TRA
TRANSPORT RESEARCH ARENA
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Estimating Railway Resilience Curves:

Recovery Duration and Train Traffic Response to Floods and Tree Fall

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Definition: Infrastructure Resilience

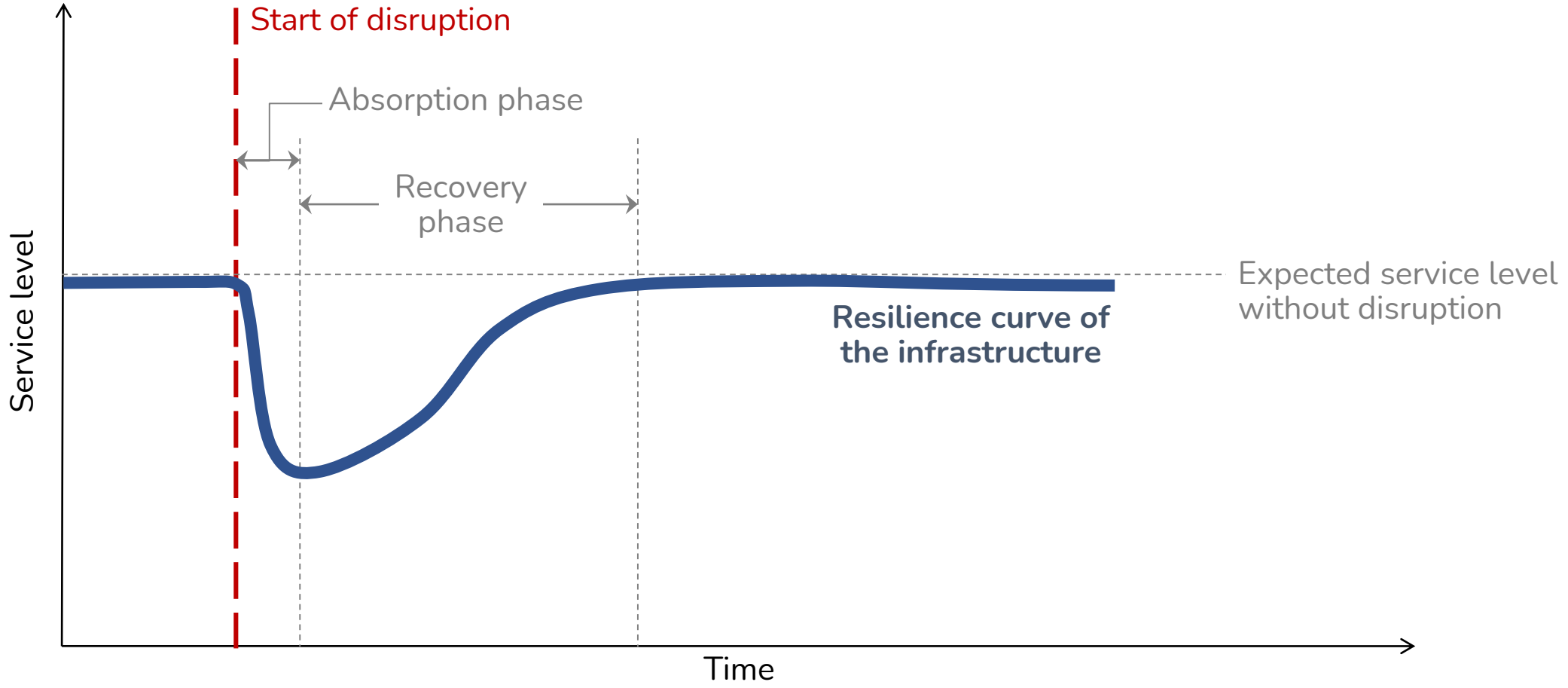
"The ability of a system, community or society exposed to hazards to resist, absorb, accommodate and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions"

– United Nations Office for Disaster Risk Reduction (UNDRR)

"The ability to continue to provide service if a disruptive event occurs"

– European Committee for Standardization (CEN)

Definition: Infrastructure Resilience



Motivation and Research Question

- Complete picture of resilience: absorption and recovery
- Previous studies focused on absorption, i.e. operational or economic damage to the rail system.
  - Chan and Schofer 2016; Kellerman et al. 2016; Xu, et al. 2016
- The few studies on recovery focus on specific disaster events.
  - Janic 2018; Bhatia, et al. 2015; Yadav, et al. 2020

→ Weak external validity

How long does it take on average for traffic to recover after a natural hazard disruption?

Data: German Railway

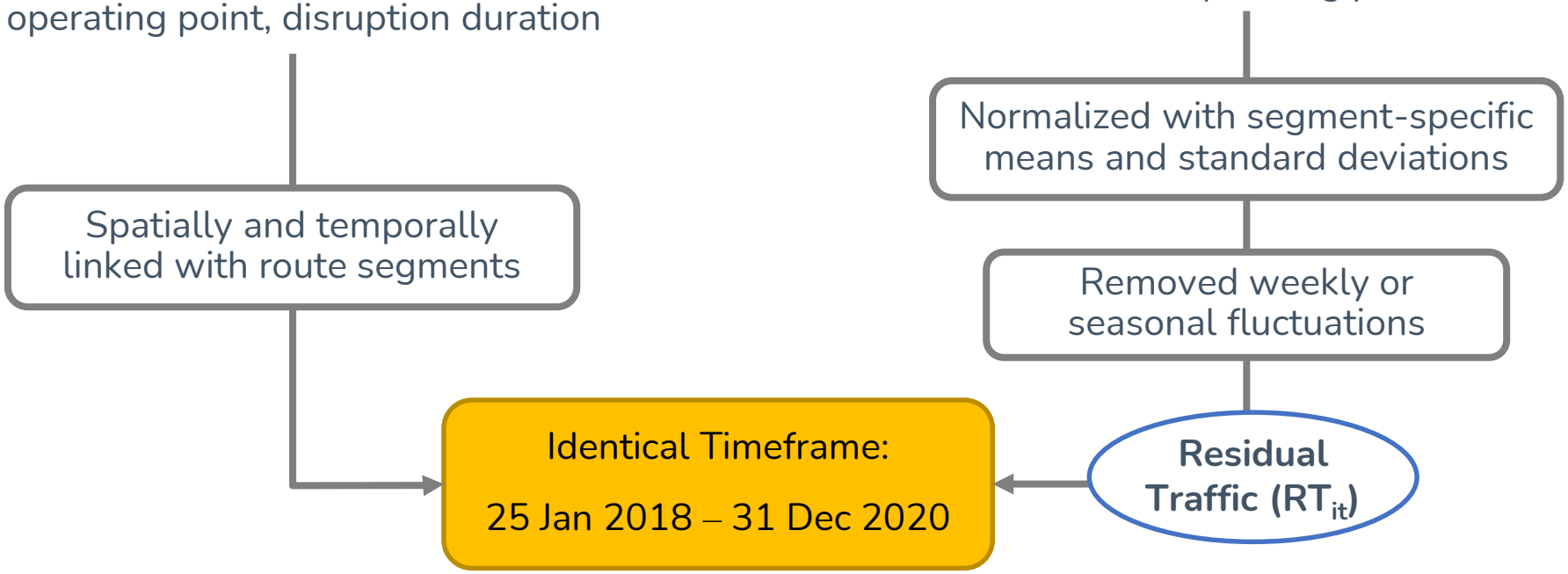
Source: DB Netz AG

Disruption data

- Floods and tree-fall events along the railway network of the Deutsche Bahn (DB)
- Date of disruption, route, location or operating point, disruption duration

Train traffic data

- Daily traffic information for all railway segments of the DB network
- Number of freight and passenger trains between two operating points



Resilience Curve Estimation

For each disruption type $d \in$ (*tree fall*, *flood*) and day $t \in (-7, +14)$ around the disruption, we calculate the mean residual traffic, *MRT*, as

$$MRT_t^d = \frac{\sum_{i=1}^{N_t^d} RT_{it}}{N_t^d}$$

where

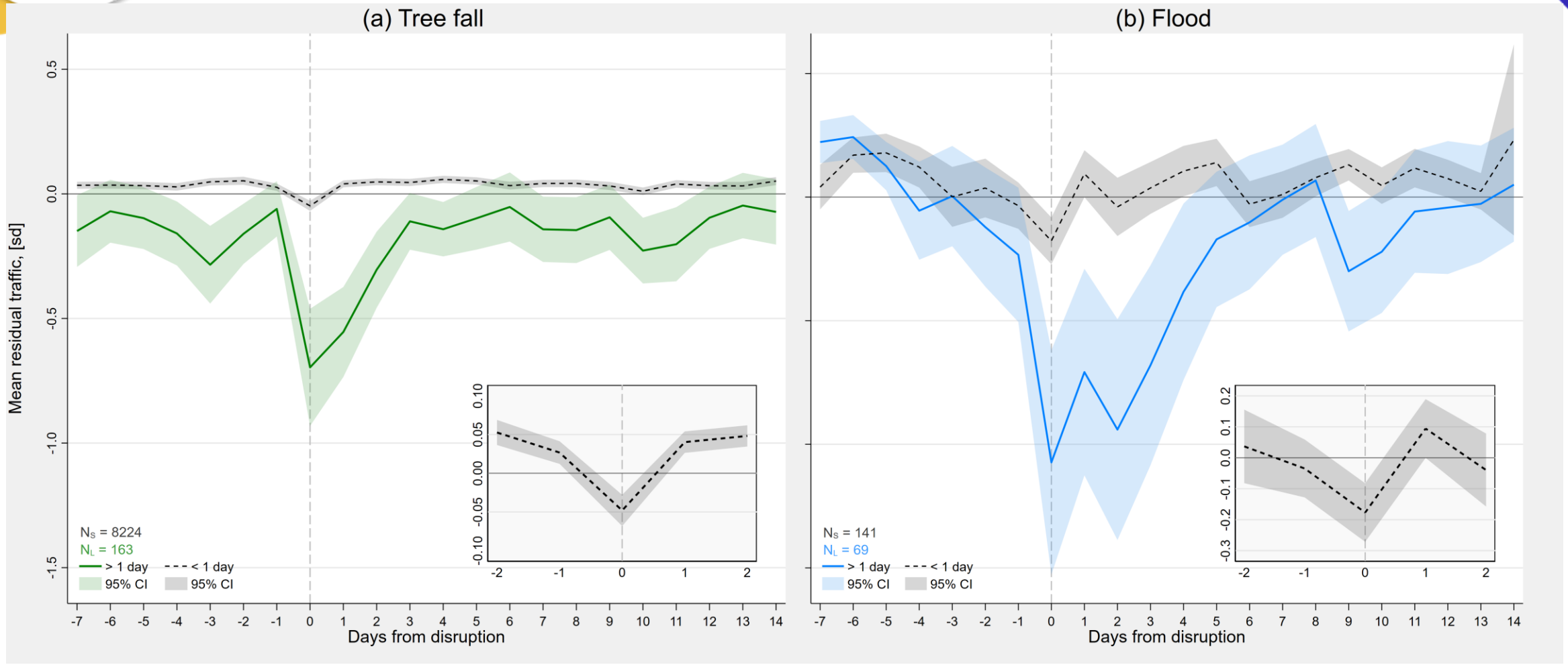
RT_{it} = residual traffic of event i on day t, and

N_t^d = the total number of events for disruption type d on day t.

- Service level: MRT (in standard deviations)
- Unit of time: Days

Estimated Resilience Curves

Tree Fall Events and Floods



Thank you!

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