Research group Plants and Ecosystems (PLECO)

Ivan Nijs & Ivan Janssens & Erik Verbruggen
& Matteo Campioli & Sara Vicca

About 60 team members, at campus Drie Eiken

Focus: global change
Topics Ivan Nijs & Erik Verbruggen
1. Climate extremes

**Free-air Exposure System:** system to simulate climate extremes (droughts, heat waves, extreme rainfall) in realistic conditions
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Infrared lamps: heating up to +10°C = heatwave
1. Climate extremes

**Free-air Exposure System:** system to simulate climate extremes (droughts, heat waves, extreme rainfall) in realistic conditions

Past research: **individual** events

Current research: **regimes** of extremes events (recurrent events)
1. Climate extremes

12 independent units
1. Climate extremes

4-year project on more persistent weather:

longer dry and wet spells
1. Climate extremes

Heat is redistributed from the equator to the poles

Arctic amplification: polar regions warm 2 to 4 x faster than the equator

Figure 10-8. Circulation pattern in a static environment.
1. Climate extremes

Arctic amplification: polar regions warm 2 to 4 x faster than the equator

more persist weather

slower air circulation

Figure 10-8. Circulation pattern in a static environment.
1. Climate extremes

More persistent weather: Norway 2018

Jul: 2\textsuperscript{nd} driest

Aug: 2\textsuperscript{nd} wettest month in >100 y
1. Climate extremes

Current climate

- regime 1
- regime 2
- regime 3
- regime 4
- regime 5
- ....
- regime 8

Future climate

Gradient approach
1. Climate extremes

Current climate

regime 1

regime 2

regime 3

regime 4

regime 5

....

regime 8

Future climate

Organisms adapted to extreme dry and extreme wet?
1. Climate extremes

Current climate

Where is the tipping point for irreversible damage?

Future climate

Organisms adapted to extreme dry and extreme wet?
1. Climate extremes

Large project: 5 professors, 6 postdocs, 4 PhD students

Multiple topics: room for up to 3 master students

Study of **ecosystem impact**  Study of **societal adaptation**
1. Climate extremes

Impact of more persistent weather (longer dry and wet spells) on:

- **plant biodiversity and changing species interactions.** MP or IP summer 2020. [simon.reynaert@uantwerpen.be](mailto:simon.reynaert@uantwerpen.be). Room C0.15.

- **soil carbon storage and ecosystem CO$_2$ fluxes.** MP or IP summer 2020. [simon.reynaert@uantwerpen.be](mailto:simon.reynaert@uantwerpen.be). Room C0.15.

- **soil bacteria and fungi** (DNA analysis of microbiome). MP summer 2020. Contact: [lingjuan.li@uantwerpen.be](mailto:lingjuan.li@uantwerpen.be). Room C2.03.

- **soil fauna diversity and consequences for soil structure and hydrofobicity** (experimental and/or modelling, with KUL soil lab). MP summer 2020. [gaby.deckmyn@uantwerpen.be](mailto:gaby.deckmyn@uantwerpen.be). Room C0.17.
1. Climate extremes

Societal adaptation to more persistent weather (longer dry and wet spells):

Joint PLECO - ILVO research to increase ecosystem robustness via:

- new grass cultivars tolerant to drought
- increasing soil organic matter and thus soil water content

MP spring-summer 2020.
1. Climate extremes
1. Climate extremes

Impact of extreme drought on the carbon cycle: mediated by nutrient availability and mycorrhizal fungi?

**Hypothesis:** Largest drought impact in nutrient-rich ecosystems because of low C allocation to roots and mycorrhizae

**Options:**

- Database update and *meta-analysis* on drought experiments worldwide (MP)
- Growth chamber *experiment* in Antwerp AND/OR limited *review/meta-analysis* on drought*nutrient* experiments worldwide (MP/IP)
- *Meta-analysis* on drought/heat x other environmental factors (nutrients, CO$_2$) → additive, antagonistic or synergistic responses? (MP/IP)

Contact: Kevin.VanSundert@uantwerpen.be  Sara.Vicca@uantwerpen.be
Species on the move: changes in species distributions as a result of climate change and human disturbances

Part of a global long-term project: MIREN or the Mountain Invasion Research Network

Several possible topics in a range of disciplines:

- Mycorrhizae as drivers of plant distribution shifts
- Species invading along mountain trails
- Microclimatic hotspots as stepping stones for species movement

...
2. Mountain ecology

Range of methods (depending on topic) in ecology, botany, genetics, climatology...

- Seed-addition experiments in the field
- DNA sequencing for mycorrhizal diversity
- Alpine plant species inventories
- Soil sampling and analysing
- Modelling in R and/or ArcGIS
- ...

Practically:

- ± 30 days of fieldwork in summer 2020 in Swedish Lapland.
- Mountain hikes: reasonably good condition required
- Enthusiastic international fieldwork team
- Come and discuss your favorite topics with Jonas Lembrechts
3. Microclimate

Improving the **climate data** we use in ecological models

- Follow-up of climate loggers across Flanders
- Using a **global database** to improve our models of the link between plant species and climate

**Practically:**

- ± 3 weeks of fieldwork in summer 2020 throughout **Flanders**
- Database work (data from > 50 countries)
- Obtaining crucial skills in R and/or ArcGIS
4. Ecosystem modelling

- **Soil fauna**: the ‘missing’ link between soil C, nutrients and hydrology?

- **How can agricultural management affect soil infiltration**: a model analysis (or partly experimental)

- **Forests in Europe under drought**: using models to understand measured data

*All titles are open to change - Programming is optional*

Contact: gaby.deckmyn@uantwerpen.be
Topics Ivan Janssens & Sara Vicca
European network of greenhouse gas (flux) monitoring stations
Several topics are possible, e.g. analyzing the impact of climate extremes using long term data series of greenhouse gas fluxes from:

- pine forest
- poplar bio-energy plantation
- heathland

With/without field work at ICOS sites.

Get in touch! marilyn.roland@uantwerpen.be; CDE C2.16
Rainforest greenhouse gas balance
Several topics possible
- With/without field work in French Guiana

Quantify ecosystem sinks and emissions of three major greenhouse gases: \( \text{CO}_2 \), \( \text{CH}_4 \) and \( \text{N}_2\text{O} \), in a pristine tropical rainforest

Contact:
Laetitia.brechet@uantwerpen.be
After the greening, the browning?

Impact of climate change on global vegetation ➔ an Earth Observation analysis

- No field work

Contact:
Ivan.janssens@uantwerpen.be
CDE, C2.14
Removing CO₂ from the atmosphere for stabilizing climate – Nature Based Solutions

- 1.5°C or 2°C scenario’s not possible without CO₂ removal
- Several thesis topics possible, with/without experimental/field work on campus

Contact: sara.vicca@uantwerpen.be
CDE, C2.16
Topics Matteo Campioli
Seasonal growth of deciduous trees and shrubs: the secrets of phenology

Contact Matteo Campioli PLECO
matteo.campioli@uantwerpen.be
• Functioning and ecology of trees or shrubs

• Phenology: “study of recurrent biological events”
  – climate change, forest production

• Phenology of different organs:
  – Leaves (bud-burst, leaf fall etc.)
  – Wood (start production new cells, end lignification in autumn etc.)
  – Fine roots (start elongation in spring, end elongation in autumn etc.)

• Environmental drivers of phenology (temp, nutrients, lights etc.)

• Get trainings and expertise on
  – Eco-physiology (e.g. instrumental measurements, manipulative exp.)
  – Forest tree measurements (e.g. tree-coring)
  – Stays abroad possible
EU project LEAF-FALL

- Manipulative experiments on young trees: warming, drought, fertilization, modified photoperiod
- Monitoring trees in natural conditions
- Database

https://www.uantwerpen.be/en/projects/leaf-fall/about-leaf-fall/
BELGIUM
2 MPs or 2 IPs possible

• *Comparison of above- and belowground phenology in temperate deciduous forests* (forests Brasschaat, wood anatomy, root imaging etc.)

• *Leaf phenology of young trees in manipulative experiments* e.g. *warming, drought, longer days light* (experiments Wilrijk, ecophysiology)
NORTHERN SWEDEN (1 MP)

- Autumn phenology of boreal trees and shrubs at the sub-arctic tree-line
  - Sampling different natural site
  - Studying shrubs manipulative experiments (e.g. warming)

Practical: 3 months stays (July-September) at Abisko Research Station

https://eu-interact.org/field-sites/abisko-scientific-research-station/
https://polar.se/en/research-in-abisko/
EUROPE

1 MP or 1 IP possible ....

• “What determines end of wood growth in autumn? Temperature, lights or what-else”? (data analysis, R coding)
Check out our website for the slides (overview of MP and IP):

https://www.uantwerpen.be/en/research-groups/pleco/education/master-and-individual-projects/

Presentation of topics in detail:

Thursday 31 Oct 13h45 – 15h45

start in D.C.006

(slides will be on the website on Monday 4 Nov)

Contact people directly