



## ECOPOTENTIAL Reporting period: 30<sup>th</sup> November 2016 [M18] – 28<sup>th</sup> February 2018 [M33]

### WP 4 activities

#### Task 4.1 EO data pre-processing and integration modules (Lead: DELTARES) [M4-M16]

This task finished on M16 and D4.1 was submitted on M16. Additionally, the outputs of the task, such as the optimal methods for preprocessing Sentinel 2 data, were presented to the Protected Areas Managers during the Protected Area Managers Training week held in Pisa (19<sup>th</sup>-23<sup>rd</sup> February 2018).

#### Task 4.2 Retrieval bio-geophysical variables modules (Lead: UPS) [M8-M23]

This task was finished during this period [M23]. Terrestrial bio-geophysical variables retrieval and marine, coastal and transitional waters monitoring were conducted for all PA resulting in more than 350 requests, more than 250 products developed and more than 0.6 Tb of information generated. Among such data user can find products such as above ground biomass, tree height, tree canopy density, leaf type, land cover classification, soil and vegetation moisture, land surface temperature, surface albedo, ocean color products, wind fields, sea surface temperature, chlorophyll a, etc. Although the task is over, some PA product requests could still be provided until the end of WP4 [M40]. Besides, significant effort has been made on improving the metadata of the data developed, as part of Task 4.6.

The results of this task can be found on the ECOPotential FTP and on the Project web map browser (<http://maps.ecopotential-project.eu/>). These data were also presented to the Protected Areas Managers during the Protected Area Managers Training week held in Pisa (19<sup>th</sup>-23<sup>rd</sup> February 2018). Publication of the results in scientific literature is on-going.

This task D4.2 entitled *EO Biophysical parameters, land use and habitats extraction modules* was submitted on M22.

#### Task 4.3 Land cover/use, ecosystem and habitats classifications (Lead: CNR) [M8-M23]

This task was finished during this period [M23]. The last 6 months of the task were dedicated to work on improving the input data to the EODESM model for all protected areas and on implementing the EODESM system on the Virtual Lab (WP10). The results can be computed through the Virtual Lab or accessed through the FTP and the Project web map browser (<http://maps.ecopotential-project.eu/>).

These activities were reported in Deliverable D4.2 *EO biophysical parameters, land use and habitats extraction modules* that was submitted on M22.

#### Task 4.4 LC/LU and habitat change detection modules (Lead: UNSW) [M8-M30]

The task was finished during this period although some work on improving the interpretation of the changes detected by the EODEMS model is still ongoing. The activities have been reported on Deliverable *D4.3 EO change detection modules* and *D4.5 Time series EOFs (maps and analysis)* that were submitted on time. Based on a collection of input datasets stored in a specific folder of the ftp, the EODEMS algorithm is able to create 2 land cover maps for the same area but with different time extents. Then the EODESM algorithm is creating a comparison map that can be analyzed deriving causes and consequences which can be associated with each

change. The EODESM algorithm has been integrated in the ECOPotential virtual lab and presented to the PA in the ECOPotential training week in Pisa.

#### Task 4.5 Data mining tools (Lead: DLR) [M12-M30]

This is a task in progress. In this task, a tool for visualization and management of satellite image time series has been implemented. The tool visualizes (zoom, pan) time series band combinations, and the spectral and temporal graph of a coordinate. It has been tested for The region of Doñana National Park, with 299 Landsat 5, Landsat 7 and Landsat 8 products. A satellite image time series training data set has been prepared with the following steps: data is filtered to remove artifacts, e.g., cloudy scenes; unsupervised clustering is performed to group data with similar temporal profiles; analyze clusters to understand the evolutions of different land covers; verification of clustering results with experts from Estación Biológica de Doñana (EBD); installation and parameters configuration of Recurrent Neural Networks - Long Short Term Memory networks (LSTM), by performing the first deep learning experiments. The application of a recurrent neural network (RNN) will be performed in the next reporting period.

This task Deliverable *D4.4 EO data mining tools* submission deadline was extended to M36 and submitted on time.

#### Task 4.6 EO product quality, validation, intercomparison and documentation (Lead: CREAF) [M4-M40]

This is a task in progress. In the last months, this task has guided the process of completing the metadata of the products created by the previous activities in Task 4.2 and Task 4.3. The guidance is based on populating the INSPIRE metadata schema. The INSPIRE metadata profiles were not designed for Earth observation products and the JRC documentation needed more to be extended, ensuring conformity with the WP10 requirements. An internal online webinar, organized on the 27<sup>th</sup> of November 2017 by CREAF, supported the written materials, which are accessible to all the project partners. Next steps are addressing/improving the ancillary data quality parameterization and to document it, and contributing to the interpretation of these data with the help of the protected areas.

*D4.6 EO data quality elicitation and documentation* is in progress.

A publication with the compendium of the main results in scientific literature will be another significant next step.

#### Task 4.7 EO data preparation for the protected sites ready to use in WP6, WP7 & WP8 (Lead: UAB) [M4-M40]

This is a task in progress. WP4 is populating a web map browser (<http://maps.ecopotential-project.eu/>) (that has been designed and implemented in WP10). Data loaded in the map service that supports the map browser have been homogenized in terms of projection, format and scales. Color-maps specific for each layer have been selected. Time series are considered as a single layer that can be animated in order to display and visualize its time evolution. Metadata and downloadable versions of data at full scale are also accessible options of the map browser.

Besides, WP4 has designed and edited a science popularization book addressed to a wide audience. The book, entitled SPACED – Using Earth Observations to Protect Natural Landscapes illustrates the capacities of Remote Sensing regarding the management of natural landscapes. This book complements the SPACED photo-exhibition (Task 12.8) which was held at the European Parliament in Brussels from the 8<sup>th</sup> to the 12<sup>th</sup> of January 2018.



## Publications

### Papers:

1. Cho M., Ramoelo A., Dziba L. 2017. Response of Land Surface Phenology to Variation in Tree Cover during Green-Up and Senescence Periods in the Semi-Arid Savanna of Southern Africa, *Remote Sensing*, 9(7), pp: 689
2. Díaz-Delgado, R., Lucas, R., Hurford, C. 2017 *The Roles of Remote Sensing in Nature Conservation: A Practical Guide and Case Studies*. Springer Nature. 332 p.
3. Dirnböck, T., Foldal, C., Djukic, I., Kobler, J., Haas, E., Kiese, R., Kitzler, B. 2017. Historic nitrogen deposition determines future climate change effects on nitrogen retention in temperate forests. *Climatic Change* 144(2): 221-235. doi:10.1007/s10584-017-2024-y.
4. Dumitru C.O.; G. Schwarz, and M. Datcu, "SAR Image Land Cover Datasets for Classification Benchmarking of Temporal Changes", *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (J-STARS)*, Vol. 11, Issue 5, 2018, pp. 1-22.
5. Gavish, Y.; J. O'Connell, C. J. Marsha, W. E. Kunin, C. Tarantino, V. Tomaselli, P. Blonda. Comparing the performance of flat and hierarchical habitat/land-cover classification models in a NATURA 2000 site. Approved on 4 Dec. 2017 by *ISPRS Journal of photogrammetry and Remote Sensing* (in press).
6. Green, A.J., Alcorlo, P., Peeters, E.T., Morris, E.P., Espinar, J.L., Bravo-Utrera, M.A., Bustamante, J., Díaz-Delgado, R., Koelmans, A.A., Mateo, R., Mooij, W.M., Rodríguez-Rodríguez, M., van Nes, E.H. & Scheffer, M. (2017) Creating a safe operating space for wetlands in a changing climate. *Frontiers in Ecology and the Environment*, 15, 99–107.
7. Kordelas, G., Manakos, I., Aragones, D., Diaz-Delgado, R., Bustamante, J. "Fast and automatic data-driven thresholding for inundation mapping with Sentinel-2 data", *Remote Sensing*, 2018, accepted for publication.
8. Lange M, Dechant B, Rebmann C, Vohland M, Cuntz M, Doktor D (2017) Validating MODIS and Sentinel-2 NDVI Products at a Temperate Deciduous Forest Site Using Two Independent Ground-Based Sensors. *Sensors* 17 (8) 1855, doi:10.3390/s17081855
9. Lucas, R.M. and Mitchell, A. (2017). Integrated land cover and change classifications. In: *The Roles of Remote Sensing in Nature Conservation: A Practical Guide and Case Studies*. Díaz-Delgado, R., Lucas, R. & Hurford, C. 2017 Springer Nature. 295-308.
10. Lumbierres, M., Méndez, P.F., Bustamante, J., Soriguer, R. & Santamaría, L. (2017) Modeling Biomass Production in Seasonal Wetlands Using MODIS NDVI Land Surface Phenology. *Remote Sensing*, 9, 392.
11. Manakos I., Technitou E., Petrou Z., Karydas C., Tomaselli V., Veronico G., Mountrakis G. (2017). Multi-modal knowledge base generation from very high resolution satellite imagery for habitat mapping. *European Journal of Remote Sensing*, 49, 1033–1060. doi:10.5721/EuJRS20164953
12. Niphadkar M., Nagendra H., Tarantino C., Adamo M., & Blonda P. (2017). Comparing pixel and object based approaches to map an understory invasive shrub in tropical mixed forests. *Frontiers in Plant Science*, 8, 892. doi:10.3389/fpls.2017.00892.
13. Padró, J.-C., Pons, X., Aragonés, D., Díaz-Delgado, R., García, D., Bustamante, J., Pesquer, L., Domingo-Marimon, C., González-Guerrero, Ò., Cristóbal, J., Doktor, D. & Lange, M. (2017) Radiometric Correction of Simultaneously Acquired Landsat-7/Landsat-8 and Sentinel-2A Imagery Using Pseudoinvariant Areas (PIA): Contributing to the Landsat Time Series Legacy. *Remote Sensing*, 9, 1319.
14. Perennou, C., Guelmami, A., Paganini, M., Philipson, P., Poulin, B., Strauch, A., Tottrup, C., Truckenbrodt, J. & Geijzendorffer, I.R. (2018) "Mapping Mediterranean Wetlands With Remote Sensing: A Good-Looking Map Is Not Always a Good Map." *Advances in Ecological Research* Vol 58: 243–277. <https://doi.org/10.1016/bs.aecr.2017.12.002>  
<https://www.sciencedirect.com/science/article/pii/S0065250417300272>
15. Pettorelli, N., Schulte, Tulloch, A., Dubois, G., Macinnis-Ng, C., Queirós, A., Keith, D.A., Wegmann, M., Schrod, F., Stellmes, M., Sonnenschein, R., Geller, G., Roy, S., Somers, B., Murray, N., Bland, L., Geijzendorffer, I.,



- Kerr, J.T., Broszeit, S., Leitão, P.J., Duncan, C., El Serafy, G., He, K.S., Blanchard, J.L., Lucas, R.M., Mairota, P., Webb, T.J. and Nicholson, E. (2017). Satellite remote sensing of ecosystem functions: opportunities, challenges and way forward. *Remote Sensing in Ecology and Conservation*, DOI:10.1002/rse2.59
16. Ramírez, F., Afán, I., Davis, L.S. & Chiaradia, A. (2017) Climate impacts on global hot spots of marine biodiversity. *Science Advances*, 3, e1601198.
  17. Ramírez, F., Rodríguez, C., Seoane, J., Figuerola, J. & Bustamante, J. (2018) How will climate change affect endangered Mediterranean waterbirds? *PLOS ONE*, 13, e0192702.
  18. Ramoelo, A.; Cho, M.A. 2018. Explaining Leaf Nitrogen Distribution in a Semi-Arid Environment Predicted on Sentinel-2 Imagery Using a Field Spectroscopy Derived Model. *Remote Sensing*, 10, 269.
  19. Schröter, M., Koellner, T., Alkemade, R., Arnhold, S., Bagstad, K.J., Frank, K., Erb, K.-H., Kastner, T., Kissinger, M., Liu, C.R., López-Hoffman, L., Maes, J., Marques, A., Martin-Lopez, B., Meyer, C., Schulp, N., Schulze, J., Wolff, S. & Bonn, A. (2018) Interregional flows of ecosystem services: a conceptual framework for future ecosystem service assessments. *Ecosystem Services*.
  20. Tarantino C., Lovergine F., Niphadkar M., Lucas R., Nativi S., Blonda P. (2016). Towards Operational Detection of Forest Ecosystem Changes in Protected Areas. *Remote Sensing*, 8(10), 850. doi:10.3390/rs8100850.
  21. Tomaselli V.; M. Adamo, G. Veronico, S. Sciandrello, C. Tarantino, P. Dimopoulos, P. Medagli, H. Nagendra, P. Blonda. (2016). "Definition and application of expert knowledge on vegetation pattern, phenology and seasonality for habitat mapping, as exemplified in a Mediterranean coastal site", *Plant Biosystems*, pp. 1-13, September 2016, doi: 10.1080/11263504.2016.1231143, I.F.=1.360.
  22. Vidal-Macua, J. J.; M. Ninyerola, A. Zabala, C. Domingo-Marimon, X. Pons, Factors affecting forest dynamics in the Iberian Peninsula from 1987 to 2012. The role of topography and drought, *Forest Ecology and Management*, Volume 406, 2017, Pages 290-306, ISSN 0378-1127, <https://doi.org/10.1016/j.foreco.2017.10.011>.  
(<http://www.sciencedirect.com/science/article/pii/S037811271730960X>)
  23. Vidal-Macua, J. J.; M. Ninyerola, A. Zabala, C. Domingo-Marimon, O. Gonzalez-Guerrero, X. Pons, Environmental and socioeconomic factors of abandonment of rainfed and irrigated crops in northeast Spain, *Applied Geography*, Volume 90, 2018, Pages 155-174, ISSN 0143-6228, <https://doi.org/10.1016/j.apgeog.2017.12.005>.  
(<http://www.sciencedirect.com/science/article/pii/S0143622817310251>)

#### Book chapters:

1. Dumitru C.O, G. Schwarz, D. Espinoza-Molina, M. Datcu, H. Hummel, and C.A. Hummel, "Analysis of Coastal Areas Using SAR Images: A Case Study of the Dutch Wadden Sea Region", book chapter in *Topics in Radar Signal Processing*, InTech Publishing, Rijeka, Croatia, March 2018.
2. Tarantino C., Blonda P., Adamo M., Niphadkar M., Lucas. R. (2017). Changes in tropical forest: assessing different detection techniques. Chapter 4.3.3. in *GOFC-GOLD & GEO BON (Eds.). A Sourcebook of Methods and Procedures for Monitoring Essential Biodiversity Variables in Tropical Forests with Remote Sensing*. Report version UNCBD COP-13, GOFC-GOLD Land Cover Project Office, Wageningen University, The Netherlands. ISSN: 2542-6729.

#### Conference proceedings:

1. Bahmayar R., M. Datcu, C. Dumitru, D. Espinoza-Molina, G. Schwarz, C. Hummel, H. Hummel, P. Blonda, R. Diaz-Delgado."Analysis of Protected Areas: The Use of Satellite Images for Data Mining within ECOPOTENTIAL", in *Proc. of the Worldcover 2017 ESA Conference*, Frascati, Italy, 14-16 March, 2017
2. Bassani C., C. Tarantino, K. Tijani, P. Blonda. (2017). "Aerosol effect on the performance of a change detection technique", in *Proc. of the Worldcover 2017 ESA Conference*, Frascati, Italy, 14-16 March, 2017.



3. Dirnböck, T., Kobler, J., Kraus, D., Schindlbacher, A., Seidl, R., Mirtl, M. 2017. From long-term ecosystem monitoring to regional modelling of ecosystem function in the National Park Kalkalpen, Austria. Proceedings of the 6th International Symposium for Research in Protected Areas 2017, Salzburg, Austria.
4. Domingo-Marimon C., L. Pesquer, N. Gómez-Cabajo, M.T. Jiménez, X. Pons, "On the interest of the spectral bands in the automatic selection of high quality MODIS data through spatial pattern identification", Proc. SPIE 10427, Image and Signal Processing for Remote Sensing XXIII, 104270X (4 October 2017); doi: 10.1117/12.2278596; <http://dx.doi.org/10.1117/12.2278596> <https://www.spiedigitallibrary.org/conference-proceedings-of-spie/10427/104270X/On-the-interest-of-the-spectral-bands-in-the-automatic/10.1117/12.2278596.pdf?SSO=1>
5. Dumitru C.O., G. Schwarz, and M. Datcu, "Image Representation Alternatives for the Analysis of Satellite Image Time Series", MultiTemp 2017, Bruges, Belgium, 27-29 June 2017, pp.1-4, online.
6. Dumitru C.O., G. Schwarz, and M. Datcu, "Monitoring of Coastal Environments Using Data Mining", Knowledge Extraction and Semantic Annotation (KESA 2018), Athens, Greece, 22-26 April 2018, accepted.
7. Espinoza-Molina, Daniela und Bahmanyar, Reza und Datcu, Mihai und Diaz-Delgado, Ricardo und Bustamante, Javier (2017) Land-Cover Evolution Class Analysis in Image Time Series of Landsat and Sentinel-2 Based on Latent Dirichlet Allocation. In: Proceeding of MultiTemp 2017. IEEEExplore. Multitemp 2017, 27-29 Jun 2017, Bruges, Belgium.
8. Espinoza-Molina, Daniela und Bahmanyar, Reza und Diaz-Delgado, Ricardo und Bustamante, Javier und Datcu, Mihai (2017) Land-Cover Change Detection Using Local Feature Descriptors Extracted From Spectral Indices. In: Proceedings IGARSS 2017, Seiten 1938-1941. IEEE Xplore. IGARSS 2017, 23.-28. Juli 2017, Fort Worth, TX, USA.
9. Filipponi F., Valentini E., Taramelli A., 2017. Sea Surface Temperature changes analysis, an Essential Climate Variable for Ecosystem Services provisioning. 2017 9th International Workshop on the Analysis of Multitemporal Remote Sensing Images (MultiTemp), Bruges (Belgium) 27-29 June 2017, IEEE Conference Publications. DOI:10.1109/Multi-Temp.2017.8035255. ISBN: 978-1-5386-3327-4.
10. Tarantino C., P. Blonda, M. Adamo. (2016). "An application of the Cross-Correlation Analysis to detect changes in semi-natural grasslands to artificial structures using very high and high resolution satellite data", in Proc. of the 2016 IEEE Workshop on Environmental, Energy and Structural Monitoring Systems(EESMS), Bari, Italy, 13rd -14th June, 2016, pp. 226-231, ISBN 978-1-5090-2369-1.

#### Posters:

1. Valentini, E., Filipponi, F., Nguyen Xuan, A., Taramelli, A . (2017) . Demonstration of SST value as EBVs descriptor in the Mediterranean Sea. AGU Fall Meeting. New Orleans (USA), 11-15 December 2017.
2. Valentini E., Nguyen Xuan A., Filipponi F., Taramelli A., 2017. Coastal vulnerability assessment using Fuzzy Logic and Bayesian Belief Network approaches. European Geosciences Union General Assembly 2017, Wien (Austria), 23-28 April 2017.
3. Lucas, R., Manakos, I., Mitchell, A., Blonda, P., 2018. The EODESM system: a New Approach to Land Cover and Change Classification. NASA LCLUC Spring Science Team Meeting, Gaithersburg, USA, 03-05 April 2018.
4. Pesquer, L., Domingo-Marimon, C., Gómez-Carbajo, N., Jiménez-Díaz, MT. (2017). Comparative analysis of variograms obtained from high wuality filtered MODIS spectral bands. Spatial Statistics Conference. Lancaster, UK. 4-7 July 2017.