

Family name: **Adrià**

Given names: **Descals Ferrando**

ORCID: 0000-0003-1644-3036

Key achievements

- Demonstrated an exponential increase in wildfire activity linked to climatic warming in the Arctic (Descals et al., 2022, *Science*).
- Developed the first global map of oil palm plantations using satellite big data and deep learning techniques (Descals et al., 2021, *Earth System Science Data*).
- Contributed to the understanding of the impacts of climatic constraints on vegetation phenology under climatic warming (Descals et al., 2023, *Global Change Biology*; Descals et al., 2020, *Science of the Total Environment*)

Current research foci

- Understand long-term impacts of fire regimes on ecosystem functioning and vegetation growth.
- Integrate remote sensing and global ecology to monitor global environmental change under climatic warming.
- Develop novel tools for Earth Observation using state-of-the-art satellite data, cloud computing, and machine learning techniques.

Professional experience

- 01/10/2022 - current position** CREAM (Ecological and Forestry Applications Research Centre) (Spain) / *Postdoc*
Main task: Junior coordinator ALFAwetlands project (Horizon Europe). Mapping Europe's wetlands to evaluate best restoration practices.
- 01/09/2018 – 31/08/2022** CREAM (Spain) / *Predoctoral researcher*
Main task: Ph.D. responses of vegetation phenology under climatic warming.
- 01/09/2017 – 31/08/2018** CREAM (Spain) / *Technician*
Main task: Develop LAI/FAPAR algorithm for the CGLS-Copernicus programme
- 01/11/2016 – 31/03/2017** University of Cambridge (United Kingdom) / *Research consultant*
Main task: Assess water scarcity at the global scale using remote sensing data.
- 01/04/2016 – 30/09/2016** European Commission - Joint Research Center (Italy) / *Traineeship*
Main task: Detect illegal logging on tropical islands using high-resolution SkySat.
- 01/01/2015 – 31/03/2015** University of Agriculture in Krakow (Poland) / *Traineeship*
Main task: Processing airborne LiDAR for improving national forest inventories.

Education

- 01/09/2018 – 09/09/2022** Ph.D. in Terrestrial Ecology. Autonomous University of Barcelona (Spain).
- 01/09/2015 – 15/09/2016** Master of Science in Remote Sensing (60 ECTS). University of Valencia (Spain).
- 01/09/2008 – 07/04/2014** Bachelor's degree in Forestry Engineering with a minor in Forest Management (380 ECTS). Polytechnic University of Valencia (Spain).

Peer-reviewed publications

[1] **Descals, A.**, Verger, A., Yin, G., Filella, I., Fu, Y. H., Piao, S., ... & Penuelas, J. (2023). Radiation-constrained boundaries cause nonuniform responses of the carbon uptake phenology to climatic warming in the Northern Hemisphere. *Global Change Biology*, 29(3), 719-730.

Qualitative assessment (QA): Demonstrated the constraints of radiation on carbon uptake phenology. Future climatic warming will limit the lengthening of the growing season and terrestrial carbon uptake.

- [2] **Descals, A.**, Verger, A., Yin, G., Filella, I., & Peñuelas, J. (2023). Local interpretation of machine learning models in remote sensing with SHAP: the case of global climate constraints on photosynthesis phenology. *International Journal of Remote Sensing*, 44(10), 3160-3173.
QA: Demonstrated feasibility of interpretable machine learning for modelling phenology.
- [3] Filella, I., **Descals, A.**, Balzarolo, M., Yin, G., Verger, A., Fang, H., & Peñuelas, J. (2023). Photosynthetically Active Radiation and Foliage Clumping Improve Satellite-Based NIRv Estimates of Gross Primary Production. *Remote Sensing*, 15(8), 2207.
QA: Contributed by processing all the remote sensing data in the study.
- [4] Gu, H., Yin, G., Yang, Y., Verger, A., **Descals, A.**, Filella, I., ... & Peñuelas, J. (2023). Satellite-Detected Contrasting Responses of Canopy Structure and Leaf Physiology to Drought. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 16, 2427-2436.
QA: Contributed by generating the vegetation indices from MODIS time series.
- [5] **Descals, A.**, Verger, A., Yin, G., Filella, I., & Penuelas, J. (2023). Widespread drought-induced leaf shedding and legacy effects on productivity in European deciduous forests. *Remote Sensing in Ecology and Conservation*, 9(1), 76-89.
QA: Demonstrated the increasing impacts of summer heatwaves on leaf shedding in deciduous forests. The study demonstrates that leaf shedding is more recurrent than previously thought.
- [6] **Descals, A.**, Gaveau, D. L., Verger, A., Sheil, D., Naito, D., & Peñuelas, J. (2022). Unprecedented fire activity above the Arctic Circle linked to rising temperatures. *Science*, 378(6619), 532-537.
QA: Revealed an exponential increase in annual burned area in the Arctic using cloud computing and a 38-year record of satellite data. In the future decades, summer temperatures will cross a threshold and fires will strongly impact the permafrost layer, emitting large amounts of CO₂ and CH₄. The article received high media coverage and is currently in the top 5% of all research outputs scored by Altimetric.
- [7] Yin, G., Verger, **A.**, **Descals, A.**, Filella, I., & Peñuelas, J. (2022). Nonlinear thermal responses outweigh water limitation in the attenuated effect of climatic warming on photosynthesis in northern ecosystems. *Geophysical Research Letters*, 49(16), e2022GL100096.
QA: Contributed by processing SIF and ERA5 data.
- [8] Yang, Y., Chen, R., Yin, G., Wang, C., Liu, G., Verger, A., **Descals, A.**, ... & Peñuelas, J. (2022). Divergent performances of vegetation indices in extracting photosynthetic phenology for northern deciduous broadleaf forests. *IEEE Geoscience and Remote Sensing Letters*, 19, 1-5.
QA: Contributed by generating the vegetation indices from MODIS time series.
- [9] Gaveau, D. L., Locatelli, B., Salim, M. A., Husnayaen, Manurung, T., **Descals, A.**, ... & Sheil, D. (2022). Slowing deforestation in Indonesia follows declining oil palm expansion and lower oil prices. *PLoS One*, 17(3).
QA: Contributed by validating the oil palm time series obtained from Landsat.
- [10] Yin, G., Verger, A., **Descals, A.**, Filella, I., & Peñuelas, J. (2022). A broadband green-red vegetation index for monitoring gross primary production phenology. *Journal of Remote Sensing*.
QA: Contributed by processing the satellite time series and estimating all phenology metrics in the study.
- [11] Gaveau, D. L., **Descals, A.**, Salim, M. A., Sheil, D., & Sloan, S. (2021). Refined burned-area mapping protocol using Sentinel-2 data increases estimate of 2019 Indonesian burning. *Earth System Science Data*, 13(11), 5353-5368.
QA: Contributed by developing the algorithm for burned area detection using Sentinel-2, machine learning, and cloud computing. The study is becoming a reference in burned area monitoring using decametric scale; it demonstrates the feasibility of Sentinel-2 for improved burned area estimates. The study highlighted the government's underestimation of the large burning that occurred in 2019.
- [12] Peaucelle, M., Janssens, I. A., Stocker, B. D., **Descals, A.**, Fu, Y. H., Molowny-Horas, R., ... & Peñuelas, J. (2019). Spatial variance of spring phenology in temperate deciduous forests is constrained by background climatic conditions. *Nature communications*, 10(1), 5388.
QA: Contributed by estimating GDD and phenology metrics.
- [13] Bórnez, K., Verger, A., **Descals, A.**, & Peñuelas, J. (2021). Monitoring the responses of deciduous Forest phenology to 2000–2018 climatic anomalies in the northern hemisphere. *Remote Sensing*, 13(14), 2806.
QA: Contributed by generating the maps of land surface phenology.

- [14] **Descals, A.**, Wich, S., Meijaard, E., Gaveau, D. L., Peedell, S., & Szantoi, Z. (2021). High-resolution global map of smallholder and industrial closed-canopy oil palm plantations. *Earth System Science Data*, 13(3).
QA: The study is the very first global land cover map generated with semantic segmentation (deep learning) and 10-m resolution Sentinel-2 data. The accuracy of the map is also unprecedented given its resolution. The dataset has been downloaded 2,635 times in Zenodo and is becoming a reference in studies of land use changes in the tropics (e.g., it has been included in the catalog of Google Earth Engine and the World Resources Institute)
- [15] Meijaard, ... , **Descals A.**, ... & Sheil, D. (2020). The environmental impacts of palm oil in context. *Nature plants*, 6(12), 1418-1426.
QA: Contributed by evaluating the impacts of oil palm on biodiversity at the global scale.
- [16] **Descals, A.**, Verger, A., Filella, I., ... & Peñuelas, J. (2020). Soil thawing regulates the spring growth onset in tundra and alpine biomes. *Science of the Total Environment*, 742, 140637.
QA: Demonstrated a correlation between soil thawing and the start of the growing season in the Arctic.
- [17] Bornez, K., **Descals, A.**, Verger, A., & Peñuelas, J. (2020). Land surface phenology from VEGETATION and PROBA-V data. Assessment over deciduous forests. *International Journal of Applied Earth Observation and Geoinformation*, 84, 101974.
QA: Contributed by estimating all phenology metrics from Vegetation and Proba-V using different methods.
- [18] Bórnez, K., Richardson, A. D., Verger, A., **Descals, A.**, & Peñuelas, J. (2020). Evaluation of vegetation and PROBA-V phenology using PhenoCam and Eddy covariance data. *Remote Sensing*, 12(18), 3077.
QA: Contributed by estimating all phenology metrics from Vegetation and Proba-V using the threshold method.
- [19] **Descals, A.**, Verger, A., Yin, G., & Peñuelas, J. (2020). A threshold method for robust and fast estimation of land-surface phenology using google earth engine. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 14, 601-606.
QA: Provided an algorithm for rapid processing of satellite data and estimation of phenology metrics in cloud computing platforms. This enables users to process large amounts of satellite data for their own applications.
- [20] **Descals, A.**, Verger, A., Yin, G., & Peñuelas, J. (2020). Improved estimates of arctic land surface phenology using Sentinel-2 time series. *Remote Sensing*, 12(22), 3738.
QA: Provided maps of land surface phenology in the Arctic using decametric-scale satellite data (Sentinel-2). The study demonstrates the feasibility of such measurements in a region with high cloud coverage.
- [21] Yin, G., Verger, A., Filella, I., **Descals, A.**, & Peñuelas, J. (2020). Divergent estimates of forest photosynthetic phenology using structural and physiological vegetation indices. *Geophysical Research Letters*, 47(18), e2020GL089167.
QA: Contributed by estimating the phenology metrics from different MODIS indices.
- [22] **Descals, A.**, Szantoi, Z., Meijaard, E., Sutikno, H., Rindanata, G., & Wich, S. (2019). Oil palm (*Elaeis guineensis*) mapping with details: smallholder versus industrial plantations and their extent in Riau, Sumatra. *Remote Sensing*, 11(21), 2590.
QA: Developed an algorithm for oil palm classification using Random Forest. The study demonstrates the importance of integrating Sentinel-1 and Sentinel-2 (optical and radar data) for oil palm classification.

Seminar and conference contributions

- [1] Verger, A., Weiss, M., **Descals, A.**, Camacho, F., Sánchez-Zapero, J., Lacaze, R., & Baret, F. Long-term time series of global vegetation products: challenges and lessons learnt from AVHRR to Sentinel-3. *European Geosciences Union (EGU) 2023*. Poster presentation.
- [2] **Descals A.**, Verger A., Yin G., Bornez K., Filella I., & Peñuelas J.. Reducing uncertainties in land surface phenology for improved modelling of vegetation climate dynamics. *Living Planet Symposium (LPS) 2022*. Bonn, Germany. Oral presentation.
- [3] **Descals A.**, Verger A., Yin G., Bornez K., Filella I., & Peñuelas J.. Cloud computing and geospatial analysis with Google Earth Engine. *CREAF - Global Ecology Unit Seminars 2021*. Barcelona, Spain. Oral presentation.
- [4] K. Bornez, A. Verger, **A. Descals**, I. Filella, M. Balzarolo, & J. Peñuelas. PROBA-V Land Surface Phenology. *Living Planet Symposium (LPS) 2018*. Ostend, Belgium. Oral presentation.

- [5] **Descals A.**, Alonso L. & Camps-Valls G. Predicting year of plantation with hyperspectral and LiDAR data. *International Geoscience and Remote Sensing Symposium (IGARSS) 2017*, Fort Worth, Texas, USA. Poster presentation.
- [6] **Descals A.**, Hawrylo P., Wezyk P. Monitoring of the forest cover dynamics in the Tatra National Park using remote sensing data and GEOBIA approach. *European Association of Remote Sensing Laboratories (EARSeL) 2015*, Cracow, Poland. Oral Presentation.

Datasets and algorithms

- [1] **Descals, A.** (2023). [Dataset] High-resolution global map of closed-canopy coconut palm. v1.0. Zenodo, <https://zenodo.org/record/8128183>
QA: Global dataset at 10-meter resolution (Sentinel-2) depicting coconut palms. The dataset will be crucial for understanding the impacts of coconut plantations on threatened biodiversity in tropical islands.
- [1] **Descals, A.** (2023). [Code] Machine learning Local Interpretation with SHAP. GitHub, https://github.com/adriadescals/SHAP_PHENO_SIF
QA: The algorithm integrates explainable machine learning and remote sensing. The code may help researchers to create maps that explain their importance in a model; for instance, assess the importance of gridded climate re-analysis for explaining Leaf Area Index observations.
- [2] **Descals, A.** (2022). [Code] Burned area mapping using Sentinel-2 time series in the Arctic. Zenodo, <https://zenodo.org/record/7277895>
QA: Algorithm for burned area mapping using Sentinel-2 and cloud computing in the Arctic. I originally developed this algorithm for Indonesia, which unfolded the large underestimation in burned area by the Indonesian government. See more details in ref [11] in the section *Peer-reviewed publications*.
- [2] **Descals, A.** (2021). [Dataset] High resolution global industrial and smallholder oil palm map for 2019 v1.0. Zenodo, <https://doi.org/10.5281/zenodo.4617748>
QA: Global dataset at 10-m resolution (Sentinel-2) depicting oil palm plantations. The dataset is becoming a reference in studies of land use changes in the tropics. See more details in ref [14] in the section *Peer-reviewed publications*.
- [3] **Descals, A.** (2020). [Code] Maximum Separation method for land surface phenology estimation. GitHub, https://github.com/adriadescals/MaximumSeparation_method
QA: Algorithm for rapid processing of satellite data and estimation of phenology metrics in cloud computing platforms. This enables users to process large amounts of satellite data for their own applications.

Fellowships

- 01/01/2015 – 31/03/2015** **Erasmus+ (traineeship)** from the European Union (host institution: University of Agriculture in Krakow, Poland)
- 01/10/2013 – 30/03/2014** **Travel grant** from the Polytechnic University of Valencia for developing the bachelor's thesis outside the EU (host institution: Mie University, Japan).
- 01/01/2012 – 30/06/2012** **Erasmus Mobility Grant (student mobility)** from the European Union (host institution: Mendel University, Czech Republic).

Professional activities and service

- Journal reviewer for *Nature Climate Change*, *Nature Communications*, and *Remote Sensing of Environment*.
- Contributing author to the Algorithm Theoretical Basis Document (ATBD) of the biophysical variables in the Copernicus Global Land Service (Copernicus programme).

Language skills

Catalan and Spanish: Mother tongues

English: Proficient (spoken and written)

Computer skills

R, MATLAB, Python, JavaScript (Google Earth Engine), ENVI, ArcGIS/QGIS, C, AutoCAD