



Mobilisation des ressources forestières : enjeux climatiques, sociaux et technologiques

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Jean-Francois Dhote, Jean-Michel Carnus, Jean-Michel Leban, Barry Gardiner. Mobilisation des ressources forestières : enjeux climatiques, sociaux et technologiques. CEPIA : Biomasses - quelles fonctionnalités ?, Oct 2015, Pont-à-Mousson, France. pp.51 slides. hal-01512203

HAL Id: hal-01512203

<https://hal.science/hal-01512203>

Submitted on 5 Jun 2020

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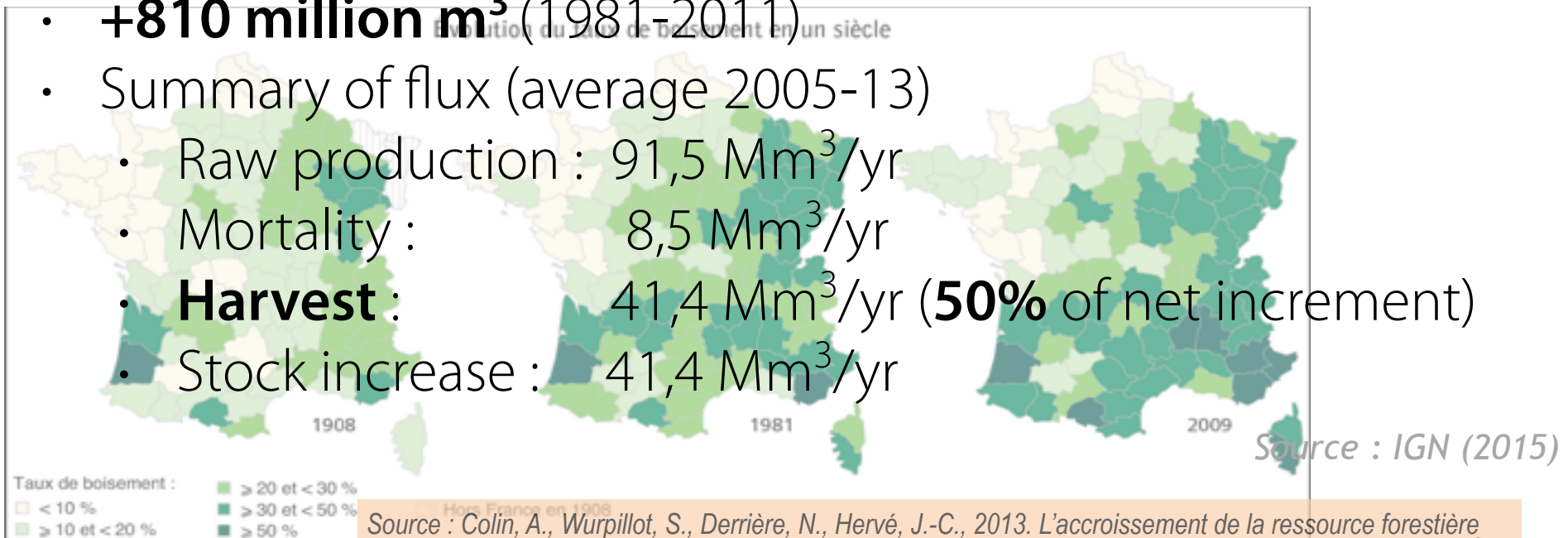
Mobilisation des ressources forestières : enjeux climatiques, sociaux & technologiques



Séminaire CEPIA, Pont-à-Mousson
« Biomasses - quelles fonctionnalités ? »
contribution du dépt EFPA

French forests in a nutshell

- 16,5 millions hectares (30% of country area)
- Expanding : 9 M ha in 1830, +87 000 ha/an (1980-2011)
- **74% private** owners, 17% communities, **9% State**
- 88% natural regeneration, **12% plantation**
- > 130 tree species
- Stock : 2,6 billion m³, **64% hardwoods**, 36% conifers
- **+810 million m³** (1981-2011)
- Summary of flux (average 2005-13)
 - Raw production : 91,5 Mm³/yr
 - Mortality : 8,5 Mm³/yr
 - **Harvest** : 41,4 Mm³/yr (**50%** of net increment)
 - Stock increase : 41,4 Mm³/yr



Source : Colin, A., Wurpillot, S., Derrière, N., Hervé, J.-C., 2013. L'accroissement de la ressource forestière française: 810 millions de m³ supplémentaires en 30 ans. Forêt-entreprise 212, 20–24.

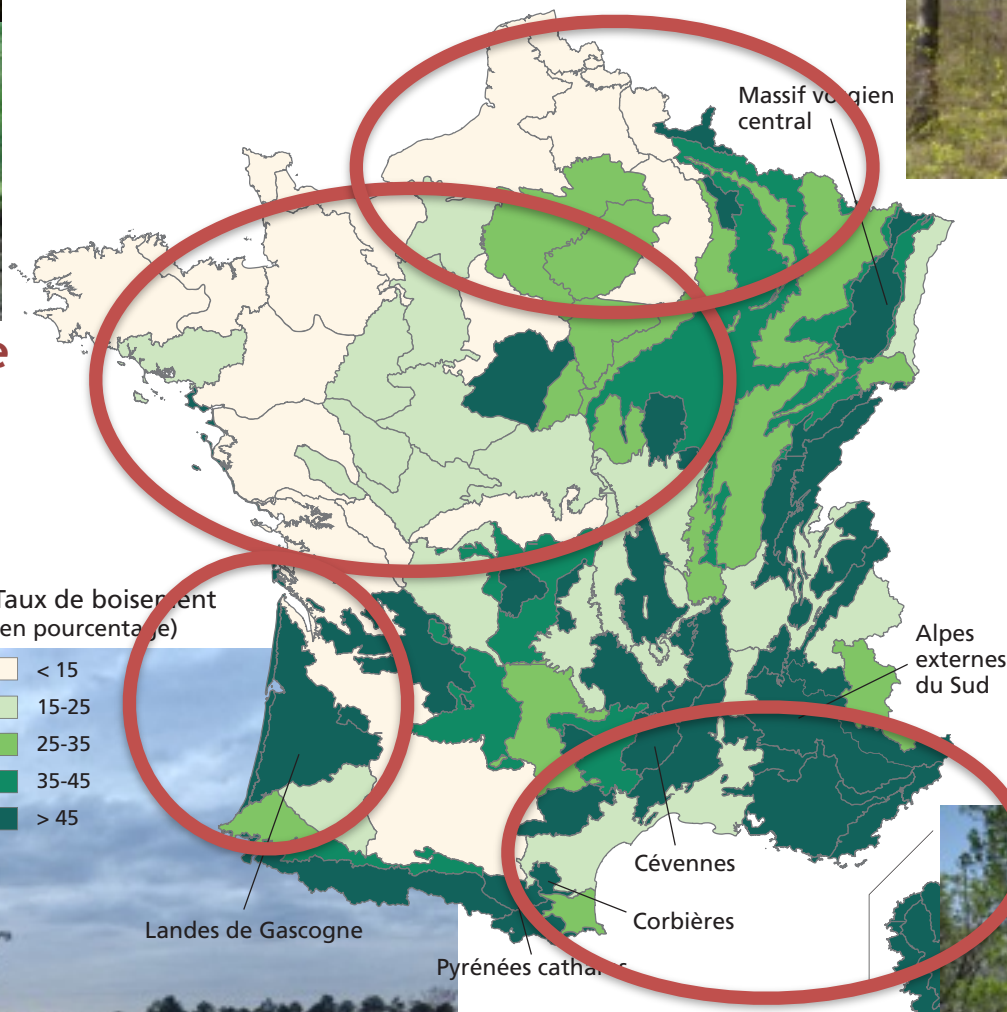


Highly diverse forest types

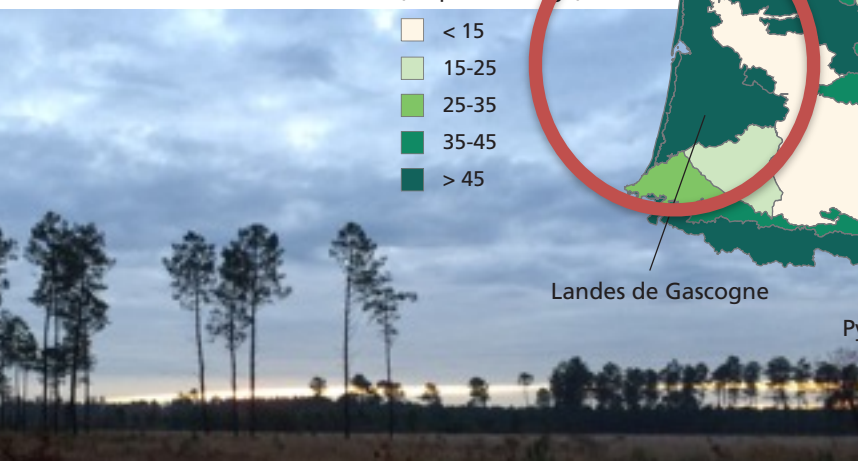
Beech



Oaks, Scots Pine
(lowlands)



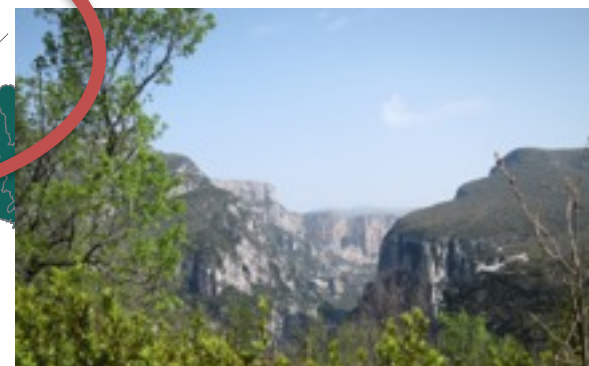
Maritime Pine



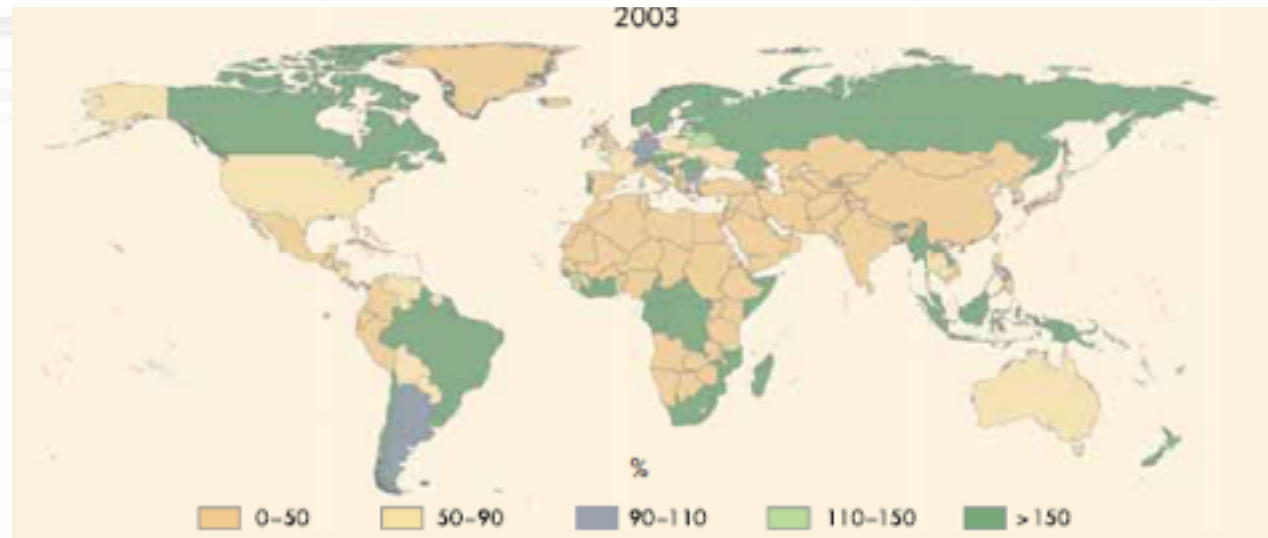
Fir, spruce, larch
(mountains)



Mediterranean
forests



Commerce international intense de produits-bois



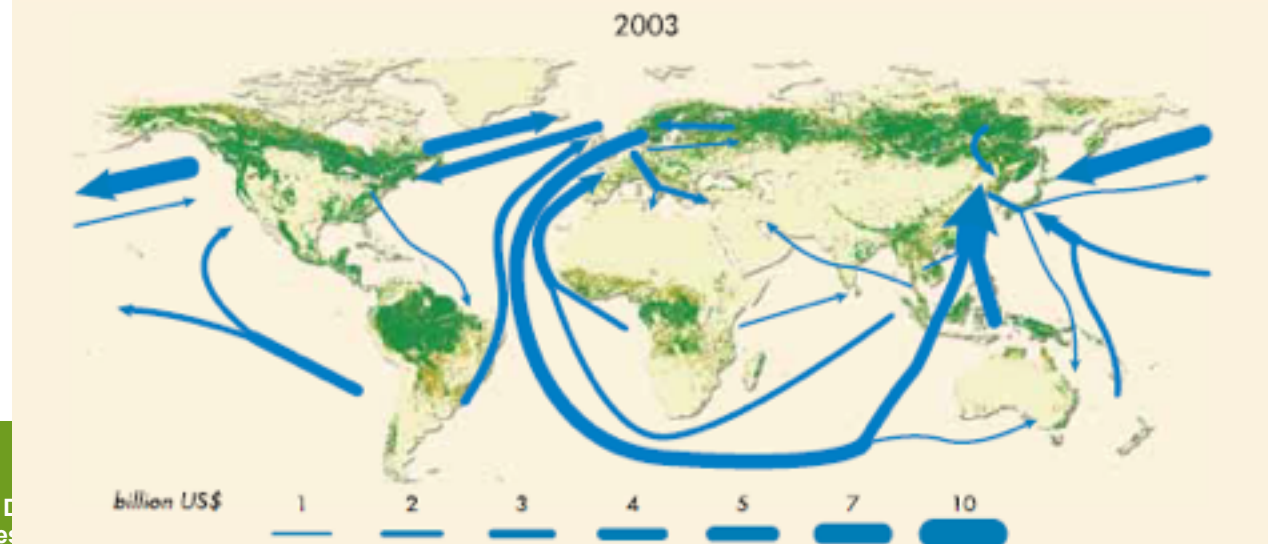
تدفق منتجات الأخشاب في التجارة الأساسية بين الأقاليم

主要区域间木材产品流向

Main interregional trade flows of wood products

Principaux courants commerciaux interrégionaux des produits ligneux

Principales flujos comerciales interregionales de productos madereros



Source : FAO

Objectifs de la présentation

❖ Arrière-plan :

- ❖ population mondiale & développement → demande produits-bois
- ❖ forêts sollicitées pour fournir une gamme croissante de produits/services, en dépit de contraintes renforcées
- ❖ forêts sous pression par les autres usages du sol (à nouveau)
- ❖ apporter une réponse intégrée au changement climatique : adaptation, atténuation, régulation des services écosystémiques

❖ Offre de biomasse forestière en France :

- ❖ **diversité** : atout, encore insuffisante ; comment la gérer efficacement ?
- ❖ **sous-utilisée** : peu d'attention à la productivité depuis 30 ans
- ➔ la bioéconomie peut changer la donne pour les forêts
- ➔ enjeux (climat, société, techniques) pour relever le défi ?

Final harvest in highest-quality Oak Forests

rotation age : 180 to 250 years



Source : ONF
(Jarret, 2014)

Natural regeneration

Source : ONF
(Jarret, 2014)



age : 1 yr



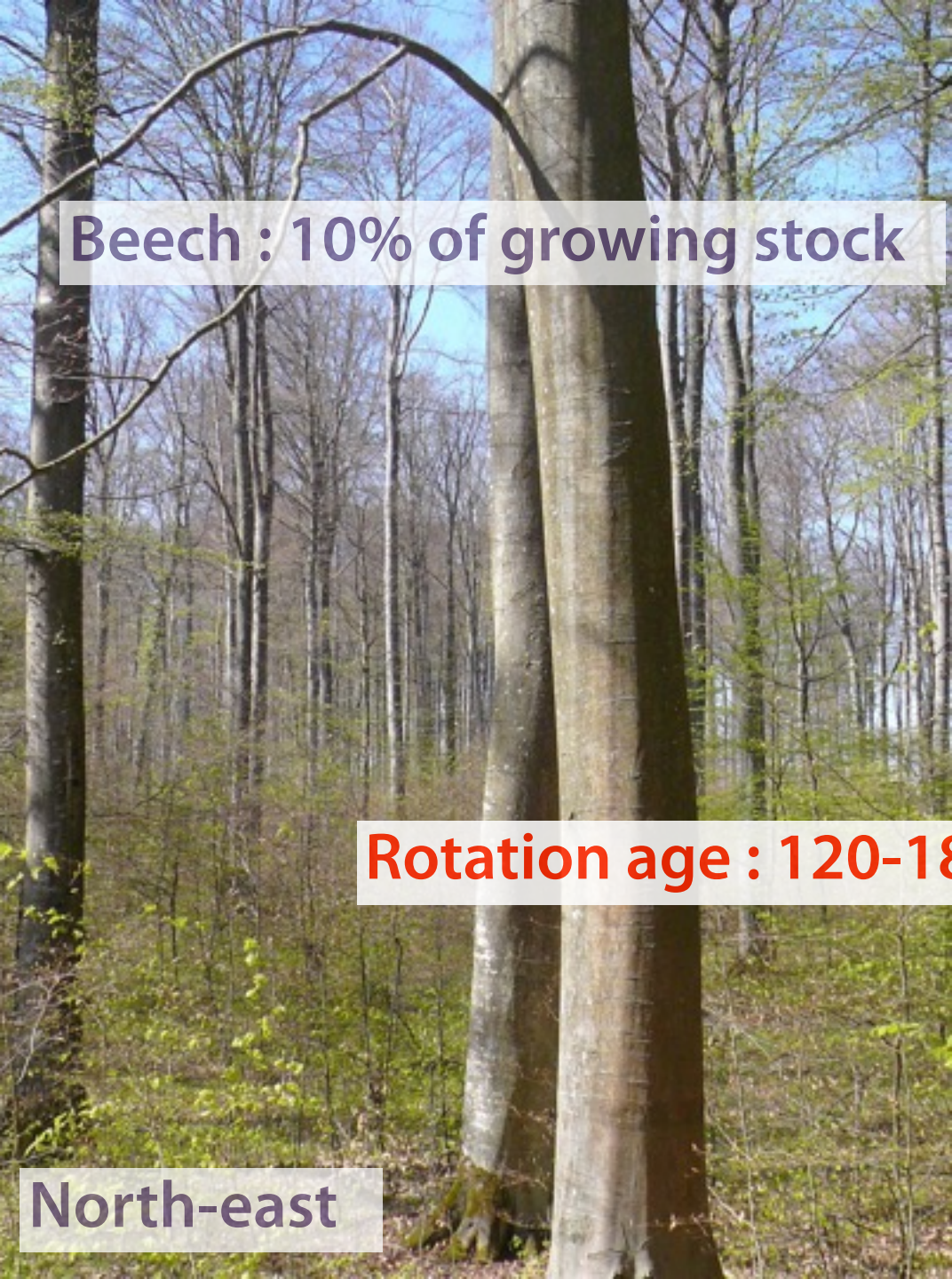
age : 25 yrs

Young stand tending (mixture & competition control)

Present best products : barrel manufacturing

Source : ONF
(Jarret, 2014)

Today, this is a very profitable production system,
Question :
very long rotations + exposition to climate/social risks :
how to diversify and increase resilience ?



Beech : 10% of growing stock

Rotation age : 120-180 yrs

North-east



North-west

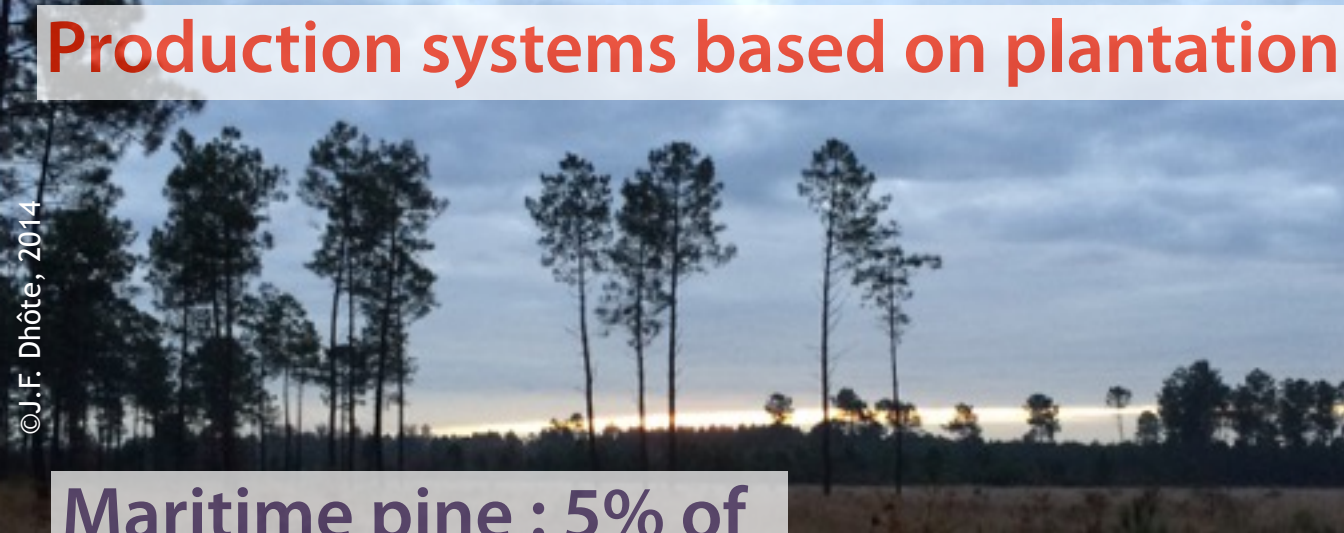


Silver fir : 8% of growing stock

Rotation age : 100-150 yrs

Uneven-aged management :
irregular shelterwood system (« *Plenterwald* »)

Production systems based on plantation...



Maritime pine : 5% of growing stock

A wide-angle photograph of a maritime pine plantation at sunset. The trees are silhouetted against a bright orange and yellow sky, with a dark horizon line.

Rotation age : 40-50 yrs



Douglas fir : 4%

A close-up, low-angle shot of a Douglas fir tree trunk, showing its characteristic bark texture and the way it tapers upwards towards the canopy.

Rotation age : 50-80 yrs



Other conifers : 5%

A photograph of a forest with various coniferous trees. The focus is on a large, dark tree trunk in the foreground, with other trees visible in the background against a blue sky.

Norway spruce : 8% of
growing stock

Rotation age : 70-120 yrs





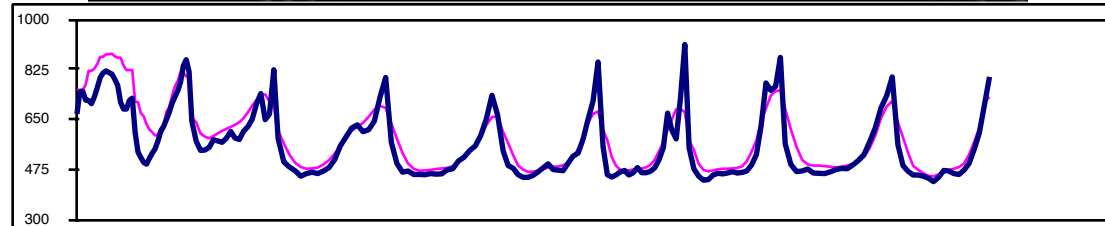
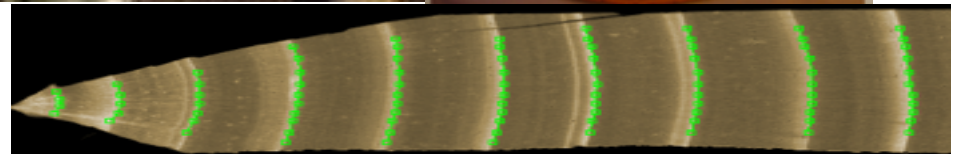
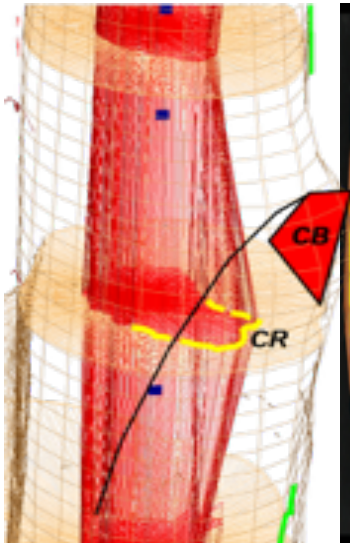
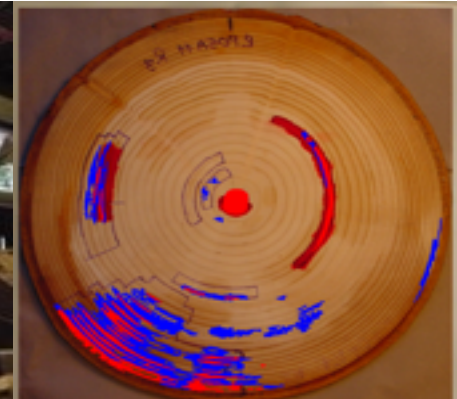
©J.F. Dhôte, 2009

Rotation age : 15-30 yrs

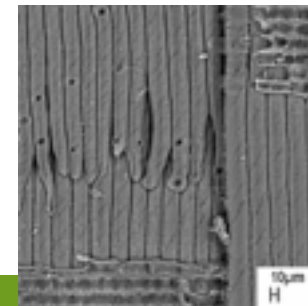


Hybrid poplar plantations :
1,2% of growing stock (30 M m³)
1,2% of area (180 000 ha)

Indicateurs de qualité



Mothe et al., 2008



Wernsdörfer et al. (2005a) Trees

1

Mitigation Measures

-  **More efficient use of energy**
-  **Greater use of low-carbon and no-carbon energy**
 - Many of these technologies exist today
-  **Improved carbon sinks**
 - Reduced deforestation and improved forest management and planting of new forests
 - Bio-energy with carbon capture and storage
-  **Lifestyle and behavioural changes**

IPCC AR5 Synthesis Report

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WHO UNEP

AR5 WGIII SRM

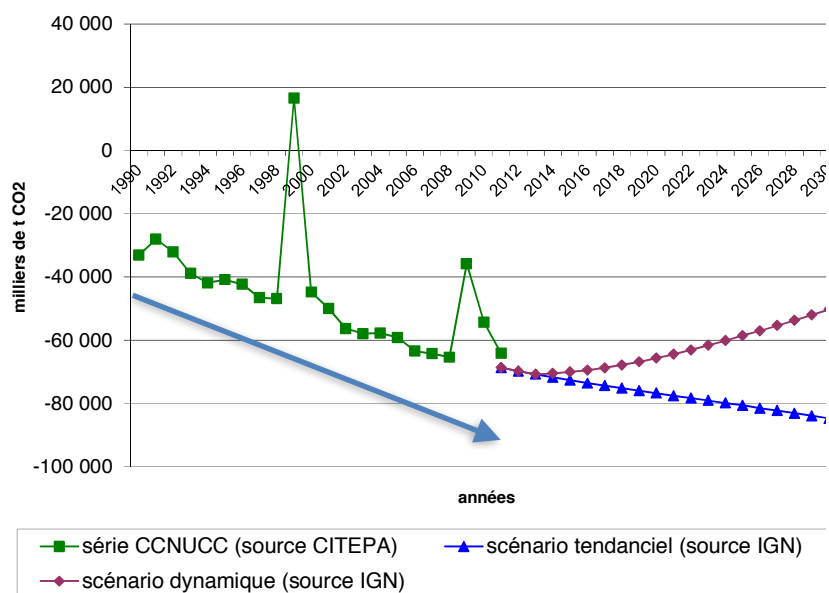
Atténuer le changement climatique : valoriser les feuillus, co-adapter forêts et industries, augmenter la productivité, développer la ressource résineuse

Puits de C forestier français - trajectoire actuelle :

- approfondissement rapide du puits
- accumulation de bois sur pied dont vieux bois
- hésitation sur le *policy-mix* : stocker / mobiliser ?

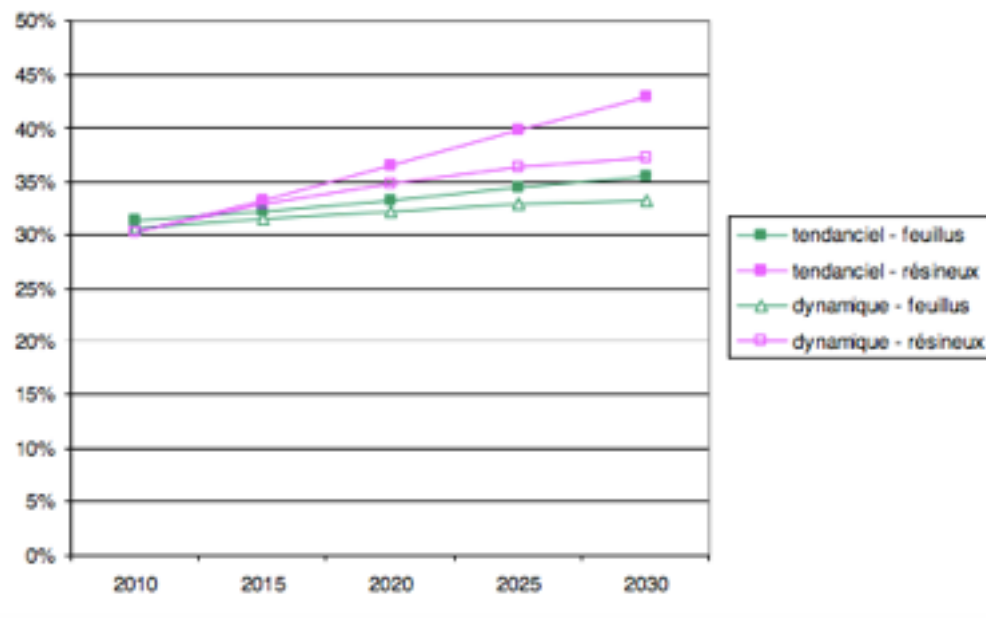
Source : IGN (Colin, 2014) & CITEPA (2006)

Puits de CO₂ dans la biomasse forestière
France métropolitaine



Stocks de bois « surannés »

Part de la ressource dans des dimensions supérieures ou égales au
diamètre d'exploitabilité des essences



Diversify technologies to value the whole range of wood properties



as building material :
raw timber and fibres ;
toll-station, motorway A89
(Limoges)

as bioenergy ;
district heating (Besançon)



as packaging material...
and for chemical properties



©CNDB, 2007



Biorefinery
Tembec Tartas

Use wood instead of competing materials,
engineer to overcome defects



Glue-laminated structure :
Simonin Frères
(Montlebon, Franche-Comté)

Use emblematic buildings to change social perception of wood (performance, modernity, design)

Tree houses: are wooden skyscrapers the future of tall buildings?



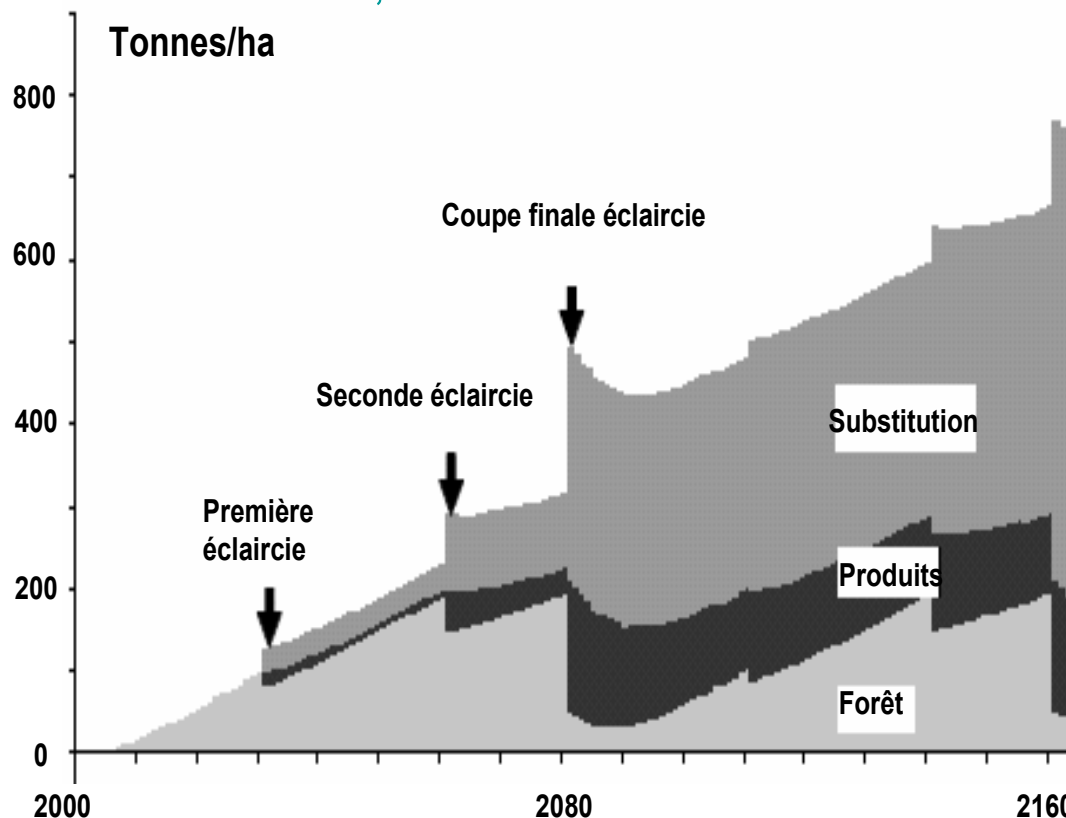
📷 A render of the wooden structures planned for the Baobab development in Paris. Illustration: Michael Green Architecture

Philip Oldfield, The Guardian, 7 July 2015

<http://www.theguardian.com/artanddesign/2015/jul/07/tree-houses-are-wooden-skyscrapers-the-future-of-tall-buildings>

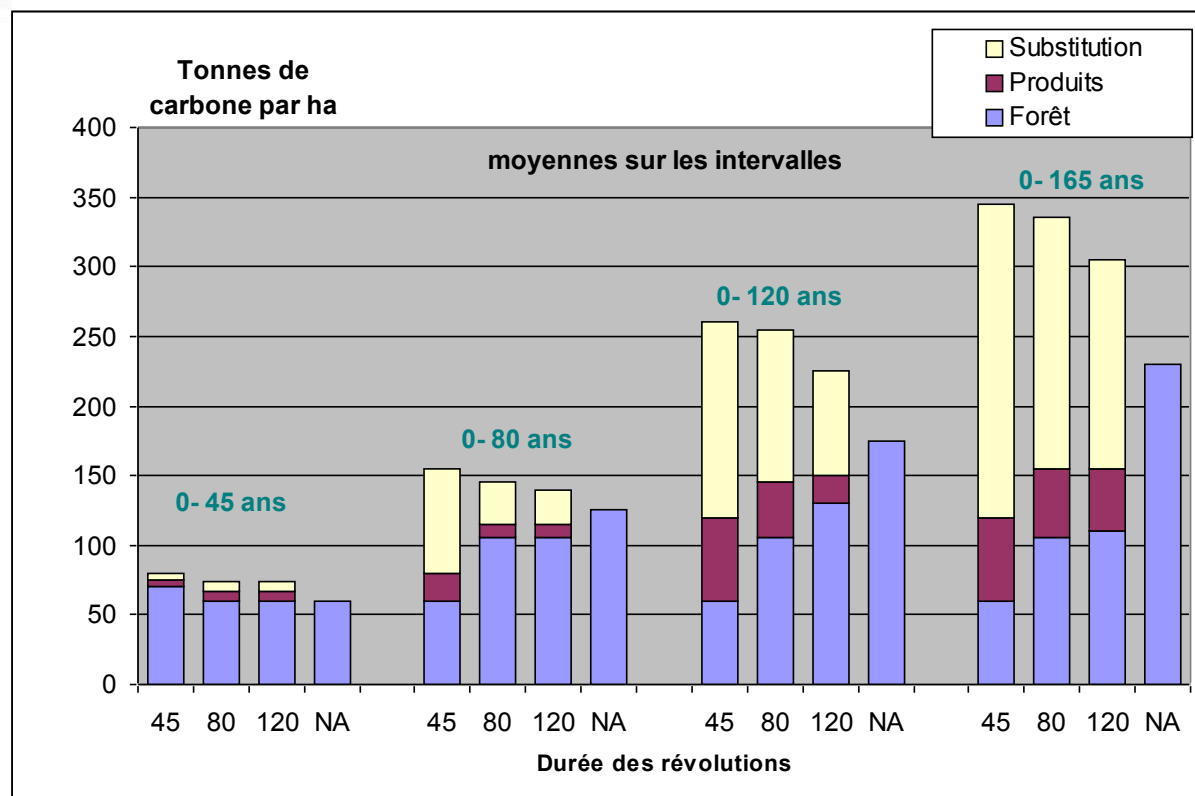
3 valeurs-carbone des choix forestiers : stocks, flux, substitution

Carbone en forêt, dans les produits et en substitution
du béton dans la construction
Ressource résineuse, révolution 80 ans



Bruce Lippke et Jim Wilson, *CORRIM FACT SHEET 2*, 2004,
Malmshheimer R. et al., 2008, *Forest management solutions for mitigating climate change in the US. Journal of Forestry*

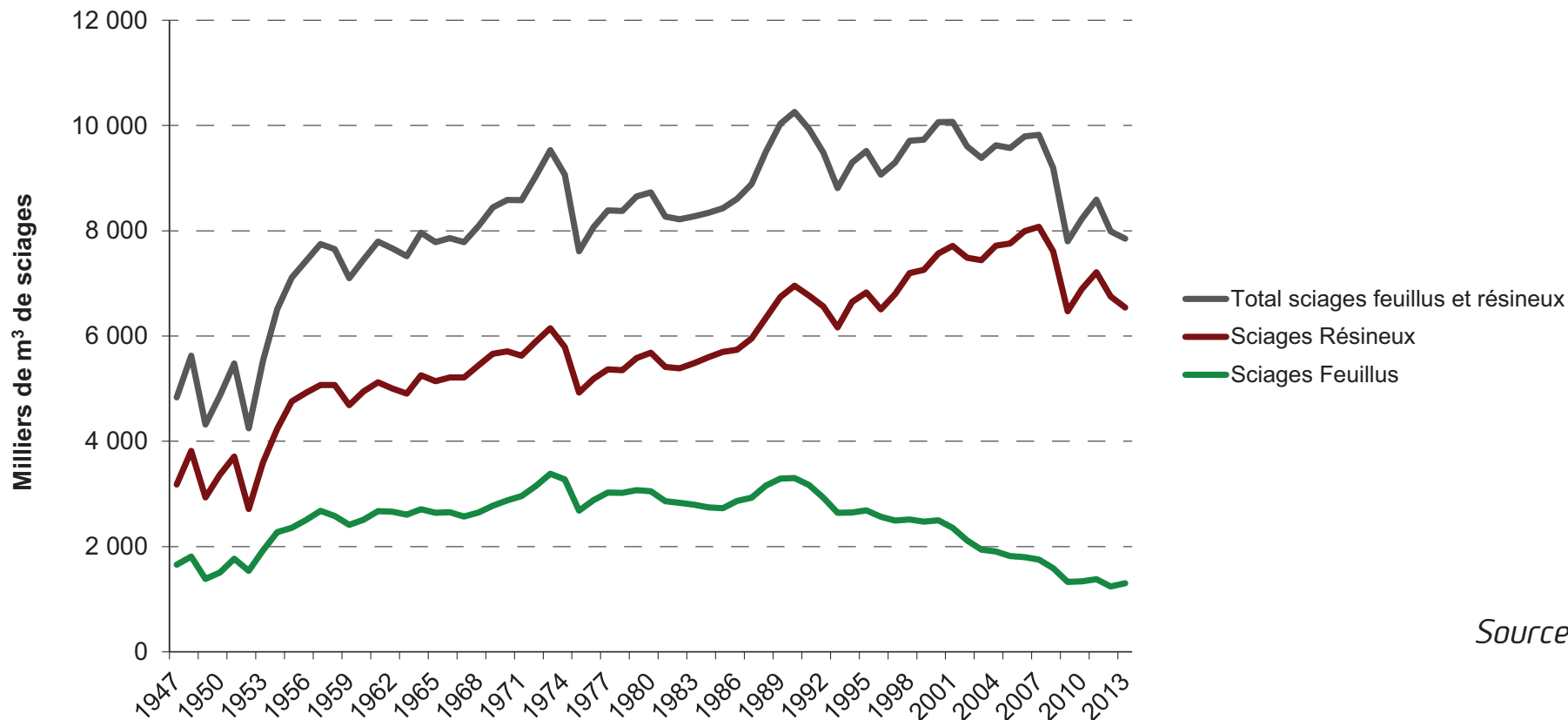
Bénéfices de substitution : potentiellement importants, sensibles au contexte industriel



Malmsheimer R. et al., 2008,
Forest management solutions for mitigating climate change in the US. Journal of Forestry

Le jugement sur les révolutions optimales s'inverse selon qu'on considère :
(1) carbone dans l'écosystème ; (2) idem + devenir des produits et leurs effets induits

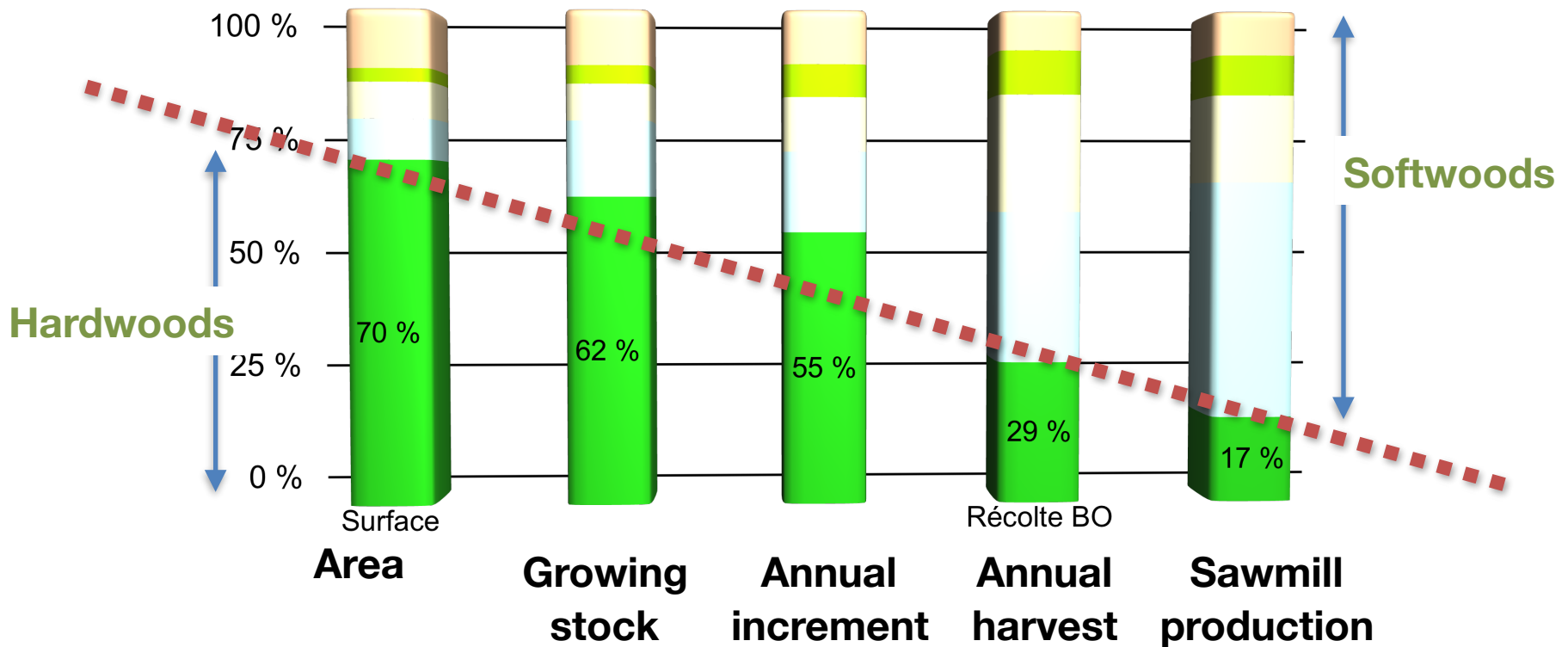
Production de sciages : des tendances divergentes pour les feuillus et les résineux



Source 2

Source : EAB (Les chiffres-clé de la forêt privée, 2015)

Abundant hardwood resource... under-used by industries and consumers



Source : FCBA
(Monchaux, 2014)

■ Feuillus ■ Sapin / Epicéa ■ Pin Maritime ■ Douglas
■ Autres résineux

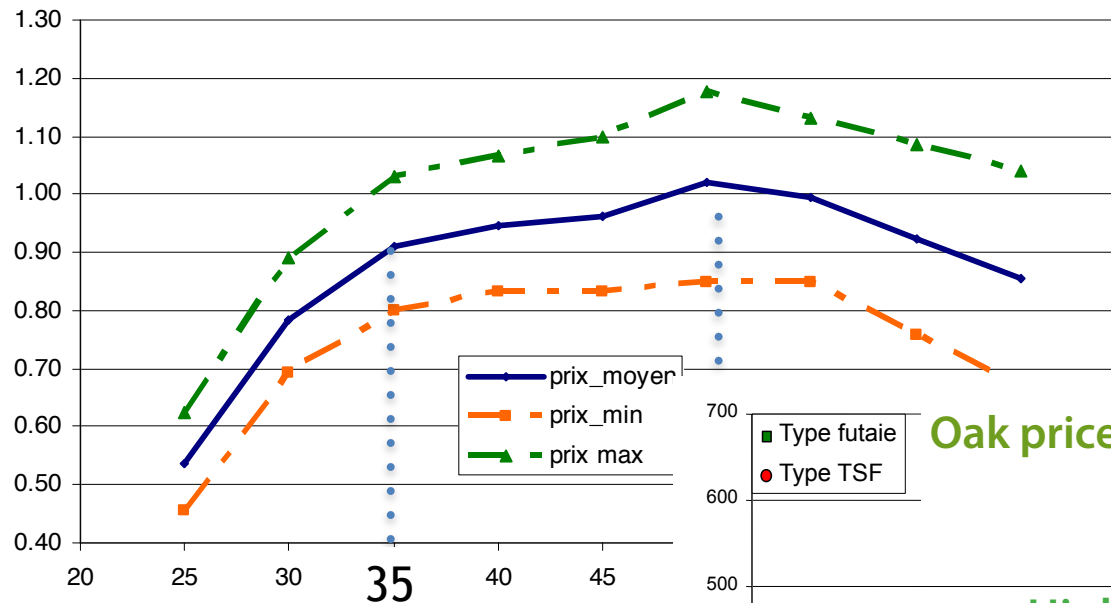
Sawmilling efficiency optimized for Ø30-50cm logs



**Siat sawmill (Urmatt, Alsace) :
700 000 m³/yr**

Conifer value curve reflects sawmilling process

Timber price (relative units)

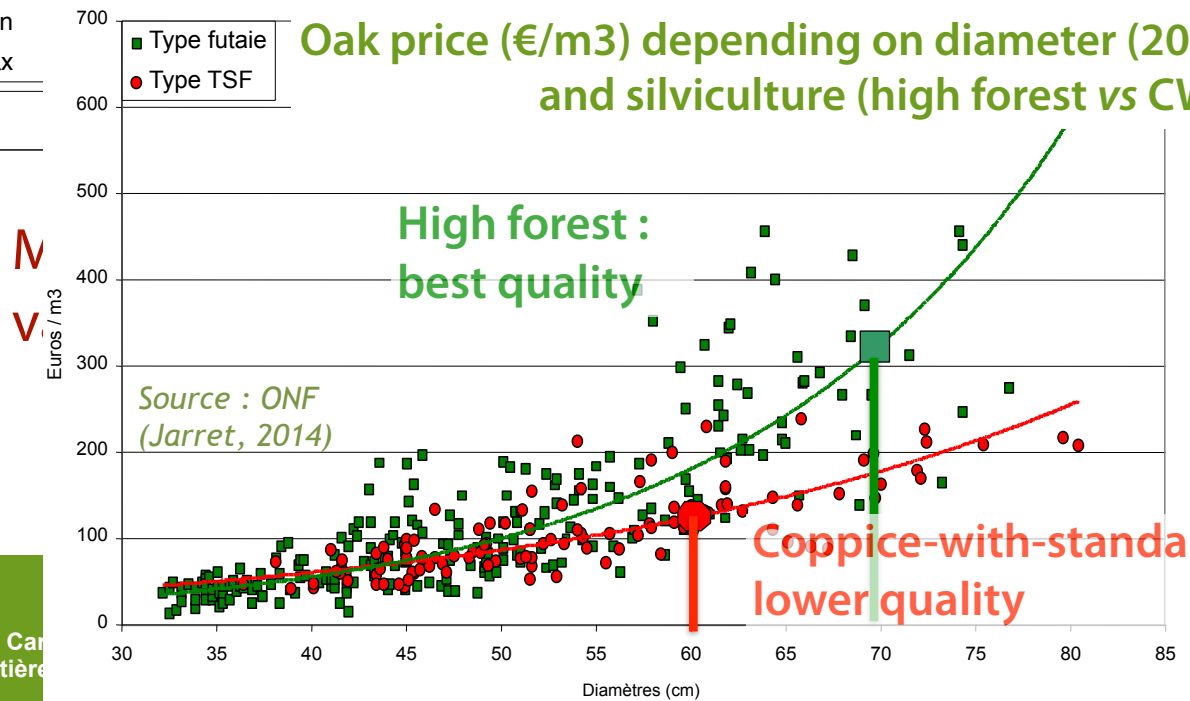


Fir-Spruce - Vosges
mean (sept. 2009-sept. 2010)

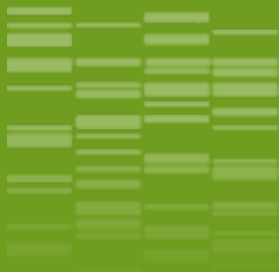
Source : ONF
(Gamblin, 21/3/2011)

90% of
Max value

Oak price (€/m³) depending on diameter (2006)
and silviculture (high forest vs CWS)



Coppice-with-standards
lower quality



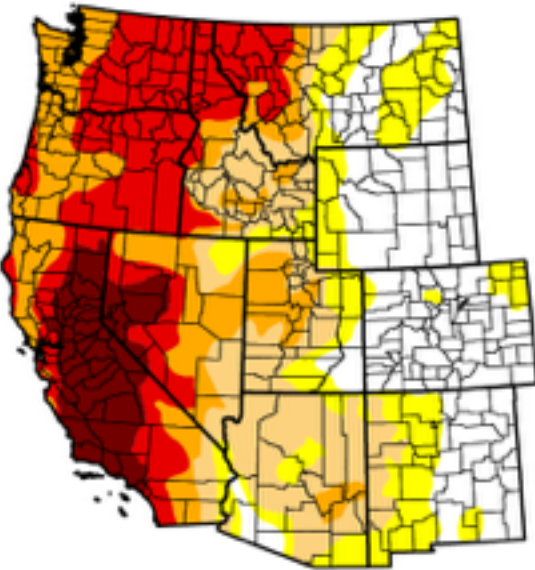
2

Impacts du changement climatique : tendances, événements extrêmes & crises

(Méga-)Sécheresses

Eté 2003 France

U.S. Drought Monitor
West



September 15, 2015
(Released Thursday, Sep. 17, 2015)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	00-04	05-09	10-14	15-19	20-24	25-29
Current	24.88	35.33	38.66	42.88	26.73	7.82
Last Week	24.88	35.33	38.67	42.88	26.73	7.82
5 Months Ago	27.92	32.87	36.17	34.40	17.12	7.25
Start of Calendar Year	34.76	65.24	54.40	33.50	19.86	6.40
Start of Water Year	31.40	69.52	55.57	35.05	19.96	6.90
One Year Ago	28.74	70.26	57.24	38.88	19.88	6.90

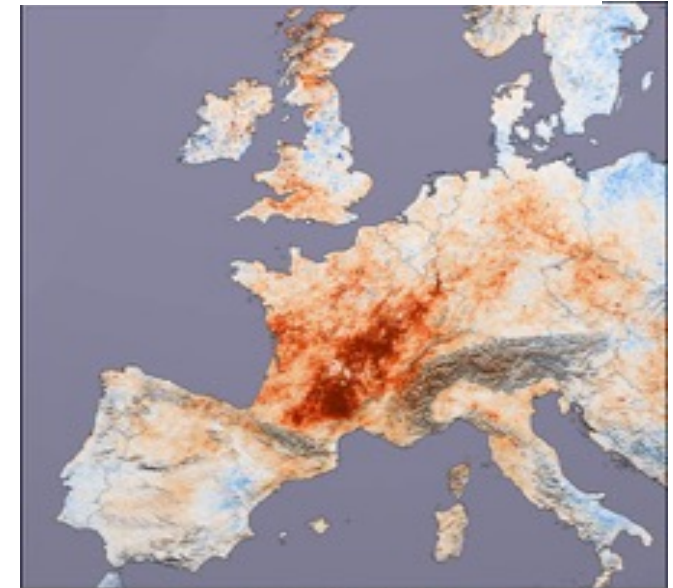
Intensity:



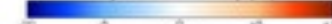
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text on way for forecast details.

Author:

Chris Petersen
NOAA/NESDIS/NCED

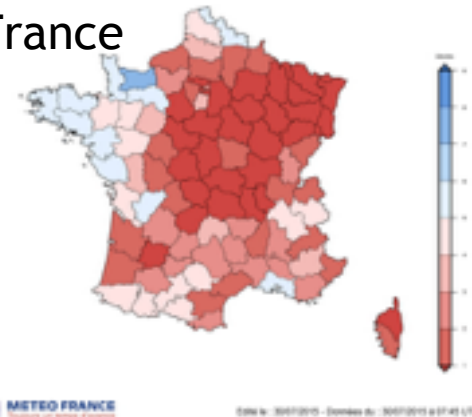


Temperature Anomaly (°C)



29 juillet 2015

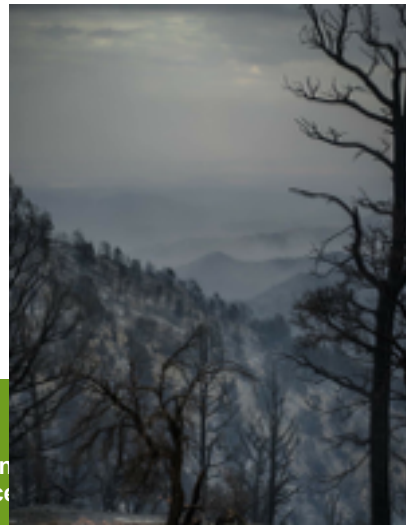
Eté 2015 France



METEO FRANCE

Date: 2015-07-15 - Données de: 2015-07-15 à 07:45 (UTC)

Source : N. Bréda



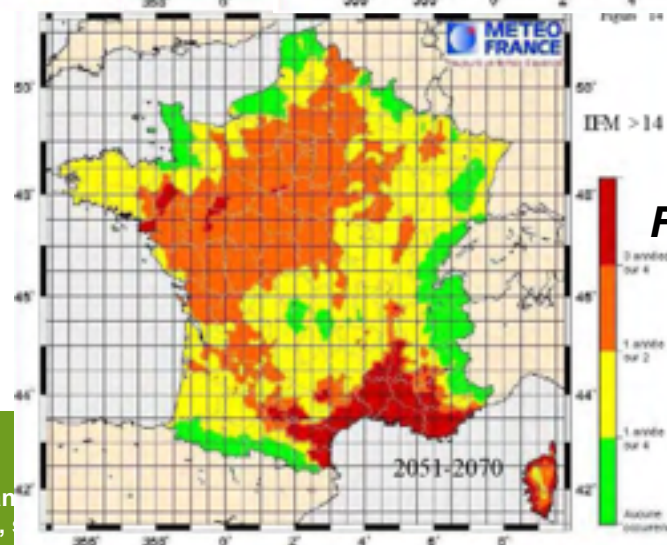
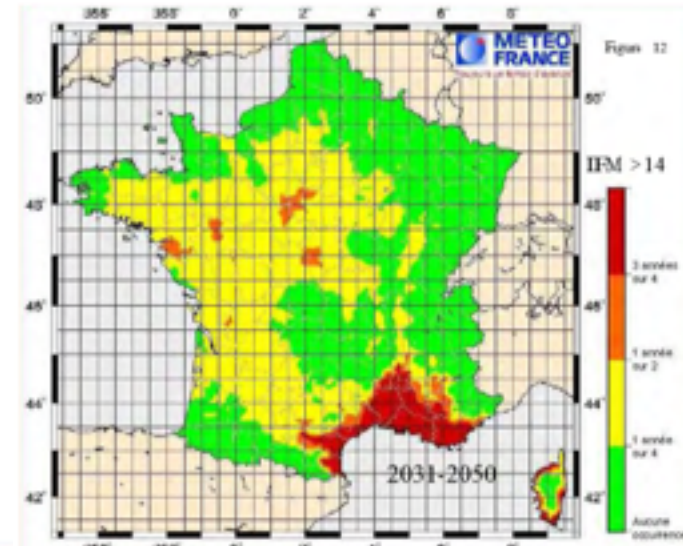
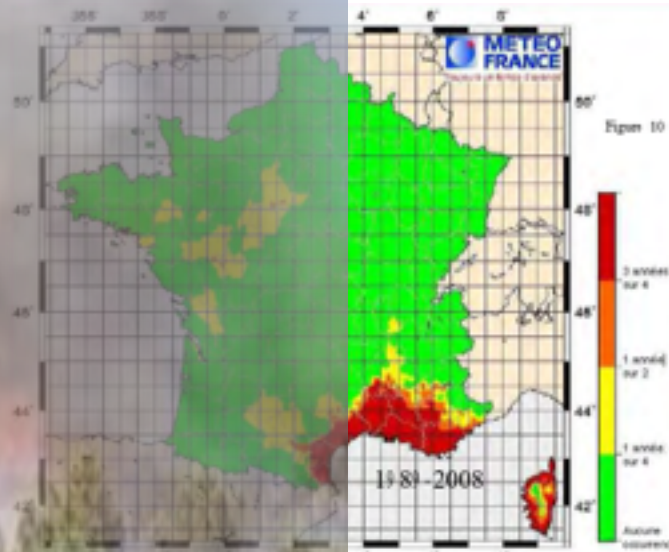
Extension du domaine + aggravation des incendies

Actuel

Futur proche

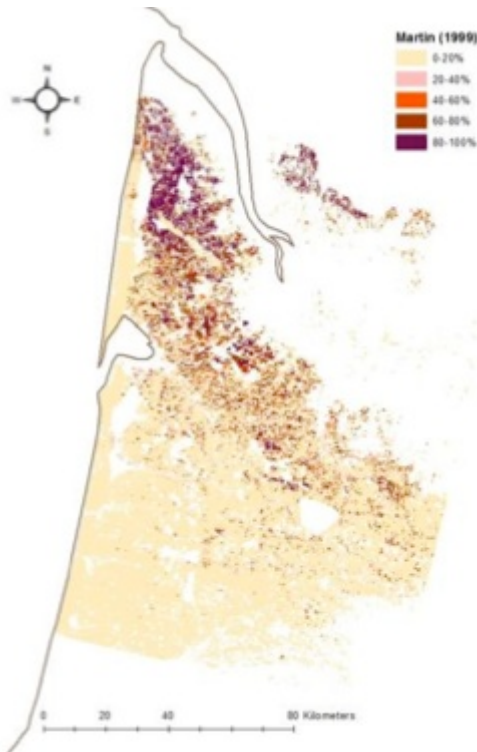


Source : Rapport mission interminist., Chatry et al. (2010)

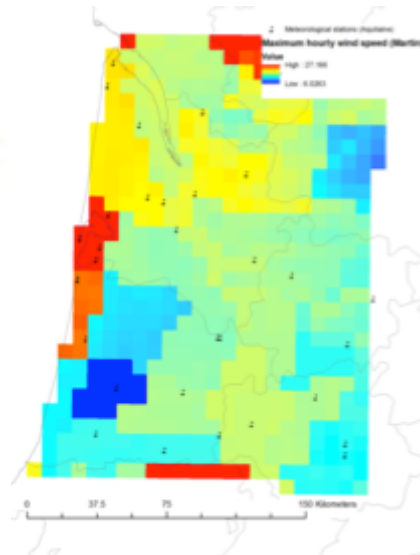


Futur lointain

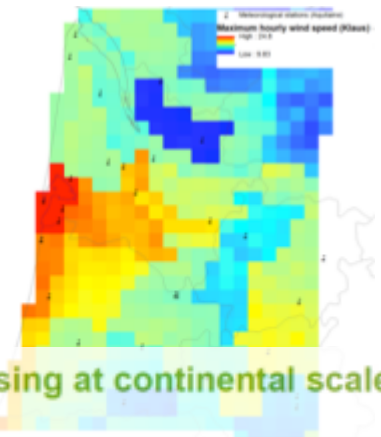
Tempêtes majeures qui préfigurent/initient des dommages combinés déstabilisants



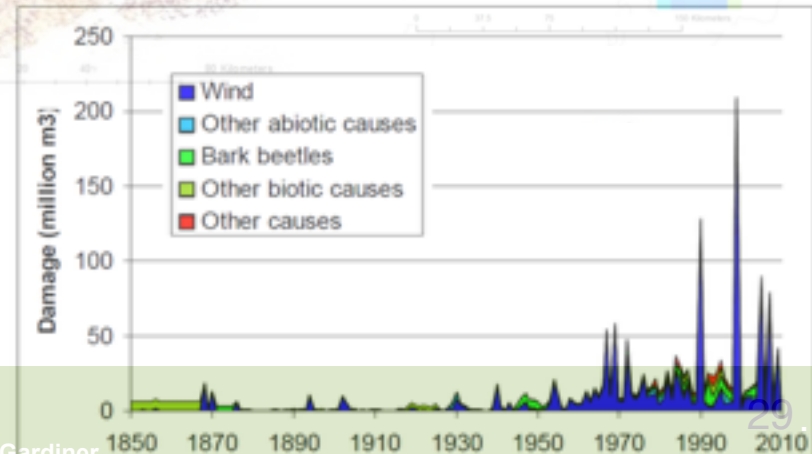
Tempête Martin (1999)
perte de 24 millions de
 m^3 de pin maritime



Tempête Klaus (2009) :
perte de 43 millions
de m^3 de pin maritime



disturbances are increasing at continental scale



Sources : Meredieu et al. (2014), Gardiner et al. (2010)

Gradation de ravageurs/échelles inusitées

Prelude to Disaster

1990-1996



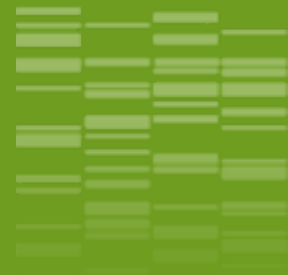
Into the Jack Pine

2007-2013



Mountain Pine Beetle outbreak in Western North America

Source : <http://ngm.nationalgeographic.com/2015/04/pine-beetles/epidemic-map>



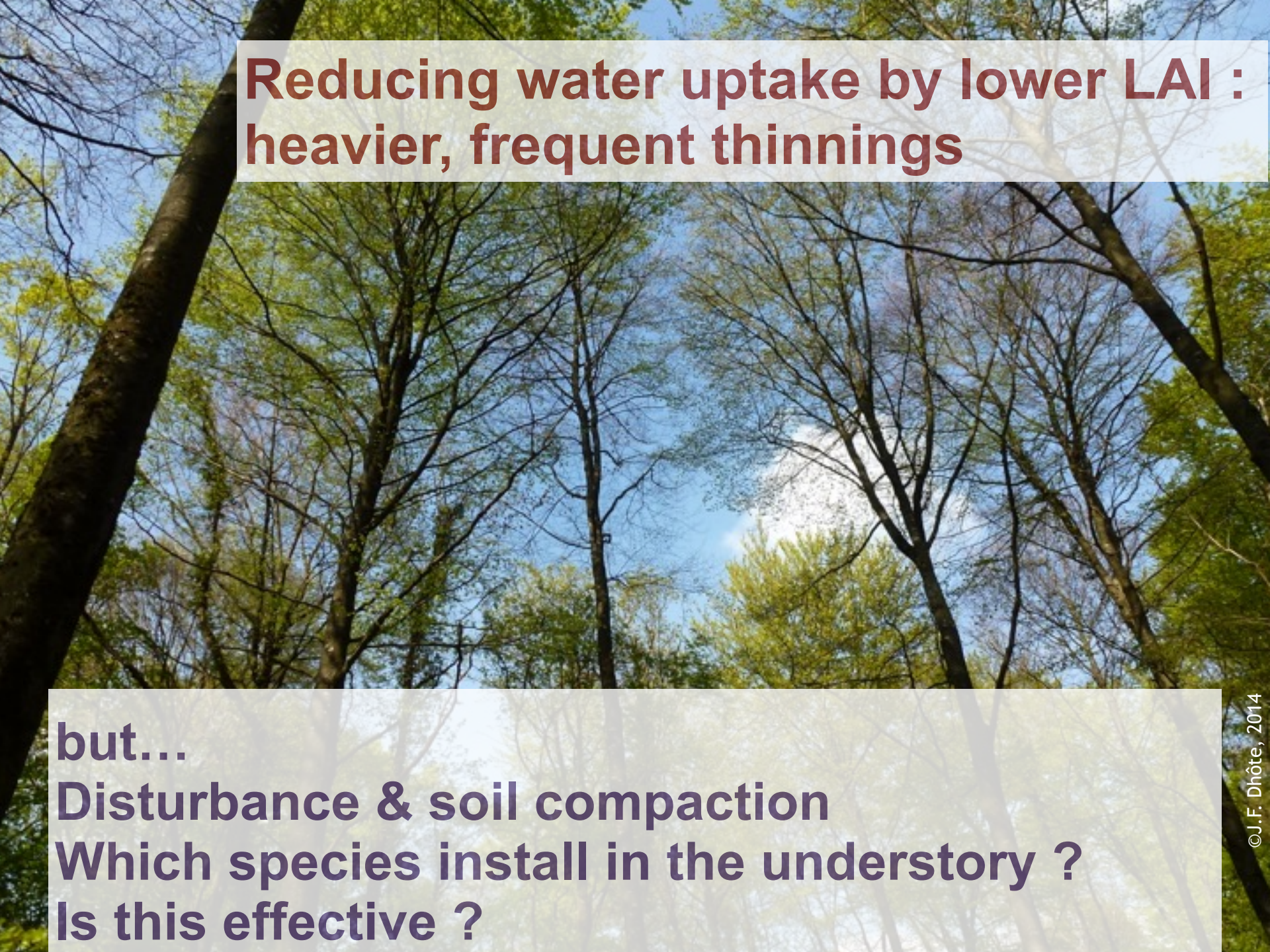
3

S'adapter dans l'incertitude : options de diversification & technologies



Shortening rotation ages to reduce abiotic risk sensitivity :

- storm damages
- drought-induced weakening



**Reducing water uptake by lower LAI :
heavier, frequent thinnings**

but...

Disturbance & soil compaction

Which species install in the understory ?

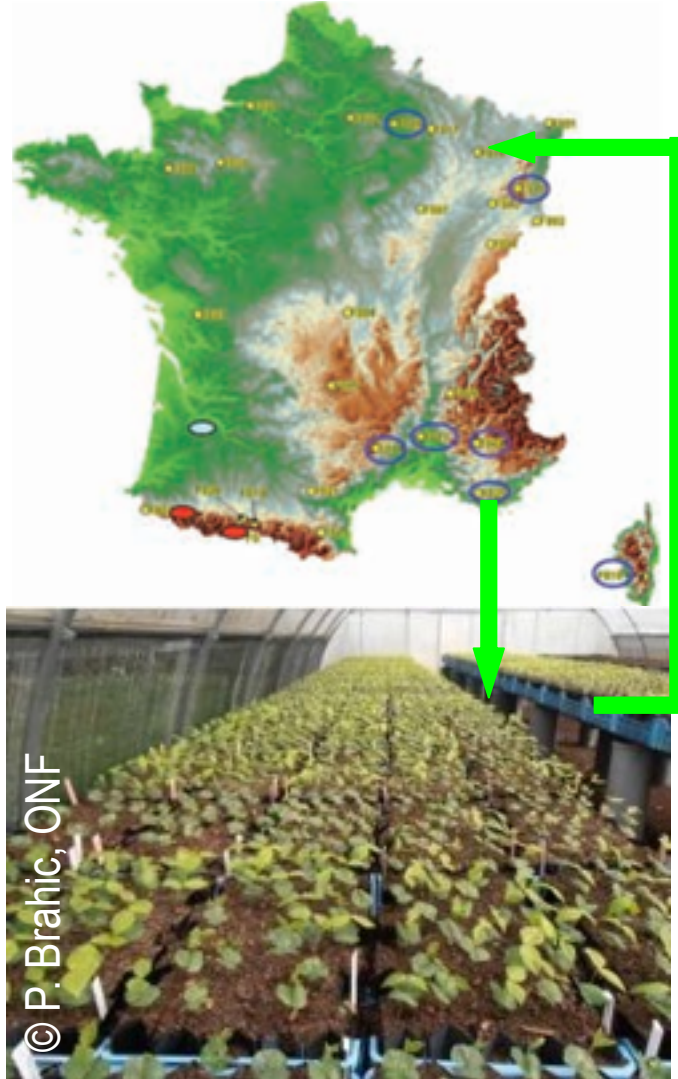
Is this effective ?



Favouring mixed stands...

**mixtures are eventually more
productive, and more resistant
against biotic hazards**

Changing species/genetic resources... : transferring populations (assisted migration)



Projet GIONOE

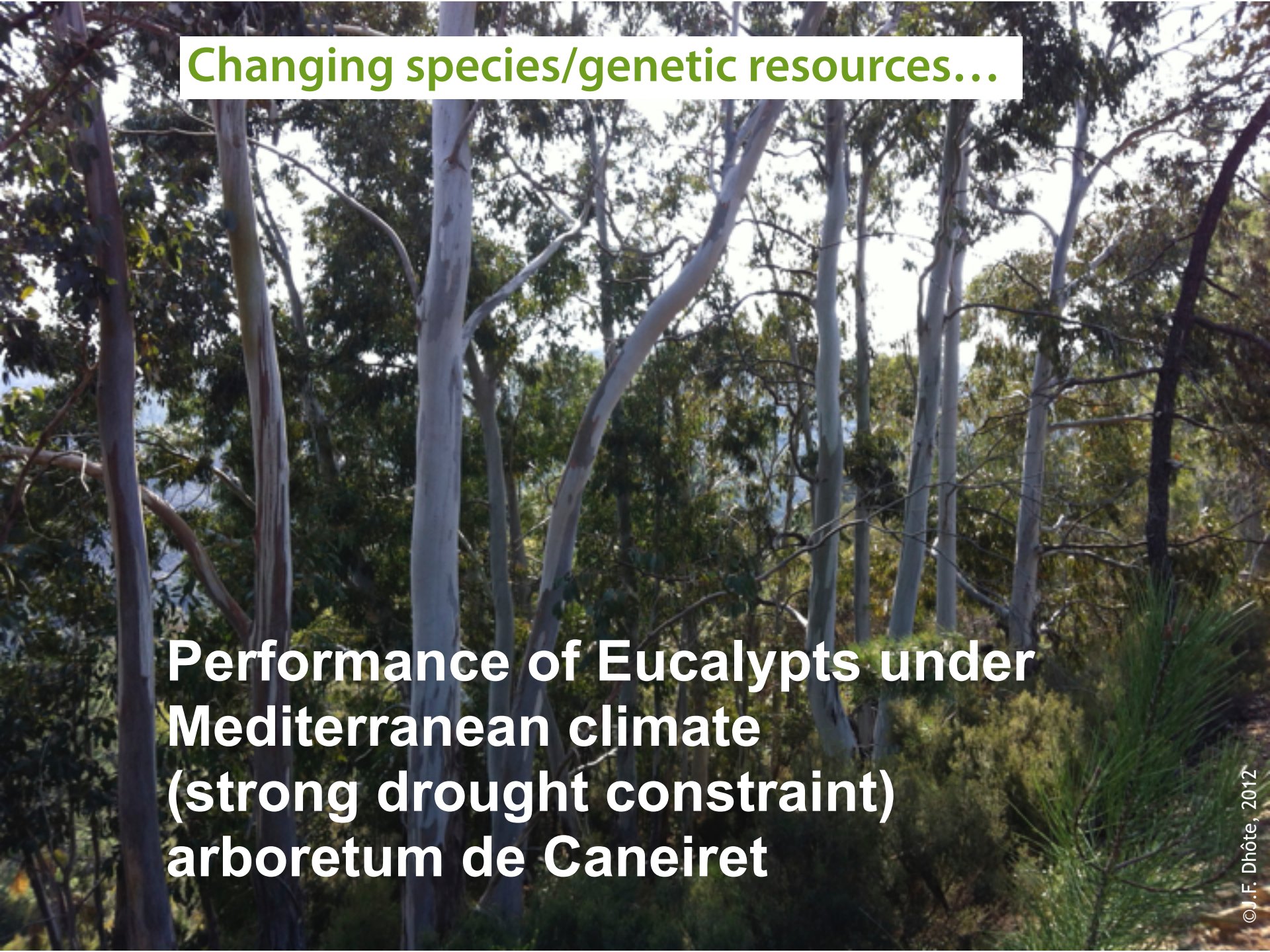
■ (in northern hemisphere)

- vulnerability of populations at southern edge of distribution area
- transfer seeds
- plant in northern locations

■ Possible applications

- for conserving genetic resources
- for supporting local adaptation of existing species

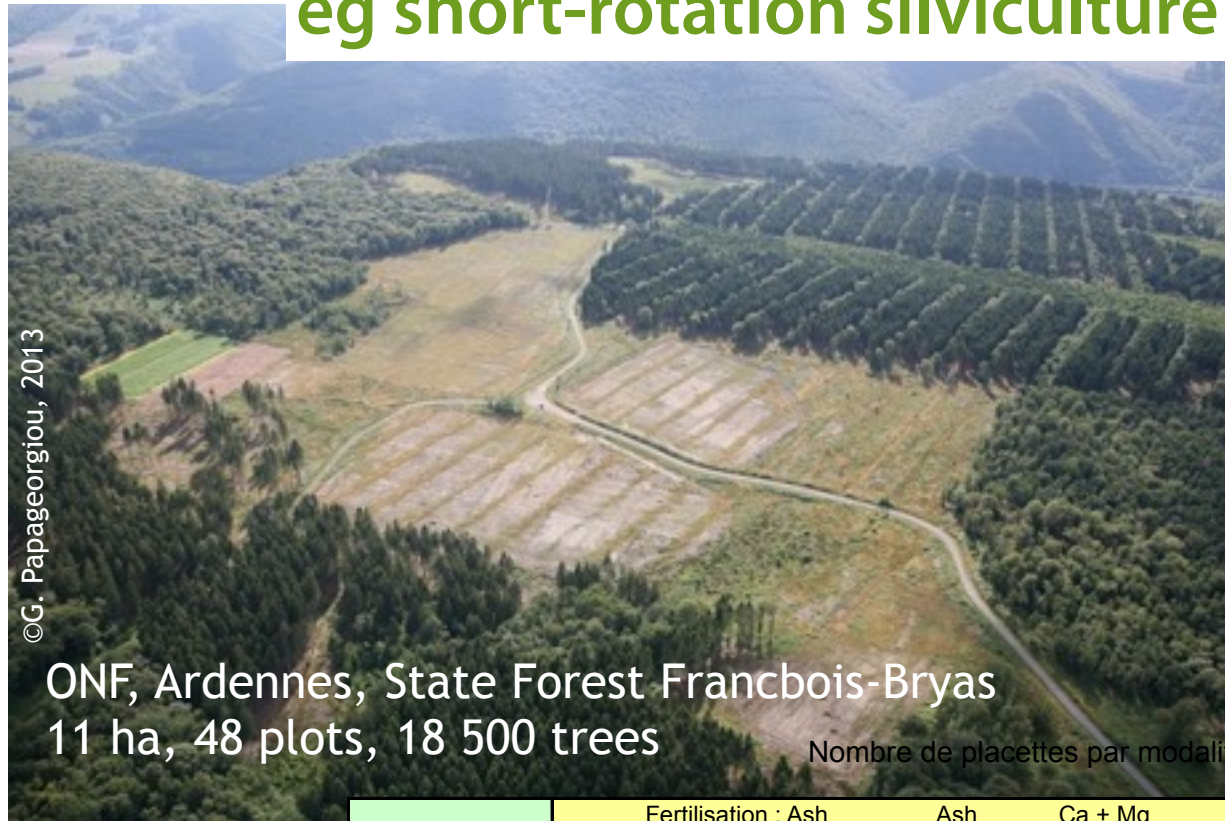
Source : Brigitte Musch, Hervé Le Boulter, Olivier Forestier, Patrice Brahic, Myriam Legay (ONF)



Changing species/genetic resources...

**Performance of Eucalypts under
Mediterranean climate
(strong drought constraint)
arboretum de Caneiret**

Changing production systems : eg short-rotation silviculture



Species :	Fertilisation : Ash		Ash		Ca + Mg		No	
	Soil preparation:	Yes	No	Yes	Yes	No	Yes	No
Douglas fir	1 100 t/ha	3						
Douglas fir	1 600 t/ha	3	3	3	3	3		3
Douglas fir	2 000 t/ha	3						
Norway spruce	2 200 t/ha	3						
Cupressocyparis	1 600 t/ha	3						
Willow	2 000 t/ha	3	3	3	3	3		3
Black locust	2 000 t/ha	3						
Spontaneous vegetation		3	3				3	3

ONF, Ardennes, State Forest Francbois-Bryas
11 ha, 48 plots, 18 500 trees

Nombre de placettes par modalité

Source : ONF
(Richter, 2014)

Tree breeding for changing production systems

**Test de clones de peuplier
pour TCR**

**Source : C. Bastien & G. Bodineau
(INRA Orléans)**

Un besoin renouvelé de planification et de gestion multi-échelle

Poplar (high forest)
SRC Poplar
Mix (HF-SRC)

Fast-growing conifers :
Douglas fir, hybrid larch

Multi-purpose,
« mainstream »
management

National parks,
natural reserves,
recreation areas

Specialization :
products

Land use planning, forest policy : specialize functions in space,
e.g. « Triad » (USA, UK)

Improve resilience
through :

Natural regeneration

Very short
cycle

Standard
rotation

Assisted
migration

Plant other
Oak spec.

Plant exotic
spec.

Example : diversify regeneration options in Oak management

Very short
cycle

Standard
rotation

Delayed
harvesting

Natural
reserve

Example : diversify rotation ages in Beech management

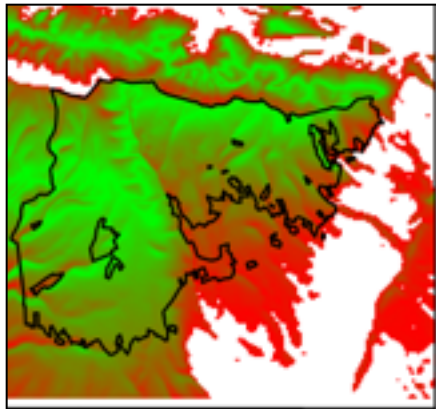
...genetic
res. mgt

...prevent
abiotic
damages

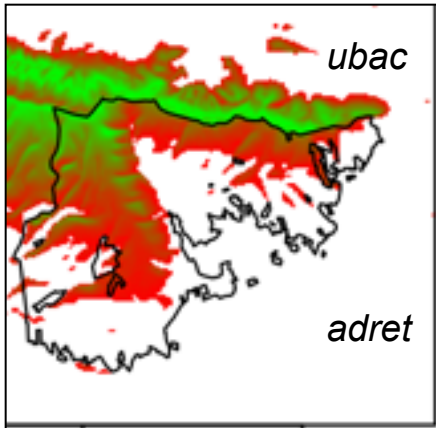
Modéliser : ex. de la cartographie prédictive à haute résolution

0 : **Vert** = **optimal** 0.5 : **Rouge** = **limite** Blanc = **non viable**

HÊTRE

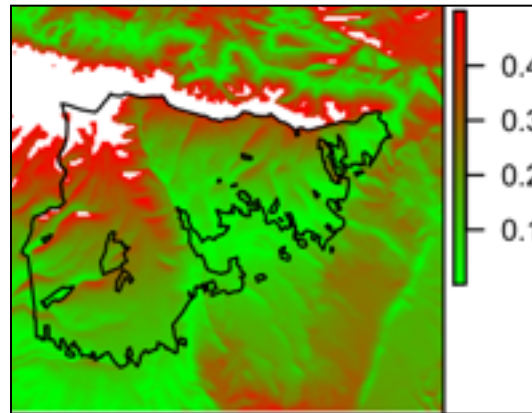


2010

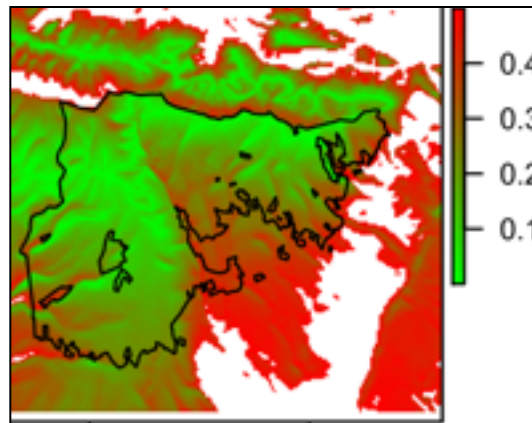


2045

PIN NOIR

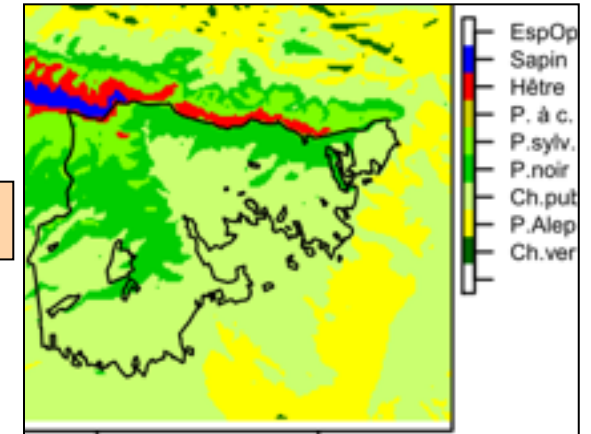
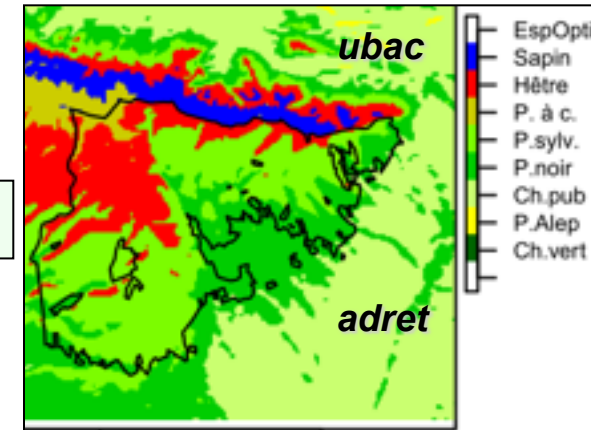


2010



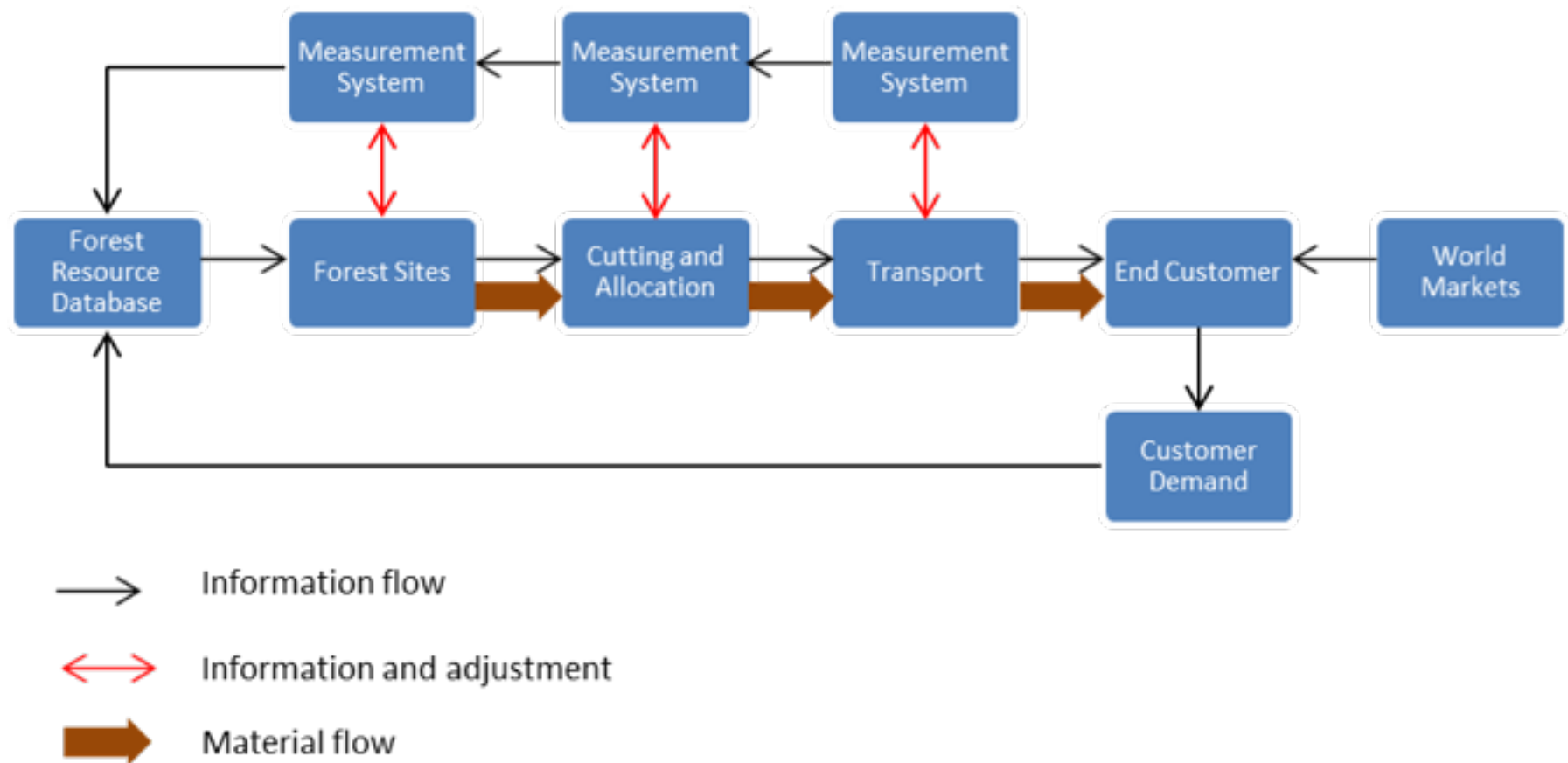
2045

Espèce la + proche de son optimum

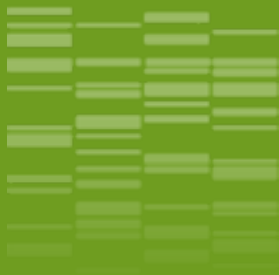


← 5 km →

Integrated supply chain : better use of information linked to production processes



Source : Gardiner (2015)



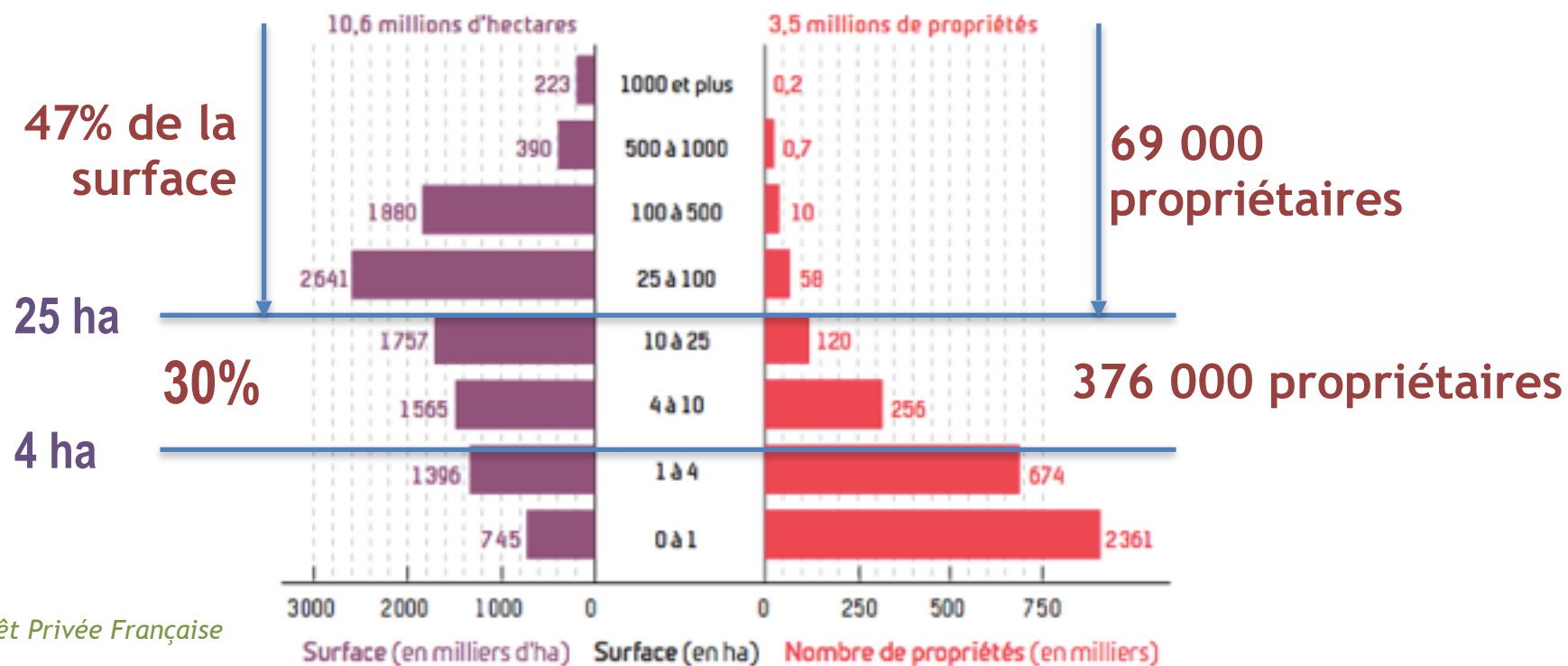
4

**Des tendances sociales qui freinent
l'adaptation & accentuent les risques :
insuffisance ou absence de gestion**

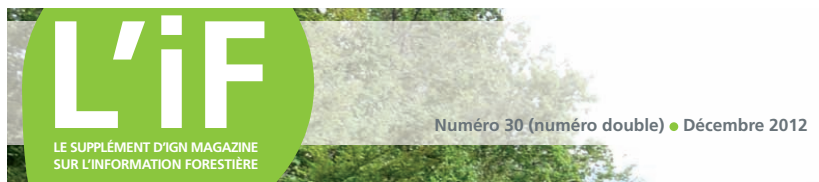


Fragmentation de la propriété privée – facteur d'incertitudes

RÉPARTITION DE LA FORÊT PRIVÉE PAR TAILLE DE PROPRIÉTÉ



Source :



Où coupe-t-on du bois en France ? Où y a-t-il des gisements inexploités ?

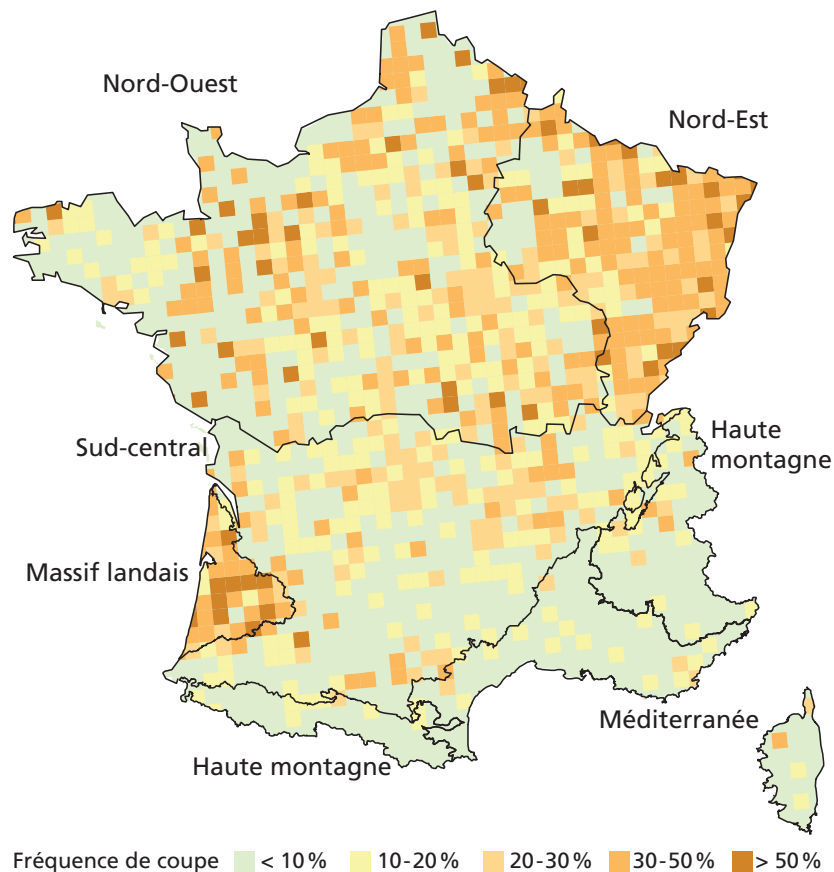


Fig. 5. Fréquence de coupe sur la période 2005-2011

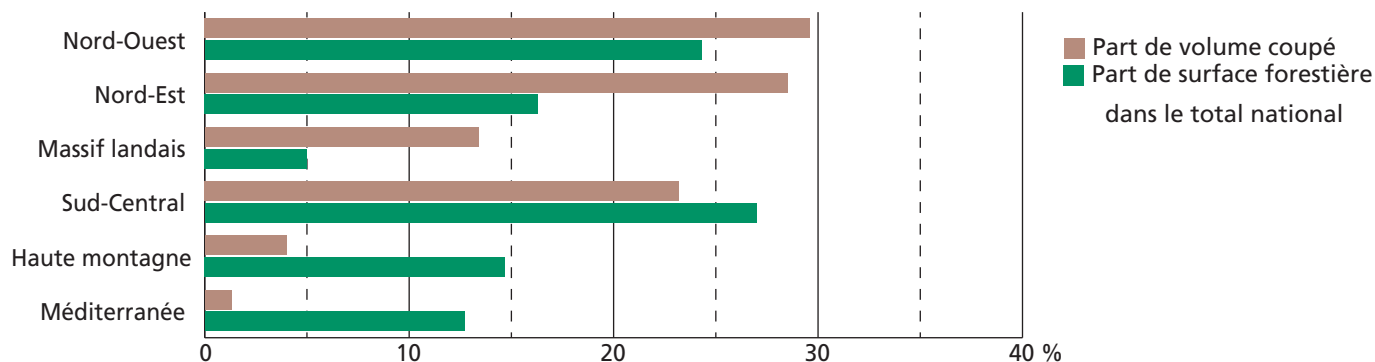
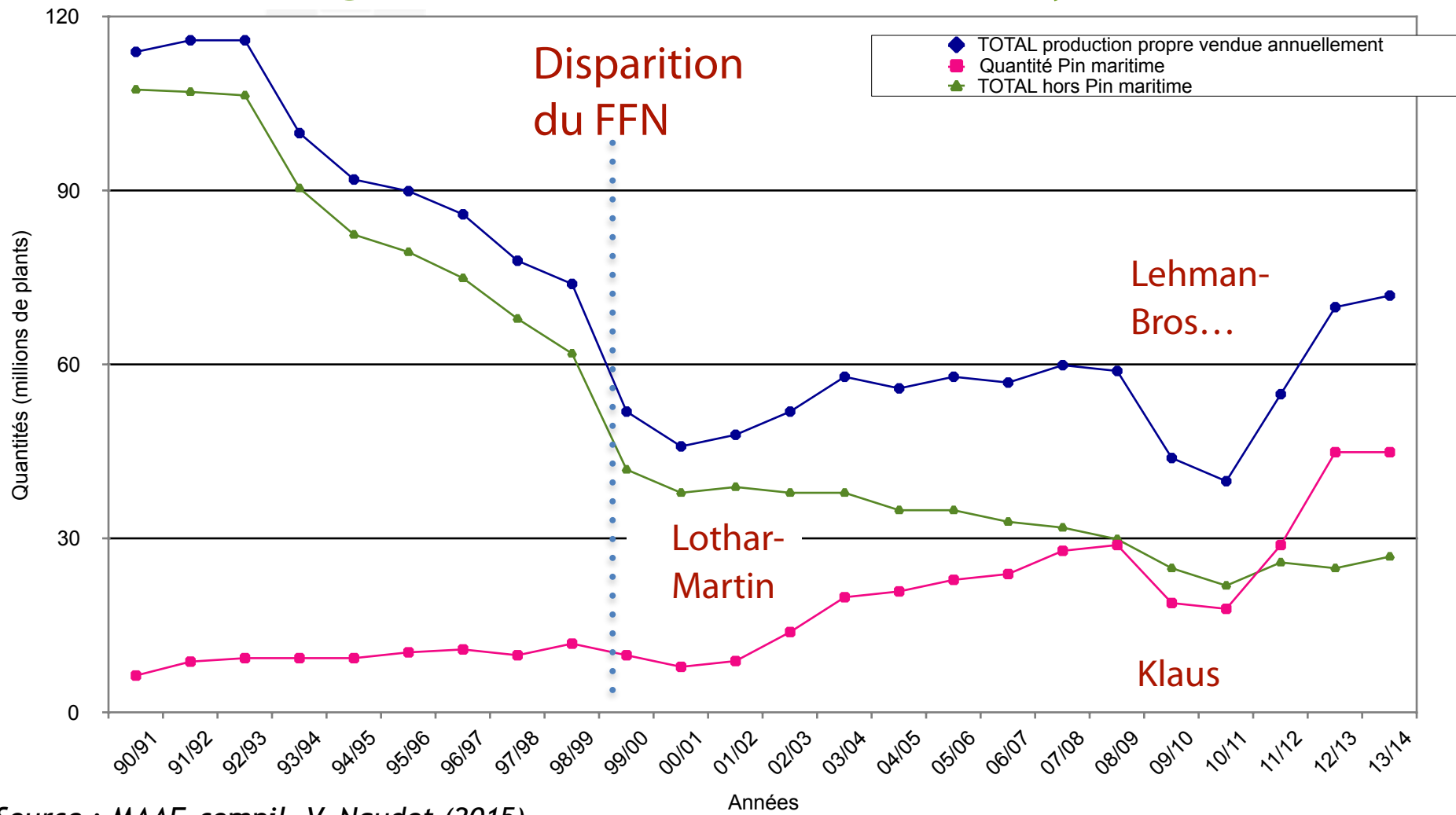


Fig. 6. Part de volume coupé et de surface forestière des six zones dans le total national

Historique des ventes de plants forestiers : divergence Aquitaine/reste du pays



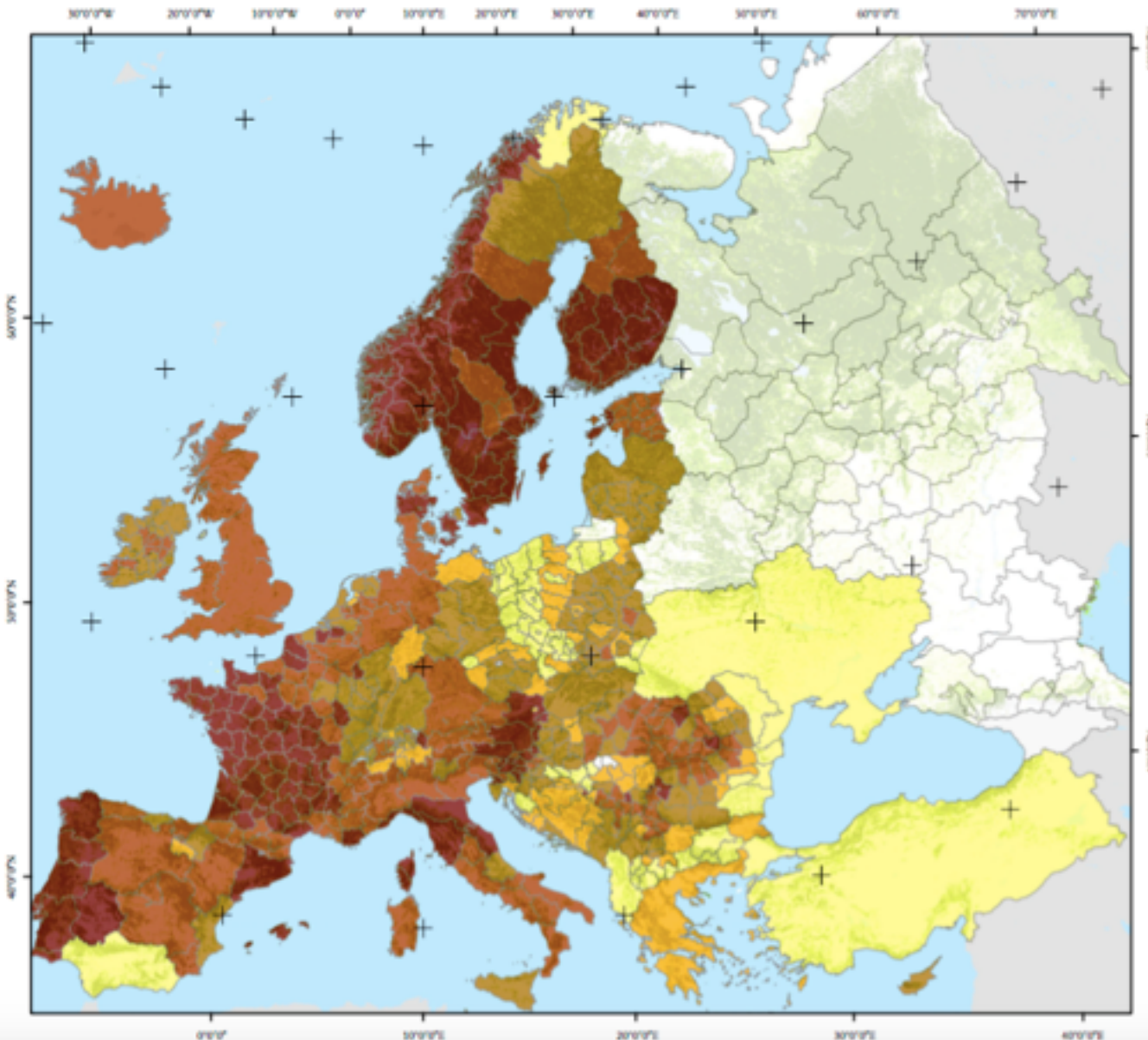
Source : MAAF, compil. V. Naudet (2015)

Hétérogénéité de la propriété



EUROPEAN FOREST INSTITUTE

PRIVATE FOREST OWNERSHIP MAP OF EUROPE



FOREST MAP OF EUROPE

Recommended citation for the forest ownership map of Europe:

Pelle, P., Schuck, A., Verbeke, P. J., Lüssem, B., Marchetti, M. and Green, T. 2013. Mapping the distribution of forest ownership in Europe. EPI Technical Report 88, 92 p.

Forest ownership data

Compiled from official national and international information sources on private, public and other forest ownerships (publications, websites and information portals)

Private ownership

Forest owned by individuals, families, communities, private co-operatives, corporations and other business entities, private religious and educational institutions, pension or investment funds, NGOs, nature conservation associations and other private institutions. (FAO 2010)

References

FAO 2010. Global Forest Resources Assessment 2010. Terms and Definitions. Working Paper 144/5, 27 p. Food and Agriculture Organization of the United Nations, Rome.

Goris, K., Plummer, K., Zudin, S. and Zudin, E. 2012. Forest map of Europe. European Forest Institute. http://www.efi.int/journal/virtual_library/information_services/mapping_services/forest_map_of_europe/



0 250 500 Kilometers
EPSG:31466 Lambert Azimuthal Equal Area projection

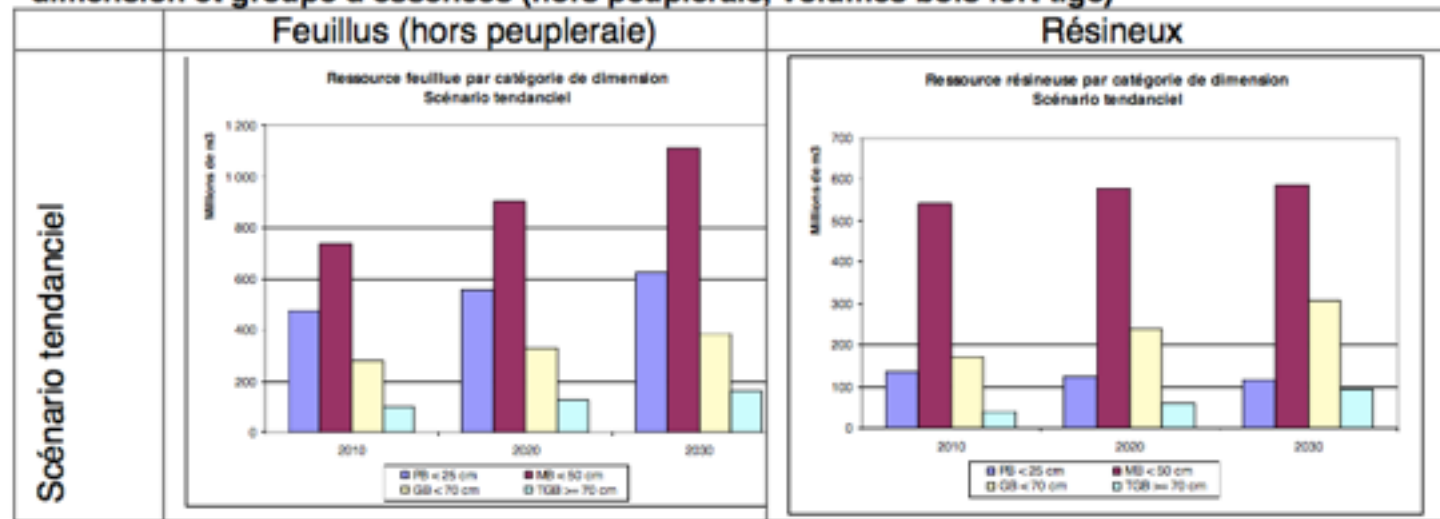


The way forward ?

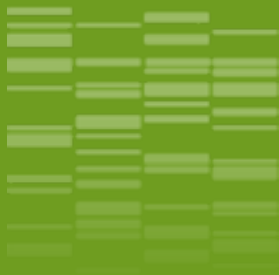
Main uncertainty until 2030 : actors' management behaviour

Present trend :
accumulation
of hardwoods
and large-size
conifers

Figure 3 : évolution du volume sur pied avec le scénario tendanciel, ventilé par catégorie de dimension et groupe d'essences (hors peupleraie, volumes bois fort tige)



Source : IGN
(Colin, 2014)



4th Foresight (2015)

Sustainable Agriculture, Forestry and Fisheries in the Bioeconomy - A Challenge for Europe

5

Conclusions

Management change : why and how ?

- ❖ Climate challenges **drive** forest management change :
 - ❖ Monitor/analyse local damages, anticipate large-scale crises
 - ❖ Increasingly rely on existing and new planted forests
 - ❖ Enhance resilience at $\neq$ levels of management systems
 - ❖ Achieve higher degree of forestry-wood chain integration
 - ❖ Optimize the use of the world's wood fibres and energy
 - ❖ Much more targeted & efficient use of forest land
- ❖ Some general rules for change ?
 - ❖ No obvious, no *one-size-fits-all* solutions : **diversify options**
 - ❖ **Multi-scale**, adaptive resource **management planning**
 - ❖ **Ecological intensification** ($\neq$ close-to-nature forestry)

Durabilité, circularité, performance

- ❖ Durabilité :
 - ❖ planifier : combinaison de services, ≠ voies de **diversification**
 - ❖ **resilience** : révolutions + courtes, exploitation faible impact...
 - ❖ **information** : inventaires, monitoring, traçabilité
- ❖ Usage en cascade & circularité :
 - ❖ respecter une **hiérarchie** d'usages (autant que possible)
 - ❖ favoriser des **variétés naturellement durables** (ex. robinier)
 - ❖ recyclage de cendres de chaufferies, gestion fertilité...
- ❖ Performance :
 - ❖ créer de nouvelles variétés, réviser les critères de sélection...



Bio-based Economy: feedstocks, processes and products (without food & feed)

