

CASCADE

Catastrophic shifts in drylands

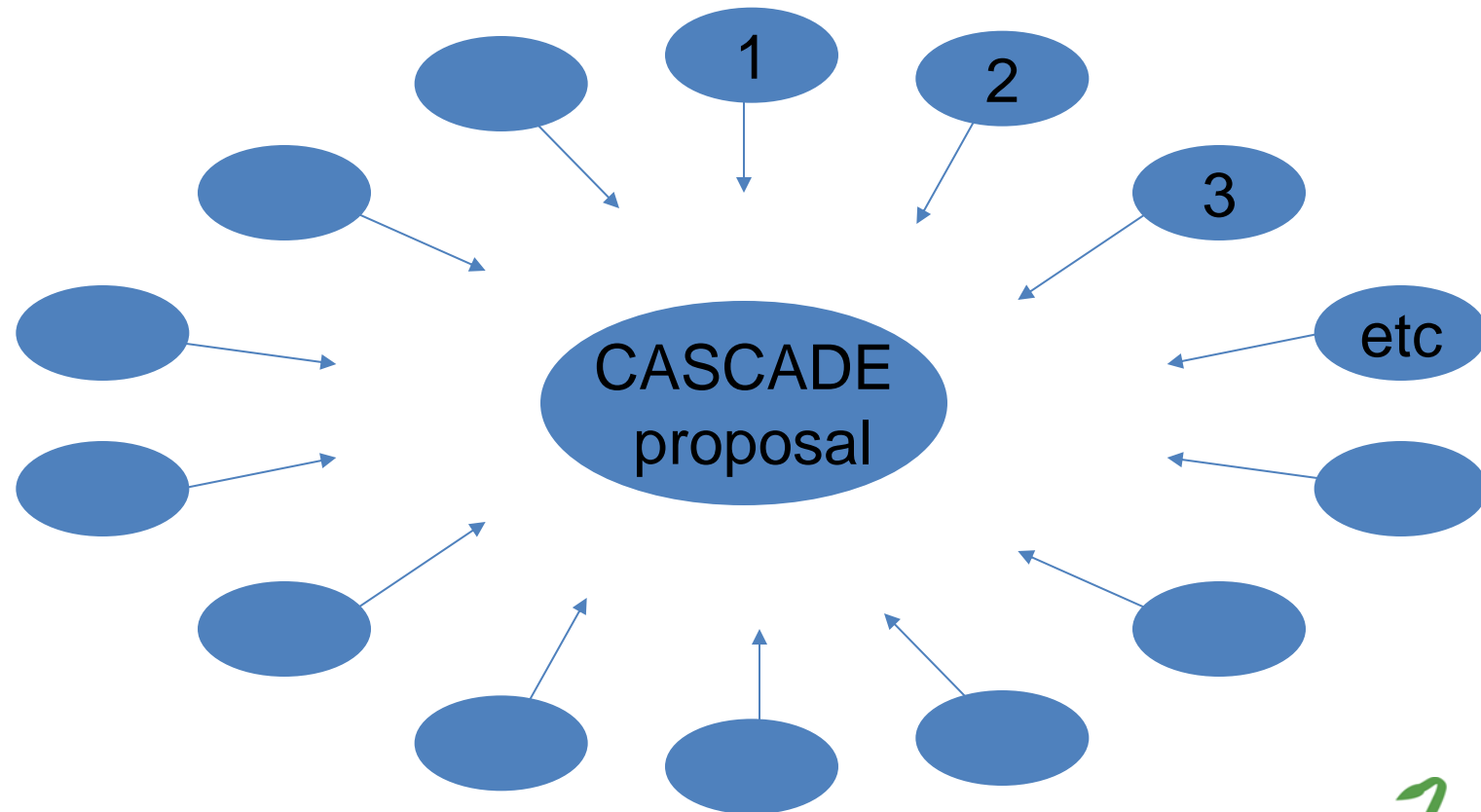
how can we prevent ecosystem
degradation?

Violette Geissen and Coen Ritsema



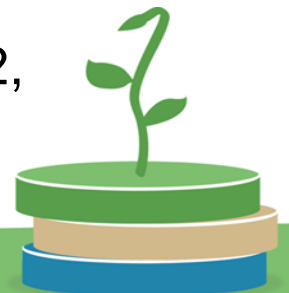
Introduction

Preparation of the proposal a real joint effort with contributions of all of the 14 partners!

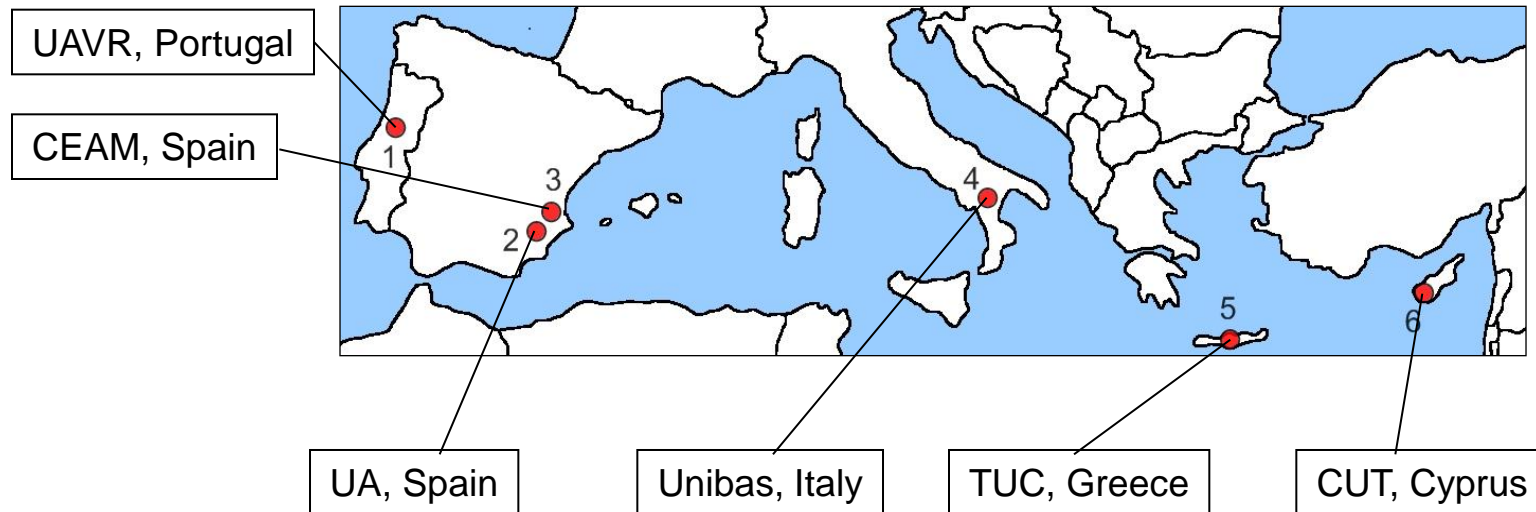


Project start: Jan. 2012, Kickoff meeting: Feb. 2012,

60 months



Study sites and institutions



WUR team



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Erik v.d.
Elsen

Simone
Verzandvoort



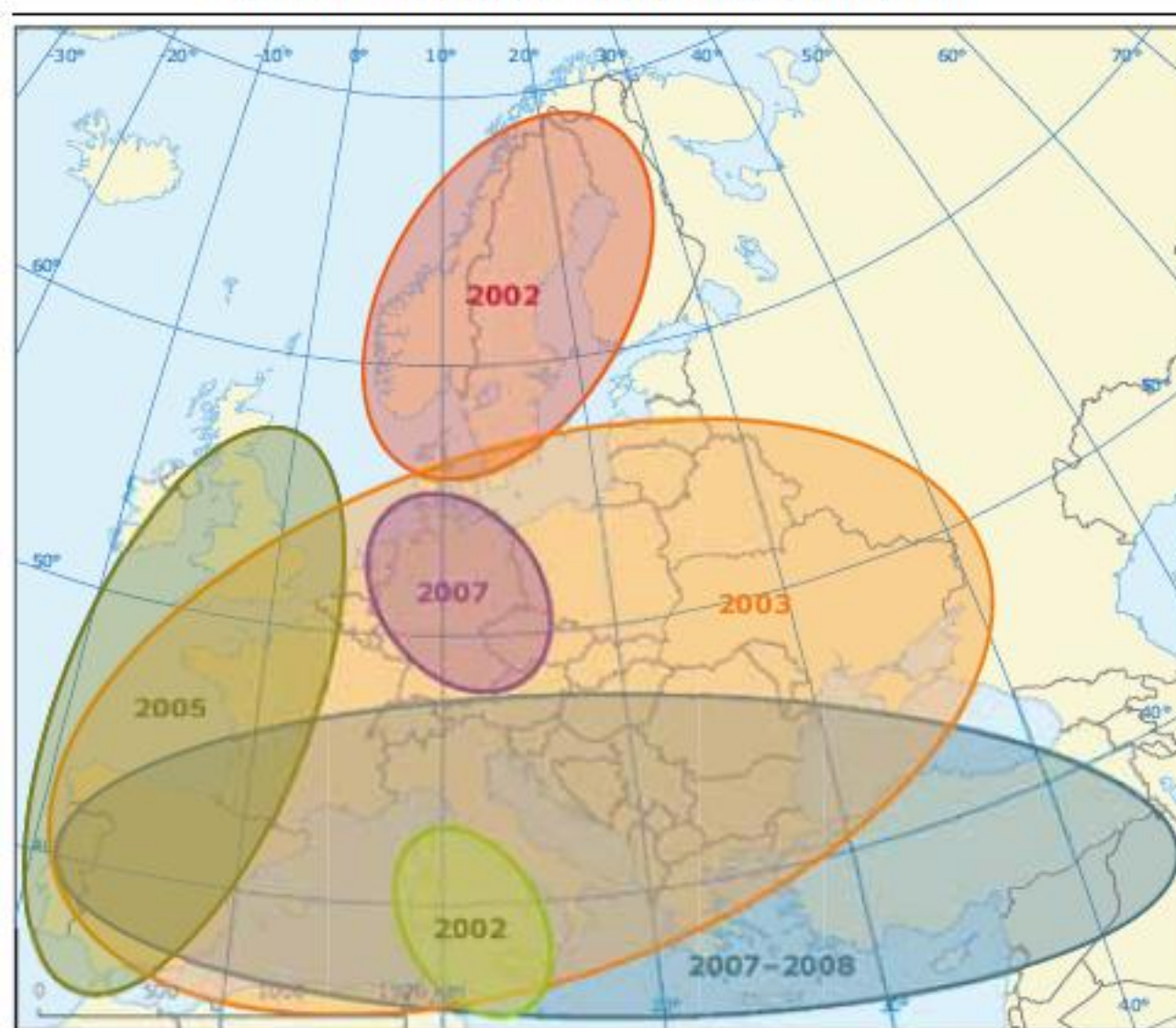
So, we have new challenges ahead of us!

What are some recent developments regarding drylands in the Mediterranean?



Recent developments

Main drought events in Europe, 2000–2009



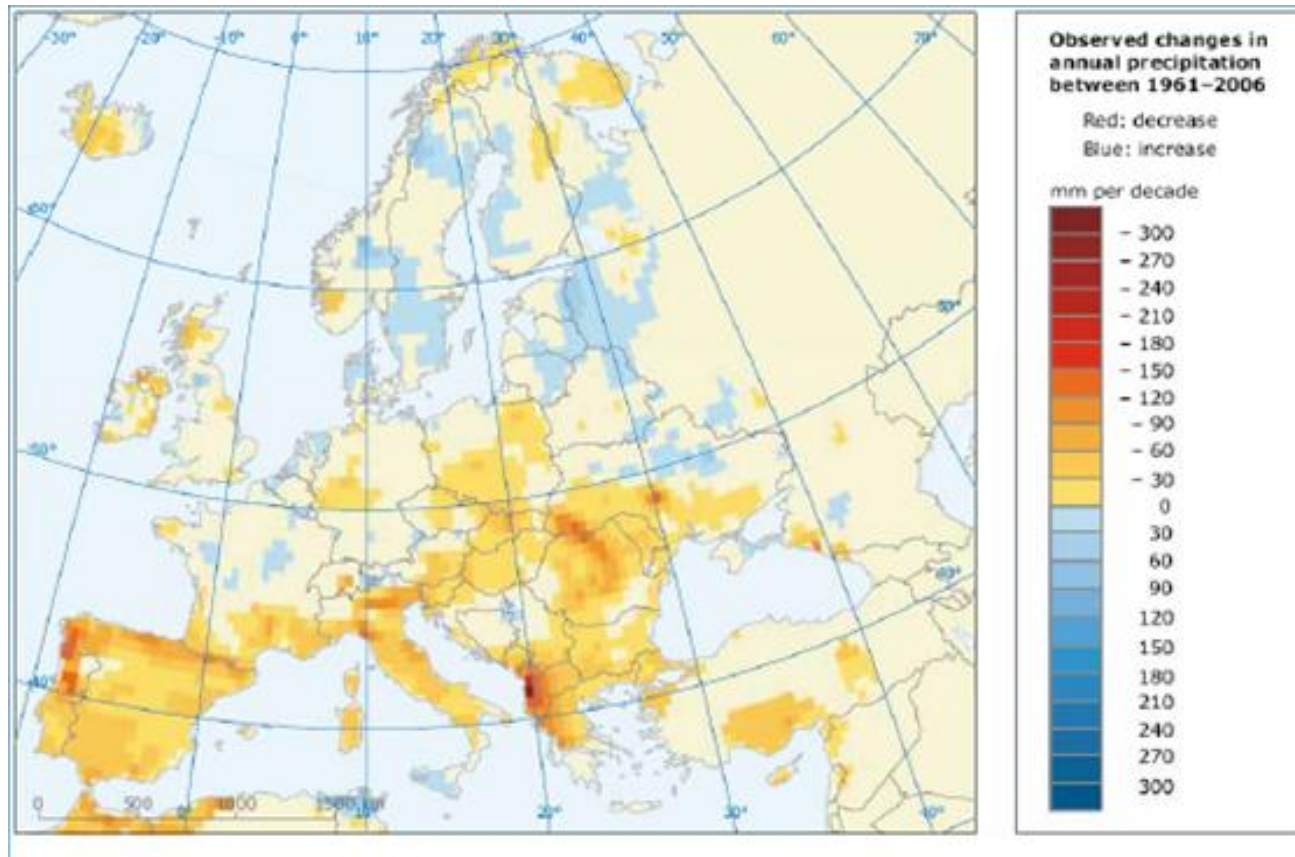
Major drought events during 2000-2009 affected especially the southern parts of Europe

Source: The European environment State and Outlook 2010, EEA



Recent developments

And 45 years of rainfall records indicate indeed that precipitation patterns across the EU are already changing, with substantial rainfall reductions in the Mediterranean regions



Recent developments

And water shortages become even more pressing due to increasing water demands for e.g. tourism, horticulture, and irrigated agriculture



Recent developments

Droughts and subsequent water scarcity are receiving more and more attention from scientists but also politicians

Climate change: Drought may threaten much of globe within decades

October 19, 2010

BOULDER—The United States and many other heavily populated countries face a growing threat of severe and prolonged drought in coming decades, according to a new study by National Center for Atmospheric Research (NCAR) scientist Aiguo Dai. The detailed analysis concludes that warming temperatures associated with climate change will likely create increasingly dry conditions across much of the globe in the next 30 years, possibly reaching a scale in some regions by the end of the century that has rarely, if ever, been observed in modern times.

Using an ensemble of 22 computer climate models and a comprehensive index of conditions, as well as analyses of previously published studies, the paper finds that extreme drought will be more common in the next 30 years in large parts of Eurasia, Africa, and Australia.

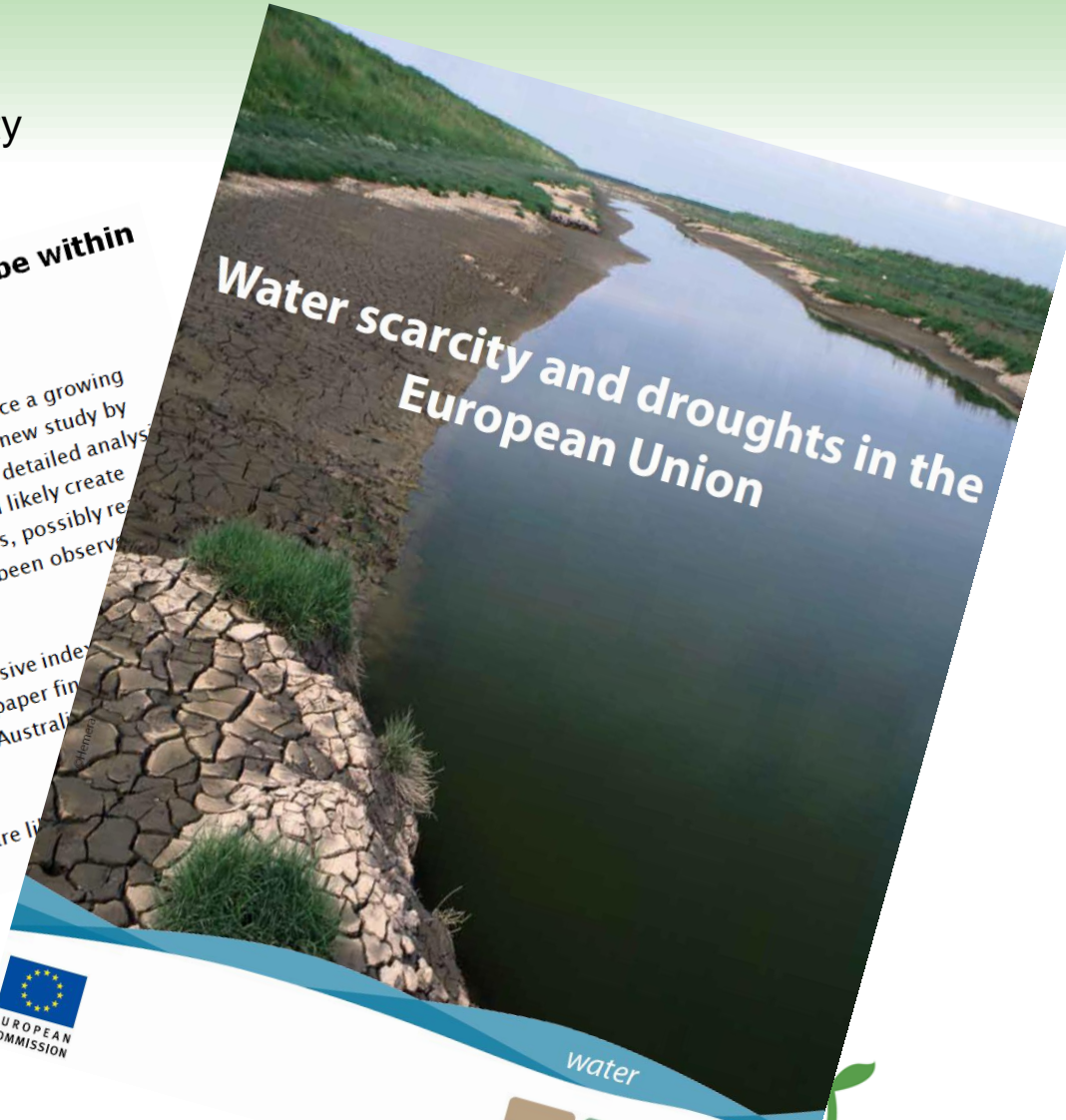
In contrast, higher-latitude regions from Alaska to Scandinavia are likely to become more moist.

Source: UCAR, press release, 2010

CASCADE
Catastrophic shifts in drylands



WAGENINGEN UR
For quality of life



water
environment

Recent developments

Overall, climatic change and increased human pressure on the land in the Mediterranean results into:

- Higher temperatures, longer heat waves
- Reduced rainfall, often more erratic with high intensity storms
- Changed hydrology and soil functioning
- Increased wildfire risk
- Reduced water availability for plants/ecosystems
- Stressed crops/vegetation, leading to increased diseases and plant mortality
- Encroachment of invasive species
- Gradual or abrupt changes in dryland ecosystems



VAGENINGEN
For quality of life



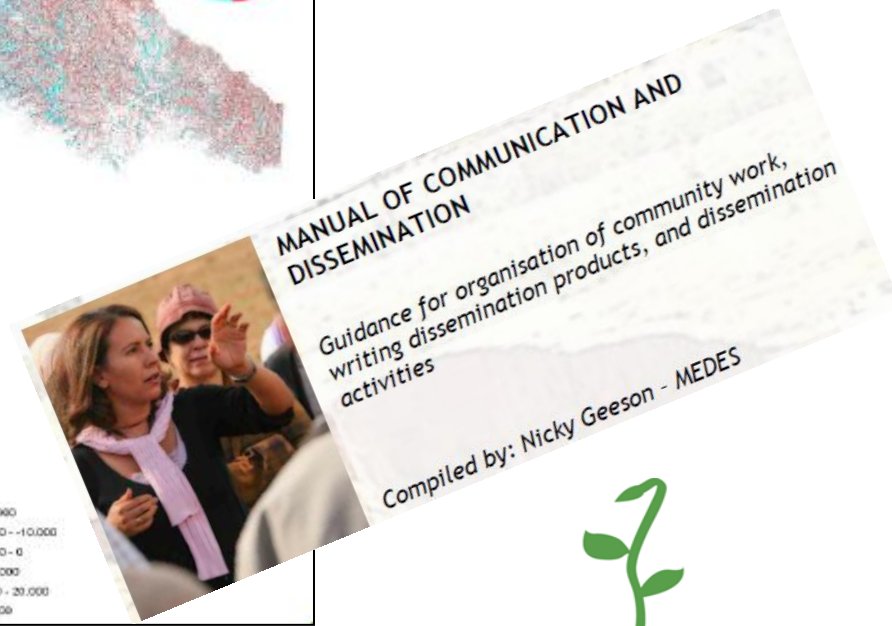
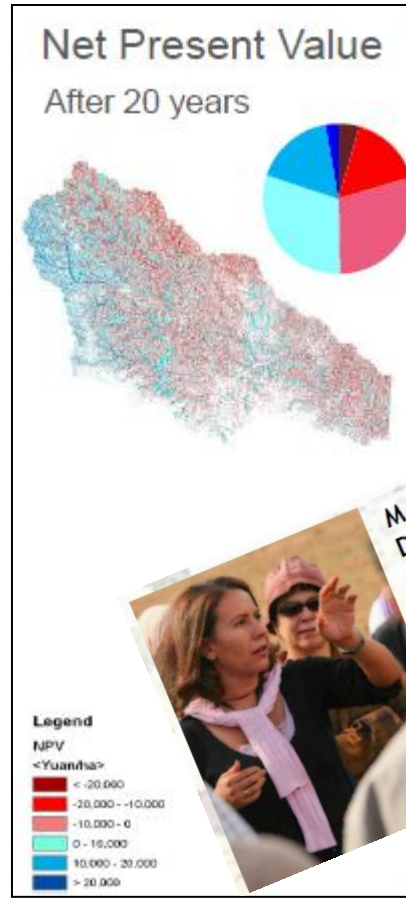
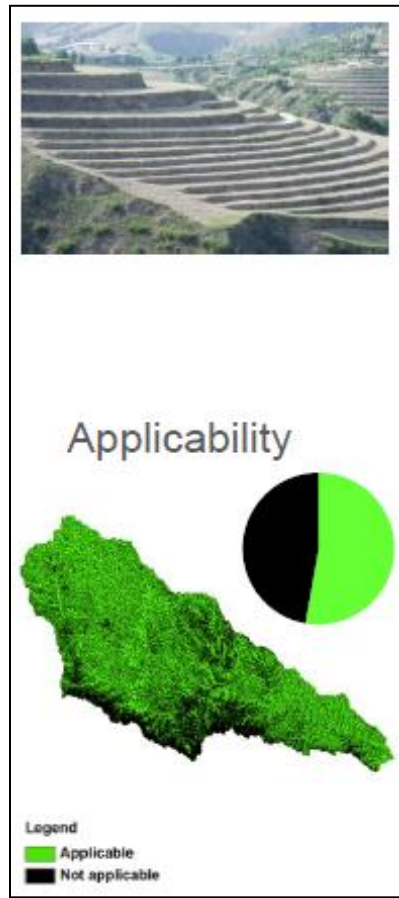
CASCADE general aims

These aspects relate directly to our CASCADE project aiming to better understand ecosystem changes in drylands under increased pressure of climate and human population, with special attention to unravel regulating thresholds and underlying process mechanisms



CASCADE general aims

and understanding early warning signals for change, exploring potential prevention and remediation technologies (including costs and benefits), and disseminating results to targeted audiences



CASCADE general aims

To tackle such problems, a joint effort is needed covering disciplines like ecology, soil science, hydrology, agronomy, meteorology, remote sensing, economics, land use planning and communication and dissemination

With the CASCADE partners, we have the potentials to advance the state of knowledge in this field

Field of expertise	Partner													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	ALT	TUC	UNIBAS	CNRS	UALI	UAVR	MEDES	ULEED S	UNIBE	UU	JRC	CUT	WU	CEAM
Ecology	x		x	x	X	x				x			x	x
Hydrology	x	x			x	x				x			x	x
Soil science	x		x		x	x		x		x	x		x	x
Biology	x				x	x				x				x
Soil biodiversity	x										x		x	
Droughts	x	x	x		x	x		x				x		x
Critical thresholds and tipping points	x			x	x	x				x				x
Ecological regime shifts			x	x						x			x	x
Environmental chemistry						x							x	
Ecophysiology				x		x							x	
Early warning systems			x	x						x				
Environmental social science								x	x					
Risk and uncertainty		x				x								
Ecosystem services	x		x	x	x	x		x	x	x			x	x
Impact assessment	x		x				x	x	x					
Multistakeholder and multiscale approaches			x				x	x	x					
Sustainable land management	x	x	x			x		x	x		x			x
Knowledge transfer and dissemination	x	x	x		x		x	x	x		x			x
Participatory approaches			x		x	x	x	x	x		x			
Policy advise and recommendation		x	x			x	x	x			x			x
Remote sensing		x	x						x		x	x		
Laboratory experimentation	x				x	x								
Field trials and monitoring	x	x	x		x	x			x	x		x		x
Integrated modelling		x		x		x		x		x		x	x	
Data management		x			x				x		x			
Project management	x	x	x	x	x	x	x	x	x		x	x	x	x

The red line of Cascade – what we promised, what we expect



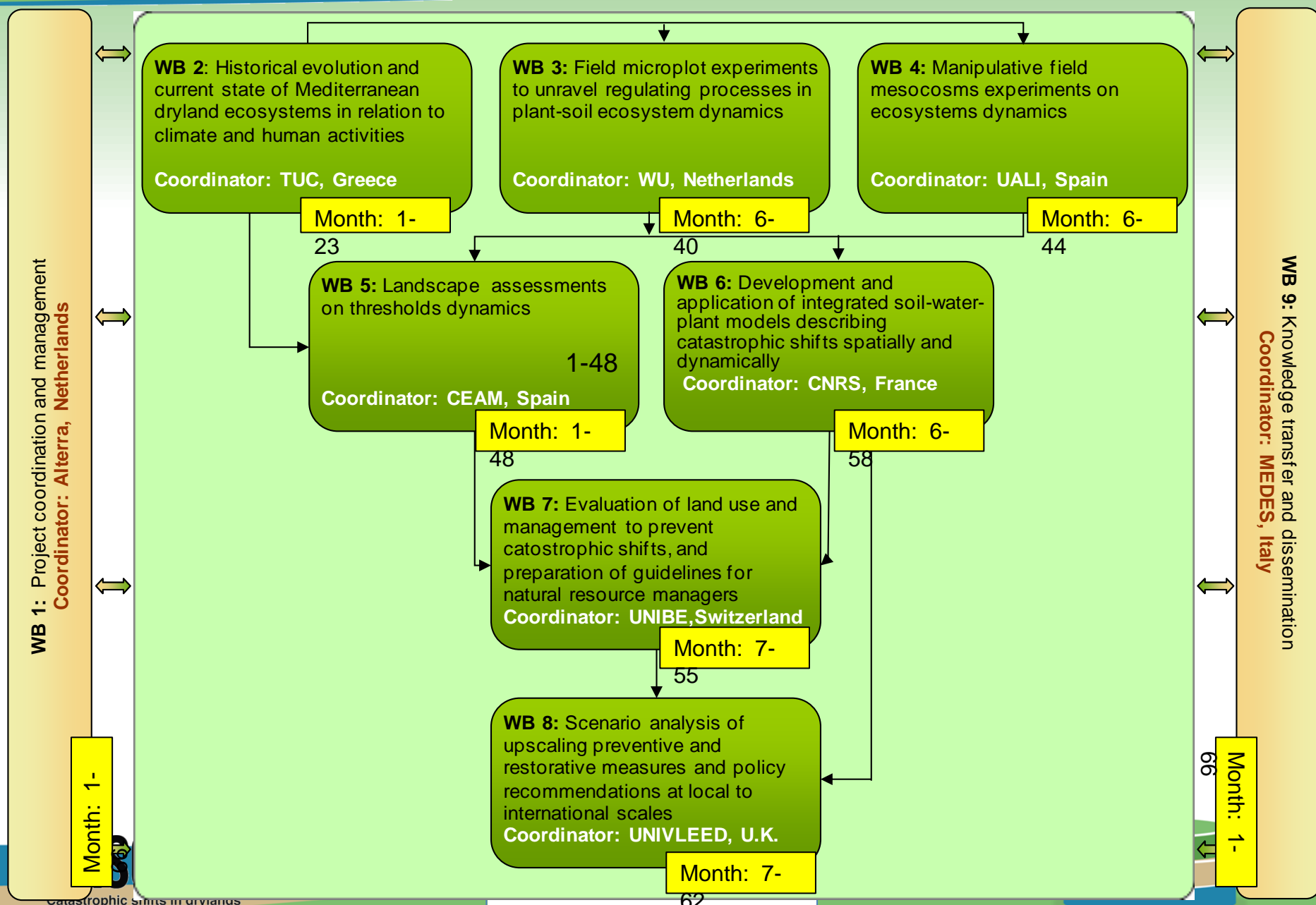
Catastrophic shifts in drylands: how can we prevent ecosystem degradation?

Objectives

- Better understanding of sudden shifts in drylands that may lead to major losses in biodiversity and ecosystem services.
- Improve our understanding of the biogeochemical mechanisms underlying sudden and catastrophic shifts, and of the key biotic and abiotic factors influencing these processes.
- Develop ways to predict the proximity of the CASCADE's dryland ecosystems to thresholds in such a way that these predictions can be used by policymakers and land users for more sustainable management of drylands worldwide.



CASCADE the red line



Specific Objectives

- Analyse the historical and current state of selected dryland ecosystems in relation to climate and human activities, and the role of thresholds and tipping point in the land degradation processes in these sites (WP2)



Crete



CASCADE the red line

Nr.	Deliverable	month
D2.1	Historical evolution and current state of Mediterranean dryland ecosystems in relation to climate and human activities	18
D2.2	Drivers of changes in the study sites	23



- Assess on a *field microplot scale* the interplay between spatial and temporal variation in water and nutrients and how that affects facilitation and competition, tipping points and sudden regime shifts in vegetation structure and composition (WP3)



CASCADE the red line

Nr.	Deliverable	month
D3.1	Identification of critical changes preceding catastrophic shifts in selected plant-soil ecosystems that can serve as early indicators	41



CASCADE the red line

- Assess on a *field mesocosm scale* the interplay between vegetation structures (spatial patterns and composition), hydrology, land use, and sudden regime shifts (WP4)



CASCADE the red line

Nr.	Deliverable	month
D4.1	Report on the potential for sudden shifts in ecosystem functioning and provision of services through feedbacks between plant pattern changes and resource redistribution	35
D4.2	Report on the role of increasing environmental pressure in triggering sudden shifts in ecosystem structure and function	42
D4.3	Report on threshold dynamics in dryland plant cover restoration	44



- Assess on a *landscape scale* the vegetation structure (composition, cover, spatial patterns) and ecosystem services before and after regime shifts, as well as the potential of restoration of degraded systems (WP5)

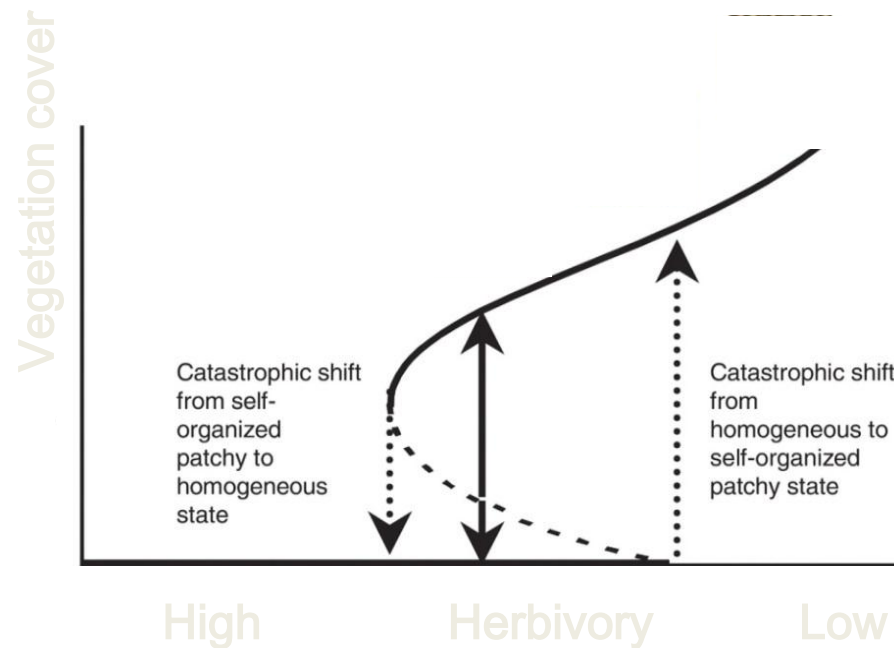


CASCADE the red line

Nr.	Deliverable	month
D5.1	Report on structural and functional changes associated to regime shifts in Mediterranean dryland ecosystems	42
D5.2	Report on the restoration potential for preventing and reversing regime shifts in Mediterranean drylands	48



- Develop a spatially explicit model that links the empirical observations on the various scales in WP3, WP4 and WP5 to come up with reliable and empirically based indicators of the proximity of the ecosystems to thresholds and sudden shifts (WP6)



CASCADE the red line

Nr.	Deliverable	month
D6.1	Report on simulated pressures and ecosystem responses	53
D6.2	Report on appropriate indicators for critical thresholds	58



CASCADE the red line

- Design management strategies to deal with tipping points and thresholds in dryland ecosystems and their resilience towards change; comprehensive guidelines including principles, best practices, implementation approaches and recommendations (WP7)



Nr.	Deliverable	month
D 7.1	Documented and evaluated natural resource management practices (technologies and approaches) in each study site in the WOCAT databases	30
D7.2	Study report on the resilience of natural resource management practices, their role regarding ecosystem tipping points, thresholds and shifts, and their sustainability over time and scale. This includes a tested resilience assessment tool.	49
D7.3	Comprehensive guidelines for natural resource managers including principles, best practices, implementation approaches and recommendations	55



CASCADE the red line

- Integrate socio-economic factors into the ecological model and undertake scenario analyses of land management strategies, to enable formulation of policy recommendations for preventive and restorative dryland management (WP8)



Nr.	Deliverable	month
D8.1	Report on adaptation strategies of local land users in study sites	38
D8.2	Report on integrated modelling strategy	59
D8.3	Report on multi-scale evaluation with policy makers linked to dissemination outputs of WP8	62



CASCADE the red line

- Make the results accessible to the scientific community focused on the outcomes of the integrated modelling, indicators of sudden shifts, and adaptation strategies of local land users and develop a multi-media communication strategy on knowledge transfer and dissemination (WP9)



Nr.	Deliverable	month
D 9.1	Manual on knowledge transfer and dissemination	16
D9.2	Final CASCADIS website	66
D9.3	Video/film presentations of scientific issues underlying shifts in dryland ecosystems and the management of land degradation	66



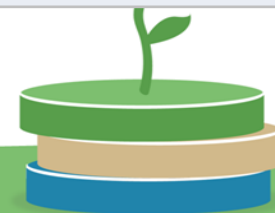
A wide-angle photograph of a desert landscape featuring large, undulating sand dunes. The dunes are a warm, golden-brown color, with some areas in shadow appearing darker. The sky is a pale, clear blue. In the foreground, there are small, dark green shrubs and patches of dry grass. The overall scene is serene and expansive.

Thank you for your attention

Nr.	Milestone	WP	Part- ner	month	Description
M7	RS images acquired for all study sites	2	2	8	Study site descriptions available, and interpretation with regard to drivers of change
M11	Landscape field assessments started	5	14	8	Using groundtruth and RS techniques
M15	Survey with local stakeholders completed	7	9	12	
M8	Representative plant-soil ecosystems selected	3	13	13	Will be selected in each of the study sites
M9	Field microplot experiments implemented	3	13	14	Design of experiments and data collection procedures finetuned with WP6
M10	Mesocosm field experiments implemented	4	5	14	
M19	Training event organised	9	7	14	For all project partners



Nr.	Milestone	WP	Part- ner	month	Description
M12	Ecosystem functioning assessed through using indices	5	14	43	
M13	Improved dryland vegetation models available	6	4	50	Model description, including a manual for use
M14	Trends toward degradation evaluated with indicators	6	4	55	
M16	Point-based integrated model completed	8	8	52	Model description and user manual
M17	Spatial model integration WP6/WP8 achieved	8	8	55	Including application on study sites
M18	Evaluation workshops with policy-makers held and documented	8	8	59	Report, and as news item on project website



CASCADE kickoff meeting

The first challenge was our joint kick-off meeting in Portugal!



NR	Partner	Country	Responsibilities	WP leader	Study site
1	Alterra	NL	Coordinating, field microplot experiments	WP1	
2	Technical University of Crete	GR	Historical change in dryland ecosystems and their drivers	WP2	Yes
3	Universita degli studi della Basilicata	IT	Management techniques, recommendations, ecosystem changes on landscape level		Yes
4	Centre National de la Recherche Scientifique	FR	Modelling	WP6	
5	Universidad de Alicante	SP	Field mesocosm experiments		Yes
6	University of Aveiro	P	Ecosystem changes on landscape level	WP4	Yes
7	Fondazione per lo sviluppo sostenibile del Mediterraneo	It	Management techniques, recommendations, Dissemination	WP9	



NR	Partner	Country	Responsibilities	WP leader	Study site
8	University of Leeds	UK	Scenario analysis, policy recommendations	WP8	
9	Universität Bern	SW	Management techniques, recommendations	WP7	
10	Universiteit Utrecht	NL	Modelling		
11	Joint Research Centre	It	Modelling Management techniques, recommendations		
12	Cyprus University of Technology	Cy	Management techniques, recommendations		Yes
13	Wageningen University	NL	Field microplot experiments	WP3	
14	Fundacion Centro de Estudios Ambientales del Mediterraneo	SP	Ecosystem changes on landscape level	WP5	Yes

