

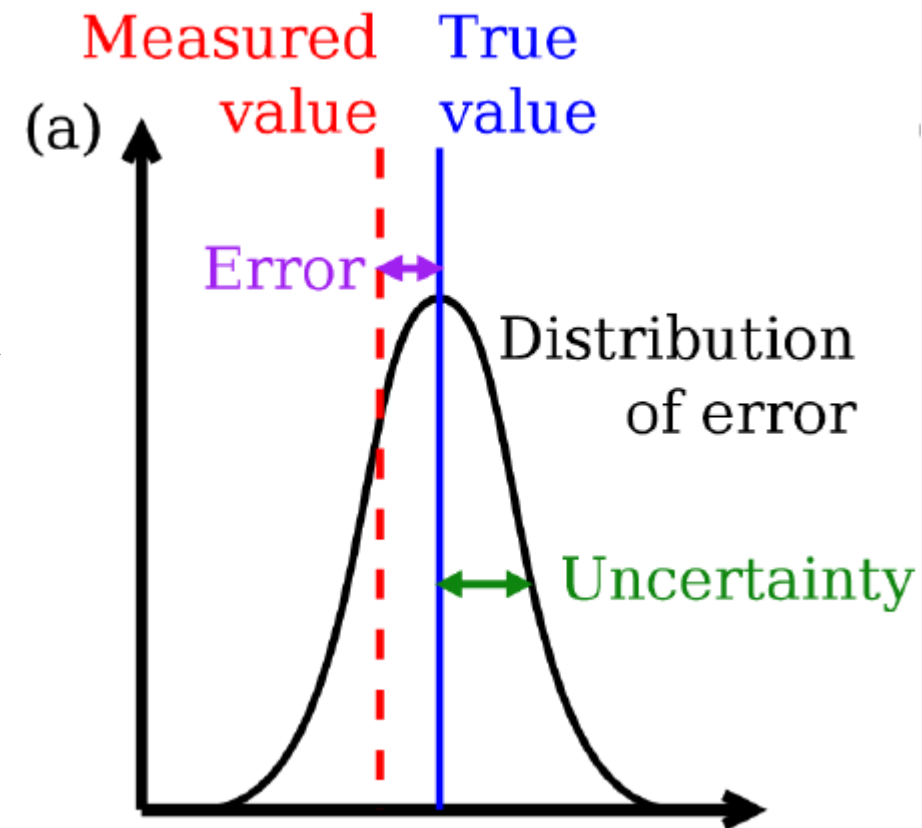
# Pixel-level uncertainties

**An AEROSAT discussion**  
**Thursday, October 18<sup>th</sup>**

*Adam Povey (Chair) and Linlu Mei (Rapporteur)*

# Definitions

- **Error:** Difference between what was measured and the theoretical “true” value.
  - Varies between **random** (averages to zero over many observations) and **systematic** (does not).
- **Uncertainty:** Characterisation of the range of values that could reasonably be attributed to the measurement.
  - An estimate of the statistical distribution of error.
  - Varies between **prognostic** (how wrong you *think* you are) and **diagnostic** estimates (how wrong you *actually* were).



# Minutes from Helsinki 2017

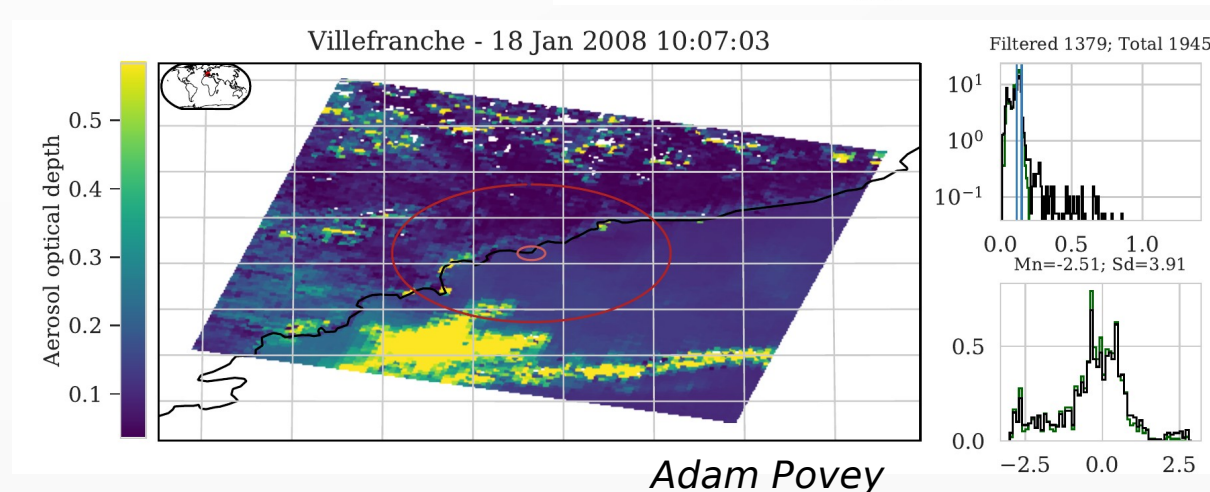
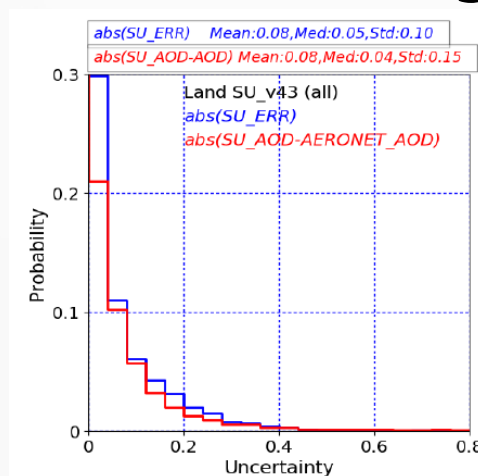
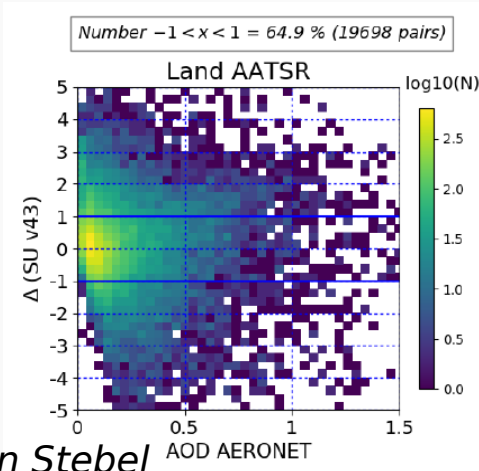
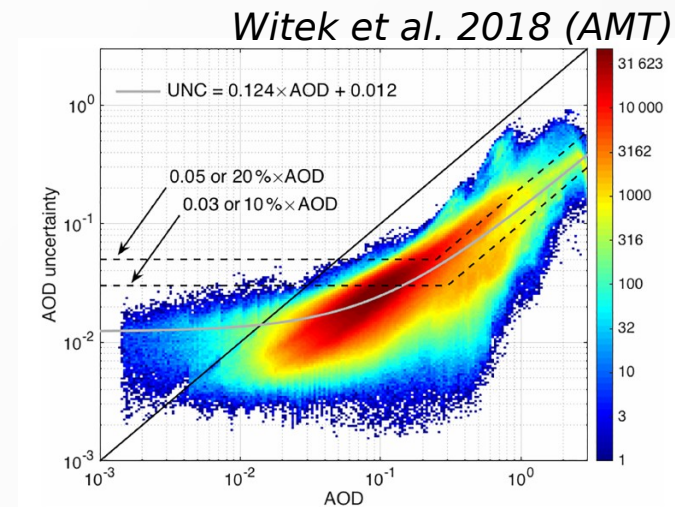
- Representation
  - AOD believed to be log-normally distributed.
  - Level 3 data is the most widely used product but gets less development than Level 2 and doesn't express variability.
- Propagation of uncertainty
  - Needs to separate random and systematic components.
  - Distribution of error is expected to be Gaussian-like but this hasn't been confirmed.
  - Moving away from solely diagnostic approaches.
- Validation
  - AOD evaluated against AERONET but there is no standard method.
  - Unclear what to do for derived products.
- Andy Sayer proposes to lead an inter-comparison experiment.

# Previous questions

- How do we define and calculate uncertainty?
- Who uses uncertainty information?
- How do we validate uncertainties?
- How do we propagate uncertainties into Level 3 data and other derived products?
- Can/should we separate the uncertainties from different error sources, especially those that aren't Gaussian?

# Progress since 2014

- There is a greater understanding of the meaning and utility of uncertainty data.
- Pixel-level uncertainties are provided with MISR v23, CCI ATSR, MODIS DT and BAR.
  - Derived using a variety of techniques.
- Several published examples of validating satellite uncertainties against AERONET.



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- ~~Who uses uncertainty information?~~
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# Discussion questions

- Propagation
  - Is it more important for uncertainty to be theoretically sound and traceable or accurate and transferable?
  - Is it practical to separate random/uncorrelated, systematic/correlated and sampling errors?
  - Should we report the data people expect or that which minimises the uncertainty (e.g. Angstrom vs FM-AOD)?
- Validation
  - Is there a single metric by which to judge a dataset?
  - What other data should we validate against?
- What experiment should we do next?