Bob's lawn: an introduction to remote sensing

An Intro to GIS problem case prepared by

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Note: This case is designed as an applied problem in remote sensing. The characters quoted in the introductory 'story' are fictitious. However, their statements and scientific information are based on facts. Students are referred to various sources of data; therefore this problem case should not be cited as an informational source on GIS, remote sensing, or private investigation...!

STAGE 1: The problem

Bob was certainly an interesting man. Perhaps that is what drew Wanda to him during college. Bob and Wanda had been president and vice-president, respectively, of the University of Nebraska-Lincoln Geography Club during the early 70's. Since then, Bob had gotten a job with UNL's Conservation Survey Division, monitoring wells throughout the state of Nebraska.

Perhaps Bob's downfall was that he had time to burn as he drove from well to well. Those conservative talk show hosts really made Bob think in different ways. Suddenly, his nights were filled with thoughts of liberal conspiracy theories. He would wake up in bed shouting, "Clinton paid Gore to lose the election with oil money from the Bush family!!"

When he wasn't working, Bob was in his yard. He had worked for 23 years to develop the well-manicured bent-grass yard, complete with a small pond, which held large fish, called "Koi," in a Japanese garden. He liked to talk to the Koi. And the grass.

Wanda had taken enough of the lonely days, and the long discussions of why Panama was a actually major player in Middle Eastern politics. She was tired of Bob spending more time with the Koi than he did with her. The divorce papers had spoken for themselves, and Wanda had gotten the house in the deal. Bob had agreed to that in return for her promise to keep up the yard.

Now, Bob worked for the EPA and lived in Reno, Nevada. Still monitoring wells. Just much deeper wells, now.

A restraining order from Wanda kept him out of the state of Nebraska. A late-night foray to steal back his Koi had been one step too much for the judge. Bob would never see his yard again.

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10 August 2002

Bob's computer beeped. Another email. It was from a former colleague in the Conservation Survey Division at UNL.

"Bob,

"Thought you'd be interested to know that I drove past your house in Lincoln last night. The lawn has gone to pot. Doesn't have your loving care anymore. It looked to me like the Koi pond was all dried up, too. Guess Wanda's new man doesn't have the time to work in the lawn!

"Regards, Frank"

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11 August 2002

Bob found the office of Dr. Lynn Ursury in the University of Nevada-Las Vegas' Geography Department. Dr. Ursury sat behind a wall of large monitors and stacks of CD's.

"Thanks for seeing me on short notice," Bob exclaimed, as he reached for Dr. Ursury's hand. "But, this is paramount to a national emergency."

Bob explained his problem to Dr. Ursury. Bob told him about his well-manicured lawn and his Koi pond. He told him about his evil wife and the restraining order. He told him about the email from Frank. He even mentioned Panama.

"What I need," Bob explained, "is the ability to see what my wife and her new boyfriend are doing to my lawn. And, I need to know if the Koi pond is still there. But, I can't go near the yard, or I'll end up in jail. However, I understand that you are a remote sensing expert?"

"Our department is well-known for its bank of remote sensing data," replied Dr. Ursury. "I'm in the middle of a state-wide habitat classification project, now."

"Great!" shouted Bob. "I used to work with some remote sensing people in the Conservation Survey Division in Nebraska, and yesterday I heard a report on NPR about satellites in Argentina helping the government fight tax evasion among farmers. That tripped my though process, and I stayed up last night boning up on remote sensing. I think it would work perfectly to solve my problems without violating my restraining order. So, I've got a request for you, as a taxpayer of the state of Nevada."

Bob unleashed a stack of papers on Dr. Ursury's desk. "I'd like some very recent satellite imagery," explained Bob. "My internet information shows that the ERS-1 satellite takes images every 3 days. Let's use that."

"Wait a minute!" shouted Dr. Ursury. "First of all, I'm not sure I want to be your private investigator. But, even if I wanted to play this game, I don't think you have a clue about remote sensing."

"Well, I know that you're interpreting the reflectance of electromagnetic waves, and I know that this web site I found said you could tell the difference between vegetation types and other ground cover by reading those signals," stammered Bob. "So, I think

you can tell me if my yard in Nebraska is dead grass or live grass, and I think you can tell me if there is any water left in my Koi pond."

His response and his challenge intrigued Dr. Ursury. In a surreal sort of way.

"How big is this Koi pond?" Dr. Ursury asked. "That's important, because there is a limit to the resolution of these images. I know we couldn't pick up data on a 5-foot wide pond."

He held up a photo. "This is a recent SPOT satellite photo in eastern Nebraska," he said. "You can see that the resolution is not at the scale you're asking for."
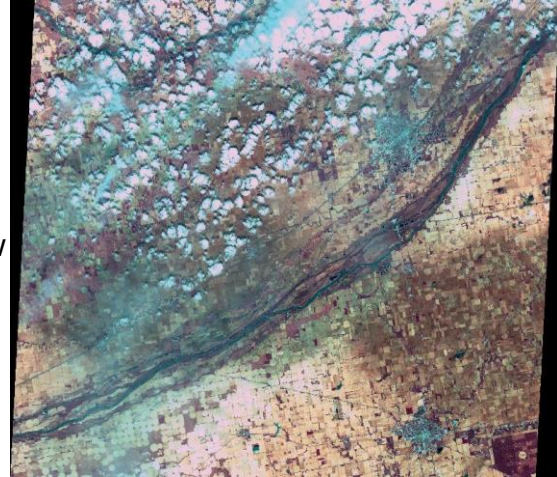
"And," he continued, "Each satellite takes different types of imagery. For example, the ERS-1 only uses Thermal Infrared spectral bands. That may actually be able to tell you things about vegetative stress, but I think you may really need Near Infrared to tell you what type of vegetation is in the yard, as well as its vigor and biomass content. In addition, Near Infrared can also be used for delineating water bodies. You may actually want Landsat imagery, but I'm not sure if we can get down to the resolution you need."

Bob was stymied. He hadn't foreseen such detail. He really couldn't even define 'electromagnetic', but had used it to impress Dr. Ursury. He could tell he was getting in over his head, but he continued to press.

"Is there any way to do remote sensing with finer resolution?" he asked. "What about all those spy planes that are always up in the sky? Can we tap into their signal?"

Dr. Ursury grinned. "I'm not sure about spy planes, but there are other platforms that could be used. Our University owns a special airplane, for example, that does low-level photography."

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1 September 2002

Bob's hidden bank account--hidden, at least, from lawyers and Wanda--had financed a special flight of the UNLV Cessna, equipped with Near Infrared video cameras. The data were now back in Dr. Ursury's lab, and Dr. Ursury had called Bob to report the results.

"I've got good news and bad news," commented Dr. Ursury. "The Koi pond is still there, but your bent grass is all dead."

Bob bit his lip, and fought tears. "Out of interest, how could you tell that?" he choked.

"We took the digital number values in the file and performed an unsupervised spectral classification of the land in your old neighborhood," responded Dr. Ursury. "Sometimes this is hard, but it turned out to work fairly well in your case.

"We were also lucky to find a DOQQ from 2 years ago with which to compare our results. You can see the Koi pond in both images, and our remote sensing confirms that there is water in the pond. By the way, according to the signature of the spectral reflectance data, a portion of your back yard is bare dirt. I'm wondering if Wanda is putting in a garden?"

Bob really had no idea what Dr. Ursury had told him, but it didn't matter at the moment. He was thinking of suing Wanda to get his house back. He had evidence and an expert witness...

LEARNING ISSUES: What issues are presented to Bob that need clarification if Bob is to understand what Dr. Ursury has done for him? What issues do you see that you will need to learn more about to effectively use and understand remote sensing?

LEARNING ISSUE REPORT: your assignment

Your assignment will be an in-class learning experience in which you will perform a classification of land in Lincoln