Irrigation need and expected future water availability for potato growing in Belgium

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Introduction

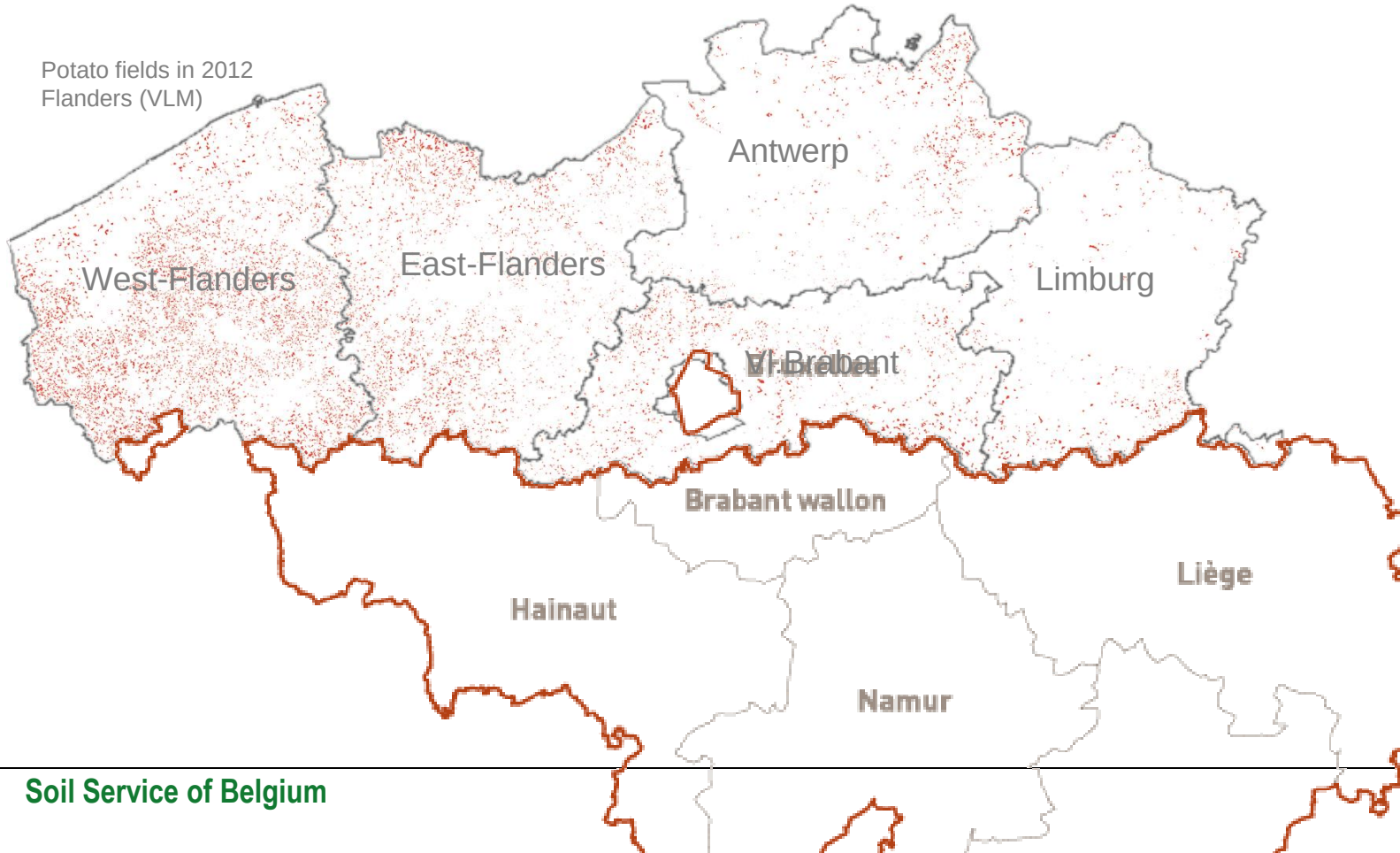
- **Potato, Evapotranspiration and Yield**
  - Highly sensitive to water stress (Van der Zaag & Burton, 1978)
    Drought is the main yield limiting factor in the world potato production
  - WUE = 199 kg/ha.mmET
    (Soil Service of Belgium, 1988 - 1995)
  - In the temperate climatic zones both short and long periods of drought occur in most years due to irregular rainfall.
  - Yield (Belgium):
    - $Y_{a\ (ETa)}$: 50.1 t/ha (FAO, 2011)
      approx. 95% rainfed
    - $Y_{m\ (ETm)}$: 60, up to >80 t/ha
      (Soil Service of Belgium, 1988 - 1995)

Opbrengstgegevens over meerdere jaren op proefvelde verschillende textuur, variëteiten en beregeningsregimes

Jaar	Plaats	Bodem-type	Irri-gatie	cv. variëteit	ETm (1)	ETa (2)	Knol-opbrengst (kg/ha)(3)
1988	Soyécourt	leem	nee	Saturna	323	249	60650
			ja	Saturna	323	310	69950
1989	Soyécourt	lemige klei	nee	Saturna	374	205	27130
			ja	Saturna	401	375	52640
1991	Postel	zand	nee	Bintje	410	319	33214
			ja	Bintje	425	409	51035
			nee	Saturna	410	319	25048
			ja	Saturna	425	409	44717
			nee	Nicola	410	319	35443
			ja	Nicola	425	409	52700
			nee	Prevalent	410	319	28083
			ja	Prevalent	425	409	49086
1992	Ieper	zwaar zand-leem	nee	Bintje	356	322	51528
			ja	Bintje	368	353	56978
			nee	Saturna	356	322	47036
			ja	Saturna	368	353	50686
1992	Postel	zand	nee	Bintje	447	388	66175
			ja	Bintje	463	439	69670
			nee	Saturna	447	388	57608
			ja	Saturna	463	439	59492
			nee	Nicola	447	388	78775
			ja	Nicola	463	439	76278
			nee	Anosta	438	381	63181
			ja	Anosta	449	426	69236
1992	Poches-E.	zand-leem	nee	Russet Burb.	373	342	60300
			ja	Russet Burb.	373	370	67507
1994	Rumbeke	lichte	nee	Bintje, Nicola	372	339	55241
		leem	ja	Bintje, Nicola	377	376	58648
1995	Thorem-bais-l.-B.	leem	nee	Bintje	421	297	59438
			ja	Bintje	421	401	78396

Introduction

- **Potato, area and irrigated area**
  - Potato area 2014, Belgium : ≈80.000ha (consumer+seed)
    of which 27 % in West-Flanders
    26 % in Hainaut



Introduction

- **Potato, area and irrigated area**
  - Area 2014, Belgium : ≈80.000ha

***Irrigated area**: adequate registration is lacking*

Flanders: 5% of the potato area *(FAO, 2007)*

Wallonia: 'no mentionable irrigation' (comm. ,2013)

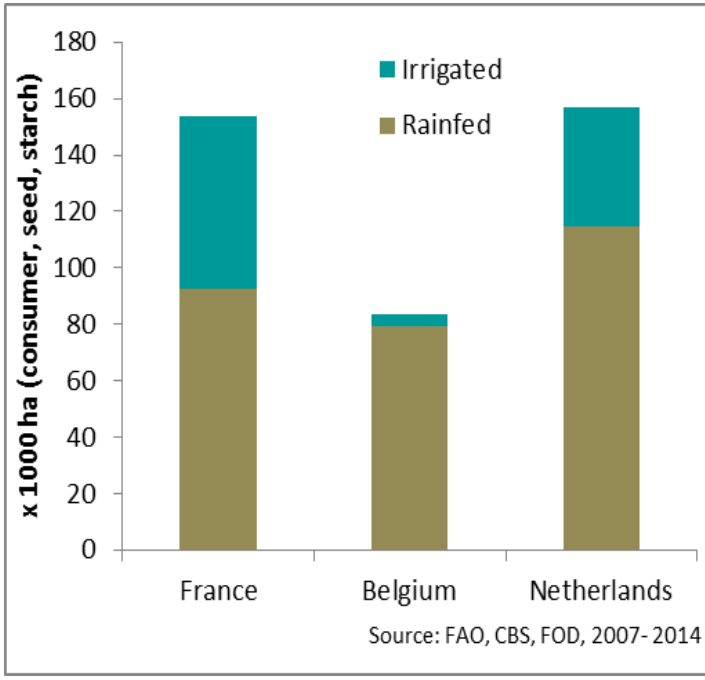
Compared to:

- France: 30% (2000)
  40% (2010)

- Netherlands: 27% (2007)

Belgian catch up is likely ?

Rough estimate: up to 20%



Introduction

- **Potato, area and irrigated area**

  Only 5% of the potato area is irrigated (Flanders; FAO, est. 2007)

  The irrigated area is likely to increase:

  + positive return on investment and on marginal cost
  + agricultural policy
  + new (semi-)public infrastructure (network, stock,..)
  + market price +7% in 2030 (consumer p.) (DLV)
  + spinning water policy
  + climate change inflicting water stress

  - drought tolerant varieties
  - energy cost
  - limited groundwater stock
  - (tax, dissuasive ?)

Introduction

Objective of this contribution:

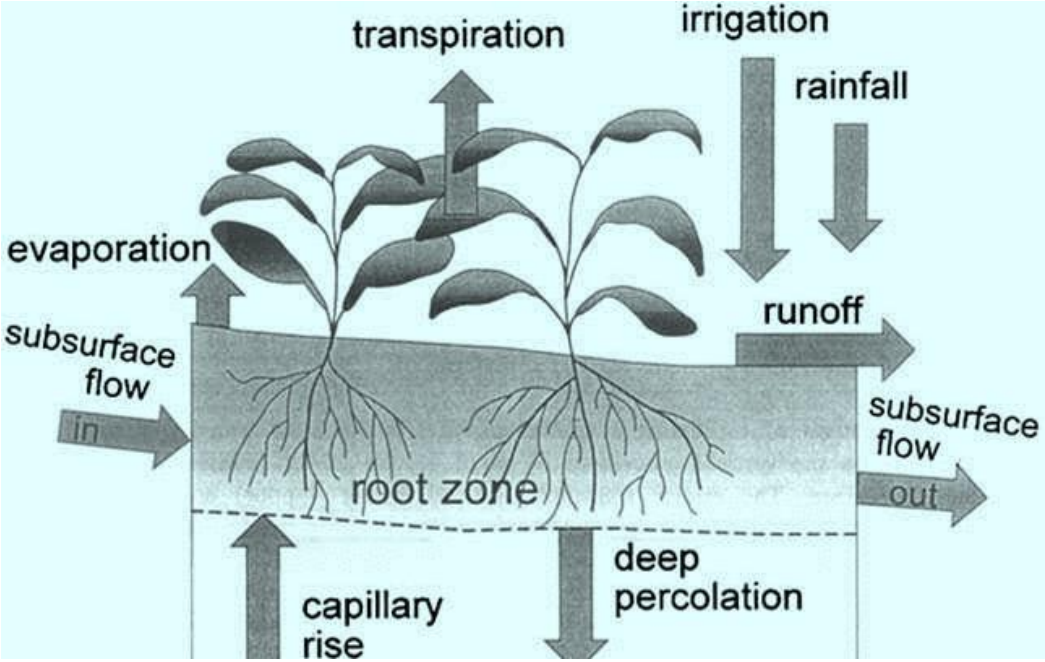
to asses the climate change impact on yield, and
on water need for irrigation of potato

and to confront this need with water availability in Belgium

Method

- Soil water balance model

  ~ FAO 56, 1996

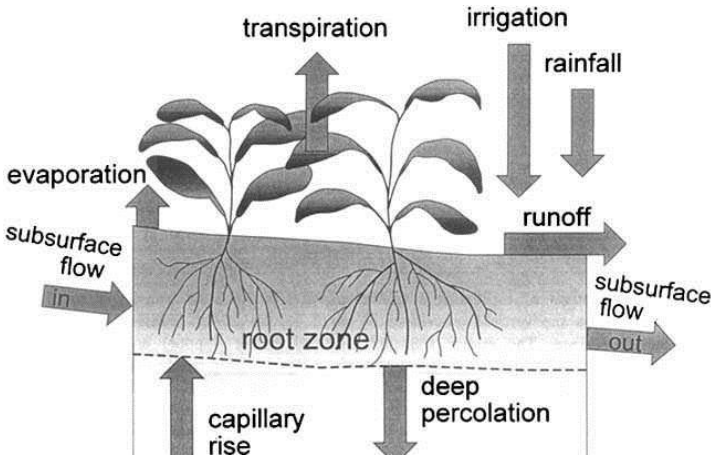


Input parameters of the model :

- Soil and water retention characteristics
- Crop evapotranspiration
- Rain and irrigation events

Method

- Soil water balance model

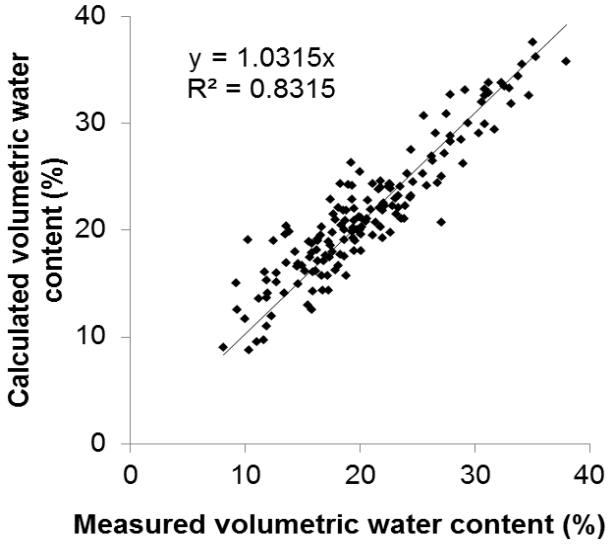


➢ Used for irrigation scheduling,
a commercial advisory service
for, yearly, some 30 Belgian potato fields, since 1989

➢ Model parameters where calibrated on the base of 3-weekly soil moisture measurements

Well calibrated soil water balance
for Belgian agroclimatological conditions

e.g. 30 potato fields in 2012:

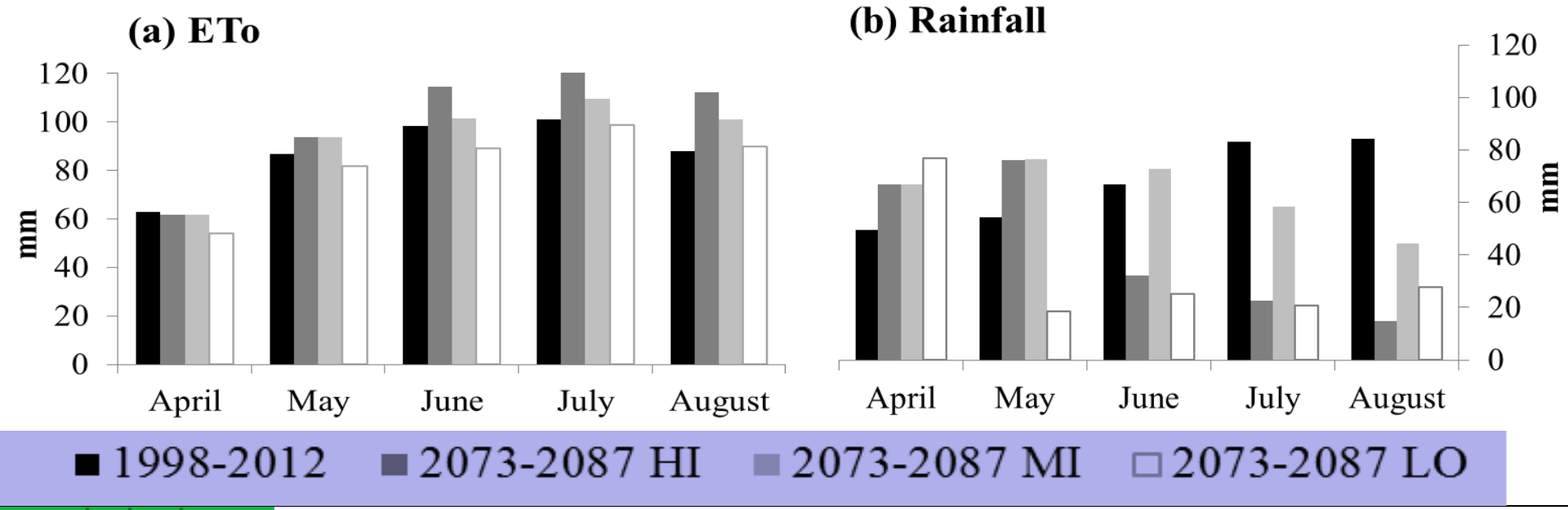


Method

- Climate change: 3 scenarios **'HI', 'MI', 'LO'**,

  based on SRES (IPCC) for 2066 – 2095, calculated with the CCI-HYDR perturbation tool (KULeuven; Ntegeka et al., 2008) **,** based on ET0 and rainfall series 1961-1990 (Ukkel, B)

1998 – 2012 compared to **2073 – 2087**



Method

- Soil

Soil type and potato area:

Texture (ref. USDA)	Sign. capillary rise in spring	Total area (ha)	Irrigated area (est.) (ha)	Fraction (est.) (ha)
Sand - loam sand		3355	336	7%
Sand - loam sand	x	12.119	1212	25%
Sand loam - loam		1604	160	3%
Sand loam - loam	x	8409	841	18%
Silt loam - loam		7675	767	16%
Silt loam - loam	x	14.662	1466	31%
Total		47.825	4782	100%

VLM, Flanders, 2012

Focus on main soil types:

silt (grouping clay, silt loam, loam) and
sand (grouping sand, loam sand),
with capillary rise in spring

Method

- Irrigation need:

  the irrigation water quantity necessary for optimal production:

  up to ETm during stolonisation-tuberisation

- Yield reduction due to water stress

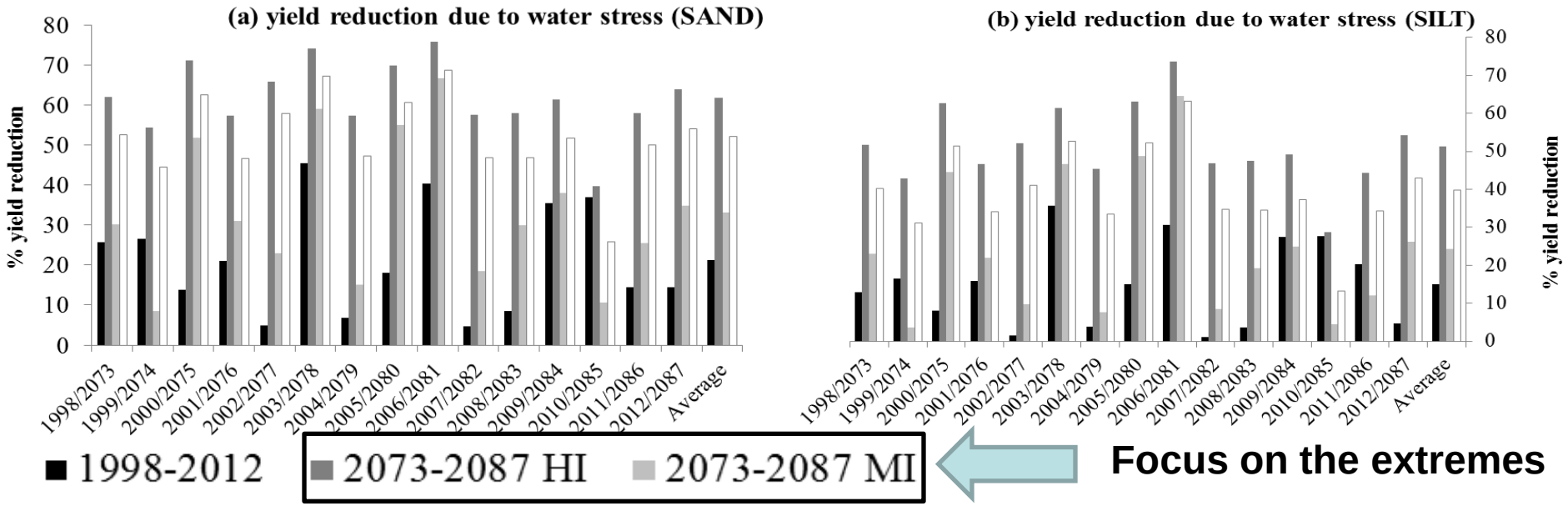
  linked to relative drought (ETa/ETm)

  (FAO, Doorenbos and Kassam, 1986)

  and Ky = 1.18 (Belgium 1988-1995; Elsen et al., 1995)

Results

- **Yield reduction due to water stress (Rainfed)**



Focus on the extremes

Average yield reduction:

	Sand	Silt
Actually (1998-2012)	21%	15%
Forecast 'MI' (2073 - 2087)	33%	24%
Forecast 'HI' (2073 - 2087)	61%	51%

Results

- **Yield reduction due to water stress (Rainfed)**

	Sand	Silt
Forecast 'MI' (2073 - 2087)	33%	24%
Forecast 'HI' (2073 - 2087)	61%	51%

Dramatic yield reduction ?

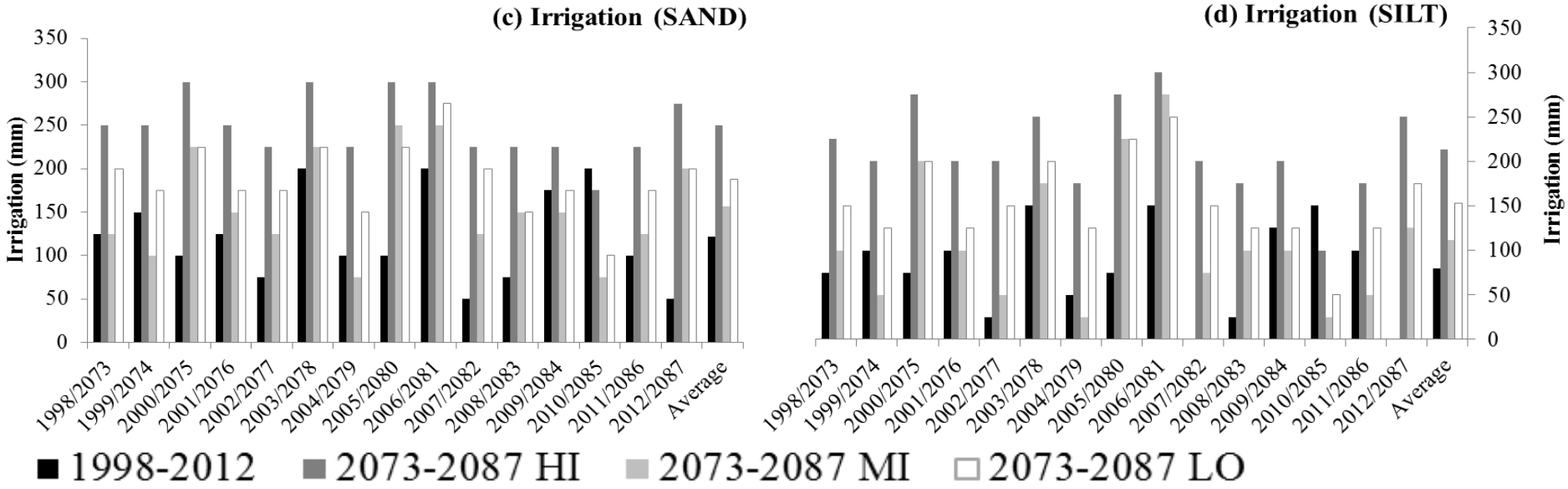
- Consistent with previous more general figures (Gobin A., 2010)
- Scenario MI: Rainfed potato growing might be no longer economical feasible
- Scenario HI: The Belgian agroclimatological zone will become unsuited for rainfed potato growing

Without irrigation, a general shift of the potato area within Europe has to be envisioned

Note: Altered CO_2availability, CO_2fertilisation is not considered

Results

- **Irrigation need**



Average irrigation need (mm/y):

	Sand	Silt
Actually (1998-2012)	121	80
Forecast 'MI' (2073 - 2087)	156	112
Forecast 'HI' (2073 - 2087)	250	213

Results

- **Irrigation need, Belgium**

Actual use: $I_{(actual)}$ = 4 mio m³/y

Forecast 'MI' (2073-2087) : $I_{(actual)}$ X 1.3 à 1.5
catch up : X 2 ?

Forecast 'HI' (2073-2087) : $I_{(actual)}$ X 2 à 2.7
potato area almost covered: X 10 ?

Forecast 'MI': $I_{(MI)}$ = 12 mio m³/y

Forecast 'HI': $I_{(HI)}$ = 200 mio m³/y

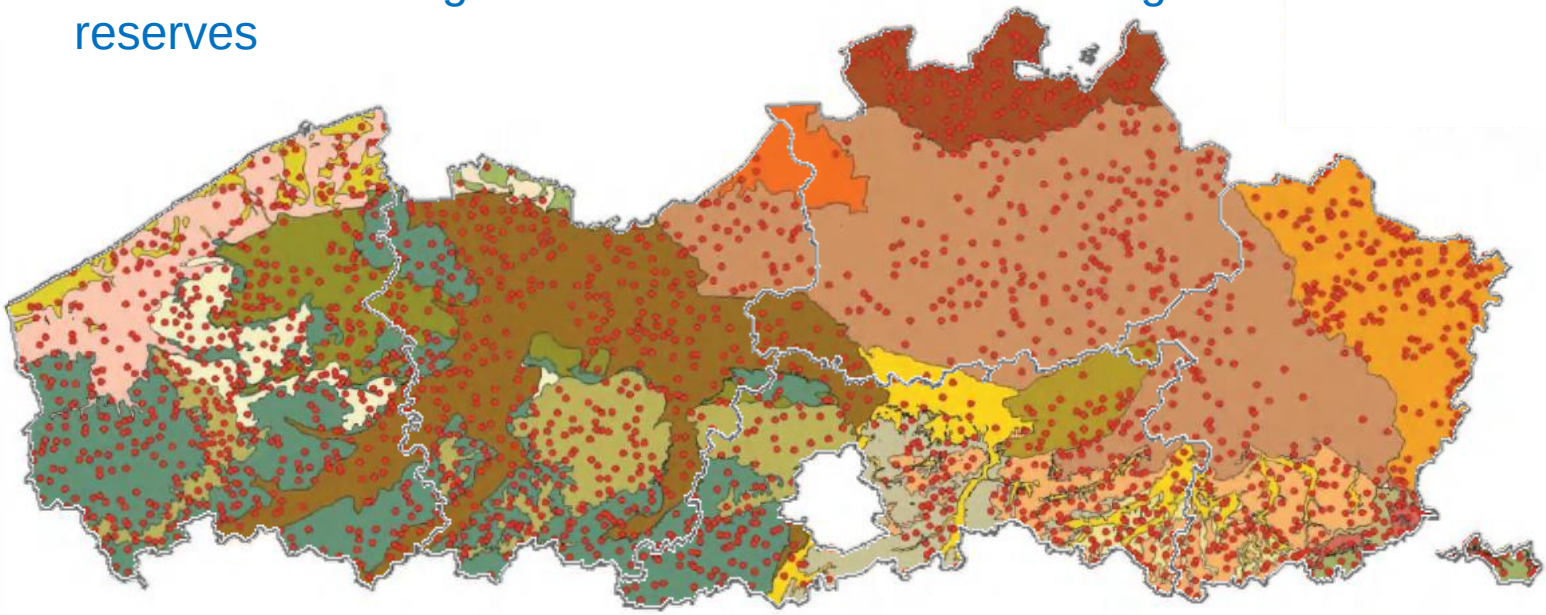
Availability of water for irrigation

Forecast : I = 12 up to 200 mio m³/y

Actual catchment (all sectors, Flanders): groundwater : 130 m³/y
surface water : 160 m³/y

Water sources:

- Surface water: problematic spreading of brown rot
- Groundwater, water policy:
  - Sustainable catchment, with natural recharge
  - Catchment for irrigation will be restricted to freatic groundwater reserves

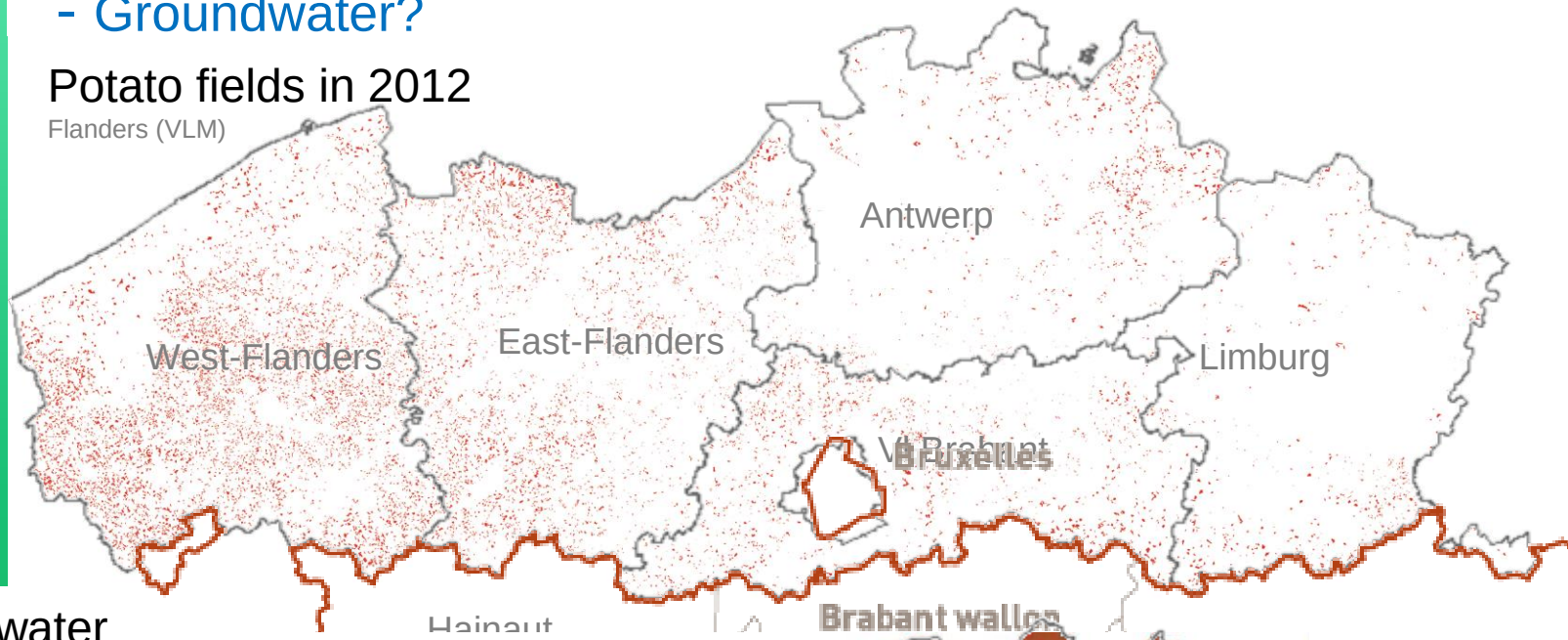


Availability of water for irrigation

- Groundwater?

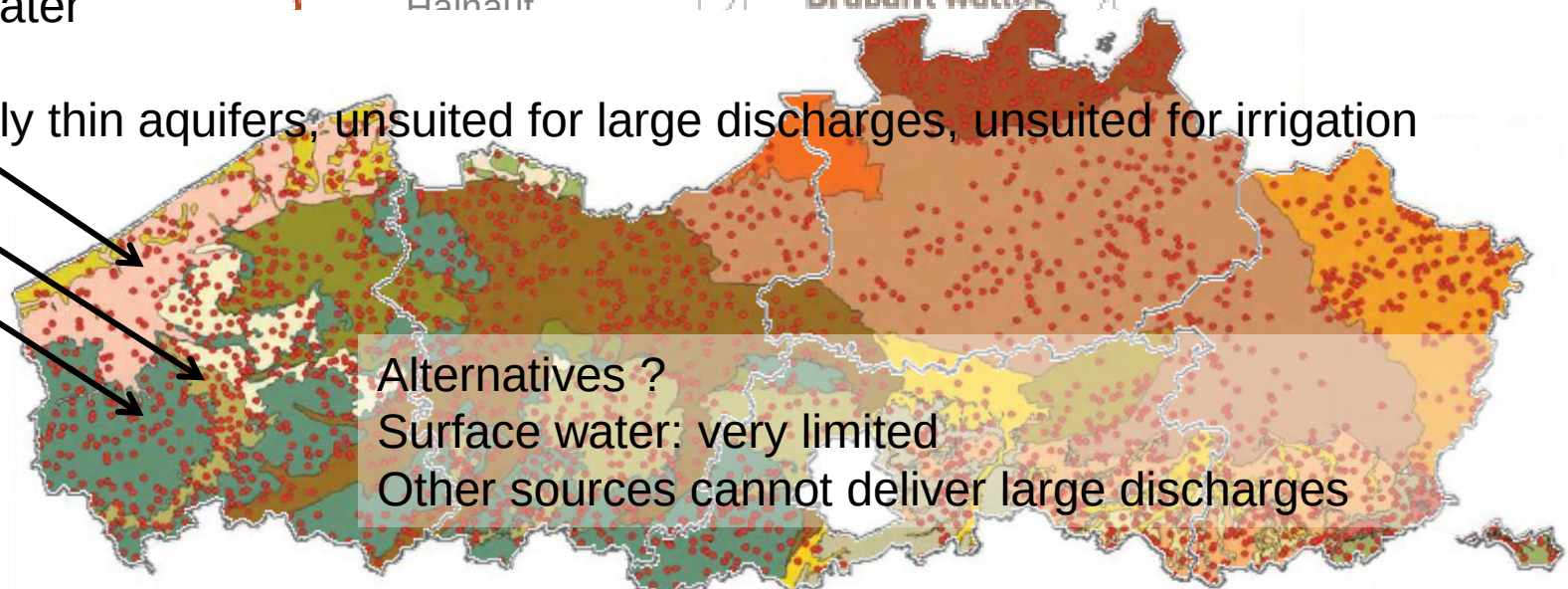
Potato fields in 2012

Flanders (VLM)



silted water

generally thin aquifers, unsuited for large discharges, unsuited for irrigation



Alternatives ?
Surface water: very limited
Other sources cannot deliver large discharges

Conclusions

- Limited future potential for rainfed potato growing ?
- Irrigation need will increase significantly
  - catch up as compared to adjacent regions
  - induced by climatic change
- Insufficient water reserves in major potato areas
- Need for a long term vision and water policy

  --→ very large water bassins ?
- Drought tolerant varieties !
- Partly shift in potato growing zone
  and consequently delocalisation of industry
  might be expected

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Thank you

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