

Contribution of a Distributed Agro-Hydrological Model in the Meuse Catchment

*Aurore Degré & Catherine Sohier
Ulg Gembloux Agro-Bio Tech*

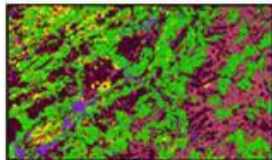
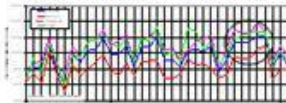


EPICGRID
Catchment
Modelisation
Soils and vadose zone

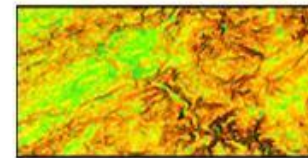
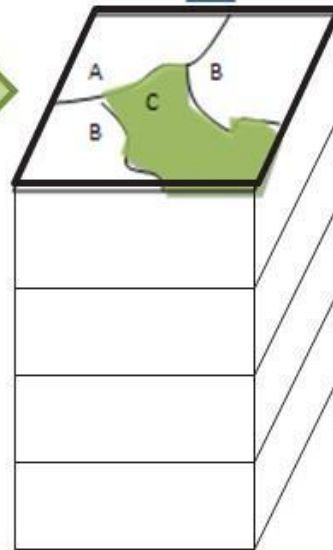


Grid square : 1 sq.
km.

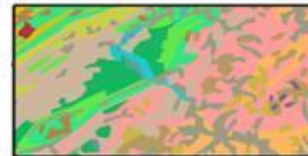
Climate data



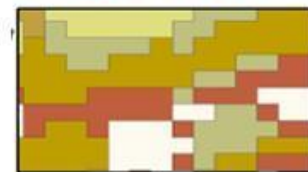
Landuse, Crop
growth,
agricultural
practices



DEM



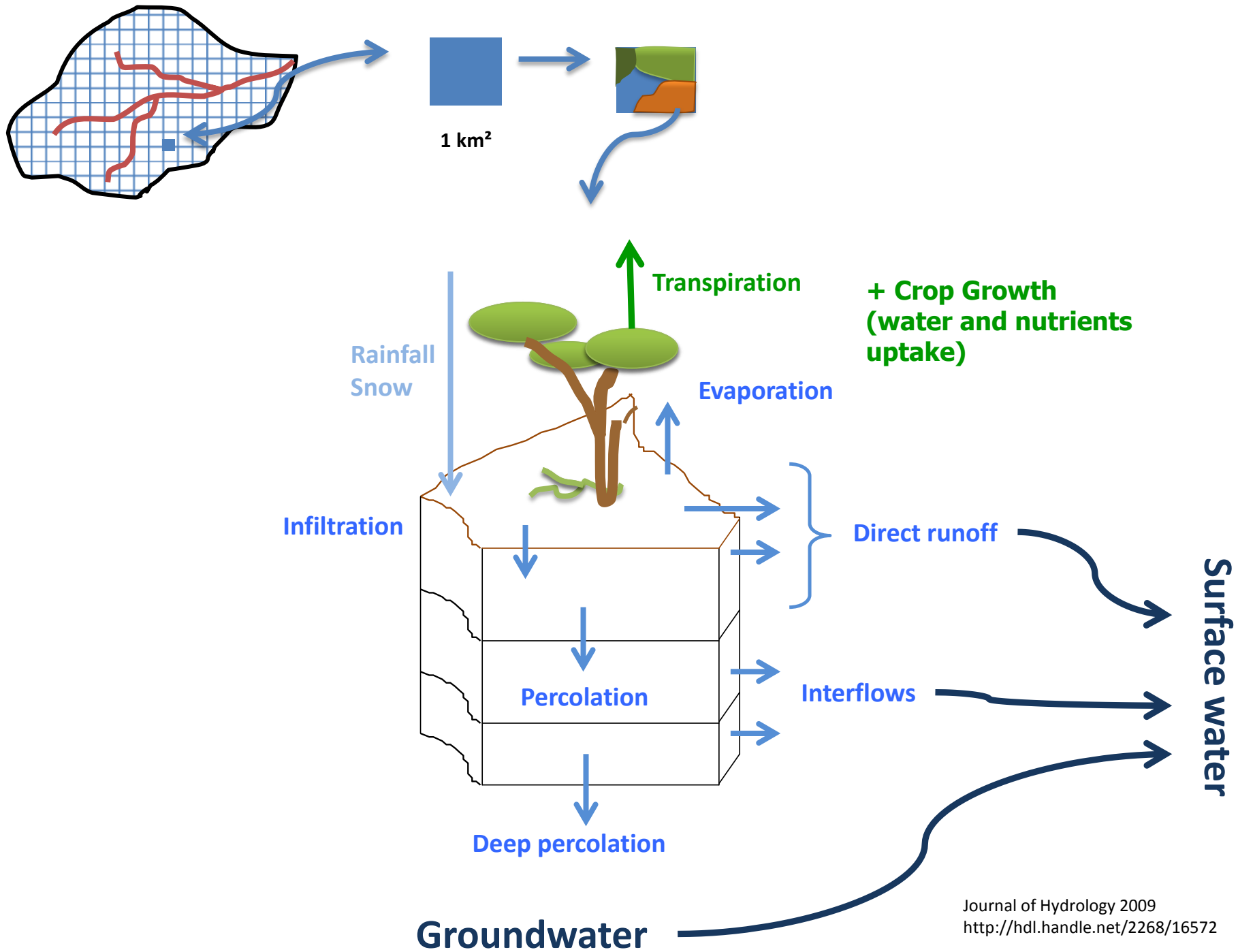
Soils

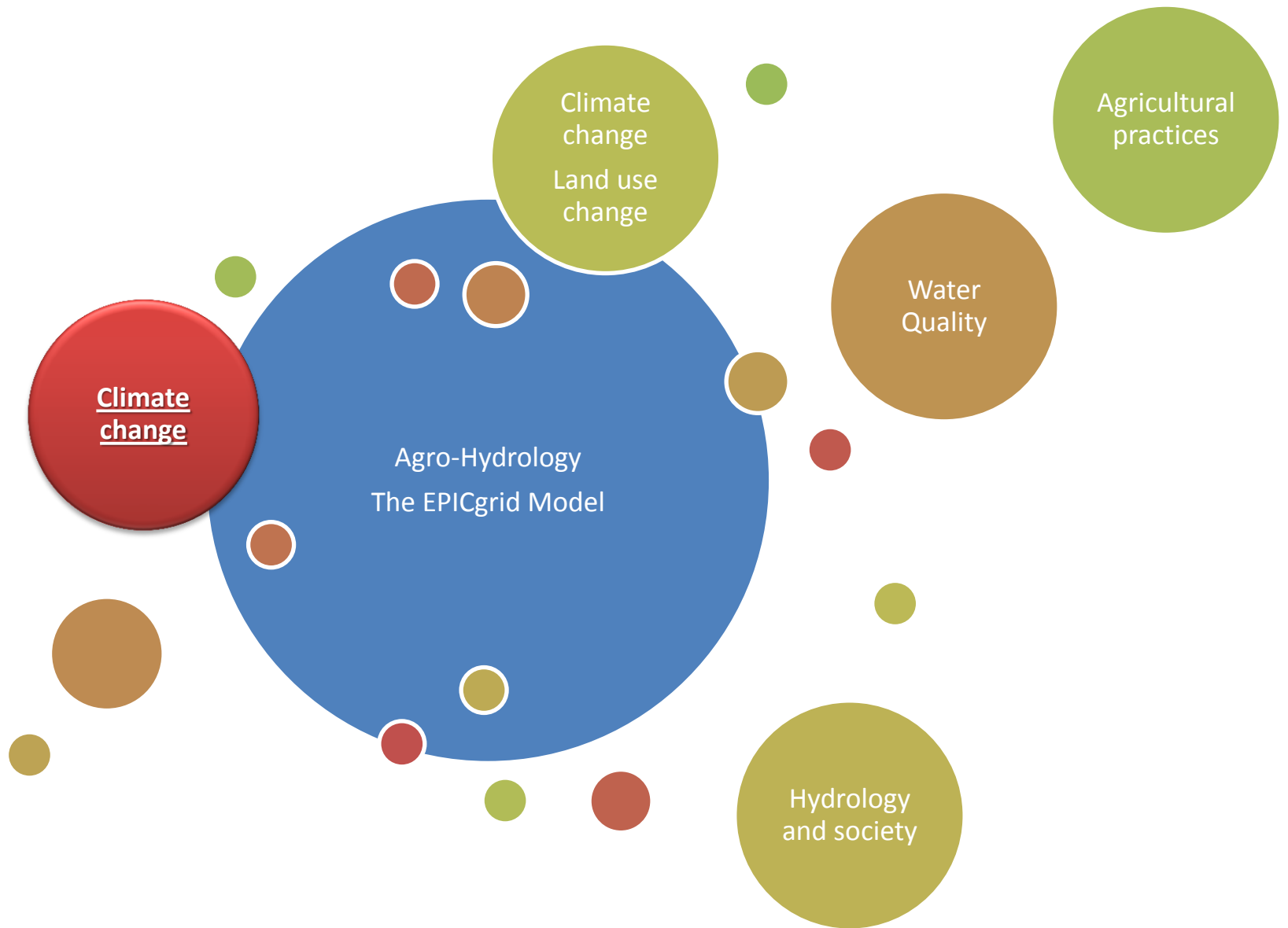


Geology



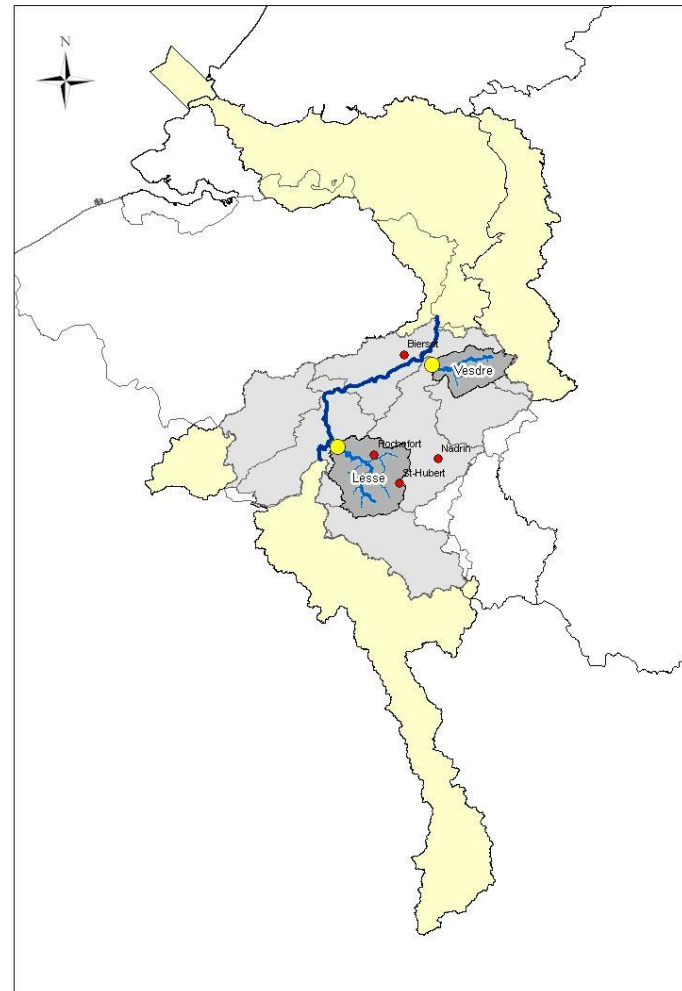
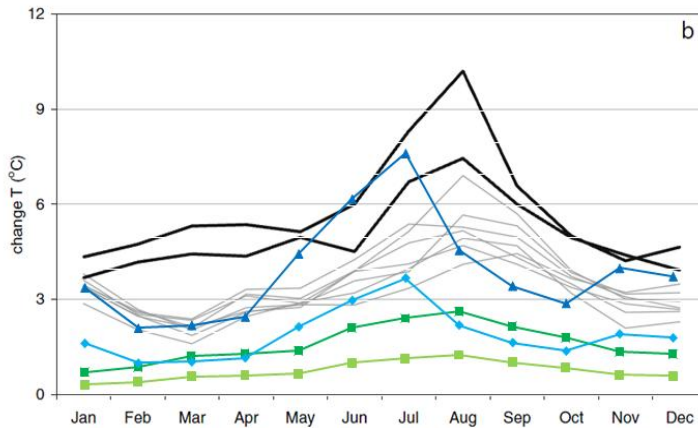
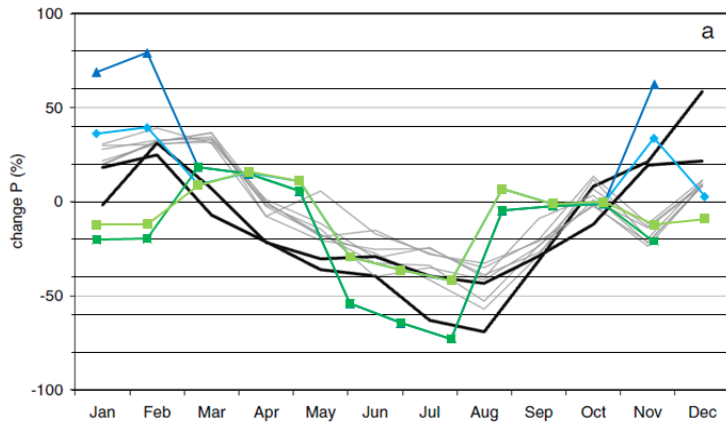
In each grid square ponderation
of the different components



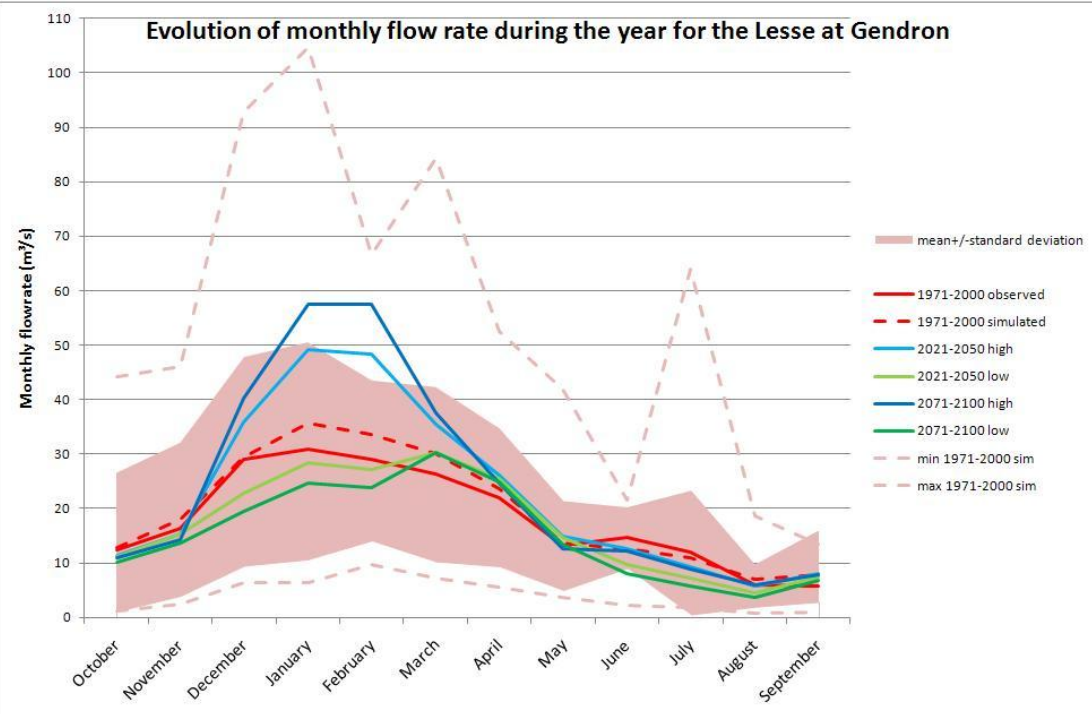
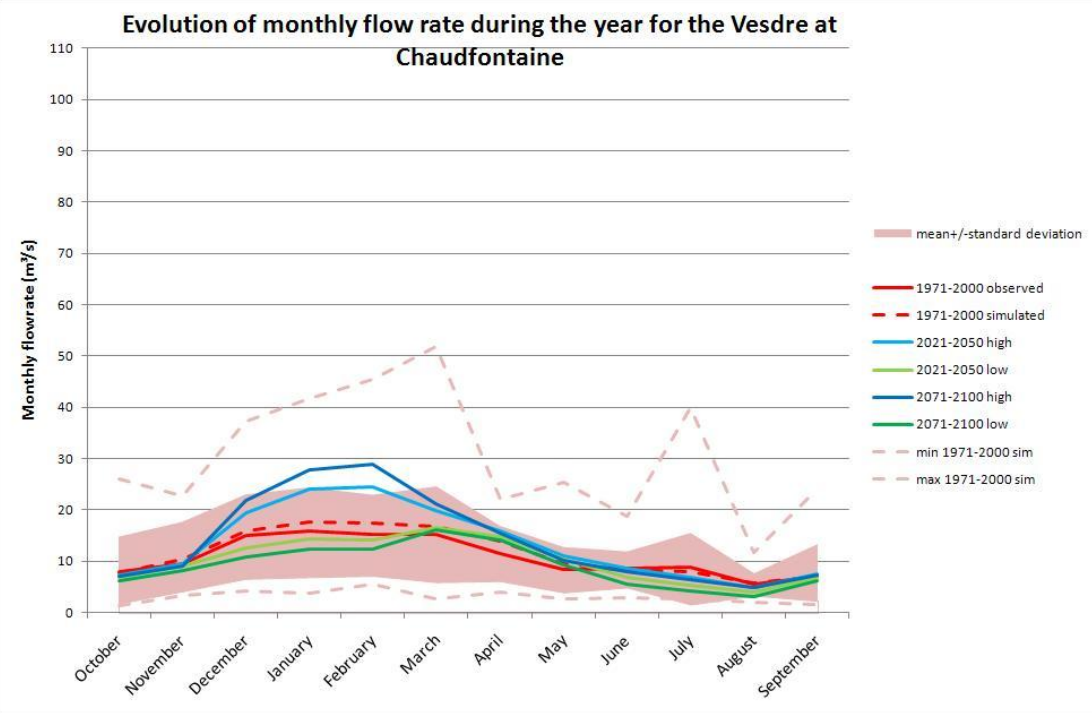


AMICE project : hydrology of the Lesse and Vesdre catchments

CCI-Hydr perturbation tool
high (blue) and low (green) scenarios
2020-2050 and 2070-2100

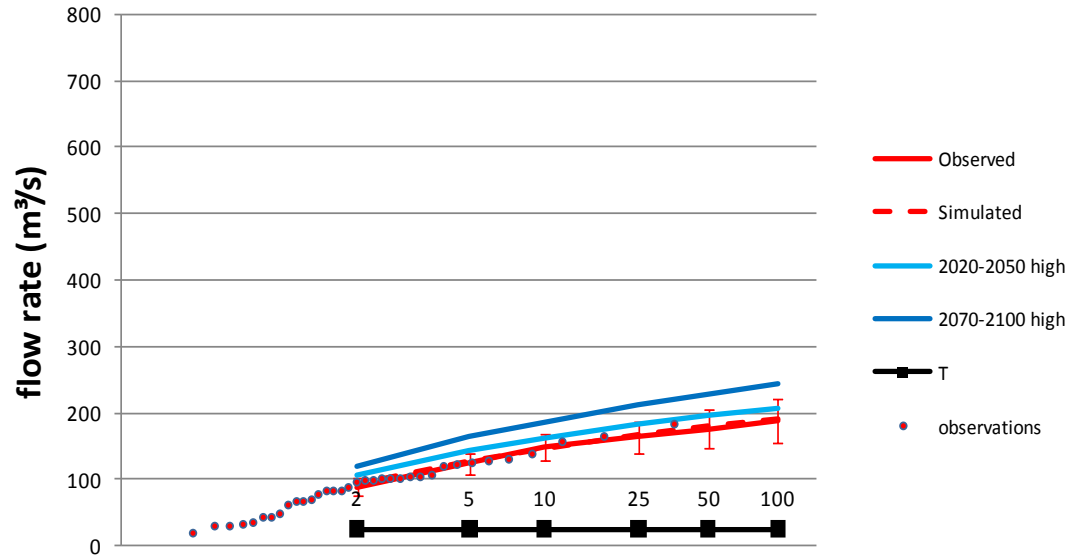


- Seasonal contrasts in river discharge could be strongly accentuated due to climate change in the Vesdre and Lesse catchments. (consistent with Wit et al. (2007) in the Meuse and other studies in surrounding catchments).
- For both high and low-flows even if far less studies have focused on low-flows

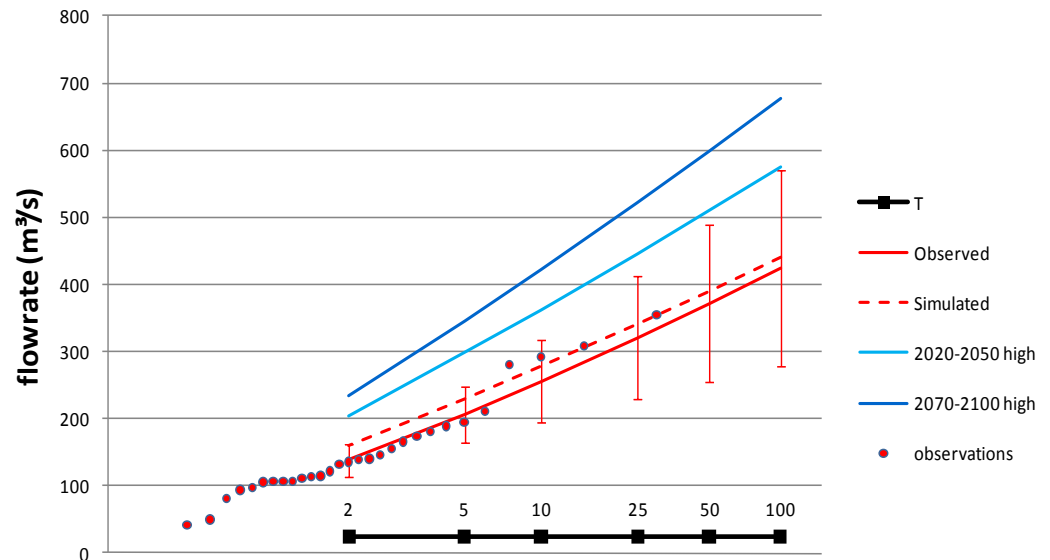


- Seasonal contrasts in river discharge could be strongly accentuated due to climate change in the Vesdre and Lesse catchments. (consistent with Wit et al. (2007) in the Meuse and other studies in surrounding catchments).
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Daily flood discharges for the Vesdre at Chaudfontaine

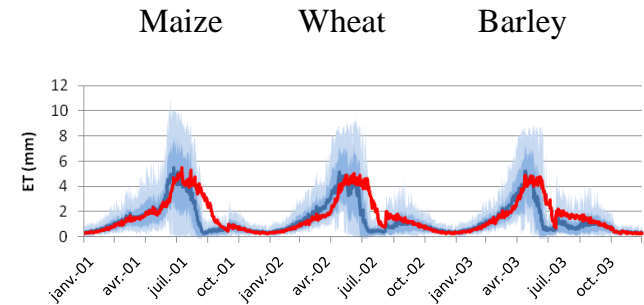
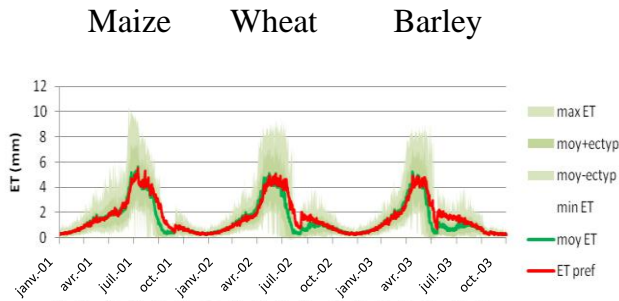


Daily flood discharges for the Lesse at Gendron

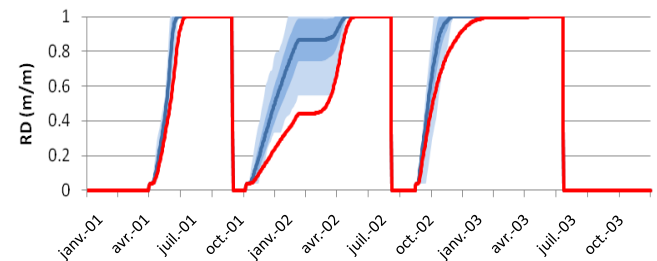
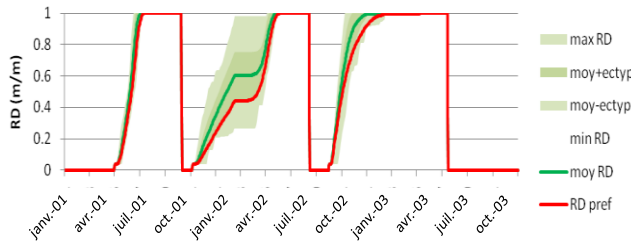


Focus on the soil-water-plant continuum

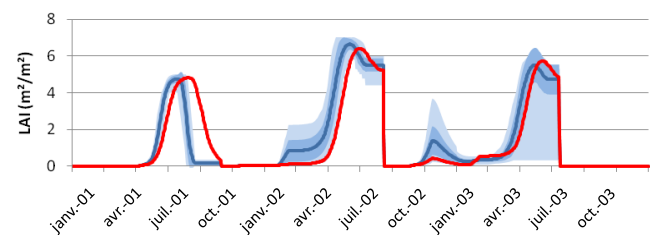
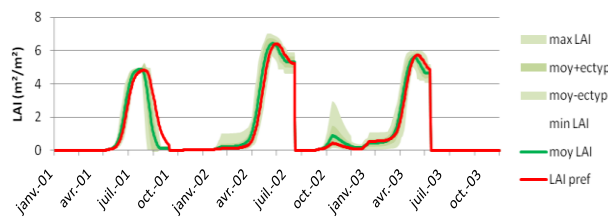
Actual evapotranspiration



Root depth



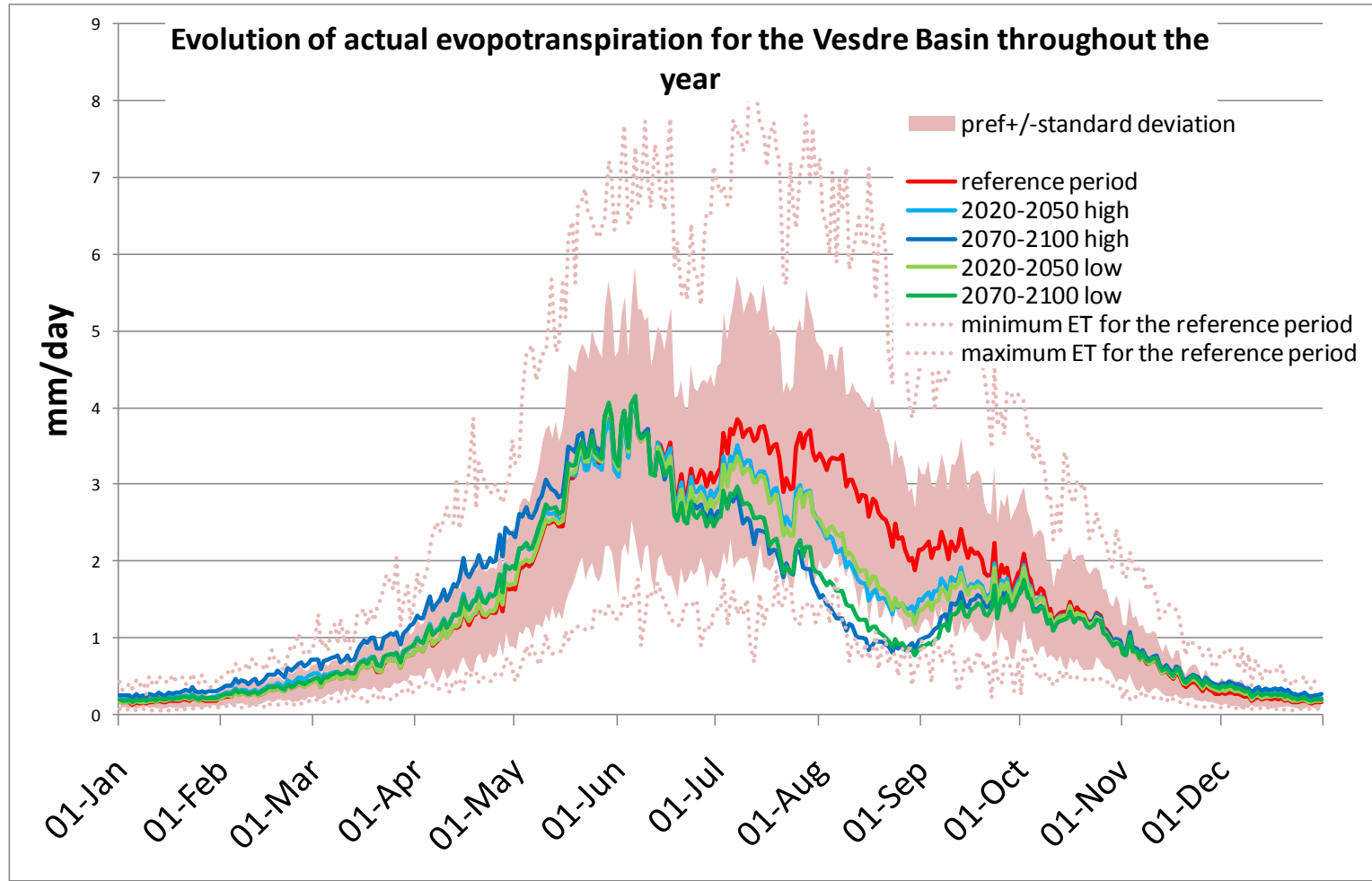
Leaf area index (crop development)

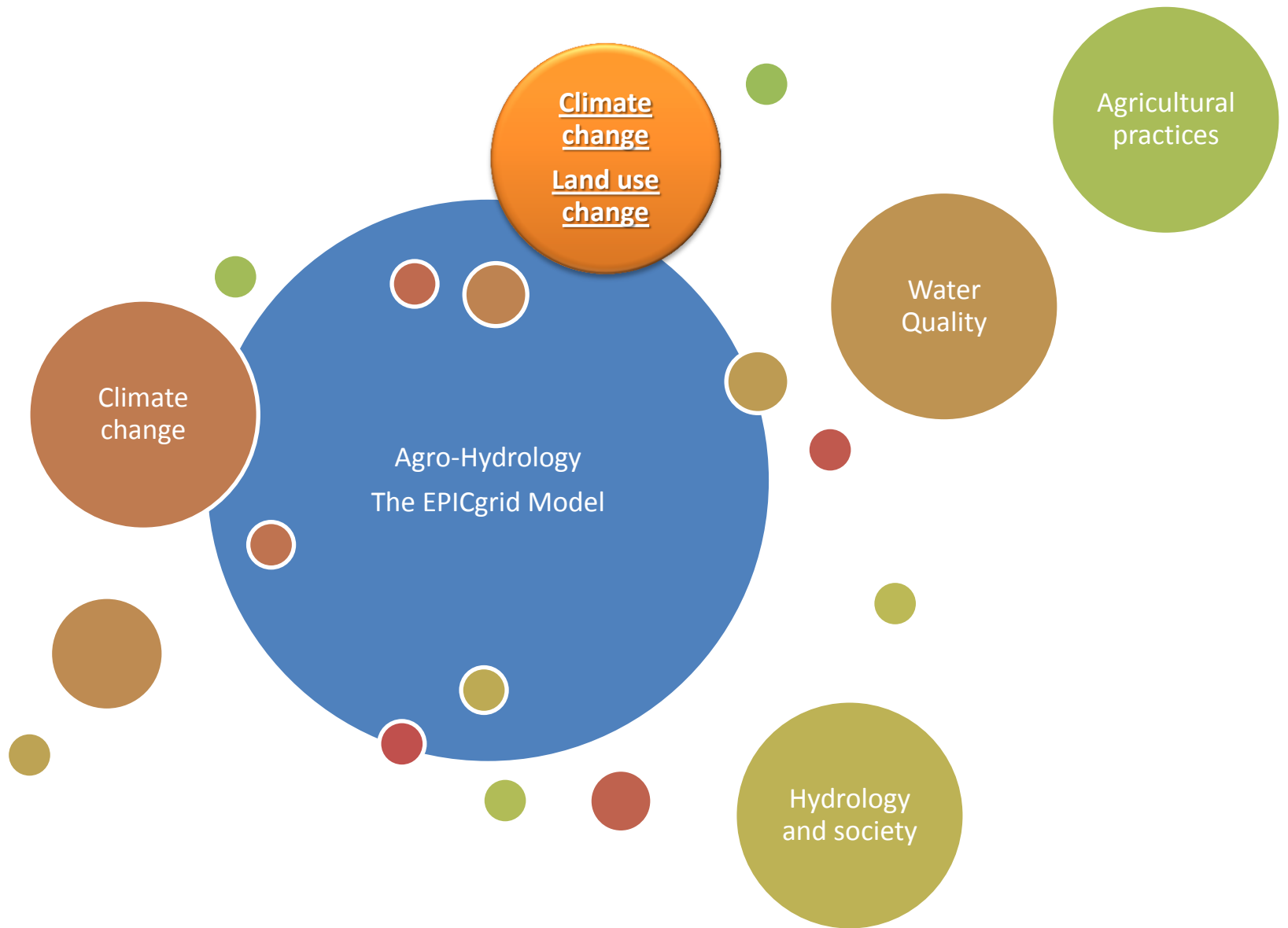


2070-2100 Low

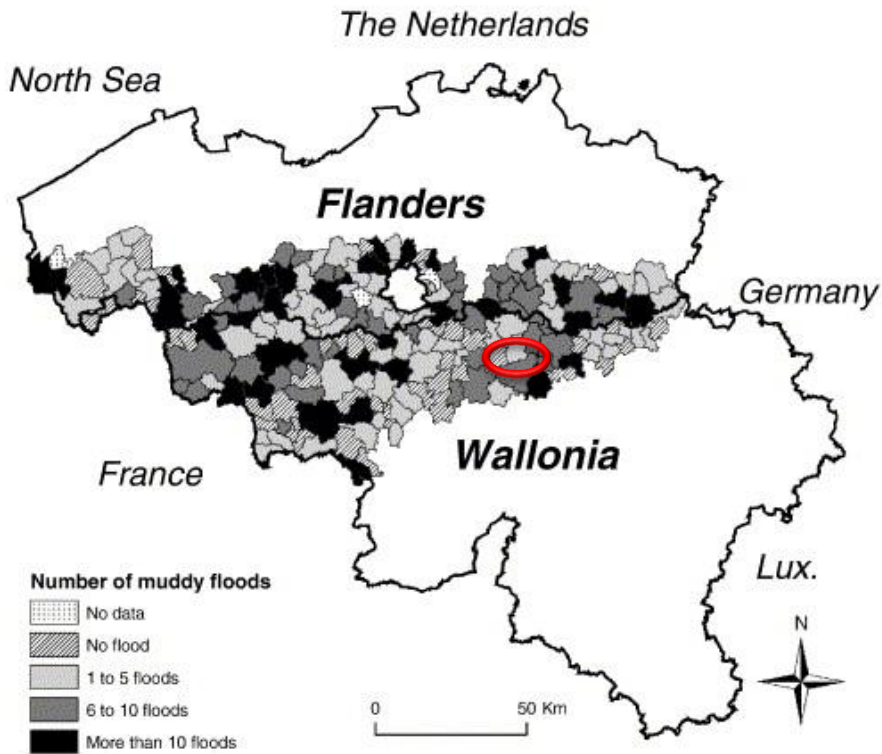
2070-2100 High

Actual ET – CC scenarios

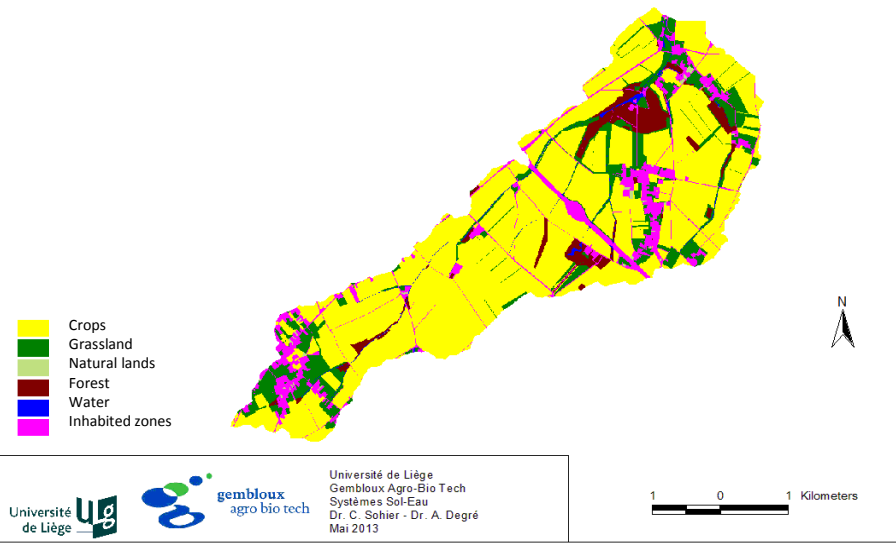




Land use



Land use : Mehaigne head catchment (17 km²)



Frequency of muddy floods over a 10-year period in all municipalities of the study area; data for Wallonia (1991–2000) taken from Biielders et al. (2003), data for Flanders (1995–2004) derived from a questionnaire sent to all municipalities in 2005.

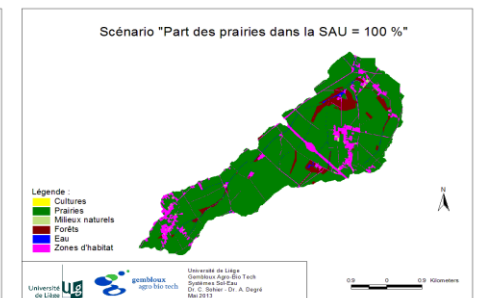
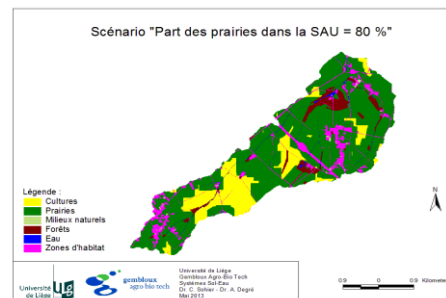
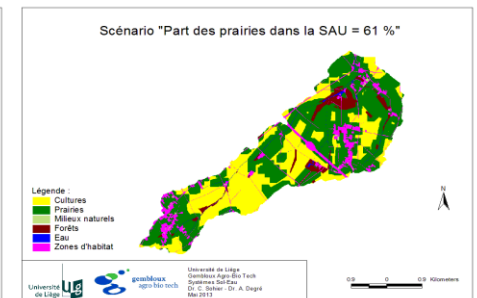
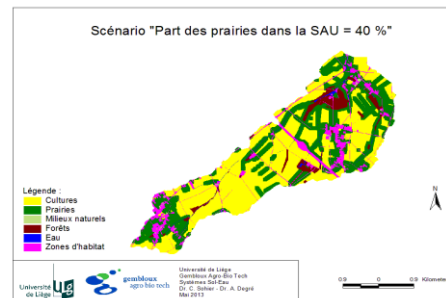
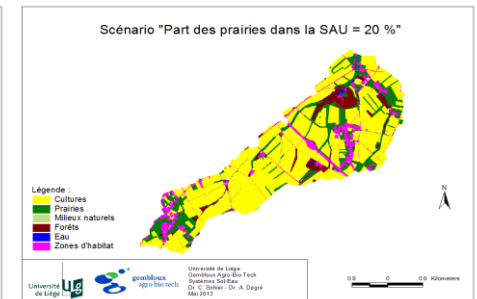
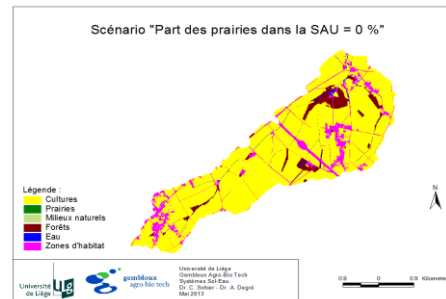
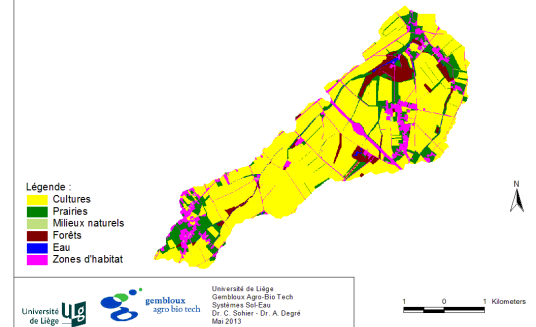
O. Evrard, C. Biielders, K. Vandaele, B. van Wesemael, Spatial and temporal variation of muddy floods in central Belgium, off-site impacts and potential control measures, CATENA, Volume 70, Issue 3, 1 August 2007, Pages 443-454, ISSN 0341-8162, 10.1016/j.catena.2006.11.011.



Land use change

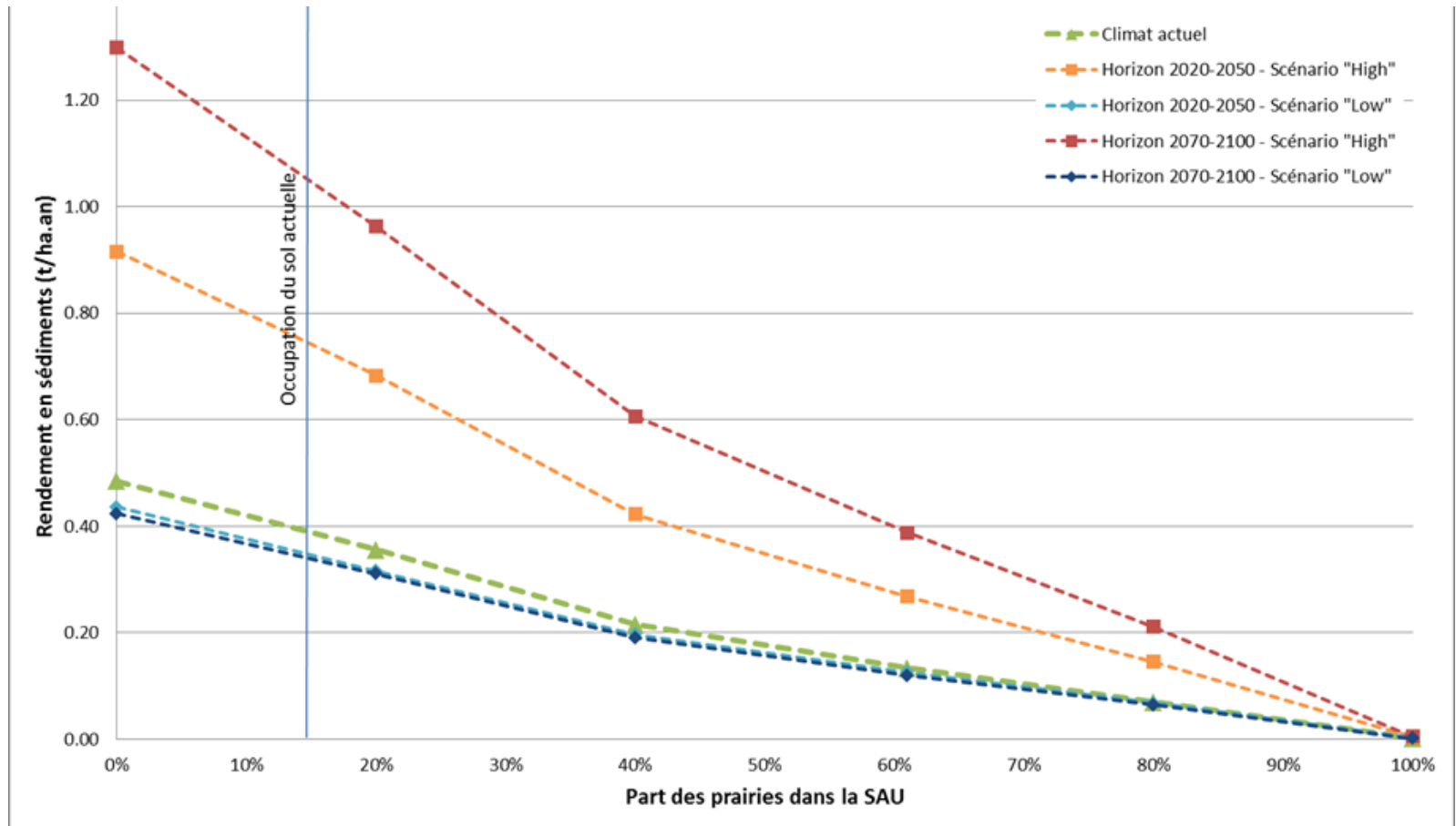
- Current situation
 - 10% settlements
 - 84% agriculture
 - 71% crops
 - 13% grasslands
- Scenarios
 - 10% settlements
 - 84% agriculture
 - From 100 to 0% crops
 - From 0 to 100 % grasslands

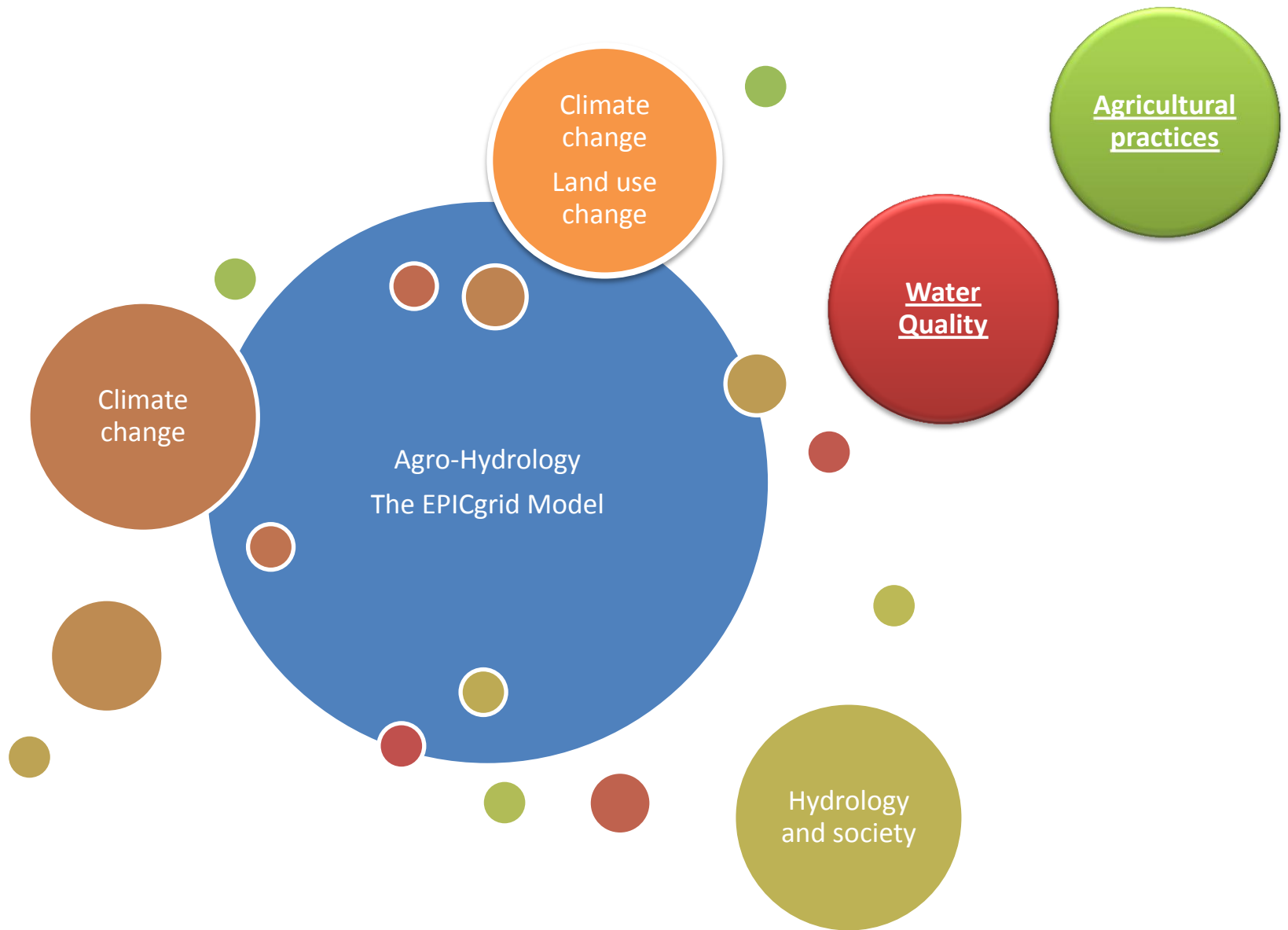
Modèle EPICGrid - Carte des classes hydrologiques d'occupation du sol - Bassin versant de la Mehaigne à Upigny (Source : CNOSW)



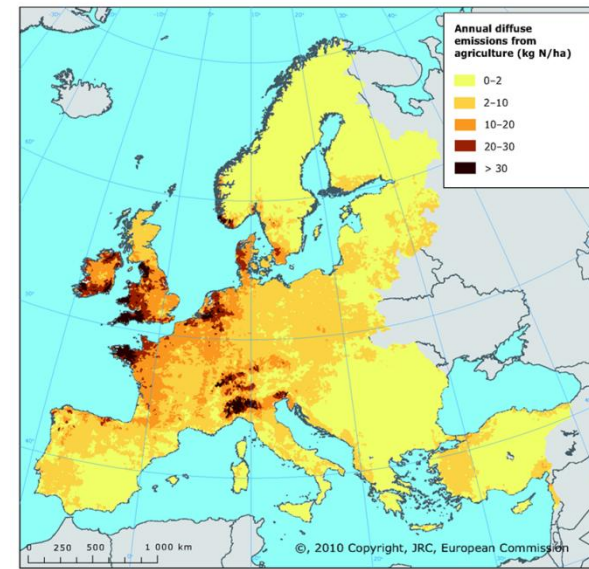
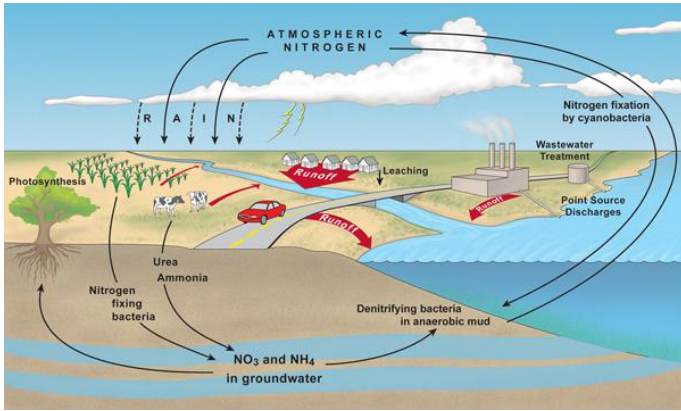
Land use change

EPICgrid – sediment yield under current climate and CCI-Hydr high and low scenarios – The Mehaigne in Upigny (17 km²)





Water quality



Bare field during winter



Row crops

cereals



grasslands



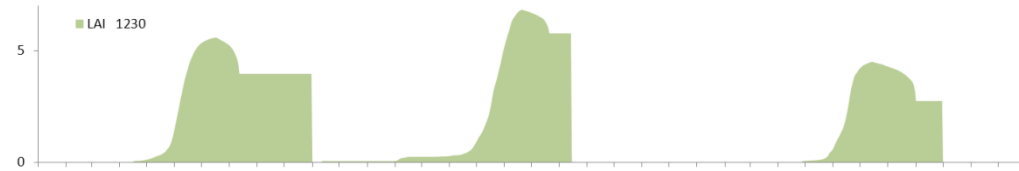
catchcrops



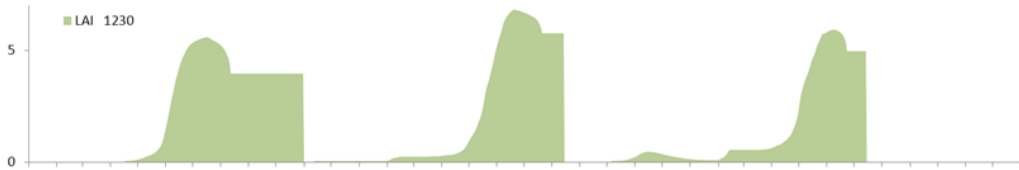
Comparison of different crop rotations

Leaf Area Index

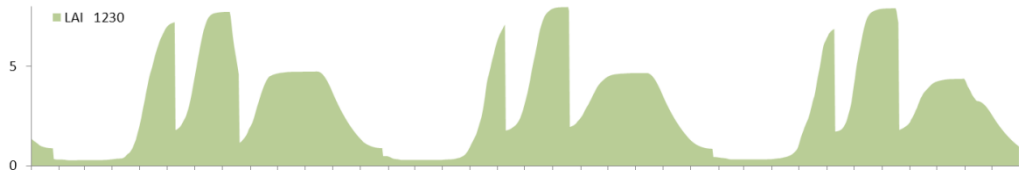
Sugar beet – Wheat - Potato



Sugar beet – Wheat - Barley

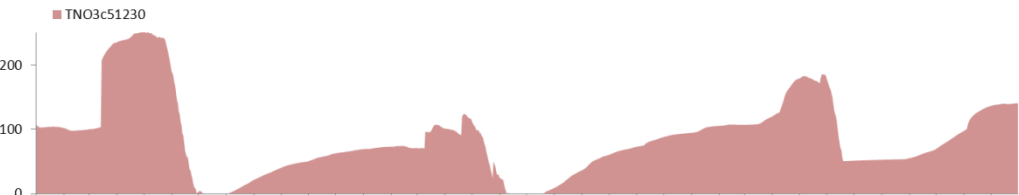


Grassland



Nitrogen content
in the root zone
(kg/ha)

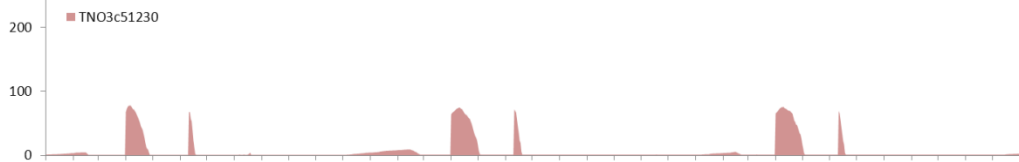
*Sugar beet – Wheat –
potato*



Sugar beet – Wheat - Barley



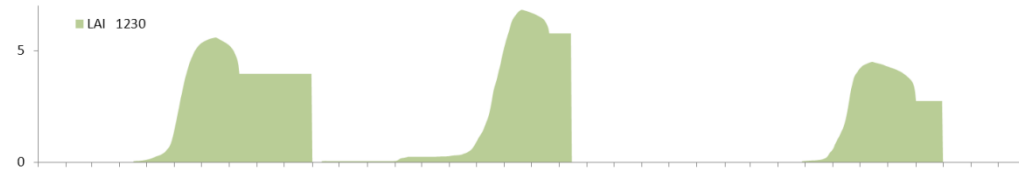
Grassland



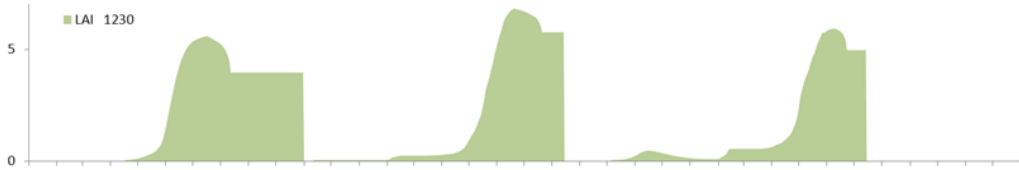
Comparison of different crop rotations

Leaf area index

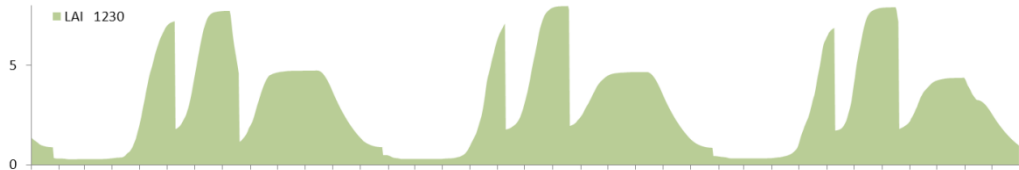
Sugar beet – Wheat - Potato



Sugar beet – Wheat - Barley

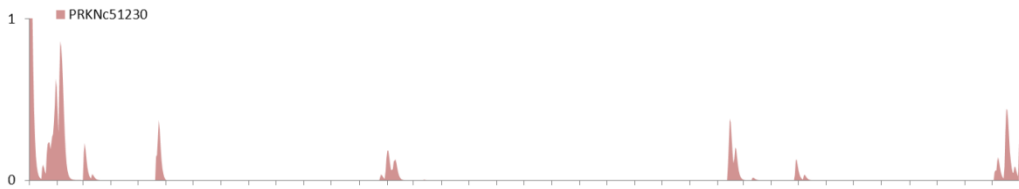


Grassland

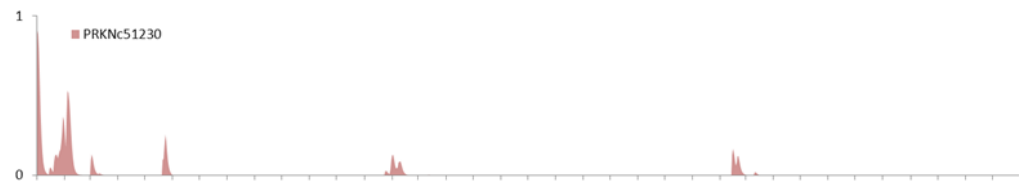


Nitrogen loss to groundwater
(kg N/ha)

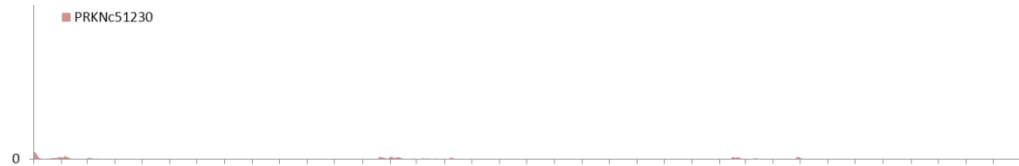
Sugar beet – Wheat – potato



Sugar beet – Wheat - Barley



Grassland



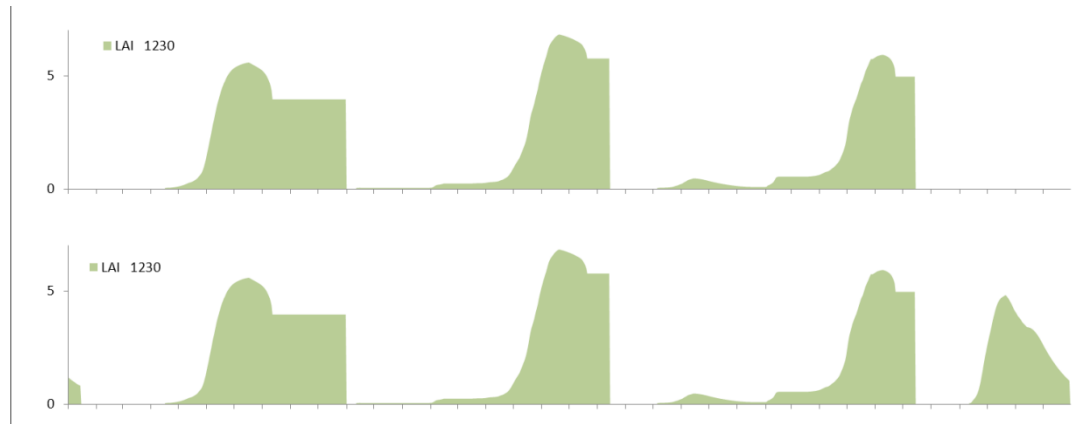
Effect of a catch crop

Sugar beet → Wheat → Barley

Leaf area index

**Without
catchcrop**

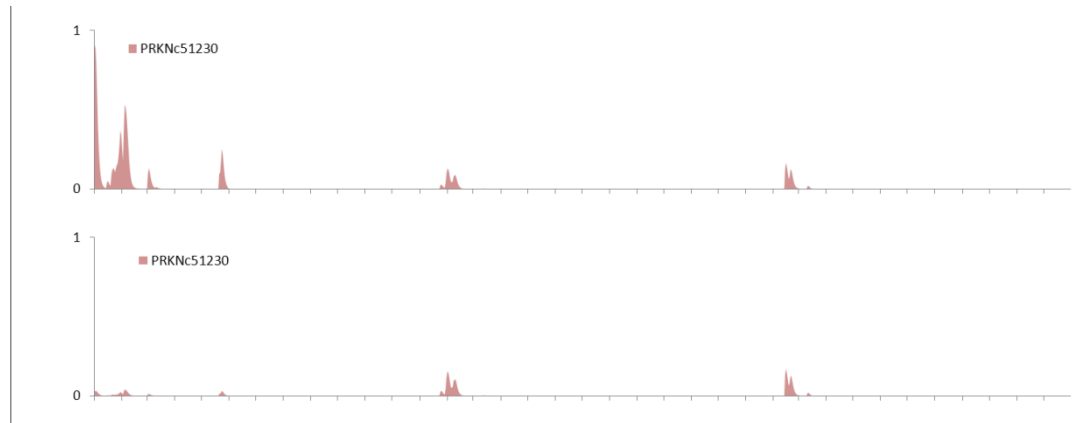
**With
catchcrop**



Nitrogen loss under the root zone (kg N/ha)

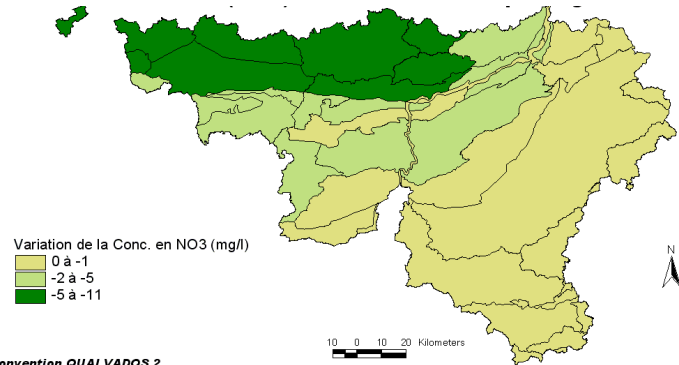
**Without
catchcrop**

**With
catchcrop**



Regional modeling

Nitrate concentration decrease under the root zone due to mitigation measures – high



Convention QUALVADOS 2

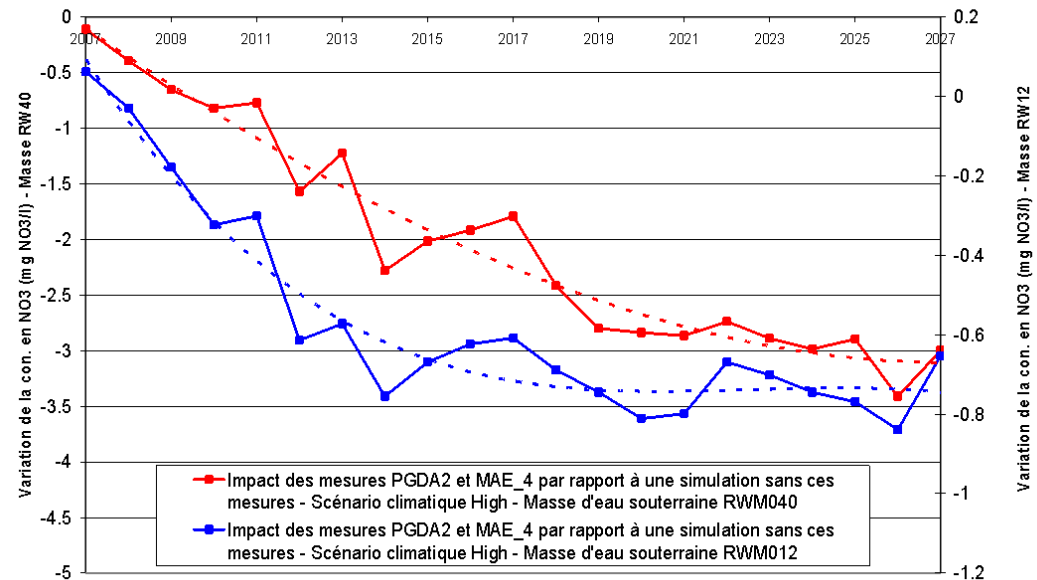
Université de Liège
Gembloux Agro-Bio Tech
Unité d'Hydrologie & Hydraulique agricole
Ir. C. Sohler - Dr. A. Degré
Mars 2010

SPGE
Service Public de l'Etat

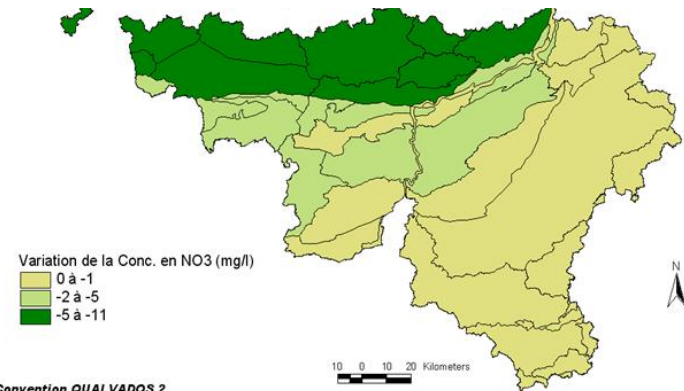
* Couverture hivernale du sol
** Moyenne par masse d'eau souterraine (masses dites "supérieures")

*Impact of all the mitigation measures put into practice in the frame of the nitrate Directive
Results presented at the groundwater bodies level*

Temporal effect of the mitigation measures
(assessment of nitrate concentration decrease in the recharge water)



Nitrate concentration decrease under the root zone due to mitigation measures – low



Convention QUALVADOS 2

Université de Liège
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* Couverture hivernale du sol
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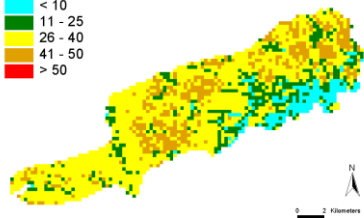
Environmental Science and Policy (2010)
<http://hdl.handle.net/2268/70276>

Combination of different scenarios around an abstraction zone

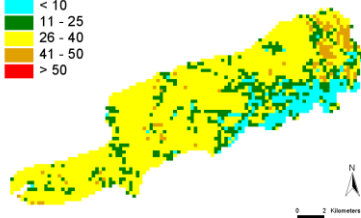
Reference

Scénario climatique « High » Scénario climatique « Low »

Conc. NO3 (mg/l)
< 10
11 - 25
26 - 40
41 - 50
> 50



Conc. NO3 (mg/l)
< 10
11 - 25
26 - 40
41 - 50
> 50

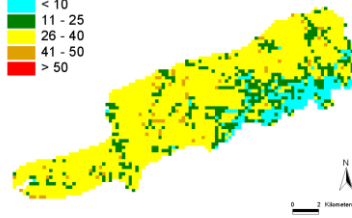


Scenario « 2/3 cereals »

Scénario climatique « High » Scénario climatique « Low »

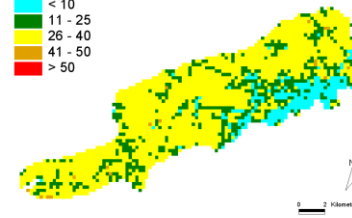
Conc. NO3 (mg/l)

< 10
11 - 25
26 - 40
41 - 50
> 50



Conc. NO3 (mg/l)

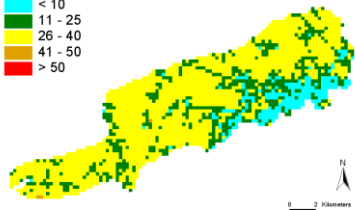
< 10
11 - 25
26 - 40
41 - 50
> 50



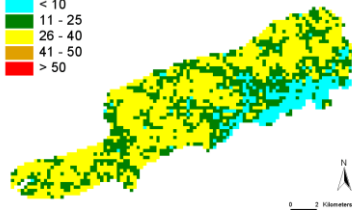
Scenario « -30 kg Nmin »

Scénario climatique « High » Scénario climatique « Low »

Conc. NO3 (mg/l)
< 10
11 - 25
26 - 40
41 - 50
> 50



Conc. NO3 (mg/l)
< 10
11 - 25
26 - 40
41 - 50
> 50

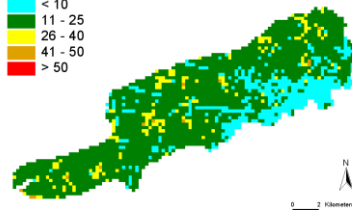


Scenario « grassland »

Scénario climatique « High » Scénario climatique « Low »

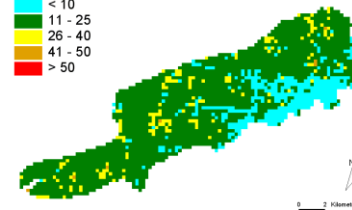
Conc. NO3 (mg/l)

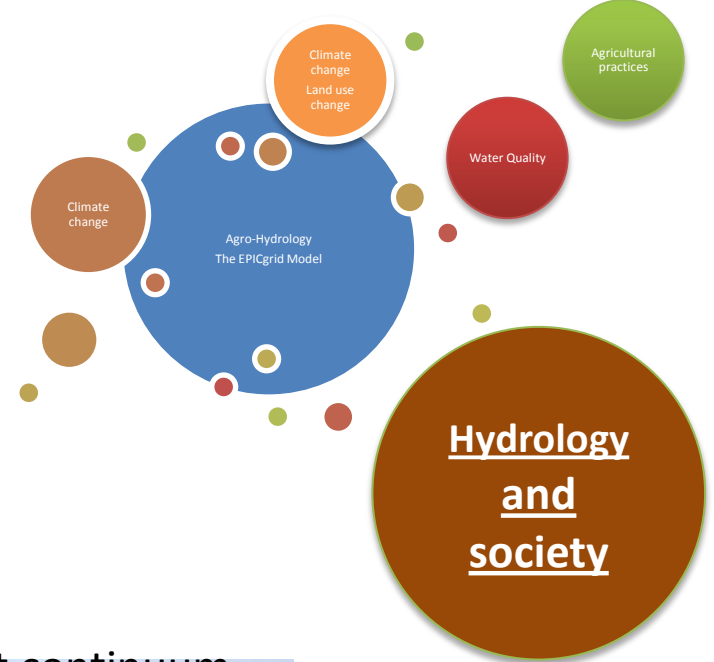
< 10
11 - 25
26 - 40
41 - 50
> 50



Conc. NO3 (mg/l)

< 10
11 - 25
26 - 40
41 - 50
> 50





Take home messages

Agronomy and hydrology are closely interconnected,
Agro-Hydrological model put the light on water-soil-plant continuum
It shows some open ends about (evapotranspiration, water quality, sediment yield)



Thank You



With the financial support of SPGE and SPW

Aurore Degré et Catherine Sohier

Systemes Sol – Eau

Ulg - Gembloux Agro-Bio Tech

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<http://www.gembloux.ulg.ac.be/ha>

Publications et rapports <http://www.orbi.ulg.ac.be>