Storm Risks in the European Union

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INTERNATIONAL CONFERENCE ON PRIVATE FOREST INSURANCE POLICY IN SOUTH-WEST EUROPE

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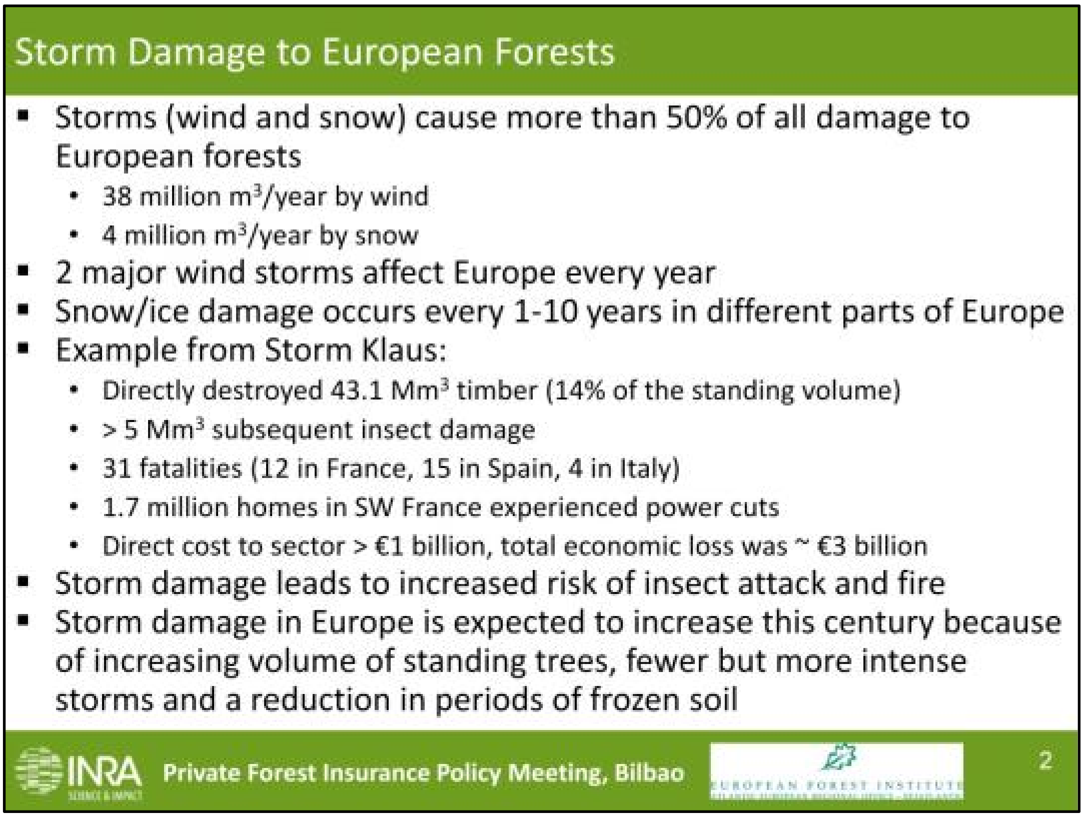
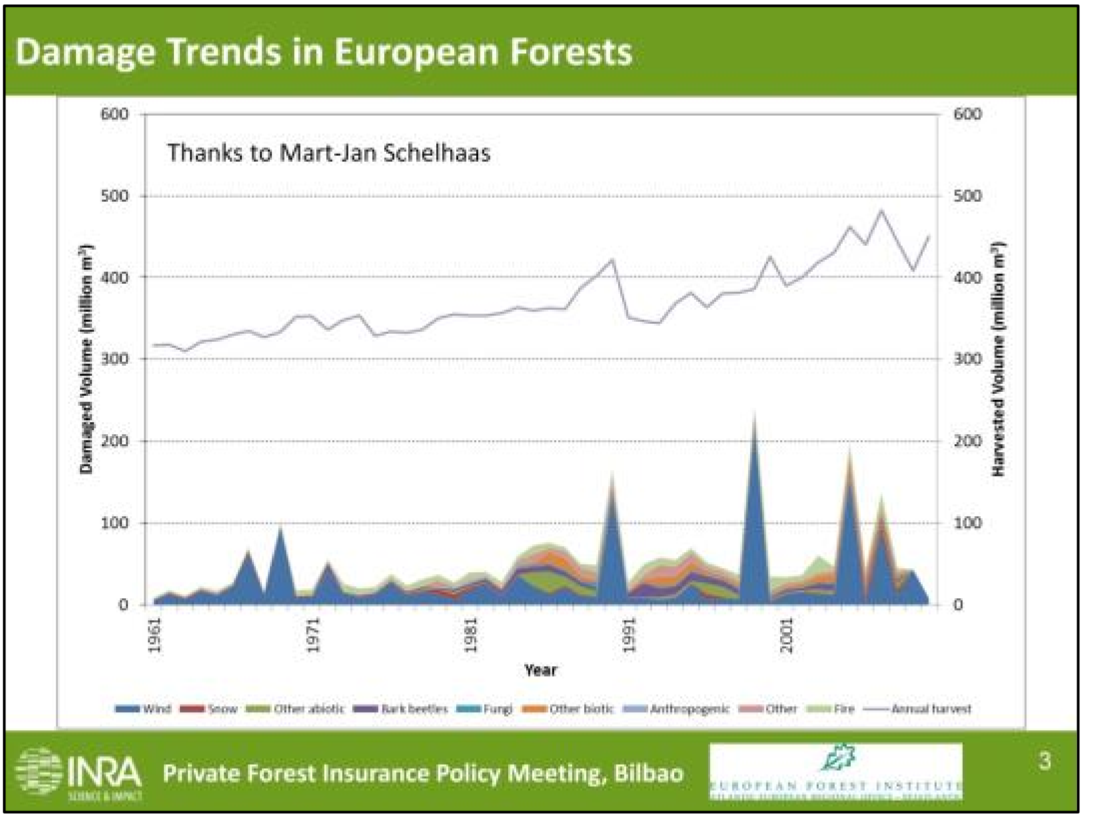
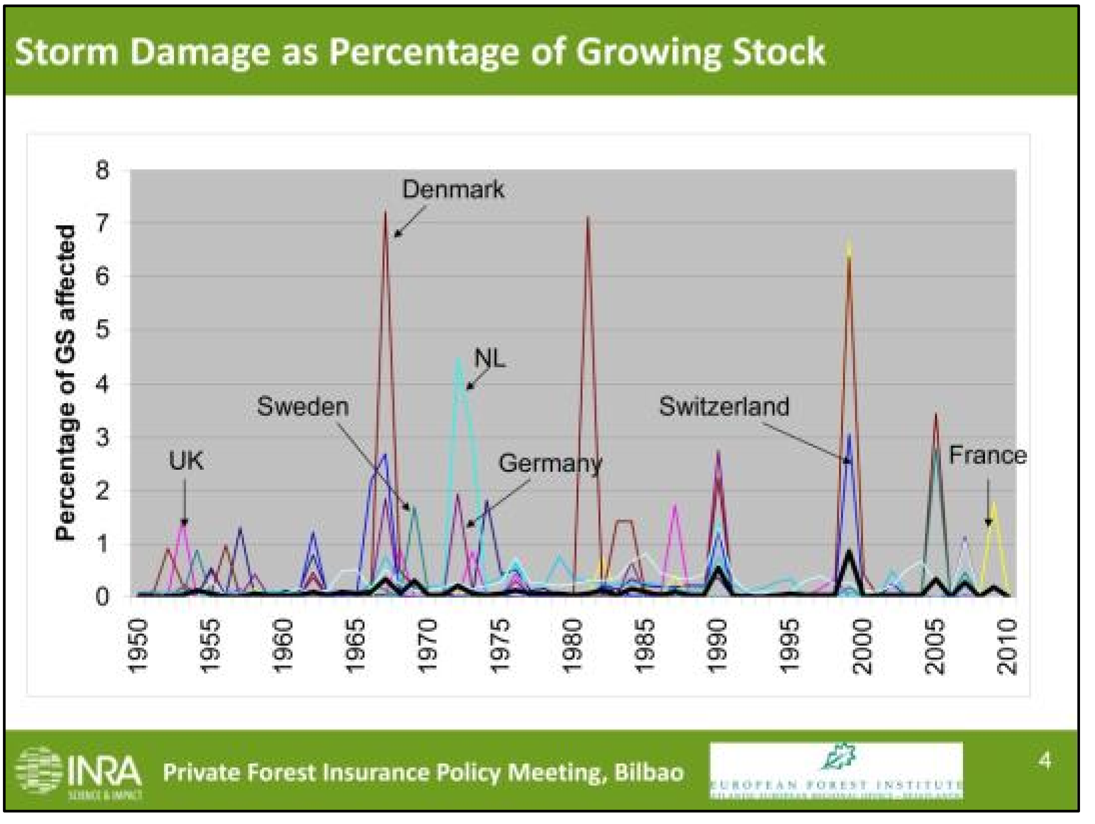


- Storms (wind and snow) cause more than 50% of all damage to European forests
  - 38 million m^3/year by wind
  - 4 million m^3/year by snow
- 2 major wind storms affect Europe every year
- Snow/ice damage occurs every 1-10 years in different parts of Europe
- Example from Storm Klaus:
  - Directly destroyed 43.1 Mm^3 timber (14% of the standing volume)
  - > 5 Mm^3 subsequent insect damage
  - 31 fatalities (12 in France, 15 in Spain, 4 in Italy)
  - 1.7 million homes in SW France experienced power cuts
  - Direct cost to sector > €1 billion, total economic loss was ~ €3 billion
- Storm damage leads to increased risk of insect attack and fire
- Storm damage in Europe is expected to increase this century because of increasing volume of standing trees, fewer but more intense storms and a reduction in periods of frozen soil



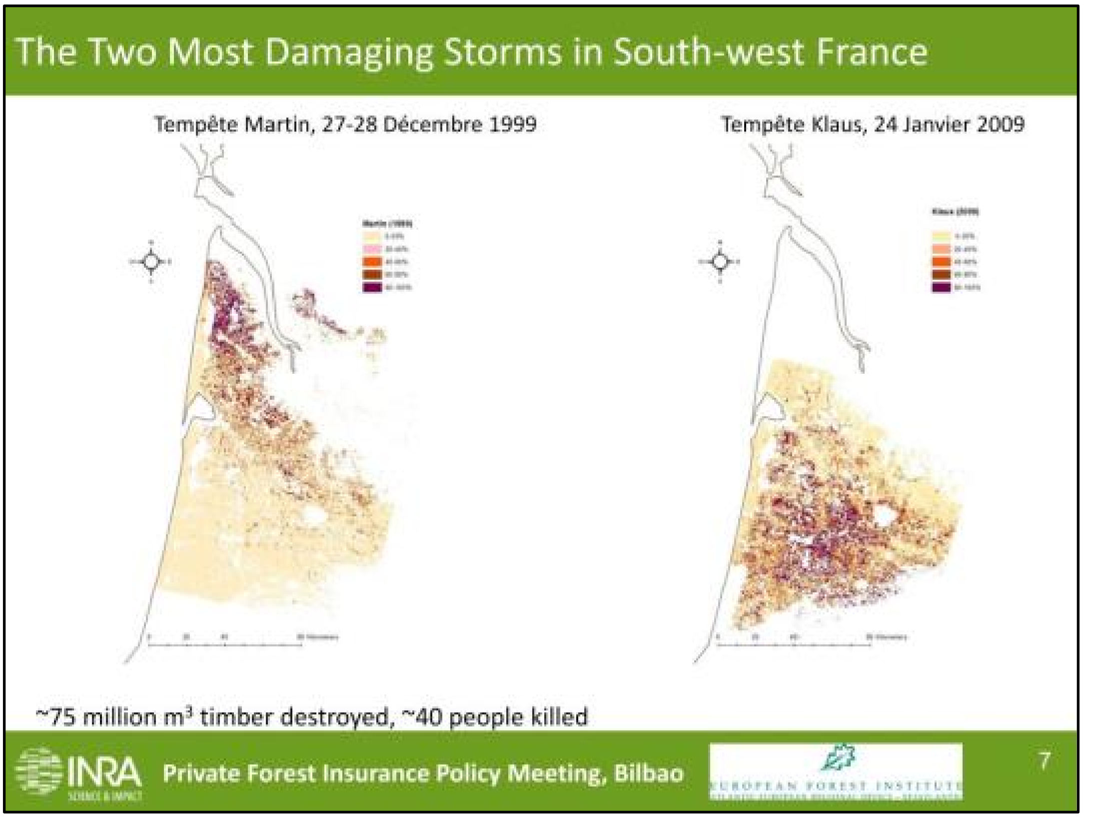
Damage levels are continuing to increase in Europe due to a combination of management practices and changing climate. There are some particularly devastating events such as the wind storms of 1967, 1969, 1972, 1990, 1999, 2005, 2007 and 2009. These cause severe disruption to the regions and countries affected and have a negative impact on wood prices.



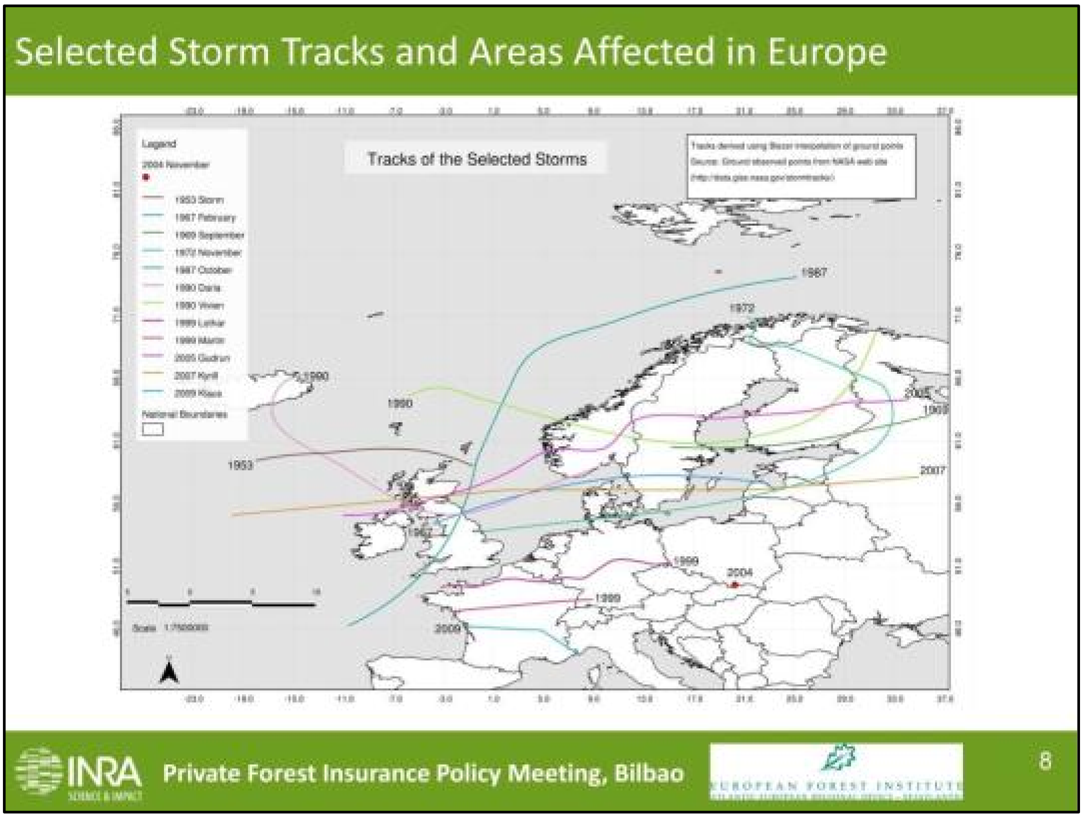
The relative proportion of damage to European forests since 1950 has been a consistent proportion of standing volume or growing stock. In the diagram above it can be seen that damage across Europe is a few tenths of a percent of total growing stock (solid black line) with no obvious trend with time. Damage to the total growing stock in particular individual countries badly affected by storm damage can be much higher, with small countries such as Denmark, Netherlands and Switzerland having proportionally high levels of damage. Of course at the regional scale the damage in larger countries such as Sweden, France and Germany can represent a large percentage of local growing stock and annual felling. In the worst storms to affect Europe such as 1999, the total damage can be equivalent to up to approximately half of all timber felled in Europe (excluding Russia), in individual countries can be more than 3 times annual harvest, and at forest district level represent more than 20 years of felling.

The main damaging agents in order of importance are wind, fire, bark beetles, snow/ice, drought, pathogens and herbivores. I will concentrate on wind, snow/ice and secondary damage from bark beetles in this talk.

Wind damage has been an increasing problem for European foresters since the 1950s but seems to have become particularly pronounced over the last 20 years. This is due to a combination of an increase in forest area in Europe, mainly of coniferous plantations, and an increase in growing stock due to annual harvest levels being below the overall annual growth increment. Currently wind accounts for 51% of all damage to European forest by volume.



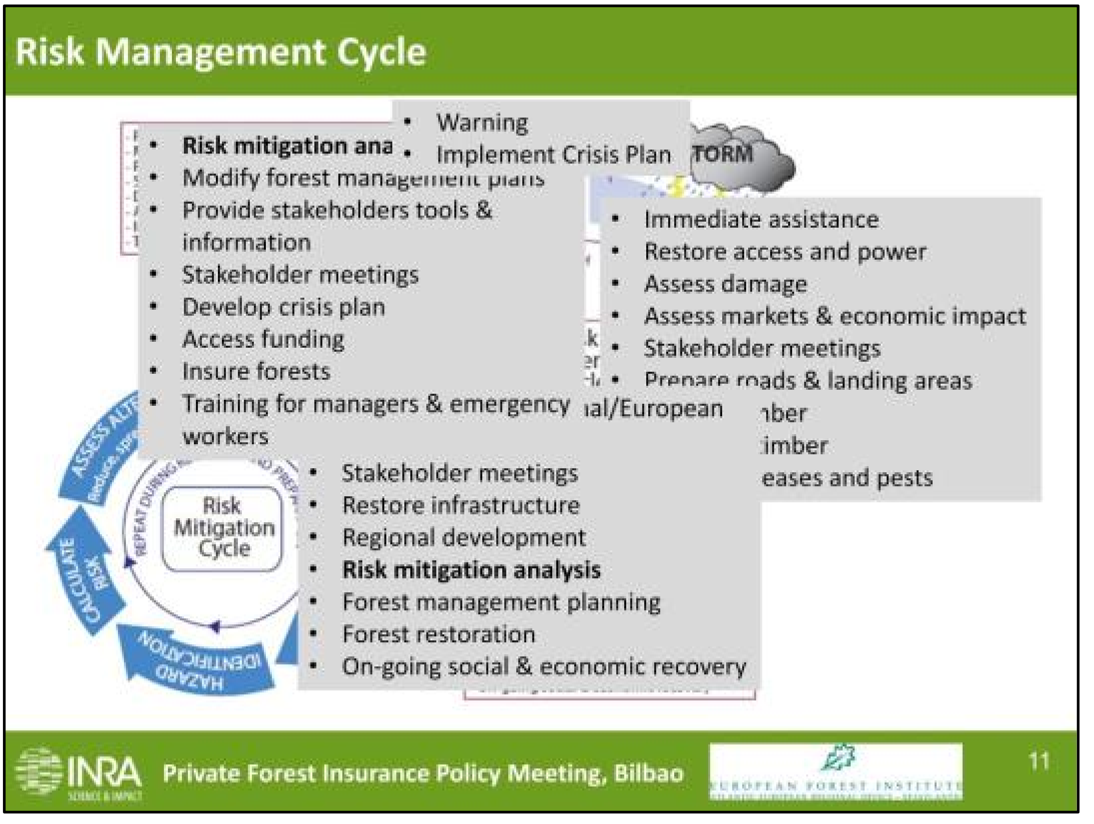
In South-west France there have been 2 major storms in 1999 and 2009 that have caused approximately 75 million m^3 of damaged timber and approximately 40 people killed.



The tracks of storms causing storm damage in Europe appear to have moved further south and to have penetrated further east in Europe. This means that storm damage has been recently experienced in countries in southern and eastern Europe that have not previously experienced storm damage.

Snow and ice damage can be a particular problem in some parts of Europe, particularly mountainous areas. Recently in January/February 2014 there was a lot of damage to forests in the Balkans with more than 9 million m^3 of damage in Slovenia alone.

Many damage agents are coupled. So, for example, fire will follow drought, and bark beetle attacks increase after wind storms. After Storm Klaus in South West France there was 43.1 Mm^3 of direct damage and an additional > 5 Mm^3 due to bark beetles.



Risk management is a crucial requirement for the successful reduction of the impact of storm damage. It consists of 3 major components:

1. Preparation
2. Response
3. Recovery

A key part of the Recovery and Prepare stages is the Risk Mitigation cycle and a key part of risk mitigation is the ability to predict the level of risk.

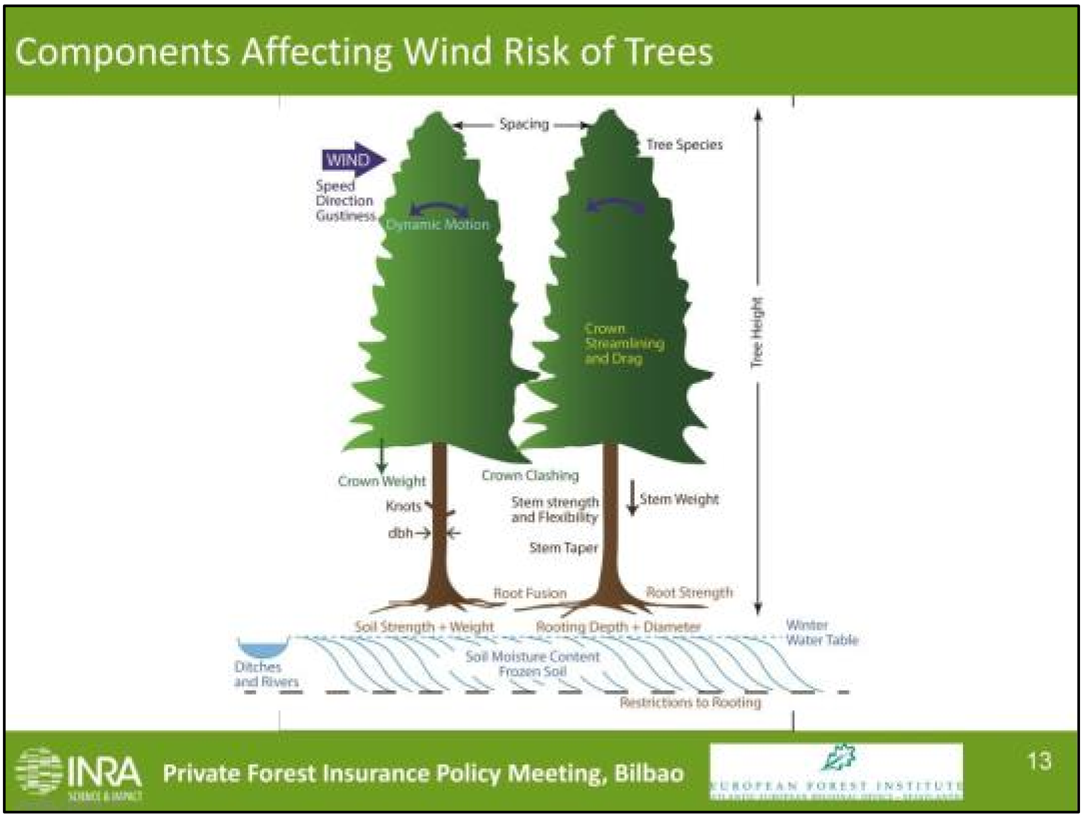
One of the first attempts to predict storm damage risk was the Windthrow Hazard Classification, which is a scoring system that is based on:

Windiness Scores

- -Region
- -Elevation
- -Topographic Shelter (Topex)

Soil Score

- -Rooting Depth



In order to reduce the levels of wind damage it is important to understand the factors controlling wind damage to forests. Storm damage is a complex interaction between the meteorological conditions and stand location, soil type, stand composition, and past forest management. The following points summarise our existing knowledge and understanding:

•Gust peak wind speed is strongly correlated to the levels of damage.

•Tree height has an important impact on vulnerability.

•Statistical analysis of storm damage suggests that spruces and poplar are among the most vulnerable and silver fir and oak among the least vulnerable respectively of the conifers and broadleaves. Conifers generally have higher susceptibility to damage than broadleaves but these differences are confounded by differences in species management and the choice of sites on which they are planted.

•Soil condition is very important. Root anchorage strength is increased by soil freezing, and reduced by water-logging and heavy rain and by poor drainage that allows soil saturation during storms.

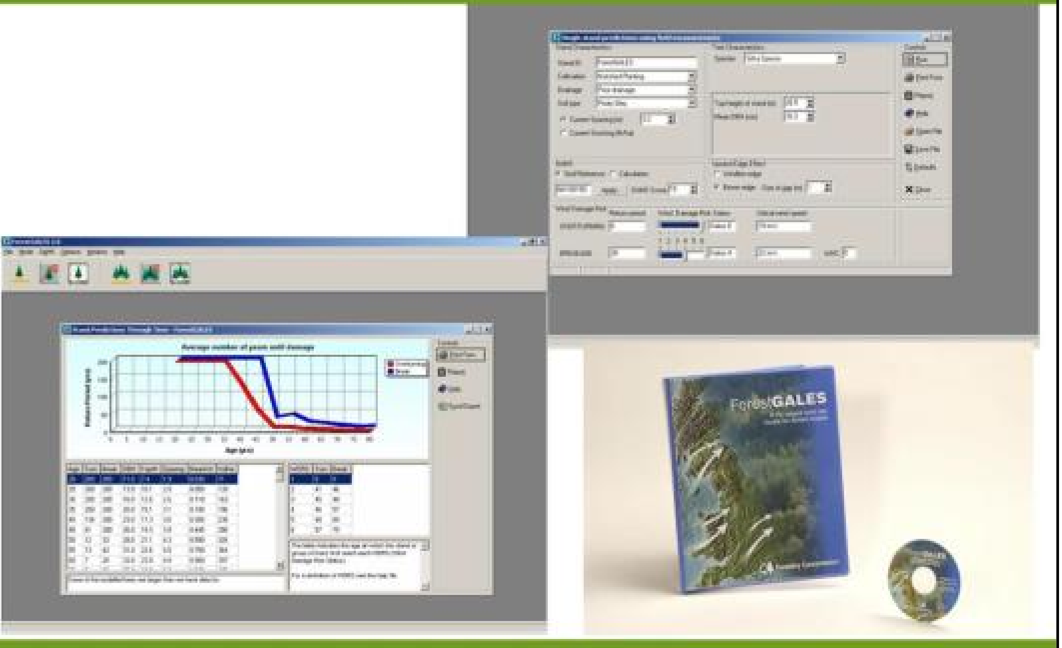
•Recent thinning, particularly in older stands, is often associated with increased damage.

•The vertical structure of stands (e.g. irregular versus regular) appears to have little influence on stability.

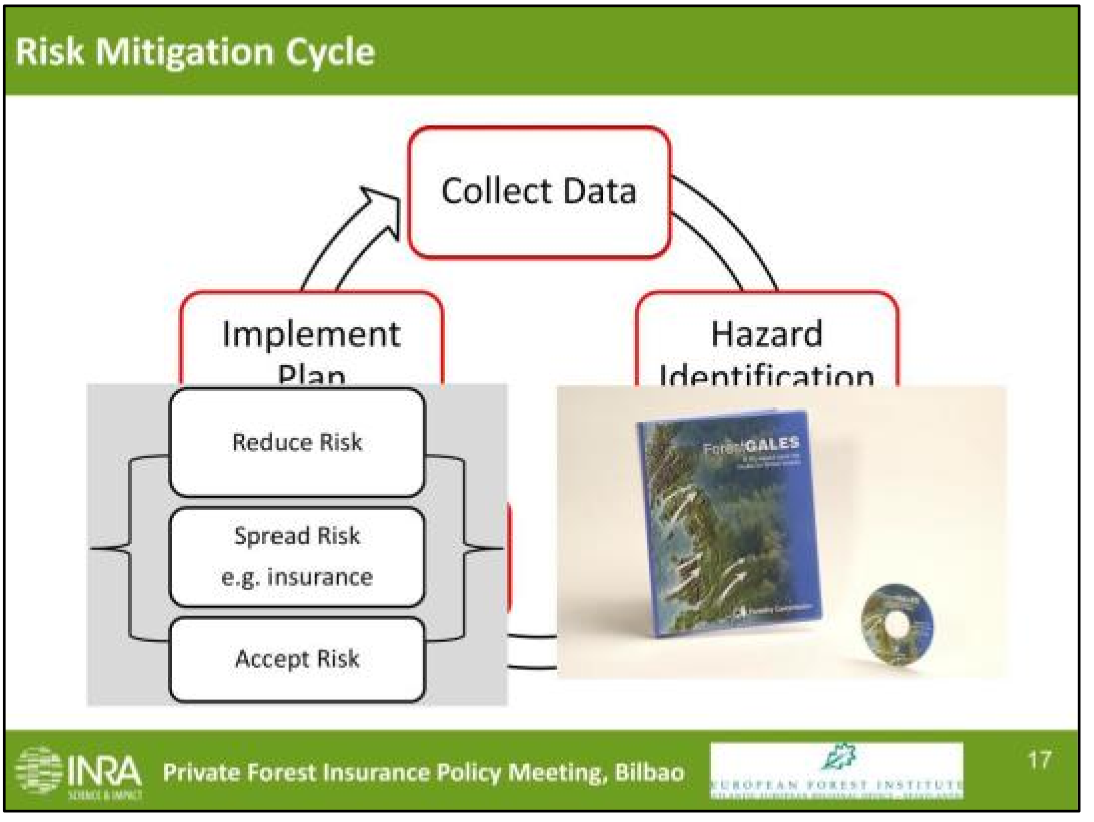
Established edges are resistant to damage but newly created edges are very vulnerable to damage.

Forests are vulnerable to damage immediately following thinning but recover with time as the trees acclimate to their new wind climate.

ForestGALES 2.5: Wind (and Snow) Risk Modelling



Based on all the factors affecting wind damage risk the mechanistic model ForestGALES has been developed to predict wind damage risk as a function of tree species, tree size and stand conditions.

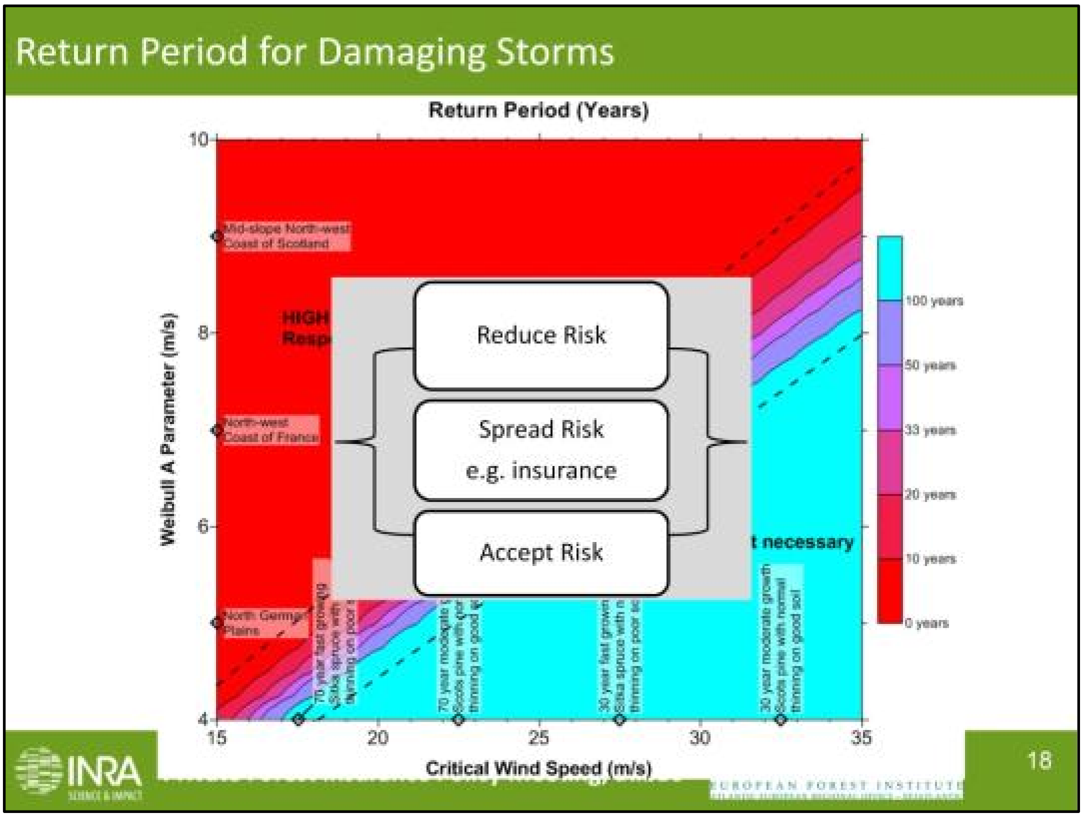


A wind risk model is a key part of the Risk Mitigation Cycle. This involves 5 stages:

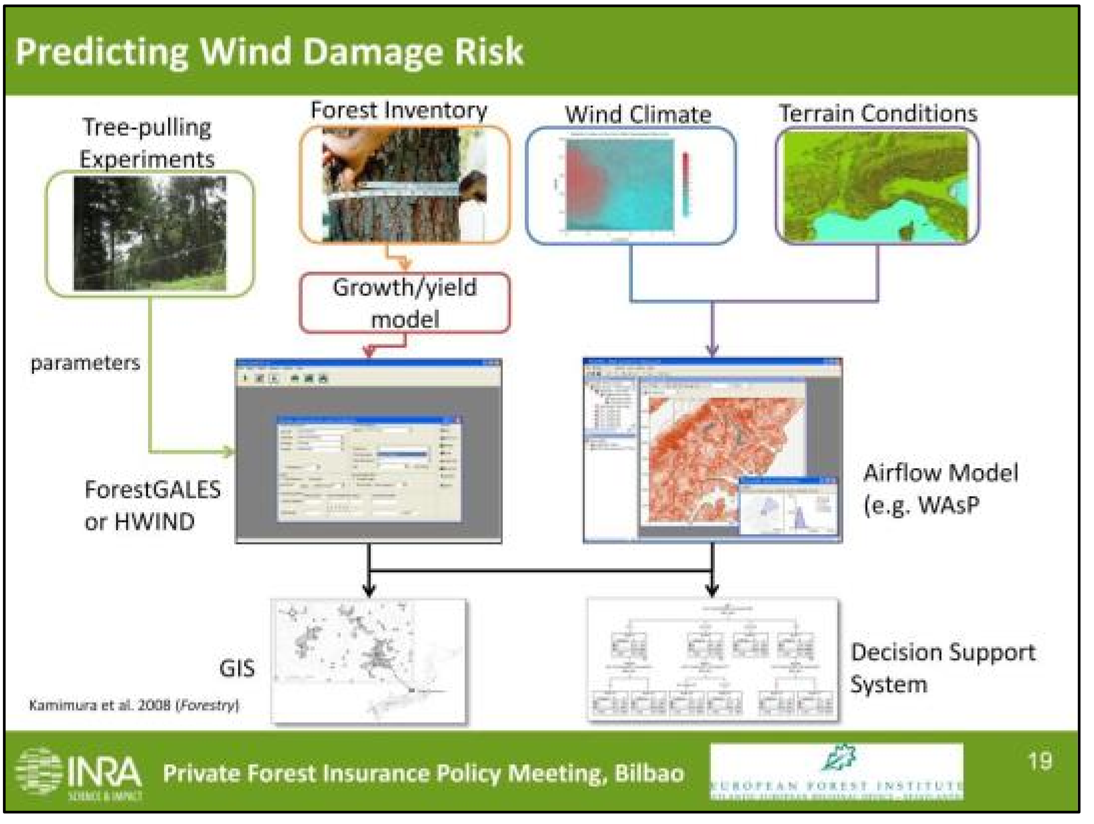
1. Collect data
2. Identify Hazard
3. Calculate Risk
4. Assess alternative actions
5. Implement a plan of action

The risk model is used to calculate the risk and when assessing the possible actions there are 3 options:

1. Take action to actively reduce the risk
2. Spread the risk by e.g. having a mixture of forest types or through insurance.

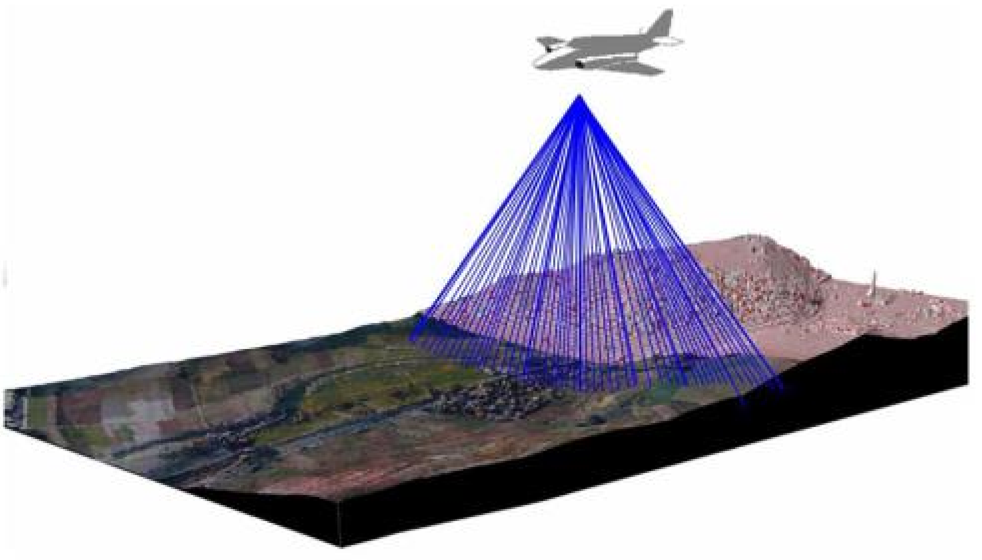


When assessing options for action it is important to know the level of risk. If the risk is very high there may be no possibility of any action and if the risk is low the cost of action may not be justified. It is when the level of risk is intermediate that action can be most effective.



By linking forest inventory data, forest growth models, wind risk models, wind climate data and airflow models it is possible to make wind damage risk predictions either in map format or as part of a Decision Support Systems. Of particular importance is having accurate forest inventory data.

Data Capture using Airborne LiDAR



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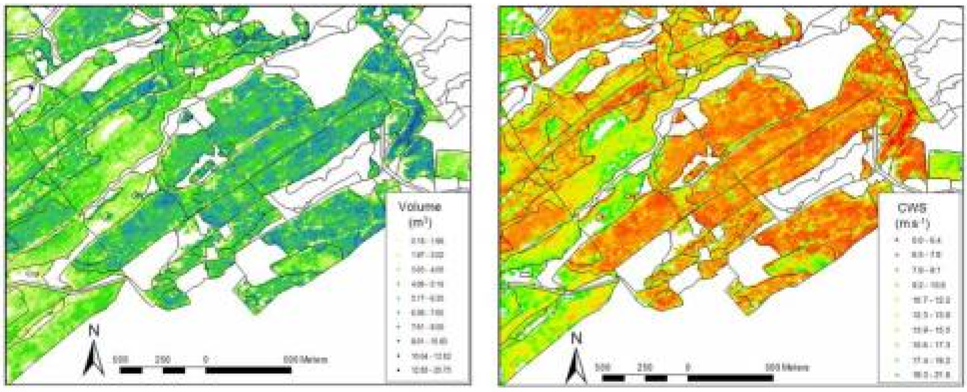
One of the most effective methods for obtaining forest inventory data is the use of airborne LiDAR to measure tree height and number and indirectly tree diameter and volume.

Wind Risk Modelling at Forest Level: Aberfoyle, Scotland



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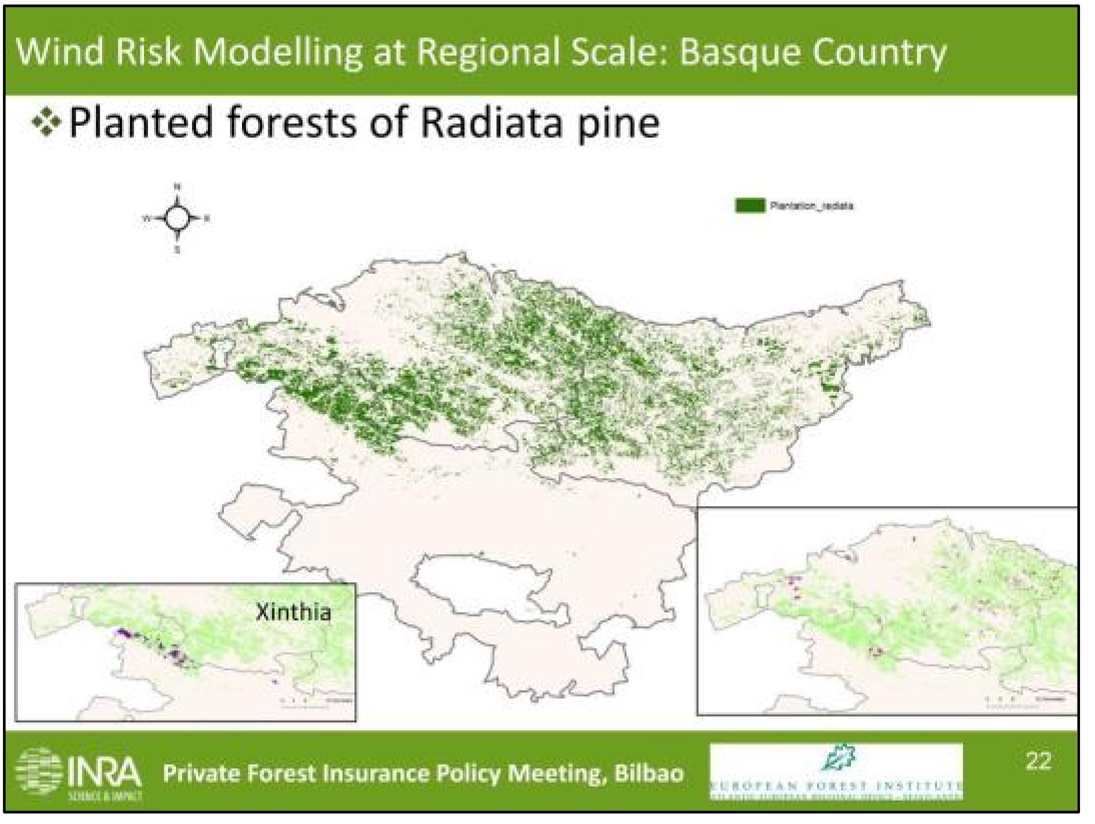
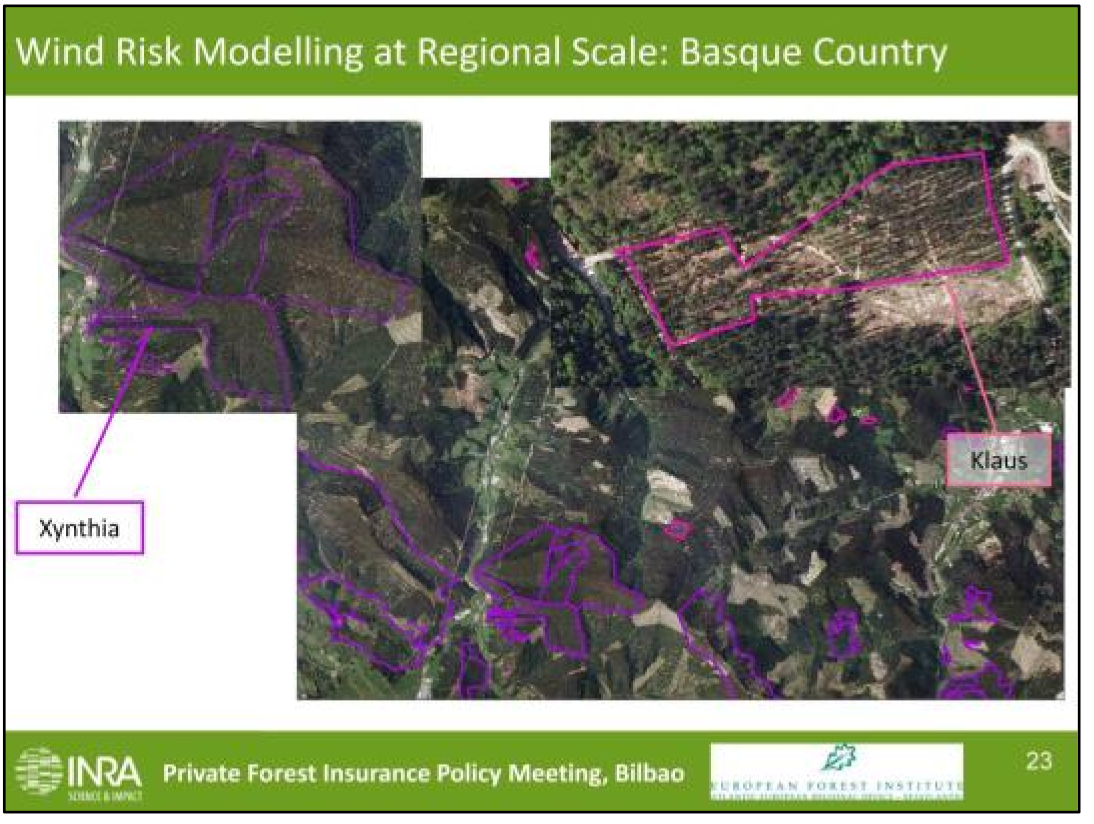
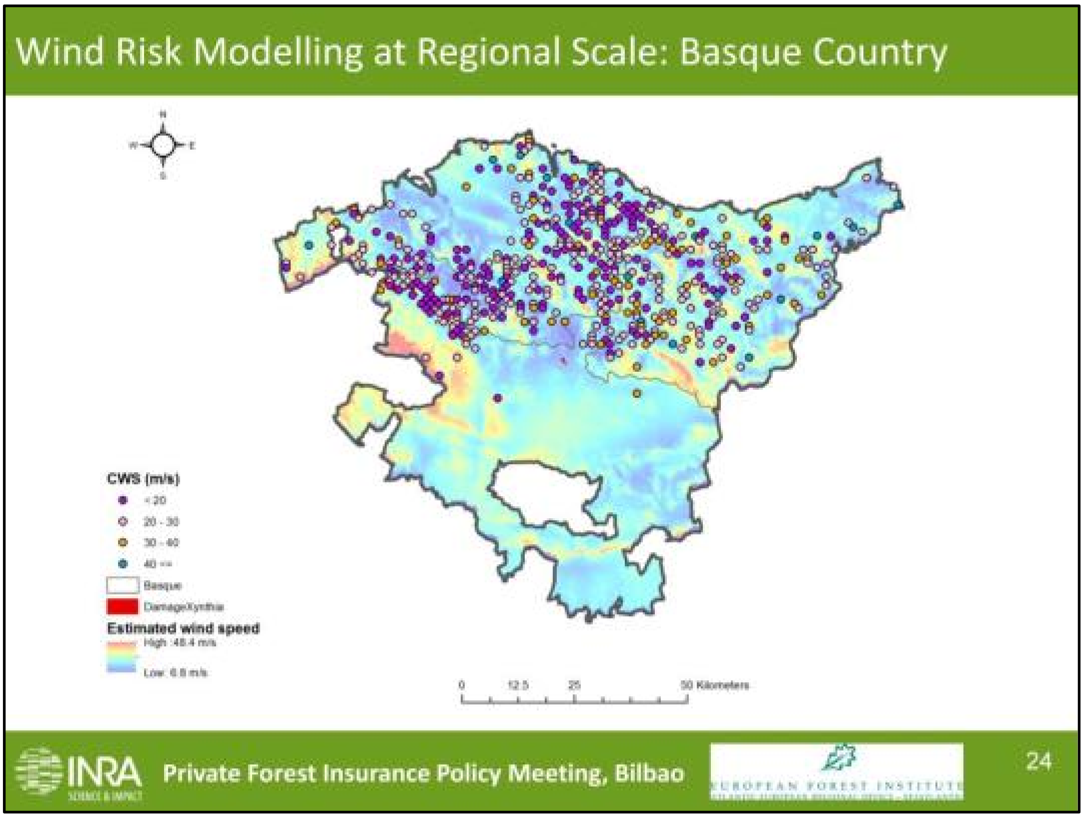
Such LiDAR data can be used as input into the ForestGALES wind risk model. Here is the example of wind risk modelling at a forest scale for Aberfoyle Forest, Scotland.



It is also possible to use LiDAR data at regional scale such as in the Basque Country, Spain which conducted LiDAR surveys of the whole region in 2008 and 2012. The Basque Country lost 1.1 million m^3 of timber in storms Klaus (2009) and Xynthia (2010) predominately in radiata pine stands located in the north of the region.



Damaged stands from the two storms were determined using ortho-photography.

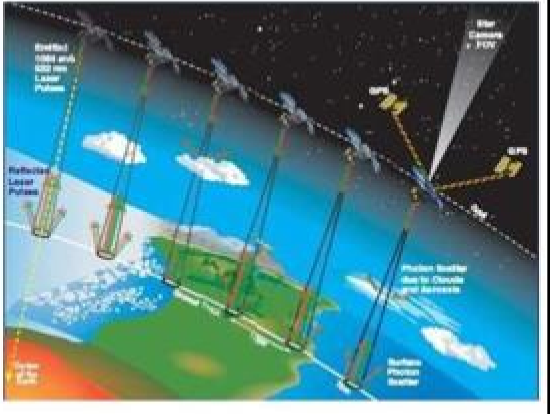


Risk of storm damage has already been predicted in the Basque Country for stands measured in the National Forest Inventory. The predictions are being tested against actual damage from the storm Xynthia and the maximum wind speeds recorded during the storm. Currently we are producing maps of wind risk for the whole region using the 2012 LIDAR survey.

ICESat: LiDAR from Space

Potential of Full Waveform Satellite Lidar:

- Forest parameter retrieval
- Application at a regional and national scale
- 172 m between footprint centres
- Approximately 64m diameter footprints



ICESat ice sheet elevation and cloud cover
Source: http://icesat.gsfc.nasa.gov/

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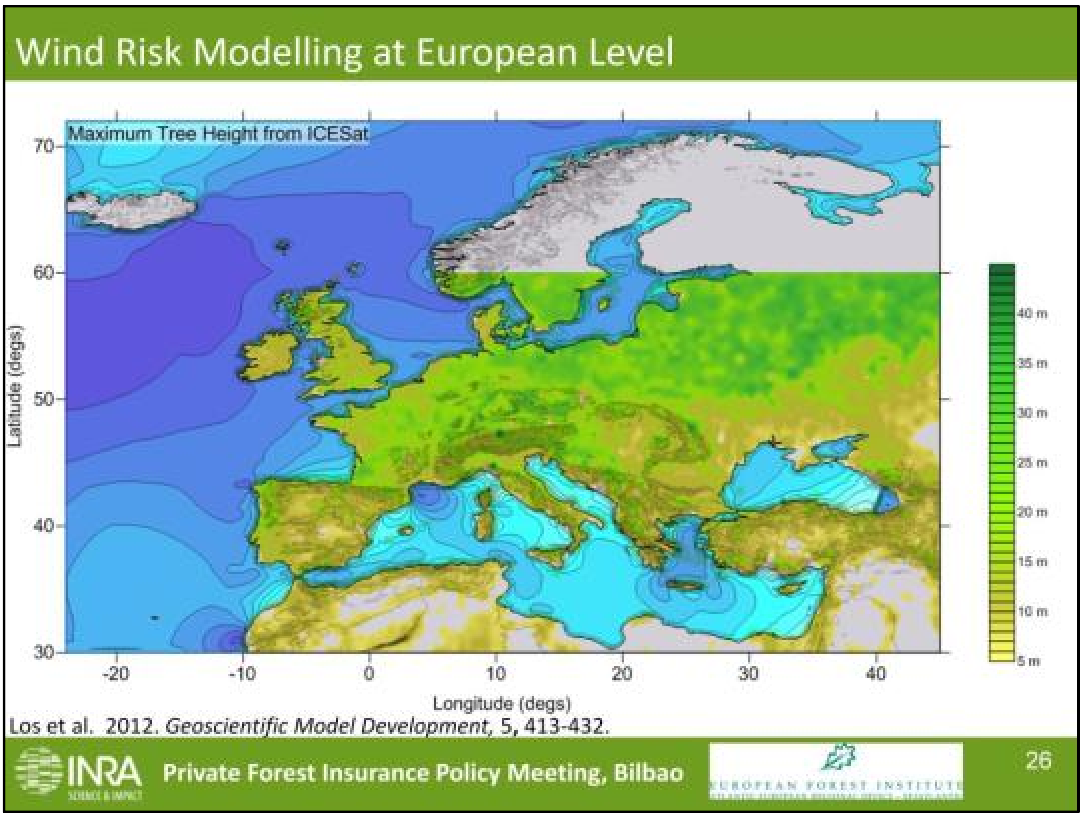
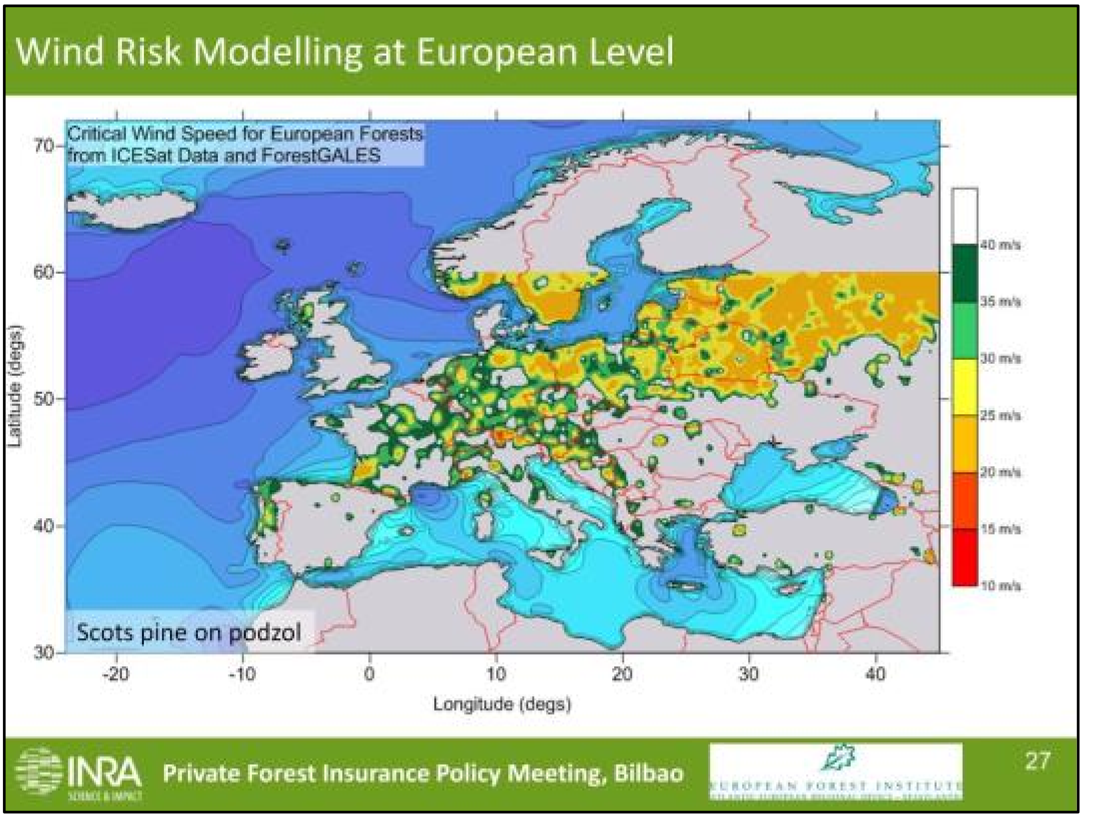
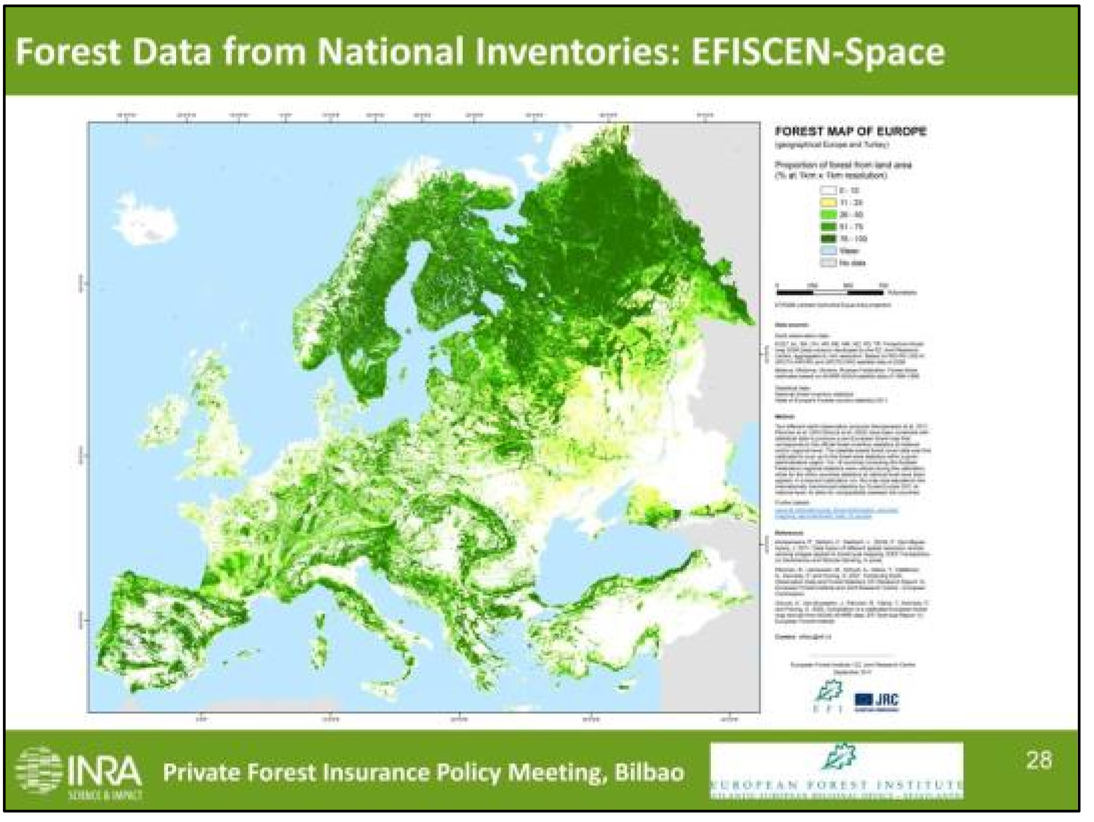
It is also possible to obtain LiDAR data from satellites but at much lower spatial resolution than with airborne LiDAR. One example is the ICESat satellite, which has a footprint of approximately 64m.



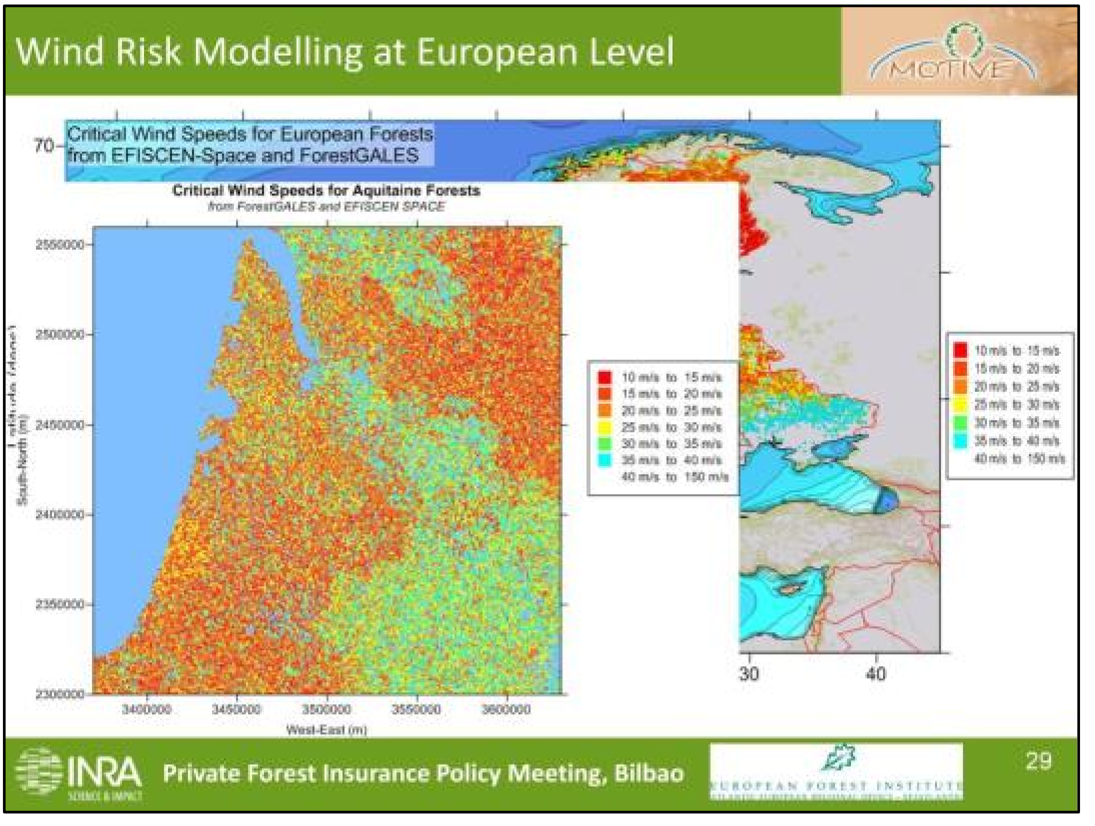
The LiDAR data from ICESat has been used to map vegetation levels across Europe by Los et al. 2012. *Geoscientific Model Development*, 5**,** 413-432. They provide a measure of the range of vegetation heights within each 64m footprint.



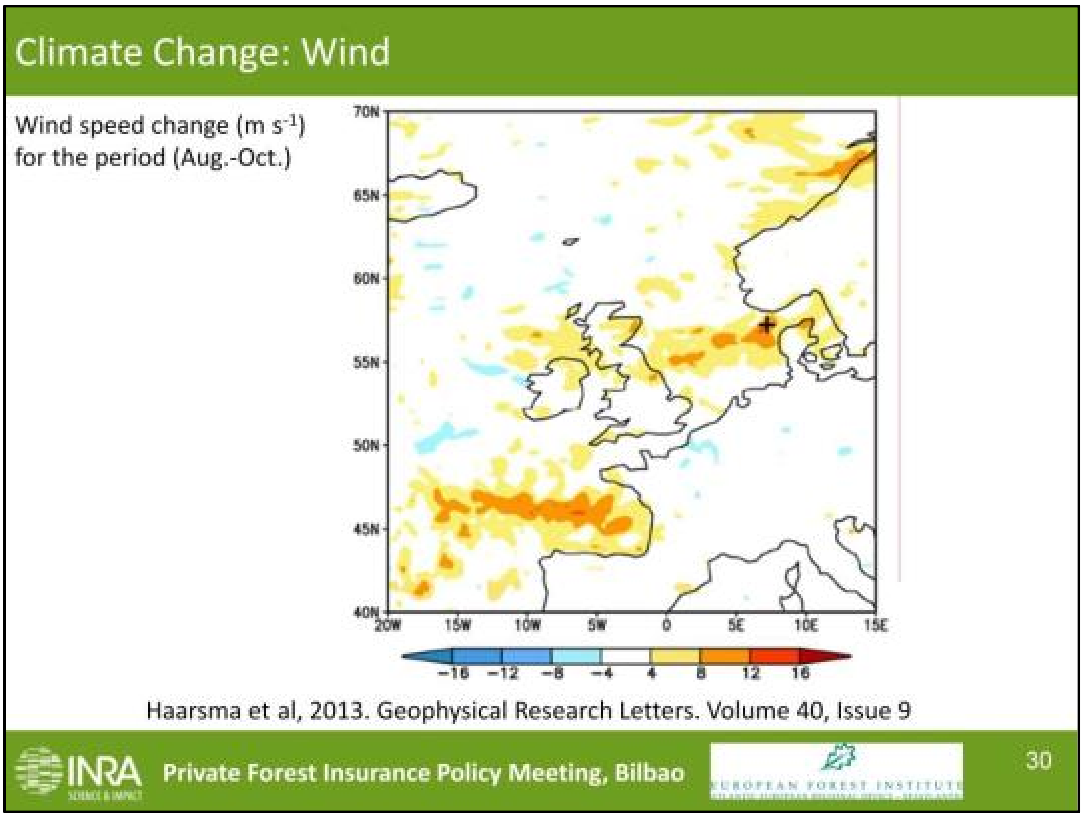
The data can be used to make predictions of the critical wind speeds for damage for forests across Europe if certain assumptions about species and soil are made. Here are presented results assuming all trees are Norway spruce on poorly rooting sites and then assuming all trees are Scots pine on well rooting sites.



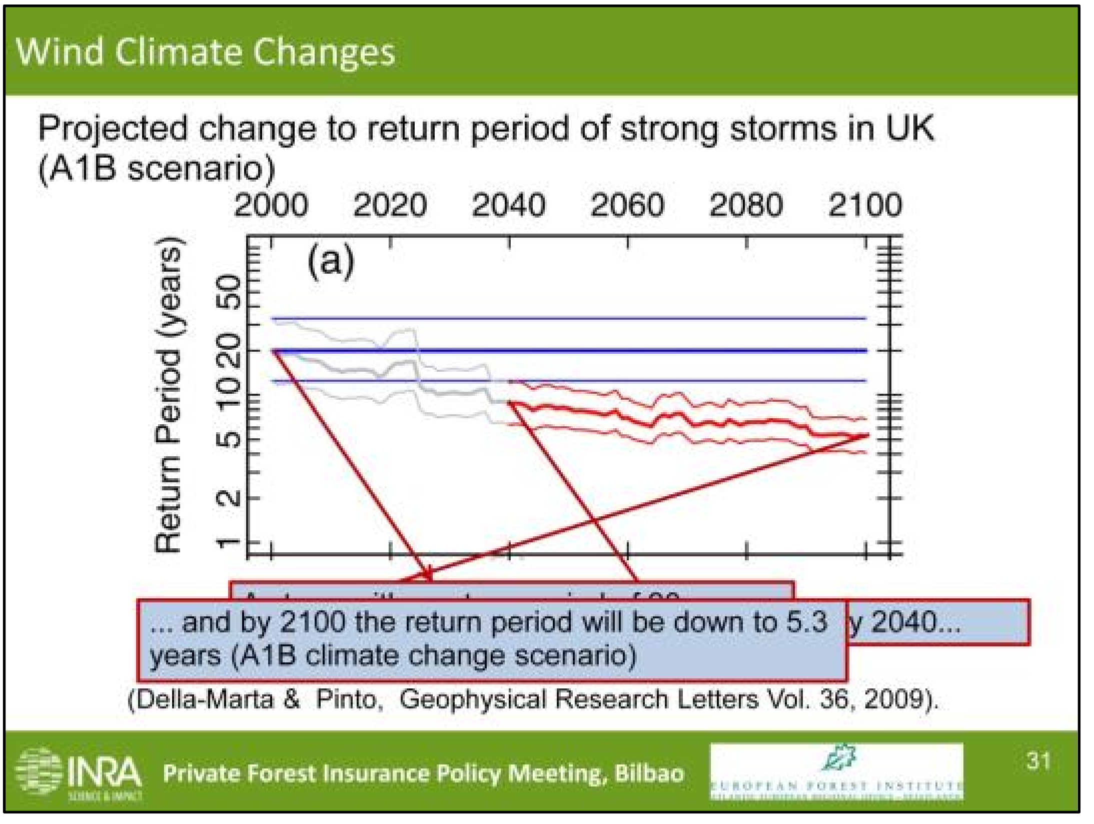
Another alternative is to use national inventory data from all European countries to provide a comprehensive assessment of forest cover, tree size and species. Such data has been combined by EFI to produce EFISCEN-Space.



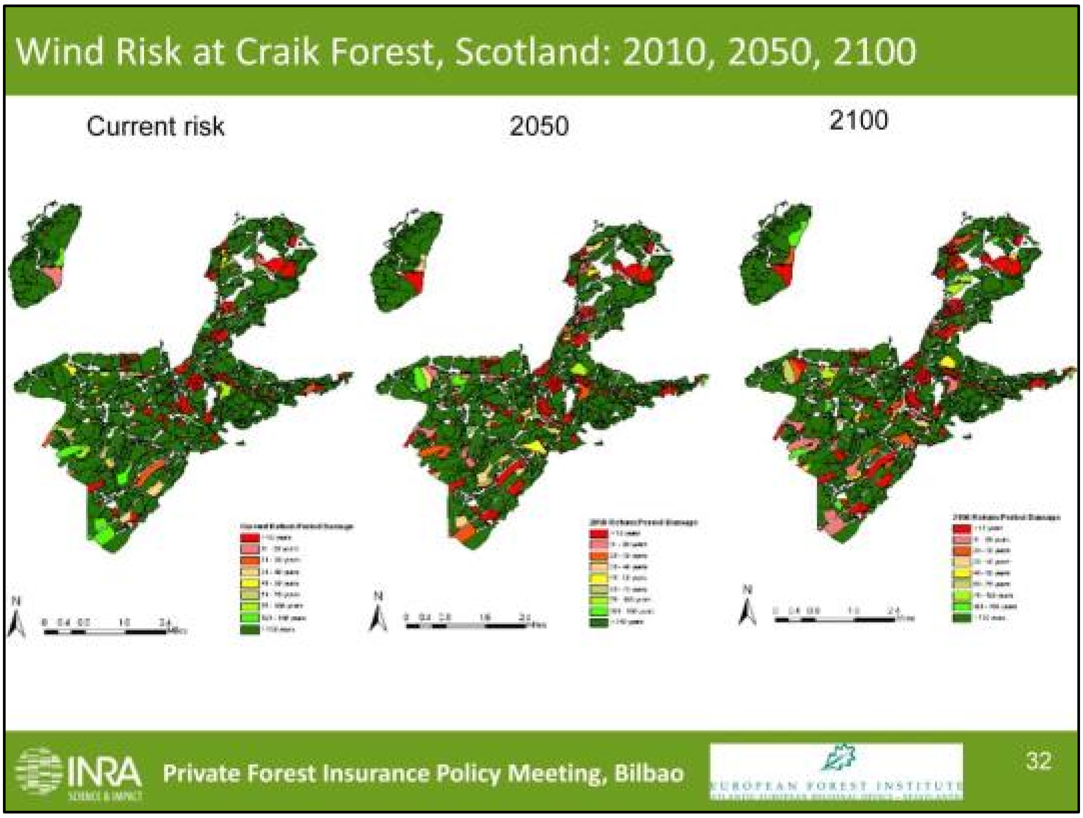
Using national inventory data collected in EFISCEN and the ForestGALES risk model allows a prediction of the critical wind speeds across Europe. It is possible to provide such information at very fine resolution (see example for Aquitaine, France). But it needs to be remembered that the predictions are only as good as the inventory data that are used as inputs for the risk model.



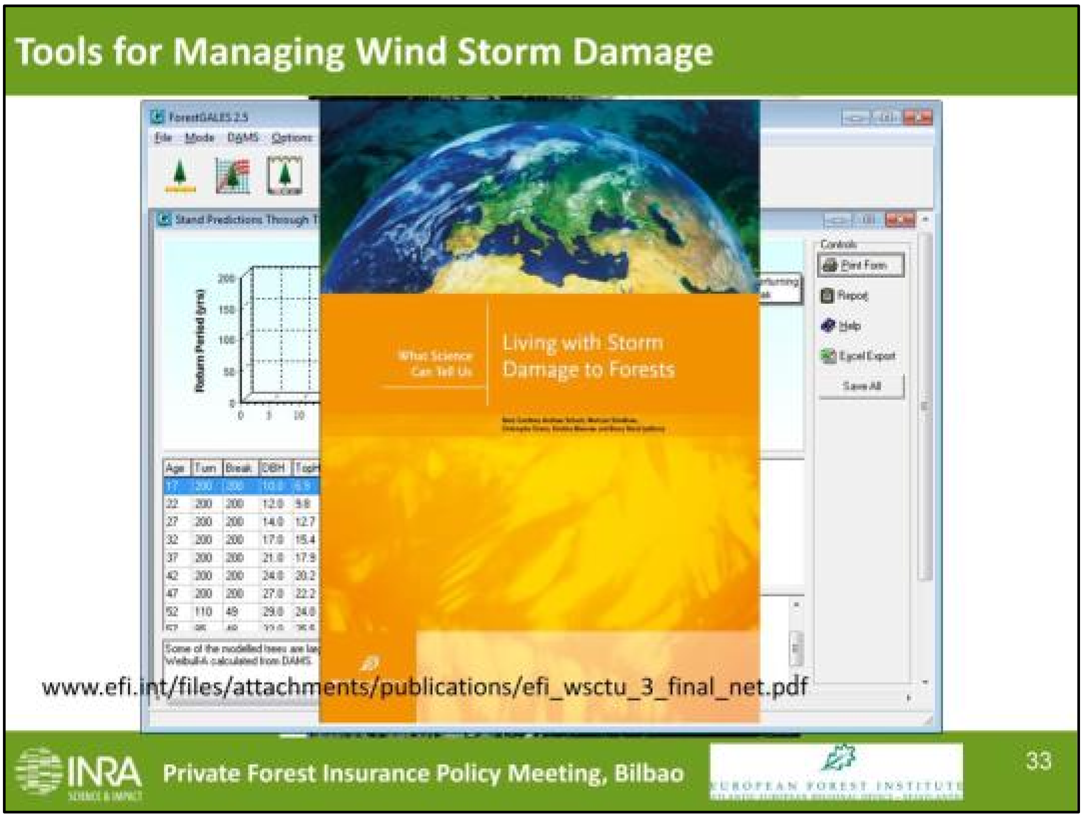
One big question is how the risk of wind damage will change with climate change. Some models show particular areas of increased wind speed such as in the North Sea and the Bay of Biscay (Haarsma et al, 2013. Geophysical Research Letters. Volume 40, Issue 9).



Here is an example of the predicted return periods for strong winds in the UK based on the work of Della-Marta & Pinto, Geophysical Research Letters Vol. 36, 2009, which show the probability of damaging winds increasing in the UK.



These predictions can be used to show the change in risk for different UK forests. Here is an example of the changed level of risk for Craik Forest in Southern Scotland for the present, 2050 and 2100.



There exist a number of tools and sources of information for predicting and managing forest storm risk. These include publications, risk models and Decision Support Systems. Such information and tools can be important components of implementing successful risk mitigation policies in European forests. However, such tools are not yet always utilised as a normal part of forest management.

- ☐ Storm damage to forests has increased in Europe over the last 50 years
- ☐ Storms now cause more than 50% by volume of all forest damage
- ☐ Number of North Atlantic damaging storms has not increased
- ☐ Storm damage is a common at a European level but may be infrequent at a national level
- ☐ Recent forest damage from storms is directly linked to growing stock
- ☐ Wind damage is a complex interaction between wind speed, storm duration, topography, site conditions and stand conditions
- ☐ Tree height, water-logging and recent thinning are strongly related to wind damage
- ☐ Indication storm frequency will decrease but intensity will increase due to climate change
- ☐ Wind damage likely to quadruple by end of century due to increased storm intensity, higher winter precipitation and reduced periods of frozen soils
- ☐ Informed management can reduce the risk and incidence of wind damage
- ☐ Large amount of information & knowledge within Europe on the causes of forest storm damage and the best methods for dealing with their aftermath
- ☐ Tools exist to predict the probability of wind damage and help in risk mitigation

- Risk mitigation is the part of risk management which identifies level of risk, assesses alternative strategies and implements risk reduction. It has 2 distinct components:
  - reduce the risk through implementation of risk reducing policies and practices
  - spread the economic impact though, e.g. forest policy and insurance schemes.
- Successful mitigation of the financial impact of wind damage to storms requires a co-ordinated link between private insurance, regional and national forest restoration funds and European Union level emergency funding.
- The proportion of insured forest stands is reducing in many European countries.
- The European Commission could help extend the areas covered by insurance and the number of insured owners by for example:
  - Sharing the risk between very large areas and various type of stands
  - Set-up public/private mechanisms to support the development of private insurance
  - Contribute to reduction of the cost of insurance to forest owners through regulation
- Consideration could also be given to the European Commission supporting Member States by setting up a specific fund for forest reconstitution after major disasters.

From "Destructive Storms in European Forests: Past and Forthcoming Impacts" http://ec.europa.eu/environment/forests/fprotection.htm