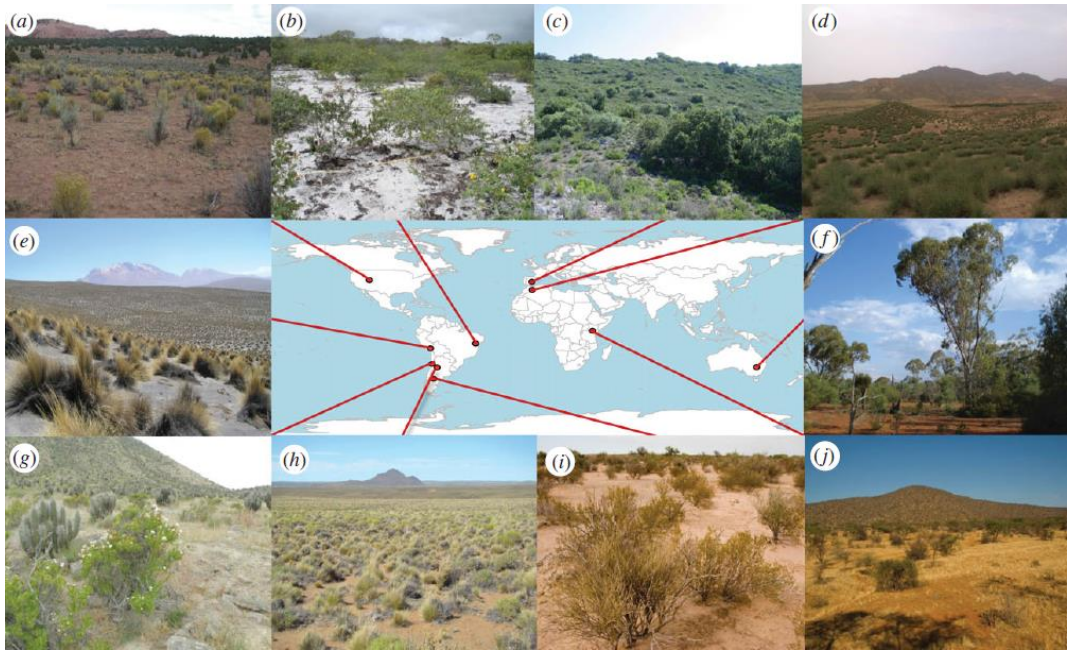
In the footsteps of Humboldt: understanding the ecology of our planet through global scientific collaboration



Fernando T. Maestre

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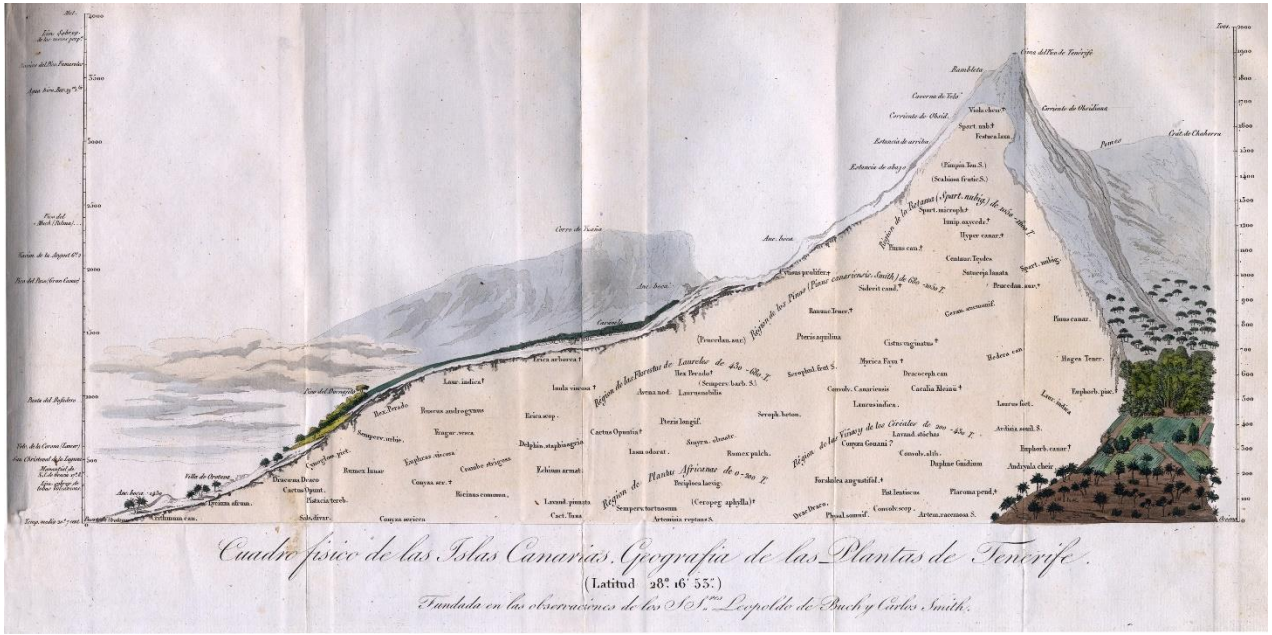
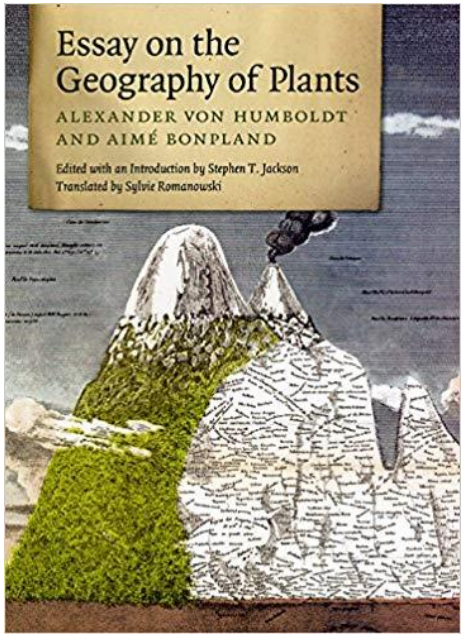
DRYLAND ECOLOGY AND GLOBAL CHANGE LAB

Humboldt as a pioneer of global science

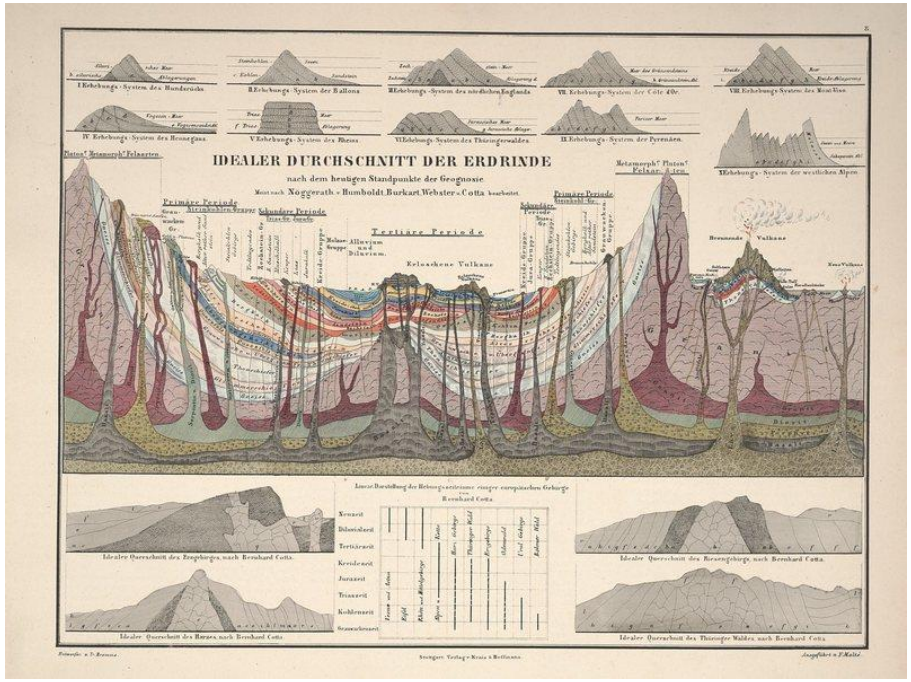


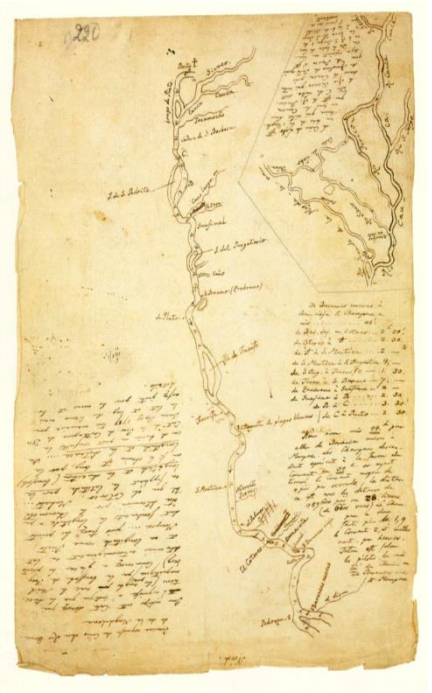


→ Alexander von Humboldt developed a unified vision for the environmental sciences that integrated the traditional disciplines of botany, zoology, physics and astronomy with the emerging fields of ecology, climatology, geology, geography, anthropology and economics.

→ His work launched a distinctly Humboldtian style of science, comprising vast numbers of spatially and temporally referenced observations of environmental variables and cultural practices.

Humboldt as a pioneer of global science





→ Collectively, these observations could reveal spatial and temporal patterns that would in turn reveal important underlying physical and biological processes and relationships.

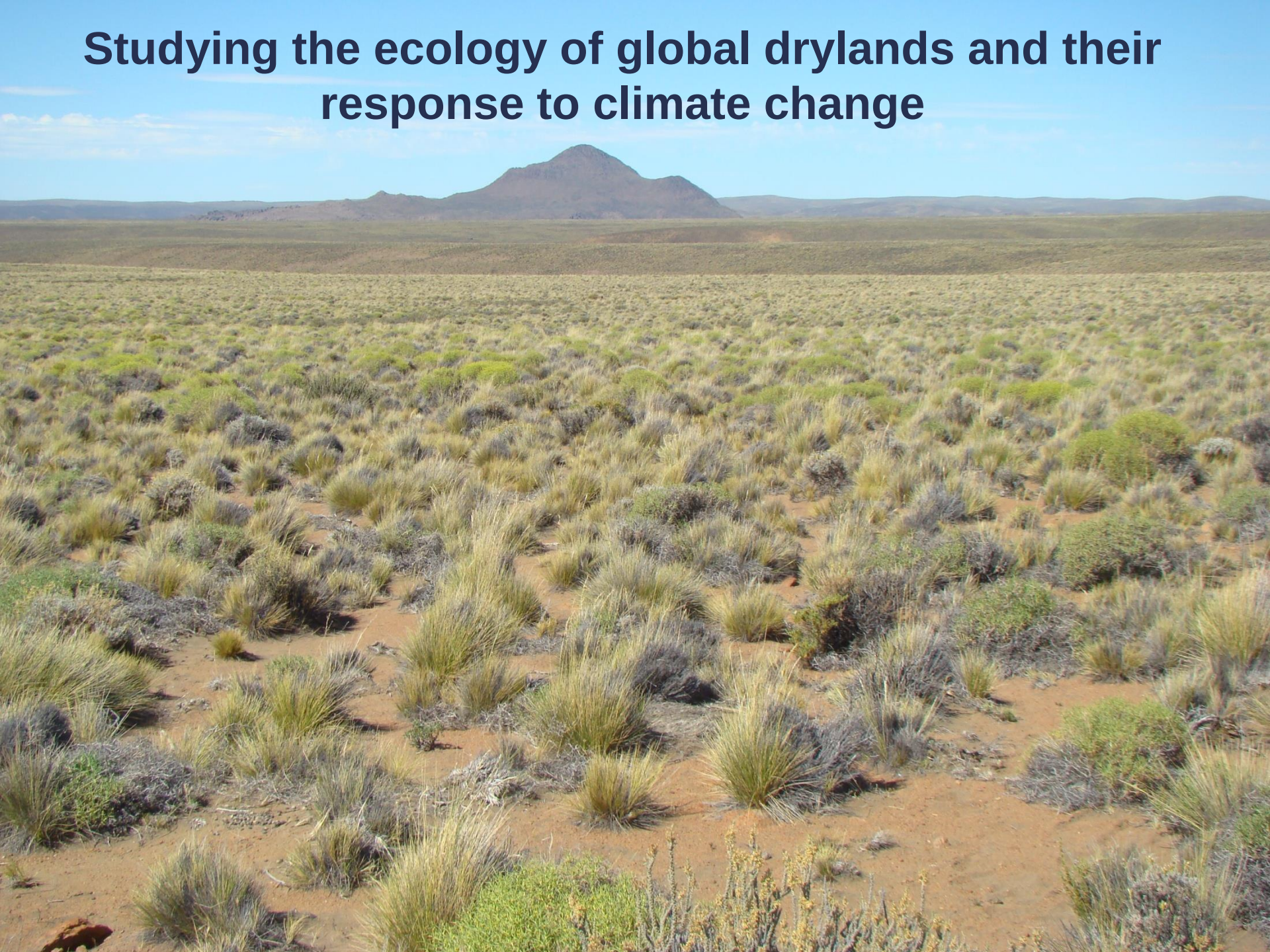
→ Careful observation of nature, together with extensive travel and the set up of collaborations with multiple scientists across the world were landmark characteristics of Humboldt´s work.

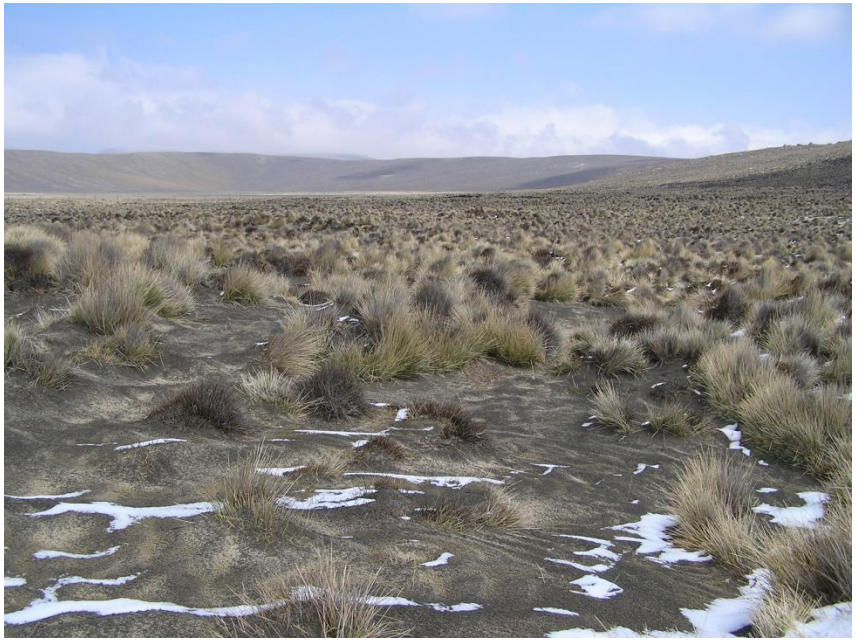
Why is important to follow Humboldt steps today?

→ Major environmental issues we are facing, such as climate change, biodiversity/habitat loss and land degradation, affect all countries and require the development of global approaches and the establishment of international collaboration to understand and tackle them.

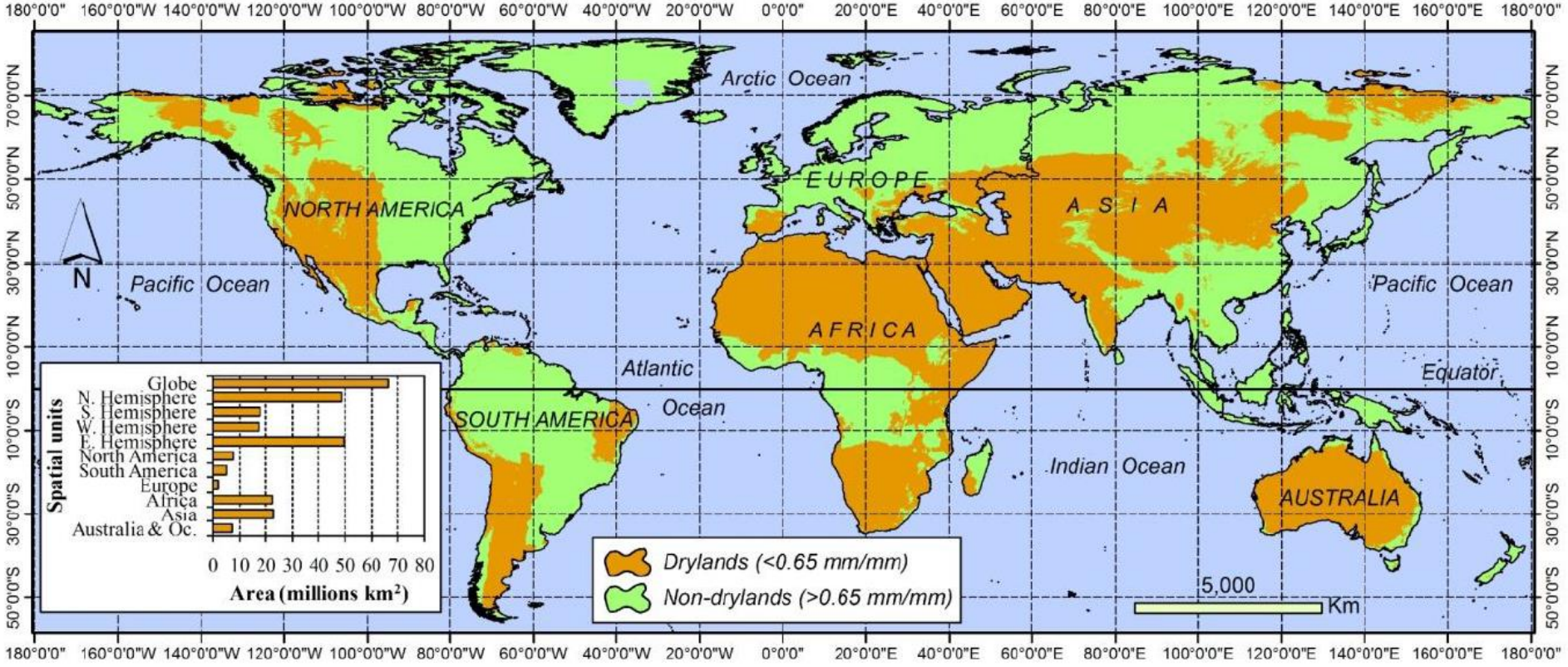
→ A Humboldtian approach to the study of the environmental issues and their ecological consequences is not only very timely but also urgently needed.

Studying the ecology of global drylands and their response to climate change



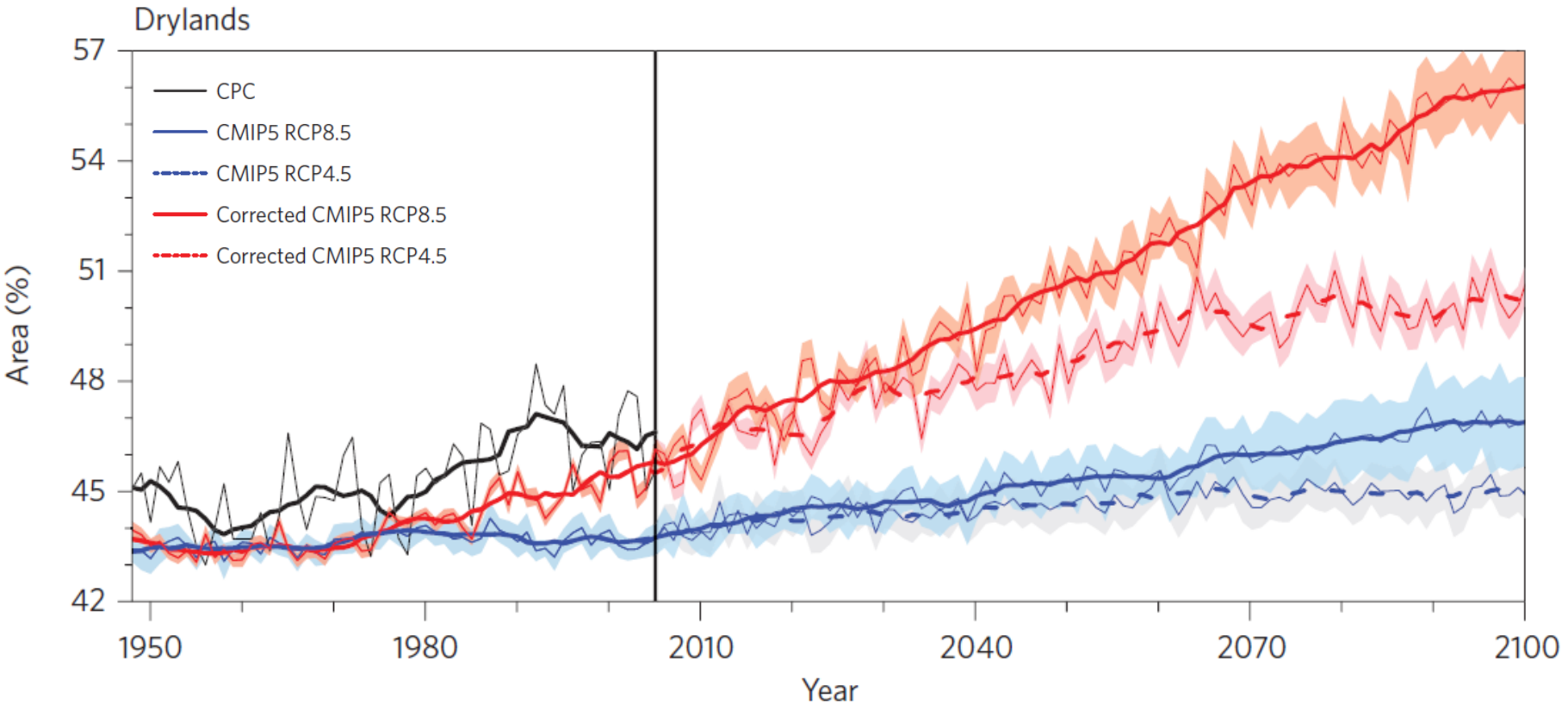


Why studying the ecology of global drylands?



→ Drylands are a key terrestrial biome, as they cover ~45% of terrestrial surface and are the home of ~40% of global population.

Why studying the ecology of global drylands?

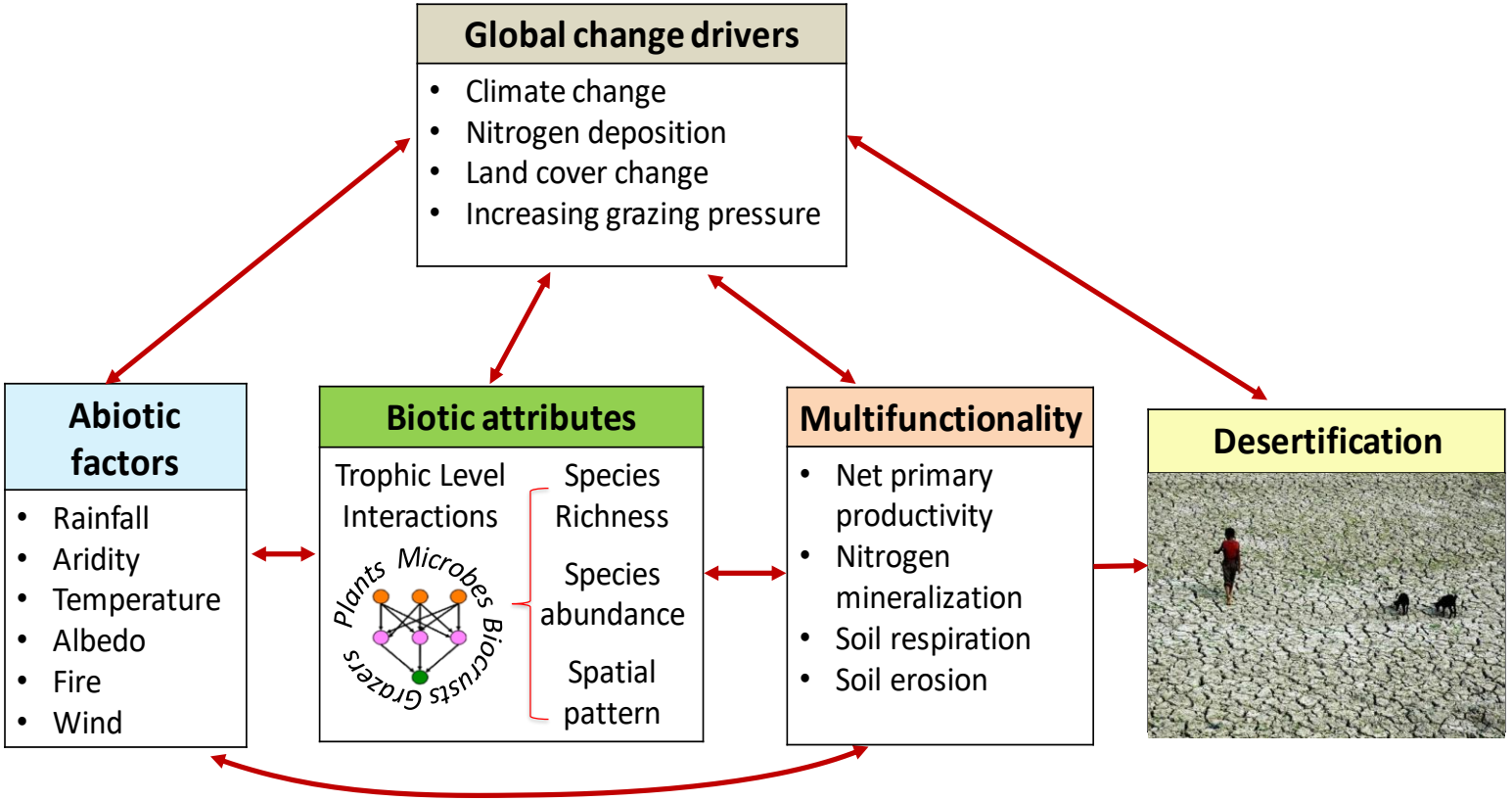


→ Dryland area, projected under representative concentration pathways RCP8.5 and RCP4.5, will increase by 23% and 11%, respectively, relative to 1961–1990 baseline.

Huang, J. et al. 2016. *Nature Clim Change* 6, 166–171

The BIOCOM global network (2006-2016)

MAIN OBJECTIVE: Evaluate the relationships between abiotic factors, ecosystem structure and functioning in global drylands



The BIOCOM global network (2006-2016)

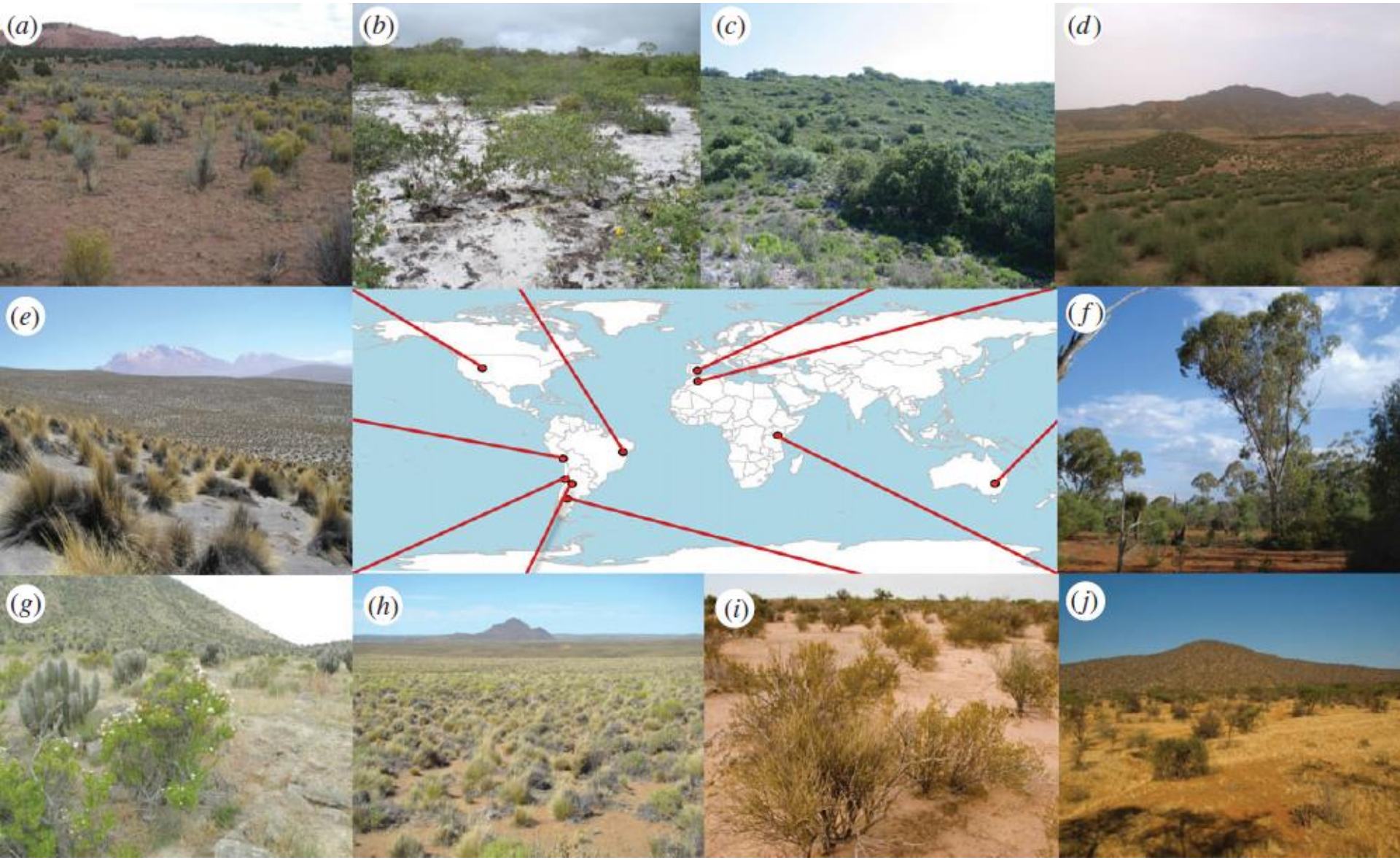
→ 236 dryland ecosystems from six continents (19 countries). More than 60 scientists from 30 research groups involved.

→ Vegetation data from 944 transects and 18800 1.5 x 1.5 m quadrats, > 3000 soil samples analyzed (18 variables per sample) using standardized protocols

→ Primary productivity (using remote sensing) and multiple soil variables related to C, N and P cycling (“functions”)

→ Soil microbial communities (Bacteria, Fungi and Cercozoa) characterized using molecular approaches (qPCR and Miseq) in 80 sites

We captured the wide variety of vegetation found in global drylands



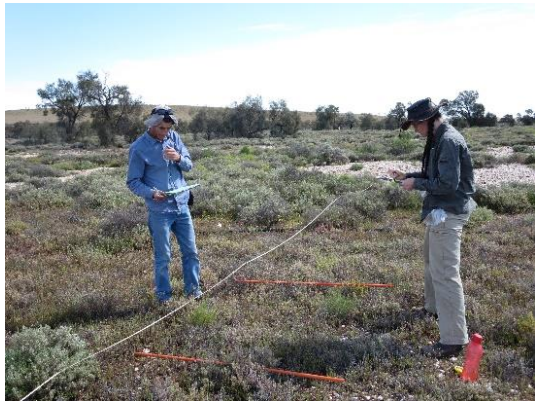
Maestre et al. 2012. *Phil Trans R Soc B* 367: 3062-3075

Development of the BIOCOM network

→ 2005-2007: Testing of protocols and establishment of field sites in Spain. Funding from the Spanish Ministry of Education and Science (14000 €) and Comunidad de Madrid (30000 €)

→ 2007-2010: Expanding the network to Latin America. Funding by CYTED (136000 €)

→ 2010-2016: Making the network global. Funding by an ERC Starting Grant (1460000 €)



Output of the BIOCOM network

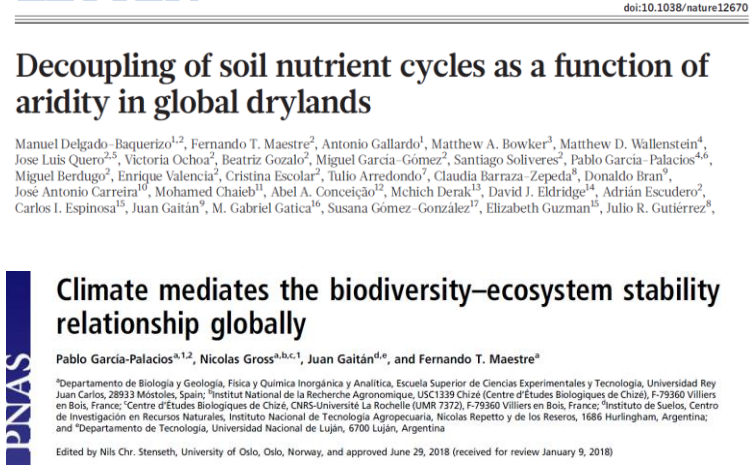
→ Provided multiple and novel insights on the ecology of global drylands and their potential responses to climate change. > 40 scientific articles have been published

→ Contributed to the capacity building of many groups in developing countries

→ Promoted multiple local and regional scientific collaborations

→ Supported the careers of >20 PhD and postdoc researchers

→ Raised the scientific profile of dryland research and researchers



LETTER

doi:10.1038/nature12670

Decoupling of soil nutrient cycles as a function of aridity in global drylands

Manuel Delgado-Baquerizo[1,2], Fernando T. Maestre[2], Antonio Gallardo[1], Matthew A. Bowker[3], Matthew D. Wallenstein[4], Jose Luis Quero[2,5], Victoria Ochoa[2], Beatriz Gozalo[2], Miguel Garcia-Gómez[2], Santiago Soliveres[2], Pablo Garcia-Palacios[4,6], Miguel Berdugo[2], Enrique Valencia[2], Cristina Escolar[2], Tulio Arredondo[7], Claudia Barraza-Zepeda[8], Donaldo Bran[9], José Antonio Carreira[10], Mohamed Chaieb[11], Abel A. Conceição[12], Mchich Derak[13], David J. Eldridge[14], Adrián Escudero[2], Carlos I. Espinosa[15], Juan Gaitán[9], M. Gabriel Gatica[16], Susana Gómez-González[17], Elizabeth Guzman[15], Julio R. Gutiérrez[8],

PNAS

Climate mediates the biodiversity–ecosystem stability relationship globally

Pablo García-Palacios[a,1,2], Nicolas Gross[a,b,c,1], Juan Gaitán[d,e], and Fernando T. Maestre[a]

[a]Departamento de Biología y Geología, Física y Química Inorgánica y Analítica, Escuela Superior de Ciencias Experimentales y Tecnología, Universidad Rey Juan Carlos, 28933 Móstoles, Spain; [b]Institut National de la Recherche Agronomique, USC1339 Chizé (Centre d'Études Biologiques de Chizé), F-79360 Villiers en Bois, France; [c]Centre d'Études Biologiques de Chizé, CNRS-Université La Rochelle (UMR 7372), F-79360 Villiers en Bois, France; [d]Instituto de Suelos, Centro de Investigación en Recursos Naturales, Instituto Nacional de Tecnología Agropecuaria, Nicolas Repetto y de los Reseros, 1686 Hurlingham, Argentina; and [e]Departamento de Tecnología, Universidad Nacional de Luján, 6700 Luján, Argentina

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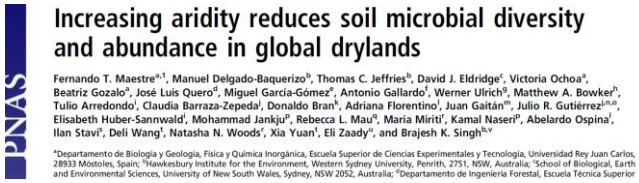

PNAS

Increasing aridity reduces soil microbial diversity and abundance in global drylands

Fernando T. Maestre[a,1], Manuel Delgado-Baquerizo[b], Thomas C. Jeffries[b], David J. Eldridge[c], Victoria Ochoa[a], Beatriz Gozalo[a], José Luis Quero[a], Miguel García-Gómez[a], Antonio Gallardo[d], Werner Ulrich[g], Matthew A. Bowker[h], Tulio Arredondo[i], Claudia Barraza-Zepeda[j], Donaldo Bran[k], Adriana Florentino[l], Juan Gaitán[m], Julio R. Gutiérrez[l,n,o], Elisabeth Huber-Sannwald[i], Mohammad Jankju[p], Rebecca L. Mau[q], Maria Miriti[r], Kamal Naseri[p], Abelardo Ospina[l], Ilan Stavi[s], Deli Wang[t], Natasha N. Woods[r], Xia Yuan[t], Eli Zaady[u], and Brajesh K. Singh[b,v]

[a]Departamento de Biología y Geología, Física y Química Inorgánica, Escuela Superior de Ciencias Experimentales y Tecnología, Universidad Rey Juan Carlos, 28933 Móstoles, Spain; [b]Hawkesbury Institute for the Environment, Western Sydney University, Penrith, 2751, NSW, Australia; [c]School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, NSW 2052, Australia; [d]Departamento de Ingeniería Forestal, Escuela Técnica Superior

nature sustainability ARTICLES

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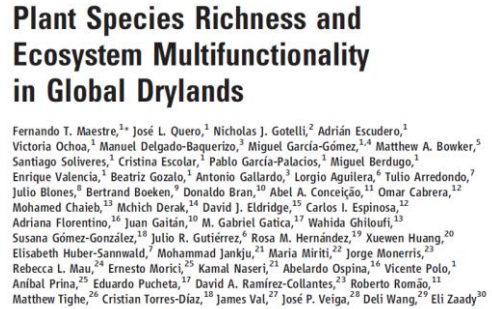
Aridity and reduced soil micronutrient availability in global drylands

Eduardo Moreno-Jiménez[1*], César Plaza[2,3], Hugo Saiz[2], Rebeca Manzano[1,4], Maren Flagmeier[1,5] and Fernando T. Maestre[2]



Plant Species Richness and Ecosystem Multifunctionality in Global Drylands

Fernando T. Maestre,[1*] José L. Quero,[1] Nicholas J. Gotelli,[2] Adrián Escudero,[1] Victoria Ochoa,[1] Manuel Delgado-Baquerizo,[3] Miguel García-Gómez,[1,4] Matthew A. Bowker,[5] Santiago Soliveres,[1] Cristina Escolar,[1] Pablo García-Palacios,[1] Miguel Berdugo,[1] Enrique Valencia,[1] Beatriz Gozalo,[1] Antonio Gallardo,[3] Lorgio Aguilera,[6] Tulio Arredondo,[7] Julio Blones,[8] Bertrand Boeken,[9] Donaldo Bran,[10] Abel A. Conceição,[11] Omar Cabrera,[12] Mohamed Chaieb,[13] Mchich Derak,[14] David J. Eldridge,[15] Carlos I. Espinosa,[12] Adriana Florentino,[16] Juan Gaitán,[10] M. Gabriel Gatica,[17] Wahida Ghiloufi,[13] Susana Gómez-González,[18] Julio R. Gutiérrez,[6] Rosa M. Hernández,[19] Xuewen Huang,[20] Elisabeth Huber-Sannwald,[7] Mohammad Jankju,[21] Maria Miriti,[22] Jorge Monerris,[23] Rebecca L. Mau,[24] Ernesto Morici,[25] Kamal Naseri,[21] Abelardo Ospina,[16] Vicente Polo,[1] Aníbal Prina,[25] Eduardo Pucheta,[17] David A. Ramírez-Collantes,[23] Roberto Romão,[11] Matthew Tighe,[26] Cristian Torres-Díaz,[18] James Val,[27] José P. Veiga,[28] Deli Wang,[29] Eli Zaady[30]


Want to follow Humboldt´s footsteps?
10 simple rules for setting up a global network

Ten simple rules to set up a global network

1. Define a clear research question that can be addressed using a simple protocol

2. Have bullet-proof, tested, protocols

3. Plan ahead carefully: a global network requires your full attention and dedication to be successful

4. Form a team with clear task division

5. Be responsive to build trustful relationships

Ten simple rules to set up a global network

6. Form scientific advisory and conflict resolution boards

7. Develop clear policies about the use of network resources and the publication of results

8. Foster active engagement within and beyond the network

9. Be truly global: target traditionally understudied regions and promote the participation of scientists from developing countries

10. Be aware of legal issues

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