Flexible Representation of

Spatio-Temporal Random Fields in the Model Web

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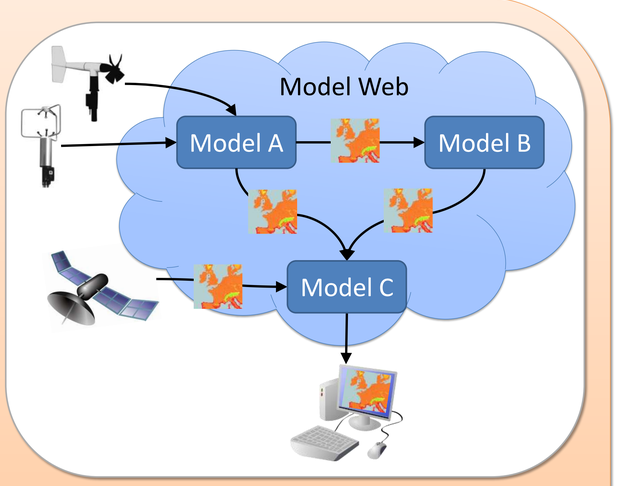
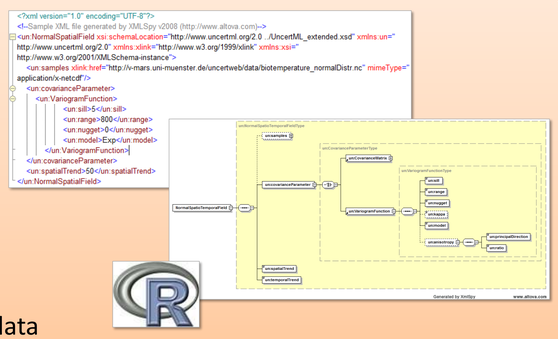
Problem Statement:

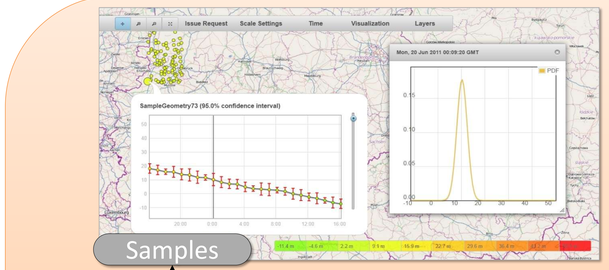
- In environmental sciences, the phenomena of interest are usually not well bounded objects, but rather continuous phenomena in space and time (spatial or spatio-temporal fields)
- Spatio-temporal fields are often modelled as random variables
- Spatio-temporal fields are usually represented and exchanged as raster data:
  - *Communication overhead of data values, BUT*
  - *Interpolation method used to calculate the raster values is not communicated*
  - *Original observations the raster originates from are usually not communicated*
  - *Natural randomness in the interpolated variables and interpolation uncertainties are also not available*



Implementation:

- Conceptual Model is an Extension of the Uncertainty Markup Language (*UncertML*)
- XML Schema Encoding and JSON Encoding
- JAVA API for Encoding/Decoding
- Web Service for Interpolation and Spatial Simulation (based on 52°North Web Processing Services)
- R-functions reading and writing UncertML-enriched data





representedBy

ST-RandomField

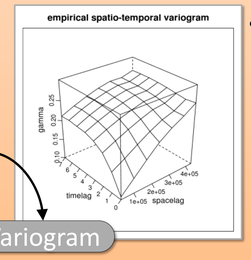
definedBy

Trend

Variability

representedBy

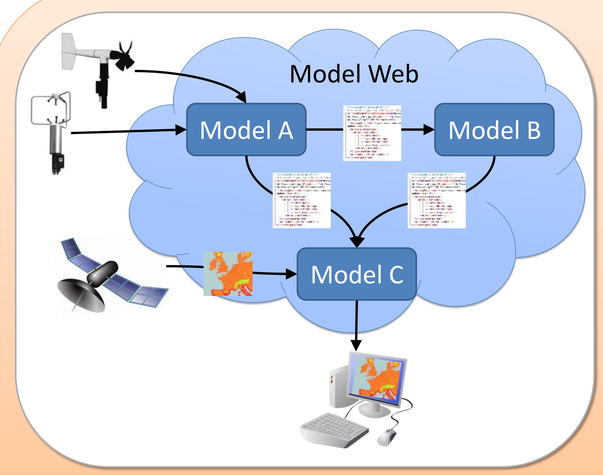
CovarianceMatrix



Variogram

Approach:

- The spatio-temporal variable is decomposed into its *variability* and *trend* component
- A typical (Gaussian) data set contains raw observations alongside with model assumptions on variogram and (potentially constant) trend
- The model implicitly addresses the natural randomness
- Any raster can be derived from this machine readable implementation



Conclusion & Outlook:

- No information is lost, a richer flexibility is achieved
- The traffic is considerably reduced
- Interpolation methods can be adopted by the modellers needs
- Raster resolutions are not unnecessarily fixed by the data provider
- Simulations become possible
- Uncertainty enabled analysis becomes feasible

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