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KNOWLEDGE BASED FUSION OF REMOTE SENSING TIME SERIES WITH HETEROGENEOUS SPATIO TEMPORAL RESOLUTION: AN APPLICATION FOR CROP CLASSIFICATION AND MONITORING

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1. Problem Faced

Appropriate **agricultural Remote Sensing monitoring needs high resolution multispectral data with dense revisiting cycles**, which are actually not operational. Currently, only **high spatial resolution (*H*) data (< 30 *m*) but temporally sparse** due to both revisiting time (16 to 26 days) and cloud contamination or **quasi-daily data with low or very low spatial resolution** (*L*) (250-1000 *m*) are available for agricultural Remote Sensing monitoring.

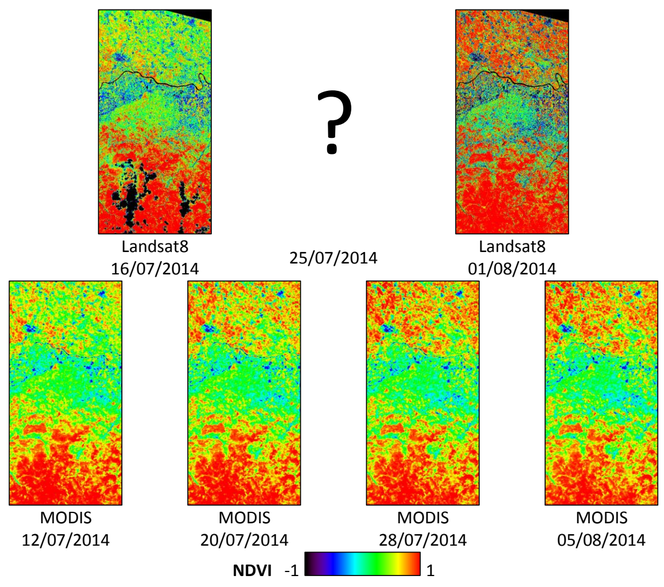
2. Objectives of the Work

Exploiting the agronomists expert knowledge on the crops growth dynamics and practices **to perform the fusion of the available heterogeneous Remote Sensing time series** so as **to generate new temporal series of data characterized by better spatio-temporal information** than the original ones **with a desired timestamp.**

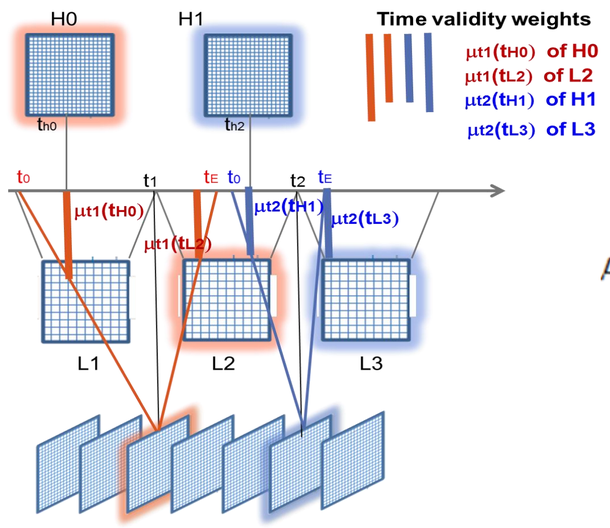
3. Study Area and Dataset

A fusion experiment has ben designed considering as input two time series in an **agricultural area of Lombardy (Italy)**. The **H series has been partitioned into two sub-series**, one for the fusion (**input series**) and the second for the testing (**target series**).

SERIES	SENSOR	# IMAGES	SPAT. RES.	FREQUENCY
H_{input}	Landsat8	7	30 *m*	16 days
H_{target}	Landsat8	6	30 *m*	16 days
L_{input}	MODIS	14	500 *m*	8 days



4. Proposed Fusion Procedure



$$\mu_t(t_H) = \begin{cases} \frac{t_H - t_O}{t - t_O} & if\ t_O \le t_H < t \\ \frac{t_H - t_E}{t - t_E} & if\ t \le t_H < t_E \end{cases}$$

$|t_0 - t|$ and $|t - t_E|$ can change depending on the seasonal variation of crop growth

1. Definition of desired Output Timestamps: $t_1, t_2, \ldots t_n$

2. Definition of temporal Validity of Input images at output Timestamps based on Knowledge

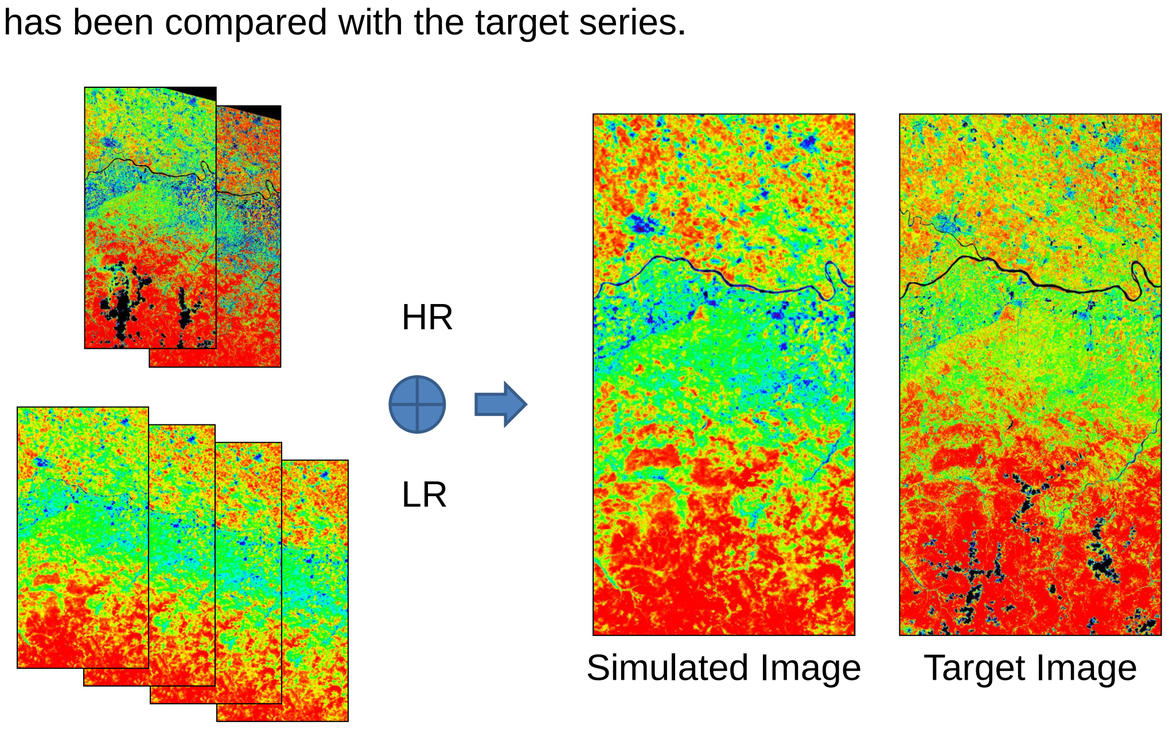
For each timestamp t, the validity of each input image H_i or L_i acquired before t_0 and after t_E is Null, otherwise is $m_t(t_H)$ and $m_t(t_L)$

3. Pixel level Fusion

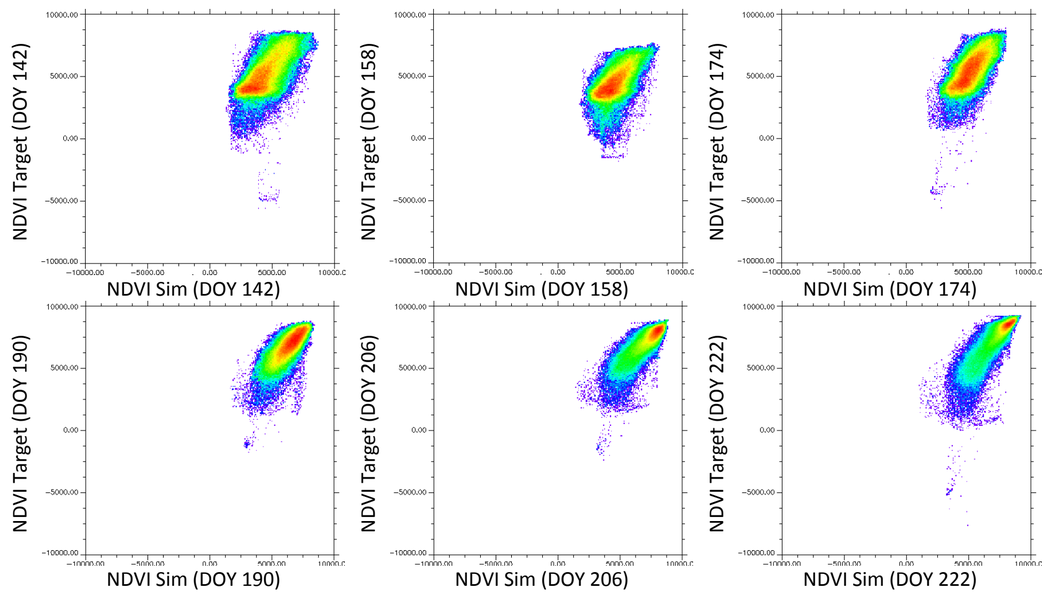
At each timestamp t, the fusion is a weighted average of input images within t_0 and t_E, using validity as weights.

5. Results

We applied the fusion defining a desired timestamp corresponding to the dates of the target series and generating the simulated series which has been compared with the target series.



Statistics (Simulated vs Target)		
R	RMSE	Accuracy
0.783	0.105	0.931



Acknowledgements

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