ESSENSE - Mapping regulating Ecosystem Services using remote SENSing imagEry

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ESSENSE – Administrative details

» Project Period: Feb 2012 – Dec 2013

» Innovation project

» Partners:
ESSENSE – Project background

» Biodiversity is rapidly declining worldwide, and this decreases ecosystem functioning and services

» Biodiversity loss, and loss of the services it supports, highly impacts human well-being and increases the replacement costs for technical measures

» This represents a high socio-economic risk, mostly in densely populated areas subjected to global change

» Well-informed land-use management can decrease this risk by conserving critical hotspots of ecosystem service delivery

» Determining ES-hotspots and gradients is essential
ESSENSE – Project background

» Biodiversity is the support and insurance of ecosystem functioning

Consensus: high biodiversity = “better” functioning

- Nutrient cycling,
- Productivity,
- Resistance,
- Resilience,
- ...

- Species number,
- Diversity indices,
- Functional diversity,
- Trait diversity,
- ...

Debates on measurement and definition

Debates on mechanisms

Debates on measurement and definition

Ecosystem functioning

Biodiversity
High plant diversity is needed to maintain ecosystem services

Forest Isbell¹, Vincent Calcagno¹, Andy Hector², John Connolly³, W. Stanley Harpole⁴, Peter B. Reich⁵,⁶, Michael Scherer-Lorenzen⁷, Bernhard Schmidt⁸, David Tilman⁹, Jasper van Ruijven⁹, Alexandra Weigelt¹⁰, Brian J. Wilsey¹¹, Erika S. Zavaleta¹¹ & Michel Loreau¹

Figure 3 | The proportion of study species that promoted ecosystem functioning increased when more (a) years, (b) places, (c) ecosystem functions and (d) environmental change scenarios were independently considered. Solid blue lines indicate generalized linear model fits for each study; dashed red line indicates grand mean generalized linear model fitted across all studies. Box plots summarize observed data: black band, median; bottom and top of boxes respectively correspond to lower and upper quartiles; error bars, ± 1.5 times the interquartile range. See Supplementary Data for the specific years, places, functions and environmental change scenarios considered in each study.
ESSENSE – Project background

Biodiversity is related to spectral heterogeneity

- Debates on measurement and definition
- Debates on mechanisms
- Different approaches

Species number,
Diversity indices,
Functional diversity,
Trait diversity,
...

Consensus: high spectral heterogeneity = high biodiversity

- Local heterogeneity
- Spectral Distance approaches for regional heterogeneity
- Temporal stability and distance approaches...
- Indices vs full reflectance
- ...

Biodiversity

Spectral heterogeneity
Remotely sensed spectral heterogeneity as a proxy of species diversity: Recent advances and open challenges

Duccio Rocchini a,*, Niko Balkenhol b, Gregory A. Carter c,d, Giles M. Foody e, Thomas W. Gillespie f, Kate S. He g, Salit Kark h, Noam Levin i, Kelly Lucas c, Miska Luoto j, Harini Nagendra k,l, Jens Oldeland m,n, Carlo Ricotta o, Jane Southworth p, Markus Neteler a
ESSENSE – Project objectives

Regulating services:
- Regulation of material flows and moderation of extreme events.
- Very high socio-economical value
- Threatened by current land-use developments
- Bio-physical models and data available
- Potential direct fingerprinting of ES

Heterogeneity of HS signal:
- Hyperspectral: Detects >50 bands
- Correlations with biota diversity (habitats, species) have been proven.
- Heterogeneity at different scales: α-, β- and γ-diversity
**ESSENSE – Project approach – WP breakdown**

**WP 2**
Literature study / Data acquisition / Data pre-processing

**WP 3 – Mapping regulating ecosystem services using RS**
- 3.1: Exploration of HS-indices
- 3.2: Development of hotspot mapping/detection methods
- 3.3: Development of suitable spectral distance measures
- 3.4: Analysis of scale effect

**WP 4 – Modelling of regulating ES, using:**
- process-based models
- existing GIS data layers
- field verifications (vegetation mapping, soil sampling, soil moisture)

**WP 5 - Comparison of the results of both approaches**
- 5.1: Comparison of maps
- 5.2: Interpretation and analysis of HS-ES links
ESSENSE – Project approach – Study areas

» De Vennen
  » Grote Nete catchment region
  » many nature reserves and momentum for reserve expansion
  » ongoing EU-LIFE-project “between Dune and Nete”
  » Anthropgenic pressure:
    » afforestation, eutrophication, habitat fragmentation, intensification of agriculture, and disturbances of the natural hydrology
  » Mainly wetland (semi-)natural habitats

Habitats
- Transition mires and quaking bogs
- Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)
- Dry sand heaths with Calluna and Genista
- Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Nanojuncetea
- Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation
- Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation
- European dry heaths
ESSENSE – Project approach – Study areas

» Turnhouts Vennengebied and De Liereman
  » Campine region
  » Highly heterogeneous area
  » Anthropogenic pressure:
    » habitat fragmentation, conifer plantations, changes in the natural hydrology and lack of appropriate land use

» Habitats different from De Vennen:

Habitats
- Depressions on peat substrates of the Rhynchosporion
- Old acidophilous oak woods with Quercus robur on sandy plains
- Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)
- Malcolmietalia dune grasslands
- Dry sand heaths with Calluna and Genista
- Oligotrophic waters containing very few minerals of sandy plains
- Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoë-Nanojuncetea
- Northern Atlantic wet heaths with Erica tetralix
- European dry heaths
- Species-rich Nardus grasslands, on silicious substrates in mountain areas (and submountain areas in Continental Europe)
ESSENSE – Project approach – Study areas

» One long flightline crossing various ecosystems

» mosaic of natural and anthropogenic (e.g. agricultural land and urban environments) ecosystems
Time for Questions..

Under construction..  http://essense.vgt.vito.be