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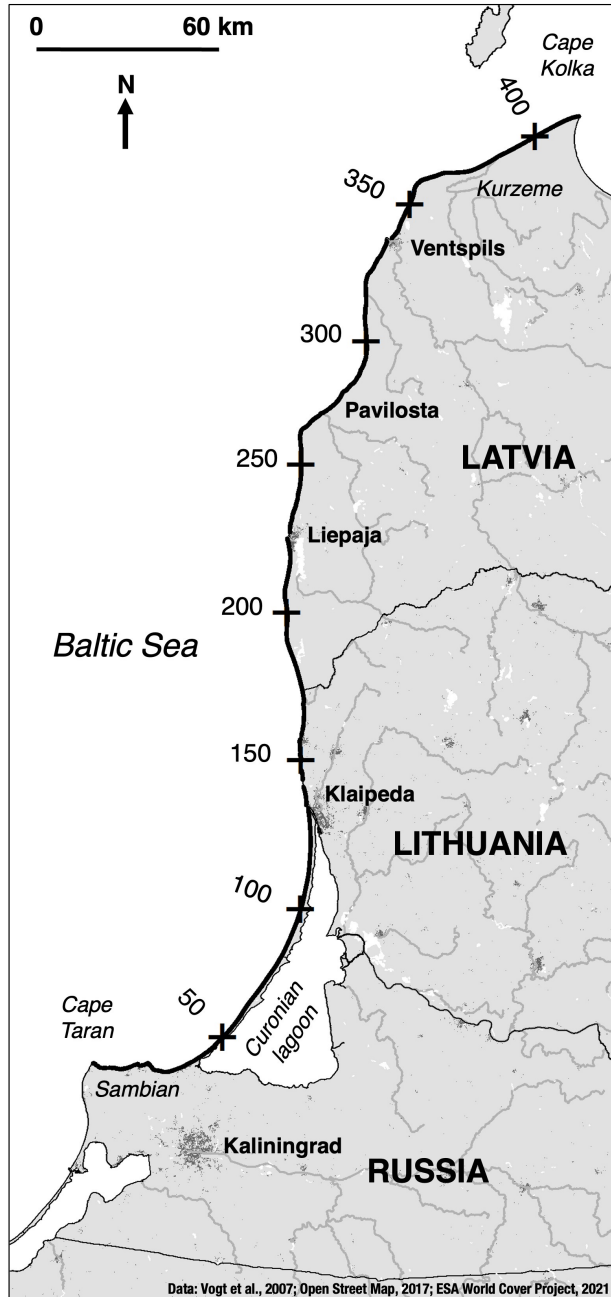


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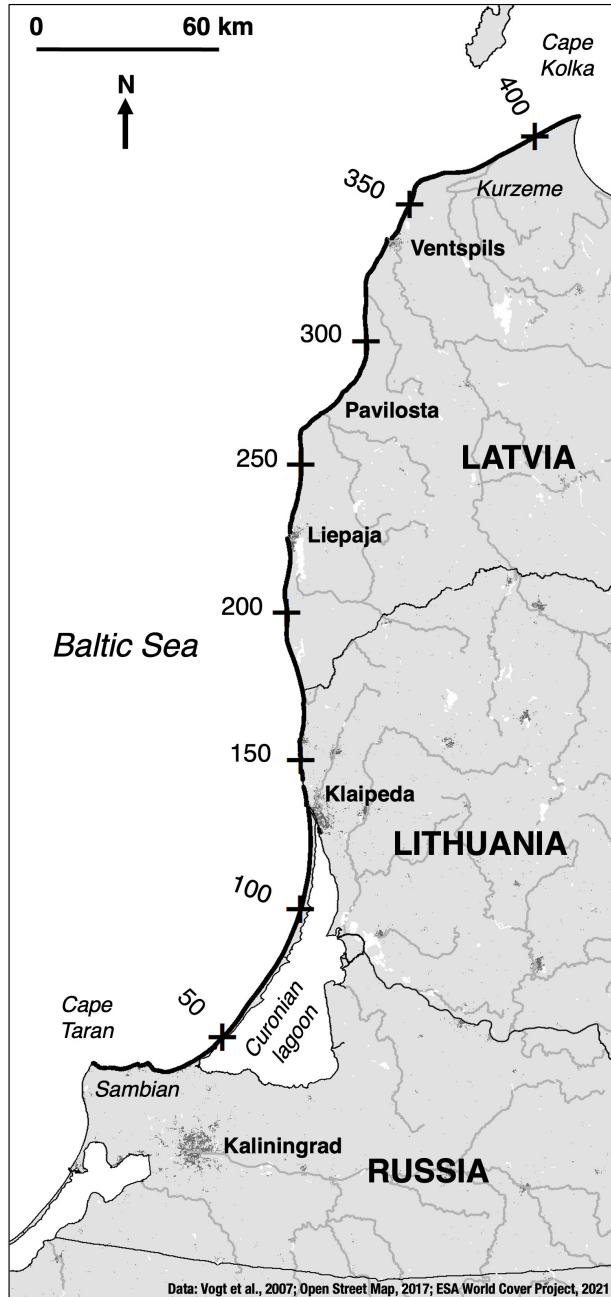


The Evolution of the South-Eastern Baltic Sea Coastline Between 1988 and 2018 by Remote Sensing

Prof. Dr. Sébastien Gadal, Thomas Gloaguen
Aix-Marseille University, CNRS, UMR 7300 ESPACE
Kaunas University of Technology



Research context



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- Analysis of coastal dynamics between 1988 and 2018.



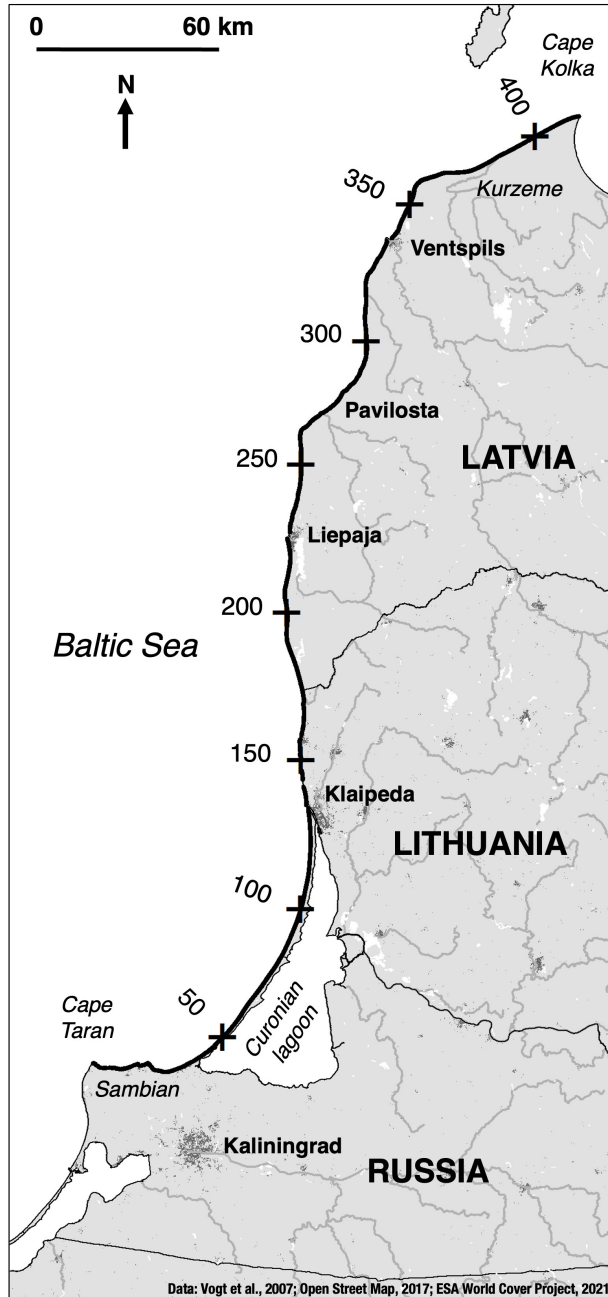
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- The study covers the coasts of Russia (Kaliningrad Oblast), Lithuania and part of Latvia, i.e. 415 kilometres.



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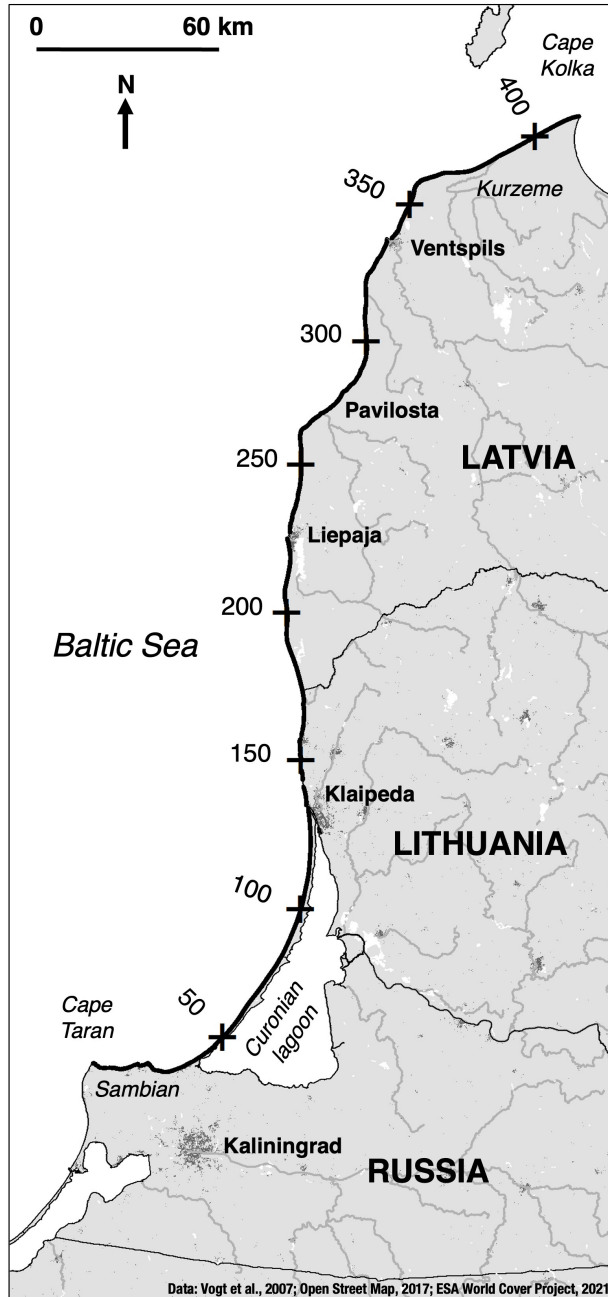
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- Historical perspective (Landsat archives since the 1970s).



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Interest of spatial imagery in coastal studies

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- Historical perspective (Landsat archives since the 1970s).
- Standardisation of the archives and the measurements.

Increasing anthropisation of the south-eastern Baltic coastal zone

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- Militarisation of the territory during Soviet period: control and limitation of movement and human occupation.



Example of former military infrastructure on the Latvian coast

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Development of tourism issues in Palanga (Lithuania)

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Coastal landscape of wide sandy beaches in Lithuania

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- Large sand and gravel beaches and dunes predominate on the coast.
- Morphodynamics factors: swells, longshore drift, tectonic movements, tidal movements, etc.
- The effects of climate variability will modify the current morphological processes.



Example of former military infrastructure on the Latvian coast



Development of tourism issues in Palanga (Lithuania)



Coastal landscape of wide sandy beaches in Lithuania

Data acquisition

Data acquisition

- Use of Landsat 4-5 TM and Landsat 8 OLI satellite images composed of spectral bands covering visible and infrared with a resolution of 30 m by 30 m + thermal with a resolution of 100 m by 100 m and 120 m by 120 m (resampled to 30 m by 30 m).

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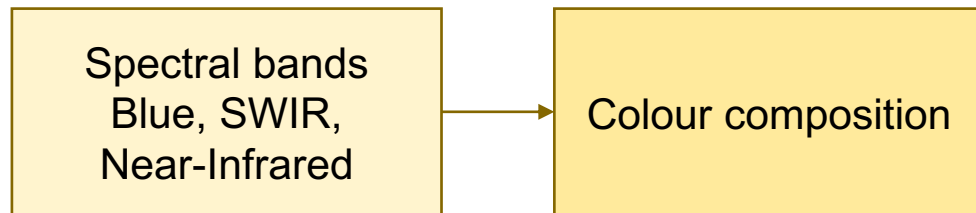
Spectral bands
Blue, SWIR,
Near-Infrared

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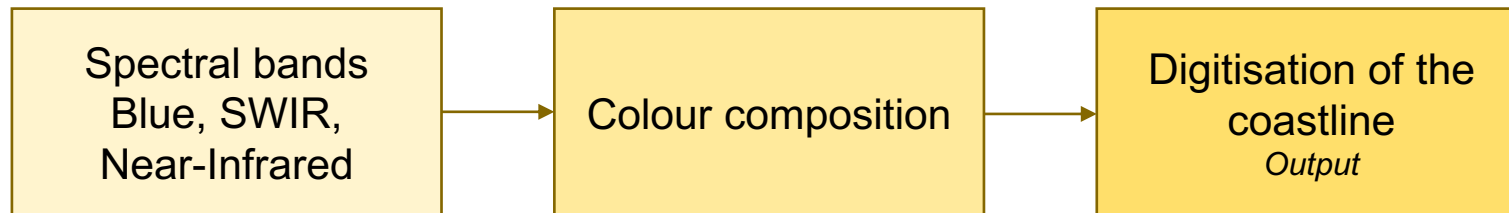


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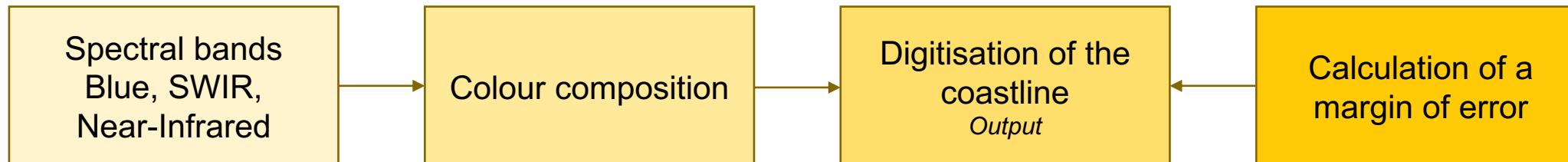


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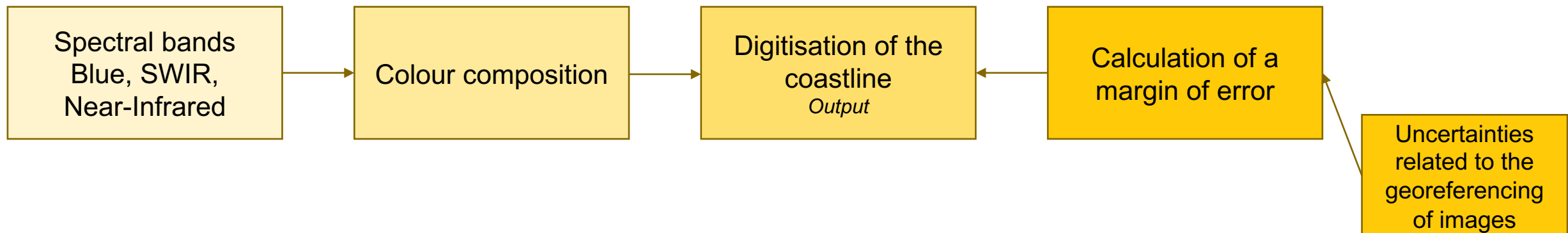


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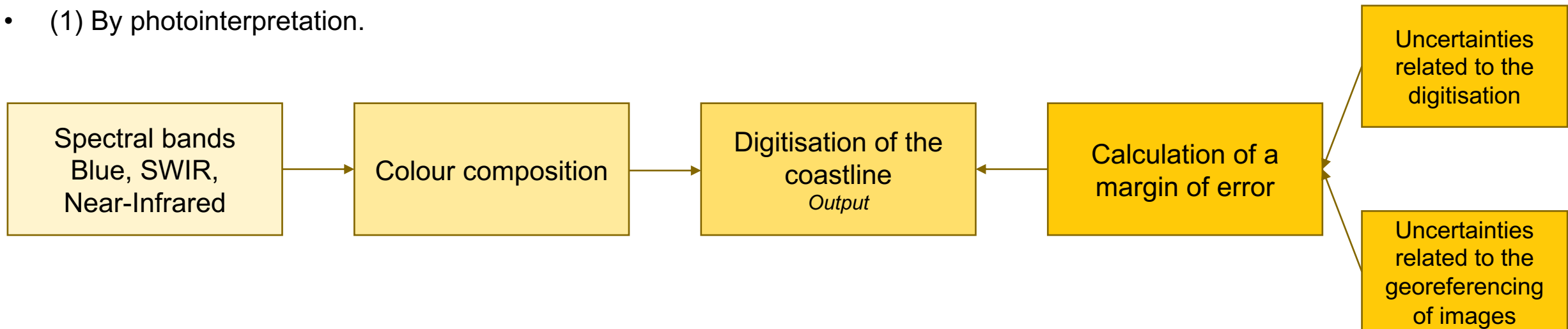


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2 methods of coastline extraction

- (2) By transformation and enhancement of satellite images.

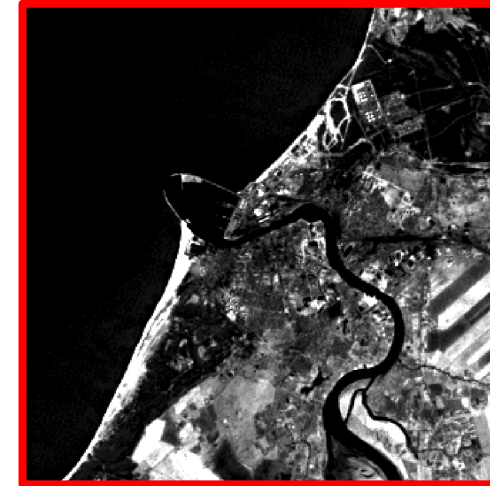
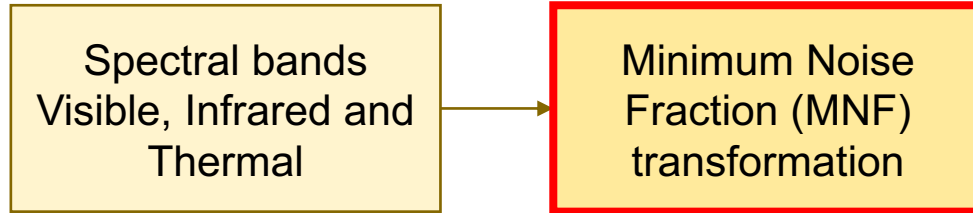
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Spectral bands
Visible, Infrared and
Thermal

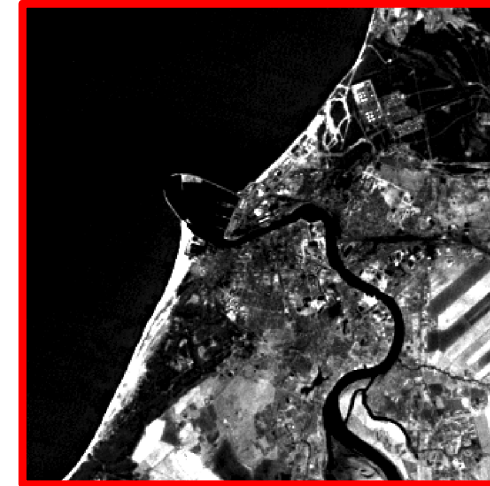
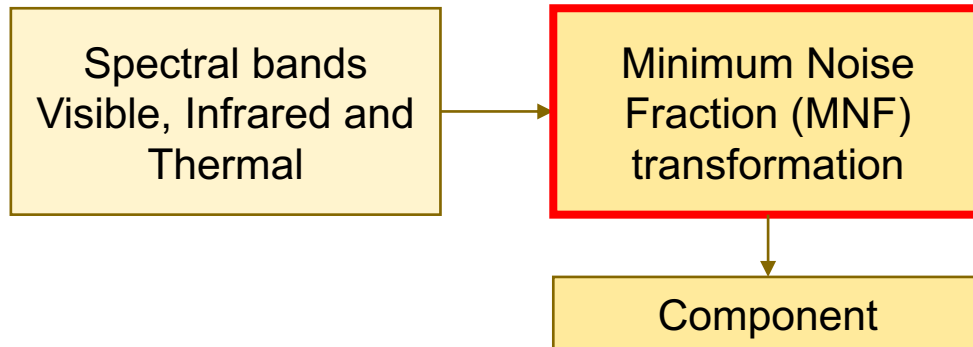
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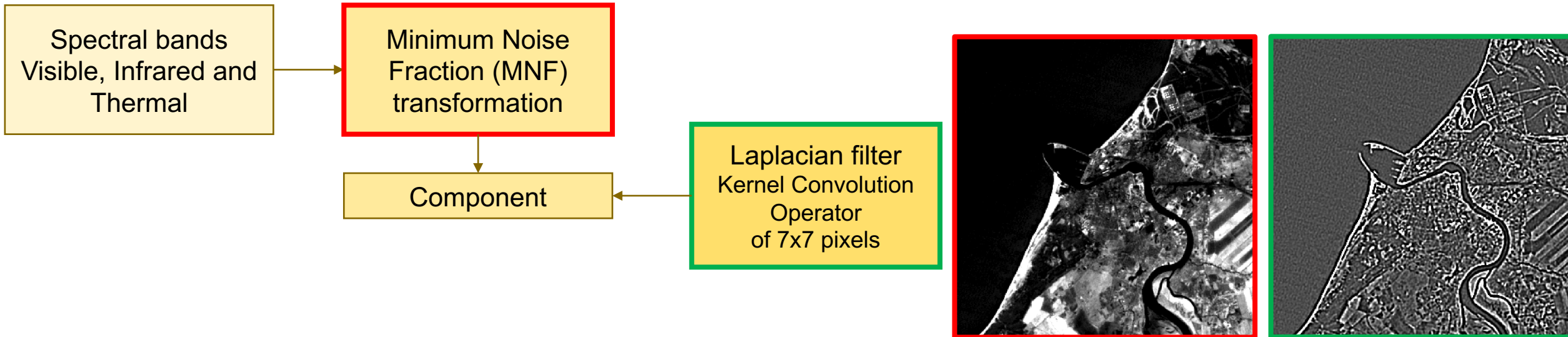
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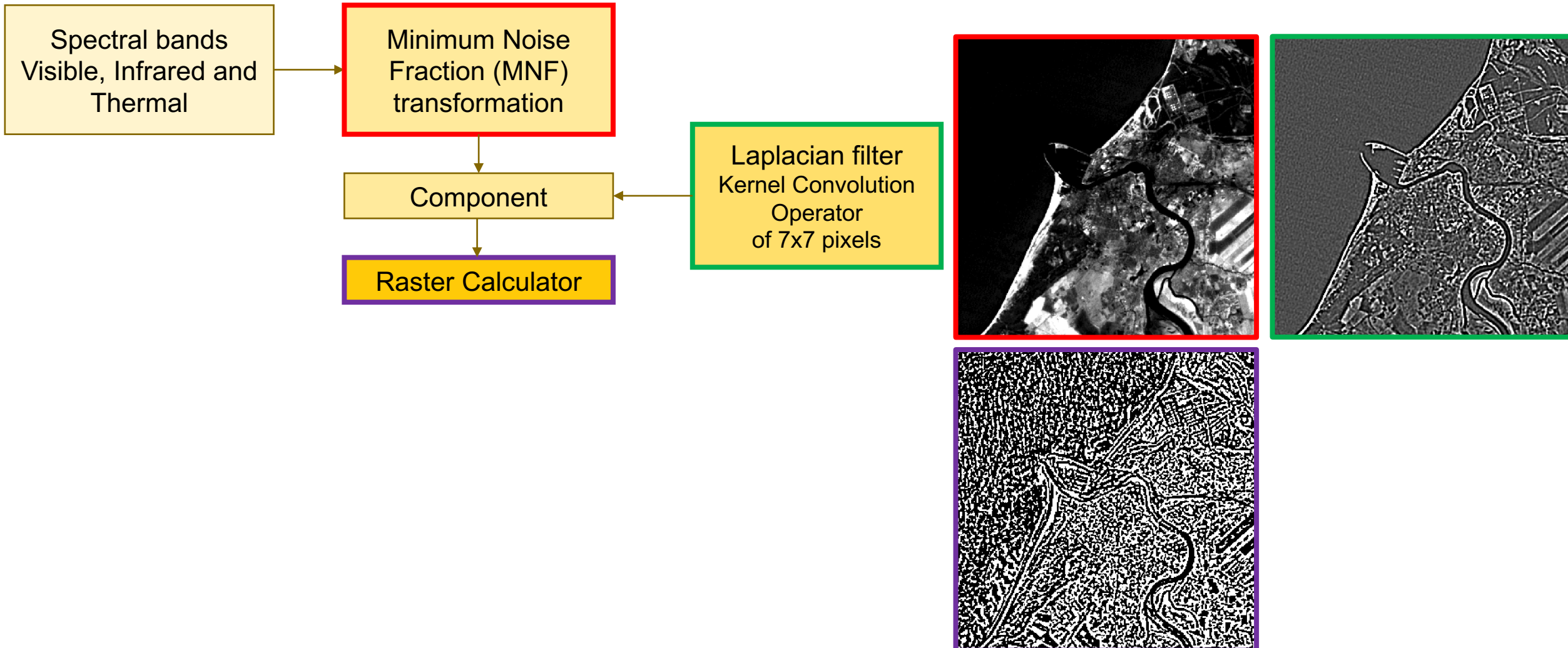
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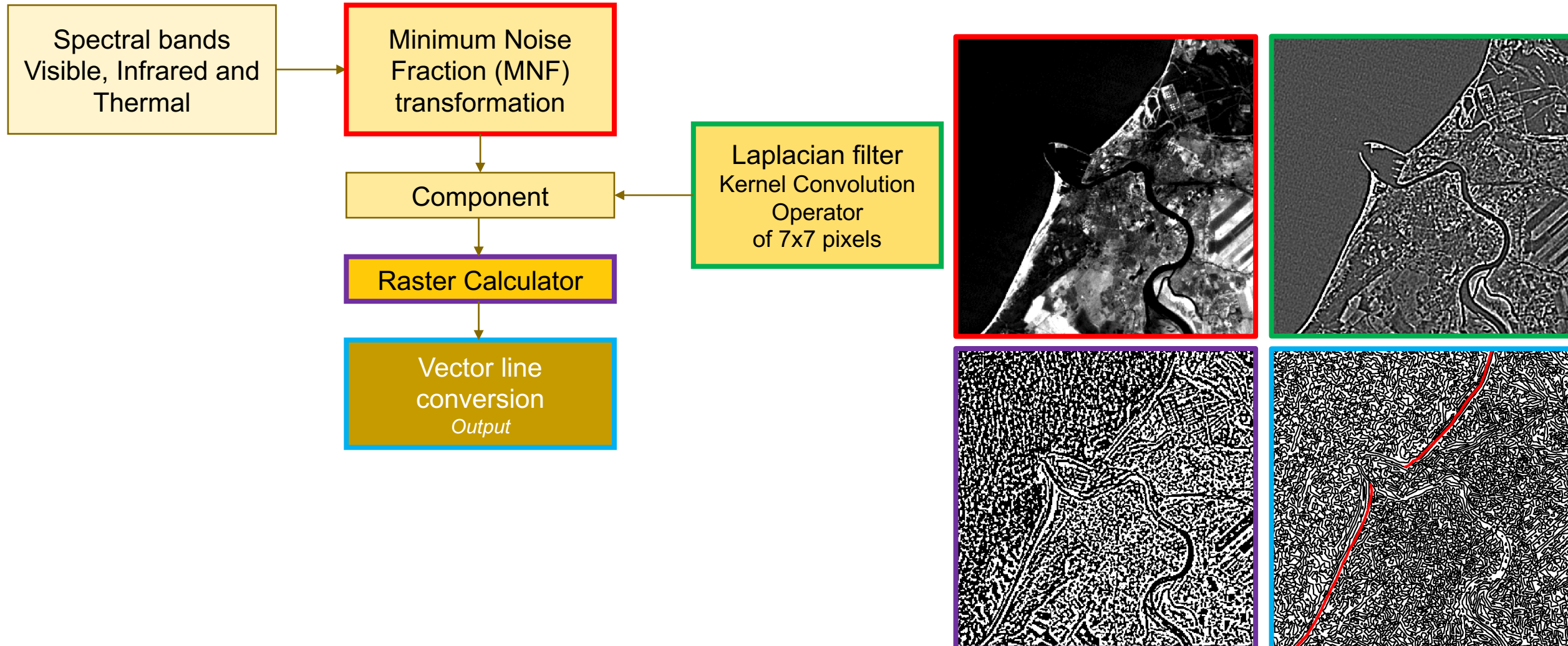
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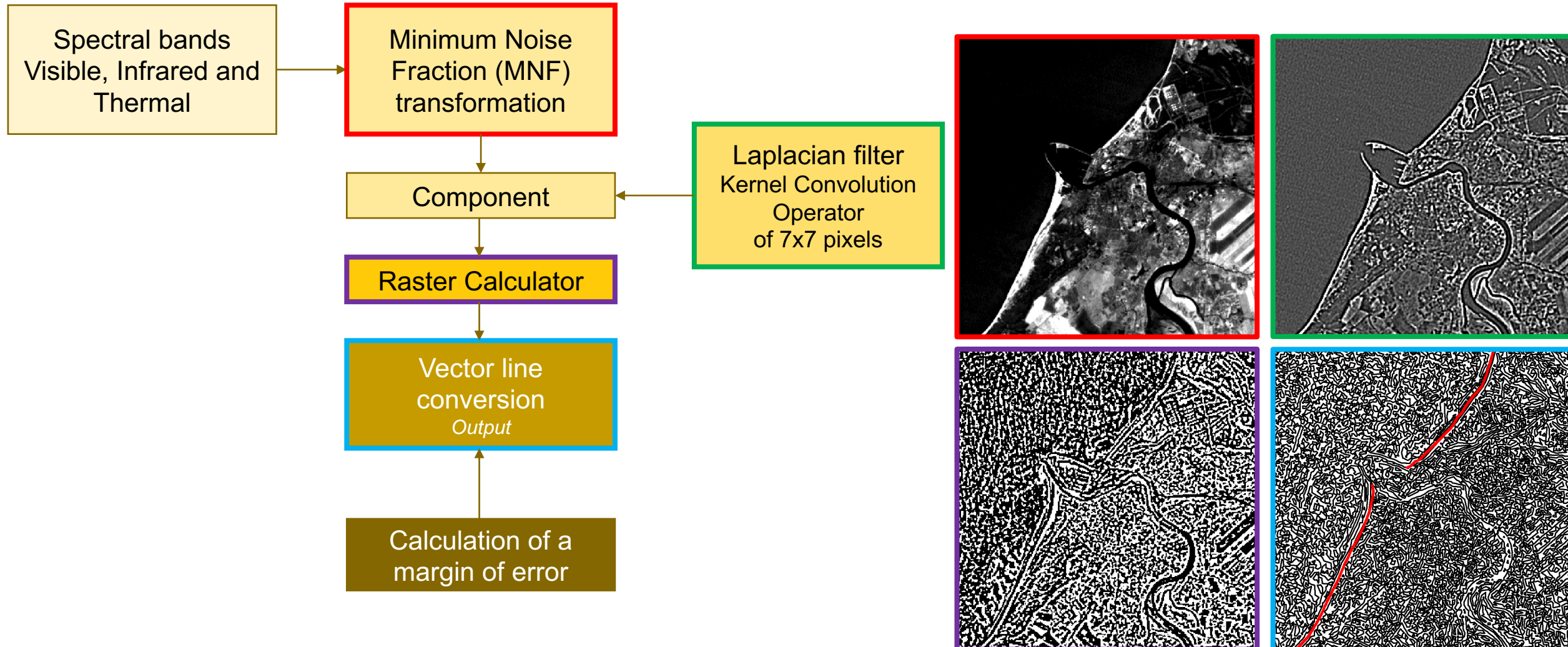
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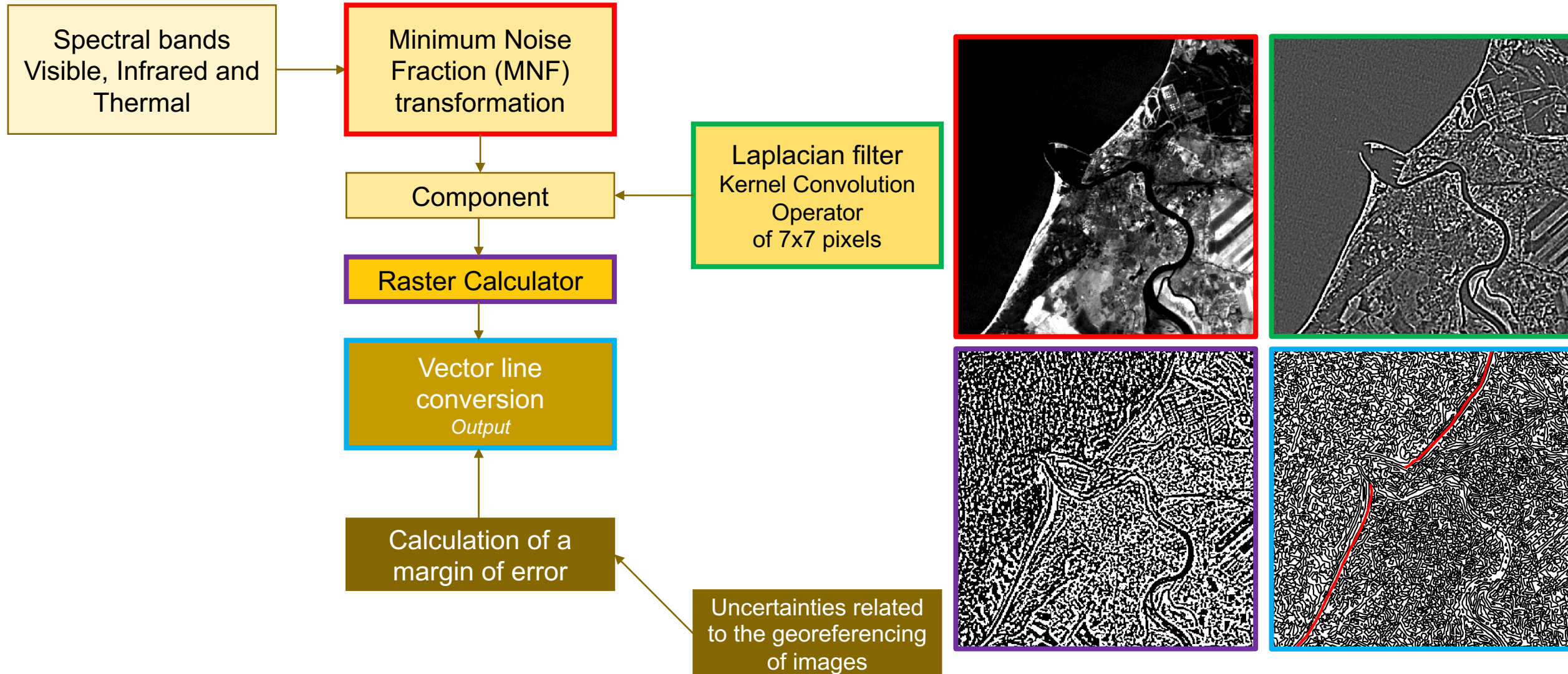
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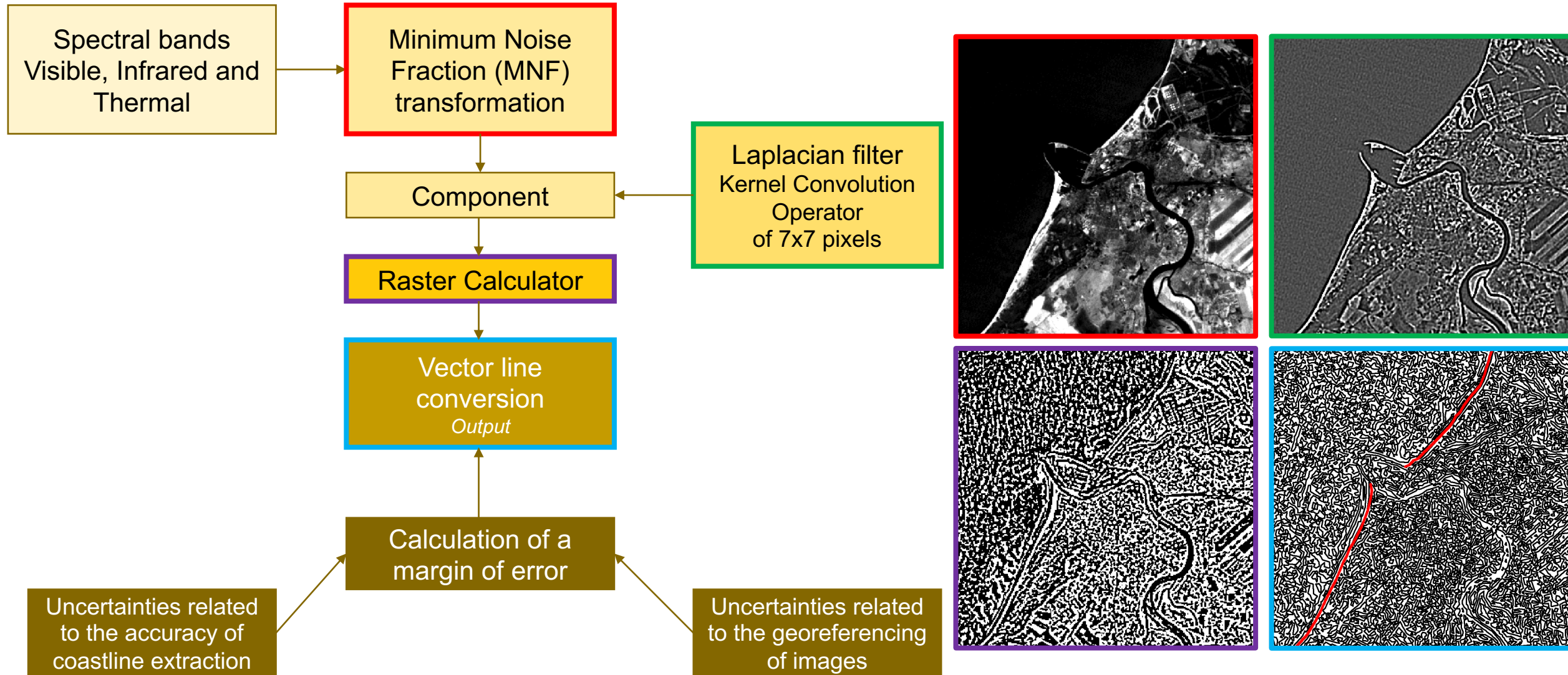
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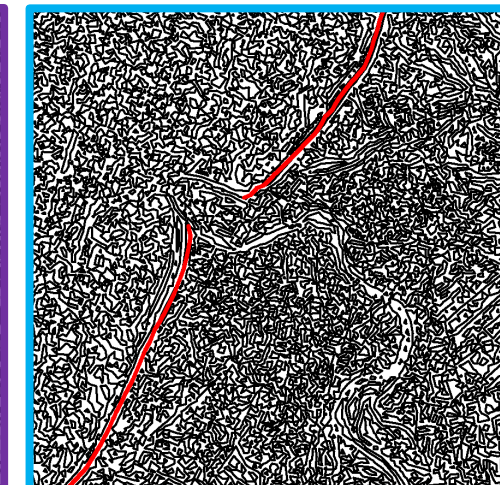
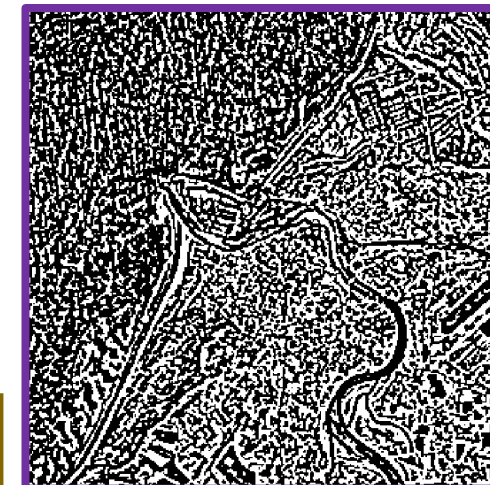
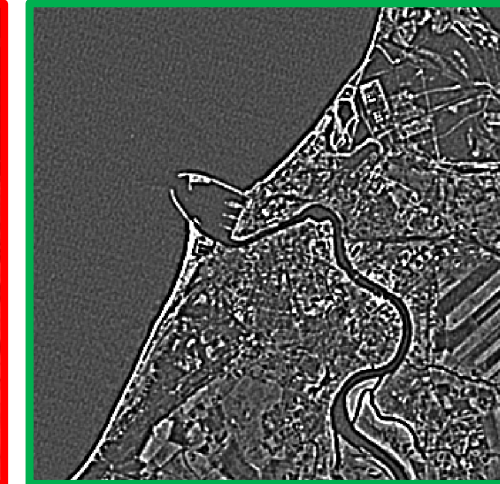
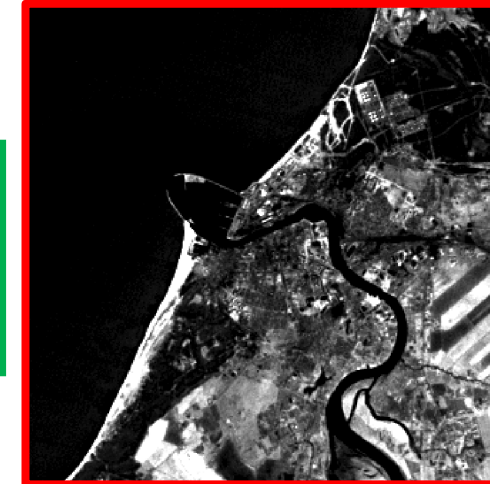
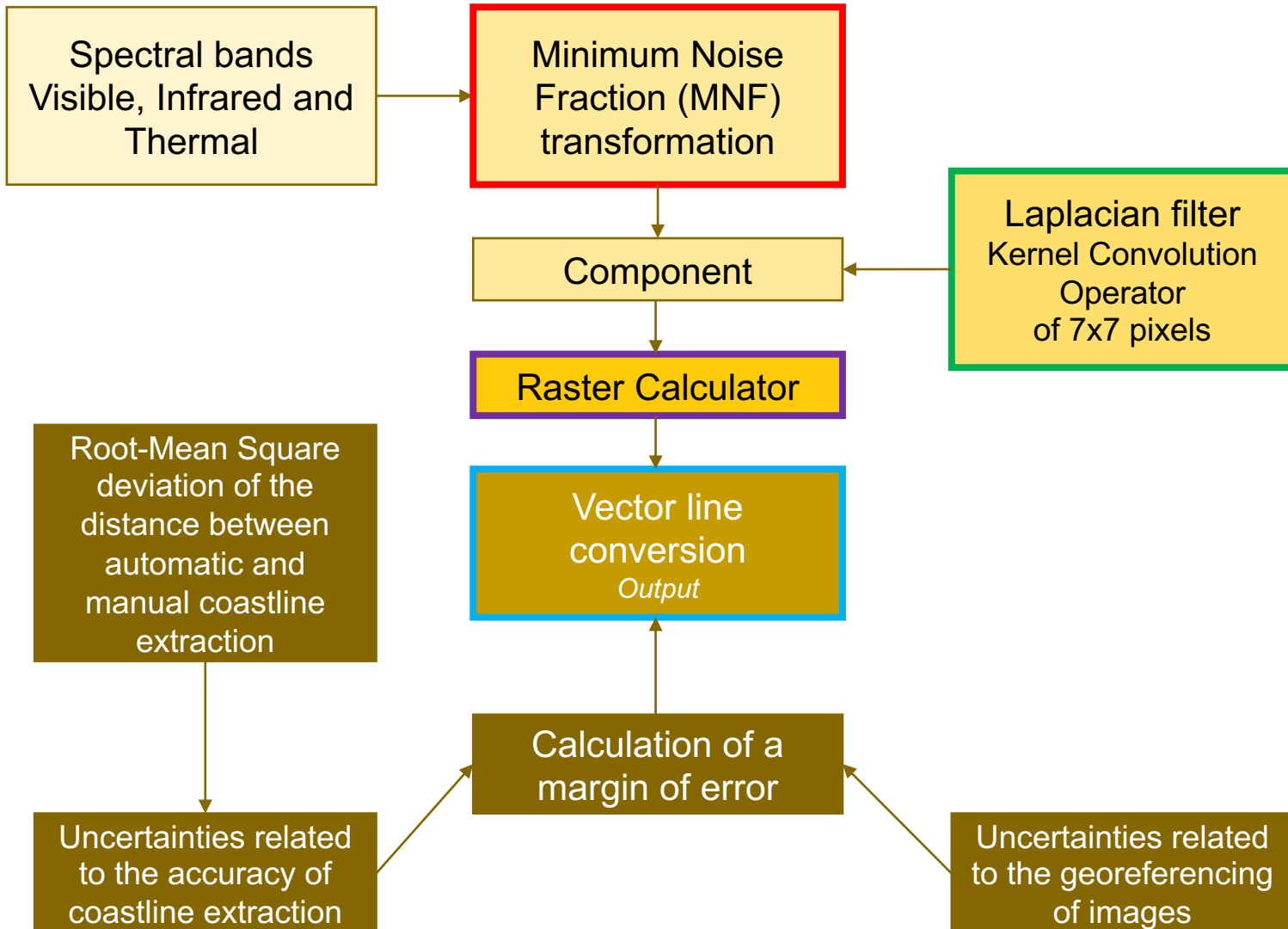
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Statistical analysis of historical shoreline variation

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- Use of the DSAS tool on ArcGIS for shoreline evolution calculations.

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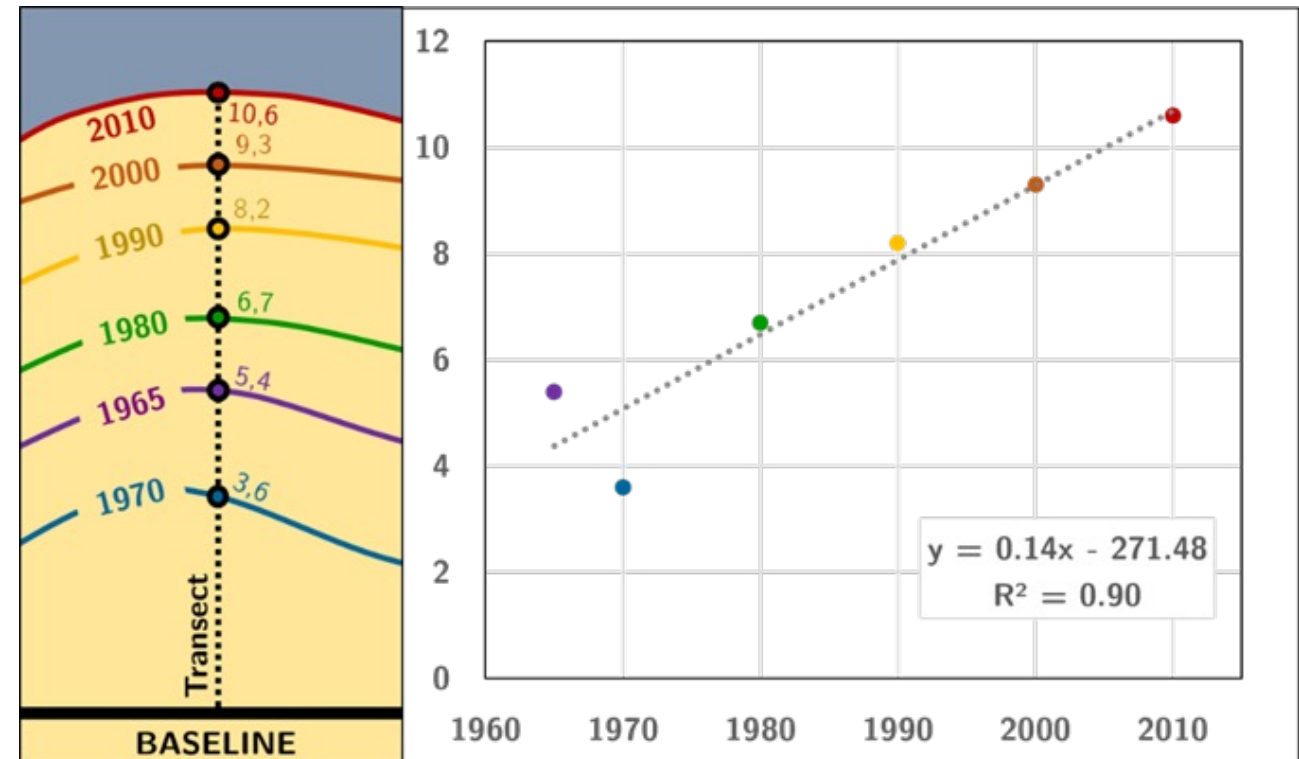
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Statistical analysis of historical shoreline variation

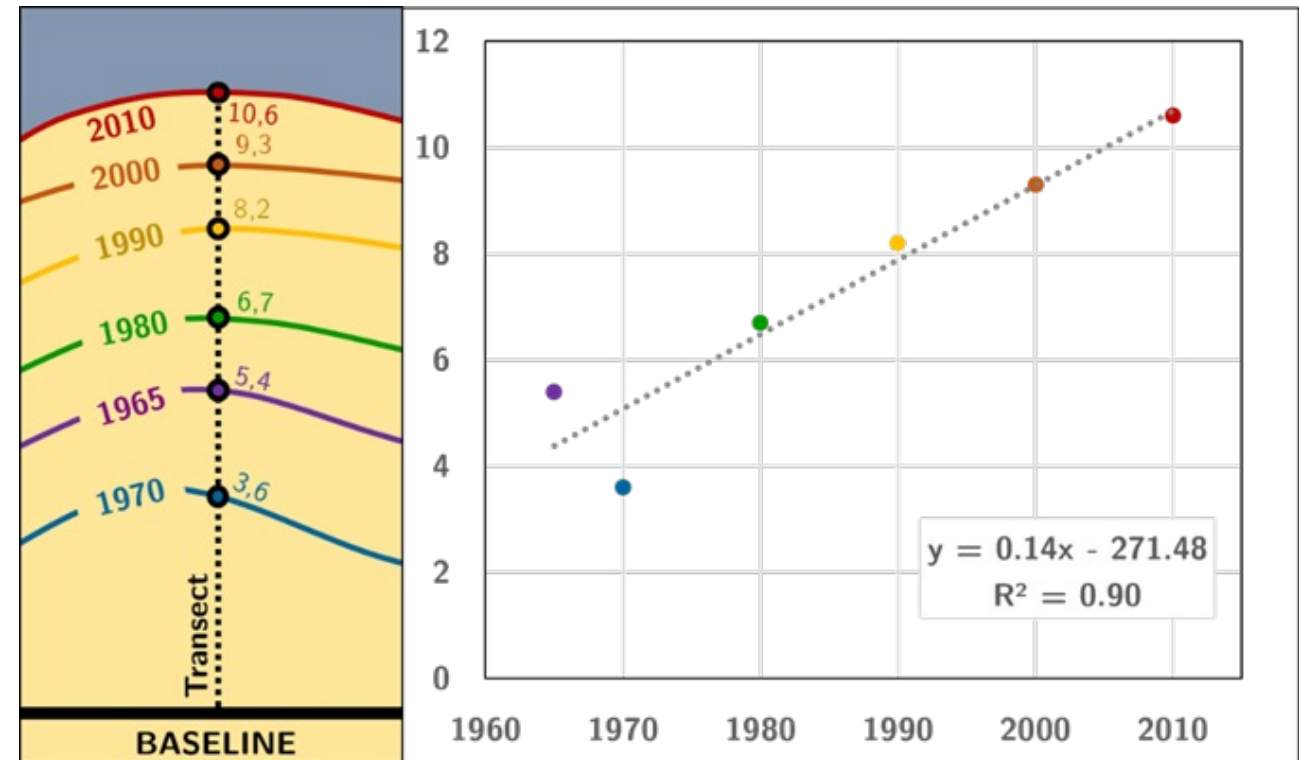
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Thieler et al., 2018

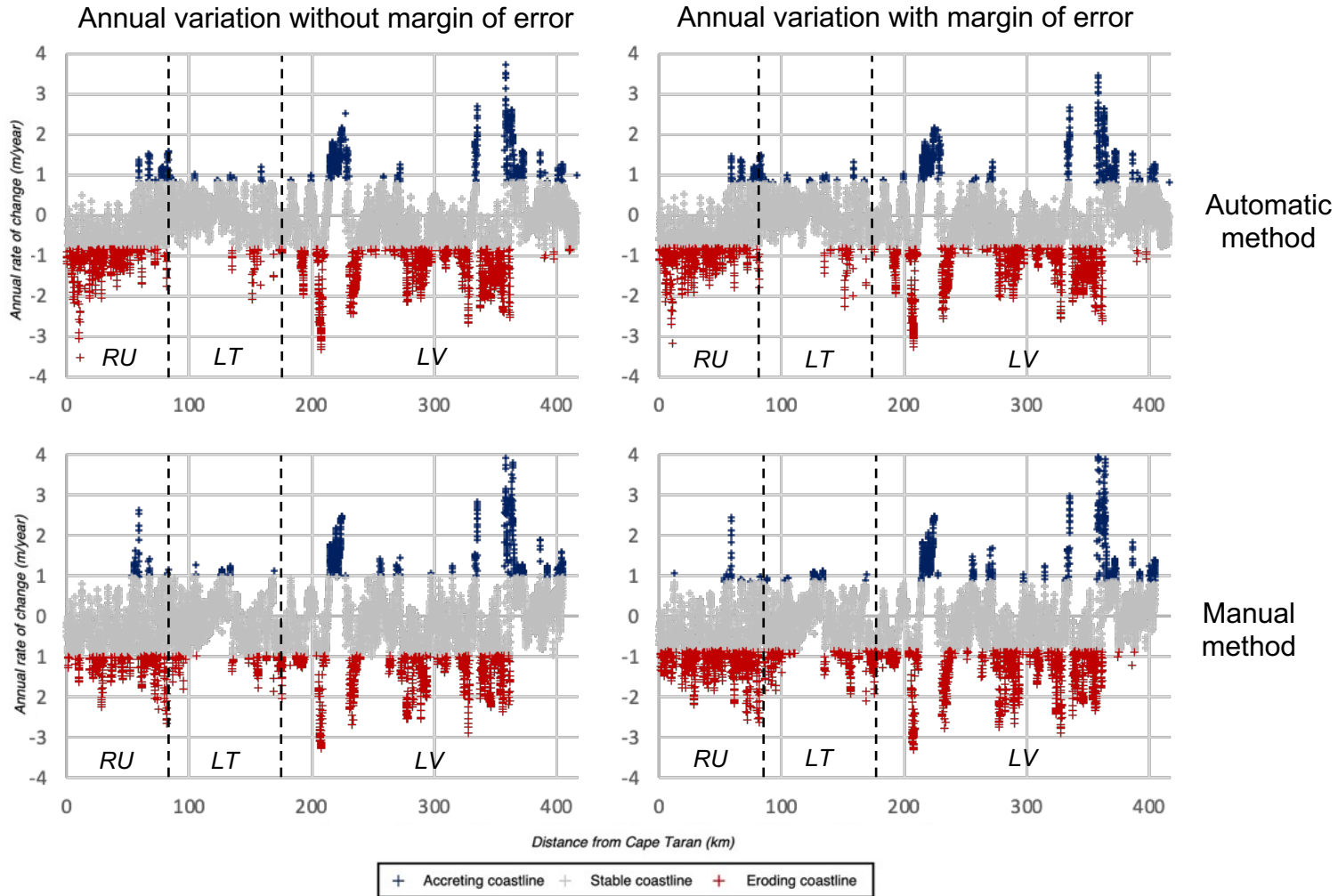
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- Weight Linear Regression: same principle but considering margins of error in the calculation.



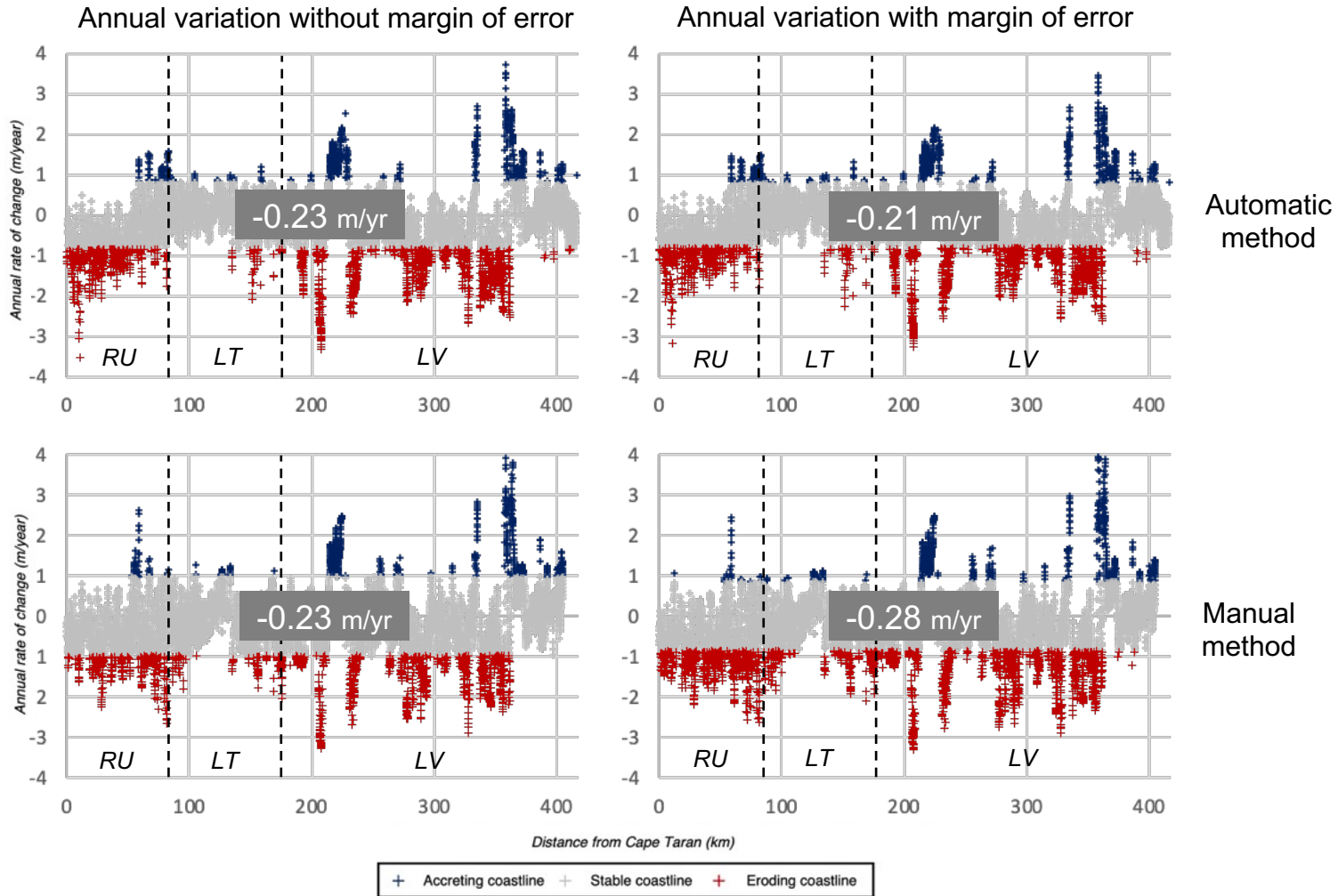
Thieler et al., 2018

An intra-period evolution characterised by a great stability of the coastline

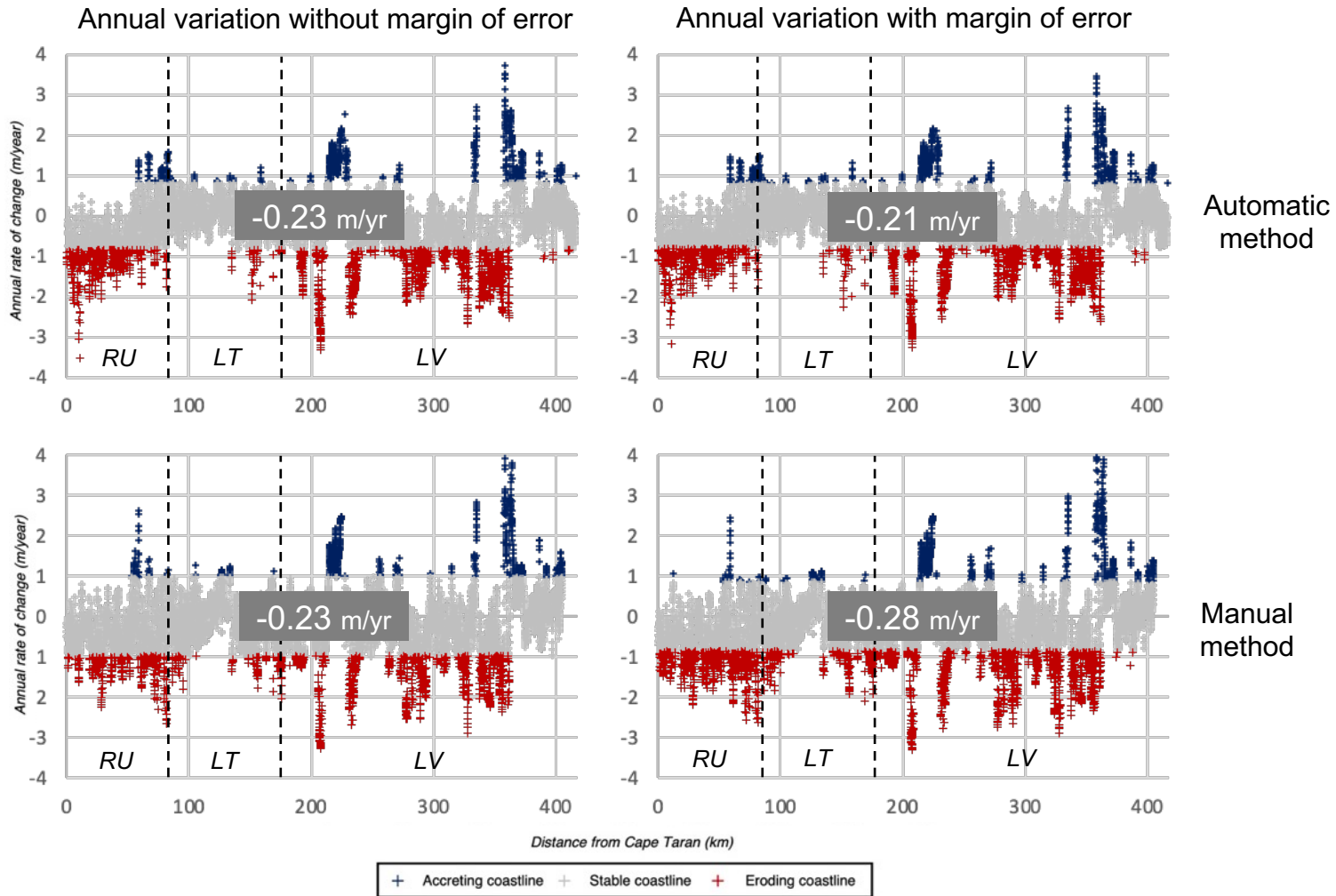


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- Between 1988 and 2018, the south-eastern Baltic coast is characterised by overall stability.

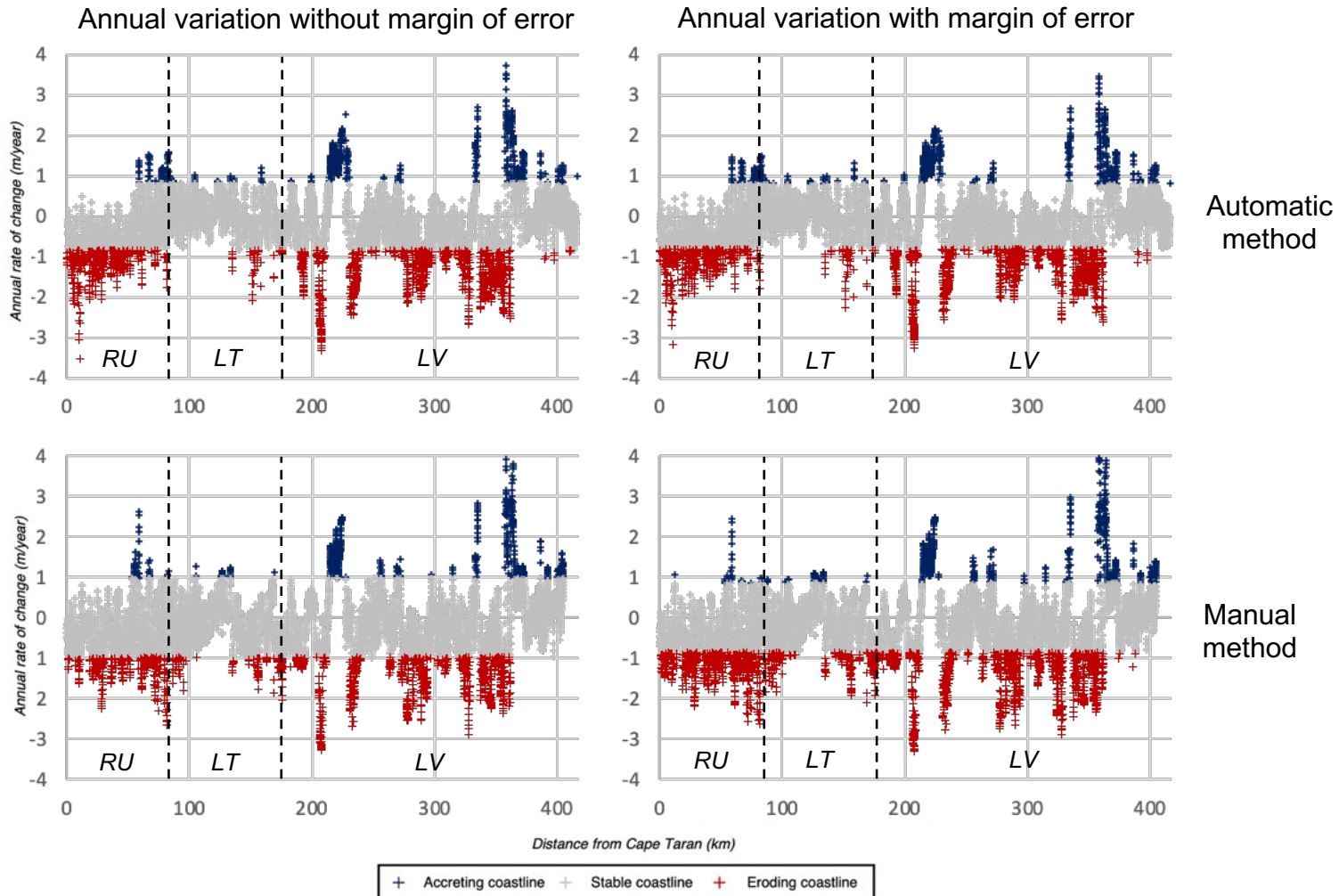


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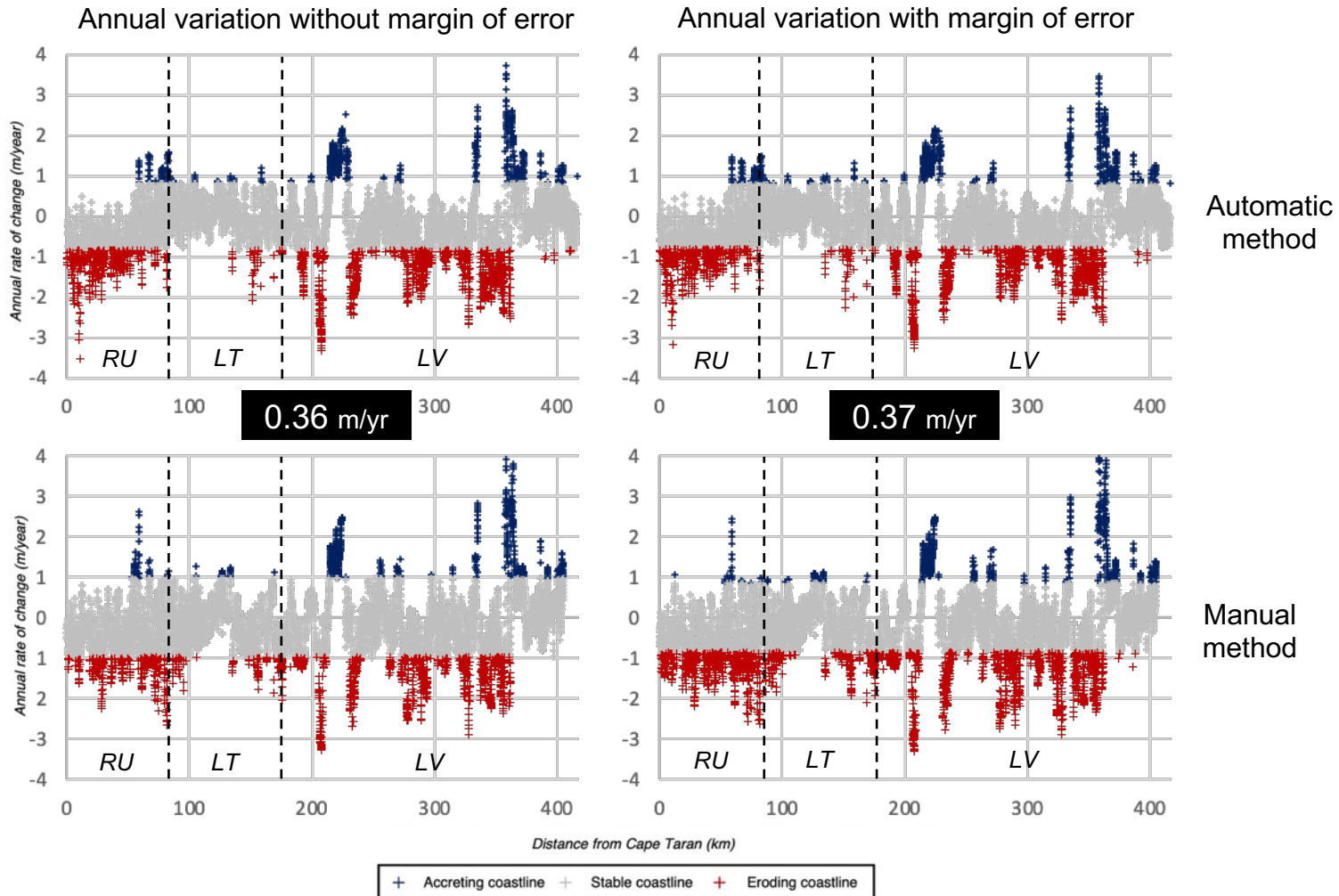
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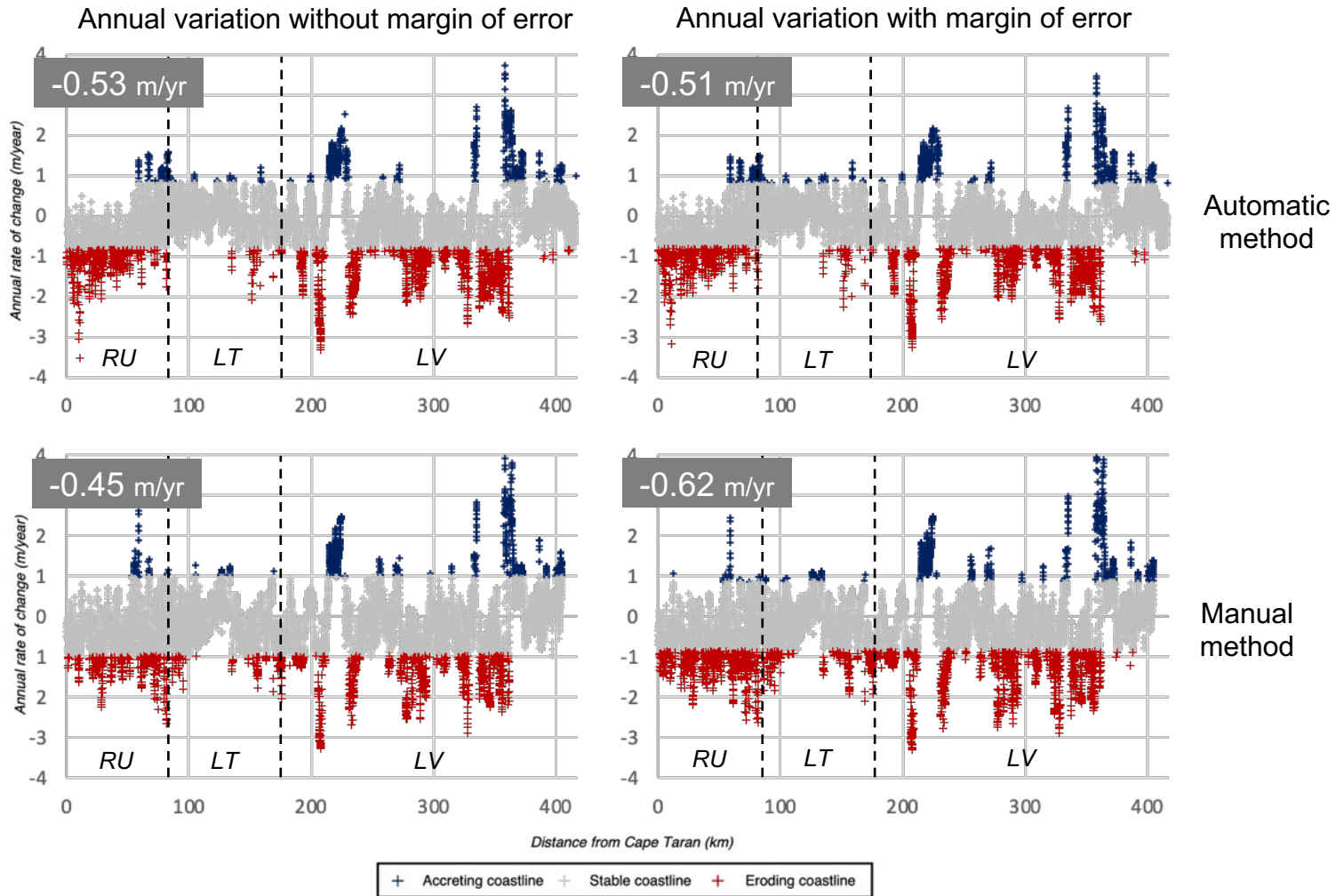
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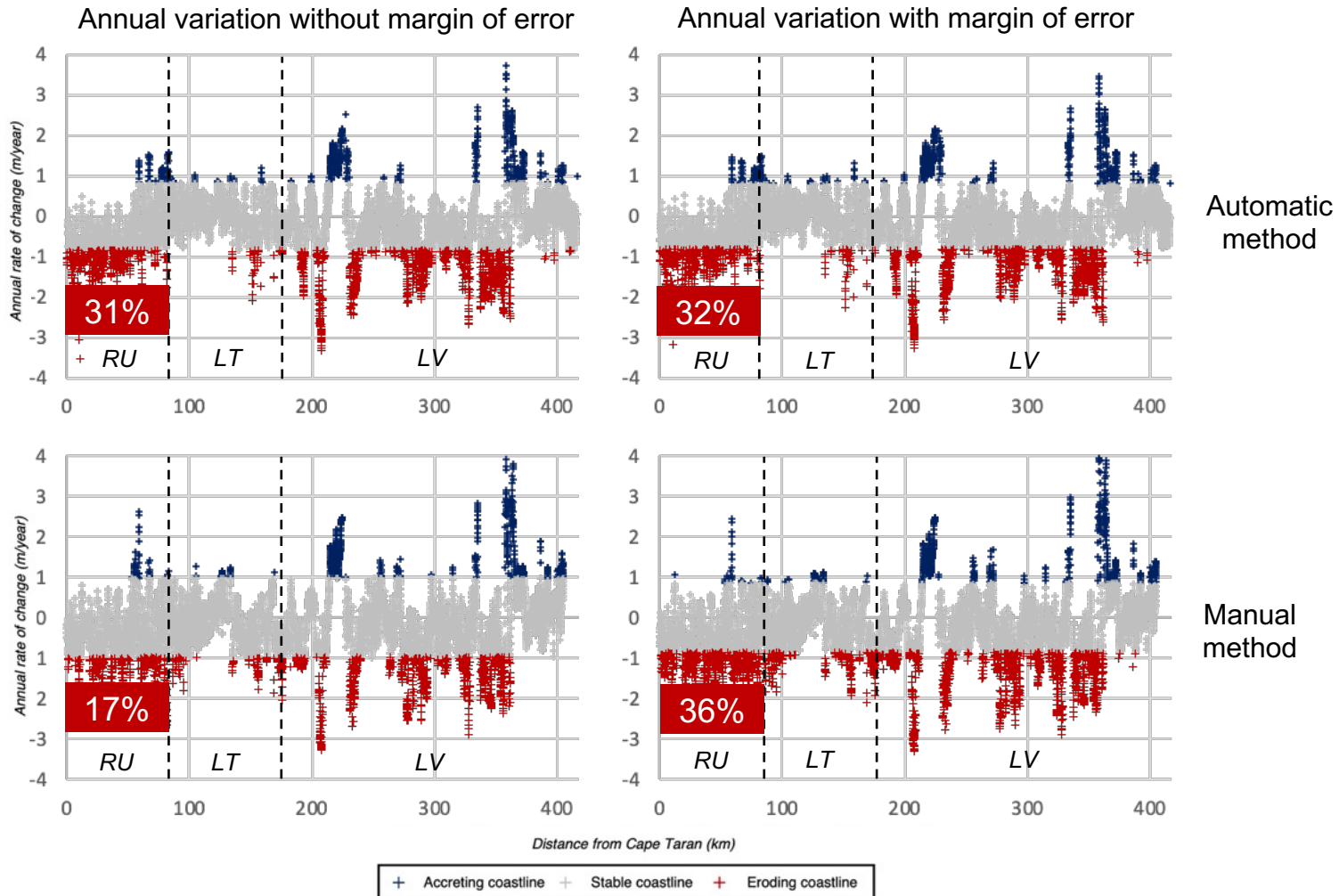
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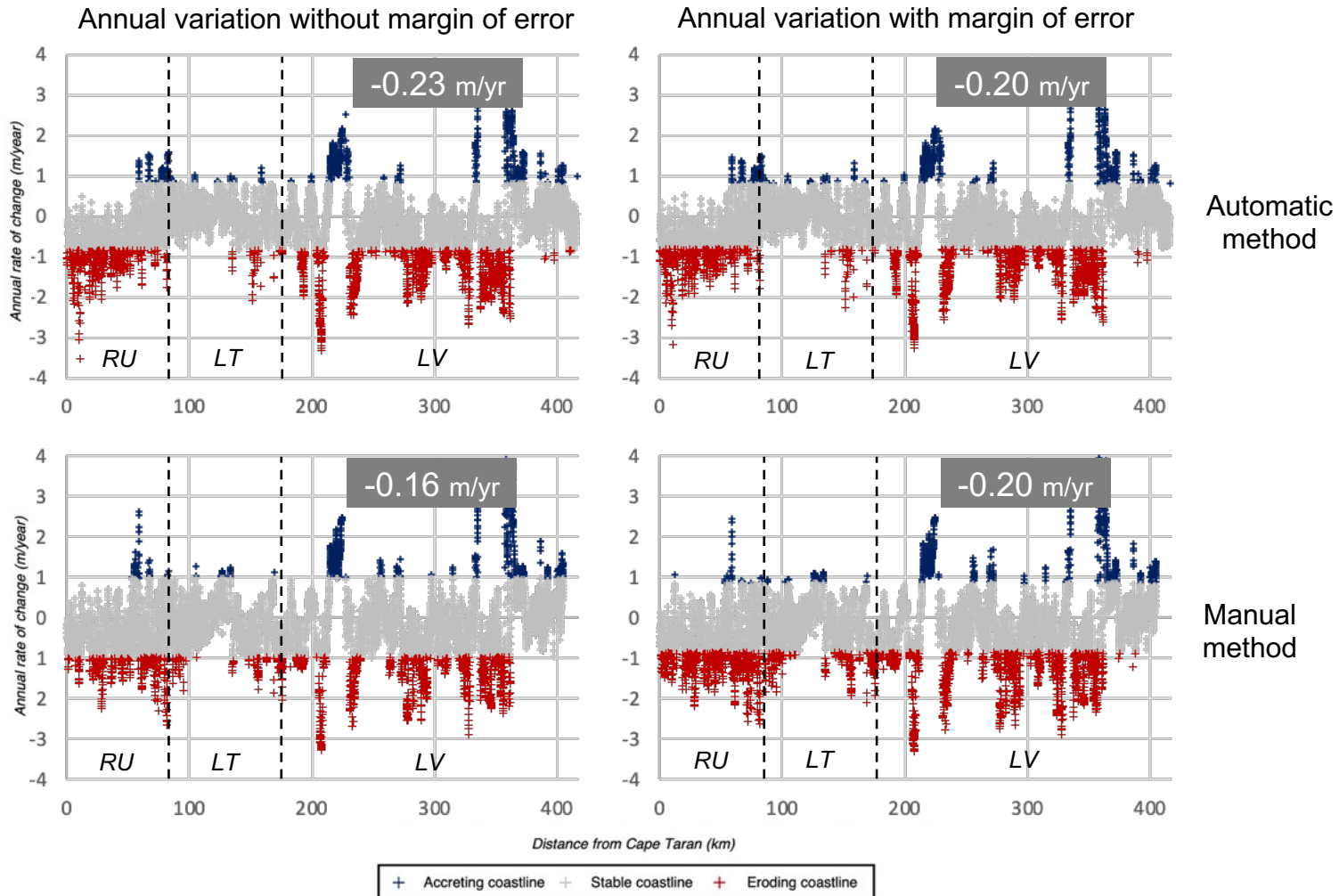
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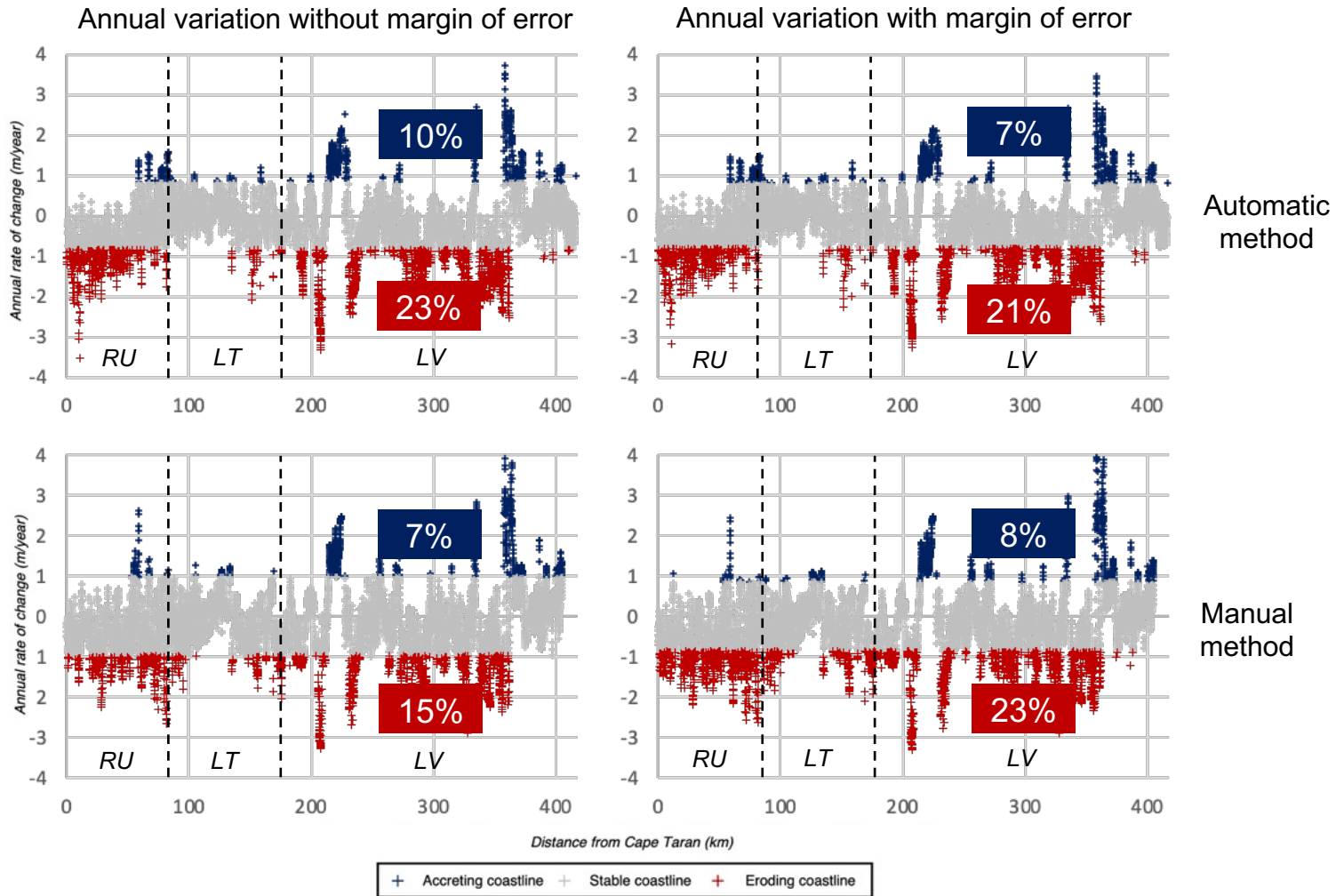
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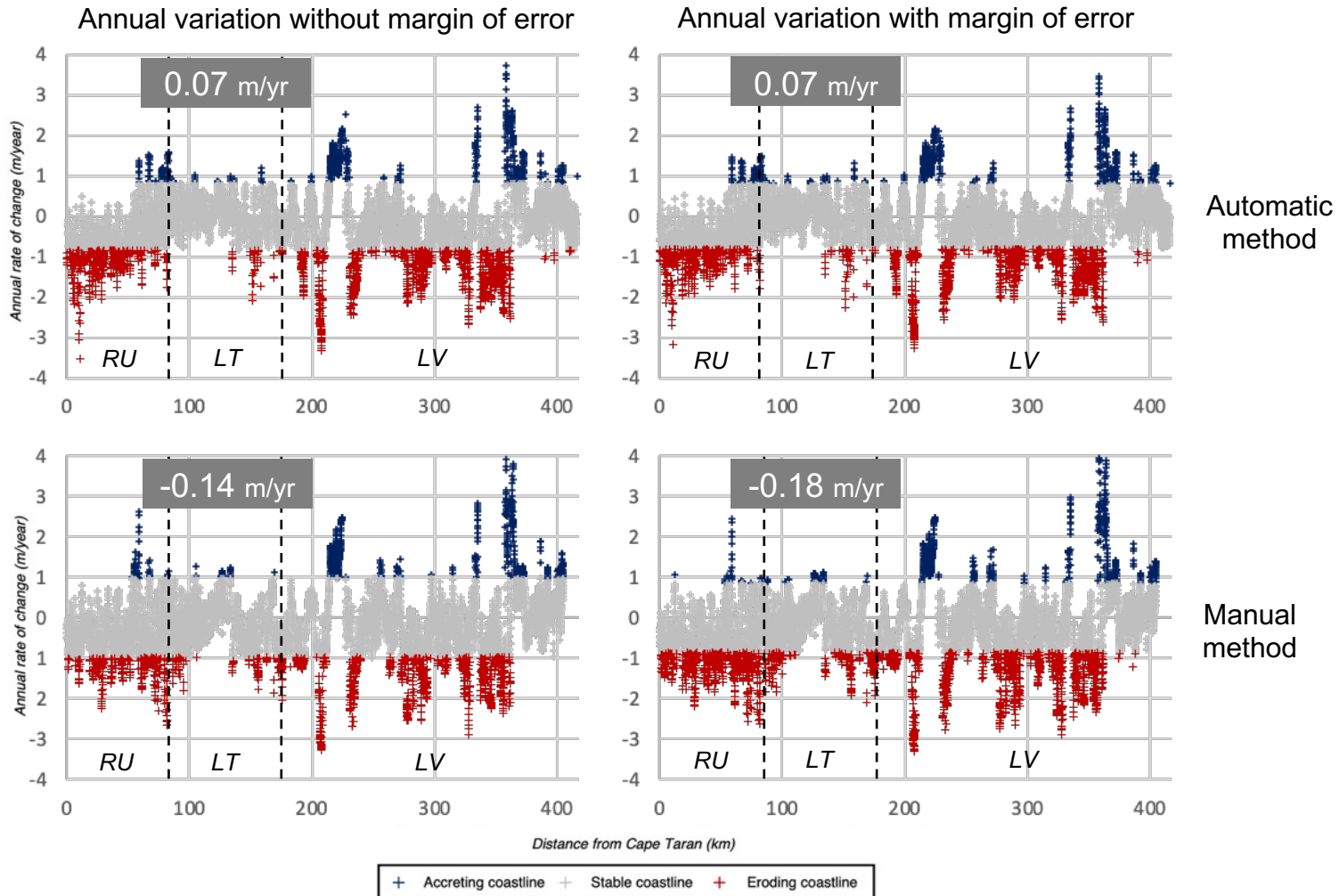
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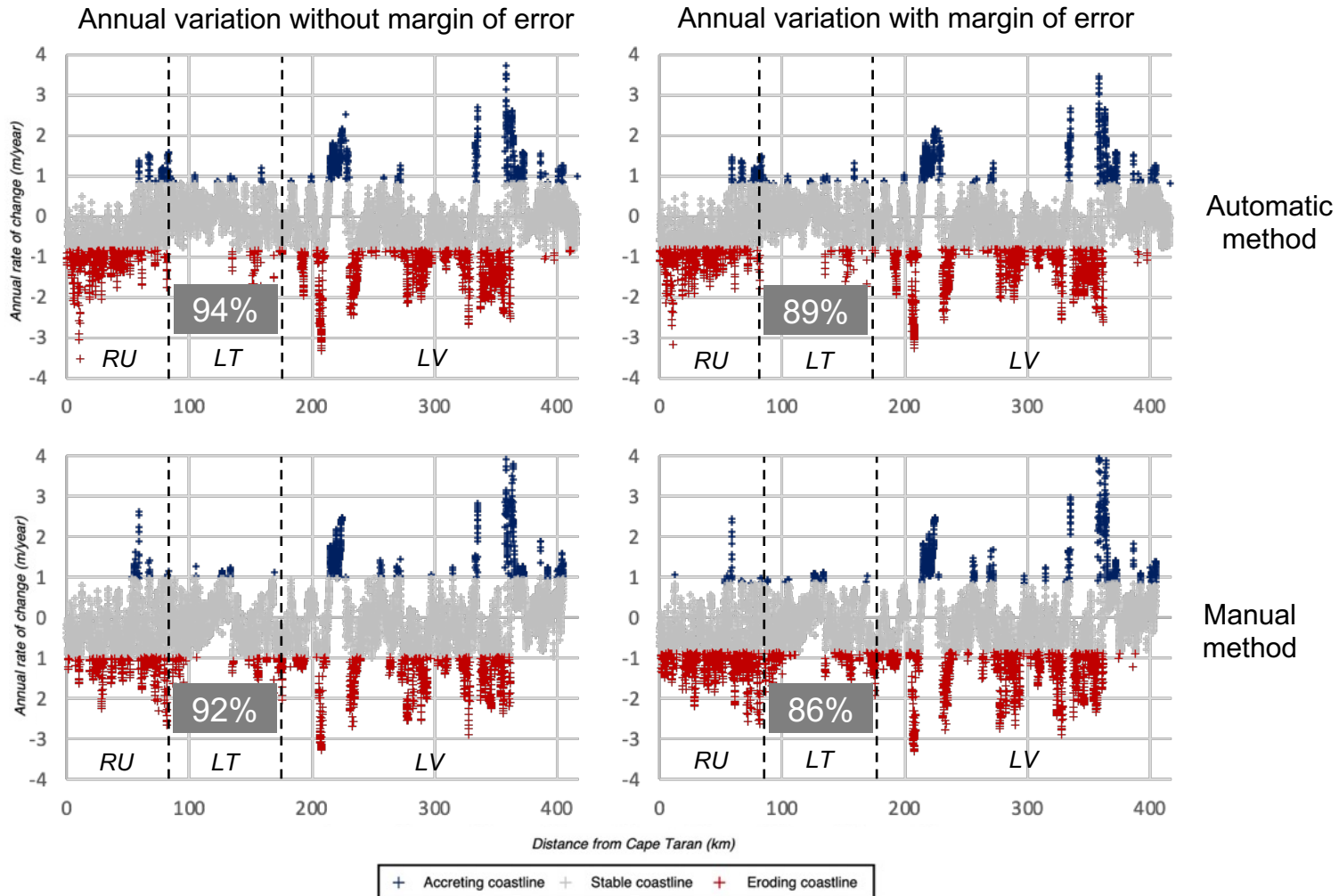
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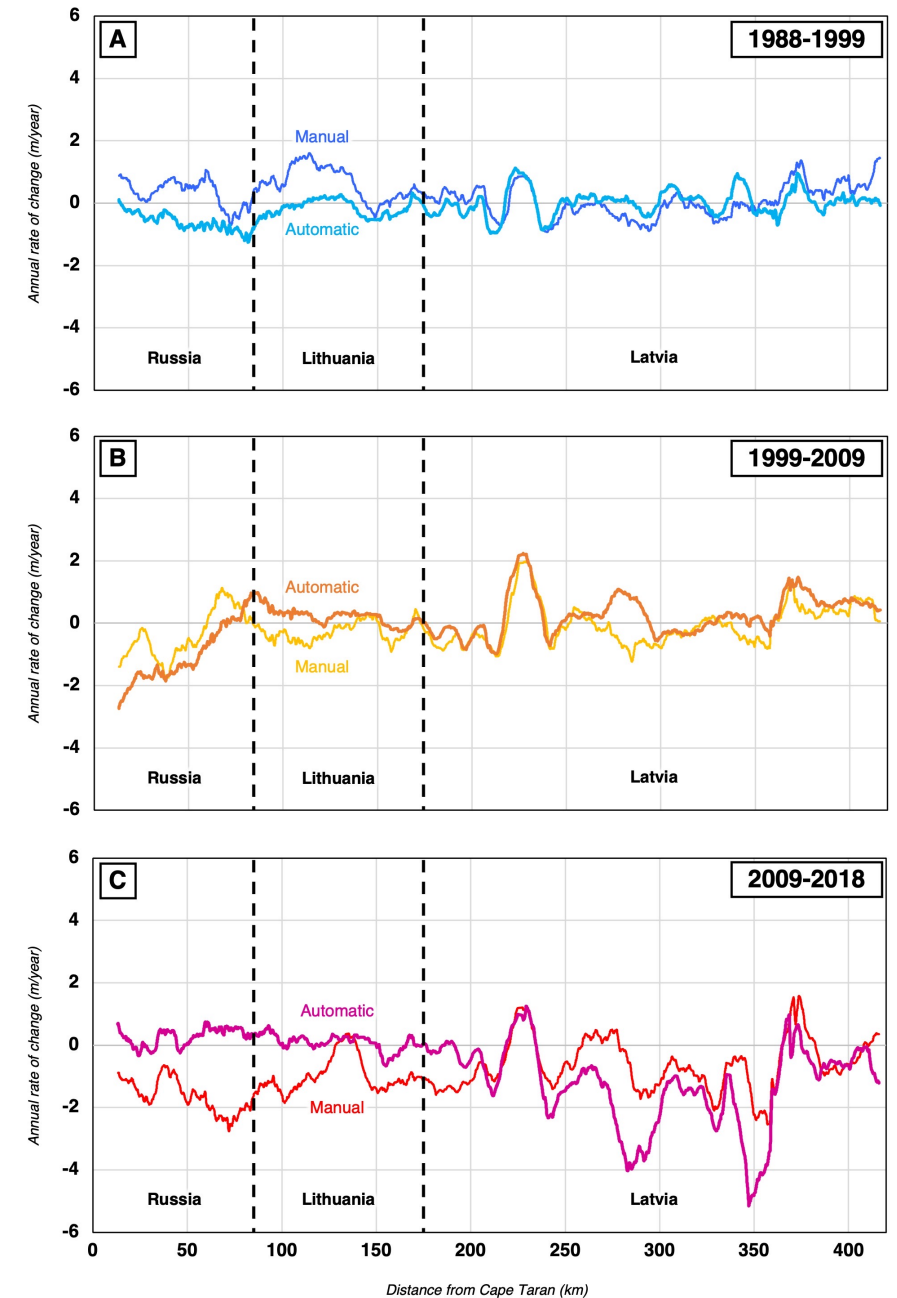
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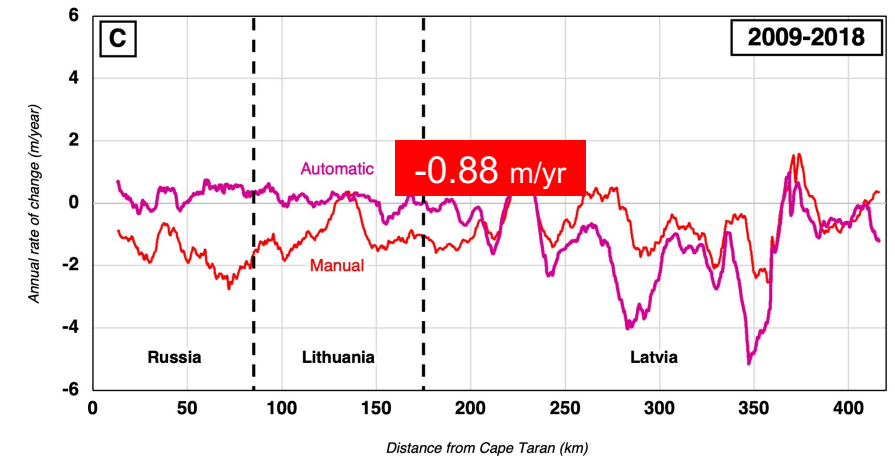
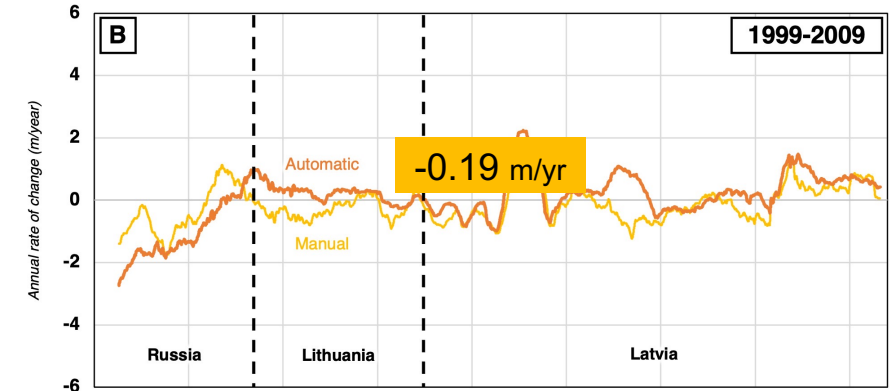
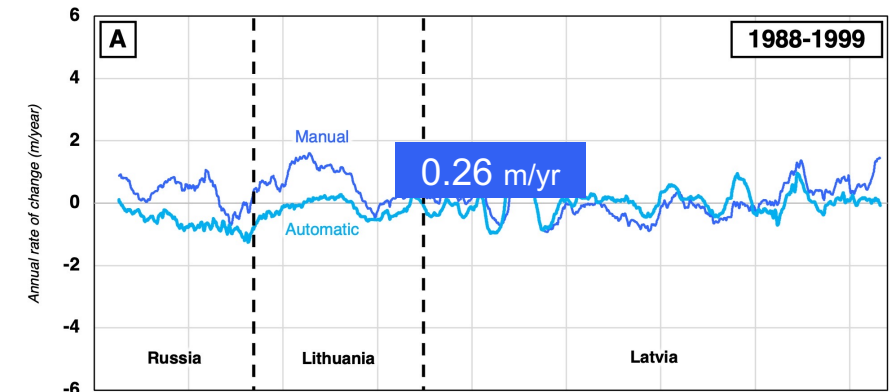
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An inter-period evolution with a regular alternation between accretion and erosion zones disturbed over time



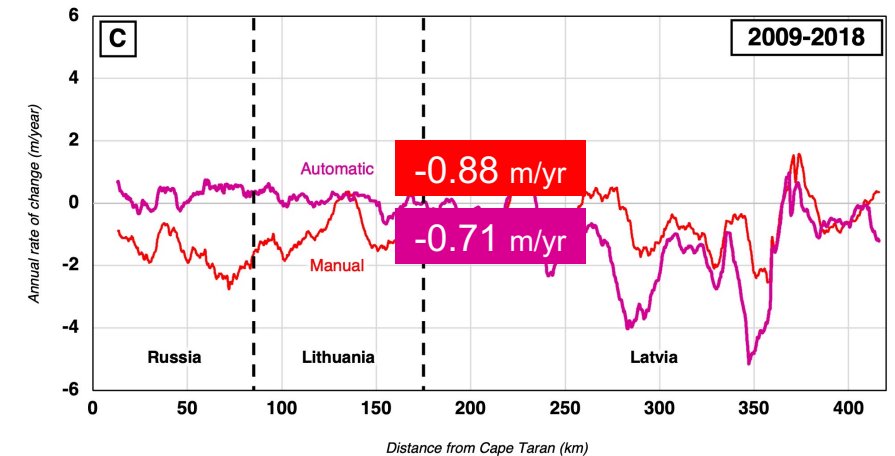
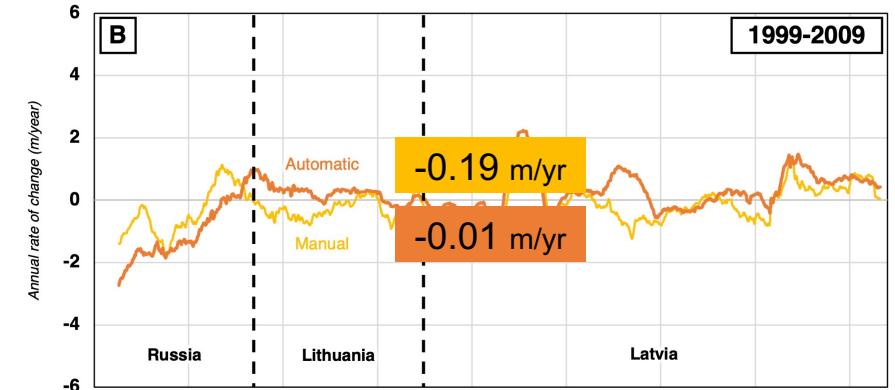
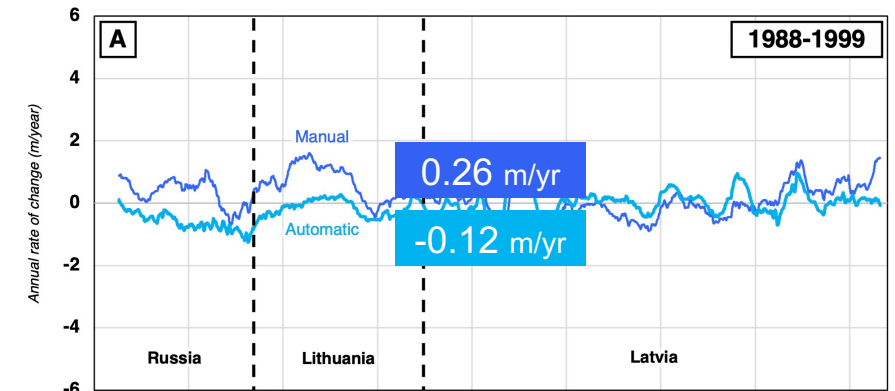
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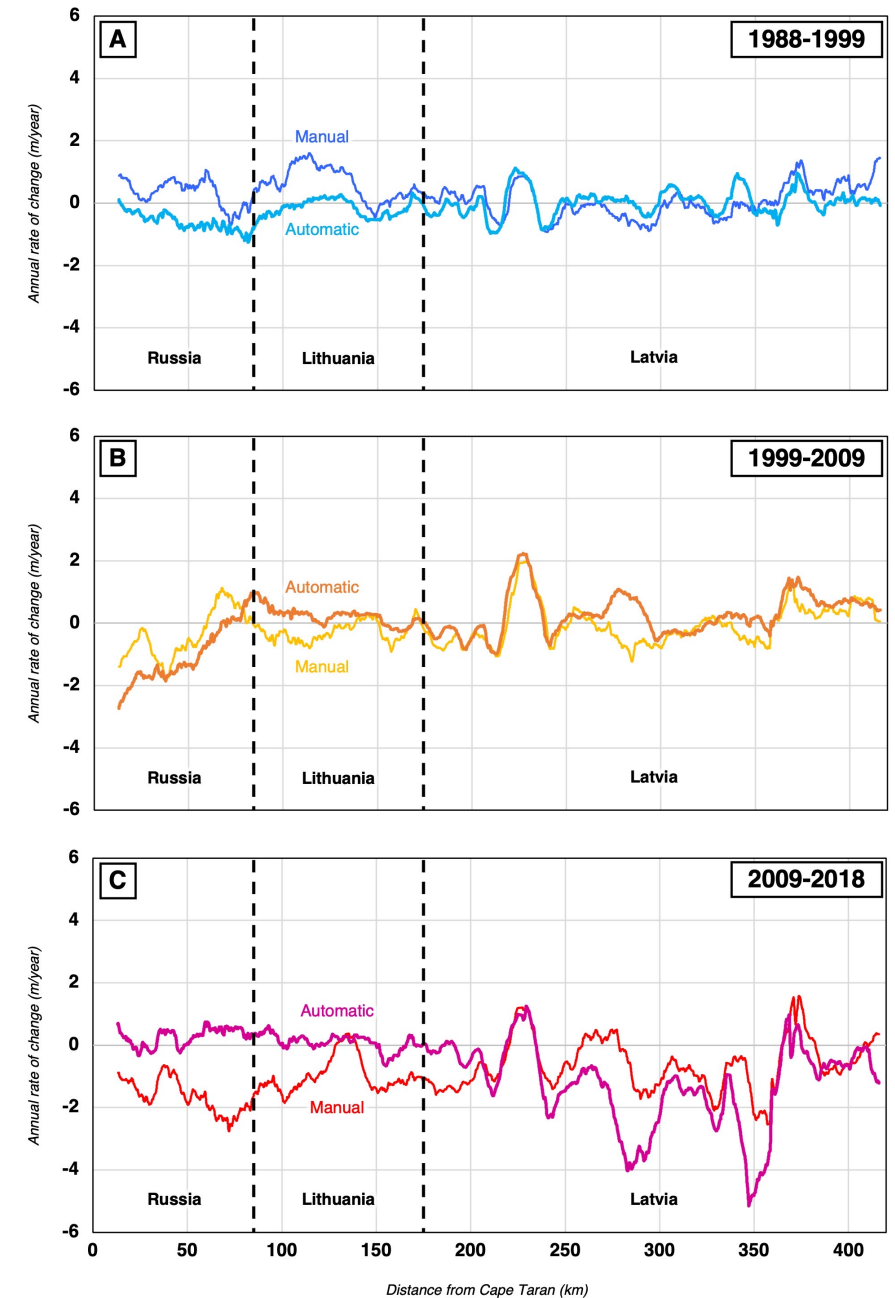
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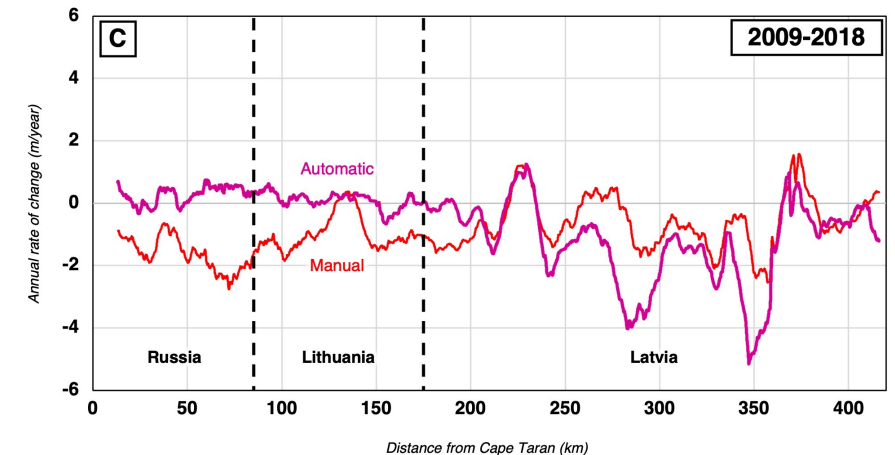
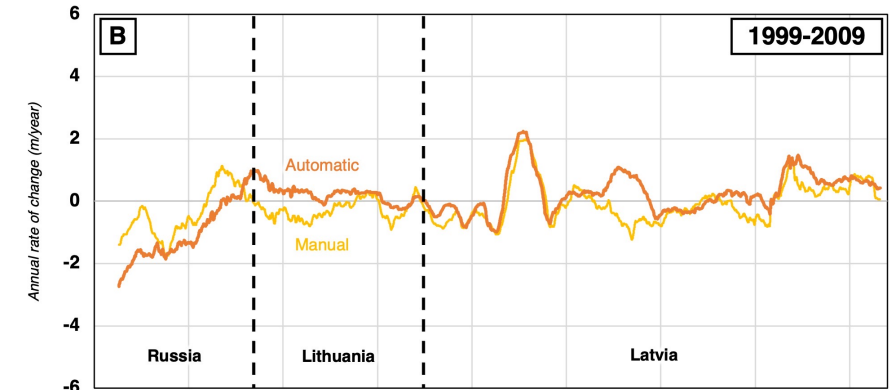
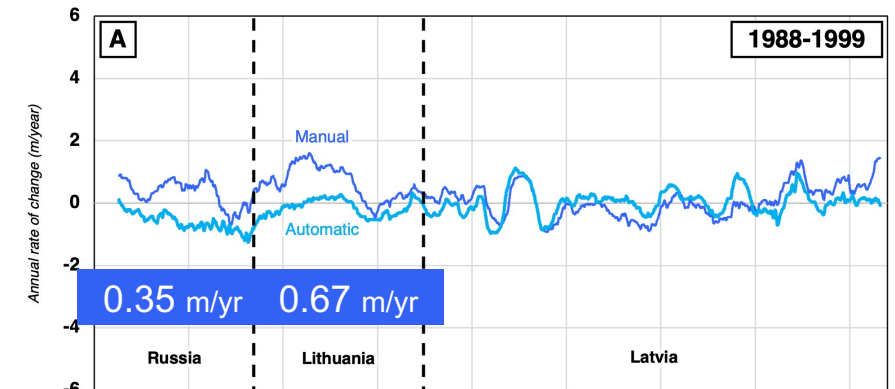
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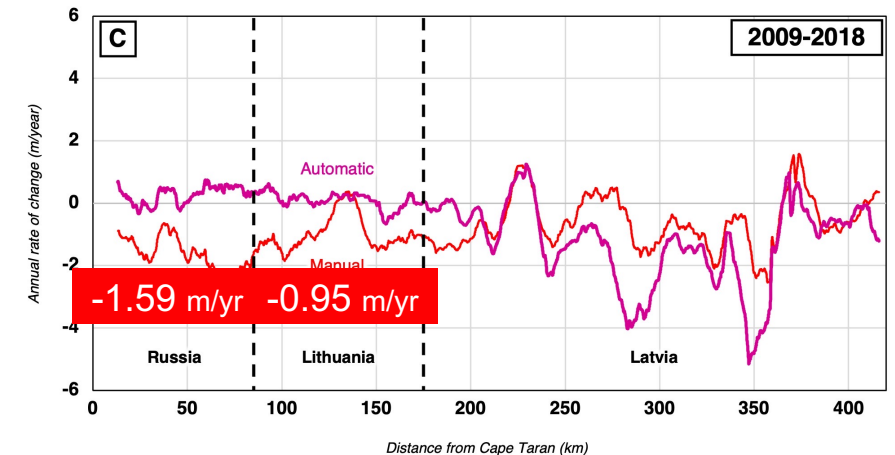
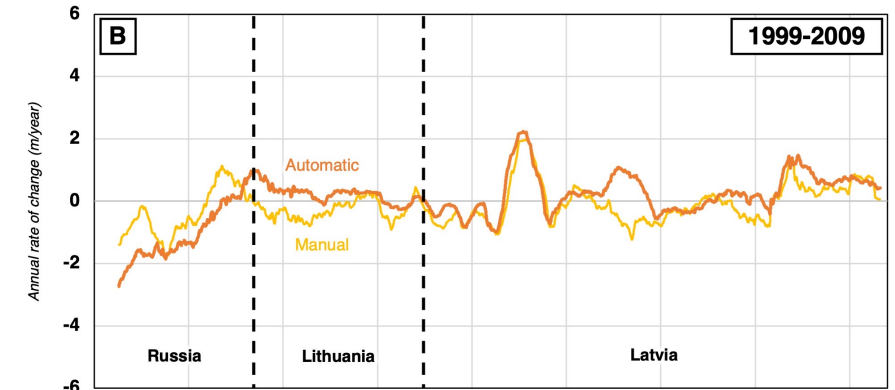
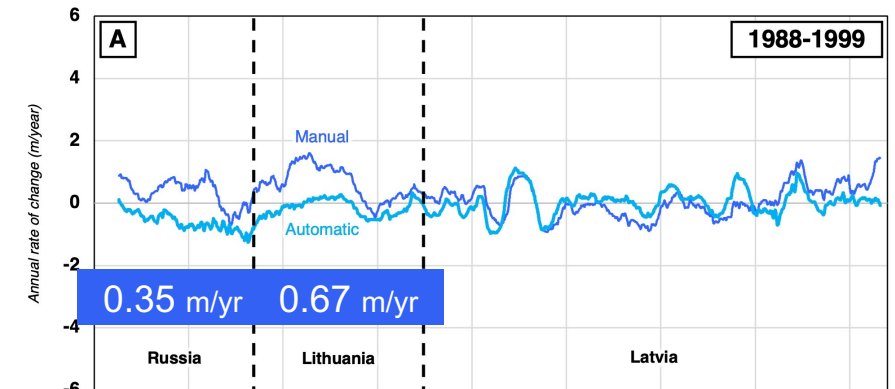
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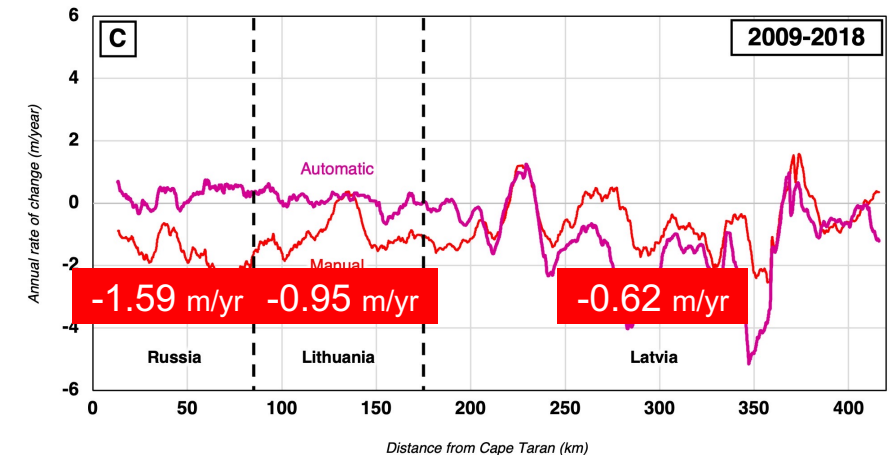
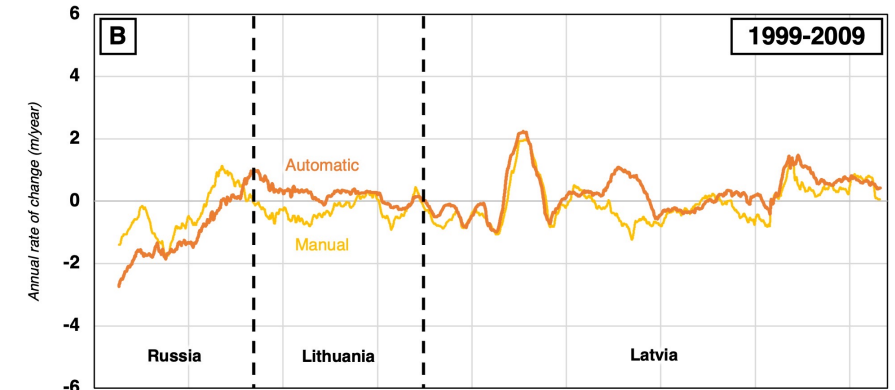
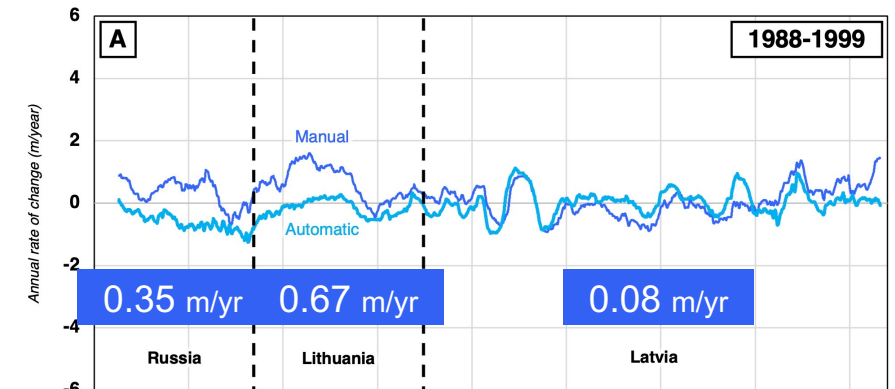
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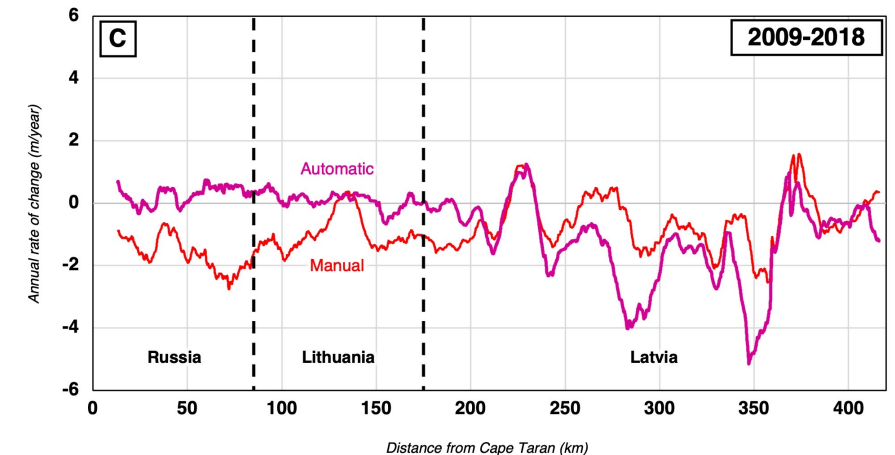
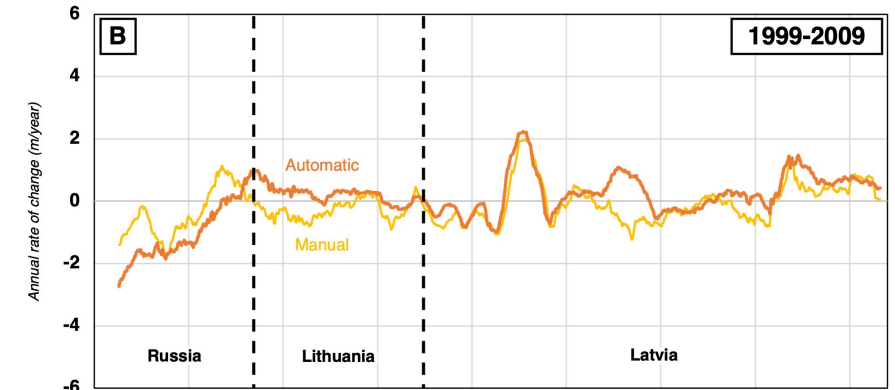
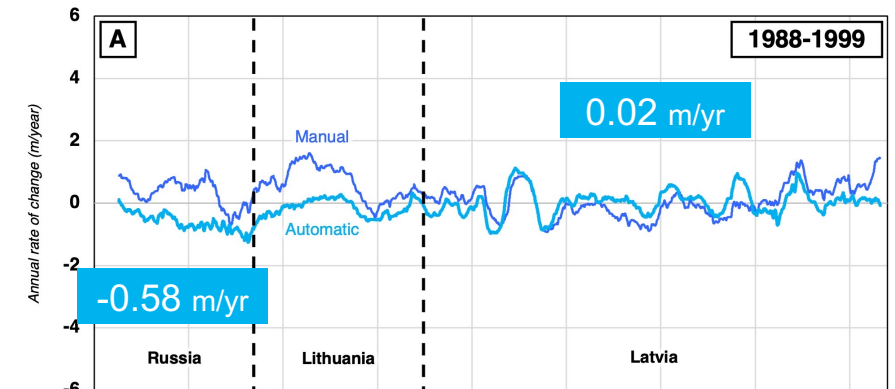
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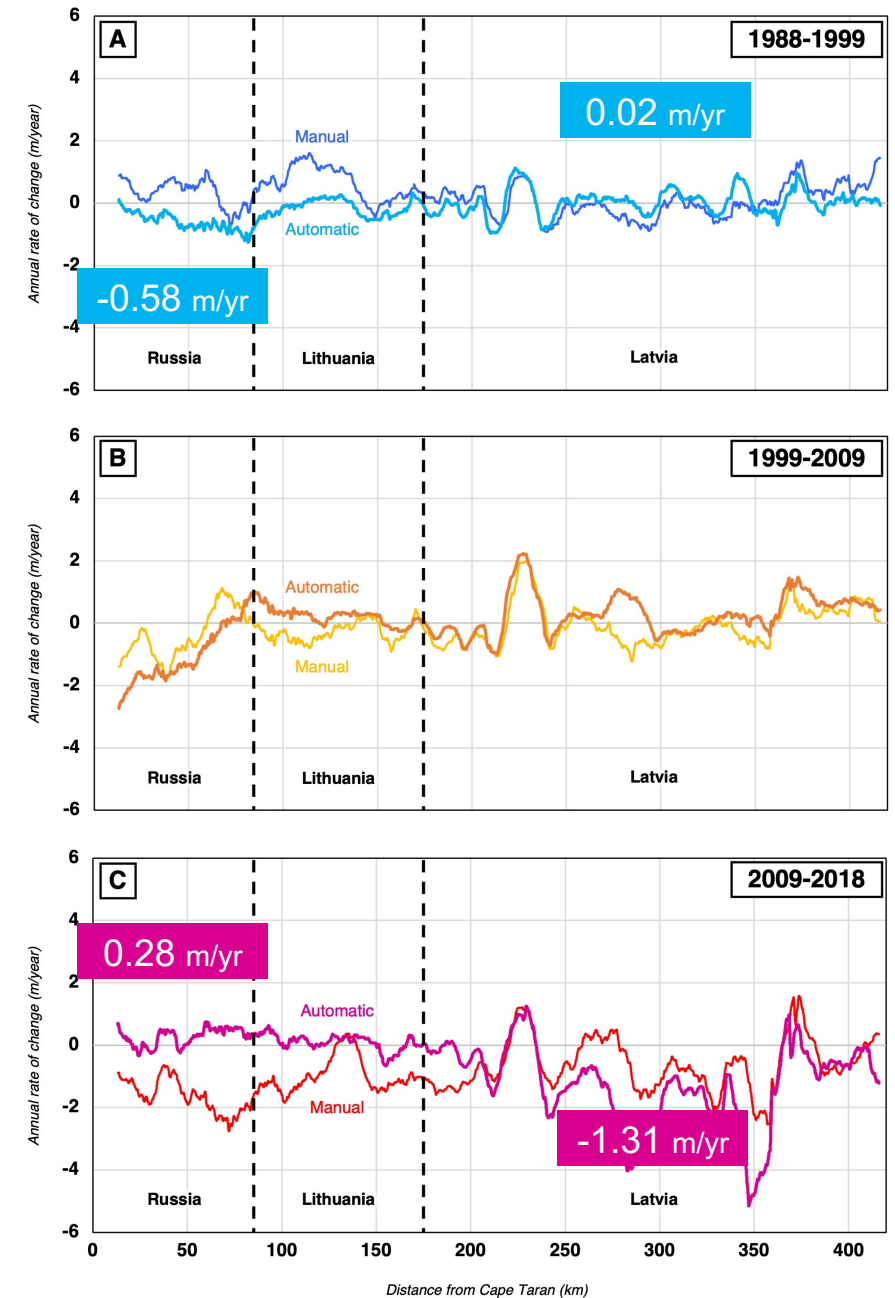
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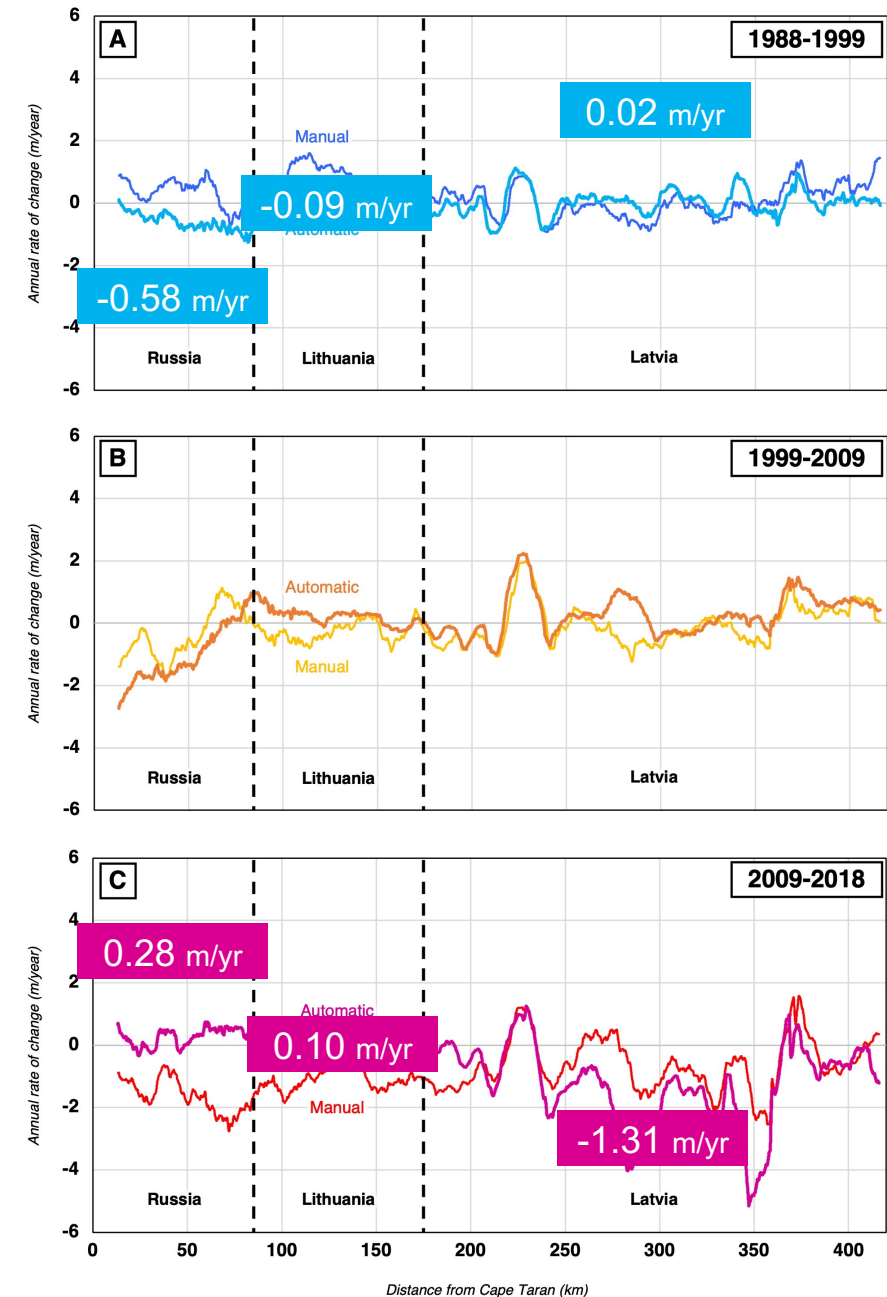
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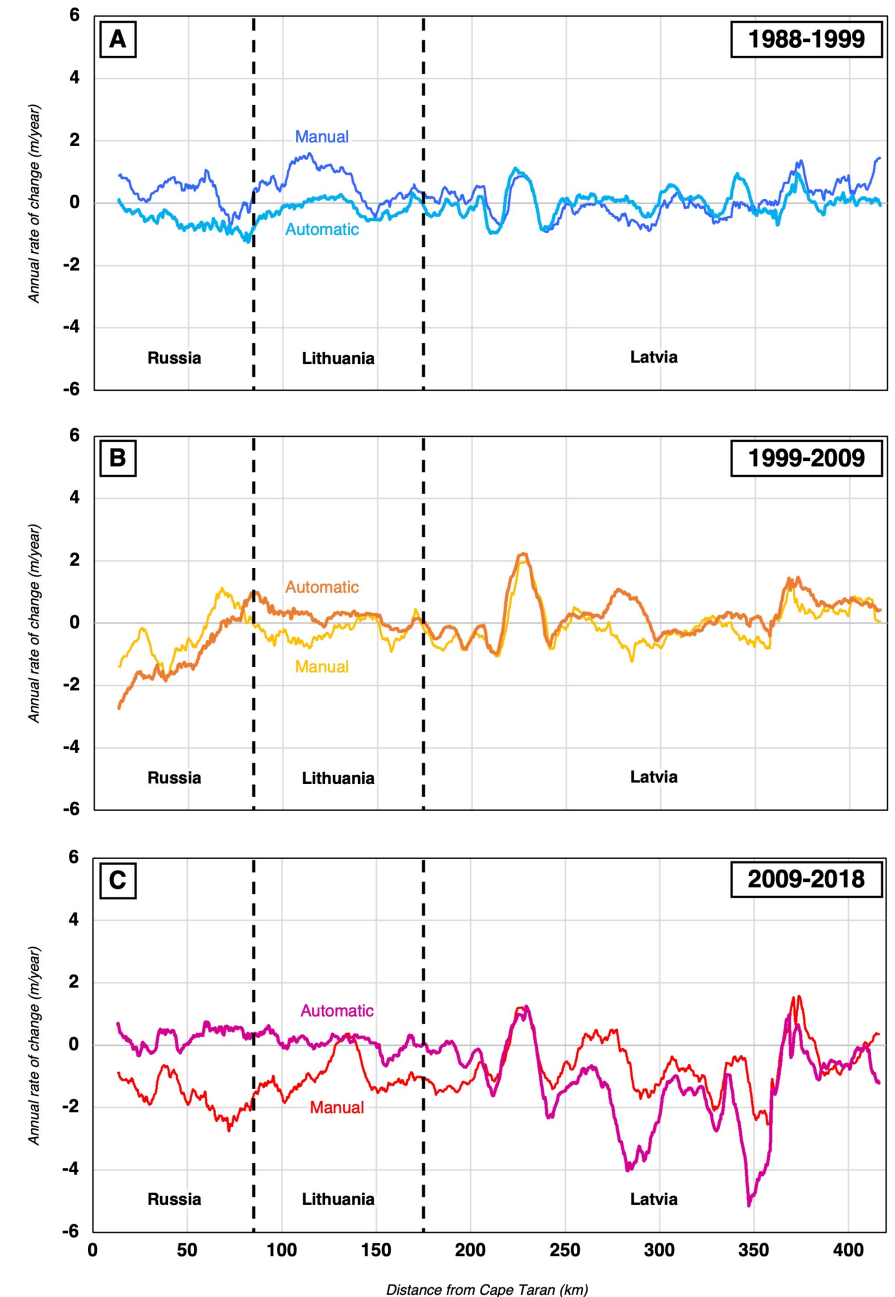
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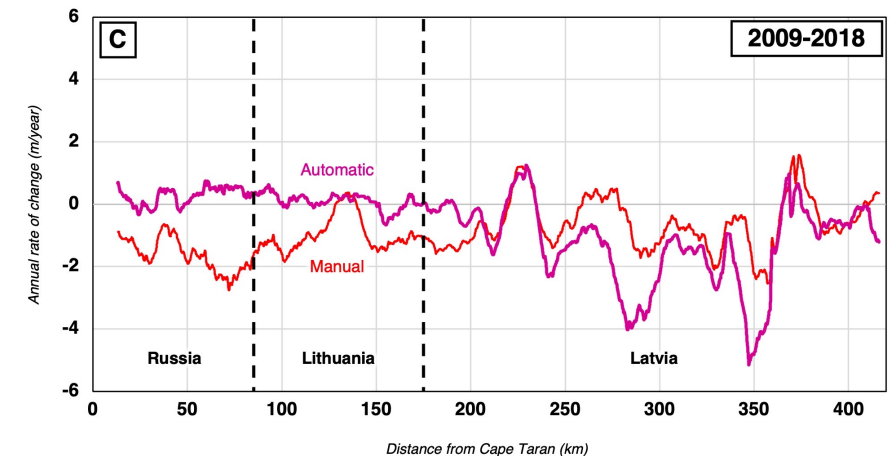
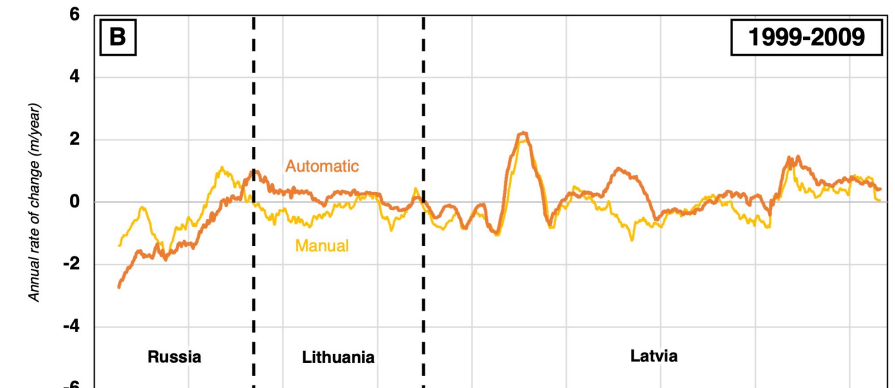
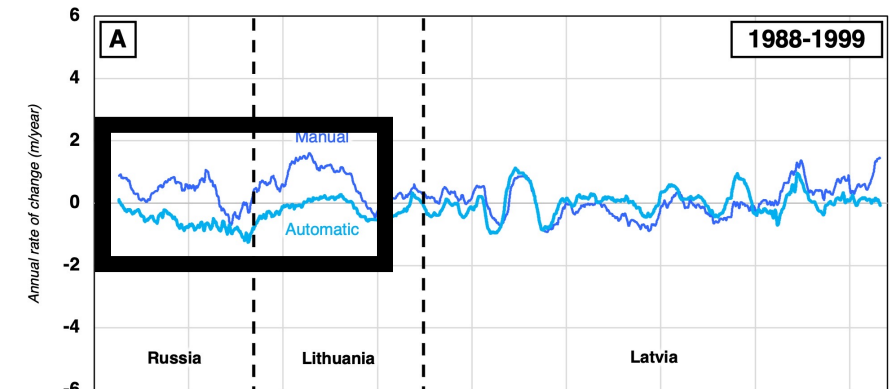


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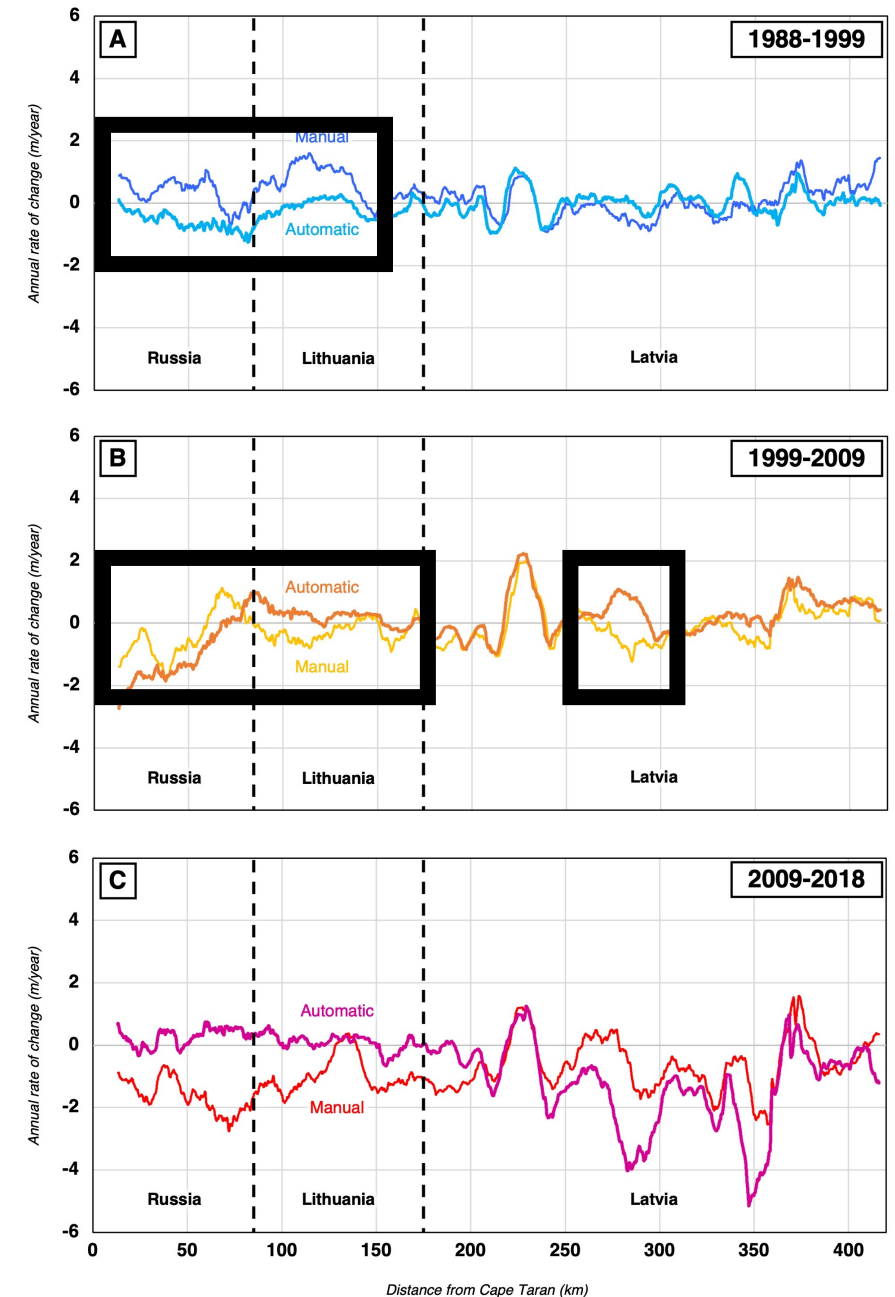


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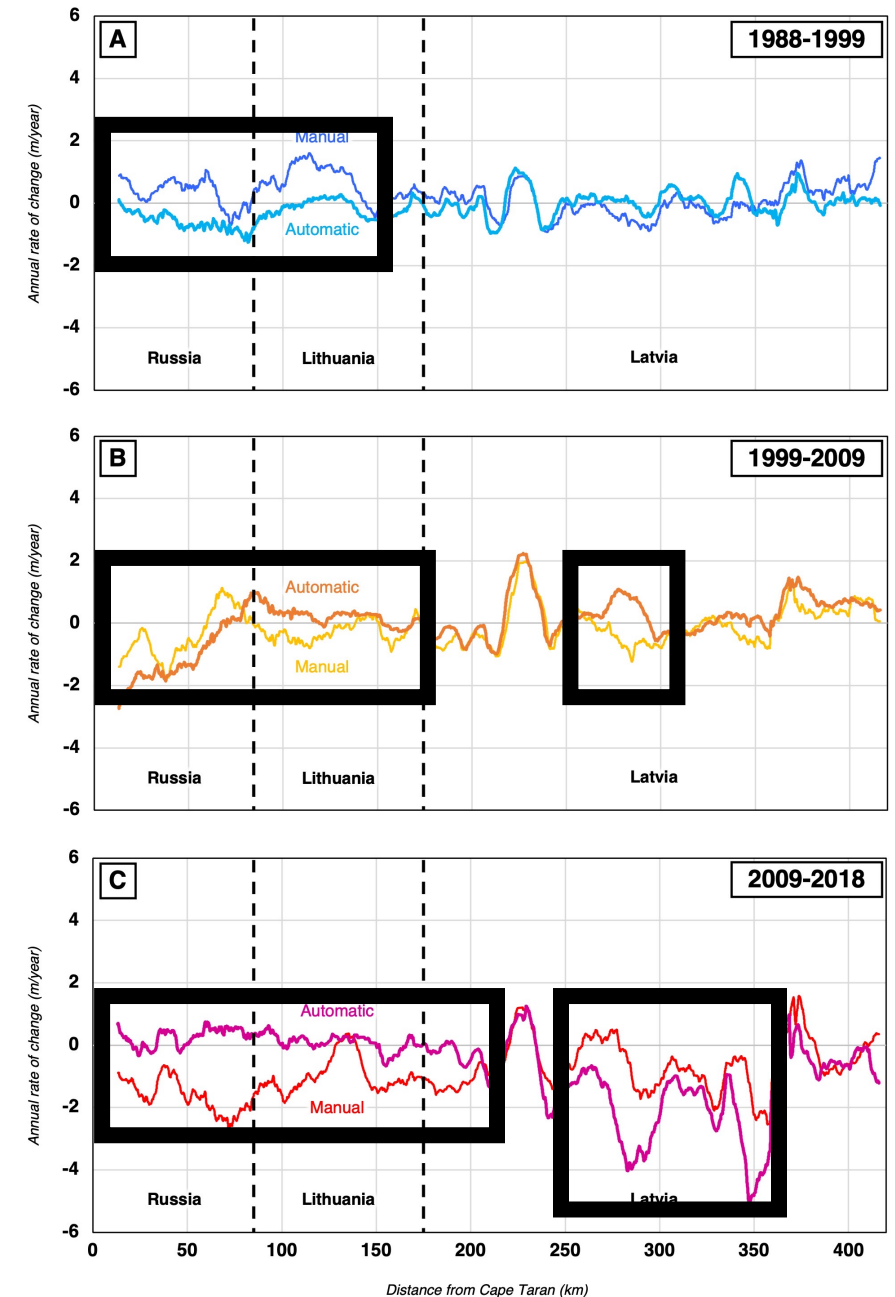


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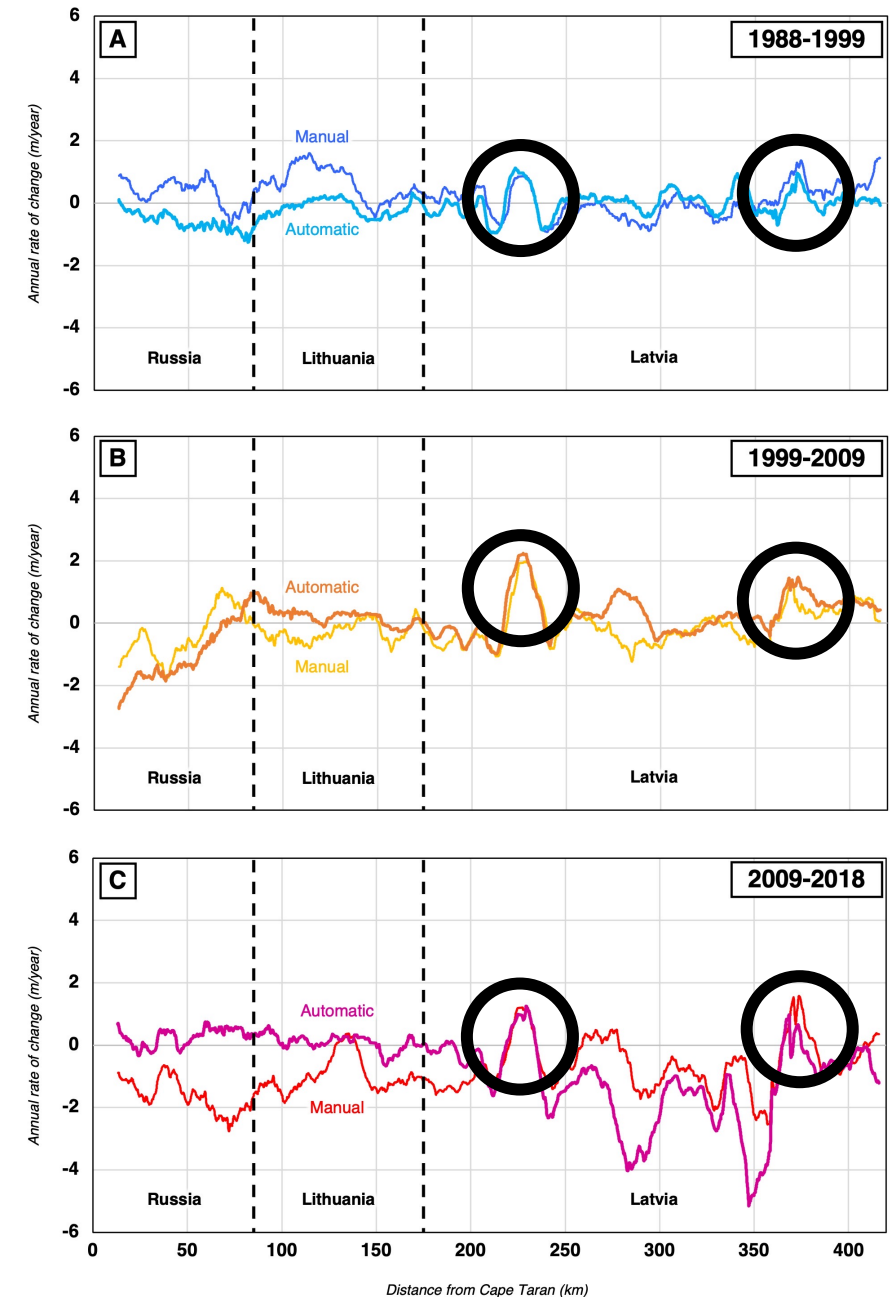


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- Cyclical dynamics in port areas whatever the period and the method.



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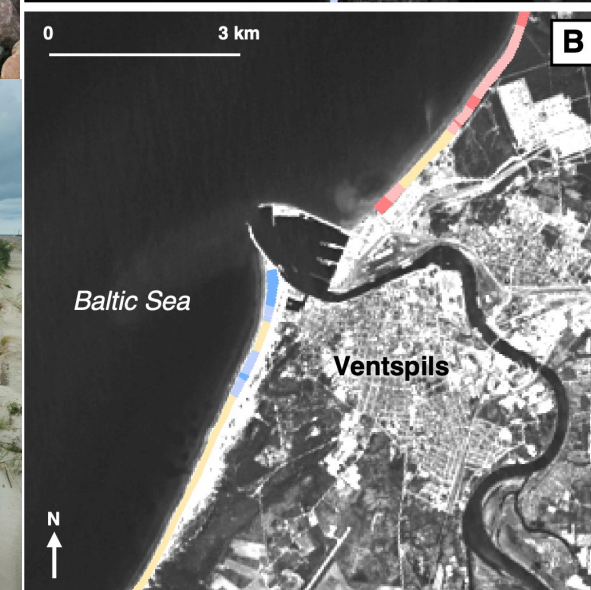
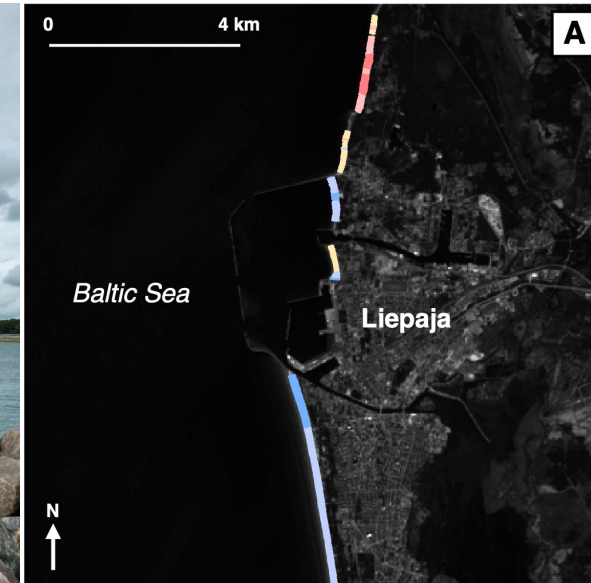
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- The case of ports: a disturbance of the littoral drift which causes local erosion of beaches downstream of port structures.

Hard structures in Klaipeda port
(Gloaguen, 2020)



Coastal annual evolution (m/year) with weighting of the margins of error	Color
-2.80 - -1.80	Dark Blue
-1.80 - -0.80	Light Blue
-0.80 - 0.80	Yellow
0.80 - 1.80	Red
1.80 - 2.80	Dark Red

Critical analysis of the methodology

Automatic method

Manual method

Critical analysis of the methodology

Automatic method

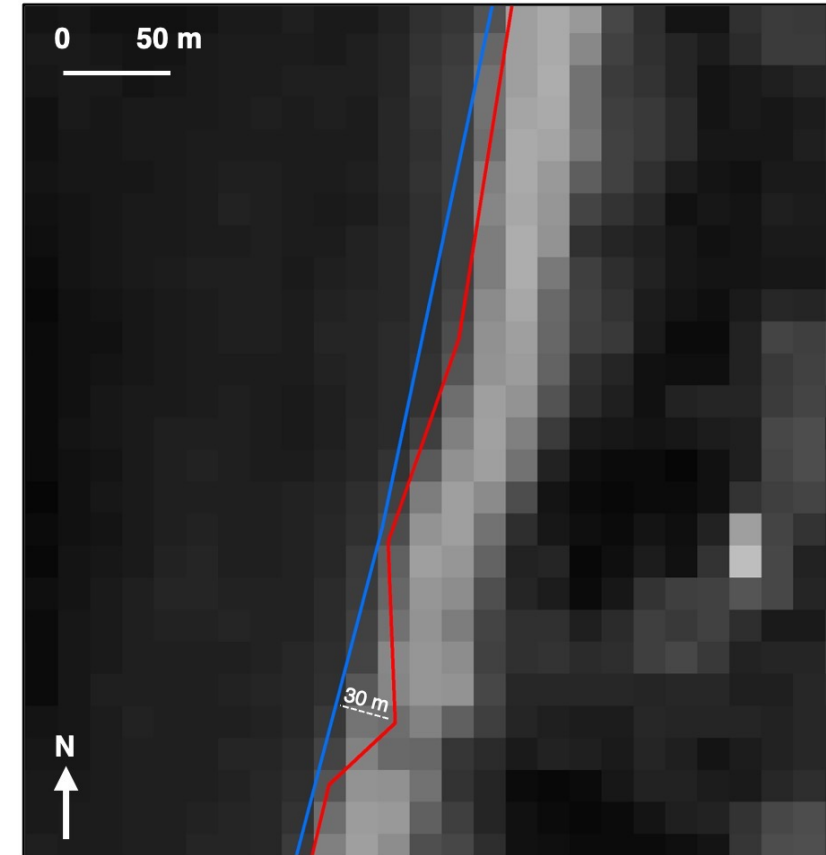
Manual method

Time-processing



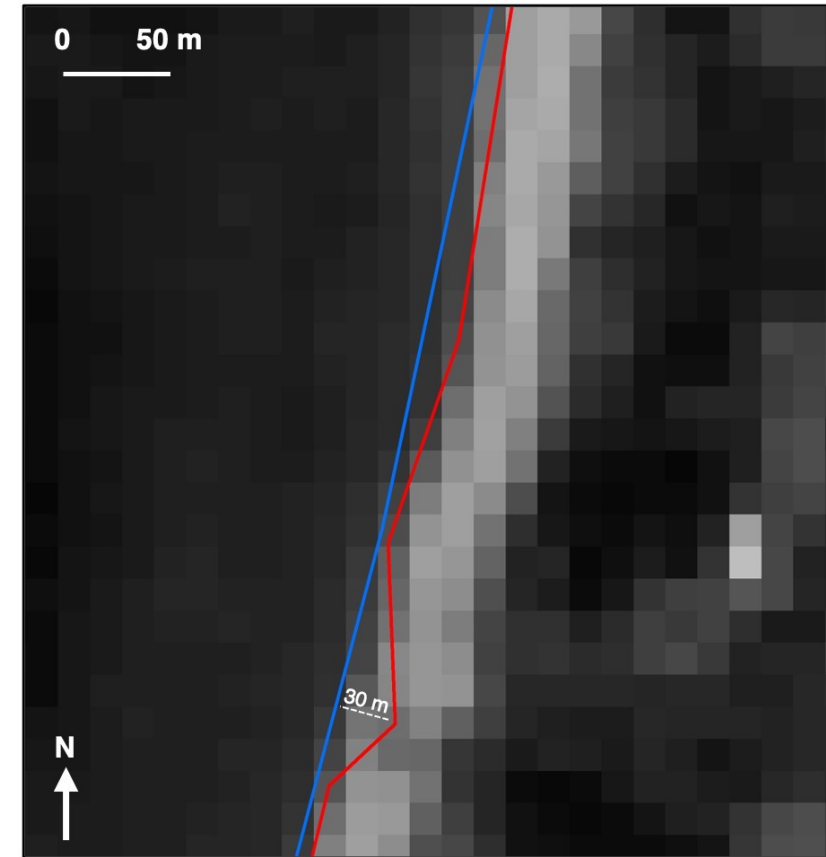
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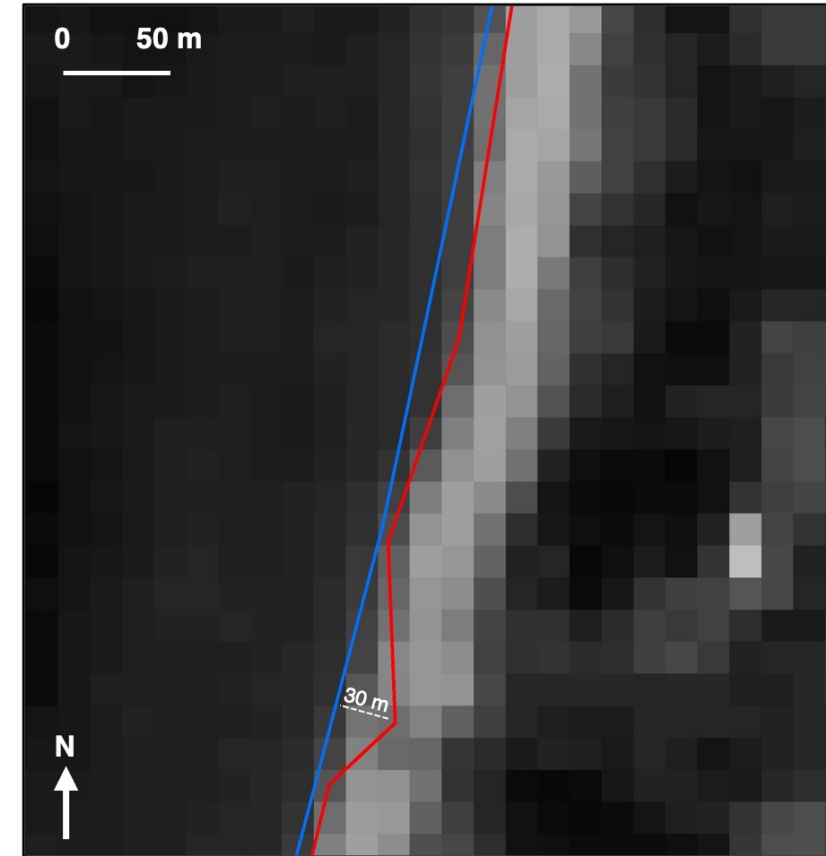
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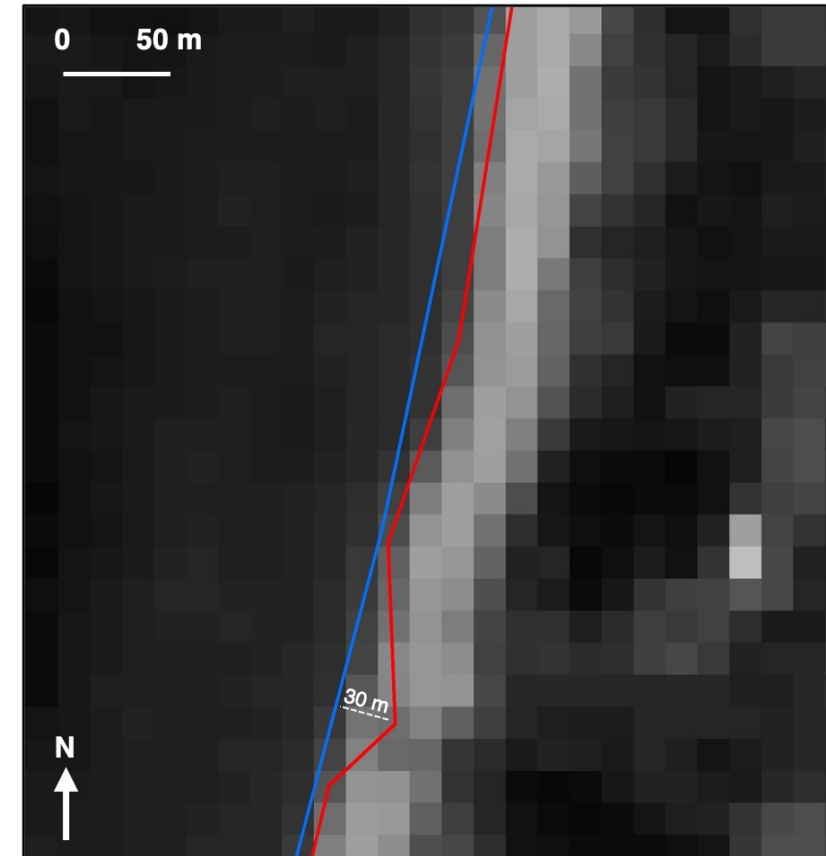
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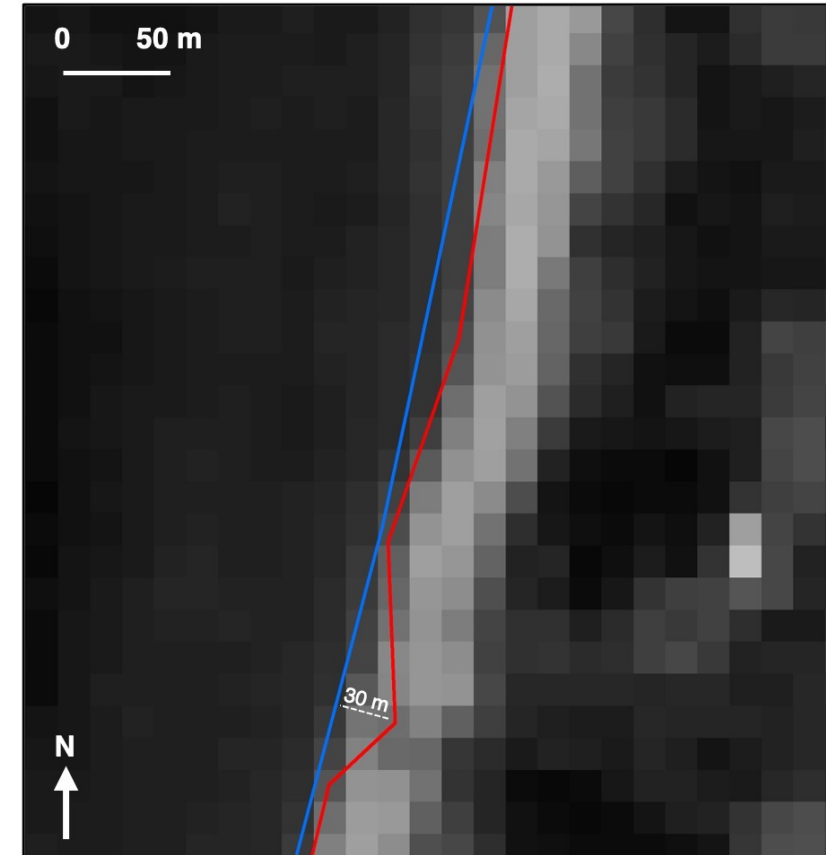
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- Use of satellite images with better spatial resolution (at the expense of spectral resolution?)



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- The automatic extraction method (MNF transformation and Laplacian filter) showed its advantages in terms of processing time and robustness of the results even if the differences observed between the two methods remain insignificant.





Thank you for your attention!