Graphical Interactive Systems
Technische Universität Darmstadt

Visual Analysis Approaches to Time Series Prediction

Visual Analytics – Interaktive Visualisierung sehr großer Datenmengen – Seminar SS 2018

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Outline

1. Introduction

2. Abstract Time Series
   - An Early Approach
   - A Trendy Approach
   - A Popular Approach
   - A Selective Approach
   - A Specialized Approach

3. Spatial Time Series
   - Predicting and Detecting Hotspots
   - Mapping between Time and Space

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Introduction

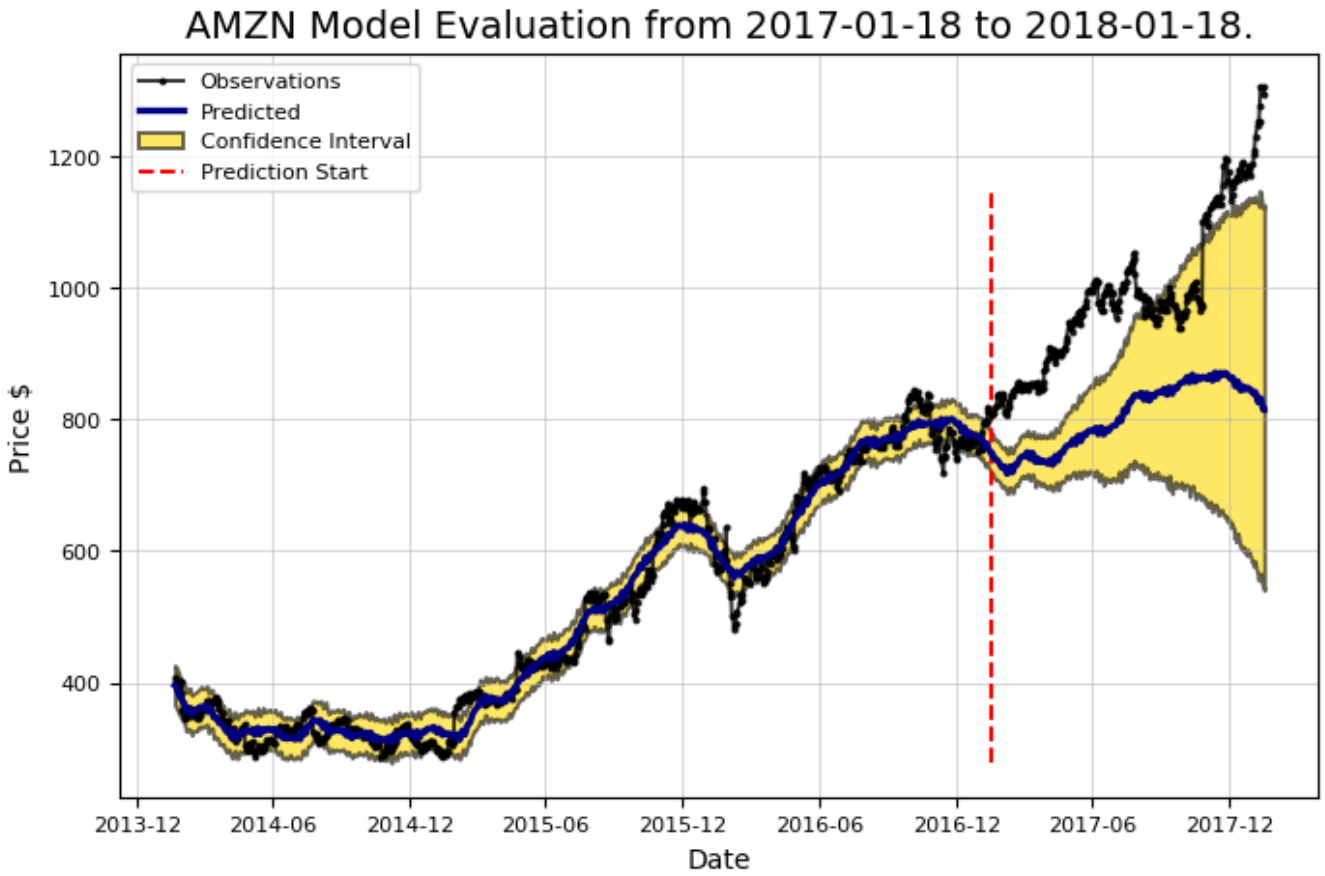

Figure 1: Amazon stock price prediction
[*https://towardsdatascience.com/stock-prediction-in-python-b66555171a2*]

Introduction

Abstract Time Series:

- What is the overall global trend?
- Do I have cyclic patterns?
- What are important periods of time?
- What is the best model?

Spatial Time Series:

- What are regions with unusually high occurrences of events?
- How are these regions developing?
- Where are new hotspots occurring?

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An Early Approach

Figure 2: Workplace environment
[*Ichikawa et al., 2002*]

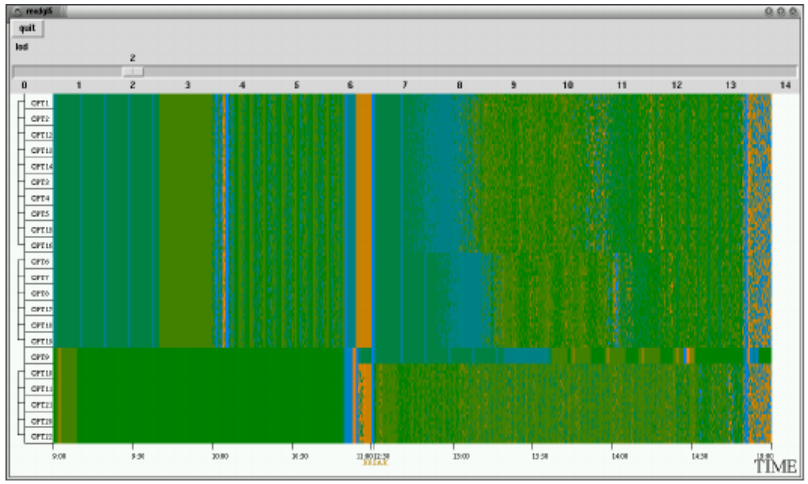

Figure 3: Color band display
[*Ichikawa et al., 2002*]

- Goal: Trend detection, correlation detection
- Compare multiple variables and different time series
- External simulations

A Trendy Approach

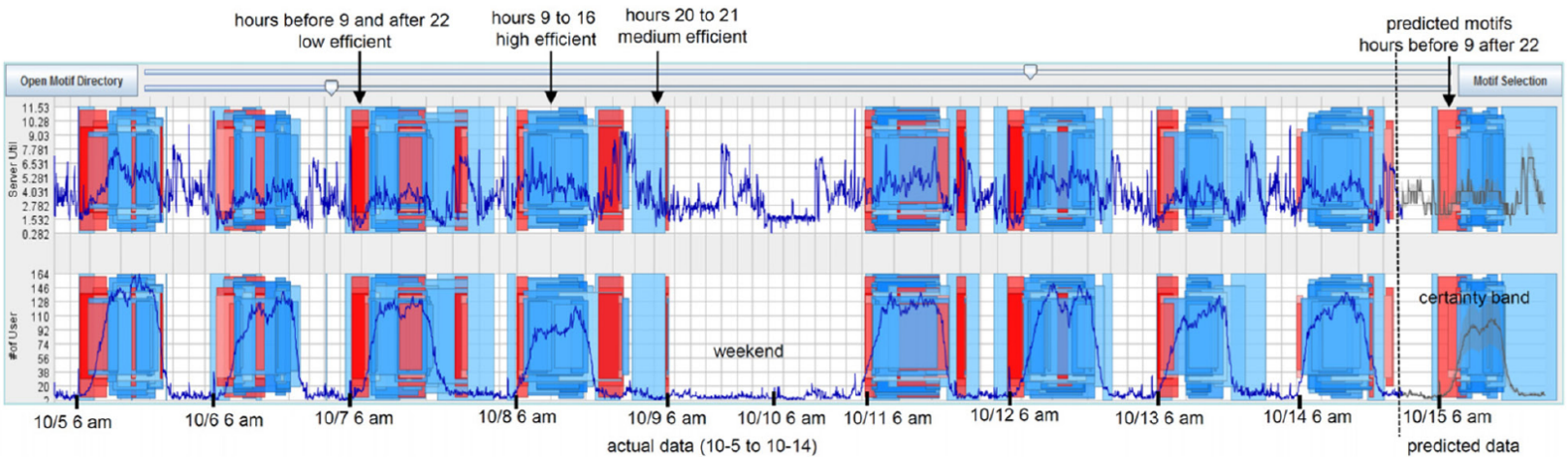

Figure 4: Peak preserving prediction [*Hao et al., 2012*]

- Goal: Trend detection
- Ensures Peak preservation

A Popular Approach

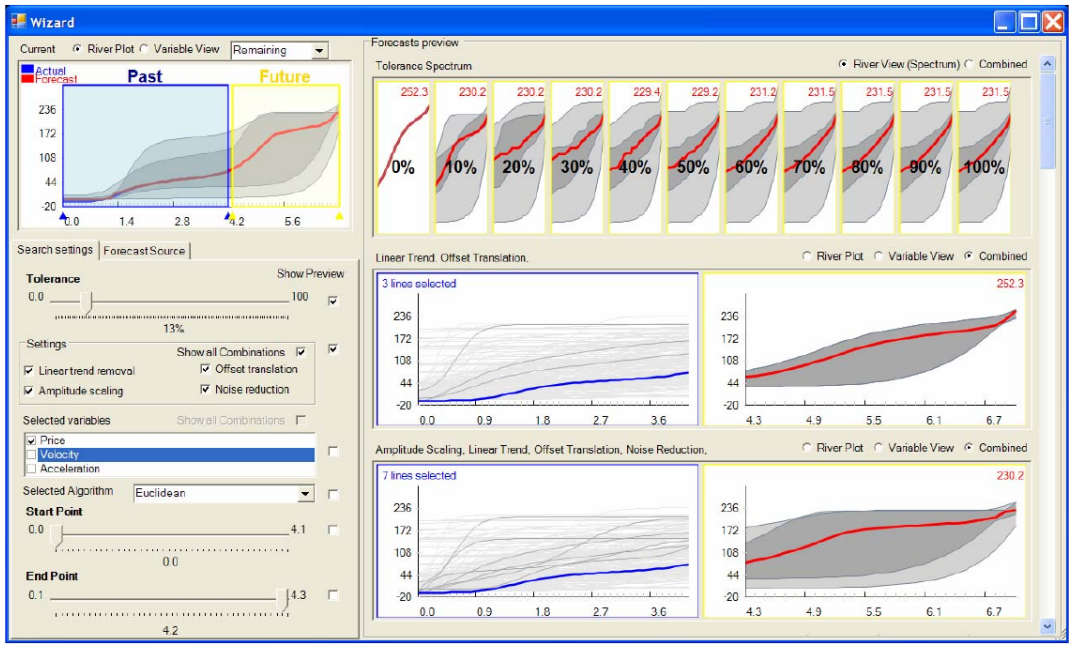

Figure 5: TimeSearcher3 simultaneous preview interface [*Buono et al., 2007*]

- Goal: Model selection
- Similarity based model and prediction
- Compare different parameters and subsets of data

A Selective Approach

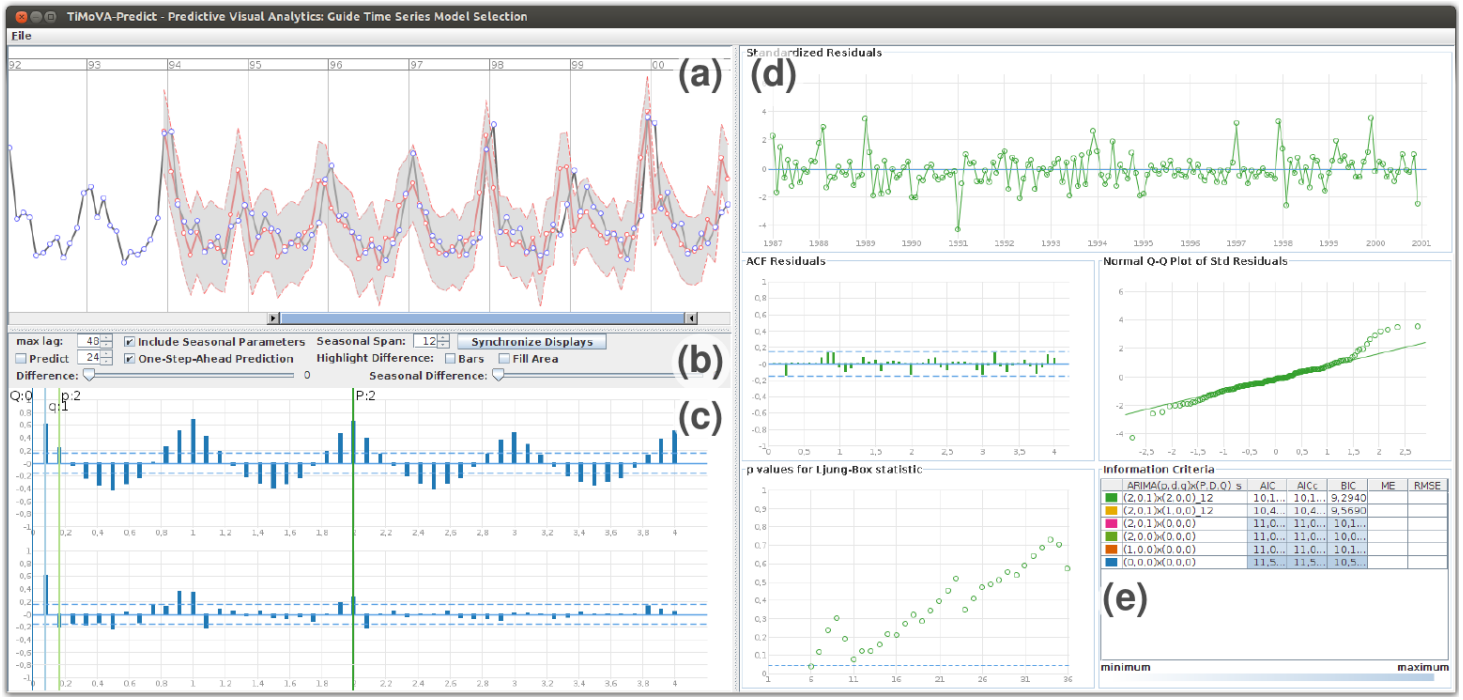

Figure 6: TiMoVA User Interface [*Bögel et al., 2013*; *Bögel et al., 2014*]

- Goal: Model selection
- Follows Box-Jenkins-Method

A Specialized Approach

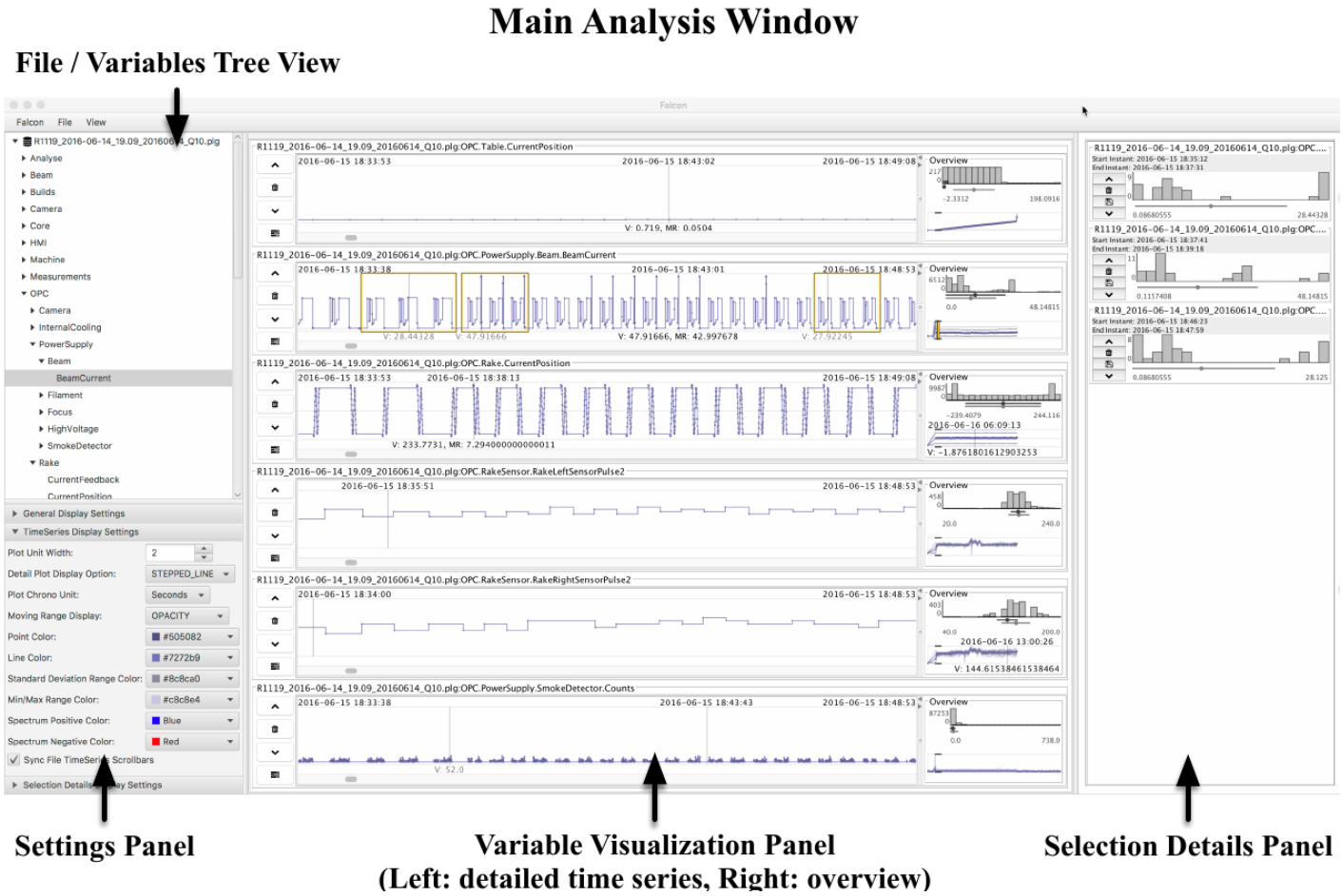

Figure 7: Falcon main window visualization [*Steed et al., 2017*]

A Specialized Approach

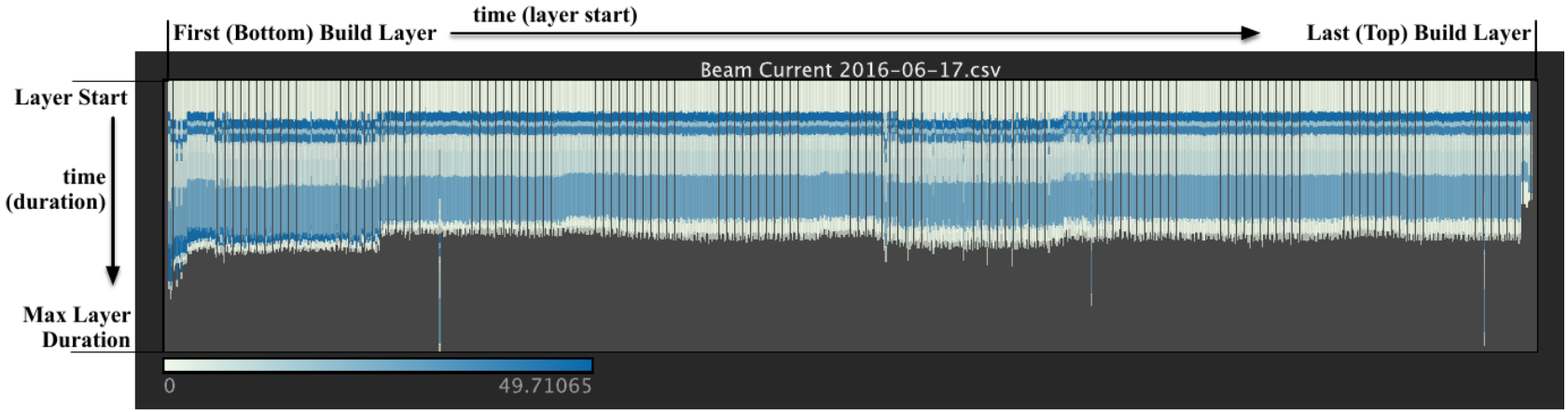

Figure 8: Falcon waterfall visualization [*Steed et al., 2017*]

- Goal: Correlation detection
- Supports high dimensional time series
- Application areas: predictive maintenance, quality assurance

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Predicting and Detecting Hotspots

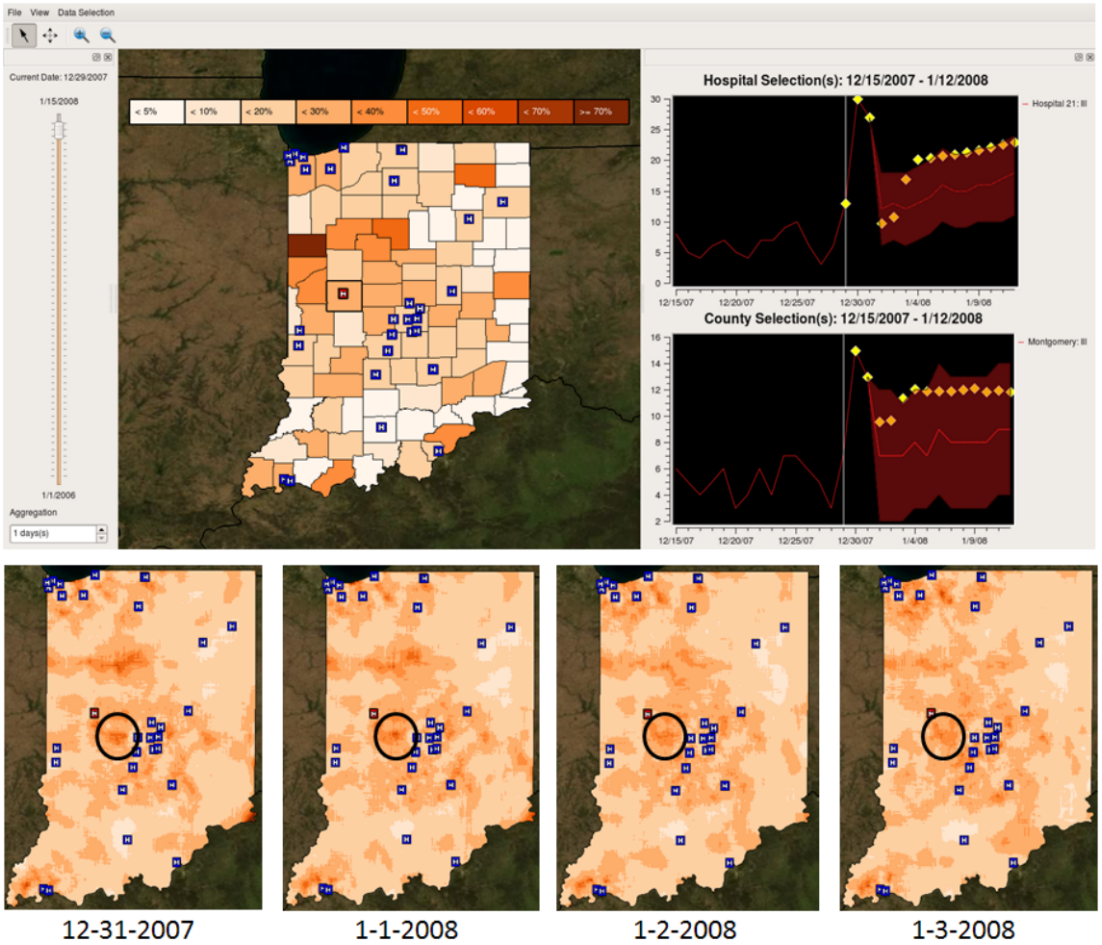

Figure 9: Forecasting Hotspots [Maciejewski et al., 2011]

- Modeling spatial approximation of time series prediction
- Combined visualization of time series prediction and spatial information
- Main focus: Hotspot detection and prediction

Mapping between Time and Space

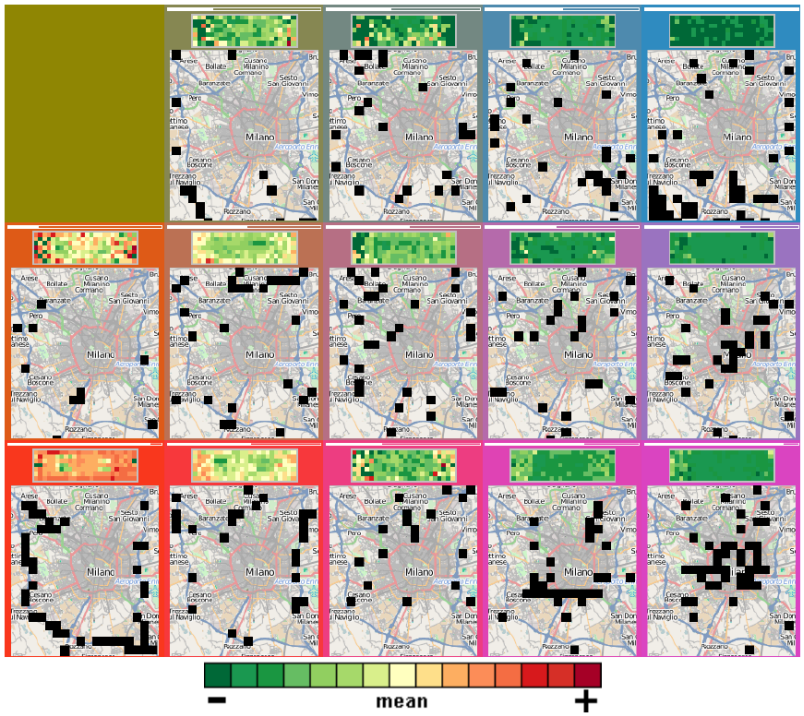

Figure 10: Time-in-space matrix [*Andrienko et al., 2010*]

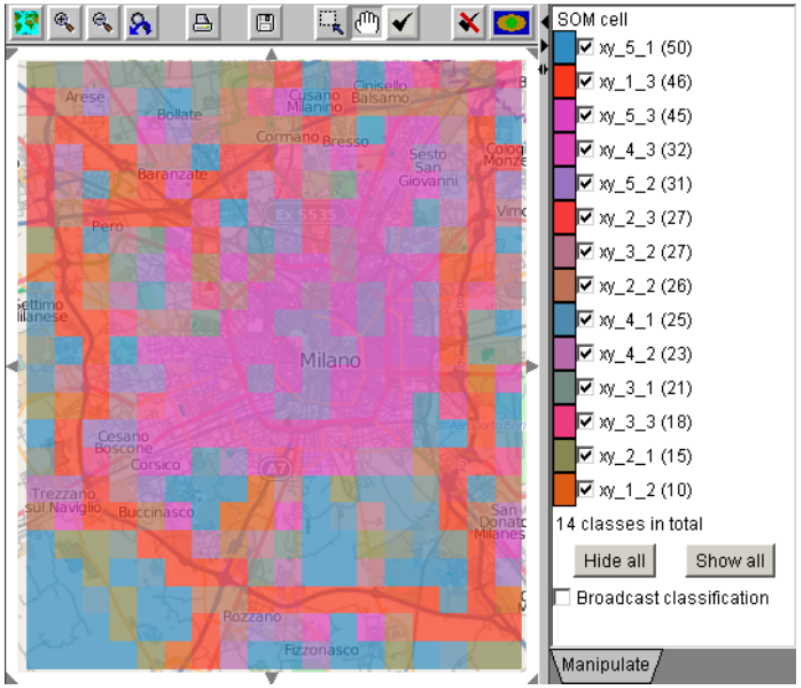

Figure 11: Spatial mapping of Time-in-space matrix [*Andrienko et al., 2010*]

- Clustering on spatial or temporal level and linkage to other dimension

Summary

Three different goals:

- Trend detection
- Model selection
- Correlation detection

Problems and open questions:

- Turning points, seasonality and outliers
- Applications are often specifically designed for one task
- Freedom vs. usability
- Multiple predictions and uncertainty
- How to deal with large amounts of predictions?
- What about sparse data?
- Preserve or remove peaks?

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Thank you for listening

Questions?