

# Weather: CSI

or,  
Confessions of a Forensic Meteorologist



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Certified Consulting Meteorologist  
#587

# What is a forensic meteorologist?

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- A forensic meteorologist uses meteorological and/or climatological information to determine the impact of weather on accidents, crimes, and other events that have a weather component.



# What does a forensic meteorologist do?

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- Identify location of event
- Determine what weather was occurring
- Acquire weather and/or climate data for time of event and antecedent times (if needed)
- Review reports of police, engineers, and witnesses for weather information
- Prepare reports on weather conditions
- Testify by deposition or in trial





# How do you become one?

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- Experience in a wide range of weather and climate areas is helpful
- Master's or PhD is a good credential to have
- Become certified as a Certified Consulting Meteorologist through the American Meteorological Society (AMS)—not required but a good idea



# What is a CCM?

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The AMS certifies meteorologists that have met certain requirements as a professional meteorologist:

- Minimum of 5 years of experience
- Written take home comprehensive exam  
(3 months to complete)
- Oral defense of written exam in front of panel
- Evidence of competence in technical writing
- Pay fee to AMS



# Amtrak train crash

## May 6, 2003 in Hinesville GA

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Silver Star  
passenger train  
hit lumber truck at  
7:20 am south of  
Savannah



# Amtrak train crash

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Train crash occurred at gravel road with no railroad lights when a lumber truck stopped and then proceeded across the tracks right in front of an Amtrak train doing 70 mph

## Issues in crash:

- Weather
- Visibility
- Light conditions
- Driver behavior
- Engineer behavior





# Amtrak train crash



## Weather conditions:

Nearest hourly data are from Savannah ASOS, Ft. Stewart AWOS, and Midway GFC site

### Savannah:

Antecedent rainfall 0.72 inches in previous week  
6:53 am LDT T=72F Td=72F WS=3 mph Vis=6 BR  
7:53 am LDT T=73F Td=72F WS=CLM Vis=10

### Ft. Stewart:

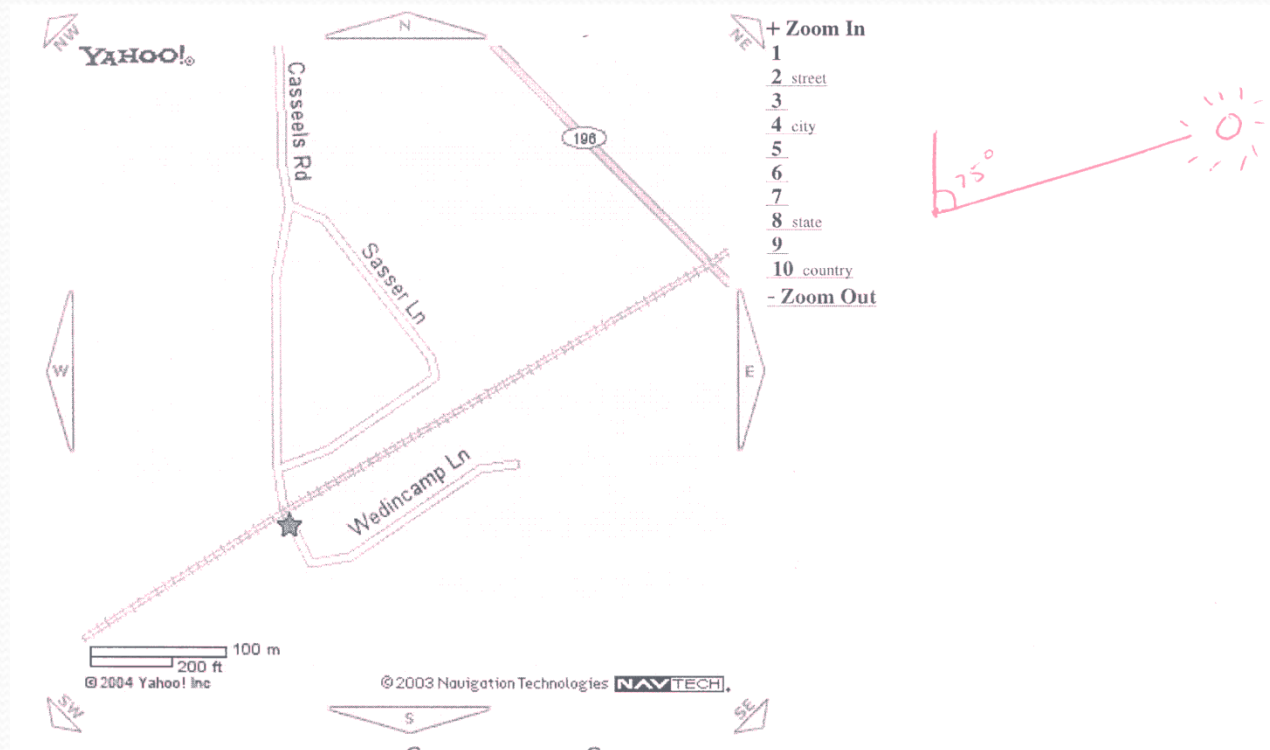
6:58 am LDT T=72F Td=72F WD=VRB WS=4 mph Vis=6 BR  
7:54 am LDT T=75F Td=75F WD=230 WS=8 mph Vis=6 BR

### Midway:

7:00 am LDT T=71F RH=99 WD=203 WS=1 mph  
8:00 am LDT T=72F RH=95 WD=230 WS=2 mph



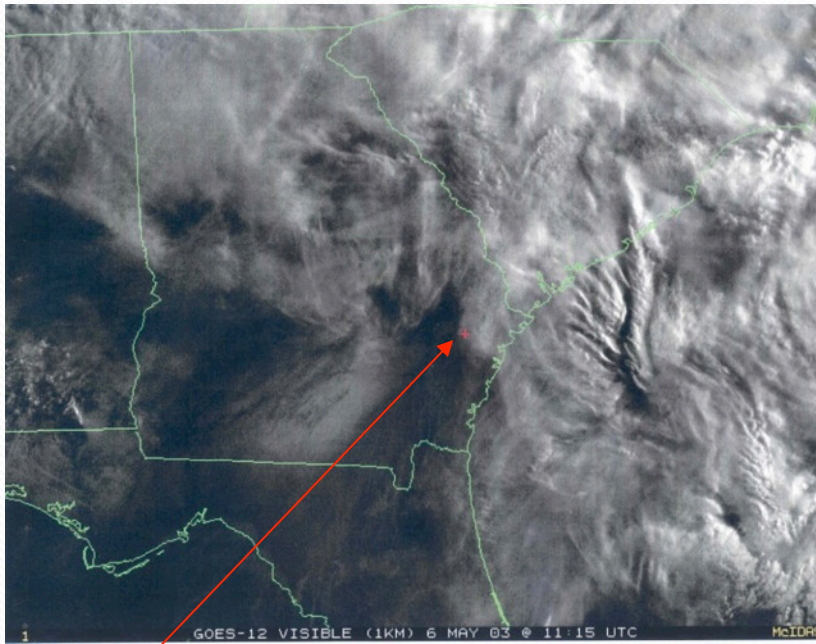
# Amtrak train crash



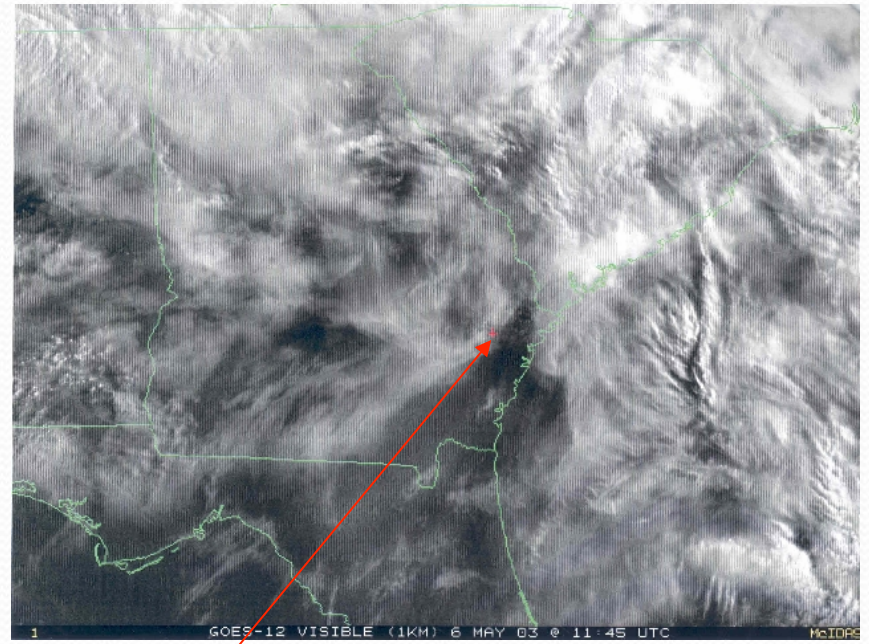
At 7:15 am the sun was at a height of 7 degrees above the horizon at an azimuth of 75 degrees from north

# Amtrak train crash

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Satellite picture from 7:15 AM



Satellite picture from 7:45 am



# Amtrak train crash

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Witness's house

Accident site

Witness from house states there was fog in the area, above the surface and rising over time at about 6:30 am. The fog was in his yard to the south of his house and moving north slowly.

Another witness crossed over railroad track on that road around 7 am and did not notice fog.

# Amtrak train crash

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## Conclusions from evidence:

- Weather conditions were conducive to fog in vicinity of accident
- Layered fog was observed in area of accident by a witness who lived nearby
- The sun was located almost directly in the direction the truck driver would have looked when about to cross the tracks
- An opening in the clouds occurred from about 7:15 to 7:45 am



**I believe the truck driver looked up the tracks but was unable to see clearly because of the forward scatter from the fog particles near eye level and the sudden appearance of the sun at that time, even though the train engineers looking down the tracks in the opposite direction could see the truck clearly.**



# I-75 hydroplaning accident



Terminix tank truck traveling north on I-75 near Lenox, GA, hydroplanes on water on road, crosses median, hits oncoming van and kills driver



# I-75 hydroplaning accident

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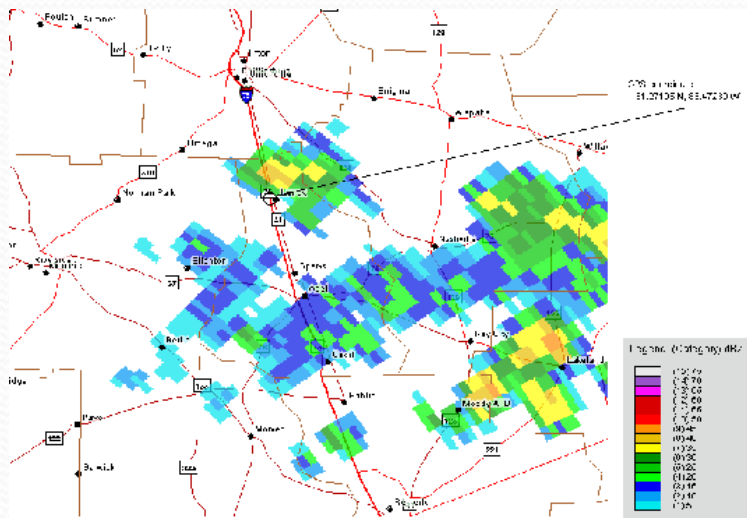
The driver says that it had just started to rain heavily and that he was driving near the speed limit. When he tried to pass a semi truck, he hydroplaned and lost control of his truck and slid across the median into oncoming traffic and hit a van with a family. The mother, who was driving, was killed, and her children were injured.

## *Issues with the accident:*

- Amount and timing of rainfall
- Water on road/condition of road
- Speed of truck
- Condition of truck

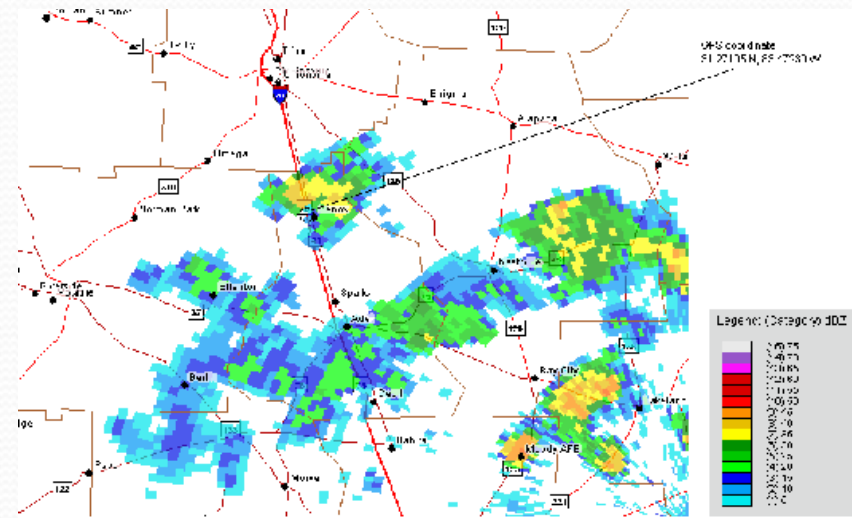


# I-75 hydroplaning accident



Radar image taken from Tallahassee National Weather Service radar on July 24, 2003 at 8:28 AM local time

WRS coordinates: 31.27135N, 85.47233W | located at the opening of entrance 13 and northbound I-75 at County Road 240



Radar image taken from Moody Air Force Base (near Valdosta) on July 24, 2003 at 9:26 AM local time

WRS coordinates: 31.27135N, 85.47233W | located at the opening of entrance 13 and northbound I-75 at County Road 240

There are no hourly rainfall observers near the site, so we have to use radar to determine rain information. Valdosta Moody AFB and Tallahassee NWS are the closest radar sites.



# I-75 hydroplaning accident

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Rainfall rates from radar can be calculated using:

$$\text{dBZ} = 10 * \log (Z)$$

For dBZ of 40 intensity is .48 inches per hour

For dBZ of 45 rainfall intensity is 1.09 inches per hour

For dBZ of 50 rainfall intensity is 2.50 inches per hour

This relationship is not useful for higher intensity due to exponential curve.



# I-75 hydroplaning accident

**Table A-15  
Valdosta**

		Return Period			
		1	2	5	10
N		0.6292	0.9691	0.9554	0.9484
A		64.11	144.16	185.56	181.52
B		12	19	21	22
Hours	Minutes	Rainfall Intensity			
0.05	5	0.12	0.09	7.36	7.97
	6	5.83	6.37	7.10	7.70
	7	5.58	6.13	6.86	7.45
	8	5.35	5.91	6.63	7.21
	9	5.13	5.71	6.42	6.99
	10	4.94	5.52	6.22	6.78
	11	4.76	5.34	6.04	6.59
	12	4.60	5.17	5.86	6.40
	13	4.44	5.02	5.70	6.23
0.25	14	4.30	4.87	5.54	6.07
	15	4.17	4.73	5.40	5.91
	16	4.04	4.60	5.26	5.76
	17	3.93	4.47	5.12	5.62
	18	3.82	4.36	5.00	5.49
	19	3.72	4.25	4.88	5.36
	20	3.62	4.14	4.77	5.24
	21	3.53	4.04	4.66	5.13
	22	3.44	3.94	4.55	5.02
	23	3.36	3.85	4.45	4.91
	24	3.28	3.77	4.36	4.81
	25	3.21	3.68	4.27	4.71
	26	3.14	3.60	4.18	4.62
	27	3.07	3.53	4.10	4.53
	28	3.01	3.46	4.02	4.44
0.50	29	2.95	3.39	3.94	4.36
	30	2.89	3.32	3.87	4.28
	31	2.83	3.25	3.80	4.20
	32	2.78	3.19	3.73	4.13
	33	2.73	3.13	3.66	4.06
	34	2.68	3.07	3.59	3.99

*The defense said that it was raining incredibly hard and that anyone would have had trouble driving in these conditions.*

You can use NOAA Tech. Paper 40 or NWS Hydro Paper 35 to show it was not that unusual. Here I show the Georgia Stormwater Management Manual for Valdosta to show that intensity of 2.50 inches per hour for less than 30 minutes occurs more often than once per year (one year return period).

# I-75 hydroplaning accident

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The engineer noted that the drains in the area of the accident were overflowing but that at the time of the accident the puddles were not encroaching on the road.

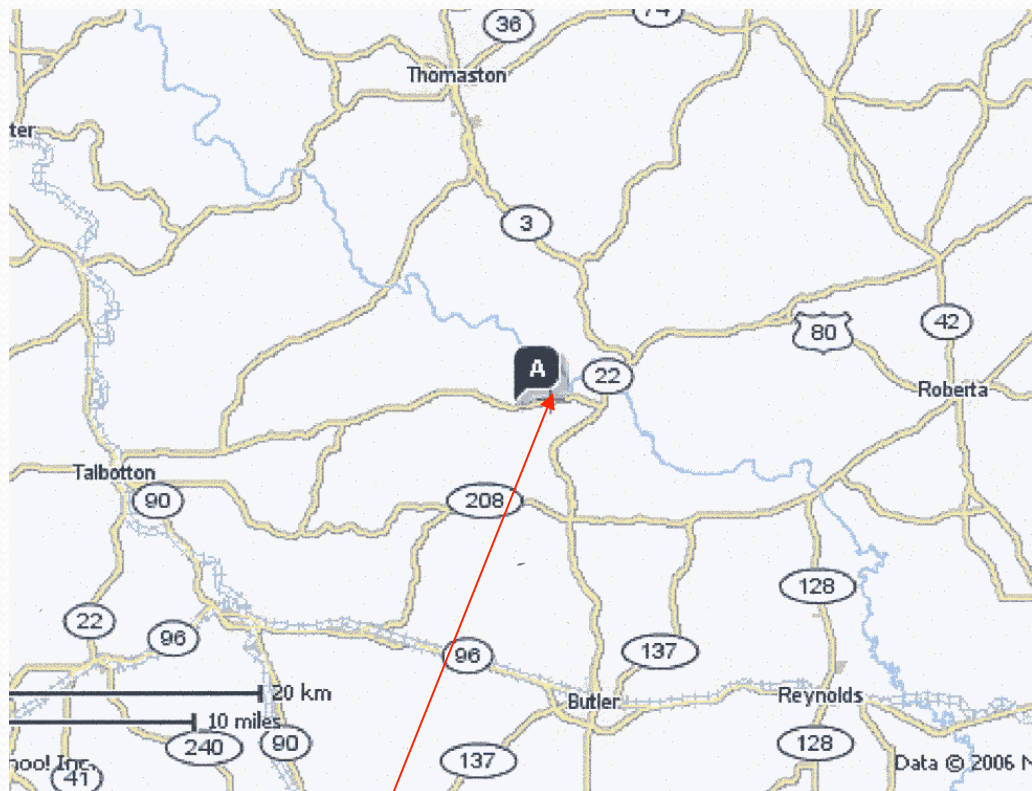
The employees driving the truck later admitted that they had noticed the tires were bald that morning and had asked their boss if they could replace them and he had said no.



**Conclusions: The driver was driving too fast for conditions and lost control of his car due to bald tires and trying to pass a semi over the speed limit. Unusually heavy rain did not cause the accident but contributed to it.**



# Beaver case, May 8, 2003



Accident site

A beaver dam caused water to back up over the road near Carsonville, GA, after a night of heavy rain. A car hit the puddle at about 7:30 am and hydroplaned into the pond. The driver drowned.

*Issues of the case:*

- Amount of rain
- Antecedent rainfall
- Condition of culvert

# Beaver case, May 8, 2003

Station	Coop ID Number	1 day precip ending am (inches) *	3 day precip ending am (inches)	Precip since May 1 (inches)	Distance from accident site (miles)	Direction from accident site
Butler	1425	0.93	1.03	2.36	10	SE
Thomaston 2 S	8661	1.20	2.07	2.70	10	NNW
Talbotton	8535	0.00	2.41	3.07	12	WSW
The Rock	8657	1.60	2.00	2.90	12	N
Woodbury	9506	3.90	4.47	5.36	24	NW
Fort Valley AEMN		0.10	0.10	0.43	25	ESE
Macon Airport	5443	0.95	1.59	2.68	30	E
Byron AEMN		0.98	1.08	1.87	30	E
Warner Robins	9124	0.92	0.99	2.25	31	E
Buena Vista	1372	0.00	0.00	1.38	31	SSW
Montezuma	5979	0.00	0.00	0.64	32	SSE
Juliette	4728	0.55	2.01	2.16	34	NE
Experiment	3271	1.46	4.19	5.57	35	N

Table of rainfall amounts from coop stations surrounding accident site





# Beaver case, May 8, 2003

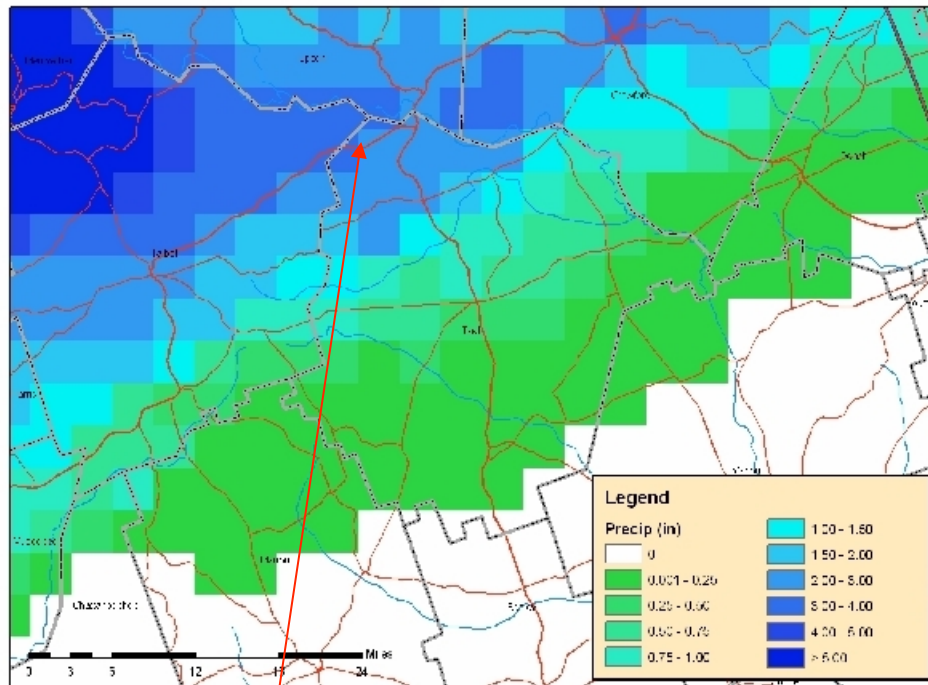
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## *Factors in the case:*

- Georgia DOT claims that the culvert was cleaned out earlier that week.
- One engineer says it would have to have rained over 6 inches to accumulate that much water in the beaver pond.
- NCDC's archives do not contain the radar data due to an ingest problem.
- Engineer has a rainfall map from radar that shows rainfall amounts of about 3-4 inches of rainfall overnight—where is it from?

# Beaver case, May 8, 2003

NCEP Stage-4 Radar Mosaic -- 24hr Total -- 05/08/2003 12:00 UTC



Accident site

The rainfall map was found to be provided by a research meteorologist at NCDC from the NCEP reanalysis of daily rainfall totals and shows that the rainfall estimate from radar was 3-4 inches in 24 hours.



# Hurricane cases

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- In a hurricane there are often two different insurance companies that cover wind damage and water damage from storm surge. If the house is gone or significantly damaged, how do you know which one should pay?

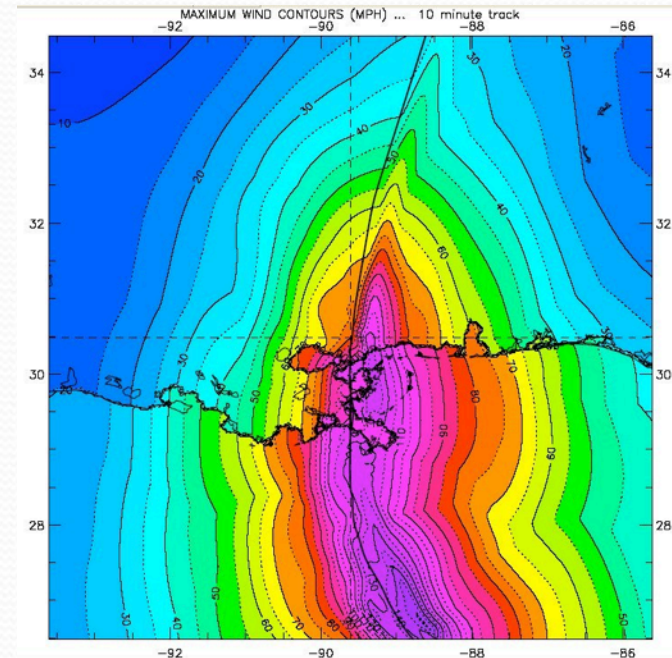




# Hurricane cases

Winds in Katrina at many coastal locations at landfall were only 80-100 mph and houses inland from the storm surge areas had mainly missing shingles and blown-out windows.

*Did the winds do enough damage to destroy the house before the water washed it away?*







# Other cases

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- Temperature of deck surface on Egyptian cruise ship
- Wind damage at home under construction
- Rain conditions for slip and fall off garbage truck
- Visibility and light conditions for older driver in sunset car accident
- Ice build-up on sidewalk for falls at church and car wash

# Serving as an expert witness

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- Must establish credentials as an expert in the field
- Must show no bias or conflict of interest
- Must use established practices to do analysis
- Must use valid data sources
- Must be able to get the lawyer to understand what you did and why so they can ask effective questions
- Must be able to explain methods to a jury who probably does not understand the science well
- Must be able to defend your analysis in cross-examination







# Other consulting work

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- Business study on the effect of rainy days on outdoor sales activities
- Statistical study on how using 10-year averages instead of 30-year normals would affect daily degree days for utility company use

# Creative puzzle-solving

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*Problem:* Where to build a new casino that will minimize odor issues with cattle feedlots in the area

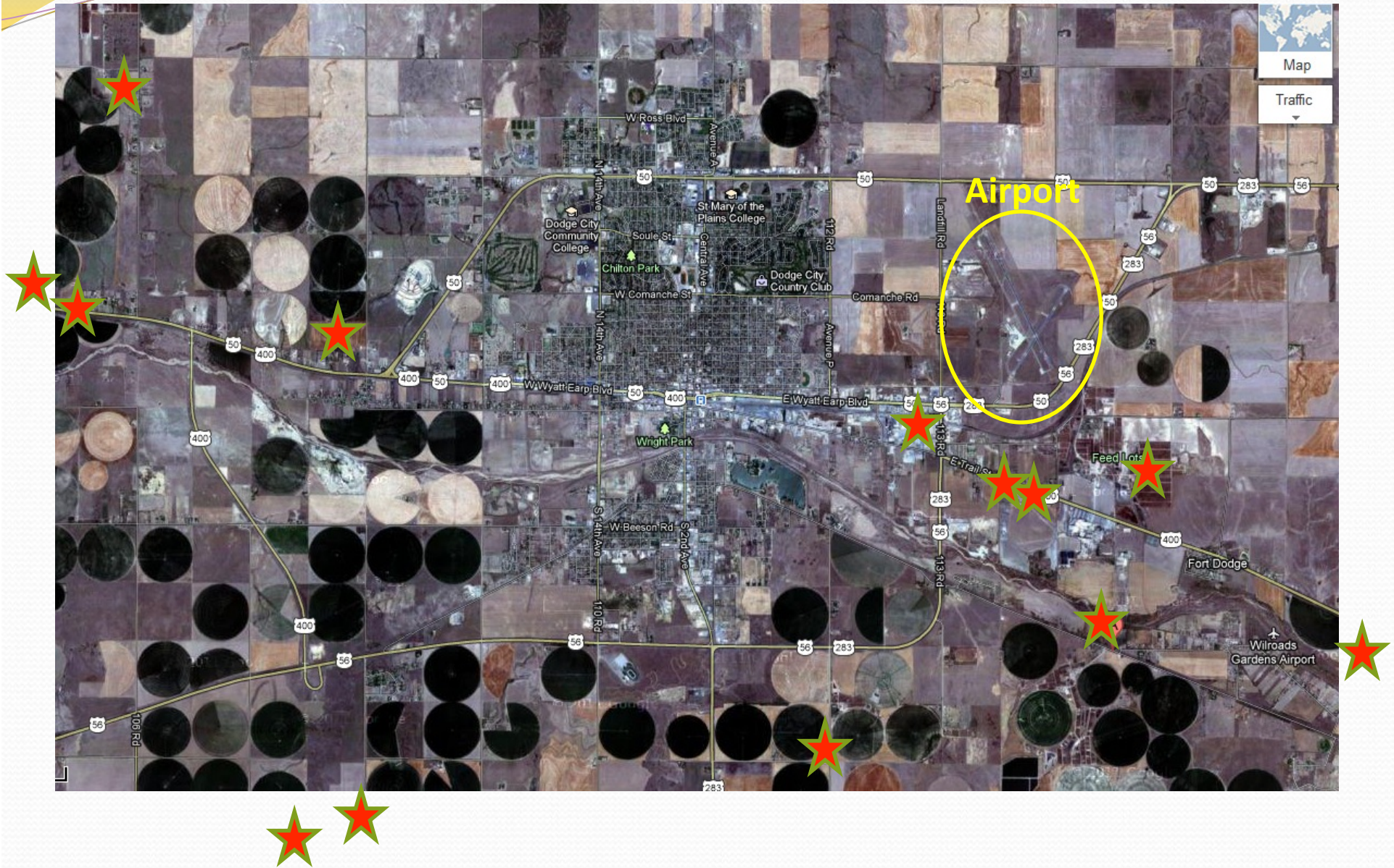






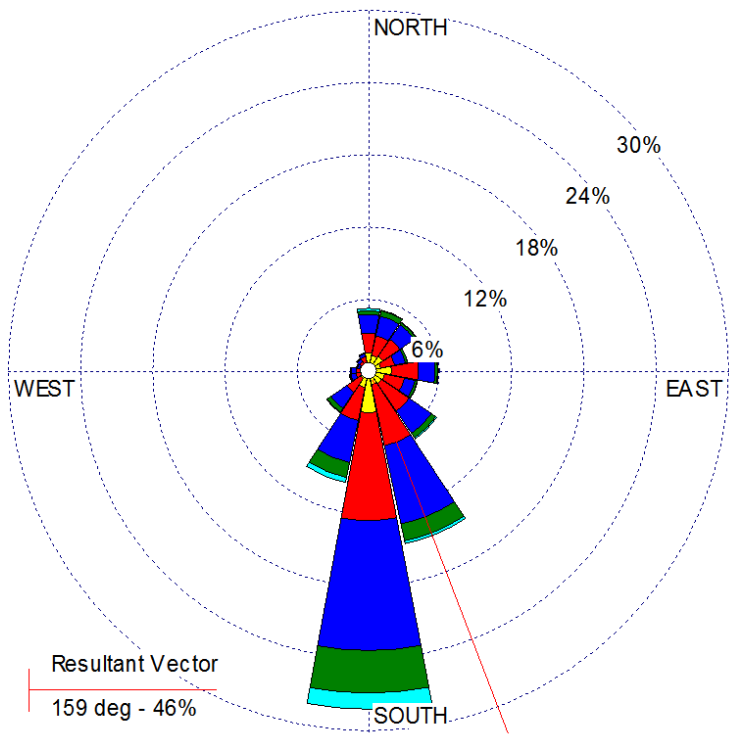


# Locations of feedlots and meat processing plants

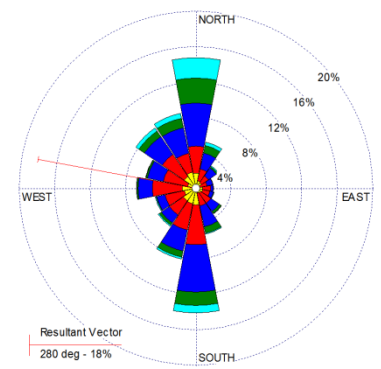




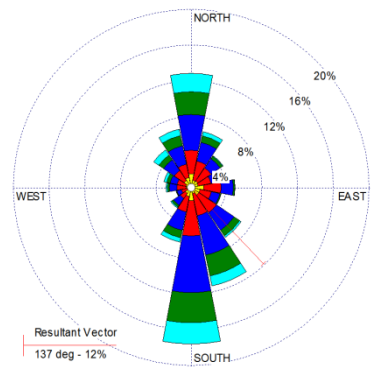
# Wind roses



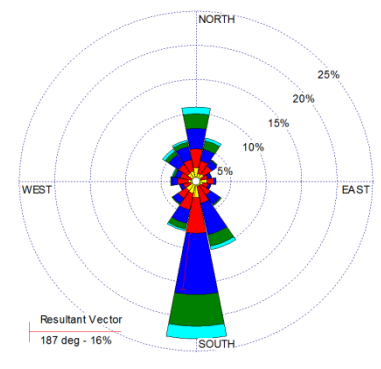
Summer



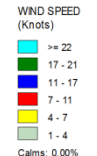
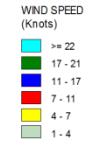
Winter



Spring

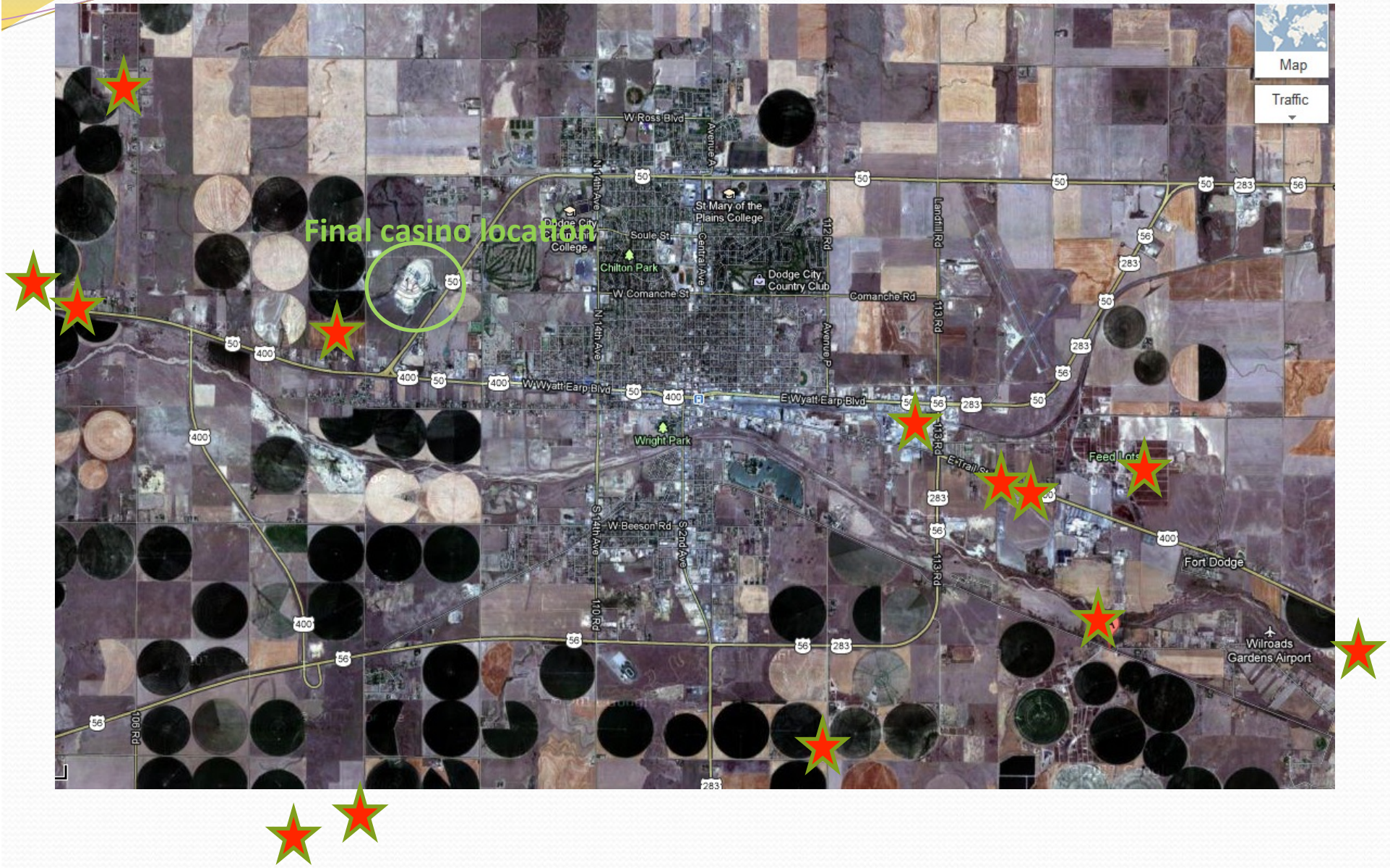


Fall





# Locations of feedlots and meat processing plants







## A successful forensic meteorologist...

- Can work with a wide variety of research topics
- Collaborates with other scientists and stakeholders to identify and study topics that cross disciplinary boundaries
- Uses well-known techniques as well as innovative solutions to answer questions from non-scientists that result in real economic and safety benefits



# Where can you find a CCM?

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[Http://www.ametsoc.org/memb/CCM/ccmhmfrm.html](http://www.ametsoc.org/memb/CCM/ccmhmfrm.html)

or search for “CCM list”





# Thank You!

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