conclusions

experiments

dataset

idea

problem

Leveraging Machine Learning to Predict the Autoconversion* Rates from Satellite Data

Maria Carolina Novitasari (UCL)
Johannes Quaas (U. Leipzig)
Miguel R. D. Rodrigues (UCL)

*) Rain formation in liquid clouds.

in collaboration with

UNIVERSITÄT LEIPZIG

This research receives funding from the European Union's Horizon 2020 research and innovation programme under Marie Skłodowska-Curie grant agreement No 860100 (iMIRACLI).

Tackling Climate Change with Machine Learning workshop at NeurIPS 2021

conclusions

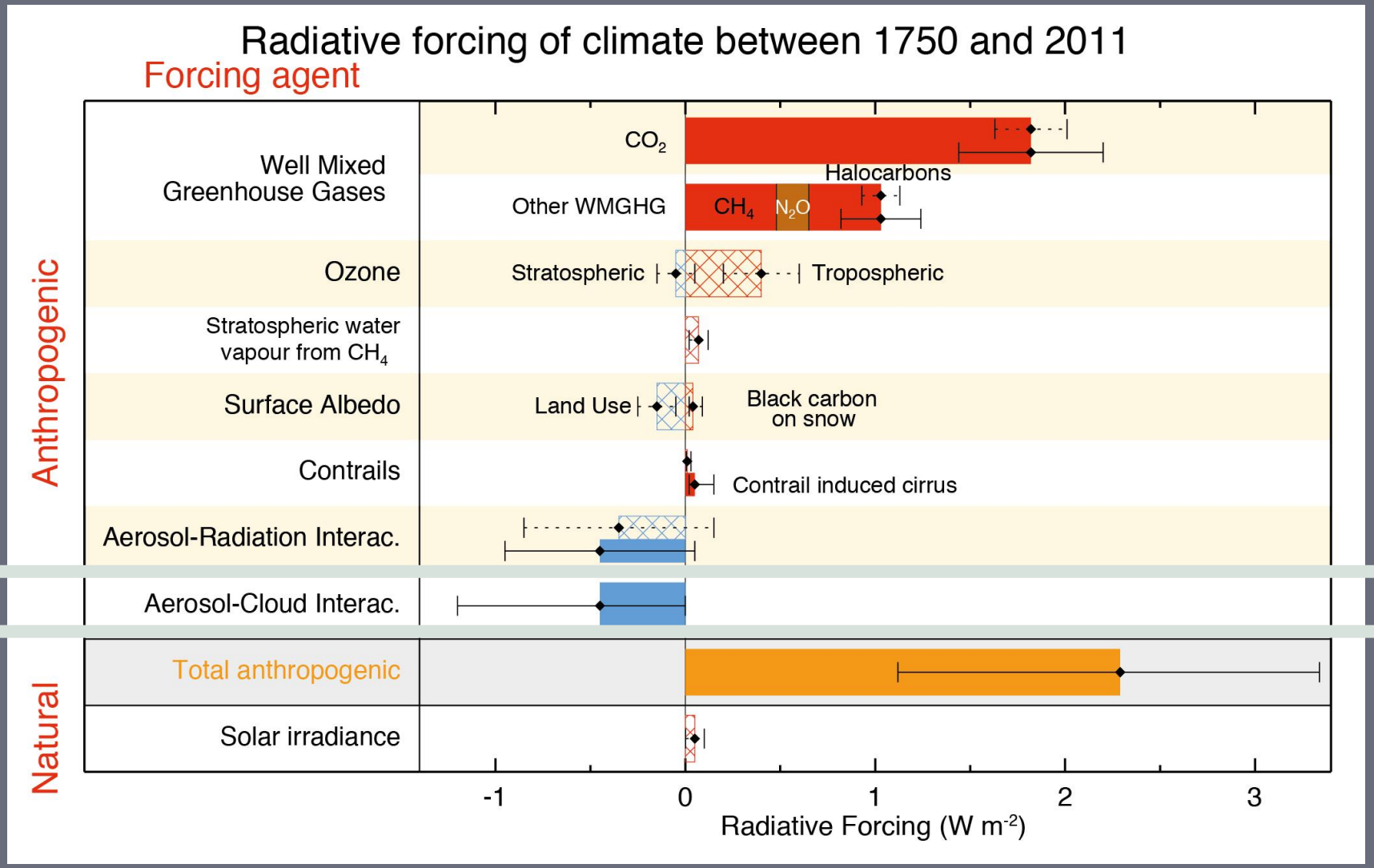
experiments

dataset

idea

?

problem



Radiative forcing of climate between 1750 and 2011; image obtained from Figure 8.15 of Intergovernmental Panel on Climate Change (IPCC) AR5 Report of Working Group 1

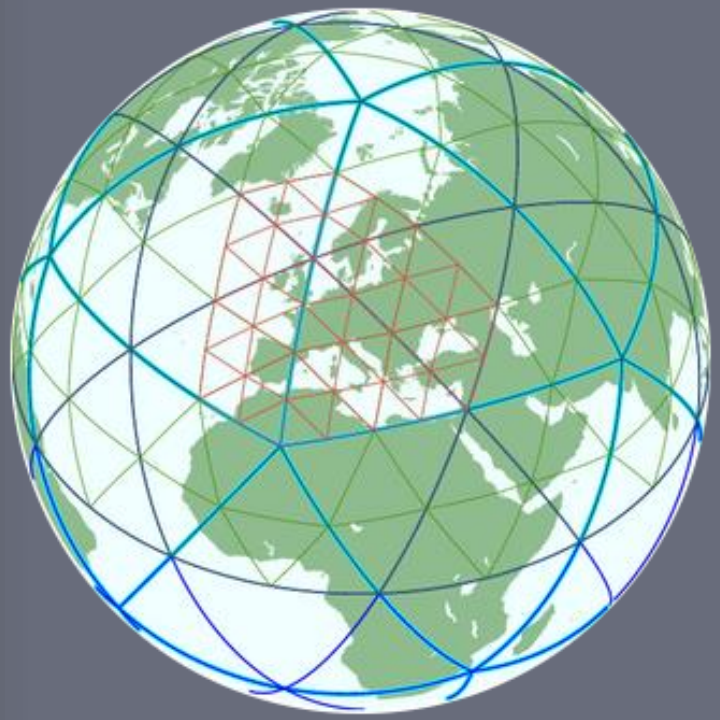
conclusions

experiments

dataset

idea

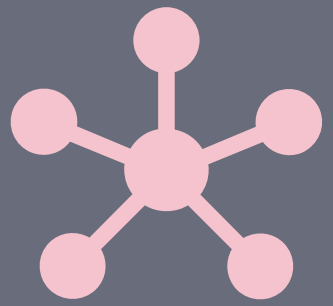
ICON-LEM



1 simulated hour

Real running time:
13 hours

EUR 100 000
/ simulated day



300 nodes

? problem

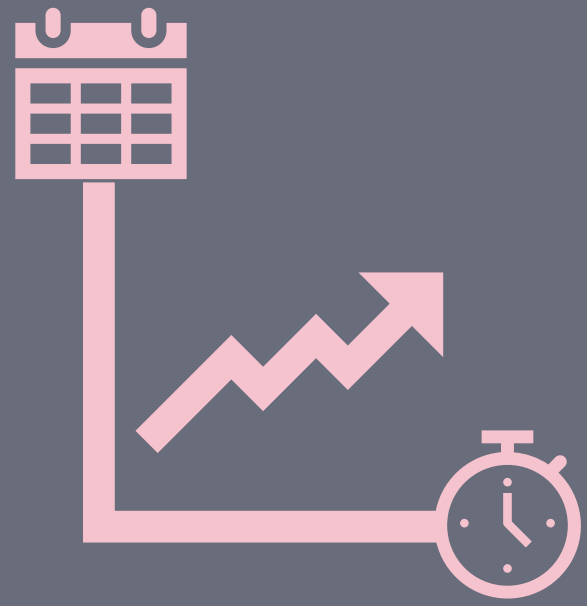
conclusions

experiments

dataset

idea

Global coverage



Long time series

?

problem

conclusions

experiments

dataset

idea

?

problem

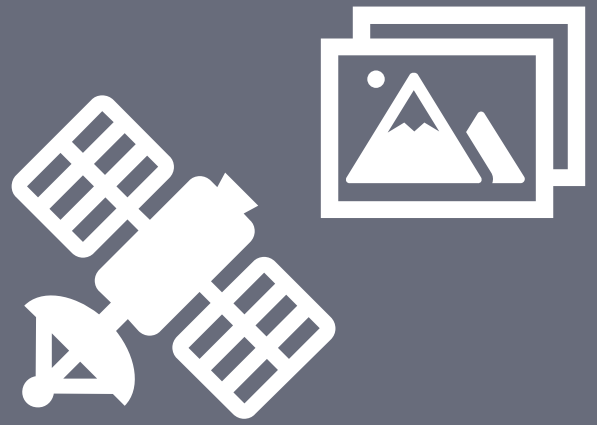
conclusions

experiments

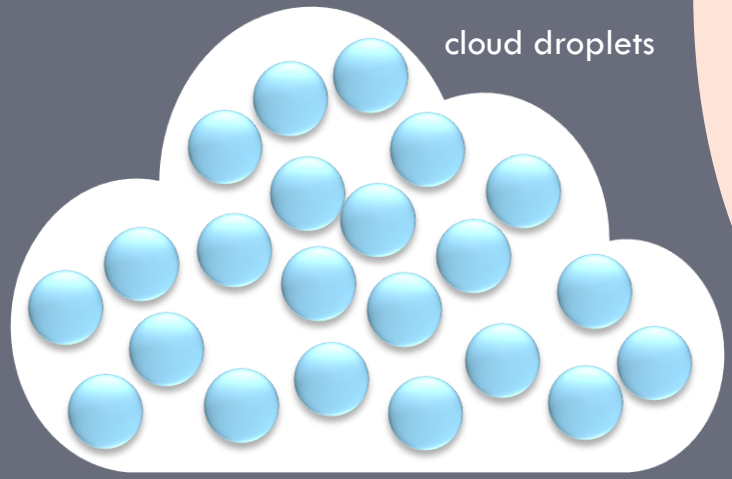
dataset

ML models

Satellite data



Key process of precipitation



Autoconversion

idea

problem

problem

idea

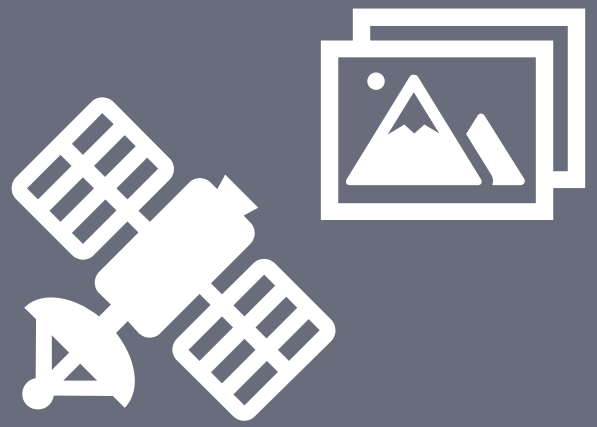
dataset

experiments

conclusions

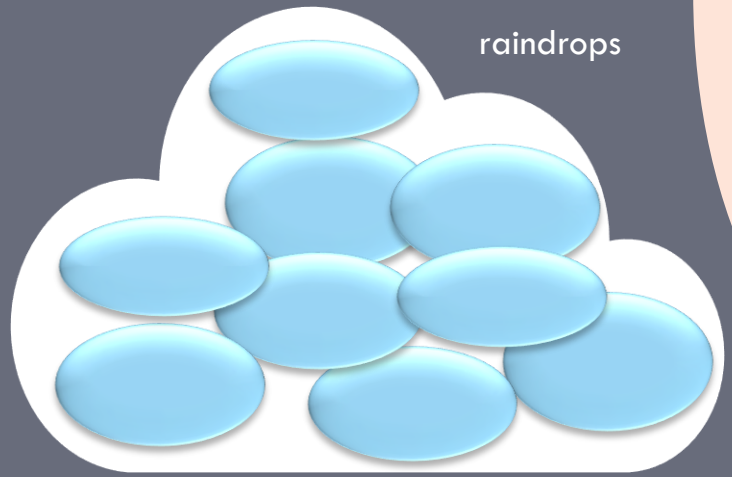
ML models

Satellite data



Key process of precipitation

raindrops



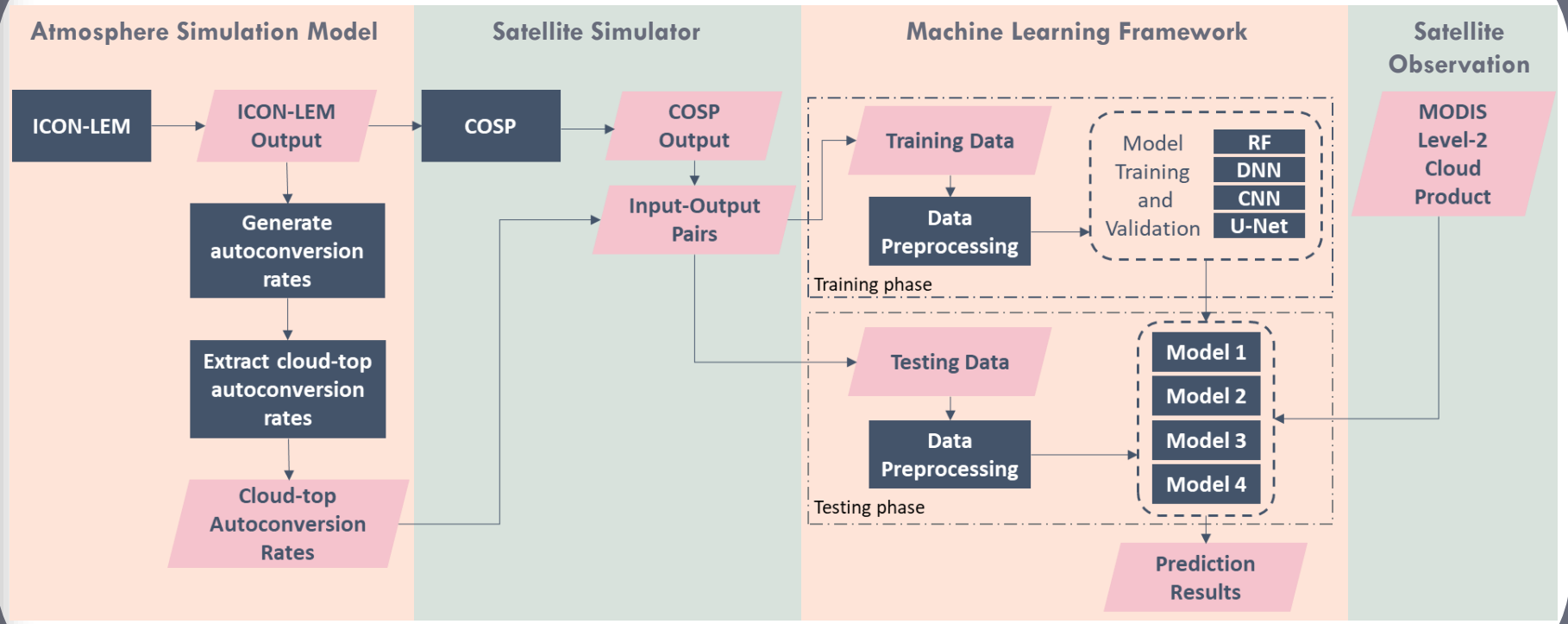
Autoconversion

conclusions

experiments

dataset

General Framework



idea

problem

conclusions

experiments

problem

idea

dataset

Atmosphere Simulation Model (ICON-LEM)

Germany – 02 May 2013
156m horizontal resolution
9:55am to 1:20pm UTC

ICON-LEM Output

Autoconversion rates

Satellite Simulator (COSP)

Match with MODIS Cloud Product Level 2

f1: LWP

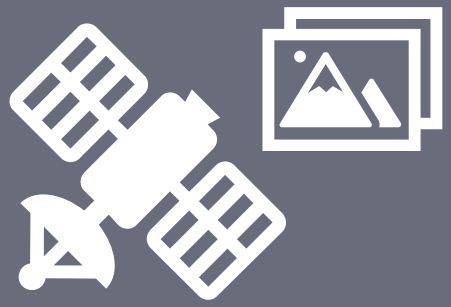
f2: CER

f3: COT

f4: N_c

f5,f6: spatial

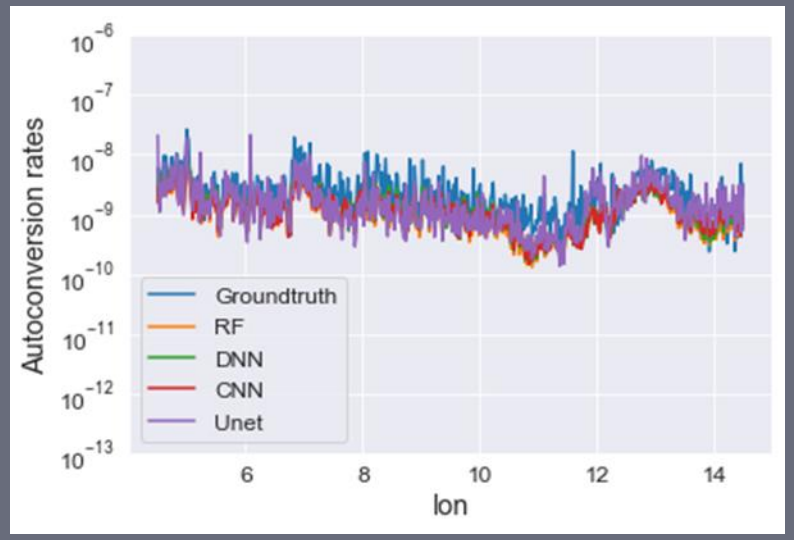
Satellite Observation (MODIS)



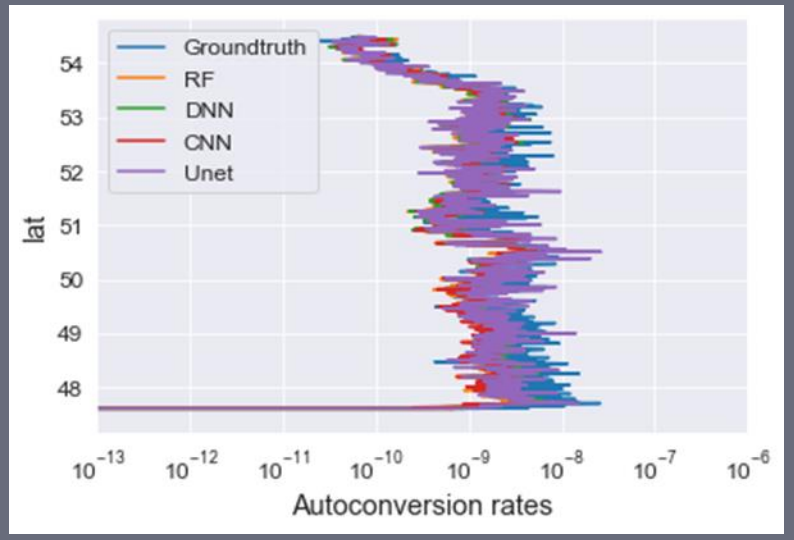
MODIS Cloud Product Level 2

LWP: liquid water path
CER: cloud effective radius
COT: cloud optical thickness
N_c: cloud droplet number concentration
spatial: spatial information

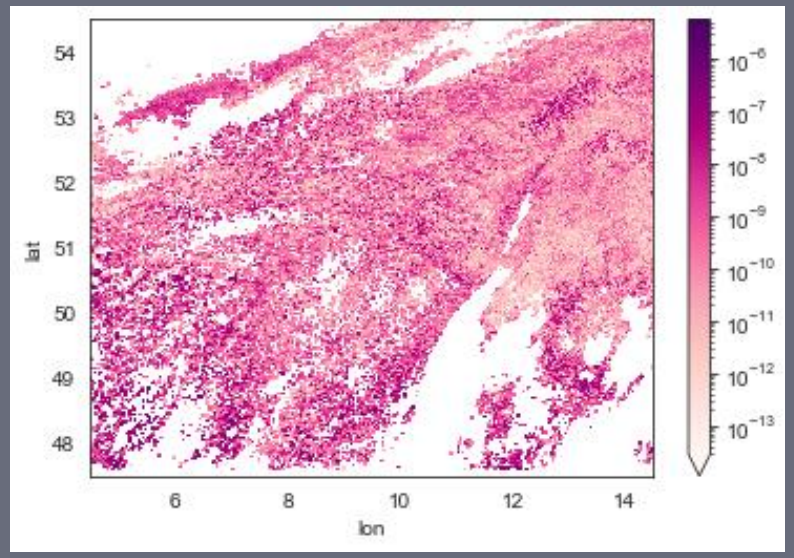
Autoconversion on Simulation Models (ICON/COSP)



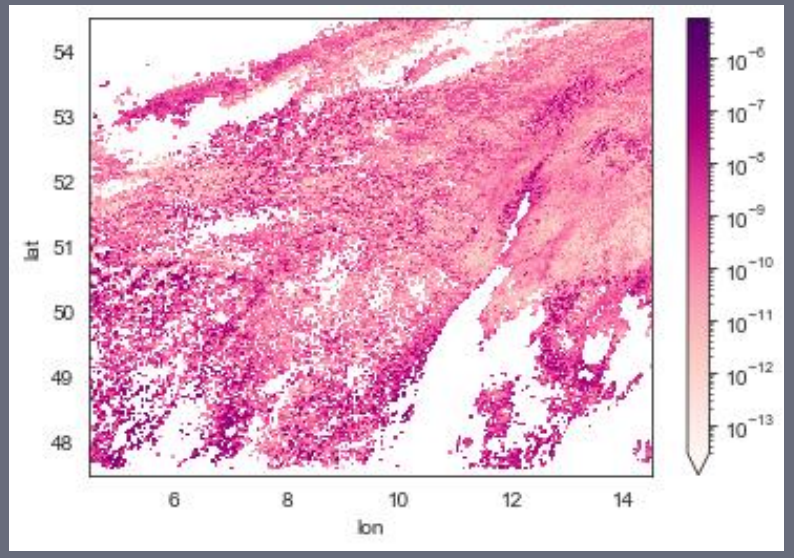
Mean over longitude



Mean over latitude



Groundtruth



Prediction: DNN (SSIM: 96.80%)

conclusions

experiments

dataset

idea

problem

Autoconversion on Satellite Observation (MODIS)

MODIS Aqua over Germany, 13:20 UTC
AoI = [5.87, 47.50, 10.00, 54.50]

	Mean	Standard Deviation	25th Percentile	Median	75th Percentile
LWP COSP (g m^{-2})	73.7	128	10.3	30.8	82.8
LWP MODIS (g m^{-2})	113	265	17.0	37.0	98.0
CER COSP (µm)	10.80	5.06	7.34	9.65	13.00
CER MODIS (µm)	12.30	7.28	7.75	9.40	13.90
COT COSP	9.53	13.30	1.59	4.87	11.90
COT MODIS	14.50	24.10	2.15	5.83	17.40
Nc COSP (cm^{-3})	178	205	45.3	108	236
Nc MODIS (cm^{-3})	177	179	38.3	124	265
Aut COSP (kg m^{-3} s^{-1})	1.77e-08	1.32e-07	2.66e-11	2.12e-10	1.85e-09
Aut MODIS (kg m^{-3} s^{-1})	6.09e-08	5.74e-07	2.19e-11	1.02e-10	1.19e-09

Mean, standard deviation, median, 25th and 75th percentiles of COSP and MODIS variables: liquid water path (LWP), cloud effective radius (CER), cloud optical thickness (COT), cloud droplet number concentration (Nc), and autoconversion rates (Aut).

Conclusions and Future Work

- Premilinary results appear promising -- machine learning could help unravel the key process of precipitation
- A generalization test of the trained models to new locations and times would be interesting

Thank you!

This research receives funding from the European Union's Horizon 2020 research and innovation programme under Marie Skłodowska-Curie grant agreement No 860100 (iMIRACLI).