EPISODE 9: FORENSIC SCIENCE

<music up>

Levin: You're listening to The Loop, an audio series about the mud, microbes, and mammals in the Gulf of Mexico. I'm David Levin.

In 2010, the Deepwater Horizon oil spill was the biggest environmental disaster ever to hit the Gulf of Mexico. It broke all records – including one set by a 1979 spill that lasted nine months. That spill, called Ixtoc 1, spewed oil all across the Mexican coastline. Even parts of Texas.

Murawski: [7:45] …that spill, and Deepwater Horizon as well, will continue to contribute to oil pollution-related issues in the Gulf for decades.

Levin: Steve Murawski heads a joint team of US and Mexican researchers that are revisiting Ixtoc today. They want to find out how, and if, the environment near the spill has recovered – which will give them a glimpse of how the area near Deepwater Horizon might look in the future. Their first step: some digital archaeology—dusting off satellite data from the late 70s—before twitter, before facebook, and yes, even before podcasts.

Stay tuned.

<music out>

[AMBI: music on radio aboard Justo Sierra; chatter TK]

We're aboard the Justo Sierra, a Mexican research ship parked in the middle of the Gulf of Mexico. In the galley, music plays constantly. It feels festive. But at a small table, an international team of scientists are huddling, making serious plans.

Levin: Where are we right now?

Travis Washburn: That's a good question. Within a few miles of the actual Ixtoc well head that blew out 40 years ago.

Levin: Travis Washburn is part of a team of scientists combing the southern Gulf of Mexico to measure the aftermath of the 1979 Ixtoc 1 spill. Together with their Mexican colleagues, they're on a sort of forensics mission, taking samples of mud on the sea floor near the spill site. They'll use what they gather to find out how well the ecosystem recovered over the last 40 years... IF it recovered. And what they learn might help them predict how the area affected by Deepwater Horizon will fare 40 years into the future.

But when it comes to oil spills, there are always complications lurking just under the surface.

[Ambi out]

To understand how these scientists even ended up aboard this ship, we've got to back up and head to the other side of the Gulf, to an office overlooking Tampa bay, to talk to this guy.

Murawski: Hey, David, how's it going.

Levin: Steve Murawski.

Murawski: Professor at the University of South Florida College of Marine Science.

Levin: He's one of the scientists in charge of US-Mexico collaboration. And he says the big issue with studying Ixtoc is that nobody's really sure exactly where all that oil *went.* In '79, there was no way to map the spill… meaning millions of barrels went unaccounted for.

Murawski: (2, 2:19) I haven't seen any comprehensive maps that were drawn in the day… Comprehensive in the sense that it was well documented in terms of the total footprint of the oil spill. (1, 5:01)// At that time, the only real maps of // Ixtoc were cartoons that people had drawn from some notions of where the oil was.

Levin: Without a data-driven map, knowing where to find traces of the spill would be impossible. There's scant information on Ixtoc. By contrast, Deepwater Horizon was measured by multiple satellites. Dozens of ships and aircraft, every hour of every day, giving real-time detail on where oil was going as it spread from the wellhead.

Murawski: (1, 13:34) Deepwater Horizon was absolutely a unique event in terms of the amount and diversity of resources available to actually do this tracking. // (2, 3:40) – Y'know, people wanted not only to see the imagery at the wellhead, // but they also wanted to know where it was, so people could make up their own minds about the risk of oil coming ashore at different places. // the notion that we can wait for these maps or that we can get by with bits and pieces is really not going to fly in this wired world that we live in nowadays.

Levin: In the 70s, though, that level of detail wasn't even a possibility.

Chuanmin Hu: [laughing] No. no way.

Levin: Chuanmin Hu is an optical oceanographer at USF. He uses satellites to study modern oil spills. The advantage, he says, is that a single satellite image can let him survey the entire Gulf in one shot.

Chuanmin Hu: (Conf_07: 10:40) Think about, if you want to do that with aircraft, it would take days or even months to have one complete view of the gulf. Not to mention a boat - It takes years for a boat.

Levin: Back in 1979, though, a handful of planes and boats was pretty much all first responders had to work with. So they did the best they could, and once the well was plugged, the spill was mostly forgotten.

But what cleanup crews *didn't* know was that a few hundred miles overhead, two early satellite instruments were busy clicking away.

The first was called the Landsat MultiSpectral Scanner — basically a sort of digital camera in orbit. The second was the Coastal Marine Color Scanner, or CZCS.

Hu: (1, 5:59) - At that time, satellites were just launched; very few people knew how to use them, and there were // much fewer satellites. And the technology used onboard is also not as good as today's, to put in the best way.

Levin: To put it *another* way, the satellites were less powerful than an old Nintendo game. And because of their orbits, they didn't fly over the Gulf of Mexico that often. CZCS took measurements of the Gulf just once every four days.

Hu: For the other sensor, // every 16 days you have a measurement.

Levin: And that doesn't mean the measurements were even usable…

Hu: (1, 32:34) //Exactly. // There's no guarantee you have cloud-free data. // On average in the Gulf of Mexico, the odds of having cloud-free measurement is one over three. So basically if you have three images, then you *may* have a cloud-free measurement.//

Levin: But even with these limitations, Hu thought the old data might still come in handy. If he and his team could use it to piece together images of the Gulf from 40 years ago, they might be able to make a basic map of where oil traveled during Ixtoc. One that could help Steve Murawski's team figure out which areas to to study first.

So Hu and his students revisited the old satellite files. They're actually not that hard to get—just visit the NASA website.

Hu: Everybody, not just from this country, but around the world has access to that data. It's public domain. How you process the data, that's the challenging part.

Levin: It means means turning raw data from the satellites into an image, then figuring out what region of the Gulf it's actually showing. And *then,* you've got to figure out whether there's any oil in the water. Which isn't always obvious.

Hu: (1, 16:30) The first thing is // to look at contrast on the ocean surface. // Any outstanding features, that's a suspicious feature, right?

Levin: Hu says you can tell at a glance if the image just shows clouds, or stuff floating on the surface. But you can't easily tell if that material on the water is algae, oil, or something else. To do that, you have to analyze the subtle colors of light being reflected and absorbed.

Hu: (1, 19:00) These well-designed sensors // measure the different colors reflected from oil, from non-oil, and from other things in the ocean. And they each have different color shade measured by the sensor. So oil has a different shade than others. // Although your eyes can barely tell the difference.

Levin: So Hu's grad student, Shaojie Sun (SHAU-gee SOON), started poring over all the data. He figured out — slowly — which measurements showed oil instead of clean seawater. And over the course of a few months, he squeezed out enough information to make *this.* A map.

Shaojie Sun: 28:03 So I have a map // of the Gulf of Mexico… // on the lower left, the brownish color maps the/ / Ixtoc oil spill.

Levin: On his computer screen, Sun points to a swirling brown streak near the Mexican coastline. It represents where oil traveled over nine months in 1979. In other words, it's the first map ever to be made of the Ixtoc spill—nearly *four decades* after the well was plugged.

Shaojie Sun: 22:20 It's really exciting to map out a 40 years old oil spill, but other scientists can use my own map and my own work to do their own science.

Levin: Scientists like Steve Murwawski. He sees the work as a goldmine.

Murawski: 10:00 We looked at map the we got from the satellite imagery as a // treasure map! // It's incredibly valuable from a scientific point of view. And that treasure map has basically told us where to look for concentrations of oil, both on the bottom and also ashore on the shoreward areas.

Levin: Murwaski says that by dusting off old data, Shaojie Sun and Chuanmin Hu have created something entirely new—a tool that lets scientists revisit the past. It's made possible the work that Murawksi and his team are doing on Ixtoc.

Murawski: 9:30 Mmm hmm, yeah. The new map that we have // gives us not only a mosaic of what happened over nine months, so we can see the full footprint, // but it also gives us some time slices for how that oil spill evolved over time. //

Levin: Back aboard the Justo Sierra, scientists are using Sun and Hu's map to plan out where to take samples along the Mexican coast. They're pulling bits of mud from the seafloor. Collecting worms and other creatures living there. And they're analyzing the water surrounding them…. all based on the guidance they're getting from 40 year old satellites. What they find will help them understand the impact of Deepwater Horizon four decades in the future—and tell whether the next generation of Gulf residents will still be feeling its effects.

<Music up>

Levin: For The Loop, I'm David Levin.

Funding for the Loop, and for C-IMAGE, is provided by grants from BP and the Gulf of Mexico Research Initiative. The Loop is a production of the University of South Florida.