

Supplementary Materials

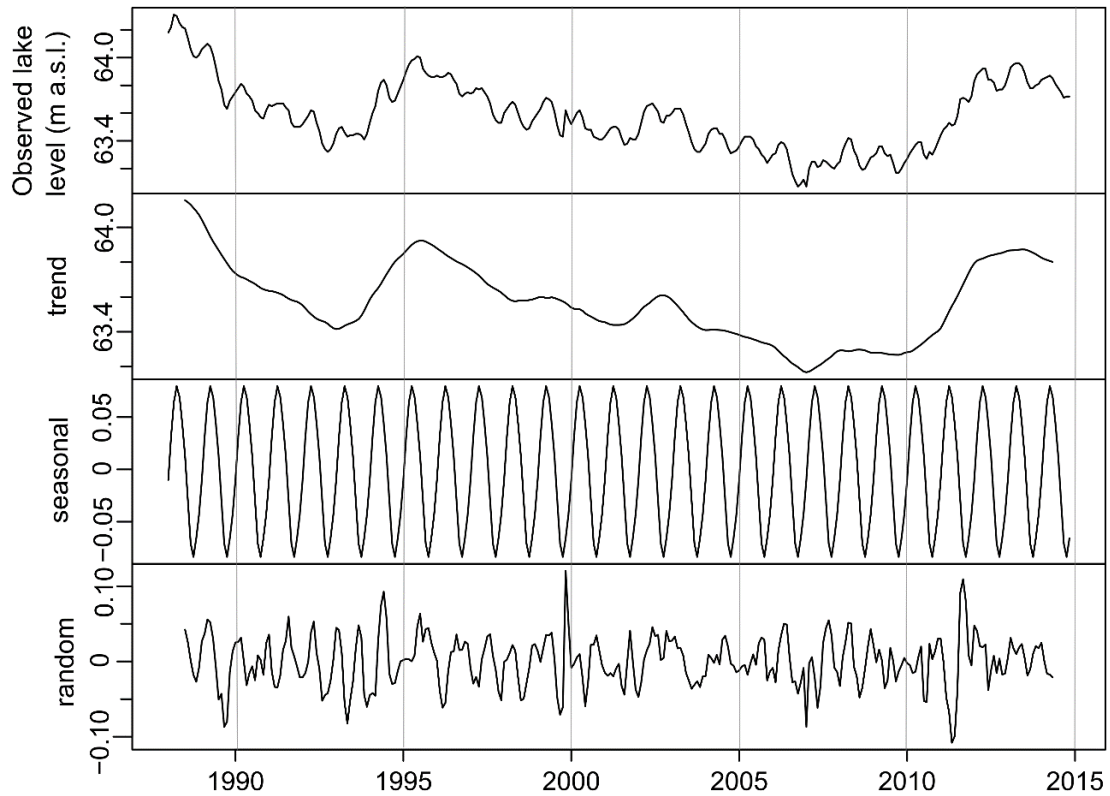


Figure S1. Level changes of LF, including a decomposition of the time series from 1988 to 2014. The observed values are the gauged lake levels. The trend component is calculated by a moving average of the observed data. The seasonal figure is computed by averaging the difference between observed data and trend for each day of all the years considered. The seasonal figure is then centered. The error component (“random”) is determined by removing trend and seasonal oscillations from the observed gauging [1].

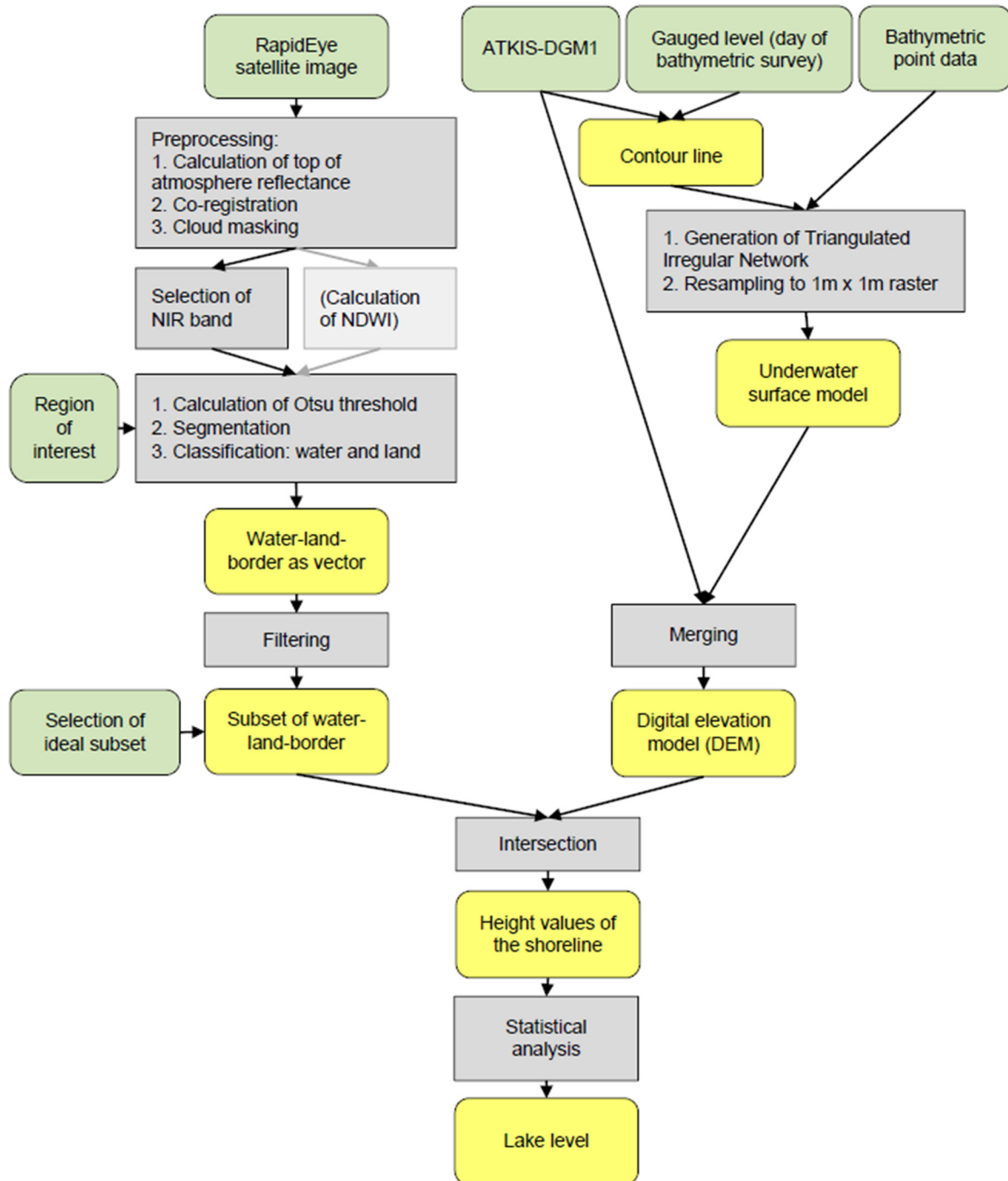


Figure S2. Workflow of the data preparation and the processing chain for the reconstruction of lake levels (*cf.* Chapter 3, Materials and Methods).

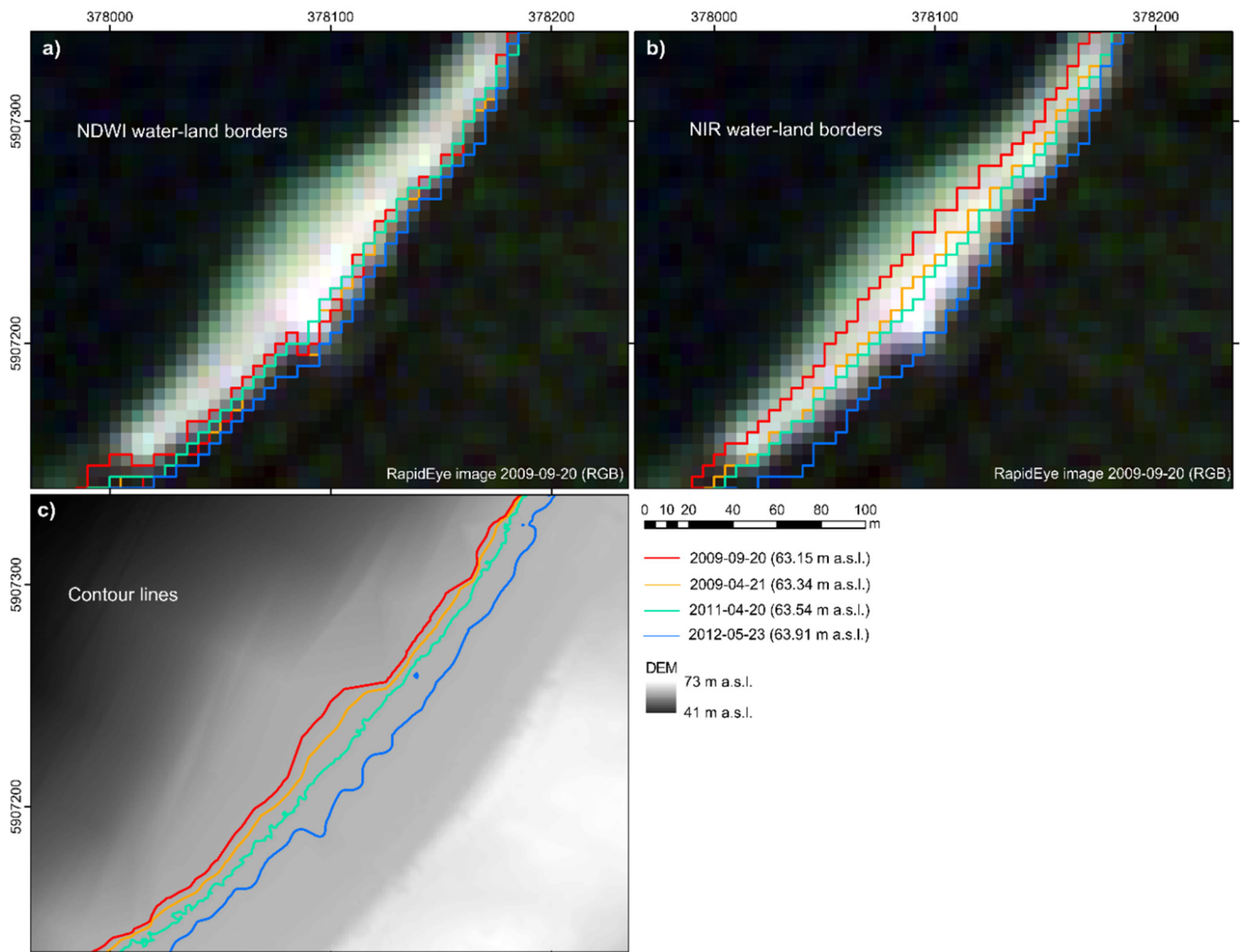


Figure S3. Illustration of the water-land borders and contour lines at the southeastern, shallow beach of LF (subset B) on 21 April 2009, 20 September 2009, 20 April 2011, and 23 May 2012. Figure (a) shows the water-land borders extracted from the RapidEye images using the NDWI; Figure (b) shows the water-land borders extracted from the RapidEye images using the NIR; Figure (c) represents the GIS analysis with contour lines: The levels measured *in situ* on the four dates are delineated as contour lines in the DEM. The minimum level (63.15 m a.s.l.) between 2009 and 2014 was measured on 20 September 2009, the maximum level on a cloud free image (63.91 m a.s.l.) on 23 May 2012.

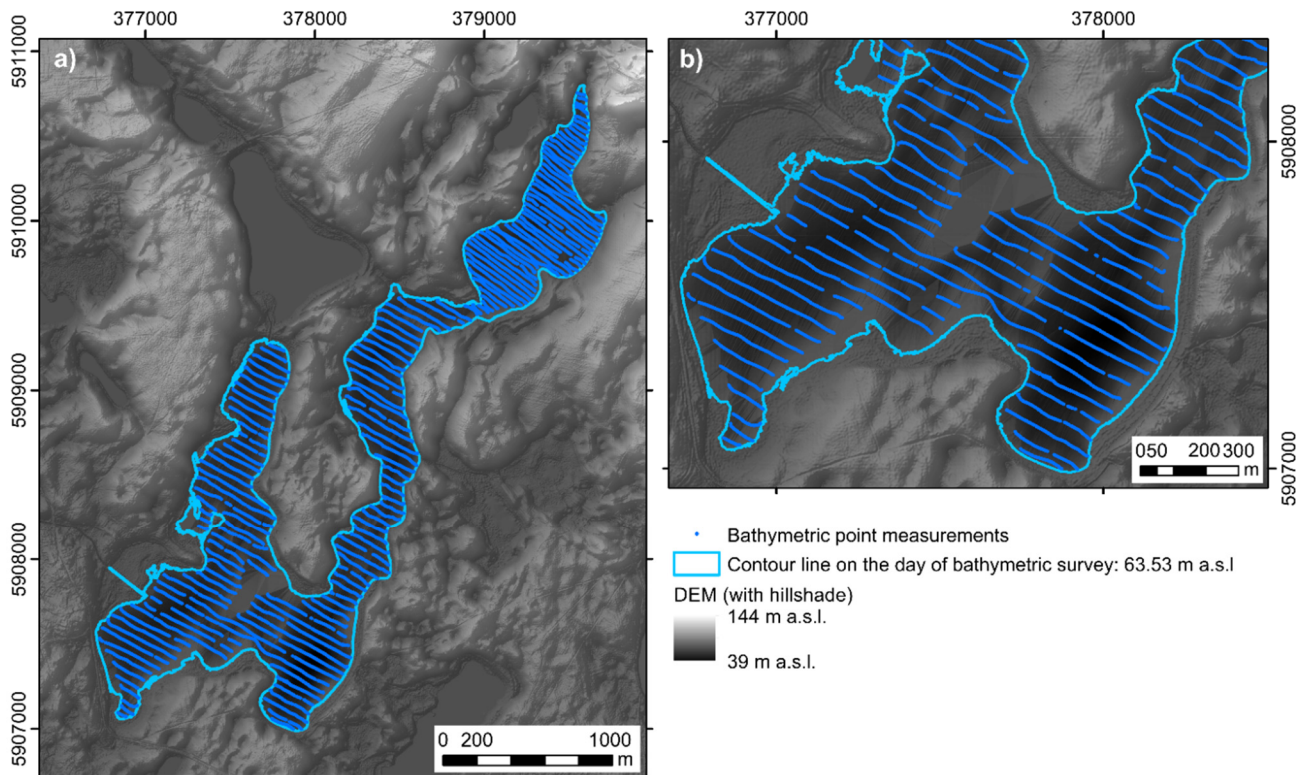


Figure S4. Digital elevation model (DEM) of (a) LF and (b) its southern part at a smaller scale. The blue dots are the bathymetric point measurements. The light blue line is the contour line from the DEM that illustrates the *in situ* measured lake level on the day of the bathymetric survey. Points and contour line are used to generate the underwater surface model as a Triangulated Irregular Network. The final DEM is the merged result of the digital surface model (ATKIS-DGM1) and the underwater surface model.



Figure S5. Photos of the shallow, southeastern beach in 2009 and 2014 (subset B), looking northwards. In 2009 there is a wide sandy beach, in 2014 the beach is flooded and the water-land border extends to the surrounding trees.

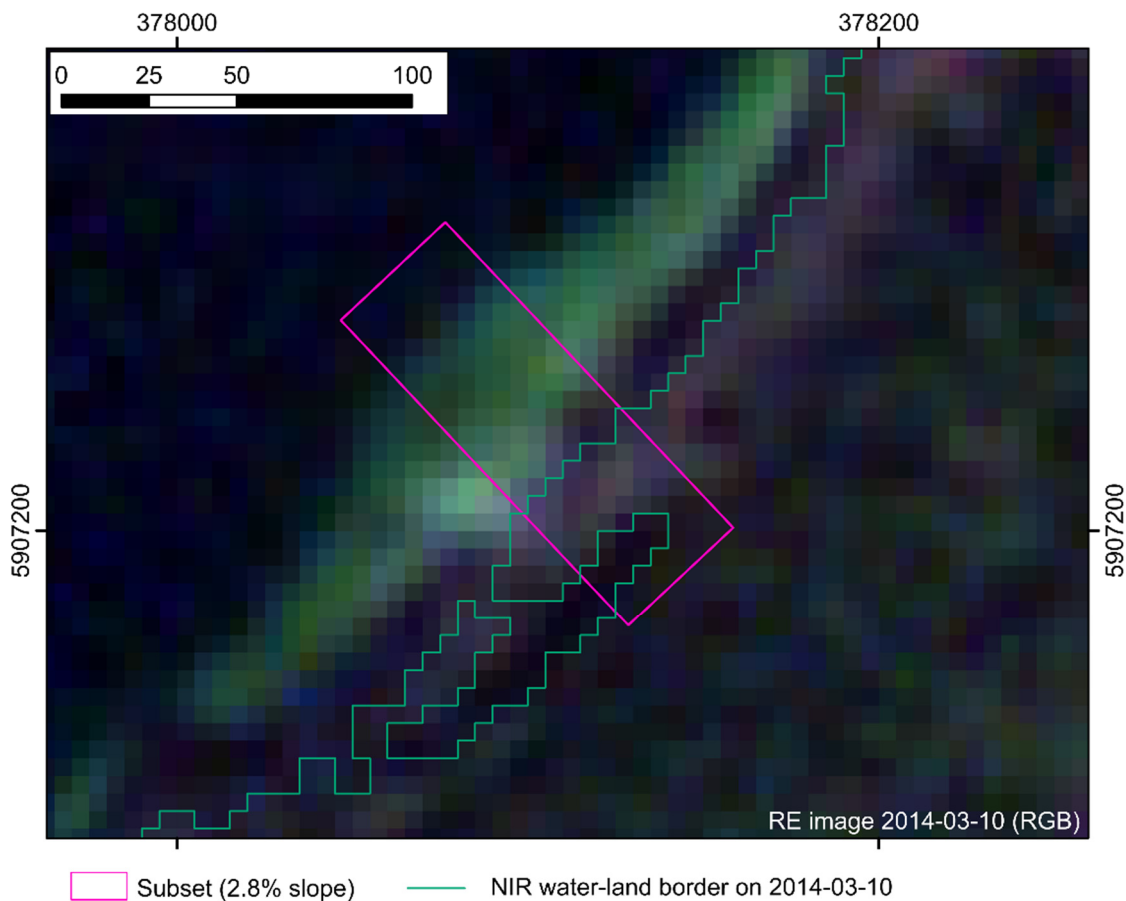


Figure S6. Misclassification of the NIR water-land border on 10 March 2014. The automatic thresholding of the water-land border spreads into a clearing in the surrounding forest. The ideal subset with a 2.8% slope is marked in pink.

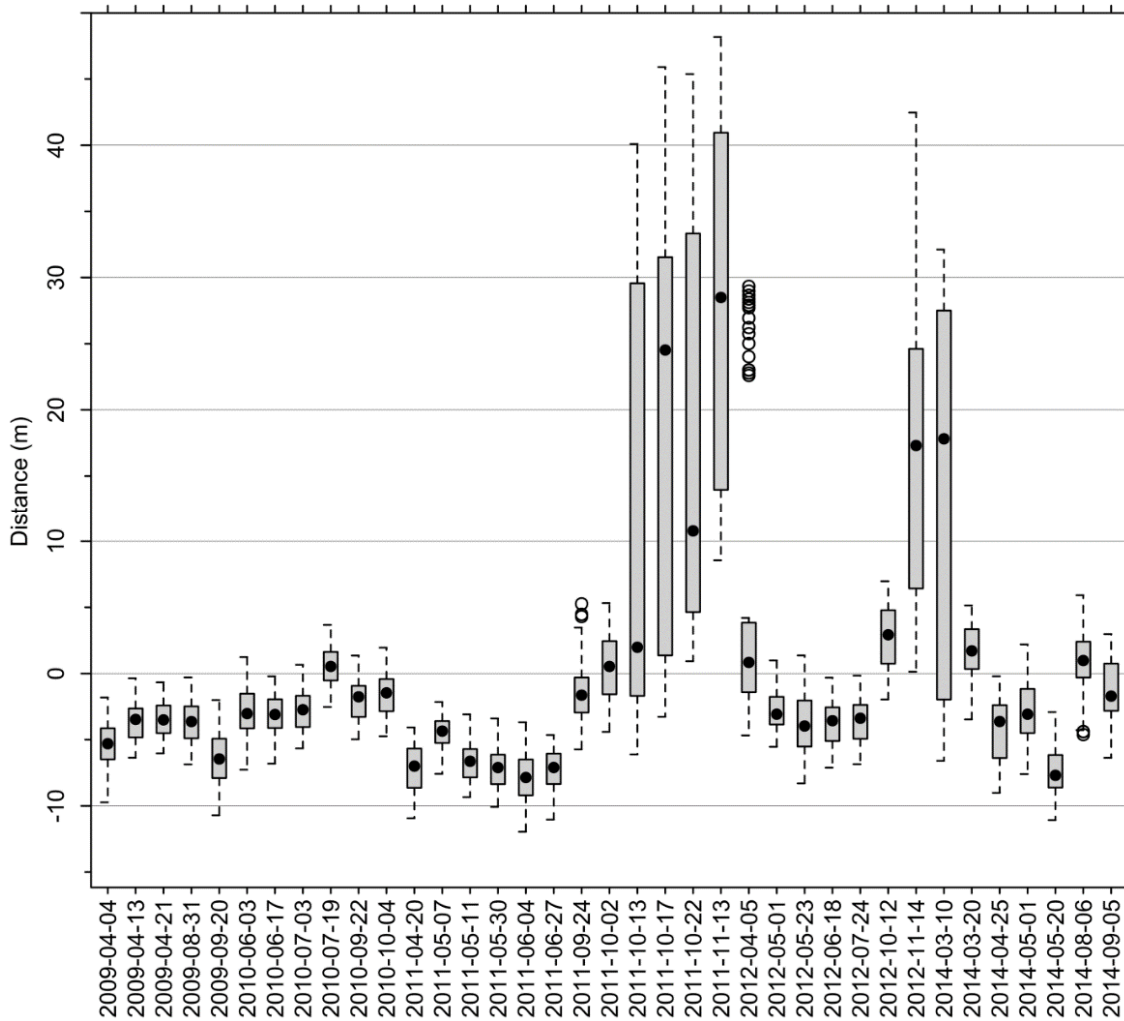


Figure S7. Boxplot of the minimum distances (in m) between the NIR water-land borders and the according contour lines at the ideal subset (subset 2.8%). The black dots represent the median. The RMSE for all dates is 13.5 m. The RMSE is reduced to 5.0 m when dates with a very low sun elevation angle (SEA) below $<30^\circ$, and dates with a SEA angle below $<45^\circ$ in cases of high lake levels (≥ 63.7 m a.s.l.), are excluded.

Reference

1. Meyer, D. R documentation: Classical Seasonal Decomposition by Moving Averages. Available online: <https://stat.ethz.ch/R-manual/R-devel/library/stats/html/decompose.html> (accessed on 15 June 2015).

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