1. LIST OF PEOPLE WHO MAKE UP THE RESEARCH TEAM

The Geospatial and Precision Technologies for Sustainable Agriculture Group (tec4AGR0) has the qualification of research group by CSIC, and it belongs to Institute of Agricultural Sciences. Our scientific objectives are focused on three areas: 1) Development of tools for obtaining and processing spatial information on crops and their major pests, such as monitoring technologies, proximity sensors, remote sensors/drones, and management zones; 2) Application of new monitoring technologies and Decision Support Systems (DDS) to smart weed control; 3) Study of biotic (pests) and abiotic (water, nutrients) factors affecting their spatial and temporal impacts in Mediterranean crops using geospatial technologies in combination with environmental and agronomic data (crop development, site conditions, climate, soil) on diverse scales.

In recent years we have been assessing the agronomic, economic and environmental consequences of using different types of cropping systems in rainfed agriculture, focusing particularly on their effects on the vegetation dynamics, crop productivity and environmental footprint. We have developed tools (e.g., customized algorithms for remotely-sensed data and image analysis) for obtaining and processing spatial information on several herbaceous and woody crops and retrieving their main features related to crop production (e.g., 3D canopy architecture) and protection (e.g., weed infestations). The group has also recently open a new research line on water use efficiency and precision irrigation using both remote and on-ground sensing.

The current members of the Research Team are:

Name	**Position**
José Manuel Peña Barragán	Tenured Scientist (IP of this project)
José Dorado Gómez	Scientific Researcher (co-IP)
Héctor Nieto Solana	Tenured Scientist
Irene Borra Serrano	Post-doc “Juan de la Cierva” granted
Vicente Burchard Levine	Post-doc “Juan de la Cierva” granted
Benjamin Mari	Post-doc hired
Gustavo Adolfo Mesías Ruiz	PhD Fellow
Juan Diego Mena Castillo	PhD Fellow
Miguel Ángel Herrezuelo Bermúdez	PhD Fellow
David Campos López	Research assistant
José Manuel Martín Fernández	Research assistant

2. SCIENTIFIC-TECHNICAL ACHIEVEMENTS AND CONTRIBUTIONS TO SOCIETY

Activity of the Research Team (abbreviated, last 5 years):

- 4 Research contracts obtained as services to companies.
- 2 Innovation & Transference Projects
- 5 patent, software or methods developed and registered as intellectual properties in the past that are still active.
- Research projects: 4 International RTD, 5 National RTD program, 3 by CSIC (all under public competition).
- 82 articles in JCR journals.
- 1 books edited, 11 book chapters and 14 contributions in technical journals.
- 25 chapters in multi-authored volumes.
- 3 PhD thesis (+3 in progress) and 5 Master thesis (+3 in progress).
- 51 contributions to international and national congress.

Publications in JCR journals (last 5 years)

1. Belissent, N., Peña, J.M., Mesías-Ruiz, G.A., Shawe-Taylor, J., Pérez-Ortiz, M., 2024. Transfer and zero-shot learning for scalable weed detection and classification in UAV images. Knowledge-Based Systems 292, 111586.
2. Burchard-Levine, V., Borra-Serrano, I., Peña, J.M., Kustas, W.P., Guerra, J.G., Dorado, J., Mesías-Ruiz, G., Herrezuelo, M., Mary, B., McKee, L.M., de Castro, A.I., Sanchez-Élez, S., Nieto, H., 2024. Evaluating the precise grapevine water stress detection using unmanned aerial vehicles and evapotranspiration-based metrics. Irrig Sci. https://doi.org/10.1007/s00271-024-00931-9.
1. Burchard-Levine, V., Nieto, H., Mesías-Ruiz, G.A., Dorado, J., de Castro, A.I., Peña, J.M., 2023. Precision monitoring of vine water stress using UAVs and opensource processing chains, in: Precision Agriculture´23. Wageningen Academic Publishers, pp. 99–105.
2. PJ Gómez-Giráldez, J Cristóbal, H Nieto, D García-Díaz, R Díaz-Delgado, 2024. Validation of Gross Primary Production Estimated by Remote Sensing for the Ecosystems of Doñana National Park through Improvements in Light Use Efficiency Estimation. Remote Sensing 16 (12), 2170
3. T Ghisi, M Fischer, H Nieto, N Kowalska, G Jocher, L Homolová, 2024. Evaluation of the METRIC and TSEB remote sensing evapotranspiration models in the floodplain area of the Thaya and Morava Rivers. Journal of Hydrology: Regional Studies 53, 101785.
4. MC Anderson, WP Kustas, JM Norman, GT Diak, CR Hain, F Gao, Y Yang, H Nieto. 2024. A brief history of the thermal IR-based Two-Source Energy Balance (TSEB) model–diagnosing evapotranspiration from plant to global scales. Agricultural and Forest Meteorology 350, 109951.
5. Escolà, A., Peña, J.M., López-Granados, F., Rosell-Polo, J.R., de Castro, A.I., Gregorio, E., Jiménez-Brenes, F.M., Sanz, R., Sebé, F., Llorens, J., Torres-Sánchez, J., 2023. Mobile terrestrial laser scanner vs. UAV photogrammetry to estimate woody crop canopy parameters – Part 1: Methodology and comparison in vineyards. Computers and Electronics in Agriculture 212, 108109.
6. Mesías-Ruiz, G.A., Borra-Serrano, I., Peña, J.M., de Castro, A.I., Fernández-Quintanilla, C., Dorado, J., 2024. Weed species classification with UAV imagery and standard CNN models: Assessing the frontiers of training and inference phases. Crop Protection 182, 106721.
7. Mesías-Ruiz, G.A., Pérez-Ortiz, M., Dorado, J., de Castro, A.I., Peña, J.M., 2023. Boosting precision crop protection towards agriculture 5.0 via machine learning and emerging technologies: A contextual review. Frontiers in Plant Science 14.
8. Torres-Sánchez, J., Escolà, A., Isabel de Castro, A., López-Granados, F., Rosell-Polo, J.R., Sebé, F., Manuel Jiménez-Brenes, F., Sanz, R., Gregorio, E., Peña, J.M., 2023. Mobile terrestrial laser scanner vs. UAV photogrammetry to estimate woody crop canopy parameters – Part 2: Comparison for different crops and training systems. Computers and Electronics in Agriculture 212, 108083.
9. Guerra, J.G., Cabello, F., Fernández-Quintanilla, C., Peña, J.M., Dorado, J. (2022). How weed management influence plant community composition, taxonomic diversity and crop yield: A long-term study in a Mediterranean vineyard. Agriculture, Ecosystems and Environment, 326, 107816
10. Nassar, A., Torres-Rua, A., Hipps, L., Kustas, W., McKee, M., Stevens, D., Nieto, H., Keller, D., Gowing, I., Coopmans, C. (2022) Using Remote Sensing to Estimate Scales of Spatial Heterogeneity to Analyze Evapotranspiration Modeling in a Natural Ecosystem. Remote Sensing, 14 (2), 372,.
11. Guerra, J.G., Cabello, F., Fernández-Quintanilla, C., Dorado, J. (2021) A trait-based approach in a Mediterranean vineyard: Effects of agricultural management on the functional structure of plant communities. Agriculture, Ecosystems and Environment, 316, 107465
12. Lima, F., Blanco-Sepúlveda, R., Gómez-Moreno, M.L., Dorado, J., Peña, J.M. (2021) Mapping tillage direction and contour farming by object-based analysis of UAV images. Computers & Electronics Agriculture, 187, 106281
13. Dorado, J., Almendros, G. (2021) Organo-mineral interactions involved in herbicide sorption on soil amended with peats of different maturity degree. Agronomy, 11(5), 869
14. de Castro, A.I., Shi, Y., Maja, J.M., Peña, J.M. (2021). UAVs for Vegetation Monitoring: Overview and Recent Scientific Contributions. Remote Sensing 13, 2139.
15. Lima, F., Blanco-Sepúlveda, R., Gómez-Moreno, M.L., Dorado, J., Peña, J.M., (2021). Mapping tillage direction and contour farming by object-based analysis of UAV images. Computers & Electronics Agriculture, 187, 106281.
16. Aguirre-García, S.-D., Aranda-Barranco, S., Nieto, H., Serrano-Ortiz, P., Sánchez-Cañete, E.-P., Guerrero-Rascado, J.-L. (2021) Modelling actual evapotranspiration using a two source energy balance model with Sentinel imagery in herbaceous-free and herbaceous-cover Mediterranean olive orchards. Agricultural and Forest Meteorology, 311, 108692
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assessment and monitoring of forest health: A systematic evidence synthesis. Forests, 12 (8), 1134
18. Nassar, A., Torres-rua, A., Kustas, W., Alfieri, J., Hipps, L., Prueger, J., Nieto, H., Alsina, M.M., White, W., McKee, L., Coopmans, C., Sanchez, L., Dokoozlian, N. (2021) Assessing daily evapotranspiration methodologies from one-time-of-day suas and ec information in the grapex project. Remote Sensing, 13 (15), 2887
19. Burchard-Levine, V., Nieto, H., Riaño, D., Migliavacca, M., El-Madany, T.S., Guzinski, R., Carrara, A., Martín, M.P. (2021) The effect of pixel heterogeneity for remote sensing based retrievals of evapotranspiration in a semi-arid tree-grass ecosystem. Remote Sensing of Environment, 260, 112440
20. Simpson, J.E., Holman, F., Nieto, H., Voelksch, I., Mauder, M., Klatt, J., Fiener, P., Kaplan, J.O. (2021) High spatial and temporal resolution energy flux mapping of different land covers using an off-the-shelf unmanned aerial system. Remote Sensing, 13 (7), 1286
21. Bellvert, J., Nieto, H., Pelechá, A., Jofre-Čekalović, C., Zazurca, L., Miarnau, X. (2021) Remote Sensing Energy Balance Model for the Assessment of Crop Evapotranspiration and Water Status in an Almond Rootstock Collection. Frontiers in Plant Science, 12, 608967
22. Burchard-Levine, V., Nieto, H., Riaño, D., Kustas, W.P., Migliavacca, M., El-Madany, T.S., Nelson, J.A., Andreu, A., Carrara, A., Beringer, J., Baldocchi, D., Martín, M.P. (2021) A remote sensing-based three-source energy balance model to improve global estimations of evapotranspiration in semi-arid tree-grass ecosystems. Global Change Biology , 18(4), 1493-1515
23. Guzinski, R., Nieto, H., Sanchez, J.M., Lopez-Urrea, R., Boujnah, D.M., Boulet, G. (2021) Utility of Copernicus-Based Inputs for Actual Evapotranspiration Modeling in Support of Sustainable Water Use in Agriculture. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 14, pp. 11466-11484
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26. Lati R.N., Rasmussen J. Andújar D., Dorado J., Berge T.W., Wellhausen C., Pflanz M., Nordmeyer H., Schirrmann M., Eizenberg H., Neve P., Jørgensen R.N., Christensen S. (2020) Site-specific weed management - constraints and opportunities for the weed research community. Weed Research, 61(3), 147-153
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28. Messina G., Peña J.M., Vizzari M., Modica G. (2020) A comparison of UAV and satellites multispectral imagery in monitoring onion crop. An application in the 'cipolla rossa di tropea' (Italy). Remote Sensing 12, 3424
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31. Bellvert, J., Jofre-Ĉekalović, C., Pelechá, A., Mata, M., Nieto, H. (2020) Feasibility of using the two-source energy balance model (TSEB) with Sentinel-2 and Sentinel-3 images to analyze the spatio-temporal variability of vine water status in a vineyard. Remote Sensing, 12 (14), 2299
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33. Song, L., Bian, Z., Kustas, W.P., Liu, S., Xiao, Q., Nieto, H., Xu, Z., Yang, Y., Xu, T., Han, X. (2020) Estimation of surface heat fluxes using multi-angular observations of radiative surface temperature. Remote Sensing of Environment, 239, 111674
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35. Aboutalebi, M., Torres-Rua, A.F., McKee, M., Kustas, W.P., Nieto, H., Alsina, M.M., White, A., Prueger, J.H., McKee, L., Alfieri, J., Hipps, L., Coopmans, C., Dokoozlian, N. (2020) Incorporation of Unmanned Aerial Vehicle (UAV) point cloud products into remote sensing evapotranspiration models. Remote Sensing, 12 (1), 50

3. DOCTORAL TRAINING CAPACITY OF THE RESEARCH GROUP

PhD Thesis presented in the last 5 years

Associated to the project "Desarrollo y validación de nuevas tecnologías de teledetección y aprendizaje automático aplicadas al control inteligente de malas hierbas"
Student: Juan Diego Mena Castillo
Supervisors: J. Dorado and I. Borra
University: Universidad Politécnica de Madrid

Associated to the project "New technological, agronomic and computer tools for weed management"
Student: Gustavo Adolfo Mesías Ruiz
Supervisors: J. Dorado and J.M. Peña
University: Universidad Politécnica de Madrid

Development of a monitoring system for forest health in the Autonomous Region of Madrid using remote sensing techniques.
Student: Pablo Jesús Torres Hernández
Supervisors: M. García and H. Nieto
University: Universidad de Alcalá

Evaluation and optimization of methodologies to estimate crop evapotranspiration in woody crops throughout remote sensing.
Student: Christian Cekalovic
Supervisors: J. Bellvert and H. Nieto
University: Universidad de Lleida

Desarrollo de nuevas herramientas tecnológicas y conceptuales para la implantación de sistemas de Gestión Integrada de Malas hierbas en viña.
Student: José García Guerra
Supervisors: J. Dorado and F. Cabello
University: Universidad Politécnica de Madrid

Monitoring Water Fluxes in Complex Landscapes: Improving remote sensing-based evapotranspiration models for tree-grass ecosystems.
Student: Vicente Felipe Burchard Levine
Supervisors: M.P. Martín Isabel, H. Nieto and D. Riaño
University: Universidad de Alcalá

Development and application of innovative remote sensing techniques for early-season monitoring of crop vigor and vegetative stress in Mediterranean agro-ecosystems
Student: Gaetano Messina
Supervisors: G. Modica and J.M. Peña
University: Università degli Studi Mediterranea di Reggio Calabria

The tec4AGRO group is integrated in the Doctorate Programs in Agro-environmental Technology for a Sustainable Agriculture (UPM, Madrid); in Agricultural Engineering, Food, Forestry, and Sustainable Rural Development (UCO, Cordoba); and in Remote Sensing, GIS and Cartography (UAH Alcalá de Henares). The group is active member of the Interdisciplinary Thematic Platform TELEDETECT, which integrates all CSIC research groups actively working on remote sensing. Therefore, the candidate will also benefit from the expertise and experience of TELEDETECT participants in diverse disciplines of interest.