EPSRC Senior Fellowship in Digital Technology for LWEC (DT/LWEC)
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Idea: Use ‘datasets of opportunity’ alongside scientific observing networks to improve predictions of urban natural hazards.
DARE programme

WP1: DA for urban flood inundation modelling
See Sanita Vetra-Carvalho’s talk

WP2: Understanding natural variability of urban observations

WP3: Technology Translation and Knowledge Exchange

WP4: DT/LWEC network
Rest of the talk

• What are the issues in using datasets of opportunity?

• What are the benefits of these data?

• Mode-S EHS aircraft data
  • Temperature data from vehicles (no time!)

• Conclusions
Issues in assimilating datasets of opportunity

\[ y = H(x) + \varepsilon \]

- Metadata vs privacy
- Intellectual property
- Near real time communication
- Intermittency
- Data volume
Issues in assimilating datasets of opportunity

\[ y = H(x) + \varepsilon \]

- Natural variability in urban areas
- Variability that can be represented by a model

T_b Facets Walls, Roof, Ground
(Morrison et al 2015)
Issues in assimilating datasets of opportunity

\[ y = H(x) + \varepsilon \]

- **Accuracy**
  - Large numbers of low precision sensors?
  - Insufficient metadata to blacklist

- **Heterogeneity**

- **Provenance** - data tampering

[Image: Map of locations, with a sticker reading "MORE FAKE NEWS"]
Benefits

• Observations where people are
  – E.g. satnav route avoiding frost hollow

• Large numbers of cheap (free?) observations

• Observing locations where there may not be much “scientific data”
  – e.g. boundary layer temperature inversions
Example - Mode S EHS data

Thanks to Andrew Mirza, Gabriel Rooney, Ed Stone and Sue Ballard

- $10^7$ observations per day
- Boundary layer near airports
- Wind
- Temperature

UK Met Office Mode –S EHS receiver network coverage. Reports from May-June 2015 (Stone and Kitchen 2016)
Low precision problem
(Mirza et al 2016, Mirza 2017)

• Temperature calculation sensitive to Mach no.

• Mach is transmitted at reduced precision
Temperature errors

• ~ 7K error at low Mach (low altitude)

• 1-2K at cruising altitudes

• Systematic errors hard to reduce by signal processing

• Work with air traffic management for next protocol....

• Positive assimilation impacts at KNMI, DWD, Met Office (only use data above 1500-2000m)
Conclusions

• Using datasets of opportunity is challenging
  – Privacy, Data Volume, Intermittency, QC....

• BUT data has benefits
  – Cheap, useful locations

• Need to establish a proper framework for dealing with this type of data
• Faster operationalization?
References

