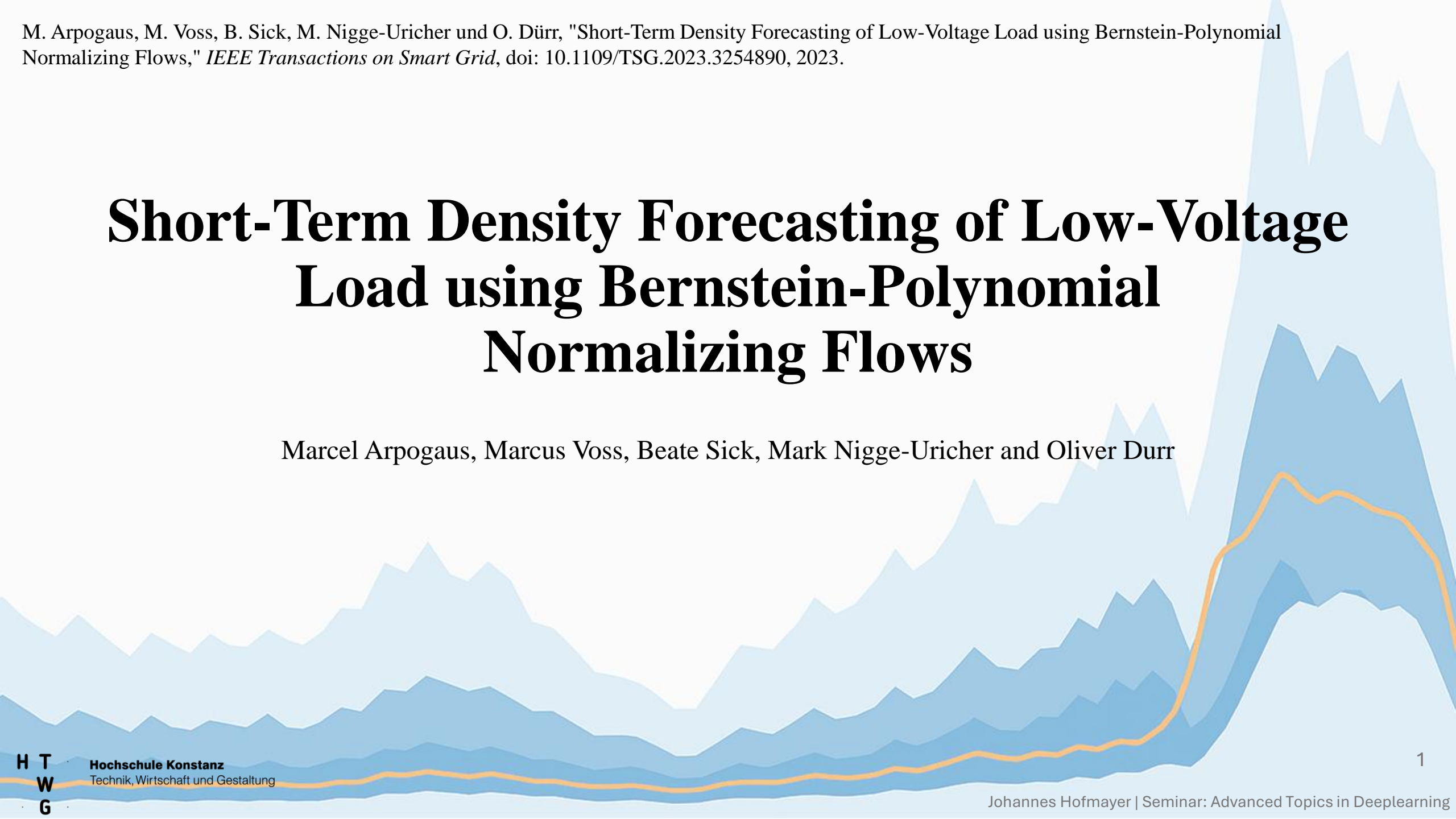


Short-Term Density Forecasting of Low-Voltage Load using Bernstein-Polynomial Normalizing Flows

Marcel Arpogaus, Marcus Voss, Beate Sick, Mark Nigge-Uricher and Oliver Dürr



Motivation

CER – Data set

Data from smartmeters in private households (N = 3639)

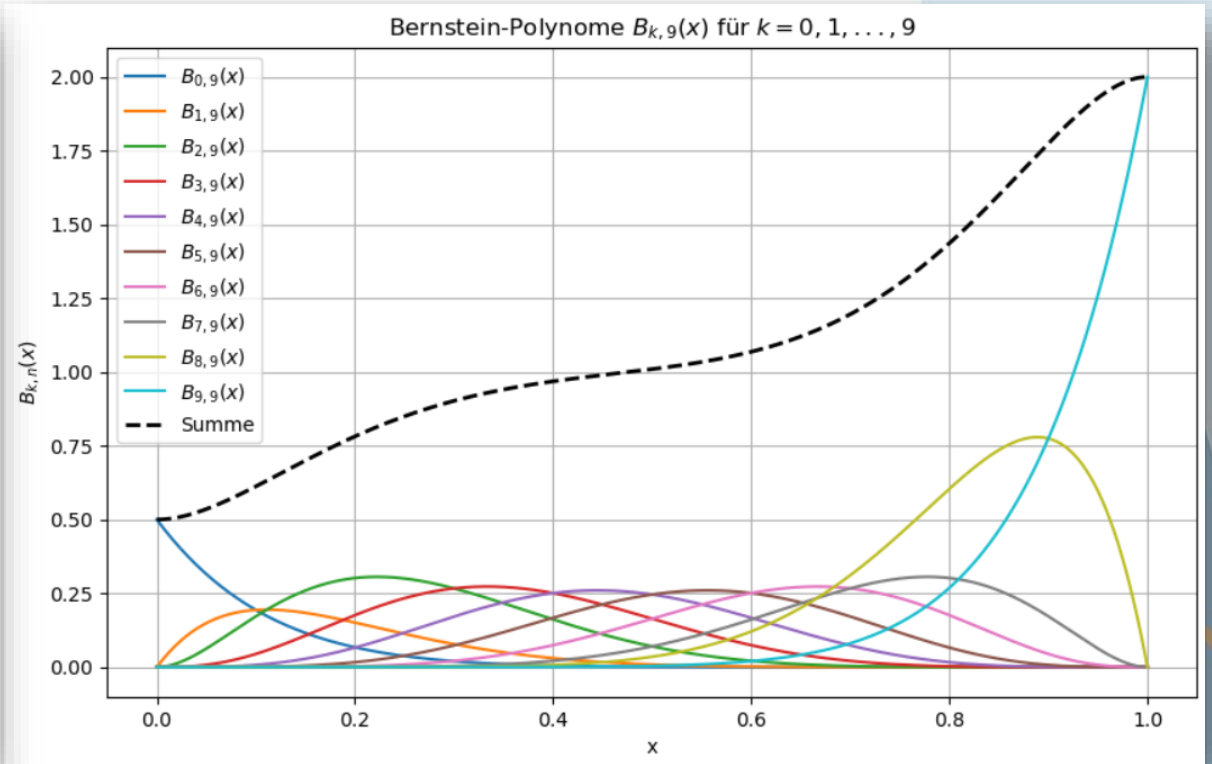
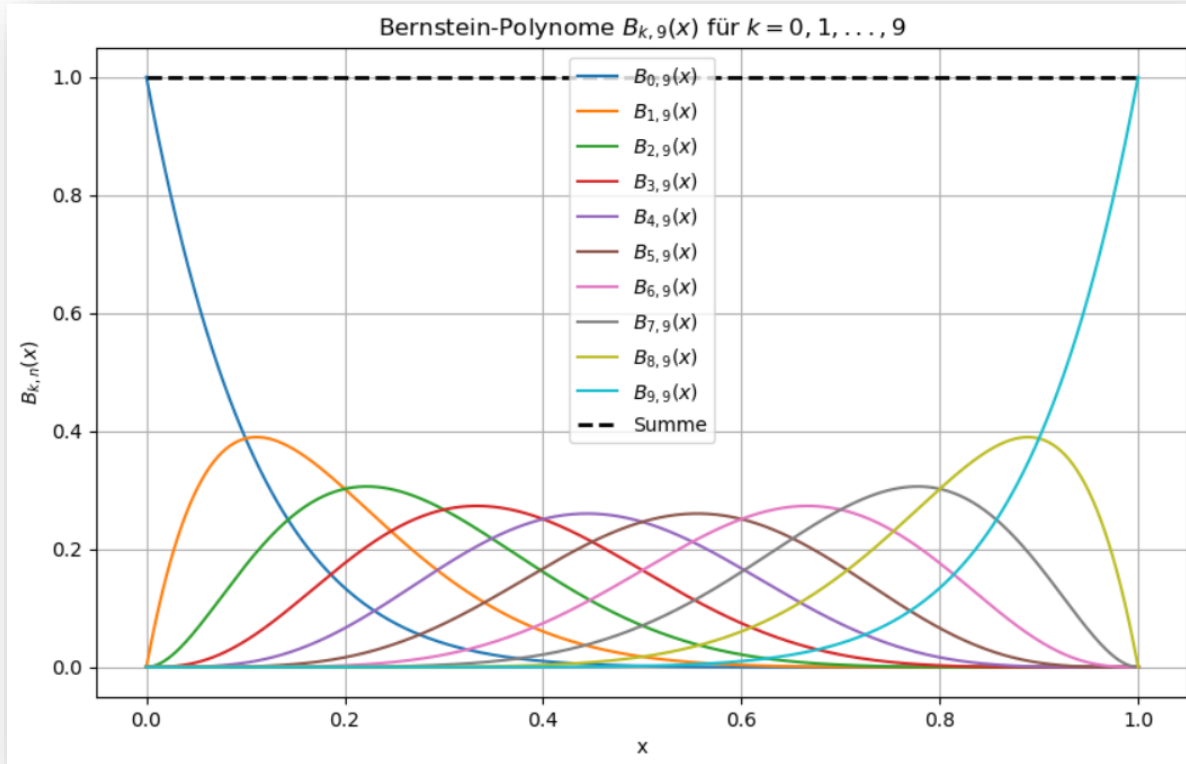
Period: 14.07.09 – 31.12.10

Resolution: Sample every 30min



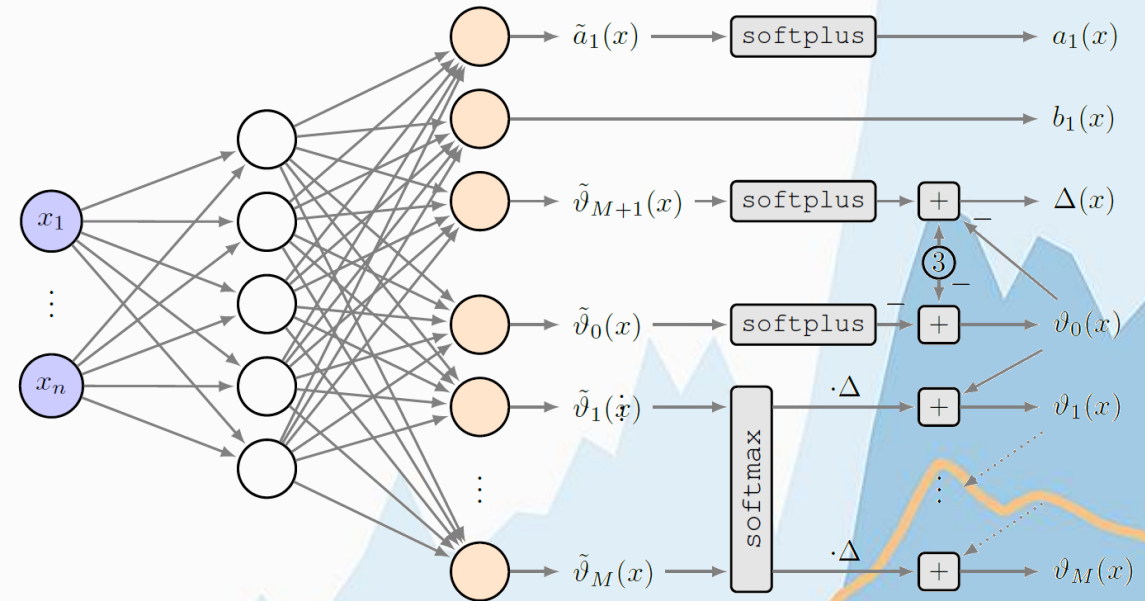
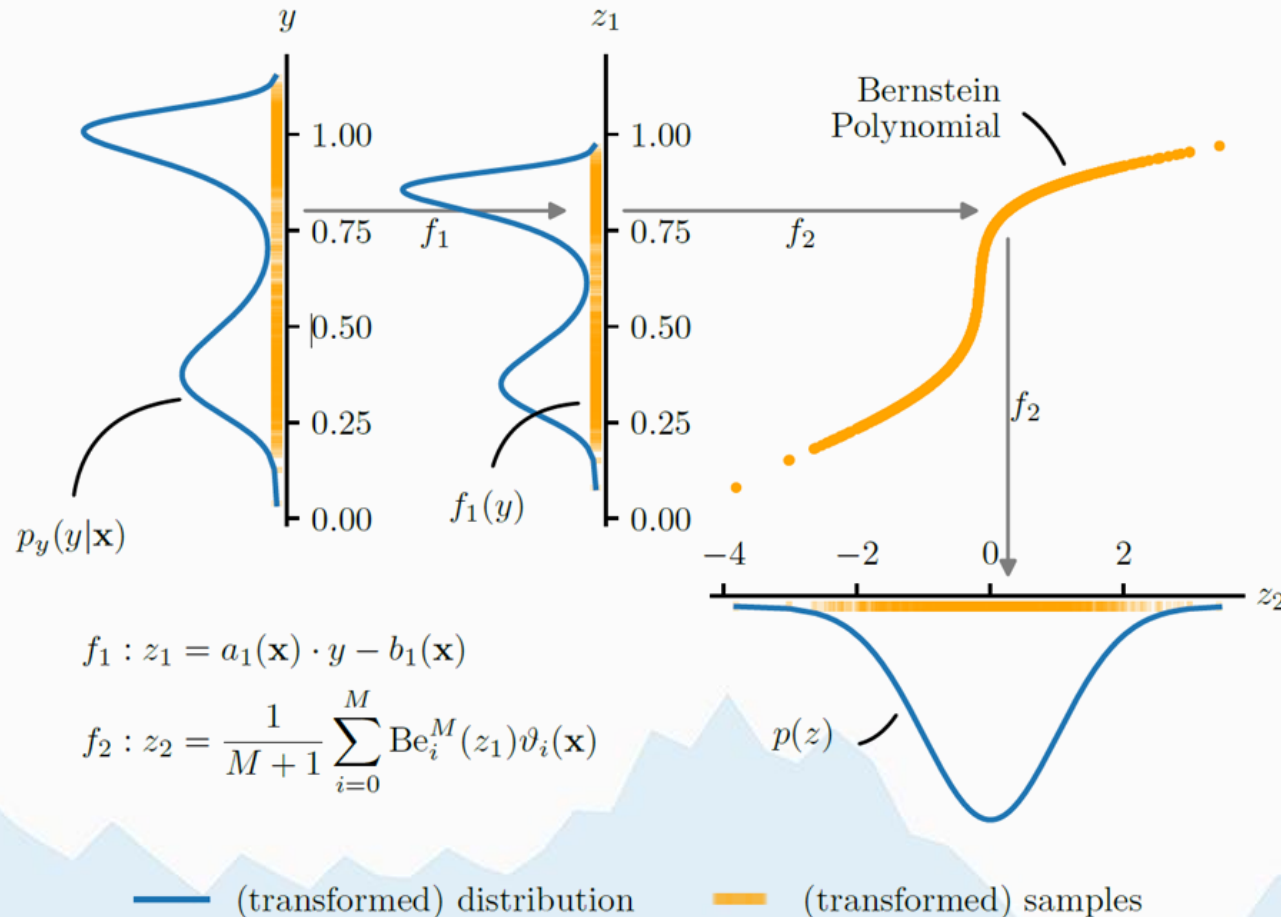
Quelle: <https://www.smarter-fahren.de/smart-grid-fuer-elektroautos/>

Bernstein-Polynomials



Quelle: eigene Abbildungen

Normalizing Flows using Bernstein-Polynomials



Quelle: Arpogaus et al., IEEE Trans. Smart Grid, 2023, doi: 10.1109/TSG.2023.3254890

Comparison of Models

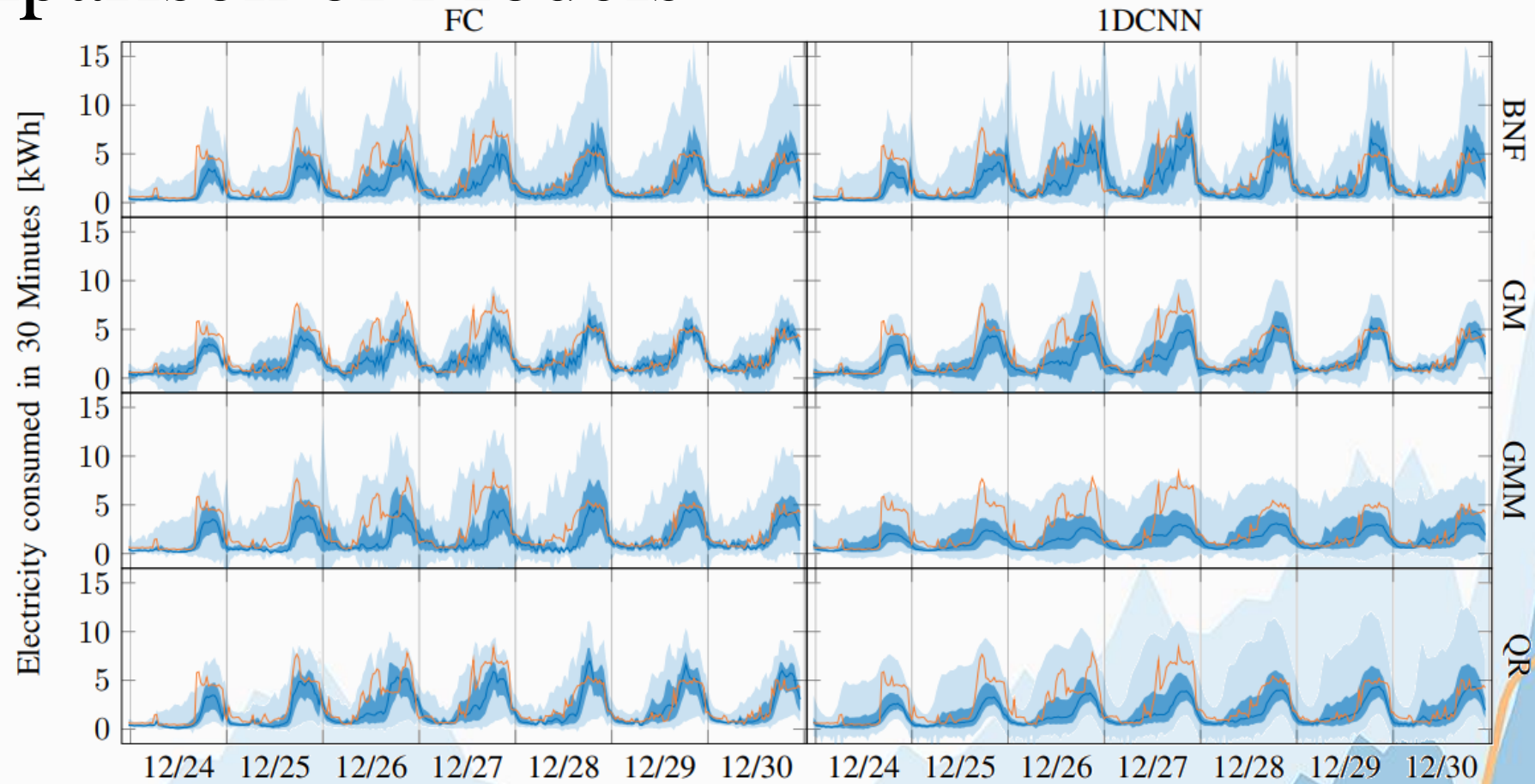


Fig. 5. The plots show the 98% () and 60% () confidence intervals, along with the median () of the predicted CPD and the measured observations () for one household with unusual high load during the Christmas week. Data from [45].

Quelle: Arpogaus et al., IEEE Trans. Smart Grid, 2023, doi: 10.1109/TSG.2023.3254890

Comparison of Models

N_{train}	NN	kind Distribution	NLL	NCRPS [%]	NMQS [%]
363	Baseline	ECDF	-111.702	1.920	1.900
	FC	BNF	-135.616 (± 0.388)	1.502 (± 0.007)	1.486 (± 0.007)
		GMM	-129.663 (± 0.642)	1.542 (± 0.008)	1.526 (± 0.008)
		GM	-100.973 (± 0.893)	1.743 (± 0.015)	1.724 (± 0.014)
		QR	–	–	2.303 (± 0.587)
	1DCNN	BNF	-137.040 (± 1.640)	1.495 (± 0.017)	1.479 (± 0.016)
		GMM	-132.622 (± 0.560)	1.613 (± 0.017)	1.596 (± 0.017)
		GM	-100.040 (± 0.408)	1.742 (± 0.011)	1.724 (± 0.011)
		QR	–	–	1.625 (± 0.006)
1091	Baseline	ECDF	-114.777	1.886	1.867
	FC	BNF	-139.262 (± 0.361)	1.443 (± 0.009)	1.428 (± 0.009)
		GMM	-135.029 (± 0.754)	1.464 (± 0.009)	1.449 (± 0.009)
		GM	-104.128 (± 0.402)	1.660 (± 0.010)	1.642 (± 0.010)
		QR	–	–	1.393 (± 0.003)
	1DCNN	BNF	-142.385 (± 0.904)	1.426 (± 0.011)	1.411 (± 0.011)
		GMM	-135.767 (± 0.692)	1.541 (± 0.015)	1.525 (± 0.014)
		GM	-103.335 (± 1.027)	1.659 (± 0.022)	1.641 (± 0.021)
		QR	–	–	1.400 (± 0.008)

Quelle: Arpogaus et al., IEEE Trans. Smart Grid, 2023, doi: 10.1109/TSG.2023.3254890