[1]

MATSim User Meeting 2023

Researching the impact of extreme weather events on an On-Demand Transport service

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Agenda

- General information
- Statistical study: Multiple Linear Regression Analysis
- Simulation study: MATSim transport model
- Discussion

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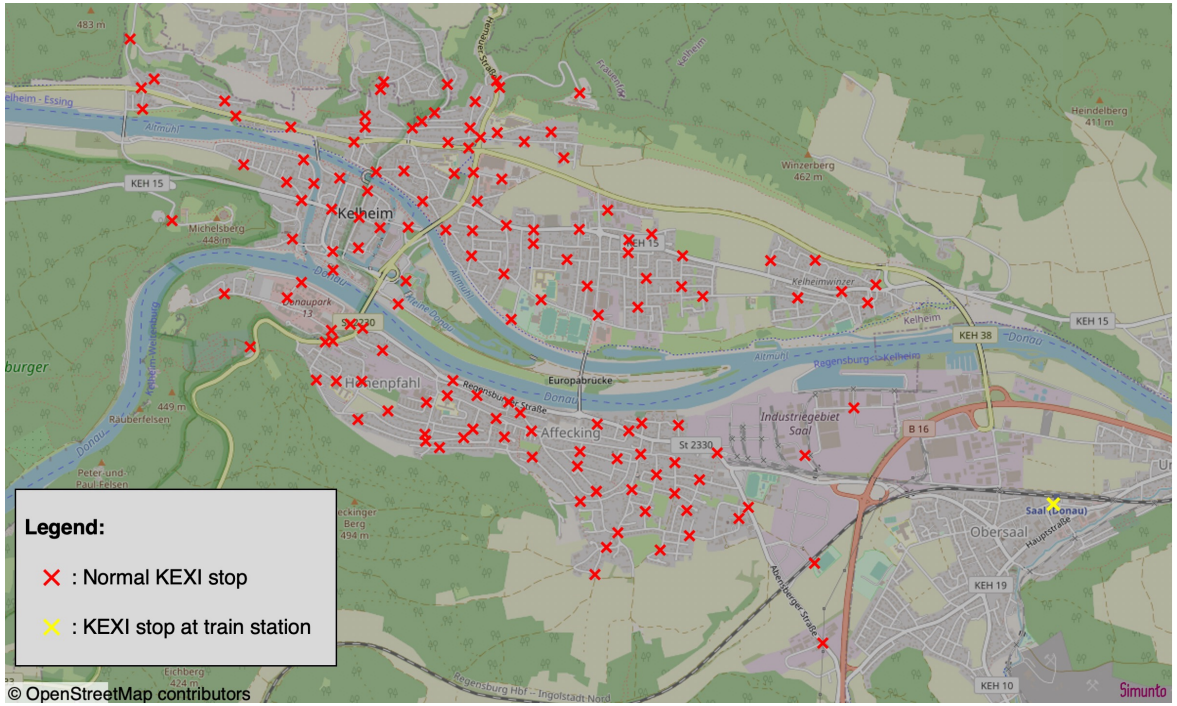
General information



[2]

- KEXI DRT service
  - Kelheim, Germany
  - 2 € / ride, 3 € from / to train station Saal (Donau)
  - Operation time: Mo – Sa 06:00-23:00
- KelRide
  - Implementation of autonomous DRT segment
  - Weather-proof autonomous shuttles

How do weather parameters influence DRT demand?

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Multiple linear regression analysis

- Input Data
  - Weather data from Meteostat [3] and Weatherstack [4]
  - Mobility data provided by KelRide-project partners -> demand data on KEXI service
  - Oxford COVID-19 Government Response Tracker [5]
- Analyzed time period: June 2020 – December 2022
- Methodology: Linear regression analysis to discover potential dependencies

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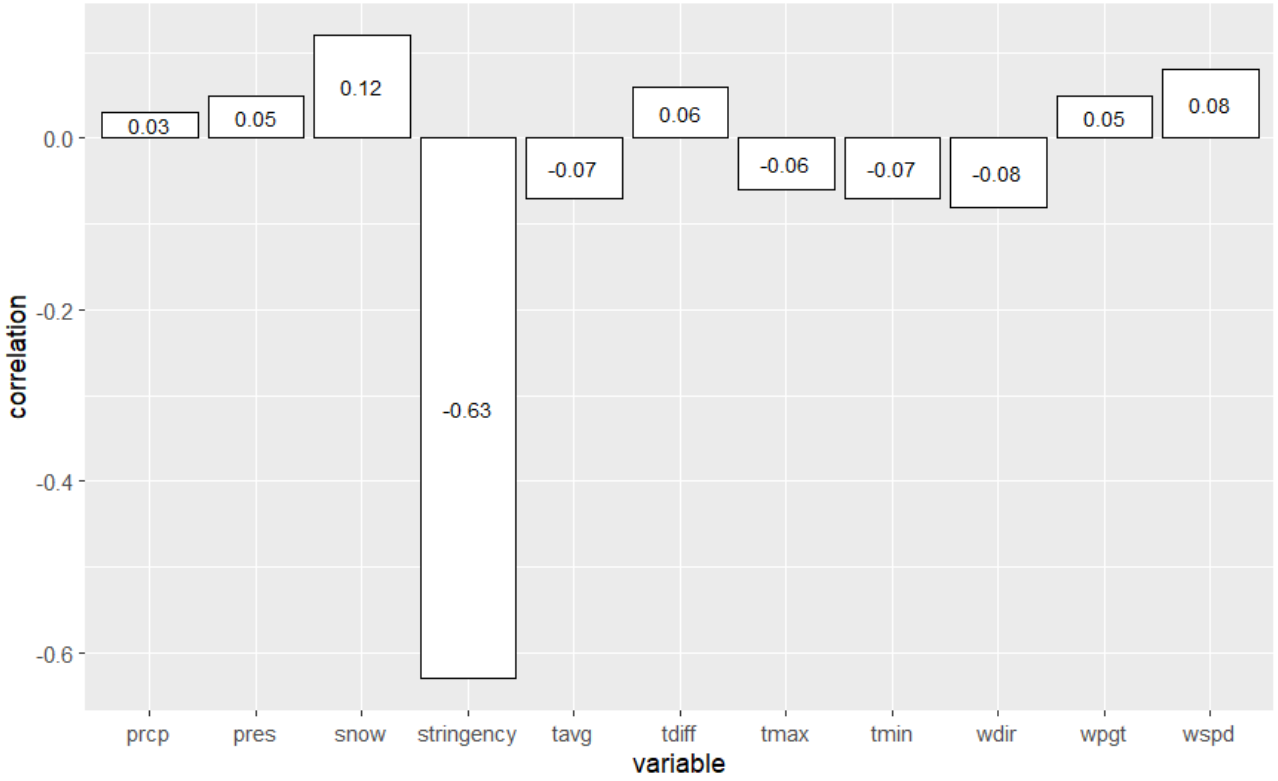
Multiple linear regression analysis



- First step
  - Find possible (general) correlations (Pearson coefficients)

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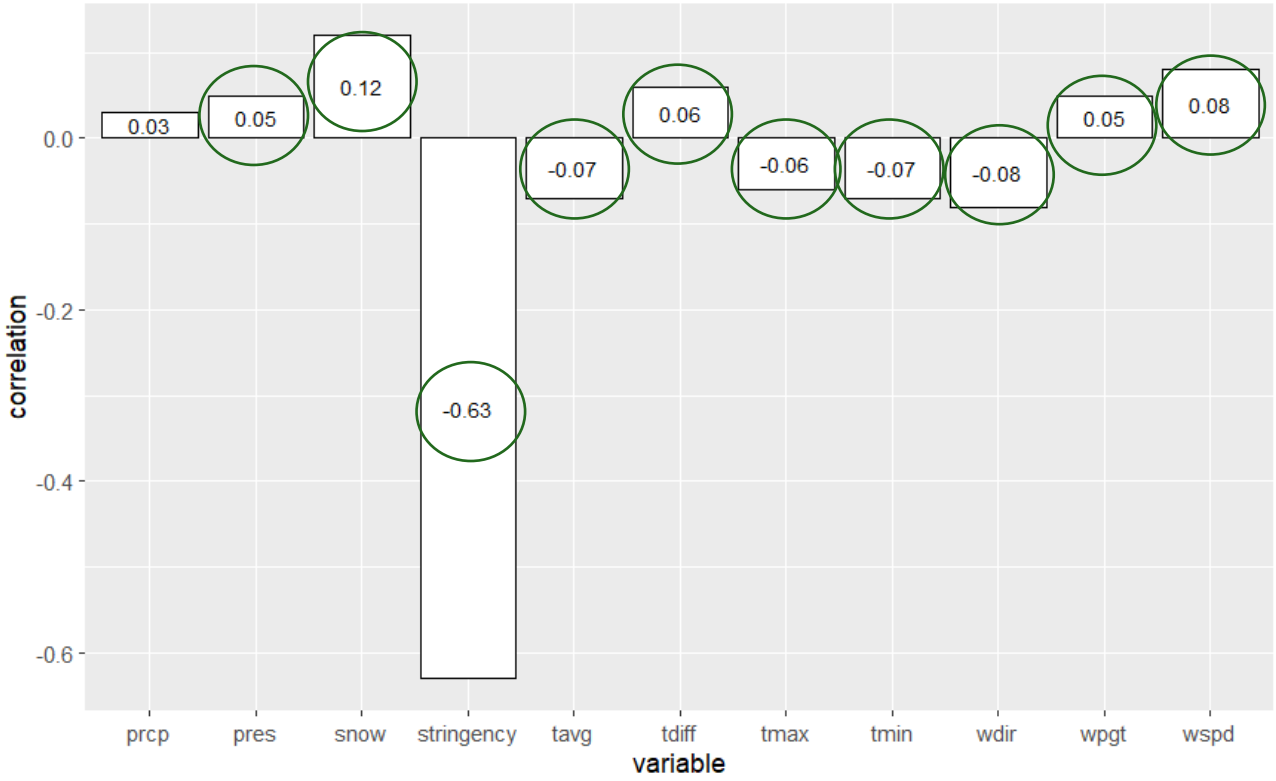
Multiple linear regression analysis



- First step
  - Find possible (general) correlations (Pearson coefficients)
  - Variables with correlation >= |0.05| are integrated into the regression model

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Multiple linear regression analysis

Variable	Coefficient	Std. Error	$p > \|t\|$	[95% CI]
Intercept	58.895346	1.812681	$< 2e-16$	(55.3346636, 62.456028269)
snow	-0.182138	0.090311	0.0442	(-0.3595371, -0.004739843)
tavg	-0.426429	0.102495	3.69e-05	(-0.6277617, -0.225096695)
trend	0.110944	0.002901	$< 2e-16$	(0.1052444, 0.116643042)
R^2		0.731		

- Final regression model
  - Reduced to significant independent variables only: **tavg**, **snow** and **trend**
  - Continuous increase of daily DRT rides over time -> trend variable
  - Integration of trend variable makes COVID-19 related variable “stringency” obsolete

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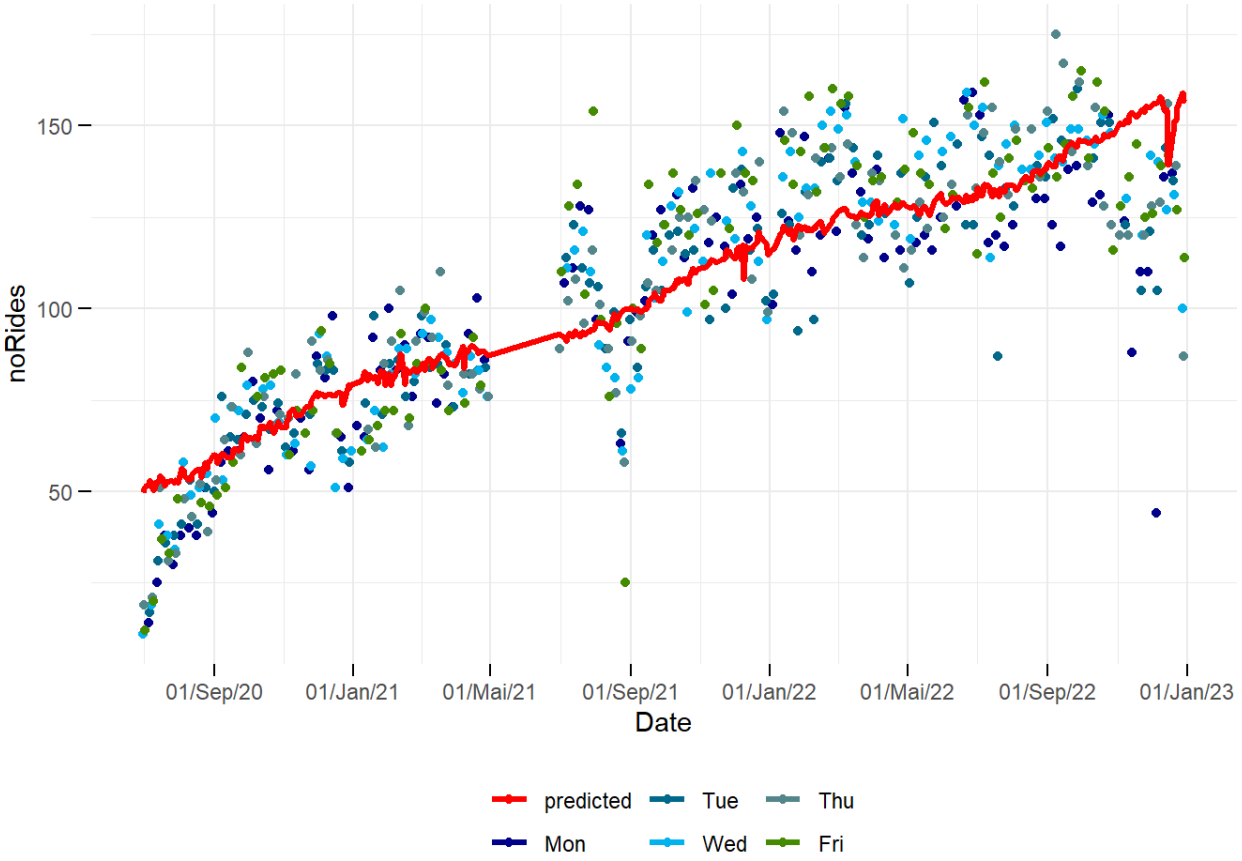
Multiple linear regression analysis



How do weather parameters influence DRT demand?

- An increase of tavg by 1°C decreases the daily number of DRT rides by 0.426429
- An increase of max. snow depth by 1 mm decreases the daily number of DRT rides by 0.182138

→ Almost no weather impact on DRT demand..

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Simulation study

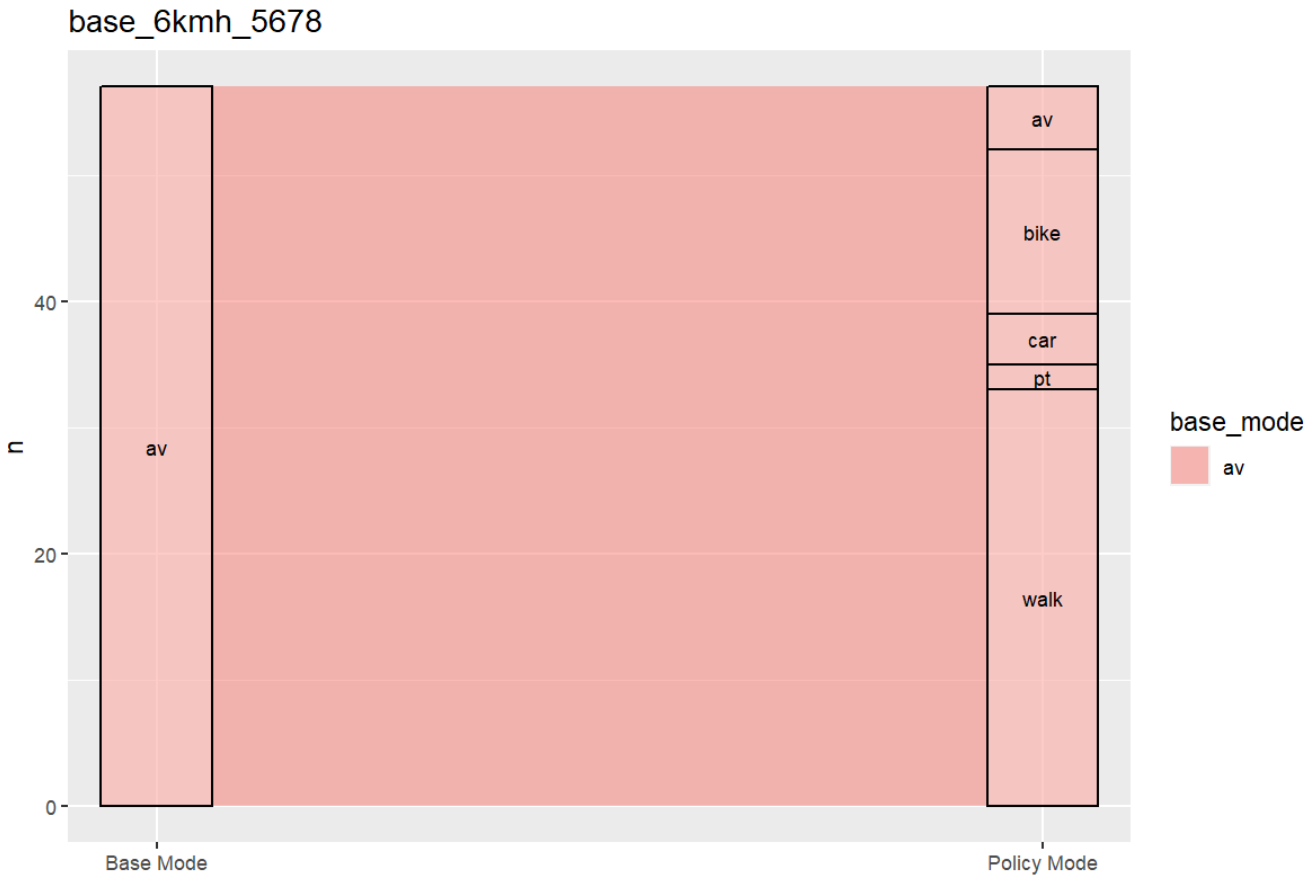
- Simulation study conducted with the MATSim Open Kelheim Model [6]
  - **We saw:** Marginal influence of weather parameters on DRT demand
  - **But:** Weather could still have influence on AV (autonomous vehicle) operation -> Parametrization of weather impact: Reduced maximum speed of AV
  - Based on information from EasyMile:
    - Base case (AV speed of 18 km/h) (based on [2])
    - Max. AV speed 12 km/h
    - Max. AV speed 9 km/h
    - Max. AV speed 6 km/h

Simulation study

Case	Number of rides per day	mean waiting time [s]	mean euclidean distance [m]	mean in vehicle travel time [s]
Autonomous DRT				
Base Case	50	178	633	281
AV 12 km/h	28	219	660	392
AV 9 km/h	18	349	685	531
AV 6 km/h	3	471	694	610

- Simulation results
  - Marginal impact on conventional DRT service
  - With decreasing max. AV speed:
    - Decreasing demand, increasing waiting time, increasing in veh. travel time

Simulation study



- Former AV users are switching to modes bike and walk mainly
  - This is where they came from in the first place (see [2])
  - This is explainable through..
    - AV service is free of charge
    - Loss of advantage (increased travel speed) -> bike and walk more attractive

MATSim Multi-Agent Transport Simulation

Conclusion

- Multiple linear regression analysis
  - Only marginal impact of avg. temperature and maximum snow depth on daily DRT demand
  - Study ought to be repeated for a time period without COVID-19 related policies
  - Marginal weather impact could also just be statistical effects
  - Demand solely consists of DRT trips
- Simulation study
  - Decreased max. AV speed causes modal shift to modes walk and bike (mainly)
  - Simulation results are limited by dimension of AV service area

Thanks for listening!

Any questions / suggestions?

References

[1] - https://kelride.com/

[2] - https://svn.vsp.tu-berlin.de/repos/public-svn/publications/vspwp/2022/22-17/

[3] - https://bulk.meteostat.net/v2/

[4] - https://weatherstack.com/

[5] - https://covidtracker.bsg.ox.ac.uk/

[6] - https://github.com/matsim-scenarios/matsim-kelheim