FINNISH METEOROLOGICAL INSTITUTE

cci

AERO-SAT meeting 2015

Session 16:
Pixel-level uncertainties

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Uncertainties

- Discussion in Steamboat, Sep2015
- Summary in the minutes:
  - What is uncertainty?
    - CCI program defines uncertainty as “a parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand”.
    - Random + systematic: random is easy to characterize but is rarely dominant; systematic will prove more difficult.
    - There are several processes that are known to introduce error into retrievals but it is not known how to quantify that
  - How to characterize pixel level uncertainty?
    - Jacobians
    - Expected Error (EE) envelopes
  - Currently outstanding issues: see next page
  - Communicating uncertainty
  - Future steps

Currently outstanding issues

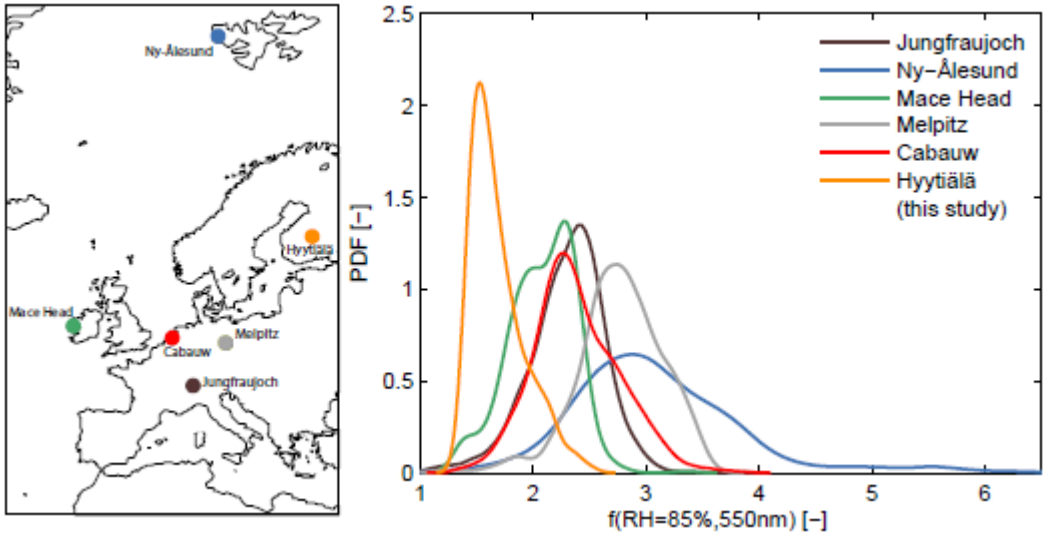
- Currently outstanding issues:
  - Pixel-level uncertainty sidesteps spatial/temporal correlations in error.
    - If you average data over large time or spatial areas, does that increase or decrease error?
  - Current methods only address the `known unknowns'. How can the `unknown unknowns' be addressed?
    - By `unknown unknowns', we mean sources of error for which we cannot produce a quantitative uncertainty estimate, such as cloud contamination.
  - Jacobian techniques assume errors are Gaussian; this is not true for some error terms.
    - Should the distributions of error should be investigated?
    - Is a single number meaningful for all uncertainties?
  - Need standardized ways of providing uncertainty so that satellites can be properly intercompared/integrated.
  - Though outside the current remit of the working group, we may wish to consider how best to characterize uncertainty at L3.

Sources of uncertainty in satellite retrievals

- Instrument / measurement uncertainty
- Assumptions in the retrieval algorithm:
  - Cloud detection / screening
  - Surface properties / correction
  - Aerosol types:
    - characteristics of components: size dsitribution, refractive index
    - a priori assumptions
  - Vertical structure aerosol
    - properties
    - relative humidity / growth
    - disconnected layers / different aerosol types
    - Chemistry
  - Solving the equations

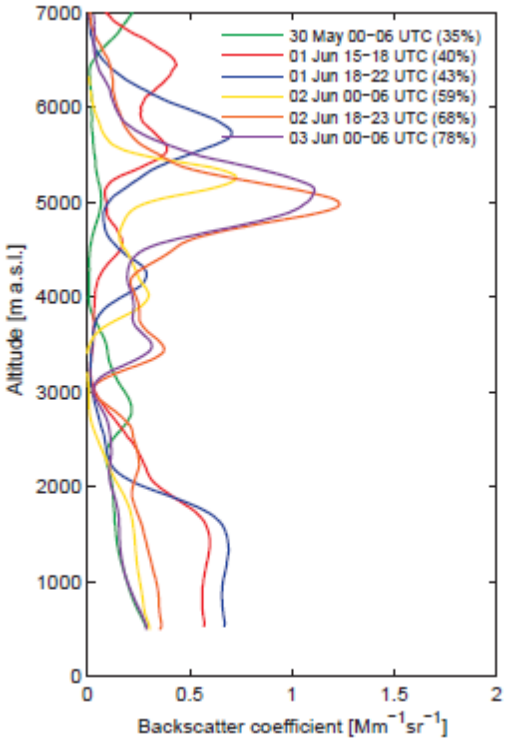
examples

scattering enhancement factor f(RH), particle light scattering coefficient at defined RH divided by its dry value (RH< 30–40%):



Zieger et al. ACP 2015

Disconnected layers (PollyXT lidar, Kuopio)

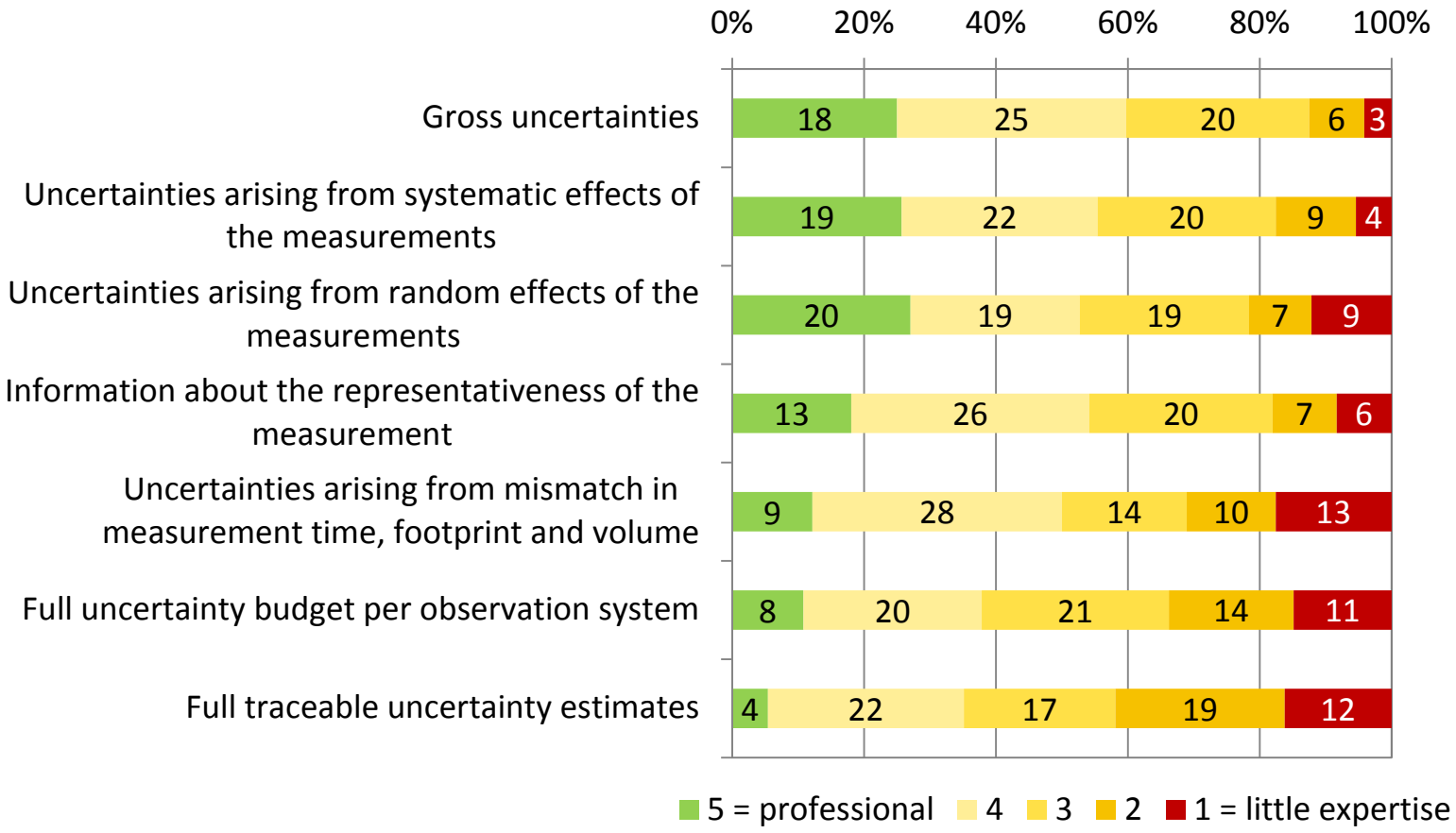


Nr in () is the % of AOD (z>3 km) to the total AOD

GAIA-CLIM: Cummunicating uncertainty: user requirements survey

Q5: What is your level of expertise using information about observational uncertainties related to satellite, ground-based, balloon-borne or aircraft data?

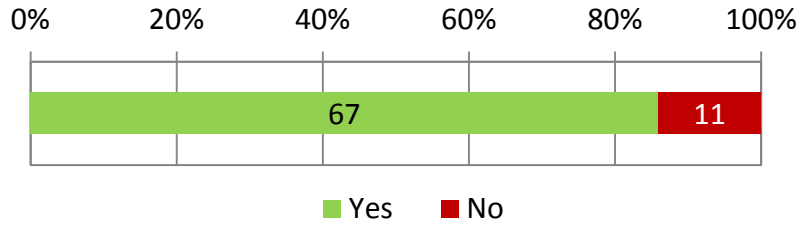
- 75 respondents

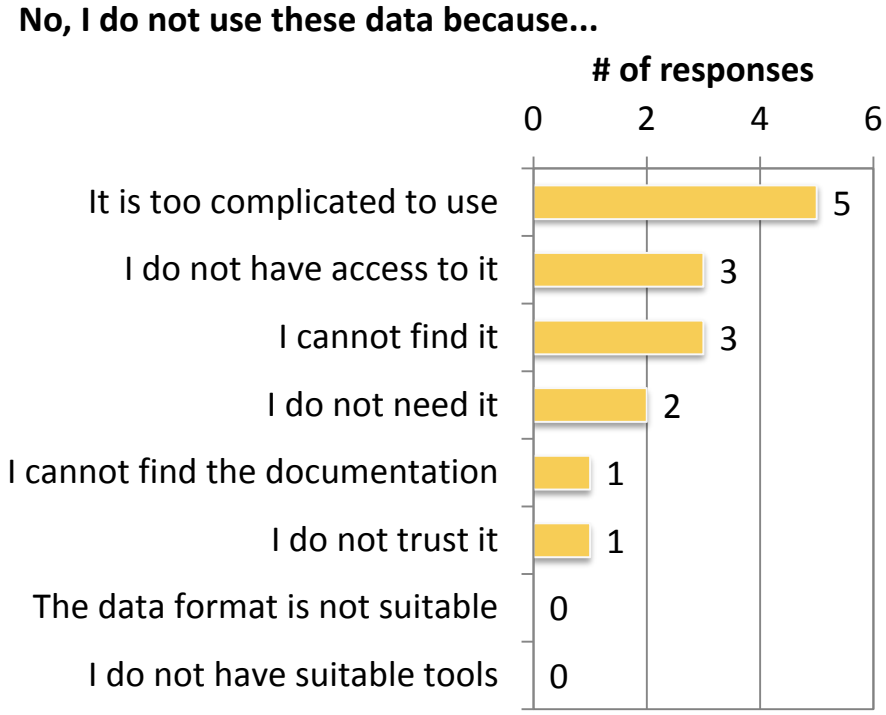


GAIA-CLIM: Cummunicating uncertainty: user requirements survey

Q6: Do you use uncertainty estimates?

- 77 respondents
- 86% of the respondents uses uncertainty estimates
- Those who don't use, find it too complicated to use or do not have access to it or cannot find it

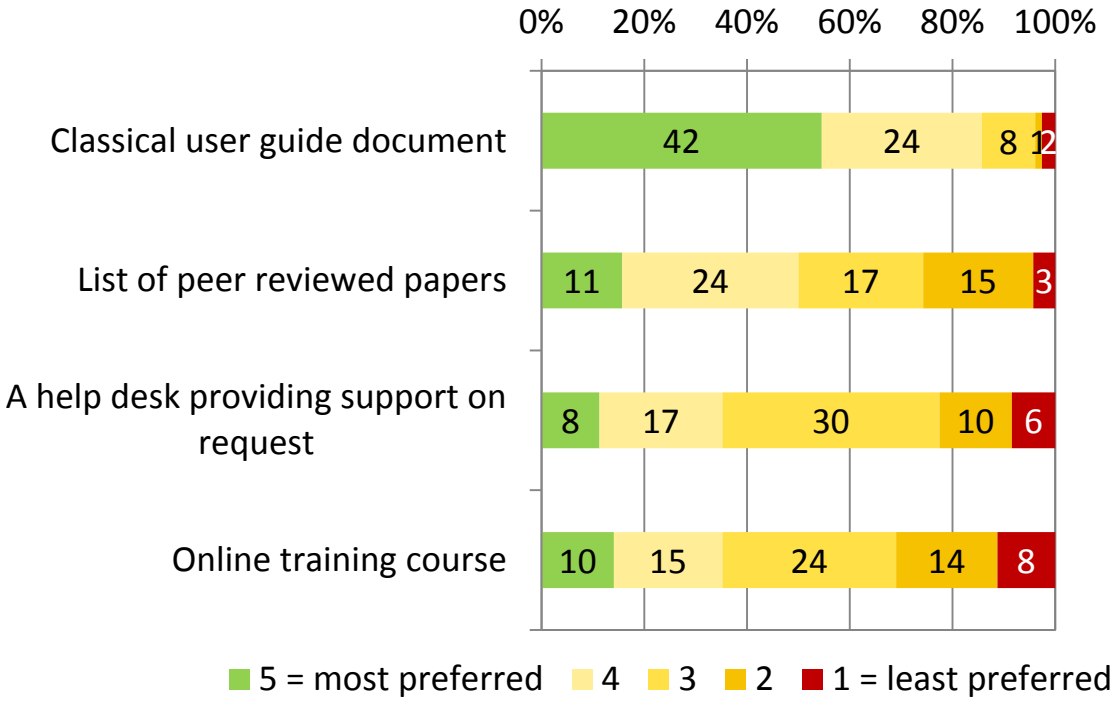




GAIA-CLIM: Cummunicating uncertainty: user requirements survey

Q7: Which guidance on how to utilize observational uncertainty information related to satellite and sub-orbital data would be valuable to you?

- 77 respondents



”Other, please specify”:

- A workshop run by instrument experts
- A web page showing examples
- A concise traceable document providing key information
- Ensemble of observations

Seed questions

- Definition of uncertainty: same for different communities?
- How well can we estimate the contributions of different sources for uncertainty?
- Does the uncertainty allocation need to be specified in detail? What is included, what does each source contribute?
- Knowns and unknowns
- What is the uncertainty in the uncertainties?
- How are uncertainties in satellite observations / retrievals used in the modeling community?
- Prioritisation of contributions to uncertainty?