Geospatial and Remote Sensing Data Use by States and Counties in Disaster Response: A Nationwide Survey

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RESEARCH QUESTIONS FOR GEOSPATIAL APPROACHES in DISASTER RESPONSE

- *What are the priority baseline data layers (collected prior to a disaster) needed and where do the counties obtain such data?*

- *Are the counties aware of and use the federal supplied data streams (e.g. NASA, HSIN, GIS Inventory)?*

- *When is remotely sensed data too late to be useful?*

- *Do the counties have GIS/Remote sensing staff?*

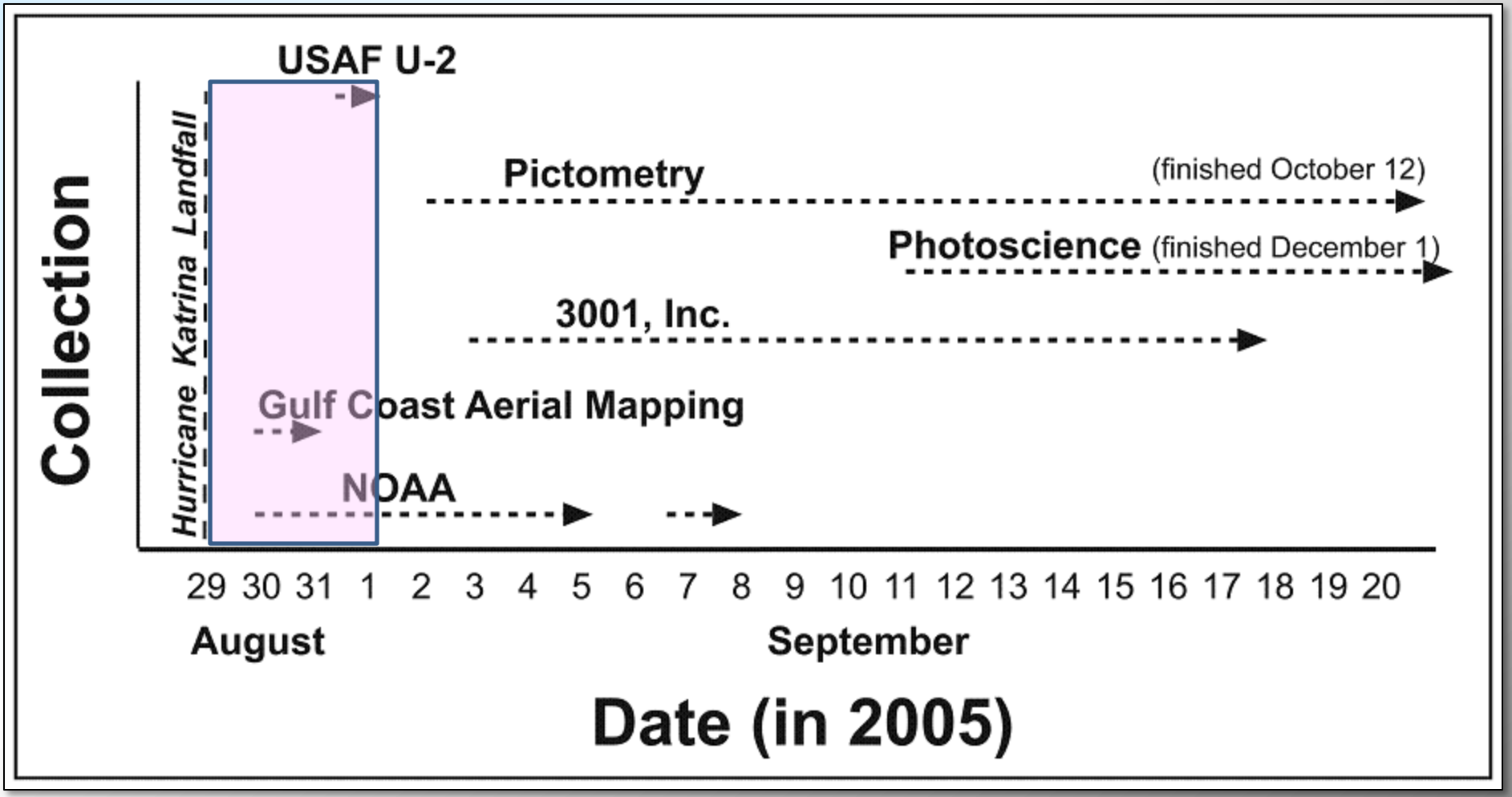
- *Do the counties receive remote sensing data from other sources?*

- *Are the counties/states using emerging technologies?*

OUTLINE OF PRESENTATION

- ***Context for Study***
- ***Methods Used***
- ***Response Rate***
- ***Selected Results***

Imagery Collection in Hurricane Katrina in 2005



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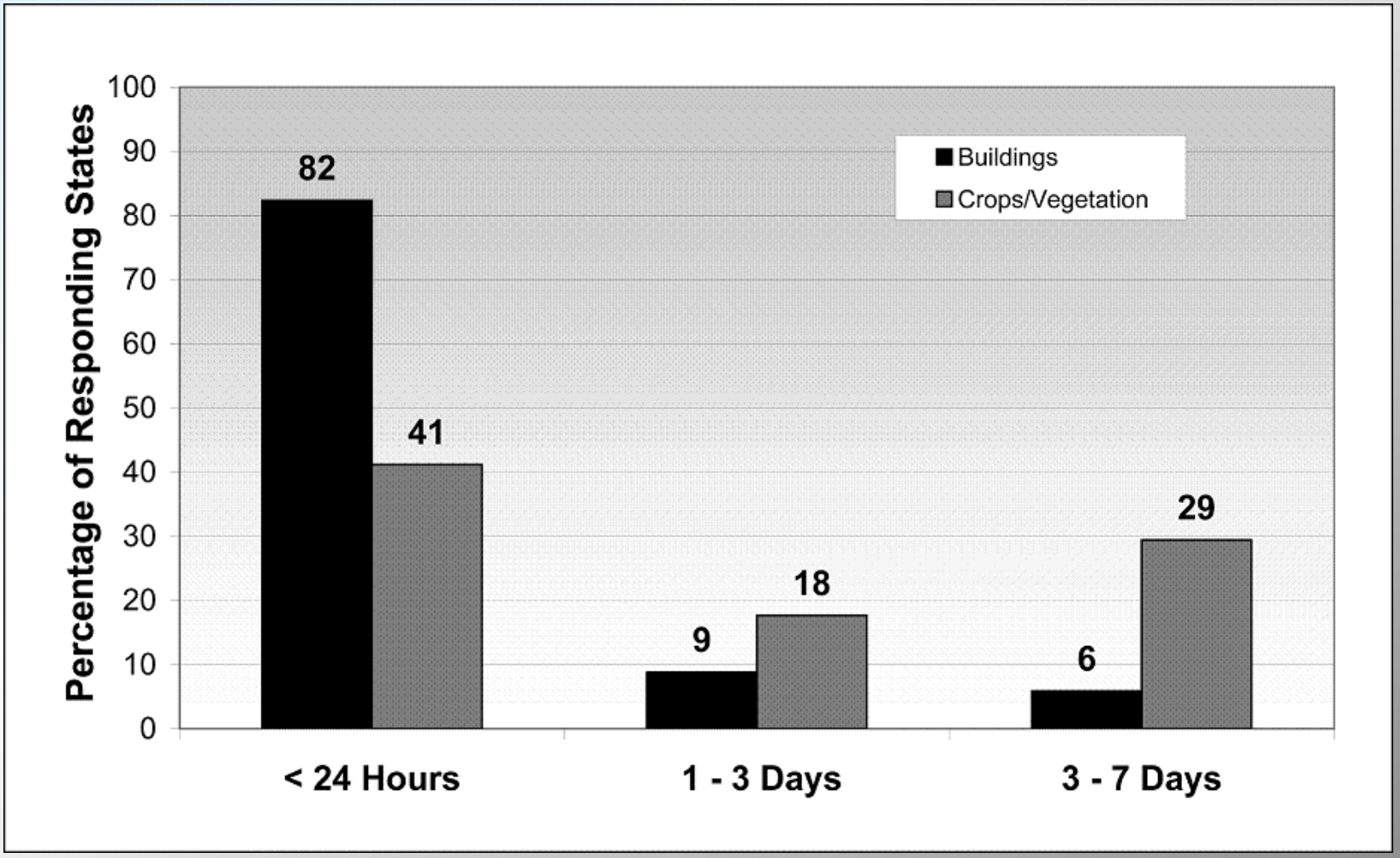
STATE SURVEY (2005): How soon after the disaster event do you need information on damaged buildings (or crops)?



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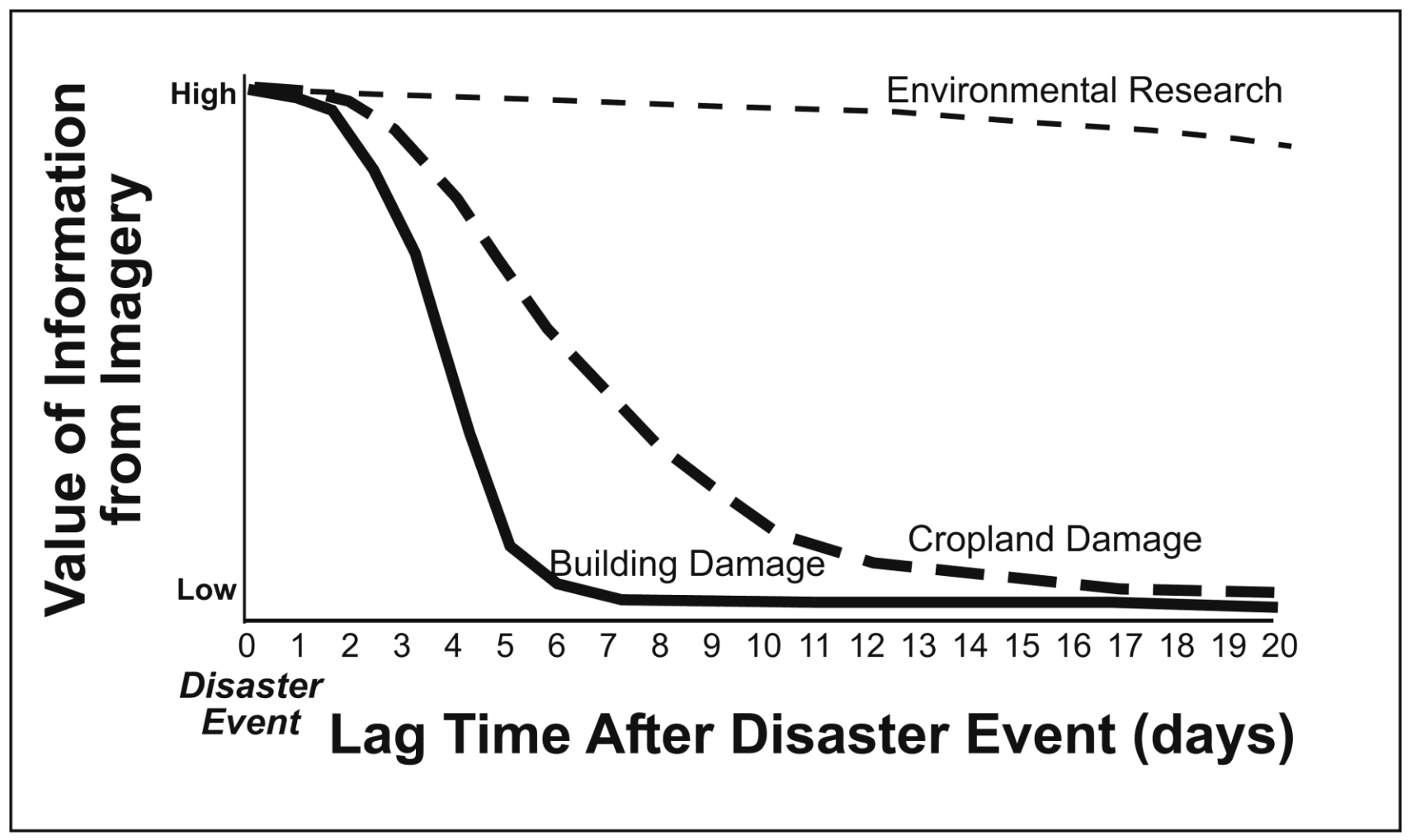
THEORETICAL: VALUE OF REMOTE SENSING DERIVED INFORMATION DURING DISASTER RESPONSE



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2011 SURVEY: METHODS

Dillman Tailored Design Survey Approach

Email Invite: Counties

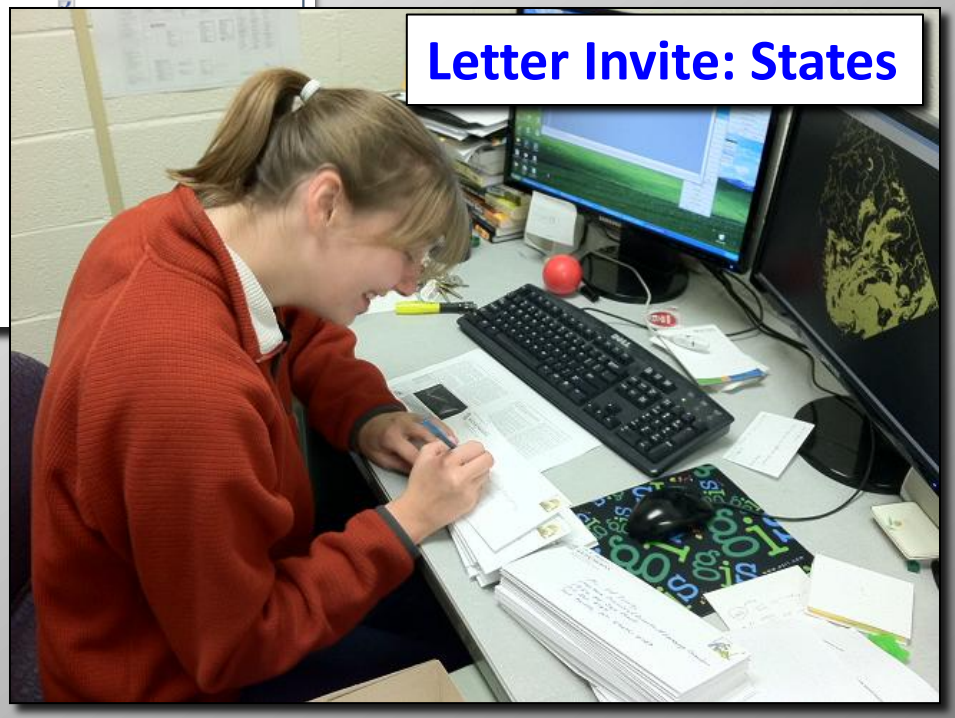
Geospatial Data

QUESTION 1:

Select the **THREE** types of **baseline data** (pre-event) that you feel have the ***highest priority*** and the **THREE** that you thin
the ***lowest priority*** to have high quality data for in the RESPONSE and/or RECOVERY phases following a disaster:

Baseline data	Highest priority	Lowest priority
Building footprints	☑	☐
Building/parcel characteristics	☑	☐
Communications networks	☐	☑
Energy and fuel supplies (e.g., electric, gas, etc.)	☑	☐
Critical infrastructure (e.g., hospitals, schools)	☐	☑
Hydrography	☐	
Land use or land cover	☐	
Population distribution	☐	
Sewer/water/utilities	☐	
Shelter locations	☐	
Elevation	☐	
Transportation networks	☐	
Aerial Imagery (vertical or oblique)	☐	

Contacts for 2485 Counties
Response Rate: 475 / 2485
19%



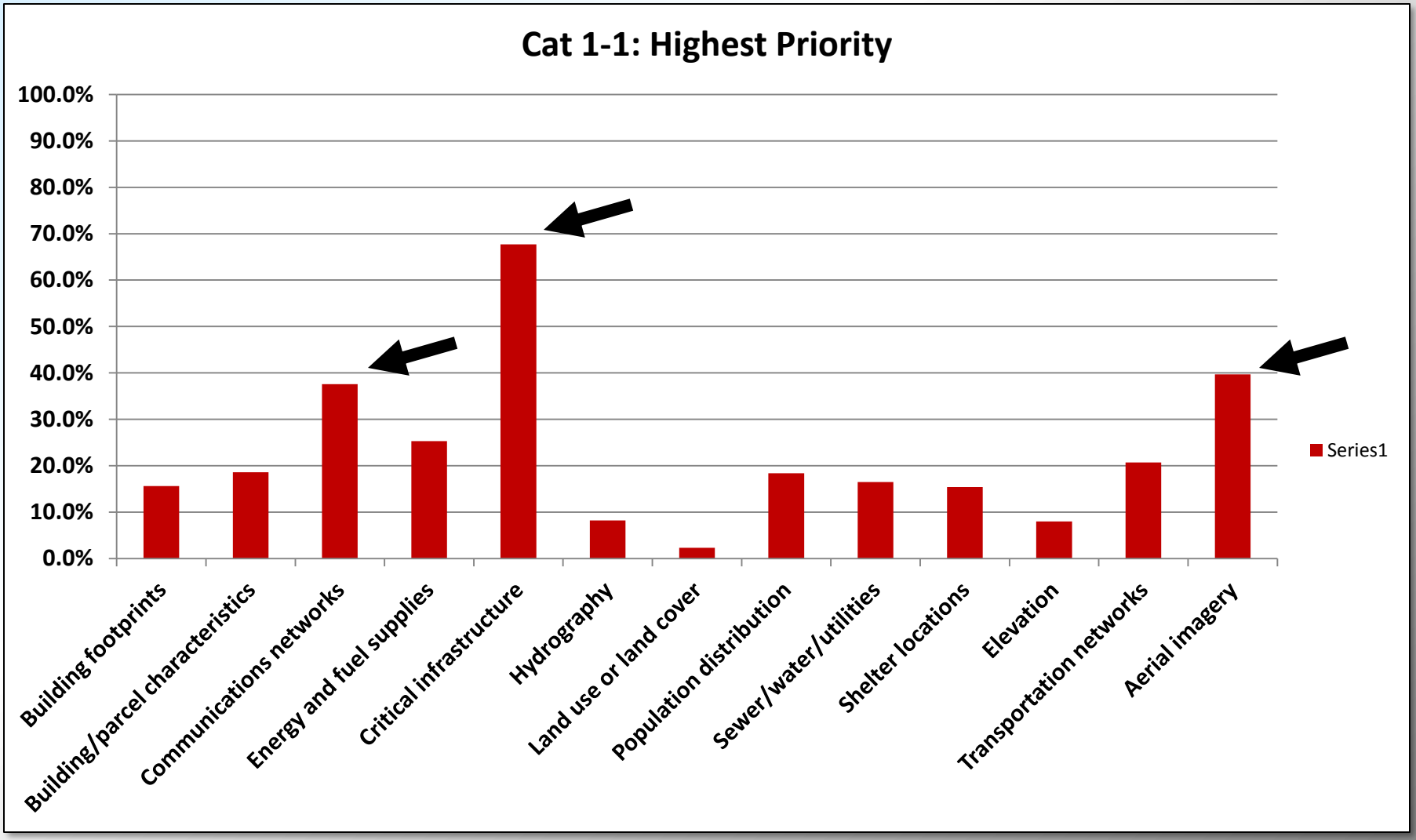
Letter Invite: States

Contacts for 50 States
Response Rate: 50 / 50
100%

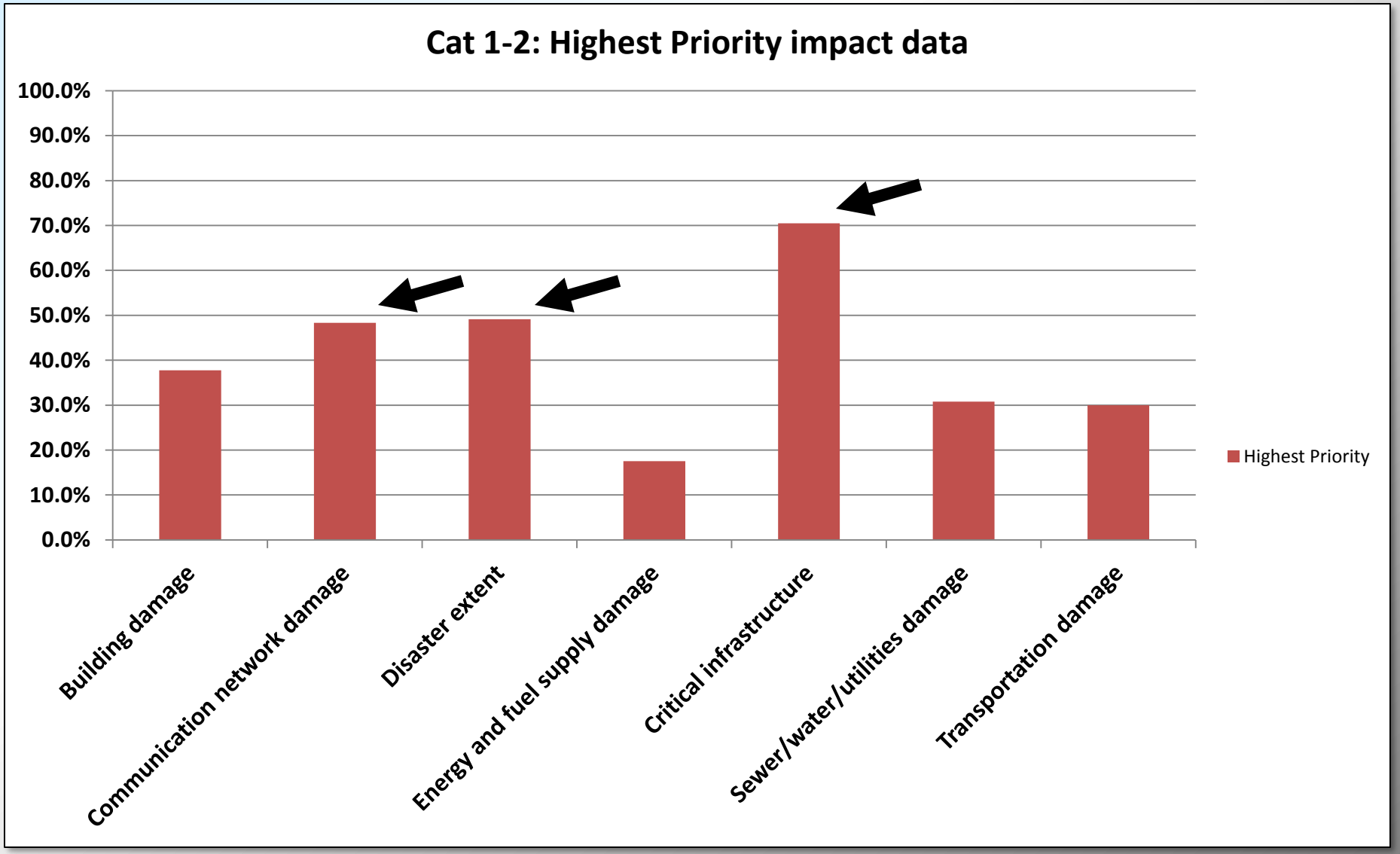
Summaries by FEMA Region

- **Concerns**: large enough responses to be meaningful and 'cloak' responding counties.
- **Decision**: If number of counties ≥ 15 report statistics for FEMA region.

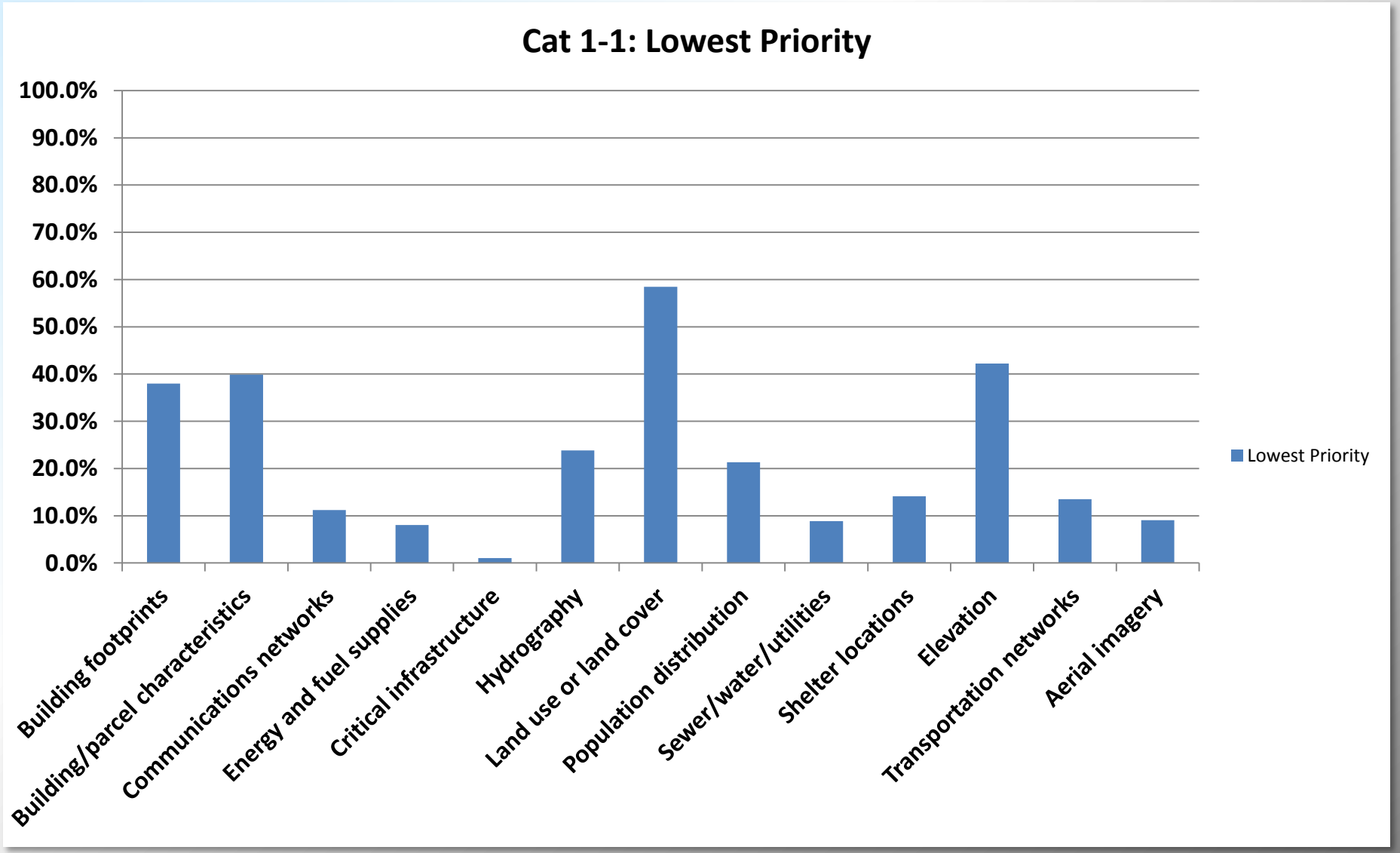
Select the three types of baseline data (pre-event) that you feel have the highest priority to have high quality data in the response and/or recovery phases following a disaster



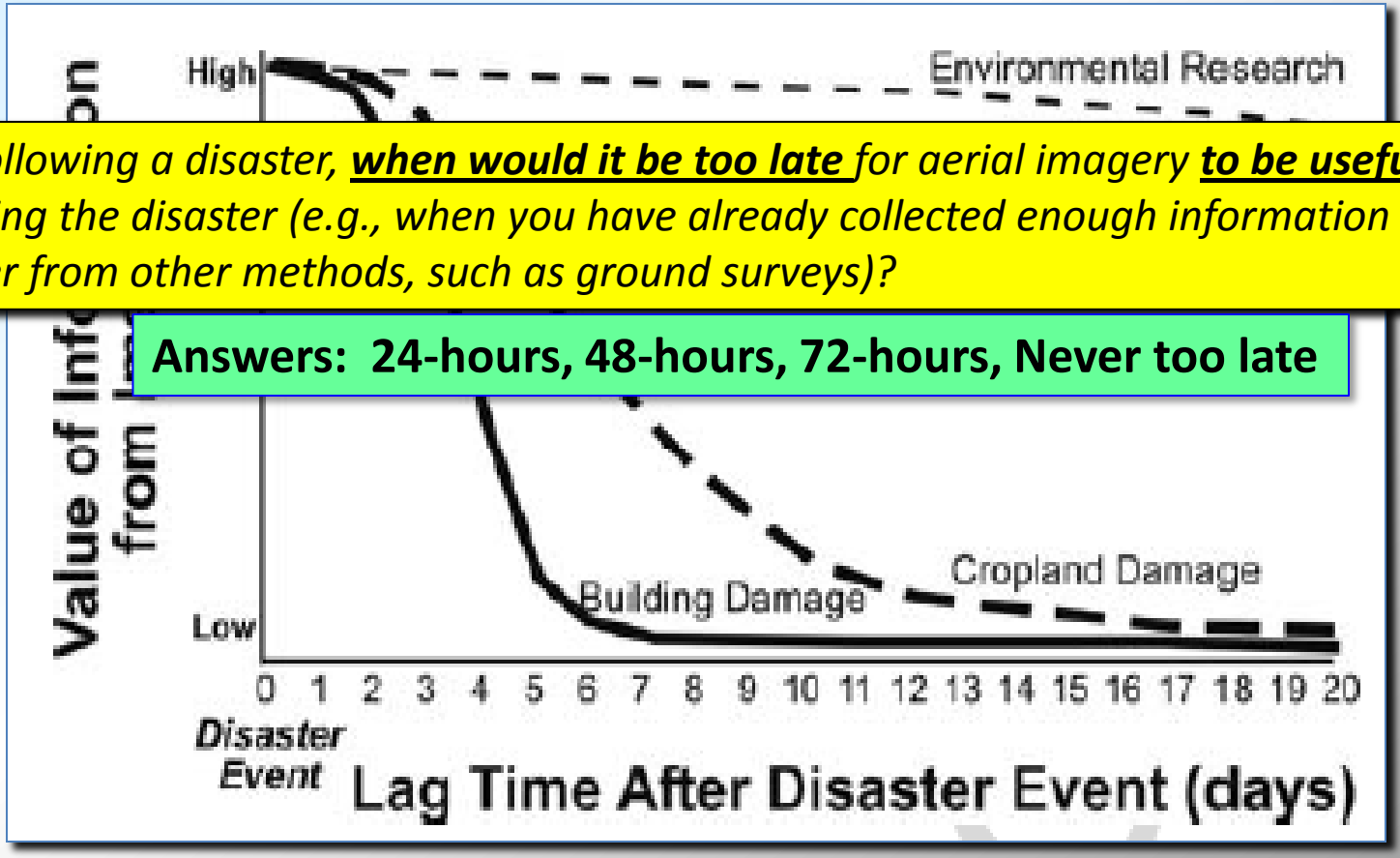
*Select the three types of **impact** data (post-event) that you feel have the **highest** priority and to have high quality data in the response and/or recovery phases following a disaster*



Select the three types of baseline data (pre-event) that you feel have the highest priority and the three that you think have the lowest priority to have high quality data in the response and/or recovery phases following a disaster



What is the relationship between **Image Value** and **Lag Time of Collection**?



Q 6. *Following a disaster,* ***when would it be too late*** *for aerial imagery* ***to be useful*** *in assessing the disaster (e.g., when you have already collected enough information about the disaster from other methods, such as ground surveys)?*

Answers: 24-hours, 48-hours, 72-hours, Never too late

Figure 3. Theoretical curve showing relative value of remotely sensed derived information received at a lag time after the disaster event. (after Hodgson, Davis, Kotelenska, 2010)

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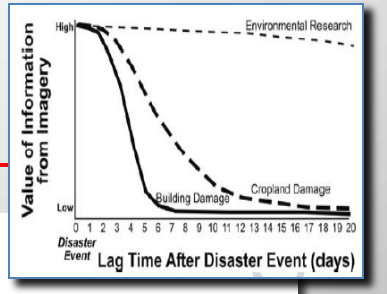
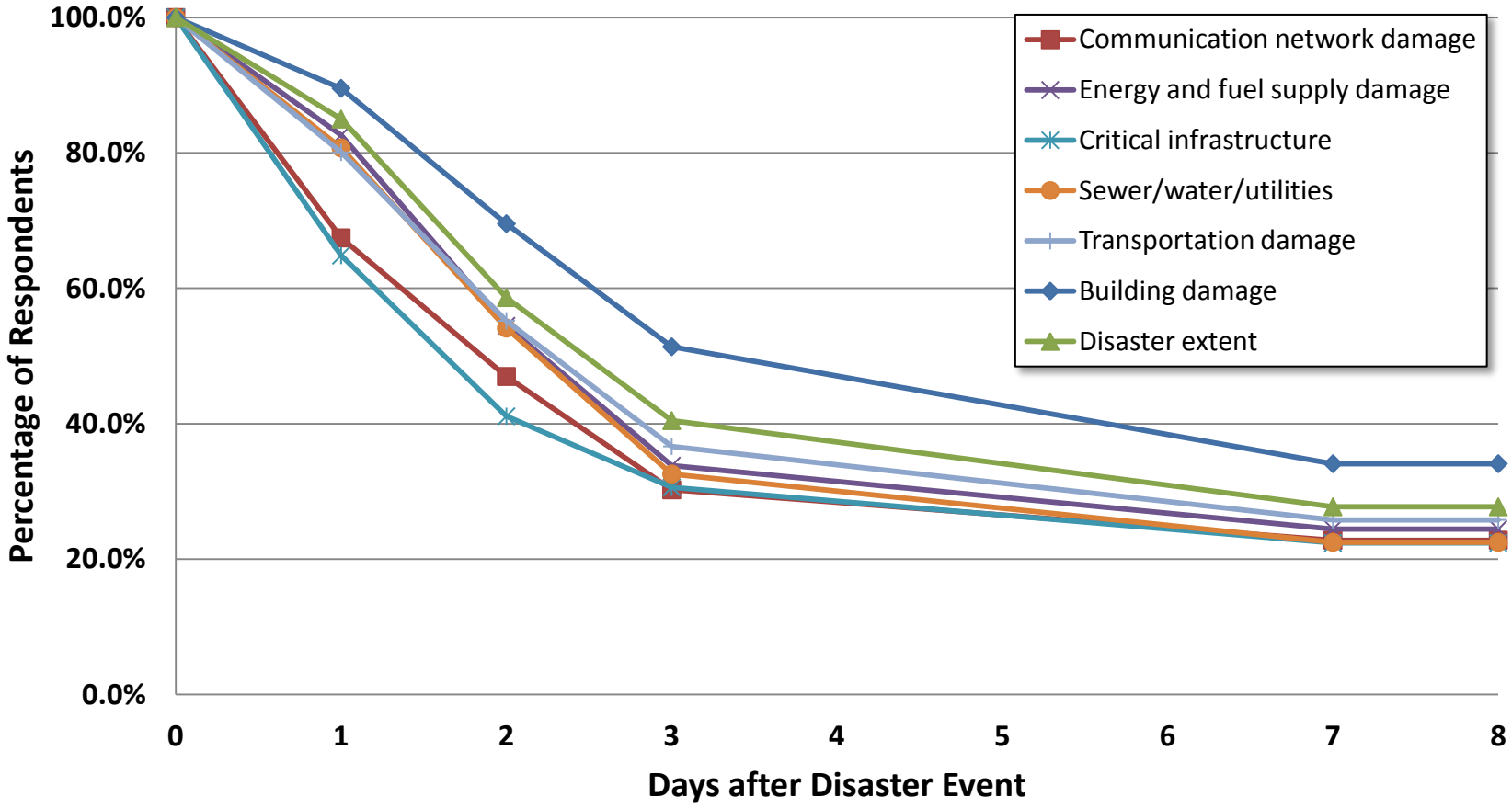


Percentage of Respondents Indicating Imagery is Not Too Late

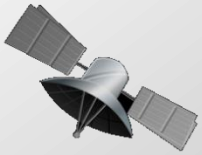


GEOSPATIAL SOURCES Post-Disaster

For each of the following types of impact data what is your county's primary source of data?

Table n. Sources of Geospatial Data after a Disaster





Data type	Ground Survey	Airborne flyover	Airborne or Satellite Imagery	Other
Building damage	91.4%	5.0%	2.1%	1.4%
Communication network damage	84.1%	2.8%	0.5%	12.5%
Disaster extent	59.5%	32.0%	6.3%	2.2%
Energy and fuel supply damage	82.1%	2.6%	0.3%	15.0%
Critical infrastructure	92.3%	2.2%	1.4%	4.1%
Sewer/water/utilities damage	89.7%	0.7%	1.2%	8.3%
Transportation damage	82.9%	10.3%	1.7%	5.1%

OTHER GEOSPATIAL SOURCES Post-Disaster

Are there other types of geospatial data that are critical for use immediately following a disaster?

Table n. Other Sources of Geospatial Data after a Disaster

Type of data critical for use	Number of mentions
Imagery	25
Assorted infrastructure	10
Damaged areas / extent	8
Flood info	7
Hazmat	5
Parcels / buildings	5
Utility	5
Debris extent	4
Special needs populations	4
Weather	4
Shelter locations	3

MISSION RESPONSIBILITY and EXPERIENCE

Does your county have a mission responsibility to acquire satellite or aerial imagery in the next major disaster (i.e., Federal declaration)?

Mission responsibility	County	State
Yes	10%	32%
No	64%	44%
Don't know	26%	24%

EXPECTATIONS FROM FEDERAL AGENCIES

In the next Federally Declared disaster, does your [county / agency] expect the Federal Government (e.g., DHS/FEMA, NASA, NOAA) to collect airborne or satellite imagery to assist in the response and recovery process?(check all that apply)

FEMA Region	…regardless of whether requested	…only if requested	…with no cost	…with shared cost	…no expectation	N
1 & 2	40.0	20.0	53.3	6.7	46.7	15
3	18.2	15.2	39.4	0.0	54.5	33
4	20.0	20.9	50.0	3.6	42.7	110
5	16.4	21.8	44.5	2.7	53.6	110
6	16.4	25.4	53.7	4.5	43.3	67
7	10.3	38.5	33.3	7.7	61.5	39
8	8.0	32.0	28.0	16.0	48.0	25
9	26.7	26.7	60.0	0.0	33.3	15
10	12.0	24.0	48.0	12.0	52.0	25
All Counties	**17.3**	**23.9**	**46.0**	**4.8**	**48.7**	**439**
All states	**30.0**	**46.0**	**54.0**	**22.0**	**22.0**	**50**

EXPERIENCE and IMAGERY USE

Table n. Percentage of Counties in Survey Experiencing a Major Disaster in Last 5 Years

Experienced major disaster	Percent
Yes	65%
No	32%
Do not know	3%

Table n. Percentage of Counties Using Imagery in Last Disaster

Use satellite / aerial imagery?	Percent
Yes	33%
No	64%
Do not know	3%

If yes, what type of imagery was used?

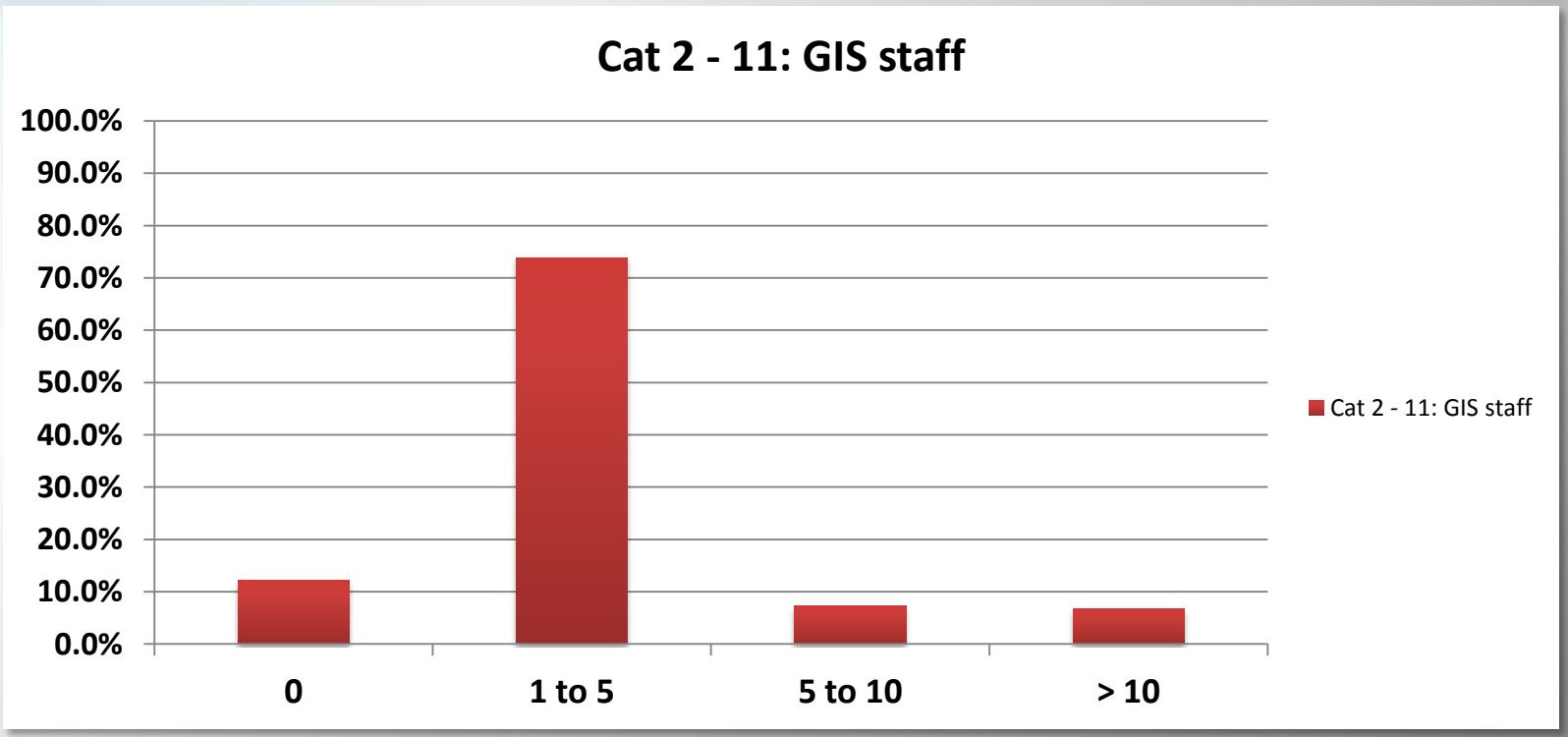
Type of imagery used	Percent
Airborne	92%
Satellite	18%

STAFFING?

QUESTION 11:

Approximately **how many** staff members does your county have that are responsible for working with **GIS** or **GIS-based tools**?

- 0
- 1-5
- 5-10
- >10



NASA IMAGERY?

QUESTION 11:

Are you aware that **NASA** provides imagery/geospatial information during and/or following a disaster (e.g., flood mapping and predictions, volcanic plume effluents, wildfire hot spots, tornado damage paths, etc.)?

- (●) Yes
- ( ) No
- ( ) Do not know

Aware that NASA provides info following a disaster?	County	State
Yes	26.0%	56.0%
No	67.1%	38.0%
Do not know	6.9%	6.0%

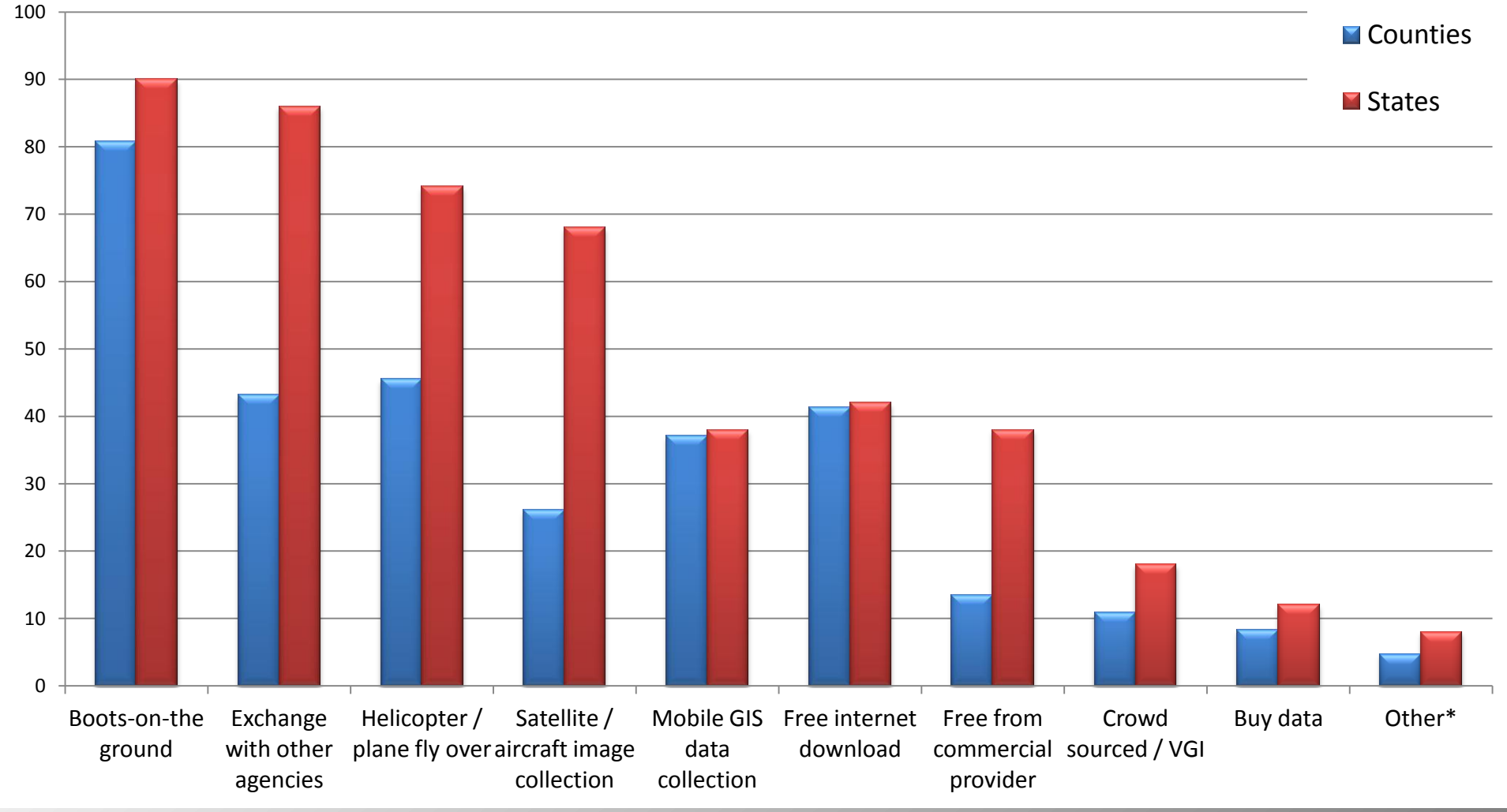
Survey part 3: Emerging technologies

- What are you *currently* using and how?
- What do you *want* to be using?
  - VGI / crowd sourced data
  - Social networking
  - Mobile data collection and transmission
  - Methods for distributing maps and data
  - Free and open source software and data

Data collection methods

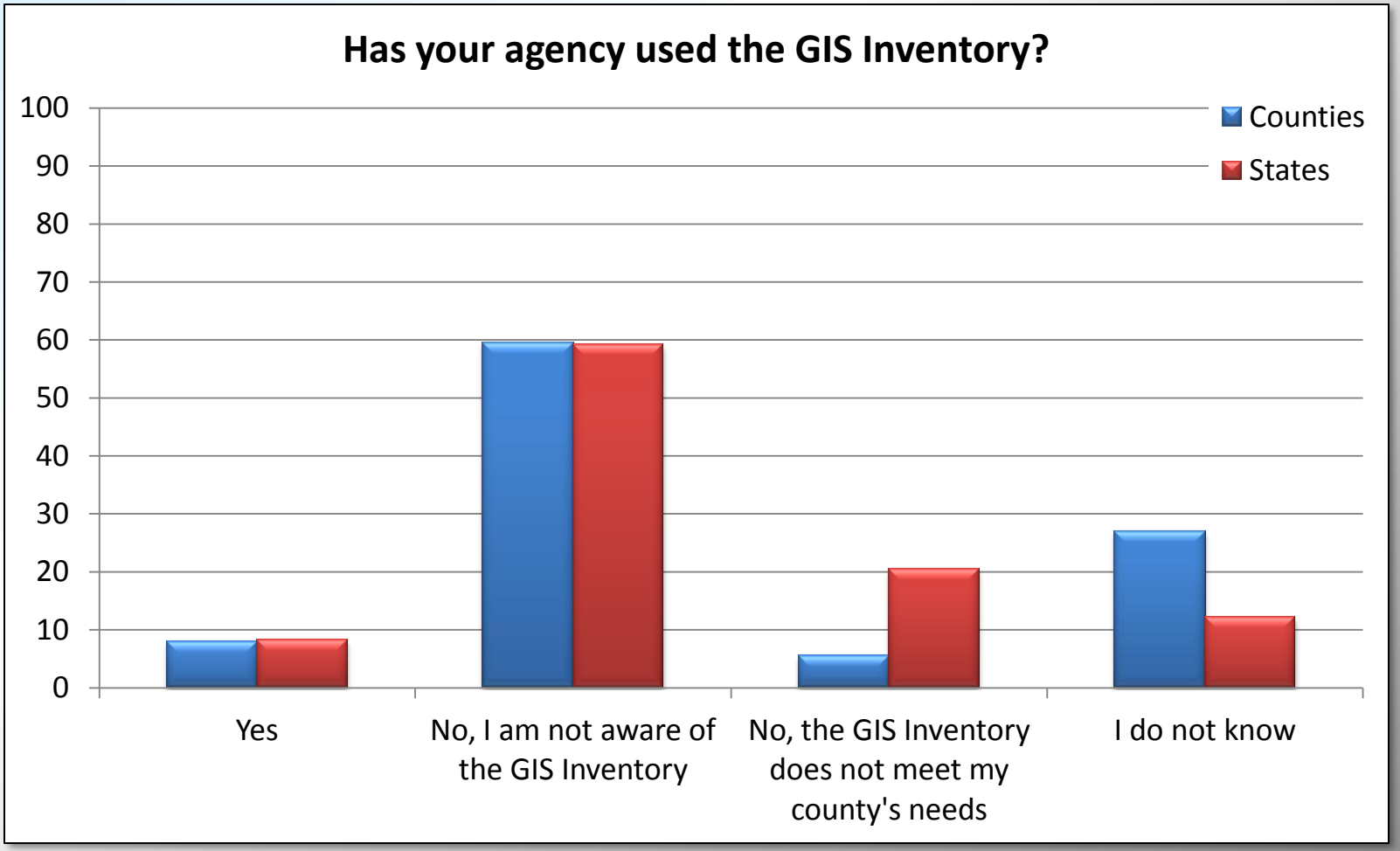
- Strong reliance on boots-on-the-ground
  - both states and counties
- Aerial / satellite imagery (68%) and “fly-overs” (74%) common for states
  - Possibly due to larger territory that needs to be covered
- Data exchanges with other agencies (84%) common for states

Data collection methods



GIS Inventory

GIS INVENTORY
The Ramona GIS Inventory is a service of the National States Geographic Information Council (NSGIC)



Has your [county / agency] used the Homeland Security Information Network (HSIN)?

FEMA Region	RESPONSE (percent) Yes	No, I am not aware of HSIN	No, HSIN is not relevant to my county/state	I do not know	N
1 & 2					14
3	52.0	20.0	4.0	24.0	25
4	41.6	31.7	5.9	20.8	101
5	33.3	38.4	7.1	21.2	99
6	29.4	48.5	7.4	14.7	68
7	37.1	31.4	8.6	22.9	35
8	21.7	30.4	17.4	30.4	23
9					13
10	33.3	23.8	14.3	28.6	21
Counties	**36.1**	**34.3**	**8.5**	**21.1**	**399**
States	**90.0**	**0.0**	**6.0**	**4.0**	**50**

VGI / Crowd Sourced data

- Limited use. Why?

Limitation / impediment	Counties Percent	States Percent
Challenge of setting up system	**46.1**	**52.0**
Cost of collection	24.3	6.0
Insufficient network resources	24.6	22.0
Mobile devices too costly	20.0	14.0
Quality of data	34.9	**66.0**
Volume of data is too large	10.9	24.0
Do not know enough	**63.3**	22.0

Section 4 - Confidential

- 9 questions on:
  - Imagery collection – timeliness and cost effectiveness
  - Recommendations for assistance
    - DHS/FEMA
    - NASA
    - other states/counties
    - Federal agencies in general
  - HSIP-Gold and HSIP-Freedom
    - Limitations
    - Most valuable layers
- Large amount of feedback provided!
- Comments provided here are unedited.

County Responses Summary

- Responses fairly consistent across counties
- Needs for
  - training and education
  - financial and personnel assistance
  - data and standardization
- Experiences
  - Some good, though mostly the not-so-good experiences shared

County Responses Example

- **Education** – a large number of counties indicated not being aware of many of the programs asked about in the survey

> *Let us know what you can provide; so that we know to ask for it. I have no clue what DHS/FEMA are able to provide to us. And let us know the conditions under which we can request it. Would have been nice to know after our tornadoes.*

County experiences Examples

- Some good

Work together just not on disasters that way there is a better working relationship. We just had a large wildfire and all the local; state and federal agencies worked seamlessly together since we all have established working connection.

- Some not

*During Both Hurricane *** and *** known Aerial assests were available and access denied from NOAA; NASA and DOD.*

Getting a MA for flood images was a pain in the ass…getting the feds to act in a timely matter was a joke unless they felt it benefited them.

States Responses Summary

- Large number of thoughtful, detailed responses
- Positive and negative experiences
- Detailed summary in report, subset of responses in this presentation

States – Remotely Sensed Imagery

- Need imagery, want more of it, but there are challenges

- Want it within 72 hours at the latest, but preferably within 24 for maximum usefulness

The imagery / remote sensing is MOST valuable in identifying the hazard footprint. … ***If the remote sensing products aren't back to us within the first 24 hours; generally we already have a hazard footprint from other sources that makes the disaster imagery irrelevant…***

States – Remotely Sensed Imagery

- Experiences on requesting and receiving imagery have been mixed
  - Some imagery has been timely, some not
  - Some requests successful, some not

The data for the event in question took a week to process (after acquisition)and by that time three ground damage assessment surveys that had been completed. *Though it was good to know the quality/go through the process.*

The NOAA-NGS has always been able to provide imagery in a timely manner….The collection of imagery through federal to federal agreements between DHS-FEMA and USGS ***has not been in a timely fashion.***

States – HSIP Issue

- It's (sort of) good, but need access to Gold pre-incident

> *State agencies do not have access to HSIP-Gold unless we get it through the JFO. By that time; it is largely irrelevant to the response and recovery effort. According to my mitigation officer (which was the avenue to request HSIP Gold access); it was cumbersome and difficult to use.*

- Numerous mentions of issues with
  - Lack of current data
  - Accuracy

THE END

STATES:

In response to the most important contribution that Federal Agencies can make... (Cat 4 - Q3):

"More support for **USGS HDDS**; which is doing a wonderful job. More support for **DHS Virtual USA**; which is also doing a wonderful job."

In response to specific recommendations for how DHS/FEMA could better help... (Cat 4 - Q6)

"We have amazingly **great contacts with our FEMA region** (***). We are in contact with them during events and they offer great communication and service."

COUNTIES:

"We just had a large wildfire and all the local; state and federal agencies **worked seamlessly** together since we all have established working connection."

"For Coastal counties; if would be helpful to have the **US Coast Guard** immediately fly the area and produce aerial maps. When deployed to *** for Hurricane ***; they were an invaluable resource for the impacted counties."