BAMS Article

The Organization of Tropical East Pacific Convection (OTREC) Field Campaign—Five Years Later

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ABSTRACT: Studying convection, which is one of the least understood physical mechanisms in the tropical atmosphere, is very important for weather and climate predictions of extreme events such as storms, hurricanes, monsoons, floods, and hail. Collecting more observations to do so is critical. It is also a challenge. The Organization of Tropical East Pacific Convection (OTREC) field project took place in the summer of 2019. More than thirty scientists and twenty students from the United States, Costa Rica, Colombia, México, and the United Kingdom were involved in collecting observations over the ocean (east Pacific and Caribbean) and land (Costa Rica, Colombia). We used the NSF NCAR Gulfstream V airplane to fly at 13-km altitude sampling the tropical atmosphere under diverse weather conditions. The plane was flown in a "lawnmower" pattern and every 10 min deployed dropsondes that measured temperature, wind, humidity, and pressure from the flight level to the ocean. Similarly, over the land, we launched radiosondes, leveraged existing radars, and surface meteorological networks across the region, some with collocated global positioning system (GPS) receivers and rain sensors, and installed a new surface GPS meteorological network across Costa Rica, culminating in an impressive systematic dataset that when assimilated into weather models immediately gave better forecasts. We are now closer than ever in understanding the environmental conditions necessary for convection as well as how convection influences extreme events. The OTREC dataset continues to be studied by researchers all over the globe. This article aims to describe the lengthy process that precedes science breakthroughs.

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SIGNIFICANCE STATEMENT: The purpose of this paper is to inform *BAMS* readers of the field campaign Organization of Tropical East Pacific Convection (OTREC) and its results 5 years later. We convey the excitement, the amount of work involved in collecting observations, the many different aspects of OTREC including many students in the field (flying, performing weather forecasts, launching radiosondes), certain challenges, and funny moments as well as the engagement component (open house, lectures, movies, blogs, creating classes, school visits). While in the field, we all felt there is nothing more important than OTREC; for 2 months straight, we lived and breathed for OTREC—we hope the readers will wish to have been a part of it.

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1. Introduction

One day, more than 10 years ago, an important conversation took place between Željka Stone (then Fuchs, hereafter Z) and David J. Raymond (hereafter Dave). This conversation, although neither one of them knew it at the time, would lead to the biggest adventure of their professional lives, to the field campaign Organization of Tropical East Pacific Convection (OTREC). Neither of them were strangers to field campaigns, but at the end of the conversation, this campaign sounded like it would be special. Once upon a time, Dave was Z's PhD advisor, but as they started planning OTREC, they were partners.

The two theorized for hours on what would our research community benefit from the most? What kind of observations have never been collected which would give us the answers to the most crucial questions in our field, the field of atmospheric physics? They settled on studying convection which is one of the least understood physical processes in our atmosphere and the one that is at the heart of the most dangerous extreme events such as storms, hurricanes, monsoons, floods, and hail.

Studying convection is not easy as it is chaotic and not easily predicted. Studying convection over the ocean is even harder as you either need many ships to launch sondes upward or a plane to drop the sondes downward. Convection develops vertically and therefore one needs a way of measuring profiles of temperature, wind, humidity, and pressure through the whole troposphere which is about 15 km deep in the tropics, the area with most convection.

That same day, after hours of discussion, Z and Dave settled on several key decisions that made OTREC different. We decided to use a high-altitude plane and release sondes every 10 min, flying a lawnmower pattern to ensure that dropsondes are deployed as close together in time and to secure a nice grid of measurements that can easily be compared to and absorbed by models. Because of the chaotic nature of the convection, poor weather prediction skill, and a scientific bias where we as scientists often get excited and steer the plane toward the biggest and most interesting clouds, we decided to pick random days for research flights and stick to the planned grid. This enabled us to systematically collect data for all different random stages of convection. (The pilots did not believe that we would stick to it, but we did.) The method for choosing flight days was developed later, and it involved flipping a coin.

It was still that day when the location for OTREC was discussed. We asked ourselves several questions: where do forecast models struggle the most with convection, where do we have a diverse environment that might influence convection, which region is full of rich processes that are not well understood, and where do we not have a good dataset from previous field campaigns for the whole troposphere? We settled on the eastern Pacific[1] and southwest (SW) Caribbean, alternating flights between the two regions to also capture the passage of easterly waves that are important to hurricane development as illustrated in Fig. 1. This implied that the possible dream headquarters location for OTREC would be in Costa Rica as that meant the shortest ferry time. We knew that reaching out to our colleagues in Costa Rica and Colombia was crucial; as to have a successful field campaign, we needed to have a strong partnership and their enthusiasm.

[1] Field campaign Eastern Pacific Investigation of Climate (EPIC) that took place in 2001 did not deploy high altitude aircraft.

Planning for a field campaign involves a lot of work, many moving parts, and lots of collaboration. Operational concerns that arose were going to be supported with help from the U.S. National Science Foundation National Center for Atmospheric Research (NSF NCAR), while logistical concerns such as graduate student involvement and in-flight staffing questions would be discussed with program managers and principal investigators (PIs). Additional questions that arose included, for example: Who will launch radiosondes four times a day at three different sites? Will we have enough transportation? Will the internet connection meet the needs of the field campaign and the vast amount of data that will be collected?

We were very grateful for the cooperation from the Costa Rican government and our international partners to host and facilitate the import of our instruments into the country, among other logistics. One of the hiccups we encountered was importing the sondes into the country as we could not promise to take them back with us—they were going to end up at the bottom of the ocean. We signed many memorandums of understanding between various research institutions in the United States and Costa Rica and Colombia. Lots of emails, discussions, and visits were needed to, for instance, pick an airport and a location for our team, gain landowners' permission to use their land, and in some cases, provide power to our instruments.

One of the early steps was to form a team of PIs whose research interests in understanding convection in the tropics aligned with ours and our international and domestic collaborators. These interests include tropical easterly waves, tropical storms, hurricanes, the intertropical convergence zone (ITCZ), and associated vertical motion profiles in high rainfall areas.

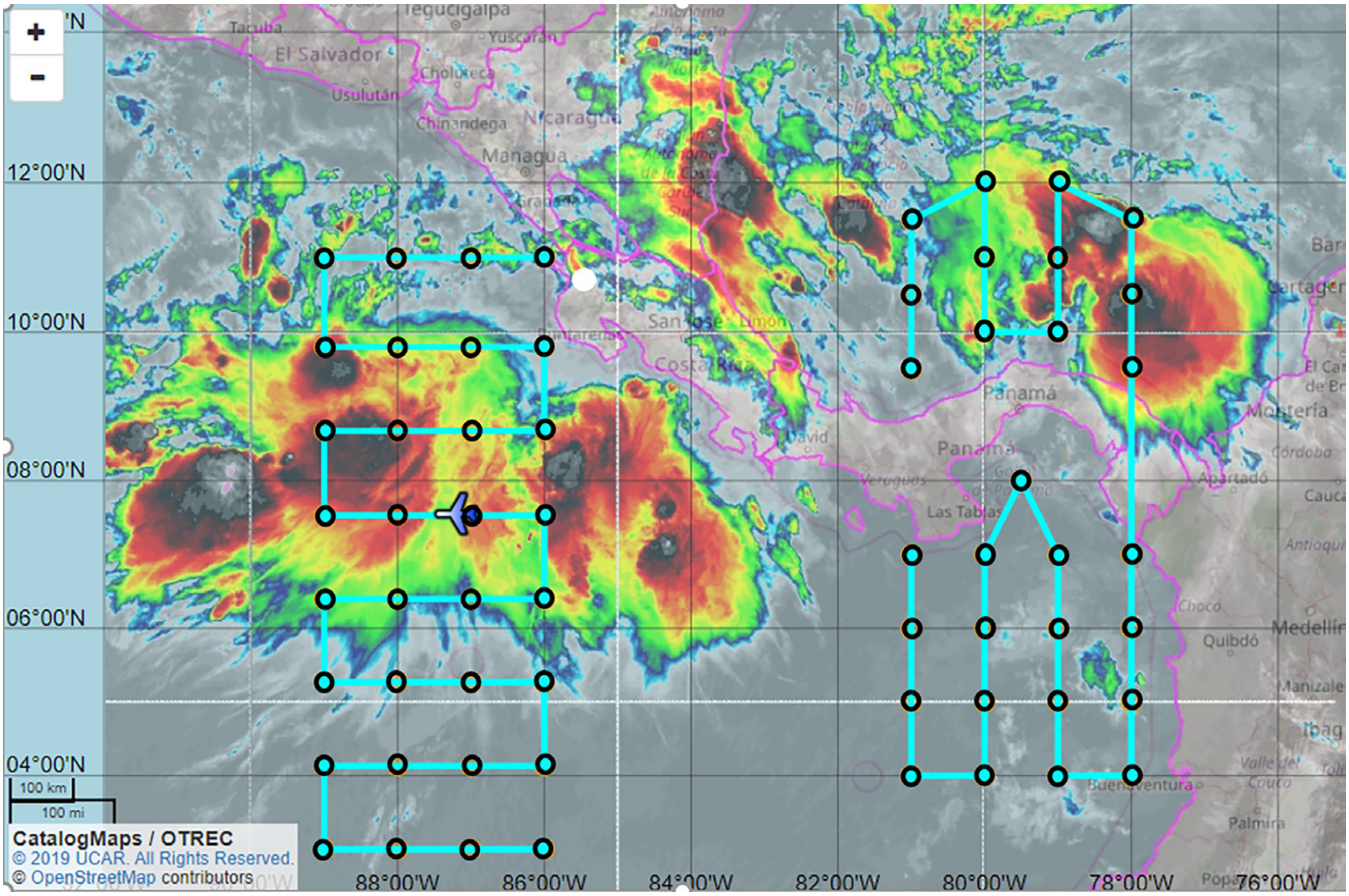

Fig. 1. Flight patterns in east Pacific and SW Caribbean.

Larissa Back recalls: "I was very excited when I heard from Dave and Z in spring 2015 that they were interested in planning a field campaign in the tropical Eastern Pacific and wanted my input. I immediately jumped on the opportunity. I was so excited because I had written several papers that were partially motivated by what appeared to be unique climatological vertical motion structures in the eastern-central Pacific (Back and Bretherton 2006, 2009a,b). The chance to actually go out and measure whether these structures could be observed first-hand in the Eastern Pacific was a professional dream come true for me."

After many emails, miniproposals, discussions, and meetings, we wrote the proposal for OTREC to the U.S. NSF. Then came the hardest part: WAITING. News that the field program was approved came while Z and Dave were participating in a NASA field project in Florida. We emailed our team immediately saying: See you in Costa Rica!

2. In the field: OTREC deployment

The field phase of OTREC started on 5 August and lasted until 3 October 2019. We used the NSF NCAR Gulfstream V (G-V) aircraft to gather data which are pictured in Fig. 2. We performed 22 research flights that amounted to 127 research hours. Six hundred forty-eight dropsondes were deployed. We had NSF NCAR's downward-pointing W-band radar (Hiaper cloud radar), which can see rain-bearing clouds on board the G-V. Radiosondes were launched from new locations in Costa Rica (Limón and Santa Cruz) and Colombia (Nuquí). Intensified radiosonde launching was also done around Colombia. The 15 global positioning system-meteorology (GPS-Met) surface stations were installed across Costa Rica to measure surface pressure, air temperature, relative humidity, precipitation, total column water vapor, and wind speed and direction, with downward solar radiation also available for some sites. During OTREC,

Fig. 2. NSF NCAR G-V aircraft in action.

researchers and students from Universidad de Costa Rica (UCR) jointly with colleagues from the United States and Mexico deployed a series of GPS-Met sites along the Costa Rican territory and traveled across the country on a weekly basis to visit our GPS-Met sites to check on the instruments and download data. Rainfall isotope samples were collected in Costa Rica and Colombia. Four new sampling stations were established at San Andrés, Quibdo, Bahía Solano, and Buenaventura in collaboration with the Colombian weather service, and the samples were analyzed at Universidad Nacional Costa Rica. This new dataset began in August 2019 and continued, except for Bahía Solano, for almost 2 years.

a. One day in the field by Z. It is 0230 LT and I wake up before the alarm. It is a flight day and I am too excited to wait for the alarm. The plan is to take off at 0600 LT, as soon as the airport opens. The airport is half an hour away, but there are many things that need to happen prior to the takeoff. First, I check the satellite images in the area of the research mission. I look at the satellite loops over and over again. Some days it's simple as there isn't much convection and some days it's very hard as the atmosphere is brewing to the point that I am not sure if we will be able to fly there. If it's tricky Dave and I consult. One of us always stays on the ground in constant communication with the plane and the other one flies. We also have a mission scientist in training, Stipo Sentic, who flew with Dave or me and logged an impressive 18 research flights! At 0330 LT we head to the airport accompanied by the howler monkeys saying good morning. At the airport we are zoomed through the security in the vans so it takes only seconds. The NSF NCAR crew and pilots are already there checking up on the plane. I look at the satellite images again and confirm the flight pattern with the pilots. On most days we had four seats for research on the plane. The rest were for NSF NCAR crew to operate instruments such as radar. Every flight mission we have couple of people that fly for the first time. They are so excited and it's contagious. They get familiar with the plane, with plans and procedures. Everybody needs to have a job while we perform research flights. Some write logs (Z and Dave always do), some learn how to deploy and process dropsondes, some follow the flight track and stare at the satellite images that come to the plane every five minutes. This part is essential as we need to know if diverting from our flight path is needed for safety issues and we need to know at least half an hour in advance to alert the pilots. Deviating from the filed flight pattern is not easy due to other air traffic. There really should not be a plane below us when we drop a sonde!

Up in the air it is exhilarating. Up in the clouds with G-V with its big windows looking and staring at the weather hour after hour, day after day, is a highlight of my professional life. I get to be so familiar with weather patterns on site and with satellite images that I feel it in my bones—I kind of develop a cell muscle memory on how to react and predict certain situations. We are on site for about five hours, trying our best to fly the regular grid and deploy dropsondes every 10 min. Touch down is around noon. Lunch and debriefing follows. Debriefing is important as with every flight we learn how to do something better.

b. Nuquí adventure by John Mejía. Nuquí is an isolated small town located in the Pacific coast of Colombia, one of the most convectively active and rainiest places on Earth. Nuquí is connected to the rest of the country only by air or sea and has very limited cellphone and internet connectivity. The surface and upper-air sounding observation site located in this town supported OTREC by taking intensive concurrent upstream observations during G-V flight missions, while enabling a great opportunity for new discoveries and participation of local scientists. The Nuquí strategy included developing 8 weeks of continuous, twice-a-day upper-air observations, switching to 6-hourly during G-V flight missions. This additional fixed observation site was only possible thanks to the NSF's Rapid Response Research (RAPID) program, and by leveraging the participation of volunteer observers and the capacity built during the ChocoJEX field experiment (Yepes et al. 2019). To maximize volunteer participation, we involved undergraduate and graduate students and faculty, distributed in several shifts over several weeks.

The field campaign operations were far from ideal due to abundant precipitation and humidity, the frequent power outages, and the limited transportation access to town. Helium gas cylinders were shipped several weeks in advance by sea, while faculty and students participating on the site flew in small charter aircraft, typically bringing goods and selected ecotourism to this coastal community. We closely followed the original observation strategy, with some exceptions due to delays in supplies, power outages, and a couple of hazardous extreme rainfall and lightning events delaying launches. An unexpected issue, and now a lesson learned, was that this coastal site is so humid that several electronic devices we brought failed due to the extreme soggy environment: several of our laptops, and more critically, the ground CPU receptor failed; a backup ground CPU receptor was flown in within a day to replace the broken one. Maybe less important but still striking was that even our clothes developed mold after only a few days in Nuquí.

A typical day in Nuquí involved more than launching balloons. Preparing, launching, and transmitting each upper-air sounding typically takes 90–120 min. We developed sounding shifts and coordinated with OTREC headquarters in Costa Rica to enhance our launches during flight days. Between soundings, our field crew also checked and cleaned the equipment, replaced empty gas cylinders, and took time-lapse pictures of clouds.

c. Graduate student field experience in Costa Rica by Lidia Huaman. Graduate and undergraduate students were thrilled to be part of this project since, for most of us, OTREC was the first field campaign that we participated in. We stopped classes and our typical research routine at our universities to attend the OTREC field campaign at three hubs in Costa Rica: Liberia, Santa Cruz, and Limón.

In Liberia, we directly assisted with the research flights by either preparing daily weather forecasts and summaries or processing real-time dropsonde data. Every day after a traditional breakfast at the hotel right next to the beach, we got together to start preparing the weather forecast and summary for a group discussion held daily at 1500 LT in one of the hotel's meeting rooms. We prepared the weather forecast for the next three days in the east Pacific and west Caribbean regions using ECMWF and GFS models complemented by satellite images and real-time radiosondes launched in Santa Cruz, Limón, and Colombia. During flight days, in addition to the weather forecast, some of us were also part of the NSF NCAR ground crew to process the real-time dropsonde data. Every student had the opportunity to fly on board the G-V to gain experience on the scientific operations as the plane collected data over deep convection.

Meanwhile, in Santa Cruz and Limón, some of the students assisted with daily radiosonde launches from the ground at 0600 and 1800 LT. In Santa Cruz, the preparation started 1 h prior to the launch—every day at 0500 LT, we headed out to a local elementary school with all the equipment needed loaded in the car trunk. When we arrived, we unloaded the antenna box and put it together next to a soccer field, turned on the laptop, and started the InterMet software to link a radiosonde and start receiving information. Once the ground radiosonde receiver was working properly, we rushed to the storage room with the helium tanks to fill the weather balloon. Then, we came back to the soccer field, attached the weather balloon to the radiosonde, and launched it. This entire process took around 30 min, but the most experienced students could do it in 15 min. After the launch, we waited for a couple hours while the balloon ascended slowly, and the weather information was recorded. Additionally, when the balloon reached altitudes of 5, 10, and 15 km, we notified the nearest airport for aviation safety purposes.

In Limón, Yolande Serra led the surface operation, fostering a space for collaborative research with counterparts in UCR. Students and a couple of lead scientists drove 40 min to the airport every morning and afternoon. They departed from a small town called Cahuita, arriving 1.5 h before the launch. The process included setting up the computer with the Graw software in a room at the small airport right next to the Caribbean coast, setting up the antenna, filling the balloon with helium and attaching it to the radiosonde, and launching it. The process could take from 20 min to an hour depending on the experience of the student and software performance. After the launch, we waited for a couple of hours at the airport until the balloon popped, enjoying the sunrise while watching the collected data come in.

During down time, at all OTREC sites, there was time for enjoying the nature, Fig. 3, swimming, doing yoga on the beaches, writing posts, and most importantly bonding professionally and personally as a team. Adam Sobel says: "The blog we collectively wrote remains as a real-time record of both our scientific thinking and our personal reflections during this transformative time, the first field experience for many on the team." Yolande Serra recalls: "We had a drone in Cahuita that our students used to record air temperature, humidity, pressure, and winds over the canopy and nearby coastal waters to better understand the gradients in these quantities at the coast. It was a big hit with the elementary school kids we visited in Cahuita!"

3. Engagement

OTREC offered a unique opportunity to share the excitement of discovery with the public, as well as train the next generation of STEM professionals. The NSF NCAR education team contributed to this goal with not only the coordination of an aircraft open house for university students and elementary school children and their families but also by recruiting and supporting four U.S. undergraduate students to take part in the campaign. NSF NCAR created bilingual

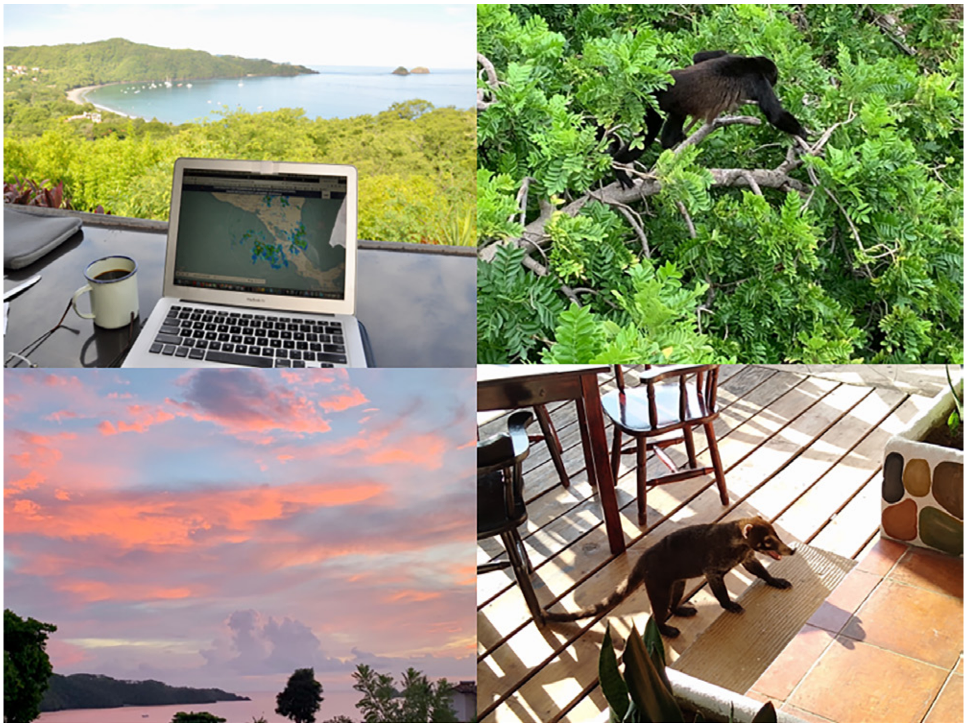

Fig. 3. **Doing fieldwork in Costa Rica at its best.**

(English–Spanish) educational materials to use in the field and during postfield engagement events. Since videos have been shown to provide viewers with authentic science experiences (Stamer et al. 2020) and even promote interest in STEM careers (e.g., Wyss et al. 2012), following the campaign, NSF NCAR produced eight short science documentary-style videos from footage and interviews collected in the field.[2] Additionally, NSF NCAR developed a supplemental teacher guide for upper high school and early university classrooms based on OTREC data and the produced videos.

[2] Link to the videos: https://ncar.ucar.edu/what-we-offer/education-outreach/public/ncar-explorer-series-field-campaigns/otrec

About 80 students of all ages local to Liberia, Costa Rica, participated in the aircraft open house to learn more about OTREC and to explore the instrumentation in the G-V aircraft. Upon arrival at the airport, visitors were welcomed with a short presentation delivered entirely in Spanish by bilingual educators and project team members from NSF NCAR and the UCR. OTREC PIs and scientists also shared information about land-based research that was taking place at various locations in Costa Rica and Colombia. After the presentation, OTREC scientists, technicians, and educators guided small groups of participants onto the tarmac where visitors talked with project team members, learned about the G-V aircraft, and boarded the G-V to see more atmospheric science instrumentation and even chat with the pilots while sitting in the cockpit. Participants went home with educational material developed by NSF NCAR.

Education and engagement was taking place at all OTREC sites. John Mejía recalls: "We wanted to reach out to the local community Nuquí, Colombia. We developed presentations to the local administration, NGOs, and the only school in the community. In these presentations, we described why we were in their town, the specific activities, and performed balloon launch demonstrations to K-12 kids, while highlighting the significance of the observations and the research we were developing to the community. We gained new friends and learned about the local knowledge of where the rainiest spot in the region is and how they managed to live in such a soggy climate. Most of them recognized a coastal site nearby as the wettest spot, which is close to the global maximum we identified using satellite Global Precipitation Measurement records (Mejía et al. 2021). We left this site with our hearts full of community interactions and new adventures."

Ana Maria Duran Quesada says: “The development of OTREC would not be possible without the commitment and effort from local scientists, technicians, students, schools, authorities and the communities, where people kindly opened their gardens and backyards to contribute with the deployment of the instrumentation. The participation of the students and the interaction with landowners and the communities showed us the need to actively integrate outreach activities and the capacity of citizen science to build bridges between the academic and the communities in the development of monitoring networks that can benefit the communities. We realized that we, the academia, must be willing to learn from the communities.”

Graduate students were as integral to engagement as they were to research. They worked diligently and were committed to the work taking place to meet the goals of the field campaign. Lidia recalls how OTREC allowed students to build friendships and professional connections and inspired them to pursue a long-term career in atmospheric sciences. After 5 years, most of the graduate students from OTREC have finished their graduate programs and are currently postdoctoral fellows, professors, or researchers at different public and private weather-related institutions.

Including students at the undergraduate level can already have a significant impact on their science identity and career paths (Eagan et al. 2013; Gardner 2015; Rasmussen et al. 2021). OTREC recruited the undergraduate students through a nation-wide call. Melissa Piper, one of those students recalls: “The 2 weeks that I spent in Costa Rica for OTREC during my senior year of undergrad were invaluable to my career. I gained insight into the research and data collection process through my participation in weather briefings, weather balloon launches, two research flights on the G-V aircraft, and discussions with graduate students and researchers. I will never forget one of the weather balloon launches at an elementary school in Santa Cruz—it was the 1200 UTC launch and the students were SO excited to see us arrive, set-up our equipment, and help us launch the balloon. I remember counting down the launch in the soccer field with the students, and when we reached zero, I released the balloon and the students started screaming and dancing in joy. I can only hope that the experience inspired those children to be curious about science.” The science team, including the OTREC PIs and participating graduate students, mentored the undergraduate students in the field. Melissa says: “I have a lot to thank the OTREC field campaign and team for. The conversations I had and advice I received from graduate students and researchers was crucial to me as I began to navigate graduate school applications and determine my next steps after finishing undergrad. My 2 weeks with OTREC opened my eyes to the complexities of tropical convection and field research, as well as the importance of collecting field observations to improve weather forecasts.” It was a team effort as George Kiladis recalls: “I led a few discussions during OTREC and found these to be very stimulating, with people from undergraduate students to senior researchers participating enthusiastically (especially when it came to forecasting!). I know I learned a lot.”

Lorena Medina Luna concludes: “The education and engagement efforts were a success because of the commitment of the PIs to the education goals of OTREC and excellent coordination and communication before and throughout the campaign. OTREC stands as an example of outstanding education activities during an airborne and ground campaign.” See Fig. 4 for some engagement images from the field.

4. OTREC ongoing legacy: Science 5 years later

So, in the 5 years since the OTREC field program, what have we learned? OTREC and OTREC-related work has appeared in a number of different areas over this period. In this section, we present brief summaries of published work using OTREC data.

Special radiosonde launches and G-V dropsonde data were central to the project. Dropsonde data were recast on regular three-dimensional mesoscale grids using a variational analysis

Fig. 4. Images of engagement with elementary students and undergraduate students during the OTREC field campaign.

scheme (3D-Var). They were then archived and made available to all investigators (Raymond 2021) for use in their research. As in a number of previous projects such as the Pre-Depression Investigation of Cloud-systems in the Tropics (PREDICT) and Tropical Cyclone Structure (TCS08), mesoscale vertical mass fluxes, vertically integrated moisture convergence, and moist entropy divergence were derived from the 3D-Var analyses along with many other variables.

Željka Stone and collaborators found that the strongest moisture convergence and hence the most significant convection occurred in regions with the largest saturation fraction (a kind of column-averaged relative humidity) and small but positive instability index (a measure of low to midtropospheric moist convective instability) (Fuchs-Stone et al. 2020; Raymond and Fuchs-Stone 2021). They also found that regions of highest saturation fraction tended to produce steady convection in numerical simulations, with moderate but long-lasting rainfall, whereas regions of lower saturation fraction and larger instability index resulted in strong but transient showers terminated by downdrafts and cold pool production (Raymond et al. 2024). This is in agreement with Colin Ramage's early categorization of tropical rainfall into rains and showers (Ramage 1971).

Columbia University PhD student Isabelle Bunge and collaborators were inspired by OTREC to revisit the long-held idea that SST variations were responsible for forcing deep convection via SST-induced boundary layer pressure perturbations (Lindzen and Nigam 1987; Battisti et al. 1999; Back and Bretherton 2009a, etc.). In Bunge et al. (2024), she found that while SST-induced pressure perturbations may be responsible for seasonally averaged convective patterns, subseasonal variations were correlated more with deep pressure perturbations presumably associated with tropical weather disturbances. As observed convection in OTREC varied in many ways that were not solely dependent on SST, this result appears to hold on hourly and daily time scales as well. On the other hand, the University of Wisconsin–Madison graduate student Miguel Bernardez and advisor Larissa Back (Bernardez and Back 2024) examined climatologically averaged convective patterns like those on seasonal scales and argued that SST-gradients influence vertical motion by influencing thermodynamic profiles which in turn influence plume buoyancies. In addition, they noted that climatological vertical mass flux profiles in convection depend on SST, with higher SST producing more top-heavy convection, consistent with OTREC observations.

Global models depend on data from many sources for model initialization. The lack of reliable data over oceans is, therefore, potentially a problem. Lidia Huaman and collaborators (Huaman et al. 2022) compared OTREC vertical velocity observations in the 86°–89°W longitude range with a variety of model reanalyses and satellite vertical velocity patterns. Vertical velocity patterns from these sources differed markedly from each other and from the OTREC observations: A sobering result indeed!

Synoptic-scale meteorology of the tropical east Pacific is complex due to the combination of tropical wave phenomena and land–sea interactions. OTREC data have been used to help us understand the synoptic meteorology of this region. John Mejía and collaborators show that the southwesterly low-level jet that impinges on the Pacific coastal Chocó province of Colombia (the ChocoJet) interacts with gravity waves produced by diurnal heating over the Colombian Andes as well as other factors to produce some of the highest (if not the highest) rainfall rates in the world (Mejía et al. 2021). Daniel Hernández used infrared satellite data to produce fine-scale maps of the diurnal and annual distribution of deep convection over Colombia and adjacent Pacific coastal waters (Hernández-Deckers 2021). In further work, Juliana Valencia and collaborators used OTREC data to show how the ChocoJet interacts with wet and dry easterly waves to control the pattern of precipitation in the region (Valencia et al. 2024).

Lidia Huaman and collaborators showed how easterly waves modulated precipitation in the OTREC domain, with the wet phase of waves enhancing deep convection and precipitation, while the dry phase enhances shallow convection (Huaman et al. 2021). Wiggins et al. (2023) used historical radiosonde and surface meteorological data at San José, Costa Rica, to study tropical easterly waves and their relationship to the diurnal cycle of rainfall, while Serra et al. (2025, manuscript submitted to *J. Climate*) used OTREC data to examine this issue further as well as examine how the easterly wave structure over land compares to that over ocean.

Justin Whitaker and Eric Maloney showed that east Pacific easterly waves can originate from MCSs in the Bight of Panama (Whitaker and Maloney 2020)—they do not all come from Africa! Yihao Zhou and Eric Maloney modeled the waves observed during OTREC (Zhou and Maloney 2024). Eric adds that modeling of OTREC systems, although in its early stages, might be one of the great OTREC legacies.

More papers are to follow and explore the OTREC dataset that is fully open access as it makes its way around the globe to wider network of researchers. Perhaps the best is yet to come as the best answers are those to questions that nobody has asked yet.

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Data availability statement. As per NSF NCAR's guidelines, all OTREC raw and quality-checked data from numerous instruments, airborne and from the ground are publicly available at https://data.eol.ucar.edu/master_lists/generated/otrec/. For a full list of OTREC publications and data product references therein, please see the OTREC publications section at https://www.eol.ucar.edu/field_projects/otrec.

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