

EPSRC Senior Fellowship in Digital Technology for LWECC (DT/LWECC)

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Idea: Use 'datasets of opportunity' alongside scientific observing networks to improve predictions of urban natural hazards.



Met Office WoW website

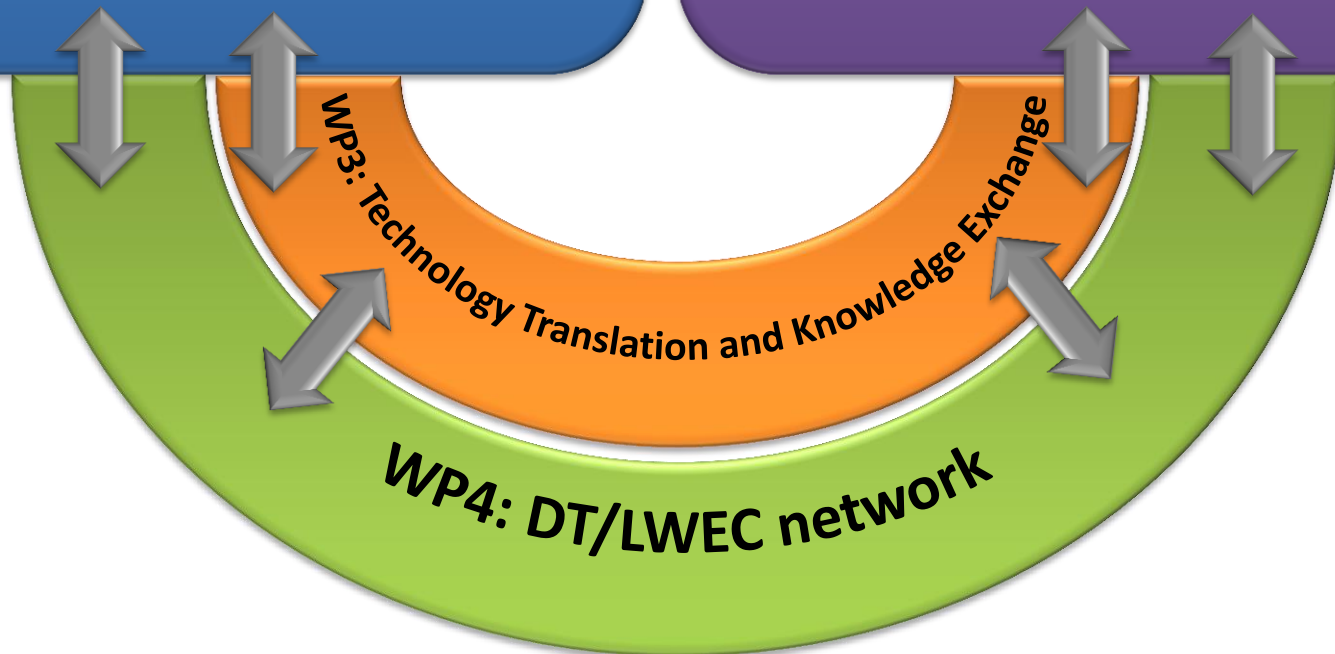


DARE programme

WP1: DA for urban flood inundation modelling

See Sanita Vetra-Carvalho's talk

WP2: Understanding natural variability of urban observations



Rest of the talk

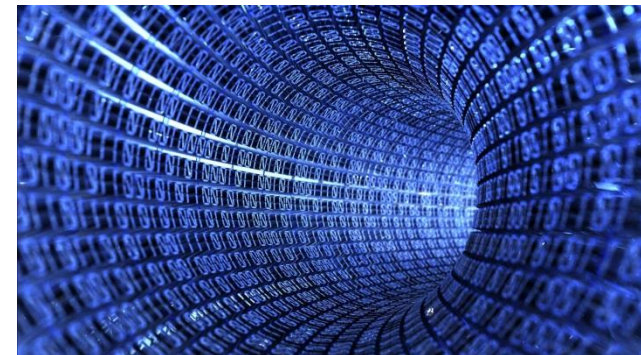
- What are the issues in using datasets of opportunity?
- What are the benefits of these data?
- Mode-S EHS aircraft data
- Temperature data from vehicles (no time!)
- Conclusions

Issues in assimilating datasets of opportunity

$$y = H(x) + \epsilon$$



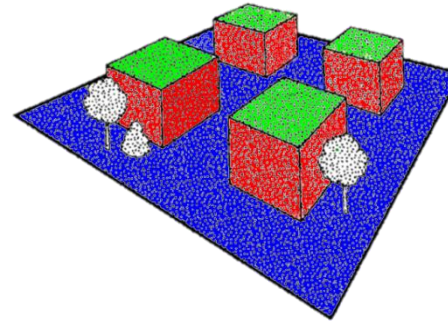
- Metadata vs privacy
- Intellectual property
- Near real time communication
- Intermittency
- Data volume



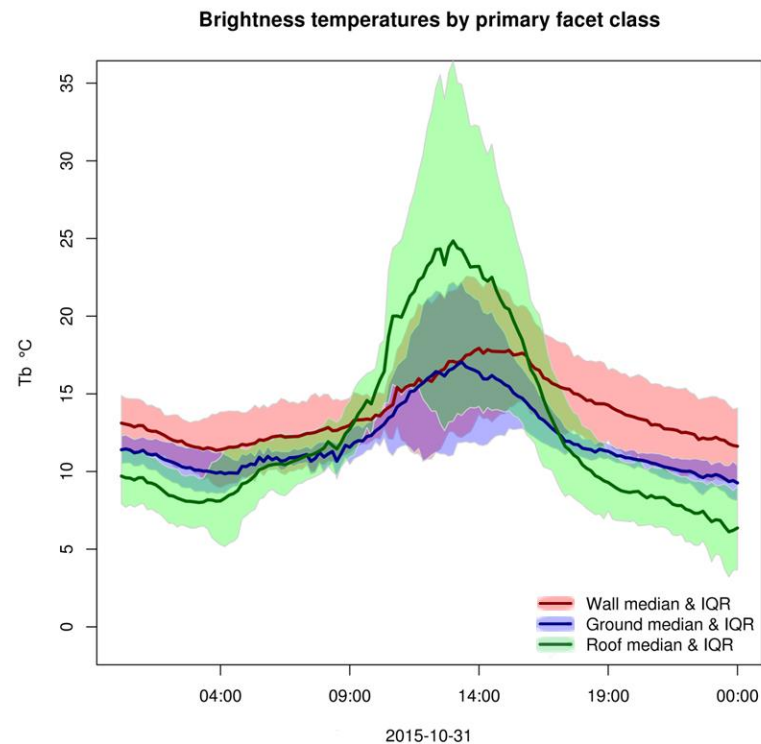
Issues in assimilating datasets of opportunity

$$y = H(x) + \epsilon$$

- 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

$$y = H(x) + \epsilon$$

- Accuracy
 - Large numbers of low precision sensors?
 - Insufficient metadata to blacklist
- Heterogeneity
- Provenance - data tampering

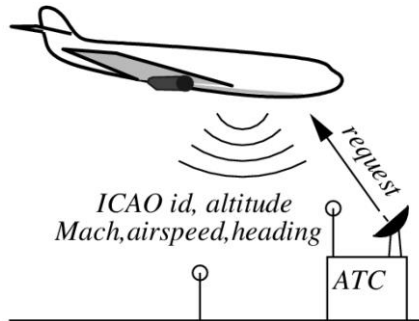


Benefits

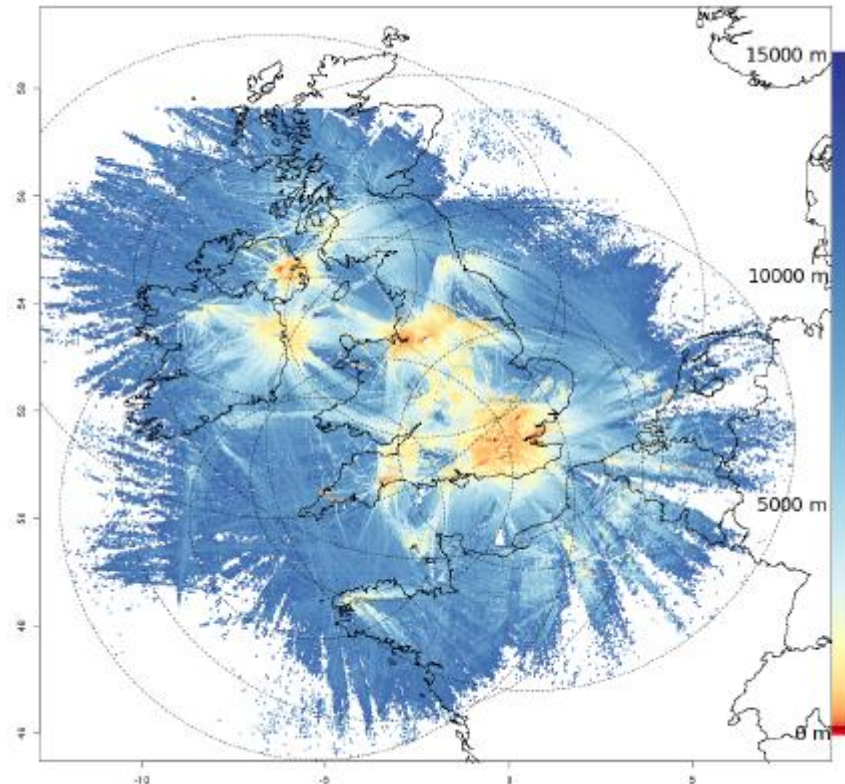
- Observations where people are
 - E.g. satnav route avoiding frost hollow
- Large numbers of cheap (free?) observations
- Observing locations where there may not be much “scientific data”
 - e.g. boundary layer temperature inversions

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

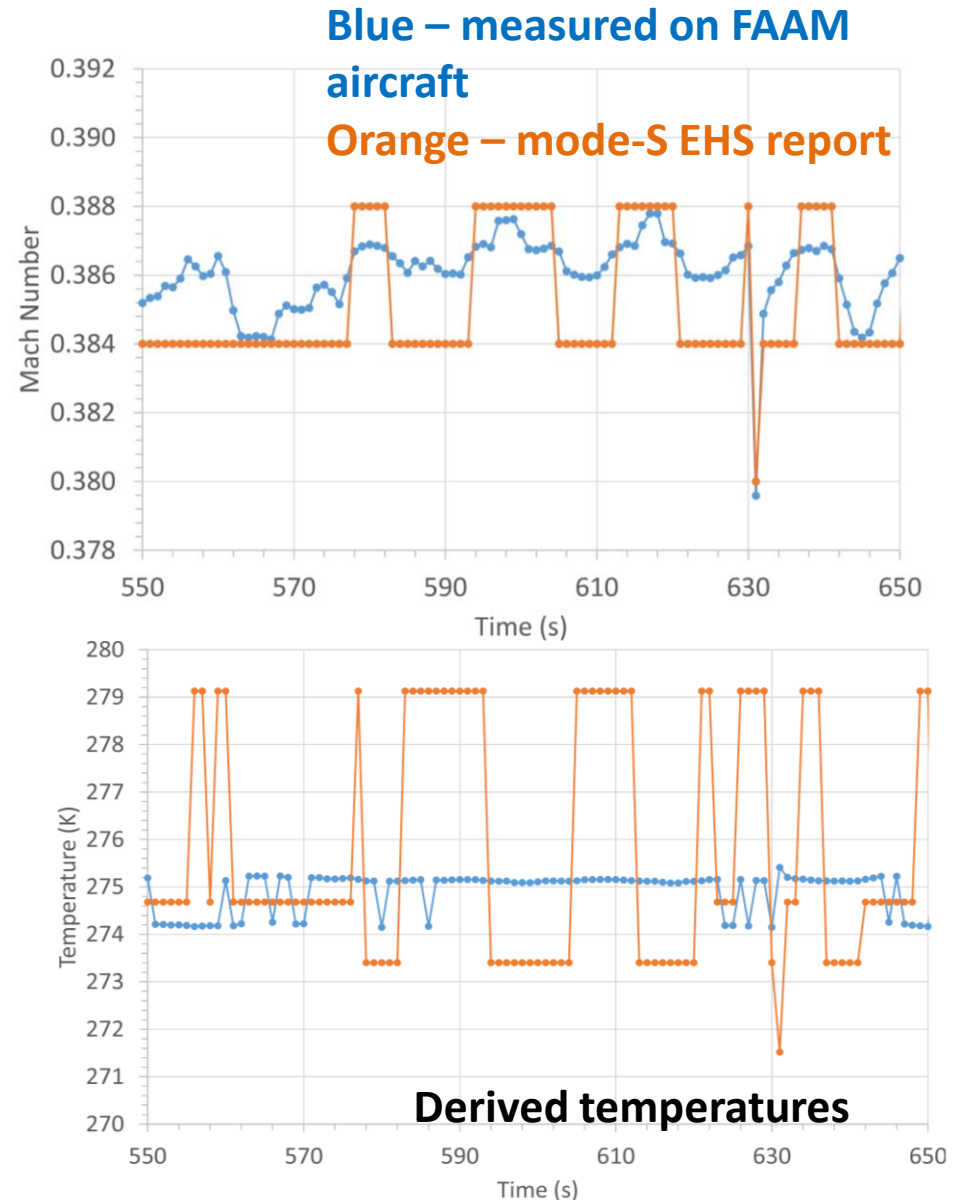


UK Met Office Mode –S EHS receiver network coverage . Reports from May-June 2015 (Stone and Kitchen 2016)

Low precision problem

(Mirza et al 2016, Mirza 2017)

- Temperature calculation sensitive to Mach no.
- Mach is transmitted at reduced precision



Temperature errors

- $\sim 7\text{K}$ 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

Mirza, A. K., Ballard, S. P., Dance, S. L., Maisey, P., Rooney, G. G. and Stone, E. K. (2016) Comparison of aircraft derived observations with in situ research aircraft measurements. Quarterly Journal of the Royal Meteorological Society. doi: 10.1002/qj.2864

Mirza, A. K. (2017), 'On the Utilization of Aircraft Derived Observations for Operational Meteorology and Numerical Weather Prediction.', PhD thesis, University of Reading

Stone, E.K. and M. Kitchen, 2015: Introducing an Approach for Extracting Temperature from Aircraft GNSS and Pressure Altitude Reports in ADS-B Messages. J. Atmos. Oceanic Technol., 32, 736–743, <https://doi.org/10.1175/JTECH-D-14-00192.1>