

THE BENEFIT OF A DENSE NETWORK OF ALL-SKY IMAGERS FOR REGIONAL SATELLITE-BASED SHORT-TERM FORECASTS OF SOLAR IRRADIANCE

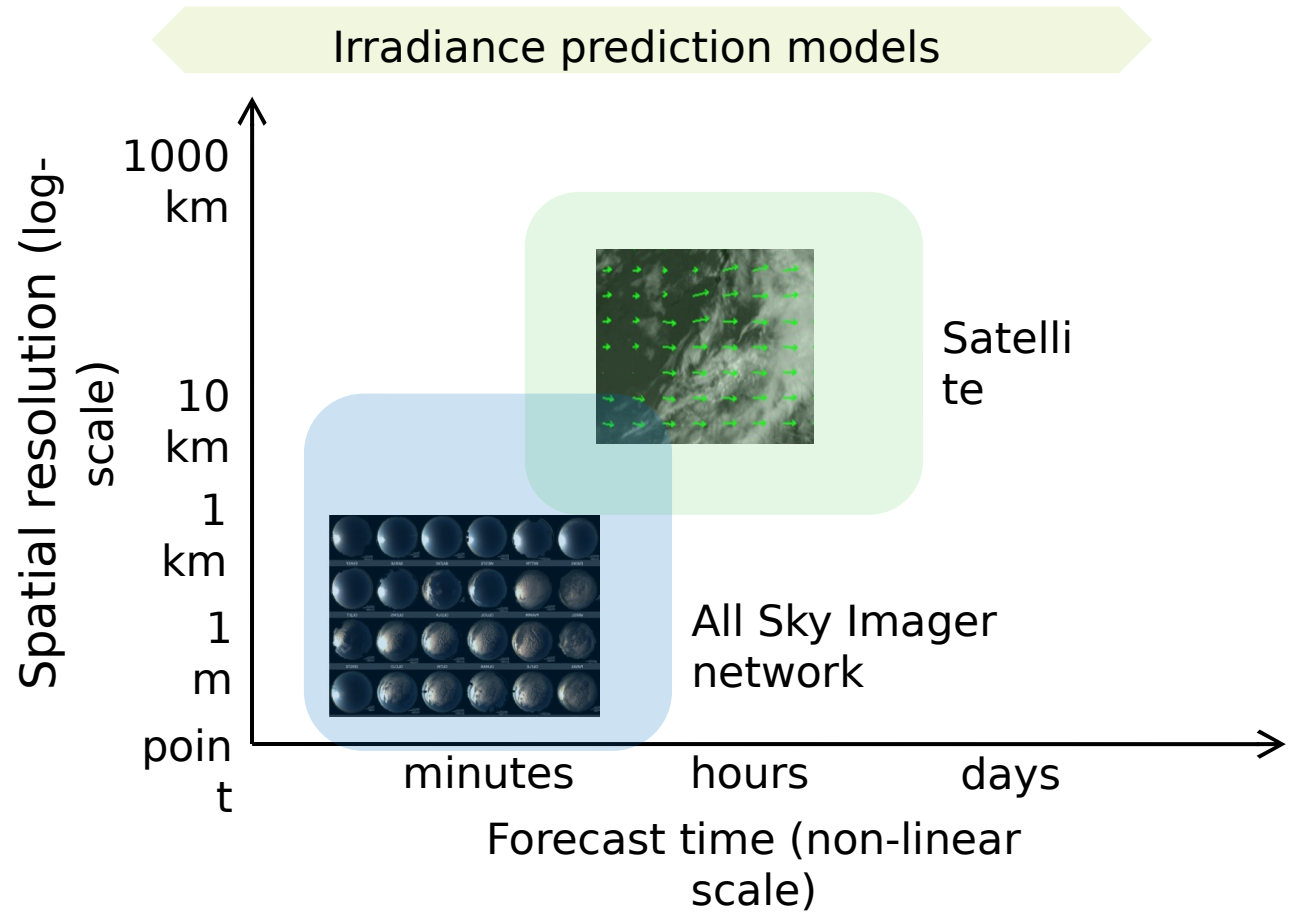
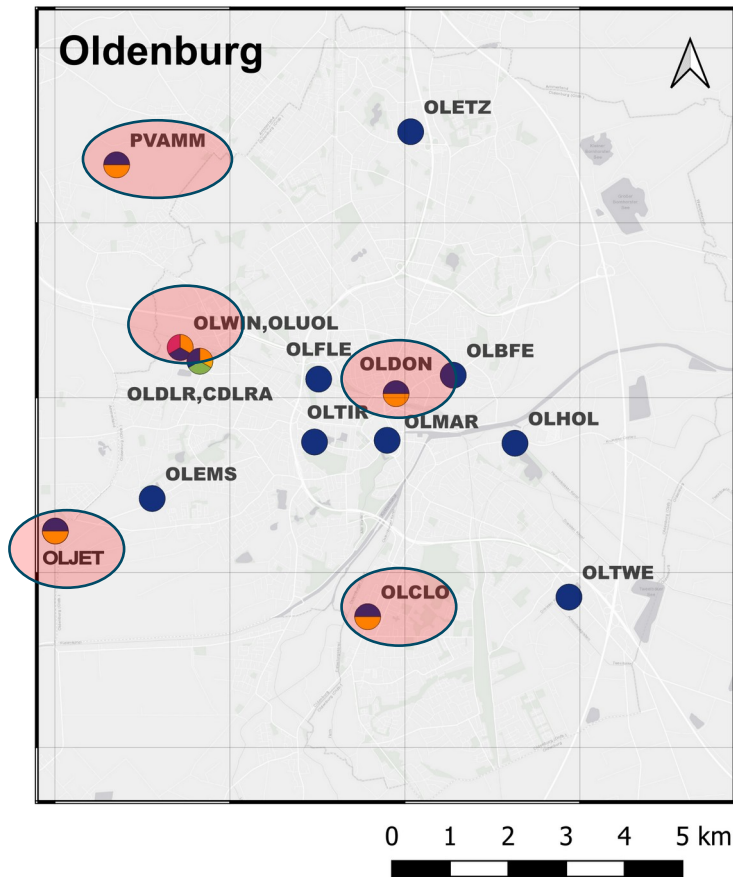
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CONTEXT

Forecast inputs

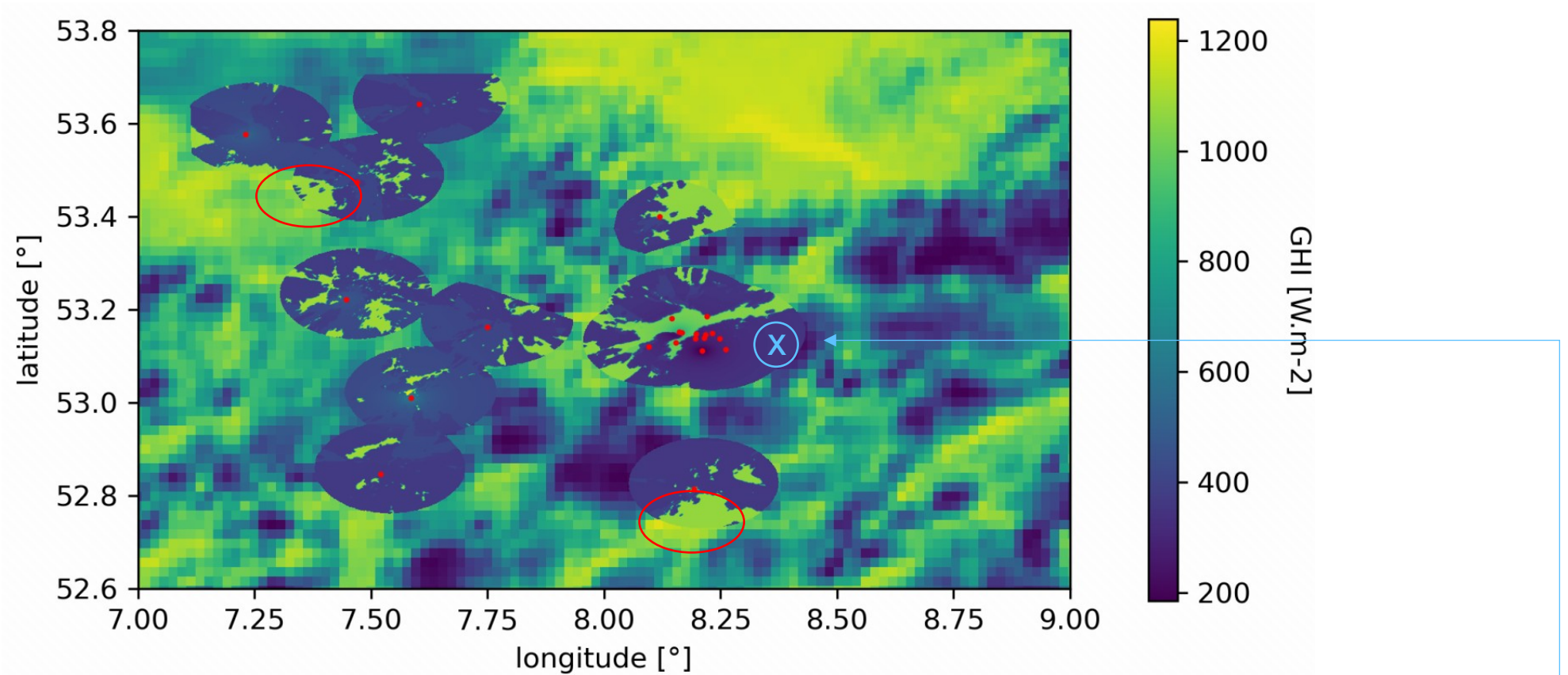
Eye2Sky : city region of interest



-  REF + MET
-  ASI + REF
-  ASI + MET + CEI
-  ASI + MET
-  ASI

Background: OpenStreetMap ESRI light gray

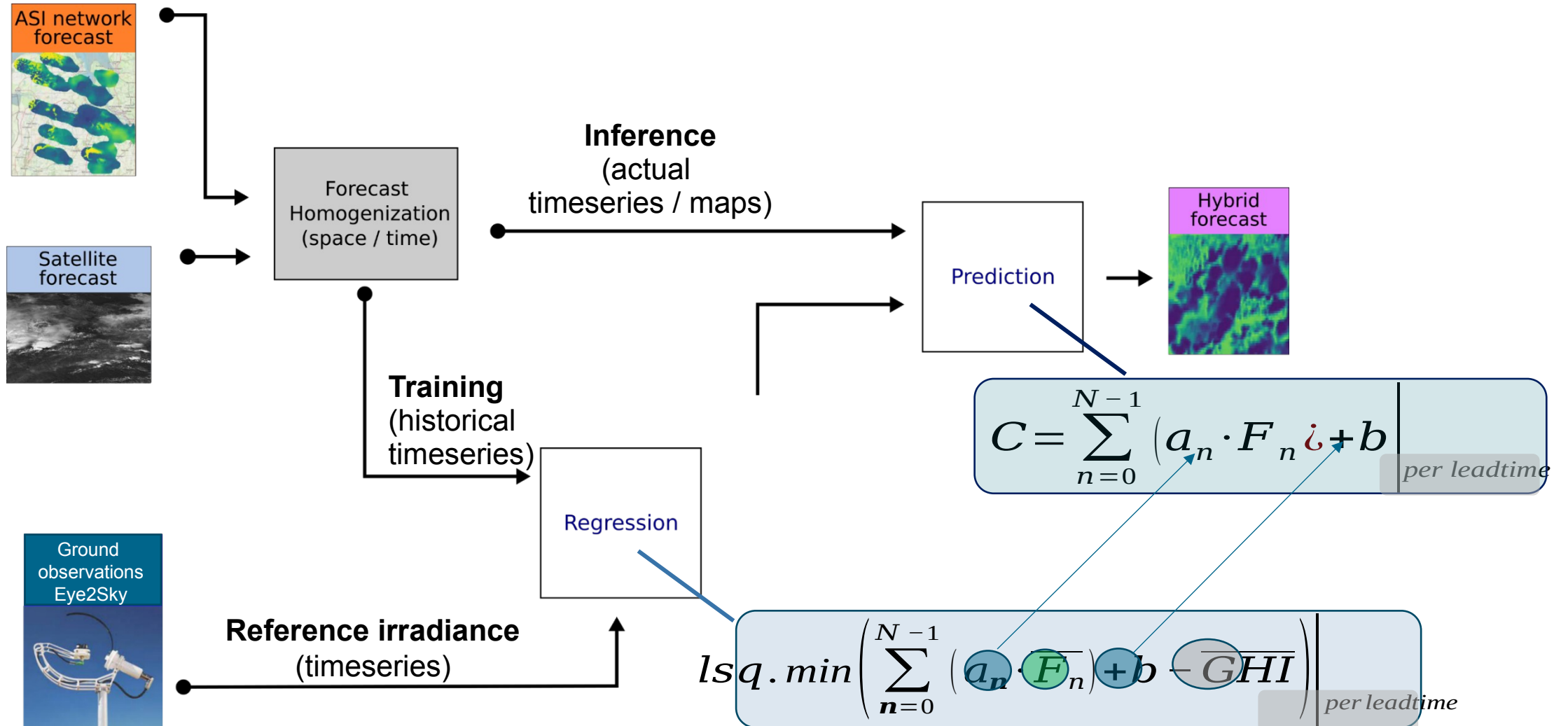
Forecast inputs : 21.07.2020 @ 13:26 UTC



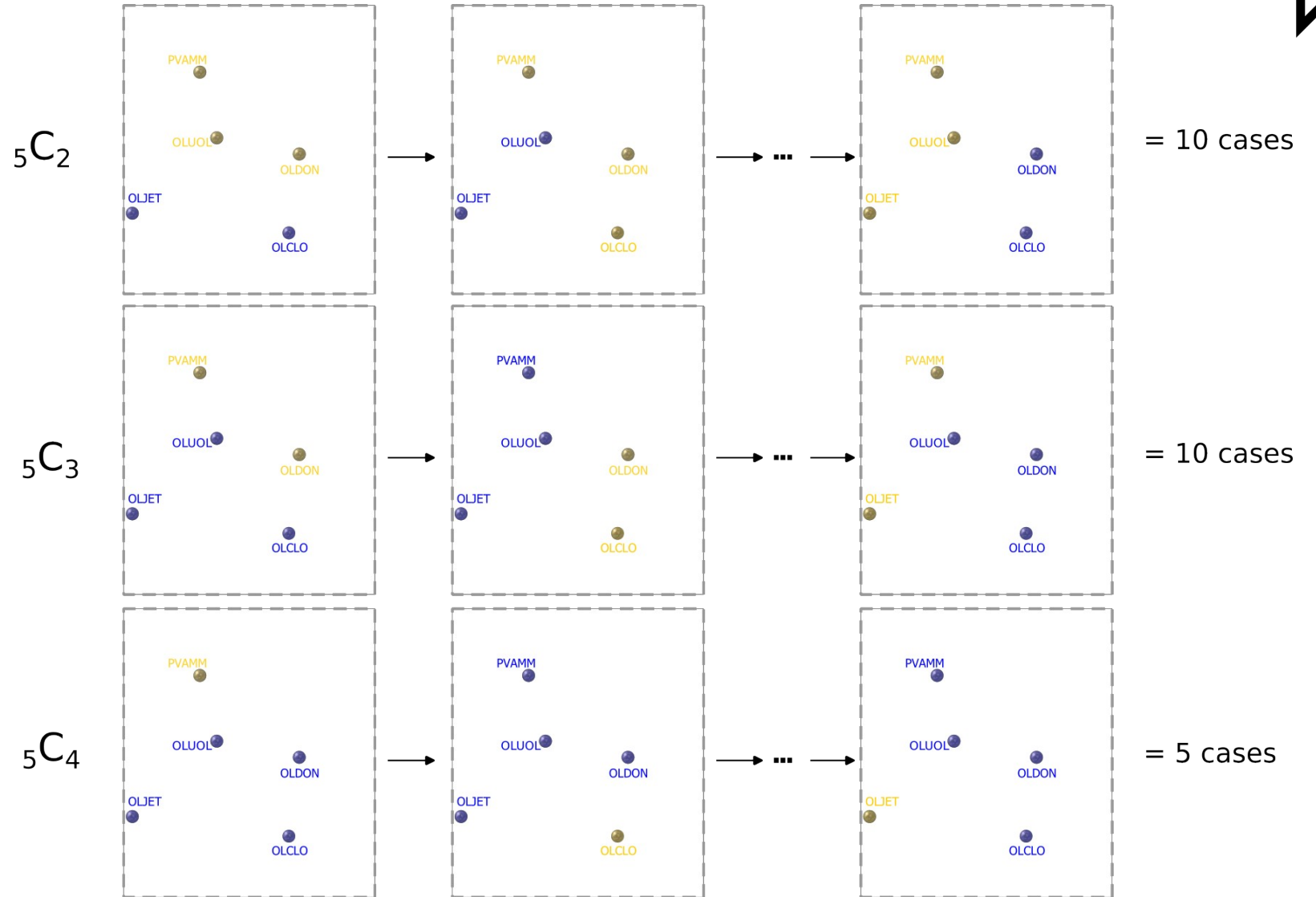
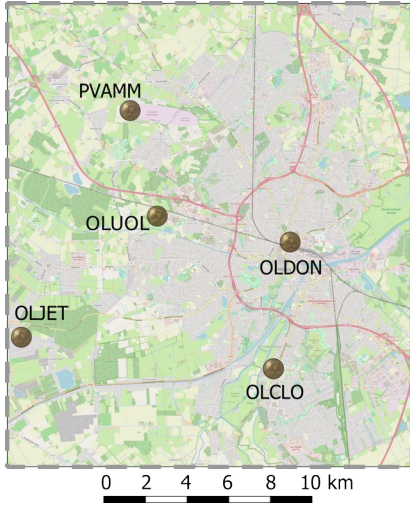
- ✓ Can the high resolution information from the ASI network forecast be used to improve the quality of the satellite forecast?
- ✓ Can we assess the benefit of the improvement at any location on the domain (independently if it has ground observations or not)?

BLENDING METHOD

Principle of the blending method



Training strategy



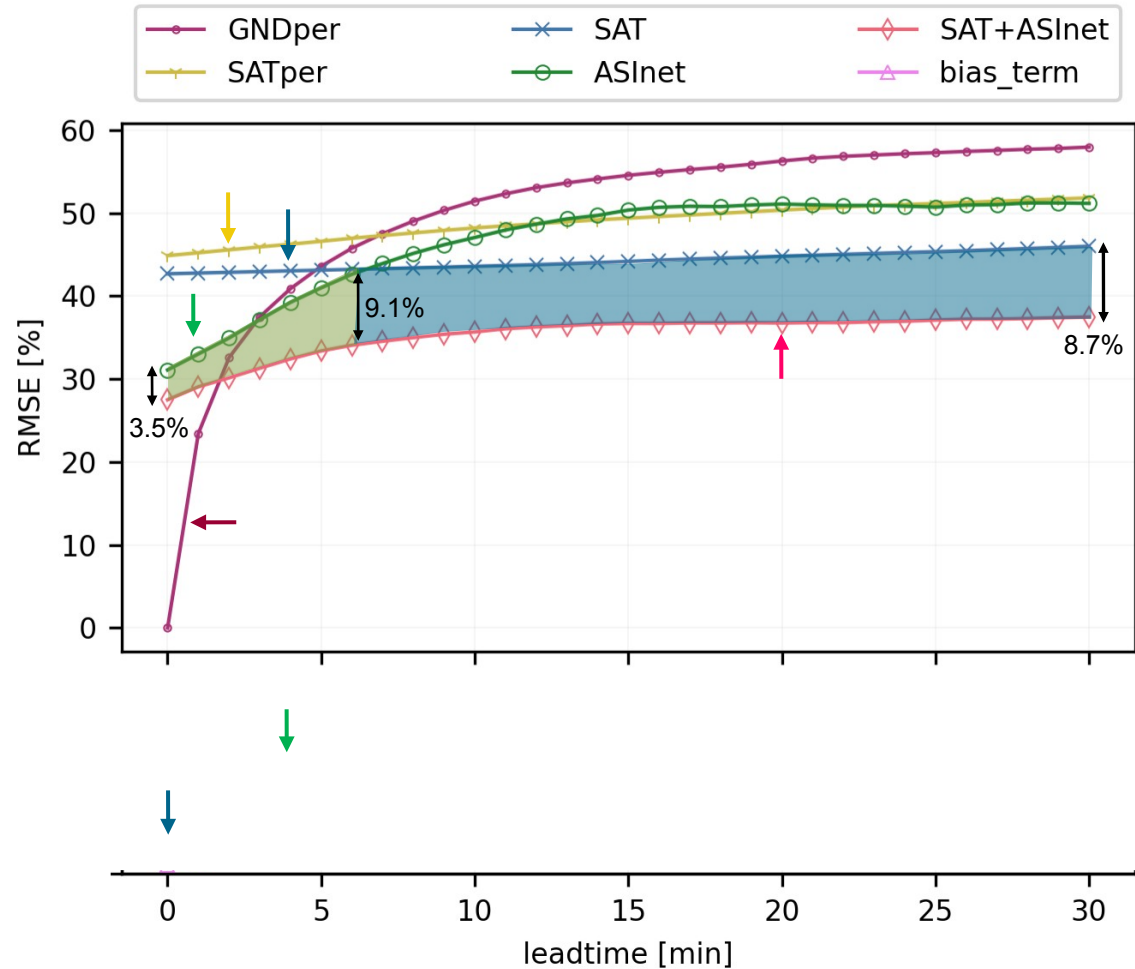
$$\sum_{i=\{2,3,4\}} 5C_i$$

25 different cases

VALIDATION

Blending results* :

average metrics for the 25 training cases



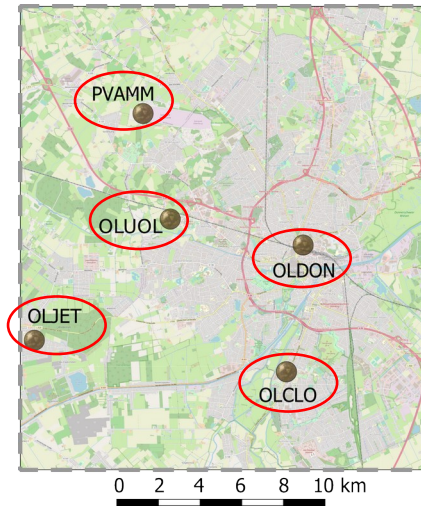
- **SAT+ASInet** improves over
 - **satellite persistence** : all leadtimes
 - **ground persistence** : from 3 min
 - forecast inputs (**SAT**; **ASInet**) : all leadtimes
- Optimal mix of weights
 - ASInet dominates from 0 to 10 min
 - SAT dominates from 11 min
 - cross point dependent on local weather

Wouldn't we obtain better/same performance by blending satellite with the less expensive ground persistence ?

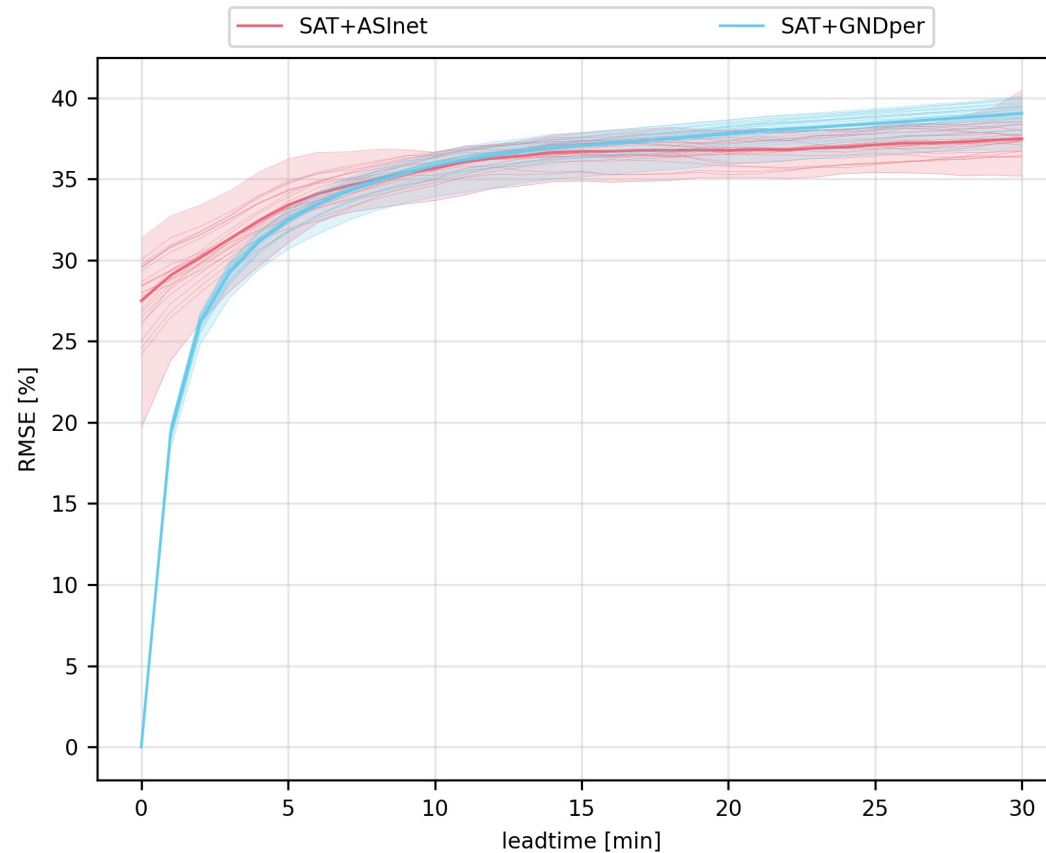
* The results shown here are part of a publication being prepared for submission in Meteorologische Zeitschrift.

Sat+ASInet versus Sat+GNDper

If forecast predictions are limited to locations with ground observations ✉ YES



only interested on these five sites (even if we have a regional forecast)

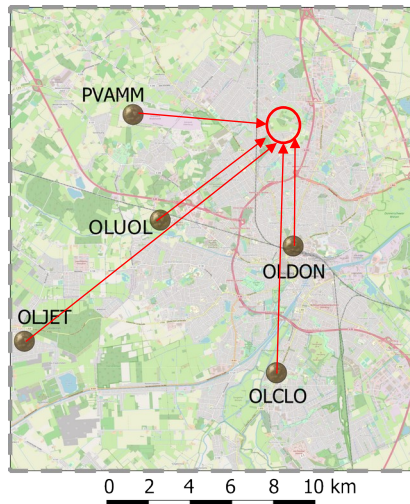


Results for the 25 different cases
Mean trend in bold

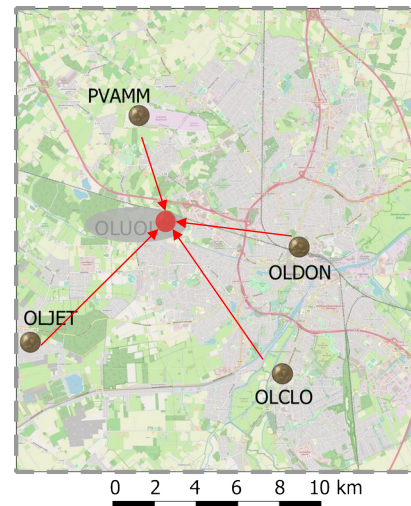
Sat+ASInet versus Sat+GNDper

If forecast predictions are not limited to locations with ground observations ?

Any location on the domain



Proxy in our study

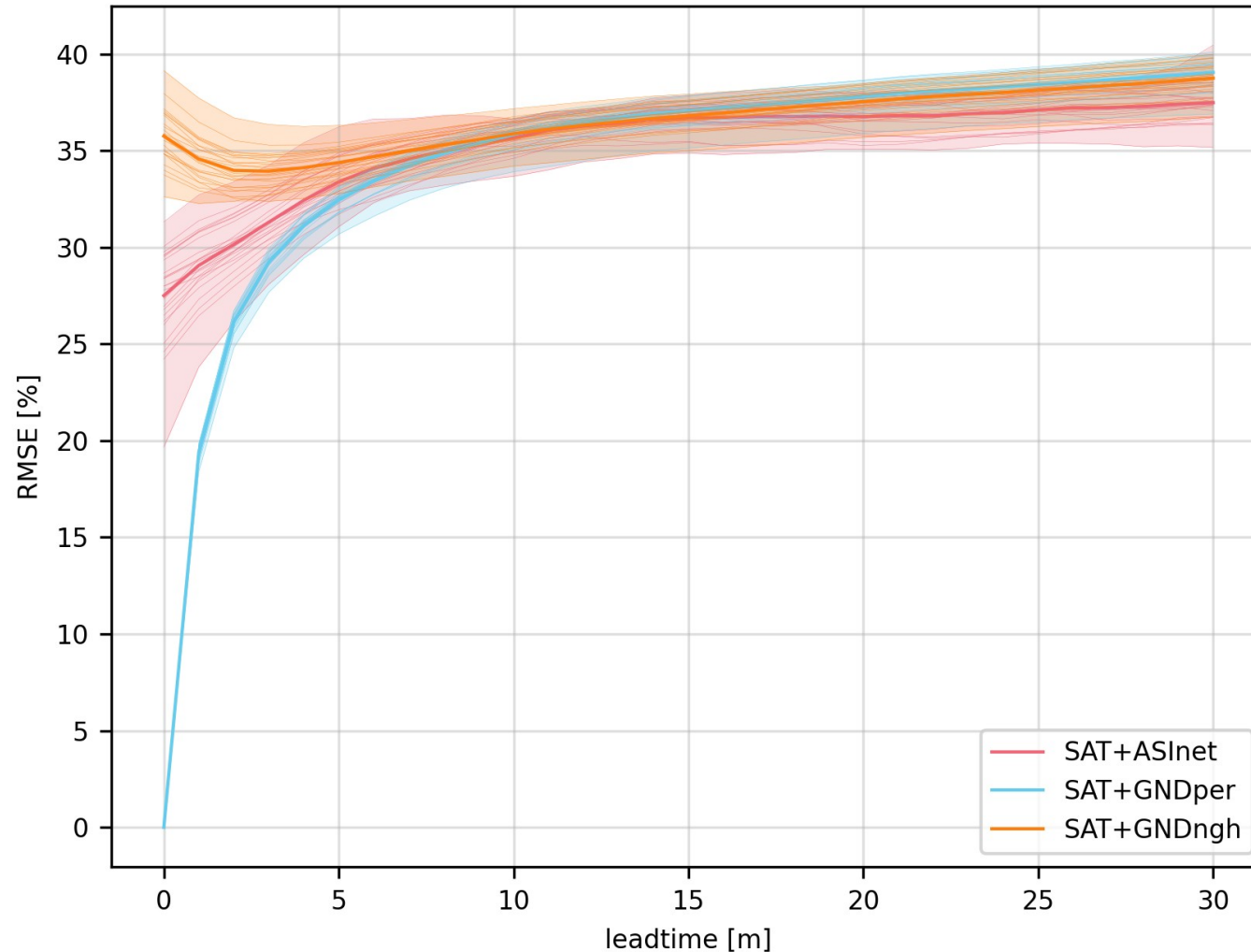


- Neglect a site ground observation
- Calculate ground neighborhood persistence forecast
- Blend satellite with ground neighborhood persistence
- Only use neglected ground observation on validation

ground neighborhood observation :

$$\text{gnd}_{\text{ngh}}^{\text{p}} = \frac{\sum_{i=1}^N \left(\frac{1}{d_{ip}} \cdot \text{gnd}_i \right)}{\sum_{i=1}^N \left(\frac{1}{d_{ip}} \right)}$$

Sat+ASInet versus Sat+GNDper



- 25 cases per blending
- The SAT+ASInet has an advantage over the SAT+GNDngh (proxy to any location on the map)
- The superiority of SAT+GNDper is limited only to the locations where ground persistence exists.

CONCLUSIONS / OUTLOOK

Conclusions and outlook



- The blending of satellite and ASI network showed an absolute RMSE improvement of 3.5% to 9% over the forecast inputs
- When the forecast is not limited to location with ground measurements, the blending of satellite with best ground persistence guess (neighborhood) is not able to outperform the satellite and ASI network blending.
- The blending should be done on:
 - bigger time range (1 year) ✉ see the season transferability
 - Other locations ✉ increased benefit ?
- Compare linear regression blending with machine learning methods

THANK YOU

Data used on this study



Characteristic	Satellite	ASI network
Source	Meteosat Second Generation	10 ASI imagers from the Eye2Sky network
Domain	Europe	25 km x 25 km around Oldenburg
Spatial resolution	2 km	50 m
Forecast horizon	6 hours	30 min
Forecast step	15 min	1 min
Temporal availability	from 2005 until today	from 2019 until today
Availability of forecasts for this study	01.07.2020 to 31.08.2020	01.07.2020 to 31.08.2020