



Uncertainty in remote sensing data and their analysis for forest inventory

Yasumasa Hirata

Forestry and Forest Products Research Institute, Japan

FFPRI



Uncertainty

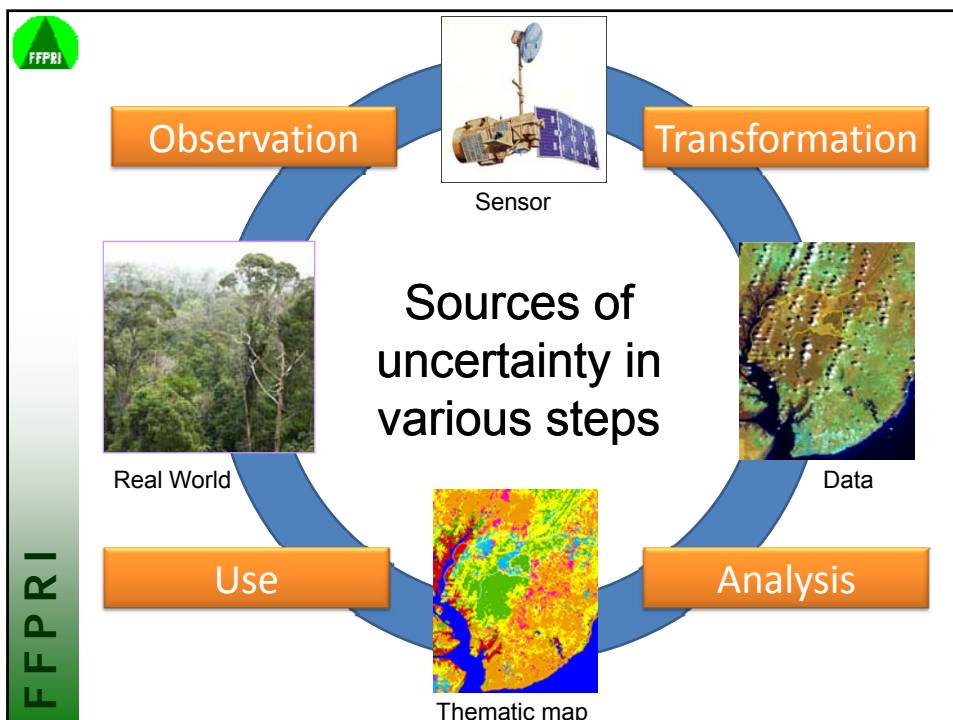
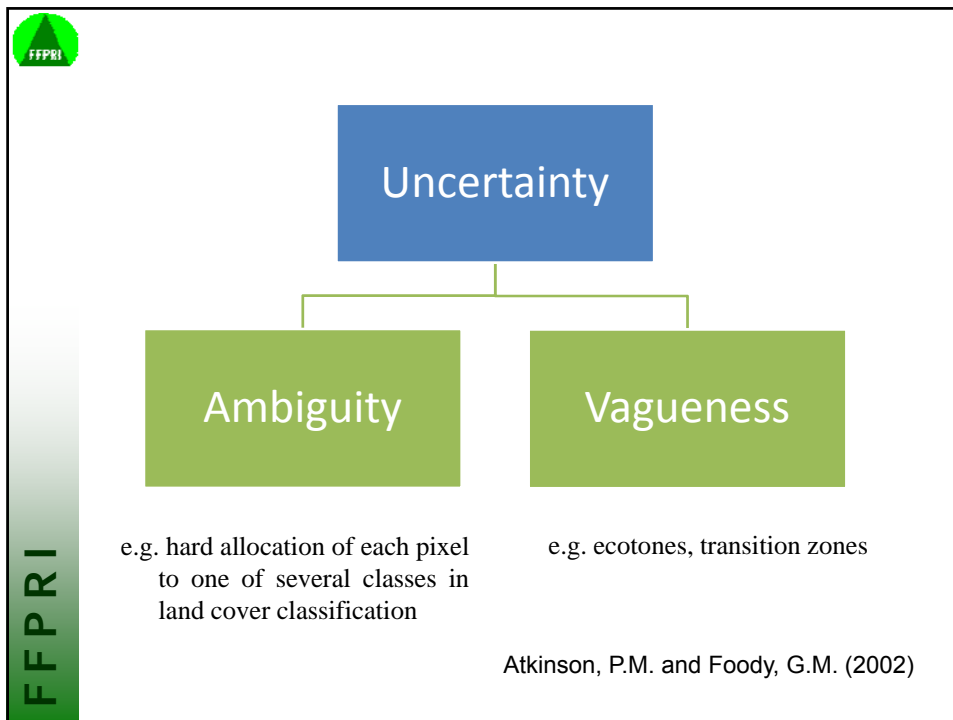
Uncertainty means the lack of knowledge of true value of a variable, including both bias and random error.

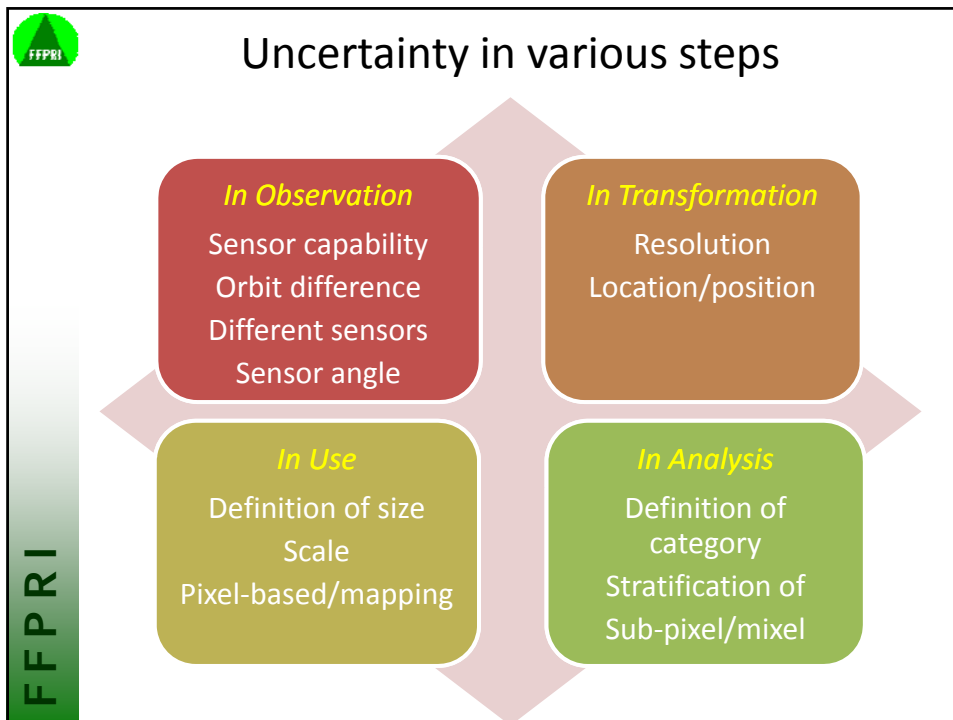
GOFC-GOLD (2009)

Uncertainty arises from many sources ranging from ignorance through measurement to prediction.

Atkinson, P.M. and Foody, G.M. (2002)

FFPRI





FFPRI

Uncertainty about location

- Ground control points
- Difference of positions between multi-temporal images
- Uncertainty about models used to transform the input variables to the desired output variables
- Requirement of finer resolution of DEM, which includes uncertainty, than image resolution

The diagram illustrates the concept of location uncertainty. It shows a satellite with a sensor beam covering a green triangular area on the ground. Below this, a grid of black and red lines represents a Digital Elevation Model (DEM) with varying resolutions.

FFPRI



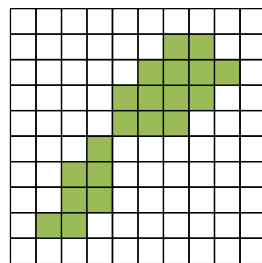
Uncertainty in definition - for category or class of classification -

- Some land surface cannot be assigned to a certain category
- Gap between definition of category and remote sensing observation

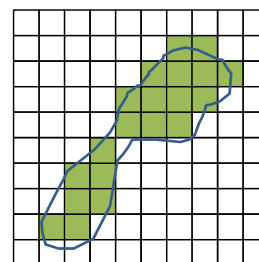


Uncertainty about definition - minimal size and continuity -

Continuity or discontinuity?

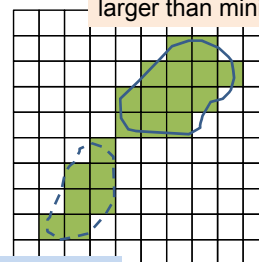


Area: 20 pixel unit



About 20 pixel unit

larger than minimal size



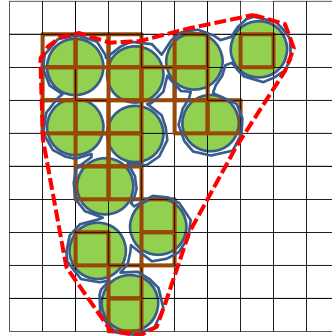
Smaller than minimal size

About 13 pixel unit

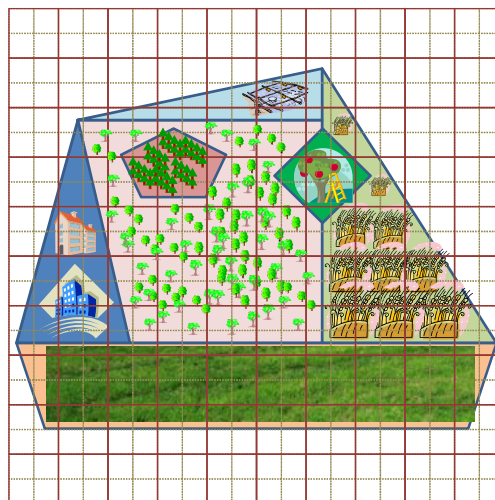


Uncertainty of boundary

- Boundary cannot be decided certainly
- Rule of recognition is required
- Effect on area estimate of category



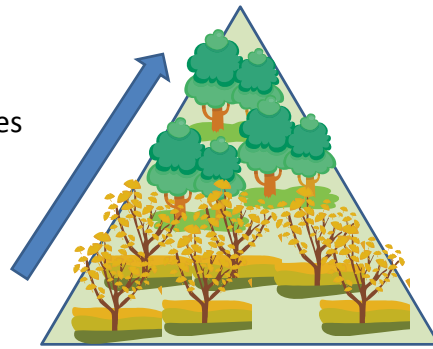
Further issues: Spatial resolution and mixel





Further issues: Phenology or seasonality

- Elevation
- Latitude
- Annual change of fallen leaves
- Probability of acquiring data



Dryness (in tropical seasonal forest)



Further issues: Agricultural land with trees

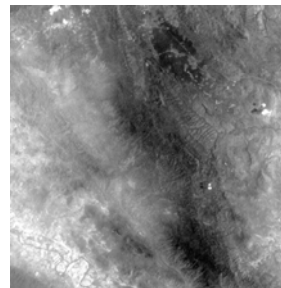
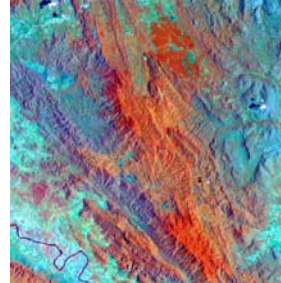
- Rubber plantation vs. plantation for timber production
- Shifting cultivation
 - Fallow land vs. abandoned area?
- Orchard vs. forest
- Similar reflectance of canopy surface





Further issues: Data acquisition

- Not only cloud and its shade but also haze affect the result of classification
- Continuity of sensor and comparability between different sensors



Concluding Remarks

- Reduction of uncertainty
 - Probabilistic approach
 - Fuzzy information representation
- Multi-temporal data analysis
 - Avoiding ambiguity still with uncertainty
- Accuracy is needed to be enough for decision-making in climate change context.
- New technology and methodology of remote sensing will improve the accuracy



References

- Foody, G.M., Atkinson, P.M. (eds.) (2002) Uncertainty in Remote Sensing and GIS. John Wiley & Sons.
- GOFC-GOLD (2009) A sourcebook of methods and procedures for monitoring and reporting anthropogenic greenhouse gas emissions and removals caused by deforestation, gains and losses of carbon stocks in forests remaining forests and forestation. GOFC-GOLD.
- Lunetta, R.S., Lyon, J.G. (eds.) Remote Sensing and GIS Accuracy Assessment. CRC Press.



Thank you for your attention!



Where is boundary?