

Physically Interpretable Probabilistic Domain Characterization

A. Halin*, S. Piérard*, R. Vandeghen, B. Gérin, M. Zanella, M. Colot, J. Held, A. Cioppa, E. Jean, G. Bontempi, S. Mahmoudi, B. Macq, and M. Van Droogenbroeck

Characterizing domains is essential in dynamic environments



Characterizing domains is essential in dynamic environments



In dynamic environments, intelligent systems should be:

1. aware of the **domain** in which they operate;
2. able to communicate an **interpretable characterization** of it;
3. able to **adapt** to it, on the fly.

We characterize domains with probability distributions



We characterize domains with probability distributions



We characterize domains with probability distributions



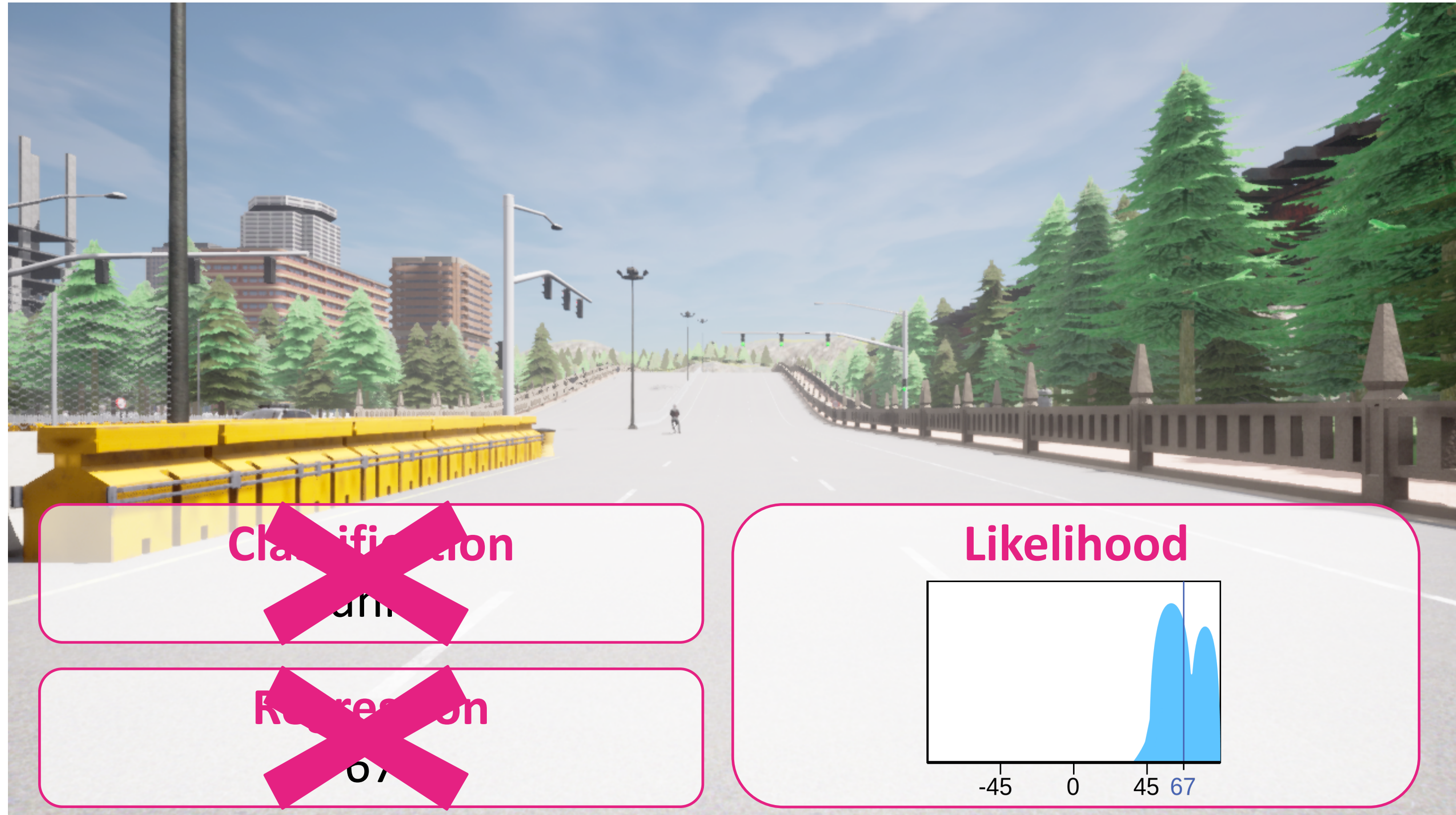
We characterize domains with probability distributions



We characterize domains with probability distributions



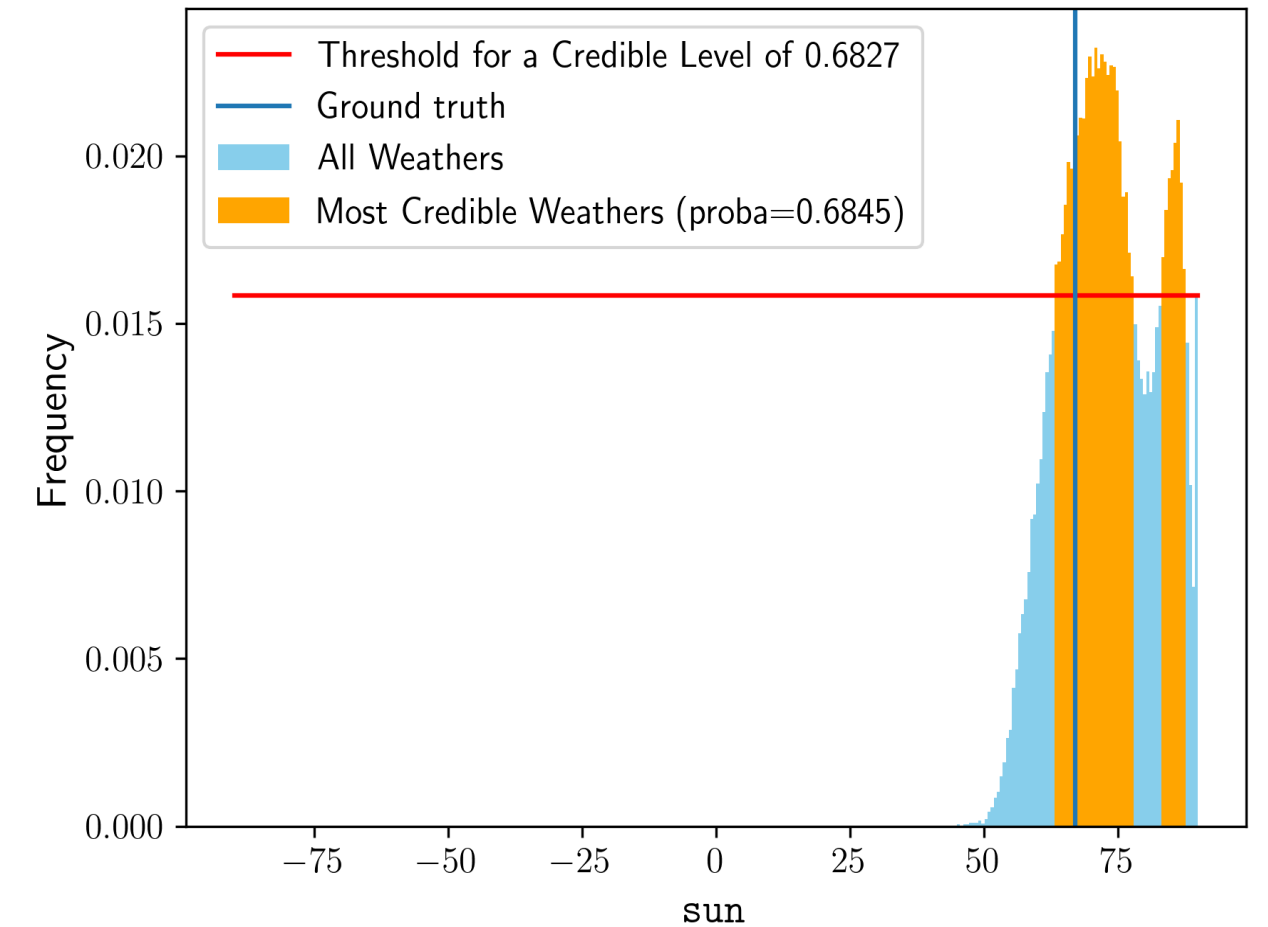
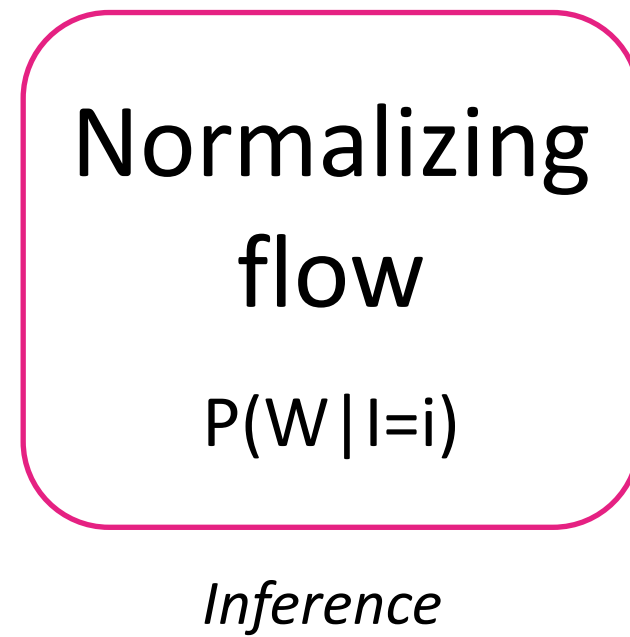
We characterize domains with probability distributions



We predict likelihoods with normalizing flows



We predict likelihoods with normalizing flows



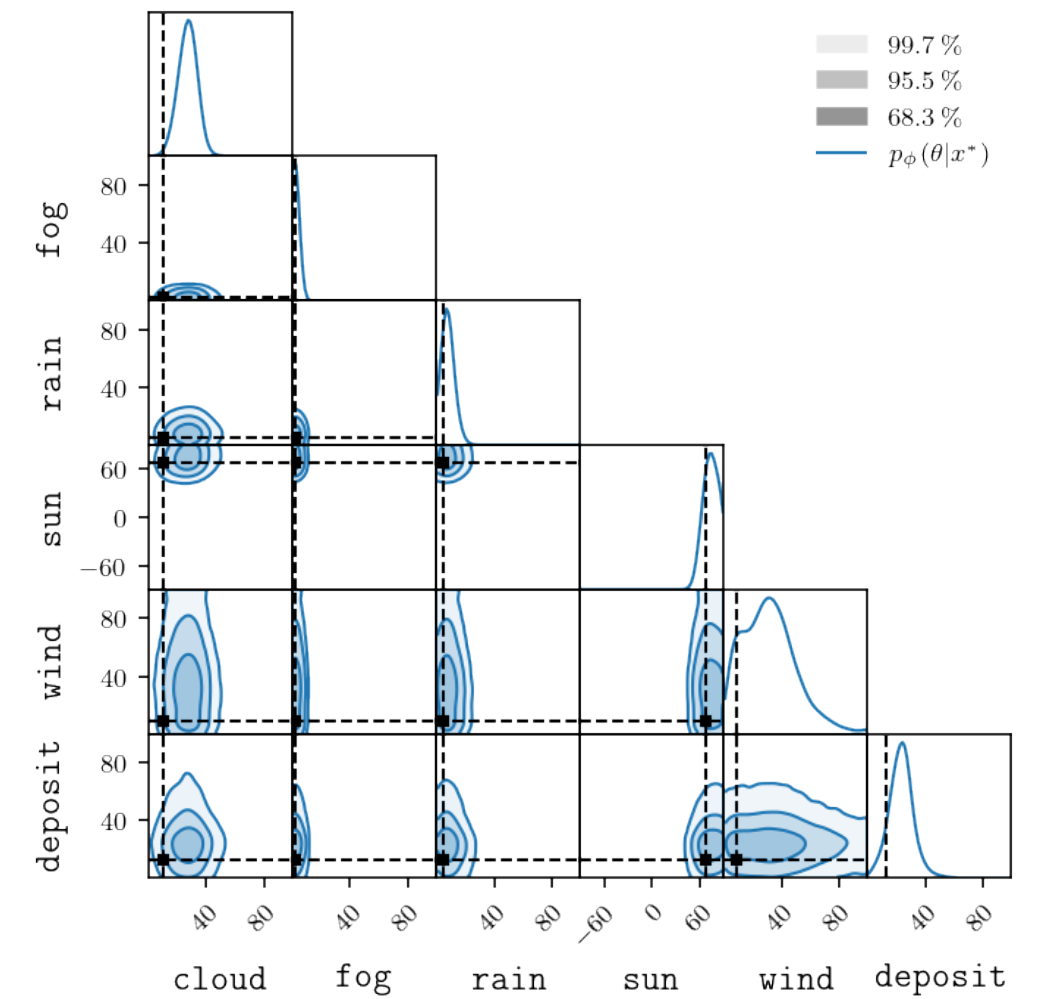
We predict likelihoods with normalizing flows



Normalizing
flow
 $P(W | I=i)$

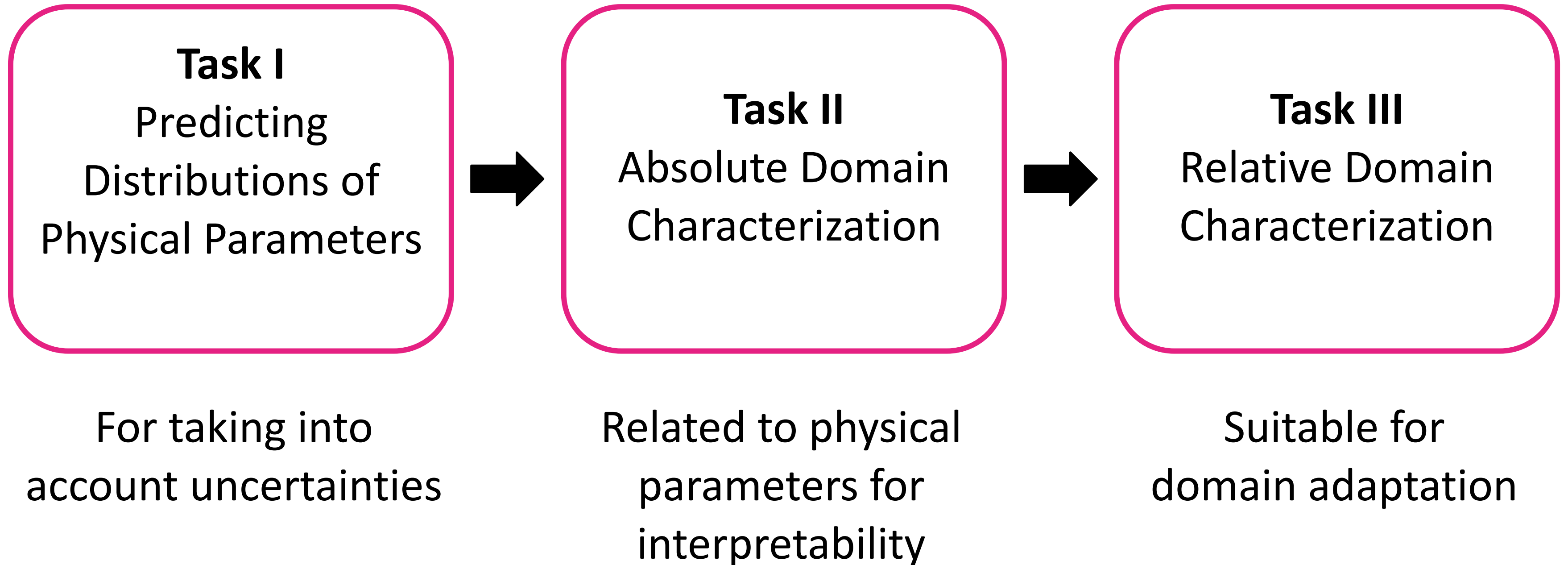


Inference



Corner plot

We define 3 tasks and provide baseline solutions



Task I: Predicting Distributions of Physical Parameters

Definition

Inference

Weather parameters

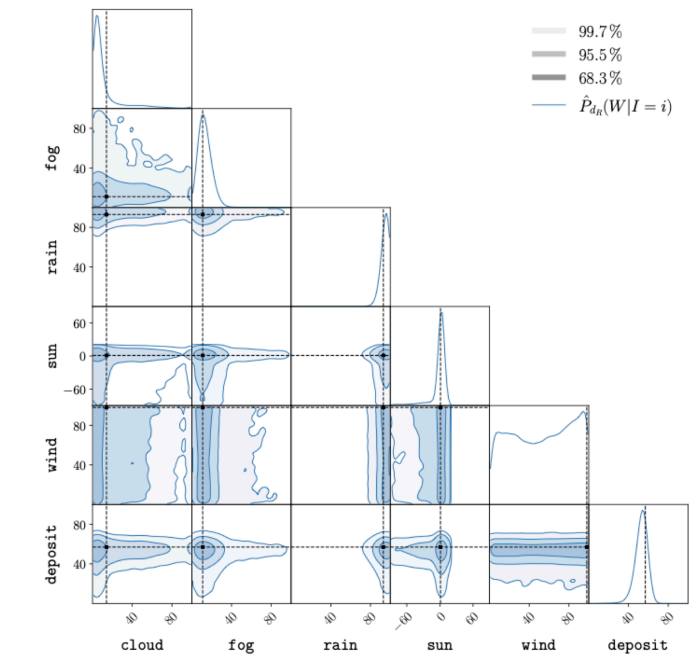
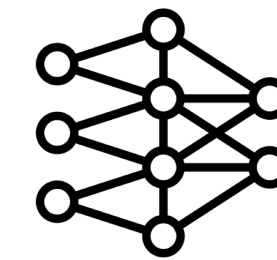
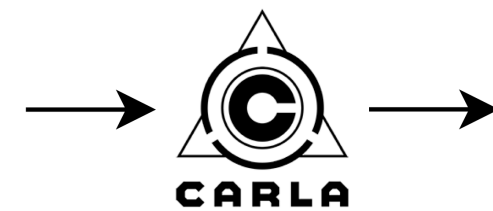
Simulator

Observation

NPE

Estimated distribution

Cloudiness
Fog density
Precipitation
Sun altitude angle
Sun azimuth angle
Wind intensity
Precipitation deposits

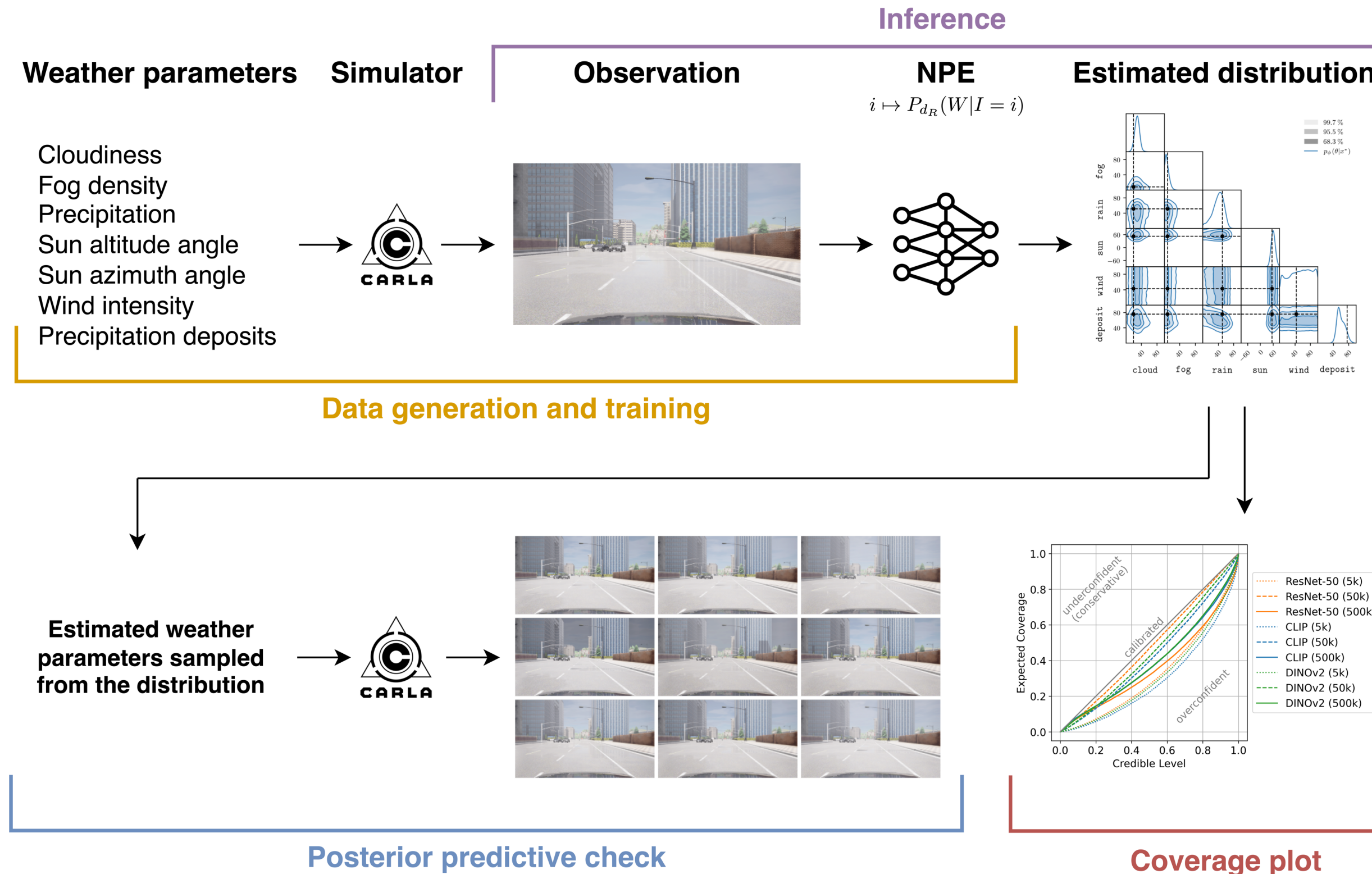


$$i \mapsto P_{d_R}(W|I=i)$$

Data generation and training

Task I: Predicting Distributions of Physical Parameters

Evaluation of our baseline solution



Task II: Absolute Domain Characterization

Definition

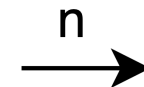
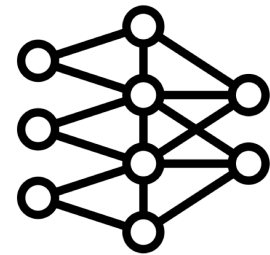
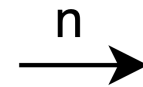
Absolute characterization

Bag of observations

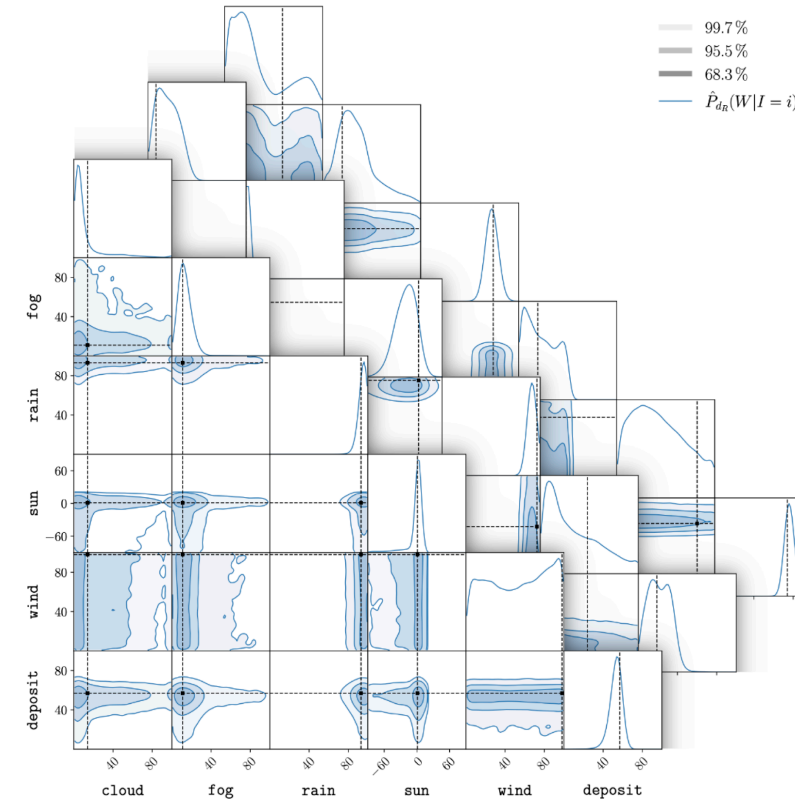


NPE

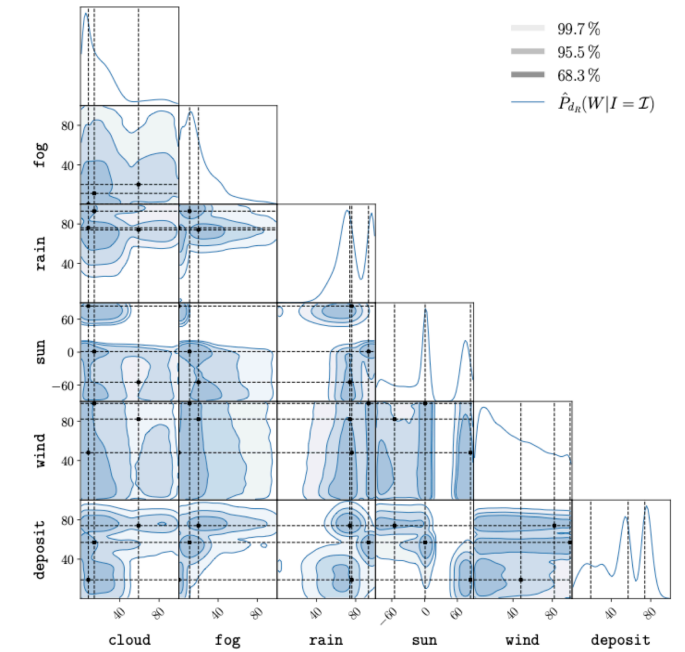
$$i \mapsto P_{d_R}(W|I = i)$$



Bag of estimated distributions



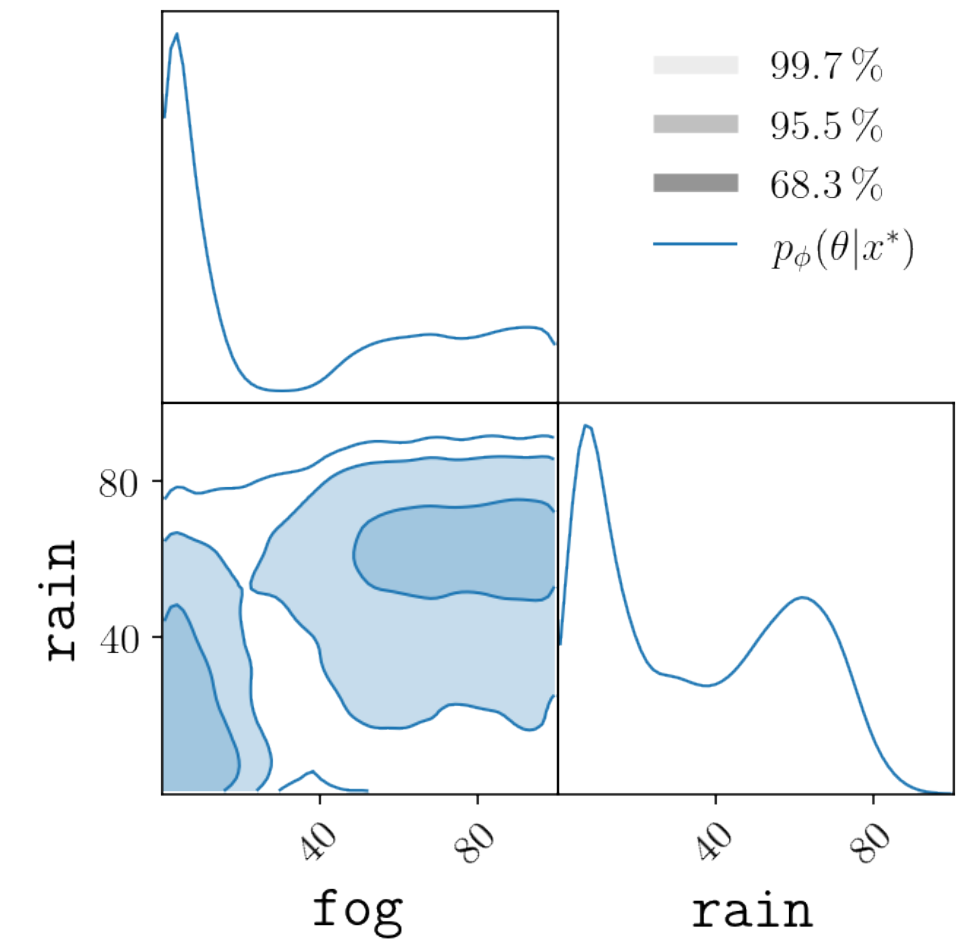
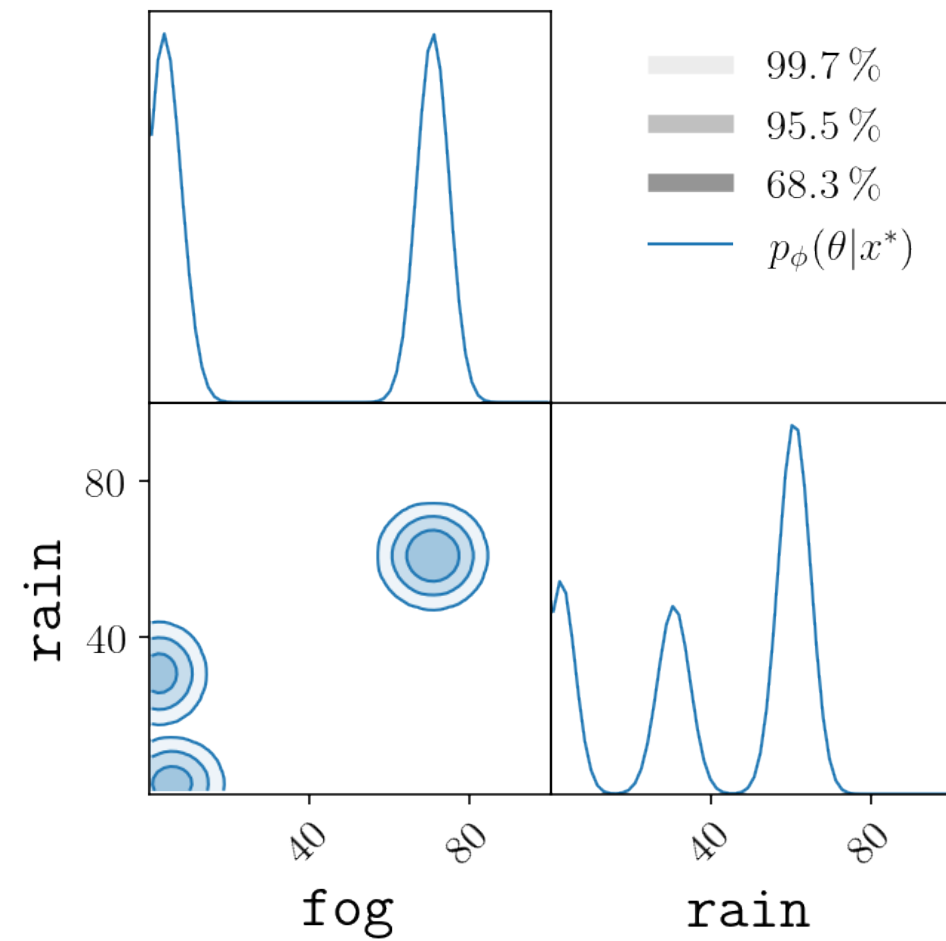
Estimated distribution of the domain



Inference

Task II: Absolute Domain Characterization

Evaluation of our baseline solution

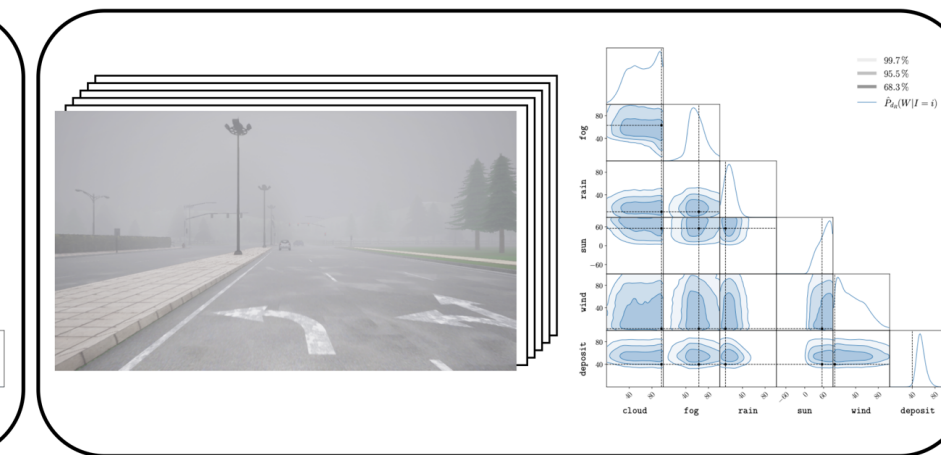
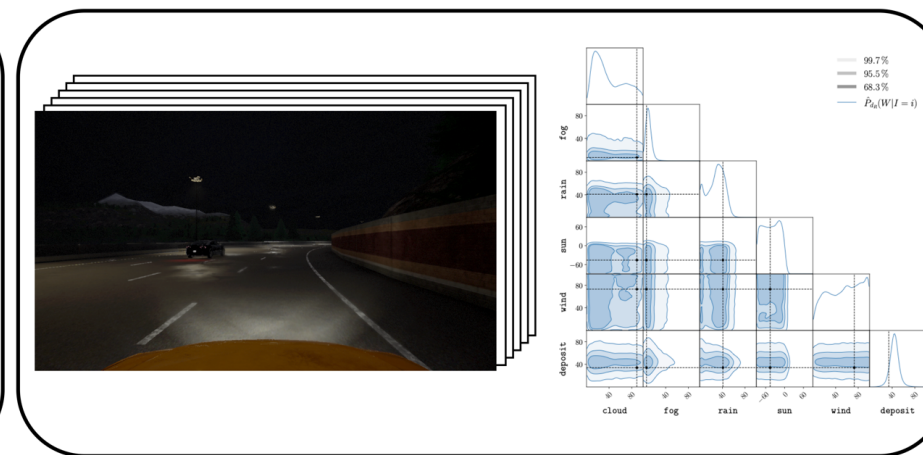
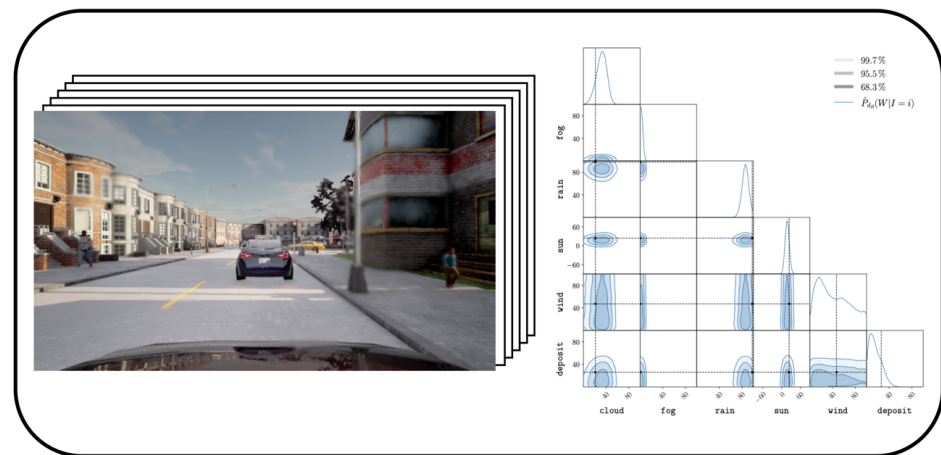


Task III: Relative Domain Characterization

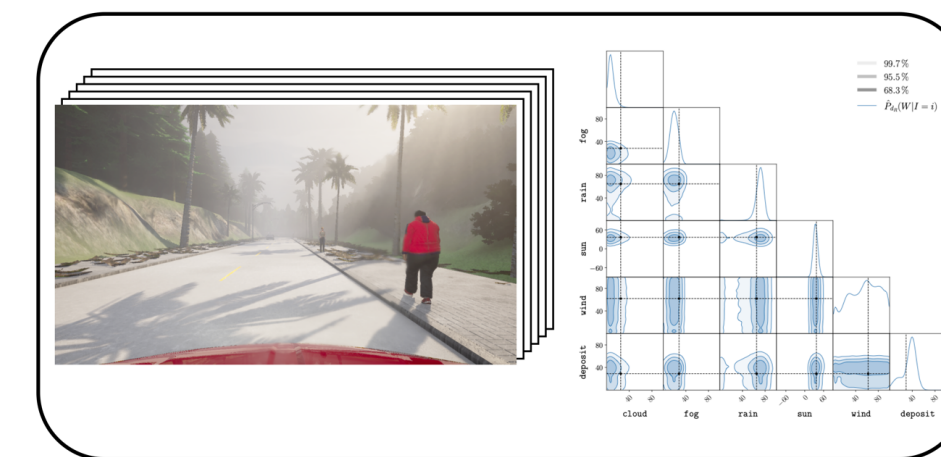
Definition

Relative characterization and out of *ODD* detection

Source domains d_{S_k}



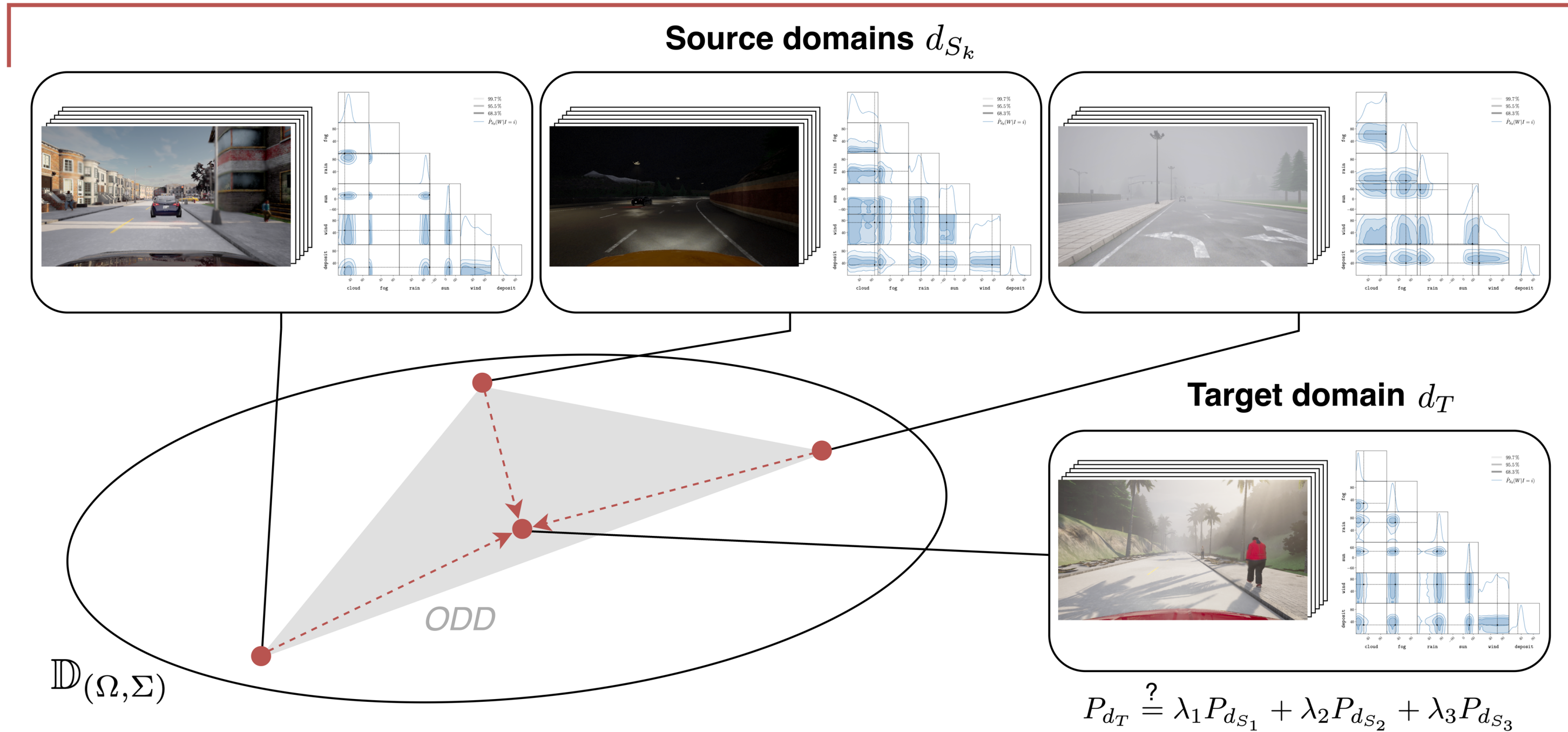
Target domain d_T



Task III: Relative Domain Characterization

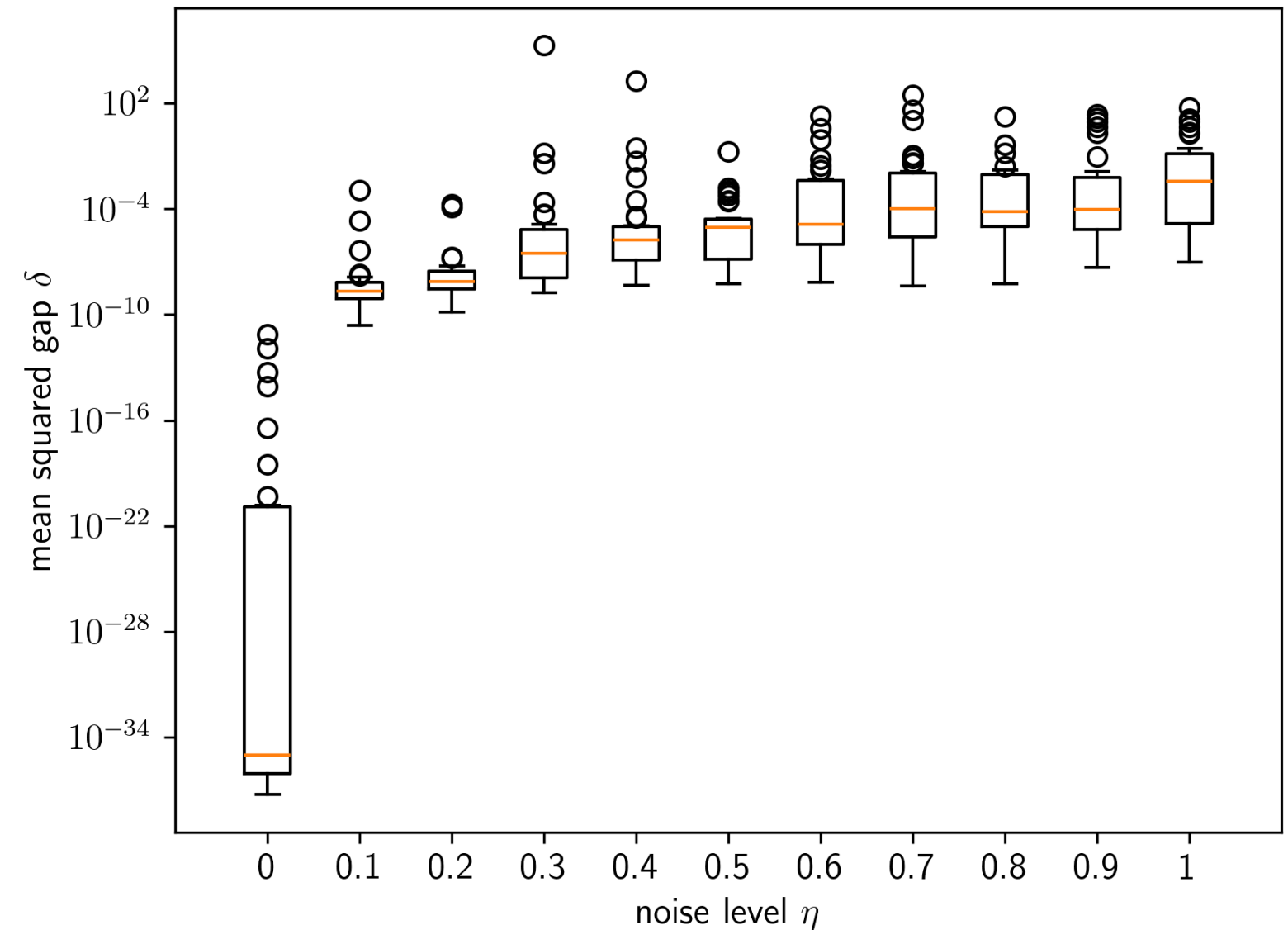
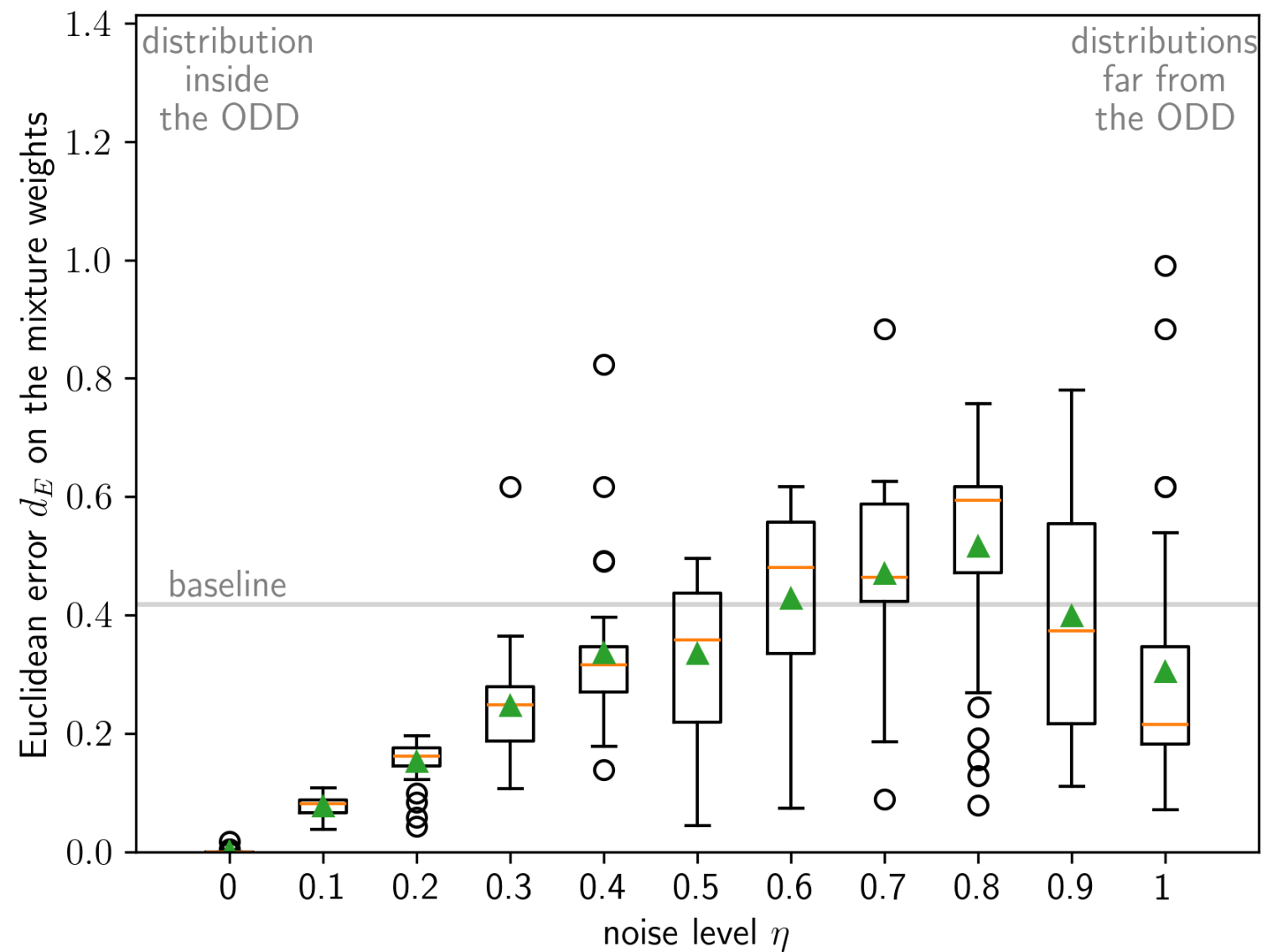
Definition

Relative characterization and out of *ODD* detection



Task III: Relative Domain Characterization

Evaluation of our baseline solution

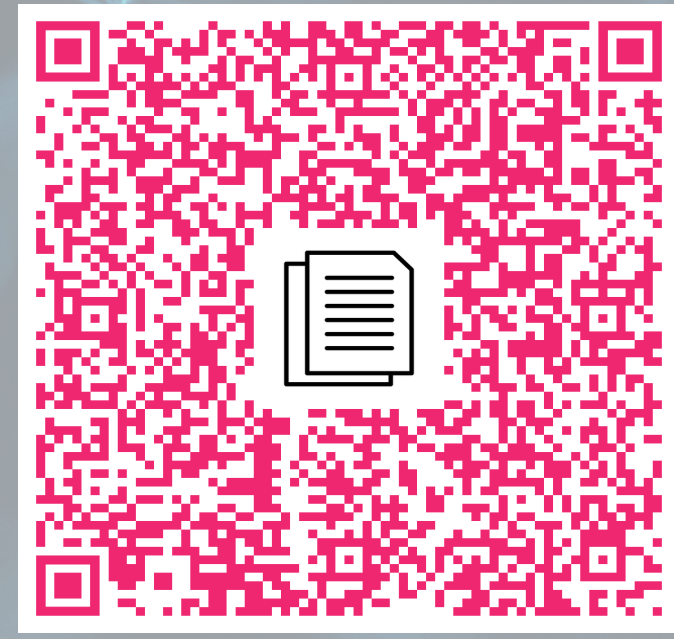
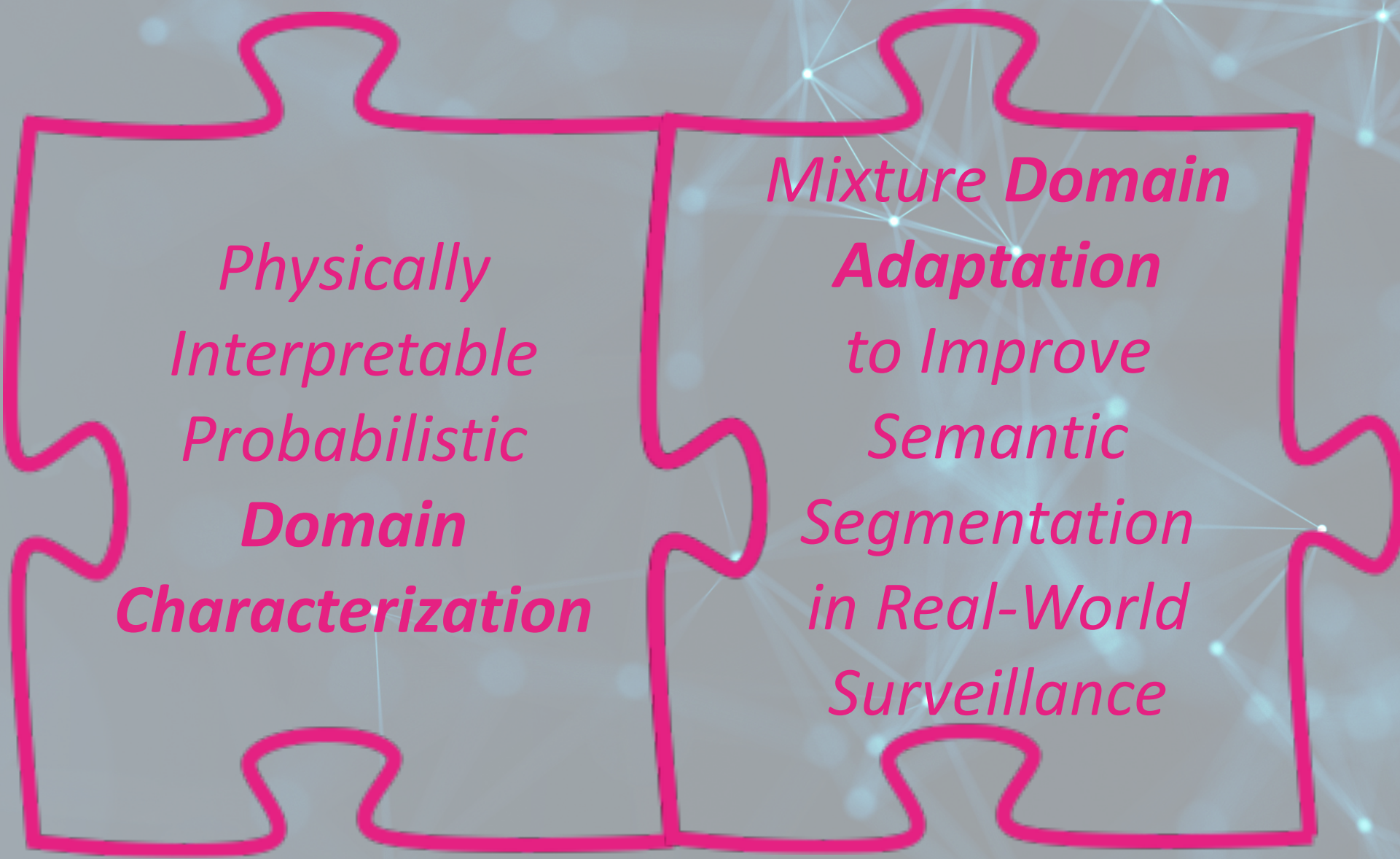


Workshop on "AI-based All-Weather Surveillance System"

*Physically
Interpretable
Probabilistic
Domain
Characterization*

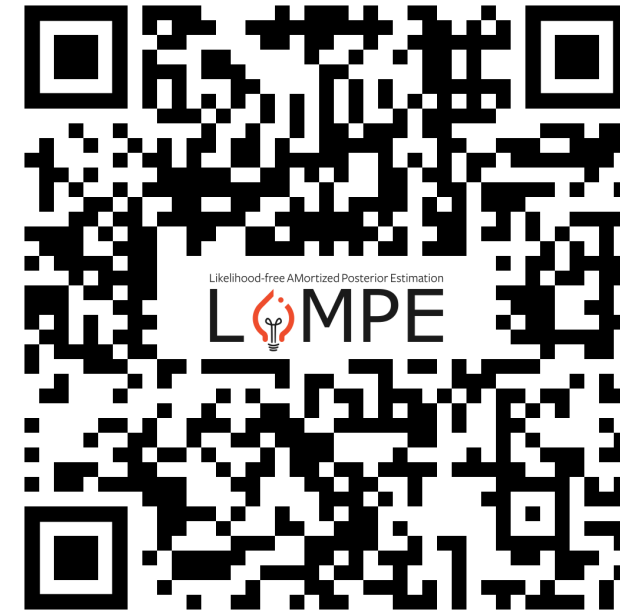
*Mixture Domain
Adaptation
to Improve
Semantic
Segmentation
in Real-World
Surveillance*

Workshop on “AI-based All-Weather Surveillance System”



Resources

Libraries to train and manipulate
normalizing flows



Resources to generate
similar data to ours

Regression fails with ambiguous cases

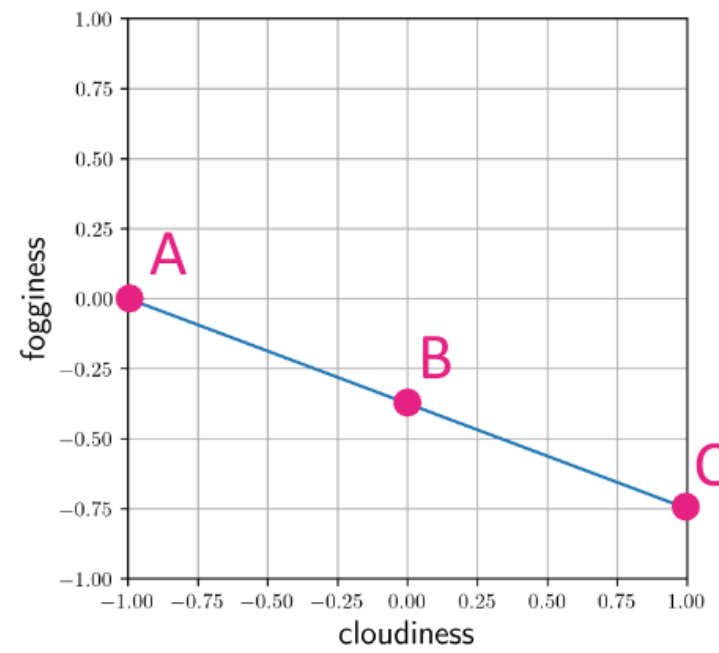


0 %	cloudiness	100 %
50 %	fog density	12,5 %
0 %	precipitation	0 %
0 %	precipitation deposits	0 %
45°	sun azimuth angle	45°
10 %	wind intensity	10 %



A

C



A

B

C

