Global Positioning Systems Evidence: Its Impact and Implications for Digital Curation

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Finding Residual Data

What are the difficulties?

What are the risks?

What are the legal implications

What are the technological options and limitations?

The Impact of Residual Data on Society

How do individuals interact with technology?

How does residual data impact the digital footprint?

What if residual data becomes evidence?

What controls available to protect organizations?

How are critical Infrastructures affected ?

What is next?

Investigating the Impact of Global Positioning System Evidence

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Building Research Partnerships
UNIVERSITY OF SOUTH ALABAMA
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Motivation

- ABIreserach predicts that personal tracking applications and devices will grow with a compounded average growth rate of 40%, enabling both markets to hit the $1 billion sales mark in 2017

- GPS technology is being embedded into everything from smartphones, to watches, to walking sticks, to shoes, to dog collars

- In the United Kingdom, police mistakenly forced their way through the wrong door based on iPhone's GPS software directions. In Ohio, a bank repossessed the wrong house and the contents based on incorrect GPS data.

tampa.onebusaway.org

OneBusAway

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Where is your bus?

Let's find out. We provide easy access to real-time transit information for the Tampa Bay region and beyond.

Our Goal

We want to make it easier to use public transit by providing easy access to schedule and real-time arrival information for the buses you ride every day.

We provide:

- Real-time arrival information for Hillsborough Area Regional Transit (HART).
- Arrival info for every bus stop.
- Easy access to information across a variety of devices.

Why? We're riders just like you and we don't like waiting for the bus any more than we have to.

Tools

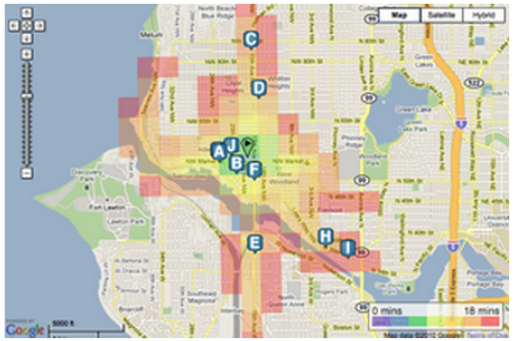
Our tools are available across a number of interfaces:

Web | Windows8 | Mobile

iPhone | Android | WP

SMS

Research



OneBusAway was started by students at the University of Washington, and it has been deployed in Tampa by the University of South Florida in collaboration with Georgia Tech. Check out our research page for more information.

Our work is all open-source software, so that others may reuse and build upon our efforts. As a result, OneBusAway software has been deployed to many other communities as well.

Foursquare Labs, Inc. [US] https://foursquare.com

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Newport Beach

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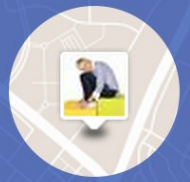
Here are some popular tips in Newport Beach. Select a taste to see more:



"Nothing makes a great day better than a Sprinkles Vegan Red Velvet cupcake. It's also great if you're having a bad day. What I'm saying is: you should have one today."

Ellen DeGeneres @ Sprinkles Cupcakes

Brunch foods | Vegetarian food | Sirloin steak | Tacos | Italian food | Cocktails | Whiskey | Performing arts

Hypothesized

The use of GPS evidence, in court proceedings, has increased during the past two decades and has, increasingly, played a critical role in court rulings.

1. Is it possible to investigate the extent to which the information about GPS evidence is explained in the court cases and determine if the criticality of the data can be quantified?

2. Can correlations between the type of crime and the transportation mode of GPS evidence be identified?

3. Are trends identifiable in the GPS evidence presented in court cases during the past two decades?

Scope

- Westlaw, Lexis Nexis, and the British and Irish Legal Information Institute (BAILII)
- Focuses on Global Positioning Systems that have been of evidentiary value in court cases
- Legal jurisdictions were limited to the United Kingdom (England, Scotland, Northern Ireland and Wales) and Europe
- If a case had multiple GPS devices, the overall impact of the devices was considered for this study, not each individual device.
- The data collection for 1993 and 2013 are not complete calendar years.

Methodology

1. Login to the online legal libraries, Lexis and Westlaw, using the University subscription.
2. Once logged in, the 'Case' section of the library was selected.
3. In the 'Case' section, all cases within the dates 01 June 1993 and 01 June 2013 were searched individually using the terms. The terms were derived from journal articles in addition to internet searches to find related systems and the identification of major brand names like Garmin, TomTom and Megallan. The database searches started with LexisNexis, then BAILII, and then Westlaw. Twenty-one searches were conducted in each database.
4. Cases from UK or Europe were individually opened and examined to determine case relevance
5. If the case involved GPS based evidence, the case was recorded in the database Case table.
6. If the case involved GPS devices, which were not presented as evidence, it was recorded in the IrrelevantCases table. This includes instances where GPS devices were stolen or mentioned in a case regarding patents or taxes. If a GPS device had no evidentiary value, or was not seized, the GPS device memory was not interrogated nor considered to have contained incriminating evidence; it was allocated to this category.
7. If the case was previously recorded or it had no Global Positioning System involved in it at all, then the case was dismissed.
8. Cases were classified as high, medium or low
9. If the case was relevant, a classification was assigned based upon the indicated admissibility of the evidence. Evidence was regarded as Admitted in cases where it was clearly stated as accepted/ admitted or if the case clearly states that the GPS evidence affected the outcome of the case. Evidence was regarded as Dismissed, if it was clearly rejected or not accepted. However, in cases where there was insufficient information or clarity regarding the admission it was recorded as Not Available.
10. The database and all of the relevant material were backed-up to an online drive.

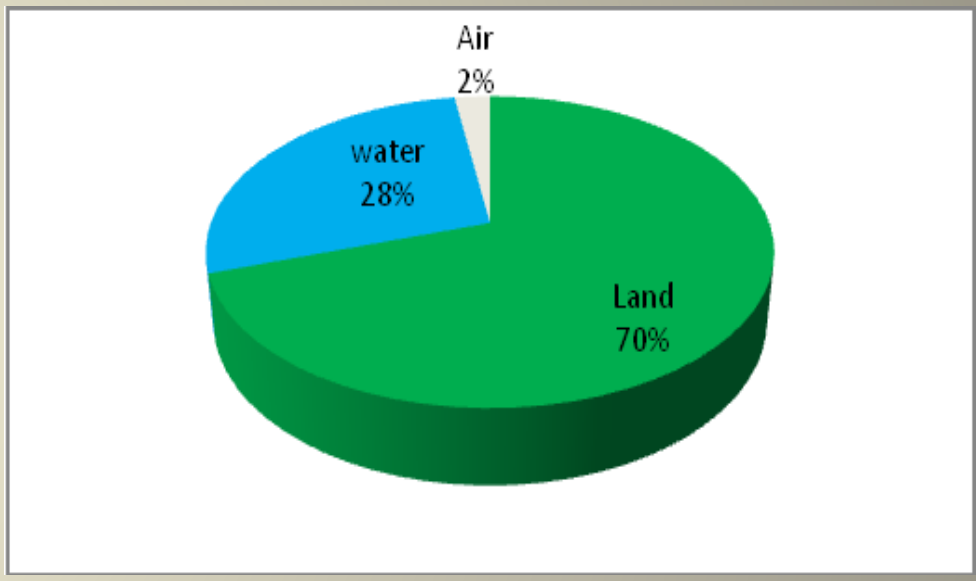
GPS
GNSS
NAVSTAR
GLONASS
Galileo
Tomtom
Garmin
Magellan
Satnav
"global positioning system"
"global navigation satellite system"
"global navigation"
"global positioning satellite"
"satellite navigator"
"satellite tracking device"
"satellite navigation"
"navigational system"
"radio navigation system"
"sat nav"
"in-dash navigation "
"tracking chip"

Results

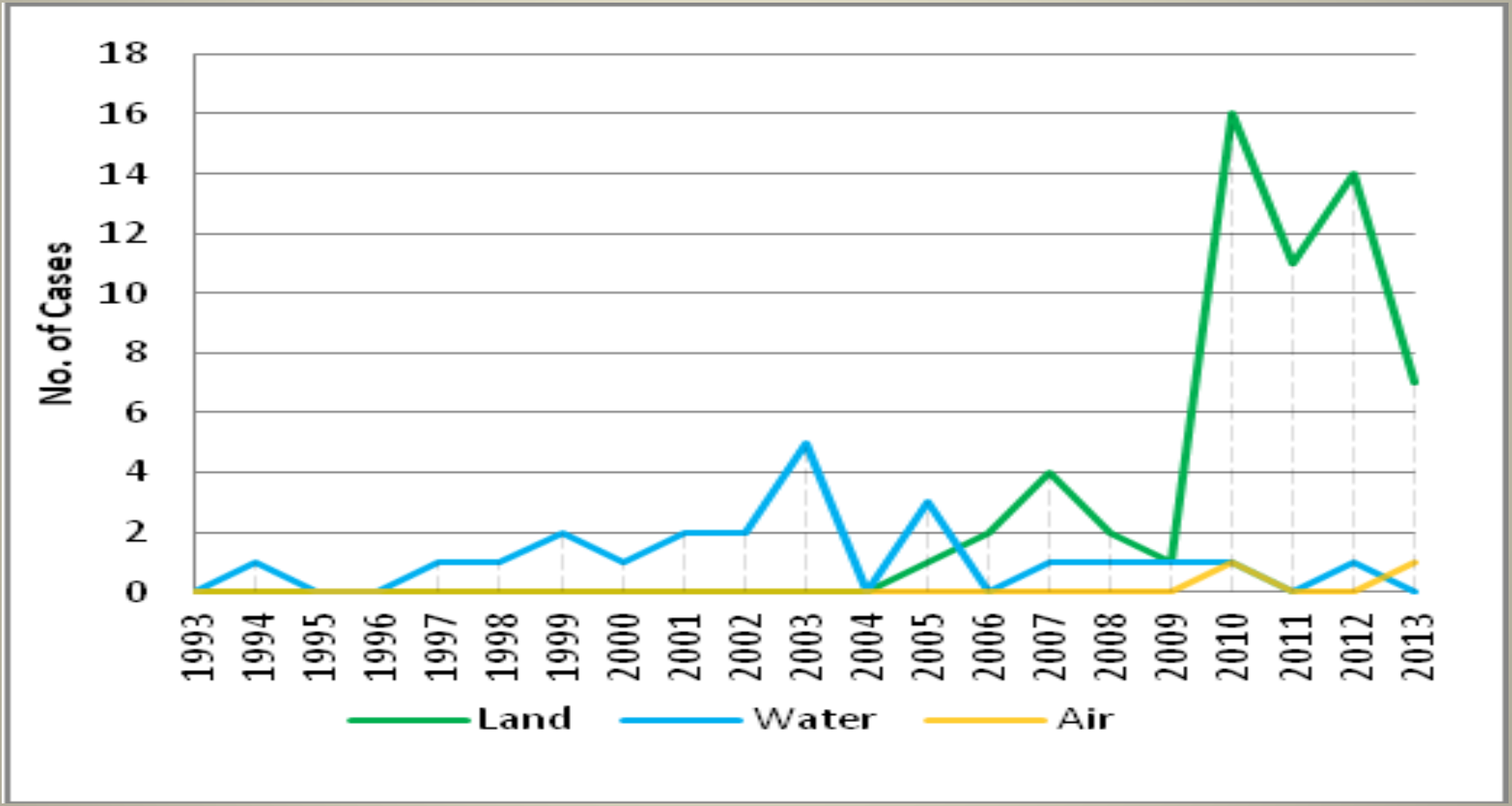
- The search results identified 281 cases that contained the keywords of which 83 were identified as relevant and assigned a rating of High, Medium or Low.
- Out of the 83 relevant cases identified, 76 cases or 91.6%, were from the United Kingdom. While seven cases or 8.4% were from Europe.
- Moreover, 55 cases were criminal cases while 28 cases were civil cases.
- There were 51 appeal cases, of which 49 were criminal and 2 were civil cases. There were 32 initial cases, of which 6 were criminal and 26 were civil cases.
- For the completeness of the study, there were 198 cases in which GPS devices were mentioned but had no evidentiary value.

Transportation

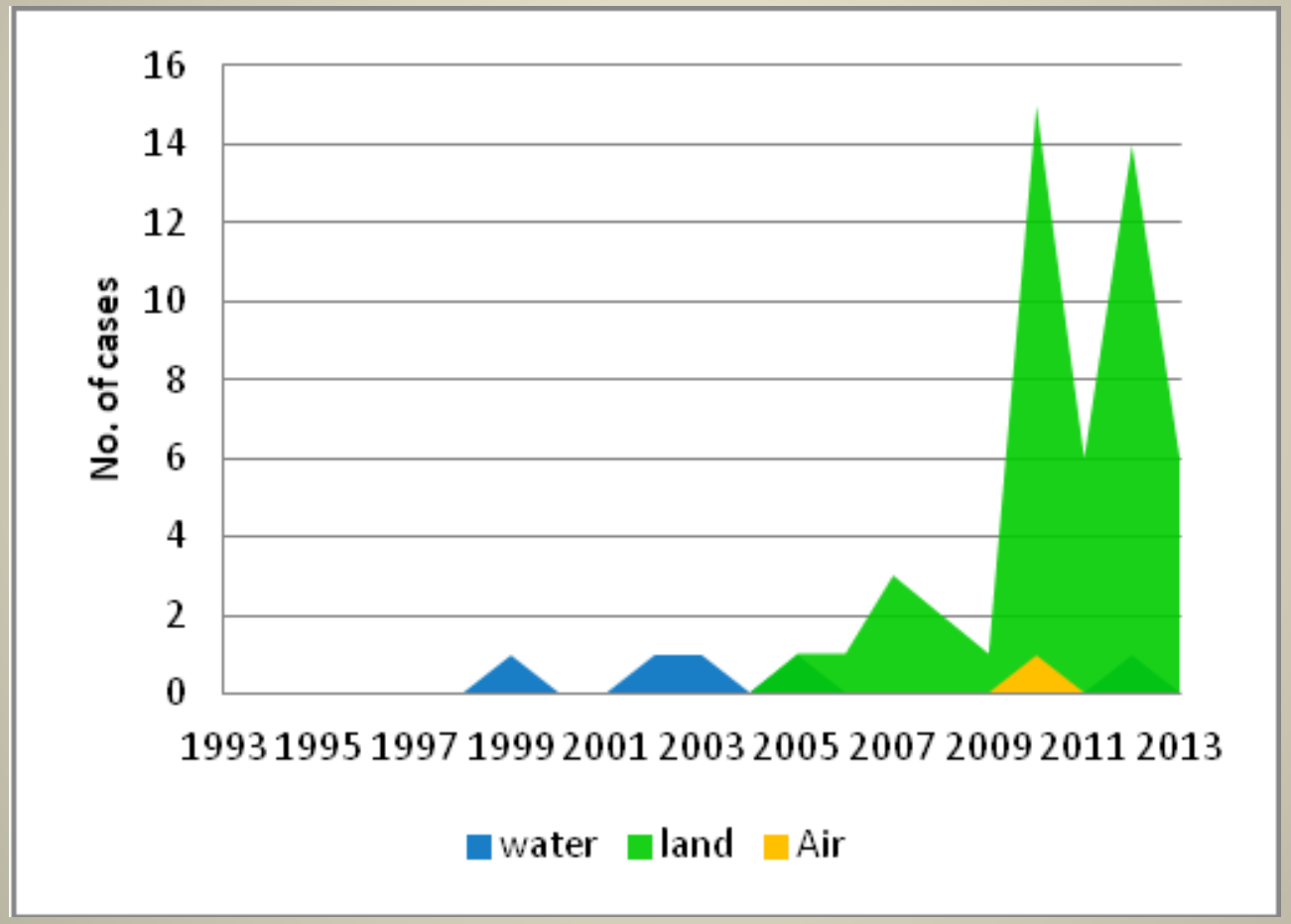
- Land accounted for the largest number of cases which was 58.
- Land cases consisted of 32 automotive cases, 22 cases involved undefined GPS devices, 1 case involved an integrated device, and 3 cases involved GPS tags.
- Water accounted for 23 cases and Air for 2 cases.
- Only three brand names were mentioned for all cases, these were TomTom, Trimble R8 GNSS and Topcon Hiper Pro



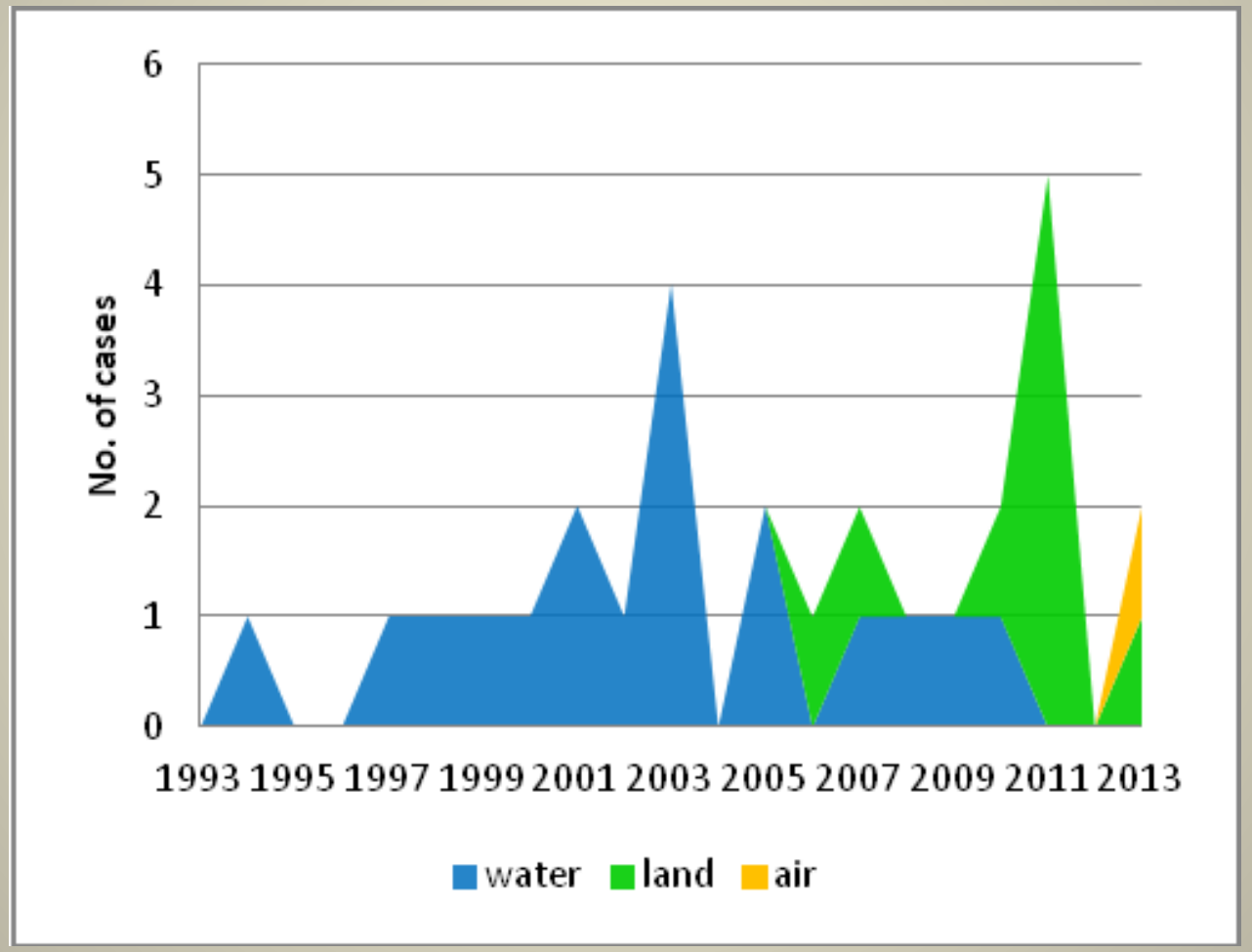
Transportation mode by year



Mode of devices in criminal cases



Mode of devices in civil cases



Classification

Criminal

Crime Type	Number
Use and/or selling of drugs	16
Importing prohibited drugs	7
Murder	4
Murder & Drug dealing	1
Murder & Conspiracy to rob	1
Conspiracy to effect illegal entries into the United Kingdom	2
Conspiracy to rob	3
Conspiracy to disguise criminal property	1
Theft	3
Burglary	2
Terrorism Acts/ terrorism Prevention	4
Speeding, dangerous driving	1
dangerous driving & vehicle collision	2
Rape	2
Robbery	2
Possession of prohibited firearm	1
Trespassing	1
Shipping and navigation – failure of satellite tracker	1
Use of jamming device/transponder	1

Civil

Case type	Number
Shipping and navigation – Collision	15
Shipping and navigation - vessel capacity	1
Shipping and navigation –accident causing death	1
Shipping and navigation -grounding of vessel	1
Land surveying to settle measurement issues	3
Employee dispute/ Unfair dismissal	2
Aircraft accident	1
Civil accident	1
Tracking offender under house arrest	1
Cost distribution	1
Speeding/ dangerous driving	1

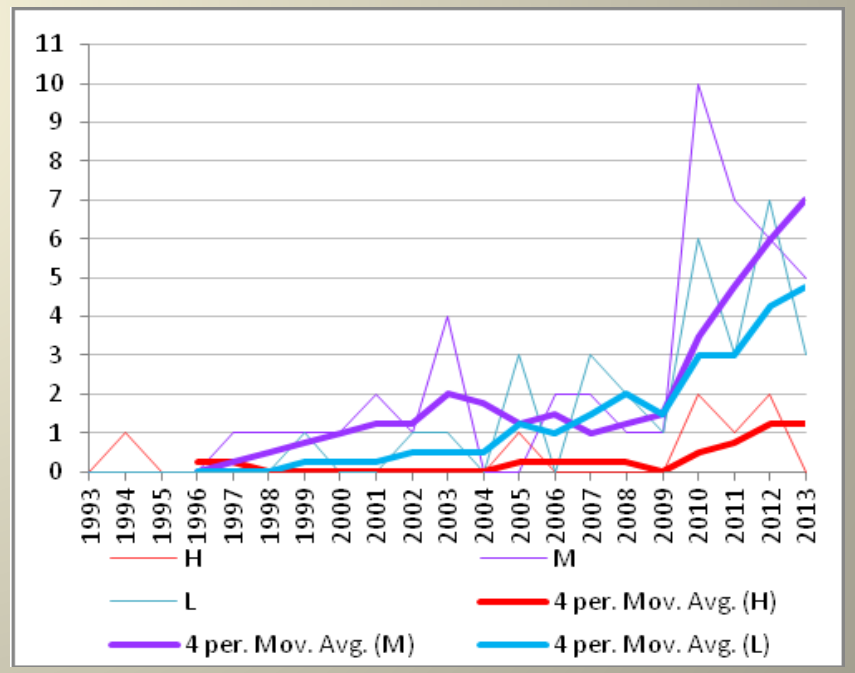
Trend lines of weights assigned

- **High**: This designation indicates that the GPS evidence in the case was vital to the outcome. A case example in this category would be an arrest based on evidence collected through GPS surveillance or for using a type of GPS device that is illegal in that particular region. The terms used to identify high weight cases included **'highly accurate' and 'mostly depended on'.**

- **Medium**: This designation indicates that GPS contributed towards the case outcome. In this instance, key aspects such as location, speed or time is determined using GPS to support a main piece of evidence. A case example in this category would be where GPS evidence leads to the location of evidence like a marijuana field. The evidence in these cases is part of a larger compilation and contained terms indicating medium impact such as **'reasonably accurate', 'revealed' and 'no controversial evidence' when describing the evidence**.

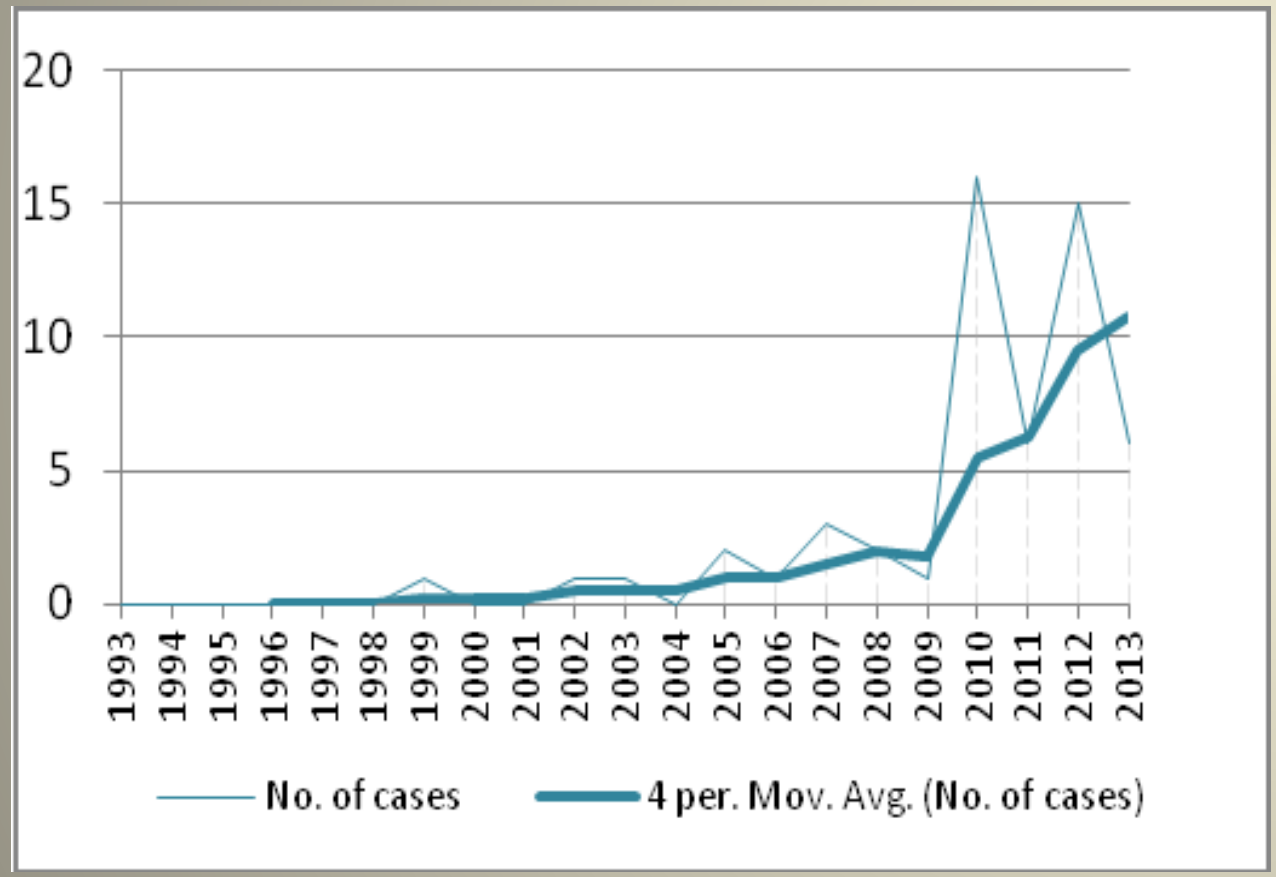
- **Low**: This designation indicates that GPS evidence was present or that GPS device(s) related to the defendant were seized for investigation. This would also include GPS evidence which was presented in court and was not questioned further or simply accepted. In this instance, there was **a lack of terminology** when describing the evidence and no active terms toward the evidence reliance was available.

Weight	No. of cases	Percentage
High	7	8.4
Low	31	37.3
Medium	45	54.2

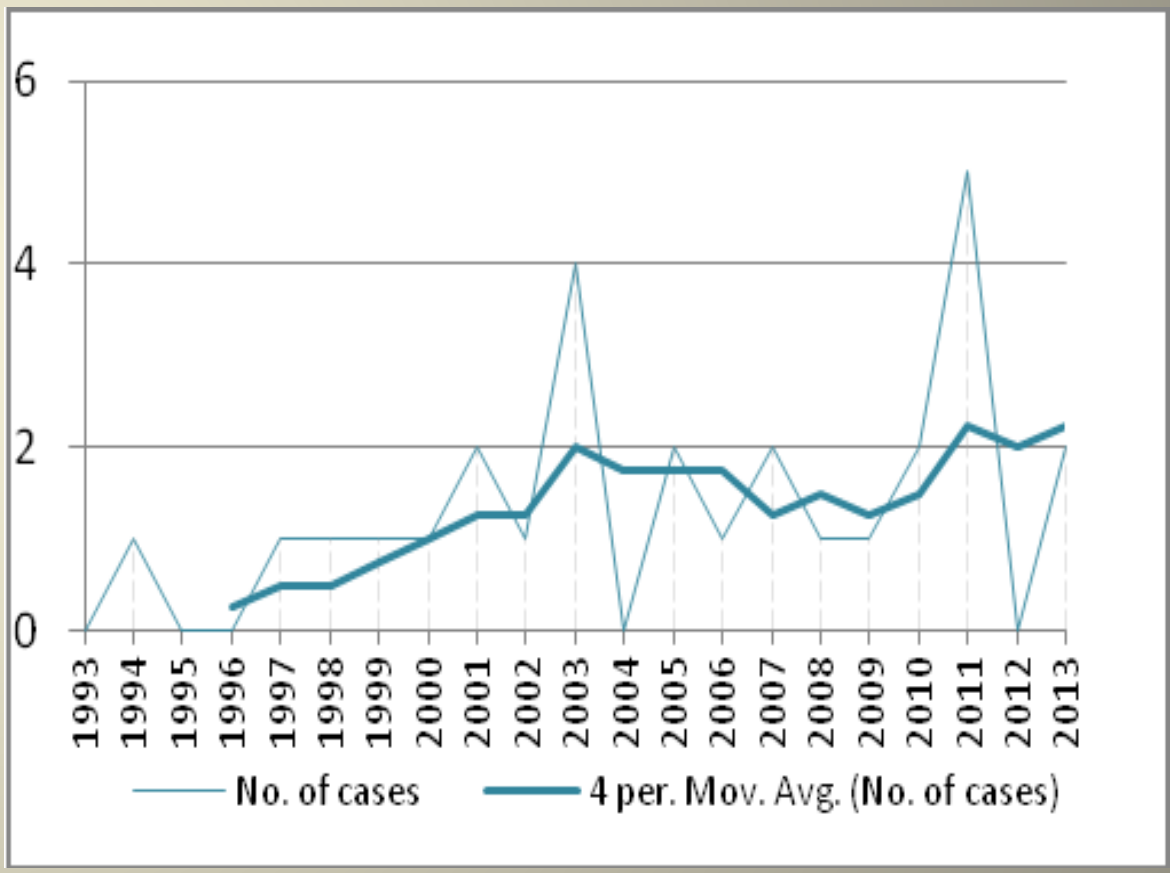


Trends

Criminal Cases



Civil Cases



Conclusions

- The ratio of the number of cases, between the first and second decades, is 12:71 indicating that the number of cases have increased dramatically since June 1, 2003.
- 75% of the cases were recorded from 2007 onwards. Overall, the same trend is true when considering criminal and civil cases separately.
- The number of criminal cases involving GPS evidence shows a steady increase from 2009 onwards.
- The number of cases involving GPS evidence has dramatically increased during the last decade and has an increasing trend, while playing a considerable role in court case verdicts.

Future Work

- Solid state drives, tablets and cloud storage applications to ascertain the impact of the data extracted from these devises and software solutions are having in legal environments
- Examine individual modes of transportation to investigate GPS technology corroboration with other potential location identification technologies such as Wi-Fi, cell towers and social media interaction.
- The research should examine the security and privacy issues in conjunction with opportunities to impact cyber physical systems.

Questions and Future Collaboration?

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