MoReDEHESHyReS
Modelling Responses of *Dehesas* with Hyperspectral Remote Sensing

Javier Pacheco-Labrador, *Mirco Migliavacca, Markus Reichstein*
Max Planck Institute for Biogeochemistry
Department Biogeochemical Integration
Biosphere-Atmosphere Interactions and Experimentation Group

22-23 October 2019
ECST meeting
1. Introduction

- Accurate representation of photosynthesis in TBMs is essential for robust projections of Carbon Cycle
- Currently, highly uncertain
  - Limited process knowledge
  - Limited parameters knowledge
    - PFT constants ($V_{cmax}, m$)
1. Introduction

- MoReDEHESHyReS Project
  - Modelling Responses of Dehesas with Hyperspectral Remote Sensing
  - DLR + BMBF (2017-2019)

---

**senSCOPE**
(Pacheco-Labrador et al., \~t.b.s.)

- Biophysical Parameters: $C_{ab}$, LAI...
- Functional Parameters: $V_{cmax}$, $m$

---

MoReDEHESHyReS
Modelling Responses of Dehesas with Hyperspectral Remote Sensing

EnMAP
Hyper spectral manager

Alexander von Humboldt Stiftung/Foundation

Bundesministerium für Bildung und Forschung

DLR
2. Methods

Mediterranean Savanna

Eddy Covariance
3 EC systems

Airborne data
17 CASI overpasses 2011-2017

Biophysical data
$LAI, N_{mass}, \Delta^{13}C$

MaNiP
Large Scale Manipulation N&P

MTCI map in Majadas de Tiétar, Spain
Pacheco-Labrador et al., 2017; El-Madany et al., in 2018
2. Methods

• Footprint climatology: Spectral-EC integration
• Synthetic EnMAP imagery (E2E simulator)
• Multiple-constraint inversion approach
3. senSCOPE. A new model for semi-arid environments

- senSCOPE
  - RTM, energy balance and photosynthesis of a mixed canopy featuring green and senescent leaves

Pacheco-Labrador et al., ~to be submitted

Figure 2. Schematic functioning of SCOPE and senSCOPE models
4. Results

CASI

EnMAP

Pacheco-Labrador et al., (in preparation)
4. Results

Pacheco-Labrador et al., (in preparation)
4. Results

Pacheco-Labrador et al., (in preparation)
4. Results

CASI

Observed

\( r^2 = 0.76^* \)

\( \text{RMSE} = 2.98 \)

(a)

\( r^2 = 0.76^* \)

\( \text{RMSE} = 57.40 \)

(b)

\( r^2 = 0.48^* \)

\( \text{RMSE} = 68.79 \)

(c)

\( \bar{\lambda} E_{\text{atm}} - H_{\text{obs}} - G_{\text{obs}} \) (W/m²)

NDVI \geq 0.40

EnMAP

Observed

\( r^2 = 0.77^* \)

\( \text{RMSE} = 2.88 \)

(f)

\( r^2 = 0.73^* \)

\( \text{RMSE} = 43.39 \)

(g)

\( r^2 = 0.35^* \)

\( \text{RMSE} = 80.90 \)

(h)

\( r^2 = 0.39^* \)

\( \text{RMSE} = 143.36 \)

(i)

\( r^2 = 0.30^* \)

\( \text{RMSE} = 0.19 \)

(j)
4. Results

- Additional characterization of functional relationships of the ecosystem

Pacheco-Labrador et al., (in preparation)
5. Conclusions

• **Key functional traits of vegetation can be retrieved combining:**
  • Coupled of RTM and Photosynthesis models
    – SCOPE
  • Hyperspectral imagery (EnMAP)
  • Diel *GPP* and *L*<sub>T</sub> data from EC stations

• **Evaluation of functional parameter estimates**
  • Evaluated against *N*<sub>mass</sub> & *Δ*<sup>13</sup>*C*
  • Soil resistances evaluated against *SM*<sub>p</sub>
Collaborations and Funding

Supported by:

- Federal Ministry for Economic Affairs and Energy
- DLR
- Senseco
- EnMAP
- Alexander von Humboldt Stiftung/Foundation
- Max Planck Institute for Biogeochemistry
- Jülich Forschungszentrum
- CEAM
- Fundación Centro de Estudios Ambientales del Mediterráneo
- CSIC
- SpecLab
- EUR-EX
- Universidad de Extremadura
- EUFRI
- COST
- COST is supported by the EU Framework Programme Horizon 2020

on the basis of a decision by the German Bundestag
CA17134 - Optical synergies for spatiotemporal SENSing of scalable ECOphysiological traits (SENSECO)

Main Proposer: M. Schlerf

WG1: Closing the scaling gap

WG2: Closing the temporal gap

WG3: Realizing synergy between passive EO spectral domains

WG4: Establishing data quality through traceability and uncertainty
Thanks for your attention

QUESTIONS AND REMARKS!