Florida Department of Environmental Protection
Florida Geological Survey

The Florida Sinkhole Experience

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Congressional Hazards Caucus & Hazards Caucus Alliance, Washington, DC
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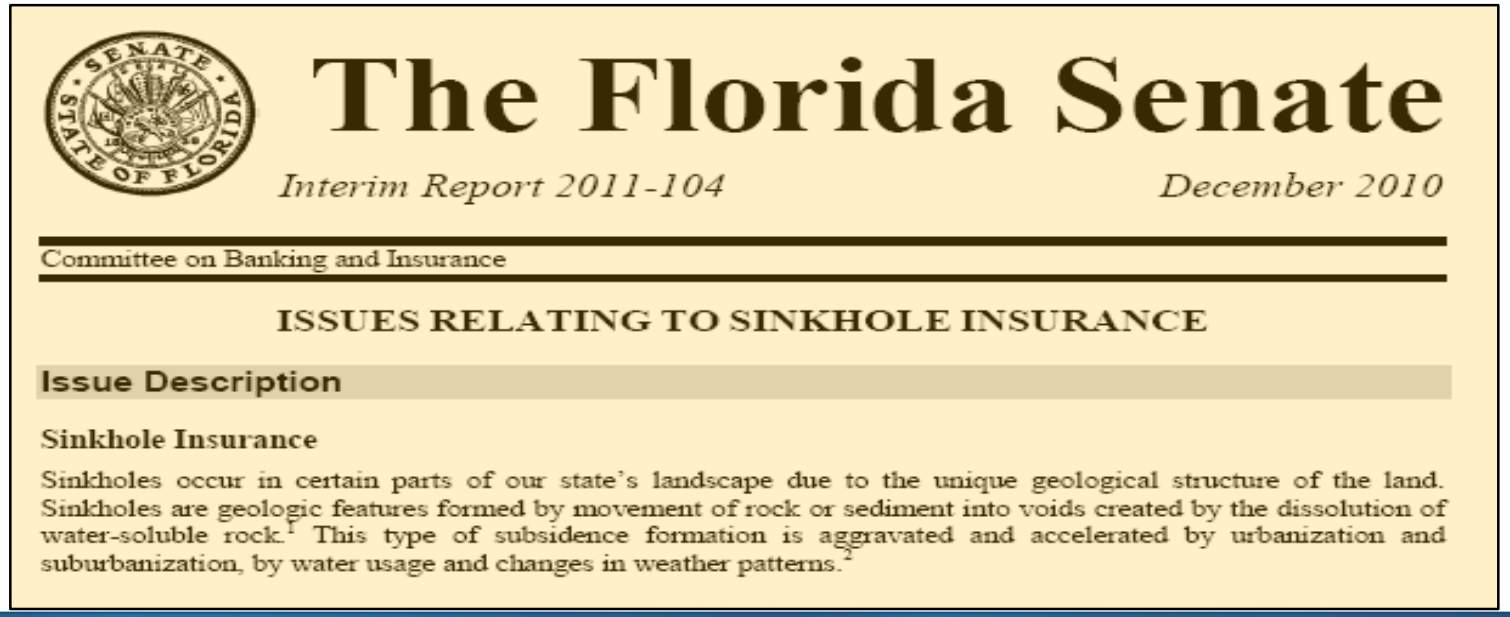
Sinkhole types

- **Cover-subsidence**
  - Slow forming
  - Perceptible over months/years
  - Most common

- **Cover-collapse**
  - Fast forming; minutes to days
  - May be triggered
  - Infrastructure
  - Newsmakers

Economic Effects

- Florida Senate Report (2005 – 2009)
  - Hernando County, $173M total market value loss
  - SW Florida – largest sinkhole insurance company losses >4X earned premiums
  - 2006 - 2010, Florida sinkhole related costs > $1.4B



The Florida Senate

Interim Report 2011-104 *December 2010*

Committee on Banking and Insurance

ISSUES RELATING TO SINKHOLE INSURANCE

Issue Description

Sinkhole Insurance

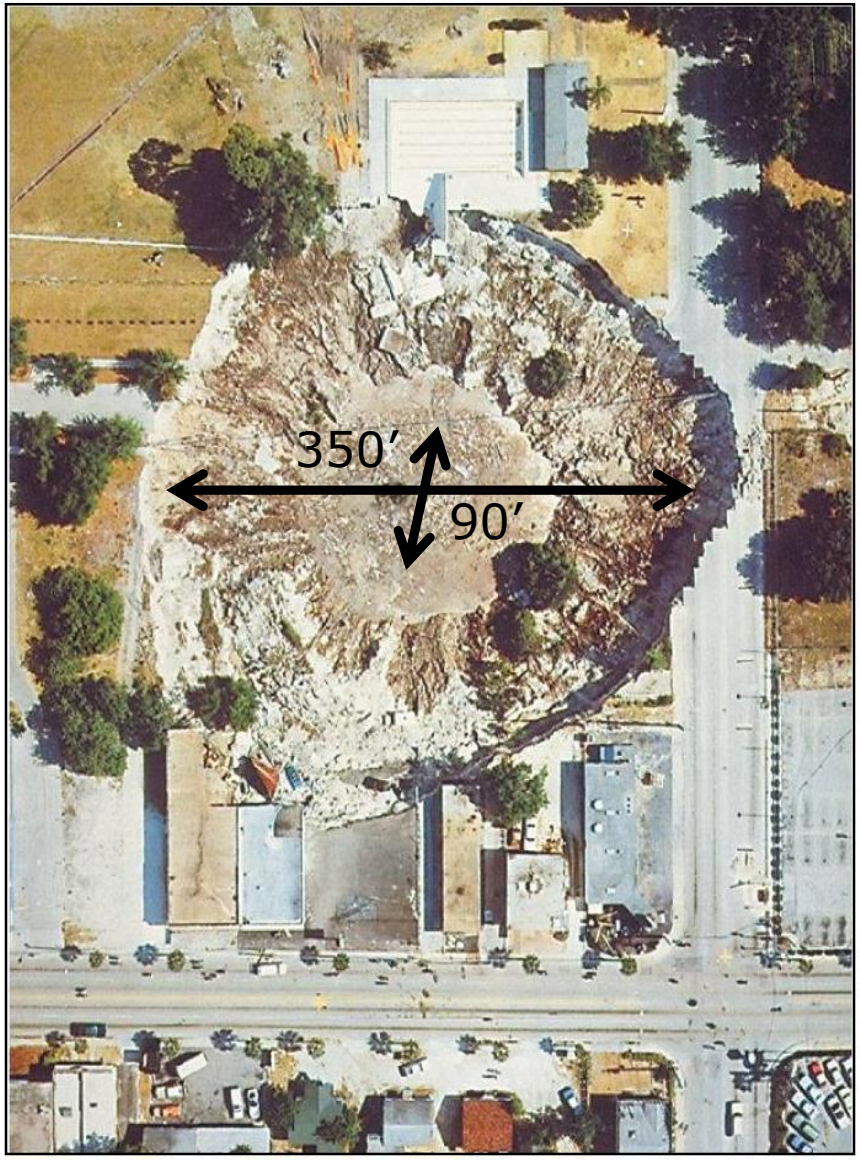
Sinkholes occur in certain parts of our state's landscape due to the unique geological structure of the land. Sinkholes are geologic features formed by movement of rock or sediment into voids created by the dissolution of water-soluble rock.[1] This type of subsidence formation is aggravated and accelerated by urbanization and suburbanization, by water usage and changes in weather patterns.[2]

Cover-Collapse Damage

Winter Park, 1981

Courtesy of NOVA

Winter Park Sinkhole + $4M = Lake Rose

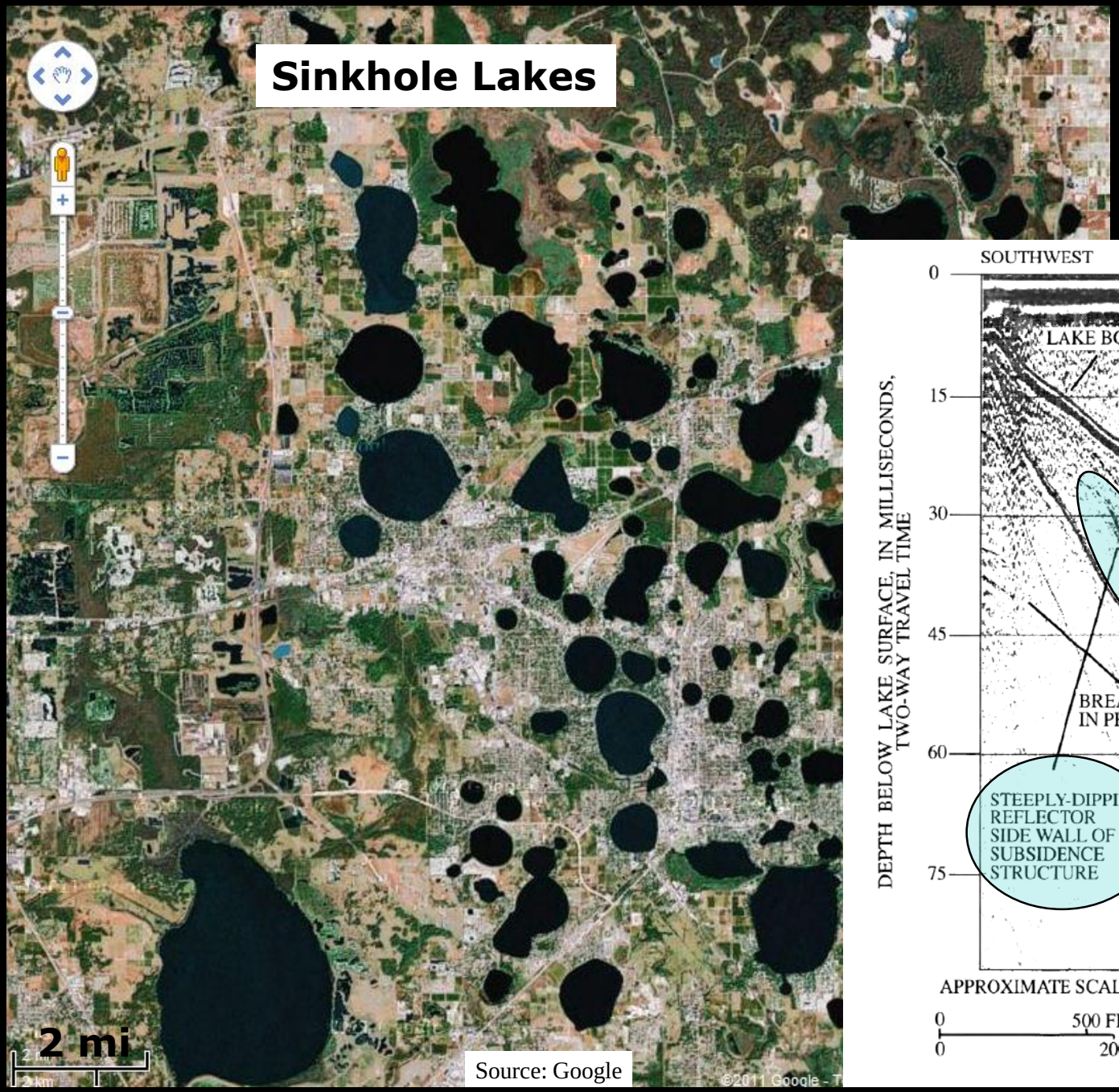


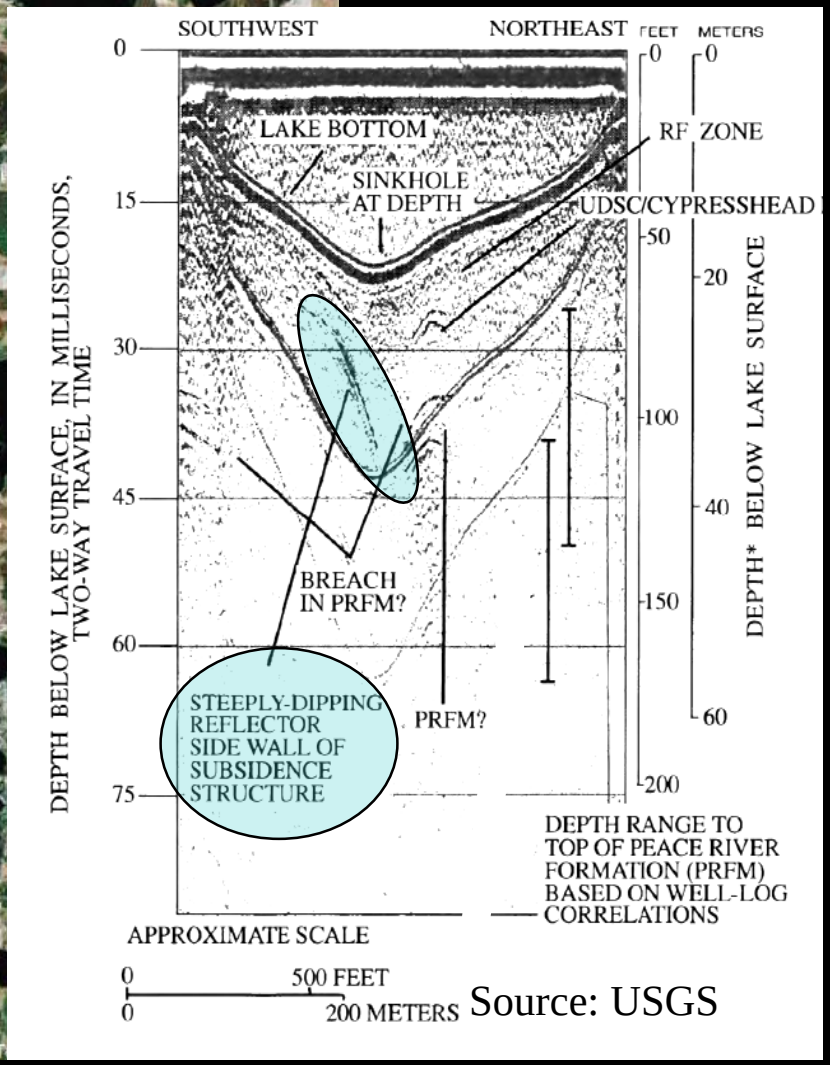
Florida's Hidden Sinkholes

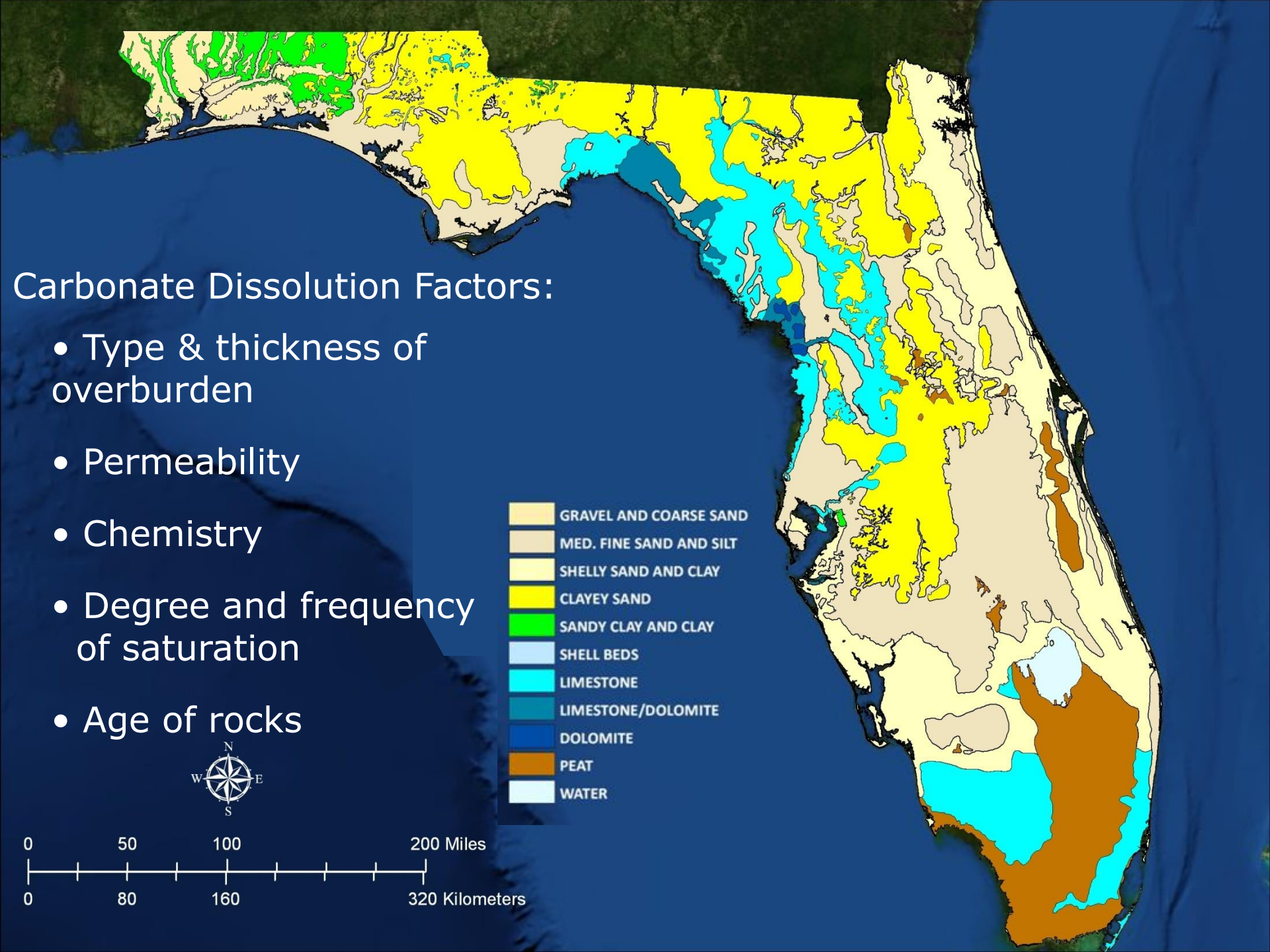
- Underground
- In Plain Sight

Buried Sinkholes Uncovered

Sinkhole Lakes



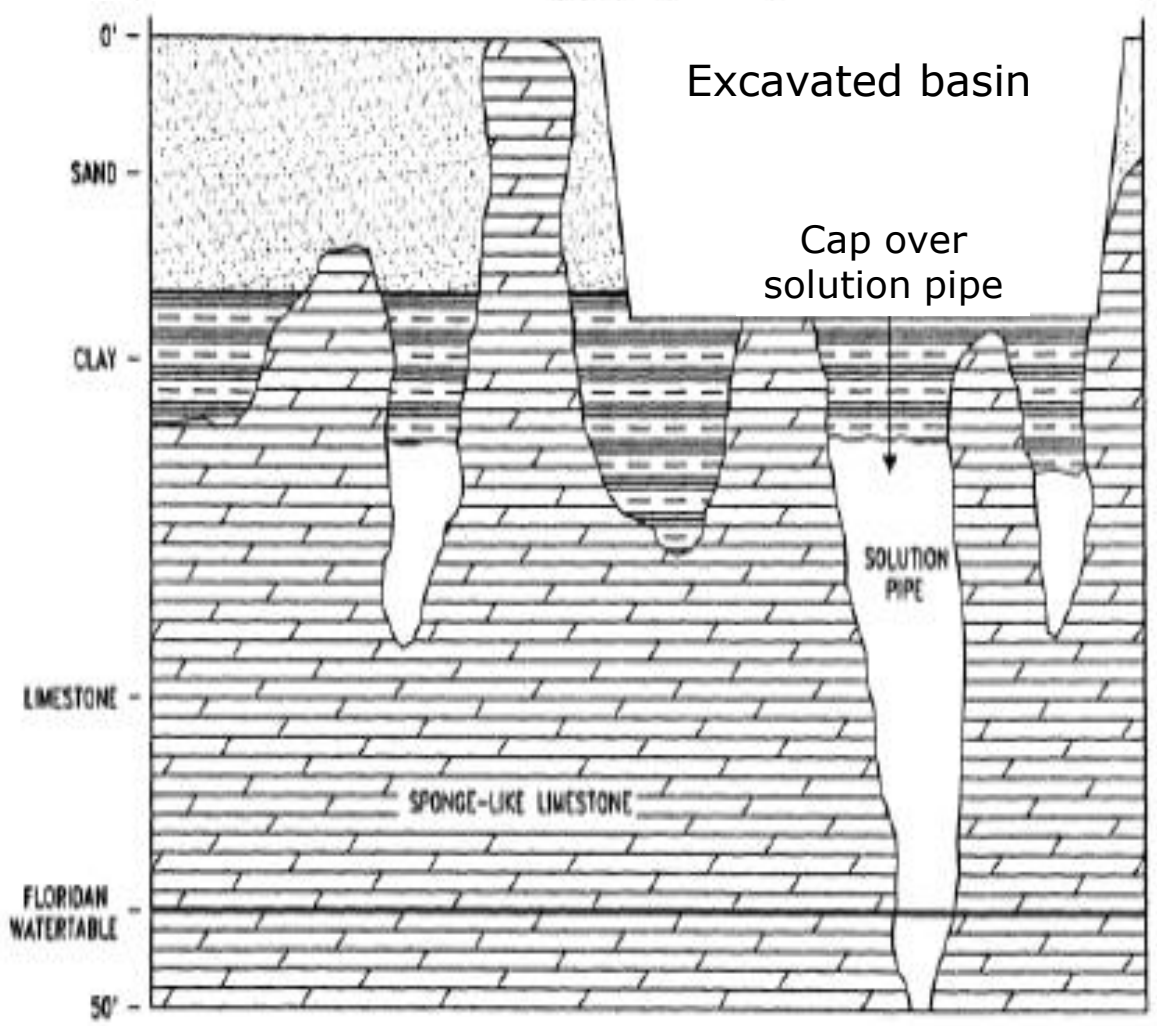



Carbonate Dissolution Factors:
• Type & thickness of overburden
• Permeability
• Chemistry
• Degree and frequency of saturation
• Age of rocks
GRAVEL AND COARSE SAND
MED. FINE SAND AND SILT
SHELLY SAND AND CLAY
CLAYEY SAND
SANDY CLAY AND CLAY
SHELL BEDS
LIMESTONE
LIMESTONE/DOLOMITE
DOLOMITE
PEAT
WATER
N
W
E
S
0
50
100
200 Miles
0
80
160
320 Kilometers

Sinkhole Triggers

- Heavy Rainfall
  - Adds excess weight
  - Loosens surface soil, sands, and clays
- Drought
  - Lowered water table – “buoyancy” loss
  - Sediment desiccation
- Focused recharge
  - Terraforming
  - Stormwater ponds
  - Infiltration basins

Buried Karst and Infrastructure



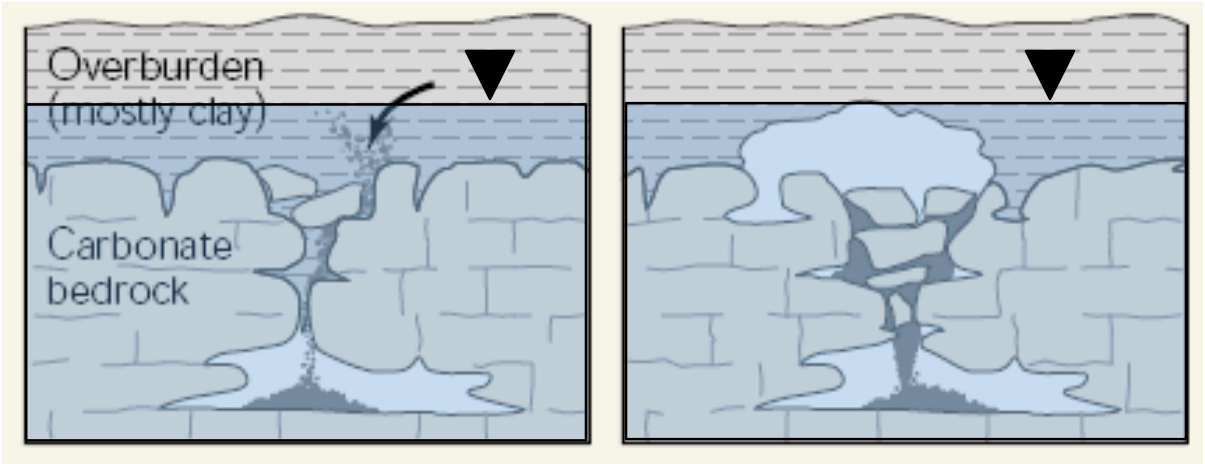
Draining Stormwater Pond

Video courtesy of Southwest Florida Water Management District

More Sinkhole Triggers

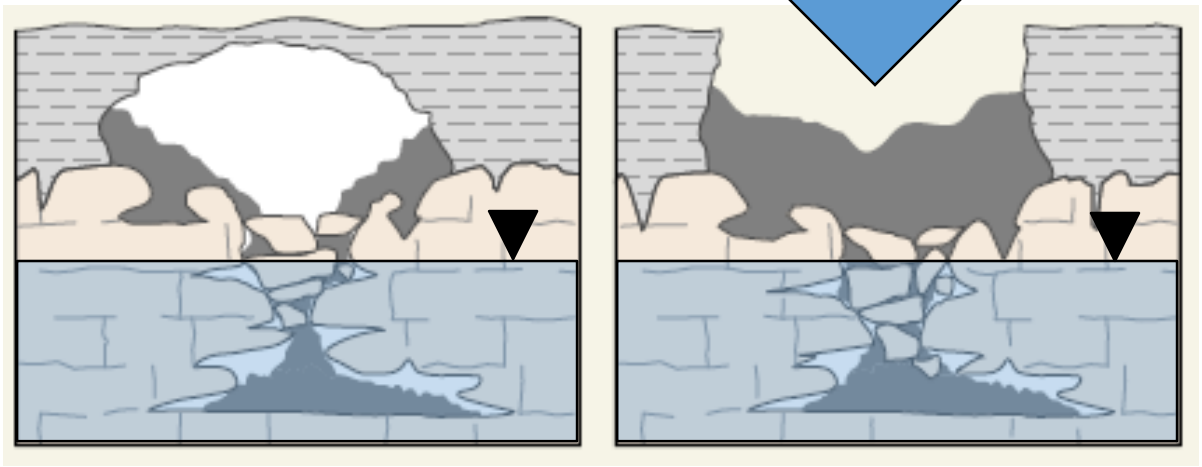
- Surface loading
  - Reservoirs
  - Landfills
  - Other infrastructure
- Rapid changes in water-table elevation
  - Pumping
  - Drought ⟶ Heavy rain

Triggered Cover-Collapse



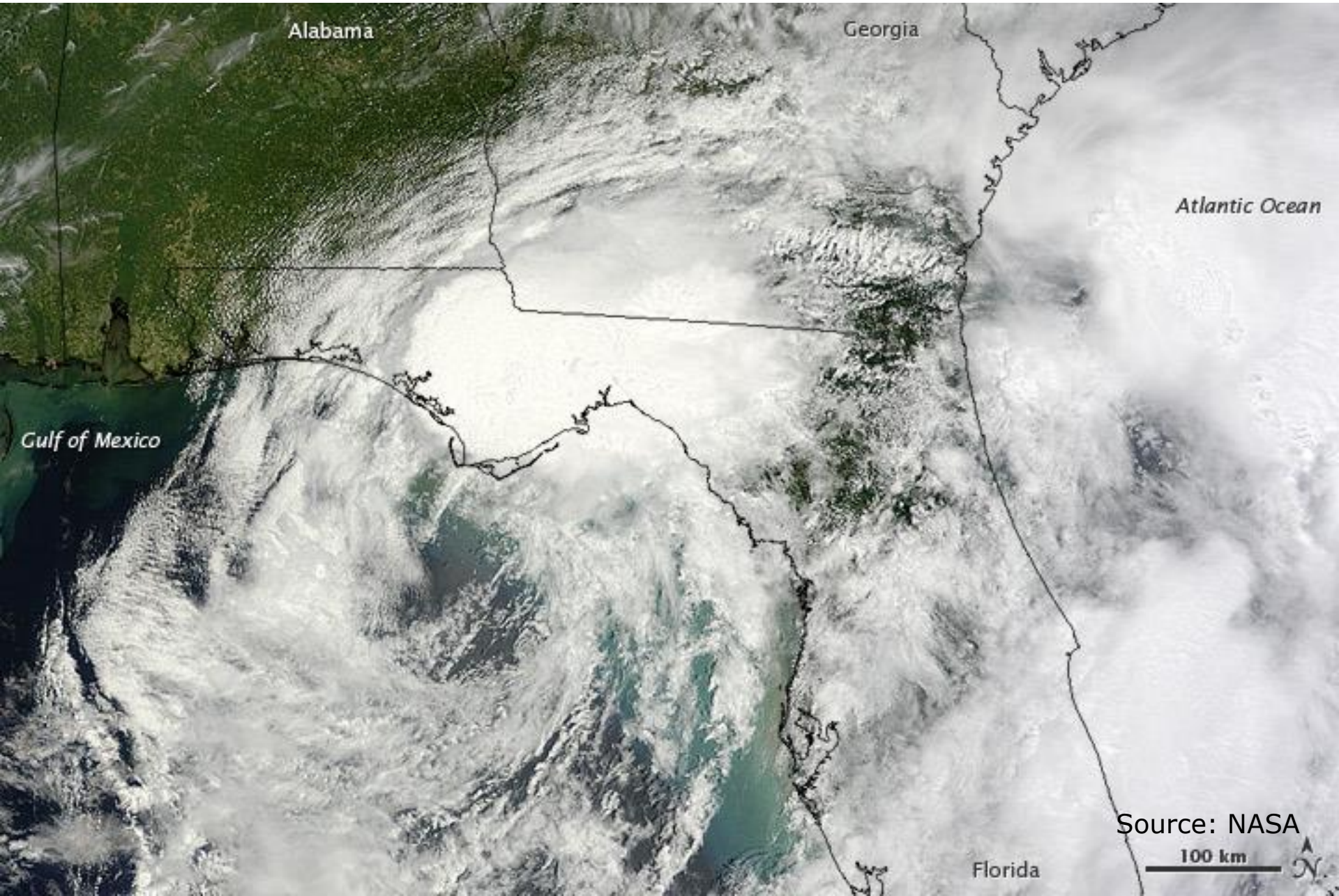
Heavy Rainfall

- Normal conditions
- Drought
- Heavy rainfall

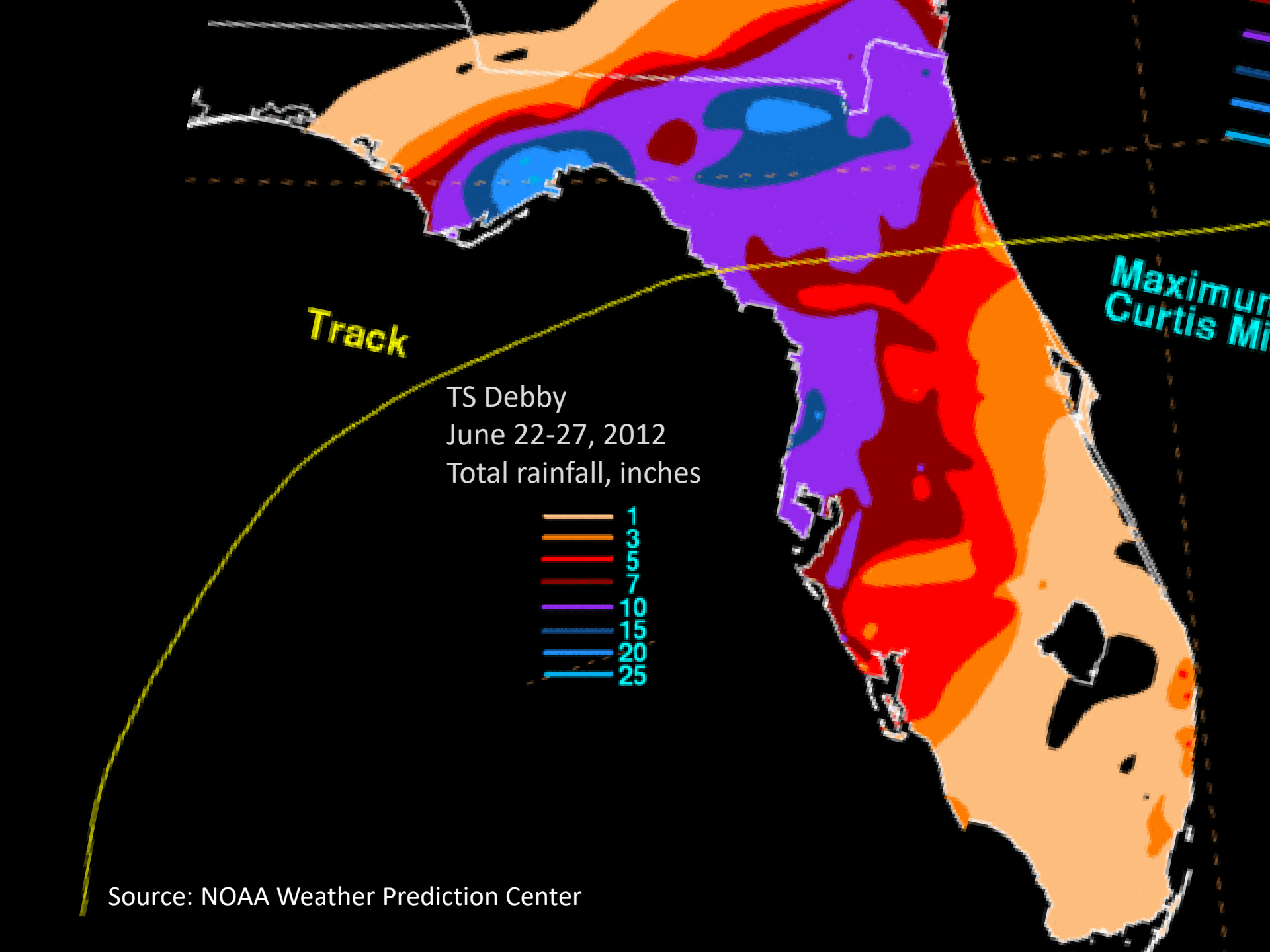


Modified from USGS

Tropical Storm Debby, June 2012



Source: NASA



Source: NOAA Weather Prediction Center

TS Debby Sinkhole Damage Suwannee County

Sinkhole developed in downtown Live Oak, affecting several local businesses and the county courthouse. (Photo taken from edge of courthouse). Now a green space.

TS Debby Sinkhole Damage
Hernando County

Hernando Co Airport

Cluster of >20 sinkholes

Environmental Effects

- Surface water – groundwater interaction
- Water Quality
  - Land use
    - Urban, industrial
    - Agriculture
- Contaminants
  - Metals, solvents
  - Human and animal waste
  - Pesticides, herbicides, etc.

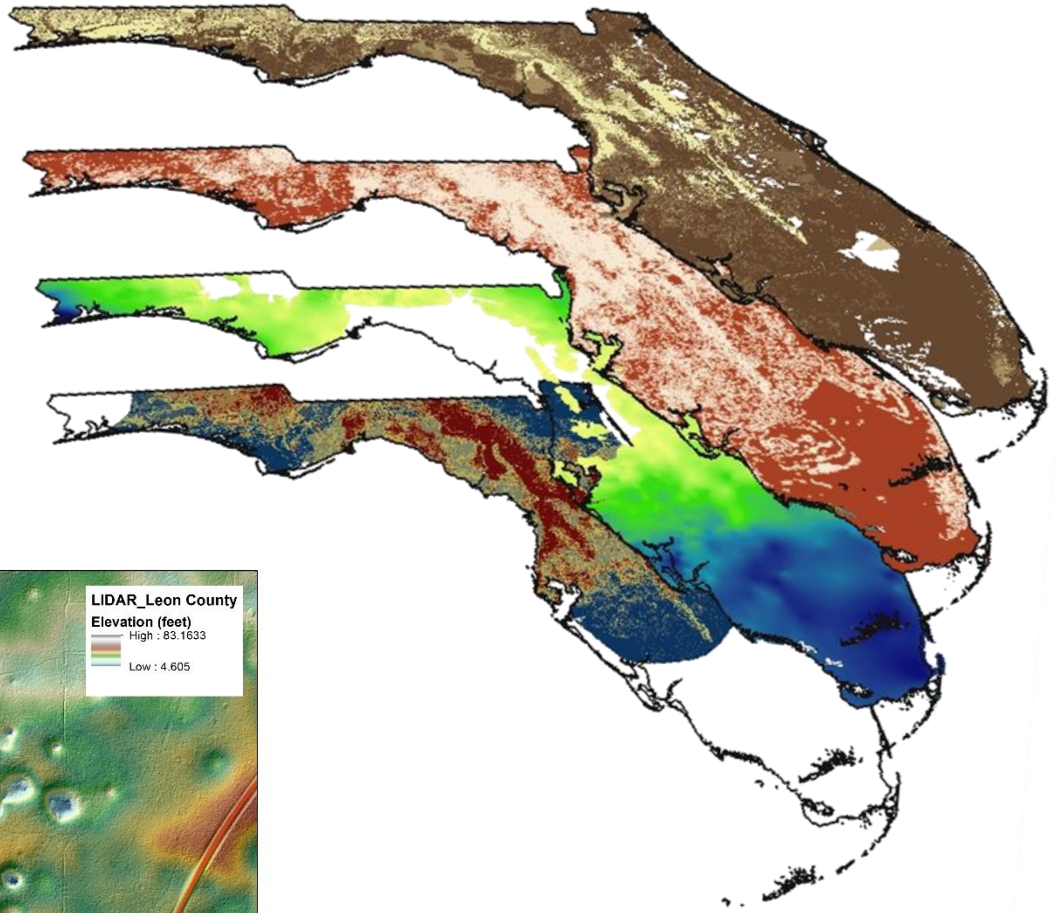
Florida Aquifer Vulnerability Assessment Project

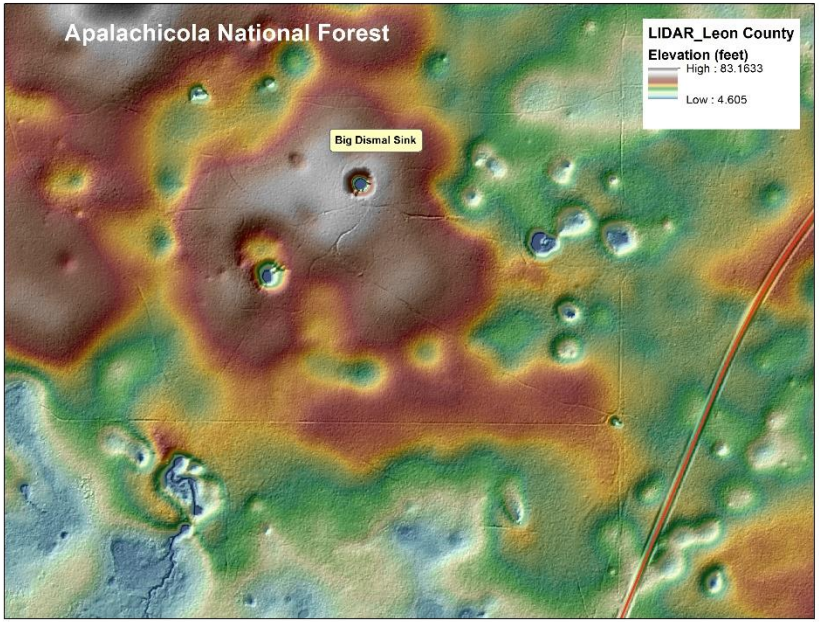
Soil properties

Circular topographic depressions

Aquifer overburden

Surface Contamination Vulnerability Model





Human Health & Safety

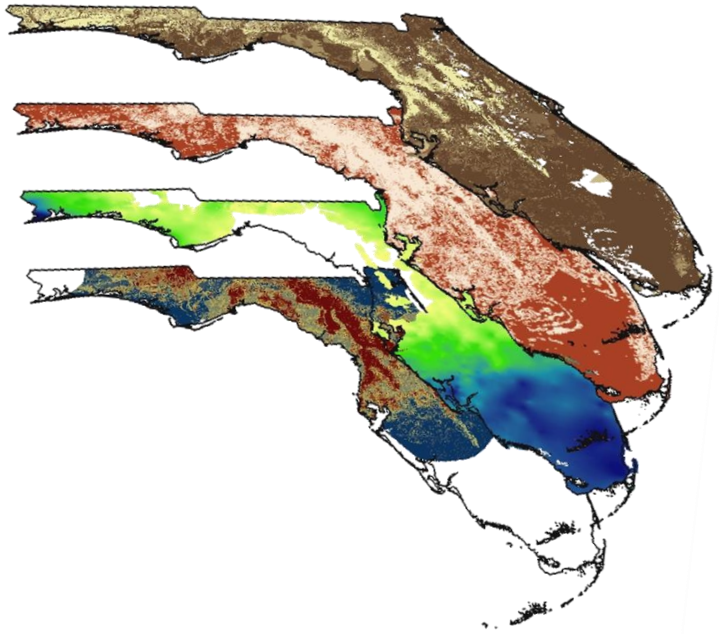
Sinkhole Favorablility Mapping

- Hazard Grant Mitigation Program (FEMA) in response to T.S. Debby

- Florida Division of Emergency Management
  - State Hazard Mitigation Plan (SHMP)

- Map based on predictive model using GIS and probability statistics

- Benefits of funding:
  - Advancing research
  - Enhance mitigation strategies
  - Potential reduction of risk to public health, safety and infrastructure
  - Public education (planned)



Integration

- Perspectives: national, state, local
- Warning signs
- Local conditions
  - Geology
  - Geophysics and geotechnical
- Triggering conditions and events
- Planning, response and awareness

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Source: NASA