Resource management planning and ecological intensification to address climate challenges in French forestry

Jean-Francois Dhote, Barry Gardiner, Jean-Michel J.-M. Leban, Myriam Legay, Brigitte Musch, Christine Deleuze, Claudine Richter

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PARIS2015
UN CLIMATE CHANGE CONFERENCE
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Jean-François Dhôte, Barry Gardiner, Jean-Michel Leban (INRA), Myriam Legay, Brigitte Musch, Christine Deleuze, Claudine Richter (ONF)

Conférence franco-chinoise sur l'agro-écologie dans le contexte du changement climatique
Pékin, 3-5 juin 2015

3 Jun 2015

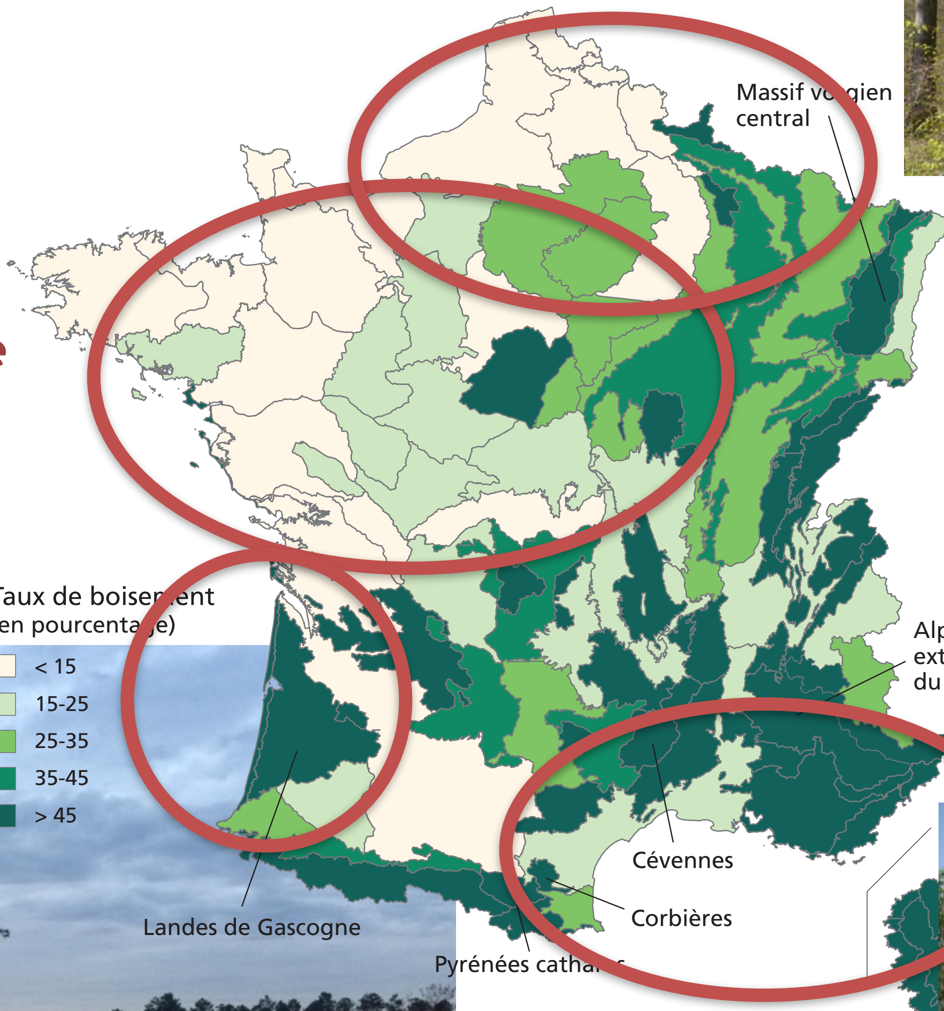
Objectives of the talk

- General background :
  - increasing world population → demand for wood-based products
  - forests provide an increasing range of products and services
  - forests are under pressure from other land-uses
  - supplying world's demand is a huge challenge to the sector
  - integrated response to climate change : adaptation, mitigation, ecosystem service regulation
- Climate change and the case of French temperate forests :
  - **natural regeneration**, large-size timber, **long rotations**
  - **imitation of nature** (Lorentz & Parade, 1837) → « *close-to-nature forestry* »
  - ➡ outline some challenges for forest **management planning**
  - ➡ define **ecological intensification** to meet these challenges

Highly diverse forest types

Oaks, Scots Pine (lowlands)

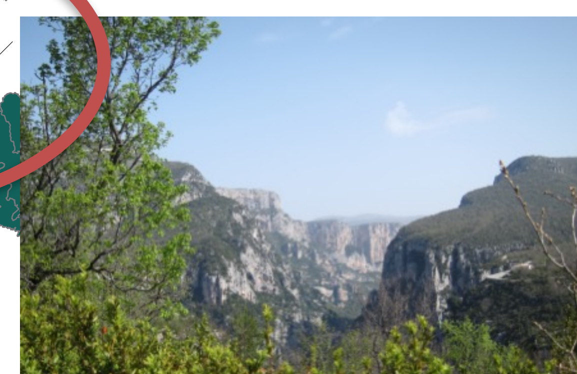
Beech



Fir, spruce, larch (mountains)

Maritime Pine

Mediterranean forests



Source : Memento (IGN, 2015)

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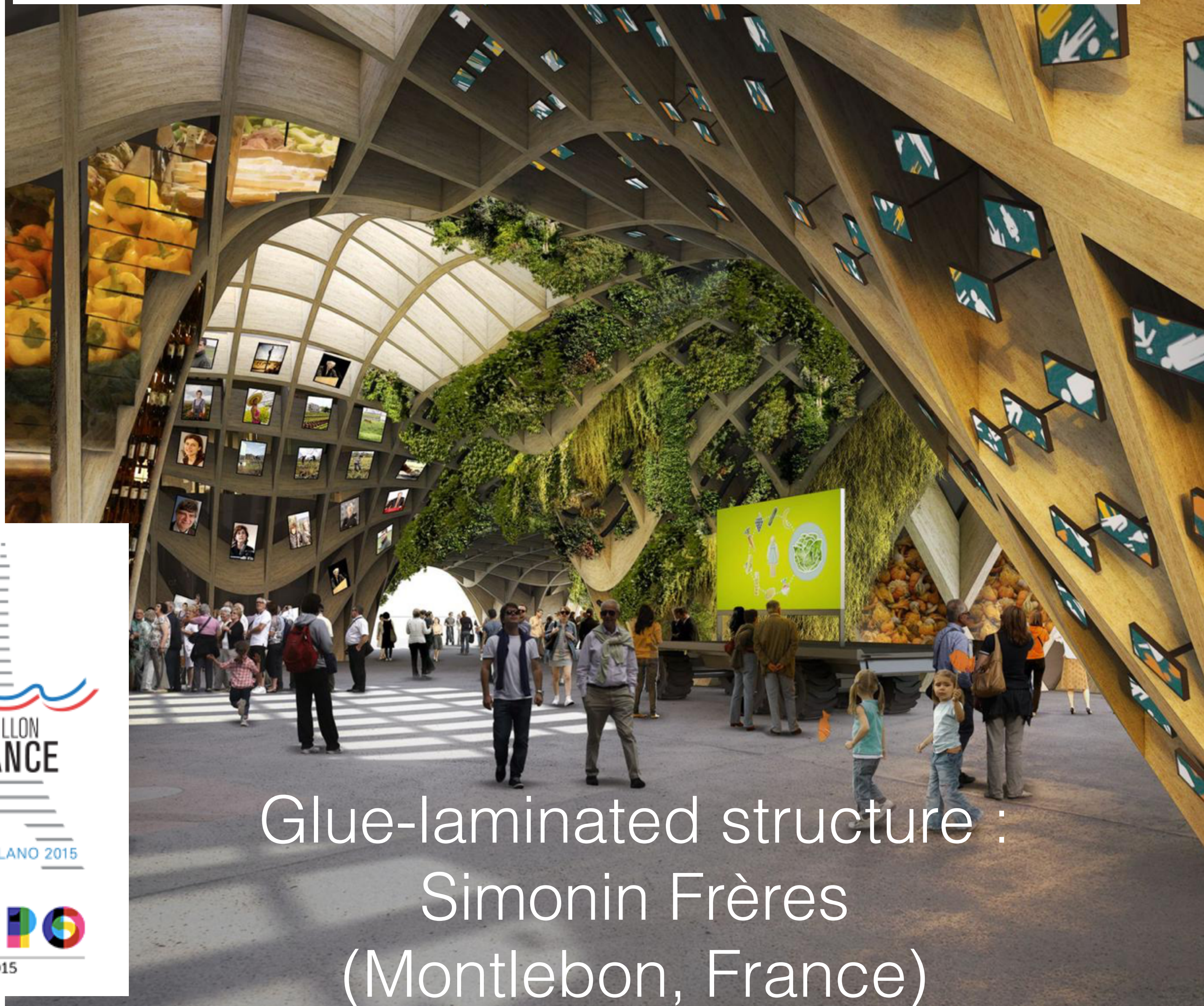
Mitigate climate change : timber marketing, sawmilling efficiency, innovation for harvesting

Various technologies to value wood : from high-tech properties to energy

as building material ;
toll-station, motorway A89 (Limoges)

as bioenergy ;
Planoise district heating - 13 000 t/year (Besançon)

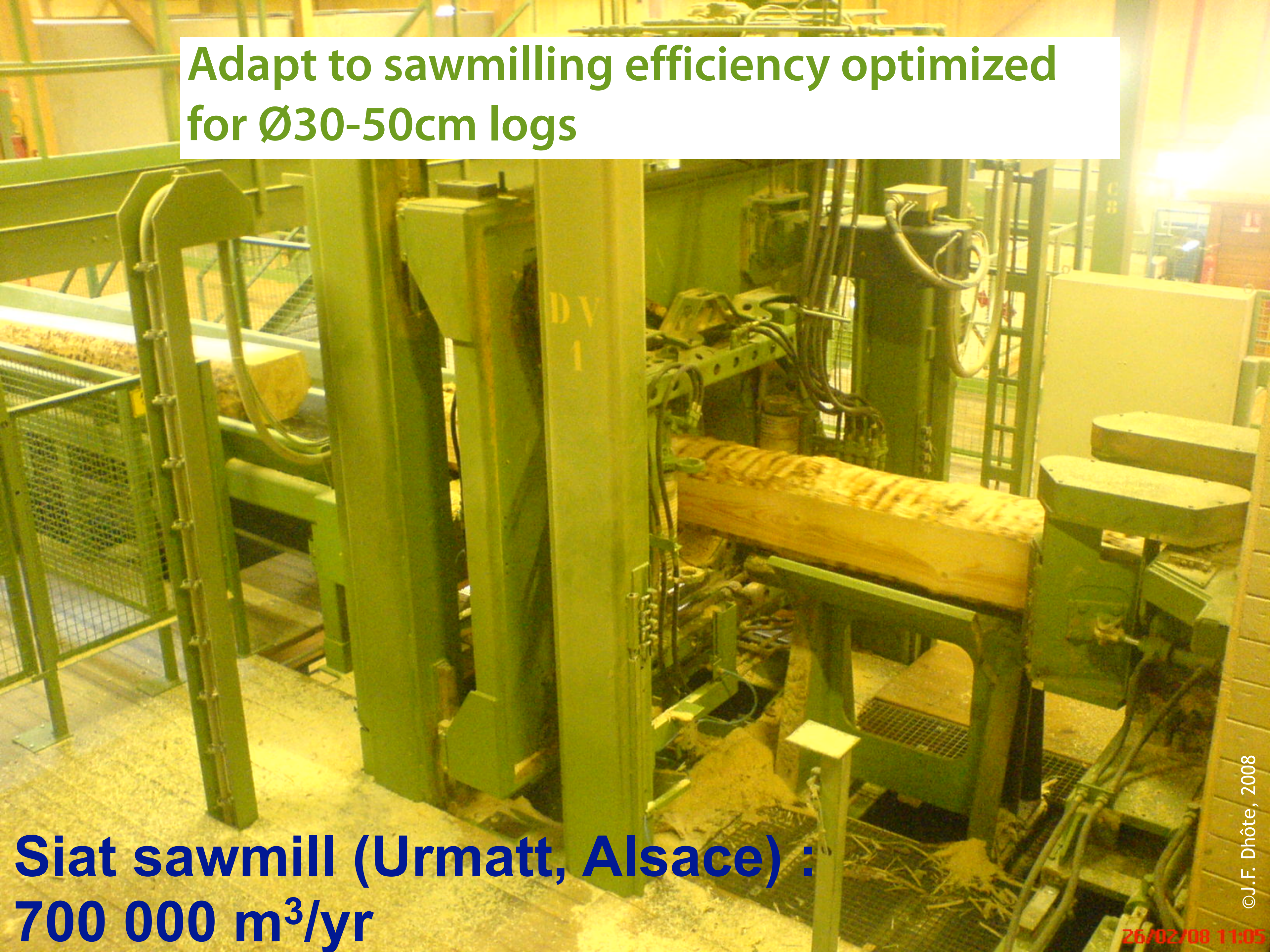
Favour wood design in emblematic buildings



Glue-laminated structure :
Simonin Frères
(Montlebon, France)

PAVILLON FRANCE
EXPO MILANO 2015
EXPO
MILANO 2015

Adapt to sawmilling efficiency optimized for Ø30-50cm logs

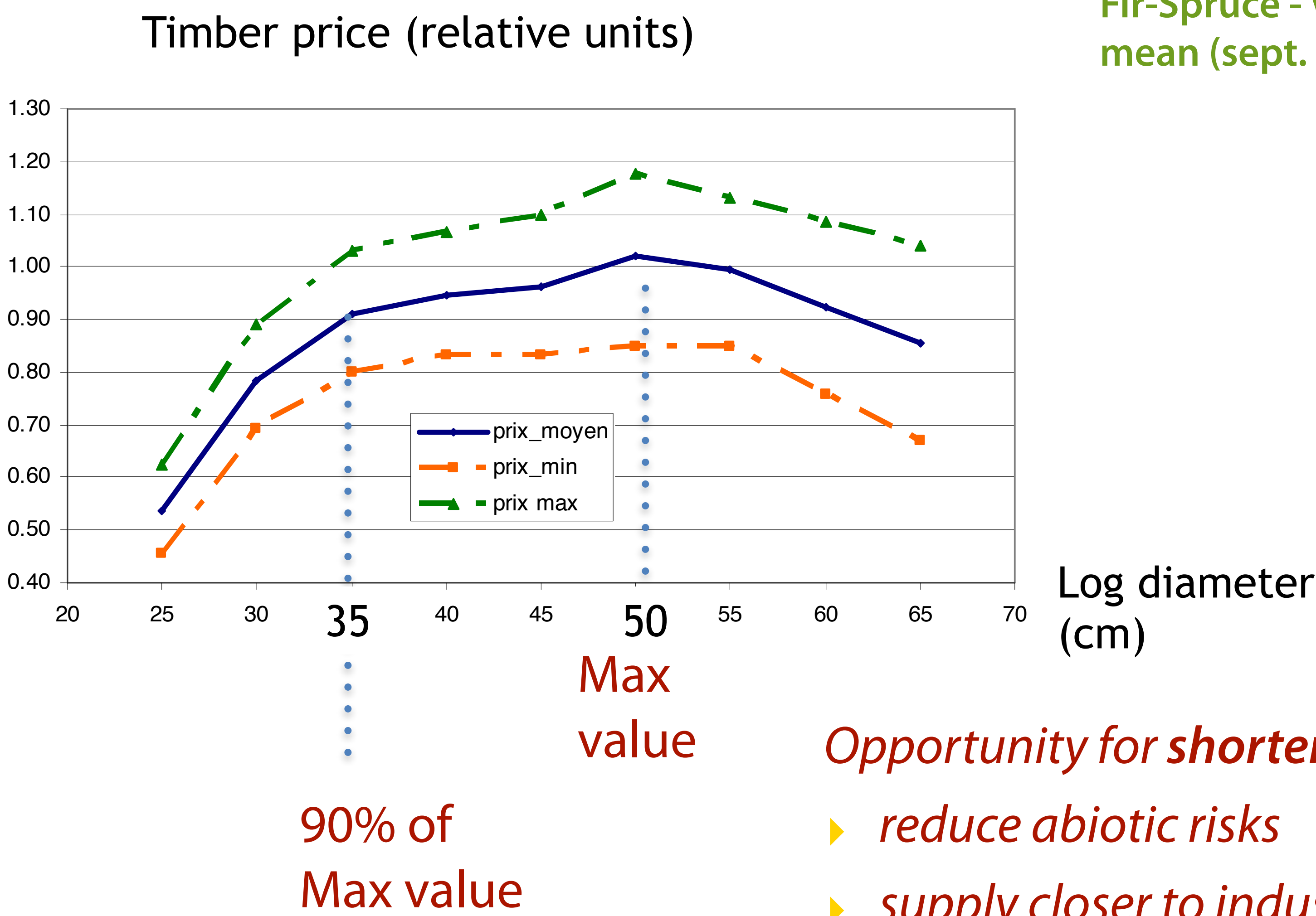


Siat sawmill (Urmatt, Alsace) : 700 000 m^3/yr

Conifer value curve reflects sawmilling process

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

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



*Opportunity for **shorter rotations** :*

- *reduce abiotic risks*
- *supply closer to industrial demand*

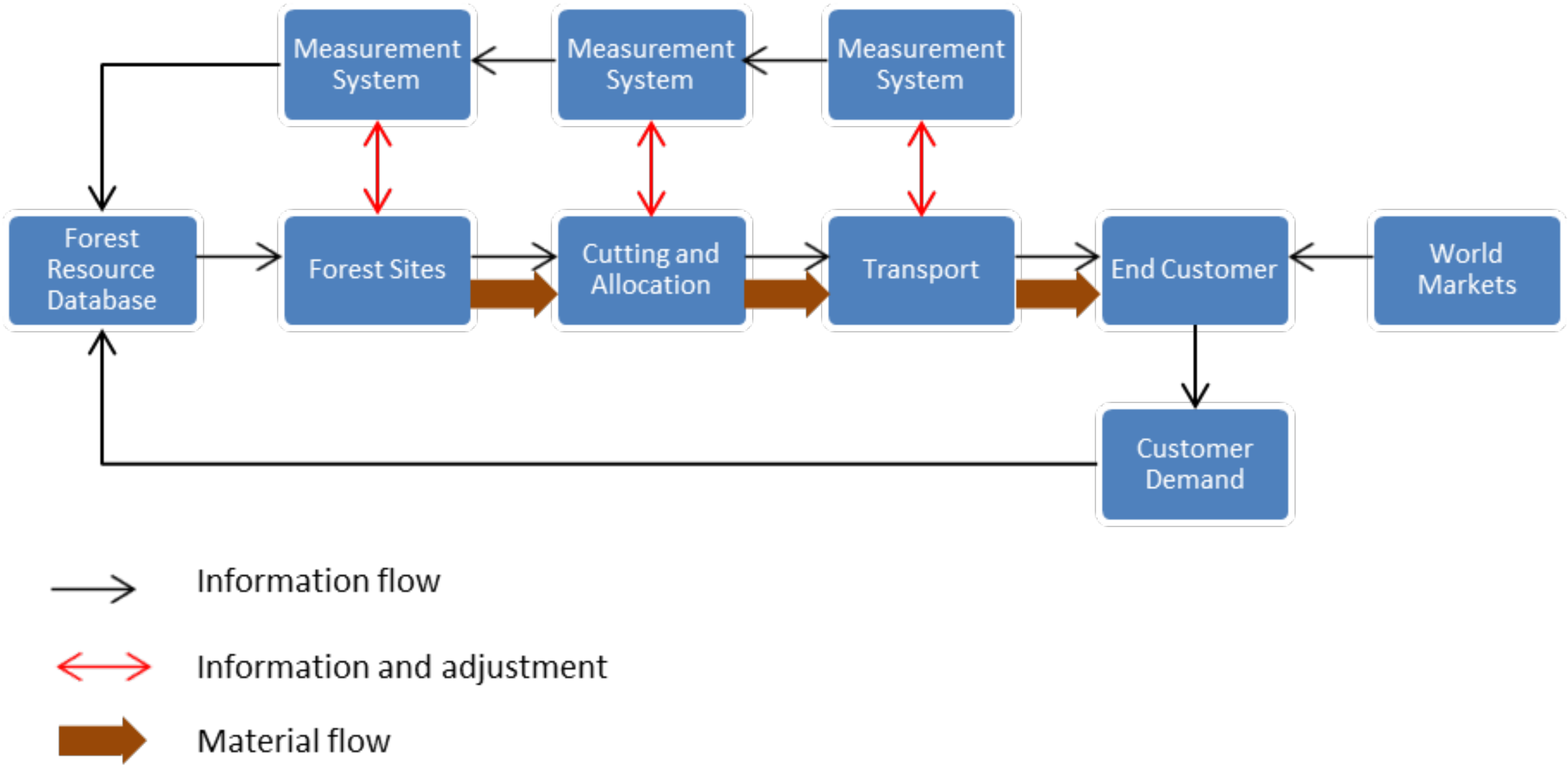
Innovation for harvesting

Sources : FCBA (E. Cacot, 2014) & ONF (E. Ulrich, 2014)

- prevent soil compaction : machine design and harvest optimal scheduling
- hardwood harvesting, work on slopes
- using data provided by harvesters

Avoir de nouveaux systèmes
techniquement et économiquement viables !

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



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Multi-scale, large-magnitude risks : prevent and mitigate damages

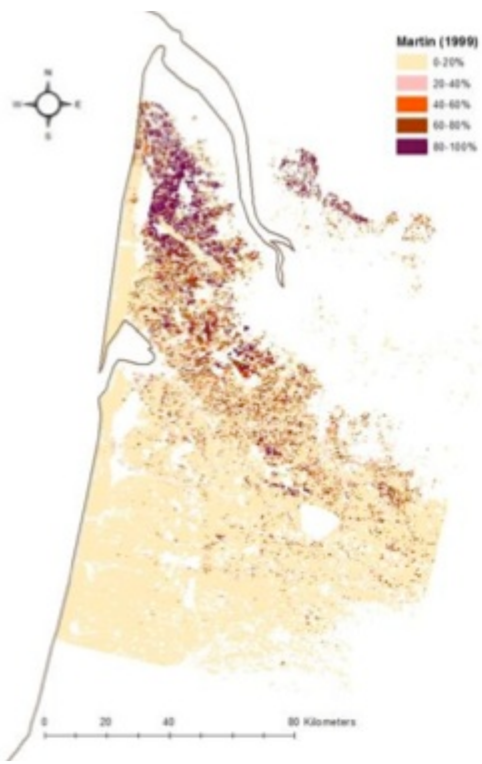
Local-scale impacts

Scattered Beech dieback at Fontainebleau (sept. 2011)

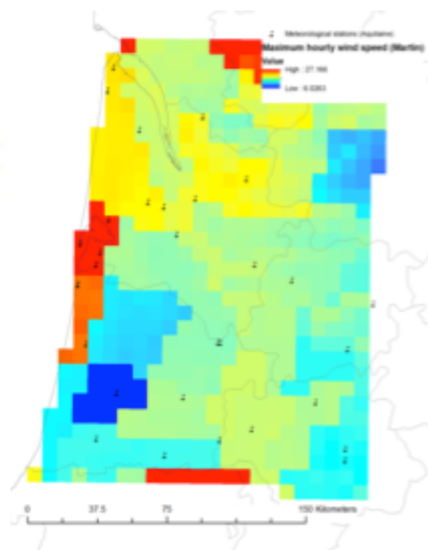
Forest-scale impacts

Prevent degradation resulting from combined damages :
heavy loss of volume & carbon
degraded protection service
increased costs for the society

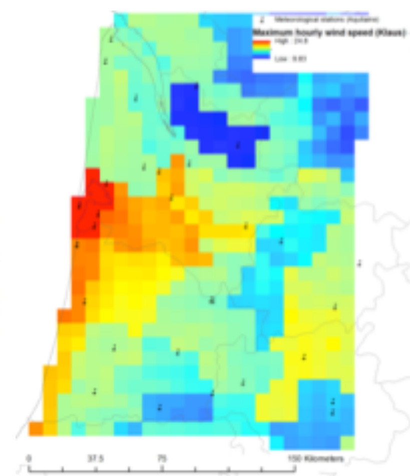
Regional-scale impacts → forestry-wood chain destabilization (eg storms)



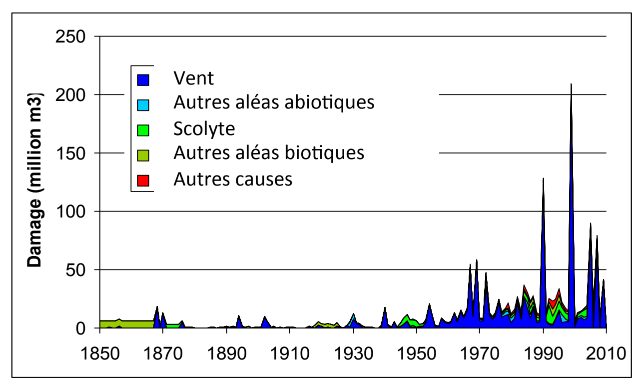
Tempête Martin (1999) perte de 24 millions de m³ de pin maritime



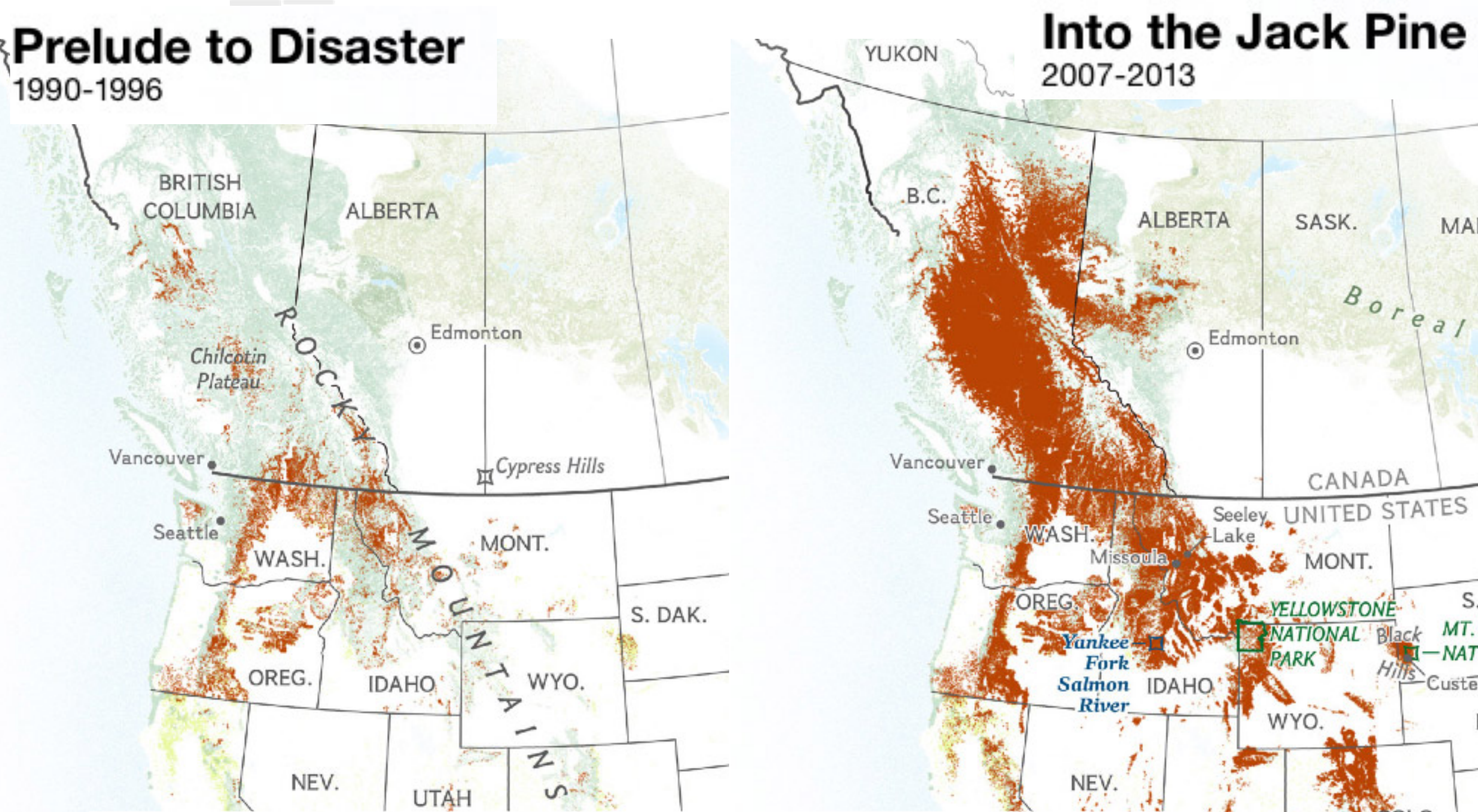
Tempête Klaus (2009) : perte de 43 millions de m³ de pin maritime



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

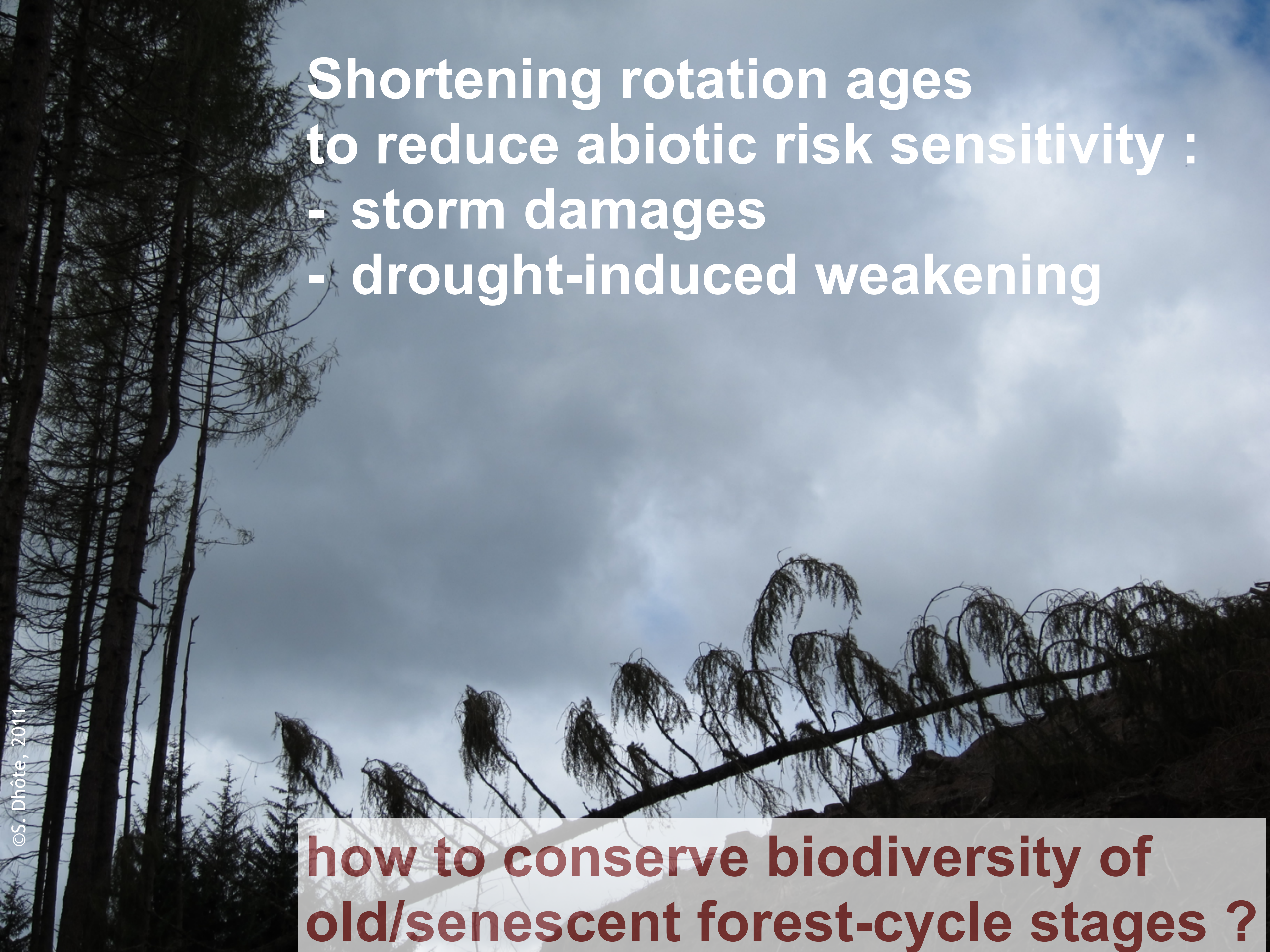


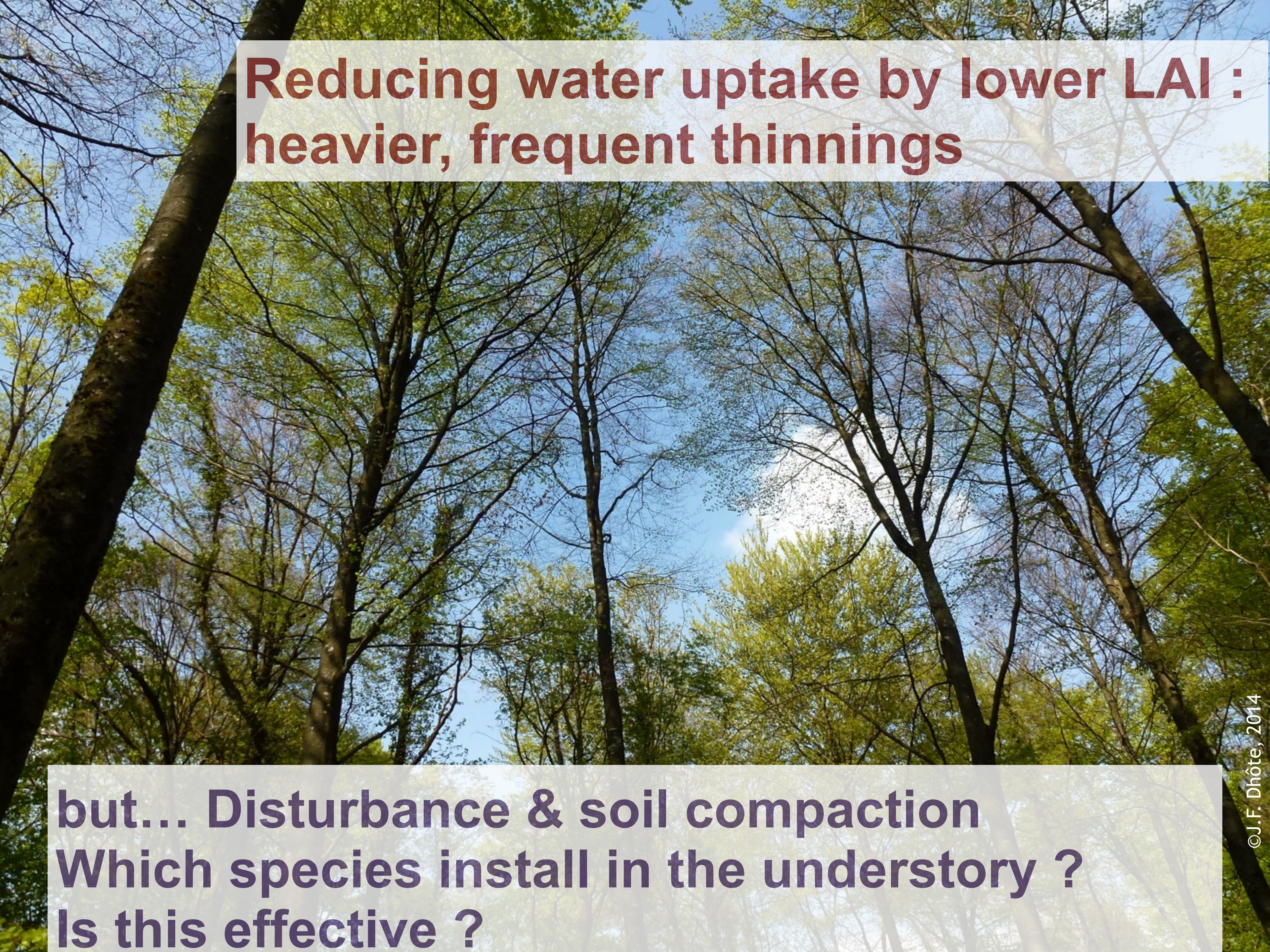
From regional to continental-scale disturbances



Mountain Pine Beetle outbreak in Western North America

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


Shortening rotation ages
to reduce abiotic risk sensitivity :
- storm damages
- drought-induced weakening
how to conserve biodiversity of
old/senescent forest-cycle stages ?
©S. Dhôte, 2011


Reducing water uptake by lower LAI :
heavier, frequent thinnings
but… Disturbance & soil compaction
Which species install in the understory ?
Is this effective ?
©J.F. Dhôte, 2014


Favouring mixed stands…
mixtures are eventually more productive, and more resistant against biotic hazards
©S. Dhôte, 2012

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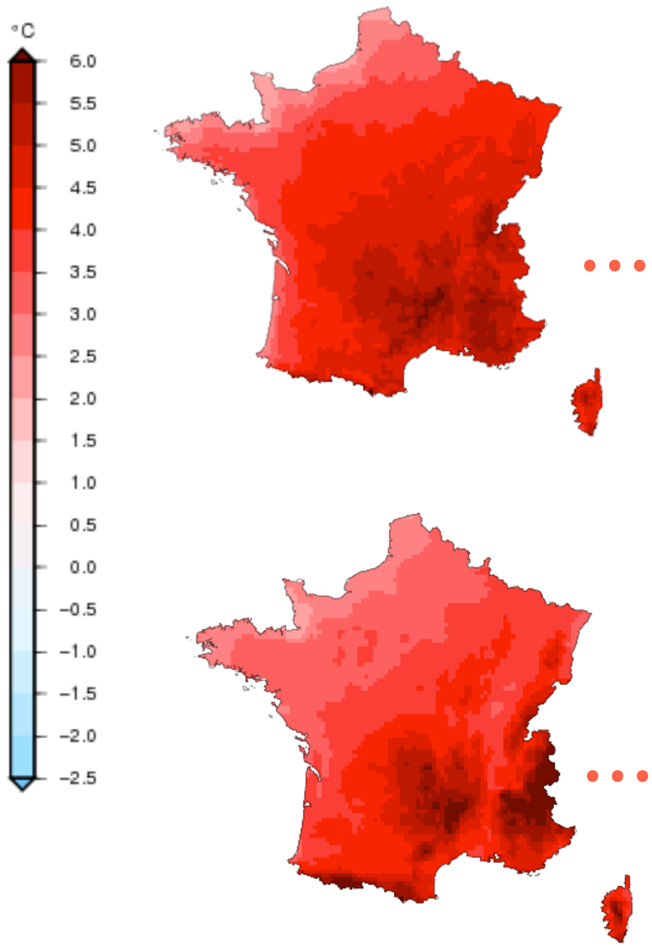
Uncertainty and adaptation : explore/ combine ≠ diversification options

Uncertainty : for which climates to adapt ?

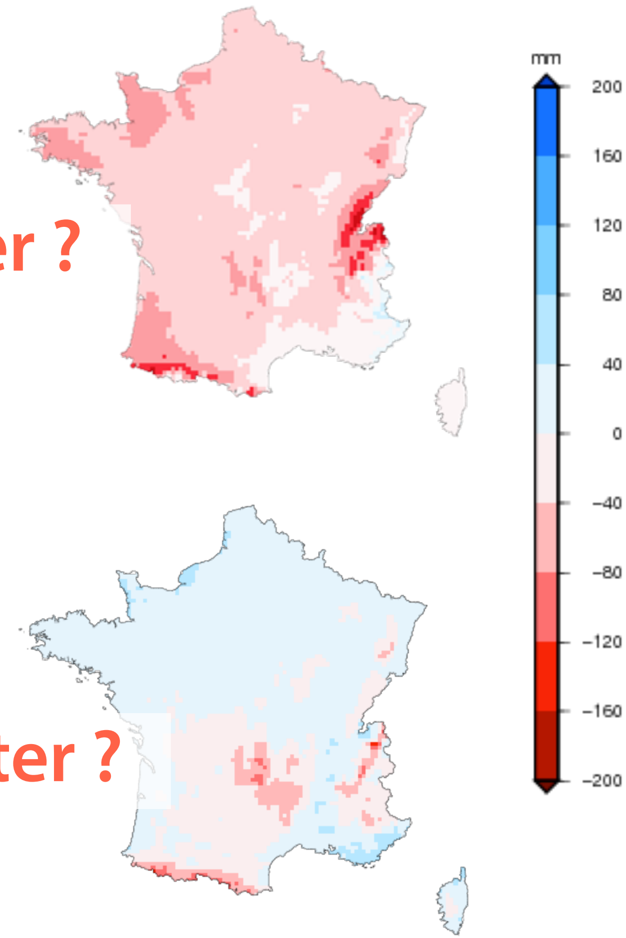


…warmer and dryer ?

Aladin

…warmer and wetter ?

LMDz1

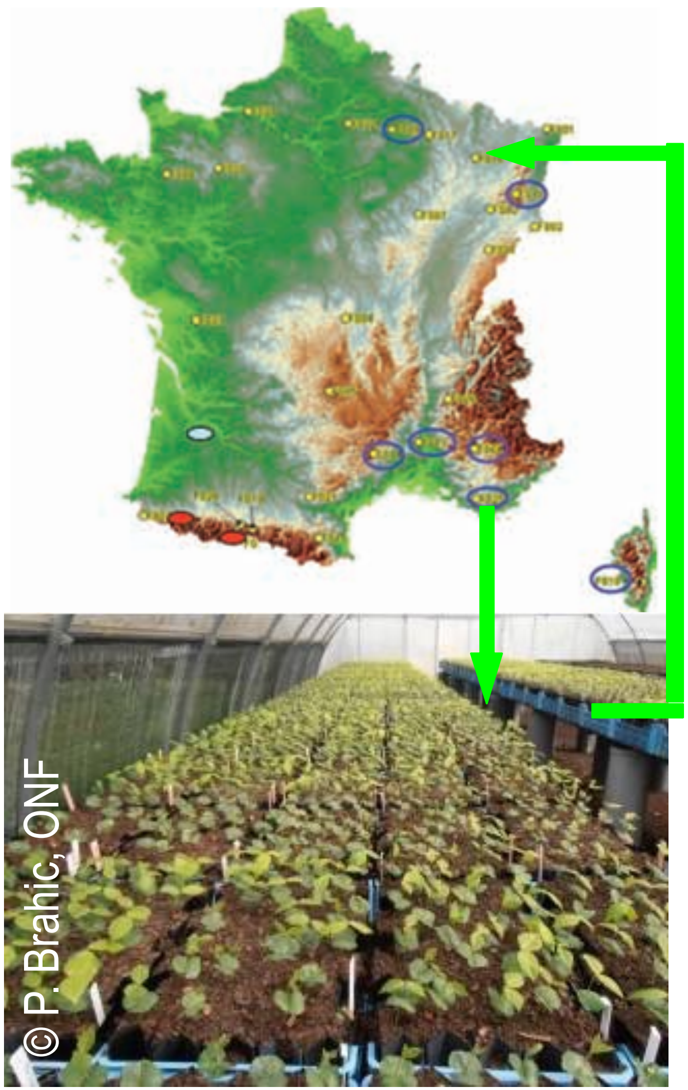


Anomaly of **summer temperature**
2100, models Aladin et LMDz
scenario A1B

Source : M. Legay (2012)

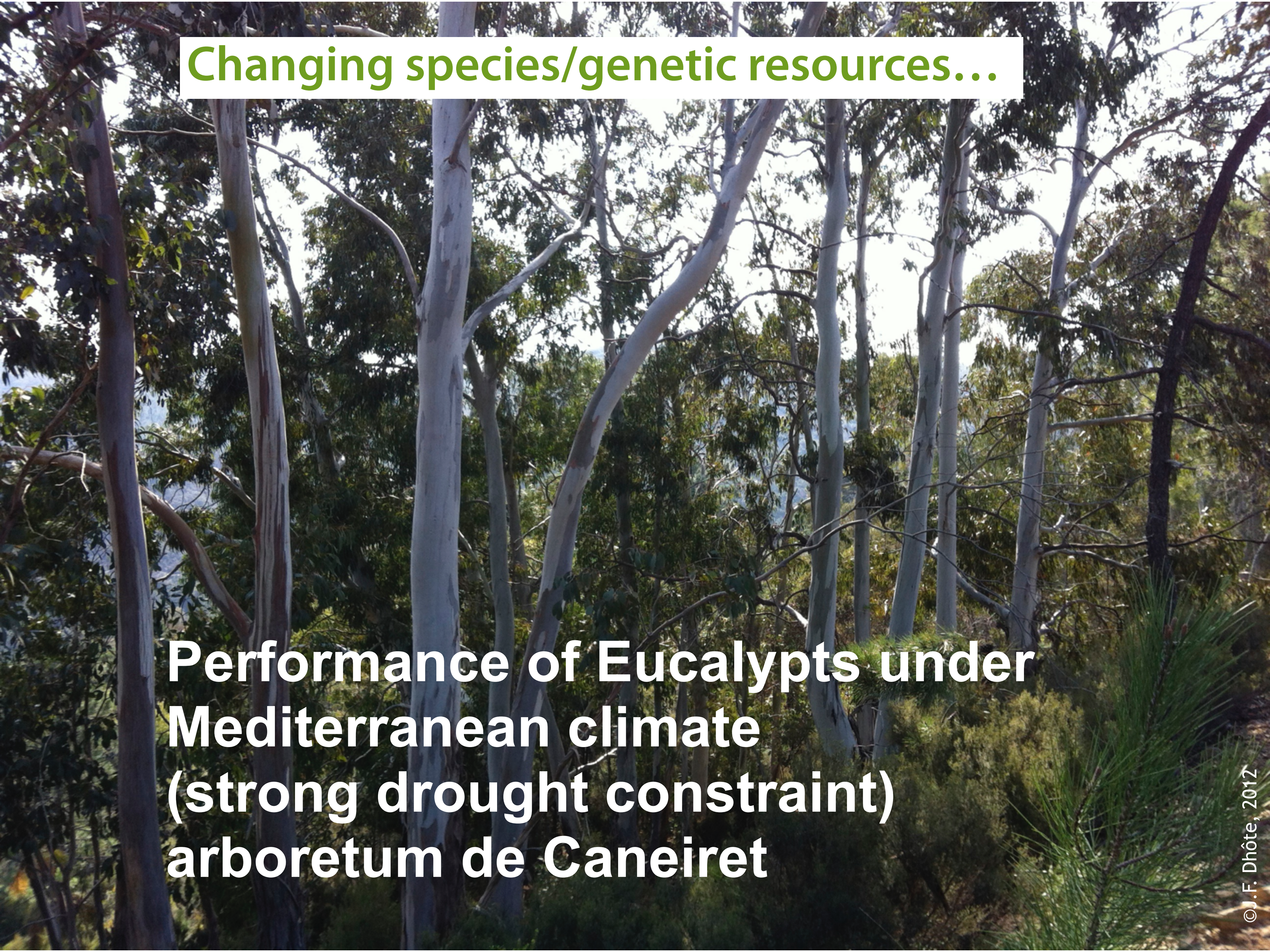
Anomaly of **summer rainfall**
2100, models Aladin et LMDz
scenario A1B

Changing species/genetic resources… : moving provenances polewards



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**


Changing species/genetic resources…
Performance of Eucalypts under
Mediterranean climate
(strong drought constraint)
arboretum de Caneiret
©J.F. Dhôte, 2012

Changing production systems : e.g. product-targeted, short-rotation silviculture

Nombre de placettes par modalité

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

Source : ONF (Richter, 2014)

Planning forests with ≠ ways to regenerate

Special case : Oak forests

- Natural regeneration *« as usual »*
  - Special case : genetic resource conservation
- Same with very short rotation
- Planting southern provenances
- Planting related species to favour hybrids
- Introducing acclimated species
- Introducing exotic species

Planning forests with ≠ rotation ages

- Long rotations for *mainstream* forestry & conservation :
  - Standard rotation age : ≈ optimal silviculture
  - Longer rotation : ageing areas (delayed harvesting)
  - No rotation age : senescence areas and biological reserves (no more harvesting)
- Short rotations for specific management objectives :
  - product-oriented silvicultures to decrease harvesting pressure on *mainstream* forestry : bioenergy, small sawlogs…
  - increase adaptability : fasten genetic turn-over
  - handle species with present vitality ≠ long-term viability prognosis

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Conclusions

Conclusions (1/2)

- 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 ≠ 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** (≠ close-to-nature forestry)

Conclusions (2/2)

- Multi-scale, adaptive resource management planning :
  - Combine ≠ ways of **diversification** : plantation/natural regeneration, mixtures, production systems, rotation ages…
  - Support **resilience** : shorter rotations, liming, low-impact harvesting, logistics (fight against storms, wildfires)…
  - **Information** : inventories, monitoring, product processing
  - Funding, priority setting and **investment** allocation
- Ecological intensification :
  - make **more efficient use** of natural and man-induced **cycles**…
  - of matter, energy and information…
  - in **ecosystems** as well as in the emerging **bioeconomy**

谢谢你的关注

Thank you for your attention

Merci

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Annexes

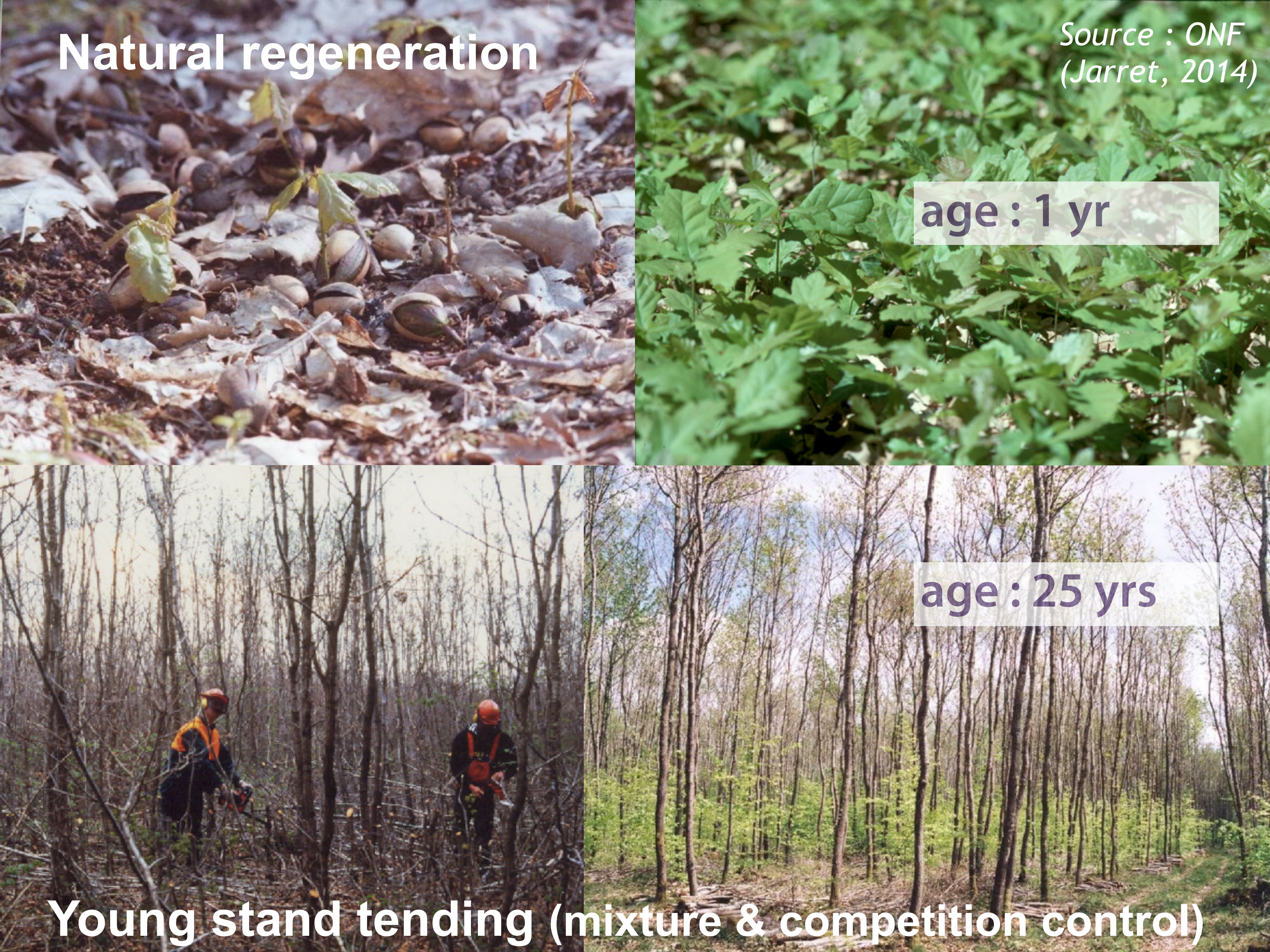
French forests in a nutshell

- 16,5 millions hectares (30% of country area)
- + 8 M ha in French Guyana
- 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 m^3, **64% hardwoods**, 36% conifers
- Summary of flux (average 2005-13)
  - Raw production : 91,5 Mm^3/yr
  - Mortality : 8,5 Mm^3/yr
  - **Harvest** : 41,4 Mm^3/yr (**50%** of net increment)
  - Stock increase : 41,4 Mm^3/yr

Source : IGN (2015)

Final harvest in highest-quality Oak Forests rotation age : 180 to 250 years

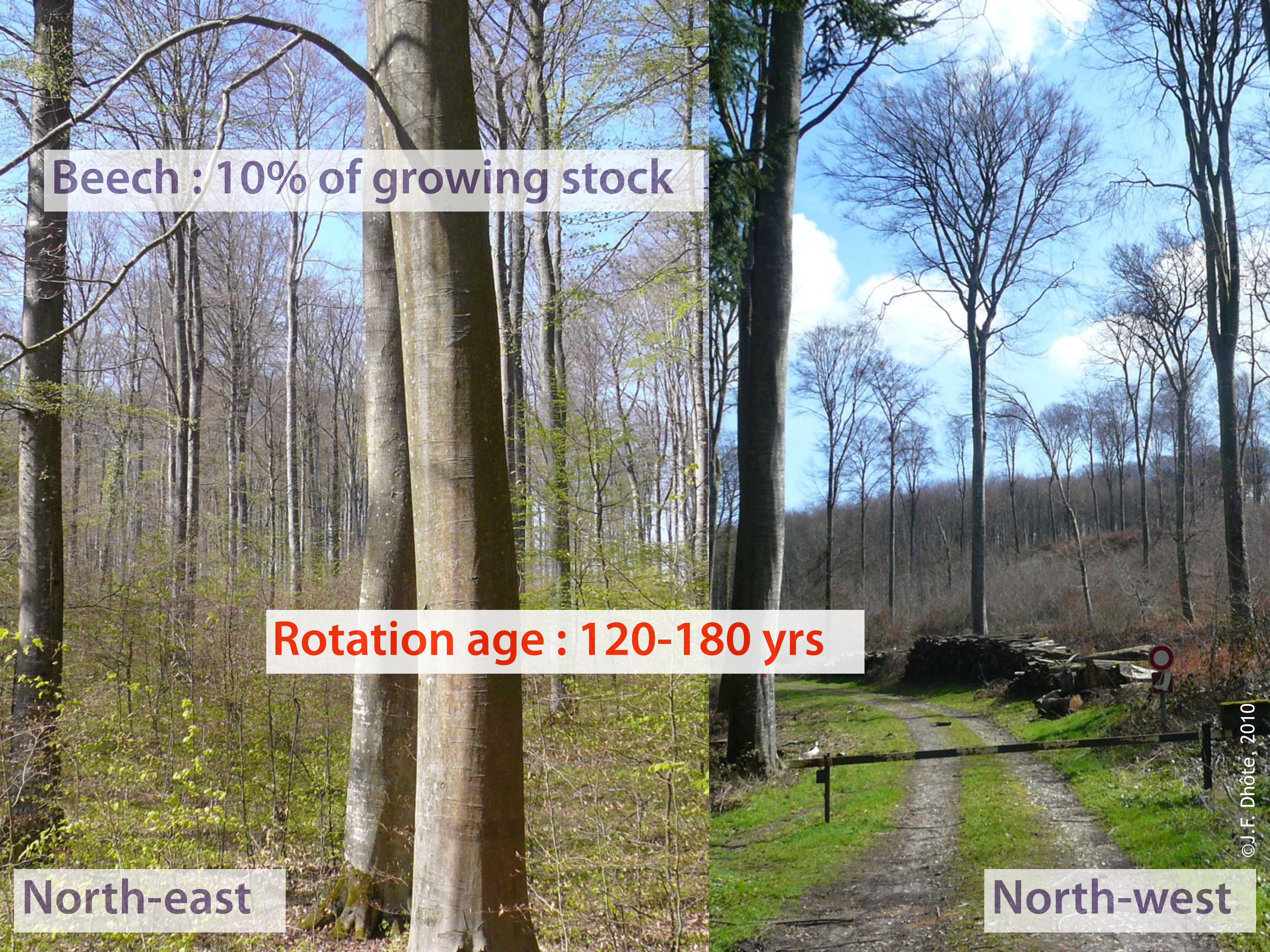
Source : ONF (Jarret, 2014)


Natural regeneration
Source : ONF
(Jarret, 2014)
age : 1 yr
age : 25 yrs
Young stand tending (mixture & competition control)

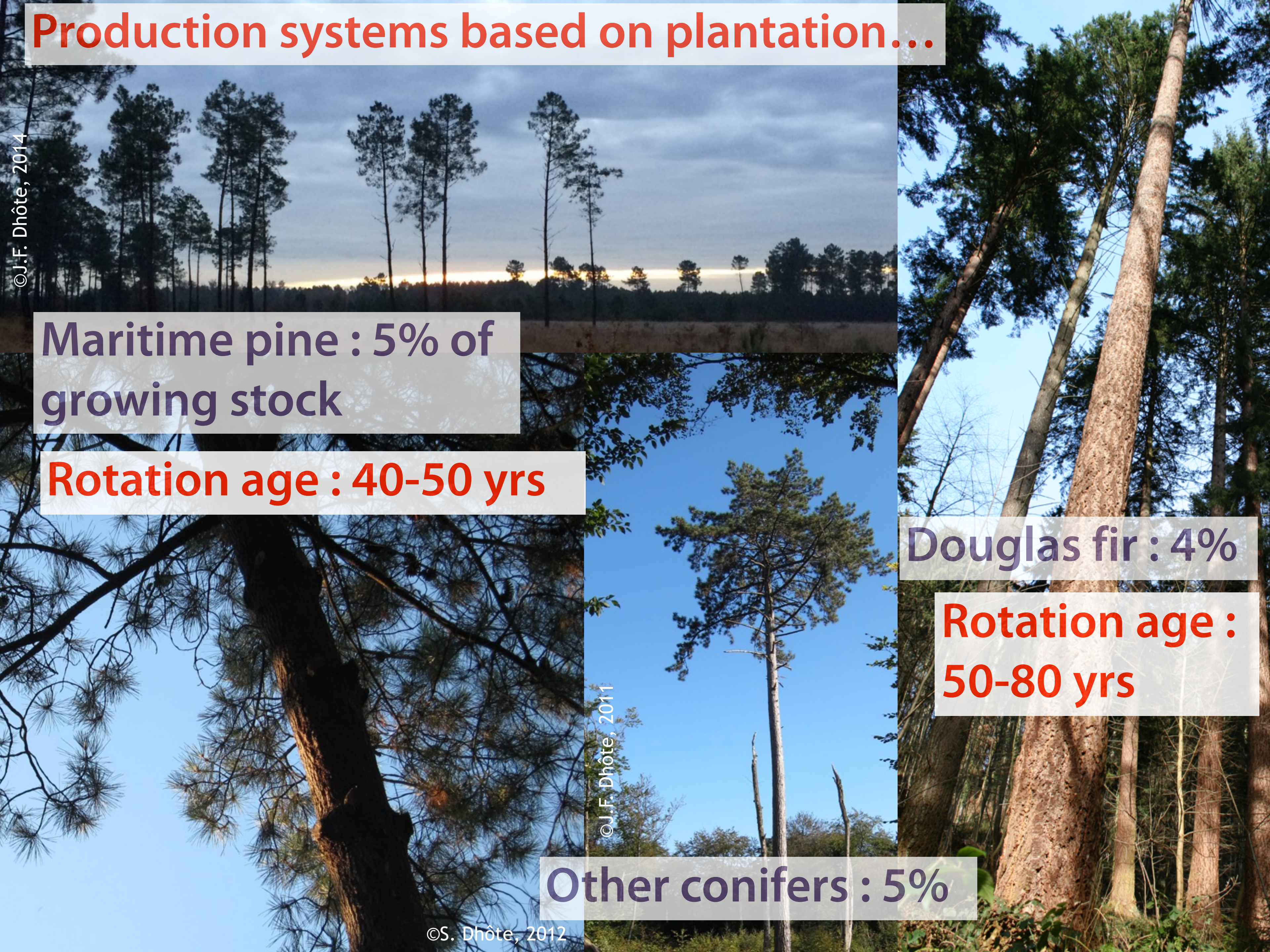
Present best products : barrel manufacturing

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 ?

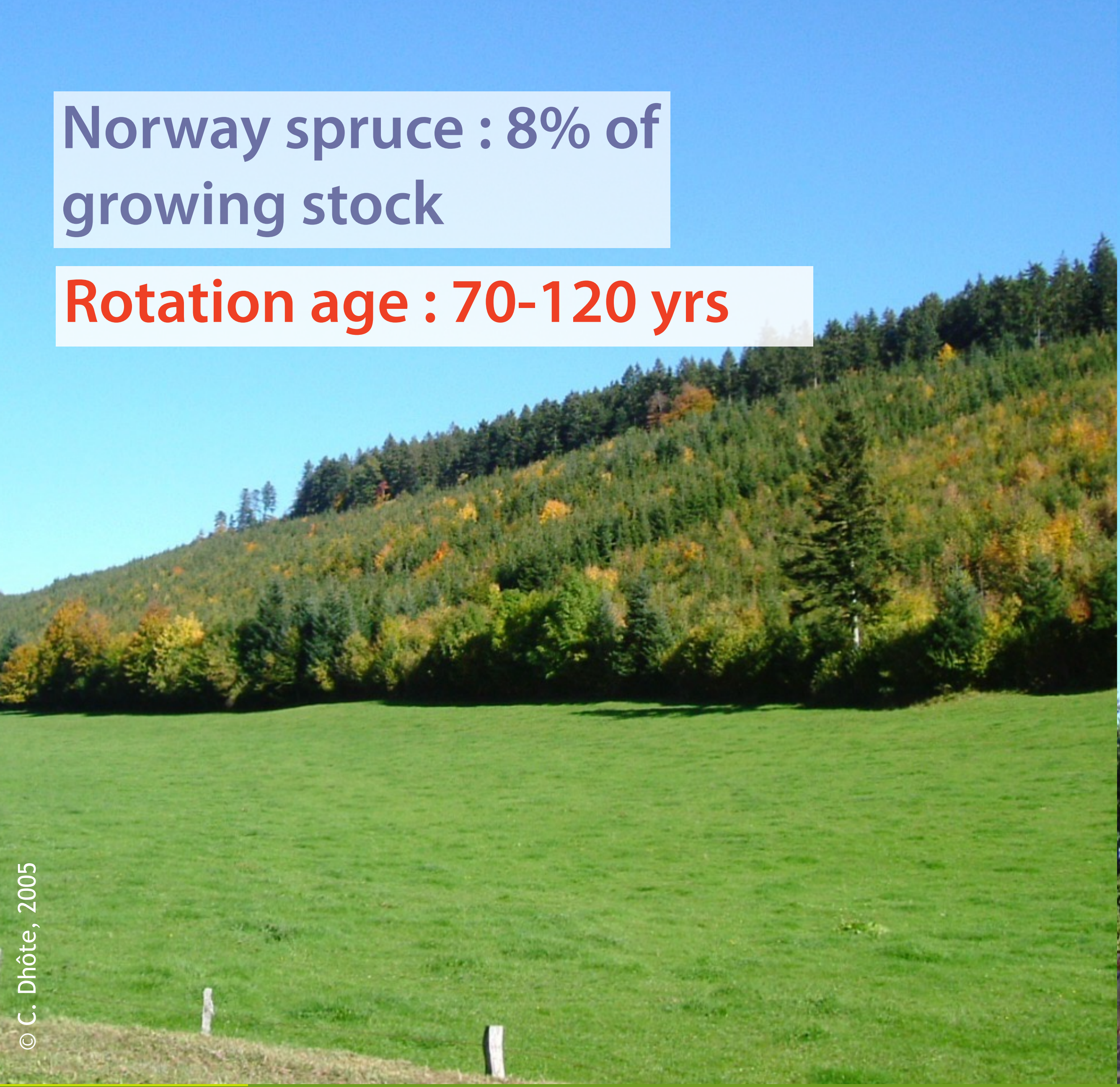

Beech : 10% of growing stock
Rotation age : 120-180 yrs
North-east
North-west
©J.F. Dhôte, 2010


Silver fir : 8% of growing stock
Rotation age : 100-150 yrs
Uneven-aged management :
irregular shelterwood system (« *Plenterwald* »)
©J.F. Dhôte, 2010, 2014


Production systems based on plantation…
©J.F. Dhôte, 2014
Maritime pine : 5% of growing stock
Rotation age : 40-50 yrs
©S. Dhôte, 2012
©J.F. Dhôte, 2011
Other conifers : 5%
Douglas fir : 4%
Rotation age : 50-80 yrs

Norway spruce : 8% of growing stock

Rotation age : 70-120 yrs



Rotation age : 15-30 yrs

Hybrid poplar plantations :

1,2% of growing stock (30 M m

1,2% of area (180 000 ha)