

WARD: Weather-Aware Road Surface Condition Monitoring Dataset

Soňa Nesnídalová^{1,2}; Tomáš Kerepecký¹; Adam Novozámský¹

¹The Czech Academy of Sciences, Institute of Information Theory and Automation, Prague, Czechia,

²Czech Technical University in Prague, Faculty of Nuclear Sciences and Physical Engineering, Prague, Czechia

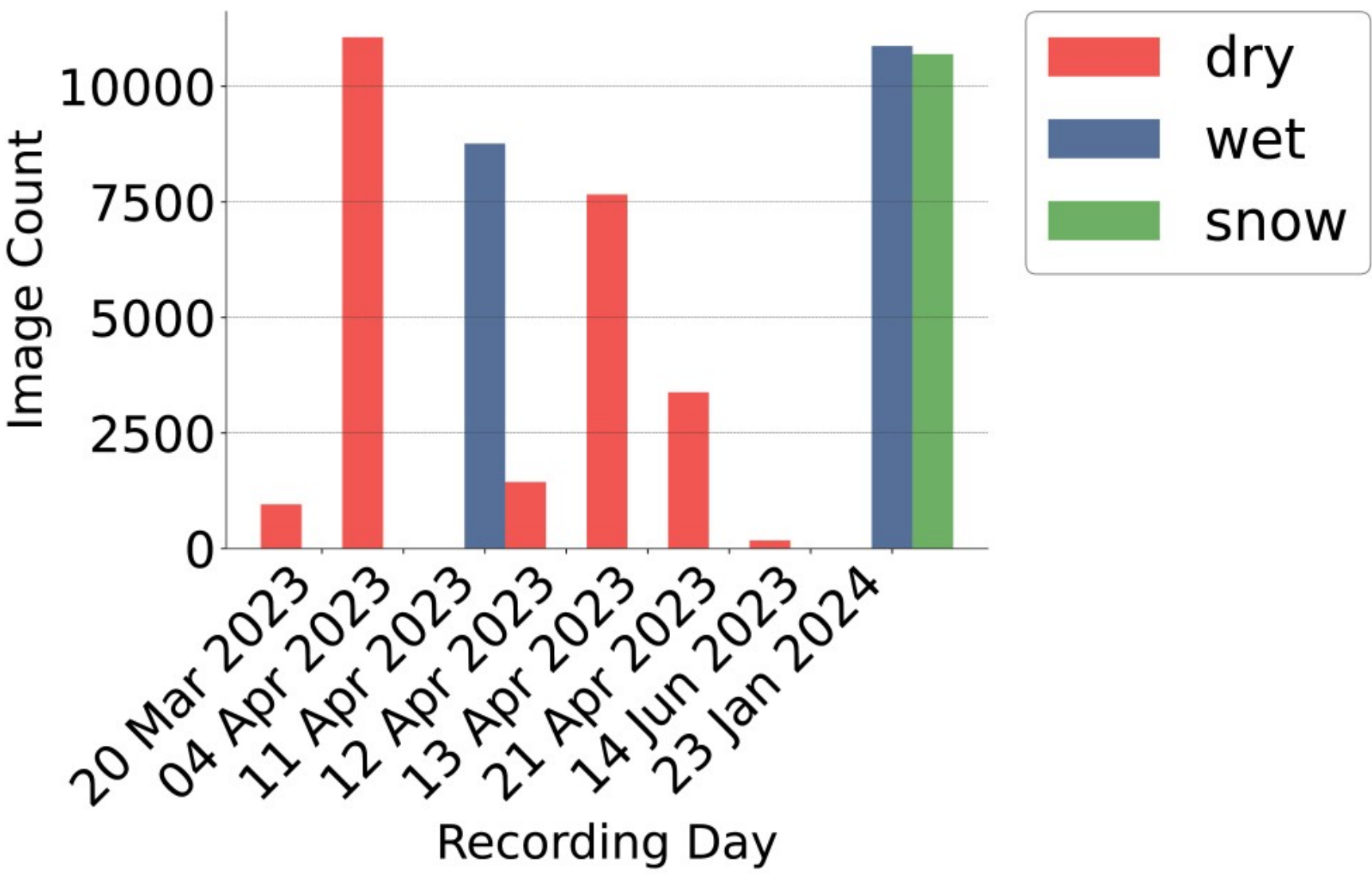
Introduction

- Road surface conditions (RSC) directly impact braking and traction, influencing vehicle safety.
- Camera-based monitoring enables **real-time, low-cost, non-contact sensing** of road surface states.

WARD

- WARD contains ≈55k images (from 66 recordings) across diverse weather and lighting conditions, captured in various locations around Czechia during a span of one year.
- Three classes: **dry, wet, snow**; hand-labeled according to broader context of the drives, including the input from drivers present during the capturing process.
- Pre-processing: **ROI extraction** and **bird's eye view** transformation.
- Dataset is **publicly available**.

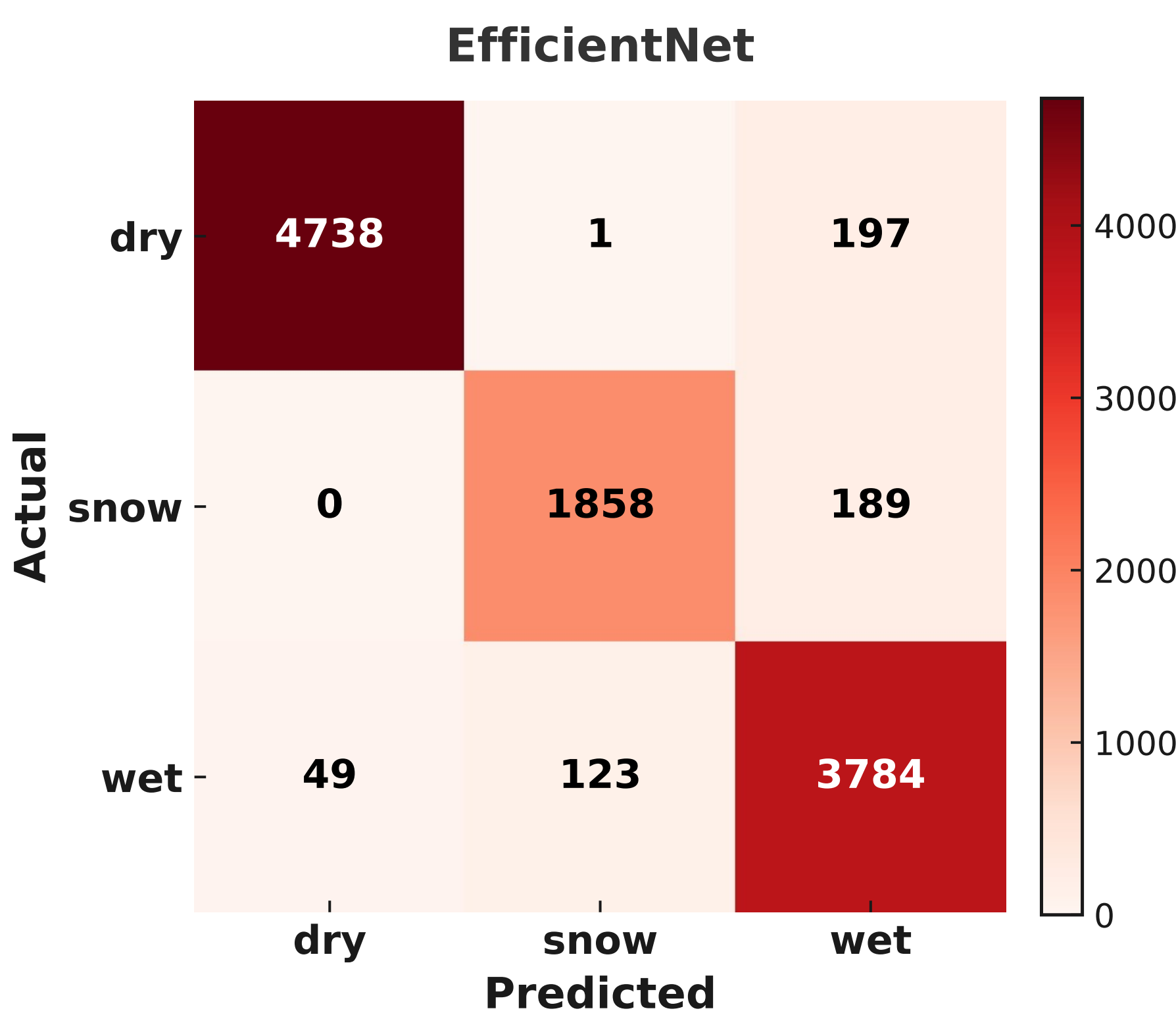
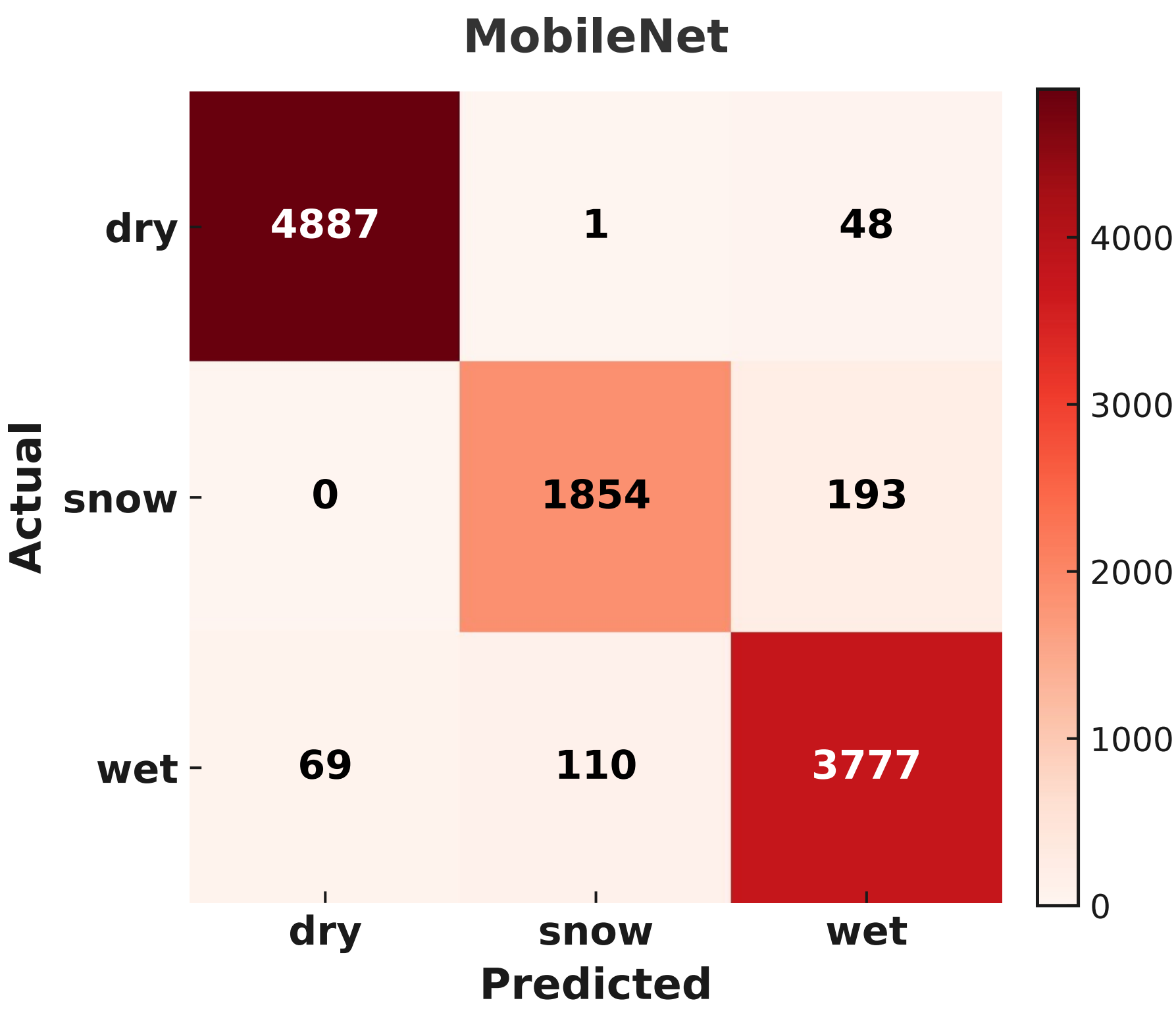
COUNT OF IMAGES EXTRACTED FROM THE DRIVES ON THE RECORDED DATES



Methodology

- 3-class classification:** dry / wet / snow
- Models: **MobileNetV3-Large** & **EfficientNetB0** pre-trained on ImageNet
- Training: weighted cross-entropy with SGD + augmentation (rotate, flip, brightness, blur)
- Temporal smoothing** via moving-window (5 frames) aggregation

CONFUSION MATRICES OF BOTH MODELS ON THE TEST SET OF WARD



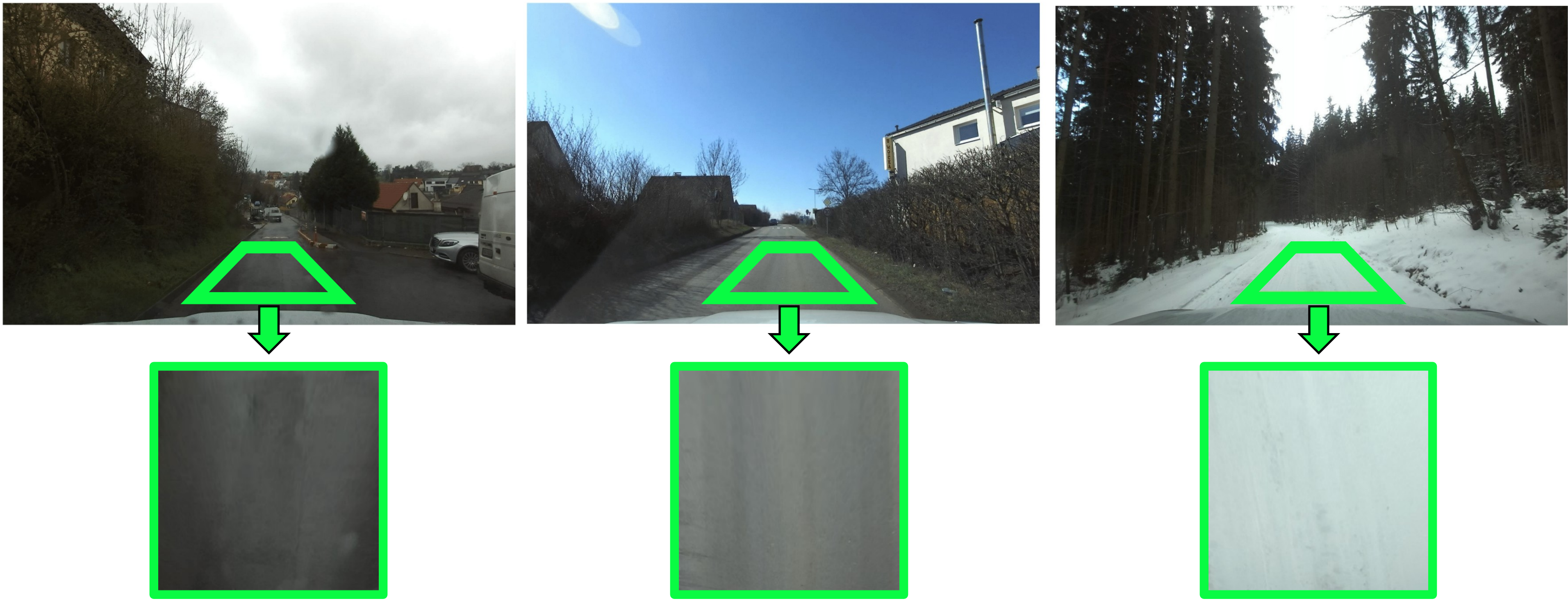
RESULTS WITH TEMPORAL SMOOTHING ON TEST SET

	Aggregation	Accuracy	F1
MobileNet	×	96.15	95.32
	✓	96.54	95.62
EfficientNet	×	94.89	94.31
	✓	95.93	95.18

Results

- MobileNet outperforms EfficientNet
- Most errors on WARD occur between wet and snowy surfaces due to **slushy/melting snow**
- Temporal smoothing improves results

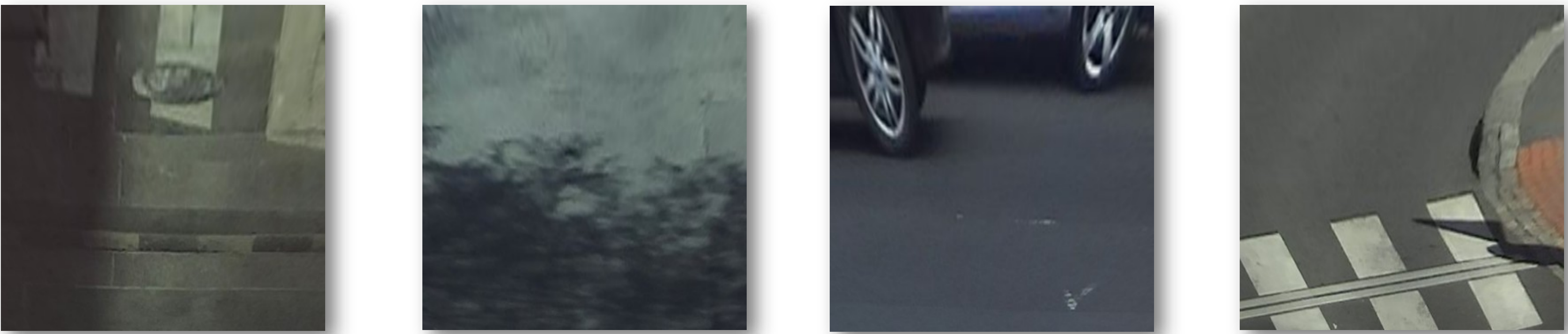
PRE-PROCESSING OF THE RECORDED DATA



COMPARISON WITH OTHER DATASETS EMPLOYED IN AUTOMOTIVE TASKS

Dataset	BDD100K	KITTI	CityScapes	Ithaca365	ACDC	RoadSaW	RSCD	WARD
Images	12 000 000	14 999	7 000	>680 000	8 012	20 244	1 000 000	54 952
Sequences	100 000	22	50	40	N/A	>250	N/A	1 854
Diverse RSC	✓	N/A	×	✓	✓	✓	✓	✓
Diverse Locations	✓	✓	✓	×	✓	×	✓	✓

EXAMPLES OF THE REAL-WORLD DRIVING SCENARIOS INCLUDED IN WARD



RESULTS OF BOTH ARCHITECTURES ON THE SUBSETS OF OUR DATASET

