Forecasting the flood in 2024 in SW Poland on virtual stations of altimetry satellites based on the AltHydro system

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XLII International School of Hydraulics
20 - 23 May 2025 • Radocza • Poland

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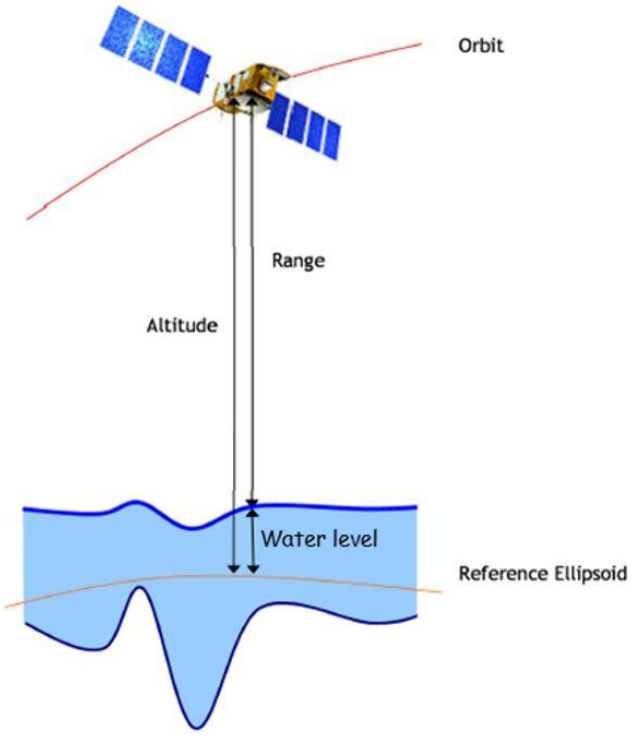
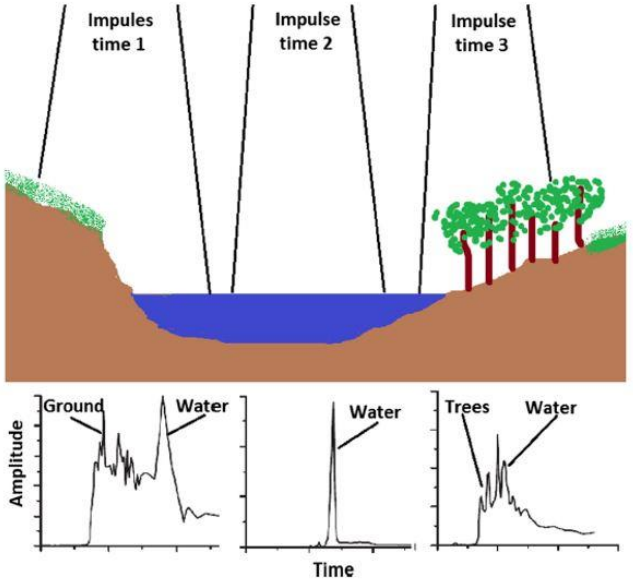
What is radar altimetry?

- Technique of measuring height
- Radar altimeter emits signal to Earth and receives the echo after its reflection
- After detecting the echo from a water surface, it is possible to measure the water level w.r.t. a vertical system, i.e. geoid or elipsoid



(a)

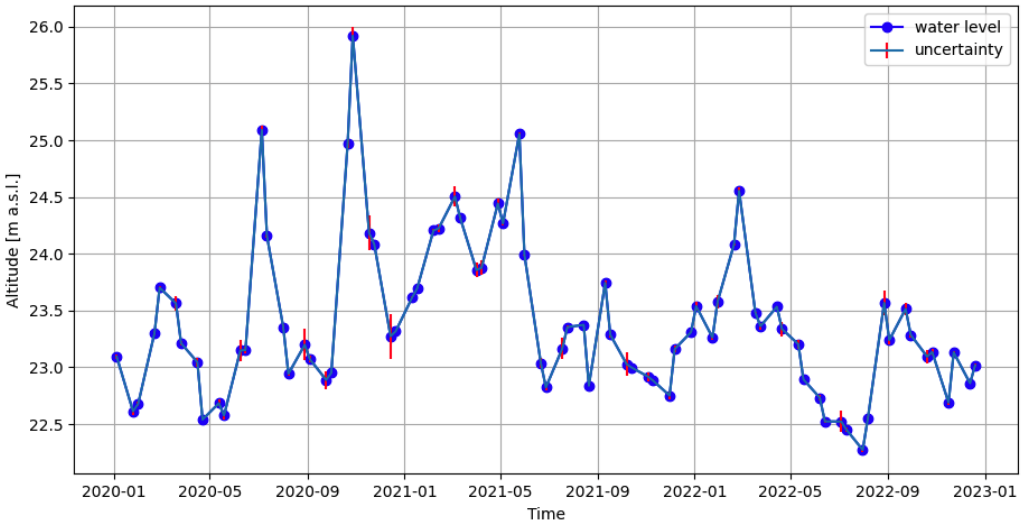


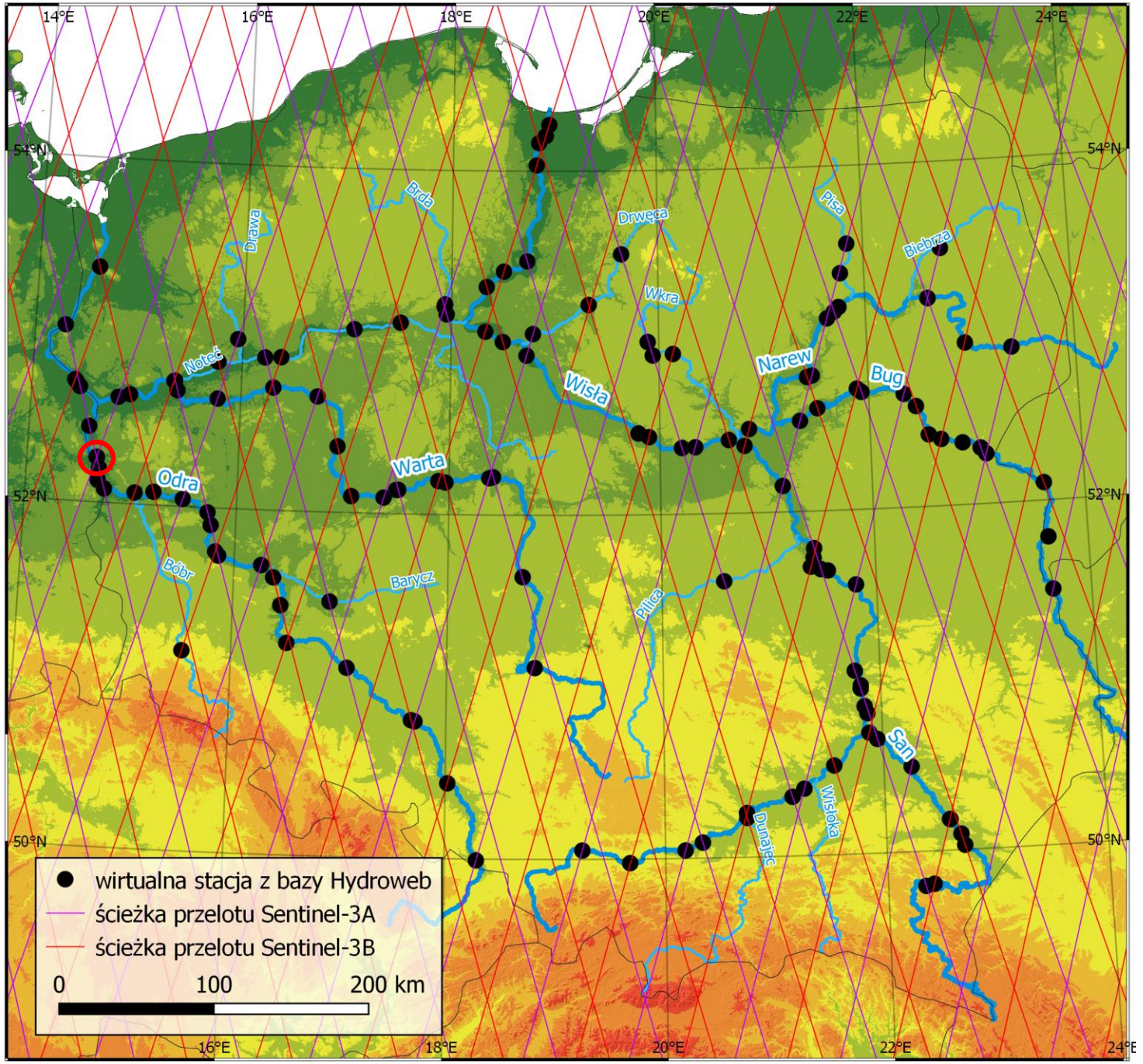
(b)

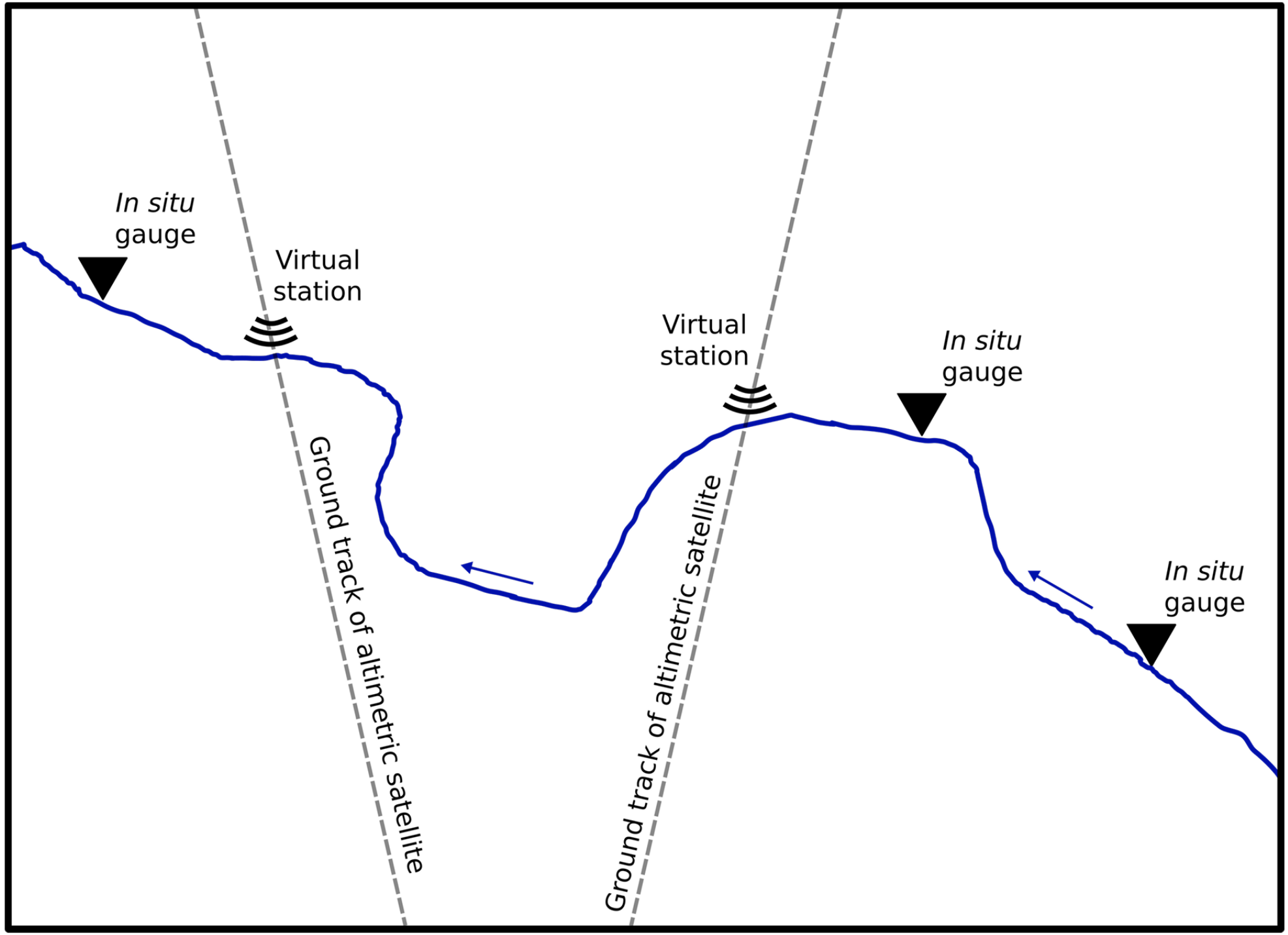
(Martins et al., 2021)

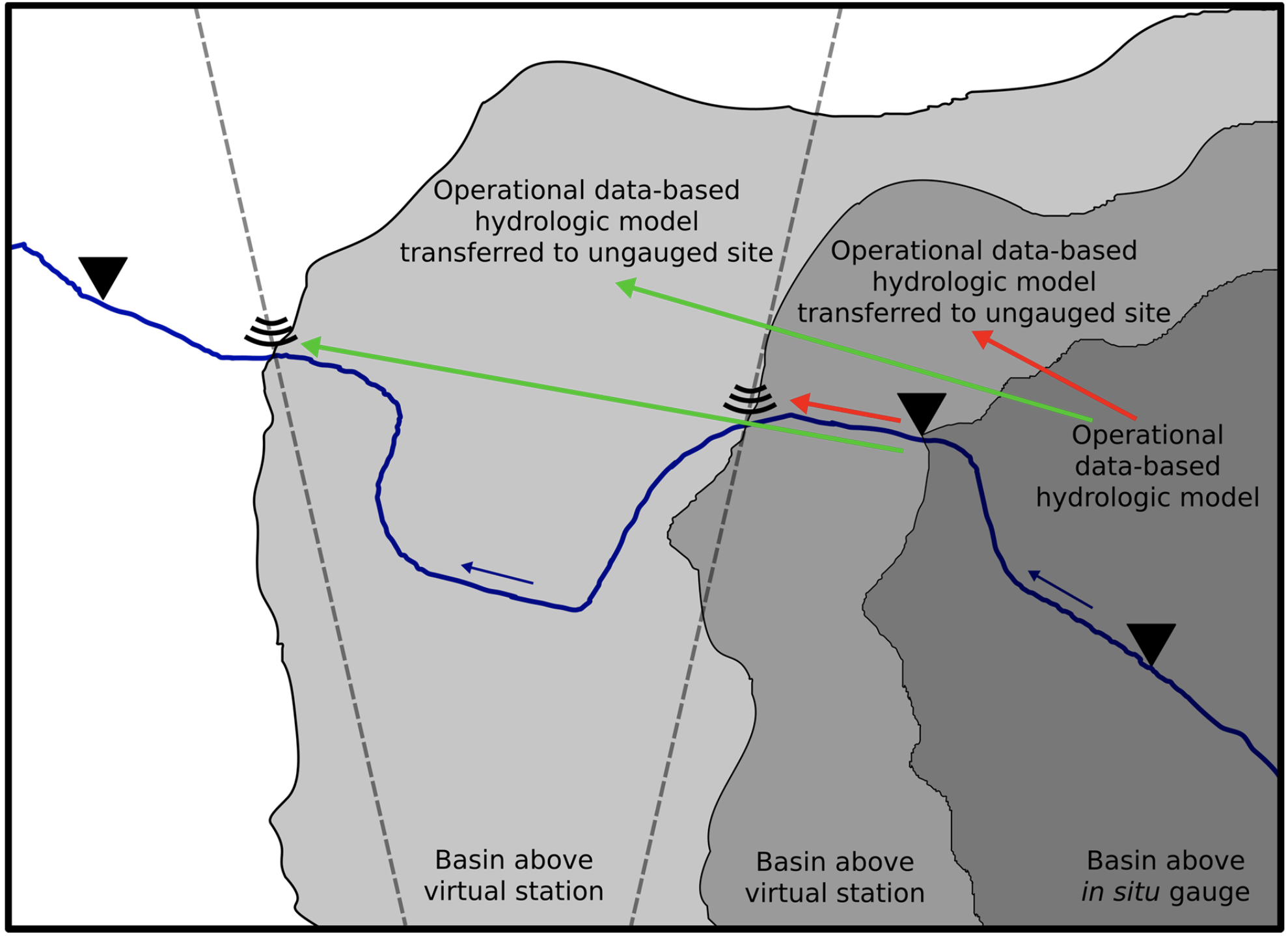
What is radar altimetry?

- Due to the nadir-looking nature of altimetry, water levels are available only at virtual stations (VS), i.e. crossings of satellite path and riverbed.
- Poor temporal resolution (27 days for Sentinel-3)
- Accuracy: +/- 20 cm

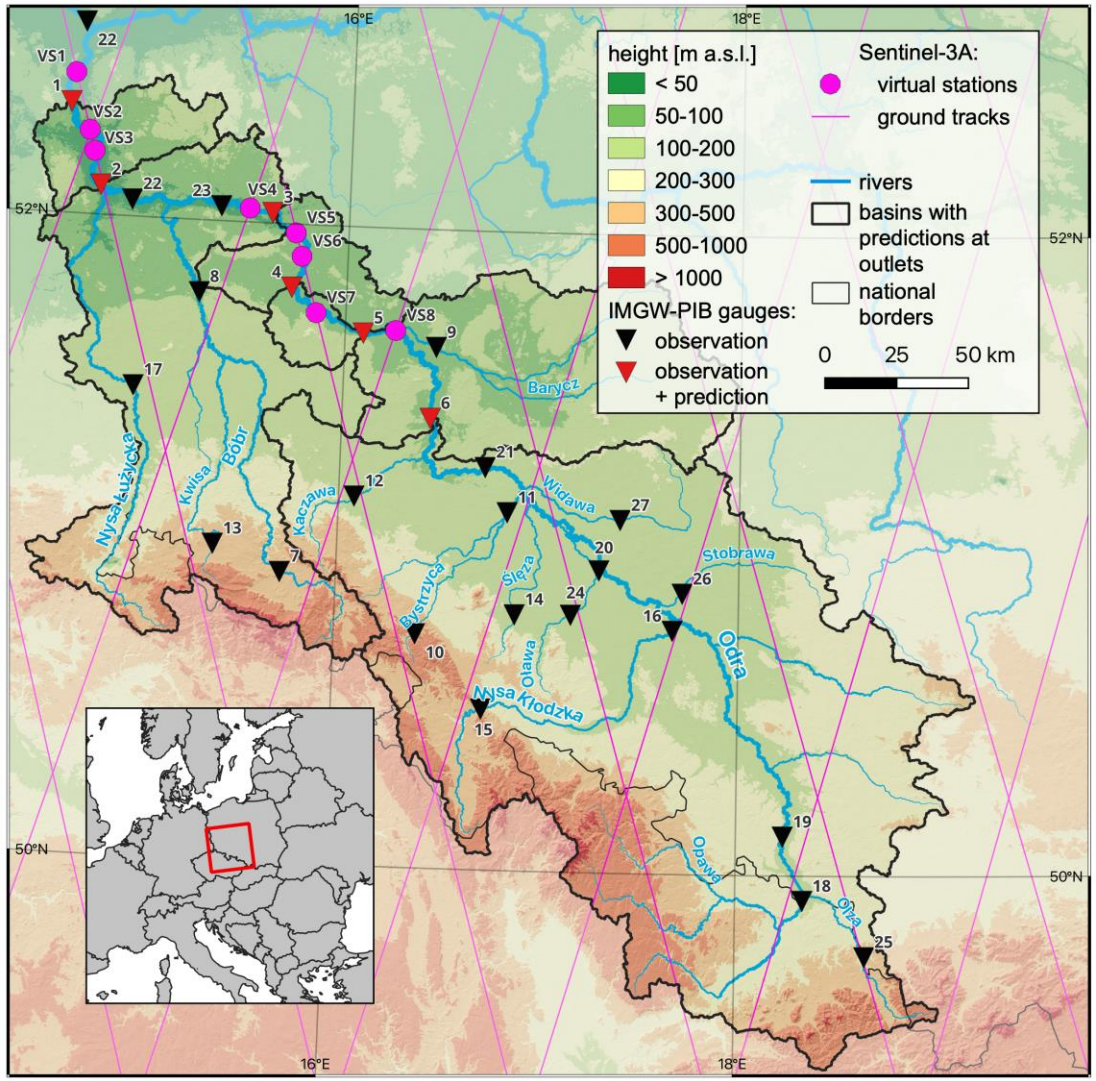


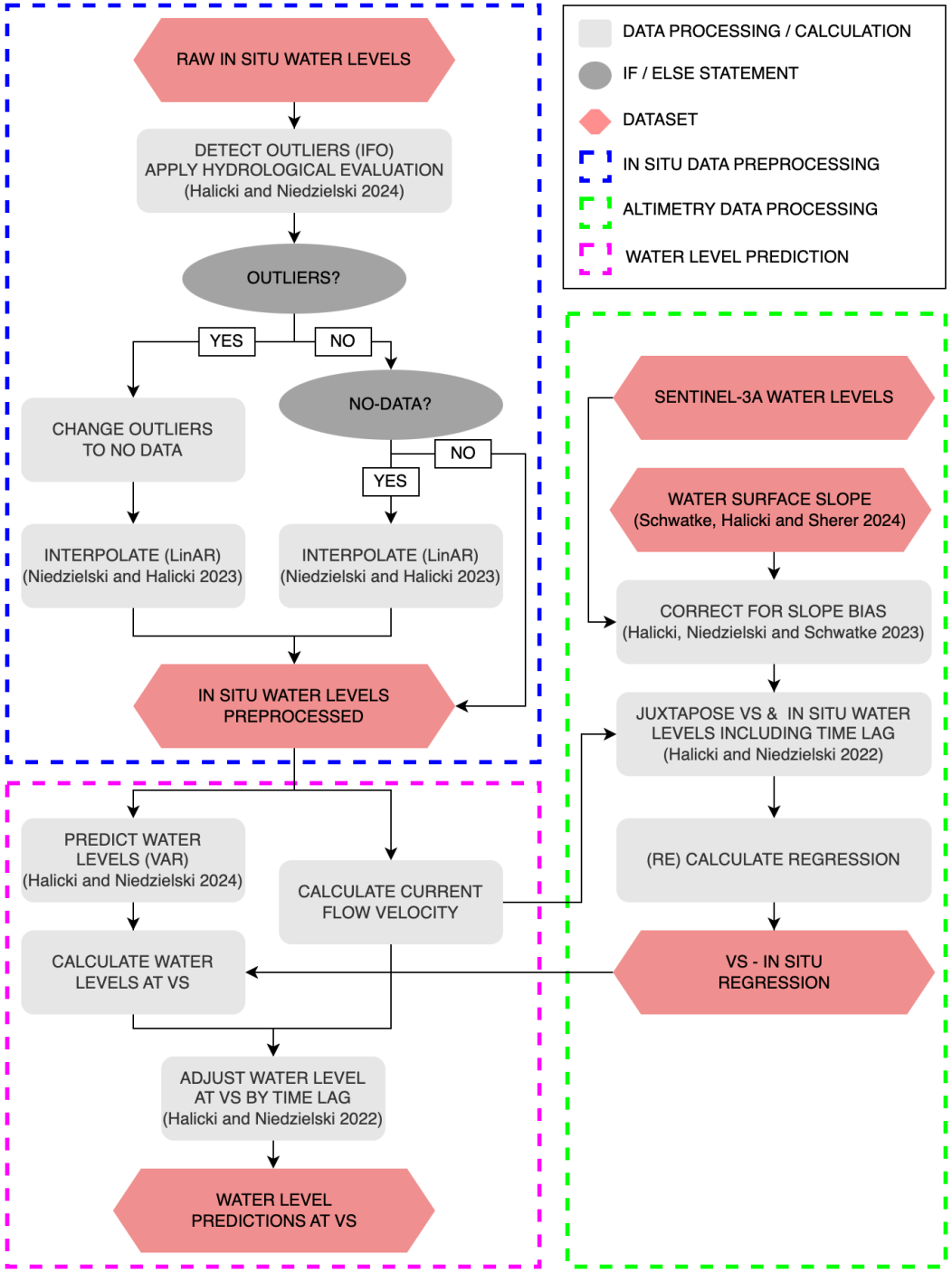



In situ
gauge
Virtual
station
Virtual
station
In situ
gauge
In situ
gauge
Ground track of altimetric satellite
Ground track of altimetric satellite


Operational data-based
hydrologic model
transferred to ungauged site
Operational data-based
hydrologic model
transferred to ungauged site
Operational
data-based
hydrologic model
Basin above
virtual station
Basin above
virtual station
Basin above
in situ gauge

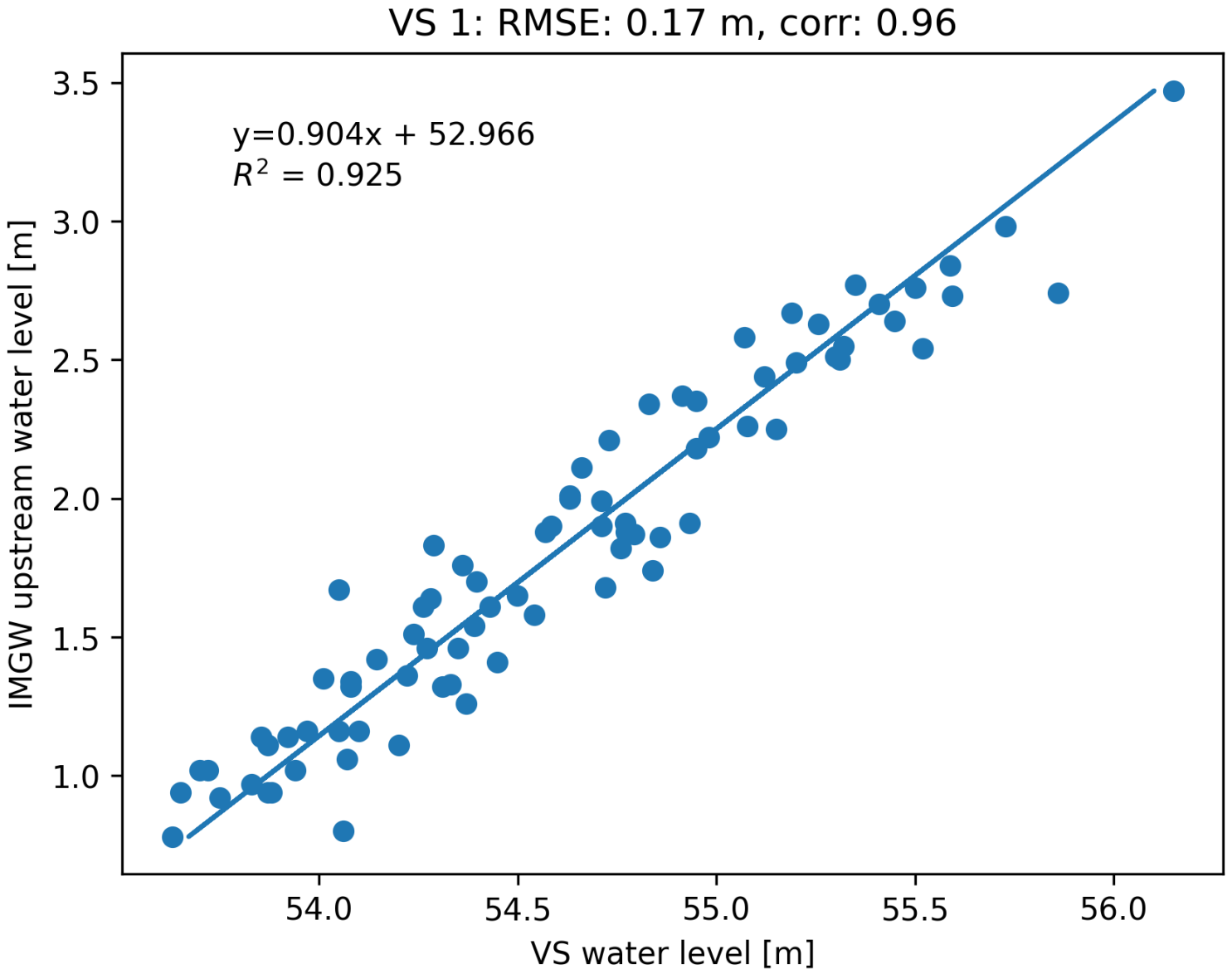
Workflow overview





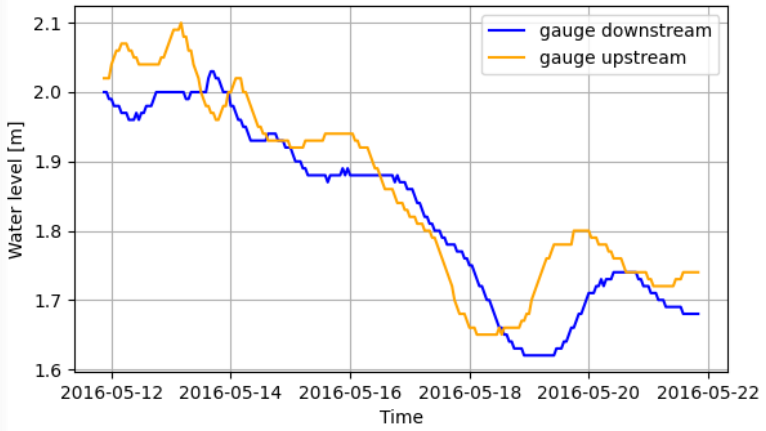
Transfering WL from gauge to VS

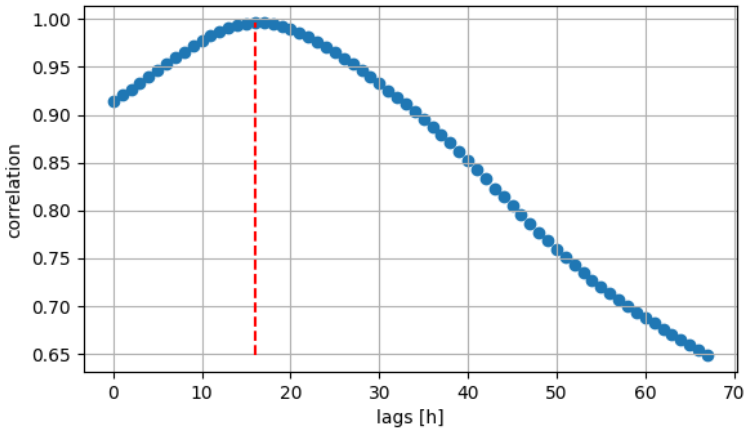
1. Juxtaposition of altimetry and water level gauge measurements
2. Determination of linear regression between observations.
3. Conversion of forecasts from gauges to virtual stations.
4. Time shift of forecasts.

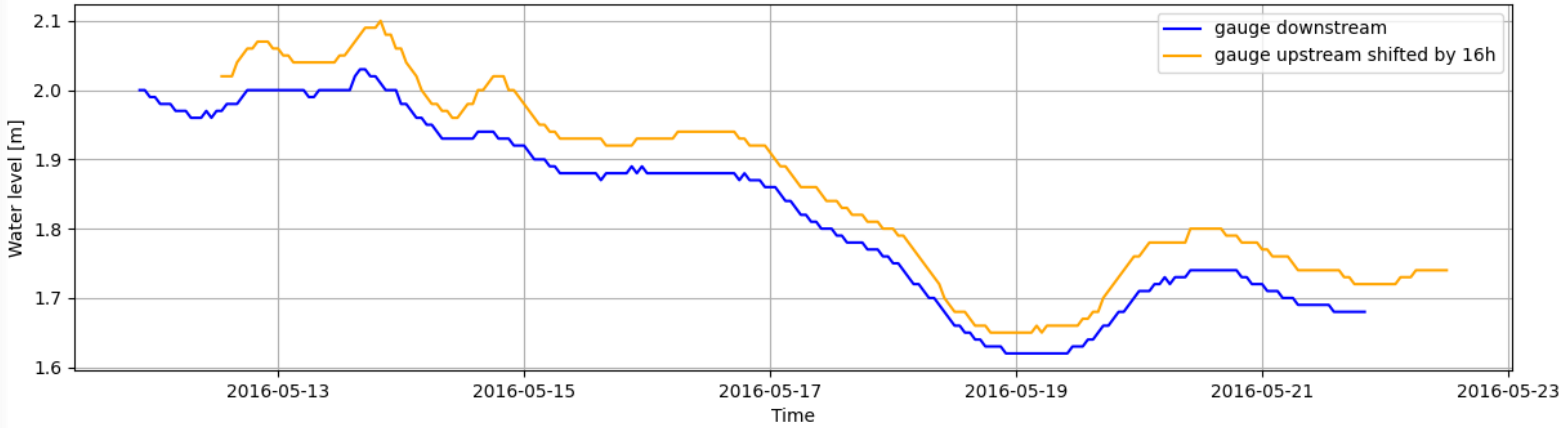


Time lag estimation

1. Determination of such an offset between neighbouring gauges, for which the correlation of the hydrographs will be the highest
2. Water velocity = distance/time (offset)







Transfer procedure

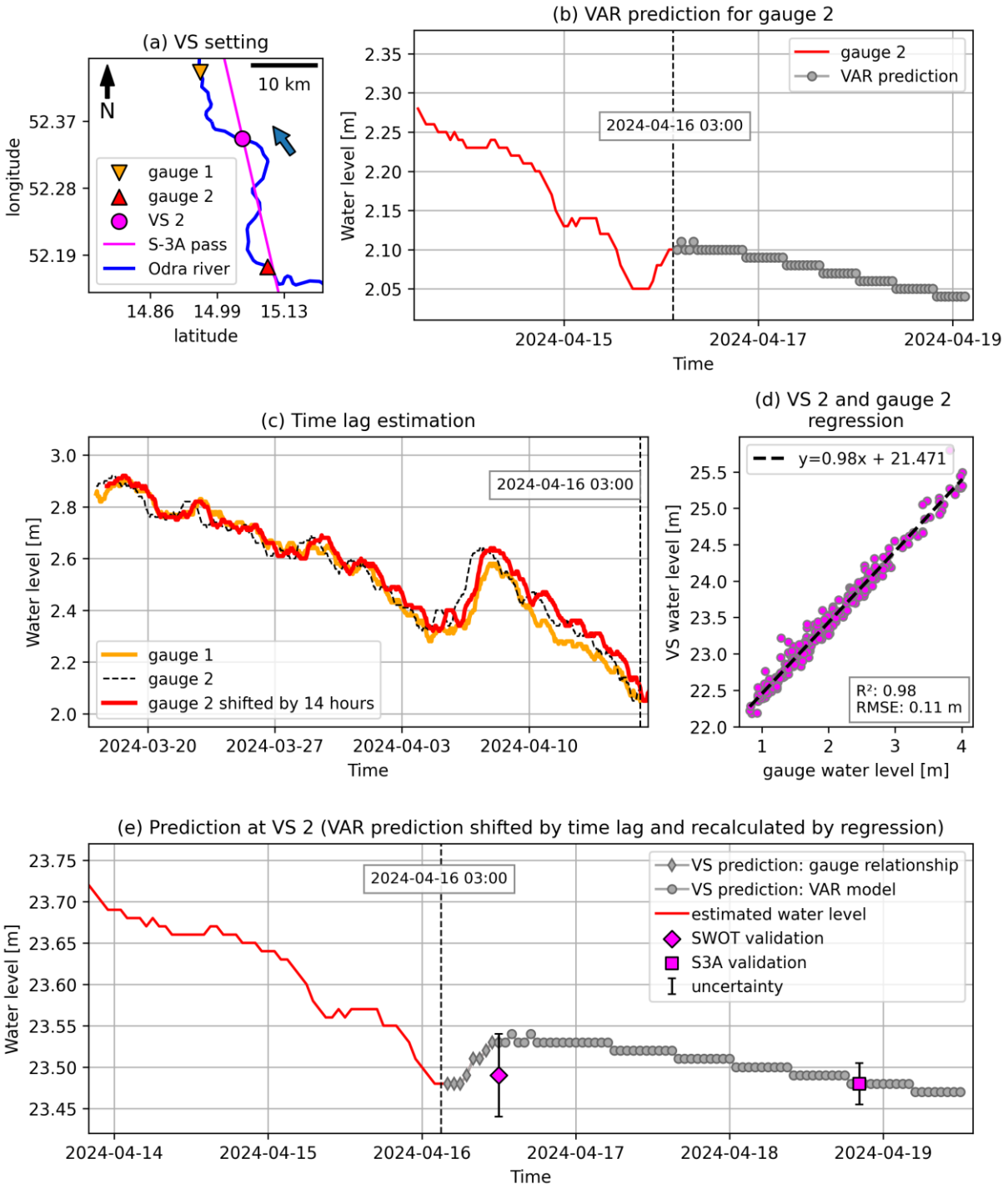
a) Setting of the VS

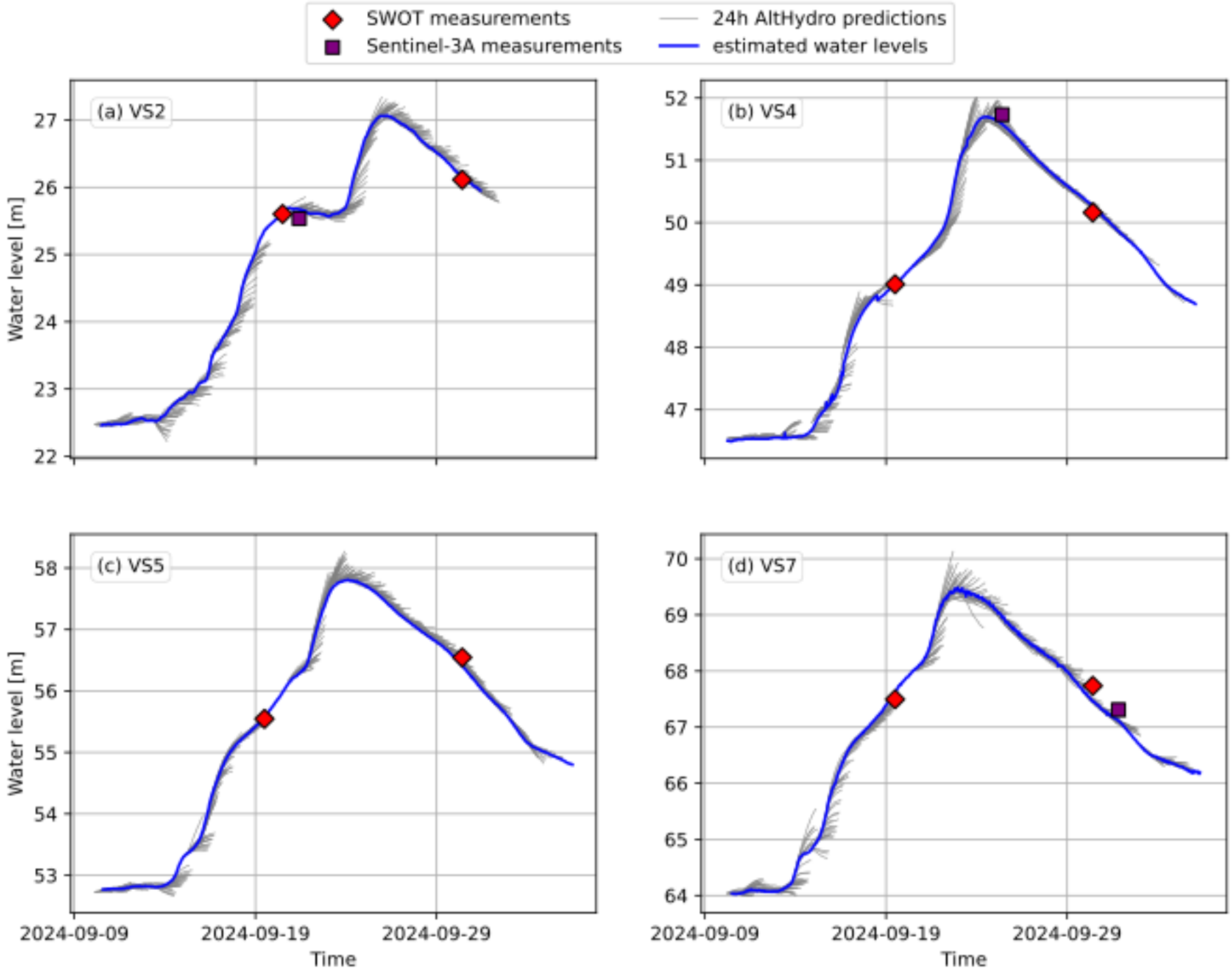
b) Prediction based on Vector Autoregressive Model (VAR) for gauge 2

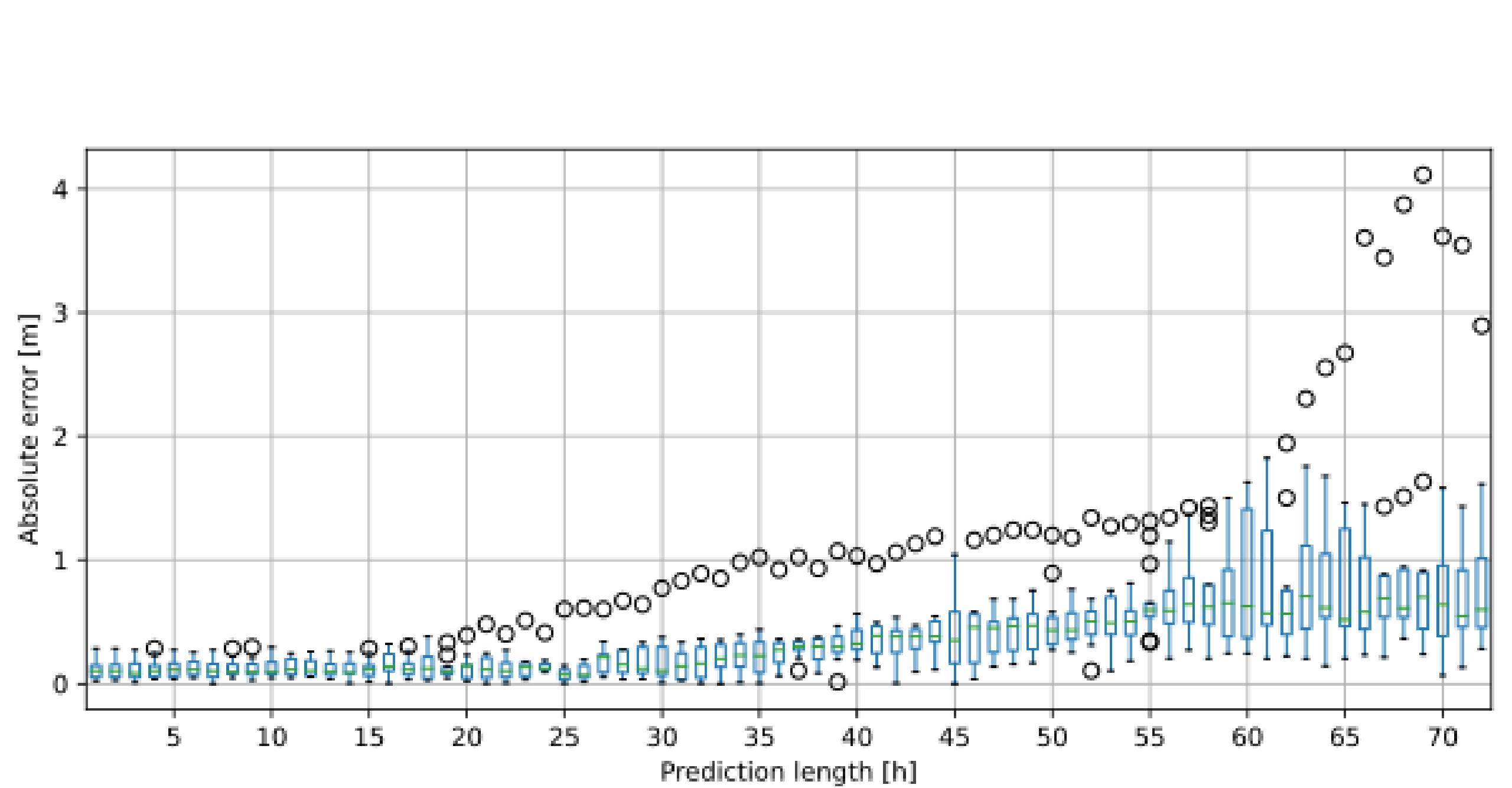
c) Time lag estimation based on gauge data from previous month

d) Current VS 2 – gauge 2 regression

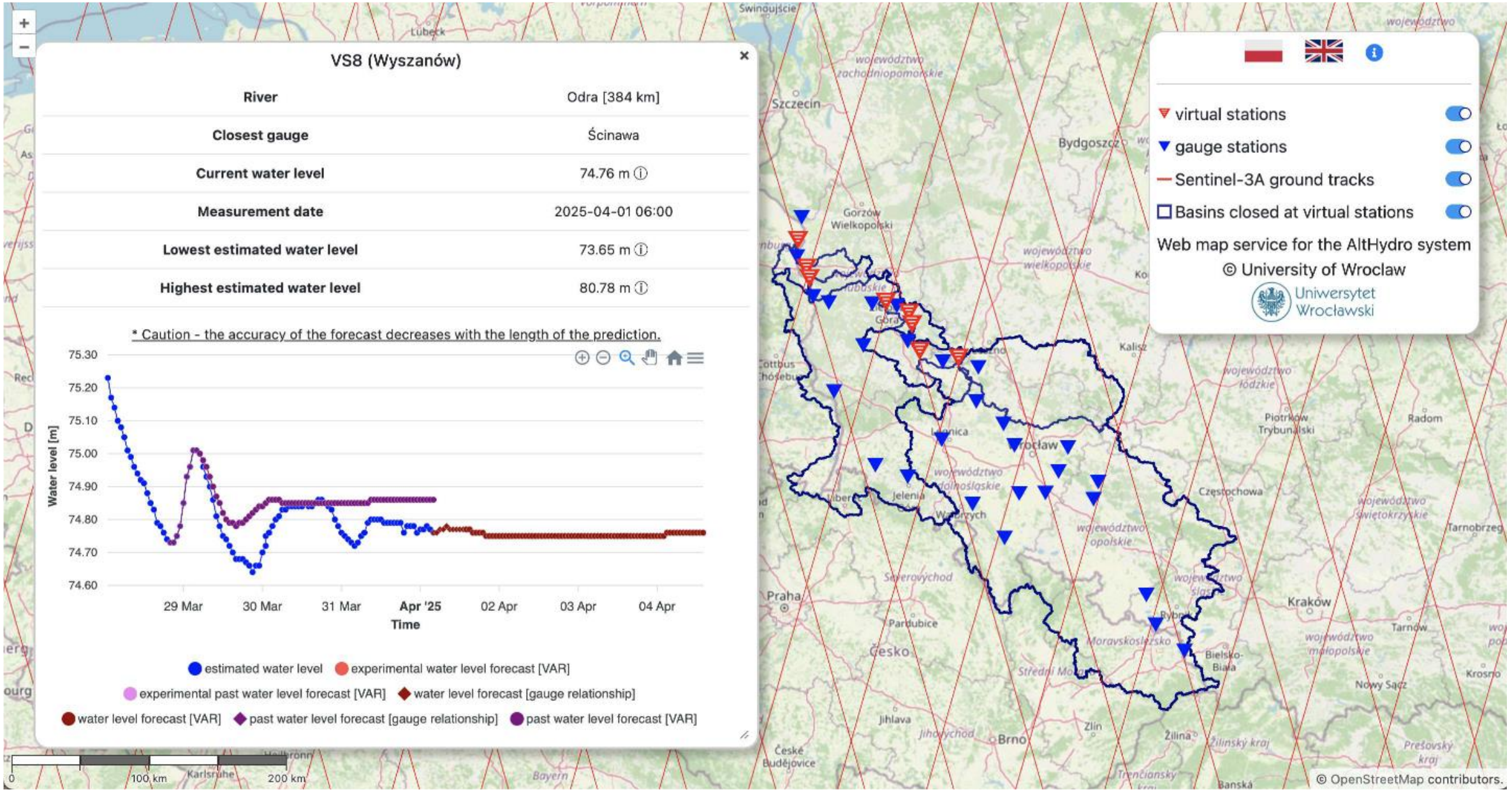
e) Transfer of VAR prediction (b) to VS2 based on regression coefficients and time lag




SWOT measurements
Sentinel-3A measurements
24h AltHydro predictions
estimated water levels
(a) VS2
(b) VS4
(c) VS5
(d) VS7
Water level [m]
Time
2024-09-09
2024-09-19
2024-09-29


Absolute error [m]
0
1
2
3
4
5
10
15
20
25
30
35
40
45
50
55
60
65
70
Prediction length [h]

Real time predictions at virtual stations:
http://althydro.uwr.edu.pl/#



Thank you for your attention!

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3. Halicki M, Niedzielski T (2024) A new approach for hydrograph data interpolation and outlier removal for vector autoregressive modelling: a case study from the Odra/Oder River. Stoch Environ Res Risk Assess. https://doi.org/10.1007/s00477-024-02711-5
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The research presented in this paper has been carried out in frame of the project no. 2020/38/E/ST10/00295 within the Sonata BIS programme of the National Science Centre, Poland. The research has also been supported by the Bekker Programme of the Polish National Agency for Academic Exchange, as well as by the program “Excellence Initiative - Research University”.