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## Modélisation & information pour la gestion des ressources forestières : une problématique du Labex ARBRE

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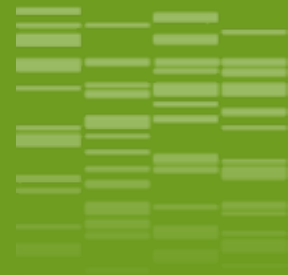
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# Modélisation & information pour la gestion des ressources forestières : une problématique du Labex ARBRE (Nancy)



**Francis Martin, Pascale Frey-Klett, Laurent Saint-André,,  
Jean-François Dhôte (INRA), Jean-Daniel Bontemps (IGN)**

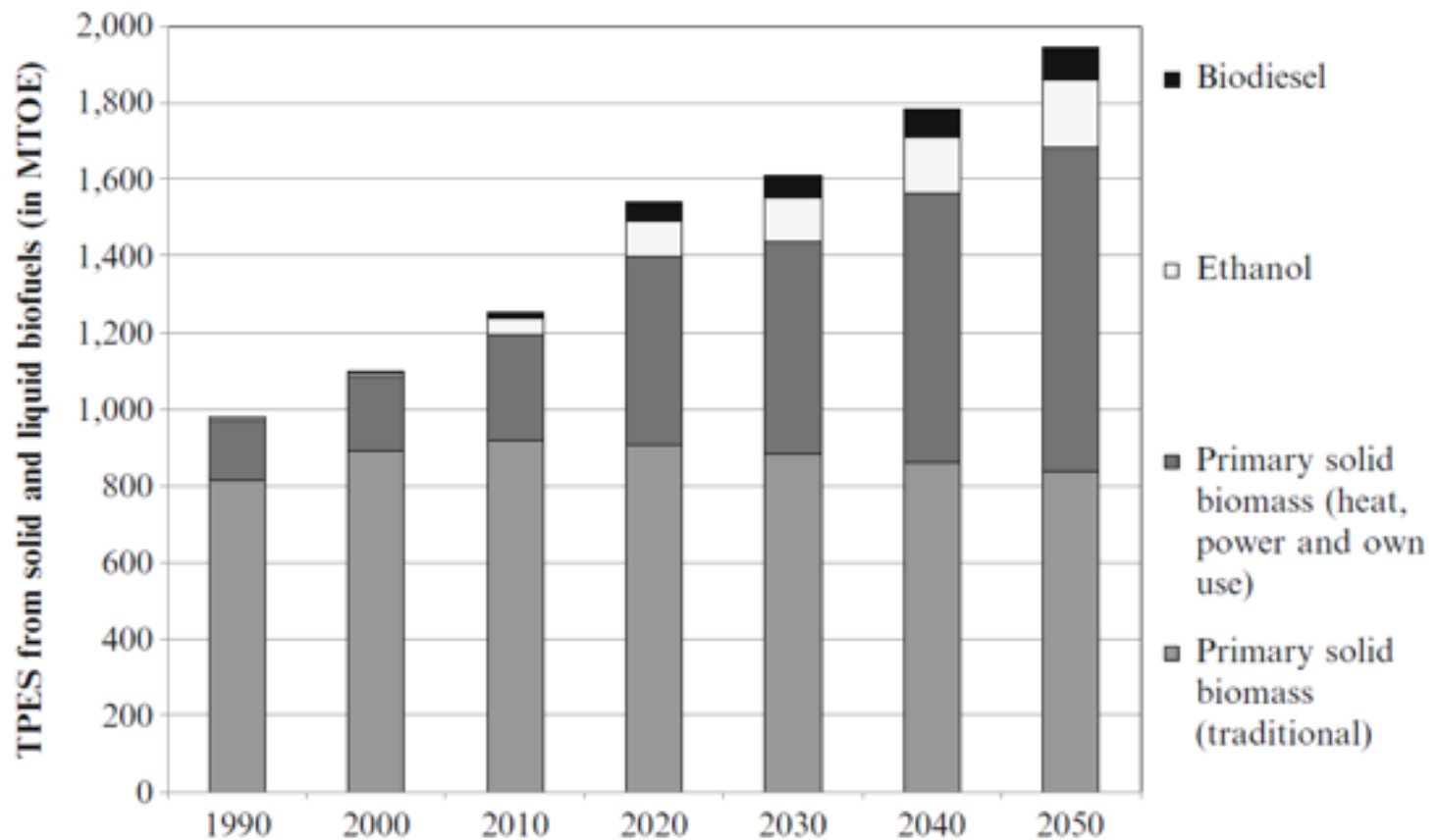


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# Éléments de contexte

**Consommation mondiale de bois en hausse, transitions écologique et énergétique, impacts climatiques systémiques, économie circulaire, gestion de l'information**

# Tendance mondiale Bioénergies → 2050 : les usages émergents vont doubler la mise



Source : Adrian Whiteman, FAO

**Fig. 7** Global trends and projections for solid and liquid biofuel production, 1990–2050 (Source: trends and projections to 2030 derived from Cushion et al. (2010), with an extrapolation to 2050 based on IEA (2012). Note that these figures are for all biofuel and not just biofuels made from wood. MTOE = million tonnes oil equivalent)

# Innovation dans la construction-bois : un fort potentiel de réduction d'émissions GES

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

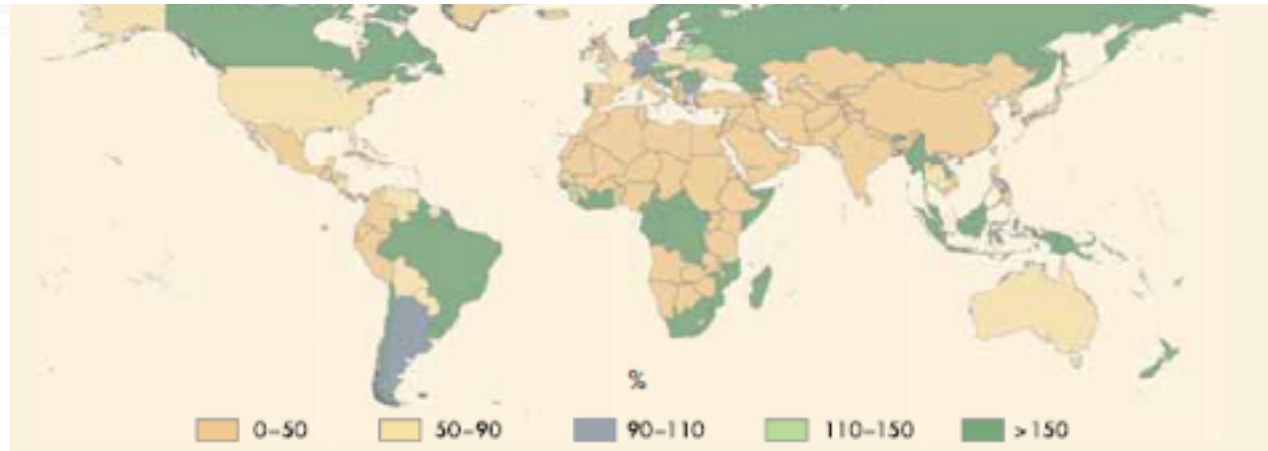


📷 A render of the wooden structures planned for the Baobab development in Paris. Illustration: Michael Green Architecture

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

Philip Oldfield, The Guardian, 7 July 2015

# Commerce des bois sur des marchés mondiaux : enjeux d'innovation & compétitivité



تدفق منتجات الأخشاب في التجارة الأساسية بين الأقاليم

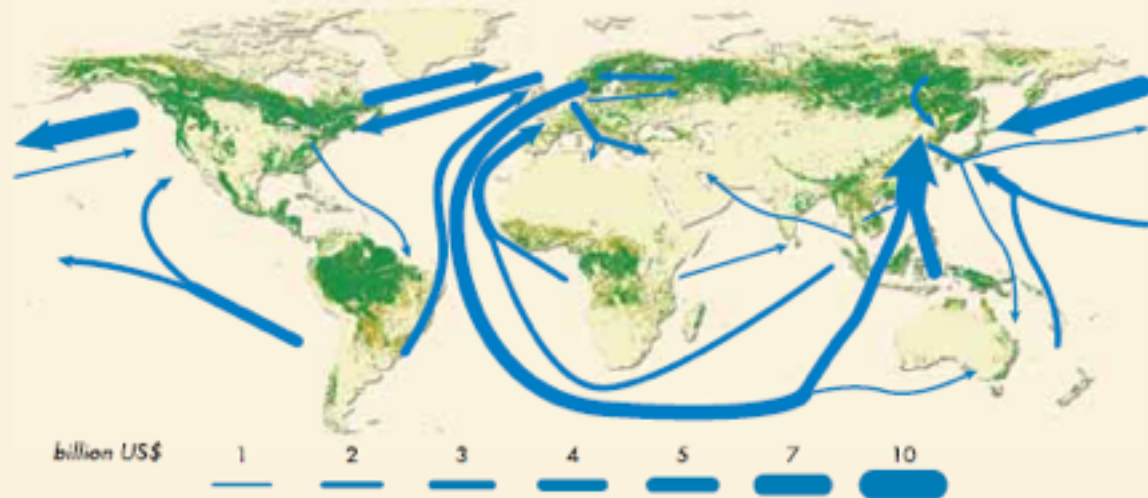
主要区域间木材产品流向

Main interregional trade flows of wood products

Principaux courants commerciaux interrégionaux des produits ligneux

Principales flujos comerciales interregionales de productos madereros

2003



Source : FAO

# Impacts du changement climatique & adaptation : raisonner à des 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>

# Bioéconomie : efficacité et circularité

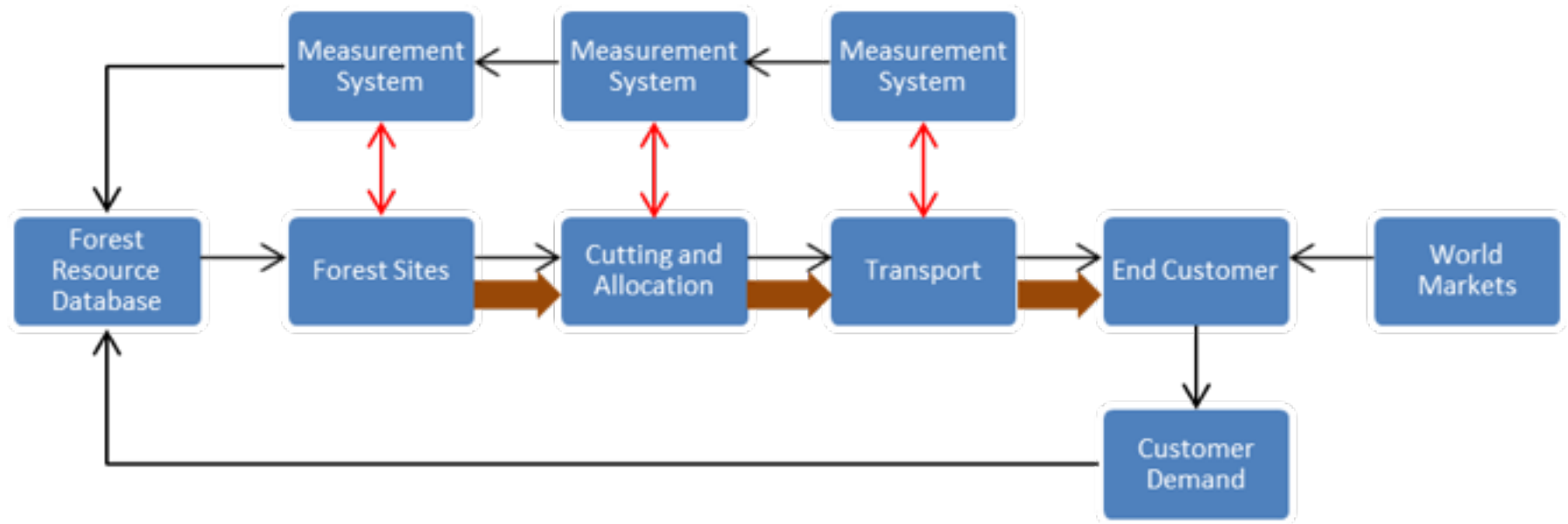


## LE PROJET FORÊT-BOIS pour la France

France Bois Forêt (FBF) et France Bois Industries Entreprises (FBIE) sont à l'initiative du



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

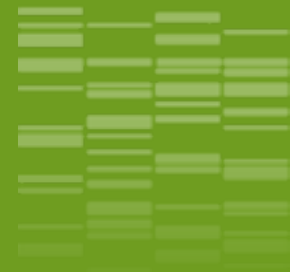


- Information flow
- ↔ Information and adjustment
- ➔ Material flow

Source : Gardiner (2015)

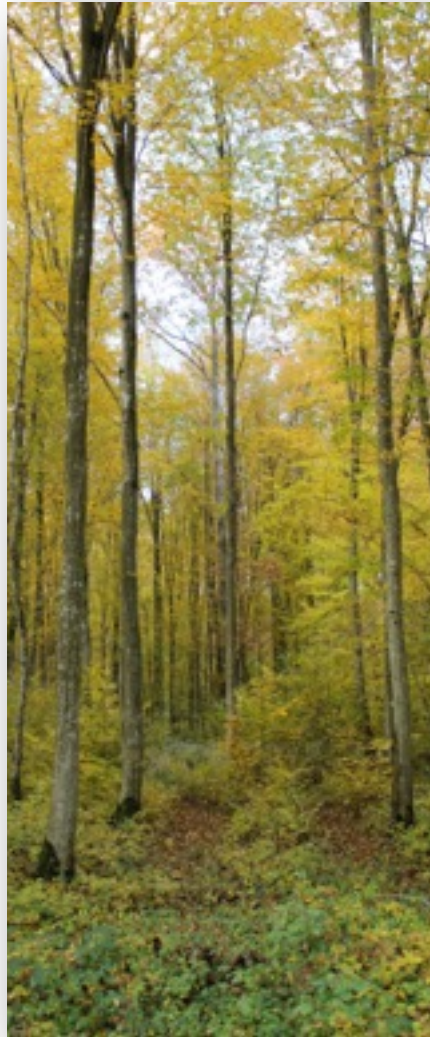
# Forest resources assessment and management planning under climate change

- ❖ 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 in temperate forests :
  - ❖ make **more efficient use** of natural and man-induced **cycles**...
  - ❖ of matter, energy and **information**...
  - ❖ in **ecosystems** as well as in the emerging **bioeconomy**



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# Excellence Lab ARBRE Nancy - Insertion of topic « information & modeling »



**ARBRE** is a consortium of **8 Research Departments**:

- Joint Research Laboratory for Forest Economics (LEF) - UMR 356
- Joint Research Unit for Forest and Wood Resource Studies (LERFoB) - UMR 1092
- Joint Research Unit for Dynamics of Genomes and Microbial Adaptation (DynAMic) - UMR 1128
- Joint Research Unit for Tree/Microorganism Interactions (IaM) - UMR 1136
- Joint Research Unit for Forest Ecology and Ecophysiology (EEF) - UMR 1137
- Research Unit for Forest Ecosystem Biogeochemistry (BEF) - UR 1138
- Research Unit for the Study and Research of Wood Materials (LERMAB) - UR 4370
- **Research Unit for Forest Inventory (LIF)**

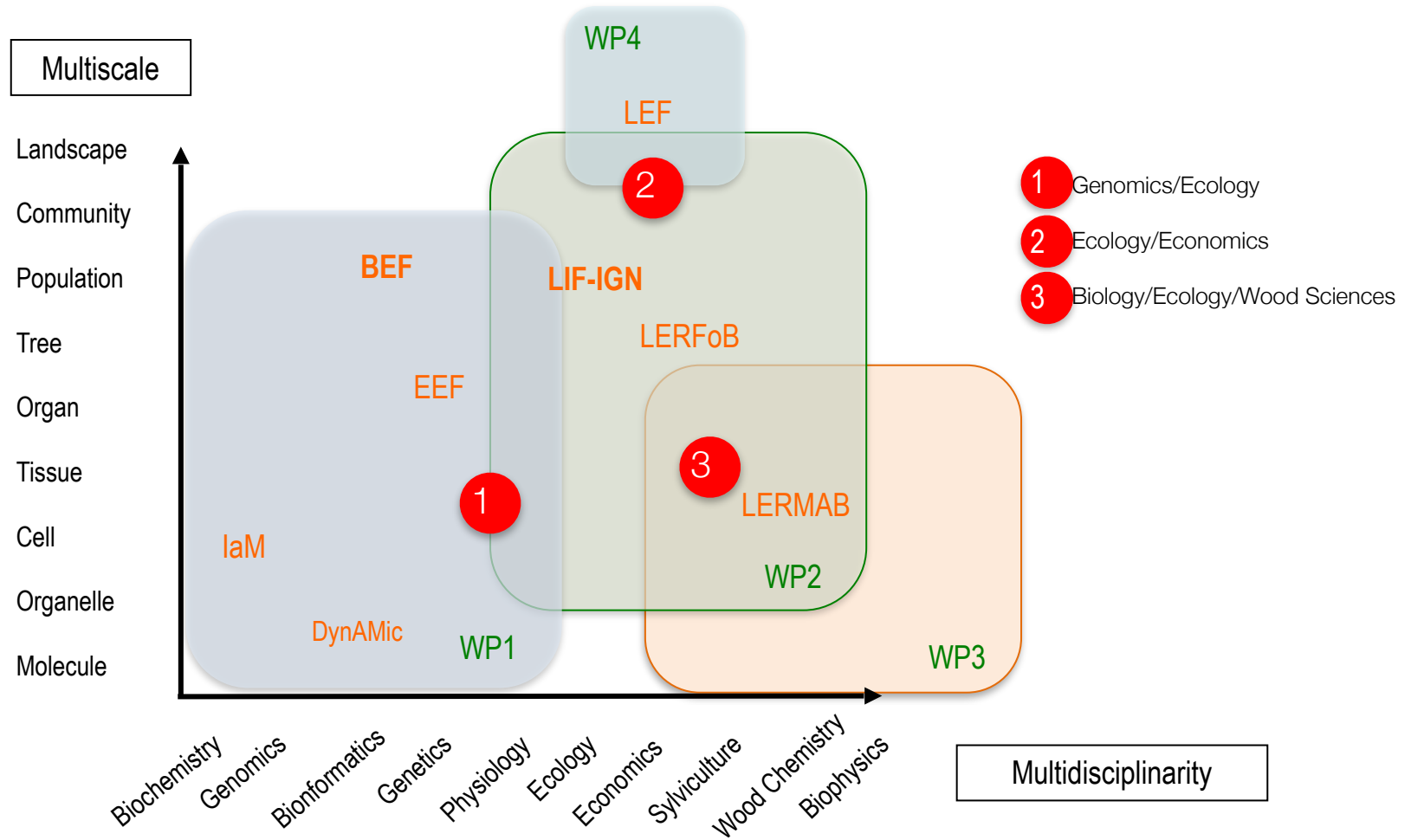
and **4 Partners** (Administration, Technical & Innovation Centers):

- National Forests Office (ONF),
- National Center for Forest Owners (CNPf-IDF),
- Regional Center for Innovation and Wood Industries Technology Transfer (CRITT-Bois),
- ~~Observatory for European Forests (OEF - European Forest Institute),~~

# Challenge 1. Promoting cutting-edge academic research and interactions between teams/disciplines



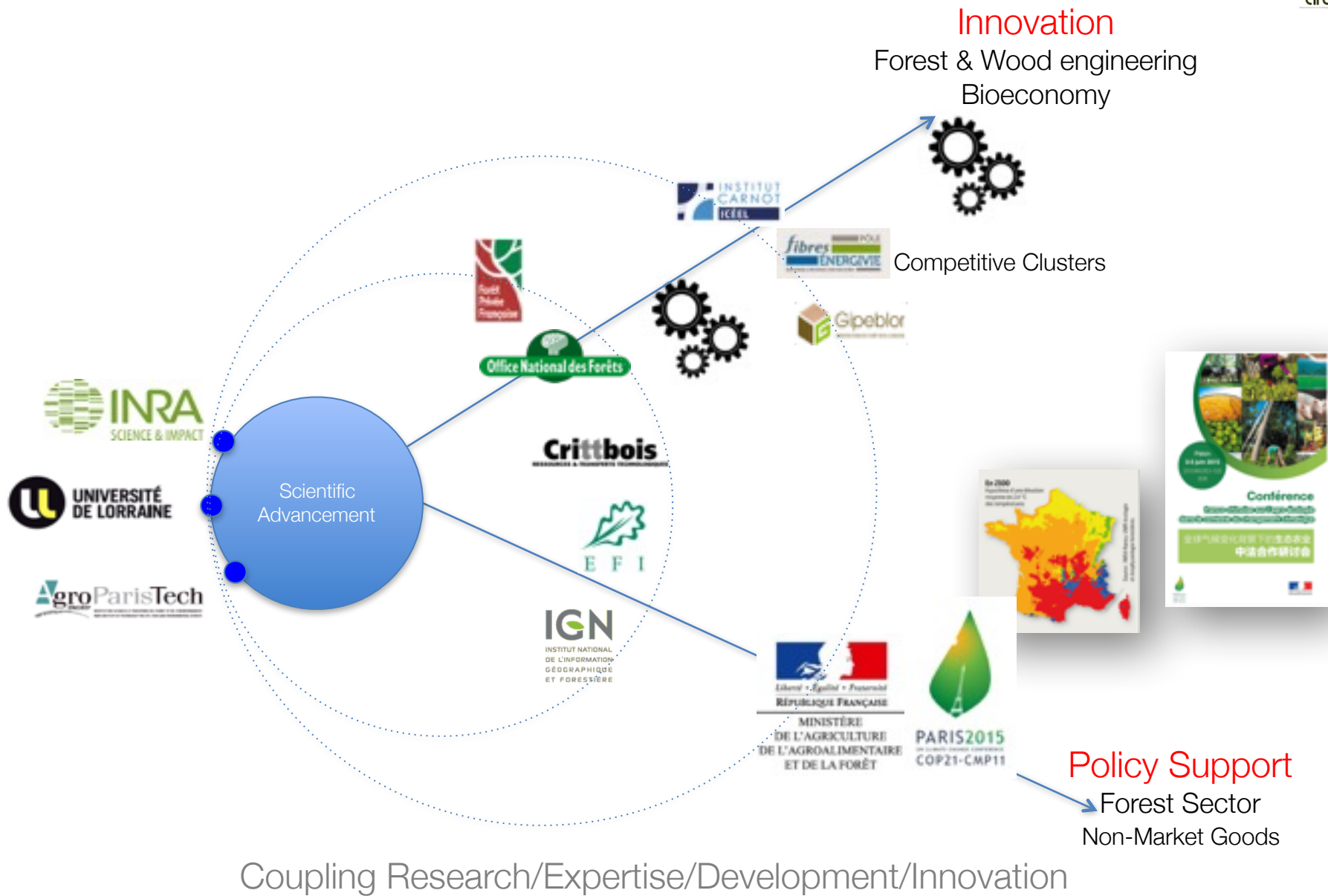
the Triple “i” dimension – international, interdisciplinary, intersectoral



- **BEF** = Biogéochimie des Ecosystèmes Forestiers
- **DynAMic** = Dynamique des génomes et adaptation microbienne
- **EEF** = Ecologie et Ecophysiologie Forestière
- **laM** = Interactions Arbres/Micro-organismes

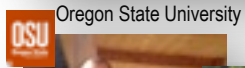
- **LIF** = Laboratoire de l’Inventaire Forestier
- **LEF** = Laboratoire d’Economie Forestière
- **LERFoB** = Laboratoire d’études des ressources forêt-bois
- **LERMAB** = Laboratoire d’Etudes et de Recherche sur le Matériau Bois

# Challenge 2. Promoting interactions between academic research & end users/stakeholders

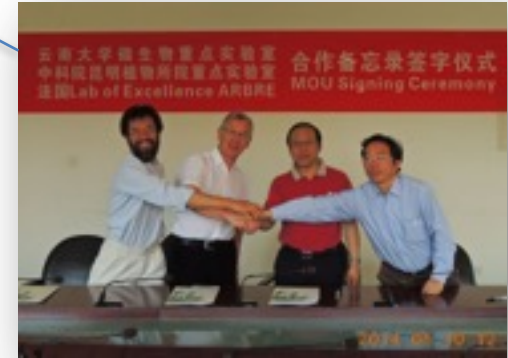


# 1 Achieving excellence in academic research

ARBRE links up to other Centers of excellence worldwide ...



Joint projects  
Visitors, Sabbatical  
Joint Calls  
MoU



Kunming Institute of Botany Chinese Academy of Sciences



WSL: Institut fédéral de recherches sur la forêt, la neige et le paysage



Max Planck Institute for Terrestrial Microbiology



## Highlights

- Coordinating the construction of the Region Lorraine Research Plan (2015-2020) (project FORBOIS2, 8 M€ in heavy equipments)
- Multidisciplinary projects funded in 2012 (298k€ each):
  - **SYMWOOD**: Comparative Genomics and Biochemistry of Symbiosis and WOOD decay mechanisms in Fungi (*Nature Genetics*, *PNAS*, licence for DNA genotyping of 'home timber decay fungi', ANR project FUNTUNE)
  - **WADE**: Wood Acclimation to Disturbed Environments (*Nature Plants*, *New Phytologist*)
  - **QLSPIMS: Quantum Leap for Soil-Plant interaction Models** (European H2020 project DIABOLO)





# Projet multidisciplinaire QLSPIMS

Quantum Leap for Soil-Plant interaction Models

Nouvelle génération de  
modèles d'interaction sol-plante à base phénoménologique



Laurent Saint-André (UR INRA BEF)  
Jean-Daniel Bontemps (AgroParisTech -> IGN)  
Damien Bonal (UMR INRA-UL EEF)





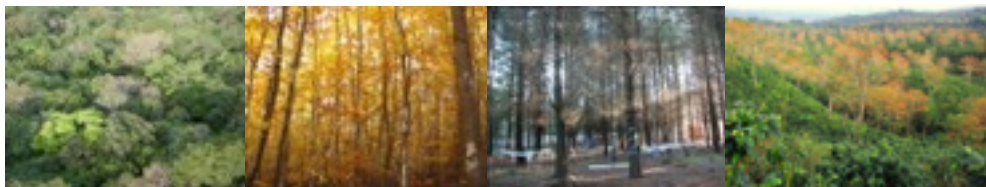
### ➤ Contexte

- Double enjeu pour les forêts:
  - atténuation/adaptation aux changements globaux
  - fournir une ressource soutenue et durable en bois

### ➤ Défi technique & politique

#### Economique

Aider au choix des essences  
Itinéraires sylvicoles  
Remédiations...



#### Ecologique

Impact  
Services rendus  
Multifonctionnalité  
des écosystèmes

Développer des modèles **sol-plante**  
Prenant en compte  
décision de gestion  
et climat

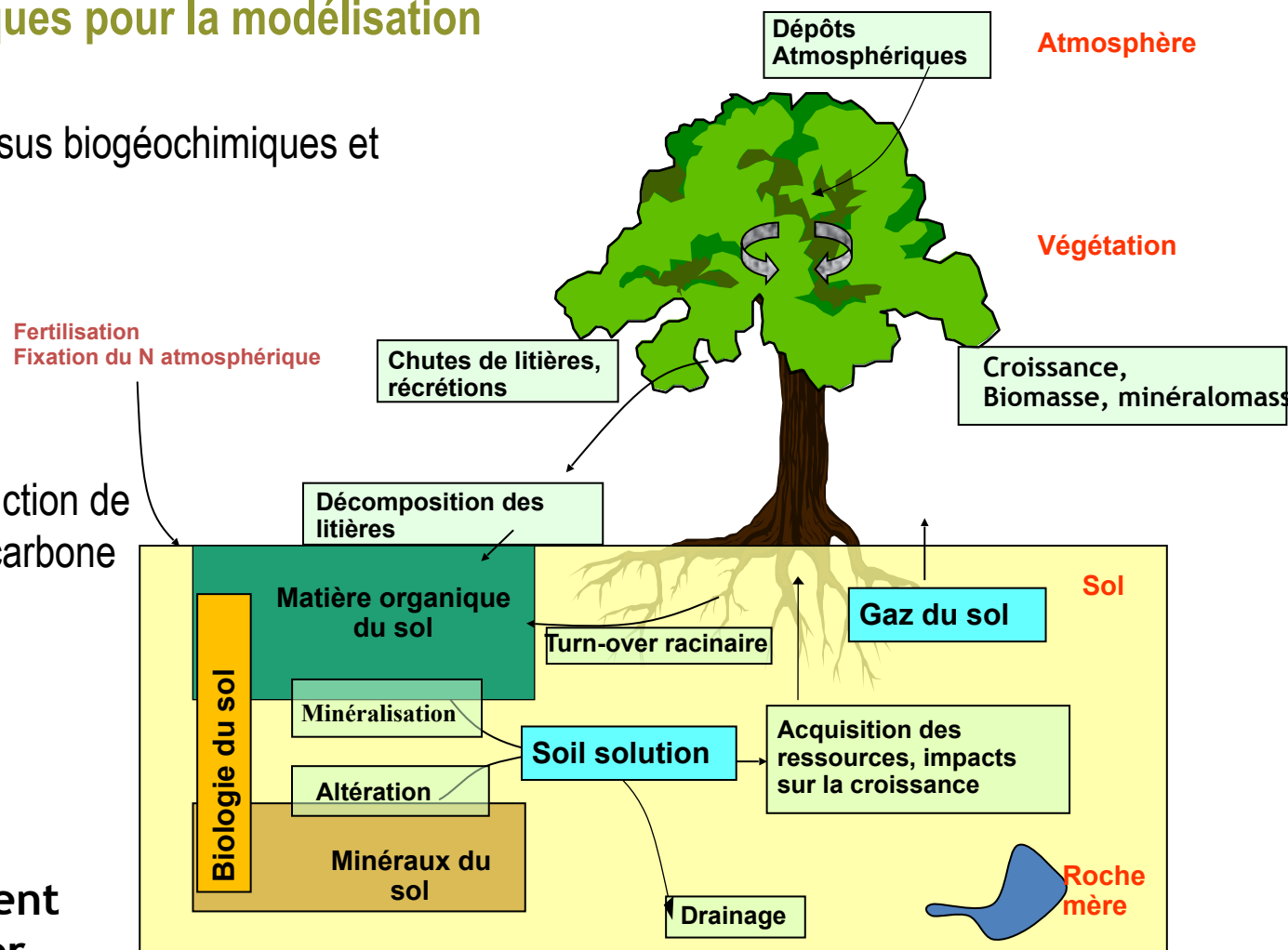


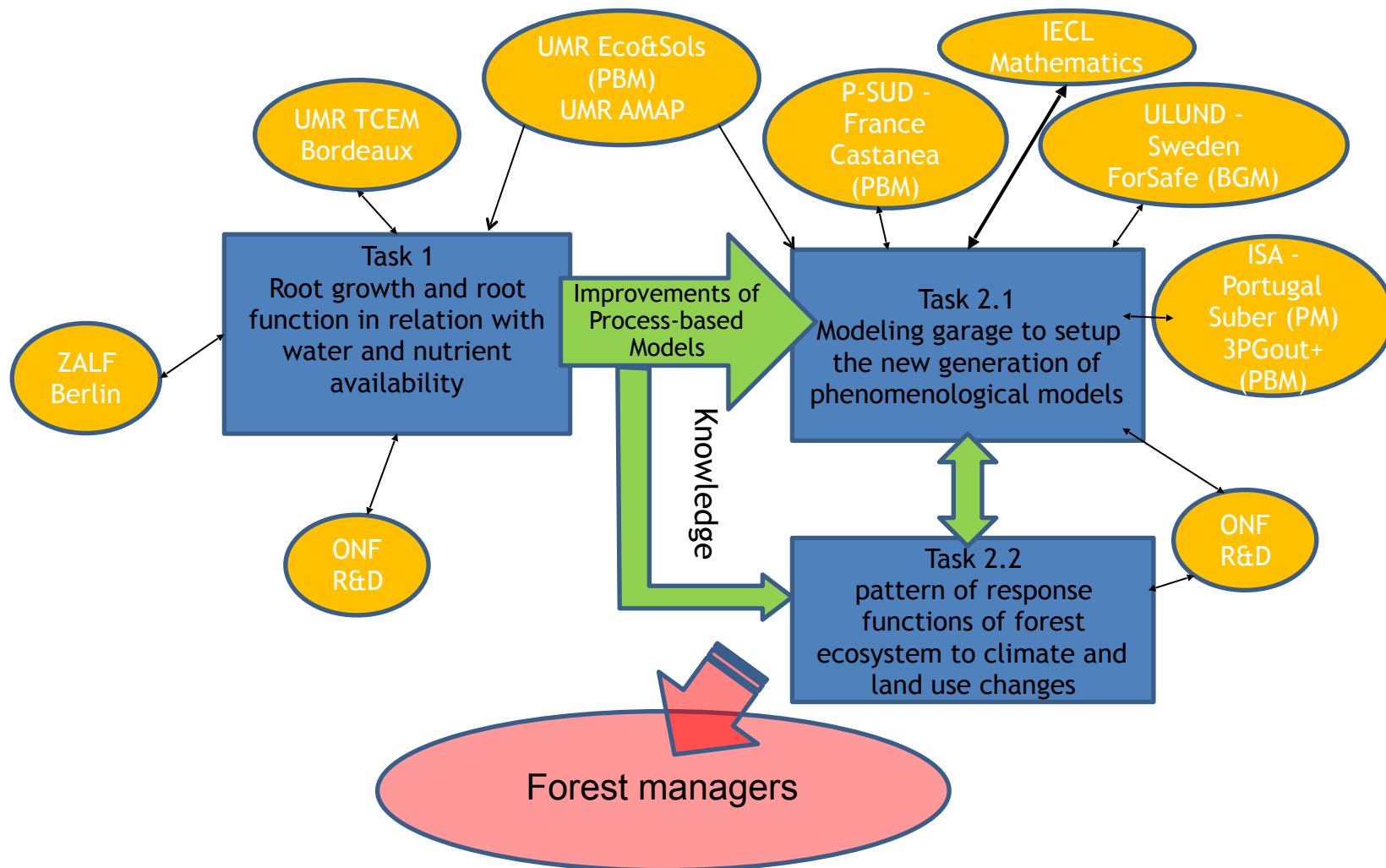
### Deux enjeux scientifiques pour la modélisation

- Intégration des processus biogéochimiques et écophysologiques

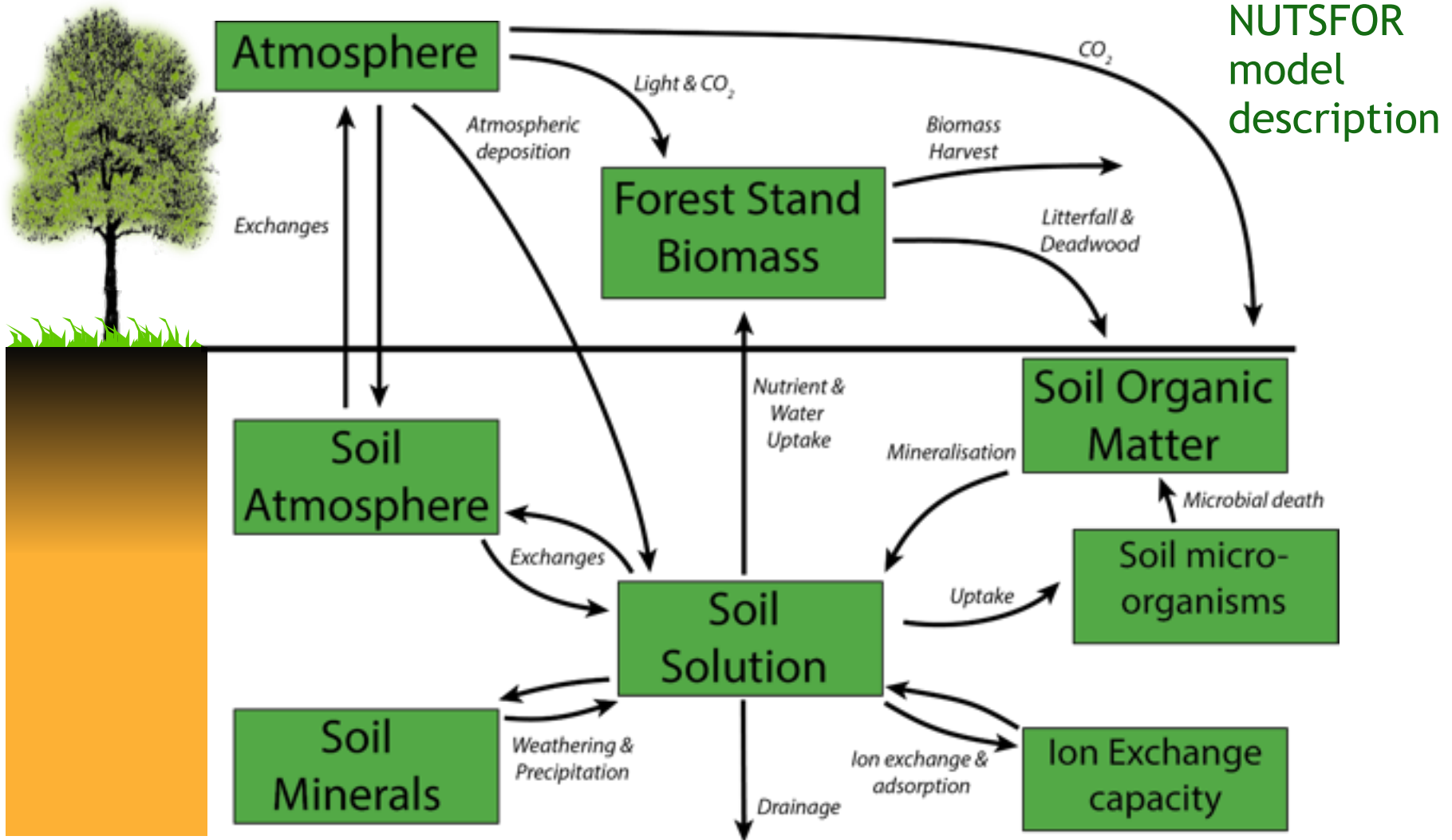
- Interactions entre la production de bois, la séquestration de carbone et les autres services écosystémiques

QLSPIMS spécifiquement construit pour avancer sur ces deux enjeux





### Développement du modèle SOL-PLANTE à base processus

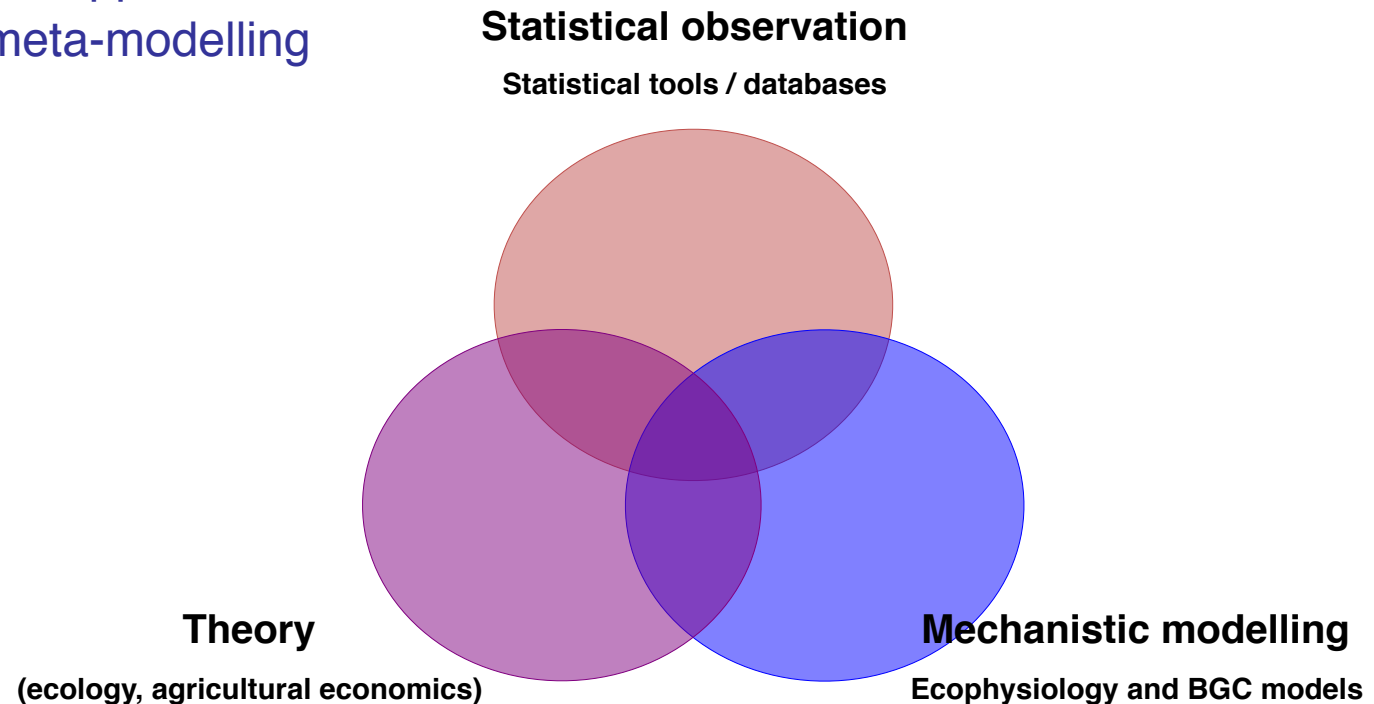




**Modélisation des effets  
des facteurs et ressources de l'environnement abiotique  
sur la productivité forestière**

**A new modelling framework built on...**

- 1- theories in agronomy and ecology
- 2- renewed statistical approaches
- 3- process-based meta-modelling



ARBRE has developed a series of actions oriented to fostering innovation and technology transfer:

- Organizing workshops (e.g., LIDAR Users, Truffle Growers Association, REGEFOR on the novel usage of wood material, FCBA)
- Providing web apps with on-line user assistance (e.g., biljou-web, Wood@nat)
- Facilitating on-site training (e.g., genome jamborees, summer schools on isotopes in ecology)
- Organizing surveys for industry actors and stakeholder users (with AgroParisTech)
- Interactions with industry associations (competitive cluster Fibres-Energie)

ARBRE has funded projects dealing with:

- Synthesis of existing data & development of novel conceptual models on forest dynamics (with ONF & IGN),
- A joint Call for proposals RMT AFORCE 2015-2016 with the Regional forest owners' centres
- Design & patented novel 'green' wood products (e.g. ABRASTAN project),
- Make policy recommendations based on scientific data, and
- Cooperate with forest & wood sector on emerging novel research questions.



Truffle Ground Management

LiDAR-enhanced forest inventory

Macroscale modelling tools of forest dynamics

Adapting Sustainable Forest Management to Climate Change

Tannin/furanic-abrasive discs





### ➤ Dépôts des projets soumis d'oct-2013 à oct-2015



- Impact d'une intensification des prélèvements des menu bois sur la fertilité et la biodiversité des sols (micro-macro-meso faune) – Ademe REACTIFF – Inra – L Saint-André



- Translocations des éléments nutritifs, impact du mélange d'essence (ANR – Irstea - N.Korboulewsky – en cours de montage)



- Impact des prélèvements des menus bois sur les chaines trophiques microbiennes (ANR – Inra – M. Buée – en cours de montage)



- Projet européen (ISIB 01-Provision of public goods by EU agriculture and forestry: Putting the concept into practice)



- **Projet européen** (ISIB 4 - 2014/2015: Improved data for sustainable forestry), **DIABOLO** – 5MEuros, Leader LUKE, **INRA-IGN leader du WP2 sur Data harmonization**



- Projet européen (ISIB 4 - 2014/2015: Improved management models for sustainable forestry), F2M2– 4MEuros, Leader INRA, IGN participant – Liste complémentaire



- Projet Labex BRIDGE (Leader M. Buée). Biomass Removal Impact on soil Diversity, Geochemistry and tree Ecophysiology. INRA laM, BEF, EEF.



- 2 projet ECOSERV avec le LEF (déposés le 30 oct 2015)