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Recurrence Quantification Techniques of vegetation time-series indices in semiarid grasslands

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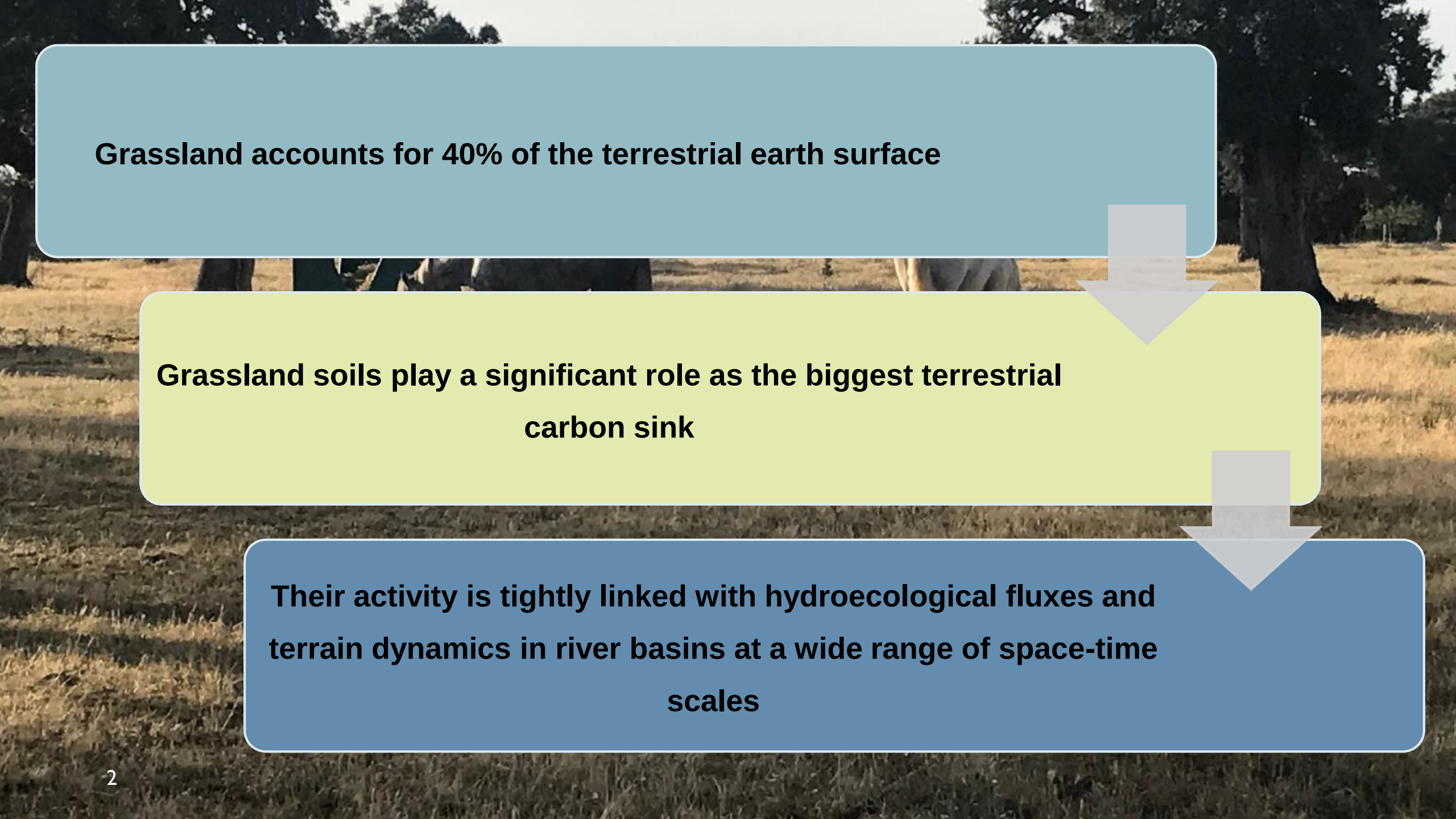
7th of May, 2020



Grassland accounts for 40% of the terrestrial earth surface

Grassland soils play a significant role as the biggest terrestrial carbon sink

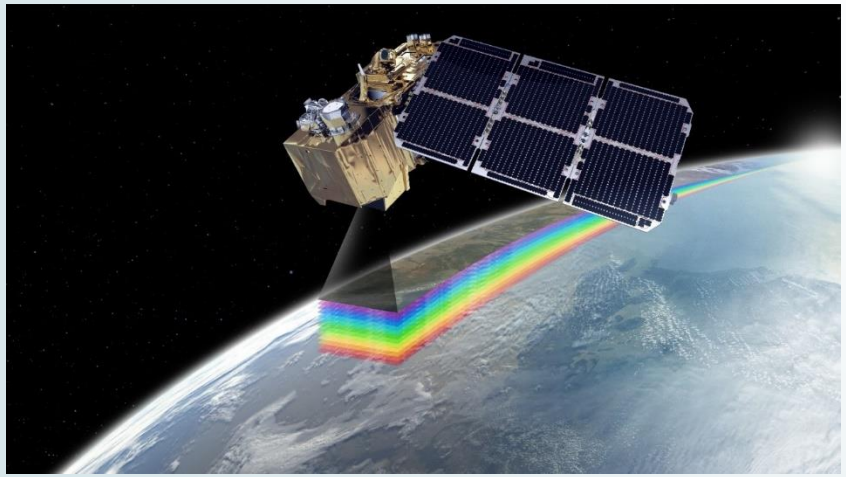
Their activity is tightly linked with hydroecological fluxes and terrain dynamics in river basins at a wide range of space-time scales

REMOTE SENSING RELEVANCE

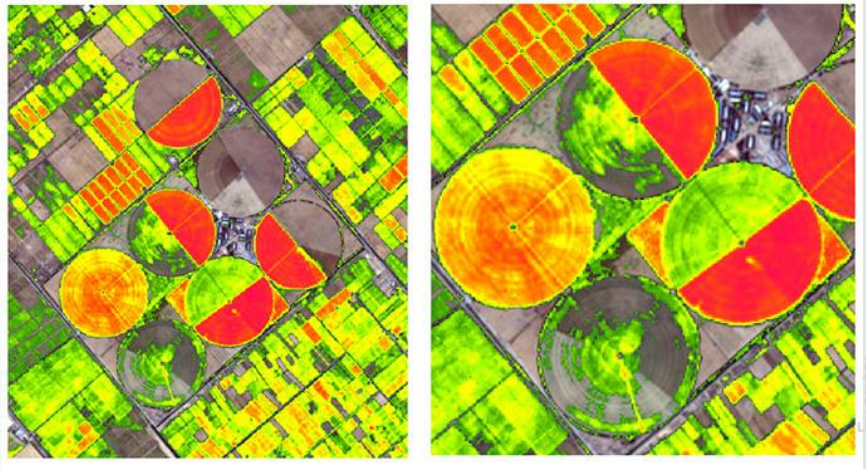
Remote sensing techniques has been pointed out as a solution to monitoring grasslands in arid and semi-arid regions.

Channels reflectance are mathematically combined to form vegetation indices(VI)

NDVI is the most widely applied VI.
Sensitivity to the effects of soil brightness



Feunte: https://www.ecoticias.com/energias-renovables/133686/Sentinel-2-ya-vigila-el-Medio-Ambiente-desde-el-espacio

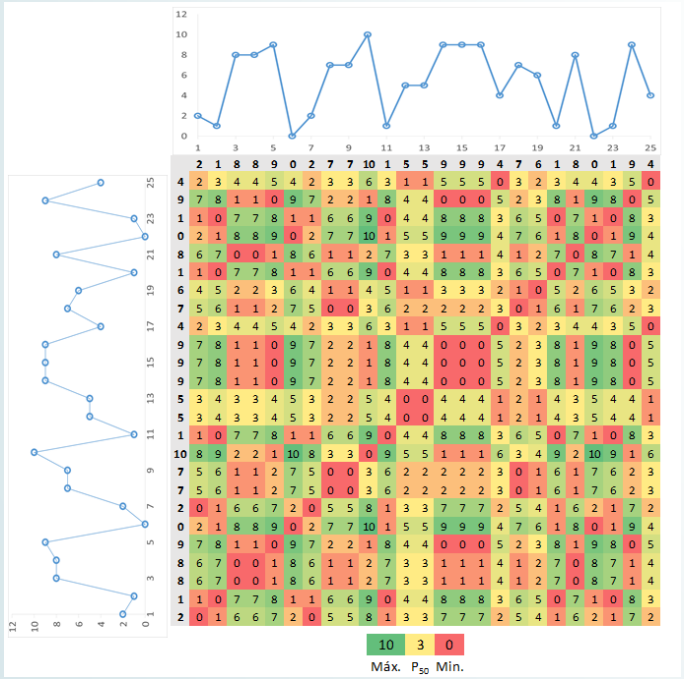


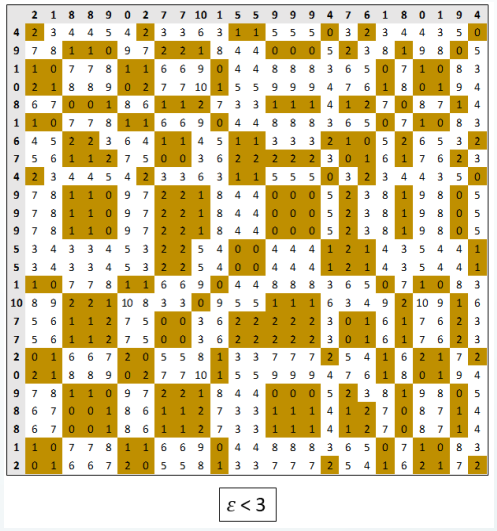
Fuente: http://www.satimagingcorp.com/applications/natural-resources/agricultures/

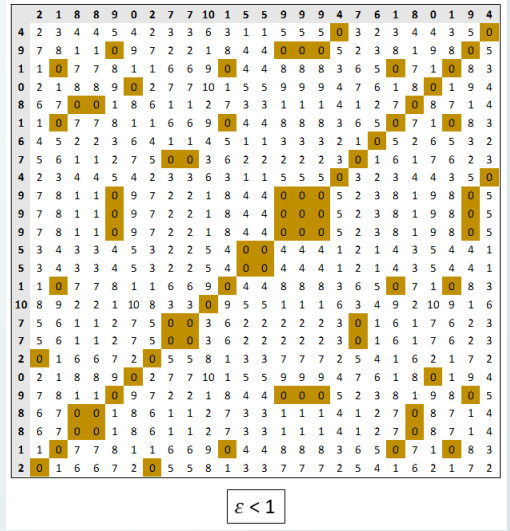
RECURRENCE ANALYSIS

Recurrence plots are a simple way to visualize the periodic or chaotic behaviour of a dynamical system through its phase space.

Several works have successfully applied recurrence plots and recurrence quantification analysis to VIs.

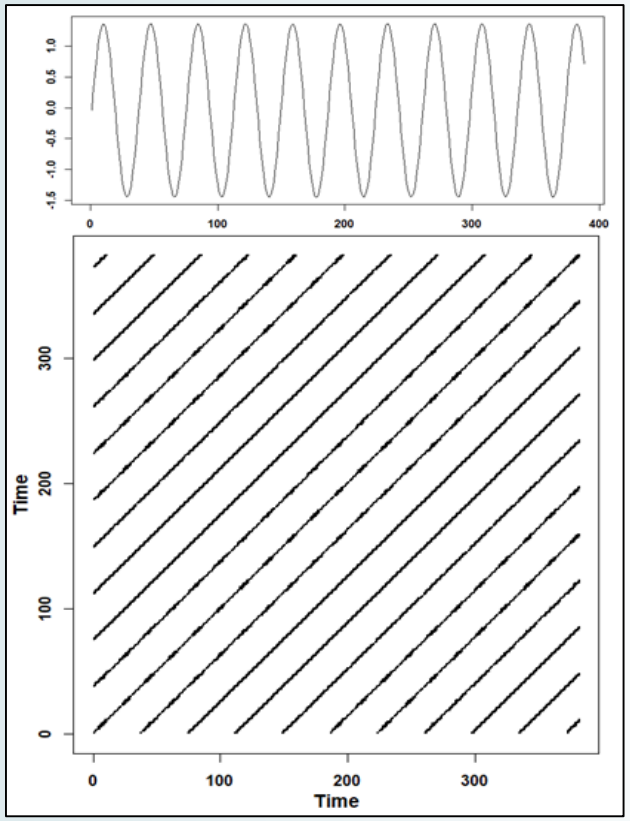




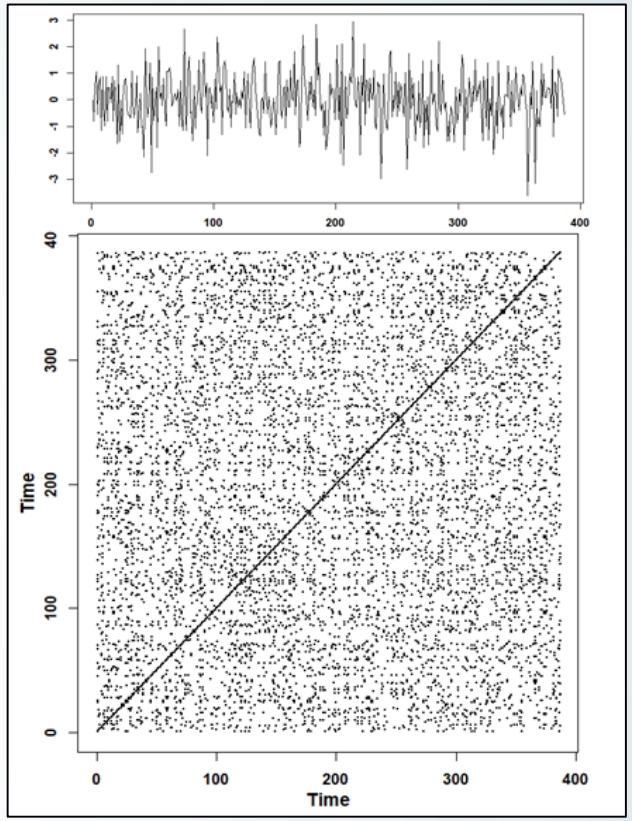


RECURRENCE ANALYSIS

Sine series



White-noise series

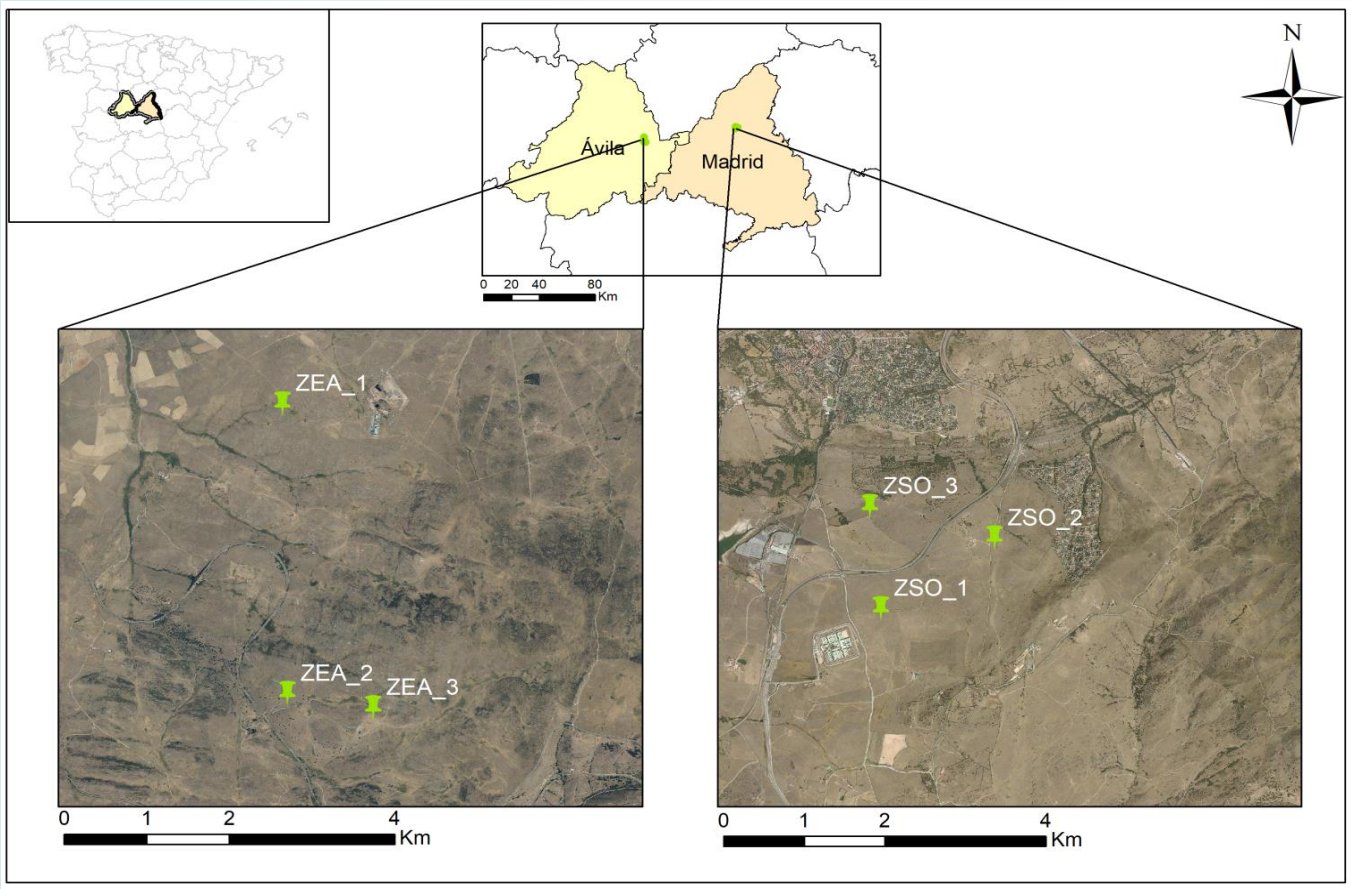


	DET (%)	LT	ENTR	LAM (%)
Periodic series	**95.90**	**11.16**	**2.20**	**82.30**
Stochastic series	**7.90**	**2.05**	**0.20**	**9.40**

*Data obtained from: Zhao, Z., Liu, J., Peng, J., Li, S. & Wang, Y. 2015. Nonlinear features and complexity patterns of vegetation dynamics in the transition zone of North China. *Ecological Indicators*, **49**, 237–246.

STUDY LOCATION

This work have considered two grassland areas. (ZEA) located in Tornadizos de Ávila and (ZSO) situated in Soto Del Real.

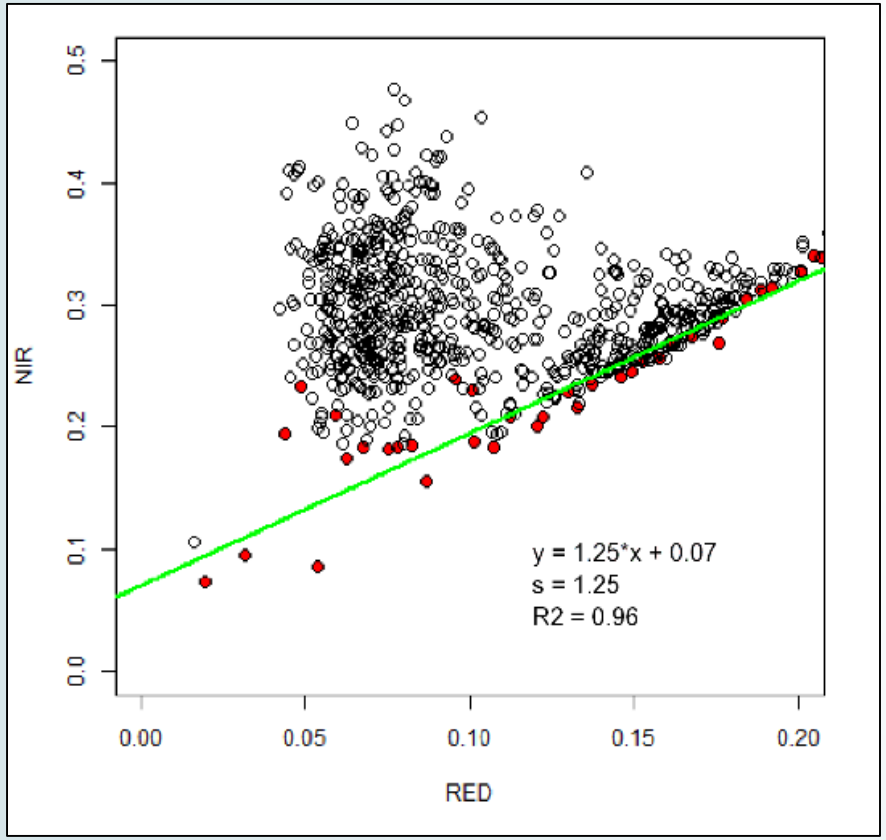


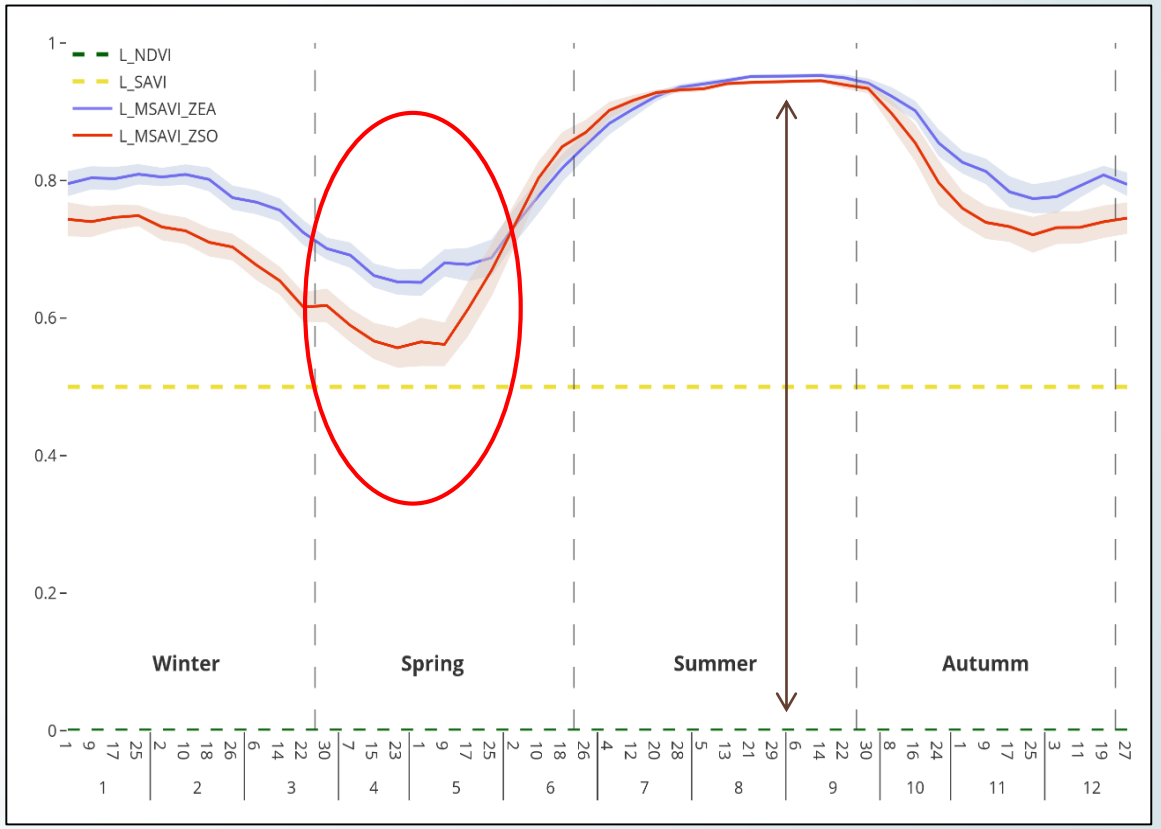
Criteria to select suitable pixels

- Maximum surface covered by pasture grassland without wood
- Continuous pastureland use
- Pastureland cover in the surrounding area

SOIL CHARACTERIZATION

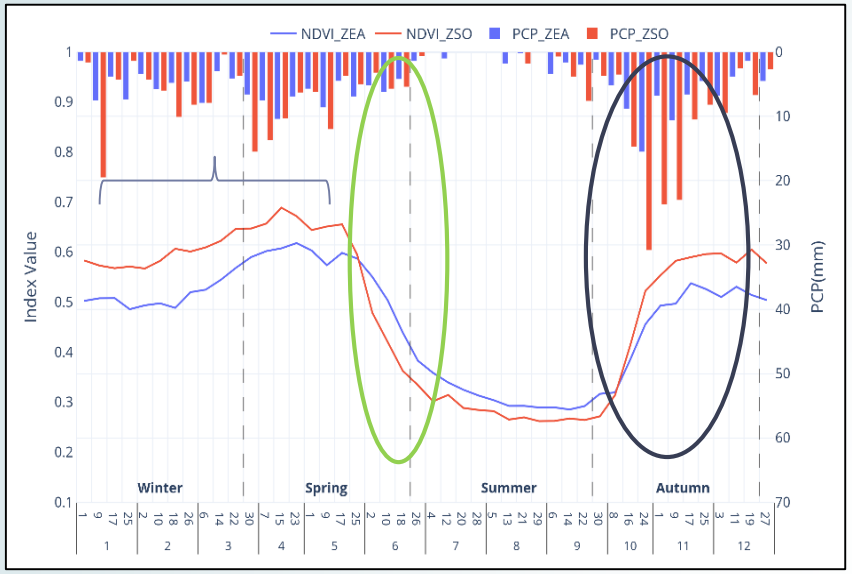
	Slope (%)	Height (m)	Silt (%)	Sand (%)	Clay (%)	Bulk Density (g/cm3)	pH	Organic Matter (%)	Water Holding Capacity (%)
ZEA	4.2 (± 1.1)	1290 (± 75)	20 (± 2)	60 (± 2)	20 (± 2)	1.3 (± 0.1)	6.5 (± 0.3)	3.8 (± 0.2)	14.4 (±1)
ZSO	4.7 (± 1.6)	958 (± 32)	18 (± 1)	76 (± 1)	6 (± 1)	1.6 (± 0.1)	5.6 (± 0.2)	3.0 (± 0.1)	11.1 (±1)



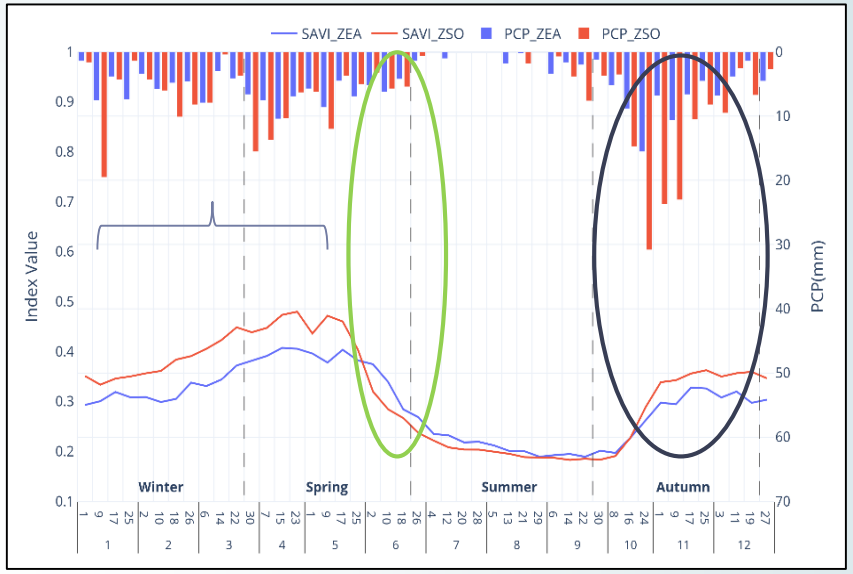


VEGETATION INDICES AND PRECIPITATION

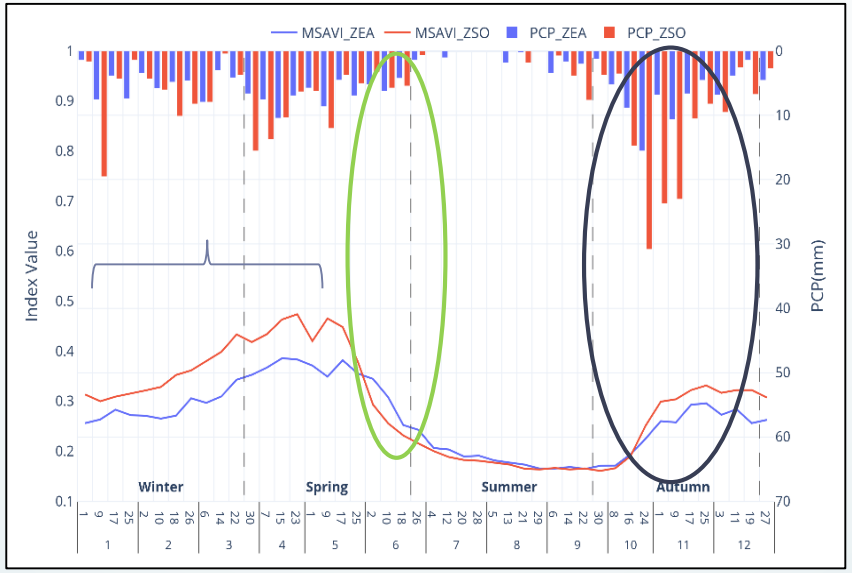
NDVI



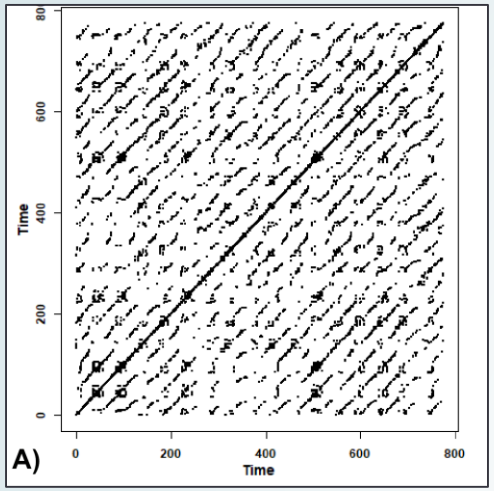
SAVI



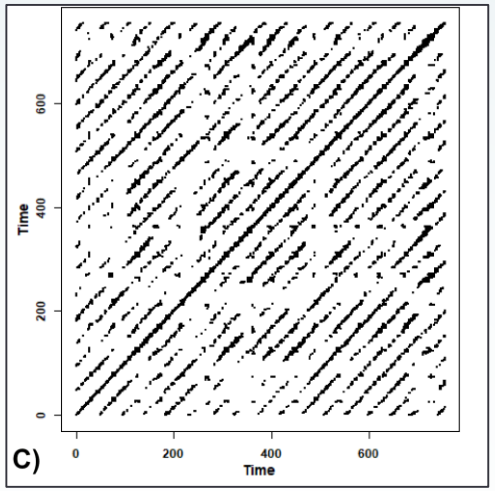
MSAVI



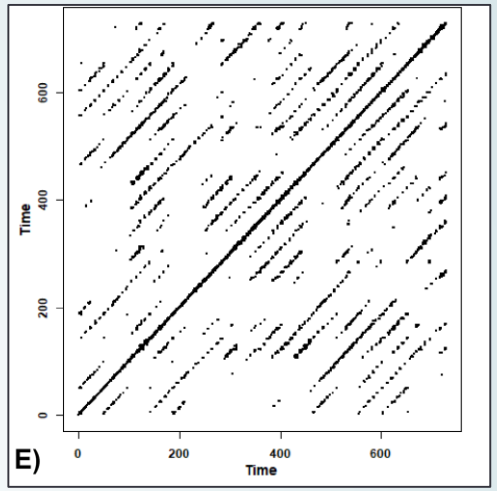
RESULTS



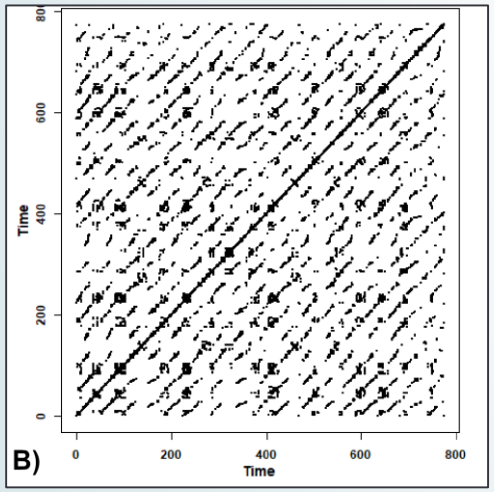
NDVI_ZEA



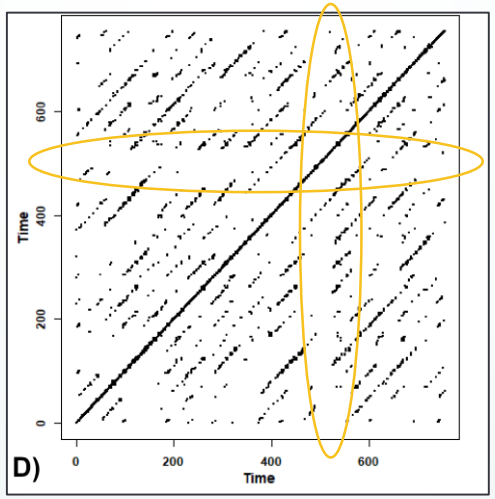
SAVI_ZEA



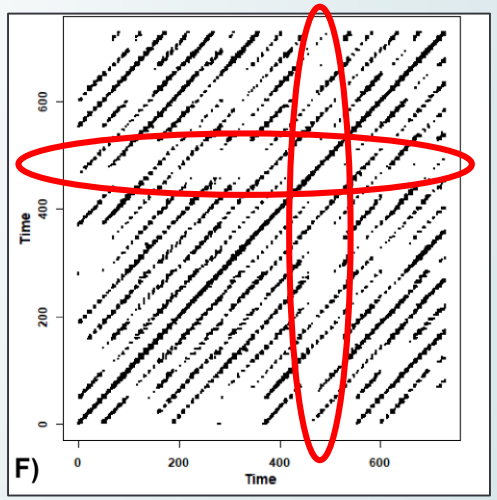
MSAVI_ZEA



NDVI_ZSO

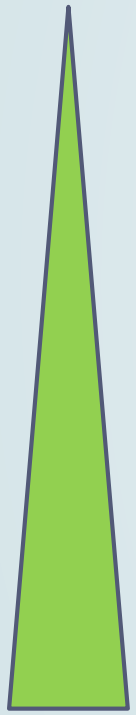


SAVI_ZSO



MSAVI_ZSO

DISCUSSION



	DET (%)	LT	ENTR	LAM (%)
NDVI				
ZEA	41.23	2.95	0.93	53.55
ZSO	47.86	2.90	1.02	60.01
SAVI				
ZEA	64.19	3.04	1.25	76.79
ZSO	48.34	3.58	0.90	58.27
MSAVI				
ZEA	54.16	3.39	1.10	69.10
ZSO	75.71	3.89	1.65	85.25
ARTIFICIAL SERIES				
Stochastic series*	**7.90**	**2.05**	**0.20**	**9.40**
Periodic series*	**95.90**	**11.16**	**2.20**	**82.30**

*Data obtained from: Zhao, Z., Liu, J., Peng, J., Li, S. & Wang, Y. 2015. Nonlinear features and complexity patterns of vegetation dynamics in the transition zone of North China. *Ecological Indicators*, **49**, 237–246,

CONCLUSIONS

The three vegetation indices used were suitable indicators to detect variations.

There is an important influence of the soil adjustment factor (*L*) on the VIs data dispersion.

The differences in the behaviours of the VIs between the two zones were explained based on the interactions of soil characteristics and precipitation regimens.

SAVI and MSAVI showed distinct temporal patterns in each location by the RPs method.

MSAVI was the most suitable index among the indices studied in semiarid pastures with higher determinism.

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