Definitions: uncertainty and error

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metrology

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Dictionary

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Search for a word

me·trol·o·gy

/məˈträləjē/

noun

noun: **metrology**

the scientific study of measurement.

Origin

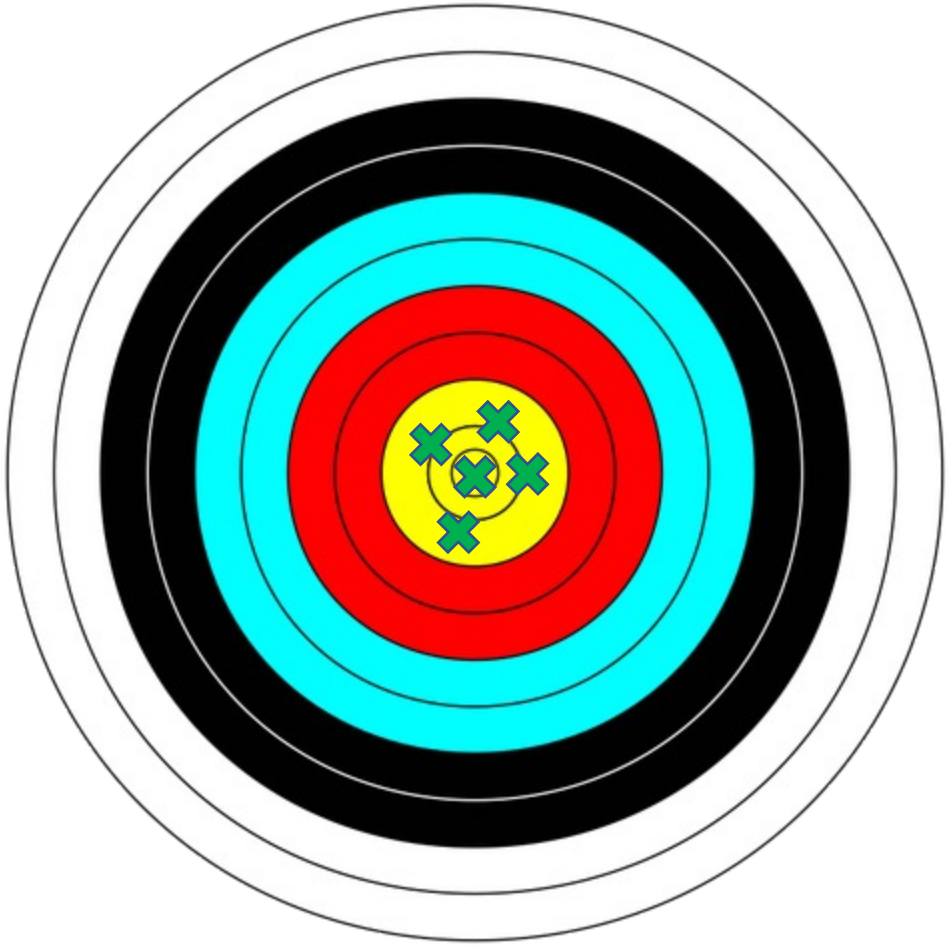
There are standards!

- International Bureau of Weights and Measures (BIPM) chairs the Joint Committee for
  - "Guide to Un
    Meas
    dopt these
    ons

We all make mistakes with this. It's ok. Do your best and correct when you realise you've made a mistake. And correct us when we do!

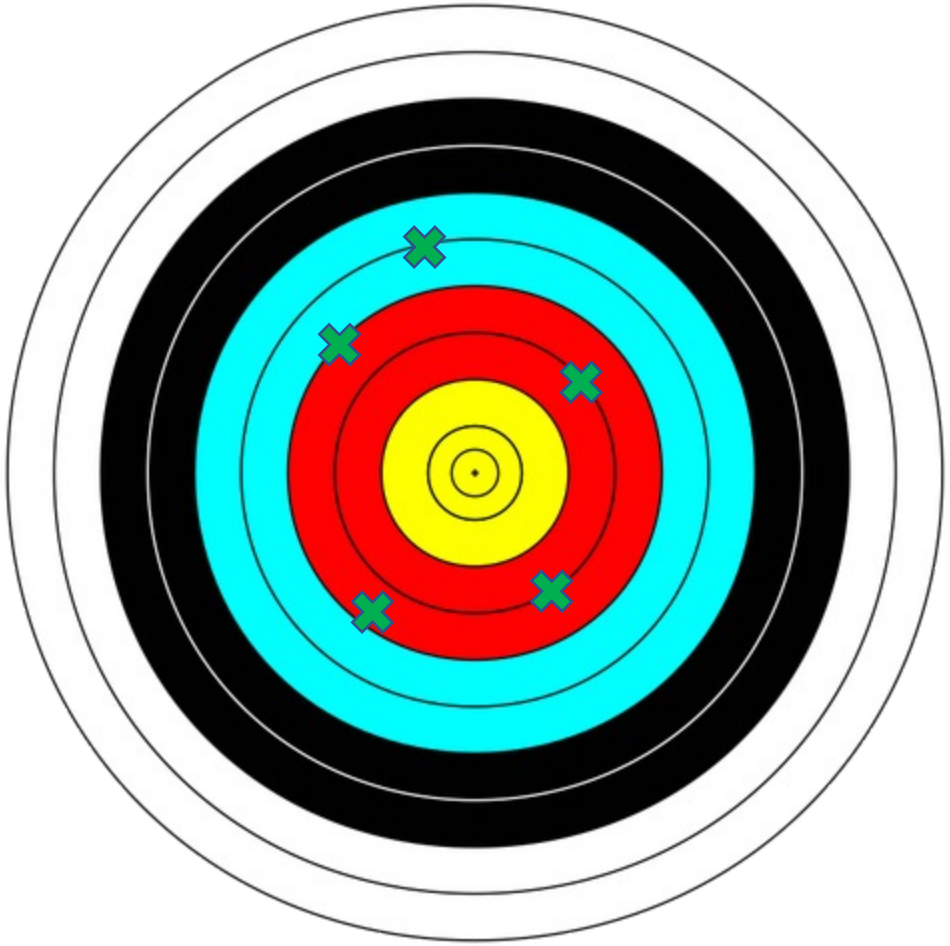
Accuracy (bias) vs precision (scatter)

Accurate and precise



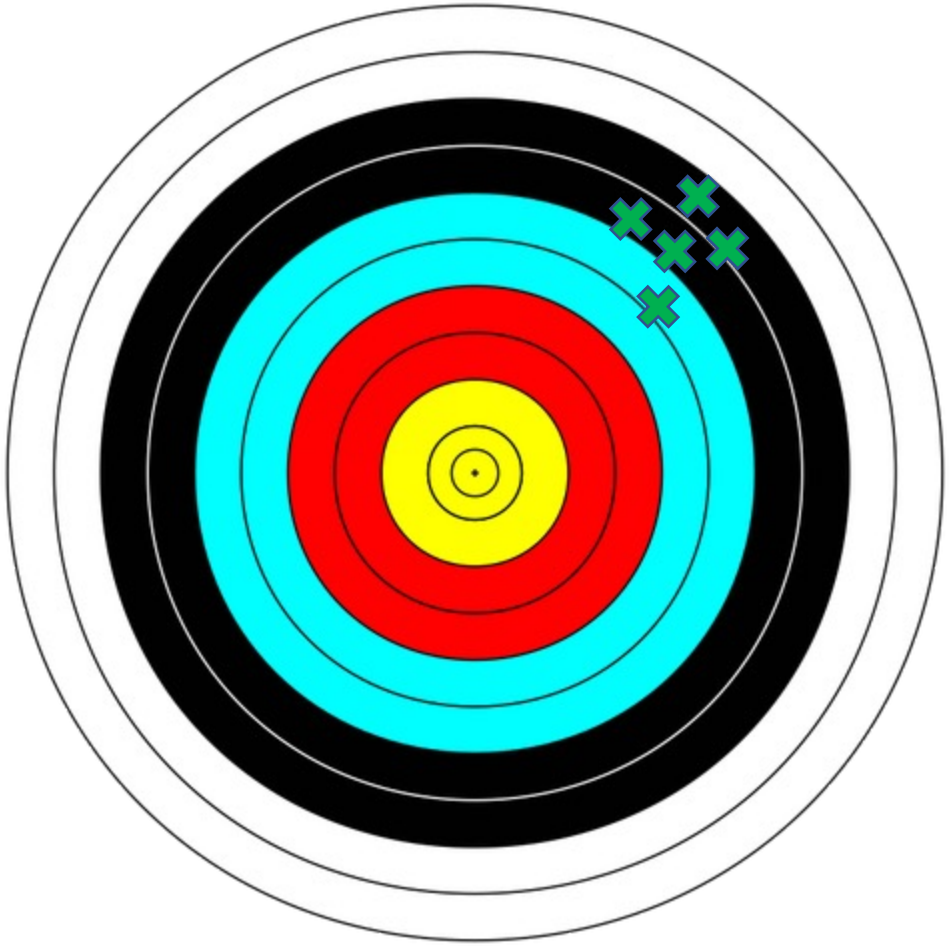
Accuracy (bias) vs precision (scatter)

Accurate, not precise



Accuracy (bias) vs precision (scatter)

Not accurate, precise



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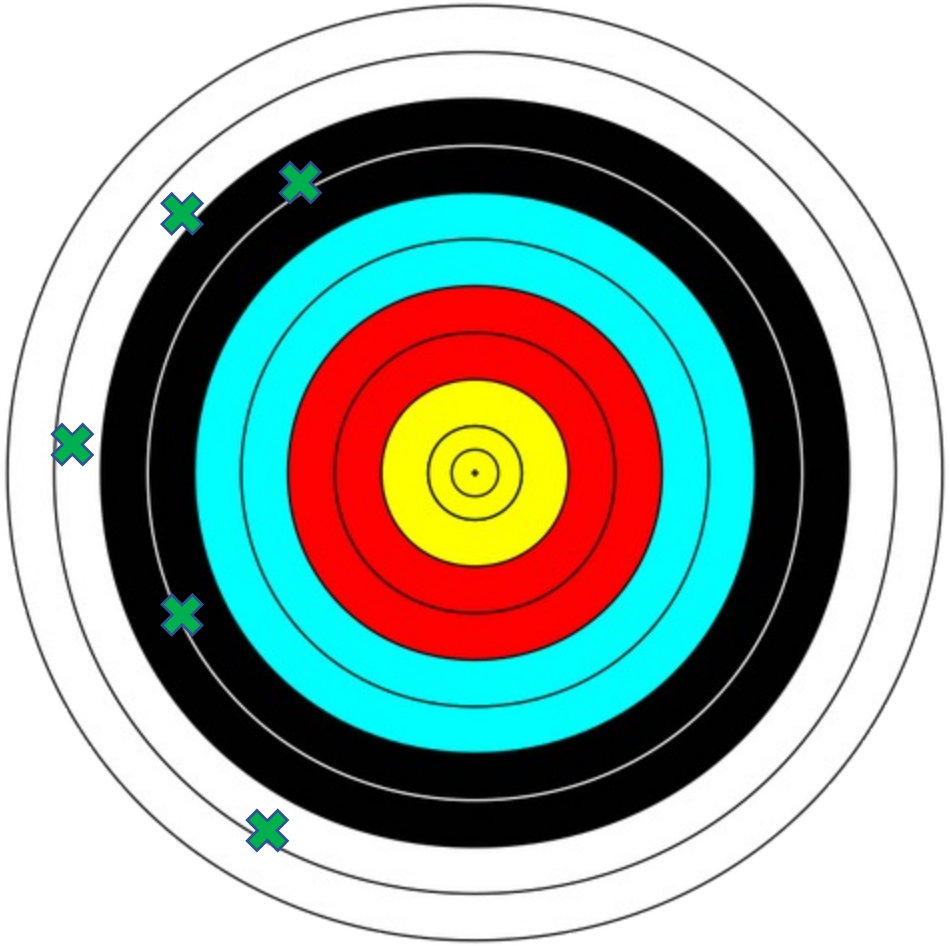


Words we often misuse

- *Error* is how wrong you are
  - Retrieval minus truth
  - Most of the time, *we do not know this*
- *Uncertainty* is a measure of reliability
  - How wrong you typically are
  - How wrong you think you typically are

Definite

Statistical

You *expect* 3.5
You *get* 1, 2, 3, 4, 5, or 6

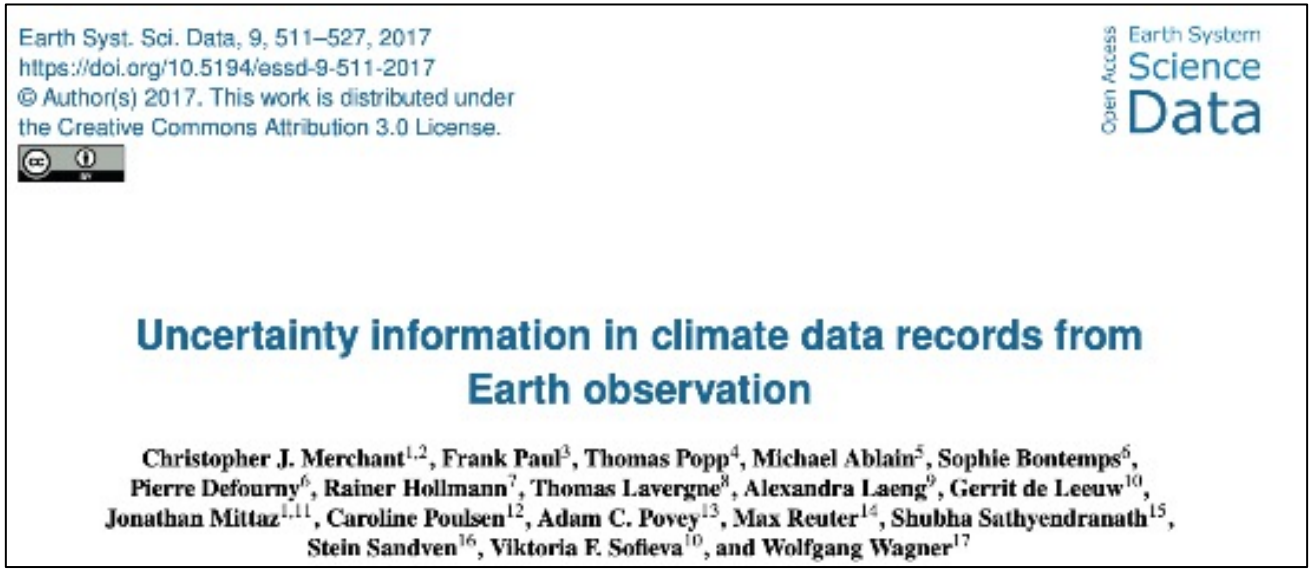
Diagnostic and prognostic uncertainty

- Diagnostic (relative to *reference truth*)
  - From validation or sensitivity studies
  - Ideally need high-quality, representative validation data
- Prognostic (relative to *retrieved state*)
  - Propagate uncertainties through retrieval system
    - Quantify measurement and forward model error sources
  - Or, parametrize based on validation
  - Pixel-level
- Both trying to estimate the *dispersion* of retrievals vs. truth under certain conditions

Sandy, by vectorjuice
https://www.freepik.com/photos/sandy

Final thought

It is clear that developing and validating uncertainty estimates involves effort comparable to developing the retrieval itself.



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Open Access Earth System Science Data

Uncertainty information in climate data records from Earth observation

Christopher J. Merchant[1,2], Frank Paul[3], Thomas Popp[4], Michael Ablain[5], Sophie Bontemps[6], Pierre Defourny[6], Rainer Hollmann[7], Thomas Lavergne[8], Alexandra Laeng[9], Gerrit de Leeuw[10], Jonathan Mittaz[1,11], Caroline Poulsen[12], Adam C. Povey[13], Max Reuter[14], Shubha Sathyendranath[15], Stein Sandven[16], Viktoria F. Sofieva[10], and Wolfgang Wagner[17]

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