# FUSION OF SENTINEL-2 AND SENTINEL-3 PRODUCTS – AN OVERVIEW OF APPLICABLE HARMONIZATION AND BLENDING TECHNIQUES

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## Abstract
- Fusion allows the spectral, spatial and temporal enhancement of images
- Certain degree of similarity between the images is needed before they can be blended
- Give an overview of existing techniques for harmonization and fusion of optical images
- Validate the concept of spatiotemporal image fusion of Sentinel-2 and Sentinel-3 images

## Sensor specifications

<table>
<thead>
<tr>
<th>Sentinel-2 MSI</th>
<th>Sentinel-3 OLCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revisit time: 5 days</td>
<td>Revisit time: &lt; 2 days</td>
</tr>
<tr>
<td>Spatial resolution: 10 m (for the bands concerned)</td>
<td>Spatial resolution: 300 m</td>
</tr>
<tr>
<td>Spectral bands used: B2 (blue), B3 (green), B4 (red), B8 (NIR)</td>
<td>Spectral bands used: Oa04 (blue), Oa06 (green), Oa08 (red), Oa17 (NIR)</td>
</tr>
</tbody>
</table>

## Harmonization and fusion

### Atmospheric correction
- **Sentinel-2**: SMAC, GRASP, SCAPE-M, Sen2Cor, iCor, ACOLITE, MACCS, LaSRC, etc.
- **Sentinel-3**: SMAC, GRASP, SCAPE-M, BAER, XBAER, GRASP (all of them have been used for MERIS)

### Cloud masking
- **Sentinel-2**: IdePix, Fmask, Sen2Cor & MACCS cloud masks
- **Sentinel-3**: IdePix, BAER cloud mask, XBAER cloud mask, etc.

### Bandpass adjustment
- Often handled by the fusion algorithm itself

### Co-registration of the images
- Flat correction models (e.g. polynomials, triangulation, spline), homography transformation, Correl Optimize, AROP, ARRSI, COSI-Corr, AROSICS

### Resampling
- nearest neighbour, bilinear interpolation, bicubic interpolation

### BRDF normalization
- ignored due to similarity in the orbit inclination and acquisition time

### Radiometric harmonization
- Flat correction models (e.g. polynomials, triangulation, spline), homography transformation, Correl Optimize, AROP, ARRSI, COSI-Corr, AROSICS
- Resampling nearest neighbour, bilinear interpolation, bicubic interpolation
- BRDF normalization ignored due to similarity in the orbit inclination and acquisition time

### Geometric harmonization
- STARFM, STAARCH, ESTARFM, SPSTFM, U-STFM, DBUX, ISTARFM

### Spatiotemporal image fusion
- **t=0**: coarse resolution
- **t=p**: fine resolution
- **p**: date of prediction

## Test sites

<table>
<thead>
<tr>
<th>Type: agriculture</th>
<th>Type: urban flooding</th>
<th>Type: Amazon forest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location: near Munich, Germany</td>
<td>Location: Houston (Texas), USA</td>
<td>Location: Ji-Paraná, Rondônia, Brazil</td>
</tr>
<tr>
<td>Sentinel-2 tile: 32UPU</td>
<td>Sentinel-2 tile: 15RTP &amp; 15RTN</td>
<td>Sentinel-2 tile: 20LPP</td>
</tr>
</tbody>
</table>

![Google Earth Pro](image1.png)
![NOAA, Mapbox](image2.png)
![Google Earth Pro](image3.png)