family that they are worried about, and that is also true for us scientists,”

Levelt said. “That is our main concern—we are just human beings like everyone else.”

How COVID-19 Has Impacted My Life

By Casey Fern (SSU 2020, media and communication major)

This is a challenging and scary time for us all. Everyone is being affected by COVID-19, regardless of whether they have the virus or not, and we are all coping in our own ways. Personally, one thing I am finding difficult to deal with during this pandemic is keeping my mental health in check, namely my anxiety. Like a lot of others, COVID-19 has caused me to struggle with my anxiety for a number of reasons. Actually getting the virus and/or unknowingly passing it to a family member is high on the list; my parents are over the age of 65, so they are most at risk (also my niece and sister have bad asthma and we all live together); all of the fun things I had planned and was looking forward to have been indefinitely postponed; and my full-time job has cut my hours to about only 15 hours per week.

Even though I am not able to work much during this time, I still consider myself lucky to have a job. I work at Kelly Volkswagen in Danvers, and we have not completely shut down because our service center is considered an essential service. The original plan for the rest of this year was to continue working there, where I have been for almost four years, while looking for jobs that have more to do with my degree once I graduate this May. After five long years, I will have a bachelor of science degree in media and communication. The goal was to apply and interview around to find a job in my field by the end of the summer, but that will no longer happen due to COVID-19.

With regard to school, I have been lucky in that I have not had to transition too much, because Salem State decided to hold all classes online—and most classes I am currently taking were already online. Still, I feel as if I am at that point where I should be ready to know what I want to do with my life and I should be getting ready to head in that direction upon graduation. At least, that’s what I have been told for most of my life. I especially feel like I should have a better idea of what I want to do since it feels like I have been in school forever. Even though I have ideas, I’m still not sure and it causes me a lot of stress and anxiety. I try not to get worked up about it because I know there are thousands of other college students who feel the same way.

I think it is all of the uncertainty regarding the virus and the impact it has had on the world that gives me the most anxiety. In order for me to cope with my anxiety, I usually like to keep myself busy. I always make plans to look forward to something, which has been extremely difficult since COVID-19 has disrupted life as we know it. I can’t go anywhere to keep my mind off of the pandemic. I cancelled a vacation with my siblings. The concerts and sporting events I had planned on going to have been indefinitely postponed, and might not even happen at all. Most of the time I am just alone with my thoughts, which can be a scary place.

Like a lot of people, I use social events and my hobbies as a way to escape from reality for a little bit. In the amount of time I spend at a concert or traveling to another state for a soccer game (Figure 2), I can



Figure 2. Author Casey Fern (at right), with her sister (at left), at a U.S. Women’s National Soccer Team game in New Jersey in March just before everything began shutting down due to COVID-19 (by Casey Fern).

forget about any trouble I'm having in school or the fear I have about never finding the right job. It feels good to not have to worry about anything for a few hours; but that can't happen anymore, and it won't be able to happen for a long time.

We may not know exactly how long it will take to "get back to normal" after this pandemic. But if everyone is being safe and following social distancing orders and the stay-at-home advisory, we can get through this together.

Life during a Pandemic

By Sara Mana

Let's acknowledge that life is a little weird right now. Covid-19 is changing how we live today and possibly will trigger societal changes in the future as well. It's stressful, disconcerting and each one of us reacts a little differently to the challenge. I decided to collect current thoughts and ideas from our community as well as some food for thought of my own (Figure 3).

"I find it very uplifting to see how people are working collectively to help one another."

"Something I've been thinking about is "is learning possible right now?" There is so much fear, anxiety, confusion, sadness, grief and all this other stuff going on, I am not surprised that students are struggling. Our routines are gone. We can't have the great discussions we did before. Right now my main focus is taking care of myself and my loved ones."

"We now fully understand how much we actually take for granted in our everyday lives."

"We now finally realized that toilet paper doesn't grow on trees after all."

"It's like there's no future – or else, we can't plan for the future, because in the age of the coronavirus, we don't know what we'll be doing in six months, or even tomorrow. We're stuck in a new kind of everlasting present."

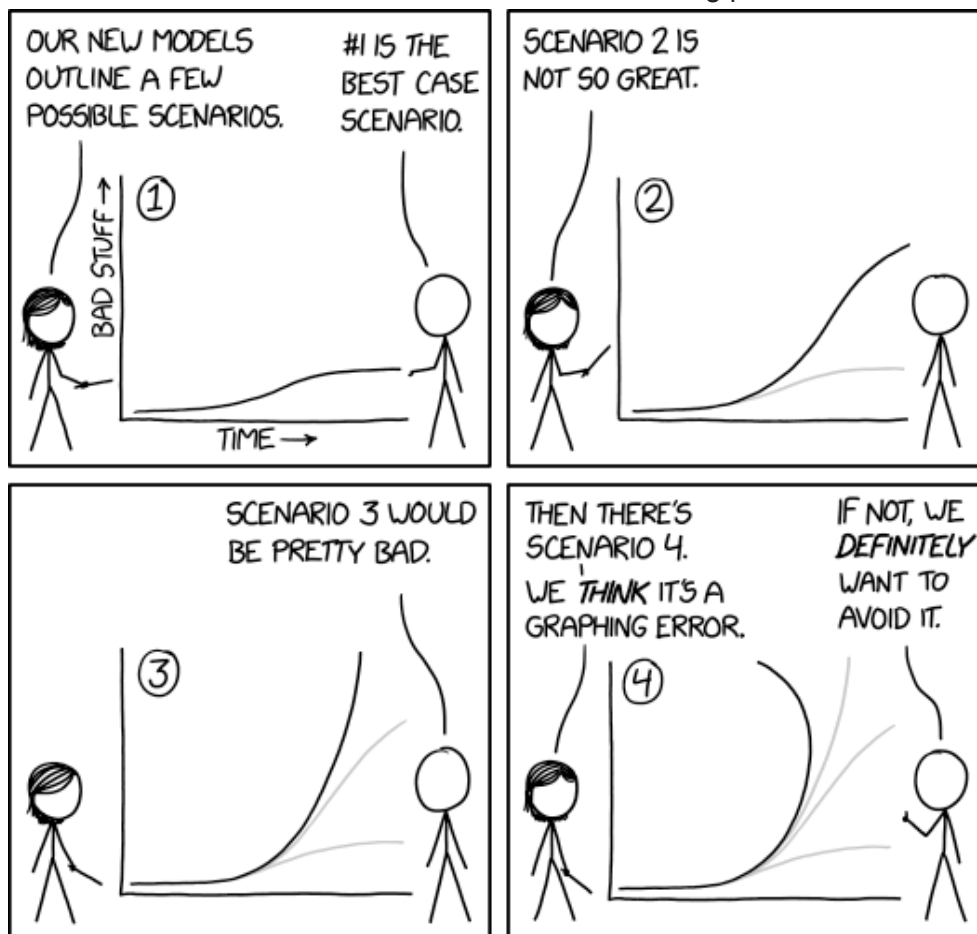


Figure 3. Coronavirus Modelling by xkcd.com

“Thank goodness we are all still healthy, and my 5-year-old has surprisingly taken to online classes with his teachers and classmates. Funny thing is that because of this experience, he now asks if the person on TV can hear and see him! He actually does this now whenever there is someone talking on a screen. This pandemic is certainly bringing all sorts of surprises.”

“This is surreal. We are thrown into a situation that we have never experienced before. It's extremely disorienting. The unknown makes us uneasy. If you've ever gone into an art museum, and you walk into a room with a big abstract painting on the wall, and look at it and you can't tell what it is, you'll feel anxious. You'll feel uneasy. Only when we eventually work it out the anxiety melts away.”

“Seeing a young girl standing in front of a nursing home window talking with her grandmother through a phone is both heartbreaking and encouraging.”

“In line at the supermarket I ponder how lucky they are that each tile is one foot. Makes it really easy... stay 6 tiles away from each other.”

“The land of uncertainty is also a land of opportunities. We might be forced to change but we get to decide who we want to be today and tomorrow.”

“My days have blurred into Google Classroom assignments, hobby seeking, aimless searching on Netflix, and on exceptionally boring days, existential contemplation.”

“I am naturally a driven, passionate learner with intense intellectual curiosity. But in the midst of this chaos, I can't help feeling like all the assignments from my classes are just busywork. I manage to stay afloat, keeping in mind that everyone is doing their best. Despite no ostensible end in sight, I hope this quarantine brings out the best in me, in society, and in nature.”

“Oh, procrastination, I know what I am supposed to do, I just have so many other things that seem more appealing and having no structure does not help.”

“I never understood how much social interaction I experienced at school until the end of the first week of my self quarantine.”

“Finding new ways to stay social has been essential, and recently, my friends and I all drove our cars to a large parking lot, parked more than 6 feet apart from each other, sat in our trunks, talked and enjoyed each other's company for over an hour and a half. We missed each other, and this subterfuge turned out to be crucial in keeping our sanity.”

Giant Trilobites of Tarhoucht, Morocco

By Tom Rich

Some of the Geological Sciences Department know me as “Trilobite Man” as I visit frequently to give Paleontology presentations. Even though my 50-year working profession was developing, pumpable roof bolts for low seam coal, abrasion, erosion, and chemical resistant products for mining, I have been an avid fossil collector and preparator of museum quality trilobites. Both careers took me to four continents.

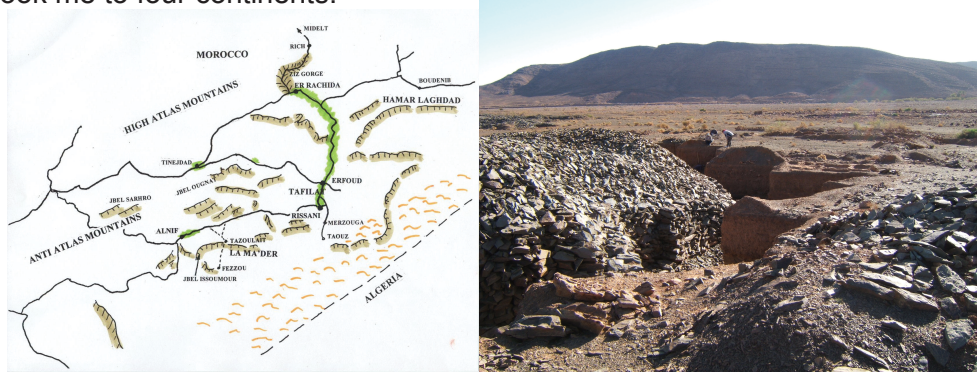


Figure 4. (Left) Map of Morocco; (Right) JbelOugnate and Cambrian Diggings (by Tom Rich).

Morocco is one of the largest fossil repositories on Earth, stretching from the Atlantic coast, over the Atlas Mountains, into the Anti-Atlas range and ending at the edge of the Sahara Desert (Figure 4). The extensive Paleozoic layers support a multi-hundred, million-dollar fossil, meteorite and mineral business for the locals.

Along the western edge of the Anti-Atlas range, between the small town of Tarhoucht and at the foot of Jbel (Mt.) Ougnate, is a lower Mid-Cambrian fossil location. The sedimentary layers represent remnants of the Souss Basin, a shallow Gondwana seaway. To the west was a micro-continent called Avalonia. Within the bay, the new creatures were speciating into large predatory trilobites. As Avalonia split away from Gondwana and started north toward the equator. One species of these large trilobites was to become the *Acadoparadoxides harlani* of Boston, and the other *Acadoparadoxides briareus* of the Souss Basin. The only morphological variation between the two was a difference in pygidium shape and ultimate size (*A. briareus* was almost twice the size) (Figure 5). Although the Boston variant was discovered in the late 1800's, by the early 1900's they were collected to extinction. To find a Boston variant today is another story, but the Jbel Wawrmast Formation in Tarhoucht still produces high quality material.

Along Jbel Ougnate's base in Tarhoucht, are several layers which contain the complete evolutionary trail of these giants. Local collectors quarry the layers using simple shovels and picks and although splitting every specimen, they sell their findings to local dealers. Some try their own talents to prepare the specimens, but most are worked by experienced preppers.

Most locals receive a few Dirhams (1 Dirham = 0.24 USD) for their work while the fee doubles for complete preparation. Local dealers complete prep and offer the specimens for sale to US dealers for hundreds of dollars. US dealers in-turn mark up the specimens five to ten times for US collectors.

The sedimentary layers of the Jbel Wawrmast Formation require time and heavy tools to expose fossils and some layers are more prolific than others. Since fossil collecting is a major source of income for most of the local inhabitants, they spend most daylight hours, 7 days a week, digging. They are not willing to let visiting collectors into their diggings, but if you can meet them without a dealer present, they will sell for a price above the dealer, but less

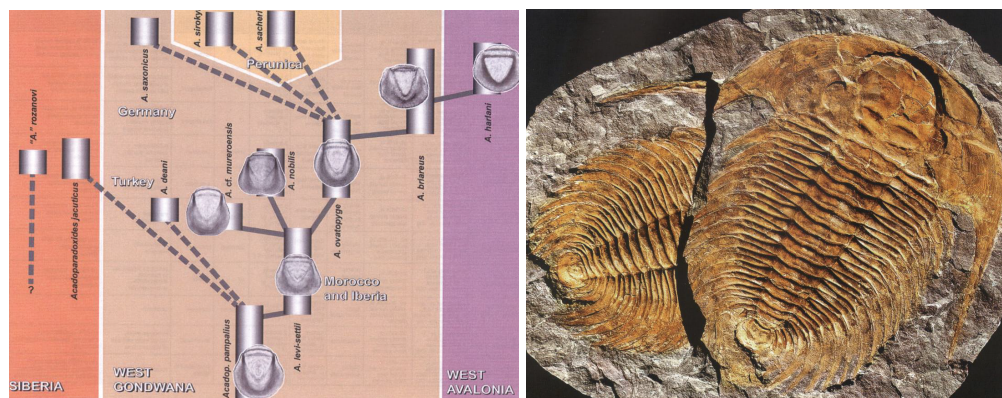


Figure 5. (Left) *Acadoparadoxides* phylogeny; (Right) MA *Acadoparadoxides briareus* 30cm (by Tom Rich).

than what the dealer would offer the collector. Doing the digging and prep work themselves, detracts from their digging time. Although the market is up in the hundreds of millions of dollars, the poor digger are not part of the wealth the local dealers enjoy.

Sources: (1) "Paradoxides puzzle resolved the appearance of the oldest paradoxidines and its bearing on the Cambrian Series 3 lower boundary"; Geyer, Gerd & Vincent, Tony; Springer-Verlag Berlin, Heidelberg 2014.