



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

On the representativeness of the observations: a philosophical detail or a basic paradigm?

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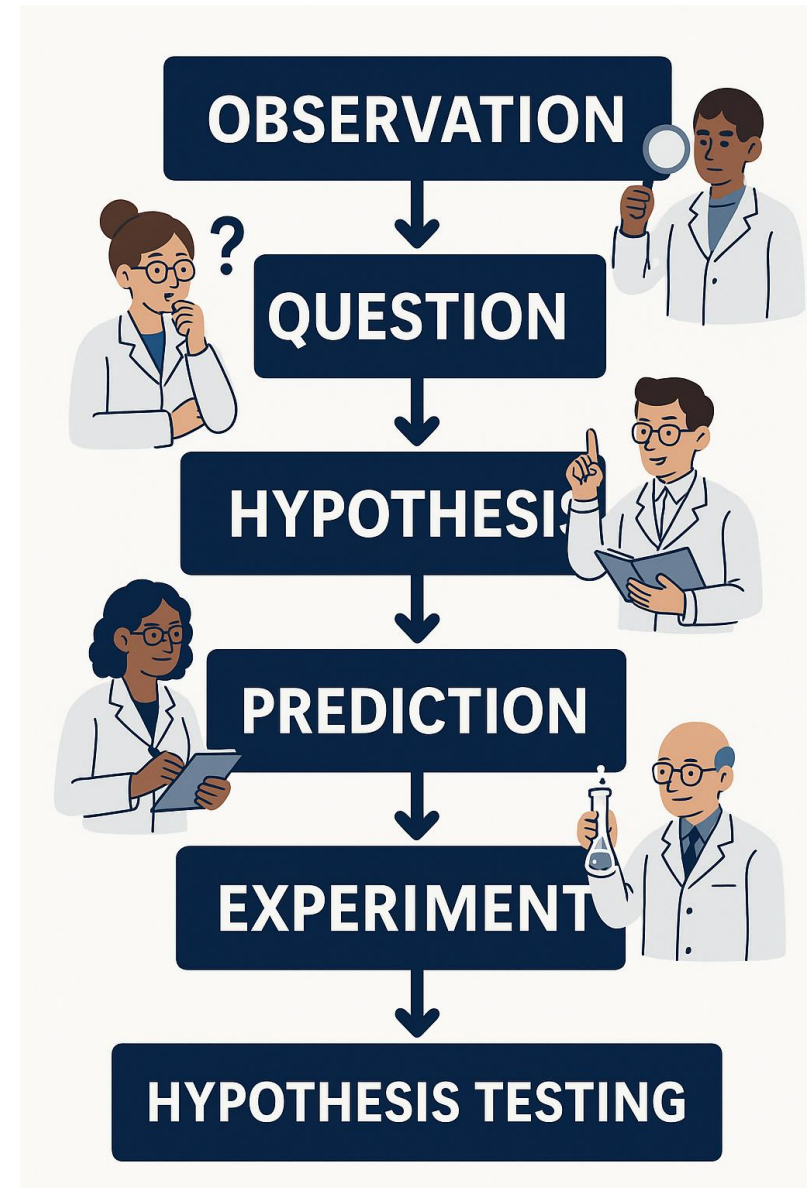
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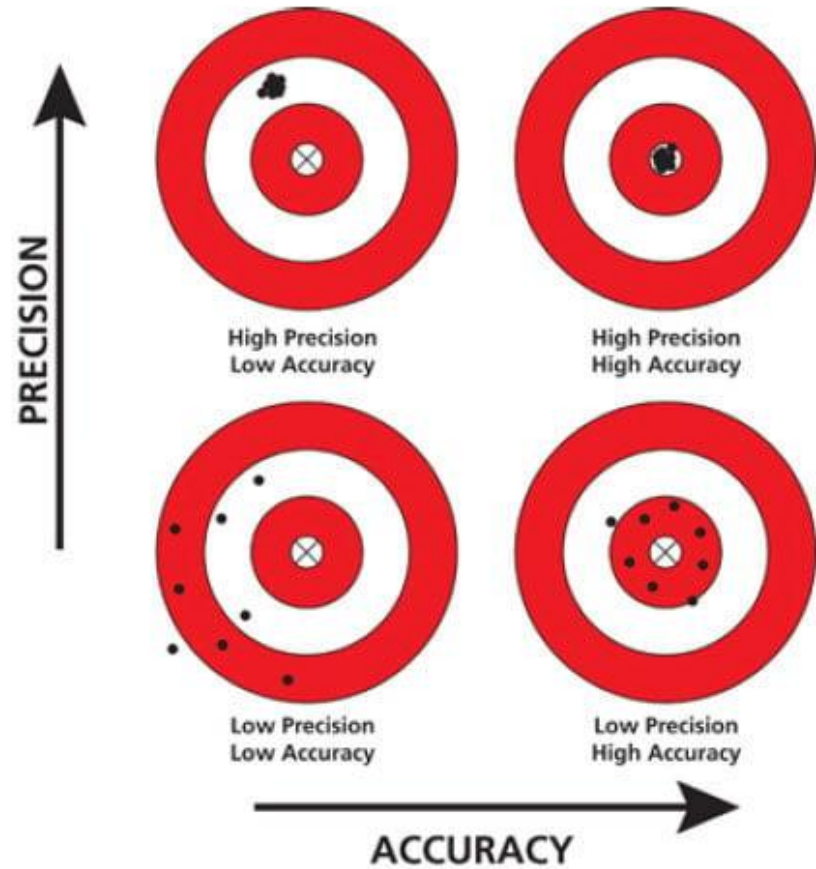
Observations

- In the scientific method, **observations** are the starting point, involving the **collection of data** through our senses or with tools (**sensors**)
- These observations lead to questions, which then drive the **formulation of hypotheses** and experimentation to **test** those **hypotheses**.

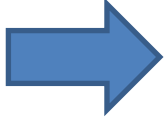


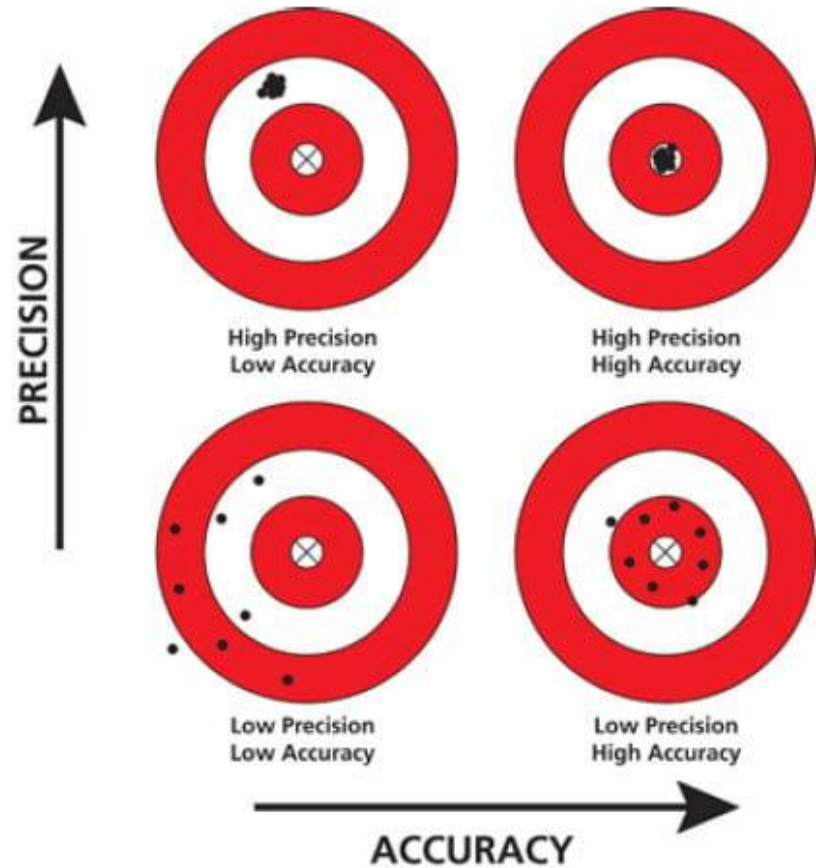
How do we characterize observations?

Started with precision and accuracy



How do we characterize observations?

Started with precision and accuracy  many uncertainty metrics



$$\text{RMSD} = \sqrt{\frac{1}{n} \sum_{i=1}^n (X_i - x_0)^2}.$$

$$r_{xy} = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2} \sqrt{\sum_{i=1}^n (y_i - \bar{y})^2}}$$

$$\text{KGE} = 1 - \sqrt{(r - 1)^2 + (\alpha - 1)^2 + (\beta - 1)^2}$$



Some additional characteristics have been introduced, e.g.,

204

A.W. Western, G. Blöschl / Journal of Hydrology 217 (1999) 203–224

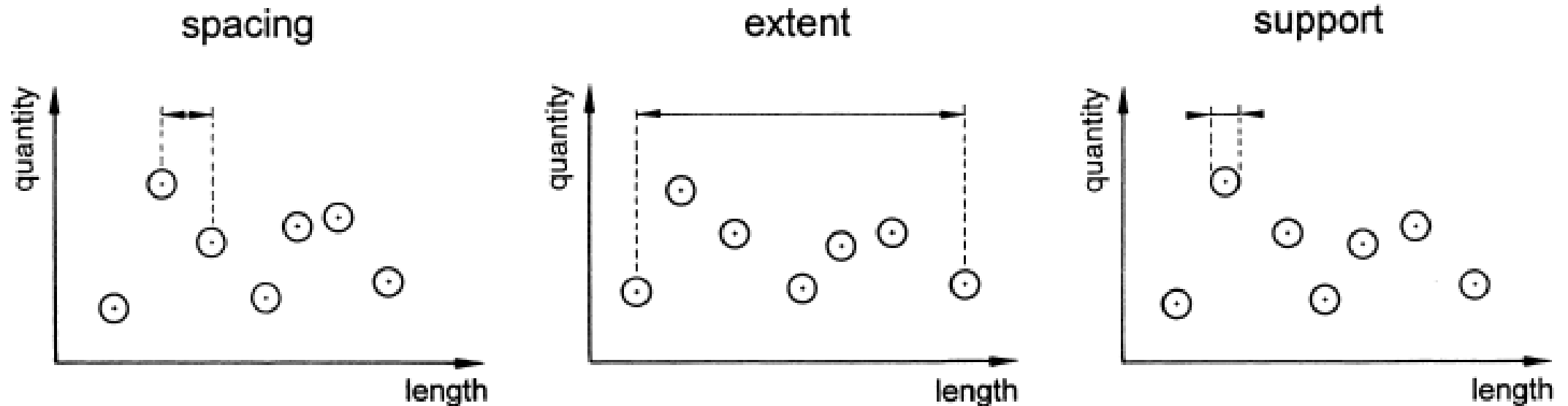


Fig. 1. Definition of the scale triplet (spacing, extent and support). This scale triplet can apply to samples (i.e. measurement scale) or to a model (i.e. modelling scale). After Blöschl and Sivapalan (1995).



About representativeness

From Nappo 1983

Representativeness is the extent to which a set of measurements taken in a space-time domain reflects the actual conditions in the same or different space-time domain taken on a scale appropriate for a specific application.

Some metrics suggested in literature:

- **Temporal stability concept** (see Vauched et al., 1985)
- **Representative elementary volume (REV)** (see Dagan, 1989)
- **Triple collocation** (see Gruber et al., 2013)
- **Inverse footprint** (see Orłowsky and Seneviratne 2014)
- ...



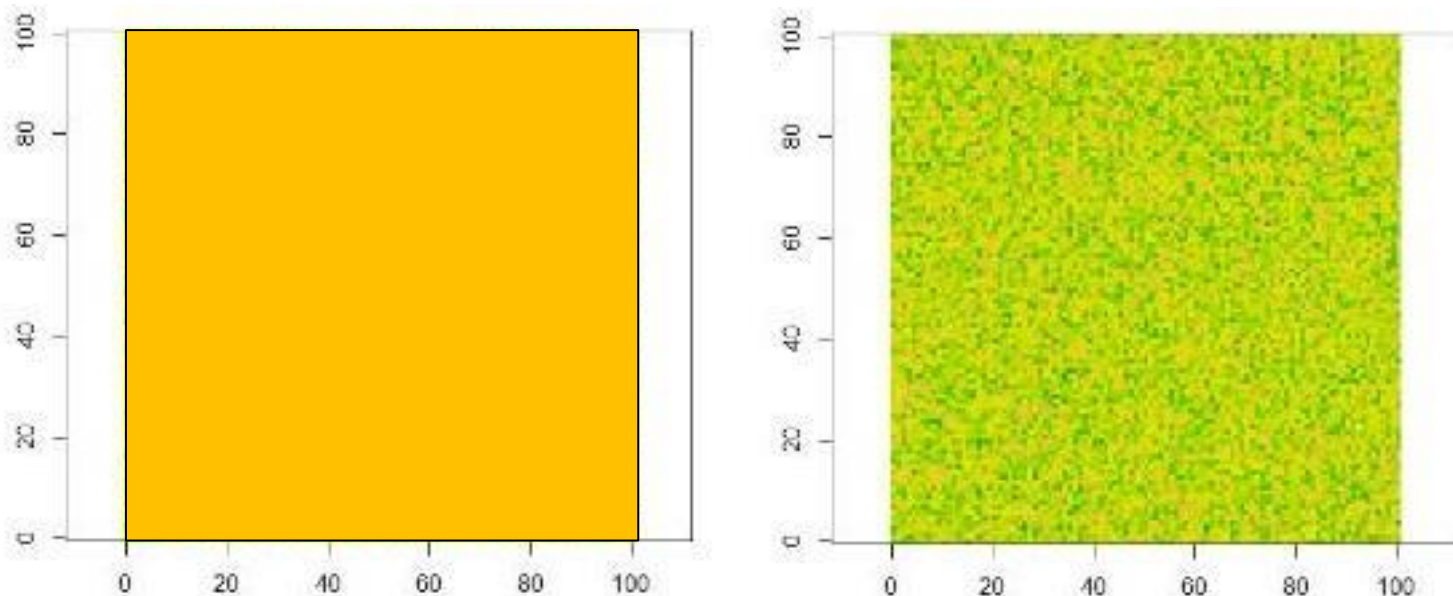
About representativeness...some issues

The **use** of representativeness metrics in the literature and in the scientific reports is **limited**

For instance:

- **intercomparison** does not consider representativeness or assumes to be the main source of uncertainty
- **sampling design** often relies on distributing observations without explicitly considering if one observation is more representative than others (random process and uncorrelated)

HOW MANY SAMPLES?



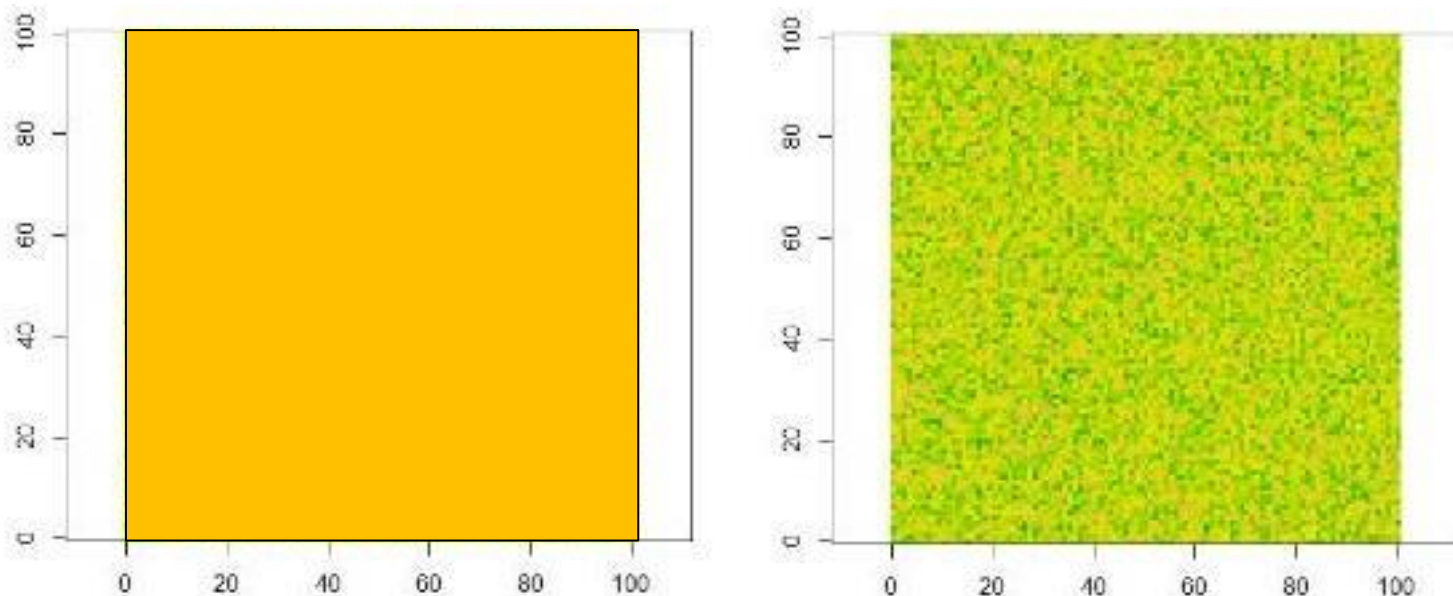
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It is a ill-posed problem if we do not specify the observation support, e.g.,

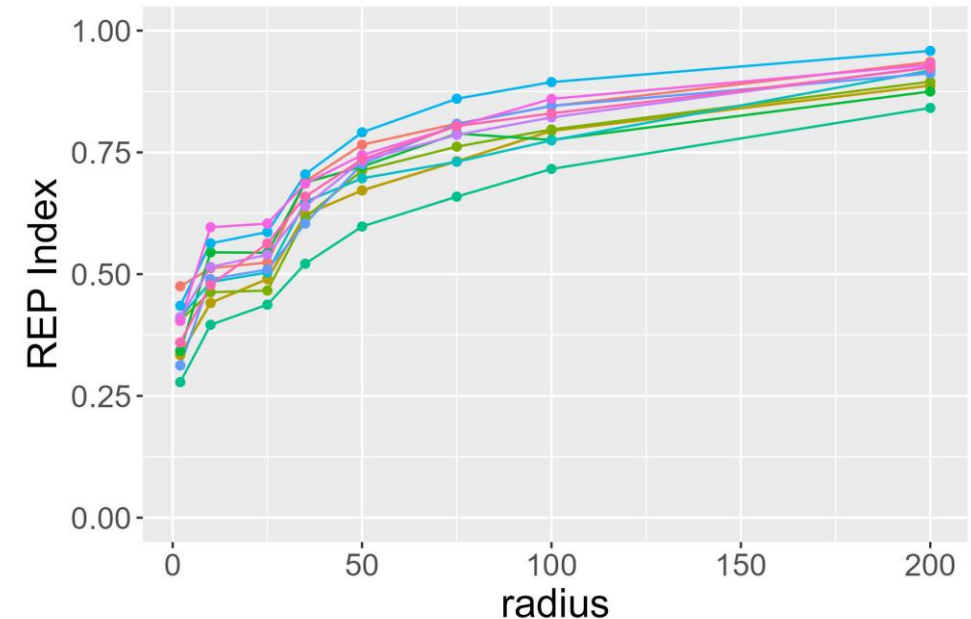
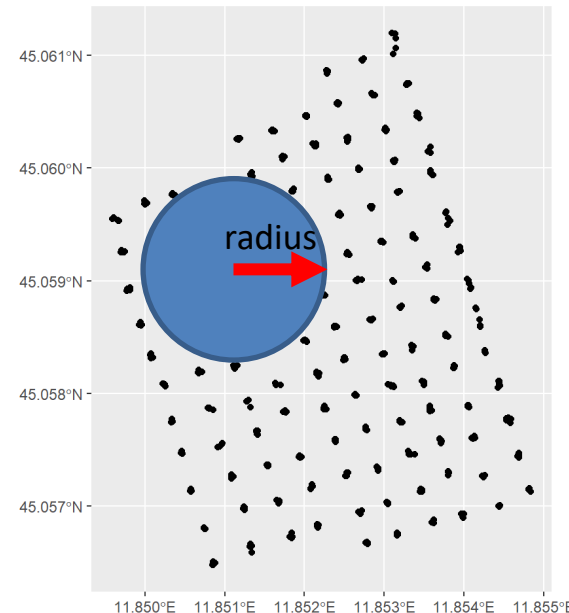
● -> for both cases one sample



Why limited use of rep. metrics and how to advance?

- One of the main limitation of the metrics proposed so far in literature is the need of **several observations**
- To overcome this limitations we are developing a metric based on the assessment of the **factors** affecting the variable of interest
- E.g., for soil water content **SWC** by analyzing **weather, topography, vegetation and soil** we can infer representativeness of a SWC observation.

- We are testing this hypothesis by looking at SWC data-sets, e.g.,



Take-home-messages

- **Representativeness**, a concept generally well acknowledged but, in comparison to other observations metrics, **not universally defined**
- **The use** in literature of representativeness metrics **limited**. However, relevant for, e.g., intercomparison and sampling design
- We are developing a relative simple metrics, but, independently from that, the question holds
- **A philosophical detail or a basic paradigm?** We believe that representativeness metrics should be routinely performed for a better interpretation of the results in any studies



THANK YOU FOR THE ATTENTION

SoMMet

Aknowledgments

<https://www.sommet-project.eu/home>

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