Towards efficient satellite image time series analysis : combination of Dynamic Time Warping and Quasi-Flat Zones

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Context

Upcoming satellites data:

- Satellite image time series (SITS) at high resolution both spatial and temporal
- Important computational cost induced by this mass of data

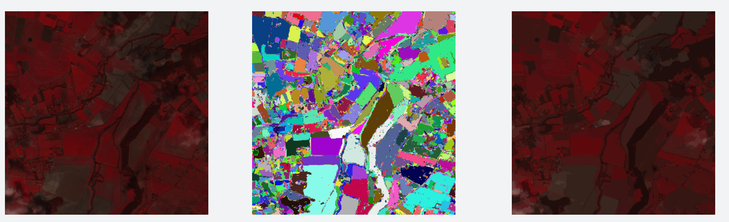
Proposed solutions:

- Reduce spatiotemporal data with Quasi-Flat Zones
- Use Dynamic Time Warping to compare reduced time series

Quasi-Flat Zones (QFZ)

- Connected areas of homogeneous pixels
- 2 homogeneity criteria are mainly used:
  - Local range (α)
  - Global range (ω)

Extended to spatiotemporal data [ISMM 2011].

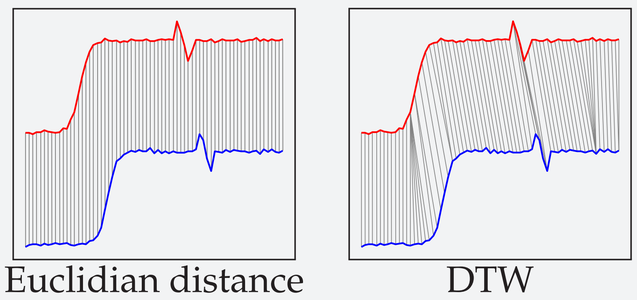


Original QFZ Simplification

Dynamic Time Warping (DTW)

- Time-designed similarity measure:
  - gather locally time-distorted sequences
  - compare sequences with different lengths

$\Rightarrow$ accurate for the analysis of SITS [TGRS 2012]



Euclidian distance DTW

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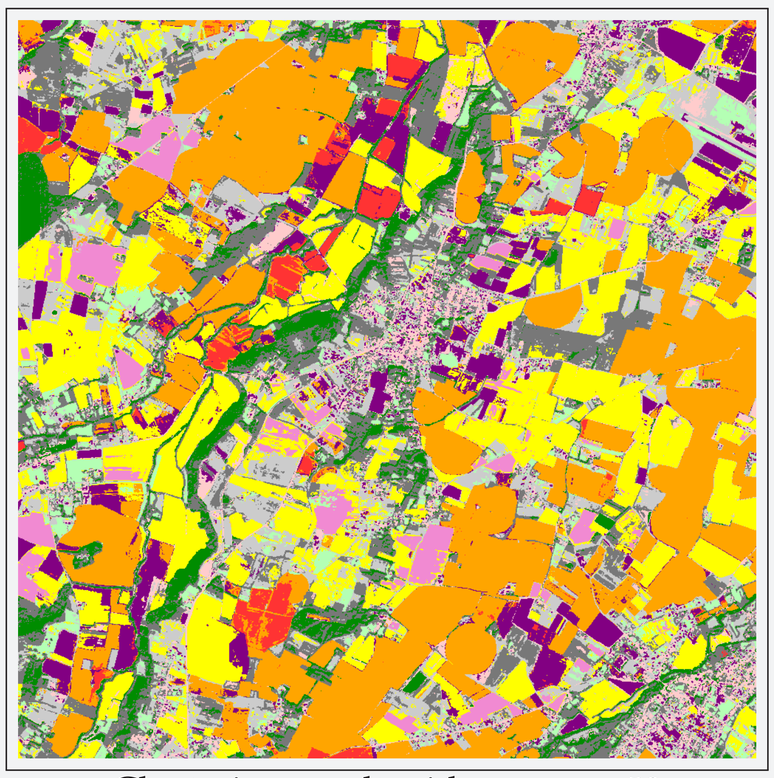
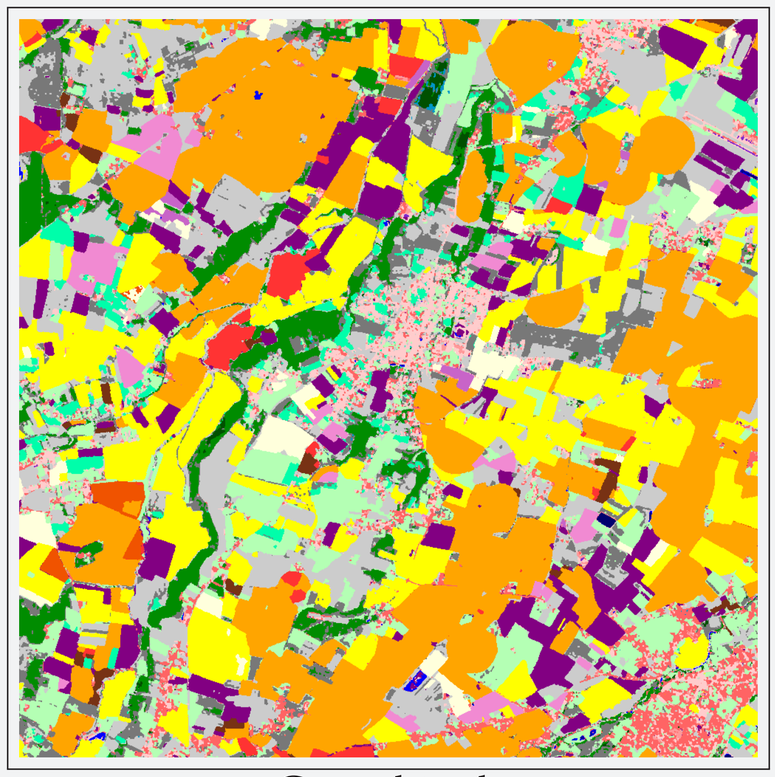
Experiments and results

Visual result sample



Clustering result with $\alpha = \omega = 50$



Ground-truth

Influence of the segmentation parameters

$\alpha = \omega$	Kappa %	F-Measure %	Memory in MB	Run-time in hh:mm
#reference	*23.1*	*28.8*	*758*	*1:41*
50	**23.5**	**29.2**	**142**	**1:26**
60	**23.3**	**29.2**	**128**	**1:24**
70	21.4	27.0	117	1:23
80	21.5	27.2	109	1:22
90	21.3	27.0	103	1:21
100	21.6	27.3	98	1:21

Conclusion and Perspectives

Combination of QFZ and DTW on SITS analysis:

- lowers memory and time consumption
- improves accuracy of the result

Perspectives :

- study other QFZ criteria to improve results
- use interactive QFZ segmentation [ISPA 2012]

Data

Samples from the time-series.
FORMOSAT-2 images © NSPO

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