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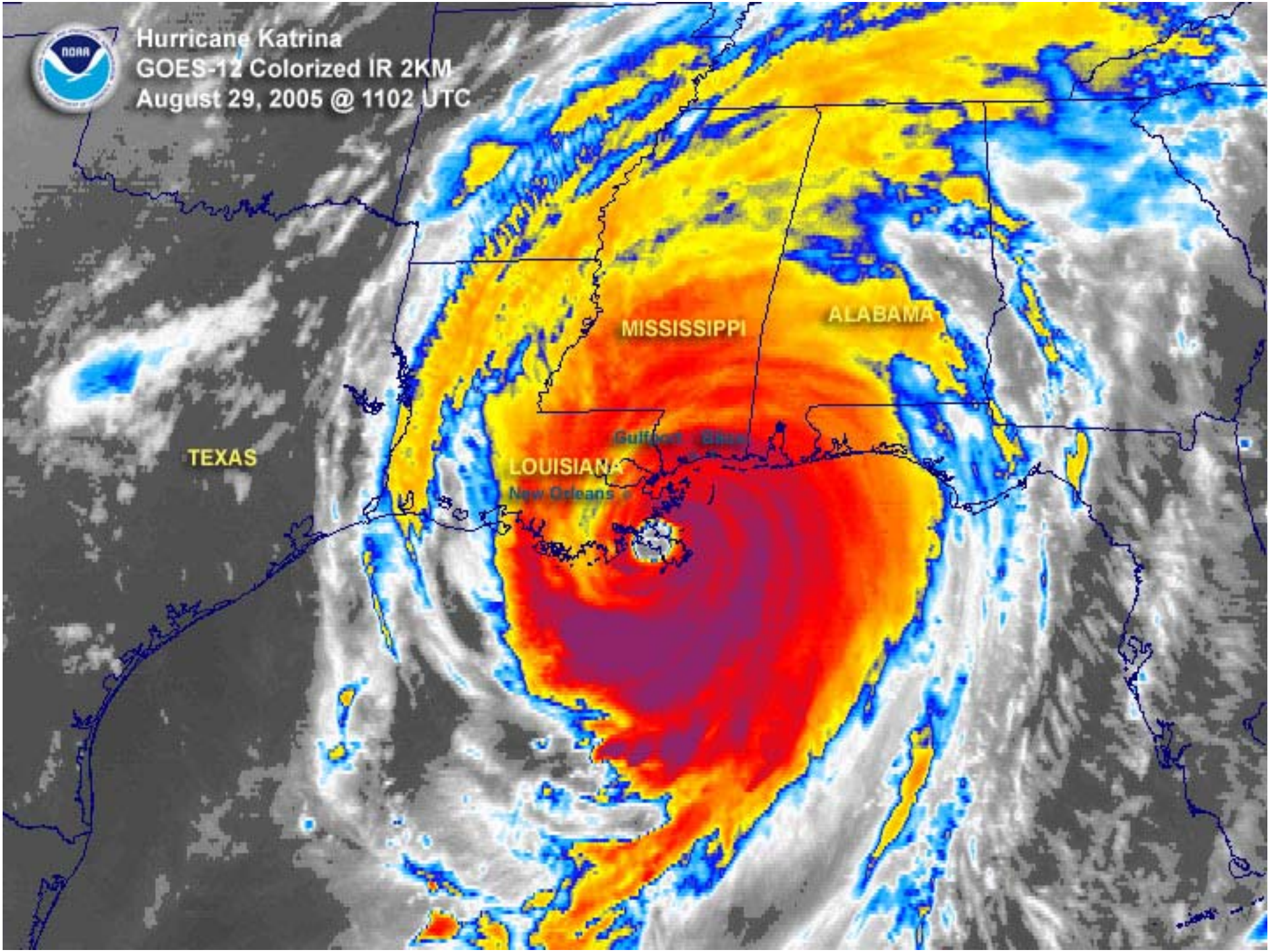
LTRC

LOUISIANA TRANSPORTATION RESEARCH CENTER

Kevin Gaspard, P.E.


Hurricane Katrina
GOES-12 Colorized IR 2KM
August 29, 2005 @ 1102 UTC
TEXAS
LOUISIANA
MISSISSIPPI
ALABAMA
New Orleans


NEW ORLEANS


6520
U. S. COAST GUARD


MISSOURI


GARAGE FULL
CASH PARKING

NEW ORLEANS AREA
31 AUGUST 2005

0 0.5 1 2 3 4 Miles

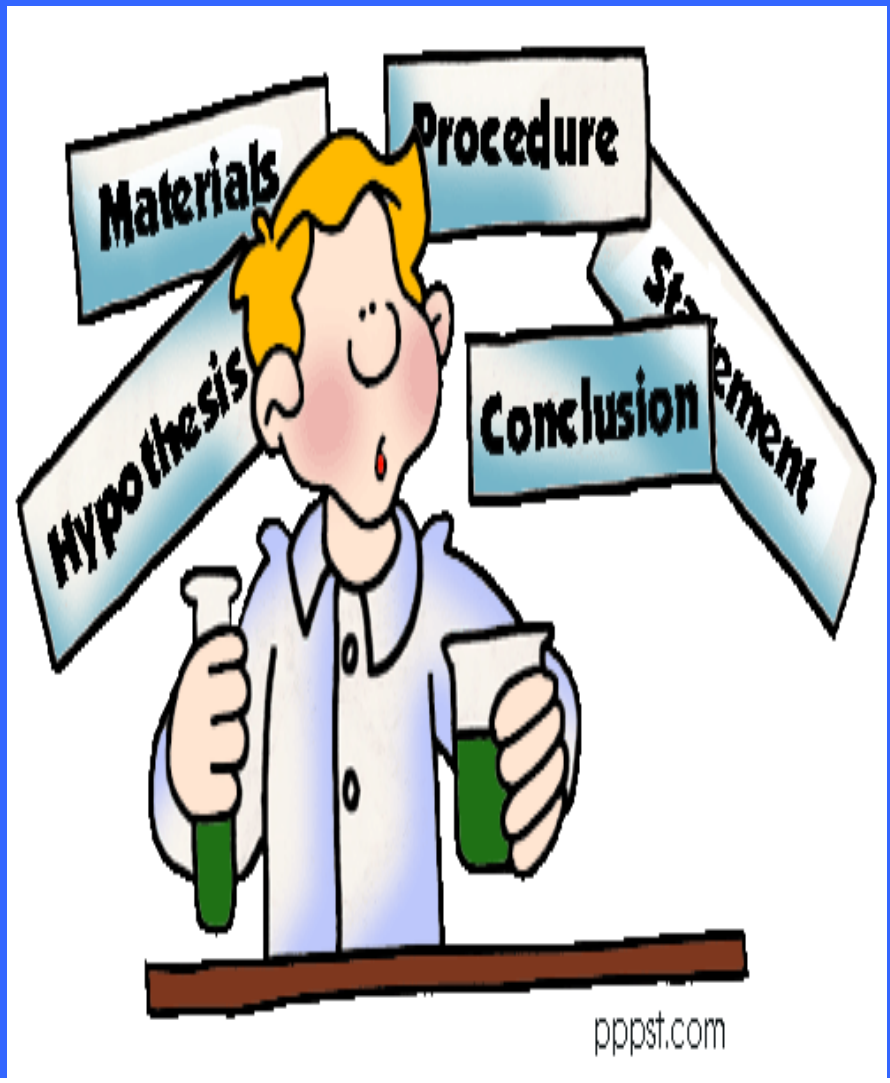
Map Name: \\H13000ms002\Xfer\Katrina\Levee_Break_Satellite.mxd, Printed: Thursday, 8 September 2005, 11:51:58 AM

Submerged Roads

- ≈ 2000 miles
- ≈ 500 miles Fed/State
- ≈ 1500 miles City/Parish
- Up to 5 weeks

Pavement Distress ?

- Submergence
- Methods
- Parameters
- Statistical Analysis



FWD
Dynaflect

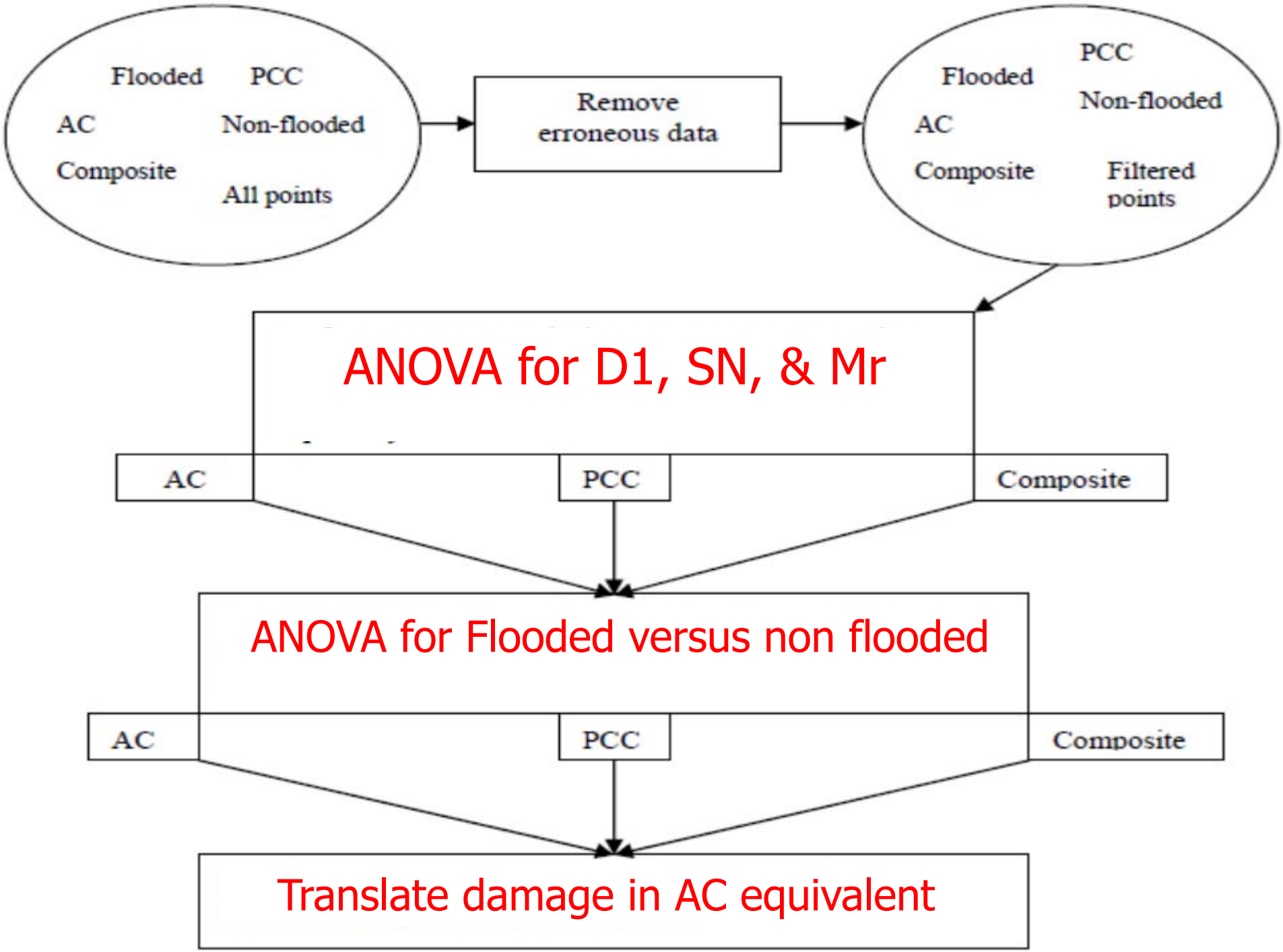
GPR

DCP

Parameters

- D_1 Overall stiffness of Pavement
- SN_{eff} Effective Structural Strength
- M_r Subgrade Resilient Modulus


Dynatest
Falling Weight Deflectometer
154794
SHOWBIZ
VIDEO
181-038
171708


Flooded
PCC
AC
Non-flooded
Composite
All points
Remove erroneous data
PCC
Flooded
Non-flooded
AC
Composite
Filtered points
ANOVA for D1, SN, & Mr
AC
PCC
Composite
ANOVA for Flooded versus non flooded
AC
PCC
Composite
Translate damage in AC equivalent

Pavement Thickness

- AC <7″, 7″ to 11″, >11 in.
- PCC < 10.5″ & > 10.5″
- Composite <16″ & > 16″

Statistical Treatment Groups

Before & After Flooding (1 site)

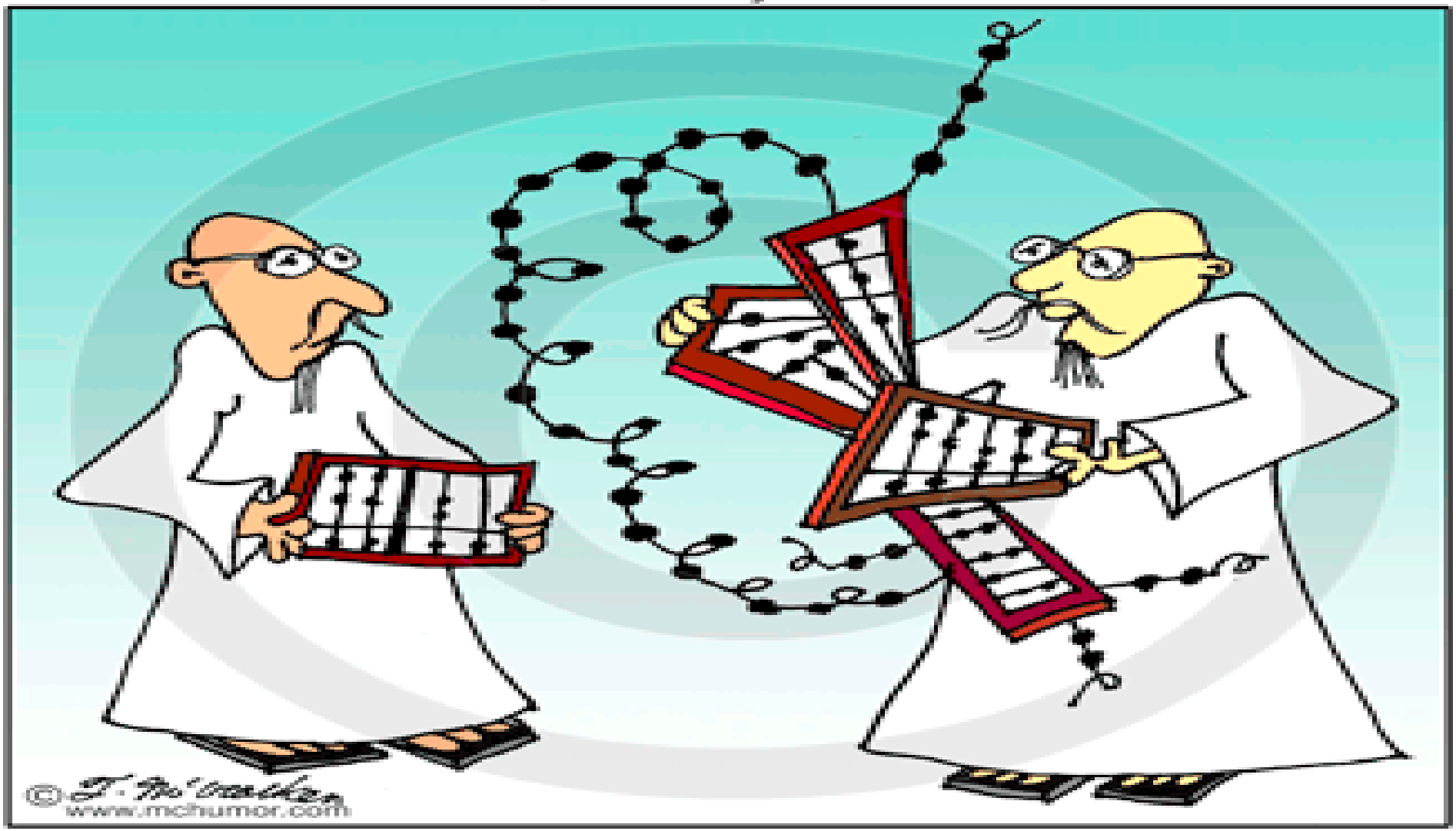
Flooded versus Non-Flooded (Duration)

Non-Flooded

One week

Two weeks

> Three weeks

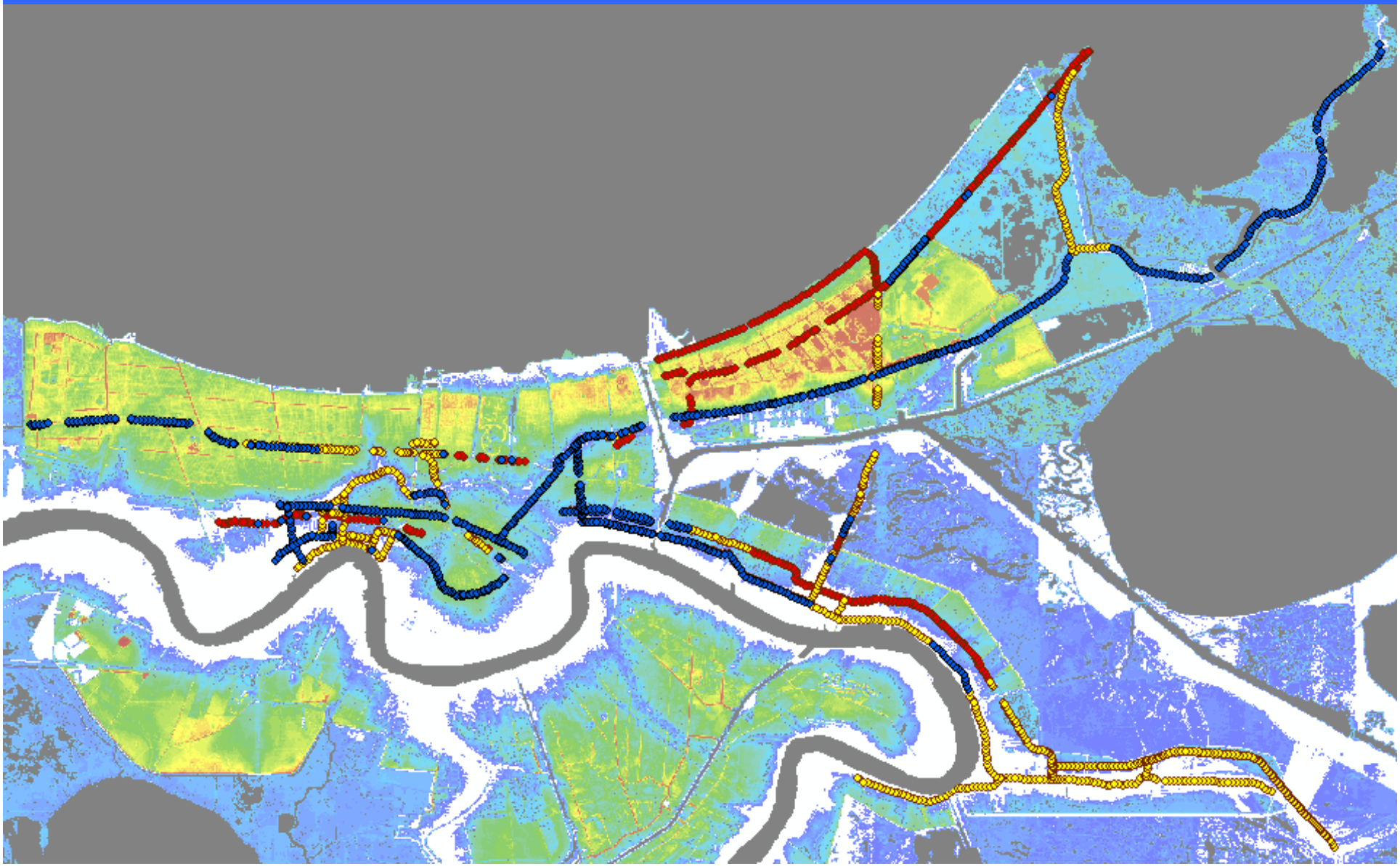


"Product development says it's based on the latest technology."

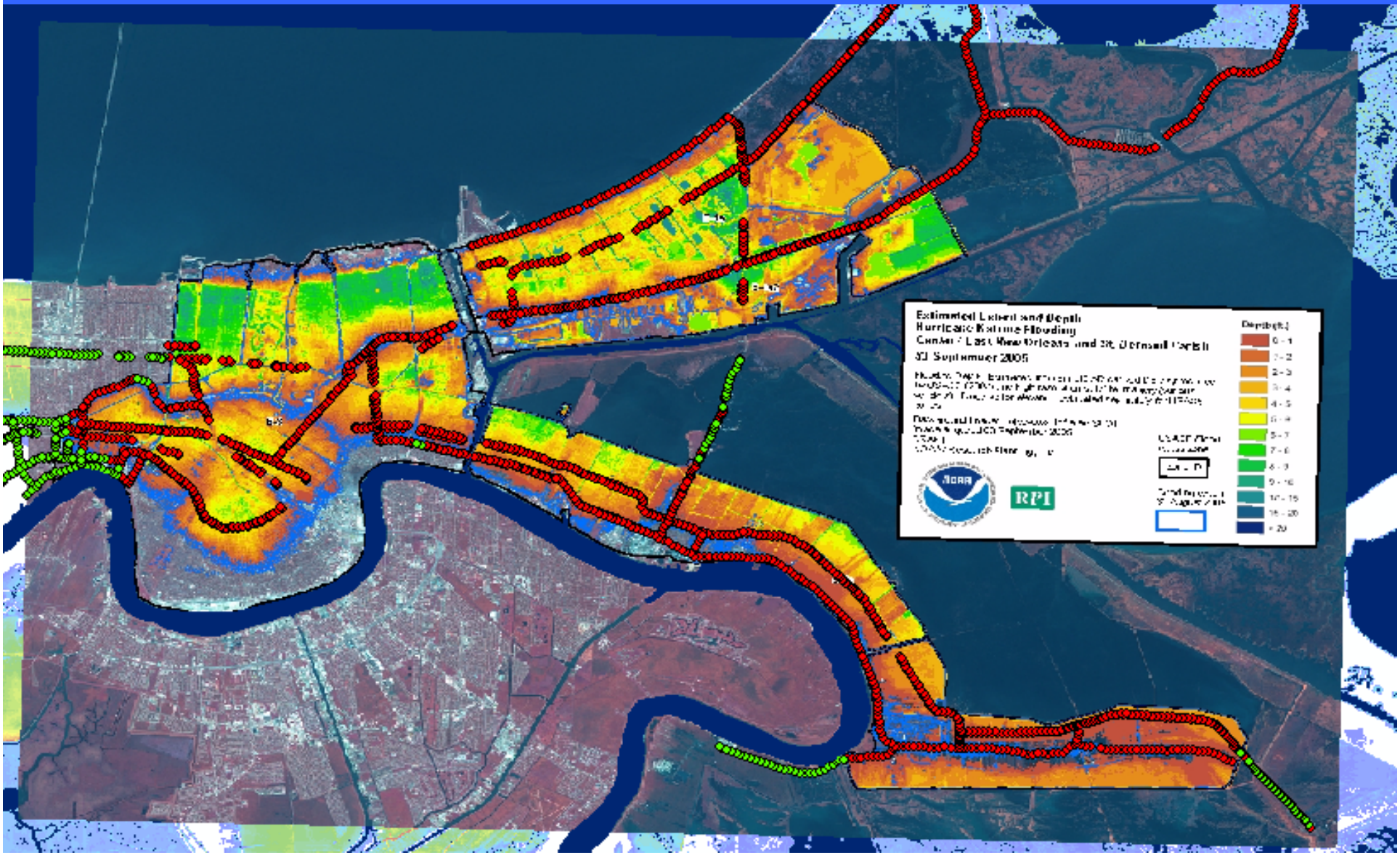
Data Sorting Method

- ARCGIS software
- Geographic information from USGS as base map
- Flooding variation with time from NOAA
- Flooding area determined by FEMA
- FWD data set with GPS

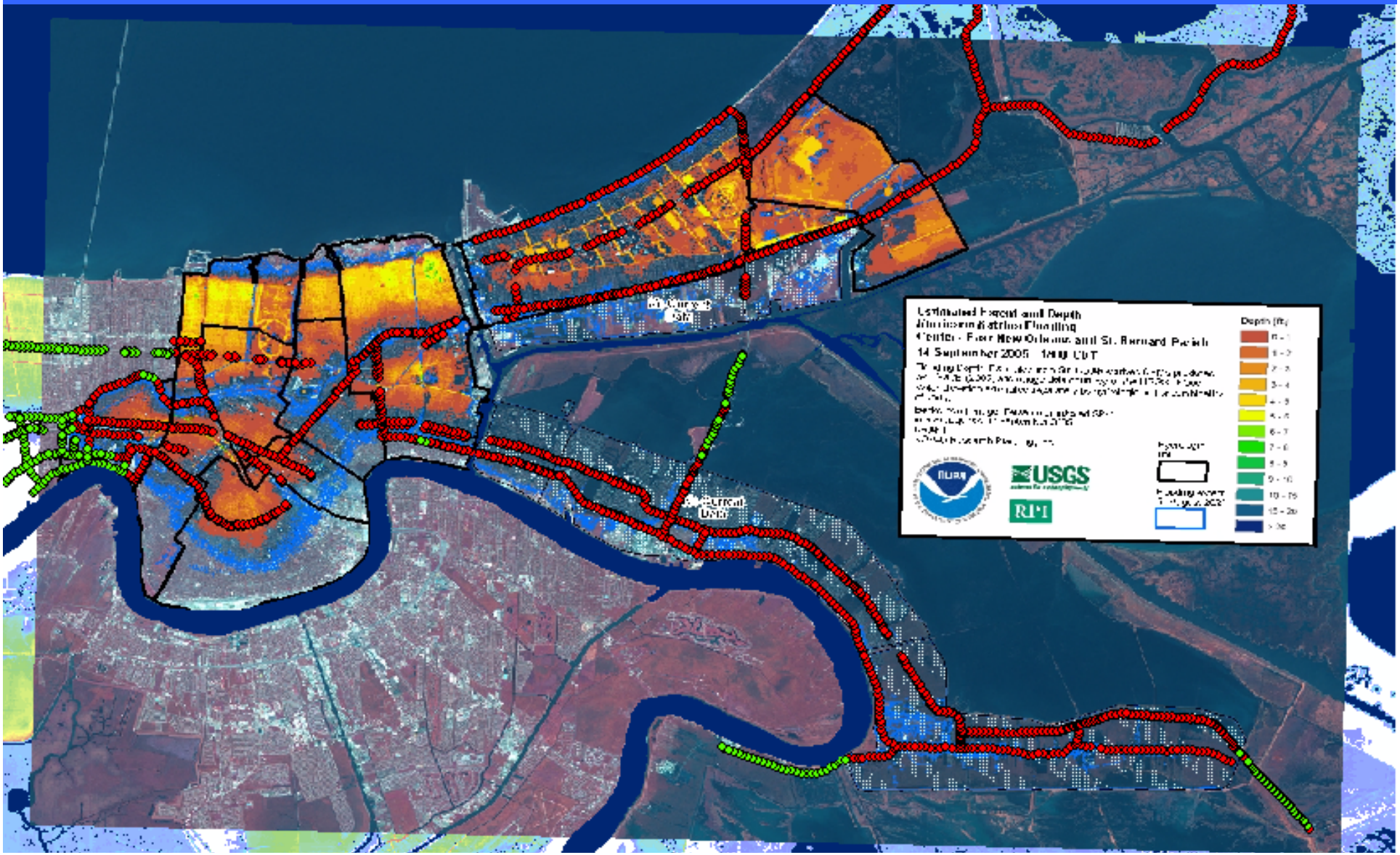
FWD Data w/ Pave. Type



Flooding on Sept. 2, 2005

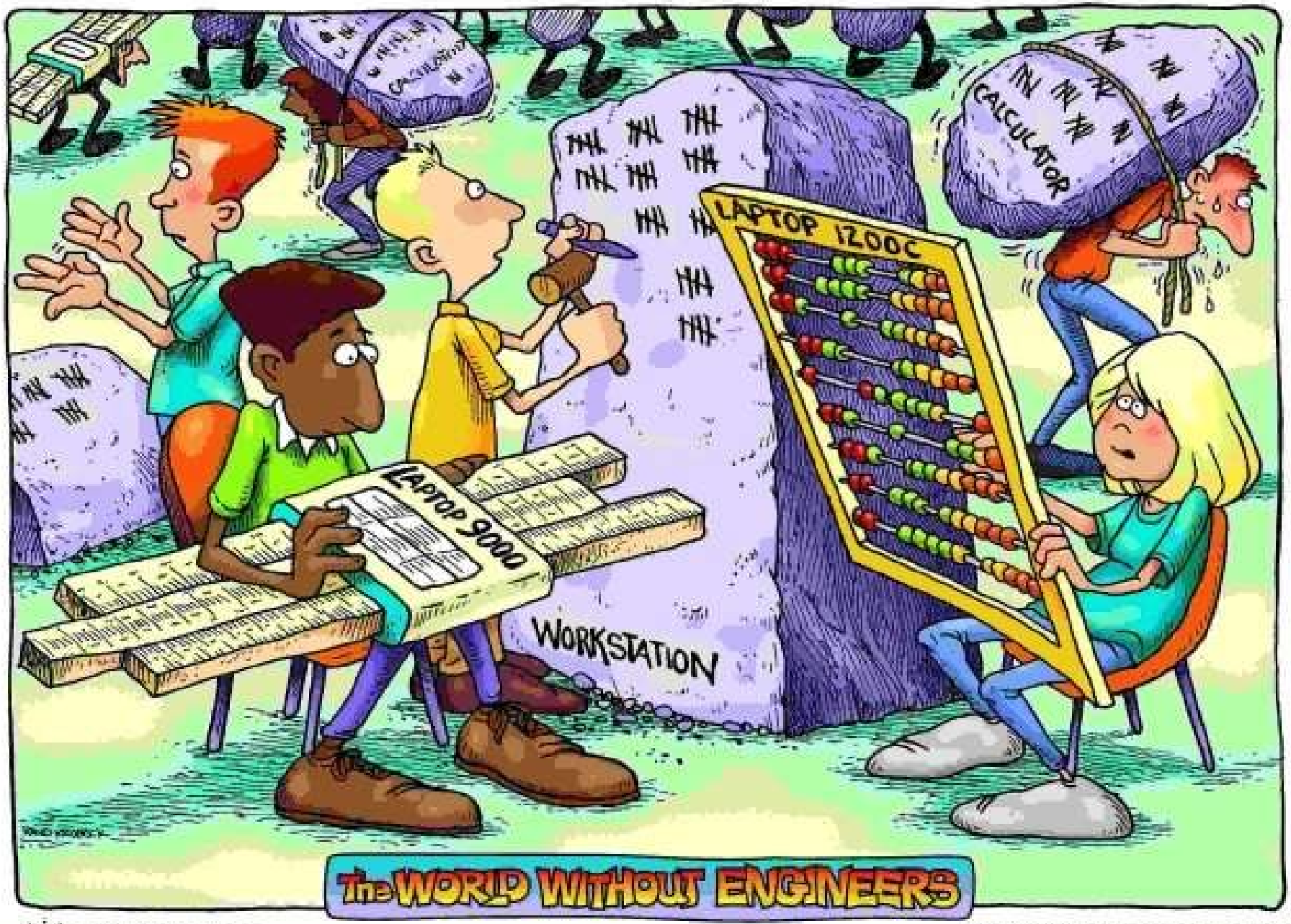


Flooding on Sept. 14, 2005

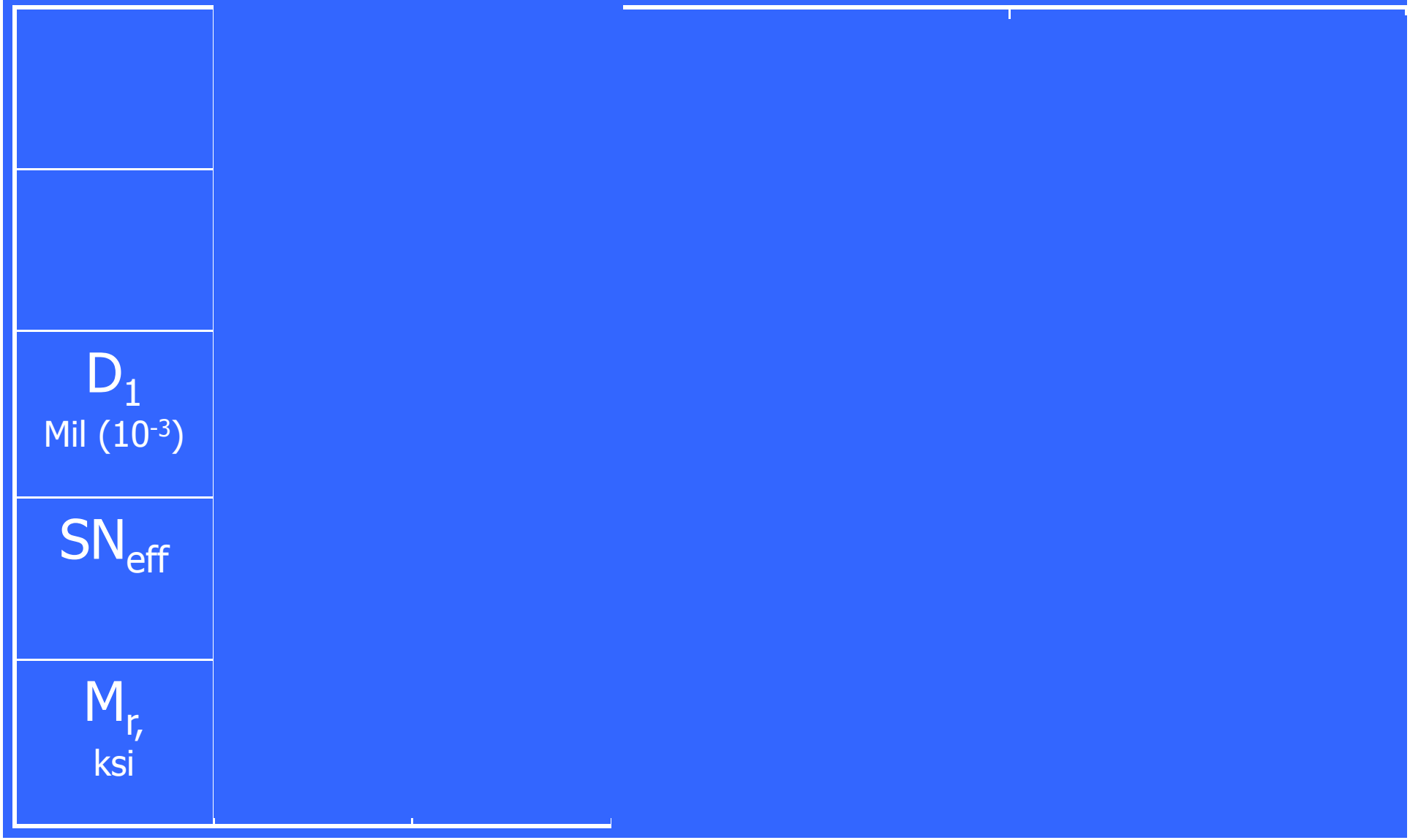


Sorted FWD Test Points

	Flooded	Non-flooded	Total
AC	677	205	882
PCC	439	45	484
Composite	712	187	899


CALCULATOR
LAPTOP 9000
LAPTOP 1200C
WORKSTATION
The WORLD WITHOUT ENGINEERS

Flooding Impact



Composite Pavement	
1	AC-PCC-BASE-PCC
2	AC-BRICK-PCC
3	AC-CRCP
4	AC-PCC-AC
5	AC-PCC-AC-PCC
6	AC-PCC
7	AC-PCC-BASE
8	AC-PCC-BASE-SUBBASE
AC thick ranged from 1.5 to 19 in.	
PCC thick ranged from 4 to 15 in.	

Statistical Analysis Summary

- AC
  - AC layer and subgrade strength reduced
  - Thinner Pavements (more damage)
- PCC
  - Minor damage compared to AC pavements
- Composite
  - Inconclusive due to various thickness & composition

AC Mitigation

Type	Thick inches	AC _ SN	AC _ Mr	Total

Based on AASHTO 1993 design procedure

Conclusions

- GIS tech. valuable
- AC pave. & subgrade weakened
- ≈ 2 in. AC overlay required
- PCC impact minimal
- Inconclusive on Composite Pave.

Recommendations

- Disaster Prone locations
- Network typical section catalogue
- Yearly or Biennial Structural testing
- GIS maps with elevations
- GIS mapping immediately following disaster
- GIS mapping (weekly intervals)