Curriculum Vitae

Jordi Inglada

March 12, 2024

Contents

1 General information **2**

2 Education and degrees **2**

3 Professional experience **3**

4 Research Activities **4**
4.1 Main interests 4
4.2 Main achievements 4

5 Publications **6**
5.1 Selected 6
5.2 Recent 6
5.3 Other 8
5.4 Books 11
5.4.1 Book chapters 11

6 PhD Students **12**
6.1 Completed 12
6.2 Ongoing 13

7 Editorial activities **14**

8 Research contracts and projects **14**

1 General information

- Current situation
  Senior Expert Scientist in Machine Learning for Earth Observation Land Surface Monitoring for Centre National d'Études Spatiales (French Space Agency) at CESBIO lab.

- Professional address
  CESBIO
  CNES - DTN/CD/CB - BPI 2801
  18, avenue Édouard Belin
  31401 Toulouse Cedex 09 - France
  jordi.inglada@cesbio.cnes.fr

- Other
  - Orcid: 0000-0001-6896-0049
  - Scopus Author ID: 55996140200
  - ResearcherID: B-4502-2018

2 Education and degrees

- July 2011. Habilitation à Diriger des Recherches (Computer Science, Automatics and Signal Processing) - Université Paul Sabatier Toulouse III: *Contributions to Remote Sensing Image Processing for Land Cover Mapping and Change Monitoring in Operational Applications.*

- September 2000. PhD (Signal Processing and Telecommunications) - Université de Rennes-1 : *Study of ocean surface radar signatures of underwater bottom topography.*

- September 1997. Master of Sciences (DEA) Signal Telecommunications Image and Radar - Université de Rennes-1.

- September 1997. Telecommunications Engineer, ENST Bretagne.

- September 1997. Telecommunications Engineer, ETSET Barcelona, Universitat Politècnica de Catalunya.

3 Professional experience

- Since March 2010: Researcher at Centre d'études spatiales de la biosphère, CESBIO
  - Since 2019: Co-lead of the Artificial Intelligence and Machine Learning team.
  - Since 2014: Lead Developer of the iota^2 large scale mapping software (`http://docs.iota2.net`).
  - 2015-2020: Project Manager for the Scientific Expertise Center on Operational Land Cover (CES OSO) for the Theia Land Data Center.
- 12/2001-3/2010: Engineer at Centre National d'Études Spatiales, CNES (French Space Agency).
  - Manager of Methodology of the ORFEO Program (Pléiades + CosmoSkymed algorithm preparation).
  - Creator and lead of the ORFEO Toolbox software (`http://www.orfeo-toolbox.org`).
  - Lead of CNES' Technical Axis for Earth Observation: Methods for information extraction from Earth Observation imagery.
  - R&D lead on information extraction from remote sensing imagery for operational and multi-temporal applications:
    * change detection;
    * object recognition;
    * multi-sensor image registration;
    * similarity measures.
  - Project Manager for the International Charter Space and Major Disasters (`https://disasterscharter.org`).
- 10/2000 - 12/2001: Postdoctoral fellow at CNES: SAR and optical image fusion for multi-temporal analysis applied to natural disasters.

4 Research Activities

4.1 Main interests

- Feature extraction, similarity measures, representation learning.
- Multi-temporal analysis, change detection, multi-sensor image fusion.
- Integration of prior knowledge about image generation processes into machine learning approaches.
- Land cover mapping, bio-physical variable retrieval.
- Large scale, operational processing chains.

4.2 Main achievements

I came to CNES in 2000 as a postdoc to work on the joint use of optical and SAR imagery for natural disasters. The International Charter on Space and Major Disasters had just been signed by ESA, CNES and the Canadian Space Agency and I had the opportunity of participating in the first implementations of the Charter. From hands on experience on real-time mapping for earthquakes, floods and volcano eruptions, I designed a research program around multi-sensor similarity measures for image registration and change detection.

In 2004, in the frame of the preparatory program to the use of Pléiades and CosmoSkymed very high resolution imagery, I took the lead of the methodology part to coordinate activities in information extraction for object recognition, image segmentation and classification. Beyond the algorithm development, I proposed the creation of a free and open source library to gather and make available the most useful algorithms. This library is the ORFEO Toolbox (OTB) which was developed using best practices (extreme programming, test driven development, etc.) and first released in 2005. Nowadays, OTB is used for research, education and is implemented on ground segments at CNES and ESA (every Sentinel-2 image is processed by an OTB pipeline).

In 2008 I started working on dense time series. It was the time of the opening of the Landsat archive, the first *hyper-temporal* data provided by Formosat-2 and the preparation of the arrival of the Sentinels. The wonderful opportunities brought by these data motivated me to move to CESBIO to work on multi-temporal analysis and land cover mapping.

In 2013 the ESA's Sentinel-2 Agriculture project started and I had the chance of being responsible of 2 products: crop type (classification) and vegetation status (leaf area index and phenological variables). The Sen2Agri system is now an operational tool able to map complete countries.

The lessons learned with cropland mapping, motivated me to generalize the approach to different types of land covers. From 2014 I led the creation of the Scientific Expertise Center on Operational Land Cover for the French National Land Data Center, Theia. This work led to the first national land cover map of Metropolitan France and, to the best of my knowledge, the first country wide land cover map produced fully automatically from remote sensing image time series. We had to implement algorithms that scale, learn with noisy labels and comply with end user specifications. Since 2017, the map is produced annually using all available Sentinel-2 data over the reference year, and the map is released before March of the following year with a fully automated workflow.

One big achievement of this work has been the development of the iota² processing chain, which is both a research platform and an operational system. The same software is used to both, scale up the algorithms of our graduate students, and run on CNES' HPC cluster to produce Theia's maps. iota² is free and open source software and it is used by scientists, private companies and public institutes in France and abroad. The software is now a platform to build large scale mapping systems for land cover (classification), bio/geo-physical parameter estimation (regression) and any other application where large amounts of EO data are needed.

Since 2018, I have shifted my focus to representation learning for multi-sensor and multi-temporal data. Indeed, the wealth of data acquired by the Sentinels, Landsat and similar systems allow to both build real-time mapping systems and long-term retrospective analysis. However dealing with different spatial, temporal and spectral resolutions can become a real challenge. I am interested in finding common representations for these different types of data by coupling deep learning generative models and prior knowledge about the image formation mechanisms (sensors characteristics, radiative transfer and models of the underlying observed processes). I am currently working on 2 ANR (Agence Nationale de la Recherche) funded projects (MAESTRIA and DeepChange) which focus on these topics. I am also member of the ANITI (Artificial and Natural Intelligence Toulouse Institute) chair led by N. Dobigeon entitled *Fusion-based inference from heterogeneous data.* The approaches developed in these projects will be implemented in EVOLAND, a Horizon Europe project planned to start in December 2022 where, with colleagues from CESBIO, CNES, DLR and Vito we will work on generic embeddings for the next generation of Copernicus Land products.

Although the paragraphs above are written in first person singular, all this work wouldn't have been possible without my colleagues, students and co-authors from which I continue to learn every day. Their names appear in the following sections.

5 Publications

	Scopus	ResearcherID
Number of cited papers	149	138
Total number of citations	3638	3084
H-index	30	26

5.1 Selected

1. **Jordi Inglada**, Alain Giros: On the possibility of automatic multi-sensor image registration. IEEE Transactions on Geoscience and Remote Sensing, vol. 42, no. 10, p. 2104–2120, October 2004.

2. **Jordi Inglada**, Grégoire Mercier: A Statistical Similarity Measure for Change Detection in Multitemporal SAR Images and its Extension to Multiscale Change Analysis, IEEE Transactions on Geoscience and Remote Sensing, Volume: 45, Issue: 5, Part 2 May 2007, pages 1432-1445.

3. François Petitjean, **Inglada, J.**, Gançarski, P. (2012). Satellite Image Time Series Analysis Under Time Warping. IEEE Trans. Geosci. Remote Sensing, 50(8), 3081–3095.

4. **Inglada, J.**, Arias, M., Tardy, B., Hagolle, O., Valero, S., Morin, D., Gérard Dedieu, ... (2015). Assessment of an operational system for crop type map production using high temporal and spatial resolution satellite optical imagery. Remote Sensing, 7(9), 12356–12379.

5. Pelletier, C., Valero, S., **Inglada, J.**, Champion, N., & Gérard Dedieu (2016). Assessing the robustness of random forests to map land cover with high resolution satellite image time series over large areas. Remote Sensing of Environment, 187(nil), 156–168.

6. **Inglada, J.**, Vincent, A., Arias, M., Tardy, B., Morin, D., & Rodes, I. (2017). Operational high resolution land cover map production at the country scale using satellite image time series. Remote Sensing, 9(1), 95.

5.2 Recent

1. **Inglada, J.**, Michel, J., & Hagolle, O. (2022). Assessment of the usefulness of spectral bands for the next generation of sentinel-2 satellites by reconstruction of missing bands. Remote Sensing, 14(10), 2503.

2. Michel, J., Vinasco-Salinas, J., **Inglada, J.**, & Hagolle, O. (2022). Sen2venμs, a dataset for the training of sentinel-2 super-resolution algorithms. Data, 7(7), 96.

3. Baudoux, L., **Inglada, J**., & Mallet, C. (2022). Multi-nomenclature, multi-resolution joint translation: an application to land-cover mapping. International Journal of Geographical Information Science, 37(2), 403–437. http://dx.doi.org/10.1080/13658816.2022.2120996

4. Laluet, P., Olivera-Guerra, L., Rivalland, V., Simonneaux, V., **Inglada, J.**, Bellvert, J., Erraki, S., ... (2023). A sensitivity analysis of a fao-56 dual crop coefficient-based model under various field conditions. Environmental Modelling & Software, 160, 105608. http://dx.doi.org/10.1016/j.envsoft.2022.105608

5. Bellet, V., Fauvel, M., & **Inglada, J.** (2023). Land Cover Classification With Gaussian Processes Using Spatio-Spectro-Temporal Features. IEEE Transactions on Geoscience and Remote Sensing, 61(), 1–21. http://dx.doi.org/10.1109/tgrs.2023.3234527

6. Barrou Dumont, Z., Gascoin, S., & **Inglada, J.** (2023). Contribution de Spot World Heritage aux séries temporelles d'observation satellitaires des montagnes francaises. Revue Française de Photogrammétrie et de Télédétection, 225(1), 1–8. http://dx.doi.org/10.52638/rfpt.2023.623

7. Zérah, Yoël, Valero, S., & Inglada, J. (2023). Physics-driven probabilistic deep learning for the inversion of physical models with application to phenological parameter retrieval from satellite times series. IEEE Transactions on Geoscience and Remote Sensing, 61, 1–23. http://dx.doi.org/10.1109/tgrs.2023.3284992

8. Bellet, V., Fauvel, M., Inglada, J., & Michel, J. (2023). End-to-end learning for land cover classification using irregular and unaligned sits by combining attention-based interpolation with sparse variational gaussian processes. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, (), 1–16. http://dx.doi.org/10.1109/jstars.2023.3343921

9. Dumont, Z. B., Gascoin, S., & Inglada, J. (2024). Snow and cloud classification in historical spot images: an image emulation approach for training a deep learning model without reference data. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 1–13. http://dx.doi.org/10.1109/jstars.2024.3361838

10. Dumeur, I., Valero, S., & Inglada, J. (2024). Self-supervised spatio-temporal representation learning of satellite image time series. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 1–18. http://dx.doi.org/10.1109/jstars.2024.3358066

5.3 Other

1. **Jordi Inglada**, René Garello: On Rewriting the Imaging Mechanism of Underwater Bottom Topography by Synthetic Aperture Radar as a Volterra Series Expansion. IEEE Journal of Oceanic Engineering, vol. 27, no. 3, pp. 665-674, July 2002.

2. **Jordi Inglada**, Jean-Marc Le Caillec, René Garello: Inversion of Imaging Mechanisms by Regularization of Inverse Volterra Models. Signal Processing, vol. 84, no. 6, p. 1021–1034, 2004.

3. **Jordi Inglada**, Jean-Claude Souyris, Caroline Henry, Céline Tison: Incoherent SAR polarimetric analysis over point targets. IEEE Geoscience and Remote Sensing Letters, vol. 3, no. 2, p. 246–249, April 2006.

4. **Jordi Inglada**, Vincent Muron, Damien Pichard, Thomas Feuvrier: Analysis of Artifacts in Subpixel Remote Sensing Image Registration, IEEE Transactions on Geoscience and Remote Sensing, vol. 45, no. 1, 254–264, January 2007.

5. Florent Chatelain, Jean-Yves Tourneret, **Jordi Inglada**, André Ferrari: Bivariate Gamma Distributions for Image Registration and Change Detection, IEEE Transactions on Image Processing, Volume 16, Issue 7, July 2007, pages 1796-1806.

6. **Jordi Inglada**: Automatic recognition of man-made objects in high resolution optical remote sensing images by SVM classification of geometric image features. ISPRS Journal of Photogrammetry and Remote Sensing. ISPRS Journal of Photogrammetry and Remote Sensing Volume 62, Issue 3, August 2007, Pages 236-248.

7. Florent Chatelain, Jean-Yves Tourneret, **Jordi Inglada**, Change Detection in Multisensor SAR Images Using Multivariate Gamma Distributions, IEEE Transactions on Image Processing. Volume: 17, Issue: 3, March 2008.

8. **Jordi Inglada**, Julien Michel: Qualitative Spatial Reasoning for High-Resolution Remote Sensing Image Analysis. IEEE Transactions on Geoscience and Remote Sensing, Volume 47, Issue 2, February 2009, Pages 599-612.

9. Tarek Habib, **Jordi Inglada**, Grégoire Mercier, Jocelyn Chanussot, Support Vector Reduction in SVM Algorithm for Abrupt Change Detection in Remote Sensing. IEEE Geoscience and Remote Sensing Letters, Volume 6, Issue 3, July 2009, Pages 606-610.

10. G. Licciardi, F. Pacifici, D. Tuia, S. Prasad, T. West, F. Giacco, A. Thiel, **J. Inglada**, E. Christophe, J. Chanussot and B. Gamba: Decision Fusion for the Classification of Hyperspectral Data: Outcome of the 2008 GRS-S Data Fusion Contest. IEEE Transactions

on Geoscience and Remote Sensing, Volume 47, Issue 11, November 2009, Pages:3857-3865.

11. E. Christophe, J. Michel, and **J. Inglada** : Remote sensing processing: from multicore to GPU, IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, January 2011.

12. V. Poulain, **J. Inglada**, M. Spigai, J-Y. Tourneret and A. Marthon : High resolution optical and SAR image fusion for building database updating. IEEE Transactions on Geoscience and Remote Sensing, Mars, 2011.

13. Vanegas, M. C., Bloch, I., **Inglada, J.** (2013). Alignment and parallelism for the description of high-resolution remote sensing images. IEEE Transactions on Geoscience and Remote Sensing, 51(6), 3542–3557.

14. Forestier, G., **Inglada, J.**, Wemmert, Cédric, & Gançarski, Pierre (2013). Comparison of optical sensors discrimination ability using spectral libraries. International Journal of Remote Sensing, 34(7), 2327–2349.

15. Petitjean, F., **Inglada, J.**, & Gancarski, P. (2014). Assessing the quality of temporal high-resolution classifications with low-resolution satellite image time series. International Journal of Remote Sensing, 35(7), 2693–2712.

16. Matton, N., Canto, G., François Waldner, Valero, S., Morin, D., **Inglada, J.**, Arias, M., ... (2015). An automated method for annual cropland mapping along the season for various globally-distributed agrosystems using high spatial and temporal resolution time series. Remote Sensing, 7(10), 13208–13232.

17. Osman, J., **Inglada, J.**, & Jean-François Dejoux (2015). Assessment of a markov logic model of crop rotations for early crop mapping. Computers and Electronics in Agriculture , 113(0), 234–243.

18. Lassalle, P., **Inglada, J.**, Michel, J., Grizonnet, M., & Malik, J. (2015). A scalable tile-based framework for region-merging segmentation. IEEE Trans. Geosci. Remote Sensing, nil(nil), 1–13.

19. Bontemps, S., Arias, M., Cara, C., Gérard Dedieu, Guzzonato, E., Hagolle, O., **Inglada, J.**, ... (2015). Building a data set over 12 globally distributed sites to support the development of agriculture monitoring applications with sentinel-2. Remote Sensing, 7(12), 16062–16090.

20. Vanegas, M. C., Bloch, I., **Inglada, J.** (2016). Fuzzy constraint satisfaction problem for model-based image interpretation. Fuzzy Sets and Systems, 286(), 1–29.

21. Valero, S., Morin, D., **Inglada, J.**, Sepulcre, G., Arias, M., Hagolle, O., Gérard Dedieu, ... (2016). Production of a dynamic cropland mask by processing remote sensing image series at high temporal and spatial resolutions. Remote Sensing, 8(1), 55.

22. Sicre, C. M., **Inglada, J.**, Rémy Fieuzal, Frédéric Baup, Valero, S., Jérôme Cros, Huc, M., ... (2016). Early detection of summer crops using high spatial resolution optical image time series. Remote Sensing, 8(7), 591.

23. **Inglada, J.**, Vincent, A., Arias, M., & Marais-Sicre, C. (2016). Improved early crop type identification by joint use of high temporal resolution sar and optical image time series. Remote Sensing, 8(5), 362.

24. Tardy, B., **Inglada, J.**, & Michel, J. (2017). Fusion approaches for land cover map production using high resolution image time series without reference data of the corresponding period. Remote Sensing, 9(11), 1151.

25. Pelletier, C., Valero, S., **Inglada, J.**, Champion, N., Marais Sicre, C., & Dedieu, G. (2017). Effect of training class label noise on classification performances for land cover mapping with satellite image time series. Remote Sensing, 9(2), 173.

26. Grizonnet, M., Michel, J., Poughon, V., **Inglada, J.**, Savinaud, M., & Cresson, R. (2017). Orfeo toolbox: open source processing of remote sensing images. Open Geospatial Data, Software and Standards, 2(1).

27. Calvet, J., Ceschia, É., Courault, D., Dewaele, H., Goulas, Y., **Inglada, J.**, Le Toan, T., ... (2017). Observation de la végétation depuis l'espace. La Météorologie, (97), 86.

28. Tardy, B., **Inglada, J.**, & Michel, J. (2019). Assessment of optimal transport for operational land-cover mapping using high-resolution satellite images time series without reference data of the mapping period. Remote Sensing, 11(9), 1047.

29. Defourny, P., Bontemps, S., Bellemans, N., Cara, C., Dedieu, Gérard, Guzzonato, E., Hagolle, O., **Inglada, J.**, ... (2019). Near real-time agriculture monitoring at national scale at parcel resolution: performance assessment of the sen2-agri automated system in various cropping systems around the world. Remote Sensing of Environment, 221(), 551–568.

30. Stoian, A., Poulain, V., **Inglada, J.**, Poughon, V., & Derksen, D. (2019). Land cover maps production with high resolution satellite image time series and convolutional neural networks: adaptations and limits for operational systems. Remote Sensing, 11(17), 1986.

31. Derksen, D., **Inglada, J.**, & Michel, J. (2019). Scaling up slic superpixels using a tile-based approach. IEEE Transactions on Geoscience and Remote Sensing, 57(5), 3073–3085.

32. Derksen, D., **Inglada, J.**, & Michel, J. (2020). Geometry aware evaluation of handcrafted superpixel-based features and convolutional neural networks for land cover mapping using satellite imagery. Remote Sensing, 12(3), 513.

33. Pageot, Y., Baup, Frédéric, **Inglada, J.**, Baghdadi, N., & Demarez, Valérie (2020). Detection of irrigated and rainfed crops in temperate areas using sentinel-1 and sentinel-2 time series. Remote Sensing, 12(18), 3044.

34. Baudoux, L., **Inglada, J.**, & Mallet, Clément (2021). Toward a yearly country-scale corine land-cover map without using images: a map translation approach. Remote Sensing, 13(6), 1060.

35. Baghdadi, N., **Inglada, J.**, Weiss, M., Bazzi, H., Demarez, V., Lagacherie, P., Biagiotti, I., ... (2021). Le Pôle Thématique national des surfaces continentales theia : produits et services pour l'agriculture. Innovations Agronomiques, (83), 11–27.

5.4 Books

1. Remote Sensing Imagery. Florence Tupin, **Jordi Inglada**, Jean-Marie Nicolas (Eds). ISBN: 978-1-118-89892-5. February 2014 Wiley-ISTE.

2. Imagerie de Télédétection. Florence Tupin, **Jordi Inglada**, Jean-Marie Nicolas (Eds). ISBN: 978-2-746-24580-8. Lavoisier, 2014

5.4.1 Book chapters

1. Andreas Wimmer, Iris Lingenfelder, Charles Beumier, **Jordi Inglada**, Simon J. Caseley: Feature Recognition Techniques. In: A. Jasani, M. Pesaresi, S. Schneiderbauer and G. Zeug (Eds.), Remote Sensing from Space – Supporting International Peace and Security. Springer, 2009. Pages 105-118.

2. Ahed Alboody, Florence Sèdes, **Jordi Inglada**: Enriching The Qualitative Spatial Reasoning System RCC8. In: Qualitative Spatio-Temporal Representation and Reasoning: Trends and Future Directions. Shyamanta M. Hazarika (Eds.), Information Science Reference, août 2010.

3. **Jordi Inglada**: Cartographie de l'occupation des sols à partir d'images optiques. In: Observation des surfaces continentales par télédétection I: Agriculture et forêt. Nicolas Baghdadi, Mehrez Zribi (Eds.). ISTE Group. 2016

4. **Jordi Inglada**: Cartographie de l'occupation des sols à partir d'images optiques. In: Land Surface Remote Sensing in Agriculture and Forest. Nicolas Baghdadi, Mehrez Zribi (Eds.). Wiley. 2016

6 PhD Students

6.1 Completed

1. Amandine Robin: *Sub-pixelic change detection and classification : Application to remote-sensing land-cover monitoring.* Supervised by Sylvie Le Hégarat-Mascle and Lionel Moisan. Université Paris Descartes. Defended 05/2007. **Co-supervision (20%).**

2. Florent Chatelain: *Multivariate Gamma based distributions for RADAR imaging.* Supervised by Jean-Yves Tourneret. Institut National Polytechnique de Toulouse. Defended 10/2007. **Co-supervision (25%).**

3. Tarek Habib: *Similarity measures for abrupt change detection for multi sensor satellite imagery.* Supervised by Jocelyn Chanussot and Grégoire Mercier. Institut National Polytechnique de Grenoble. Defended 12/2008. **Co-supervision (50%).**

4. Vincent Poulain: *Fusion of high resolution optical and SAR images to update cartographic databases.* Supervised by Philippe Marthon and Jean-Yves Tourneret. Institut National Polytechnique de Toulouse. Defended 10/2010. **Co-supervision (70%).**

5. María Carolina Vanegas Orozco: *Spatial relations and spatial reasoning for the interpretation of Earth observation images using a structural model.* Supervised by Isabelle Bloch. Télécom ParisTech. Defended 01/2011. **Co-supervision (30%).**

6. Ahed Alboody: *Reception of spatial data and their treatment : satellite image analysis for GIS updating by enriching the spatial system RCC8.* Supervised by Florence Sèdes. Université Paul Sabatier - Toulouse 3. Defended 05/2011. **Co-supervision (50%).**

7. François Petitjean: *Dynamic time warping : theoretical contributions for data mining, application to the classification of satellite image time series.* Supervised by Pierre Gançarski. Université de Strasbourg. Defended 09/2012. **Co-supervision (50%).**

8. Julien Osman: *Expert knowledge and modeling for the exploitation of Earth observation images with a high spatial, spectral and temporal resolution.* Université Paul Sabatier - Toulouse 3. Defended 02/2015. Supervised by **Jordi Inglada**.

9. Pierre Lassalle: *Study of the scalability of segmentation and classification algorithms to process massive datasets for remote sensing applications.* Université Paul Sabatier - Toulouse 3. Defended 11/2015. Supervised by **Jordi Inglada**.

10. Isabel Rodes Arnau: *Exploitation of high spatial, spectral and temporal resolution Earth observation imagery for large area land cover estimation.* Université Paul Sabatier - Toulouse 3. Defended 11/2016. Supervised by **Jordi Inglada**.

11. Charlotte Pelletier: *Land cover mapping by using satellite image time series at high resolutions: identification and processing of mislabeled data.* Supervised by Silvia Valero and Gérard Dedieu. Université Paul Sabatier - Toulouse 3. Defended 12/2017. **Co-supervision (15%)**.

12. Dawa Derksen: *Contextual classification of large volumes of satellite imagery for the production of land cover maps over wide areas.* Université Paul Sabatier - Toulouse 3. Defended 12/2019. Supervised by **Jordi Inglada**.

13. Benjamin Tardy: *Land cover mapping methods using historical data and remote sensing image time series without reference data for the mapping period.* Université Paul Sabatier - Toulouse 3. Defended 12/2019. Supervised by **Jordi Inglada**.

14. Luc Baudoux: *Multi-scale multi-label land-cover generation.* Université Gustave Eiffel. Defended 01/2023. Supervised by Clément Mallet and **Jordi Inglada**.

15. Valentine Bellet: *Artificial Intellegence for ecosystem monitoring.* Université Paul Sabatier - Toulouse 3. Defended 02/2024. Supervised by Mathieu Fauvel and **Jordi Inglada**.

6.2 Ongoing

1. Yoël Zerah: *Generative models for land cover mapping and change detection using satellite image time series.* Supervised by Silvia Valero and **Jordi Inglada**. Université Paul Sabatier - Toulouse 3. Started 01/2021.

2. Zacharie Barrou-Dumont: *Alps and Pyrenees snow cover mapping over the last 35 years using satellite imagery.* Supervised by Simon Gascoin and **Jordi Inglada**. Université Paul Sabatier - Toulouse 3. Started 04/2021.

3. Iris Dumeur: *Self-supervised multi-modal representation learning for land cover change detection.* Supervised by Silvia Valero and **Jordi Inglada**. Université Paul Sabatier - Toulouse 3. Started 09/2021.

4. Julien Michel: *Machine learning methods for the improvement of spatial and temporal resolutions in Satellite Images Time-Series, and application in the Thermal Infra-Red domain.* Supervised by **Jordi Inglada**. Université Paul Sabatier - Toulouse 3. Started 04/2023.

5. Kevin De Sousa: *Physics informed deep generic embeddings for multi-modal satellite image time series.* Supervised by **Jordi Inglada**. Université Paul Sabatier - Toulouse 3. Started 12/2023.

7 Editorial activities

- Associated editor for IEEE Transactions on Geoscience and Remote Sensing (2008-2012).
- Reviewer for:
  - IEEE Transactions on Geoscience and Remote Sensing.
  - IEEE Geoscience and Remote Sensing Letters.
  - IEEE Journal on Selected Topics in Applications of Remote Sensing.
  - IEEE Transactions on Image Processing.
  - the International Journal of Remote Sensing.
  - IEE Proceedings - Vision, Image and Signal Processing.
  - IEE Electronics Letters.
  - Remote Sensing of Environment.
  - ISPRS Journal of Photogrammetry and Remote Sensing.
  - MDPI Remote Sensing
  - MPDI Sensors

8 Research contracts and projects

EEE-SPN (2002) *Exploitation of ERS and ENVISAT using Stable Point Networks* was an ESA funded project aiming to develop SAR interferometry techniques for the joint use of the 2 generations of European SAR satellites despite they carrier frequency differences. The project consortium was composed by Altamira Information, CNES, DLR and Delft University.

Robin (2005-2006) French Ministry of Defense funded project whose goal was to build image data bases and associated reference labels for object recognition algorithm benchmarking. The project consortium was composed by Bertin technologies, CNES, Cybernetix, DGA, EADS, INRIA, ONERA, MBDA, SAGEM and THALES. The different tasks were:

- object class detection;
- generic object detection;
- object recognition;
- object characterization.

GMOSS (2005-2008) *Global Monitoring for Security and Stability* was an Excellence Network of the European Frame Program 6 aimed at making work together remote sensing scientists and civil security experts. There were 22 partners among which UNOSAT (United Nations Operational SATellite applications program), DLR, EUSC (European Satellite Center), CNES, QinetiQ and Definiens. My participation focused on generic algorithms for feature extraction and change detection.

PREVIEW (2005-2008) *Prevention Information and Early Warning*, was a European Frame Program 6 project aimed at developing novel geo-information services for natural and industrial hazards. There were 58 partners from 15 countries. My main contributions were related to automatic image registration and bi-temporal change detection.

SAFER (2009-2012) *Services and Applications For Emergency Response* was a European Frame Program 7 aimed at preparing the operational implementation of the GMES *Emergency Response Service* and was the logical sequel of PREVIEW.

Profusion (2011-2013) This project funded by BELSPO (Belgium Space Policy Office) was dedicated to the preparation of the use of PROBA-V image time series. I developed algorithms for the spatial super-resolution of PROBA-V time series by fusing them with high resolution Formosat-2 and Landsat-8 time series. This was also useful for the preparation to the use of Sentinel-2 and Sentinel-3 data.

TOLOMEO (2011-2014) The project "Tools for Open Multi-Risk Assessment using Earth Observation Data" (TOLOMEO) was funded under the Marie Curie International Research Staff Exchange Scheme (PIRSES-GA-2009) with the ultimate goal to establish an international cooperation between partners in Europe and South-America focused on the development of free tools for remotely sensed data analysis. TOLOMEO aimed at, and was able to, developing free/open source tools in the framework of collaborative with

emphasis on remote sensing analysis tools for risk assessment. The developed software tools were tested and proved to be robust, easy to use and free. The consortium was led by Paolo Gamba from University of Pavia and other partners included PUC-Rio, Universidad de Extremadura and INPE. I was responsible for the integration of the ORFEO Toolbox mainly for segmentation operators.

BIOSOS (2012-2013) The *BIOdversity Multi-Source Monitoring System: from Space TO Species* was a European Frame Program 7 project dedicated to habitat monitoring of Natura 2000 sites. My contribution was related to the implementation of scalable image segmentation algorithms of very high resolution imagery and to land cover classification and mapping.

Sentinel-2 Agriculture (2013-2015) ESA funded project aimed at developing an operational system for cropland mapping (crop mask, crop type, vegetation status). The consortium was composed by Université Catholique de Louvain, CESBIO and CS Group. I was responsible for the crop type and the vegetation status products. The system is still in development and exploited by users in many countries.

CES OSO (2014-2019) The Theia Land Data Center makes available analysis ready data derived from remote sensing imagery. Different products are defined by tailored Scientific Expertise Centers (SEC). I was responsible for the Operational Land Cover SEC (CES OSO) from its creation until 2019. I was responsible for the specification of the product, the definition of the algorithms and the lead of the implementation of the operational processing chain that runs on Theia's production center.

ANR MAESTRIA (2018-2023) Project funded by the French National Research Agency where CESBIO and LaSTIG/IGN develop novel land cover mapping algorithms that scale in terms of data volume, geographical cover and nomenclature evolution. I am responsible of the work-package about generic embeddings for multi-modal data.

ANITI (2019-2023) the Artificial and Natural Intelligence Toulouse Institute has 3 main missions: scientific research, training and economic development related to AI. ANITI aims to develop a new generation of artificial intelligence called hybrid AI, integrating data driven learning techniques and symbolic or mathematical models that permit us to express constraints and to carry out logical reasoning. ANITI also has ambitious aims with regard to education and industrial development. I am co-chair (Nicolas Dobigeon is the chair holder) of the *Fusion-based inference from heterogeneous data* chair.

ANR DeepChange (2019-2024) Project funded by the French National Research Agency and led by Silvia Valero which develops the use of Deep Generative Models to detect land cover changes by using satellite images. The project proposes a novel strategy aiming

at detecting land cover conversion changes by comparing multivariate satellite image sequences acquired on different time periods. The main novelty of the project is the development of deep learning methodologies to build new spatio-temporal representations uncovering the underlying data distributions of complex time series exhibiting spatial dependencies.

EVOLAND (2023-2025) This Horizon Europe project will develop and test new and innovative methods, algorithms and candidate Copernicus Land Monitoring Service prototypes by integrating novel EO/in-situ data and latest Machine Learning techniques to continuously monitor the status, dynamics and biomass of the land surface. The consortium is composed of Vito, CLS, IIASA, CESBIO, CNES, Sinergise, Joanneum Research, DLR, GAF and Evenflow. I will be working on generic embeddings using self-supervised generative models.