## **Unpiloted Aerial Systems Ethics:** being open, transparent, and friendly while making, flying, and taking pictures from balloons, kites, and drones

Informal conversations on ethics and hazards keep popping up on the Grassroots Mapping mailing list, and it seems about time to dive deeper into these issues. So I reached out to our mailing list, word got round, and me and a few great folks got together for a phone call, which we all then edited down into this Who are we? Raymond Cha, a UX designer working on digital map interfaces and a grassroots mapper around the Gowanus Canal, Coby Leuschke, President of Metonymy and Rocketship Systems, and an open source UAS developer, Cameron Hunt, Director of Bitworld, a non-profit working on data security, and Amie Stepanovich, Council at the Electronic Privacy Information Center (EPIC), privacy advocate, and congressional witness on surveillance issues, who also helped prepare a great note on

surveillance and US law.

Mathew: Let's start with what distinguishes the ethics of surveillance using Unpiloted Aerial Systems (UAS) from that using airplanes. Why do UAS's change the ethics? Their low-cost and accessibility? Their 24/7, ubiquitous operation? Their size and maneuverability in spaces planes can't

go? Or their auto mation—eliminating or minimizing ubiquity make human decision makers?

Amie: I've talked about these four points with other people, but in the surveillance field, I've

focused on what data is collected. From our perspective there are two automated data analysis are chang- but if one of our main differences from past aerial surveillance: UAS's are cheaper, operate longer, and therefore bring on more surveillance, and they are potentially smaller, and can peer into windows, get into office spaces, and therefore surveil much more than, say, a helicopter.

Cameron: To add to what Amie is saying about ubiquity, from my perspective, it's the automation driving down costs and increasing the possibility of 24/7 surveillance. The fact that I can put up multiple inexpensive planes with

a low human labor burden is the central factor. At what point does ubiquity make aerial surveillance a different type of thing? At what point does a shift in scale become a shift in type? The size is significant, because law enforcement can now fly over fences and into your backyard, around obstacles, and potentially in the window of my house— call it your personal airspace. How will that be dealt with?

Coby: I don't want a drone over my house, looking in my backyard. I have a 6 ft privacy fence— I have a reasonable expectation of privacy. And I make these things. I'd like these questions of ethics and the law answered sooner rather than later, because we're looking at things like natural resource management and precision agricul ture, and I think it's in everyone's interests to get these questions answered up front, and see if we can get some best practices and -Mathew Lippincott regulations in place that protect *Public Laboratory co-founder* people. There are a lot of things balloon and kite developer I want to be able to do with these tools that will, for lack of a better word, be impacted by the more sensational use cases. I just want us to have a reasonable framework where police can do their job, we can make the tools, and they get used in the right way.

#### Raymond: I'm coming from a data side, so some

t what point does things Cameron said stuck in my mind. Technolaerial surveillance a ogy and behavior different type of thing? evolve faster than formal and At what point does a informal ethical codes can dehift in scale become velop, and we're still in that pe-

> trying to catch up. Ubiquity and ing our notions of surveillance, not contracts ends up just how we as citizens use it, but the way governments use it. More expansive uses of surveillance and I wouldn't have their ubiquity are going to amplify a problem with surveillance in two vectors—we're that. I do have going to see surveillance technology used more frequently and in new kinds of situations.

Mathew: This next prompt was *inspired by Coby's analogy on our list:* to prototype right now are things A UAS "is a tool: like a hammer I can that can be operated out of the use it to build a house, or hit someone over the head." Are there 'good' and fairly easily. And when you look 'bad' objects? What ethics play into

quantify plant health or stress.

organic farming practices or to

Both scenarios also made use of

One way to measure plant health

our existing ability to reliably take

agricultural runoff.

the design of systems? Should we seek to design objects to limit user behavior guess on our part based on what to ethical behavior? Can we reduce ethics to programmed, hard laws, or is there nuance that requires case-bycase considerations?

Raymond: I definitely agree that all technologies are tools that can be put to a number of uses, good and bad. But designs are created through the designer's ethical lens, and he or she has a responsibility to design to limit bad outcomes— both for the user and for everyone else. We can't control for everything, especially what happens when the tool is in the wild, but the designer can consider the worst cases and unintended uses, and apply their ethical lens to the design process.

Coby: In my role as a designer, I definitely don't want to make any bad tech, but that's a relative thing for most folks. We don't purposely design in limitations, but there are

aspects of the design that limit what a one can do. We're dealing with small systems and its very difficult for them to become weaponized. For us, and especially my company, our designs revolve around our values and ethics statements, which say that we won't be involved with any projects that have to do with weaponized UAS's. We riod where we're won't sell to the military directly

in a military use for surveillance, a problem with them becoming weaponized.

For us it's almost pragmatic most of what we're being asked back of an SUV and transported at what will probably come out

came out of the recommendations of the Aviation Rules Making Advisory Committee that we've been sitting on since way back in '09— it looks like stuff that's less than 2 kilos or 4.4 pounds, is probably going to have less regulatory burden placed on it. So for us it's a matter of size, scale, and speed. We don't expect to do anything more than 30 mph or build anything bigger than 2 kilos.

of the FAA— and this is just a

I'm sure you've seen the news stories of the guy who got arrested who was supposedly trying to use RC aircraft as a weapon. Right now the technology is already there to do bad things. For us, it doesn't make a whole lot of sense to worry about what people will do with our designs. I mean, I can go get a foam model aircraft that can do 100mph for a few hundred bucks.

Mathew: Yeah, there are a mil-

#### Aerial surveillance and US law

Under US v. Katz, The Fourth Amendment protects a person's reasonable expectations of privacy. The plain view doctrine explains that there i those reference is no expectation of privacy as to things that are visible to the public. In California v. Ciraolo the Supreme Court concluded that a suspect did not have a reasonable expectation of privacy as to ærial surveillance conducted with the naked eye from an altitude of 1,000 feet. On the same day, the Supreme Court held that the EPA did not violate the ourth Amendment when it conducted ærial surveillance of a chemical plant, because the facility was like an "open field," and in open ields there is no privacy interest. The Court insinuated that its holding was conditioned on the fact that the EPA did not use high-tech equipment to conduct its surveillance. Finally, in *Florida v. Riley* the Supreme Court held that there was no Fourth Amendment violation when police conducted surveillance from a helicopter flying at 400 feet. Writing for a how it's built plurality, Justice White concluded that there was no Fourth Amendment i and understand violation because any member of the public could fly at 400 feet, so the it he design. The surveillance was valid under the plain view doctrine.

Recently, the Supreme Court decided US v. Jones, holding that police had to obtain a warrant before using a GPS device to track a suspect's location every day for a month. The case was decided on property grounds, but a strong concurrence by Justice Alito indicated that the long-term monitoring violated the suspect's reasonable expectation of privacy. Alito noted that privacy expectations were bound to change as technology evolves and that "[i]n circumstances involving dramatic technological change, the best solution to privacy concerns may be legislative." Upcoming Supreme Court cases, Florida v. Jardines and Florida v. Harris will question if a person's expectation of privacy is violated if a search is designed to only detect the presence of contraband.

> lion ways to cause problems— we transparency to it. Can a designer have to ask, is our hardware really design ethically and be proprimaking it easier? Probably not. We etary? I don't see why not. share similar design constraints in that we have regulatory limits, 5 pounds for kites and 115 cubic feet of gas for balloons/6ft in diameter—we aren't creating anything decided by the user. I think it's

big enough, sharp enough, or fast enough— We have to take precautions, but its hard to do a lot of damage at this scale.

Coby: Right. I can do a lot more damage with my truck. We focus on the positive use cases, natural adding some sort of alert, so if this resource management, disaster re- tool is used around a human be-

lief, humanitar-

ian assistance.

keep it open,

for us that's a

We're trying to

transparent, and

accountable, and

good way to do

business. If we're

going to design

something we

open source it,

put it out there,

improve it, maybe understand i

a bit better, so we don't have such

intense fear of technology that's

actually already out there.

Id rather not rely on access conditions or DLACKOUTS OF SENSITIVE data, Id like to see systems where beoe can pre-empt the COLLECTION OF SENSITIVE case by default data

let the community comment on it, into the world

Mathew: I

really admire

your company

for putting out

designs and

: open sourcing

Amie: I can't

officially speak

for EPIC, but

E I am very pro

open source

come in and see

: fact that some-

: one can come

in and modify

it in a nefari-

ous fashion is

: outweighed by

the benefits of

Coby: Obvi-

: openness.

: ously it has

some ethical

People can

those.

Raymond: You could also design into a UAS a tracker, and somehow watermark who is taking pictures and when. That's a de-

important for the designer— and

the data for their intended use and i yond that limit avoid. Persona sign choice a designer can make, cameras have must take precautions to prevent for example and it defines how that object will this—anybody misuses of the data. it collects an can take public individual's function. U.S. Dep't. of Health, Education and photos, but :face — there Mathew: Our Mapknitter work-Welfare, Secretary's Advisory Comhas to be a they expose flow enables a sort of watermarkthemselves mittee on Automated Personal Data way to correct ing, because the mapmaker, origiand have to Systems, Records, computers, and the : that unless nal image, and date of every image Rights of Citizens viii (1973) additional negotiate with are saved with the map. That's a their subjects. consent is level of accountability we see as Satellites are the opposite—the obtained. It's almost as if, you say crucial. I also like Amie's point of you're going to take pictures, and cameras are up there snapping alerting people to images taken of away, so push for hard rules like you take them and I see that I'm ir them, and allowing them to opt them, I would say, "I'd really like blacking out access to certain out. One thing I like about kites areas in software. But I'd rather to have my face blurred out in this and balloons is that they're fairly picture." Maybe even, if there is not rely on access conditions or obvious, and people often follow blackouts of sensitive data. I'd like a well known piece of land, even the line back to the operator. That to see systems where people can if it's legal to take pictures of it, fosters interaction, and gives the pre-empt the collection of sensisome feature that is picked up surveilled more opportunities to may be uniquely attributable to tive data opt out before any imagery hits a a person. These are all things to network. That brings up our next prompt consider when you talk beyond What are the ethics of data colthe legal concerns and really dig Amie: One of the things I have lection? What are the rights of in to the ethics of what we should to keep telling people who think the observed, the obligations of the be collecting imagery of.

the architecture, we have basic

designs is hard.

To me, tools

continuous

ethical dia-

require hard

rules. With

technologies,

surveillance

that means

ment and

tools where

direct engage-

negotiation be-

tween observe

and observed

is hard to

logue are better

than those that

that encourage

privacy protections for some of

that privacy advocates are antiprogress is to clarify that we just want certain protections built in, we want transparency and accountability. I personally believe that the transparency in the program you've just described is a great start.

Cameron: To that end, one of the

we take a page out of what Google

has done, automatically blocking

license plates and faces, and that

is something we could insert into

the video screen, with the ability

to remove it, but engineered into

but there is

Amie: I agree that there are generally not good and bad objects, and do believe that the ethics are

-Amie Stepanovich : questions,

**DIY Near-Infrared Imaging:** Chris Fastie and Jeffrey Warren watch plants photosynthesize with modified consumer cameras

isible light camera/

near-IR came

### use case wetlands and farm mapping

a shift in type?

Over the past two years, two used to assess vegetation health. of an inexpensive infrared camera at Public Lab. First, the damage to wetland vegetation caused by the Deepwater Horizon oil spill led some of us to try to duplicate some of the sensors (infrared cameras) which are found onboard many satellites, and which are commonly aerial images using balloon- and

plant health and color



hacked DIY near-infrared cameras

To evaluate plant productivity, you compare an infrared photo with a regular "visible light" photo of exactly the same view. We've begun hacking cheap digital cameras by removing their "infrared block" filters, which are deep inside, right against the sensor. Canon cameras to modify in about 10-15 minutes, and we've published a YouTube video on the process (see links in

We replace the IR-block filter

cameras either to prove new, more effective Here we'll be discussing how this reduce the use of fertilizer and thus works, why, and giving you a starting point to begin taking infrared photos vourself.

> bigger the difference between the "redness" and the "infrared-ness" of the light reflected from a plant, the more the plant is photosynthesizing, and the healthier it is. The PLOTS IR camera tool allows us to infrared light are reflected from plants and produce an index of how healthy or stressed the plants are (the Normalized Difference Vegetation Index or NDVI).

the IR-block filter. This will block all visible light, but is transparent to infrared light. Reassemble the camera and you can take infrared

(Try photographing the rest of your film negatives— they'll be



The standard filter in a film camera blocks infrared light from entering.



red light from entering the camera.



photos with the infrared camera and matching photos with a second, unmodified camera. Then the visible and infrared photos must be exactly aligned — "compositing" them using Photoshop, GIMP, or automated scripts currently in development (see links in "get

combining spectra

The process of combining visible

than one growing near it: more water, more soil nutrients, fewer pests, less competition, or just the inherent ability of some species to photosynthesize more than others. Interpreting the patterns in an NDVI image can be easy when some plants are known to be stressed, but in other cases can require some understanding of the complex interactions among neighboring plants and their environment. Although there is 40 years of literature on interpreting low

resolution (30 to 250 m per pixel) satellite NDVI images, the high resolution (3 to 15 cm per pixel) images possible with our IR camera



lighter plants are hairy vetch, a nitrogen-fixing legume, and there is more vetch in that plot than in the other.



In this NDVI image, the lighter areas have the highest NDVI values representing the most productive plants. The mowed paths are dark because the  $\vdots$  loyed good. dead clippings are not photosynthesizing. The left plot is generally lighter than the other plots. Although the left plot has more vetch, the vetch itself does not have the highest (brightest) NDVI values. One hypothesis to explain this is that the additional nitrogen fixed by the vetch is increasing the growth of neighboring plants.

http://publiclaboratory.org/tool/near-infrared-camera http://publiclaboratory.org/wiki/dual-camera-kit-guide



contributors welcome Our work is far from complete.

• streamline and simplify the pro-

cess of taking infrared photos • experiment with infrared map-

ping techniques by making more infrared maps

images

• help people interpret infrared



with a piece of exposed color film negative— just buy a fresh roll of color film, expose the whole roll by photos! pulling it out of its canister, roll it up and have it made into negatives — the whole thing should cost you transparent to the camera!) (the A490/A495 especially) are easy ~\$8. Then carefully cut out a clean piece (no fingerprints!) identical in size to the filter you removed and place it where you removed



A camera's standard light filter is usually ac cessible directly behind the lens. This illustration shows the back of a camera with the viewing LCD removed, exposing the filter. It can be easily removed with tweezers and replaced by a cut piece of developed film.

that's not myself, I'm not a designer— to look at the worst case scenario. In the realm of surveil lance, the worst case would be the ubiquitous surveillance of an individual. Maybe the ethical line is firm ethical laws into ing, that person is alerted that the tool is there. The designer may make a decision to allow the individual user to turn the alert off, but they've prevented the worst before turning the system out

> observers? When do aggregations of data cross a tipping point? Can a collection of different databases, each ethically collected, become an unethi- sons. -ed] cal and intrusive aggregate?

*Amie:* When you're collecting aerial imagery, because faces are in the imagery, or the land is private, there's a chance that private things Coby and I discussed is can information is collected. At EPIC we feel that The Code of Fair Information Practices governs all of this data collection.

> Mathew: I like that. Would you say it's important to provide

interpreting combined-spectra images

Many factors can make a plant tool could provide novel insights into fine-scale vegetation patter We are still learning how to extract meaningful information from these NDVI images and look forward to getting feedback about how to do this. We are currently working on interpreting the results of a balloon mapping flight over some cover crop trials in New Hampshire. In the example images below the rectangular plots received different nutrient or management treatments, and both the normal black and white photo and the NDVI image reveal that plants responded differently to some

treatments

In this normal black and white photograph, the mowed paths are lighter than the plots because the cut plants are dead and pale. In the left plot the

people with the chance, retrospectively, to opt out?

typically fight

for opt-in

consent for

all personally

And, even if

someone says

data being

used for one

purpose-say

they agree to

images of their

property for

and the actual

collection of

data goes be

mapping-

the most obvious things. Amie: Yes, that is incredibly Trying to build : Code of Fair Information Practices : At EPIC, we There must be no secret data-• There must be a way for a person to find out what information about : identifiable

> the person is in a record and how information it is used. • There must be a way for a person to prevent information about the that they are person that was obtained for one OK with their purpose from being used or made available for other purposes without the person's consent. There must be a way for a person to correct or amend a record of allow aerial

identifiable information about the person. Any organization creating, maintaining, using, or disseminating records of identifiable personal data must assure the reliability of

> [mapping fisheries in public waters is a contentious issue for these rea-

Raymond: While I'm sensitive to these opt out provisions, in reality they can be very hard to implement. Say you decide to blur out a person in a photo, but by crossreferencing property boundaries and longitude/latitude information that person is identifiable. When data is merged, those optout standards may not work.

Coby: From the technical side, if real estate sites like Trulia have access to all the accessory records that define my property, why can't there be a universal opt out, so I'd have to opt in to any data service None of those people on Trulia opted in to a single thing other public record. It's tough, I mean, I have a photography background, and think, if I put a balloon, UAV, take your pick, up without asking my neighbors permission, do I have a right to take a photo of someone's backvard even if they have a 6ft privacy fence? I'd say no, it's invasion of privacy.

Mathew: Public Laboratory's policy towards image collection is to either do it on public land, being very public while doing it, or if we're over private land, to get consent to photograph the space. We try to be proactive and identify ourselves. Thinking of example to Coby's point— my eighbor can report if they think 'm watering my plants during a rought, would it change if a balon and camera was used?

Amie: Now the ethics are fairly difficult, but if we talk about this rom a legal perspective, as long as you aren't out at night and using advanced imagery to determine how much water is being used inderneath the soil, its perfectly legal, even if you have a 6, 7 foot nce, it's legal to fly overhead, and see what's going on in some one's backyard.

That said, if you're frequently taking pictures in your neighbor's backyard, what story could that collection tell that your neighbor wouldn't want to it tell? This is similar to other examples of ggregation. For instance, a GPS racker on someone's car, tracking their movements over a week or a month wherever they go— I've seen studies where someone has ooked at a GPS track and they can tell where your house is and where your job is based on cell phone data. Perhaps you have to go to a doctor every week, someone can tell what doctor you visit nd perhaps what condition you have. More data is not an unal-



first regular issue of Grassroots Mapping Forum happen! -Mathew Lippincott, edito

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Interview with Scott Eustis of the Gulf Restoration Network: Shannon Dosemagen and Scott discuss the shifting sands and fortunes of the Mississippi Delta and the Chandeleur Islands



Scott Eustis with a Lemon Shark in the Chandeleur Islands, 2008

Can you tell me a bit about GRN, the work you're doing with them, mission, some of the work that your

co-workers are doing?

Gulf Restoration Network is an 18-year-old nonprofit focused on clean water for the Gulf Coast. Our first issue was around the dead zone in the Gulf of Mexico, which is due to a lot of the nitrogen pollution from up the Mississippi River. We believe that clean water builds healthy wetlands and bay. And that's how we get these healthy wetlands are the nursery that makes abundant Gulf fisher-

ies. The Gulf of Mexico is made fertile by the Mississippi Rive Delta, but it all and degraded comes back to is a jewel of an abundant, clean water flowing ecosystem for the out of the Missisentire continent of sippi River. I'm the Coastal North America. If Wetlands Speyou're a tan ot ducks cialist within GRN, which in Canada, you need means that I the Mississippi River know a lot about wetlands and I L)elta

use that knowledge to review wetlands permits under the federal Clean Water Act. While the law says that you have to avoid destruction, sometimes our regulators are not so enthusiastic— the regulatory agencies will refer to people who apply to destroy wetlands as their customers". They communicate pride in serving their "customers" very quickly and expediently. I think that our job as environmental advocates is to really make sure that they're doing their due diligence and enforcing the law. We used to have a lot more wetlands in front of the city, and

it is the lack of those wetlands that allowed New Orleans to flood in 2005. We no longer have land in front of the city to absorb the wave impact from tropical storms. This is not only a concern for New Orleans, but for our entire region, which is a unique geological landform in the world; there are many other deltas, but nowhere else in the world do you have a powerful river like the Mississippi that empties into such a gentle barrier islands.

That's a good I his place that has segue. Can you talk about the been beaten down importance of the barrier islands? And can you clarify what you mean by "gentle bay"?

Gentle bay meaning a calm sea or a large body of water that's not an ocean, in this case the Gulf. The Nile enter-

ing into the Mediterranean is the closest analog that we have, but it isn't as steep, not as powerful and doesn't drain as big a watershed. With the Mississippi, there's a lot of water coming relatively quickly with lots of sediment, and it enters into this very gentle sea. The river built the land that New Orleans sits upon because the river dominates the geological process, rather than the tide or ocean waves. When you look at a map of the southeastern portion of Louisiana, you're looking at land that's entirely built by a "delta switching" process— the

Mississippi is constantly moving back and forth, and wherever it moves it builds land. You're lookng at several different lobes, son of which are older than others. n what we call the St. Bernard Delta is the delta lobe that built he Chandeleur Islands; it's the oldest lobe.

There's a large amount of disance between the barrier island and the marshes behind it. When you look at Grand Isle, Port Fourchon, that is a much younger lobe, so there we have marshes that still onnect to the barrier islands.

The youngest lobe is where the current river is, which is called the Birdfoot Delta, and there the islands are only starting to build. The Gulf is rising because of climate change, so the river is slowing down and when the river slows down that sand drops out and starts to form islands. It's only in the past decade that we've begun to see real proto-barrier islands form on the Birdfoot and the river is backing up and it kind of wants to make another switch. The River will flow down the steepest path it can find to the Gulf, and as one way becomes flatter, islands form, the water backs up, which causes flooding and possibly a new, steeper route to the Gulf.

The barrier islands are part of a natural, integrated coast that protects New Orleans from hurricanes. That coast has been degraded so that it no longer protects us as it should, so our organization as well as many others are advocating to rebuild an integrated ecological system not only for flood protection, but because this is a tremendously productive estuary and a one-of-akind ecological engine. Louisiana is still, even though it's a degraded system, it's still the second largest producer of seafood in the United

We often hear from the Dutch, which have a similar situation of being below sea level, about a certain strategy that involves a lot of walls and gates. Certainly, we're learning a lot from the Dutch here in New Orleans, but our strategy is of a different character because their walls and gates have killed their estuary to a large degree. What we're looking to do in Louisiana is unique and unprecedented. It's to use the river, which is a great engine, to build land and wetlands that will restore our

to it?

Can you focus a bit on the Chande-

leurs i ne regulatory It's the eldest of the island systems, so in some sense. it's the closest to becoming a shoal. A shoal is still a big mound of sand, just under the water. customer It still protects

Together we're building a database of camera and phone sizes so that our community can build add-ons that transform every day cameras and phones into science tools. You don't even have to buy Grassroots Mapping Forum to help

out! Place your camera or phone down next to this scale chart and take two photos— one top view and one front view of your camera (see examples below) then go to Publiclaboratory.org and post a research note, title it with your model of camera/phone and tag it

plotscameracollection. Don't have time to visit publiclaboratory.org? Title your images with your camera model, tag them *plotscameracollection* and

post them publicly to Flickr or Instagram, and we'll add them in.







Sony Cybershot DSC-W560, top © based on a scale by Jim Elders



flood protection and to integrate engineered walls and levees.

What are some of the biggest obstacles that you see to restoring wetlands? Is it primarily natural or are there also man-made components

It's difficult—I guess the biggest obstacle is the money. We've been restoring wetlands in Louisiana since the coastal crisis was recognized as a problem in the 90s. But we haven't really had the money to do it at a scale that will actually replace enough wetlands to restore the flood protections. So I think the silver lining of the BP disaster is that we've had plan after plan after plan, and finally this may bring the money will scale with our ideas for what needs to happen to restore this ecosystem.

New Orleans even if it is a shoal, but it no longer provides habitat for birds like pelicans. That's a natural process, it normally takes thousands of years, but we in the United States have accelerated that process by making the Louisiana and Gulf such an industrial

When you say barrier islands, people imagine an island that acts like a wall, but that's really not the kind of protective function that it has. The protective function of barrier islands is really more on a daily basis. As the tide comes in, the tide goes out, the islands keep a lot of the saltwater from coming in, and they provide volume that fills the tidal prism— that's kind of a difficult concept. If you want to conserve water in your home, you put a brick in your toilet tank so that there's less water that flushes through your toilet. Well, the barrier islands and marshes as well as oyster reefs and other aspects of wetland restoration are all filling that tidal prism so that

there's less day-to-day erosion that natural flood protection with of the waters that come in and out. And they all work together, so if you just rebuilt the barrie islands and didn't rebuild the marshes behind them you'd still have so much water flowing past the islands that they'd erode really quickly, but if you didn't rebuild the barrier islands and you just rebuilt marshes, these marshes would be exposed to the daily tidal forces that would erode them and they would disintegrate more quickly.

> What makes the Chandeleur Islands very ecologically special, to me as a fish ecologist, is that they are the only known place in the Gulf of Mexico where we know that Lemon sharks pup. We don't know a lot about how sharks have babies, but we know that these islands are a very important place for this shark, which is a threatened species. We don't know a lot

do see the baby sharks, we see them when they still have their umbilical scars so we know that they've been born in the past half hour. And the babies use waters of the islands and the

sheltered seagrass beds behind the islands, as habitat in order to grow up to be healthy and happy sharks

Was there an effect on the islands because of the spill? And going forward long-term is it going to have an impact?

Oh, yes, tremendously. And this is a system that is already disintegrating... we're losing a football field of wetlands an hour. The Chandeleurs were already in a very bad way— they were already very disintegrated. It used to be one island, now it's an island chain, It was formally made a park by Theodore Roosevelt, back when it had more trees for roosting and nesting. It was one of the very first national parks in the United States because Roosevelt loved the pelicans that raised their babies there. Well, that oil is very toxic and very harmful to those mangrove trees that allow the pelicans to roost, but the roots from storms.

of the mangroves are also keeping the sand in place. So the actual island starts to melt away when the oil kills those mangrove r And normally oil floats and it hangs out on the surface, but the dispersant makes the oil hang lower in the water column, so the sea grass beds which are important for the sharks are affected by

the oil. I think a lot of people are very sad about the situation with the Chandeleur islands. It's a bad situation and that's part of why we need these BP monies, to dredge sand to be placed on the island to build it back up so that these habitats can be restored.

Can you talk a bit about the importance of restoring wetlands in Louisiana?

This place that has been beater down and degraded is a jewel of an ecosystem for the entire continent of North America. The Mississippi River Delta is an important flyway for migratory birds, so if you're a fan of ducks in Canada, you need the Mississippi River Delta. Louisiana has the second largest fishery in the United States because that delta is a tremendously productive estuary, but the wetlands also play a critical role in our flood protection strategy.

It's important to restore marshes and we've been doing that in a small way by mechanically dredging sediment, making a hold, piling the sand up to what's called marsh level, a level that the marsh plants colonize it rapidly. But we've been doing this in a small way and we've been doing it artificially with dredges and pumps. That works, but its expensive and it won't last. In order to make the wetlands last, we have to reconnect the river with the estuary because that river was the original ecological engine that built the land. So we need to combine those approaches, have the shortterm fix of dredging sediments to build marshes, and then we can sustain these marshes if we allow the river to flood them regularly in a controlled way. That's called a river diversion, or a river reintroduction. Combining both at the short- and long-term approach is important in order for us to have a productive ecosystem as well as to have enough land that will protect New Orleans and infrastructure

wetlands are important for hurricane natural environment and healthy

Yeah, wetlands soak up water, their organic soils are basically big sponges. A lot of the land in ouisiana is made up of plants,

there's no rocks in Louisiana. The plant roots themselves are ters in the history of very important for knitting the land together, as well as absorbing not only the daily wave energy of the tides, times to scale up resbut the larger toratior wave energies from storms. So its all about the roots. The roots not only anchor the ground in place and keep the storm surge from reaching the city, but they also anchor the ecosystem 'cause the plants are what provide shelter for all the shellfish and larger fishes that we eat and sell commercially.

Here in Louisiana we are very accustomed to being called a "sacrifice zone" or a "playground for industry". Do you have any thoughts on how industry effects restoration efforts in the wetlands or barrier islands?

I talked about delta switching which is how some of the wetlands in Louisiana would have degraded naturally, but that process is thousands of years long. Industry accelerated that process by dredging lots of canals and extracting oil and water from under the marshes, making them sink— and the companies refuse to acknowledge this. The oil industry really needs to do a hell of a lot more, they destroyed over 400,000 acres of wetlands in Louisiana. They do little projects here and there, but they need to step up and repair wetlands, especially in Terrebonne Parish. They could very easily fund a sediment pipeline from the Atchafalaya River to Terrebonne Parish to build wetlands in front of those communities to protect them from storms.

Although we have laws regulating wetlands destruction, often those laws are not well enforced, to say the least. Which is a shame, because it's the natural environment that keeps us here.

In no place in the United States Can you explain a bit about why are people more dependent on the plants. New Jersey has its mea owlands, but New Jersey isn't dependent on the meadowland growing healthily. Here in Louisiana, if our plants are sick and dving from oil waste, then we los our food source he silver lining of one our culture. As we lose our wetof the worst oil disas-

lands, we lose our basic shelte the world, might, if the ourstorm protection. And COMPANY IS penalized that's kind of appropriately, bring the <sup>where we are.</sup>

> That said, what's your outlook on the future

of wetlands restorations, rebuilding

People in Louisiana have been concerned about the degradation of the ecosystem for 20 years. So there's a whole generation older than me that has been advocating for this kind of wetlands restoration for a while. My elders, they have said when Katrina struck that if we don't really scale up and do large scale wetlands restoration within 10 years, it might be too late. So that was 7 years ago. If we don't get started very soon, it might be too late. But if we get started soon, and there appen to be a lot of stars that are aligning... it's a desperate situation to be sure, but we have the Louisiana Master Plan which put the river back into the estuary in an aggressive and coordinated manner with levee protection, we have the RESTORE Act that's going through the United States congress that will divert funds against BP to wetland restoration so that brings the money to finally scale up to these plans that we have to rebuild wetlands. We're thinking that the silver lining of one of the worst oil disasters in the history of the world, might, if the company is penalized appropriately, bring the fines to scale up restoration so that we can have something good; we can realize our strategy of combining wetlands with levees for flood protection. It has a chance to work if we start it right away with a lot of money, billions of which will come from the BP fines, and more of which needs to come from the oil industry.

about how they reproduce, but we agencies will refer to people who apply to destroy wetlands as their customers. ney communicate bride in serving their the shallow





license: public domain ground resolution: 8.31 cm/px bounding box: (29.798690641 -88.8701993896), (29.8071316946 -88.8620380748) publication date: May 16, 2010 background imagery: USGS Topo, New Harbor Islands Quadrangle, LA- St. Bernard Parish, 7.5-minute series





Toyoji, and Jim Smith.



Blow-up of sandwich terns and brown pelicans visible in the map to the left. Being able to actually capture wildlife in the maps was a major motivation

S a Mar 82 M to the state of th

A better view of brown pelicans on the Chandeleur islands.

to go out with low-altitude balloons.

CA, is a co-founder of Public Lab and founder of gonzoearth.com, Branigan Brennan is a diesel mechanic and ceramic artist living in New Orleans, Shannon Dosemagen lives in New Orleans and is a cofounder of Public Lab, Mariko Toyoji shooting inside the Chandeleur is currently living in Seattle, WA barrier island chain. While we pursuing a Masters of Public Health observed visible oil and chemical at the University of Washington, dispersants in the water during the Jim Smith is owner of Uptown Anglers in New Orleans.

the port of Venice and it was a long rough ride out to the Chandeleur going out, and coming back. Nobody on board got ill, but This map is of an area in the the boat was slowed by choppy seas throughout the day. The oil [was] coming in through the cuts in Chandeleur islands here. And and sand spit. The rainbow color before these hurricanes in the last is visible oil sheen on the surface 20 years these cuts didn't exist, it was once solid islands up and down. The chemical dispersants and in the wave action along the were most dominant from our sandy beach. Brown Pelican (LA ground perspective while out along State bird) and Sandwich Tern are smell that I was not familiar with, map. Captain Jim's boat is also in something like gasoline fumes. the scene. While it was windy at times,

Stewart Long lives in Oakland, was a gentle and prolonged drifting of the balloon and boat with the anchor not deployed.

Stewart Long: The balloon flight drifted along with the boat for about a half hour of continuous whole time we were out there, the extent of the mapping area was determined by the presence of ground Jim Smith: This was a full day of control among the aerial images fieldwork! The boat set out from and GPS tracks. There is resulting imagery of open water that cannot be rectified, although we do know the scale.

Chandeleur where a cut has formed in the barrier island landform. There is visible reef rock, sand bar, of the water. There is also heavy oil pollution within the sand spit, the Chandeleur. It was a chemical identifiable in the SE portion of the

The imagery was post-processed the team found calm ballooning- to reduce exposure and bring out friendly conditions at midday when more information in general that the flight took place. The actual was thinned out in the histogram flight was up at around 1,500' and from water, glare, and beach.



the bottom, which we patched with duct tape. The camera is also tied to the bottom of the balloon. We launched the balloon on masonry line.



soda bottle rigging with cardboard stabilizing wings, yo yo reel of 500' of 100 pound kite string (not used), Canon SD1000 with 4gb SD card.



the water around the Chandeleur islands. The oil visible from the air breaks down up close into little clumps like this and a surface sheen.



The Public Laboratory for Open Technology and Science (PLOTS) is a community which develops and applies open-source tools to environmental exploration and investigation. By democratizing inexpensive and accessible "Do-It-Yourself" techniques, Public Laboratory creates a collaborative network of practitioners who actively re-imagine the human relationship with the environment. The core PLOTS program is focused on "civic science" in which we research open source hardware and software tools and methods to generate knowledge and share data about community environmental health. Our goal is to increase the ability of underserved communities to identify, redress, remediate, and create awareness and accountability around environmental concerns. PLOTS achieves this by providing online and offline training, education and support, and by focusing on locally relevant outcomes that emphasize human capacity and understanding.

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This video still from the expedition shows a helicopter landing, scaring pelicans off the island and into oil-contaminated water. based on color, It might have been Phi, Inc., a local helicopter company often flying for oil & gas companies.

