

Improving Weather Radar QPE with AI and Commercial Microwave Links

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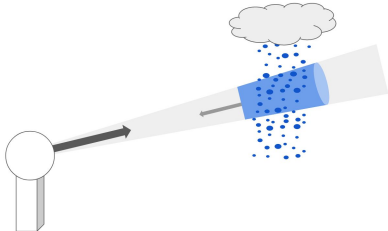
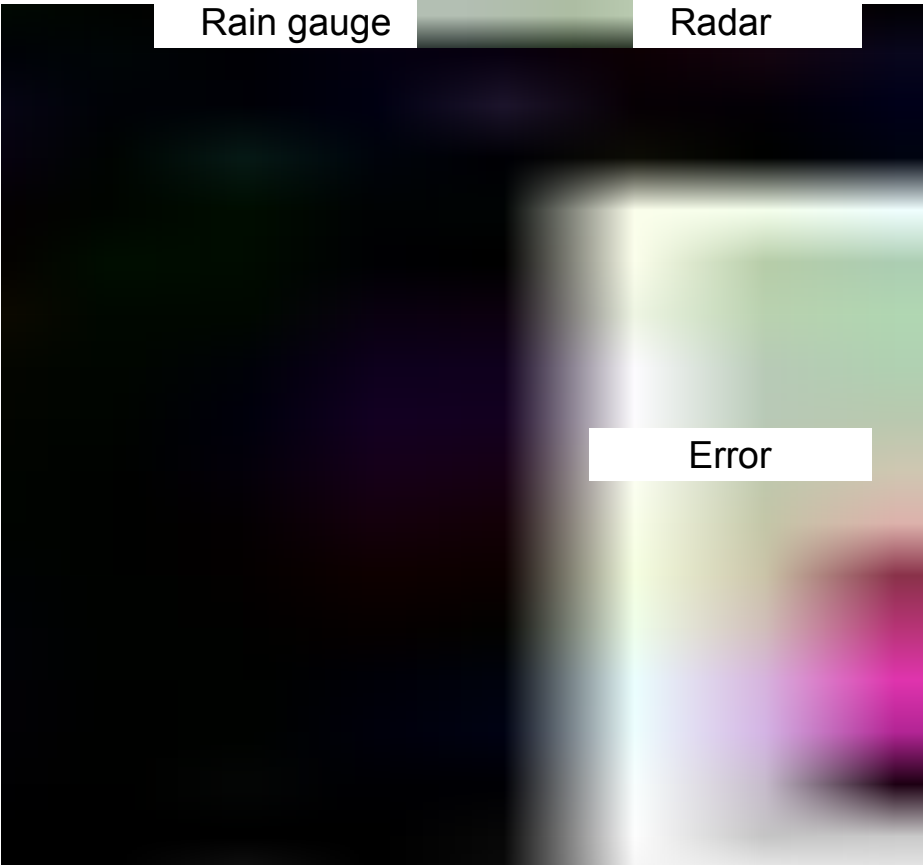
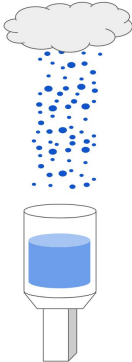
Source: Flickr

Topics:

- The ResRadNet ground adjustment concept
- First results using polarimetric QPE composite
- First results with added CML data
- ResRadNet 2.0
- Next steps

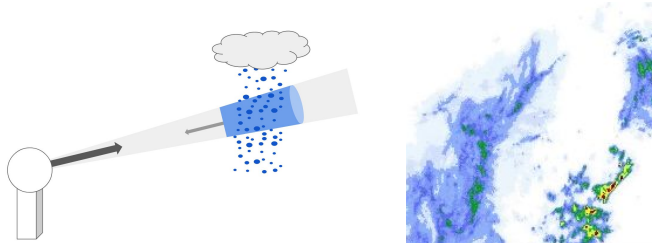
ResRadNet v1.0

Radar QPE - Error sources

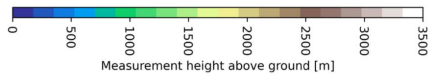
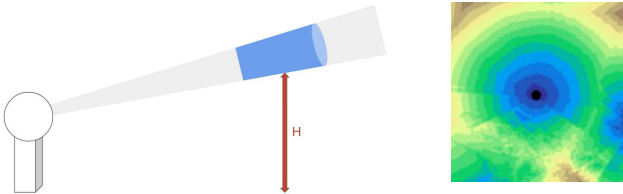


Problem formulation

Input:
Radar QPE
5 min res.

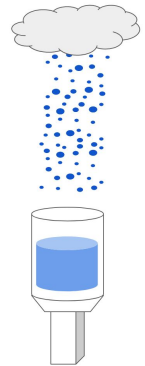


Radar Measurement height



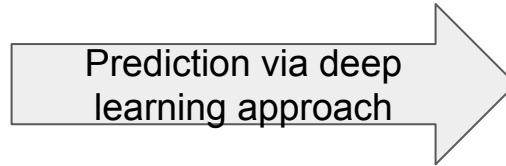
Prediction via deep learning approach

Target:
Rain gauge QPE
1 min res.



Problem formulation

Input:
Radar QPE
5 min res.



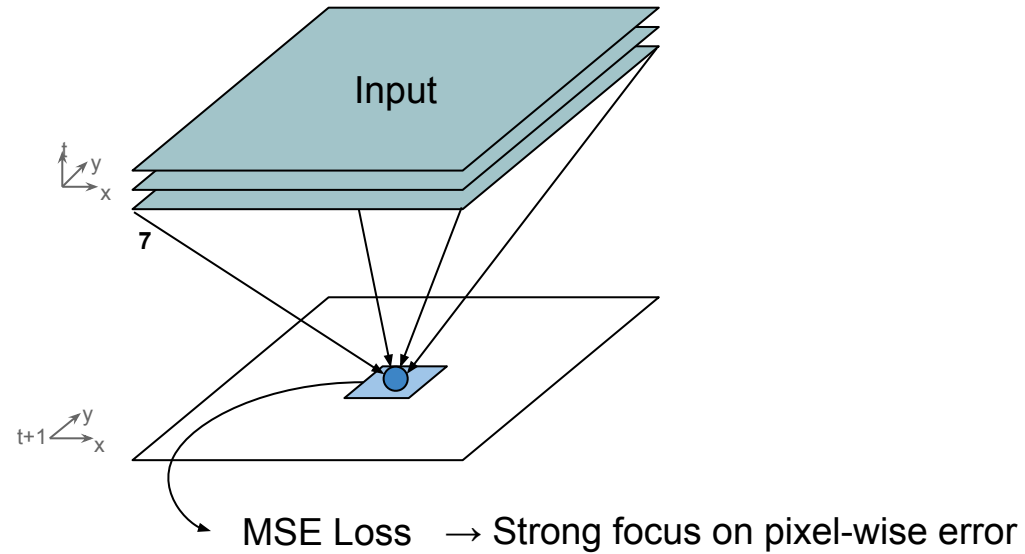
Target:
Rain gauge QPE
1 min res.

Goals:

- increase the temporal radar resolution of 5 min by a short-term prediction of five 1-min time-steps
- reduce biases between high-resolution C-band weather radar rainfall estimates and rain gauges on the ground
- provide spatiotemporally consistent country-wide rainfall maps over Germany

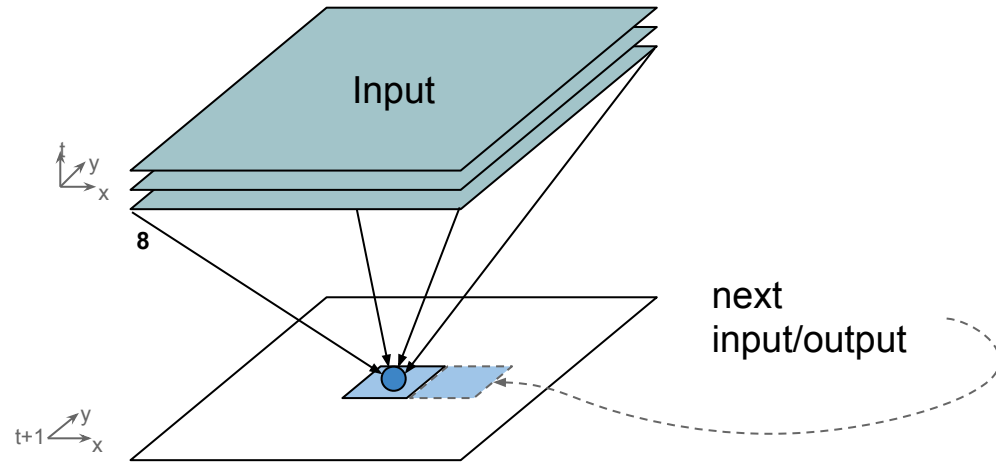
Loss at center pixel

→requires one input per pixel

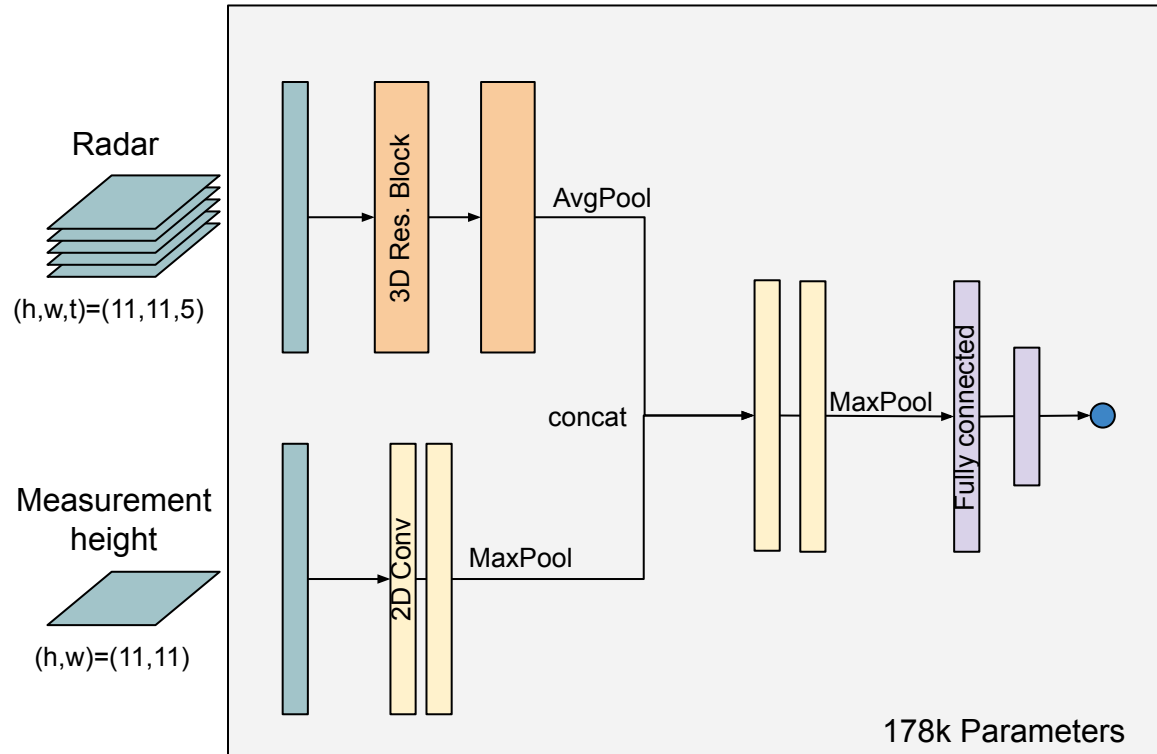


Loss at center pixel

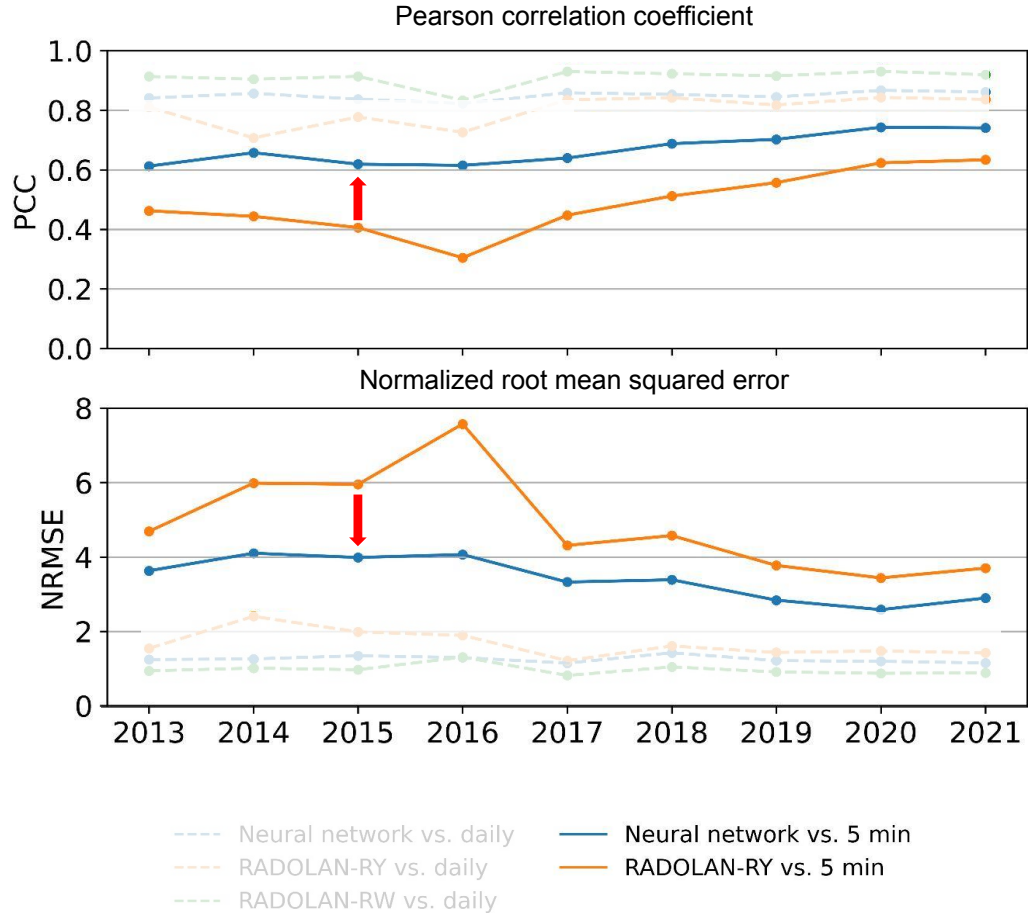
→requires one input per pixel



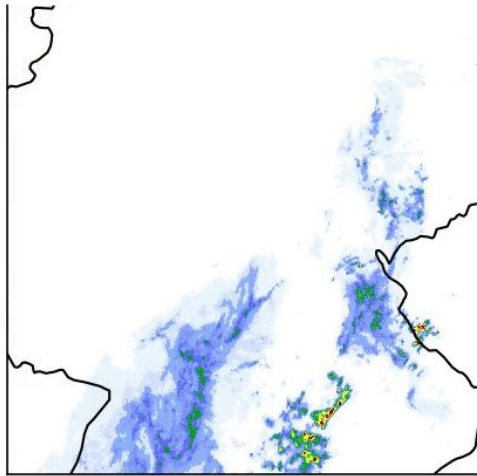
Architecture: Simple residual neural network¹



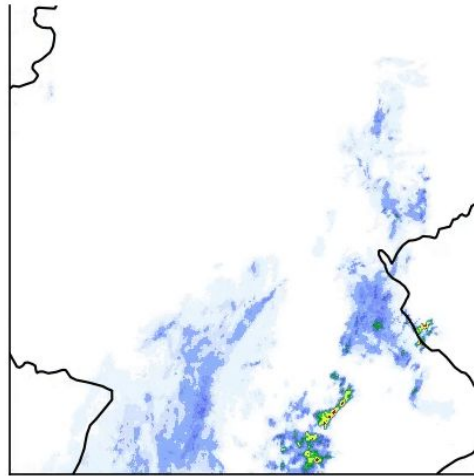
Results



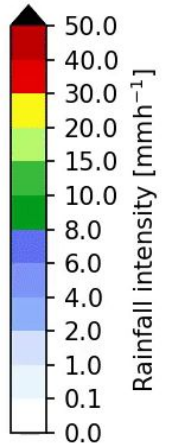
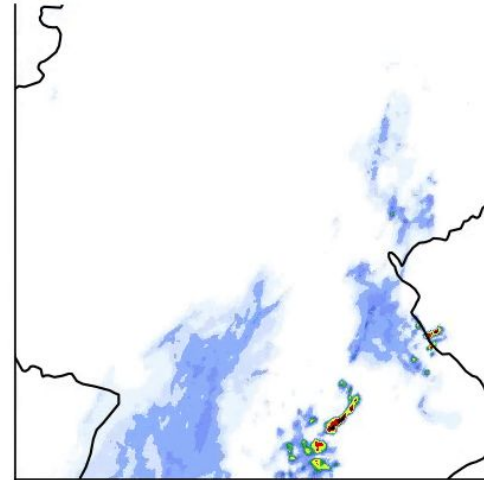
Raw radar



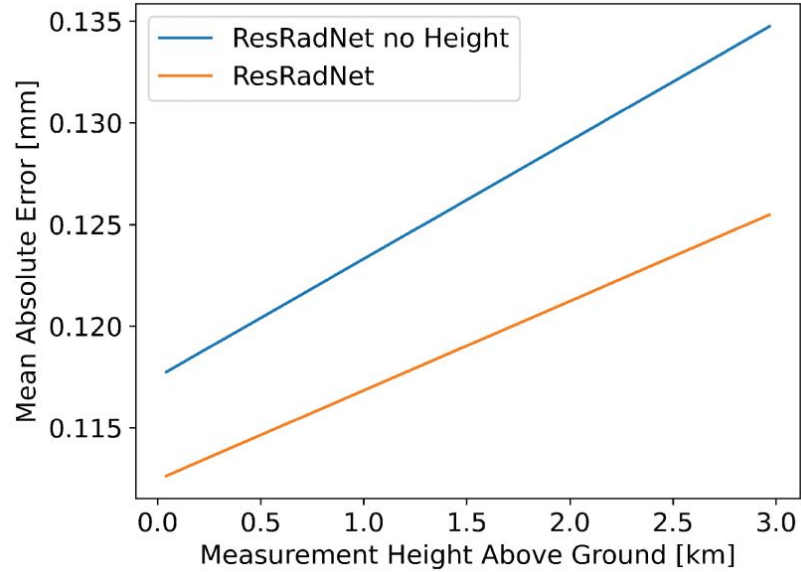
Gauge adjusted radar



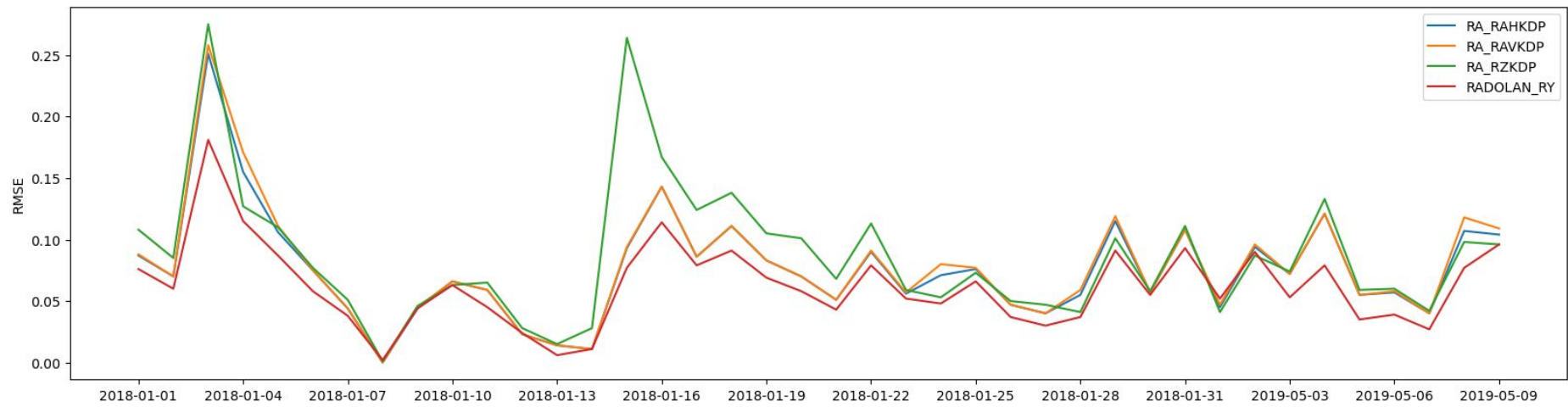
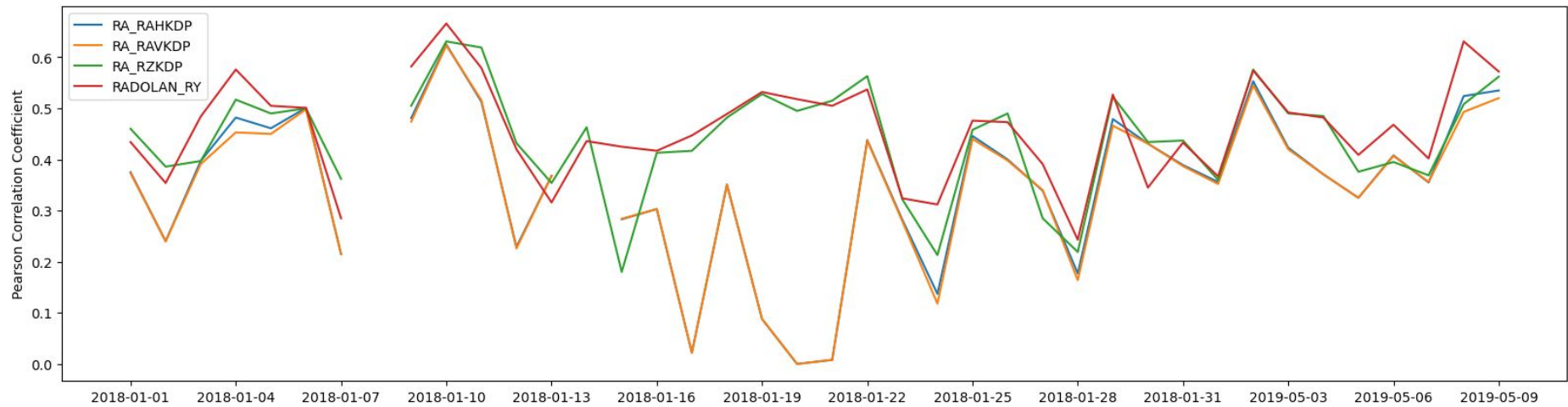
ResRadNet

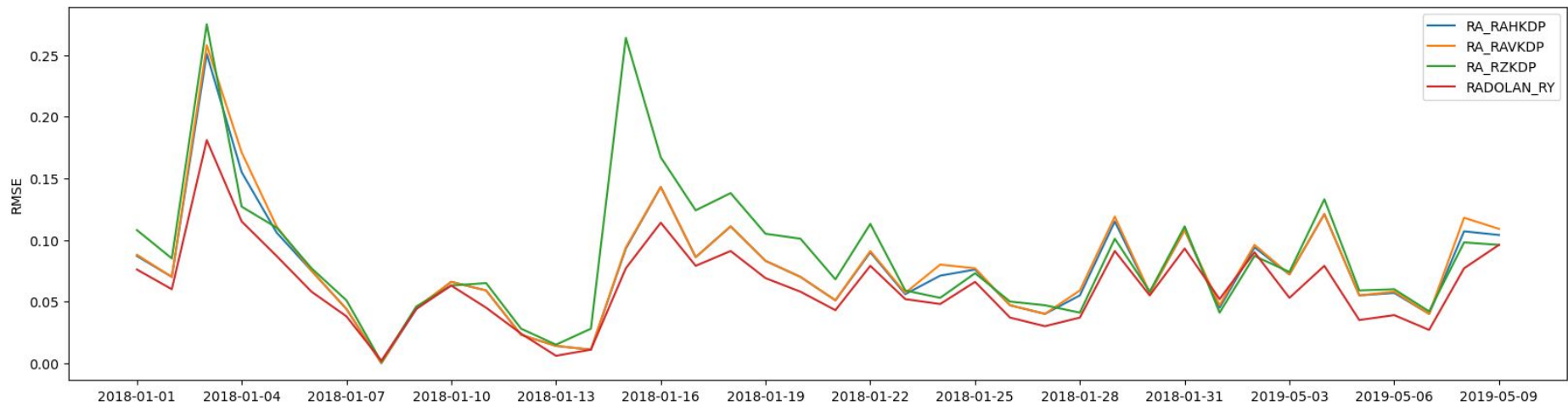
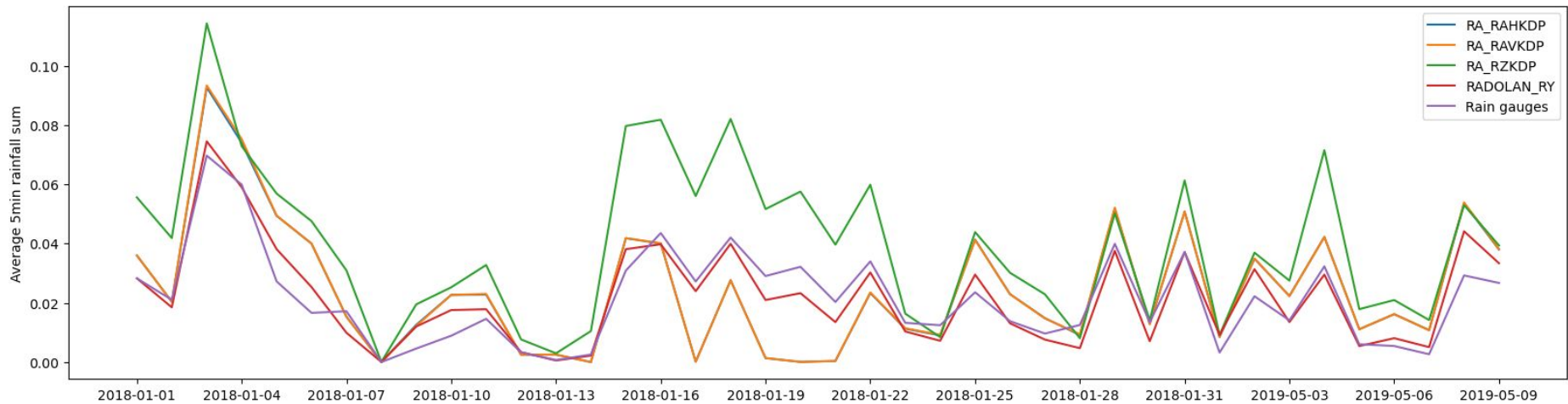


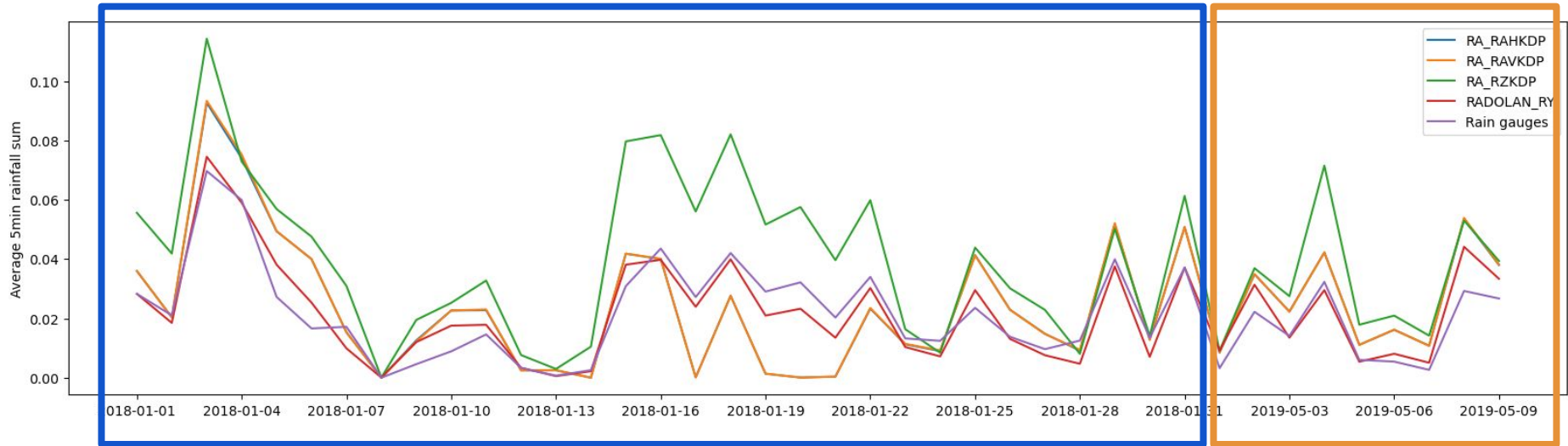
Impact of height above ground information as model input



POLARA QPE composite

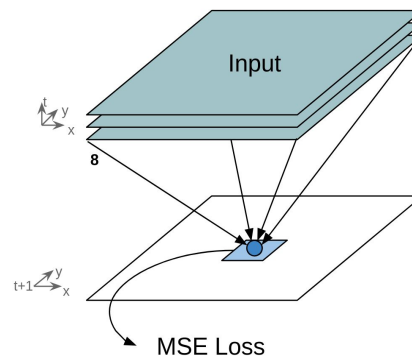




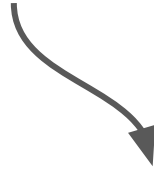


Train

Test



ResRadNet v1.0 (trained 2020) applied to Test period



Model:	RYai
SRC:	0.575
PCC:	0.607
MAE:	0.018
MDE:	0.231
RMSE:	0.057
BIAS:	0.0007
BIAS2:	-3.803
CV:	3.092
KS-test:	0.222

RY
0.549
0.552
0.021
0.226
0.07
0.0066
-37.783
3.234
0.207

ResRadNet v1.0 (trained 2020) applied to Test period

New ResRadNet v1.0 (trained 01/2018) applied to Test period



Model:	RYai	RYai	RY
SRC:	0.575	0.617	0.549
PCC:	0.607	0.609	0.552
MAE:	0.018	0.015	0.021
MDE:	0.231	0.093	0.226
RMSE:	0.057	0.055	0.07
BIAS:	0.0007	-0.0006	0.0066
BIAS2:	-3.803	3.905	-37.783
CV:	3.092	2.899	3.234
KS-test:	0.222	0.044	0.207

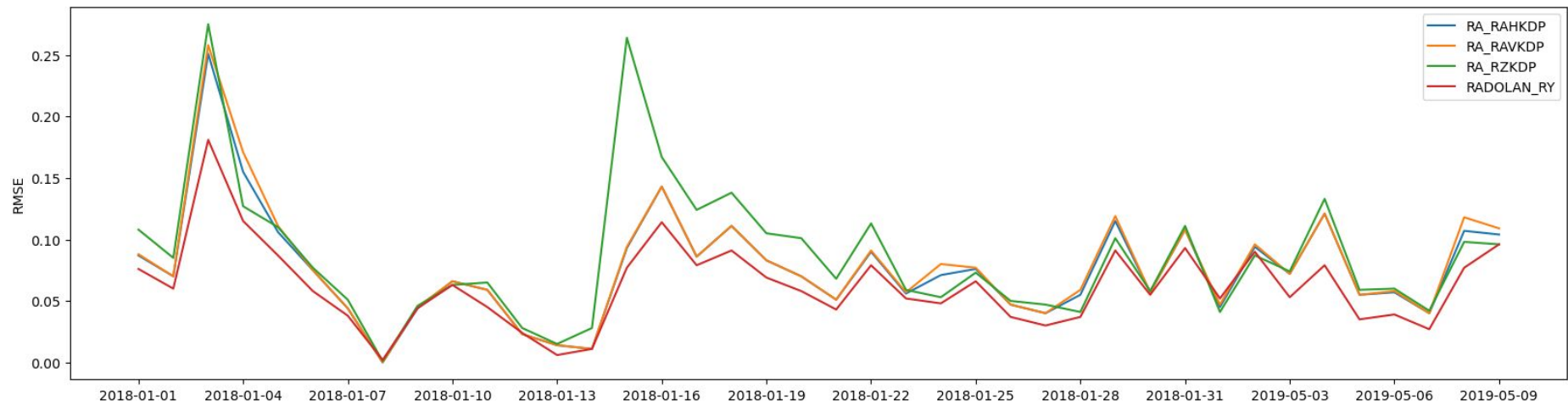
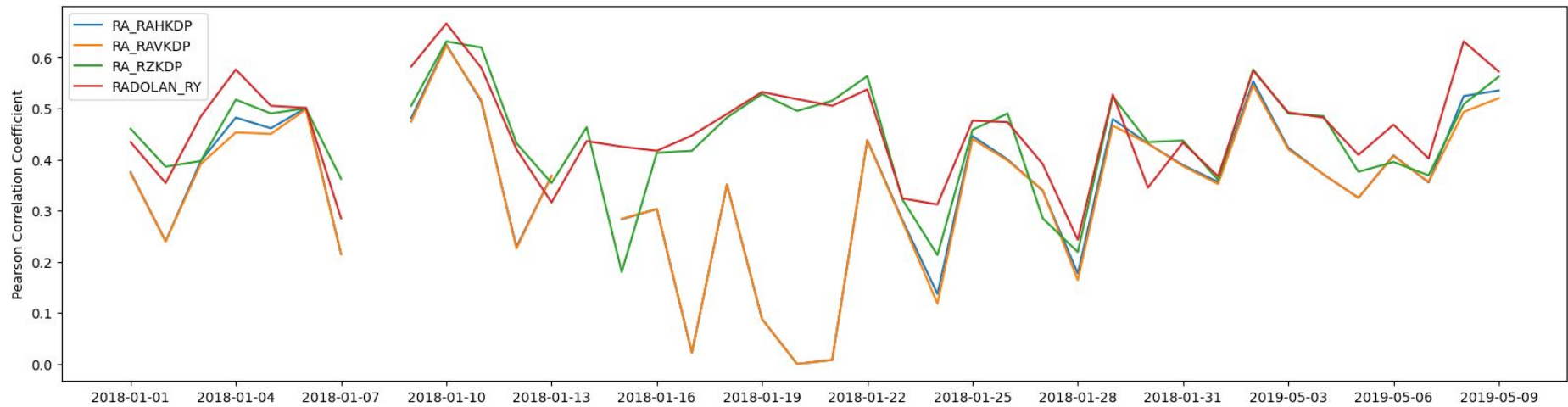
ResRadNet v1.0 (trained 2020) applied to Test period

New ResRadNet v1.0 (trained 01/2018) applied to Test period

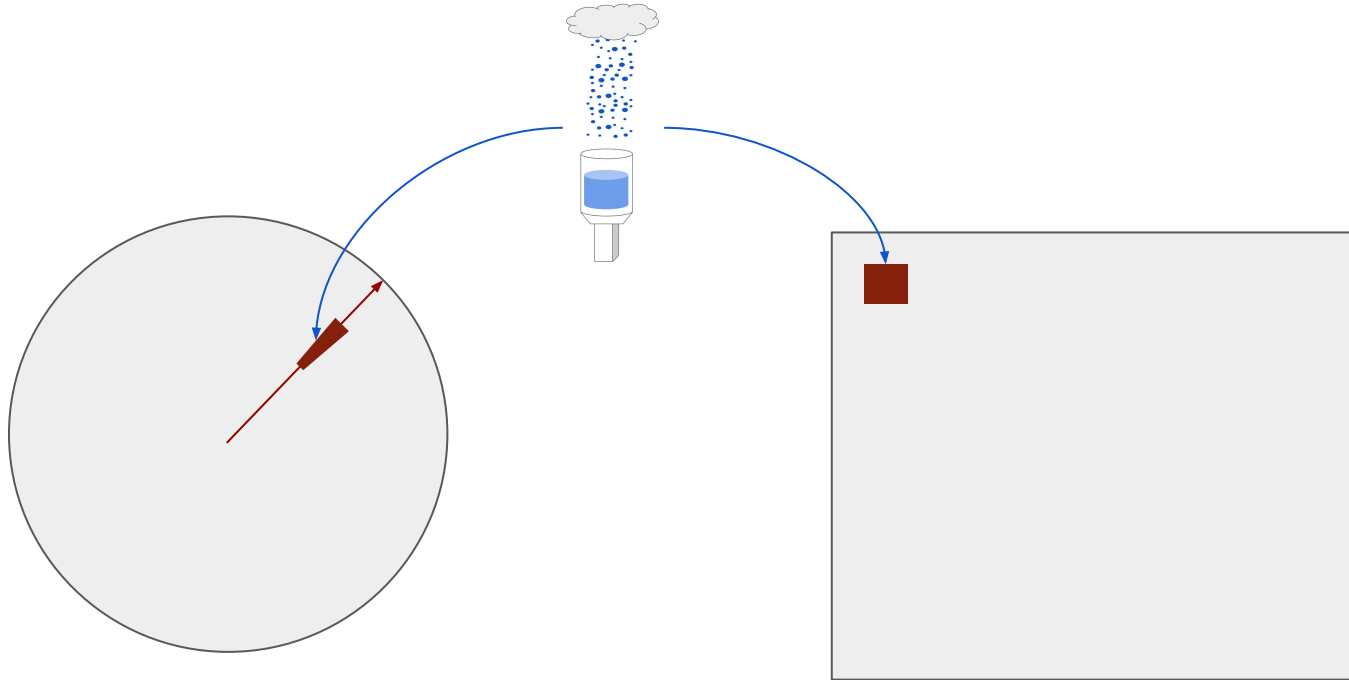


Model:	RYai	RYai	RY
SRC:	0.575	0.617	0.549
PCC:	0.607	0.609	0.552
MAE:	0.018	0.015	0.021
MDE:	0.231	0.093	0.226
RMSE:	0.057	0.055	0.07
BIAS:	0.0007	-0.0006	0.0066
BIAS2:	-3.803	3.905	-37.783
CV:	3.092	2.899	3.234
KS-test:	0.222	0.044	0.207

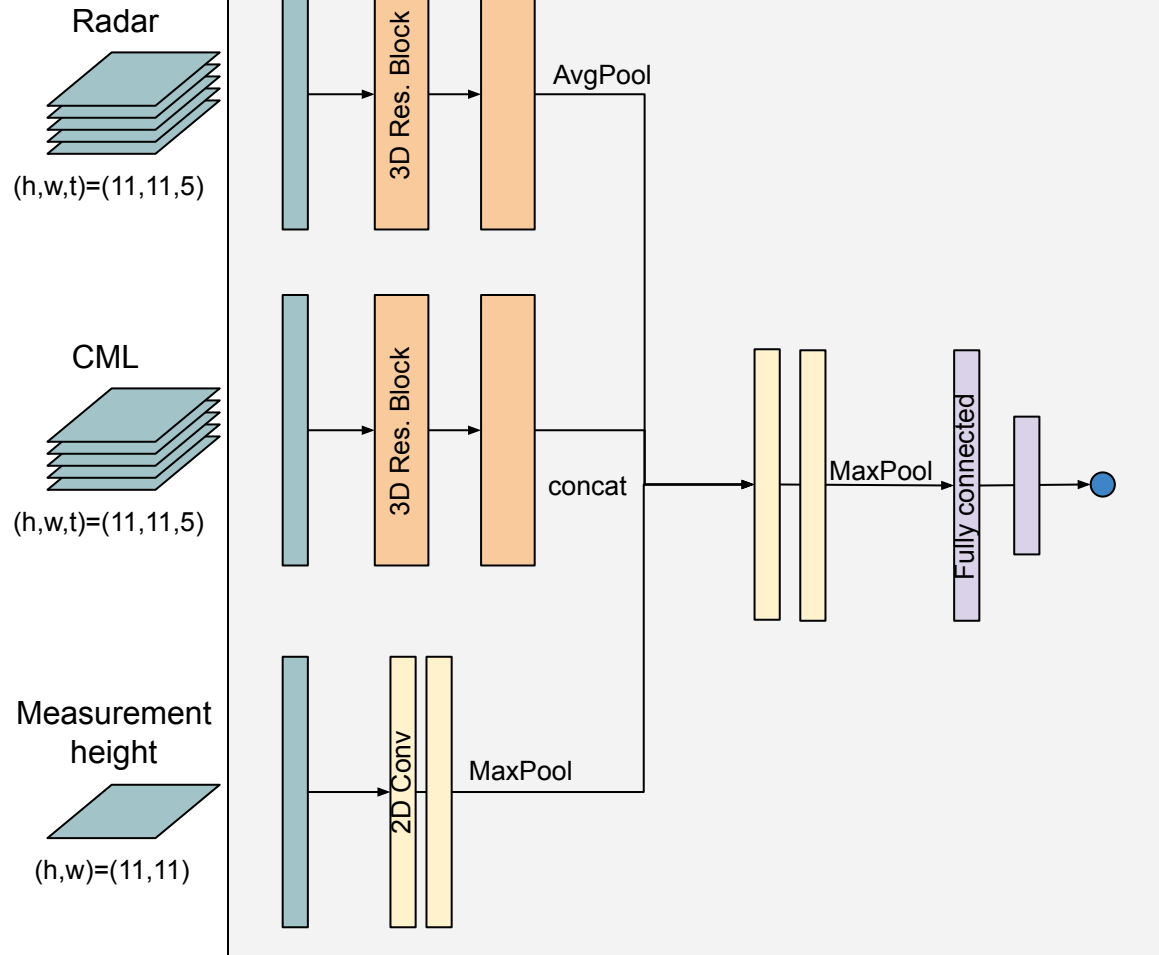
Conclusion: similar results with just 1 month of data (vs 1 year) achievable → very good



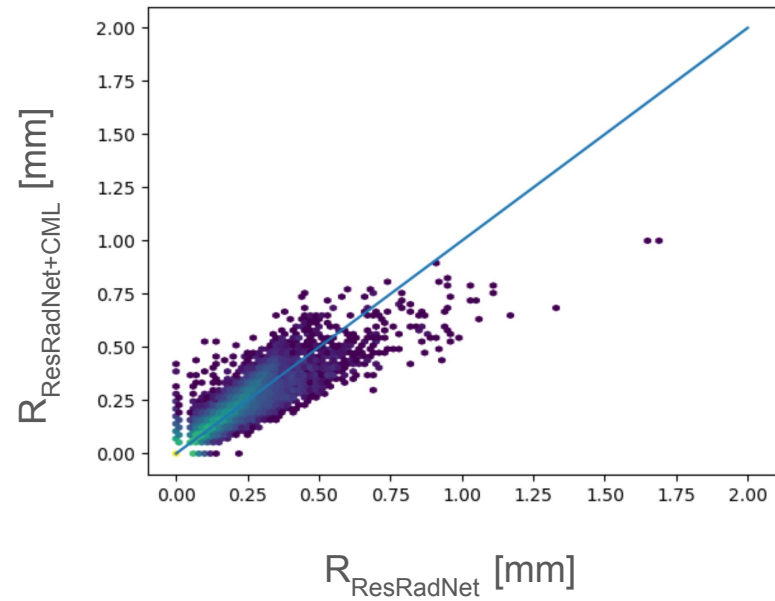
single radar or composite

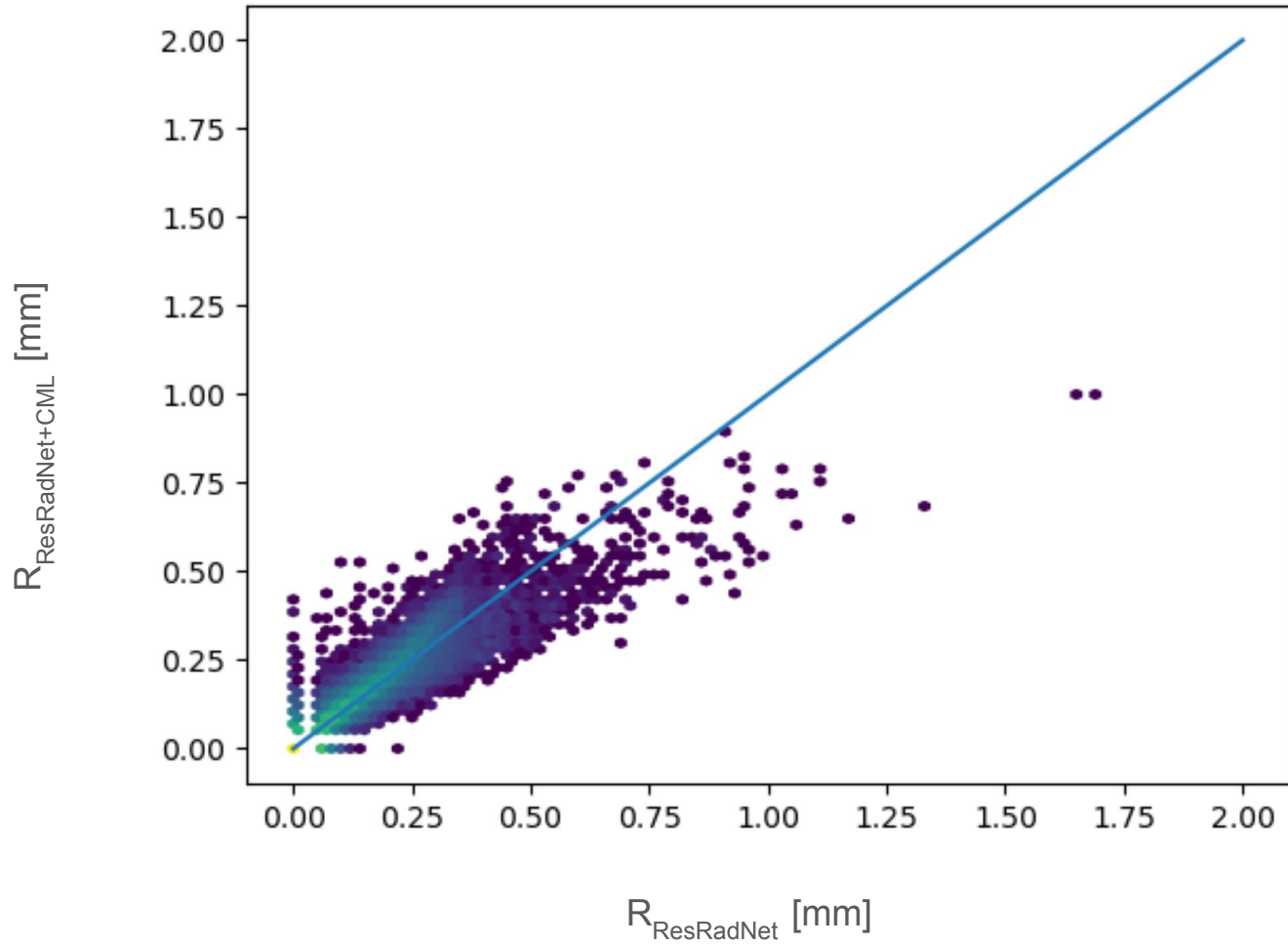


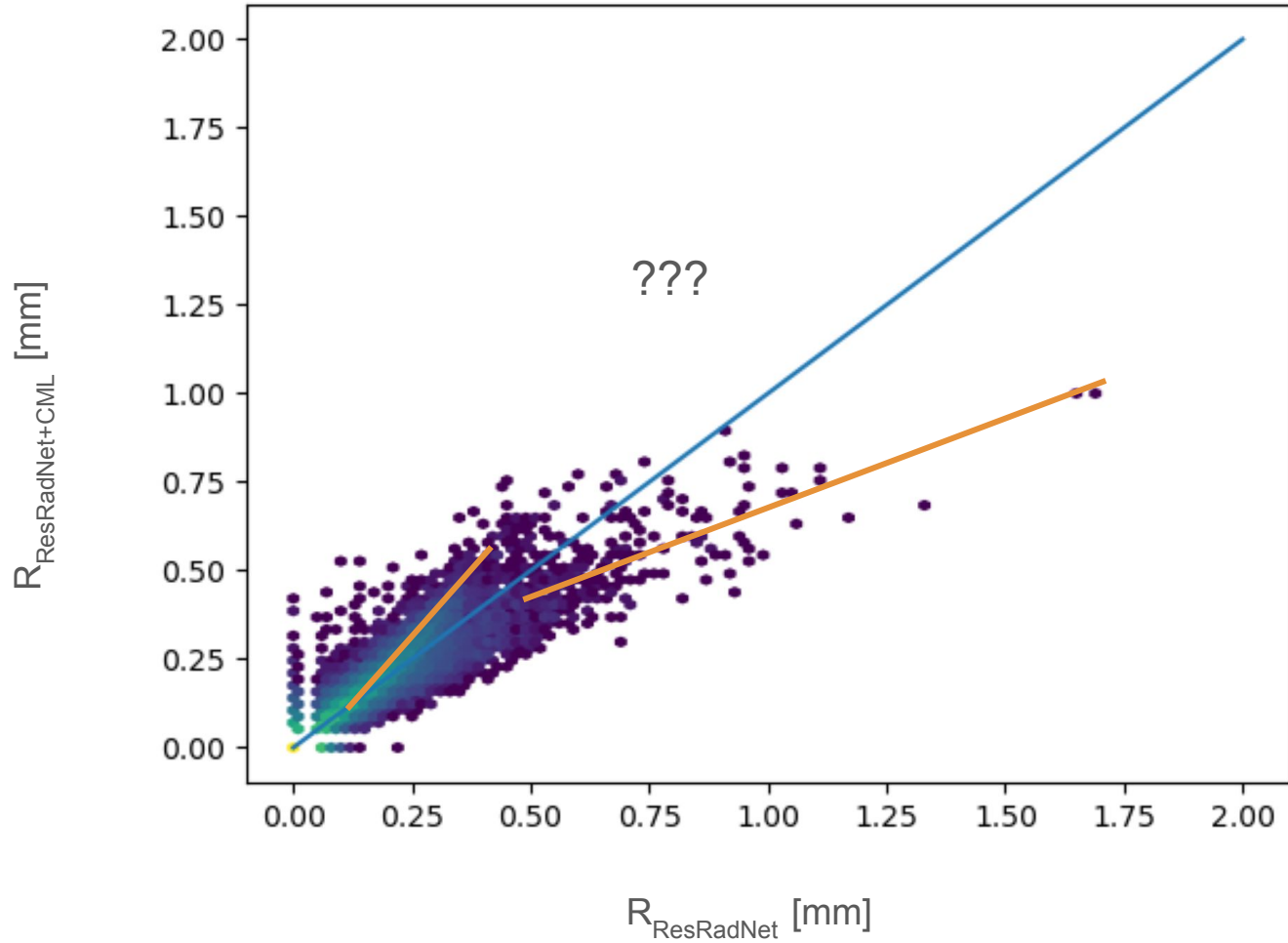
Adding CML data

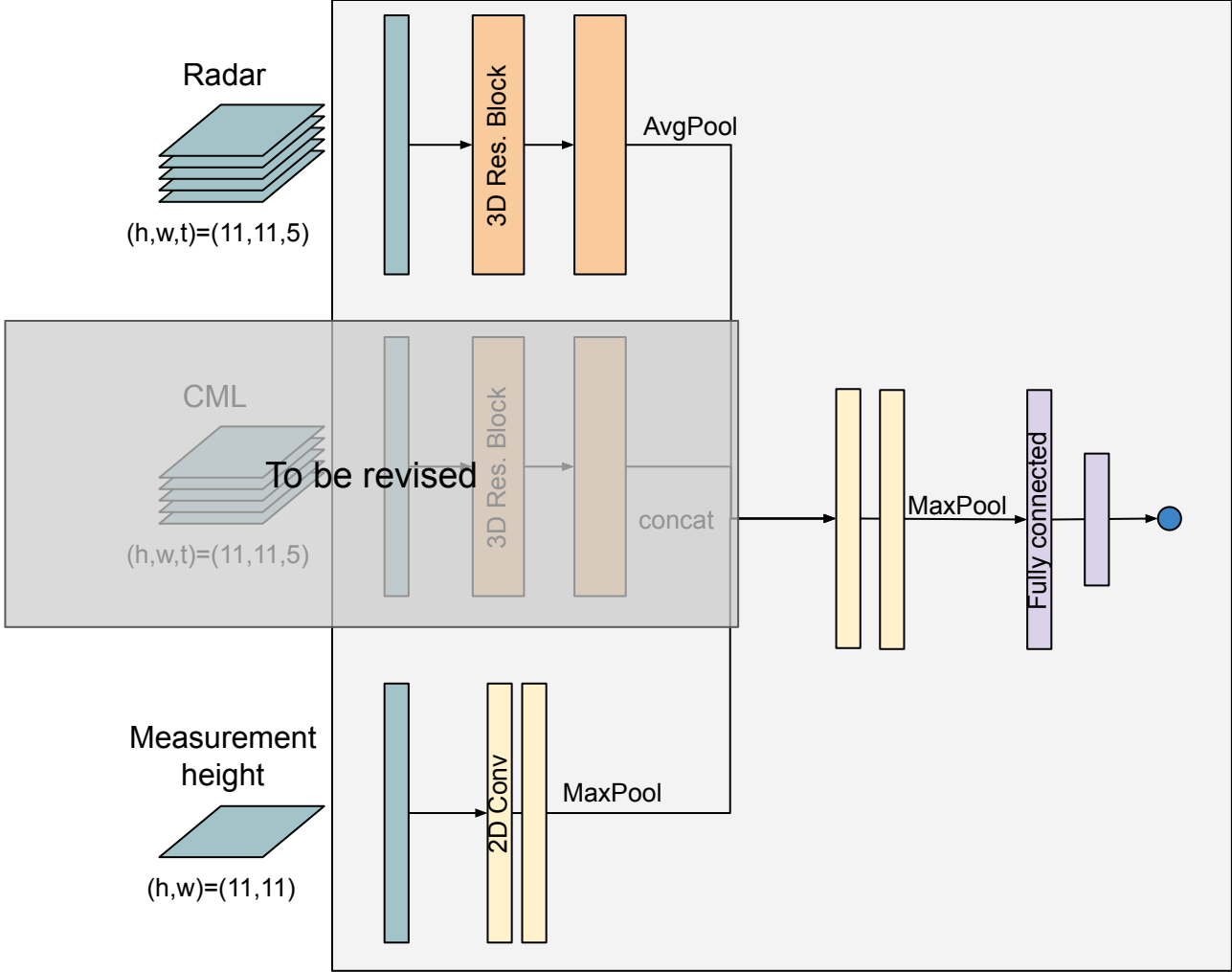


Model:	RYai	RYaicml
SRC:	0.617	0.618
PCC:	0.609	0.608
MAE:	0.015	0.015
MDE:	0.093	0.091
RMSE:	0.055	0.056
BIAS:	-0.0006	-0.0003
BIAS2:	3.905	1.58
CV:	2.899	2.923
KS-test:	0.044	0.04

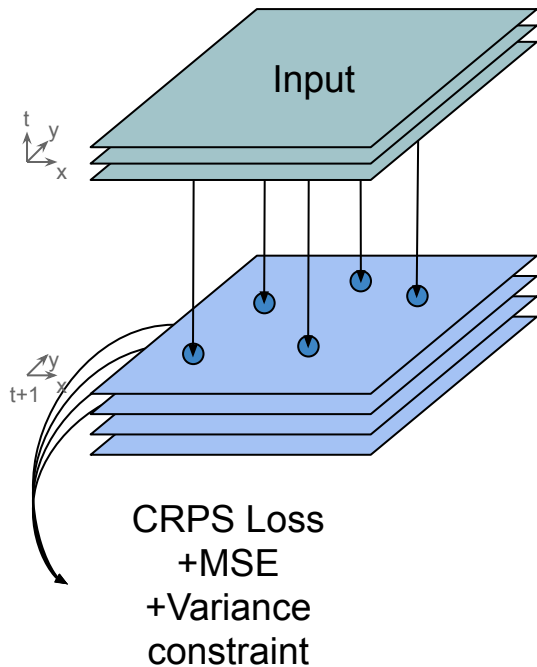








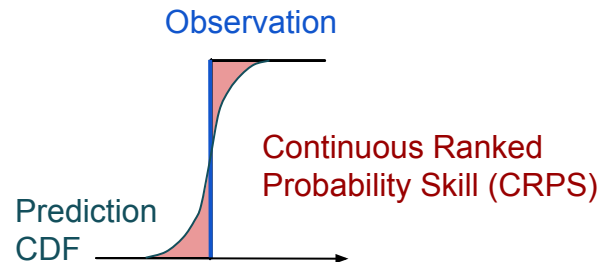
ResRadNet v2.0

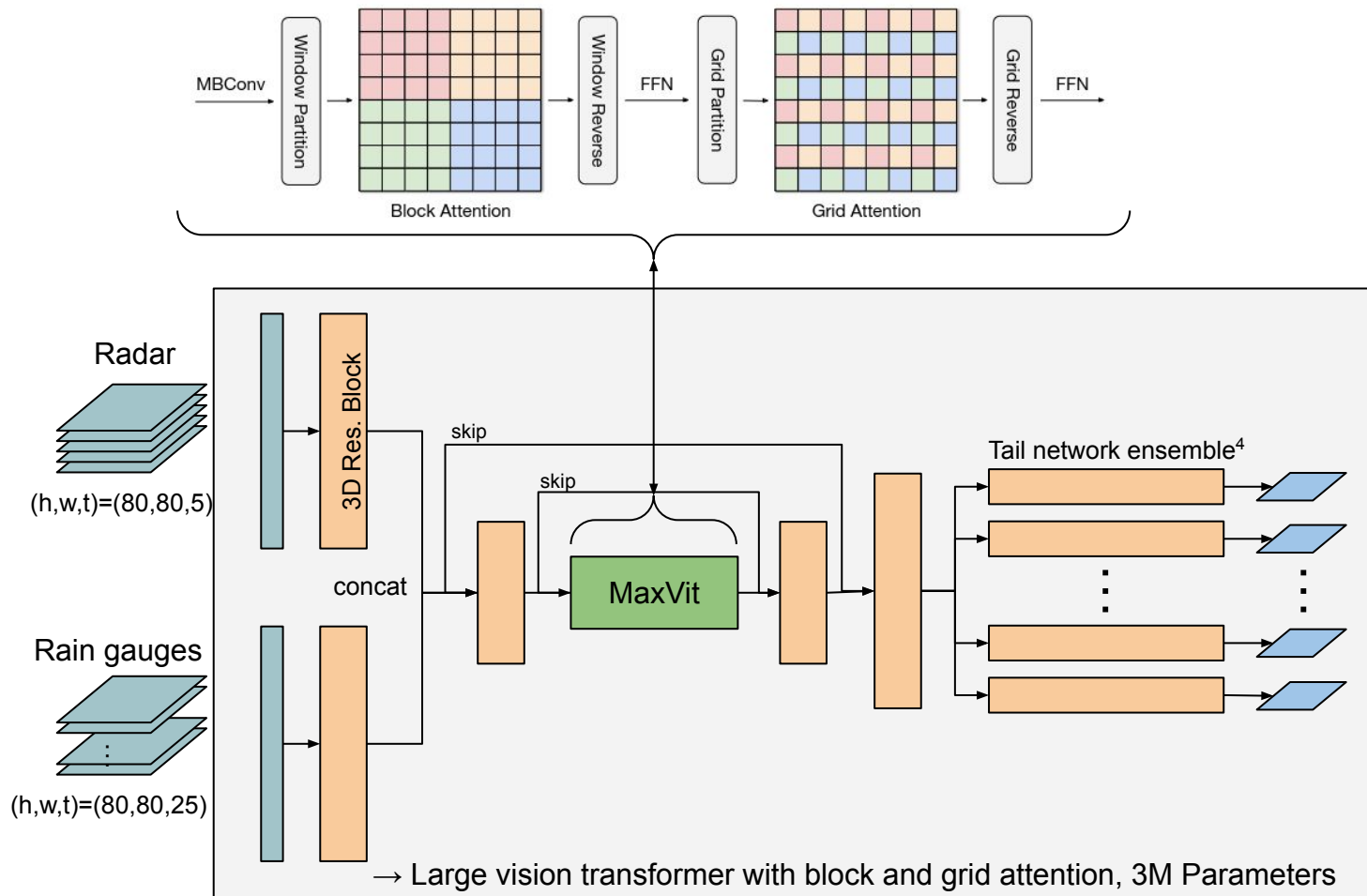


→ more efficient + acknowledges uncertainty

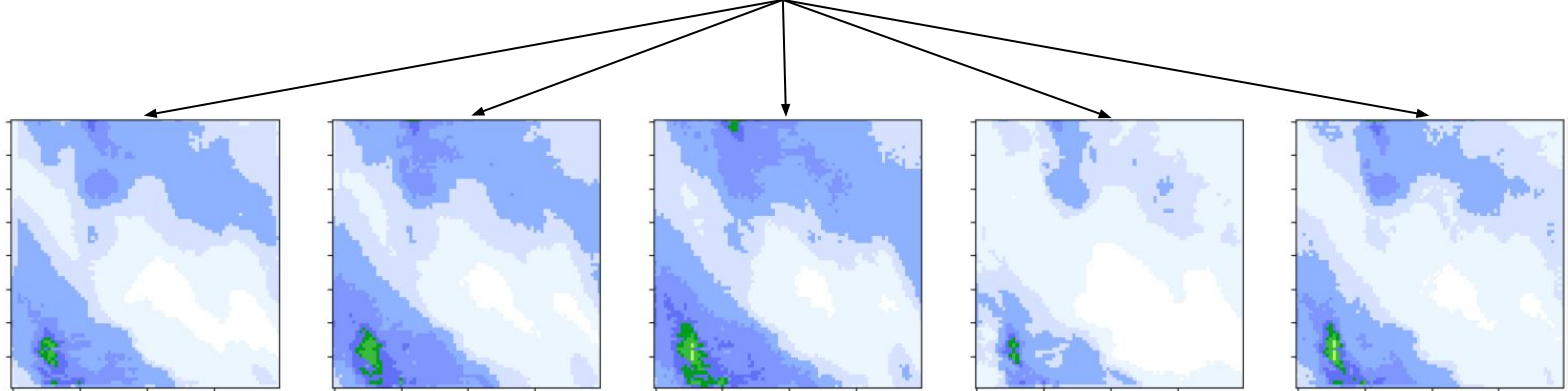
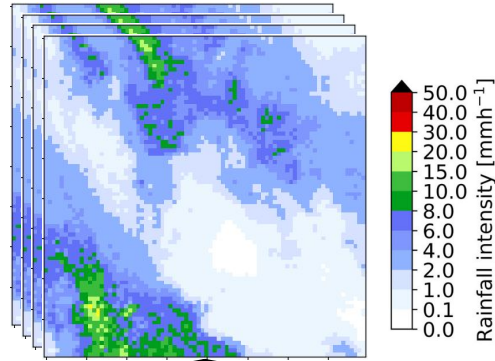
Masked loss at random locations

→enforces one dense prediction per input



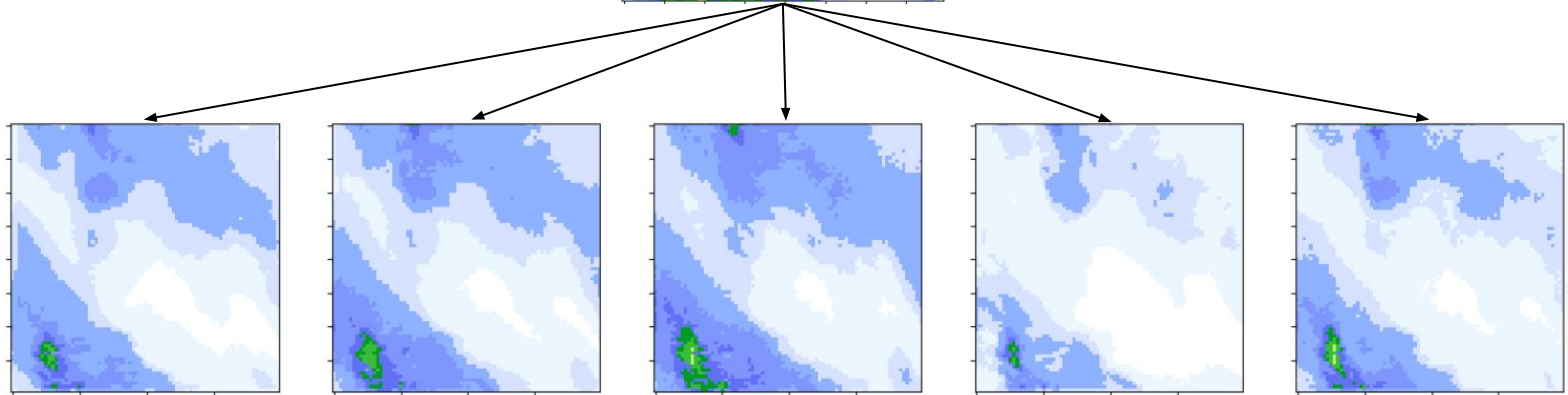
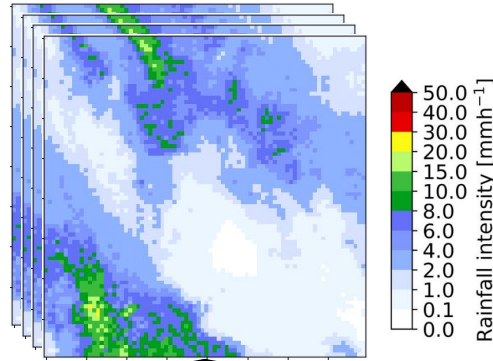


Radar input



Ensemble prediction

Radar input



Ensemble prediction → Goal of WP 1.4

Done:

- ResRadNet setup for
 - POLARA composite QPE
 - Added CML data
 - Ensemble prediction to estimate Uncertainty

To be done:

- Debug and fine-tune current setup
- Move to polarimetric variables and polar coords
- Combine everything

Discussion