

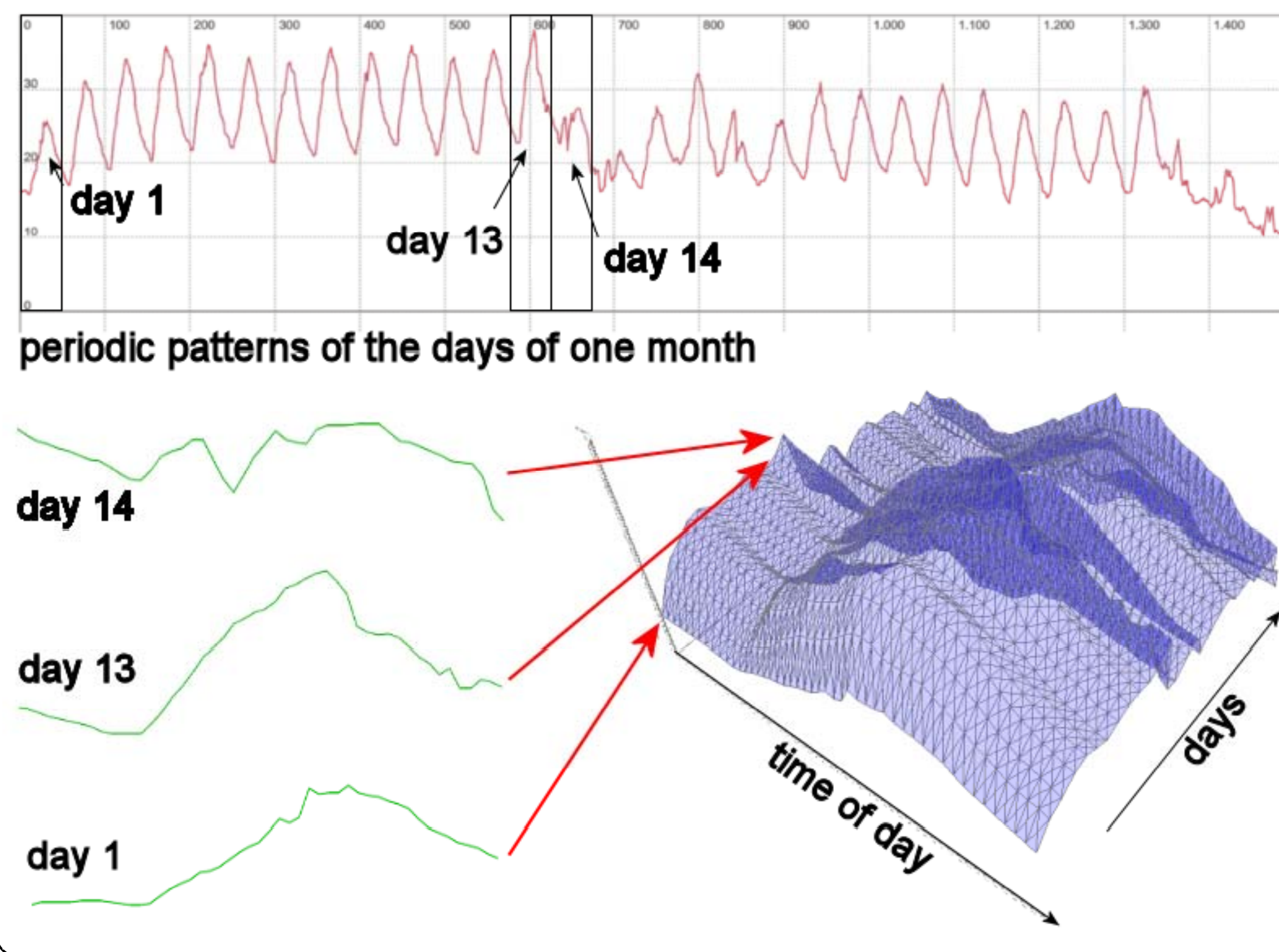
What is it about?

TiP performs similarity search and data mining on time series utilizing the dual-domain representation^[1]

$$\langle\langle x_{1,1}, \dots, x_{1,N} \rangle\rangle, \dots, \langle\langle x_{M,1}, \dots, x_{M,N} \rangle\rangle$$

based on the time domains $T = \{t_1, \dots, t_N\}$ and $S = \{s_1, \dots, s_M\}$.

Example from environmental analysis:



Application Examples

- **Environmental analysis:** Given a curve of a query month showing temperature values higher than a threshold of 80°F on the first days at one certain time of day, return all months that also show values higher than 80°F on their first days at this time of day.
- **Medical research:** Data recorded by accelerometers is used to represent a patient's activity during several time periods. The representative movement patterns are mostly periodic and can easily be extracted by TiP.

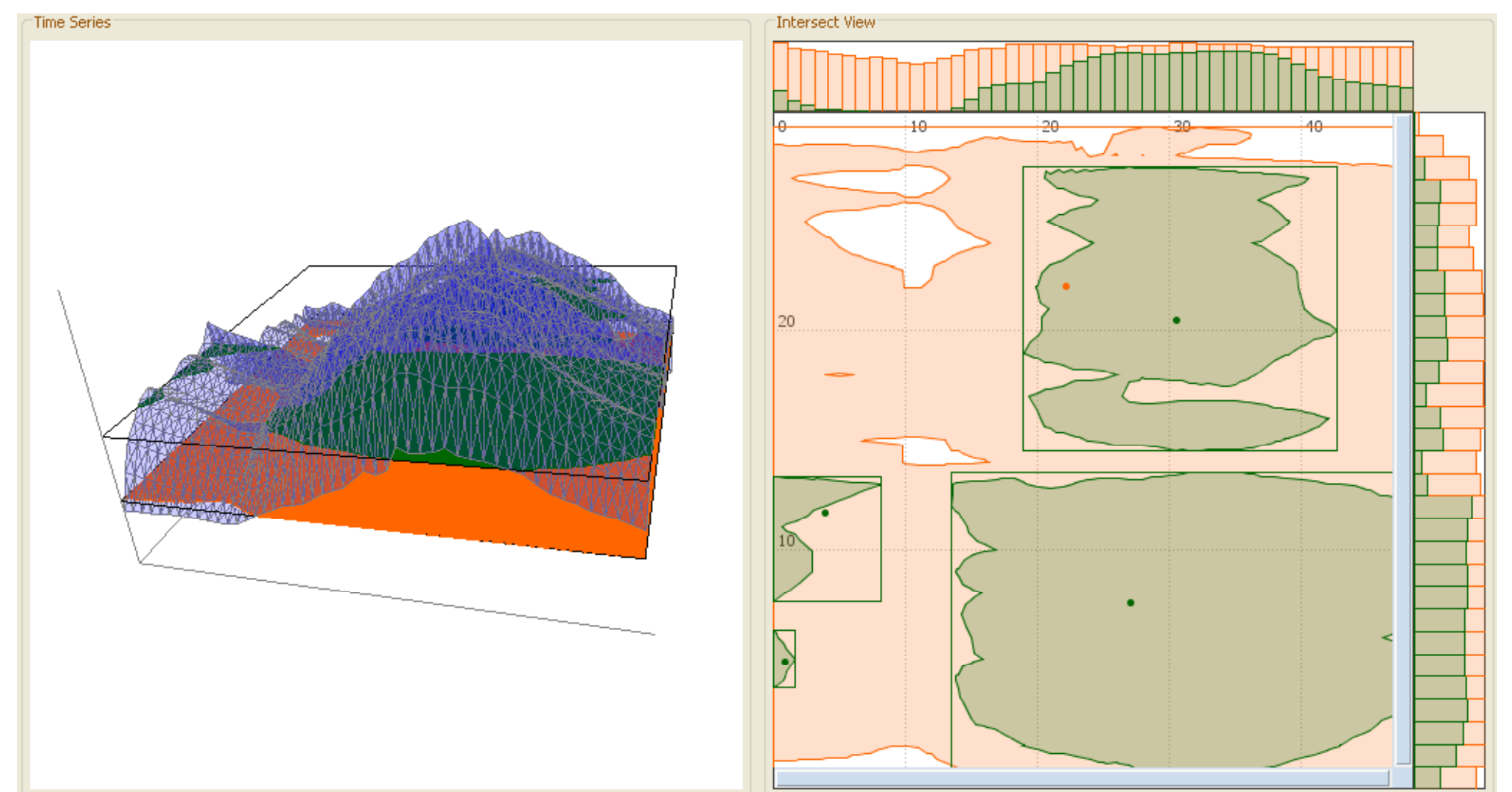
Benefits of TiP

Data Support:

- Handling of synthetic and real-world datasets (ARFF)

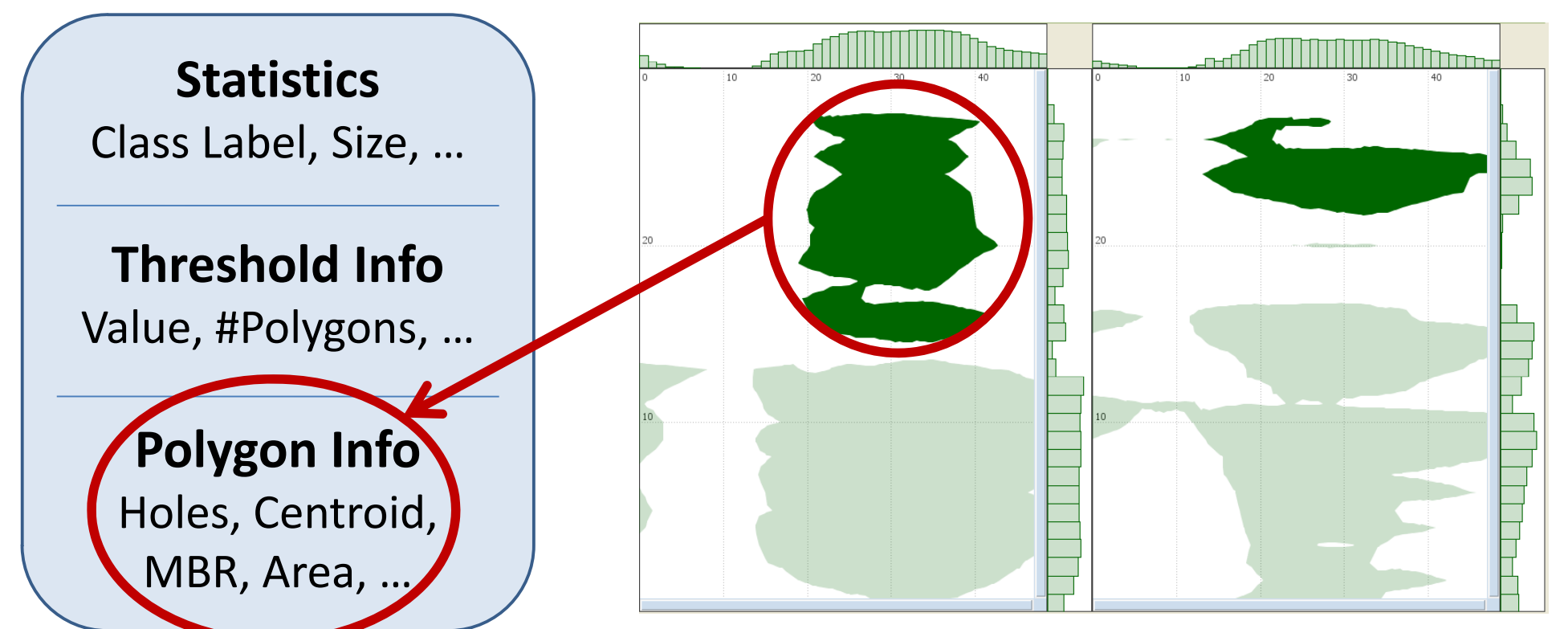
Visualizations:

- Visualization of dual-domain time series with multiple intersection sets w.r.t. different thresholds
- Visualization of global and local features



User Interactions:

- Interactive selection of patterns (polygons) in order to display further information and to mark corresponding matching partners w.r.t. SMD / Hausdorff Distance



Efficient Data Processing:

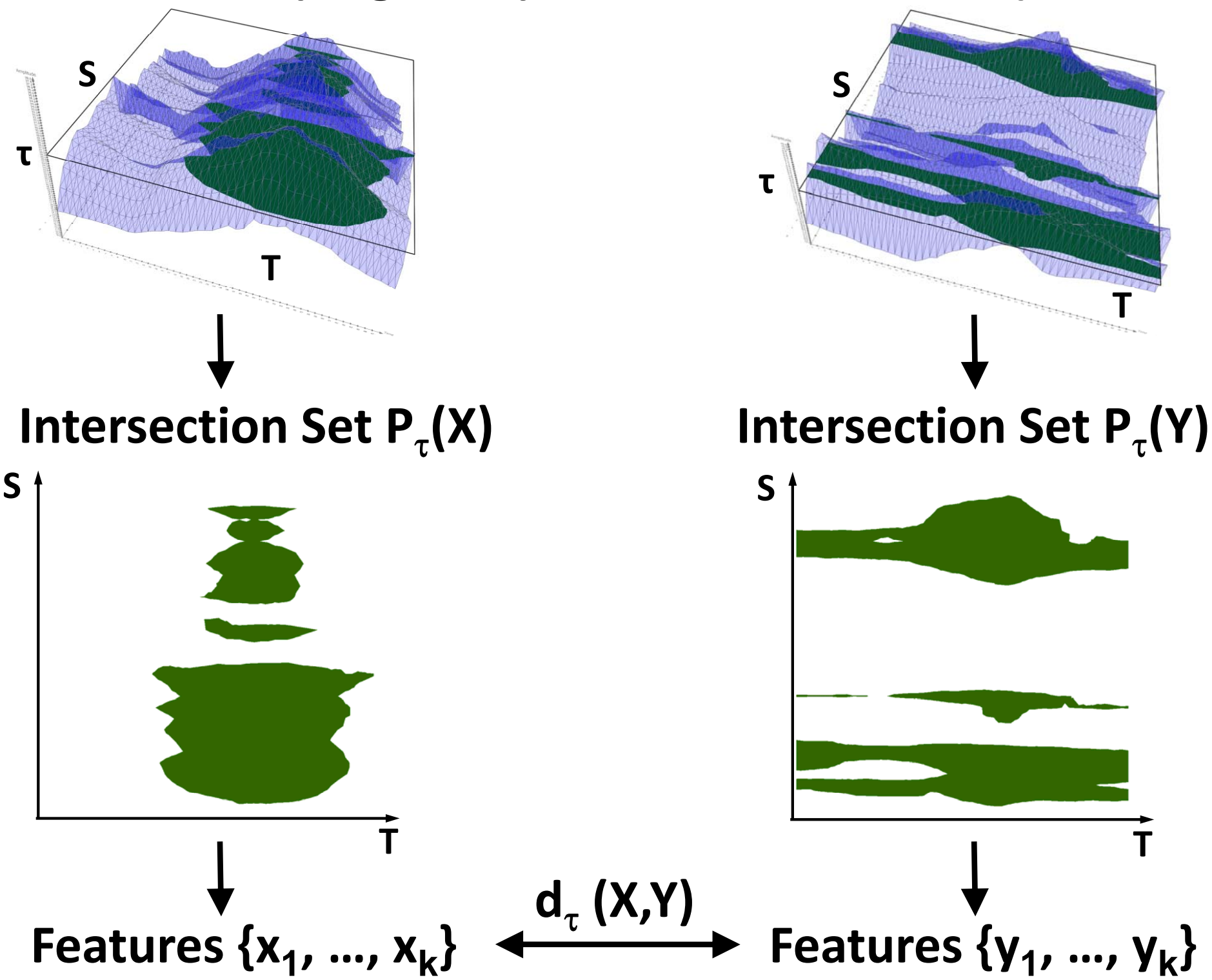
- TiP provides several similarity search and data mining techniques for dual-domain time series, e.g. distance ranking, k-NN-classification, etc.
- Pre-computation and index-supported storage of features \Rightarrow efficient analysis and query processing

The Similarity Model

The distance between time series is computed based on features of their periodic patterns w.r.t. the intersection with a threshold τ . The patterns evolve from the values above τ :

Time Series X (Aug 2003)

Time Series Y (Jan 2001)



The **feature distance** is the distance between $P_\tau(X)$ and $P_\tau(Y)$:
 Global features: $d_\tau(X,Y) = L_p$ -distance
 Local features: $d_\tau(X,Y) = \text{SMD} / \text{Hausdorff Distance}$

More theoretical background:

[1] J. Aßfalg, T. Bernecker, H.-P. Kriegel, P. Kröger, M. Renz: *Periodic Pattern Analysis in Time Series Databases*.

In Proc. of the 14th International Conference on Database Systems for Advanced Applications (DASFAA), Brisbane, Australia, 2009.