



# Towards a generalization of data gathered by Geosensor Networks

**Christoph Stasch**

**Bilateral Event 2009**

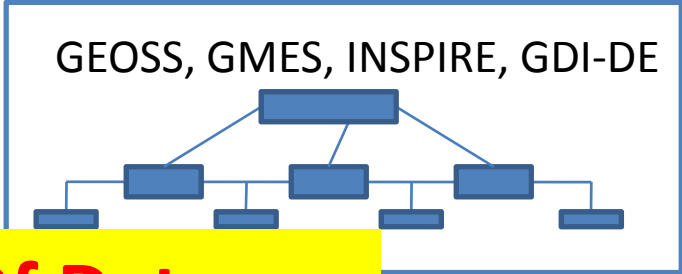
National Institute for Space Research (INPE)  
Sao Paulo, Brazil

Institute for Geoinformatics  
University of Muenster, Germany

# Overview

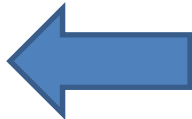
- Motivation
- Definitions:
  - Generalization
  - Geosensor Networks
- Research Questions
- Idea
- Outlook & Open Questions

# Motivation



**Large Amount Of Data**  
**Different Scales+Granularities**  
**Of Data**

Environmental Monitoring,  
Disaster Management,  
Spatial Assistance, ...



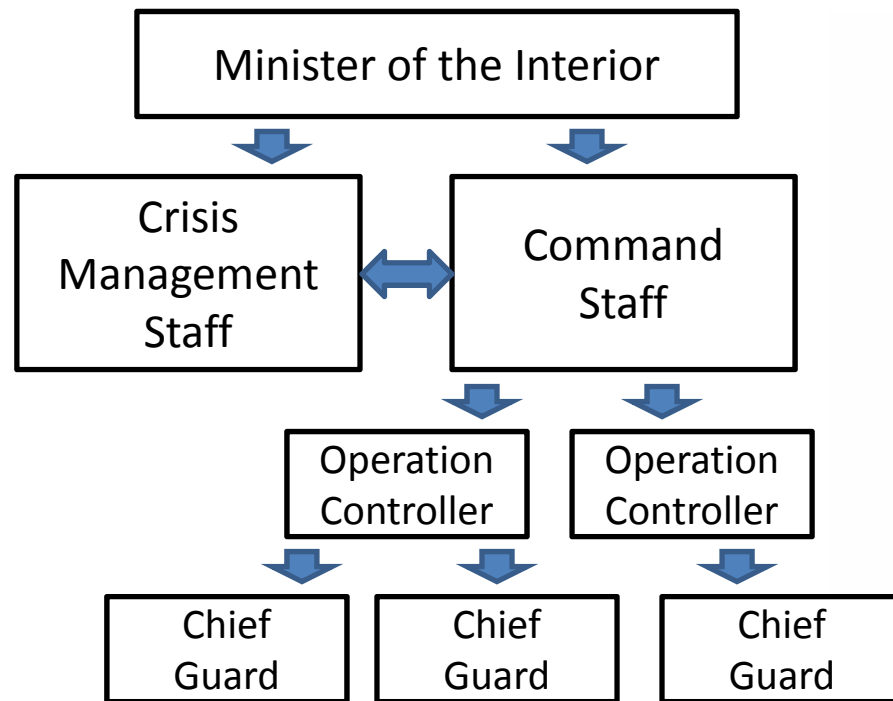
# Motivation

- Flood Disaster Scenario



# Motivation

- Hierarchies of decision makers:

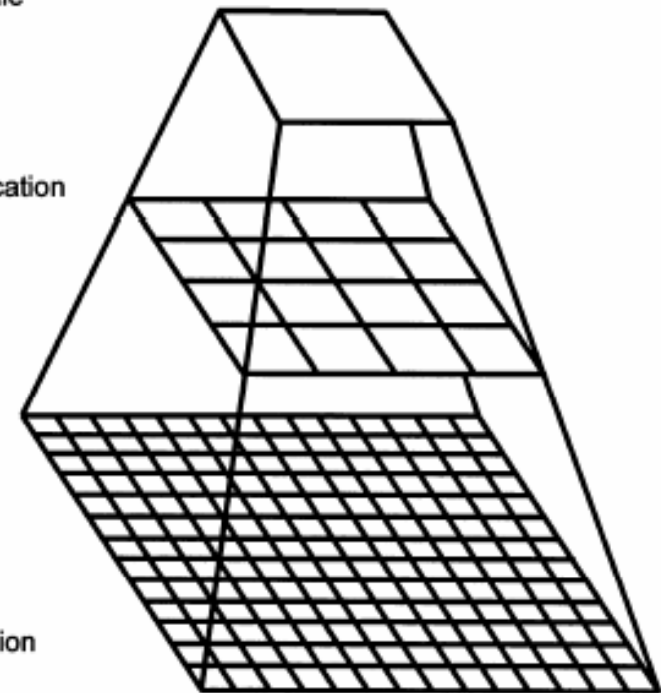


**Source:** Federal Office of Civil Protection and Disaster Assistance (BBK) of Germany

National scale

Coarse allocation scale

Fine allocation scale



**Source:** Verburg et al. (1999)

**Motivation**

Generalization

Geosensor Networks

Research Questions

Idea

Open Questions

# Towards a generalization of Geosensor Networks

# Definitions of Generalization

- “the process of **deriving**, from a **data source**, a symbolically or digitally-encoded **cartographic data set** through the application of **spatial and attribute transformations**”  
(McMaster&Shea 1992)
  - Maintain clarity
  - Appropriate content
  - Certain map purpose
  - Intended audience

# Definition of Geosensor Network

- **Sensor** (Havens 2007)
  - Phenomenon → Digital Representation
- **Distributed Sensor Networks** (Sastry&Iyengar 2005)
  - Distributed Sensors, Communication, Processing, Storage, Energy
- **Geosensor Network (GSN)** (Stefanidis&Nittel 2005)
  - Observation of phenomena in geographical space
  - measuring environmental stimuli that can be geographically referenced



# Current research in GSN

- Localization of sensor nodes (e.g. Reichenbach et al. 2008)
- In-Network Processing vs. Centralized Approach (e.g. Sadeq&Duckham 2008)
- Information Fusion (e.g. Dasarathy 2001)
- Data Modeling (e.g. Worboys&Duckham 2006)
- Protocols, standardized Interfaces, real-time Integration into common GIS applications/SDIs (IEEE, OGC, ISO)

# Research Questions

- How can data gathered by GSNs be generalized and which dimensions of sensor data should be considered in such a generalization?
- How could the appropriate spatial-temporal granularity be determined for different scenarios?
- How can generalization algorithms be realized in GSNs and sensor applications?
- Is it possible to define measures for the evaluation of the generalization results?

# Idea: Generalization of GSN

- “the process of deriving, from a data source, a symbolically or digitally-encoded cartographic data set through the application of spatial and attribute transformations”  
(McMaster&Shea 1992)
  - Maintain clarity
  - Appropriate content
  - Certain map purpose
  - Intended audience

# Idea: Generalization of GSN

- the process of deriving, from a **sensor data source**, a ~~symbolically or~~ digitally-encoded ~~cartographic~~ data set through the application of spatial, **temporal** and attribute transformations
- Similar goals
  - Maintain clarity
  - Appropriate content
  - Certain ~~map~~ application purpose
  - Intended audience
  - not only for visualization purposes
- Additional parameters:
  - Sensor characteristics

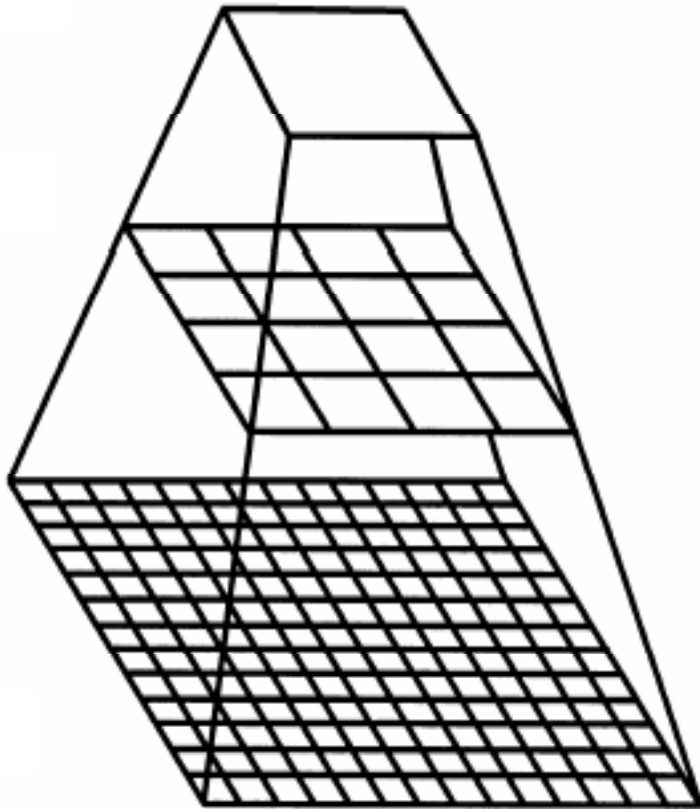
# Differences to Cartographic Generalization

	<b>Cartographic Generalization</b>	<b>Geosensor Generalization</b>
<b>Data types</b>	Discrete Objects	Discrete Objects and Spatial Fields
<b>Data sources</b>	Static data basis	Dynamic data basis
<b>Goals</b>	Improvement of visualization	Reducing amount of data; improving usability of data for further applications
<b>Dimension</b>	Spatial	Spatial, Temporal + Value Dimensions

# Idea towards a generalization of GSN

- Combination of
  - Spatial Generalization
  - Temporal Generalization
  - Information Fusion
- Methods to determine appropriate Level of Detail (LOD)

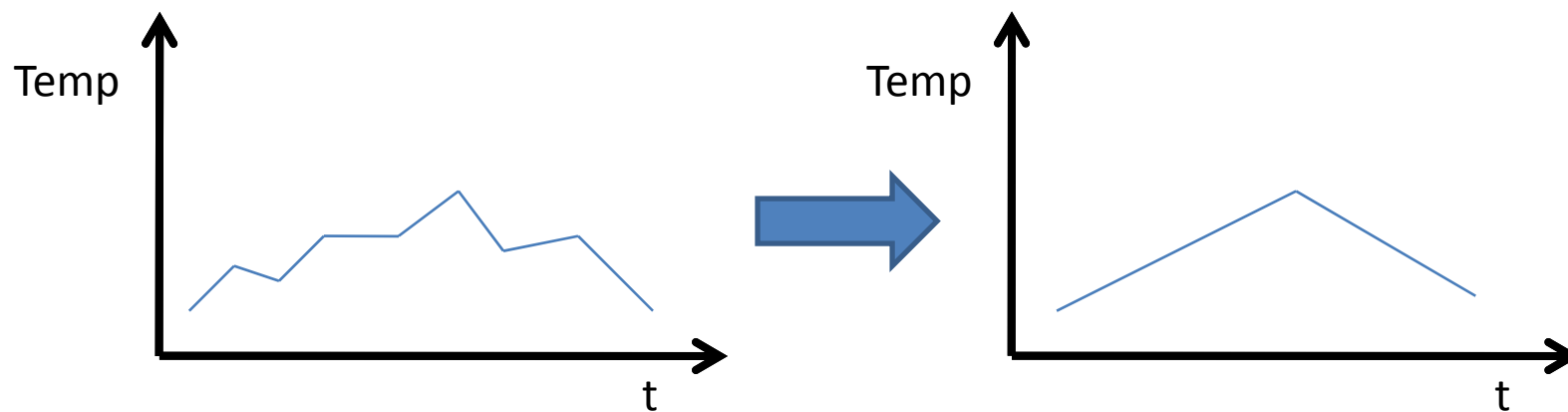
# Spatial Generalization



- Spatial Clustering Algorithms
- Further Geostatistical approaches (?)

# Generalization of observation time series

- Time in different granularities (Bettini 1995)
- Use of temporal aggregation functions (e.g. AVG)
- Time series analysis



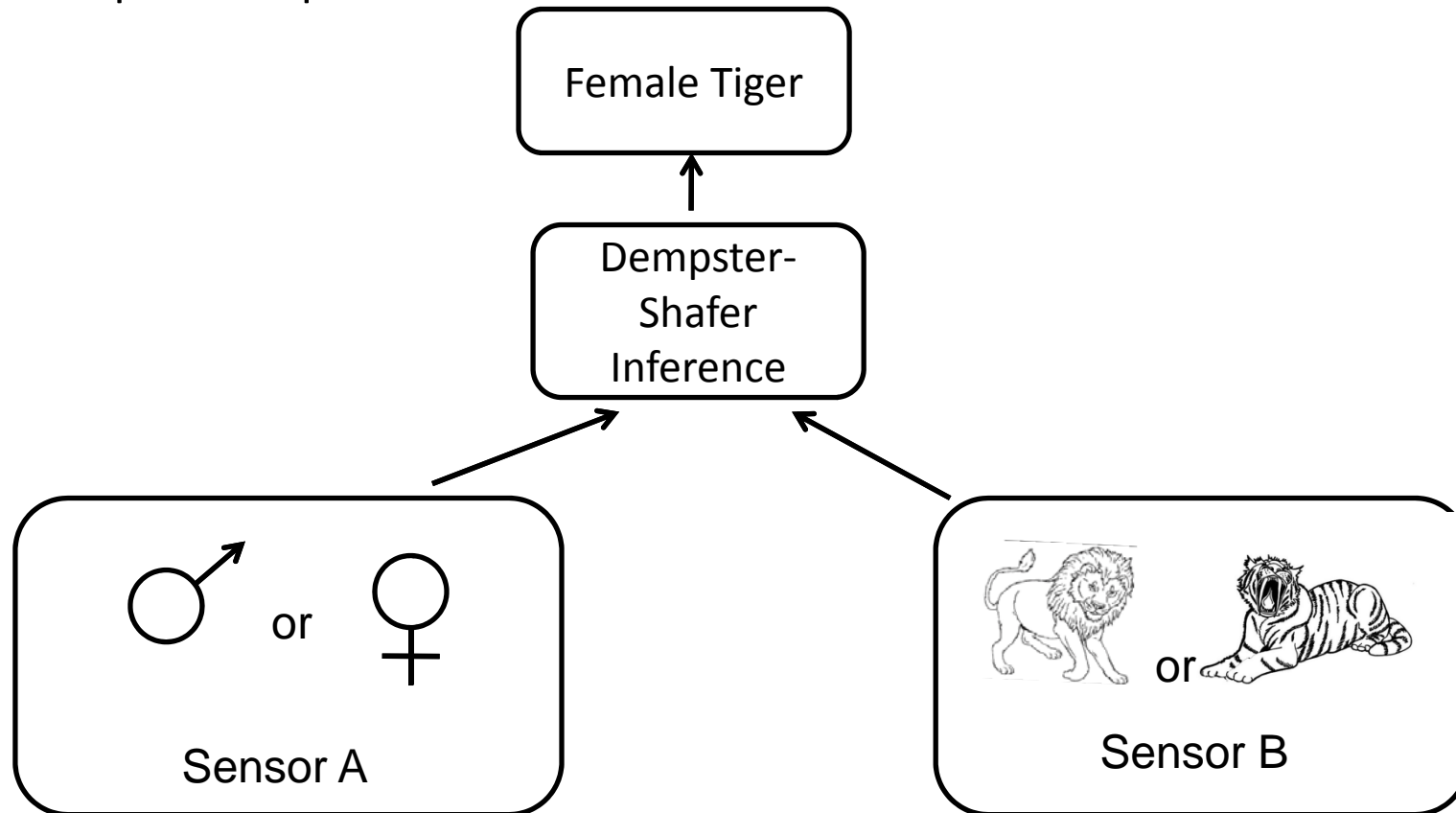


# Information Fusion

“...*theory, techniques and tools* ...to *exploit the synergy in the information* acquired *from multiple sources* (sensor, databases, information gathered by humans, etc.) in such a way that the *resulting decision or action is in some sense better* (qualitatively or quantitatively, in terms of accuracy, robustness, etc.) ...” (Dasarathy 2001)

# Information Fusion

- Example: Dempster-Shafer Inference:



(following Nakamura et al. 2007)

# Outlook

- Related work
- Generalizable data model for Sensor networks
- Development of algorithms
- Deployments in real world scenarios

# Open Questions

- Spatio-temporal generalization?
- In-network Processing or centralized approach?
- Semantics?
- Other directions (estimation)?

**Thank you!**

Questions? Comments?

# Literature

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