Multitemp: Past, Present and Future

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• Multitemp Steering Committee:
  ✓ Lorenzo Bruzzone (University of Trento, Italy);
  ✓ Pol Coppin (Katholieke Universiteit Leuven, Belgium);
  ✓ Roger King (Mississippi State University, USA);
  ✓ Ross Lunetta (U.S. Environmental Protection Agency, USA).

• Multitemp was established in 2001 as an international workshop organized every two years. We are at the 9th edition of the workshop.

• Goal of Multitemp: create a forum for discussion and interaction among scientists, people developing applications and industry for enhancing the activities in the area of multitemporal data.
Number of papers published in the major journals and conferences (source: Scopus) related to methodologies and applications of multitemporal analysis between 1990 and 2000
MultiTemp History
Change Detection in Multispectral Images

Landsat TM, Pre-event

Magnitude Difference Image

Burned area

Landsat TM, Post-event

Change Detection Map (Burned Area)

Landsat 5 Thematic Mapper images of a forest fire in the Island of Elba, Italy
Time Series Analysis

Loss of vegetation

Re-vegetation
Detection of Land Cover Transitions

May 1995 (Landsat)  July 1995 (Landsat)  Thematic Map

- BARE SOIL
- SUGAR BEET
- URBAN
- WHEAT
- BARE SOIL
- CORN
- BARE SOIL
- SOYBEAN
ERS-2 SAR images of a flood in the City of Pavia, Italy
Number of papers published in the major journals and conferences (source: Scopus) related to methodologies and applications of multitemporal analysis until 2005.

After Multitemp 2005......
MultiTemp History

Mystic 2009
Leuven 2007
Trento 2001 & 2011
Ispra 2003

MultiTemp 2011
6th International Workshop on the Analysis of Multi-temporal Remote Sensing Images
12-14 July 2011, Trento, Italy

University of Trento, Italy
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Optical Satellite Missions

Geometrical Resolution (m)

Year


Landsat 1-3
Landsat 4-5
SPOT 1-4
Landsat 7
SPOT 5
RapidEye
GeoEye 1
Sentinel-2A/2B
SPOT 6-7
Pleiades-HR 1-2
WorldView 3-4
WorldView 1-2
Eros A
Eros B
Ikonos
QuickBird

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VHR Multispectral Images

Quickbird images of the city of Trento, Italy

July 2006

October 2005
Brasilian Amazon: Landsat Thematic Mapper time series (magenta color highlights deforestation)

September 2007

September 2008

September 2010

September 2011
VHR SAR Sensors

Comso-Skymed SAR Images of the Earthquake of L’Aquila, Italy
VHR SAR Sensors

Comso-Skymed SAR Images of the Earthquake of L’Aquila, Italy

Optical image GeoEye, Tele Atlas 2011 Google ©

RGB multitemporal composition (R:04/21/2009, G:04/05/2009, B:04/21/2009)

- Backscattering decrease
- Backscattering increase
- Unchanged areas
VHR SAR Sensors

Comso-Skymed SAR Images of the Earthquake of L’Aquila, Italy

Overlay between RGB and the final buildings change detection map

Ground Truth from orthophotos acquired on April 2009 by the civil protection (GeoPortale Abruzzo)

Collapsed buildings:  
Other changes:
Number of papers published in the major journals and conferences (source: Scopus) related to methodologies and applications of multitemporal analysis until 2011.
MultiTemp History

Banff 2013
Mystic 2009
Bruges 2017
Annecy 2015
Ispra 2003
Leuven 2007
Trento 2001 & 2011
Biloxi 2005
Exploit the large amount of freely available image time series of Sentinel and Landsat data for information extraction:
- New paradigms for analysis of long time series of high resolution images;
- New products at improved resolution;
- New applications of the analysis of images time series.
<table>
<thead>
<tr>
<th>Hyperspectral System</th>
<th>VIS-NIR</th>
<th>SWIR</th>
<th>TIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyperion EO-1 (USA 2000)</td>
<td></td>
<td></td>
<td>30 m</td>
</tr>
<tr>
<td>Chris/Proba (EU 2001)</td>
<td></td>
<td></td>
<td>17/34 m</td>
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<tr>
<td>HySI (India 2008)</td>
<td></td>
<td></td>
<td>500 m</td>
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<tr>
<td>HJ-1A (China, 2008)</td>
<td></td>
<td></td>
<td>100 m</td>
</tr>
<tr>
<td>GISAT (India)</td>
<td></td>
<td></td>
<td>30 m</td>
</tr>
<tr>
<td>PRISMA (Italy 2018)</td>
<td></td>
<td></td>
<td>30 m</td>
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<tr>
<td>EnMAP (Germany 2018)</td>
<td></td>
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<td>30 m</td>
</tr>
<tr>
<td>HyspIRI (USA)</td>
<td></td>
<td></td>
<td>30 m</td>
</tr>
<tr>
<td>HISUI-ALOS-3 (Japan)</td>
<td></td>
<td></td>
<td>60 m</td>
</tr>
</tbody>
</table>

Source of data: IEEE GRSS ISIS Technical Committee
Hyperspectral Images

Hyperspectral multitemporal images acquired by Hyperion in Oregon, USA

RGB composition of the t1 image
(R: 650.67nm, G: 548.92nm, B: 447.17nm)

RGB composition of the t2 image
(R: 1729.70nm, G: 1023.40nm, B: 752.43nm)

False color composition of the image difference (R: 1729.70nm, G: 1023.40nm, B: 752.43nm)
Hyperspectral Images

Hyperspectral multitemporal images acquired by Hyperion in Oregon, USA

False color composites of the difference image
- R: 823.65nm
- G: 721.90nm
- B: 620.15nm

Multiclass Change Detection map
- R: 1729.7nm
- G: 752.43nm
- B: 548.92nm
Number of papers published in the major journals and conferences (source: Scopus) related to methodologies and applications of multitemporal analysis until 2016
Distribution of the overall number of published papers versus different topics related to multitemporal data (Source: Scopus)
Future Challenges

✓ The current scenario is rich of opportunities:
  ✓ Multitemporal VHR multispectral and SAR images;
  ✓ Long time series of HR SAR and multispectral images;
  ✓ Constellations of satellites with short revisit time;
  ✓ Large archives of data available for free;
  ✓ New data analysis paradigms (e.g., deep learning).

✓ Need to foster the development of methodologies, applications, and operational products related to mulitemporal data acquired by last generation satellite missions.

✓ Fundamental a cross disciplinary approach to the full exploitation of the potentialities of multitemporal data.
MultiTemp: a 16 year history…. but we are still at the beginning!
Thanks to All Multitemp Sponsors!