Pascal Maugis

Les impacts du changement climatique sur l'eau et l'alimentation

Ecophilia, SciencePo, 7/1/2021

Laboratoire des Sciences du Climat et de l'Environnement

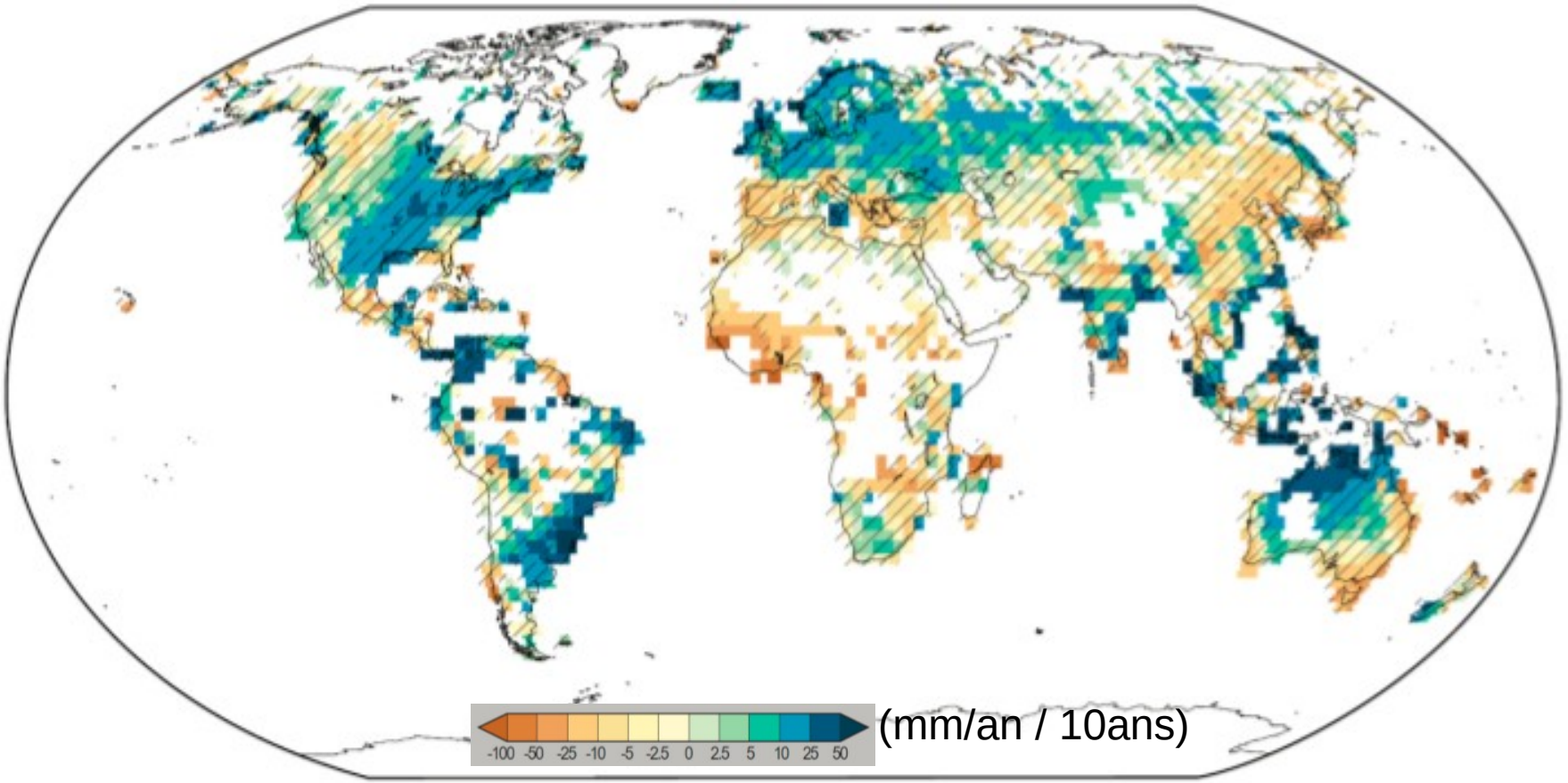
IPSL, CEA-CNRS-UPS

I

Present impact of climate change

1 - Determinants of Precipitation are evolving

Accentuation precipitation contrast since 1951



- => P -- au Sahel
- => P + nord-Eurasie
- => suspicion de variations ailleurs

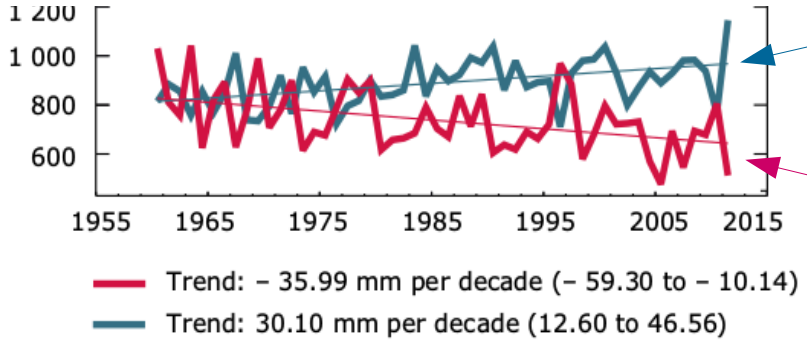
GIEC AR5 (2014)

Total precipitations (rain, snow, ...)

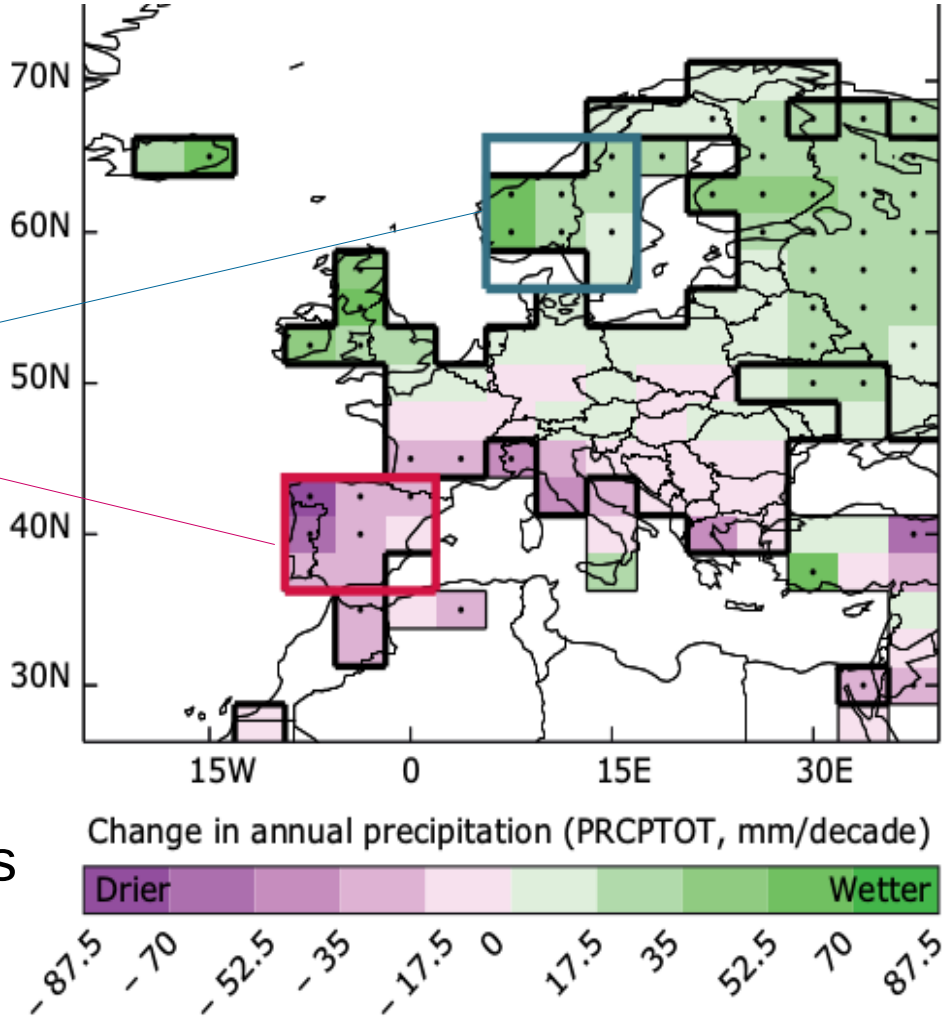
Observed variations between 1960 and 2012

AEE (2012)

précipitations annuelles (mm)



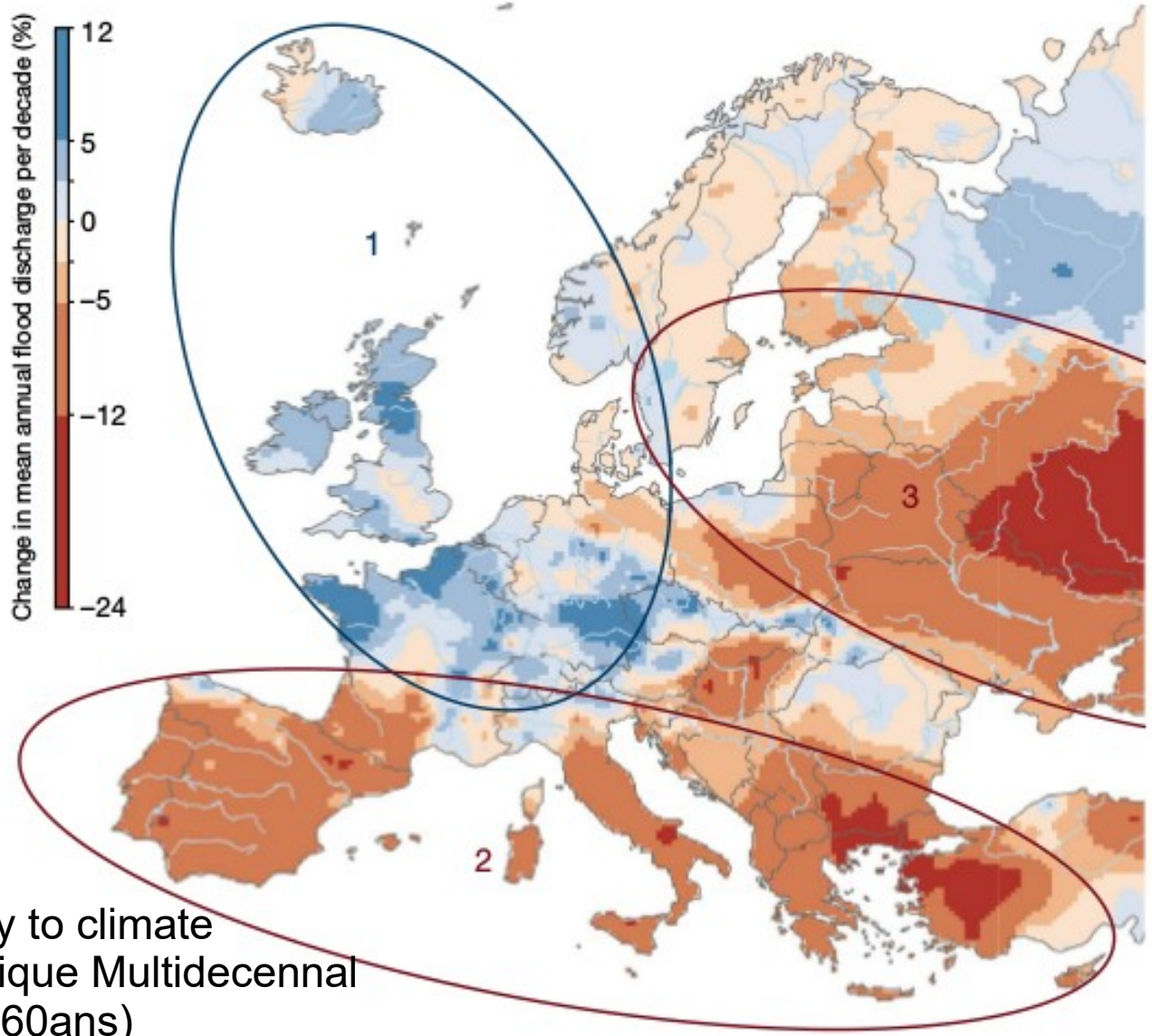
variations décennales (mm / 10ans)



Les pentes sont significatives, mais l'attribution au CC n'est pas statistiquement robuste

River High flows

Variation of annual high flow maximum 1960 – 2010 (% / decade)



not linked only to climate
(AMO : Atlantique Multidecennal Oscillation, ~ 60ans)

Blöschl et al (2019)

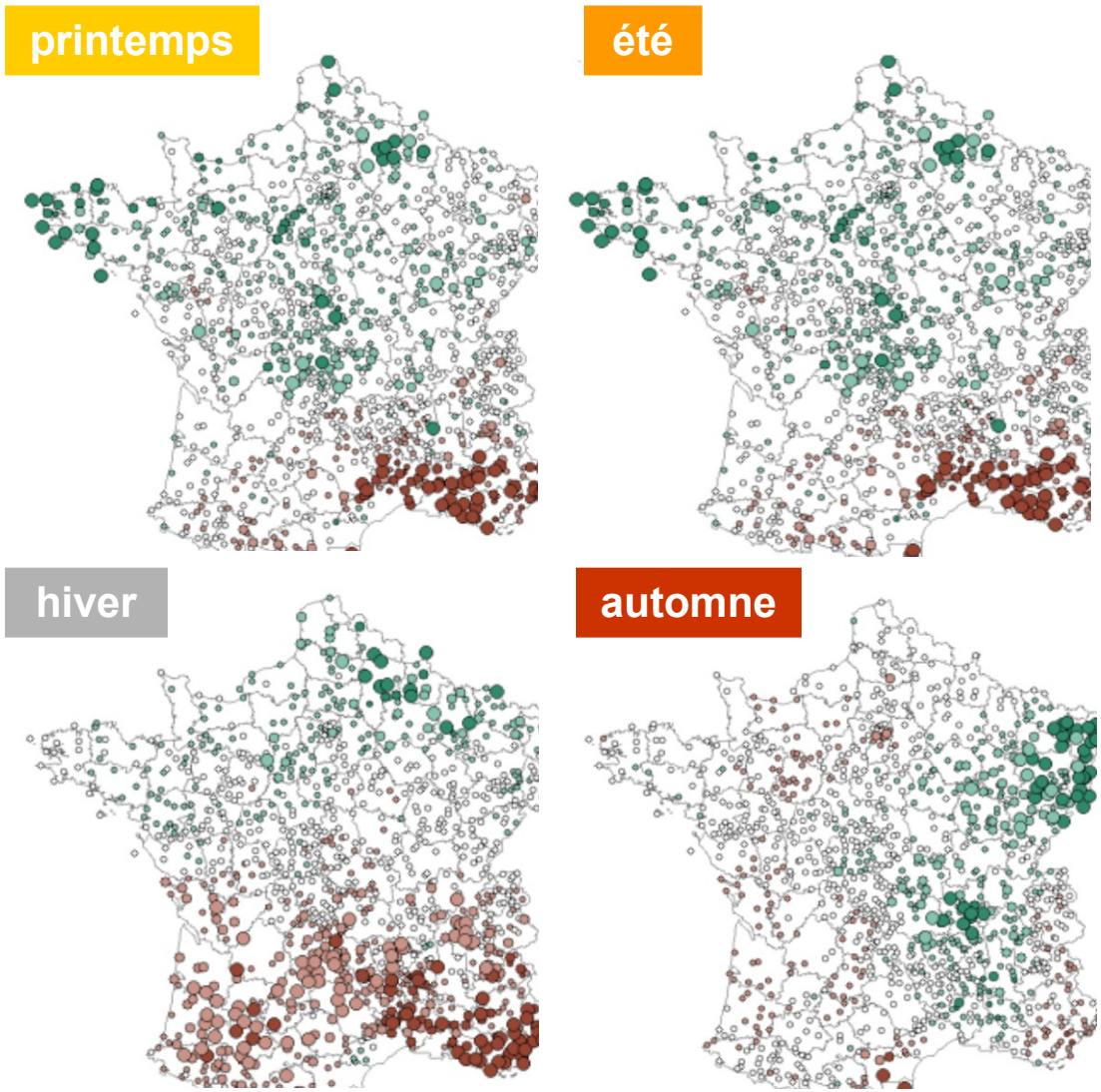
Some significant trends on precipitations since 1959

Peu de grosses tendances significatives sauf :

- augmentation l'hiver Nord
- augmentation l'automne SE Massif Central, voire Nord
- diminution Midi

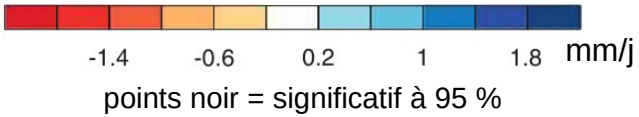
Tendances plus faibles sur 100 ans

(60ans = variabilité multidécennale)



http://www.meteofrance.fr/climat-passe-et-futur/climathd (2014)

Some significant trends on seasonal precipitations between 1979-2010

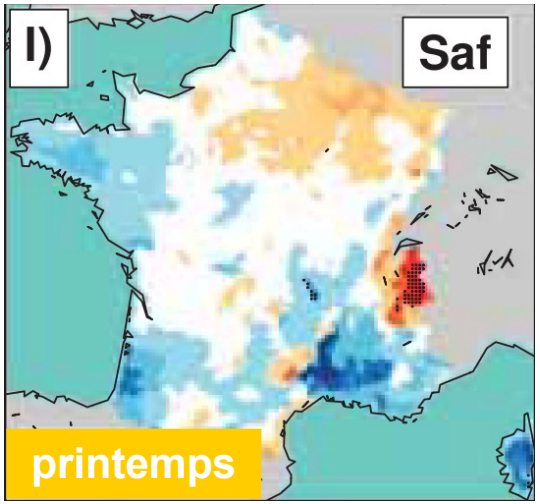


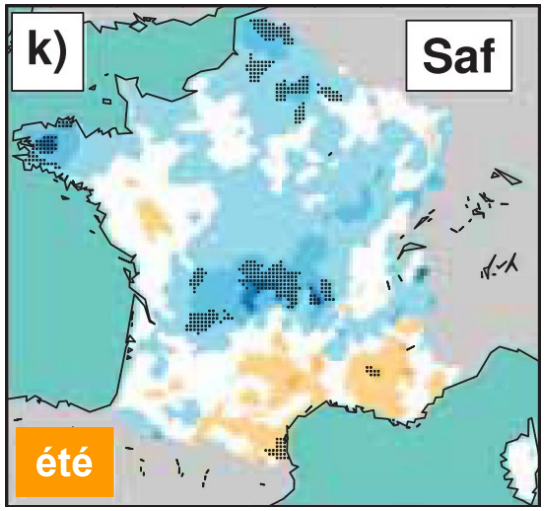
points noir = significatif à 95 %

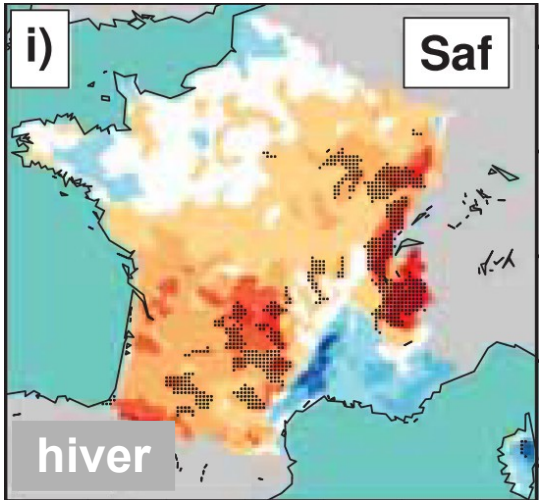
Peu de grosses tendances significatives sauf :

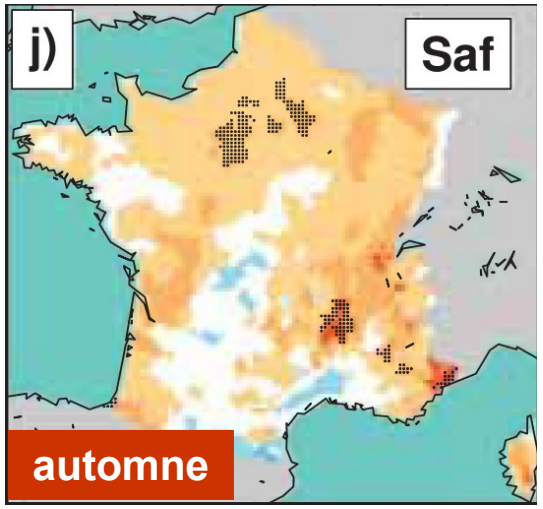
- baisse printemps Alpes N
- augmentation l'été Centre et N baisse Midi
- baisse l'automne N et SE
- baisse l'hiver diag. SW-NE

(60ans = variabilité multidécennale)







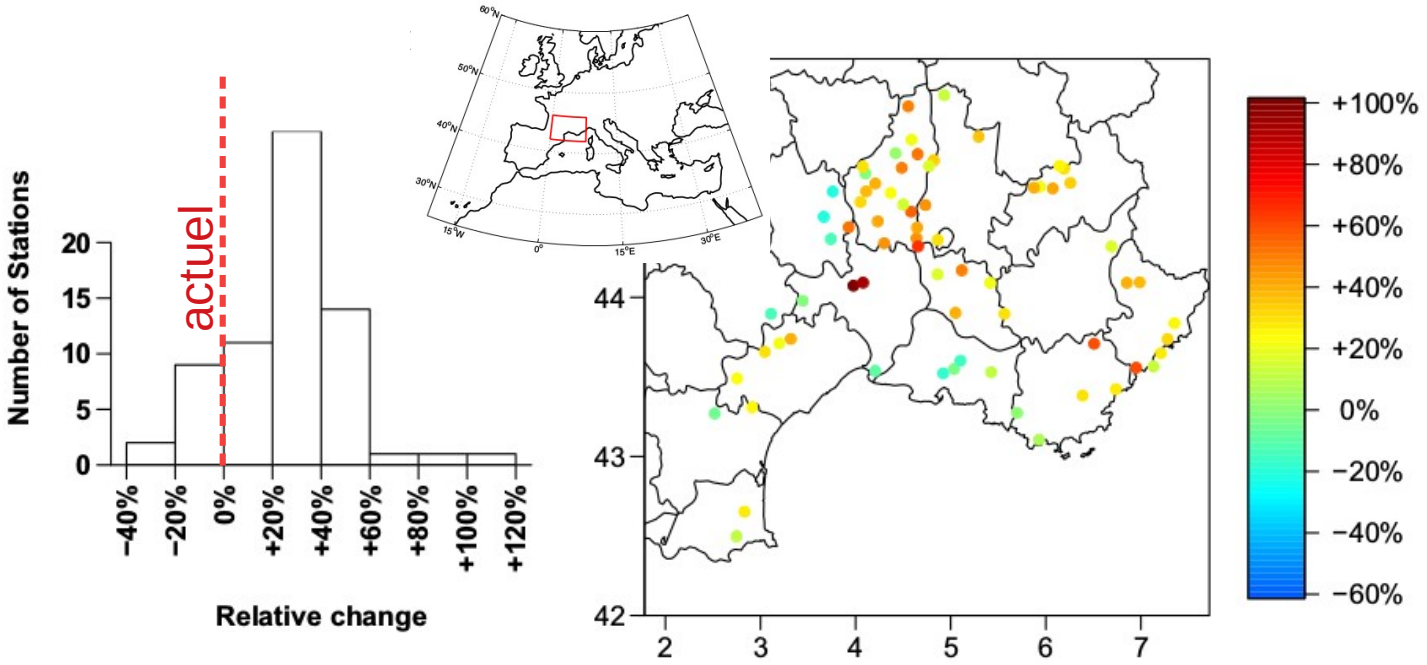


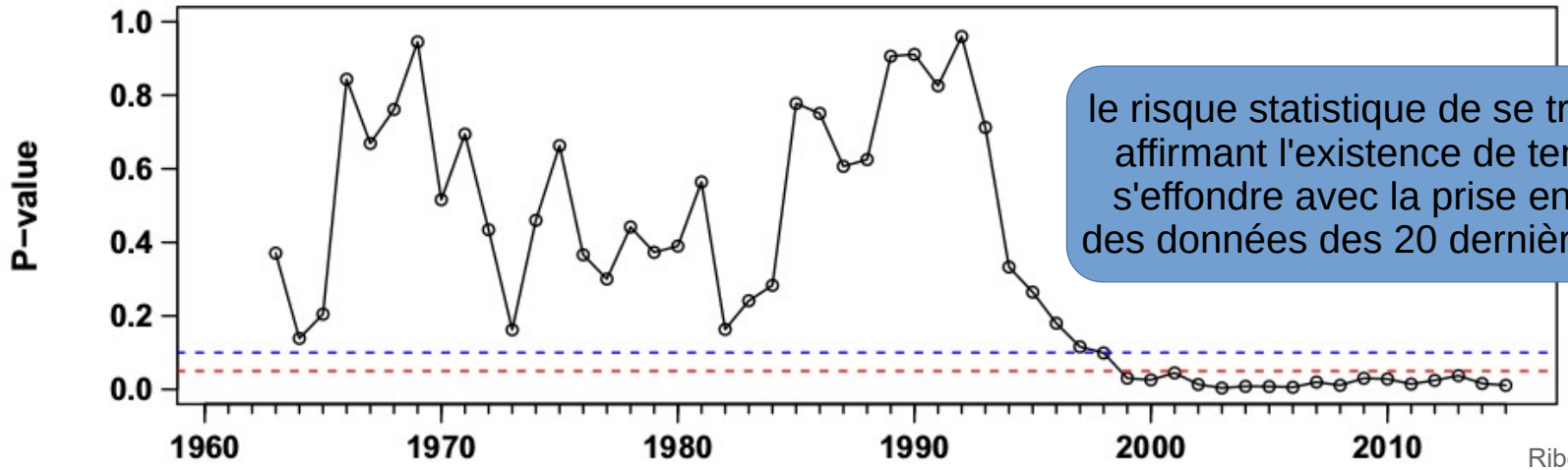
Dayon et al. (2015)

Meteorologic Extremes :

Significant trends on heavy rainfalls, south-East France

Variations sur 50 ans des maxima annuels des pluies journalières





le risque statistique de se tromper en affirmant l'existence de tendances s'effondre avec la prise en compte des données des 20 dernières années

Ribes et al (2017)

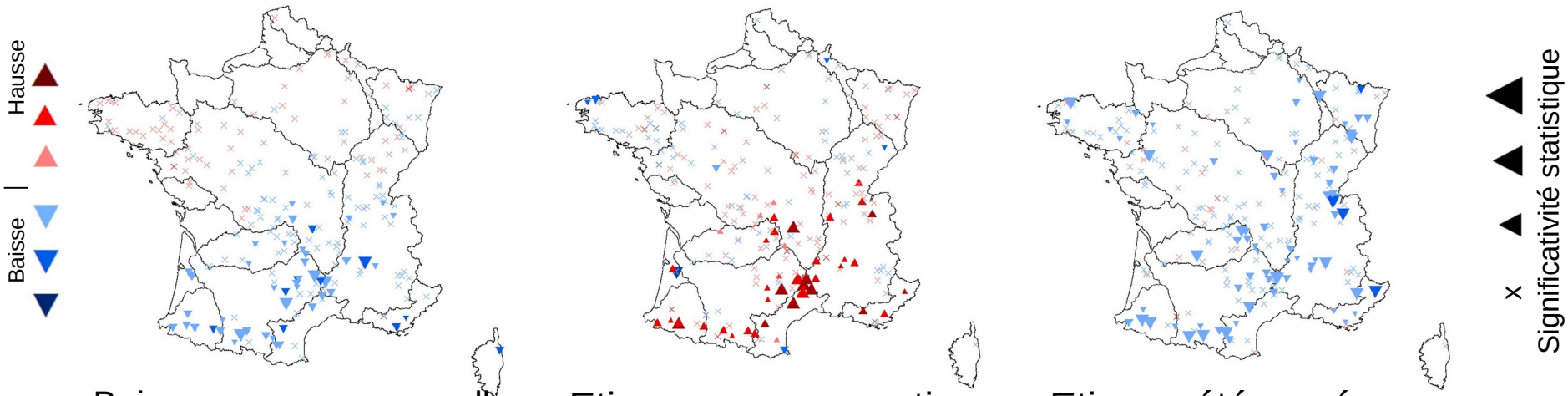
I

Present impact of climate change

2 - Impacts on water resources

River flow reacts to the climate of last 40 years

Une sensibilité au climat perceptible sur 40 ans



Baisse ressource annuelle
(débit total annuel)
jusqu'à -3 %/10 ans

Etiages en aggravation
(déficit de volume à l'étiage)
jusqu'à -4 %/10 ans

Etiages été + précoces
et + longs

- Peu de tendance sur les crues journalières.
- les débits augmentaient souvent 1940-1980 (optimum)
  en lien avec la variabilité climatique ~60 ans

Giuntoli, Maugis, Renard (2012)

Sometimes, nival river flow seasonal regime changes

Une rivière indicatrice au fonctionnement naturel : Le Chéran

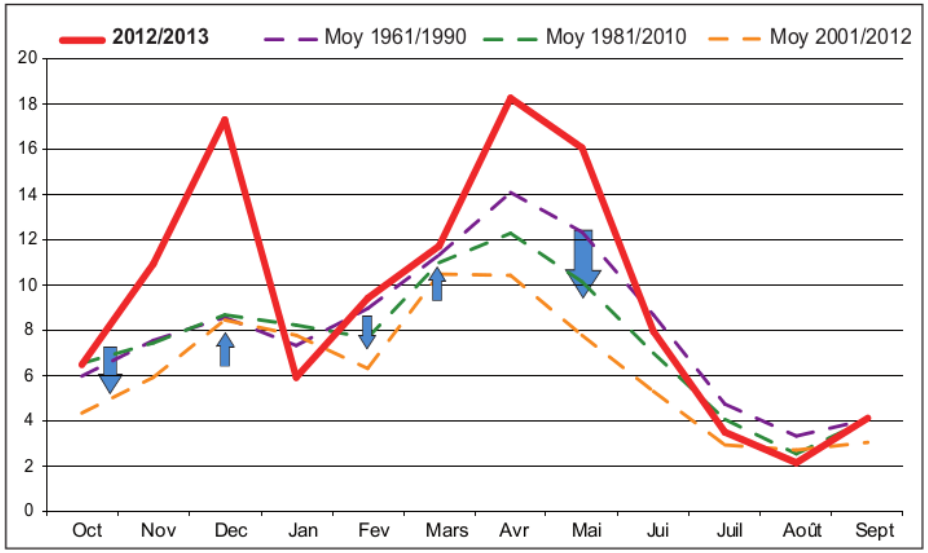


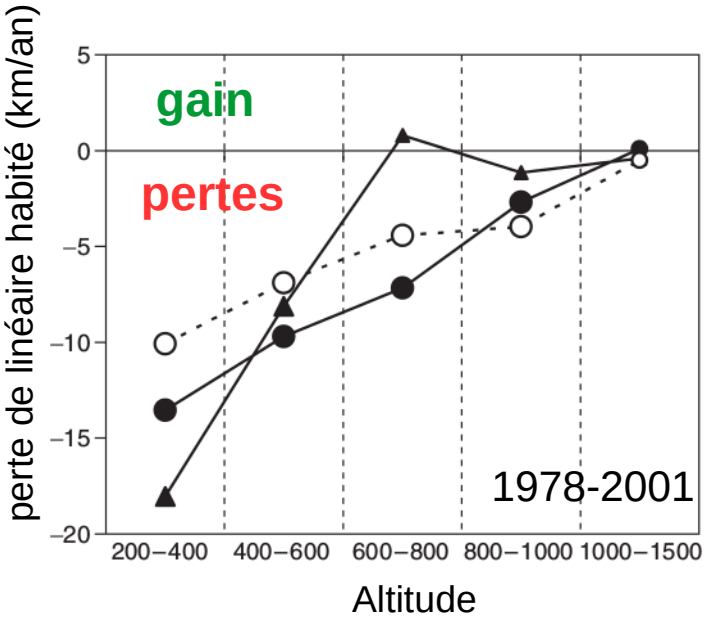
Fig.1. Débits moyens mensuels mesurés en m³/s à Allèves dans le massif des Bauges, d'octobre à septembre (année hydrologique), et de 1961 à 2013.
Flèches bleues : tendances mensuelles ou saisonnières observées sur le long terme.
Sources : DREAL, HYDRO - MEDD/DE, traitement MDP73.

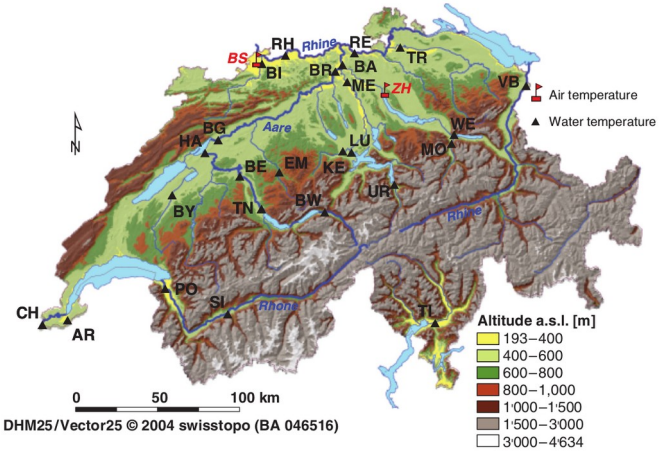
- Changement progressif du **cycle** (nival → pluvial) :
  - baisse générale de la ressource
  - baisse du soutien aux débits de fonte : printemps (crue) et été (étiage)
  - accroissement relatif des crues d'hiver

Freshwater fish species withdraw

La population de truite brune baisse dans les rivières de moyenne altitude

→ un **habitat en recul**, lié principalement aux températures de l'eau ↗

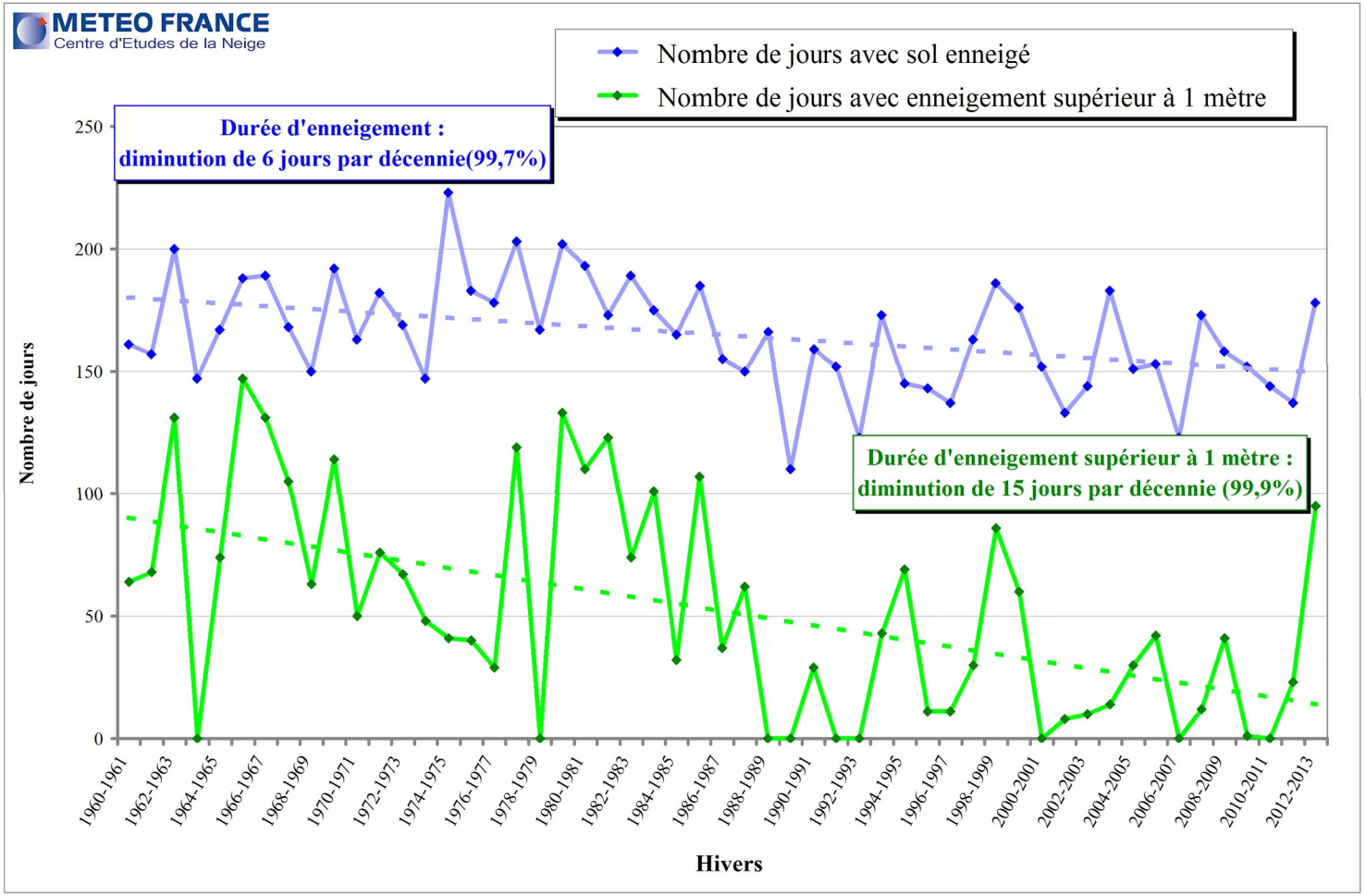




Hari et al., Global Change Biology (2006)

Snow pack diminishes

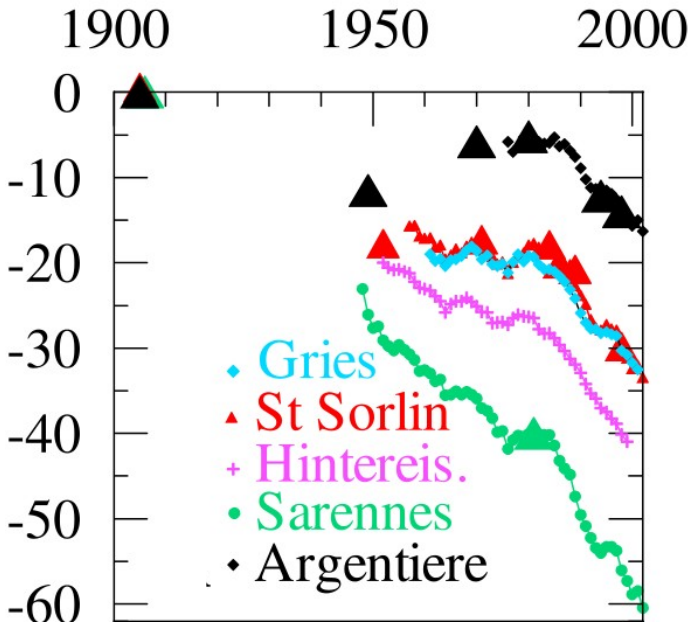
Depuis 1960



Melting glaciers

Less low-flow support

D'abord due, depuis 1830, à la baisse des précipitations neigeuses puis à l'augmentation des températures estivales depuis 1980



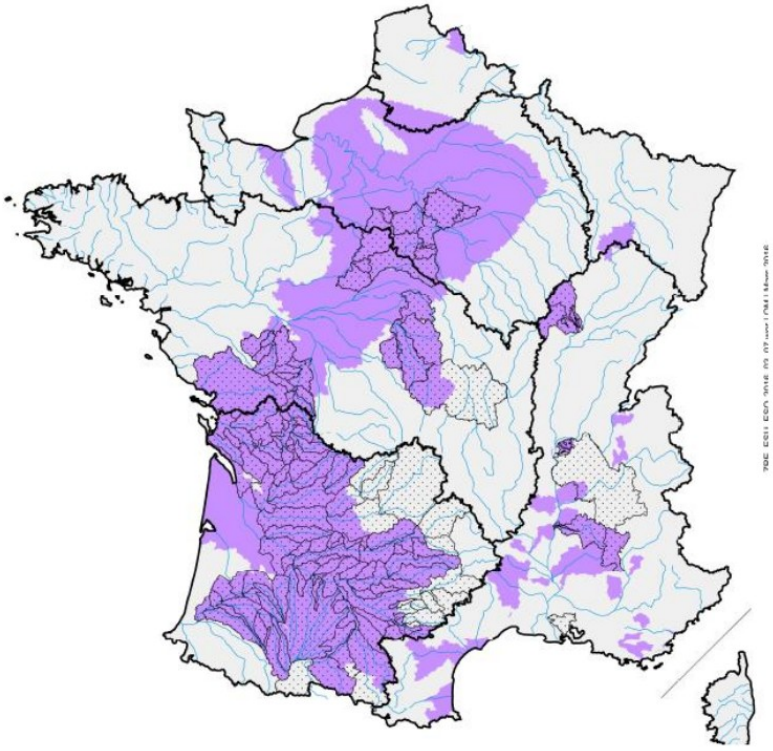
Baisse du volume de quelques glaciers alpins
(équivalent en mètres d'eau)

Vincent et al., Geophysical Research Letters (2005)

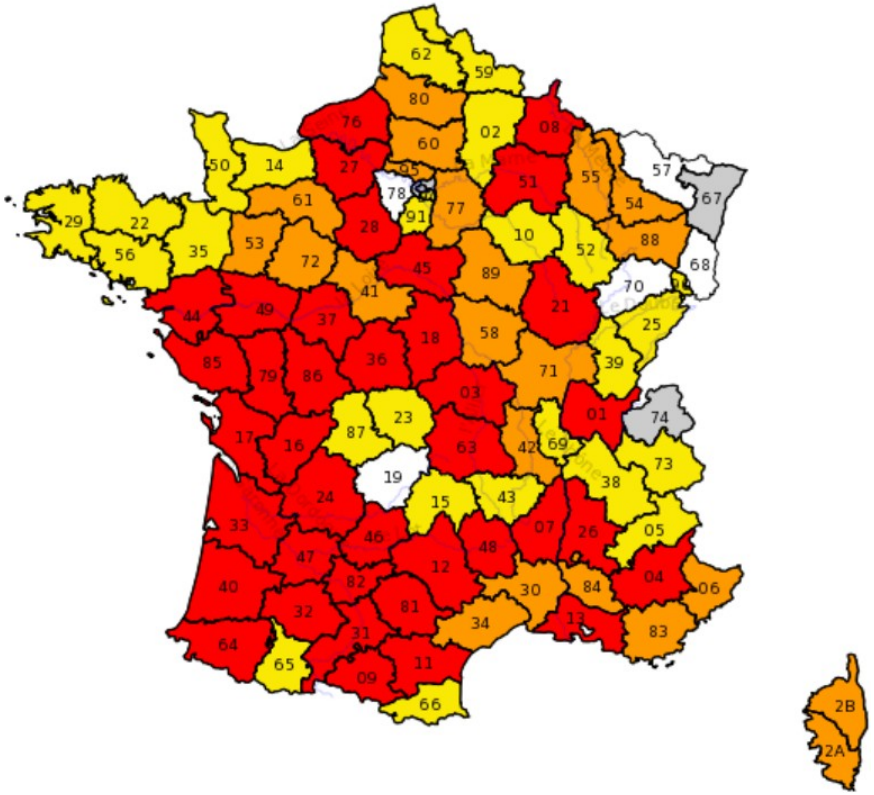
Water resources : abundent yet scarce

Present state of surface and ground-waters

Zone des Répartition des Eaux
(où il y a conflit d'usages)
=> l'essentiel des grands aquifères



Arrêtés "Sécheresse" août 2017
(limitation des usages par le Préfet)
=> 86 départements concernés



I

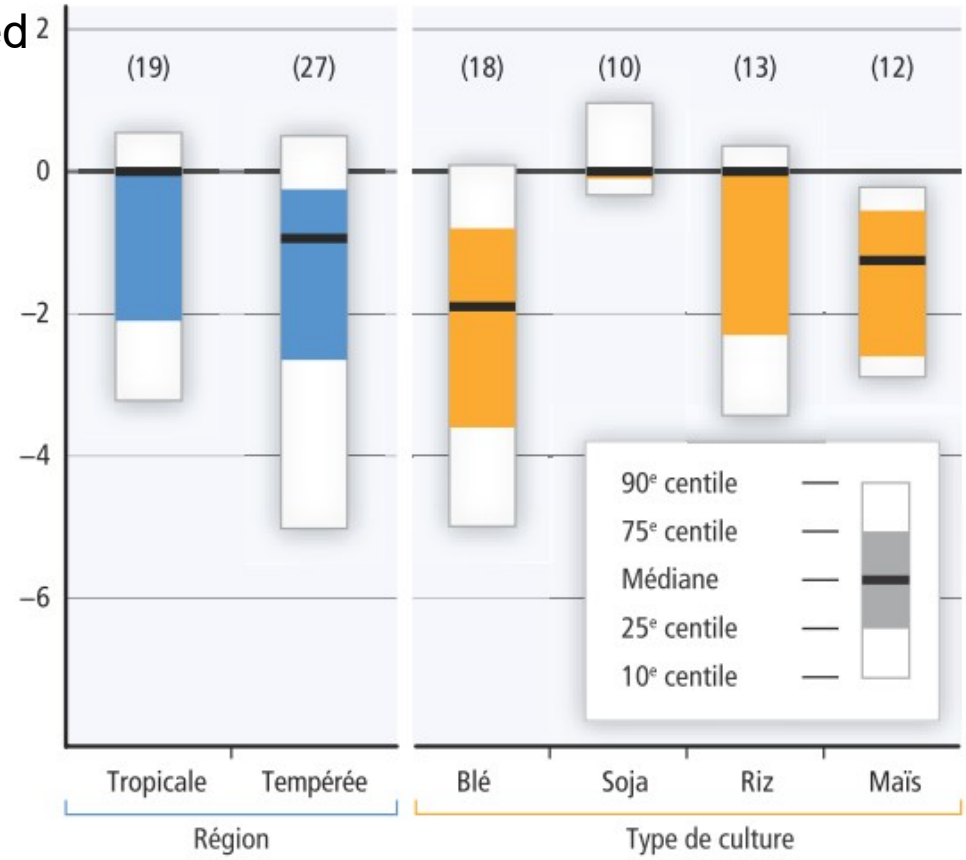
Present impact of climate change

3 - Impact on food production

Agricultural yields regress

- temperate regions are more impacted than tropics
- 0-2% yield loss
  few exceptions

- other factors affecting yield
  - soil depletion
  - lack of water, working force, know-how
  - access to inputs (€)
  - desertification
  - urban spread
  - land conversion for agrobusiness (oleaginoux, agrofuel)
  - competition with photovoltaique

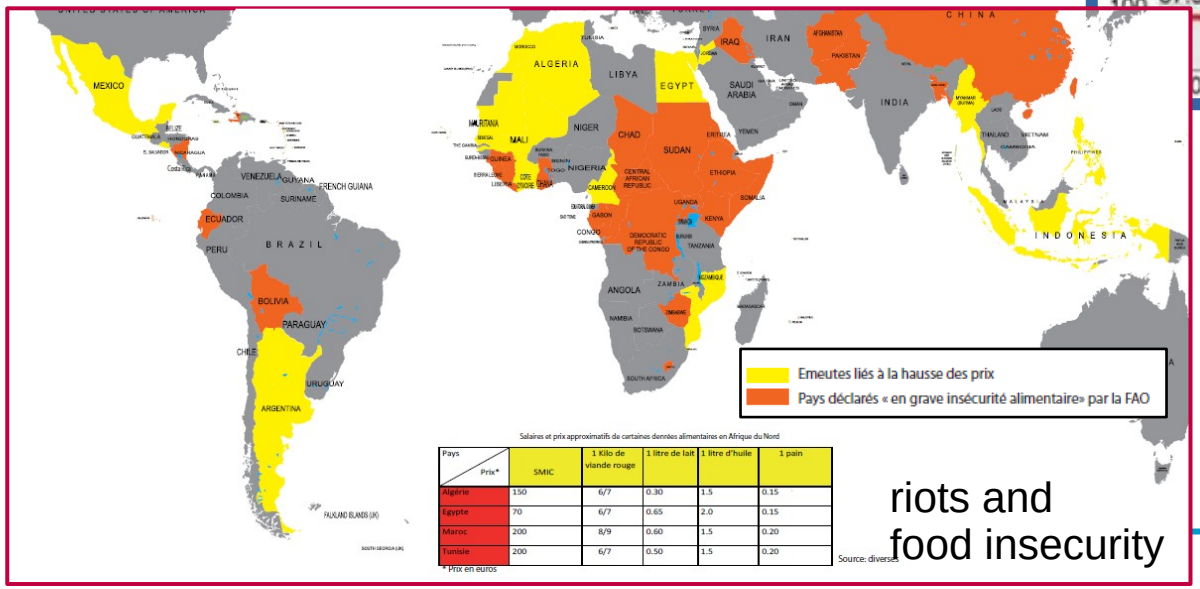


2008 food crisis

Hunger riots in a globalized system

- année trop sèche en Chine + trop humide au Canada
  => légère baisse de production mondiale
- accentuée par absence de stock (gestion en flux tendus, 3 mois max)
  spéculation sur les denrées
  stress hydrique chronique
  vulnérabilité micro-économique
- pays riches servis en premier (Moyen Orient)
- explosion des prix en Afrique

  => émeutes



riots and food insecurity

II

Impacts to come

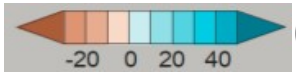
1 - An even scarcer water

Decrease in water ressources

Precipitations : a few large hotspots

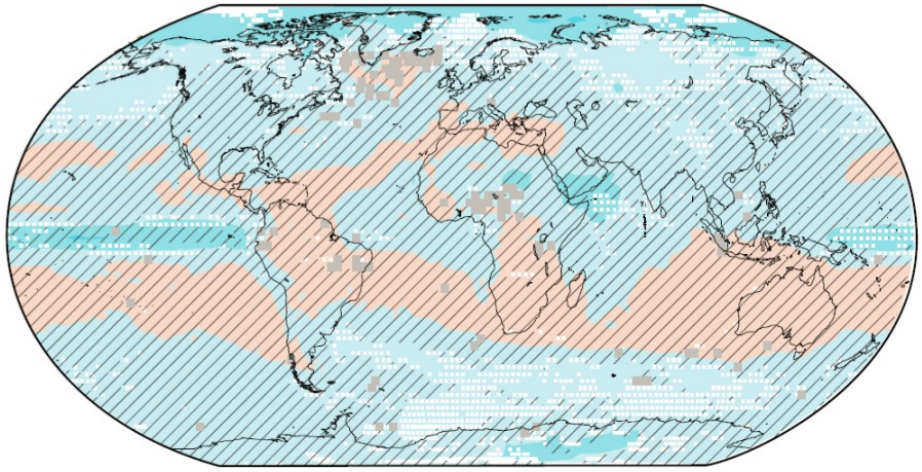
évolution des précipitations ~ 2081-2100

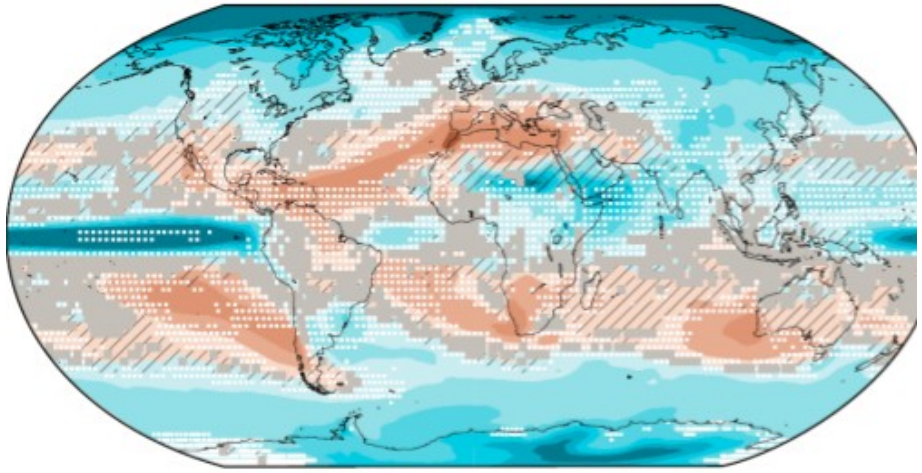
RCP 2.6



(%)

RCP 8.5





légères variations dépendant des modèles

Tendances plus robustes

=> P – régions tropicale & Méditerranée

=> P + mousson asiatique, zones boréales

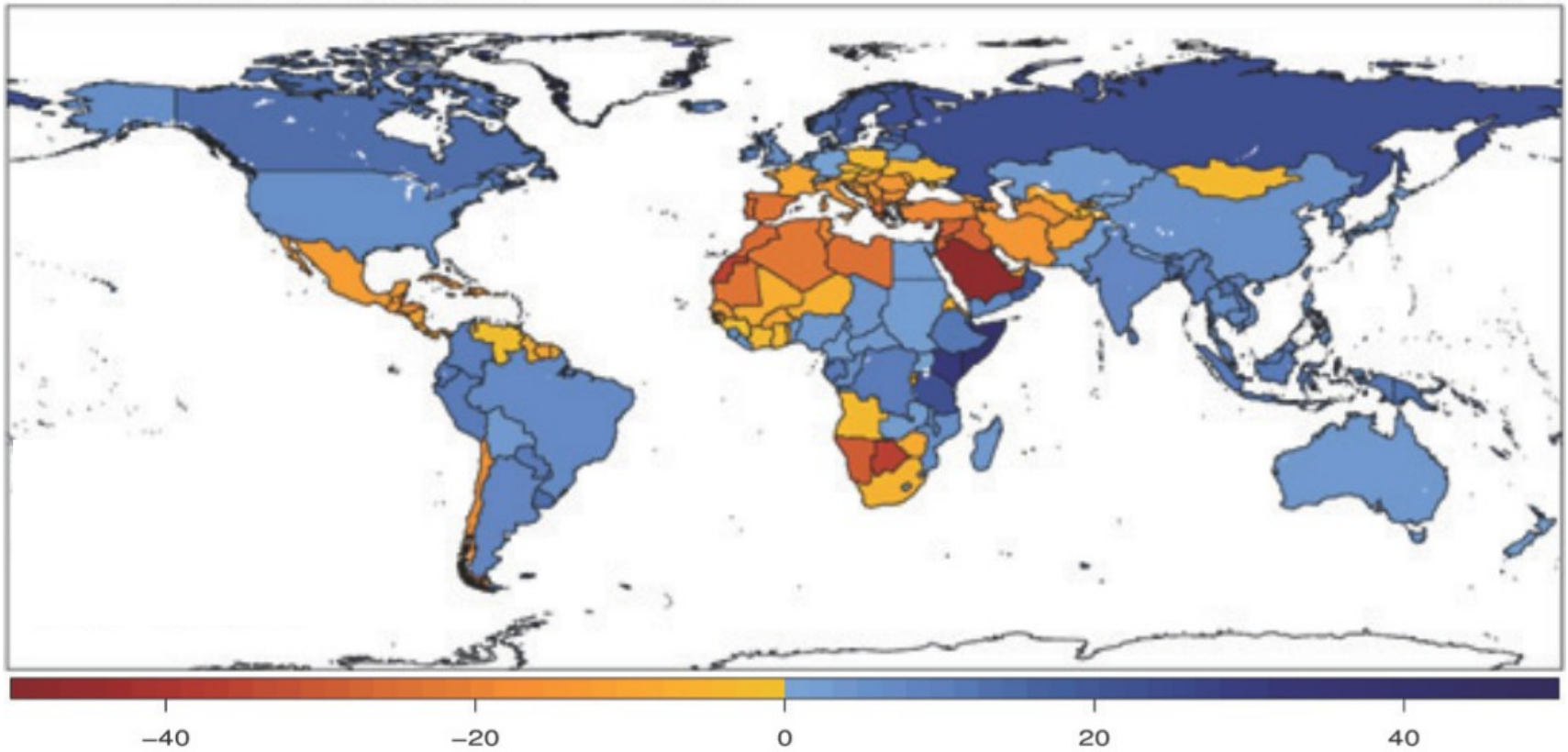
! modélisation très incertaine par les modèles climatiques !
des rétroactions importantes manquent (nuages, surface continentale…)
=> peut être localement bien pire (ou un peu moins grave)

GIEC AR5 (2014)

Decrease in water ressources

Exacerbated tensions in tropics and Mediterranean

Variation (%) entre 2000 et 2080 des ressources en eau disponibles après prélèvement par la végétation et les **cultures en place** (incluant l'irrigation si l'eau est disponible)

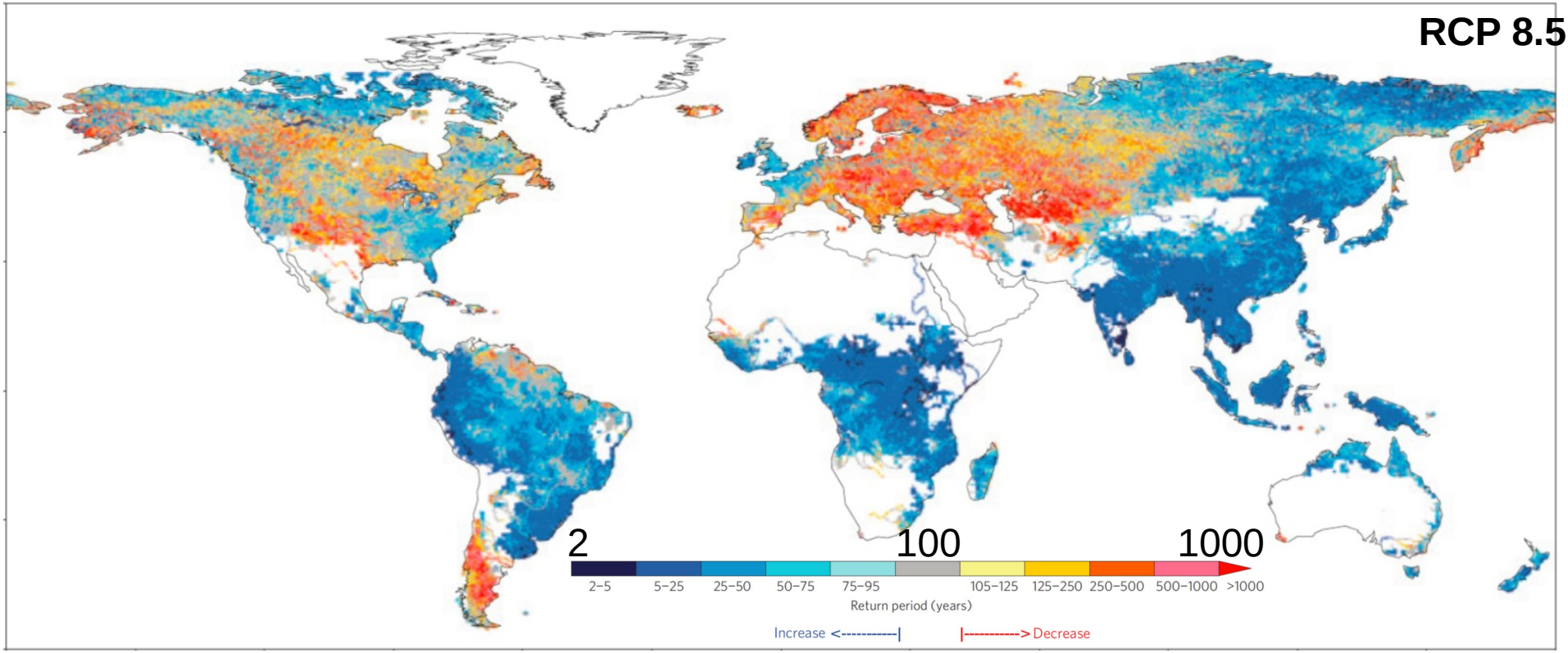


- pression accrue encore par la démographie, et usages émergents (alimentation carnée, agro-carburants, …)
- haute spécificité de chaque pays / région

Gerten et al. (2011)

A little too much water too

Return period of presently centenial floods ~2080

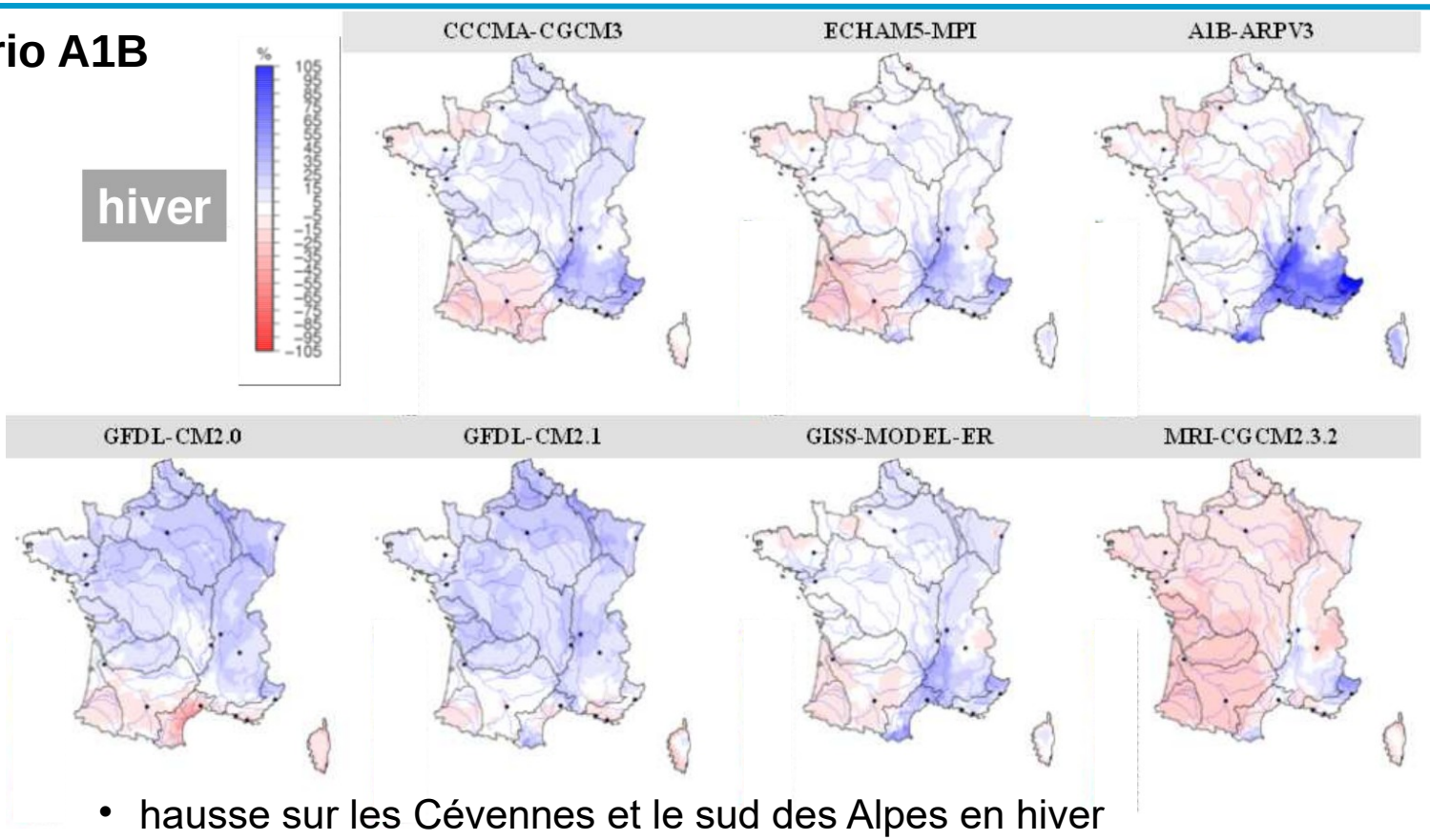


- l'Asie particulièrement touchée (topographie & densité population)
- d'autres estimations régionales => crues + en Europe du Nord

Hirabayashi et al. (2013)

Suspected yet unacertained precipitation trends (rain, snow) except during winter

Scénario A1B

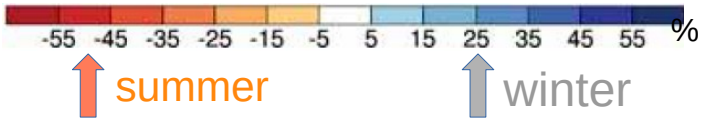


- hausse sur les Cévennes et le sud des Alpes en hiver
- baisse dans le sud-ouest en hiver (période de recharge des aquifères)
- Augmentation des précipitations extrêmes
- vents + violents dans la partie nord
- conséquences sur les forêts, les inondations, ...

Chauveau, Maugis et al. (2013)

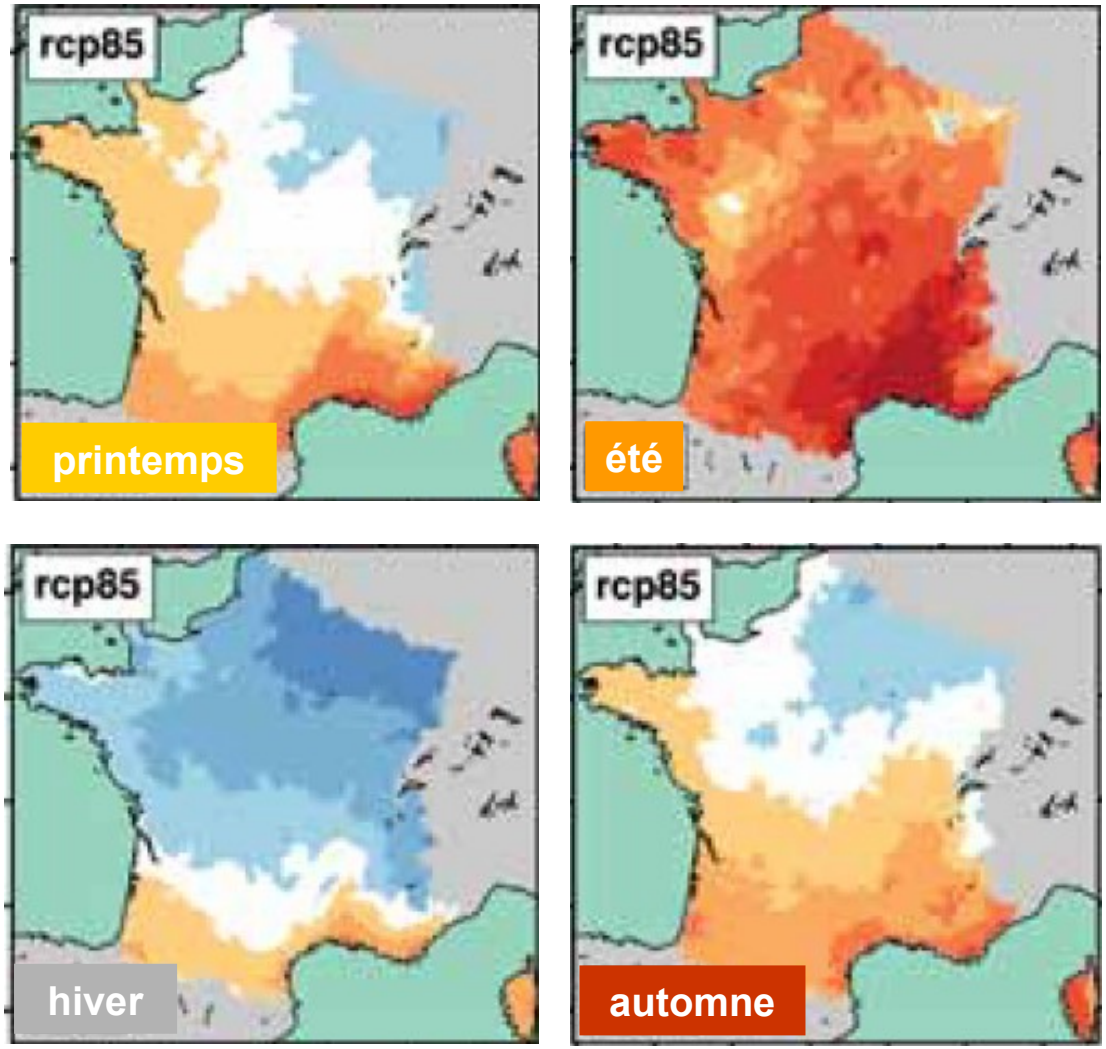
Other say : Quite less summer rain, more in winter

2070-2100 compared to 1960-1990



Scénario à forte émission GES

- jusqu'à -50 % l'été
- jusqu'à +25 % l'hiver
- -0,8 mm/j annuels (sobre : -0,3)
- hausse possible sur les Cévennes
- baisse dans le sud-ouest et en période de recharge des nappes
- + précipitations extrêmes
- vents + violents, partie nord
- conséquences sur les forêts, les inondations, ...



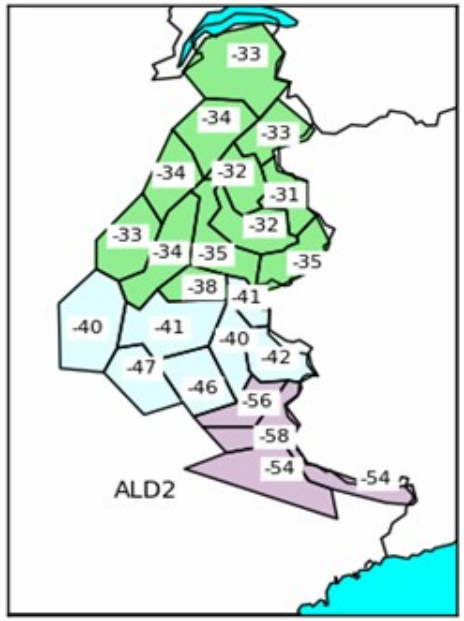
Dayon et al. (2015)

Flickering snow pack

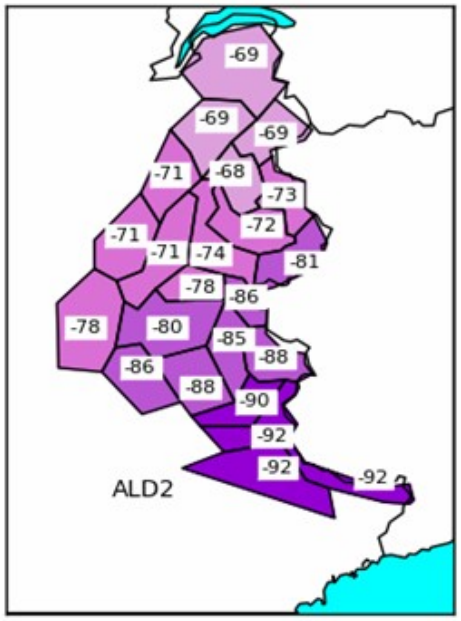
Questionning winter sport resorts

Baisse marquée de l'enneigement en **moyenne montagne** et sur les **Alpes du Sud**

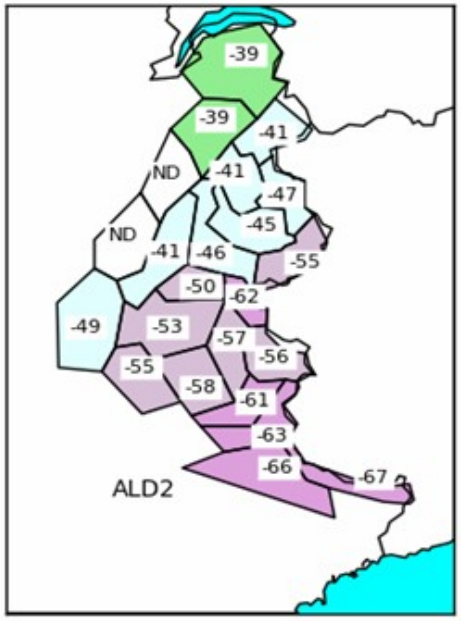
Equivalent en eau de la hauteur de neige en hiver (cm)



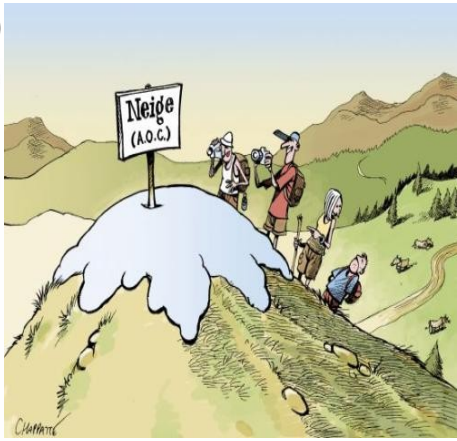
2030, 1800m



2080, 1800m



2080, 2400m



Presse Algérie

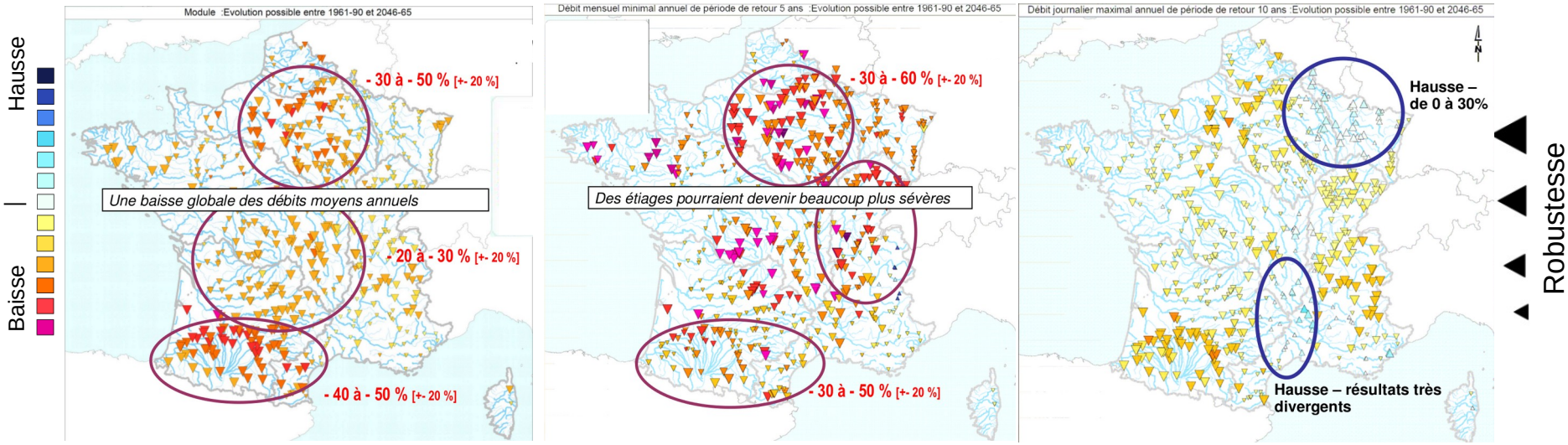
- baisse précipitations neigeuses + températures en hausse = Recul des glaciers
  - impact sur les sports d'hiver ; stations de ski en reconversion
- changement de régime des rivières à crue de printemps → hiver, étiages ↘

SCAMPEI (2012)

Flow river collapse

Drastic reduction in a few decades, heavy warming

Horizon 2055 (période 2040-2070)



Annual resources
(débit total annuel)
-20 – -50 %

severe low-flows
(QMNA5)
-30 – -60 %

less intense high flows
(débit journalier décennal)
localised high flows up to +30 %

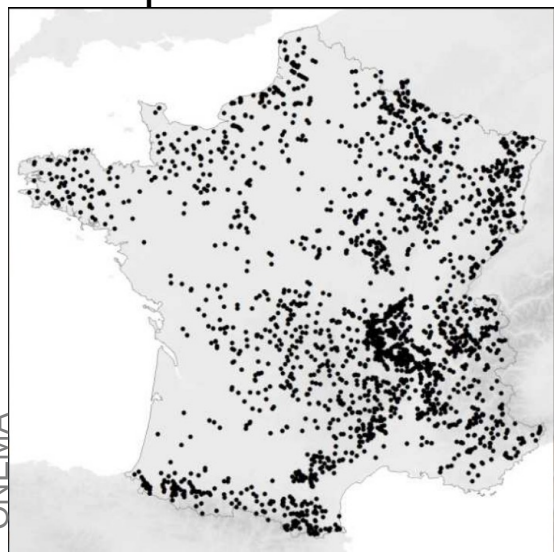
- Effect mainly from **evapo-transpiration increase**
- **Mean water Température** over France : + 1,6 ° C
  => already a heavy pressure on ecosytems

Chauveau, Maugis et al. (2013)

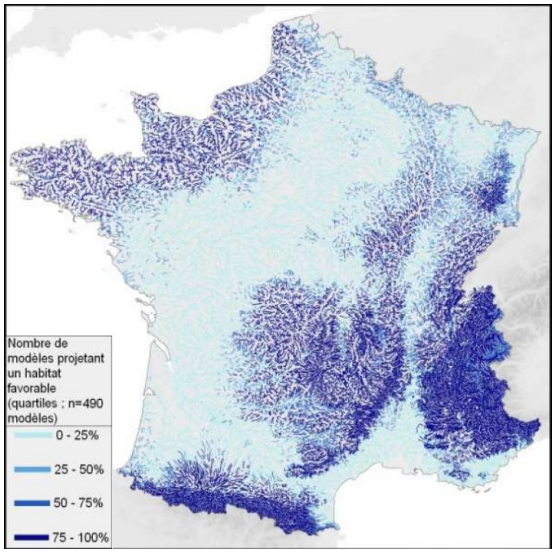
Impacts on fauna and aquatic biodiversity

Global drawback of fario trout habitats

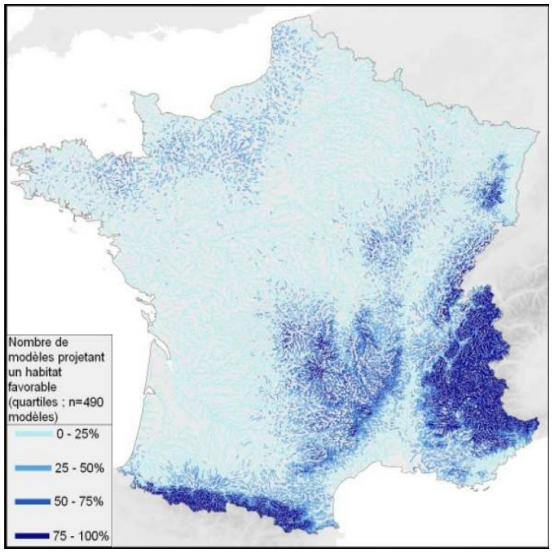
présence actuelle



modélisé actuel



Modélisé 2070



ONEMA

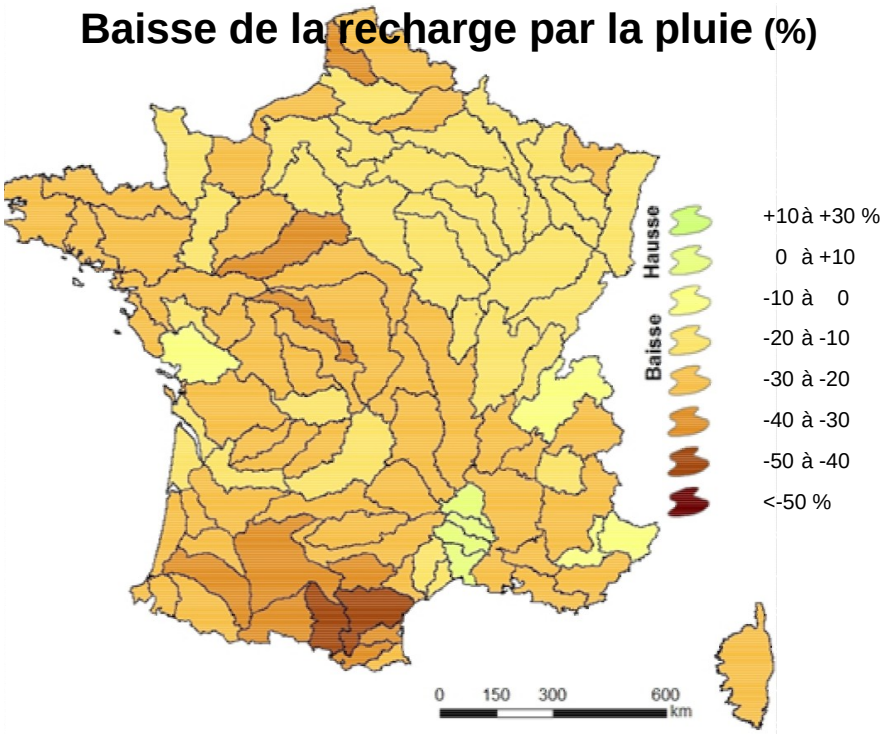
au profit d'espèces d'eaux plus chaudes (ex. toxostome)

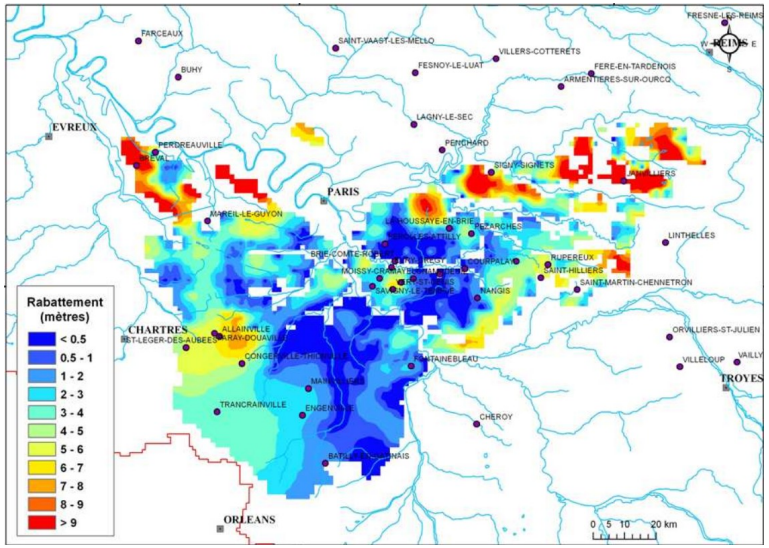
ou d'**espèces invasives**

Heavily impacted groundwaters

Aquifer recharge abatted by lower rains and higher withdrawals

Baisse de la recharge par la pluie (%)





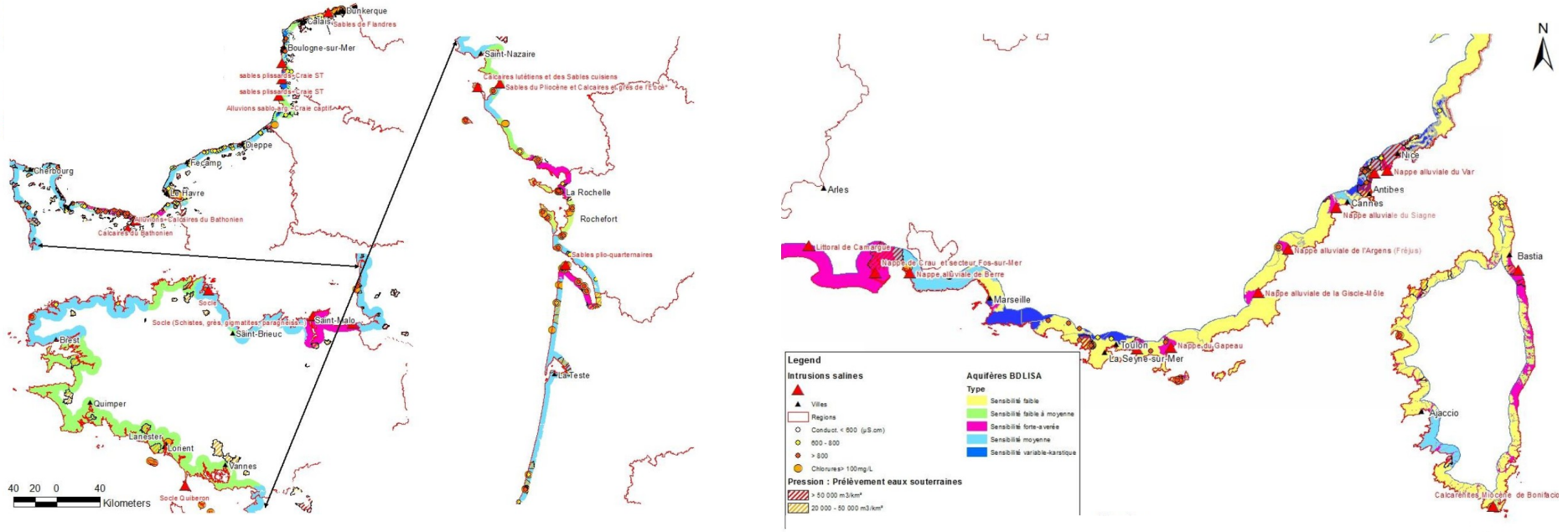
Baisse de la nappe de Beauce ~ 2055 due au climat et à l'eau potable
(0 - 10m)

Ajouter à cela :

- augmentation des prélèvements agricoles (jusqu'à +50%) & eau potable (migrations internes, tourisme)
- moins de contribution aux débits des rivières

=> une ressource menacée (épuisement, intrusion saline, ...)

Coastal aquifers particularly affected by saline intrusion of marine water

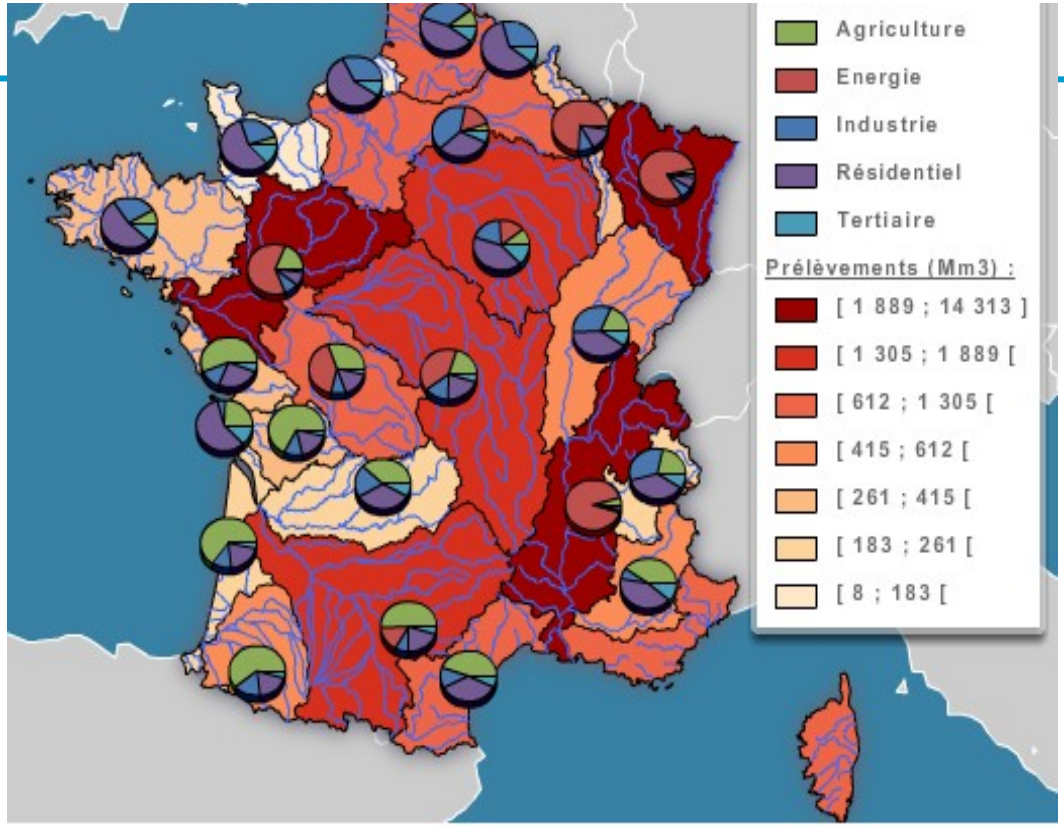


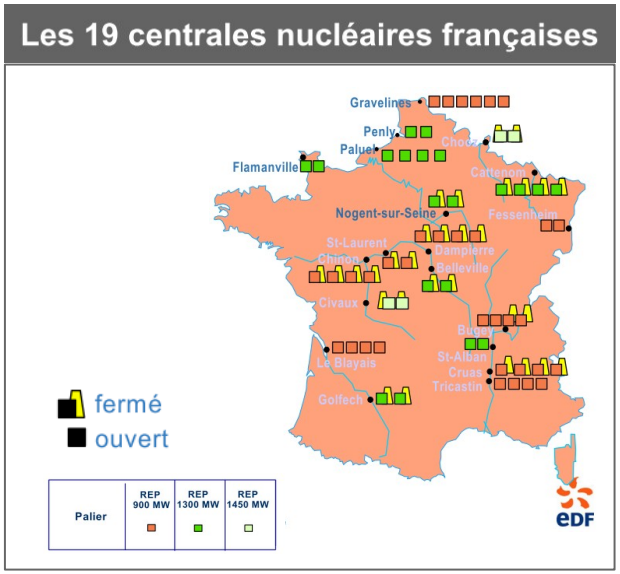
Sensibilité à l'intrusion saline sous l'effet de l'augmentation du niveau de la mer et des prélèvements en eau potable des villes

- L'intrusion saline est déjà une menace actuelle sur l'AEP
- Aggravée par les effets directs et indirects du changement climatique
- Les lagunes et zones humides côtières sont également directement menacées

Water usages

Withdrawals 2006





STRATEAU
Outil d'aide à la décision

Météo-France		Modélisation STRATEAU						
Pluie			Prélèvements			Consommation			
annuelle	dont été (%)	Secteurs d'activité	Annuels (km³)	dont été (%)	part du total été	annuelle (km³)	Conso / prélèv	part du total	Remarques
895,6 mm 494 km³	21 %	**Energie**	18,6	21%	42%	1,1	6%	14%	hors évaporation aval pour circuit ouvert
		Industrie	2,8	26%	8%	0,5	17%	6%	dont Prélèv. AEP = 0,3
		Agriculture	4,2	85%	37%	4,2	100%	54%	hors Conso. pluviale
		Résidentiel	4,2	25%	11%	1,5	37%	20%	AEP
		Tertiaire	1,0	20%	2%	0,4	39%	5%	AEP
		TOTAL	**30,9**	**31%**	**100%**	**7,7**	**25%**	**100%**	**Prélèv. AEP = 5,5**

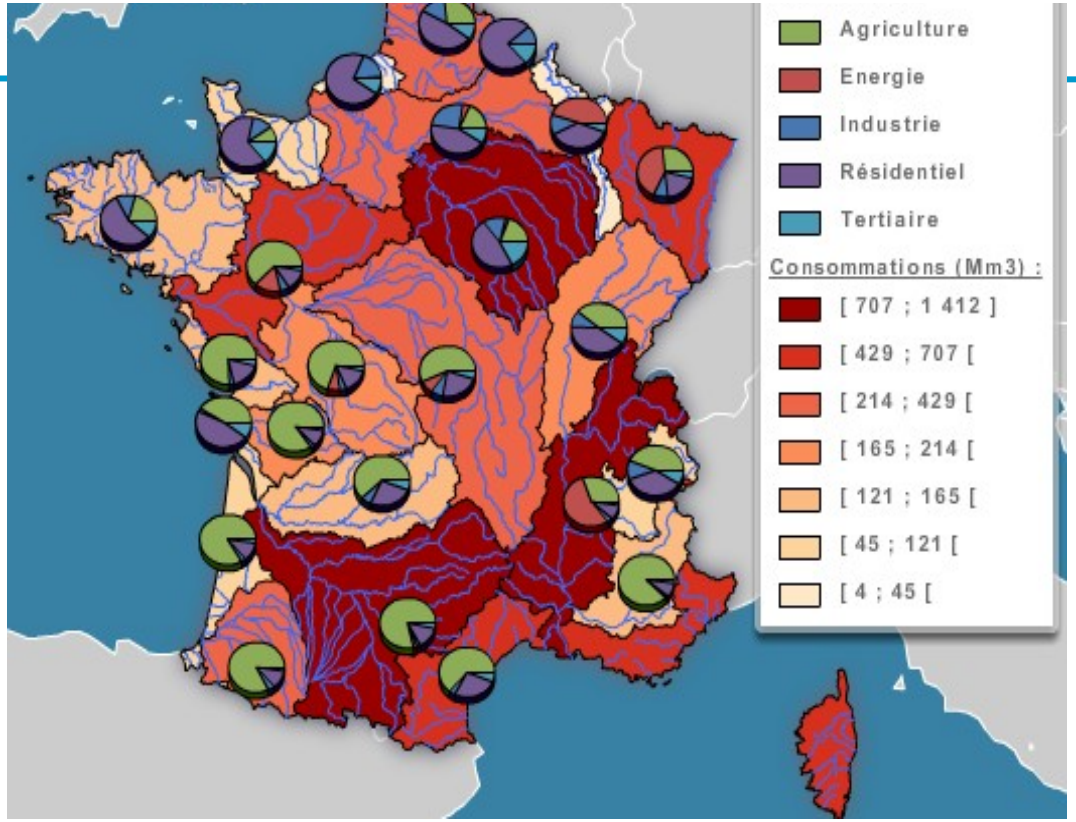
ONEMA
Office national de l'eau et des milieux aquatiques

Water usages

Consumption 2006

Production d'énergie = consommation associée :

- refroidissement centrales
- évaporation retenues
- agrocarburants
- bois de chauffage



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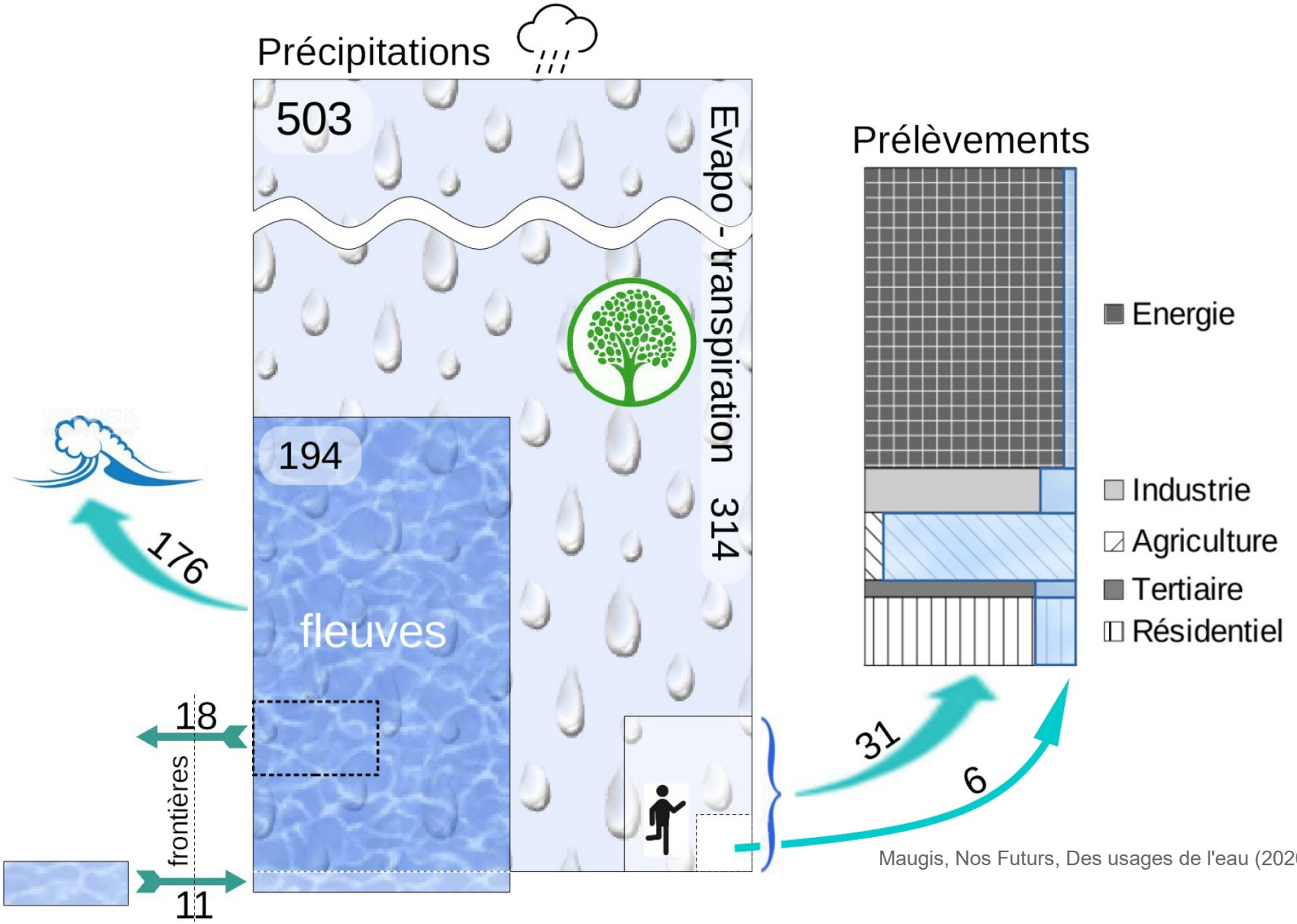
ONEMA
Office national de l'eau et des milieux aquatiques

Water usages

France water balance and use 2006



Maugis, Nos Futurs, Des usages de l'eau (2020)

Competing water uses that will require a new repartition

Augmentation de la demande en eau en amont ...

neige artificielle

irrigation du fourrage

électrique pour climatisation

… avec des besoins maintenus ou accrus en aval

CEMACS Business, Cameroun

irrigation cultures

http://www.serreponcon-tourisme.com

refroidissement centrales

www.oieau.com

http://www.humanosphere.info

démographie, rafraîchissement

Some quantitative impacts not to forget

- **Increase competition for water** by increasing demand :
  - Irrigation (including agrofuels), firewood
  - leasure, tap water, green areas (including ubran refreshment)
  - inter-basins et cross-border transfers (Rhin, Rhône, Spain ?)
- Diversification of **dam** functions (energy stock, cooling capacity safeguarding, low-flow support, tap-water, leasure) => priorizing ?

  + difficulty just to fill them and keep water (évaporation)
- Water temperature increase

  => **cooling and energy efficiency of power plants** ?
- Modification of flow and seasonal regime of rivers =>
  - **dilution potential of pollutants** (waste water station discharge, T_{water}, …) during low-flows
  - rainwater and flood management if winter rains increase

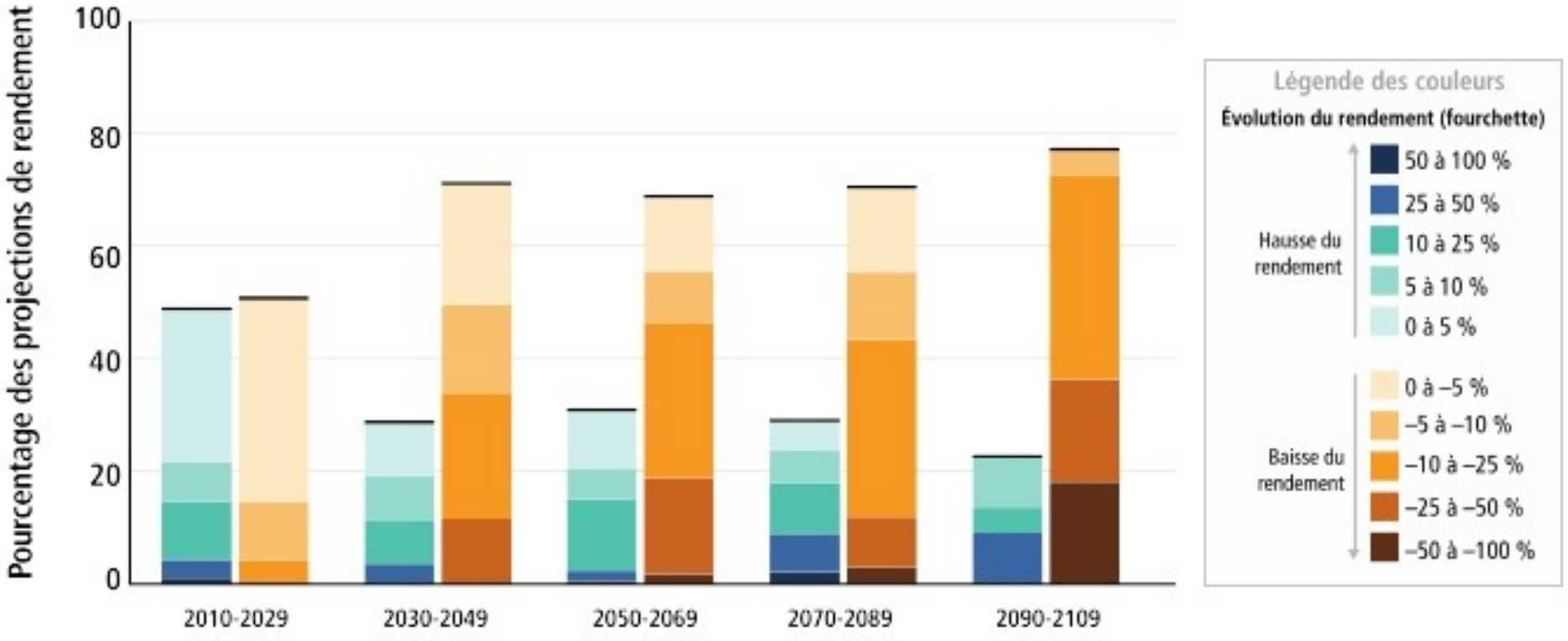
II

Impacts to come

2 - A tricky agricultural production

Decrease in crop yield

Contrasted but overall negative trends



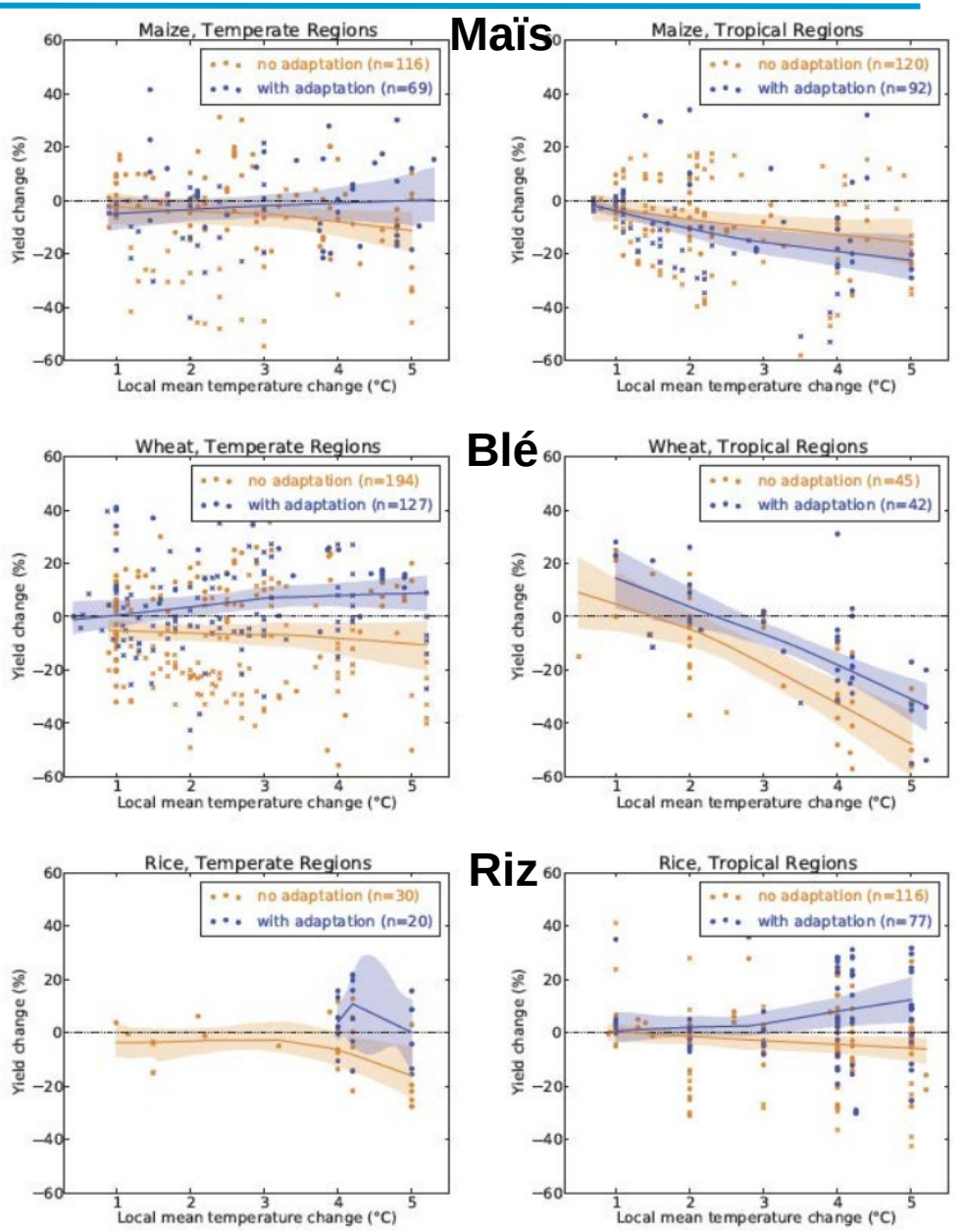
- Enjeu alimentaire mondial
  croisé avec échanges internationaux, démographie et habitudes alimentaires

GIEC AR5 (2014)

Decrease in crop yield

Depends on species and climate

- **baisse sévère de la productivité**
- parfois les rendements peuvent augmenter (fertilisation par CO_2, température) temporairement
- **l'adaptation** peut aider
- elle suppose cependant l'eau disponible pour l'irrigation mais **limitation par les ressources** :
  - en eau
  - en sol
  - infrastructures
  - gouvernance
  - formation
  - paysans
  - accès au capital
  - accès aux intrants

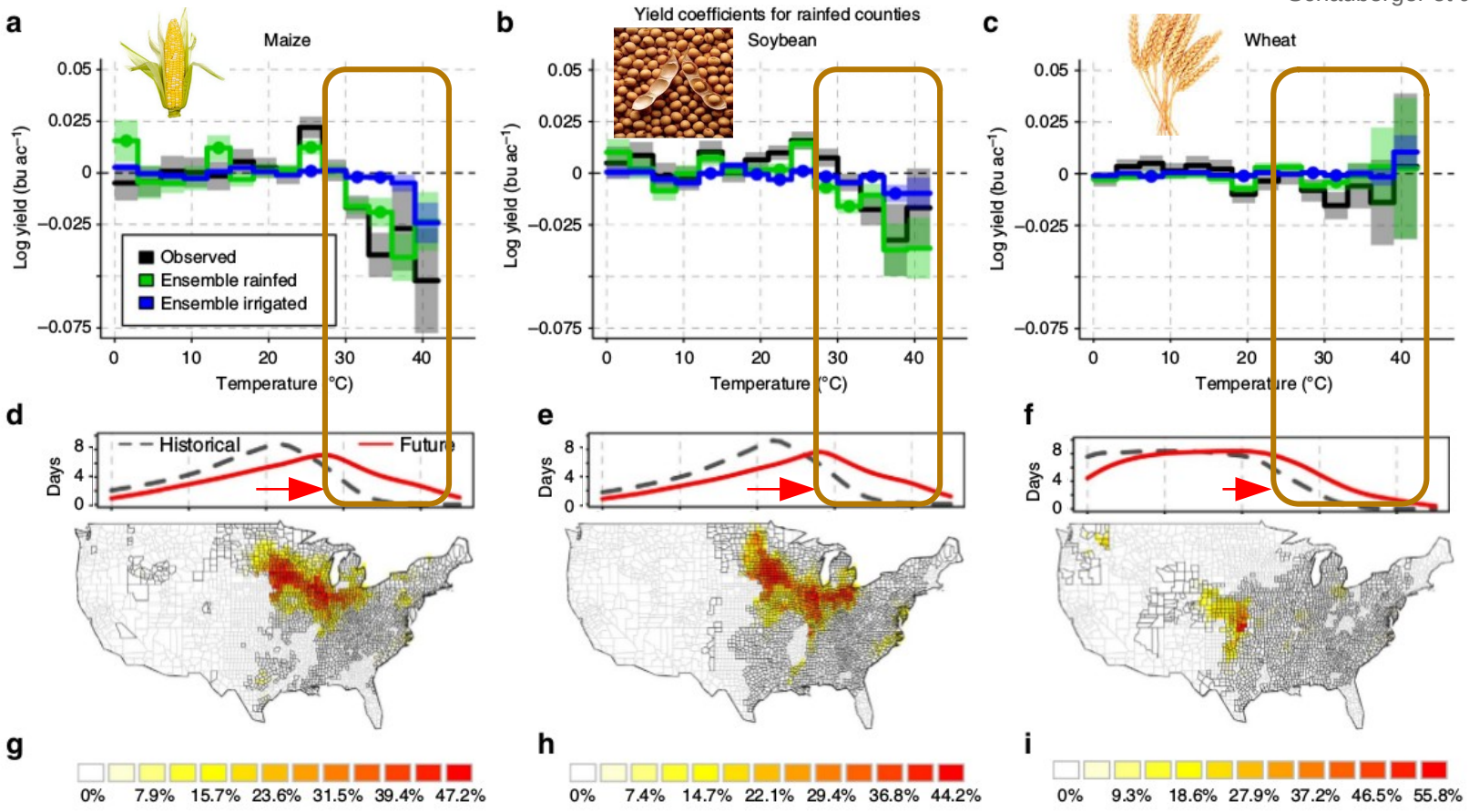


GIEC AR5 (2014)

Decrease in crop yield

Vulnerability of cereal cultures in the US

Schauberger et al. (2017)



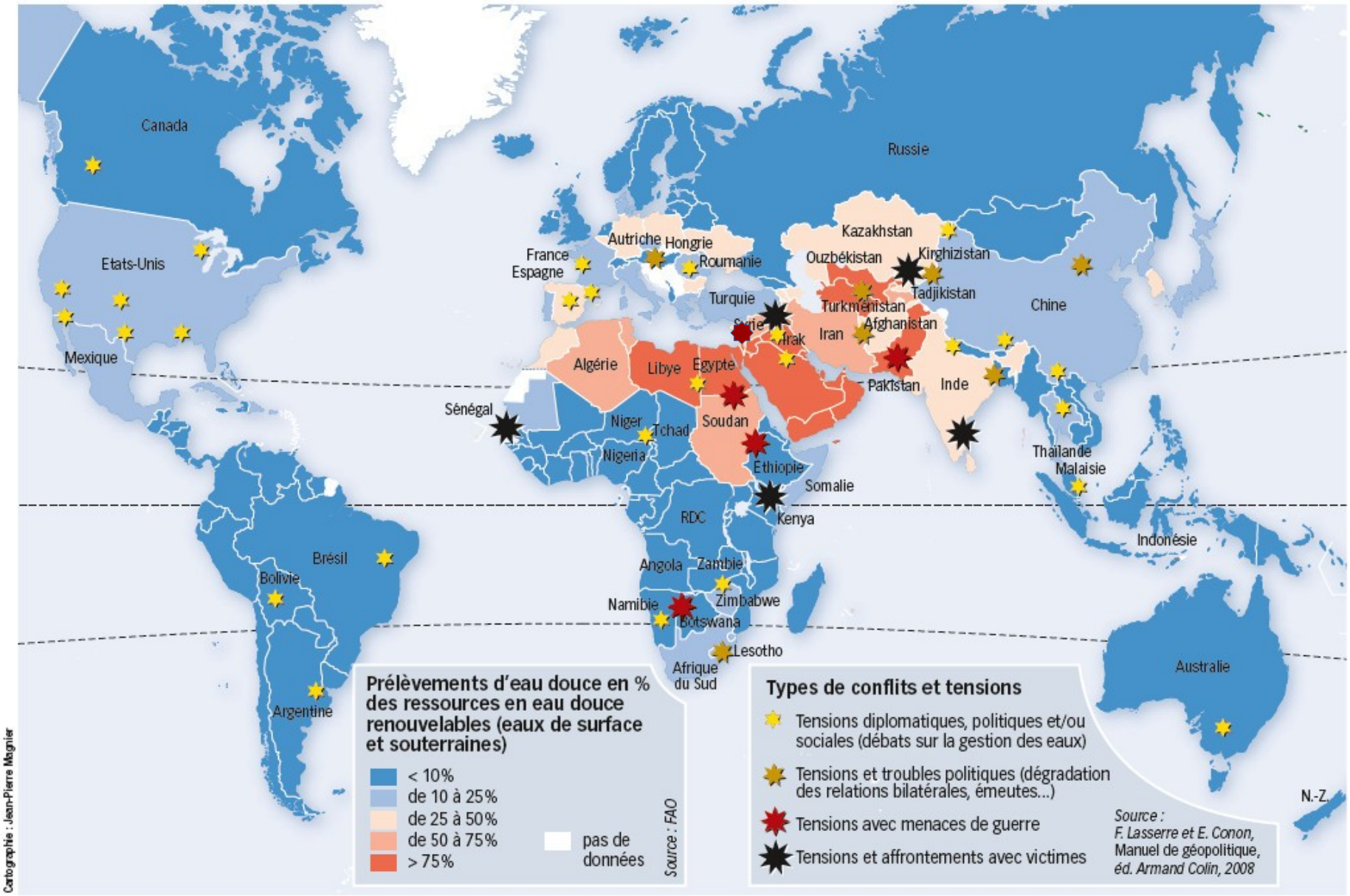
- échaudage, et surtout stress hydrique
- la fertilisation par le CO_2 compense très peu
- tension sur l'eau ++
- effet sur les prix du marché mondial
- baisse des facultés d'approvisionnement des pays pauvres

II

Impacts to come

3 - Geopolitics as a surprise guest

Water scarcity in imprinted into past century's conflicts



Climate Change contributes to conflicts around the world

- CC as a "threat multiplicator", like powerty and economic crisis
  - competition for access to local resources (water, arable land, arctic petrol and pathway...)
  - insecurity in livelyhood => migrations, illegal activities
  - extreme events, desaster => resentment
  - price instability of base products => hunger riots (Cf. 2007)
  - preemption of transboundary waters => inter-state conflicts up to regional scale
  - sea level rise => social dislocation, displacements, emigration
  - secondary effects of adaptation/attenuation measures
    (land ownership instability, minority marginalization, environmental degradation, biodiversity loss, agrofuels, strategic retreat, land grabing, ...)
- will affect first the most fragile countries

classement des pays les plus fragiles
(instabilité, désastres, pauvreté, vulnérabilité au changement climatique)

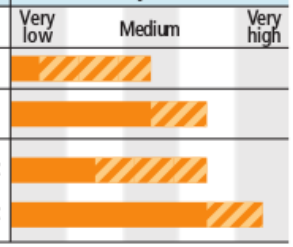
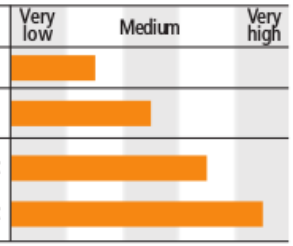
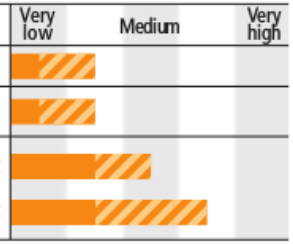
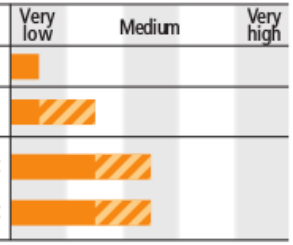
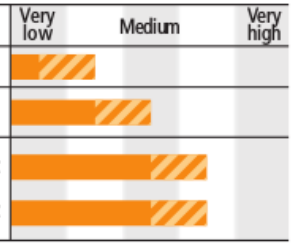
Rapport Adelphi-G7 2015

CC contributes to conflicts around the world

- Some examples :
  - Tchad lake drying => destabilisation of local economics
    => ease recrutement by Boko Haram
  - strong reccurent drought in Syria => one of war incentive
  - Sahel : pastoral people shift to agriculture or migrate southward or to the coasts, strenghening competition for water and arable land with in-place farm of fishery communities
  - Arctic opening => competition to control petrol and halieutic resources
- 20 – 30 millions of displaced people or refugies each year
- => encystment of local tensions, traffic, recrutement clusters, border locking-up, jeopardized citizen freedom

Amiral David Titley
councellor on climate of american security agencies
"The climate threat weight as much, if not more, on U.S. interior security than the terrorist threat"

Societal additional risks steming from adaptation itself

Key risk	Adaptation issues & prospects	Climatic drivers	Timeframe	Risk & potential for adaptation
Displacement associated with extreme events (*high confidence*) [12.4.1]	Adaptation to extreme events is well understood but poorly implemented even under present climate conditions. Displacement and involuntary migration are often temporary. With increasing climate risks, displacement is more likely to involve permanent migration.		Present Near term (2030 – 2040) Long term (2080 – 2100) 2°C 4°C	
Loss of land, cultural and natural heritage disrupting cultural practices embedded in livelihoods and expressed in narratives, world views, identity, community cohesion, and sense of place (*high confidence*) [12.3.2, 12.3.4]	Cultural values and expressions are dynamic and inherently adaptable and hence adaptation is possible to avoid losses of cultural assets and expressions. Nevertheless cultural integrity will be compromised in these circumstances.		Present Near term (2030 – 2040) Long term (2080 – 2100) 2°C 4°C	
Violent conflict arising from deterioration in resource dependent livelihoods such as agriculture and pastoralism (*high confidence*) [12.5.1]	Adaptation options: Buffering rural incomes against climate shocks, e.g., through livelihood diversification, income transfers, and social safety net provision; Early warning mechanisms to promote effective risk reduction; Well-established strategies for managing violent conflict that are effective but require significant resources, investment, and political will.		Present Near term (2030 – 2040) Long term (2080 – 2100) 2°C 4°C	
Geopolitical competition over access to Arctic resources that escalates into dangerous tensions and crises (*high confidence*) [12.6.2]	There are international organizations and elements of international law that regulate competition and access and provide mechanisms for resolving disputes. There are strong transnational networks that are relevant for joint problem solving. Hence adaptation action has significant potential to reduce risks associated with geopolitical rivalry.		Present Near term (2030 – 2040) Long term (2080 – 2100) 2°C 4°C	
New or exacerbated conflict through land acquisition for climate change mitigation and adaptation (*medium confidence*) [12.5.2]	Climate change mitigation (e.g., expansion of biofuel production area) and adaptation action (e.g., set-back of coastal land) can exacerbate conflicts when they are already manifest around land and water availability and scarcity. The extent of insecurity and instability from such mitigation and adaptation activities depends on the displacement of populations and the inclusiveness of the planning processes. Careful planning processes can therefore be used to ameliorate the risk of conflict	*Cumulative climate risks act as incentives for mitigation and adaptation action*	Present Near term (2030 – 2040) Long term (2080 – 2100) 2°C 4°C	

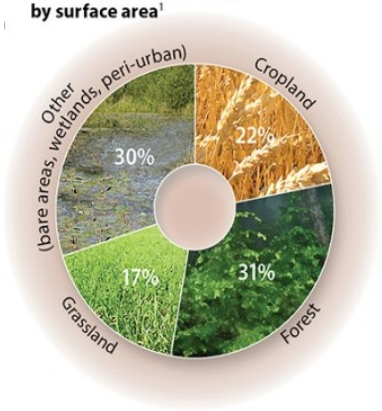
In a world that understands food security stakes

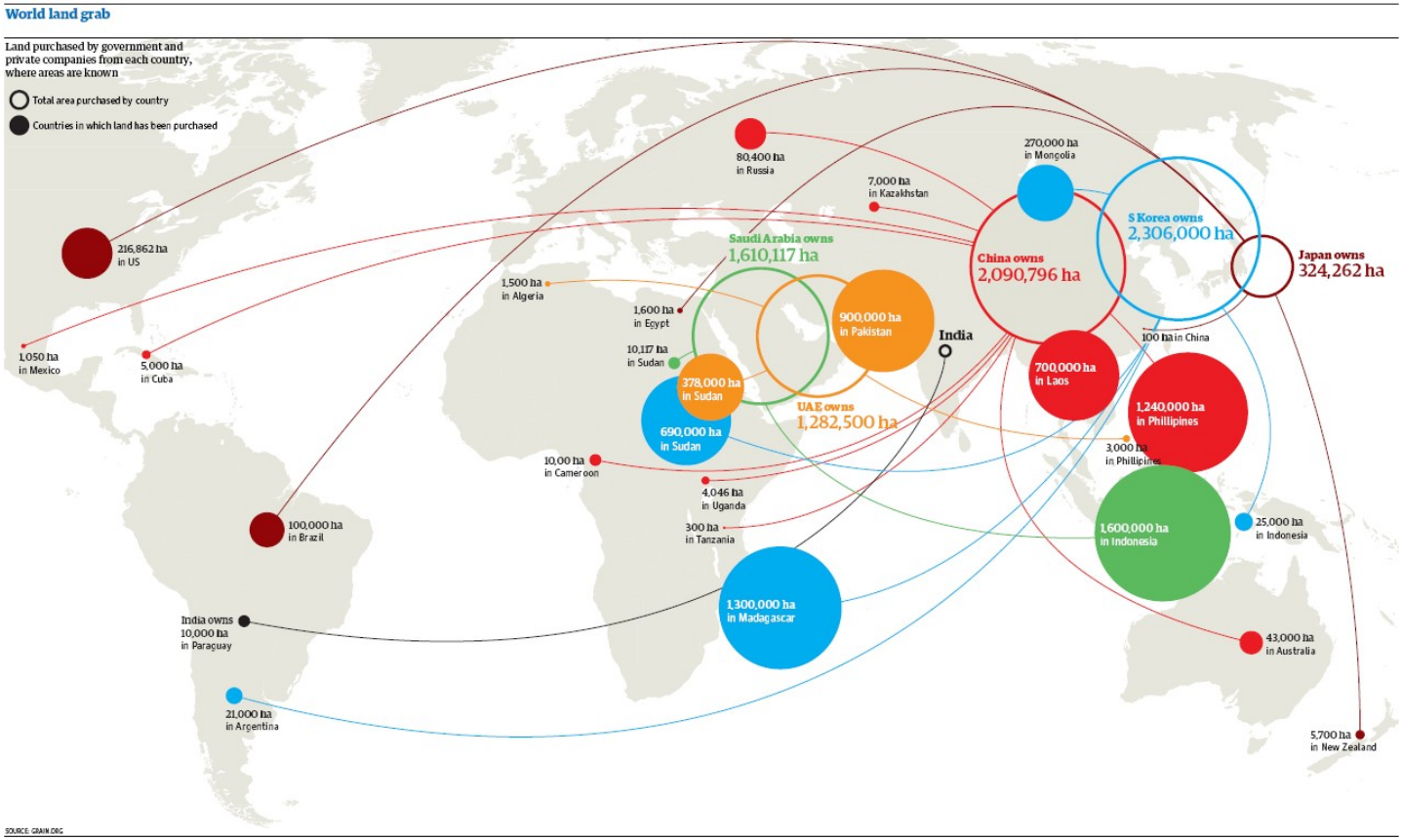
Land grabing

What grabbed land is used for (by%)

Food crops	28
Biofuels	19
Wood and fibre	11
Tourism	10
Land speculation	10
Mining	8
No information	5
Other agricultural commodities	3
Livestock	2
Industry	2
Renewable energy	1
Carbon sequestration	1

Land targeted for deals, by surface area[1]





In a world that understands food security stakes

Land grabing, most controversial hotspots

Hotspots

Some of the world's biggest and most controversial land deals.

The Global Hunger Index 2012 is calculated by the International Food Policy Research Institute (IFPRI), with partners Welthungerhilfe and Concern Worldwide.

IFPR Global Hunger Index 2012
- Extremely alarming
- Alarming
- Serious
- Moderate
- Low
- No data
- Industrialized country

ROMANIA
Western Europe's backyard — 6-10%

Foreign-owned farm land
Foreign firms register local companies to dodge a moratorium on land acquisition to non-nationals intensifying a rural exodus.

Emiliana West Rom
11,000 hectares
CEREALS AND LIVESTOCK

Western Romania is on the doorstep of capital-rich European companies. Farmer association Eco Ruralis complains that smallholders feel they have no choice but to sell-up. Meanwhile, thousands of people have left the country to seek agricultural work elsewhere in Europe, often doing jobs like fruit picking.
Emiliana West Rom, the main investor in the Banat region, acts as a 'representative' to Italian company Unigra. In 2001, it began acquiring land to cultivate cereals, and raise cattle, mainly for export.
The farming operation stands accused of destroying forest, archaeological remains and disrupting the water supply. And while not all local people are opposed, many complain that Emiliana West has not respected contracts nor honoured promises for a share in financial revenue.

CAMBODIA
Voracious rubber barons — 56%

Foreign-owned farm land
Investors work around the official 10,000 hectare limit on concessions by creating 'shell companies' to acquire adjacent plots.

CRCK
6,000 hectares
RUBBER

Thousands of Kuy highlanders are fighting against the destruction of Prey Lang forest – the largest contiguous lowland evergreen stretch in Southeast Asia – by Vietnamese firm Chu Se Rubber Company Kompong Thom (CRCK). The murder of anti-logging activist Chut Wutty, who had campaigned to protect Prey Lang forest for many years, drew much international attention to their cause.
CRCK is one of many companies in a booming sector accused of widespread illegal logging and human rights abuses. A recent report by activist group Global Witness exposed how government corruption enables companies like CRCK to grab vast tracts of land, flouting international laws.
Sugar cultivation for export has also increased massively in recent years, prompting a wave of evictions

HONDURAS
Home-grown grabbers — Not known

Foreign-owned farm land
Home to some of the most violent land rights conflict; domestic agribusiness is set on expanding palm oil estates.

Dinant
UP TO 22,000 hectares
PALM OIL

Global demand for palm oil has tripled over the last decade and Honduran élites do not wish to be left behind. There's a history here. Land seizures back in the 1990s generated a powerful counter movement for recovery of peasant farms in the Northern Aguán Valley. But since the 2009 coup, the small farmers have lost ground.
In 2009, the World Bank's private sector arm, the International Financing Corporation, lent $30 million to Dinant, a palm-oil company which controls thousands of hectares in the Bajo Aguán region. Conflicts over land between September 2009 and August last year, claimed the lives of 53 peasants, as well as resulting in kidnappings, beatings and forced evictions. A least nine farmers have been killed this year alone. The abuses have prompted the World Bank to order an audit.

CAMEROON
A test case for Africa — 4%

Foreign-owned farm land
Cameroon is teeming with plantations of palm oil, destined for biofuel production.

Herakles Capital
73,086 hectares
PALM OIL

One of the starkest examples of bio-fuelled land grabbing has got to be the Herakles plantation in South West Cameroon. It covers 73,086 hectares, of which about 60,000 are earmarked for palm oil.
The government signed a 99-year lease in 2009 with SG Sustainable Oils Cameroon, which is owned by Herakles Capital, a New York-based venture finance firm.
The project, on the edge of the Congo Basin rainforest, has sparked local opposition; the allocated land is home to 14,000 people, who claim that compensation and jobs have not materialized. Activists have suffered assault and imprisonment. Greenpeace USA has predicted that cutting down the dense natural forest would release up to 9.5 million tonnes of carbon. There are worries that the Herakles investment could be a test case, setting a precedent for the entire continent.

ETHIOPIA
Indian interests — 10%

Foreign-owned farm land
The government has made 3.6 million hectares available for lease, using violence and intimidation.

Karuturi Global
100,000 hectares
RICE, CORN, PALM OIL

In 2010, Karuturi Global, a Bangalore-based company, has leased 100,000 hectares in Western Ethiopia and plans to invest more than $100 million in East Africa.
In 2011, a Human Rights Watch report found that crops belonging to the local indigenous Anuak community had been cleared without consent in a Karuturi lease area in Ilea, Gambella.
The Ethiopian state plans to resettle 225,000 people from the Gambella region, as part of a wider 'villagization.' programme that will move over 1.5 million people.
Indian companies – the biggest group of investors, jointly controlling over 600,000 hectares – have come under fire as Indian and Ethiopian civil society groups join to struggle for land rights, aided by policy thinktank, the Oakland Institute.
In February 2013, communities met in New Delhi saying abuses were being committed under cover of 'South-South cooperation'.

AUSTRALIA
Farmyard for Asia — 11%

Foreign-owned farm land
Some 4.6 million hectares are now owned by overseas interests, with most capital come from Asia and the Middle East.

Beidahuang
30,000 hectares
GRAINS

Although foreign land ownership is nothing new here, there are growing concerns about losing control of food production and resources. And not just from the conservative opposition – the Australian Greens are calling for a 'national interest test' and the government has proposed a foreign land ownership register.
In early 2013, the Chinese state-owned Beidahuang announced it had scaled back plans to invest in Australia's grain industry complaining of 'negative media coverage'. However the company is not pulling out altogether. Heilongjiang Feng Agricultural, an arm of Beidahuang, reportedly paid $52 million for 30,000 hectares in the Great Southern and Wheatbelt region in late 2012.
But Australian companies aren't averse to grabbing– the country is eighth among the top 10 investors in land deals in the Majority World, one place behind China.

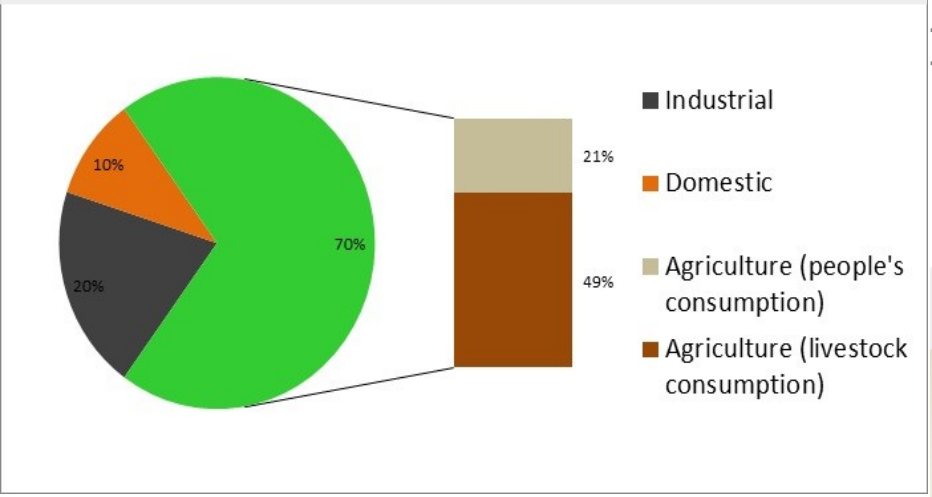
Written and researched by **Amy Hall**.

Sources: Australia Green Party, Eco Ruralis, Food First, Global Witness, GRAIN, Greenpeace USA, *The Guardian*, Human Rights Watch, LCHAO, Oakland Institute, Oxfam, Rights and Resources Institute, Transnational Institute.

1. Access to water is first an agricultural and food question

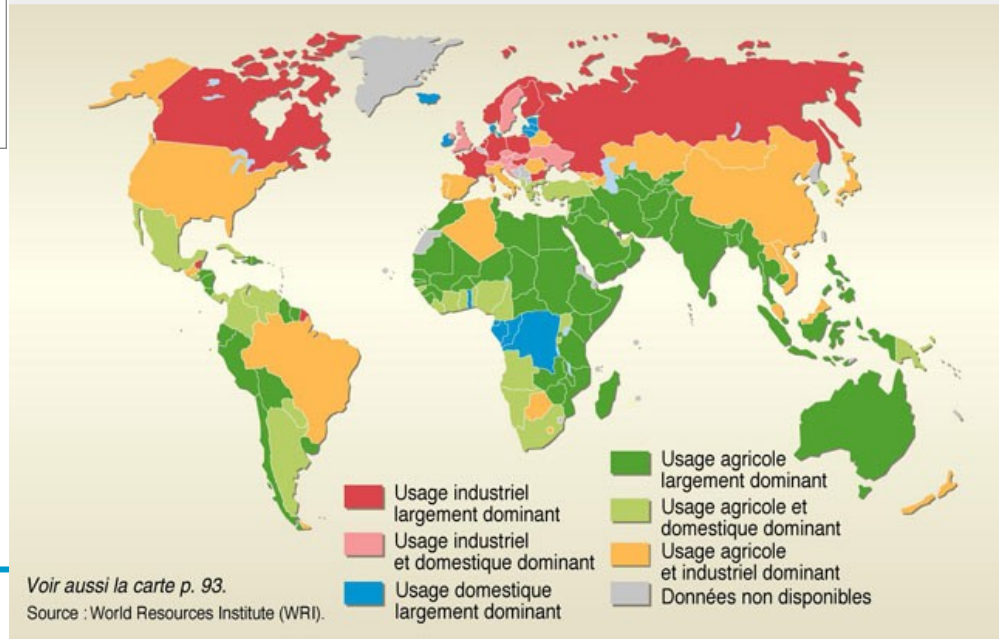
more precisely to feed cattle (have the withdrawn water)

Prélèvements en eau (hors pluie)



green straightup

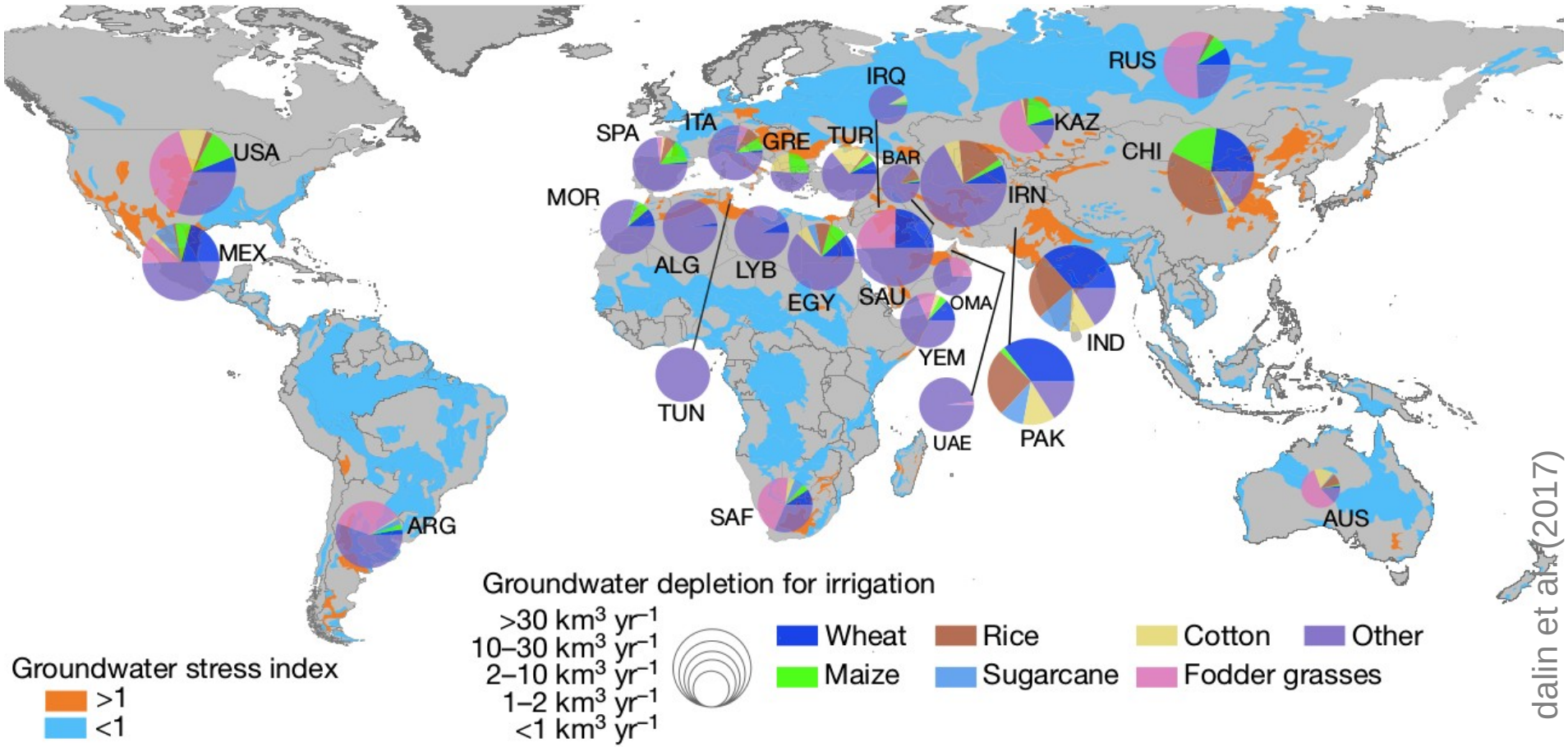
Les usages de l'eau



production agricole =>

soleil + chaleur + eau

1. That exhaust groundwater in exporting countries



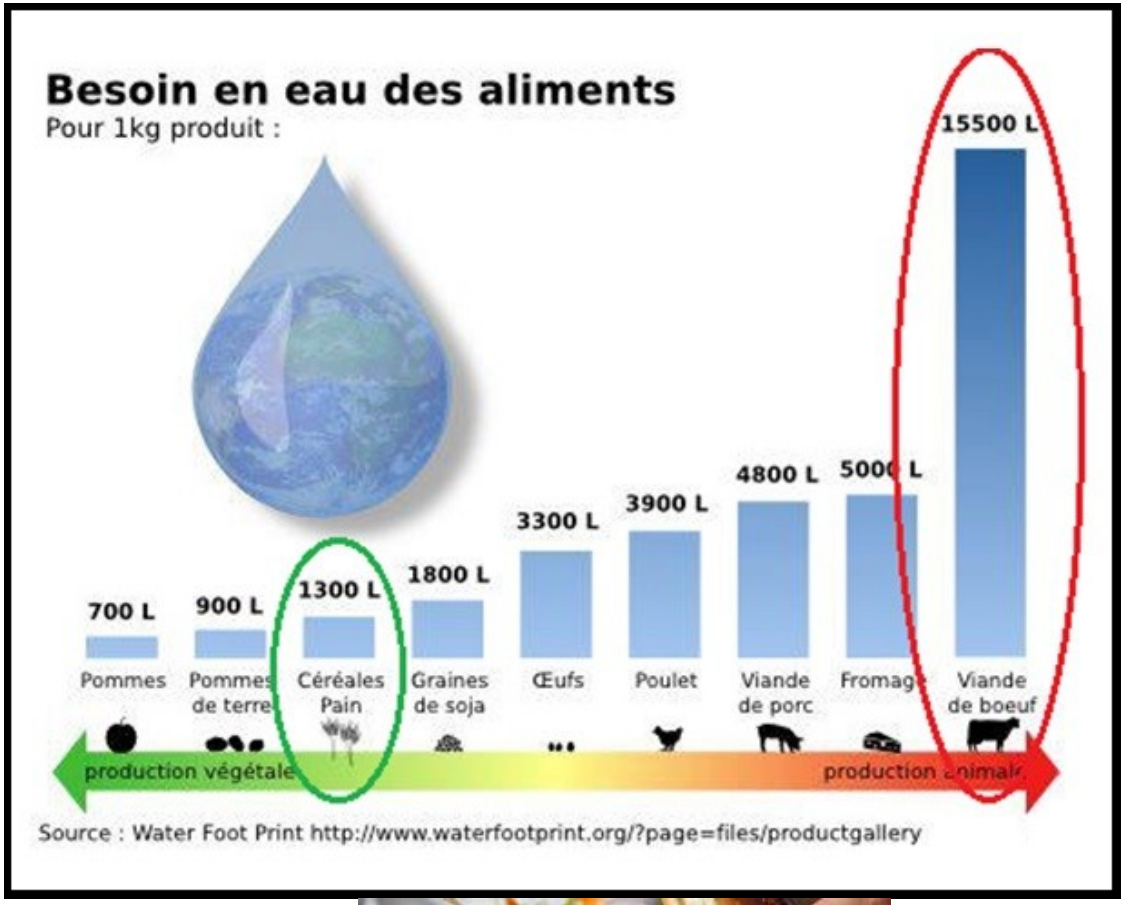
dalin et al (2017)

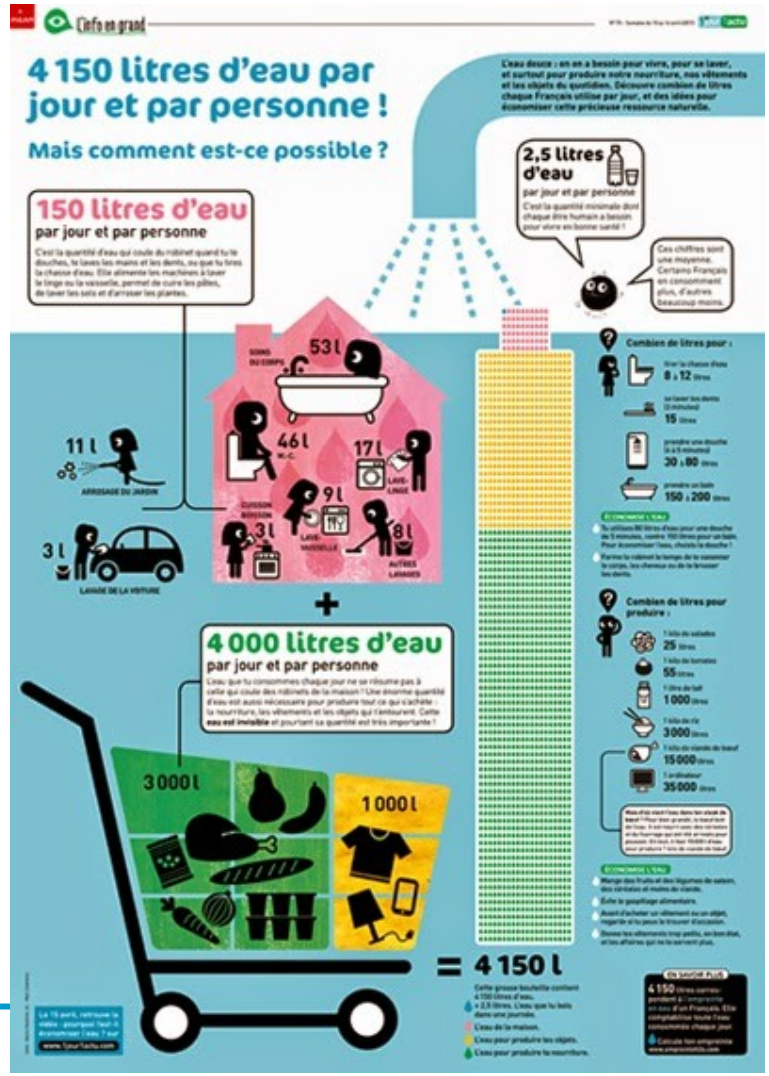
cultures irriguées pour l'exportation (contribution jusqu'à 40 %)

=> Pakistan, USA, Inde, Mexique, Iran, ...

2. Virtual water

All goods have a water cost (here withdrawal)



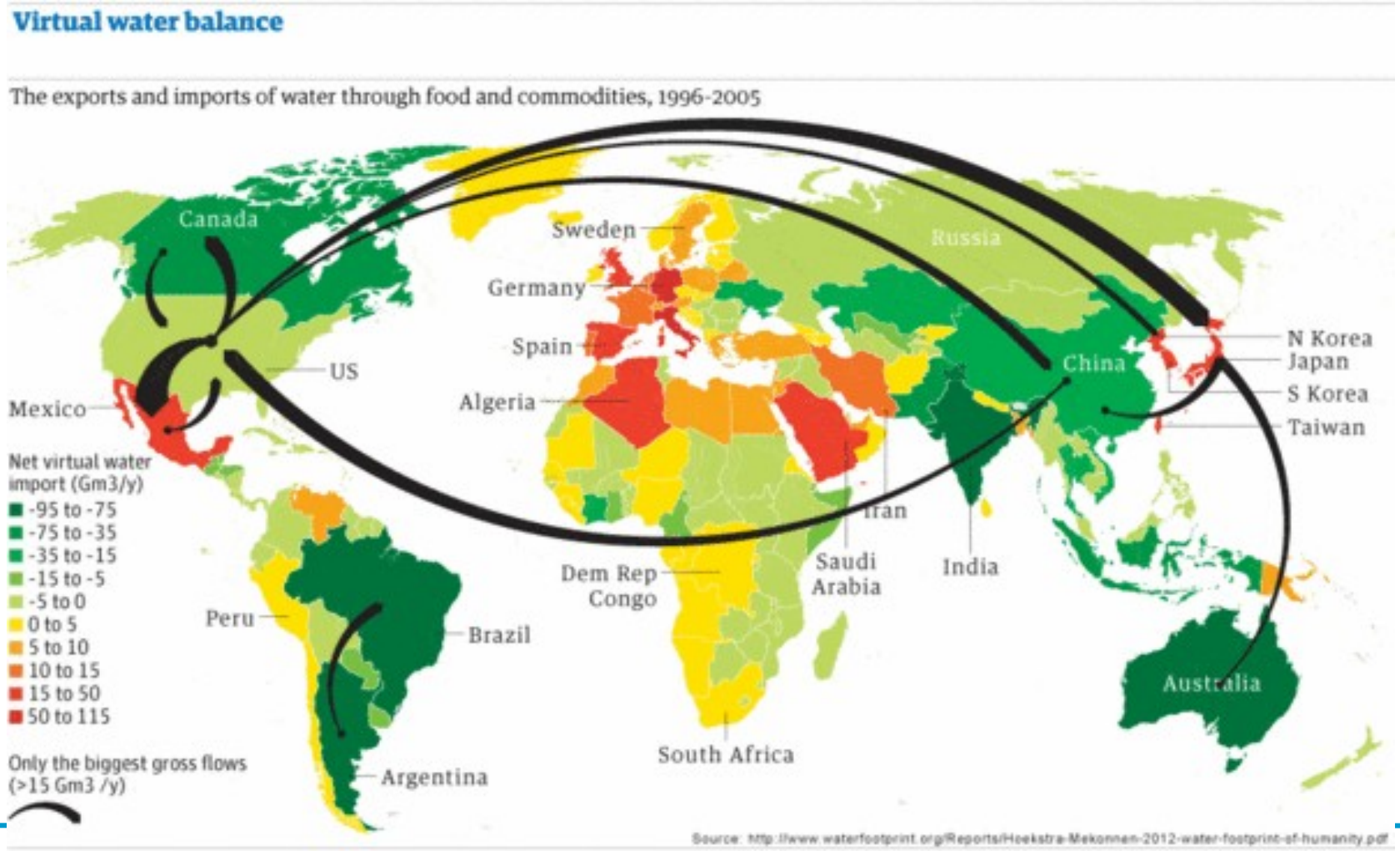


insect burger

2. Virtual water

All transported goods are also water transfer

sur 3500 km³ d'eau utilisés, 1600 km³ sont importés localement (45%)



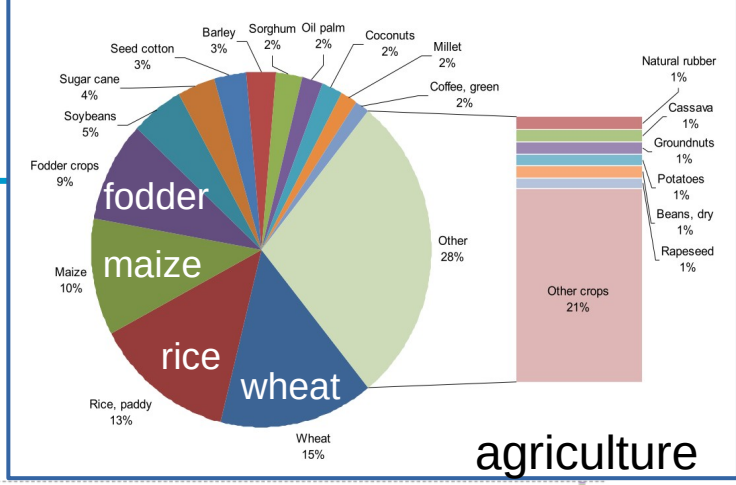
Hoekstra & Mekonnen (2012)

2. Virtual water

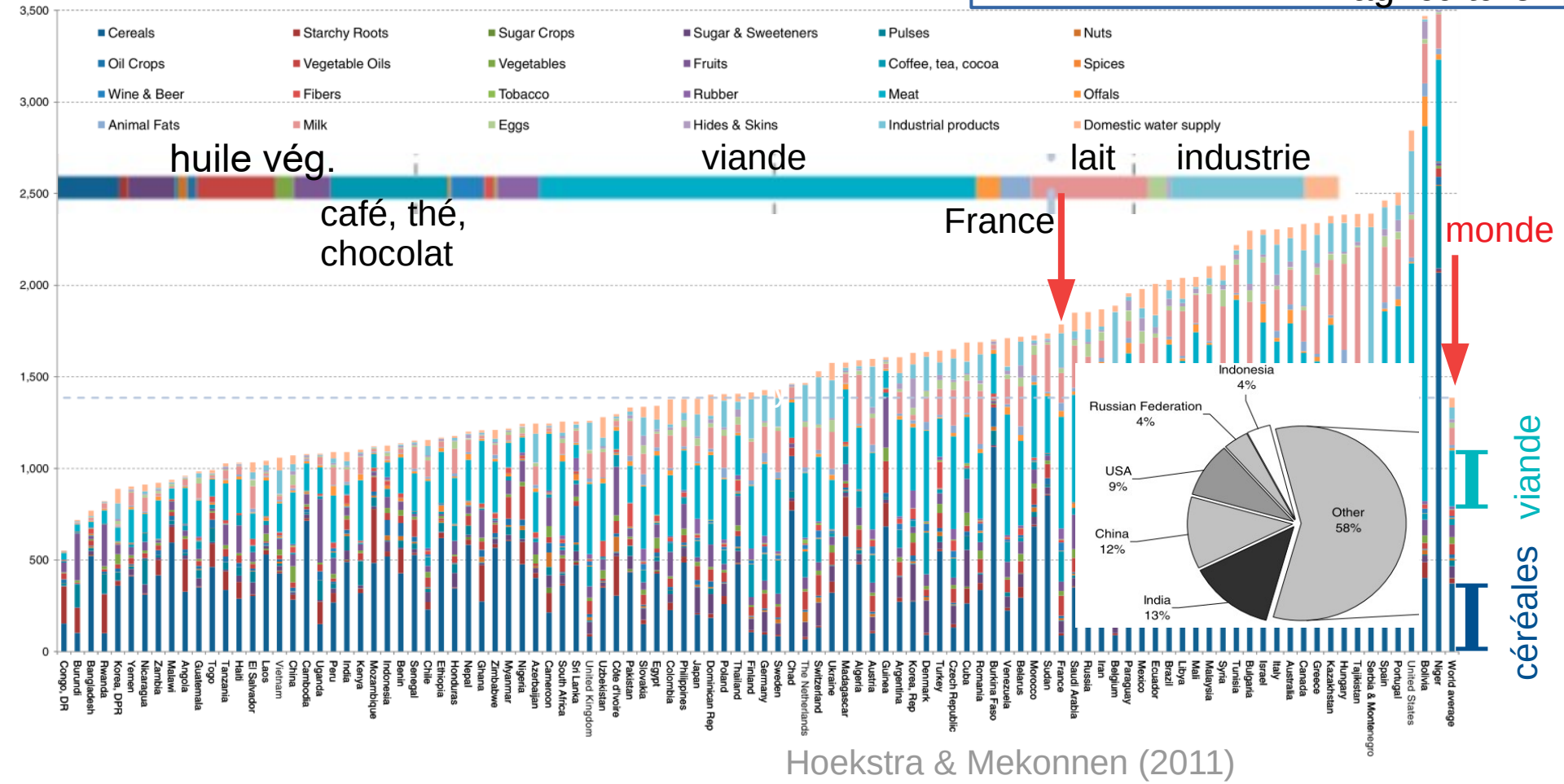
Mainly cereals and meat

empreinte hydrique nationale (m3/an/habitant)

pour pays > 5 Mhab (pas le Qatar !)



agriculture



Hoekstra & Mekonnen (2011)

2. Virtual water

Cross-border water footprint of France : 90 % of our needs

actus terre

RESSOURCES NATURELLES

ON CONNAÎT "L'EMPREINTE EAU" DE LA FRANCE

Sur le modèle de l'empreinte carbone, Arjen Hoekstra, de l'université de Twente aux Pays-Bas, a cartographié "l'empreinte eau" de la France. C'est-à-dire l'origine et les quantités d'eau mobilisées, en France comme à l'étranger, pour produire les biens que nous consommons. Résultat, près de la moitié de l'eau nécessaire à l'économie française provient d'au-delà de nos frontières. Autre enseignement, 87 % de notre empreinte est liée aux produits agricoles issus de l'Hexagone ou importés depuis le Brésil, la Belgique, l'Inde et l'Espagne. En tête du classement : les produits d'origine animale, suivis par les huiles végétales et les céréales. Poussant plus loin l'analyse, l'équipe néerlandaise s'est aperçue que dans de nombreux bassins hydrographiques, les volumes prélevés pour la consommation française contribuaient à des pénuries en eau. Pour Arjen Hoekstra, il n'est pas trop tard pour agir : *"Nous essayons désormais de déterminer les empreintes idéales des produits de base, en prenant les meilleures technologies et pratiques disponibles, afin de donner aux entreprises des références pour réduire leur 'empreinte eau' sur la planète".* E.H.

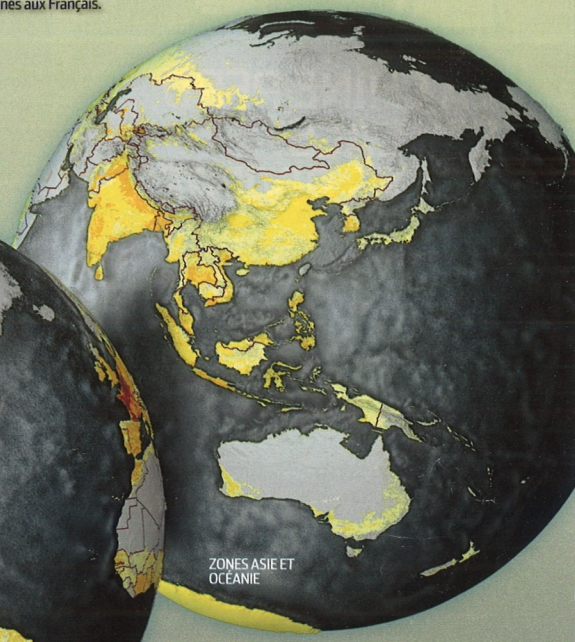
G. CIRADE - M.KONTENTE

Carte de "l'empreinte eau" de la France (en litre/m²/an)

Elle correspond aux volumes d'eau douce qui, en France et à l'étranger, ont été nécessaires pour produire l'ensemble des biens de consommation destinés aux Français.

DE 100 À 750 | DE 50 À 100 | DE 20 À 50 | DE 10 À 20 | DE 1 À 10 | DE 0,1 À 1 | DE 0 À 0,1

(mm/an)



Des besoins en eau qui aggravent la sécheresse dans le monde

En rouge, bassins souffrant de pénurie d'eau à la suite de la production de biens pour la France.

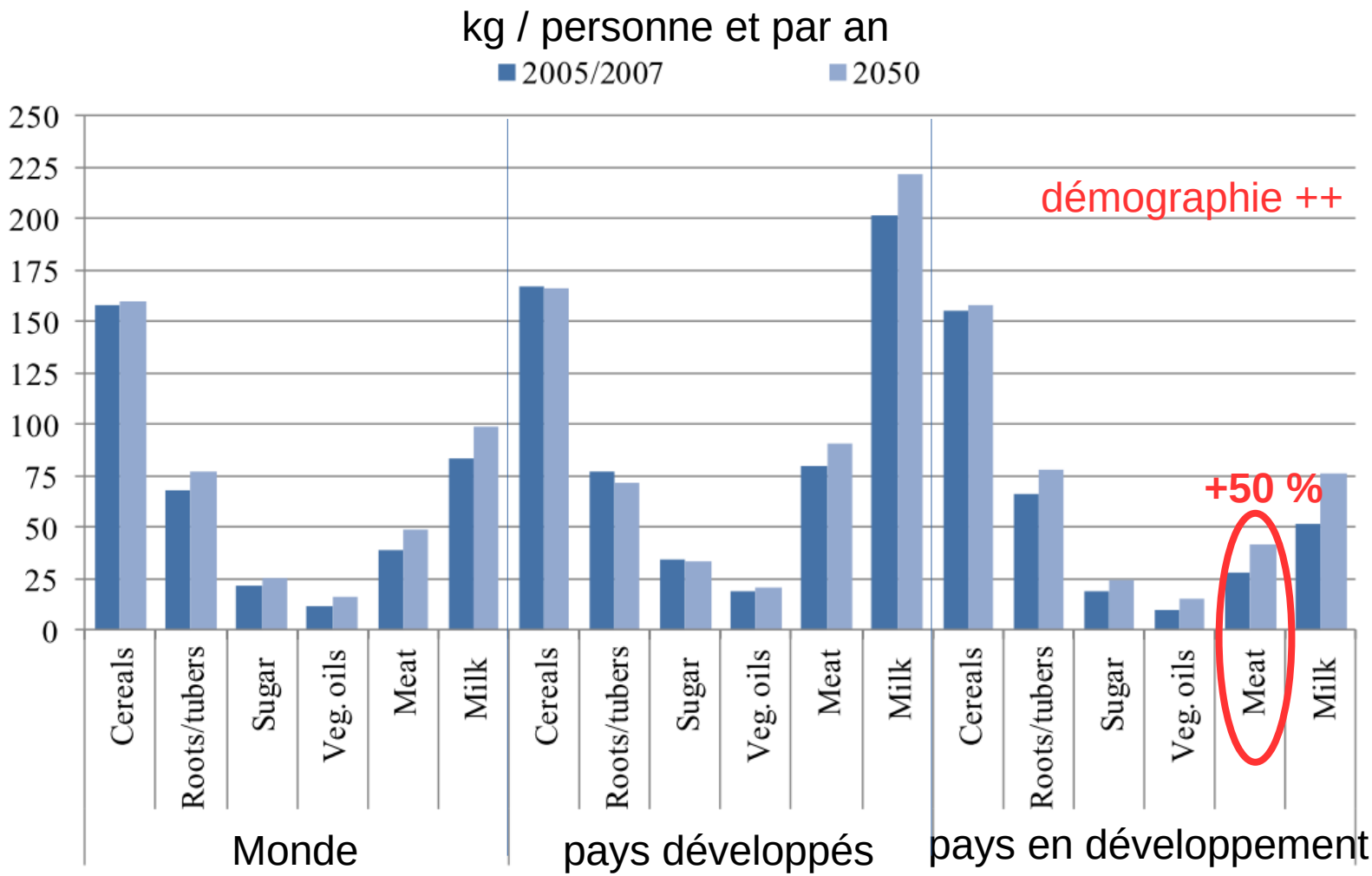
ECOLOGICAL ECONOMICS, FÉV. 2013

106 milliards de m³ d'eau par an sont utilisés pour produire des biens pour la France.

22 % de l'eau importée en France est liée à la production de coton et ses dérivés.

15 415 litres d'eau sont nécessaires pour fabriquer 1 kg de viande de bœuf.

3. Où va-t-on ~ 2050 ?
Habitudes alimentaires



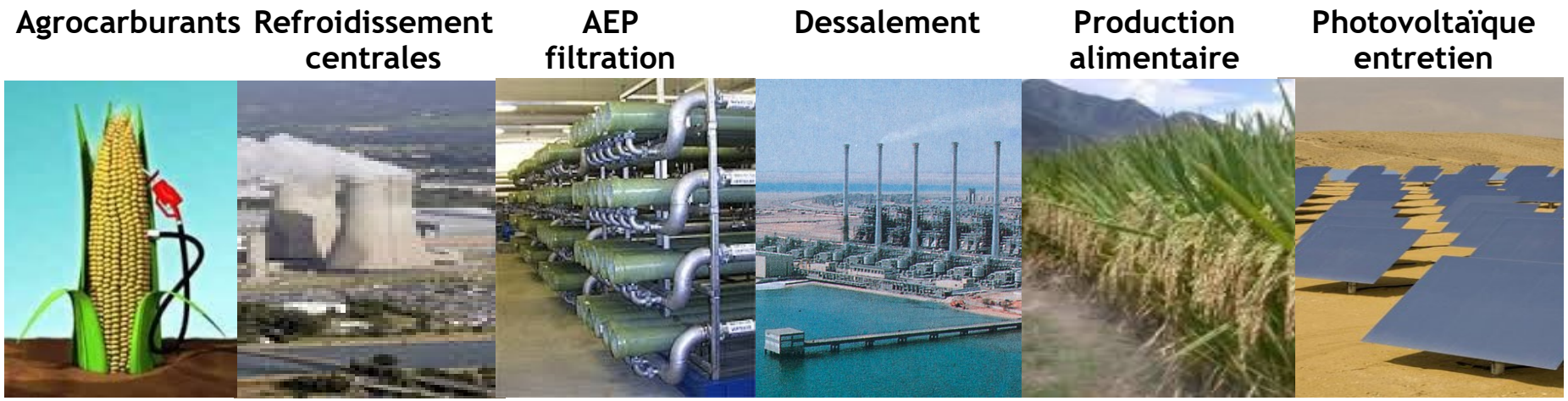
aujourd'hui, arrêter la viande

= nourrir 2x plus de monde

2. Interlaced stakes

The Water-Food-Energy nexus

- each water management activity has an energetical cost or impact, and contribute to GHG emissions or attenuation
- most economic activities impact water resources
- the different diets have opposite hydric implications (meat/fish/leguminous)
- those policies cannot be conceived separately



2. Virtual water

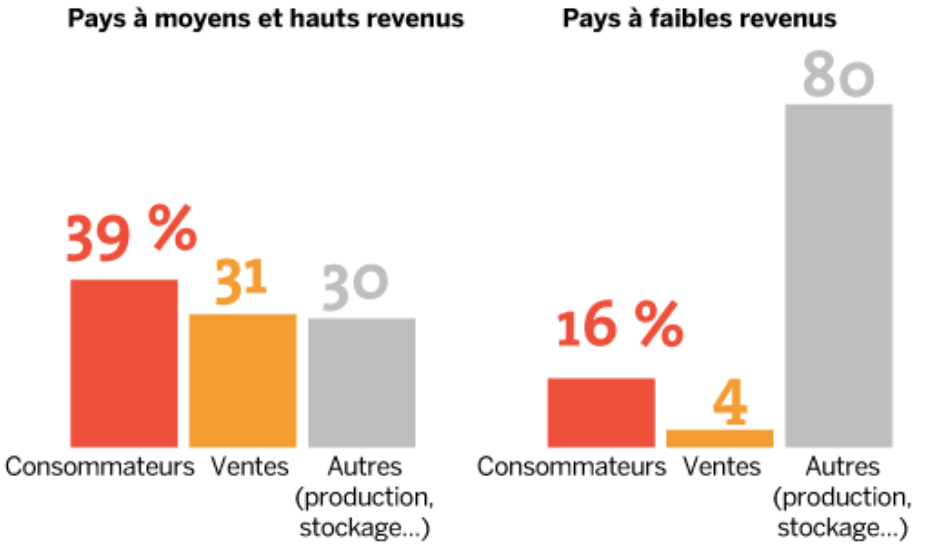
Food waste = water loss

1,3 milliard de tonnes de production alimentaire gaspillée par an

54 % du gaspillage provient de l'amont de la chaîne :
- Production
- Manutention
- Stockage après récolte

46 % du gaspillage provient de l'aval de la chaîne :
- Transformation
- Distribution
- Consommation

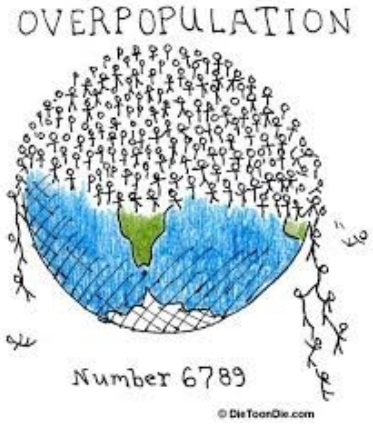
Source : FAO, 2013



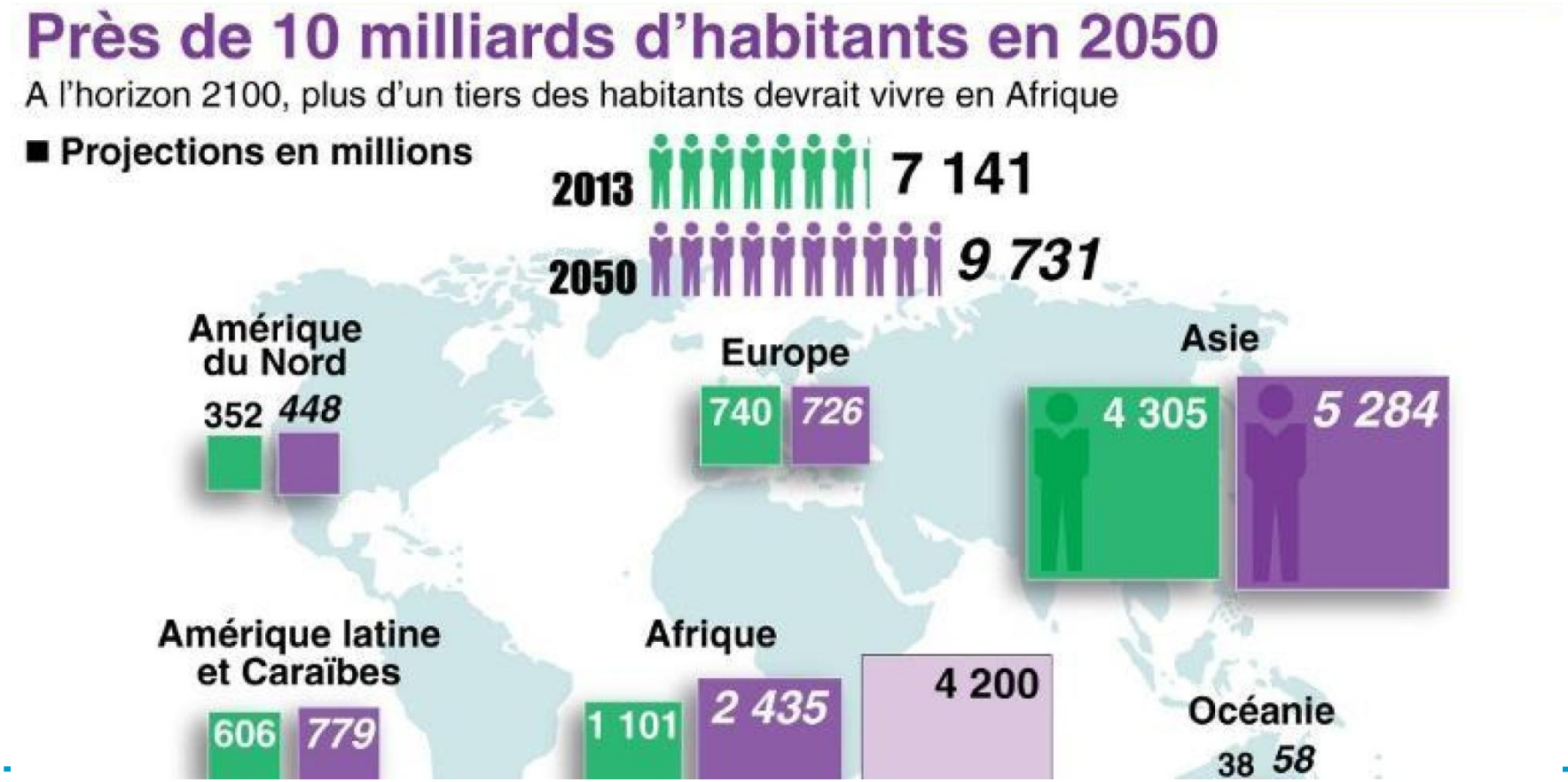
l'eau agricole est essentiellement évaporée, et donc perdue.

33 % de pertes => ~50 % de prélèvements de plus que nécessaire

3. The unspoken issue : Demography



- simple rule : the more we are, the more we impact
- demography control is key to reducing Human pressure on the planet (climate change, water stress, conflicts)

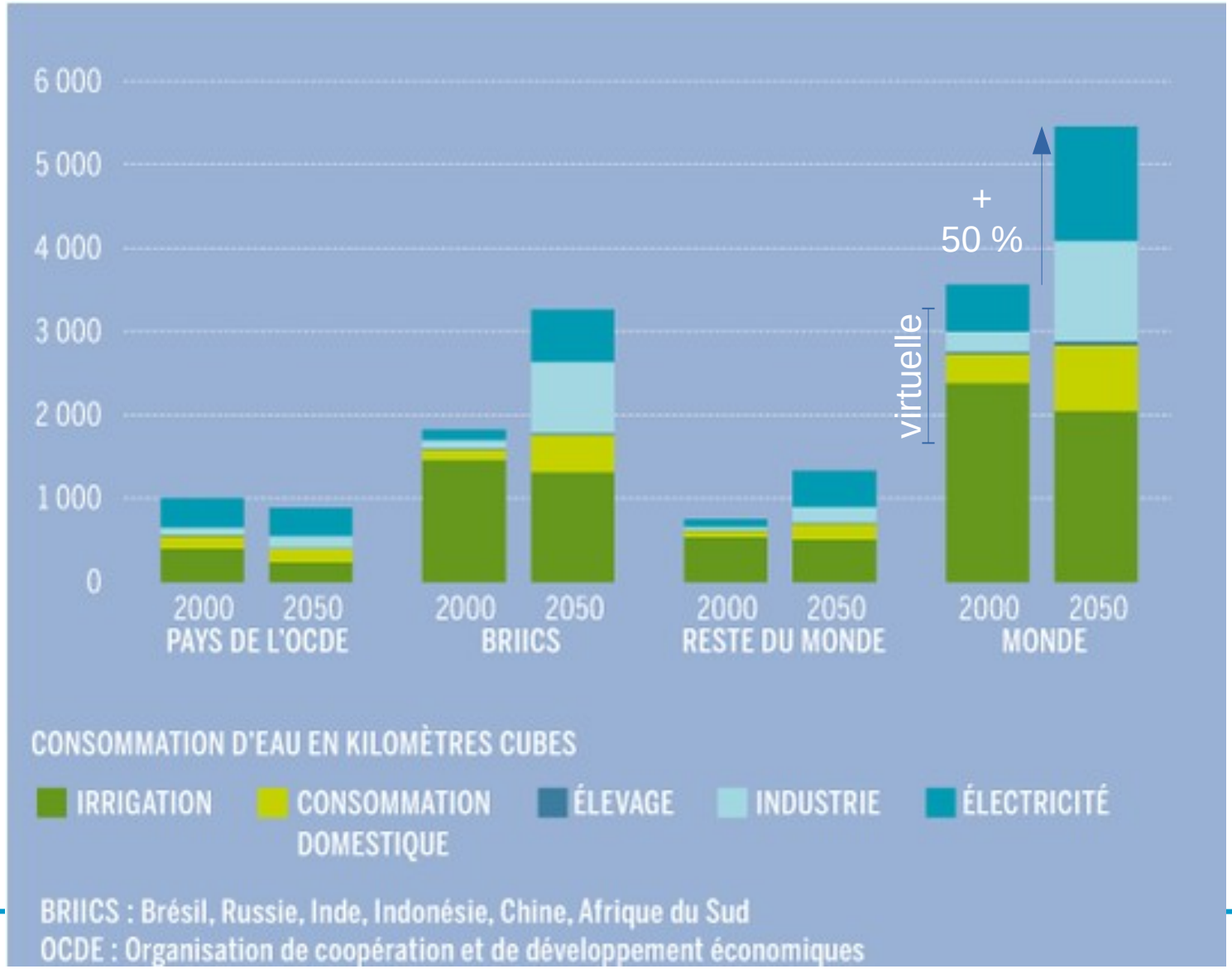


IV

Global prospective

General anticipation of global water demand

+50 % following on-going trends

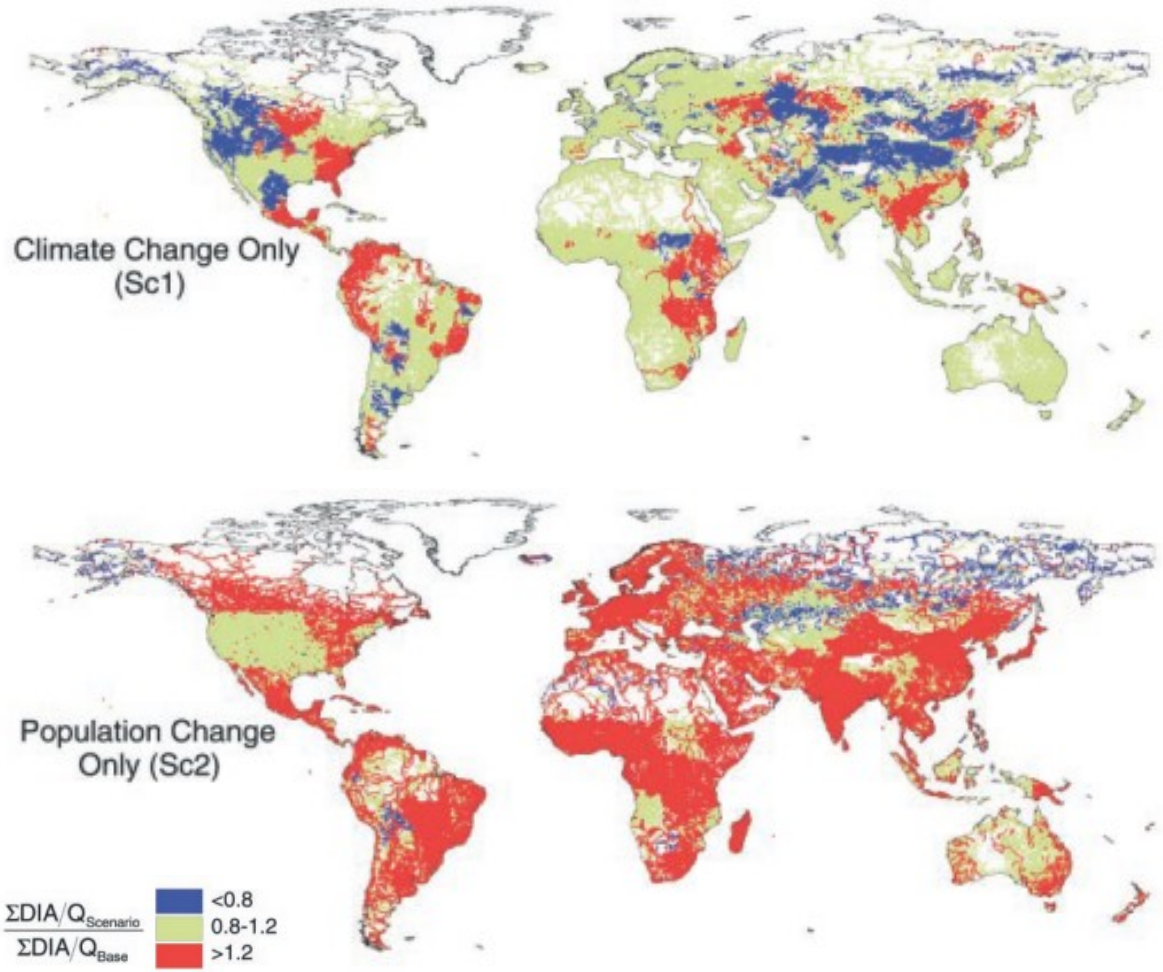


Le Monde, 20/03/2015

General anticipation of global water demand

Increased demand stress 1985 – 2025 under CC and demography

Variation (%) entre 1985 et 2025 du rapport entre demande en eau (domestique, industrielle, irrigation) et la ressource renouvelable

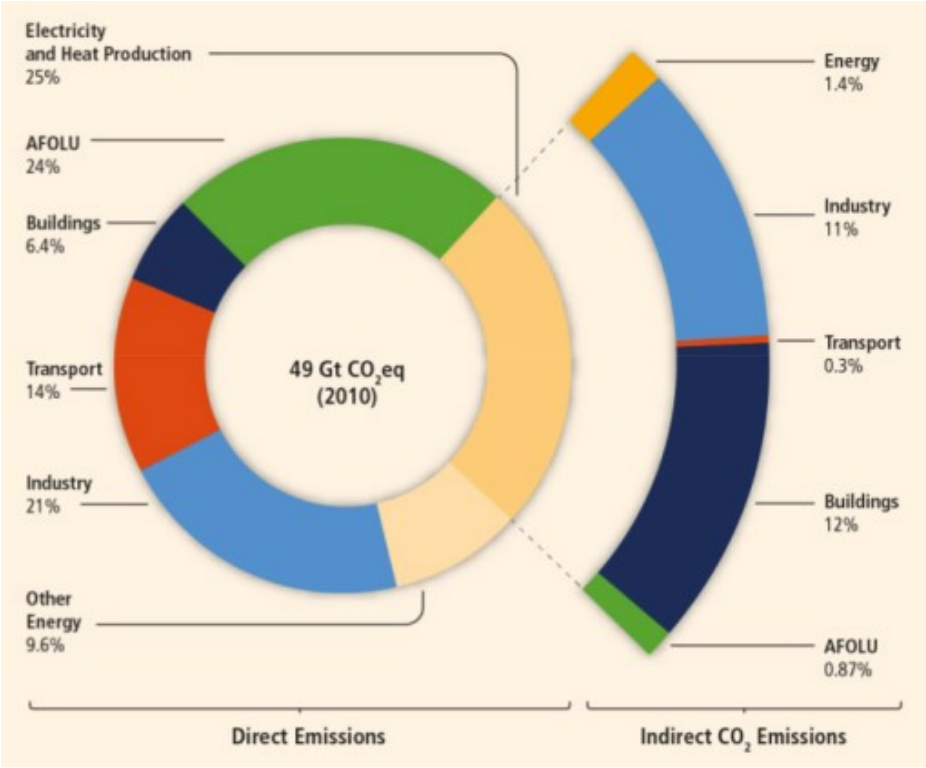


Vörösmarty et al. (2019)

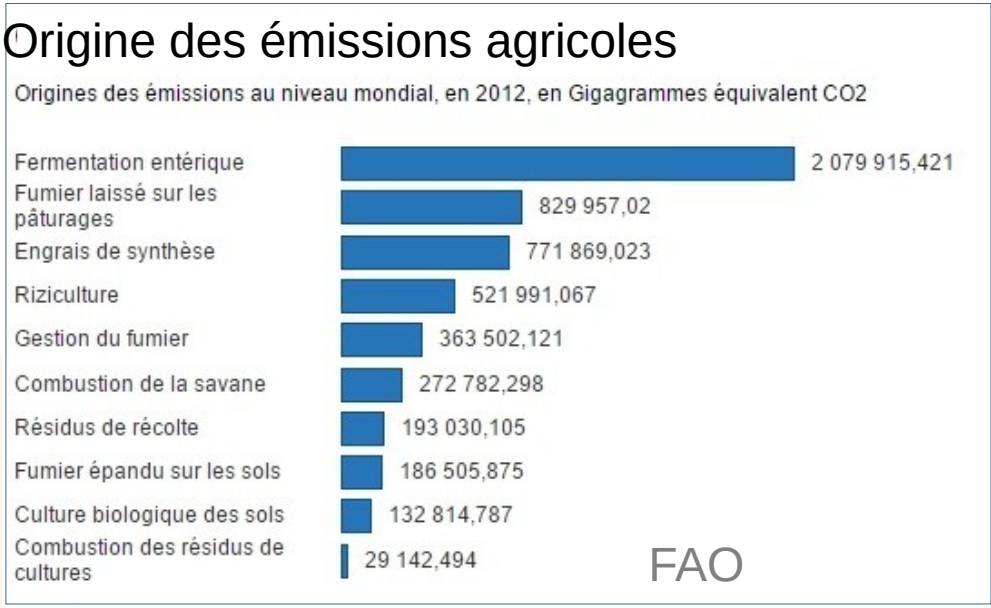
Agriculture is the first GHG emitter

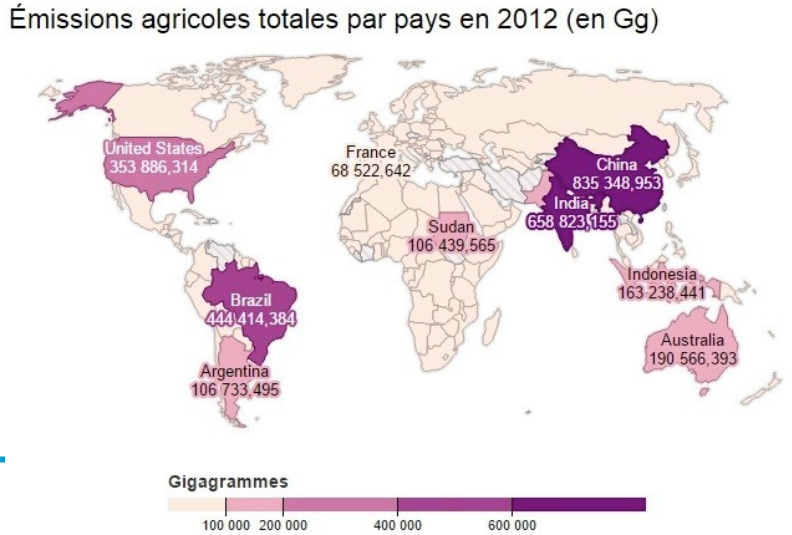
Adaptating to lack of water is also an attenuation pathway

- including cultivation, land use change, deforestation and transport



GIEC





General prospective on food security

Feeding mankind will need facing numerous challenges

- galloping demography
- meat diet
- climate change
- competition for access to water (thermic plants, hydroelectricity, environnement maintenance, tap water, transport, leasure industry...)
- soil loss (urban spread, salinization, erosion, soil depletion, non-food agriculture…)
- biodiversity loss, known-how, local crops
- lack of work power, technical skill, investment capacity, economic viability (& volatile prices)