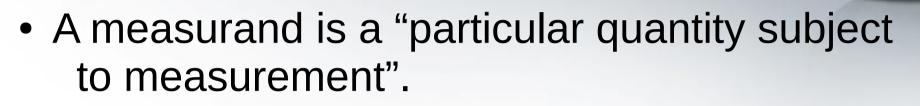
Session 1 – Pixel level uncertainties in aerosol retrievals

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Definitions



- The error of a measurement is the "result of a measurement minus a true value of the measurand".
- The uncertainty of a measurement "is a parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand".

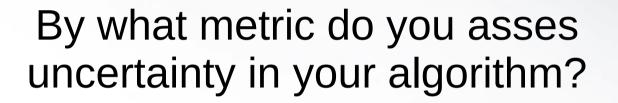
Definitions

- Random error = "result of a measurement minus the mean that would result from an infinite number of measurements of the same measurand carried out under repeatable conditions".
- Systematic error = "mean that would result from an infinite number of measurements of the same measurand carried out under repeatable conditions minus the true value of the measurand".
 - It is important that products contain estimates of both random and systematic uncertainties.

L2 error calculation

- The primary Aerosol CCI algorithms propagate measurement and surface model uncertainty through their algorithm using Jacobeans
 - Optimal estimation techniques do so as part of the retrieval calculation
 - Others perform calculation after retrieval
- "Expected error" envelopes can be produced from sensitivity studies and validation against AERONET
 - Does not comment on quality of a single pixel
 - Provides analogue for GCOS requirements

Group question 1



What techniques are used to propagate uncertainty through your retrieval?

Negligible sources of error

- Trace gases
- Vertical profile of aerosol
 - Except where gradients of composition present
- Radiative transfer
- LUT interpolation
- Surface wind speed
 - Where used

Product validation

- Comparison against AERONET
 - Even considering representivity error, the uncertainty was felt to be smaller than satellite retrieval errors.
- Inhomogeneous spatial coverage limits the range of circumstances in which AERONET can be applied.
 - The remote ocean was felt in need of attention.
 - MAN provide sparse alternative measurements, though the variation of these with surface winds should be explored.
 - New products from POLDER could be used to provide validation, though these will be of comparable accuracy to our retrievals.
- Supplemented with comparison against ground-stations

Poorly characterised errors

- Aerosol model choice
 - Monte Carlo techniques
 - Retrieval cost analysis
 - Likely highly non-linear
- Cloud filtering
 - Radiative transfer shows that clouds can affect an area of up to 5km
 - Filtering frequently removes thick aerosol plumes



Group question 2

How do you validate uncertainties in your product?

What are the limitations of that process?

Group question 3

Producers: What do you feel users don't appreciate about your uncertainty estimates?

Users: What do you most want to learn from uncertainty estimates?

Further considerations

- Are errors normally distributed? (Is a standard deviation useful? Would interquartile range, etc be helpful?)
- What is the difference between uncertainty estimation and quality flagging?
- Is it possible to exploit the spatial correlation of errors in independent retrievals?