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Towards a Quality Aware Web Processing Service

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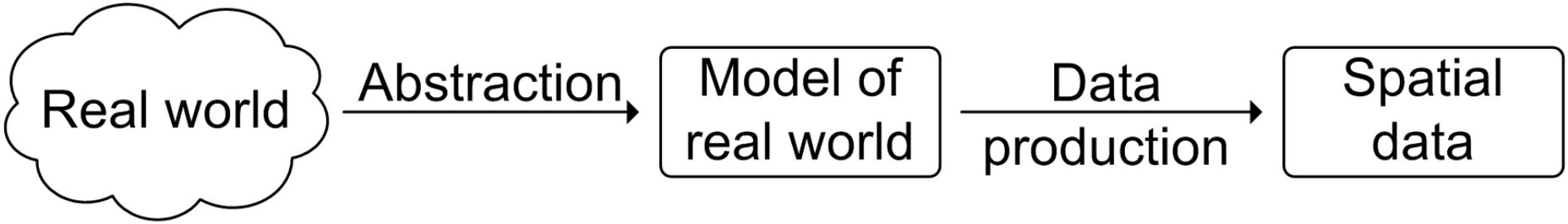
Outline

- Data quality
- Requirements
- Use case
- Integration of metadata and spatial data
- Conclusions and future work

What is data quality



Source: Gerhard Joos, 1999

- Producing spatial data causes errors
  -> Spatial data are incomplete and imprecise
- Data quality = Degree of deviation from the model

Why data quality

- Are the data suitable for my field of application (fitness for use)?
- Is the processing result significant enough?

Goal

Dynamic generation of quality information for the results of spatial analyses

Requirements

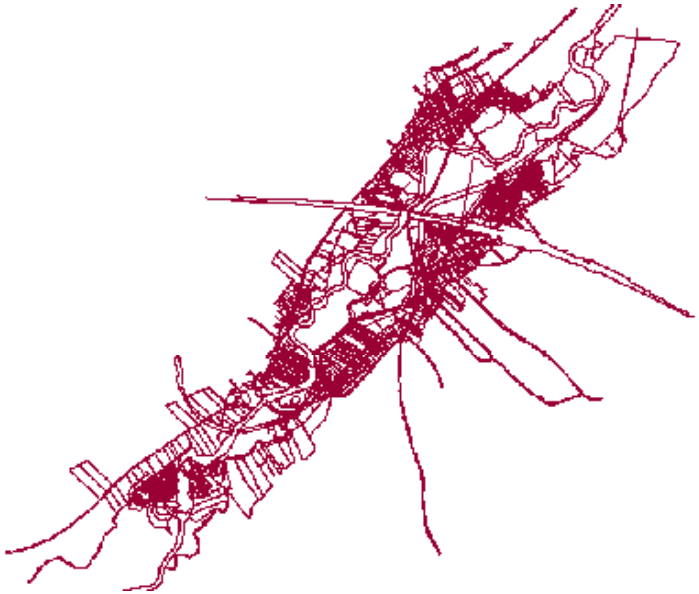
- Metadata for providing quality information (ISO 19115)
- Integration of spatial data and metadata (GML and ISO 19139)
- Web Processing Service (WPS) for

  -> Performing spatial analyses

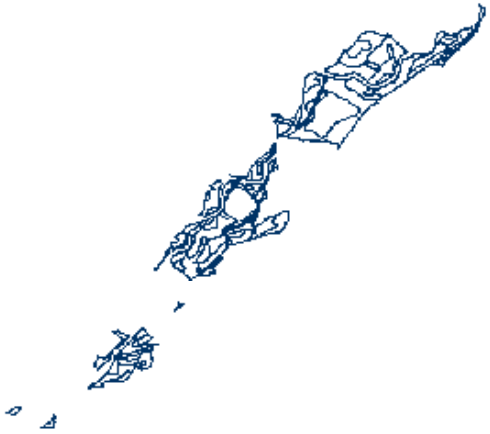
  -> Generating quality information based on the quality of the input data

Use case

Digital land register



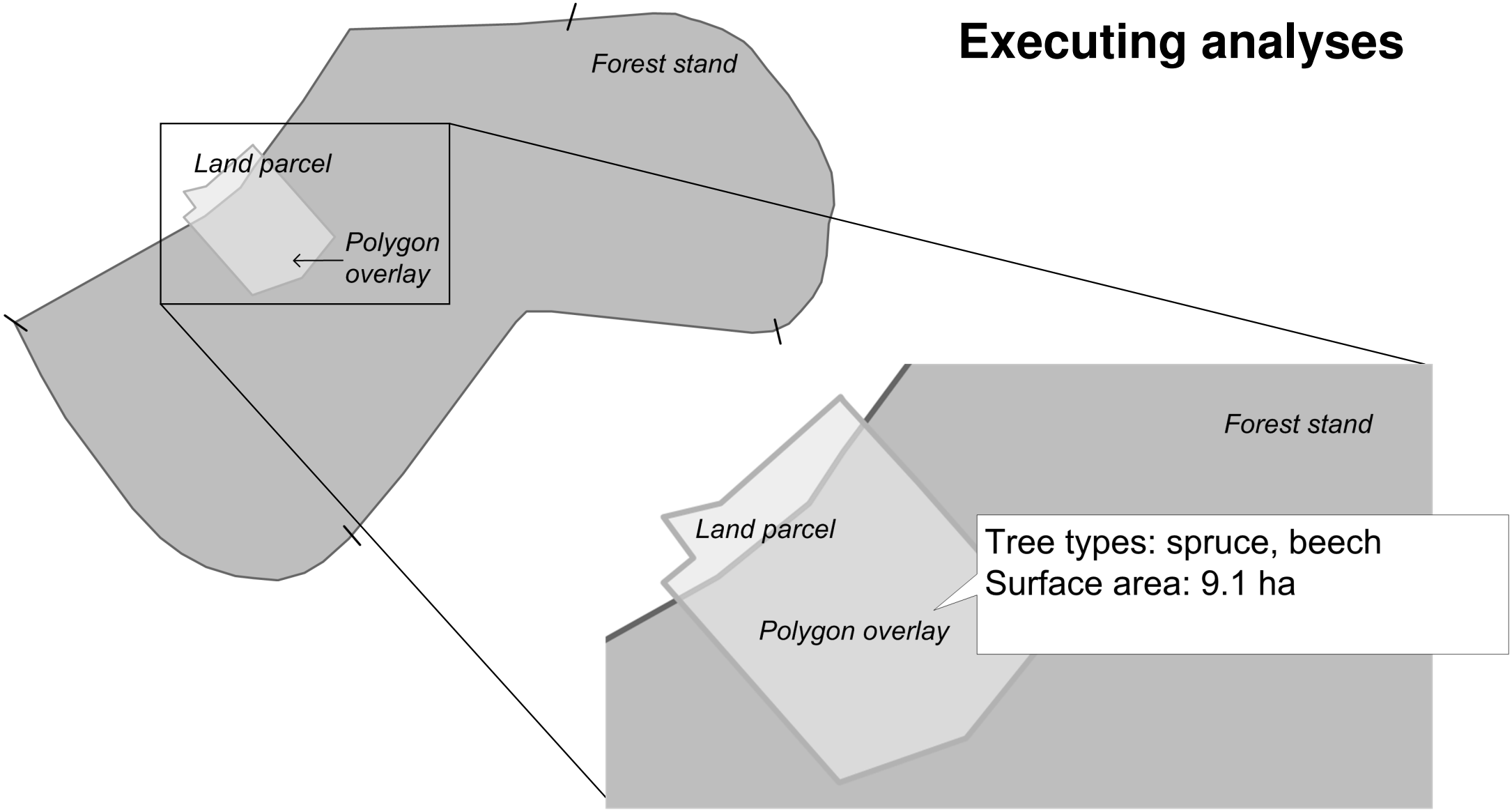
Data about forest stands



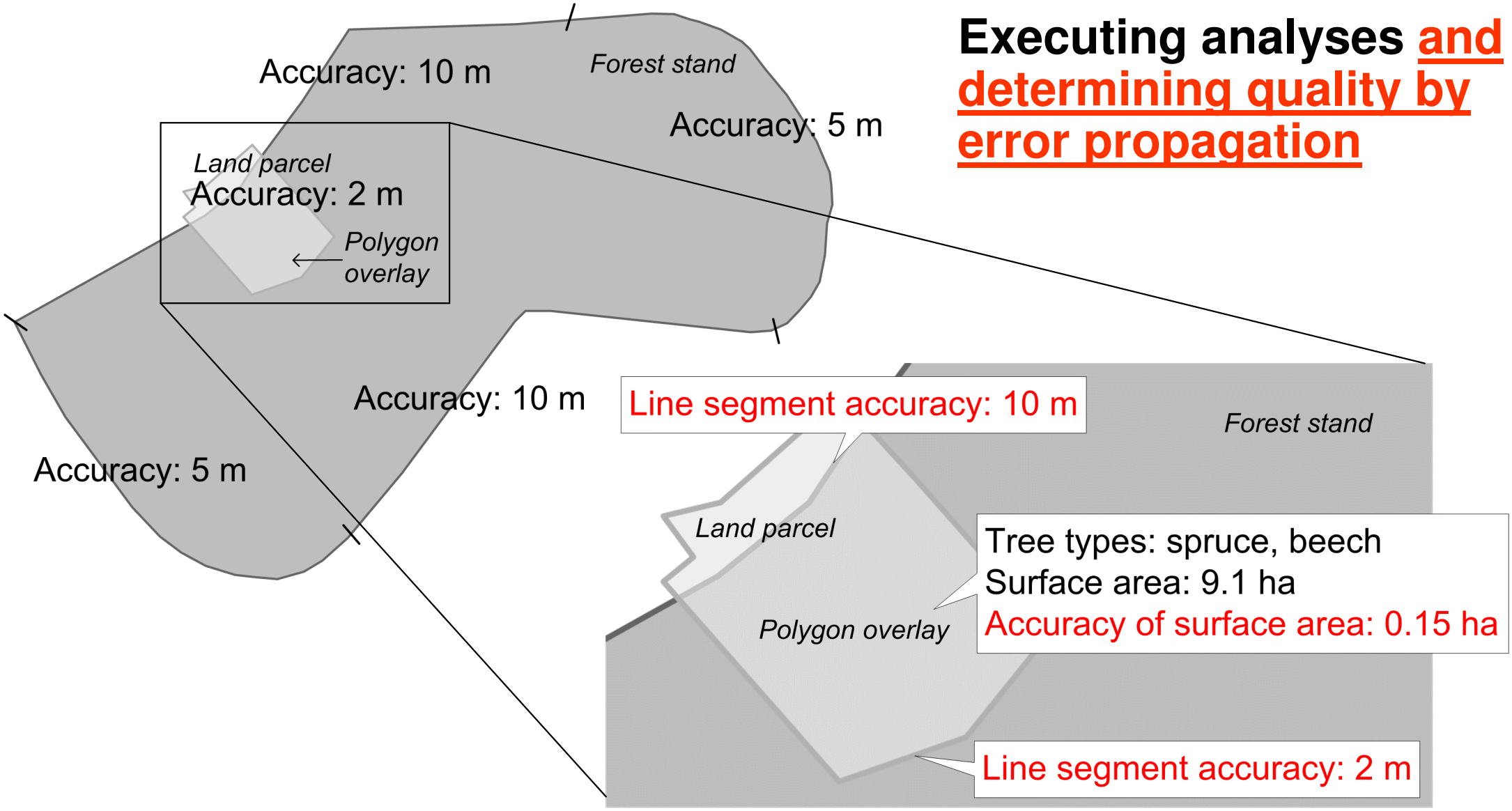
The question:

Which type of tree X is most suitable for land parcel Y and how large is the available surface area in hectares?

Use case not taking into account data quality



Use case ~~not~~ taking into account data quality



Executing analyses and determining quality by error propagation

Functionalities

Functionalities selected for processing spatial data with a WPS:

Functionality 1

1a) Performing spatial analyses (Polygon overlay)

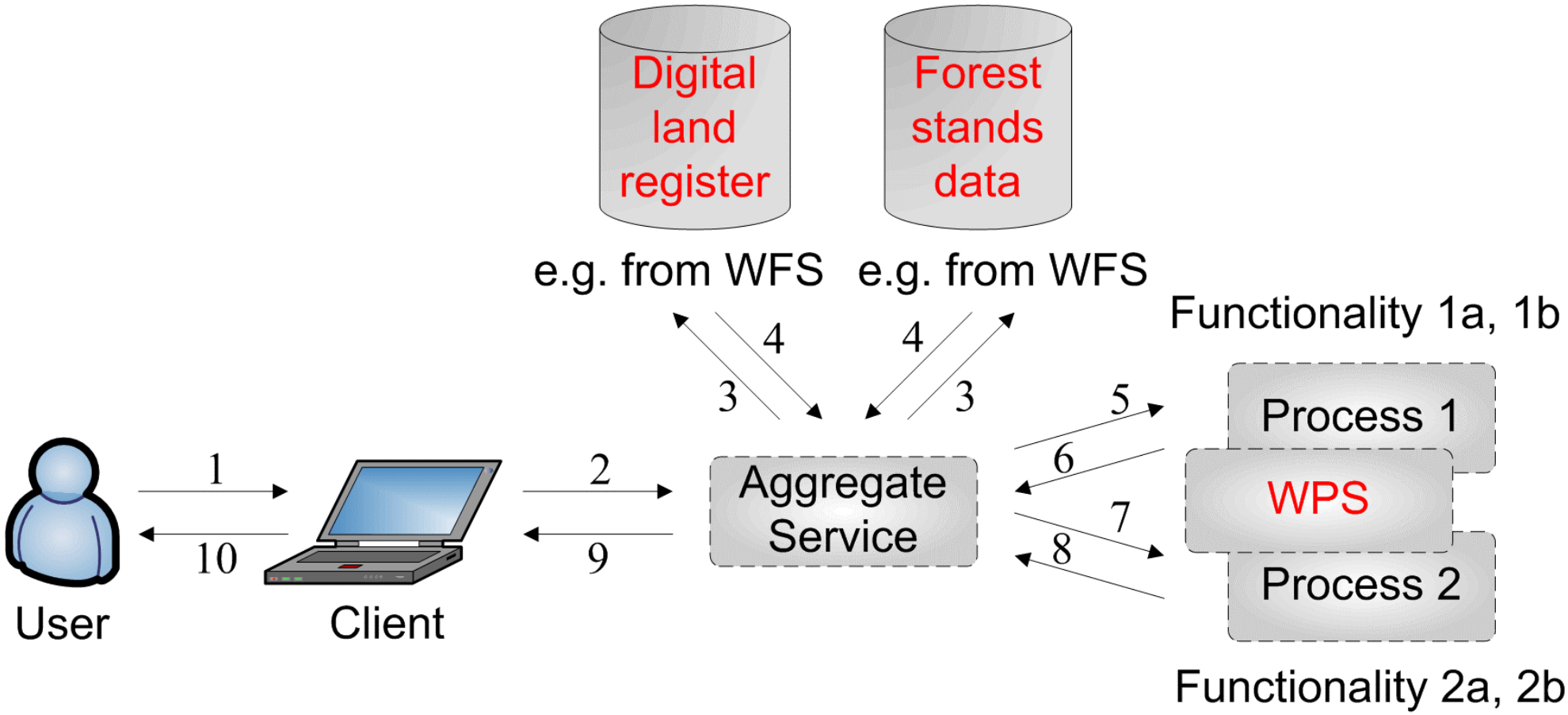
1b) Determining quality information for the analysis result (Spatial accuracy)

Functionality 2

2a) Deriving values from the geometry (Area calculation)

2b) Determining quality information for these values (Area accuracy)

System architecture of the prototype



Metadata integration – Levels of metadata

Levels for meta information in spatial data

- Dataset
- Feature
- Feature property
- Geometry
- Sub geometry

Metadata integration – Area types and quality

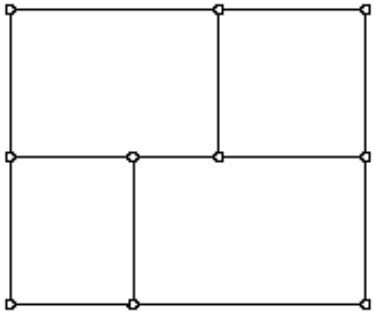
Areas with uncertain boundaries

- Natural boundaries
- Accuracy of border points depends on exactness of locating the border line

➡ Levels geometry and sub geometry

Areas with exact boundaries

- Artificial, defined boundaries
- Exact border points



➡ Level dataset

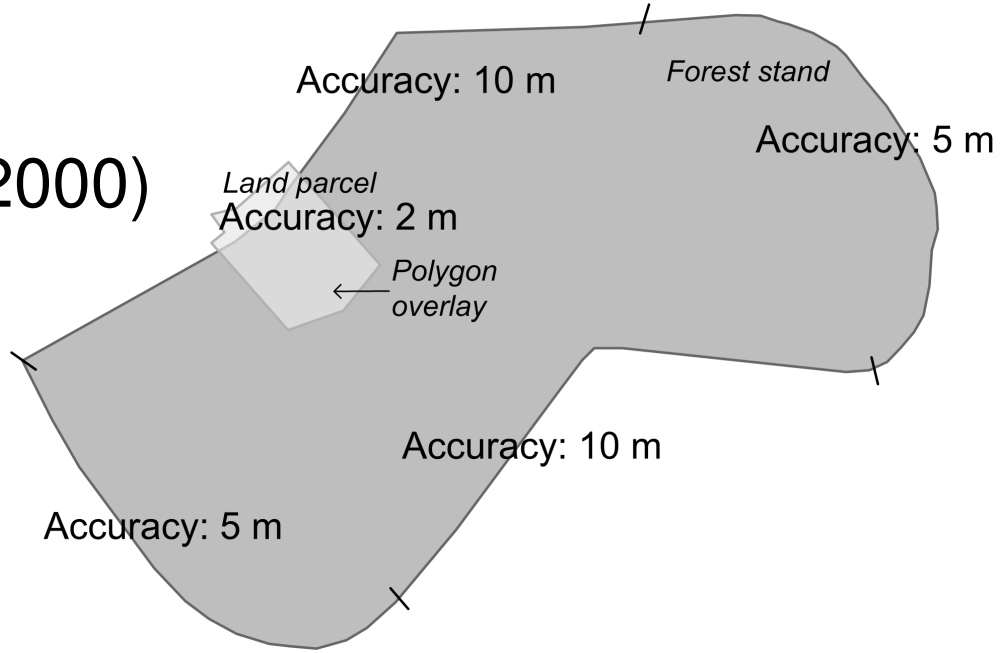
Metadata integration – Accuracy and propagation model

Accuracy model

- Line-by-line approach (Glemser, 2000)

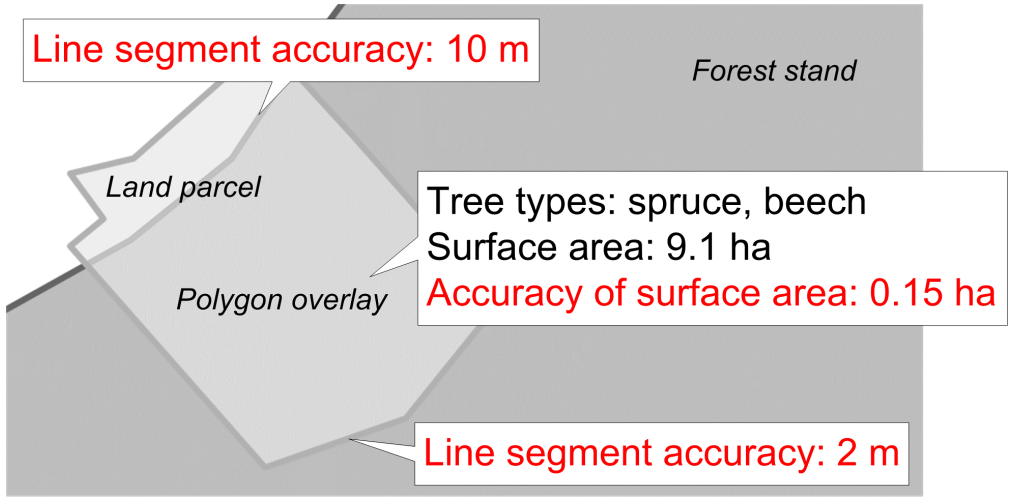
  -> Polygon is separated into line segments

  -> Quality added to line segments



Propagation model

- Quality simply transferred to line segments of new polygon



Metadata integration – Standards

Geography Markup Language (GML)

- XML-based language for modelling and transferring spatial data
- Supports integration of metadata

ISO 19115

- International standard for metadata
- Contains required quality elements

ISO 19139

- Implementation of ISO 19115 metadata as XML schemata
- Facilitates integration of metadata in GML

Metadata integration – GML encoding

Generation of WPS output for process 1

Input 1

```
<gml:FeatureCollection1>
  <app1:Feature1 gml:id="id1">
    ...
    <gml:metaDataProperty>
      ...
    </gml:metaDataProperty>
  </app1:Feature1>
</gml:FeatureCollection1>
```

Input 2

```
<gml:FeatureCollection2>
  <app2:Feature2 gml:id="id2">
    ...
</gml:FeatureCollection2>
```

Output

```
<gml:FeatureCollection>
  <wsas:AssociationPair>
    ...
    <gml:metaDataProperty>
      ...
    </gml:metaDataProperty>
    <wsas:associatedWith xlink:href="#id1">
    <wsas:associatedWith xlink:href="#id2">
  <wsas:AssociationPair>
  <app1:Feature1 gml:id="id1">
    ...
    <gml:metaDataProperty>
      ...
    </gml:metaDataProperty>
  </app1:Feature1>
  <app2:Feature2 gml:id="id2">
    ...
</gml:FeatureCollection>
```

Metadata integration – GML encoding

Generation of WPS output for process 1

```
1  <gml:segments>
2    <gml:LineStringSegment>
3      <gml:posList>0 0 10 0 5 10</gml:posList>
4    </gml:LineStringSegment>
5  </gml:segments>
6  <gml:metaDataProperty>
7    <mdl:GeometryLevelMetadata>
8      <mdl:absoluteExternalPositionalAccuracy>
9        <gmd:DQ_AbsoluteExternalPositionalAccuracy>
10         <gmd:result>
11           <gmd:DQ_QuantitativeResult>
12             <gmd:valueUnit xlink:href="#m"/>
13             <gmd:value>
14               <gco:Record xsi:type="gml:LengthType“ uom="#m">2.0</gco:Recor
15             </gmd:value>
16           </gmd:DQ_QuantitativeResult>
17         </gmd:result>
18       </gmd:DQ_AbsoluteExternalPositionalAccuracy>
19     </mdl:absoluteExternalPositionalAccuracy>
   </mdl:GeometryLevelMetadata>
</gml:metaDataProperty>
```

Line segment

Line segment accuracy

Conclusions and future work

Conclusions

- WPS suitable for dynamically generating quality information at different data levels
- Concept is generic and applicable to various areas of application
- Practicability and relevance was demonstrated

Future work

- Integration of further spatial analysis methods
- Integration of further metadata elements
- User-friendly visualization of quality information

Thank you!

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