



**SPP2115: Polarimetric Radar Observations meet
Atmospheric Modelling (PROM)**

**Polarimetric radar-based methods for evaluation of
hydrometeor mixtures in numerical weather prediction
models**

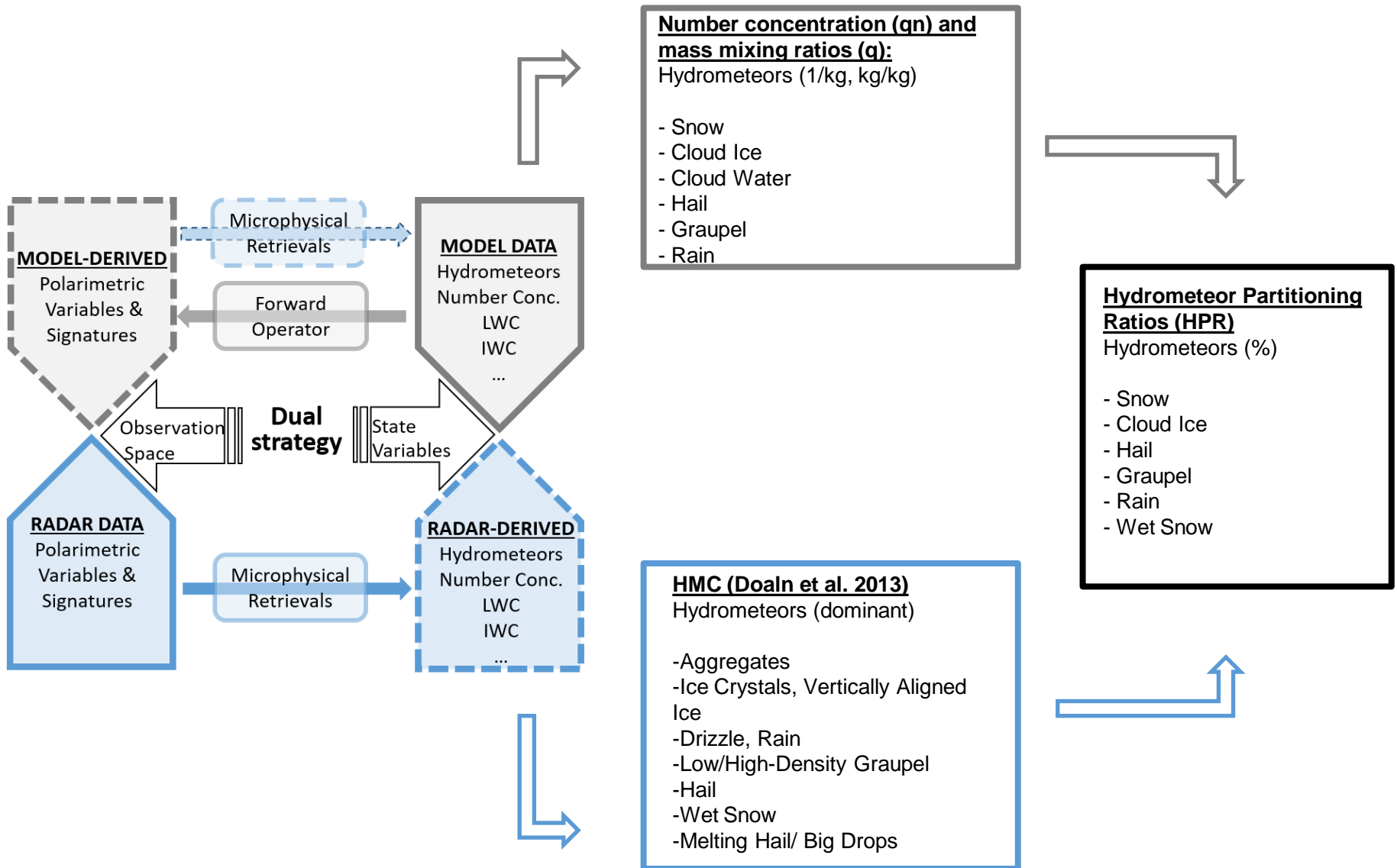
**An efficient volume scan polarimetric radar forward
OPERATOR to improve the representATIOn of
HYDROMETEORS in the COSMO model
(Operation Hydrometeors)**

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A dual strategy for model evaluation



Hydrometeor Prtitioning Ratios (HPR)



Exponential Distribution (Controids, Besic et al. 2018)

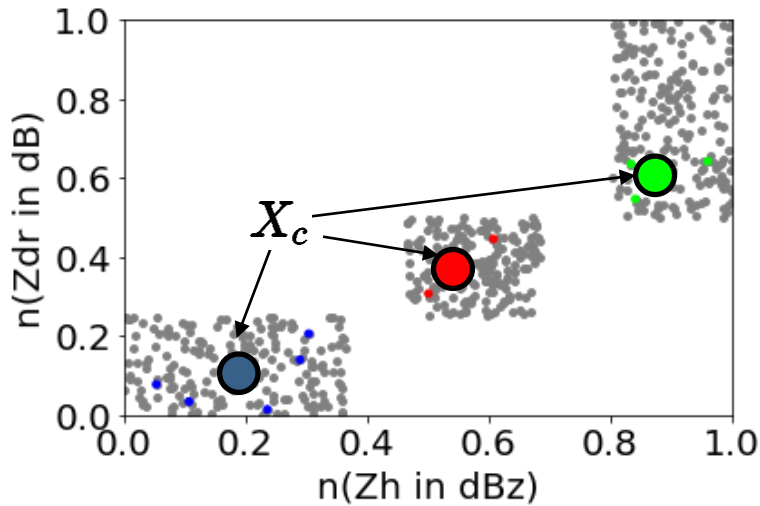
$$p_i = e^{-t_i d_i}, i = 1, \dots, n_{clusters}$$

$n_{clusters}$: Number of clusters/hydrometeor classes

p_i : Probability/mixing ratio of a hydrometeorclass i

d_i : Euclidean distance to cluster i

t_i : Probability adjustment



$$X_{obs} = [Z_H, Z_{DR}, K_{DP}, \rho_{HV}, I(T)]$$

Exponential Distribution (Centroids, Besic et al. 2018)

$$p_i = e^{-t_i d_i}, i = 1, \dots, n_{clusters}$$

$n_{clusters}$: Number of clusters/hydrometeor classes

p_i : Probability/mixing ratio of a hydrometeor class i

d_i : Euclidean distance to cluster i

t_i : Probability adjustment

Multivariate Normal Distribution (Centroids + Covariances)

$$p_i(\mathbf{X}_{obs} | X_{ci}, \Sigma_i) = \frac{1}{\sqrt{(2\pi)^d |\Sigma_i|}} \exp\left(-\frac{1}{2}(\mathbf{X}_{obs} - X_{ci})^T \Sigma_i^{-1} (\mathbf{X}_{obs} - X_{ci})\right)$$

$$i = 1, \dots, n_{clusters}$$

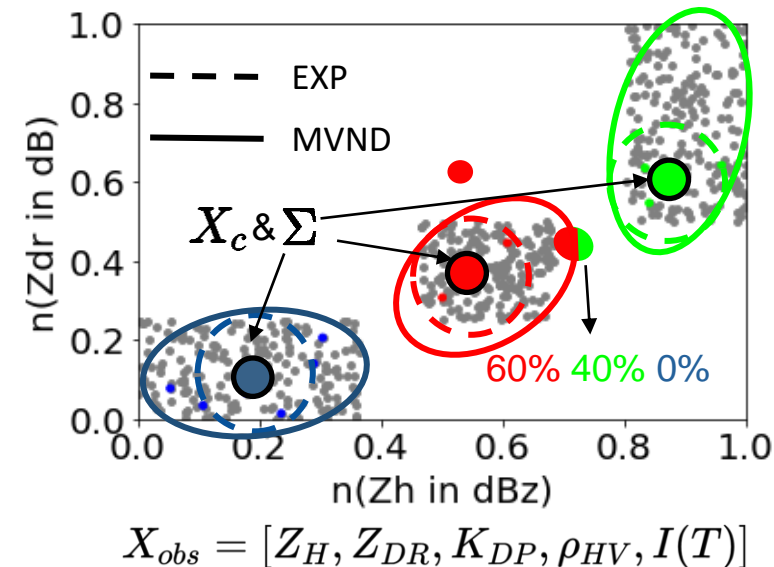
$n_{clusters}$: Number of clusters/hydrometeor classes

d : Size of observation

Σ : Covariance matrix

X_{obs} : Observation

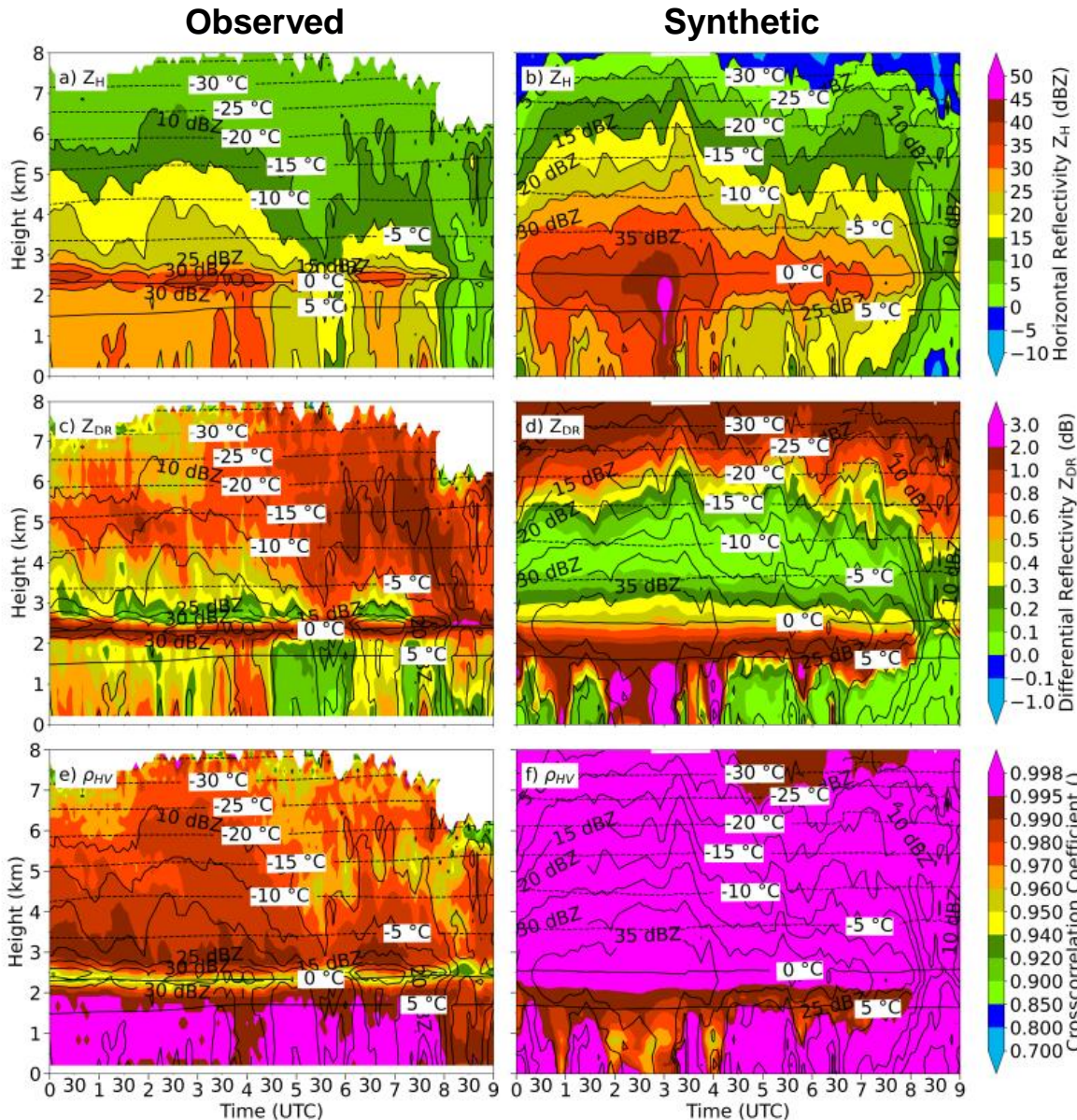
X_c : Centroid



A dual strategy for model evaluation

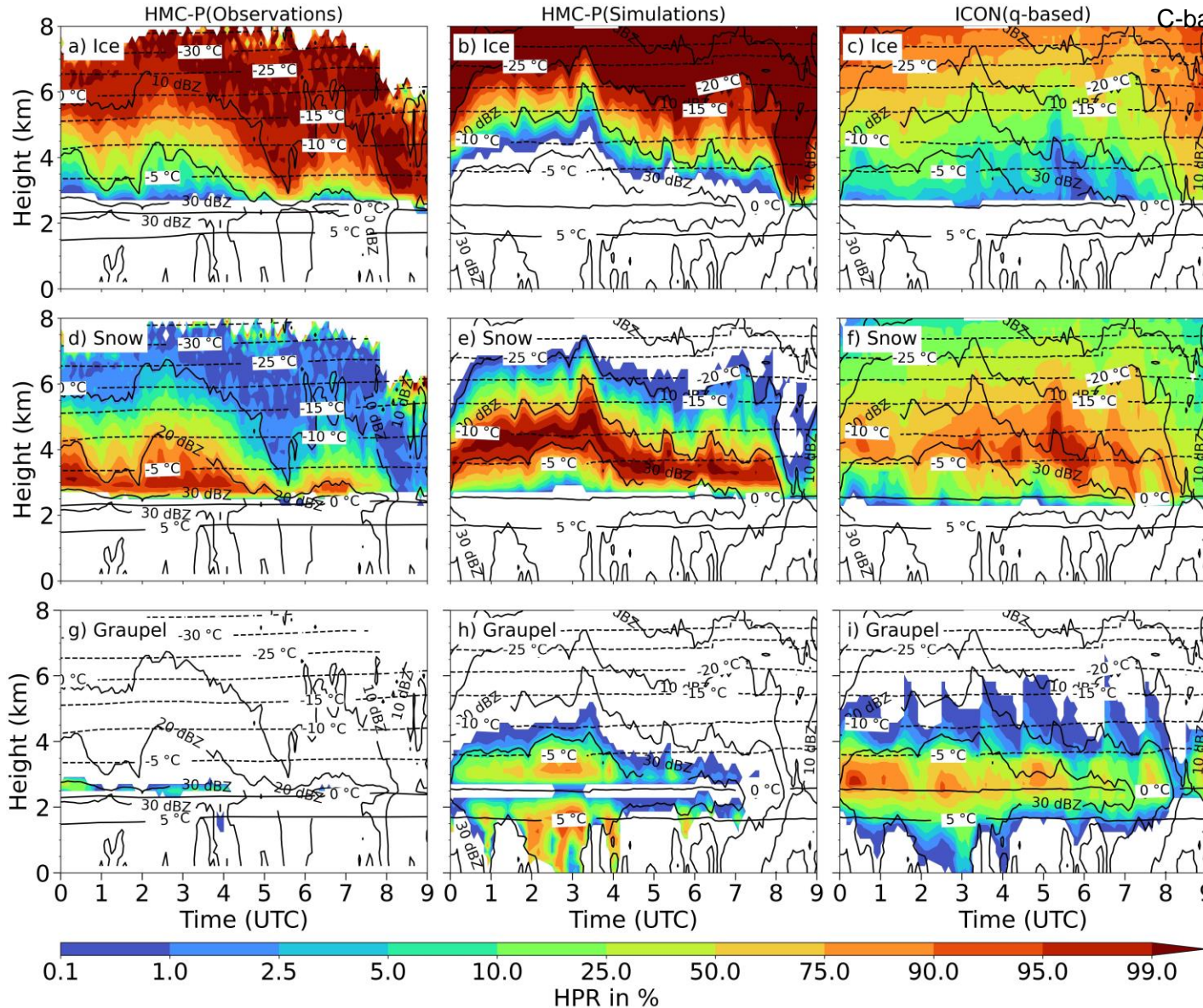


QVPs (from 12° PPIs) from
25 July 2017 at the
C-band station Prötzel



A dual strategy for model evaluation

QVPs (from 12° PPIs) from
25 July 2017 at the
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Summary



- A **dual strategy** for model evaluation was demonstrated
- An HMC with the ability to determine hydrometeor partitioning ratios (**HPR**) adapted for model hydrometeor evaluation was developed
- The dual strategy allows at the same time a **cross-check** of the HMC-P retrievals and the FO accuracy but also an **evaluation** of the model in the **observation** and **model space**.
- The evaluation in **stratiform** precipitation showed an **extensive graupel production** around the ML in the model (Z_H/Z_{DR} overestimation) and problems with the **partitioning of snow and ice** (too fast aggregation, missing Z_{DR}/K_{DP} signatures in DGL; FO).