Multimodal data fusion in remote sensing

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Motivation

- Provided space resolution of thermal data may not be sufficient for target application.
- Sentinel-3 (Copernicus) remote sensing thermal data – space resolution 1000x1000 m.
- Thermal data can be fused with Sentinel-2 product with space resolution 10x10 m.
- There are specialized methods for thermal sharpening, such as Data Mining Sharpening[1] method (DMS).
- The DMS method can be improved by integrating neural network.

Improved Data Mining Sharpening method

Checking the homogeneity

Sentinel-2 product needs to be aggregated into the Sentinel-3 space resolution. The aggregated pixel can be used in the regression process only when it is homogenous enough.

Global or local model?

The relation model between the aggregated Sentinel-2 product and the Sentinel-3 data can be built on the whole area (globally) or in a moving window (localy).

Building the regression model

The regression model between the aggregated Sentinel-2 data and the Sentinel-3 data is

$$\mathrm{LST}_c = a_c R_c + b_c$$

Training the neural network

The neural network is trained by regression model coefficients and then applied to the original Sentinel-2 data producing an estimation of thermal data in higher resolution.
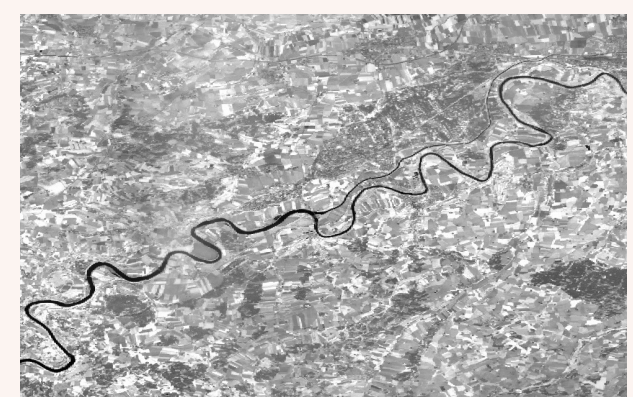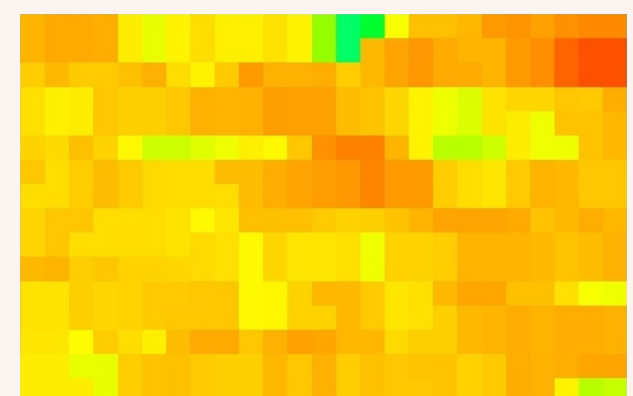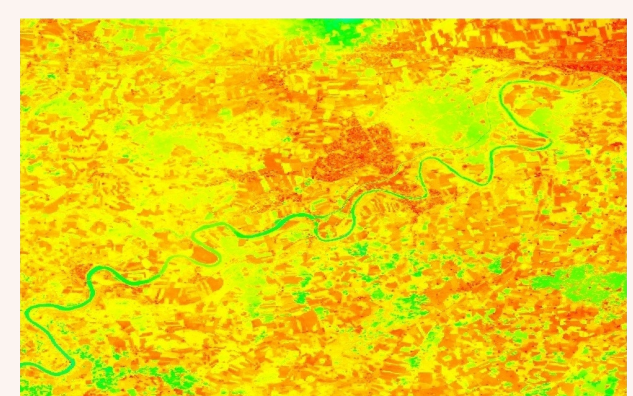
Residual analysis

Sharpened data needs to satisfy the energy conservation law. An aggregation of the sharpened thermal data and comparison with the original thermal data is used for the calculation of residuals.

Sentinel-2 visible spectral band
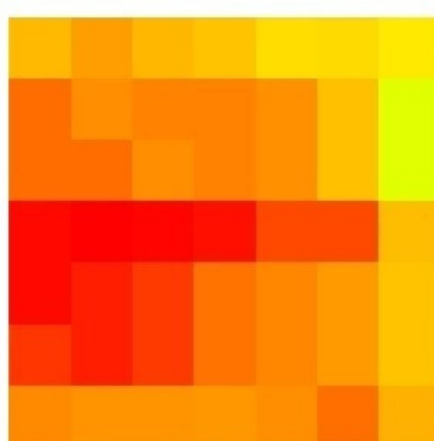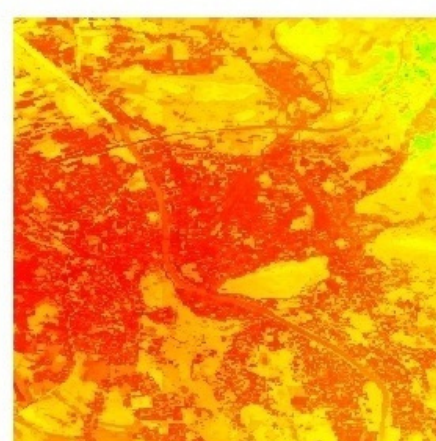
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Sentinel-3 thermal data
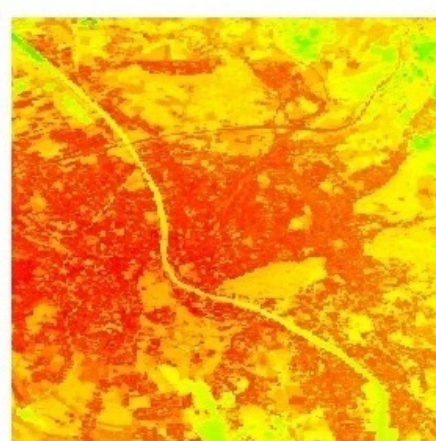
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Fused image

Why neural networks?

- Neural networks are new and powerful tool applied to various problems
- Using neural networks instead of regression trees improves the classic Data Mining Sharpening method
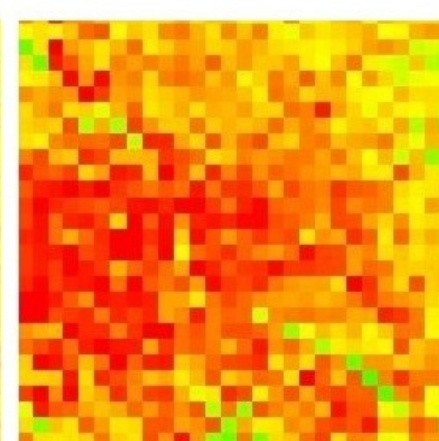

Sentinel-3 thermal data

Fused image local DMS method

Fused image global DMS method

Fused image improved DMS method

Landsat-8 TIR

- [1] *Gao, Feng and Kustas, William P. and Anderson, Martha C.*: **Data Mining Approach for Sharpening Thermal Satellite Imagery over Land**, Remote Sensing, Volume: 4, Number: 11, Pages: 3287–3319, Year: 2012, DOI: 10.3390/rs4113287.