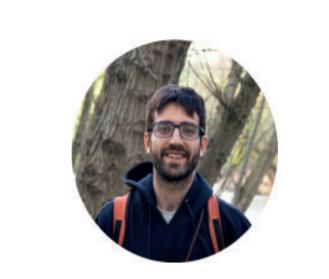


Introduction & aims

Remote Sensing Vegetation Indices to study migratory insect seasonal movements and population outbreaks











distribution suitability

Limiting factors

forcing migratory

movements:

Low temperatures

in Palearctic

Lack of foraging

resources in

Afrotropic

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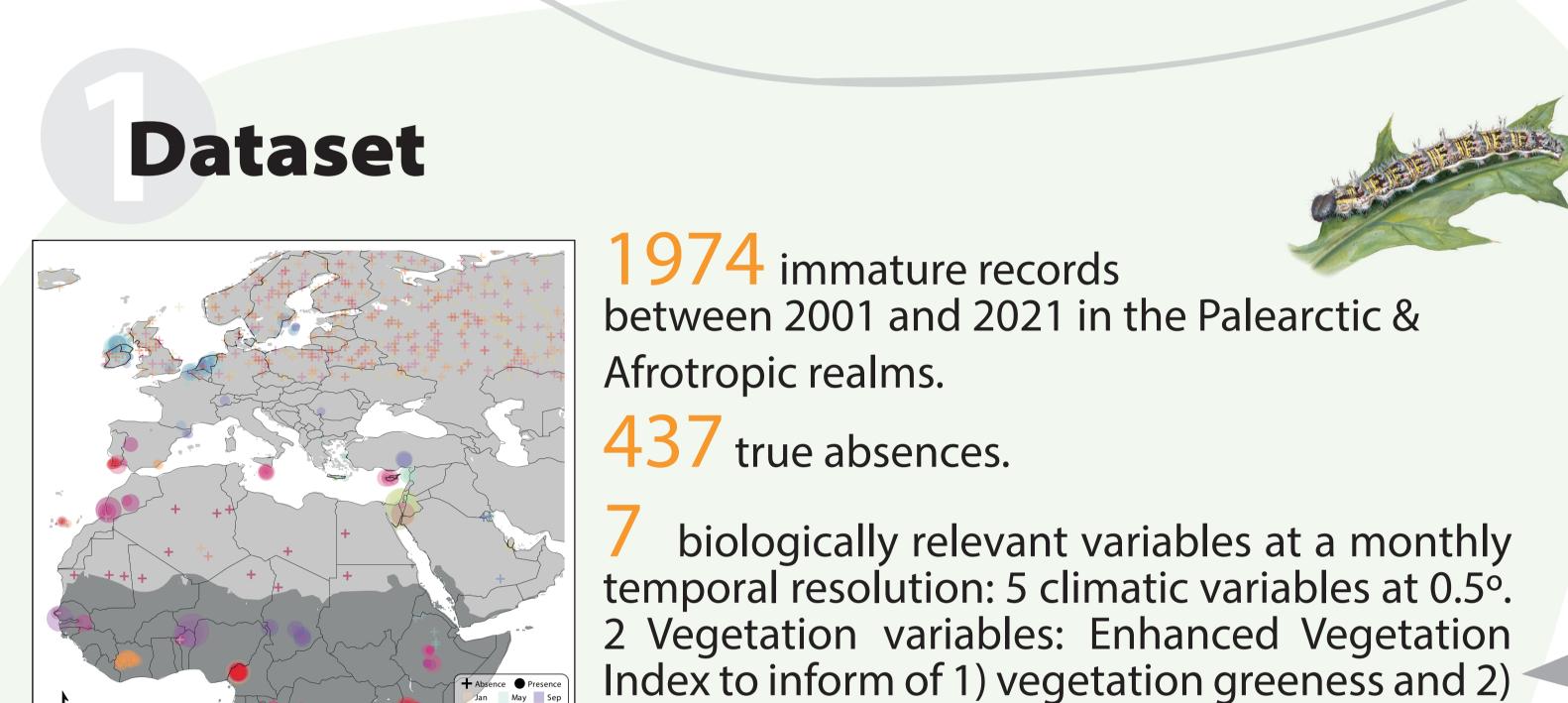
B) population outbreak origin inference through Vegetation Indices

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Large-Scale migration in insects are a major ecological phenomenon shaping good part of ecosystem services in many Earth habitats. From pollination and predation, passing through disease vector or seed dispersal, to relevant links with human activities such as possible pest development, crop pollination or biological pest control. A key factor in phytophagous insect migratory movements is resoursce availability, which can be retrieved using remote sensing products in geospatial analysis of migratory patterns: The novel introdution of NDVI data in Vanessa cardui population outbreak episodes.

A) Spatio-temporal Species Distribution Model (SDM)

How does green vegetation shape suitable areas along V. car i migratory cycle?



Variable	Units	Source	Symbol
Mean Temperature	Celsius degrees		TMP
Frost days	Nº of days	Climate	FRS
Precipitation	mm	Research Unit	PRE
Wet days	Nº of days	V 4.05	WET
Vapour pressure	HPa		VAP
Enhanced Vegetation Index	_		EVI
Monthly difference of Enhanced Vegetation Index	_	NASA MODIS MOD13C2	EVId

Model building

Variable importance

FRS

Monthly projections of the model using climatic averages of variables

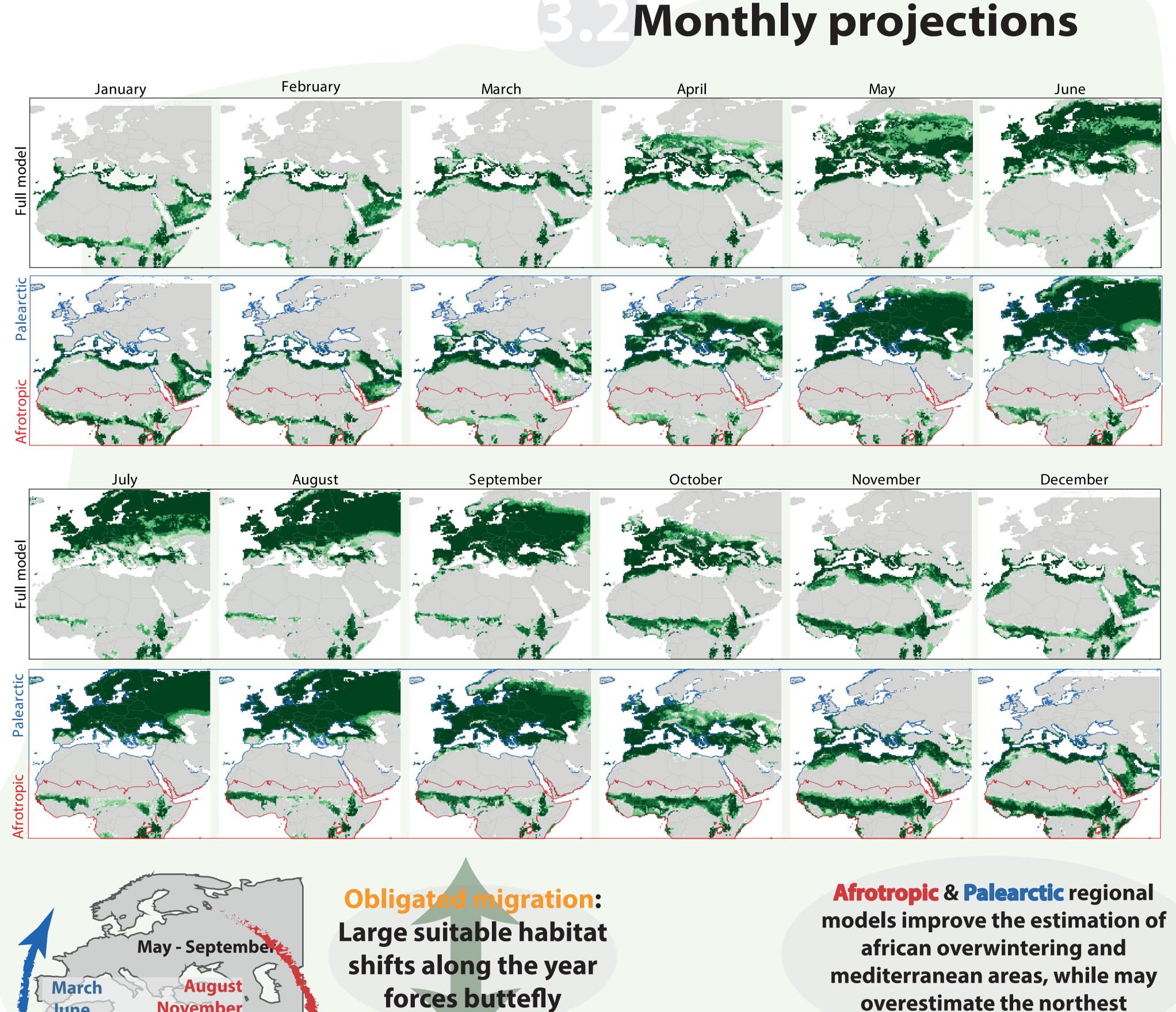
regions: Full range, Palearctic realm & Afrotropic realm

Biomod2 package in R to perfom modelling: Ensembleing of GBM, GAM, RF and MARS algorithms

Regional niche analisys

-0.2 -0.1 0 0.1 0.2

monthly changes in vegetation greeness.



forces buttefly popultions migration Model output agrees with previous research produced by Menchetti et al. (2019) & data from

0.25

Restricted EVI suitable

range in Afrotropic

green vegetation

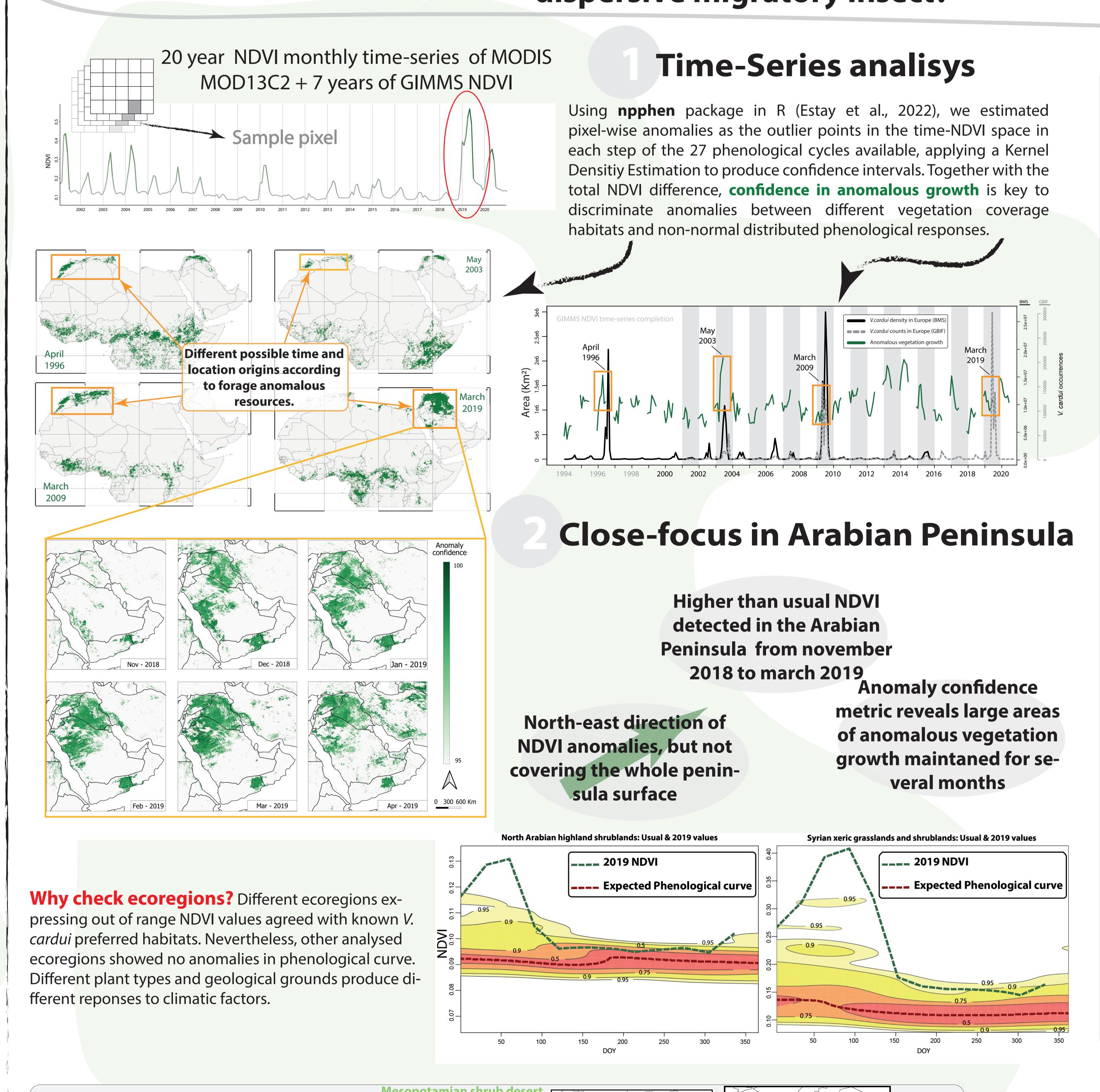
Sharp changes in EVI

are not tolerated by

breeding

References

Several massive arrival of V. cardui has been reported in Europe in recent years. Can vegetation activity data inform about the breeding origin of such large-scale & highly dispersive migratory insect?



Enhanced Vegetation Index enriched Vanessa cardui Species **Distribution Model by introducing** resource availability information.

EVI suitability distribution pointed to medium coverage of green vegetation as the preferred areas for breeding.

Vegetation resources gain importance in Afrotropical realm. There is good agreement between regional models and global models in terms of suitability along the variable range.

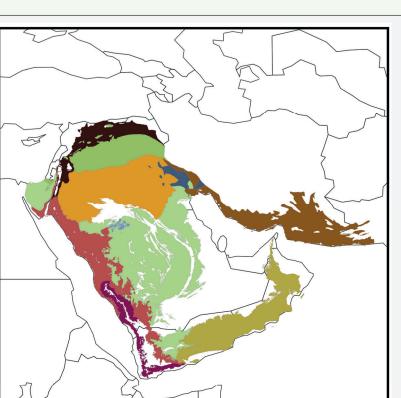
Vegetation resources fluctiations might produce population flows in different parts of the cycle. NDVI sharp increase matching time and place in modelled *V. cardui* migratory cycles was found preceeding massive observation of adult butterflies in Europe.

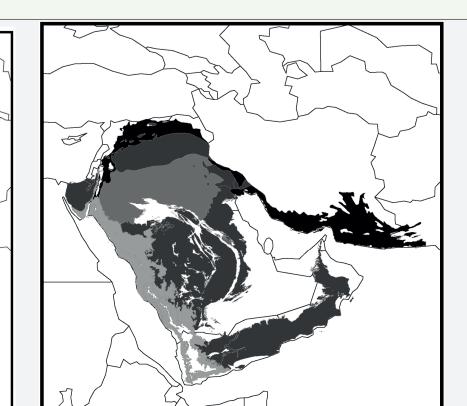
Taking all together, remote sensing vegetation indices proved to be relevant in th analisys of phytophagous migratory insect **Ecologial Niche and the exploration** of near-real time environmental state.

Further research on insect migration could especially benefit from satellite remote sensing measurements to track real-time movements based on Ecological Niche projections.

Possible ecoregions hosting *V. cardui* massive breeding

Red Sea-Arabian Desert shrubland Syrian xeric grasslands and shrublands South Iran Nubo-Sindian desert and semi-deser Tigris-Euphrates alluvial salt marsh Southwest Arabian Escarpment shrublands and woodlands









- Estay, S. A., & Chávez, R. O. (2018). npphen: An R-package for non-parametric reconstruction of vegetation phenology and anomaly detection using remote sensing (p. 301143). https://doi.org/10.1101/301143 - López-Mañas, R., Pascual-Díaz, J. P., García-Berro, A., Bahleman, F., Reich, M. S., Pokorny, L., Bataille, C. P., Vila, R., Domingo-Marimon, C., & Talavera, G. (2022). Erratic spatiotemporal vegetation growth anomalies drive population outbreaks in a trans-Saharan insect migrant. Proceedings of the National Academy of Sciences, 119(19), e2121249119. https://doi.org/10.1073/pnas.2121249119 Talavera, G., García-Berro, A., Talla, V. N. K., Ngʻiru, I., Bahleman, F., Kébé, K., Nzala, K. M., Plasencia, D., Marafi, M. A. J., Kassie, A., Goudégnon, E. O. A., Kiki, M., Benyamini, D., Reich, M. S., López-Mañas, R., Benetello, F., Collins, S. C., Bataille, C. P., Pierc

Talavera et al. (2023)

Temperature &

Vapour Pressure

are the main factors

in both regional and

Higher importance of

Frost Days in Palearctic than

in Afrotropic

Paleactic

Related contributions: EGU23-13891 | Orals | BG2.1 Megan Reich

& Peak of North Arabian highland shrubland vegetation growth production: South Arabian plains and plateau deser EGU23-11884 | Posters on site | CL5.3 Gerard Talavera N. E., ... Vila, R. (2023). The Afrotropical breeding grounds of the Palearctic-African migratory painted lady butterflies (Vanessa cardui). https://doi.org/10.13039/100006363