THE ROLE OF MEDITERRANEAN WETLANDS IN CLIMATE REGULATION

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CLIMATE CHANGE?

Donald J. Trump
@realDonaldTrump

The concept of global warming was created by and for the Chinese in order to make U.S. manufacturing non-competitive.

RETWEETS 41,199  LIKES 24,170
CARBON CYCLE in ecosystems is relevant for:

- Main ecosystem functions
- Ecosystem services (climatic regulation)

CLIMATE CHANGE

ADAPTATION vs MITIGATION

Fig. 4 The terrestrial carbon sink according to the model of Lloyd (1999). To be compared to Fig. 2 (noting that $1 \text{ mol } CO_2 \text{ m}^{-2} \text{ year}^{-1} = 12 \text{ g C m}^{-2} \text{ year}^{-1}$). (Reproduced with permission from Lloyd 1999.)
Lakes and reservoirs as regulators of carbon cycling and climate

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Fig. 5. Revision of the ‘active pipe’ hypothesis advanced by Cole et al. (2007). Revised values are explained in the text and represent annual transport of carbon (Pg, 10^15 g).

Fig. 2. Schematic diagram showing pathways of carbon cycling mediated by lakes and other continental waters. The letters correspond to rows in Table 1.
Blue future

Coastal wetlands can have a crucial role in the fight against climate change.

19 January 2016 | Corrected: 17 February 2016

Over the past decade, scientists and policymakers have joined efforts to create a science-based framework under the auspices of the United Nations to protect our remaining tropical forests. These carbon-rich ecosystems help to moderate the climate and serve as a treasure trove of biodiversity and a resource for local and indigenous peoples. Governments across the tropics have begun to incorporate forest conservation into their climate and development plans. Now it is time to do the same with coastal wetlands.

Some 2.4–4.6% of the world’s carbon emissions are captured and sequestered by living organisms in the oceans, and the UN estimates that at least half of that sequestration takes place in ‘blue-carbon’ wetlands. Often occupied by seagrasses and mangroves, these saltwater ecosystems promote healthy fisheries and sequester carbon in their soils. Mangroves also stave off erosion and serve as the first line of defence against powerful storms as well as saltwater intrusion into local groundwater resources. The world has lost more than one-third of its mangroves over the past several decades, and more succumb each year to shrimp farms, rice paddies and palm plantations, as well as to tourism and real-estate development. There’s money to be made, but it’s the environment that pays.

Global carbon dioxide emissions from inland waters

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Nascent efforts are under way to halt this degradation, and a few pioneering projects have already
On a wide sense (e.g. Ramsar definition), lakes and wetlands occupy 4 to 6% of earth surface.

But overall they are among the most productive ecosystems on Earth (estimated PPR of $4-9 \times 10^{15}$ g dw per year), but they also account for 24-40% of global methane emissions.

Because of its high rates of biological processes, determined by the presence of water, wetlands can act either as source or sink of carbon thus contributing in a significant way to the atmospheric carbon balance.
Group 31 - Standing Waters

The project **CLIMAWET**, funded by:

![flags]

aims to **evaluate the potential role of the main Mediterranean Iberian lakes and wetland types in carbon sequestration** and thereby its possible contribution to the **mitigation of climate change**

**Our main goal** was to determine if the studied lakes/wetland types **act as a source or as a sink of carbon** after estimating the **balance** between carbon sequestration and emissions, and also **make prognoses on future climate change scenarios**

 ► This work presents a theoretical and methodological framework for the carbon cycle, focusing on freshwater ecosystems as an example, from which the carbon balance could be estimated.

+ Upcoming projects
1.3.2.2. – Lagos y humedales de alta montaña (morfogénesis glaciar o periglacial)
-1.3.2.2.1- Lagos y lagunas de alta montaña de origen glaciar, septentrionales y centrales.
-1.3.2.2.2- Lagos y lagunas de alta montaña de origen glacio-kárstico, septentrionales y centrales.
-1.3.2.2.3- Lagos y lagunas de alta montaña meridionales
-1.3.2.2.4- Humedales de alta montaña (¿turberas?)

1.3.2.5.- Lagunas someras salinas (origen kárstico inducido, karst no funcional, u otros orígenes).
- 1.3.2.5.1- Lagunas temporales someras hipo-mesosalinas
- 1.3.2.5.2- Lagunas temporales someras hipersalinas
- 1.3.2.5.3- Lagunas salinas temporales bicarbonatadas-sódicas
- 1.3.2.5.4- Lagunas salinas permanentes

1.3.2.7.- Lagunas y humedales someros no salinos (origen morfoestructural) de aguas ácidas y/o de baja alcalinidad (en rañas)
- 1.3.2.7.1- Lagunas y humedales someros no salinos (origen morfoestructural) de aguas ácidas y/o de baja alcalinidad permanentes
- 1.3.2.7.2- Lagunas y humedales someros no salinos (origen morfoestructural) de aguas ácidas y/o de baja alcalinidad temporales
Study of the metabolisms involved in the wetland’s carbon cycle…
**Inputs vs. Outputs**

- **Helophytes photosynthesis** $(\text{CO}_2)$
- **Plankton photosynthesis** $(\text{CO}_2)$
- **Chemical precipitation** $(\text{CaCO}_3)$
- **Plankton respiration** $(\text{CO}_2)$
- **Benthos photosynthesis** $(\text{CO}_2)$
- **Benthos respiration** $(\text{CO}_2)$
- **CH$_4$ emission**
Inputs vs. Outputs

- Plankton GPP and Respiration: Winkler Bottles
- Methane Emissions: Sediment Cores Flow Chambers
- Benthos GPP and Respiration: Benthic Jars
- Helophytes Production: Dry Weight
Identification and delineation of **main wetlands components** and hydroperiod by remote sensing techniques.
... in order to determine the **carbon balance** of each aquatic **ecosystem type**
CARBON BALANCE IN COASTAL FRESHWATER WETLANDS

MOROS-1
Restored and managed

MOROS-2
Hydromorph. altered

PEGO-1
Restored

PEGO-2
Morphologically altered

C budget (g C m\(^{-2}\) y\(^{-1}\))

-1500 -1000 -500 0 500 1000 1500

GPP plankton
Resp plankton
GPP benthos
Resp benthos
CH4
Helophytes

Morant, Camacho et al. Inland Waters (in press)
WARMING POTENTIAL BALANCE IN COASTAL FRESHWATER WETLANDS

Mitigating capacity  Warming capacity

PEGO-2
Morphologically altered

PEGO-1
Restored

MOROS-2
Hydromorph. altered

MOROS-1
Restored and managed

GWP balance (mg CO₂-eq m⁻² y⁻¹)

Morant, Camacho et al. Inland Waters (in press)
EFFECTS OF ALTERATION IN COASTAL FRESHWATER WETLANDS

MOROS-1
Restored, managed

PEGO-1
Restored

MOROS-2
Hydrom. altered

PEGO-2
Morph. altered

RESTORATION
Mitigating capacity

ALTERATION
Warming capacity
WHAT ABOUT THE FUTURE PROSPECTS?
Effect of **environmental** variables on GPP, Respiration and CH$_4$ production

Sediment cores/lake:
- **Temperature** (4, 14, 20, 24, 30ºC)
- **Salinity** (0.2x, 0.5x, 1x, 2x, 5x)
- **Water column vs. wet sediment**

Acclimated in climate-controlled rooms for 4 days in 12 hours light/dark cycles.
Exponential increase with temperature

Strong **direct dependence** of methane emissions with temperature.

Exponential decrease with increased salinity

Methane production is **inhibited by high salinities**

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\[ y = 1.68 \times 10^{-5} e^{(0.287X)} \]

\[ p < 0.001 \]

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**Camacho et al.** (2017). Water 9: 659
Climate change scenarios

Response of the biogeochemical cycles to the climate change effects by the study of the carbon cycle in future climatic scenarios

RCP (Representative Concentration Pathways)

Source: IPCC
CLIMATE CHANGE EFFECTS ON COASTAL FRESHWATER WETLANDS

RESTORED

Increases of the sink capacity (negative C-balance)

Decreases of the warming capacity (negative GWP-balance)

ALTERED

Reduction of the sink capacity

Increases of the warming capacity
**A CLIMATE PERSPECTIVE IN ECOSYSTEM SERVICES MANAGEMENT VS ECOLOGICAL VALUES**

**BIOSPHERE RESERVE OF “LA MANCHA HÚMEDA”**

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### Table 8.2. Matrix of valuation of the effect of the different measures of management on distinct environmental values, uses and variables related to the carbon cycle in the saline lakes of interior.

**Table 8.1. Range economic and economic of values assigned to the estimation of the impact of the different measures of management on the distinct environmental values, uses, activities, and ecosystem services, indicating the positive effects for specific, and the positive values effects beneficial for the parameters measured.**
A CLIMATE PERSPECTIVE IN ECOSYSTEM SERVICES

MANAGEMENT

VS

REGULATORY SERVICES

BIOSPHERE RESERVE OF "LA MANCHA HÚMEDA"

Tabla 8.3. Matriz de valoración del efecto de las distintas medidas de gestión sobre distintos servicios ecosistémicos en las lagunas salinas de interior.

Tabla 8.1. Rango numérico y cromático de valores asignados en la evaluación del resultado de la aplicación de las distintas medidas de gestión sobre los distintos valores ambientales, uso aprovechables, y servicios ecosistémicos, indicando los valores negativos efectos perjudiciales, y los valores positivos efectos beneficiosos sobre los parámetros analizados.

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Moltes gràcies per la vostra atenció
Muchas gracias por vuestra atención
Thank you for your attention

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HELP NATURE TO HELP US!!!

EACH DROP MATTERS!!!