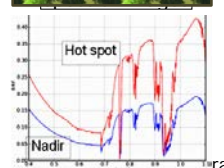
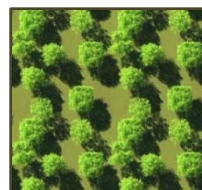


**Deep learning:**  
training a classifier  
of HRS images of  
tropical forests.



Creation of  
model of lands  
from Google im

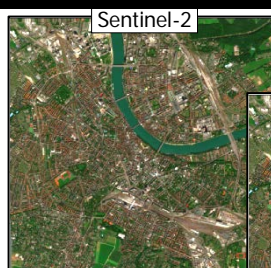


## DART Tutorial 2023

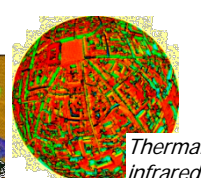
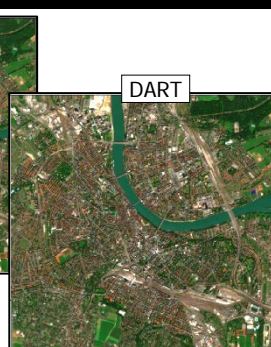
Contact: [jean-philippe.gastellu@cesbio.cnes.fr](mailto:jean-philippe.gastellu@cesbio.cnes.fr), [yingjie.wang@univ-tlse3.fr](mailto:yingjie.wang@univ-tlse3.fr), [omar.regaieg@univ-tlse3.fr](mailto:omar.regaieg@univ-tlse3.fr)

<p><b>The DART model</b></p> <p>Developed since 1992 at CESBIO (<a href="http://www.cesbio.cnrs.fr/dart">www.cesbio.cnrs.fr/dart</a>) - Toulouse III University, CNES, CNRS, IRD, INRAE -</p>	<p>DART (<a href="https://dart.omp.eu">https://dart.omp.eu</a>) is an ever-evolving radiative transfer model. It simulates the 3D radiative budget (RB), including sun induced chlorophyll fluorescence (SIF), and remote sensing (RS) satellite, airborne and in-situ signals (spectroradiometer image, LiDAR FWF, SPL, point cloud) of natural and urban landscapes, from visible to thermal infrared. It is a reference tool for a wide range of RS studies (sensitivity studies, inversion of RS images, design of new RS sensor, etc.). Licenses are free for research and education.</p>
<p><b>Objective of the tutorial</b></p>	<p>To discover/deepen DART theory, functionalities and use in 5 steps:</p> <ol style="list-style-type: none"> <li>1) Short review of physical bases,</li> <li>2) DART theory, functionalities and novelties (DART-Lux bi-directional MC, texture, etc.)</li> <li>3) Study of schematic cases through prepared exercises,</li> <li>4) Presentation of Pytools4DART, and</li> <li>5) Case studies of interest to each participant.</li> </ol>
<p><b>Program of the training</b></p>	<ol style="list-style-type: none"> <li><b>1. SHORT REVIEW OF PHYSICAL BASES</b> (optical remote sensing, radiative budget) Radiance, reflectance, emissivity, brightness temperature, radiative budget, etc.</li> <li><b>2. DART THEORY AND FUNCTIONALITIES</b> <ol style="list-style-type: none"> <li><b>a) Theory:</b> standard DART-FT and latest DART-Lux (bi-directional Monte Carlo)</li> <li><b>b) Major functionalities</b> (interactive presentation) <ul style="list-style-type: none"> <li>• <u>Mode of operation:</u> spectroradiometer (modes R, T, R+T), LiDAR, RB.</li> <li>• <u>Landscape modeling:</u> <ul style="list-style-type: none"> <li>- Geometry: scene dimensions, spatial resolution, topography, coordinates, etc.</li> <li>- Components: * directly simulated trees, houses, crops, topography, etc. * imported 3D element and landscape (urban database, tree, etc.) * 4 basic elements (facets, turbid (vegetation), fluid (air, water), atmosphere).</li> <li>- Optical properties: surface (anisotropic facets) &amp; volume (turbid, fluid and air)</li> <li>- Atmosphere: gas and aerosol vertical profiles.</li> </ul> </li> <li>• <u>DART remote sensing (RS) and radiative budget (RB) products</u></li> <li>• <u>LUT (SQL database) creation/management</u> with the DART sequencer</li> <li>• <u>Post processing tools:</u> correction of topographic effects, satellite broad bands</li> <li>• <u>Use of command lines:</u> DART, its modules and its sequences</li> </ul> </li> </ol> </li> </ol>

# Announcement



Sentinel 2 inversion  
Basel city (5kmx6km)



<p><b>Program of the training</b></p>	<p><b>3. PRACTICE OF DART WITH EXERCISES, FROM SIMPLE TO COMPLEX</b></p> <p><b>3.a Flat surfaces - VIS / NIR / TIR spectral domains</b></p> <p>Basic DART functionalities are introduced with simple 2D landscapes: scene creation, simulation of images (irradiance, albedo, exitance, directional radiance / reflectance / brightness temperature), radiative budget, sequence of simulations (landscape reflectance spectra, satellite broad bands, time series, etc.).</p> <p><u>Example of basic case study:</u> for which experimental / instrumental configuration, can we detect a fire in a thermal infrared (TIR) pixel? Can we distinguish ice and ground TIR pixels with the same thermodynamic temperature?</p> <p><b>3.b Simulation of realistic 3D landscapes</b></p> <p>The presentation focuses on functionalities / landscapes of interest to attendees:</p> <ul style="list-style-type: none"> <li>- Atmosphere simulation: gas and aerosol models, atmosphere geometry, etc.</li> <li>- Creation of complex forest, agricultural or urban scene with topography, etc.</li> <li>- Importation of 3D elements and /or landscapes</li> <li>- Simulation of fluorescence, LiDAR, etc.</li> </ul> <p><b>4. PRESENTATION OF PYTOOLS4DART</b> (<a href="https://gitlab.com/pytools4dart/pytools4dart">https://gitlab.com/pytools4dart/pytools4dart</a>)</p> <p>API python created by TETIS (<a href="http://www.umd-tetis.fr">www.umd-tetis.fr</a>) for DART massive simulations.</p> <p><b>5. IMPLEMENTATION BY EACH PARTICIPANT OF HIS/HER OWN CASE STUDY</b></p> <ul style="list-style-type: none"> <li>- Radiative budget: forest, urban landscape, etc.</li> <li>- Scene creation (forest, crop, etc.) with imported 3D objects (tree, maize, etc.)</li> <li>- Sensitivity studies (e.g., variation of forest reflectance / brightness temperature with LAI, view direction, topography, thermodynamic temperature).</li> <li>- Inversion of satellite image of city as map of optical property per urban element</li> <li>- LiDAR: waveform, solar noise, 3D points derived from waveforms, etc.</li> </ul>
<p><b>Audience</b></p>	<p>No specific requirements. PCs are provided, but to bring a "good" laptop is advised</p>
<p><b>Advice</b> (before the training)</p>	<p>Get a free DART license &amp; User Manual (<a href="https://dart.omp.eu">https://dart.omp.eu</a>). Transmit your case study</p>
<p><b>Number of participants</b></p>	<p><b>14</b></p>
<p><b>Date</b></p>	<p><b>June 12 / 13 / 14, 2023 (9 am - 6 pm)</b></p>
<p><b>Registration deadline</b></p>	<p><b>April 28, 2023</b></p>
<p><b>Place of DART tutorial</b></p>	<p>Toulouse III University, 1 Rue Tarfaya, 31400 Toulouse (<a href="https://www.mfja.fr">https://www.mfja.fr</a>), room 313</p>