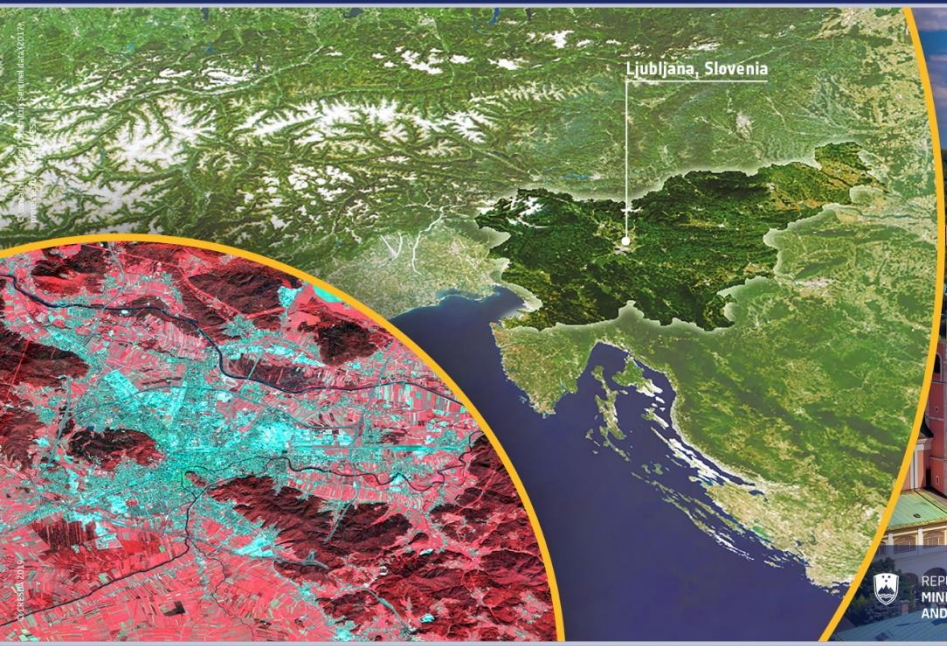
NASCC

esa



ESA–MOST Dragon Cooperation

2019 DRAGON 4 SYMPOSIUM

24–28 June 2019 | Ljubljana, Slovenia

中国科技部-欧洲空间局“龙计划”合作

2019 年“龙计划”四期学术研讨会

2019 年6月 24–28 日 斯洛文尼亚 卢布尔雅那

FRI. 28 JUNE 2019
DRAGON 4 ID. 32396
LAND DEGRADATION SURVEILLANCE OF DRYLANDS IN CHINA

LEAD INVESTIGATORS PROJECT SUMMARY PRESENTED BY BIN SUN

LI：Prof. Gao Zhihai and Prof. Gabriel del Barrio

Sub-projects and themes:

Id. 32396_1

Retrieval of vegetation and soil properties using multi-source optical remote sensing in drylands

Id. 32396_2

Advanced remote sensing methods for land degradation assessment by coupling vegetation productivity and climate in drylands

European PIs	European YS	Chinese PIs	Chinese YS
Maria E. Sanjuán	Jaime Martinez-Valderrama	Xiaosong Li	Bin Sun
Alberto Ruiz		Jianjun Wu	Hongyan Wang
			Junjun Wu
5 Ph.D. students and 11 Master students			

Participation to the 2019 Symposium

Europeans

LI: Gabriel del Barrio (Spain)

Arid Zone Research Station, CSIC,

Chinese

LI: Zhihai Gao

Institute of Forest Resource Information Techniques, CAF, China

PI: Prof. Jianjun Wu

Beijing Normal University

Prof. Xiaosong Li

RADI, CAS

Dr. Bin Sun

IFRIT, CAF, China

EO data delivery

Data access (list all missions and issues if any). NB. in the tables please insert cumulative figures (since June 2016) for no. of scenes of high bit rate data (e.g. S1 100 scenes). If data delivery is low bit rate by ftp, insert "ftp"

ESA Third Party Missions	No. Scenes
1.	
2.	
3.	
4.	
5.	
6.	
Total:	
Issues:	

ESA, Explorers & Sentinels data	No. Scenes
1. Sentinels-2	20000 tiles
2.	
3.	
4.	
5.	
6.	
Total:	
Issues:	

Chinese EO data	No. Scenes
1.GLASS-NPP	Global
2.GF-1	20
3.GF-2	8
4.	
5.	
6.	
Total:	
Issues:	

Results summary id. 32396_1

Project Background

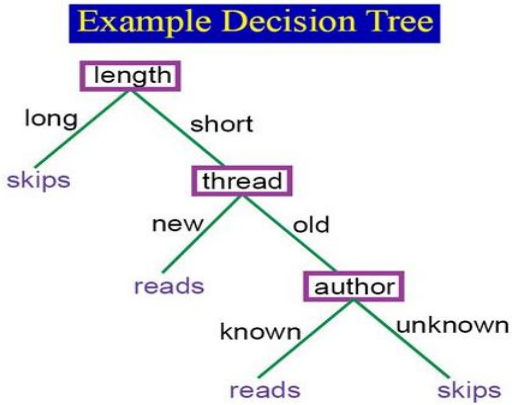
Sub-project 1: Retrieval of vegetation and soil properties using multi-source optical remote sensing in drylands

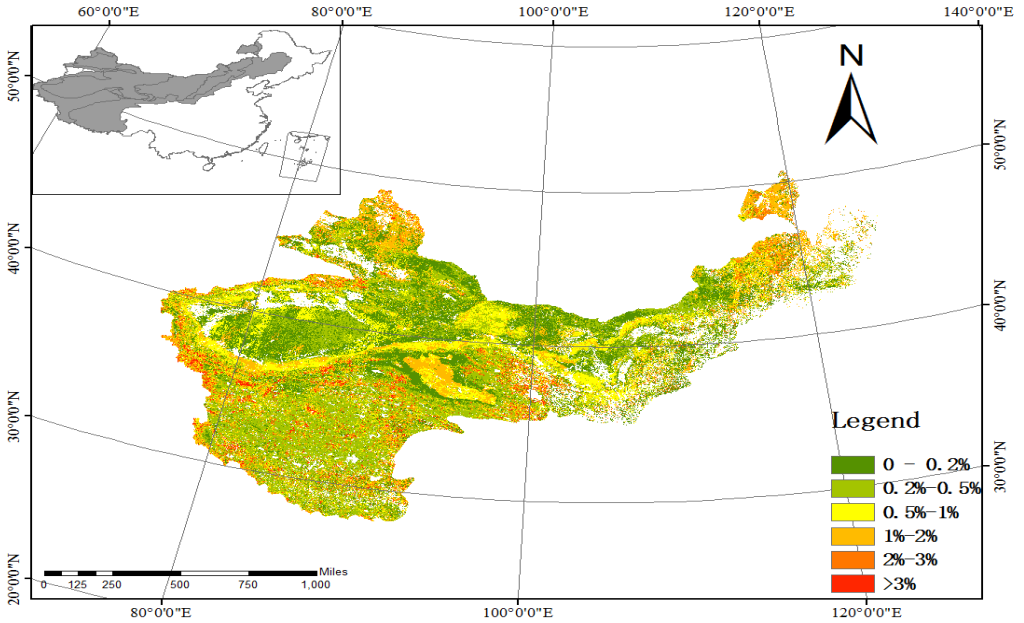
PI: Joachim Hill (University of Trier, Germany) ; Xiaosong Li (RADI, CAS, China)

- **to develop based on remote sensind data techniques and methods to retrieve vegetation bio-physical variables(PV/NPV fractional cover and NPP) in drylands at local and regional scale;**
- **to improve the accuracy of estimated soil properties (Soil organic matter and soil texture) based on field spectroscopy and to evaluate the potential to upscale the derived relationships in drylands at the local scale;**
- **to establish a relationship between PV/NPV degradation and SOM for major vegetation types in drylands.**

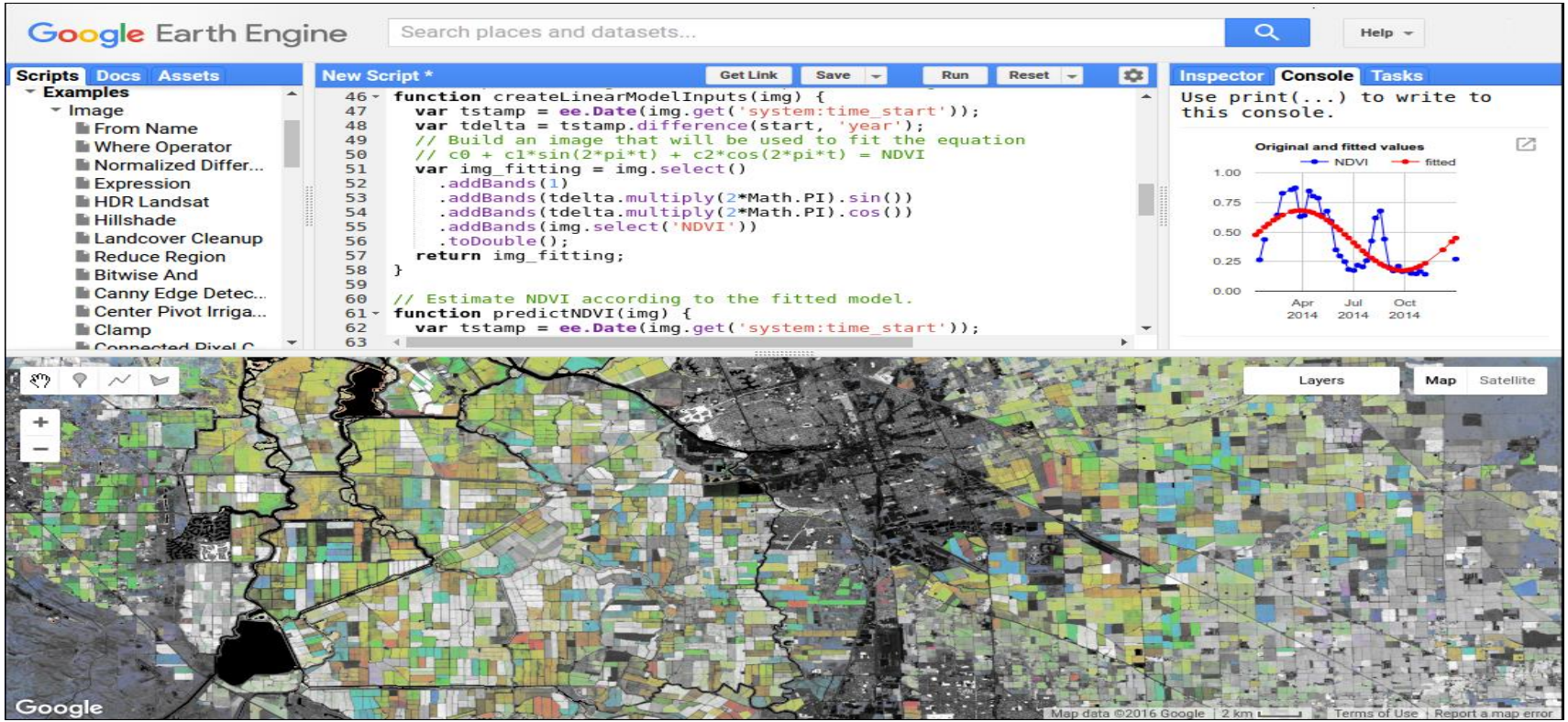
1-1. Estimating soil carbon content of desertified land in China drylands based on Sentinel 2 data

Classification and regression tree (CART)





Process platform-GEE

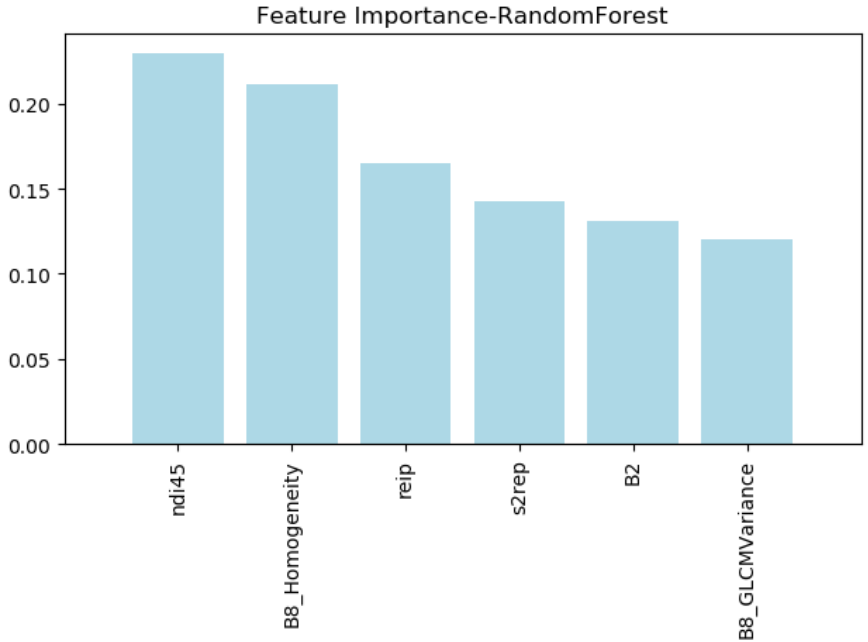


Summary

- The proposed approach could provide relative accurate SOC prediction for huge desertified land in high spatial resolution, resolving some long known difficulties of soil propertie estimation with remote sensing, especially suitable for sparse vegetation cover area in drylands.
- GEE provide huge volume earth observation data and computation capability, which enable the implementation of such kind of big data analysis very soon, has extensive application prospect.
- Although the accuracy is acceptable, but the SOC map is not expected to be as accurate or relevant as locally produced maps that make use of considerably greater amounts of local point data. Reporting the SOC dynamic based on multi-temporal S2 data for assess LDN would be our focus.

1-2 Estimation of Above Ground Biomass in Otindag SandyLand, Inner Mongolia by Using Sentinel-2 data

Importance of the variables for the AGB estimation and Model performance



- NDI45
- B8_Homogeneity
- REIP
- S2rep
- B2
- B8_GLCMvaiance

Method	Validation		
	R^2	RMSE	MAE
SVM	0.5275	33.01	29.40
RF	0.5261	24.21	23.5
MLR	0.6015	66.01	110.08

Cloud platform provided through the ESA Network of Resource Initiative

Conclusion

✓ **Machine learning algorithm could improve the accuracy of sparse vegetation AGB estimation in Otingdag sandy land. Compared with the traditional VI-based method, the R^2 of estimated model was increased 0.3;**

✓ **The red edge index and band texture information obtained from the sentinel-2 data could be effectively used for the sparse vegetation AGB estimation in the study area.**

Project objectives

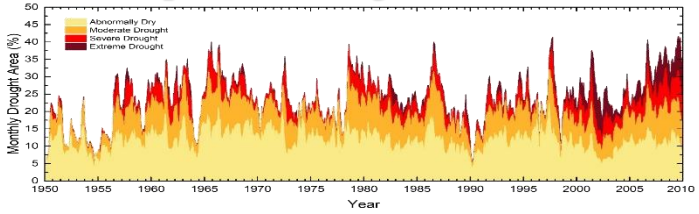
Detecting land degradation in dry lands at a regional scale.

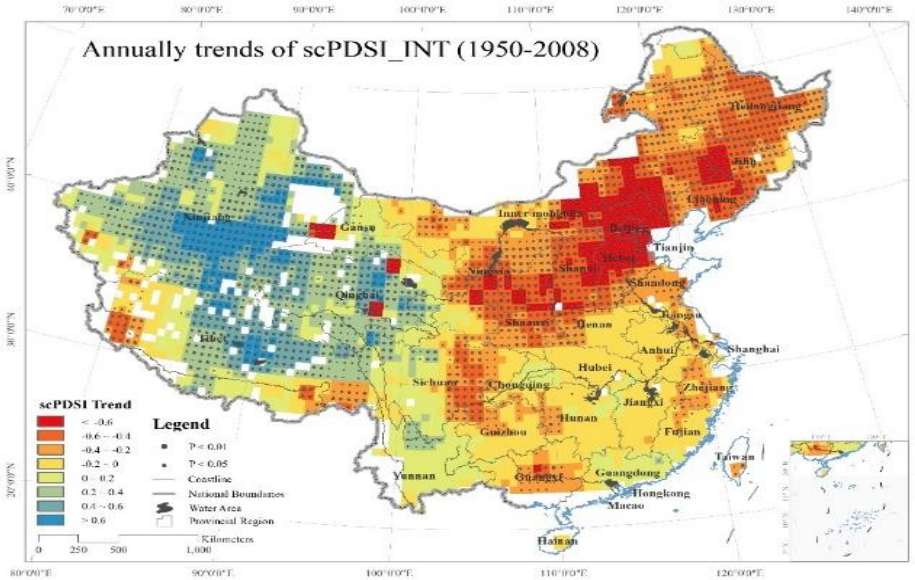
Objectives:

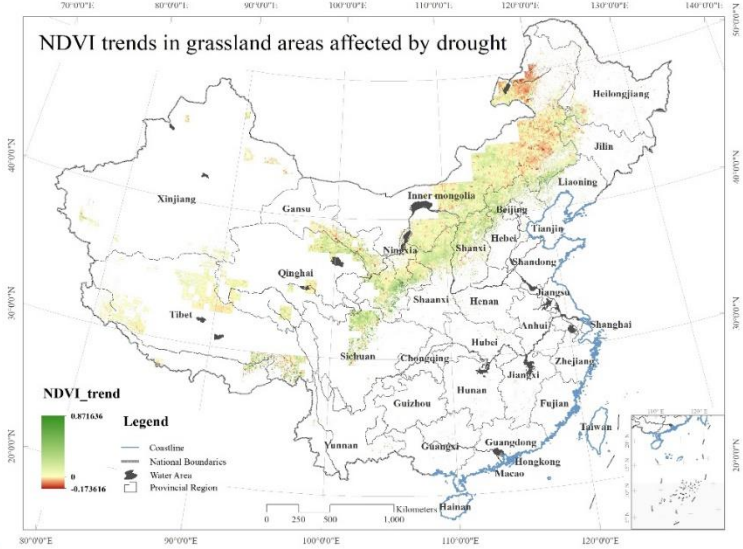
1. To enhance, benchmark and validate two novel approaches to land degradation surveillance by remote sensing: a two-dimensional implementation of Rain Use Efficiency (2dRUE), and a Moisture-responded Net Primary Productivity (MNPP).
2. To use the said approaches to map land degradation in a study area defined by the Potential Extent of Desertification in China. This is a delimitation of UNCCD-affected areas in terms of drylands within China.

2-1 Regional drought in China and its vegetation response over the past 60 years

self-calibrated Palmer Drought Severe Index







Summery

- The intensity of drought in the country has fluctuated in the past 60 years, and the overall trend of drought intensity aggravates slightly, the drought area fluctuates dramatically with a significant upward trend .
- In the regions affected by drought, the intensity in most areas is mainly abnormally dry and moderate drought. From 1950 to 2009, the country‘s severe drought area and extreme drought area show a significant increasing
- The spatial pattern of drought change in China presents that the eastern becomes drier while the western is wetter
- Due to the seasonal drought, crop and grass has more response to drought, the possibility of drought develop into a serious disaster will inevitably increase, threating grassland, crops

2-2 Global land degradation assessment and monitoring

Identification of degraded land

- Construction of MNPP
- Identification of degraded land

Assessment of land degradation degree

- Moving average
- Benchmark
- Assessment of land degradation degree

Driving forces analysis

- Driving forces analysis based on time axis and climate axis

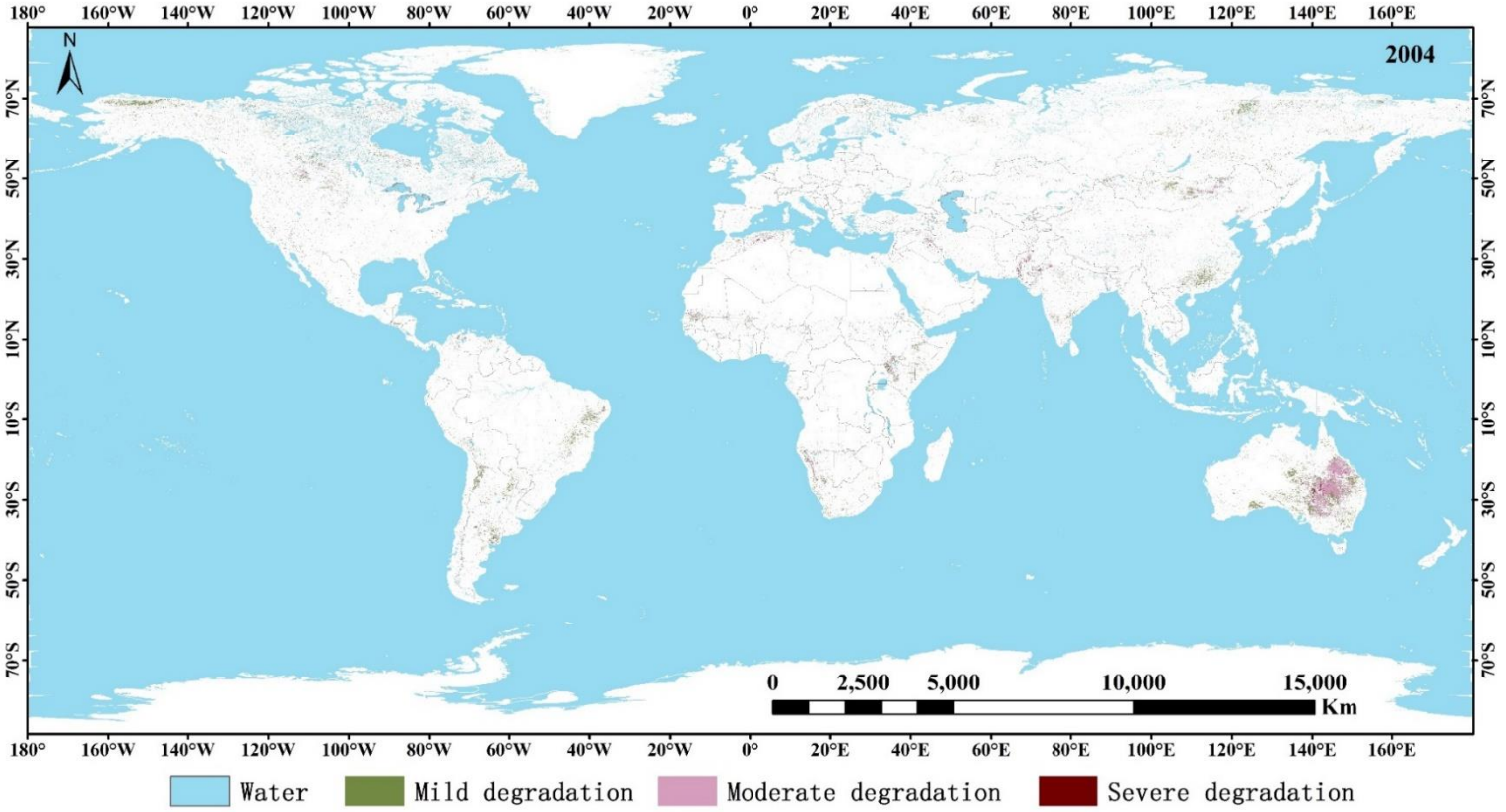
$$MNPP = \frac{NPP}{MI * 100}$$

Moving average method
Relative benchmark

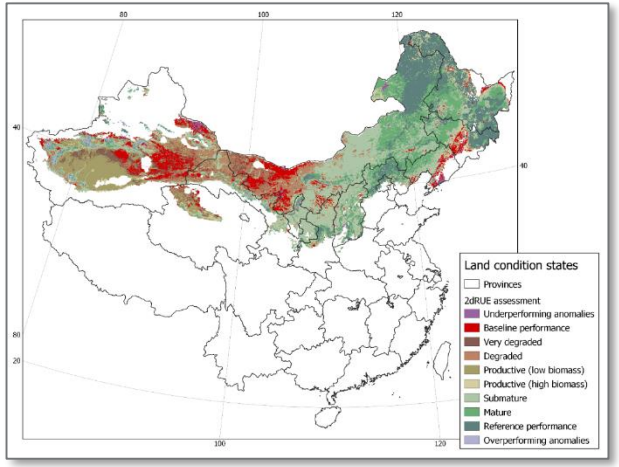
Contingency table for land degradation/restoration

Indicators & Trend			NPP		
			Sig.↓	No Sig.	Sig.↑
MNPP	Sig.↑	Sig.(MI)↓	Deg.	Flu.	Res.
		Others	Deg.	Res.	Res.
	Insig.		Deg.	Flu.	Res.
	Sig.↓	Sig. (MI)↓	Deg.	Flu.	Res.
		Others	Deg.	Deg.	Res.

Degree	Annual NPP decline ratio (%)
Severe	≧50
Moderate	20~50
Slight	<20

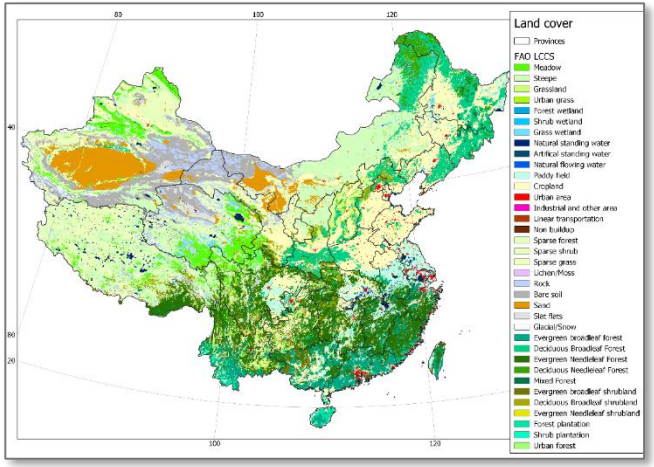

2004
N
180° 160°W 140°W 120°W 100°W 80°W 60°W 40°W 20°W 0° 20°E 40°E 60°E 80°E 100°E 120°E 140°E 160°E
70°N 50°N 30°N 10°N 10°S 30°S 50°S 70°S
0 2,500 5,000 10,000 15,000
Km
Water
Mild degradation
Moderate degradation
Severe degradation

2-3 *Land cover, land condition and management options (I)*



Land condition (ecological maturity) by 2dRUE method
(del Barrio et al 2016)

Statistic analysis: ranks mean test, Tukey's Unequal N



Land cover FAO-LCCS based
(Zhang et al., 2014)

2-3 Land cover, land condition and management options (II)

LC 2010 in ARID	rank mean	1	2	6	5	4	3
Cropland	4470	****					
Forest plantation	4391	****	****				
Deciduous Broadleaf Forest	4036	****					
Meadow	3972	****	****				
Deciduous Broadleaf shrubland	3966	****	O				
Sparse shrub	3204		****				
Steppe	2999		****	****			
Sparse grass	2614			****	****		
Salt flats	2457				****	****	
Sand	2080					****	O
Rock	1863						****
Bare soil	1820						****

Postulates:

1. Vertical: plausible path of management options.
2. Stepping down (i.e. degrading land condition) is easier than going upwards.
3. Efficient land use changes occur between classes at the same condition level.
4. Transitions between land uses may have bottlenecks.
5. Management options are proportional to the level in staircase.

Results summary id. 32396_2:

Land cover, land condition and management options (III)

- **Preliminary conclusions**
  - Land condition and land use have concrete relationships that control land management options
  - The concrete staircase pattern of a region conveys suitable land use changes
  - Land degradation means loss of management options
    - Corolary: lternative land degradation policy could target at maximizing management options

Young scientists contributions to the 2019 Symposium

European YS

Jaime Martinez-Valderrama

Arid Zone Research Station, CSIC, Almeria, Spain

Land condition and management options in China drylands

Chinese YS

Bin Sun

Institute of Forest Resource Information Techniques
Chinese Academy of Forestry

IRF in ESRIN since September, 2018.

LPS 2019. Oral presentation

Academic exchanges & joint publications

Joint publications

1.Estimating Soil Organic Carbon Density in the Otindag Sandy Land, Inner Mongolia, China, for modelling spatiotemporal variations and evaluating the influences of human activities. *Catena*,2019,179:85–97.

2.Identification and Assessment of the Factors Driving Vegetation Degradation/Regeneration in Drylands Using Synthetic High Spatiotemporal Remote Sensing Data—A Case Study in Zhenglanqi, Inner Mongolia, China. *Ecological Indicators*, (Under review)

3.Extraction of Information on Trees Outside Forests based on Very High Spatial Resolution Remote Sensing Images: A Case Study of the Otingdag Sandy Land, Inner Mongolia. *Forests* (Under review)

4. Comparing land degradation and regeneration rates in China drylands. *JRS*. (Under review) .

5. Nonlinear spectral mixture effects for photosynthetic/non-photosynthetic vegetation cover estimates of typical desert vegetation in western China. *PLOS ONE*12:12, 2017, pages e0189292.

Summary on progress and collaboration

- European LI Gabriel del Barrio has been included in a CAS-funded project
- Collaboration has been based on email exchanges of work protocols and data
- Progress is somewhat limited because of limited funding
- Still, relevant results are being obtained which strongly depend on the Dragon collaboration framework

Plans for the next 1 year

Sub-project 32396-1

- Prediction model could be improved, such as input factors, machine learning algorithm and parameters optimization.
- Atmosphere corrected S2 data are needed for replacing TOA, which would soon be available in GEE.
- Building the relationship between vegetation degradation and SOC is our priority in the near future.

Sub-project 32396-2

- Collect time series high-resolution remote sensing data in typical area.
- To enhance, benchmark and validate two novel approaches to land degradation surveillance by remote sensing: 2dRUE method and MNPP.

Thanks for your attention