U.S. Telecommunications Training Institute

Georeferencing in Catastrophic Incidents

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1. Overview:
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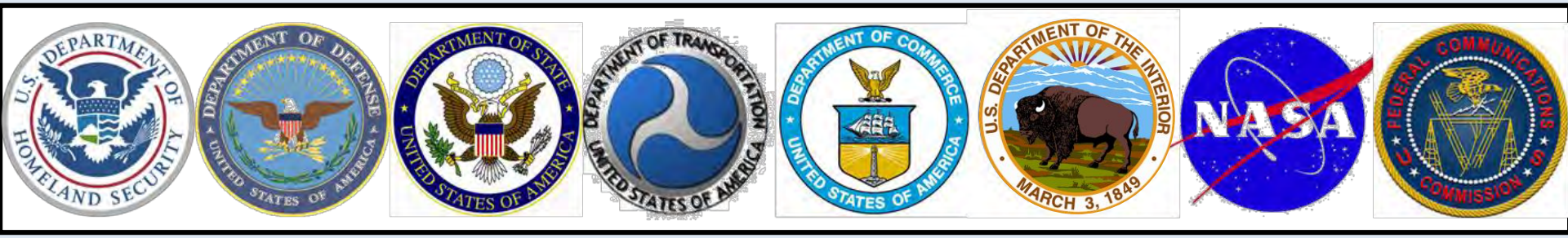
    b. Catastrophic Incident Search and Rescue
2. Georeferencing challenge during a disaster response
3. Georeferencing systems
4. Georeferencing requirements
5. Catastrophic Incident SAR Georeferencing Matrix
6. Summary

1. Overview

U.S. National SAR Committee (NSARC)

DHS DOD DOS DOT DOC DOI NASA FCC



- Civil Air Patrol, National Transportation Safety Board, SAR volunteer organizations, and State SAR Coordinators also participate

National SAR Committee

U.S. national, interagency committee focused on matters relating to:

- SAR policy, processes, organization
- Other areas of interest to promote SAR cooperation

Catastrophic Incident

"…any natural or manmade incident, including terrorism, that results in extraordinary levels of mass causalities, damage, or disruption severely affecting the population, infrastructure, environment, economy, national morale, and/or government functions.

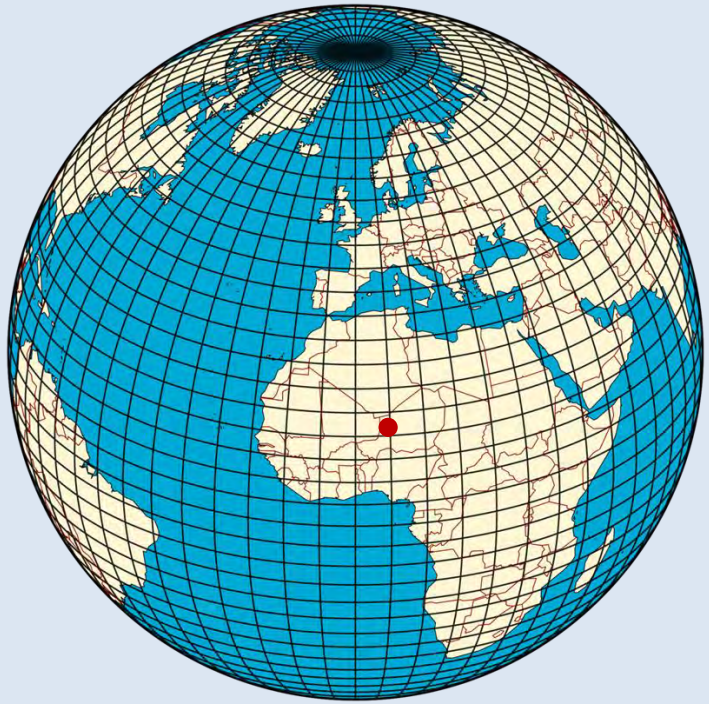
(National Response Framework)

- Guidance for Federal SAR responders in a disaster response
- Discusses georeferencing during a disaster response

www.uscg.mil/nsarc

Georeferencing

- To georeference a position is to identify that position with a coordinate referenced to the figure of the earth
  - Disaster responders have several sources of georeferencing information



2. Georeferencing challenges during a disaster response

Georeferencing challenges during a disaster response

a. How do SAR responders, planners and support personnel navigate when landmarks, such as street signs, are destroyed?

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- SAR responders may not have local/on scene knowledge
- Can cause delays in getting critical lifesaving resources on scene

2. Georeferencing challenges during a disaster response

b. How do SAR responders, planners and support personnel communicate position information in a common language/format?

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- What coordinate system should be used?
- What format should the information be relayed?

2. Georeferencing challenges during a disaster response

c. SAR resource deconfliction: Multiple SAR responders/ resources working in a common operating area

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- Accurate position information is critical to ensure limited SAR resources are effectively managed in a disaster

3. Georeferencing Systems

a. Local knowledge

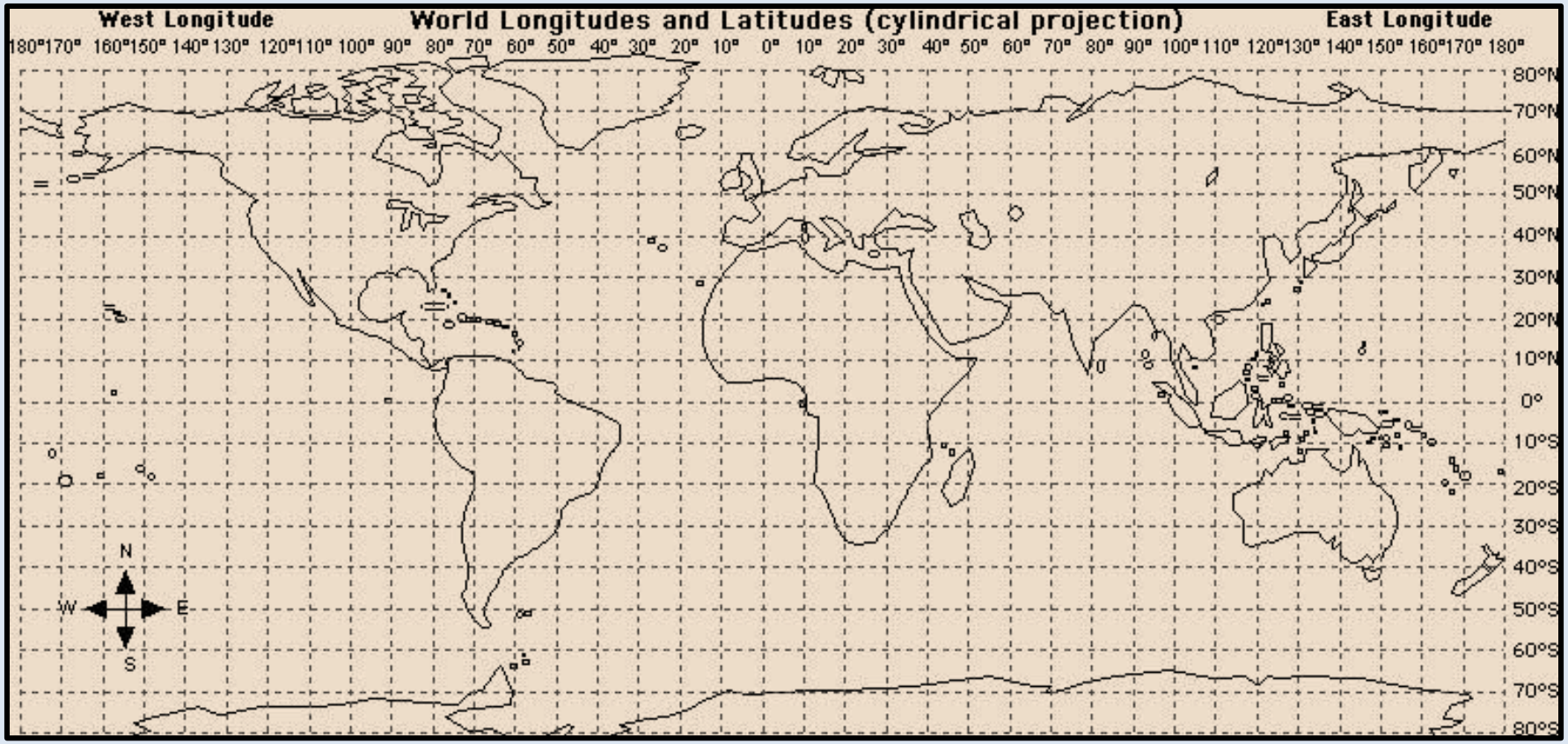
- It's great if you have it!
- If you don't, you can easily get lost in a disaster response…
  - SAR resources can be delayed in arriving on scene

3. Georeferencing Systems (Local knowledge)

- Street signs have critical design flaws that can surface during a disaster:
  - May not be visible to the SAR responder (not readily posted), limited visibility (e.g., darkness), driver, etc.
  - Inaccurate
  - Removed by the disaster itself

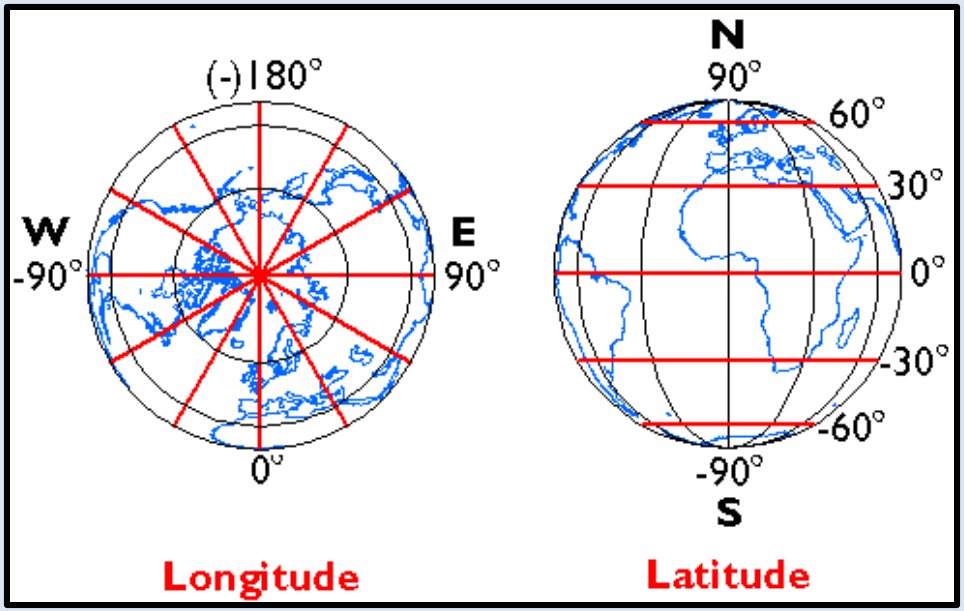
3. Georeferencing Systems

b. Latitude & Longitude



3. Georeferencing Systems (Latitude & Longitude)

- Angular measurements are used to describe a position on the surface of the earth
- Primary users: mariners and aviators



- Worldwide
- Many different types of maps/charts have lat/long markings
- Most GPS receivers are set to use lat/long as the default factory setting

3. Georeferencing Systems (Latitude & Longitude)

- Lat & Long can be communicated three different ways:
  - DD-MM-SS.s
    (43°-38’-33.2”N 79°-23’-13.7”W)
  - DD-MM.mm
    (43°-38.55’N 79°-23.23’W)
  - DD.dddd
    (43.6464°N 79.3939°W)

3. Georeferencing Systems (Latitude & Longitude)

- **DD-MM-SS.s**
  (43°-38'-33.2"N 79°-23'-13.7"W)
  - Most common format used to mark maps
  - Most cumbersome to work with…

3. Georeferencing Systems (Latitude & Longitude)

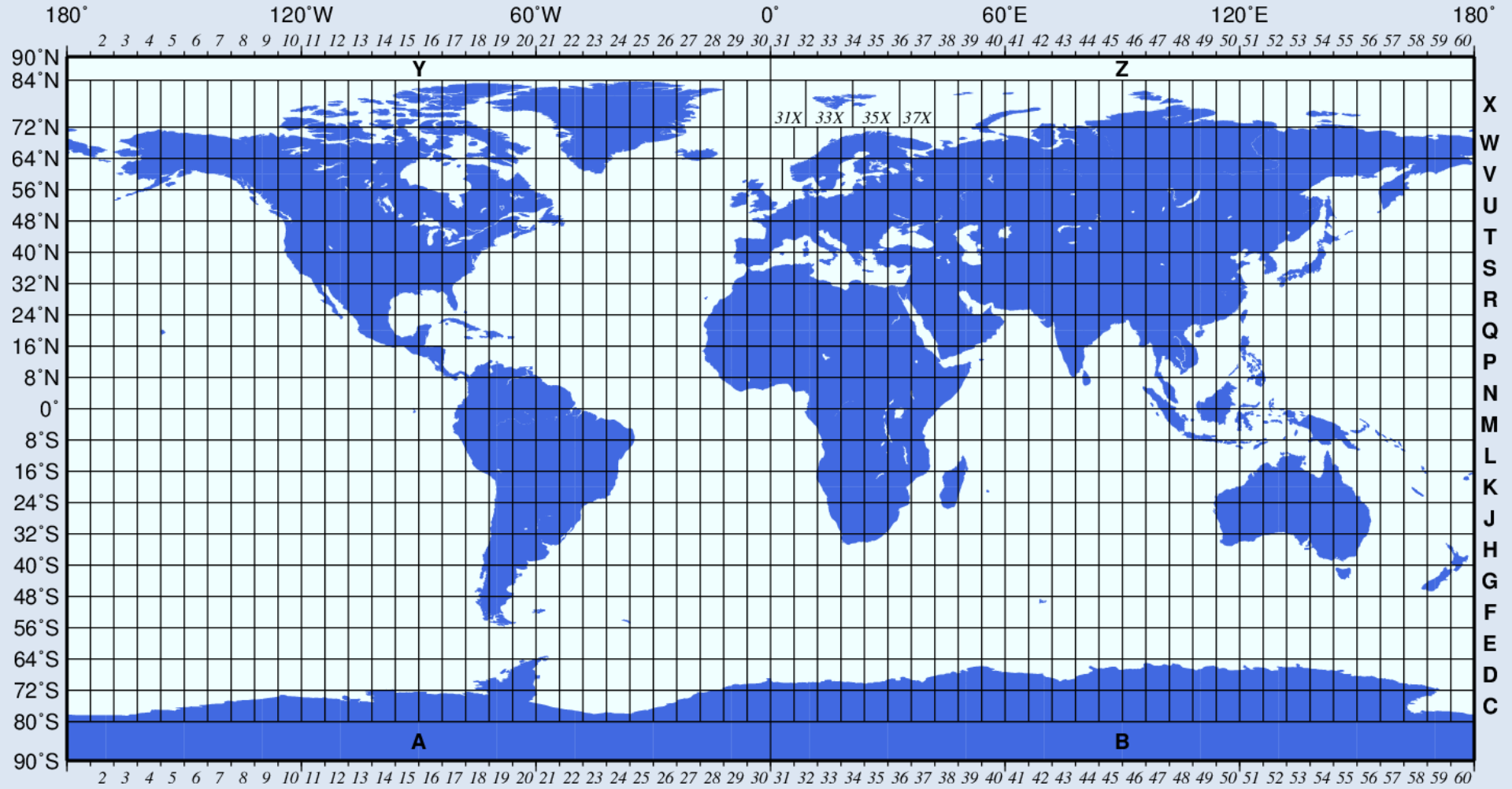
- **DD-MM.mm**
  (43°-38.55'N 79°-23.23'W)
  - Most common format used when working with electronic navigation equipment
  - Used for manual plotting

3. Georeferencing Systems (Latitude & Longitude)

- **DD.dddd**
  (43.6464°N 79.3939°W)
  - Displayed by most computer based mapping systems
  - Often N-S & E-W designators are omitted
    - "+" used north of equator; "-" to the south
    - Most programs use "-" for west long; however, some are opposite
  - Difficult to plot in the field…

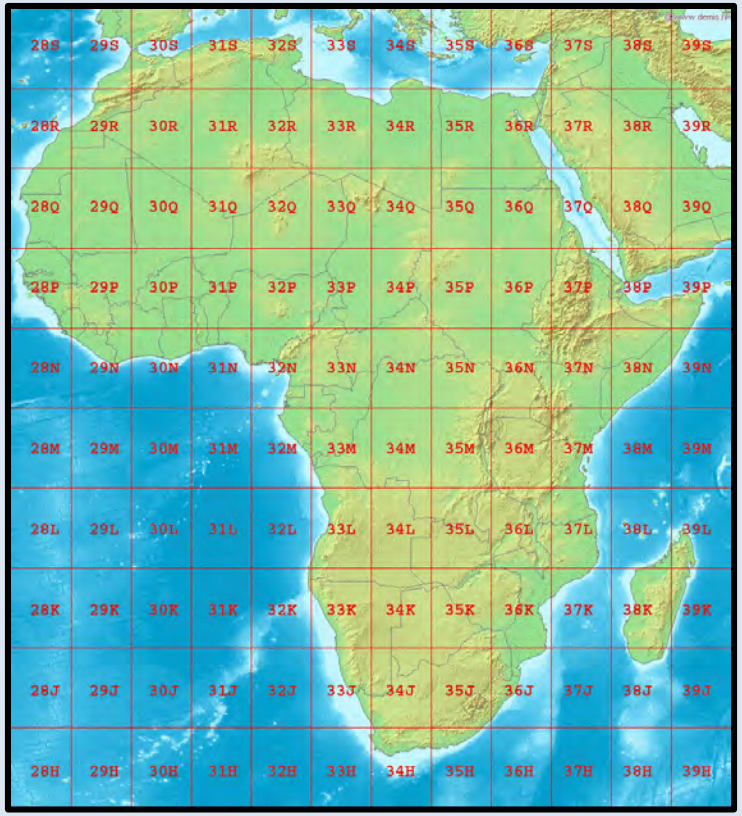
3. Georeferencing Systems

c. UTM (Universal Transverse Mercator) Grid



3. Georeferencing Systems (UTM) Grid

- Divides the Earth into sixty zones, each being a six-degree band of longitude; each zone is divided into horizontal bands of 8 degrees of latitude



- Locations are reported in meters as “eastings” and “northings” instead of latitude and longitude

3. Georeferencing Systems (UTM) Grid

- Advantages of UTM:
  - Square grids
  - East-West units of measure are the same as North-South units
  - Decimal based; no minutes or seconds
  - Coordinates translate directly to distances on the ground
  - Coordinate precision is easily understood (No need to wonder what distance a tenth of a second of longitude represents)
  - Easy to abbreviate coordinates when working in a small area

3. Georeferencing Systems (UTM) Grid

Example:

10 S 0559741

4282182

- "10 S" – represents the zone you are in
  - Zone is required to make the coordinates unique over the entire globe

3. Georeferencing Systems (UTM) Grid

Example:

10 S 0559741

4282182

- "0559741" – represents a measurement of East-West position, within the zone, in meters ("easting").

3. Georeferencing Systems (UTM) Grid

Example:

10 S 0559741

4282182

- "4282182" – represents a measurement of North-South position, within the zone, in meters ("northing")

3. Georeferencing Systems (UTM) Grid

- UTM is currently used by NATO armed forces
- With advent of inexpensive GPS receivers, many are adopting UTM because it's simpler to use than lat/long

4. Georeferencing Requirements

Which georeferencing system should be used in a disaster response?

"It is important to understand that the same geo-referencing problems identified during Hurricane Katrina can also adversely impact any type of emergency response operation—whether small or large, frequent or infrequent. How should positional information be communicated? What's the "right" reference system that should be used? Is there only one reference system that satisfies the requirements of all Emergency Responders? How/when is positional information in one reference system converted to another? How is positional information received in non-standard formats converted to a standard reference system?"

National SAR Committee paper provided to the U.S. National Transportation and Safety Board (March, 2009)

4. Georeferencing requirements

- Use standardized georeferencing information
- Use what is already available (Lat/Long, UTM) – and standard
- Must be able to easily interface between the Incident Command and SAR responders

4. Georeferencing requirements

- No single map/chart projection or coordinate/ grid system will be perfect for all applications
- There should be an existing, historic precedent for the use of a georeferencing system (Go with what you know!)
  - Disaster responders should be familiar with and understand the georeferencing system
- Using an already standard georeferencing system will reduce costs for funding, training, and implementation

4. Georeferencing requirements

- A georeferencing system should be easy to use
  - Especially where time is critical in saving lives and circumstances can be hazardous to the responder

4. Georeferencing requirements

- **Lat/Long**
  - May not be easy to plot in small areas, but it is a universal coordinate system;
  - Easy to use for any disaster responder with portable GPS receivers and aircraft avionics

4. Georeferencing requirements

- Suggested standard lat & long format:
  - Degrees, Minutes, Decimal Minutes (DD° MM.mm’)
  - Latitude is always read and written first with “North” or “South;” Longitude with “East” or “West”

4. Georeferencing requirements

- Speaking lat/long must also be standardized:

  - Example: 39° 36.06'N 76° 51.42'W would be stated as:

    "Three nine degrees, three six decimal zero six minutes North by seven six degrees, five one decimal four two minutes West"

  - The words, "degrees," "minutes," and "decimal" must be spoken

4. Georeferencing requirements

- **What about UTM?**
  - Excellent system for land SAR responders
  - Easy to use and precise (based on the metric system) for responders unfamiliar with a disaster area or if street signs have been destroyed

5. Catastrophic Incident SAR Georeferencing Matrix

Located in the CISAR Addendum (www.ucg.mil/nsarc)

5. Catastrophic Incident SAR Georeferencing Matrix

- No single coordinate system will work for all land, air, maritime SAR responders and the incident command
  - Each SAR discipline has unique georeferencing requirements
- What is important is an effective interface between each SAR component to ensure an effective disaster response

5. Catastrophic Incident SAR Georeferencing Matrix

- U.S. National SAR Committee created a SAR georeferencing matrix to:

  - Minimize confusion
  - Provide guidance on what georeferencing system each disaster responder should be using

- Matrix can be adopted for any emergency response operation

5. Catastrophic Incident SAR Georeferencing Matrix

Georeference System User	UTM (USNG)	Lat/Long DD-MM.m (1)
Land SAR Responder (2)	Primary	Secondary
Air SAR Responders (3)	Secondary	Primary
Air Space Deconfliction (4)	N/A	Primary
Land SAR Responder/Air (or Maritime) SAR Responder Interface (5)	Primary	Secondary
Incident Command: Air/Maritime SAR Coordination Land SAR Coordination	 Secondary Primary	 Primary Secondary

Footnotes

1. During CISAR operations, Lat & Long will be in one standard format: DD°-MM.m'

2. Land SAR responders use UTM; however, a good familiarity with lat & long is necessary to ensure effective interface between Land & Air SAR responders

5. SAR Georeferencing Matrix (Footnotes)

3. Air SAR responders will use lat/long

4. Air space deconfliction: only in Lat/Long

5. Air SAR responders working with Land SAR responders have primary responsibility of coordinating SAR using UTM (both need to know UTM and Lat/Long)

6. Summary

- Standardizing use of georeferencing systems for any emergency response is critical

- Need to use a georeferencing system that is best/available/ effective for your particular country/ region

6. Summary

- For more information:
  - U.S. National SAR Committee Website, "Catastrophic Incident SAR" Section and "Georeference Information for SAR Responders"

  - CISAR Addendum: www.uscg.mil/hq/cg5/cg534/nsarc/CISAR%20Addendum%20-%20Version%203-0%20(062112)%20Final.pdf

www.uscg.mil/nsarc

Questions?