Determining Uncertainty in Estimations of Global Surface Water Extent derived from a Diurnal Earth Observation Time-Series
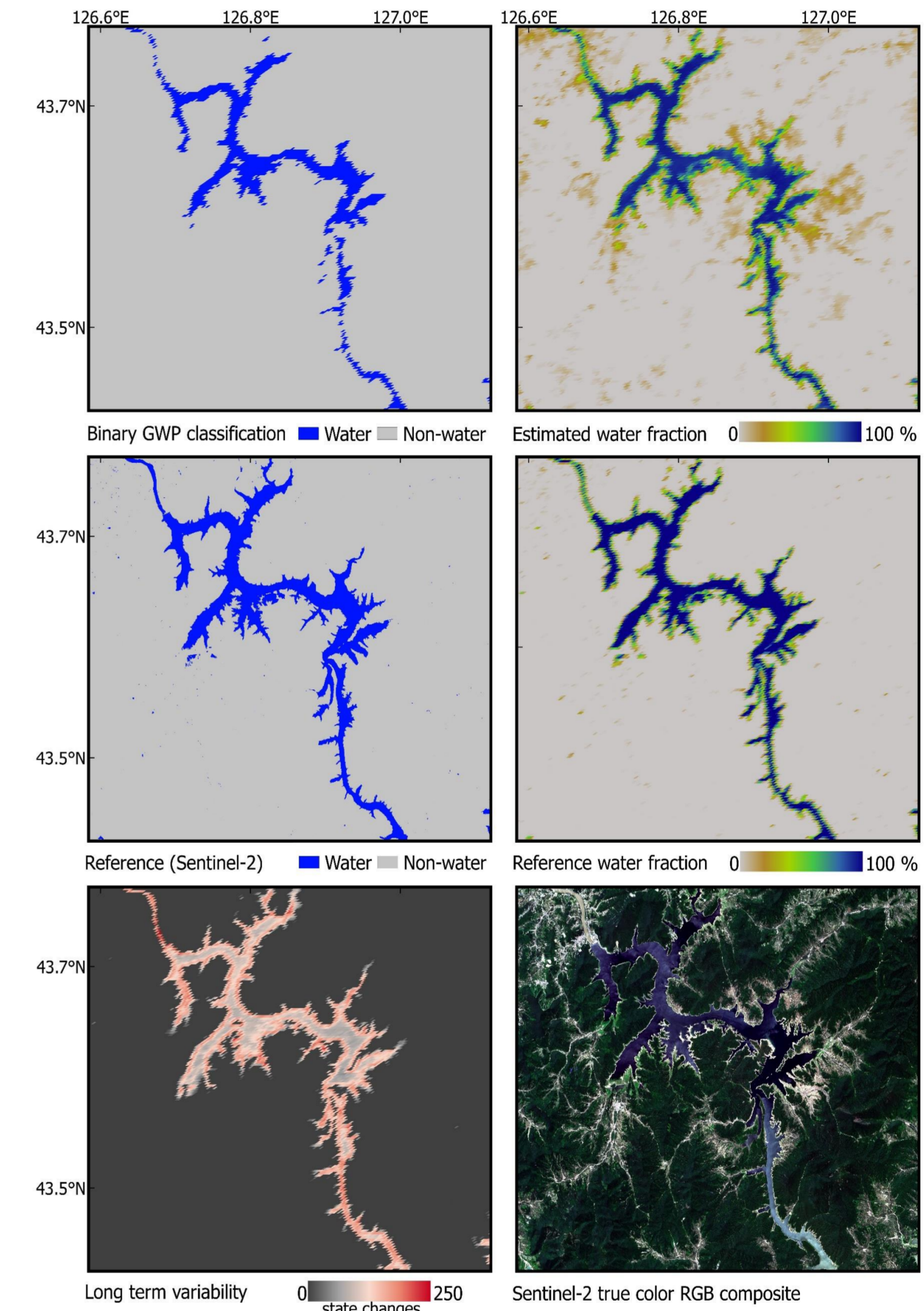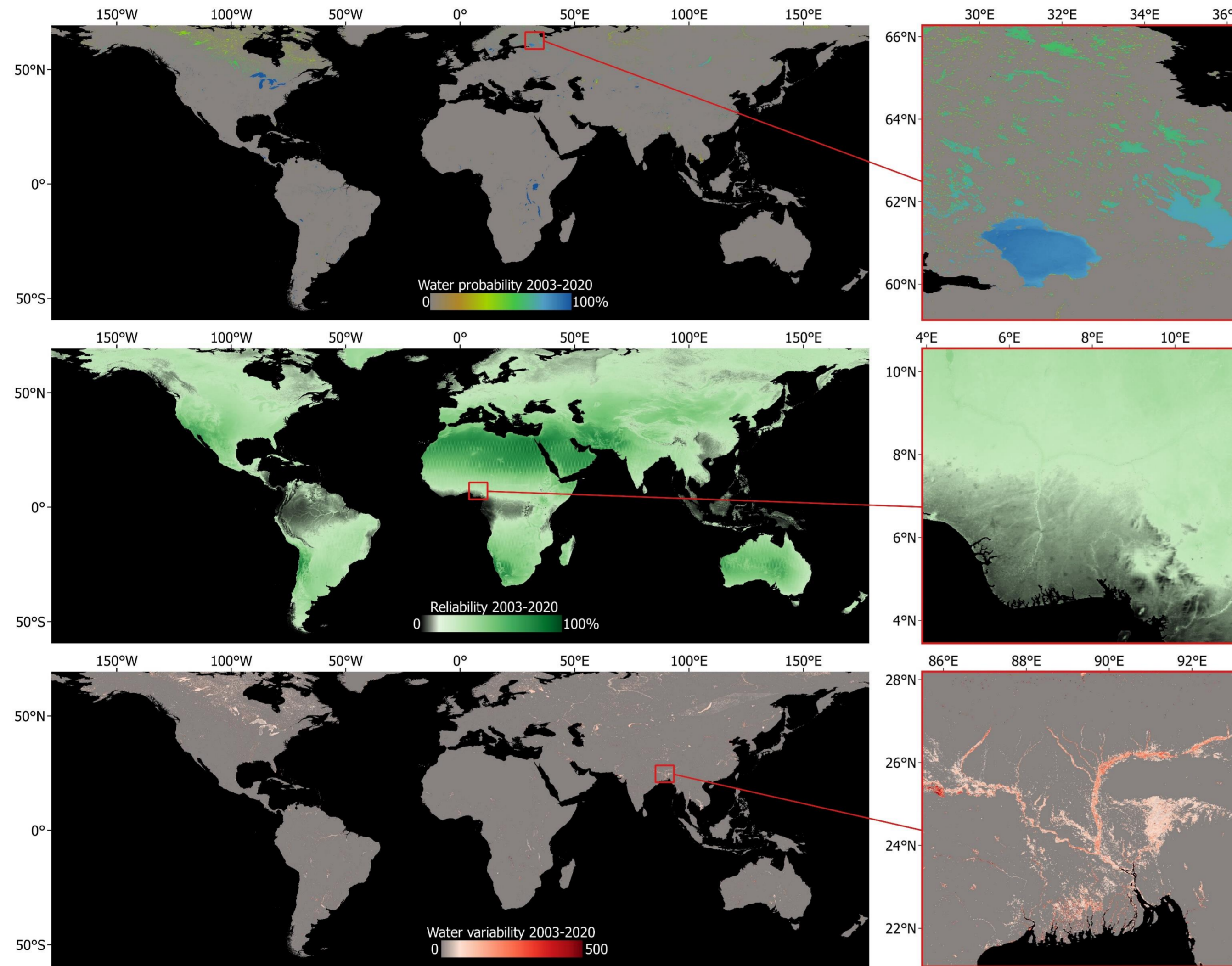
Estimation of temporal uncertainty

By considering different temporal and spatial characteristics of surface water, six layers are generated featuring water probability and reliability on pixel level.

1. Long-term (complete time-series)
2. **Temporal vicinity (year and month)**
3. **Temporal** closest observations
4. Spatiotemporal neighborhood
5. Seasonal (reoccurrence)
6. Combination (reliability weighted mean)

Estimation of observational uncertainty

Subpixel water fraction is systematically estimated by a linear mixture model, utilizing classification probability and time-series derived pure pixel reference information.

Water probability 2003-2020 0 100%

Reliability 2003-2020 0 100%

Water variability 2003-2020 0 500

Binary GWP classification Water Non-water

Estimated water fraction 0 100 %

Reference (Sentinel-2) Water Non-water

Reference water fraction 0 100 %

Long term variability 0 250 state changes

Sentinel-2 true color RGB composite

Quantifying spatiotemporal characteristics

Temporal vicinity

t [days]

| | | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | | Valid observation |
| | | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | | Detected water |

t_{min} t_{-4} t_{-3} t_{-2} t_{-1} Evaluation t_1 t_2 t_3 t_4 t_{max}

Past vicinity / Future vicinity

Water / Non-water

Seasonal state

Year 1 / Year 2 / Year N

Valid observation / Detected water

Evaluation

Water

Spatial neighborhood

1	pvm	pvm
1	1	pvy
1	0	0

pvm – monthly temporal vicinity probability
pvy – yearly temporal vicinity probability

Water / Non-water / 8-pixel neighborhood

750 m

MAE GWP / MAE Model

Error
Water fraction range
● ROI result
— Mean

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