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Technology Takes to the Sea

The MIT Sea Grant program leads the way in offshore weather forecasting

Glenna & Jacob

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The Next Wave

A new weather-tracking system gets out of MIT labs and into fishing vessels. BY R. DEXTER VAN ZILE

As much as people complain about the inaccuracy of weather forecasts on land, the problem is certainly not a lack of data. The National Weather Service uses a myriad of observation posts around the country to gather data on visibility, temperature, barometric pressure, and wind speed and direction to give people an idea of what to expect when they walk out the door. But go a few miles offshore and it's a completely different story.

Only a smattering of weather buoys bobbing up and down in the Great Lakes and the Atlantic and Pacific Oceans provide meteorologists with statistics on wind, wave height, temperature and barometric pressure. Such a lack of data can quickly translate into unexpected danger for fisherman who rely on the sea for their livelihoods.

Cliff Goudey, SM '77, SM '77, marine advisory leader for MIT Sea Grant, which is a government-funded research and outreach station charged with promoting the sustainable use of marine resources and the transfer of technology to the fishing industry, hopes to change all that.

With degrees in mechanical and ocean engineering, Goudey is one of the researchers behind the FleetLink system, an initiative that hopes to turn fishing vessels into weather observation platforms capable of relaying pertinent information to shore via satellite. FleetLink outfits fishing boats with a wide array of meteorological sensors that measure humidity, water temperature, air temperature and pressure, and wind speed and direction.

Goudey envisions that the data collected from the various sensors could be combined with information about the boat's location—obtained from the Global Positioning System located on every fishing vessel—and then transmitted on an hourly basis to shore.

"The gear turns the boat into a meteorological station for data collection," Goudey says.

The project began in 1998 with funding from the National Ocean Partnership Program, an organization that promotes cooperative research between fishermen and scientists. Other supporters include the Woods Hole Oceanographic Institution and the Office of Naval Research.

While these other organizations were interested in how the data would be used, the task of getting the gear into the vessels fell to Goudey, primarily because of his connection to the commercial fishing industry in the region. Through his work at MIT Sea Grant, Goudey has long been recognized by commercial fishermen as somebody who understands the technological problems they face.

"He's got an unfailing eye for a good project and a good problem and a better than usual sense for the engineering solution that's required," says Ann Bucklin, a researcher at the UNH Sea Grant program. "His ability to bring engineering technology into the fishing community seamlessly is exceptional."

There's little doubt among fishermen that the National Weather Service could make use of fishing-vessel-based technology to improve its forecasts, says Craig Pendleton, owner of the *Susan & Caitlyn*, a dragger based out of Portland, ME. In a bit of gallows humor, Pendleton jokes that when the National Weather Service broadcasts a range of potential wind speeds on its regular reports, mariners need to add the two numbers together to get an accurate assessment of conditions.

"If they give you 15 to 25 miles per hour, you know it's going to blow 40," says Pendleton. The problem, according to Pendleton, is the low number of offshore weather buoys—and fishermen have complained about it for years.

Dave Gilhousen, a meteorologist at the National Weather Service's National

New England fisherman Robert Kohl operates the meteorological equipment installed on his trawler, the *Glenna & Jacob*, one of three fishing boats equipped with the FleetLink system.

FERRALL-GRAY

Data Buoy Center at Stennis Space Center in Mississippi, acknowledges the huge disparity in the amount of weather data collected from the two environments. On land, there are instrument stations at every airport in the country, which translates into an observation post every 100 square kilometers.

On water, it's a different story. Nationwide, there are only 60 buoys and 60 Coastal-Marine Automated Network (C-MAN) stations to cover the Great Lakes and the coastal waters of the continental United States, Alaska and Hawaii. Consequently, there are large expanses of ocean from which mariners and forecasters lack real-time data.

Satellites yield some information about wind speed, wave height and temperature, but there is usually a three-hour delay in getting the information. Other times, high clouds make it impossible to determine surface weather patterns.

"When you take a look at what's over the water, you might get one observation in an area the size of a state," Gilhousen says. "As far as weather is concerned, there are smaller-scale features that are well below that size."

"An extra 10 miles per hour of wind from what they tell you can make a big difference. We've been caught a few times. Nothing serious, but it's enough to piss you off."

None of this is news to Robert Kohl, owner of the *Glenna & Jacob*, a 19-meter trawler that fishes out of southern Massachusetts. His boat is one of the three outfitted with FleetLink instrumentation. Kohl says the National Weather Center underestimates the strength of the wind offshore about a dozen times a year.

"An extra 10 miles per hour of wind from what they tell you can make a big difference," he explains. "We've been caught a few times. Nothing too serious, but it's enough to piss you off."

Kohl isn't squeamish about working in rough weather, though; it is just that he wants to be able to avoid it if he can. While working on a 25-meter scalloper in the Gulf of Alaska in the 1980s, he saw winds of 120 to 130 kilometers per hour and 10- to 12-meter waves.

Sometimes, Kohl says, the ocean got so rough that the boat was unable to surmount the waves, but plowed right through them instead. The boat would creak and groan as it struggled up to the surface, only to plunge headlong into the next wave. As bad as that was, it was worse when the boat did manage to make it to the top of a wave, because it would then come crashing down on the other side.

"It felt like the boat fell off the top of a building," Kohl says. "There wasn't anybody on the boat who wasn't seasick."

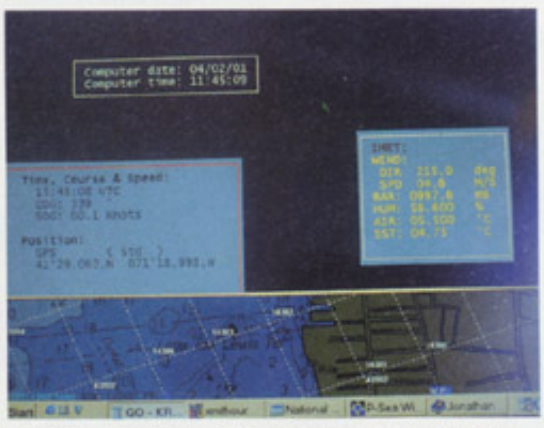
Now Kohl works on a smaller boat in New England, a vessel he renamed in honor of his daughter, 18, and son, 15, whom he hopes to put through college with fishing profits. Given the responsibilities to his family and crew, Kohl might work in 65-kilometer-an-hour winds today, but will retrieve his net and head for port at the first sign that the wind is going to top 80 kilometers per hour.

If FleetLink works, Kohl says, it could give him a few hours of warning even when he fishes close to shore. He realizes that the larger boats located further offshore might get hammered first relaying the data, but at least they wouldn't get hammered in vain.

"The offshore input from other vessels would be real good for the inshore boats," Kohl says. "You could get a warning from that. Basically, the other boats would be buoys."

David Feit, chief of operations for the National Weather Service's Marine Prediction Center in Camp Springs, MD, says the service's forecasts are much more accurate than fishermen say they are, but acknowledges that the additional observations would be beneficial.

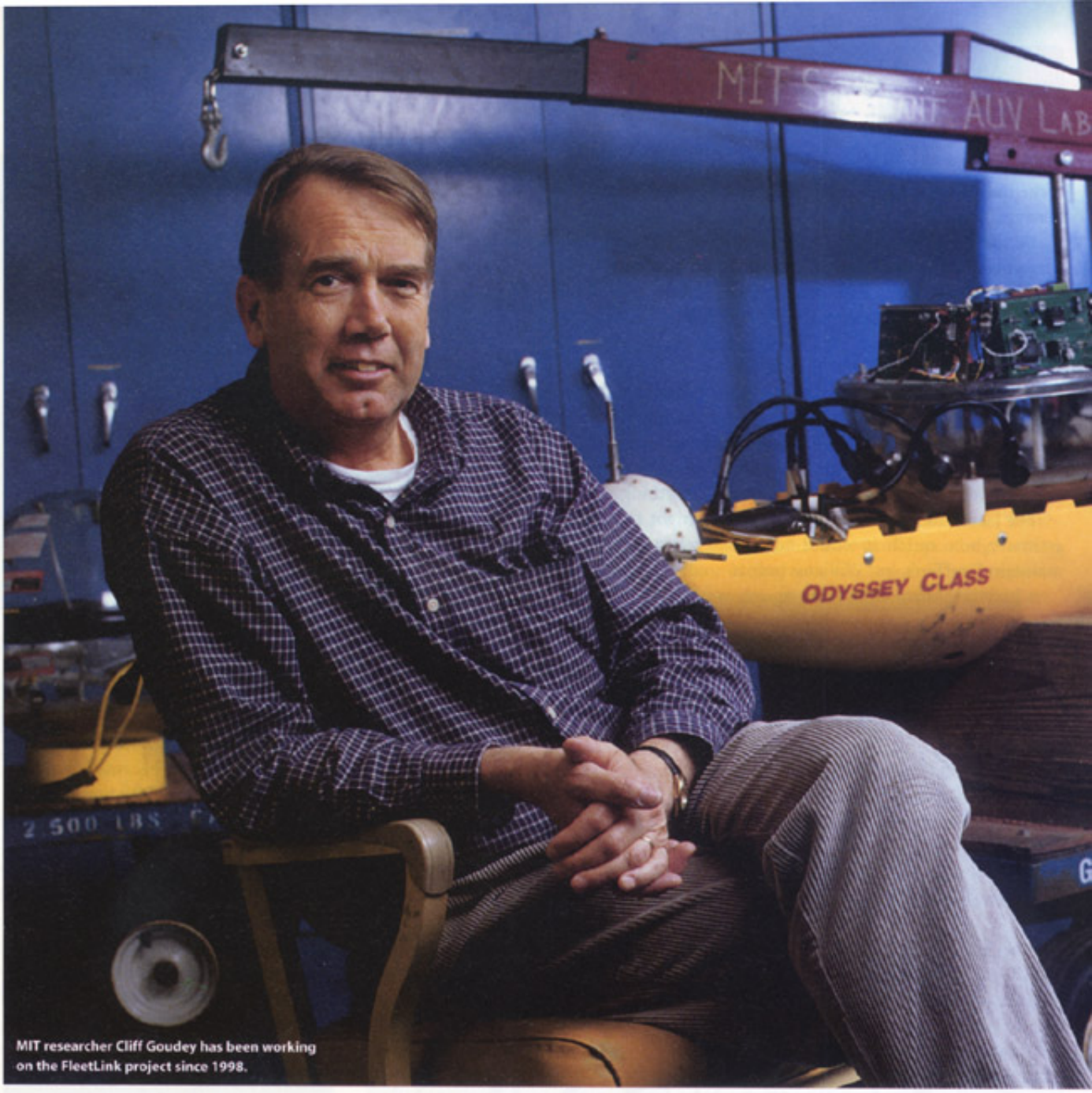
"With the forecast process, the more observations that we get, the better we are," he says.



Top: A computer-generated image pinpoints the exact location of a fishing boat via its Global Positioning System. This data can then be combined with the meteorological information from the FleetLink system for transmission back to shore.
Bottom: FleetLink technology allows fishermen to gauge information such as wind speed, humidity and temperature while they work offshore. The new technology could also aid fishermen in avoiding "bycatch"—a term used to describe the extra fish that must be thrown back after a fisherman has reached quota.

FISHING MORE PRECISELY

FleetLink also has the potential to provide much more than weather reports. Fishermen might also use hourly data transmissions to send information about their catches to buyers, enter their catch directly into a growing number of online fish auctions and even provide the National Marine Fisheries Service (NMFS) with real-time information about their harvest.



MIT researcher Cliff Goudey has been working on the FleetLink project since 1998.

Instead of having to tabulate log books, NMFS could obtain accurate, up-to-the minute data about how much of the total allowable catch has been harvested from a fishery. Regulators could also use data sent ashore to direct fishermen away from areas where there is a high concentration of protected fish.

For example, fishermen in New England can only take home 180 kilograms of cod under the current regulatory scheme, potentially forcing them to discard thousands of kilograms of dead cod after hauling them aboard. A boat may have been targeting flounder, for example, but accidentally netted cod as "bycatch." With a few entries from fishing vessels, NMFS could steer fishermen away from high concentrations of cod, Goudey says.

"The information could be used to create a very responsive fisheries management scheme," Goudey says. "You could close areas to fishing and move effort around when you're having troublesome bycatch problems."

If this information were collected, however, it would have to remain confidential, Goudey emphasizes. Right now the data is being collected from the three boats participating in the project on the condition that it not be released until it is no longer valuable to competitors.

"We need to protect the proprietary information of where guys make tows without tearing their nets up," Goudey says. "Right now those guys are pretty trusting of us."

The question facing the program now is whether it can find enough paying clients to cover the cost of getting the observations. Goudey says that in order for FleetLink to achieve optimum coverage, gear needs to be installed on approximately 100 fishing vessels, a third of which will likely be operating at any given time.

Goudey estimates it would cost $15,000 to install per boat. Putting $15,000 worth of gear on a fishing vessel subject to rough use might seem extravagant, but it's a lot less expensive than a weather buoy.

According to Gilhousen, it can cost

$100,000 to $116,000 to install an offshore buoy on the continental shelf and between $50,000 and $60,000 a year to maintain. And getting to a buoy that needs repair or regular maintenance isn't always easy for the U.S. Coast Guard, which is responsible for the task, Gilhousen says.

"The Coast Guard is so hamstrung on resources to help maintain these things," he says. "We've had replacement buoys all ready to go. We've had to wait a few months to get around to installing them."

The FleetLink researchers have yet to estimate how much it would cost to maintain FleetLink, but Williams points out that getting to the gear requires only a visit to the dock when the boat has returned to shore.

"The ships come back for repairs," Williams says. "That's one of the things that would give an immediate benefit."

Putting $15,000 worth of gear on a fishing vessel subject to rough use might seem extravagant, but it's a lot less expensive than a weather buoy.

Given the relatively low cost of FleetLink instrumentation, an outsider might think the project is a no-brainer when it comes time to allocate federal dollars for weather observation; but Goudey knows better than to think funding is merely a function of logic. Politics has long played a role in making new technologies available to the commercial fishing industry.

When oil prices rose in the late 1970s and early 1980s, for example, Goudey initially had an easy time getting funded to work with fishermen to make their boats more fuel efficient. But as time passed and people became concerned about the health of fishing stocks in the region, improving the fuel efficiency of commercial fishing vessels was a harder sell.

"Clearly, improvements in efficiency were viewed as improvements in fishing power," Goudey says.

Still, the FleetLink project should be a winner, Goudey says, because it provides such an obvious benefit to mariners and fishermen, who are clearly underserved by the current data collection system.

"We're talking about a whole population of citizens with an order of magnitude poorer quality of meteorological forecasting because there's a lack of stations," Goudey says. "Every Podunk airport has an observation station, but they become ridiculously sparse off land."

FURUNO/GRAY

COURTESY OF CAPTAIN ROBERT PAWLOWSKI, NOAA CORPS

Only 60 National Weather Service offshore weather buoys (above) exist nationwide. Thanks to FleetLink, however, meteorological sensors will be added to the masts of fishing boats (left), which will monitor weather conditions while at sea.