Forest Storm Damage and Insurance Losses
A Decision Support System
Presentation Outline

- Introduction – CoreLogic®
- RQE® - EuroWind™
- Insurance Industry & Forestry
- Forest Module
  - Model components
  - Validation
- Scenario
  - Single plot - monoculture
  - Single plot - mixed culture
  - Multiple plots
  - Market Portfolio Study
- Conclusion
- Q/A
Introduction

CoreLogic®

- Flood unit serves 16 of the 20 top firms in the U.S.
- Integrated provider of credit reports to over 50 auto dealership systems
- Integrated to most mortgage loan origination systems
- Tax Services partners with 17 of 20 largest mortgage servicers
- Approximately 70% of U.S. real estate agents access CoreLogic data
- Government Sponsored Enterprises and Federal Financial Regulators
- 80 years of ITV data
Introduction

Insurance

Hail Scope™

RiskMeter Online™

RQE®
RQE® & European Winter Storm Model (EuroWind™)

RQE® v.16.0

Peril & Country

Coverage

- Green: One Model
- Yellow: Two Models
- Red: Three or more Models
After having a measure of the damage, the loss(es) are calculated by applying financial rules (e.g., limits and deductibles).

In a probabilistic model, the hazard will be expressed as a stochastic set of events, as a representation of the risk in the real world.

Describes the relationship between the severity of the event(s) and the probable damage of this event(s).

A book of business, as a list of properties with their characteristics and (market) value.

Components of a Probabilistic Model

- Exposure Database
- Natural Hazard Model
- Financial Model
- Vulnerability

Natural Catastrophe Risk Modelling
Exposure

Insurance & Forest Industry

Windstorm Damage is devastating to the forest industry, because it causes:
• Disruption in the grow programs
• Additional clearing costs
• Unrecoverable production

Erwin Storm Facts:
• Most devastation storm in 65 years
• 75 million m3 of production forest was lost
• Total damage 2–3 billion Euro
RQE & European Winter Storm Model (EuroWind™)

What is EuroWind 2014™?

- A probabilistic model, and
- Covers 24 countries, has
- A database of 361 Historical Storms, and the hazard
- Consists of 23,000 synthetic events, which is
- Build on the latest research findings, and has
- Two additional components:
  - North Europe Offshore
  - Forest Damage
RQE & European Winter Storm Model (EuroWind™)
What are the components in EuroWind™ 2014 - Hybrid Hazard?

Historical Event Set
361 storms
1960-2013 period

Stochastic Event Set
~23,000 storms

Characteristics of
~25,000 simulated
storms 800-2000 period

Met. Station density
and accuracy “Ground Truth”

Centuries long global
simulation

HYBRID HAZARD

Measurements
<- complemented with->

AOGCM

Ensemble of Historical “proxies”
RQE & European Winter Storm Model (EuroWind™)

EuroWind™ 2014 – Local Adjustments for wind speed

Legend

<table>
<thead>
<tr>
<th>Terrain Roughness based on Land Cover</th>
<th>6,001 - 8,000</th>
<th>8,001 - 10,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 2,000</td>
<td>10,001 - 12,000</td>
<td></td>
</tr>
<tr>
<td>2,001 - 4,000</td>
<td>12,001 - 14,000</td>
<td></td>
</tr>
<tr>
<td>4,001 - 6,000</td>
<td>14,001 - 16,000</td>
<td></td>
</tr>
</tbody>
</table>

DEM (SRTM resampled to 250m)
LAND USE (Corine 2012, 100m)
GUSTINESS (10mins vs 3 sec)
DIRECTION (9 + Fetch)
Forest Module
Model Components

- Based on the EuroWind™ 2014 Hazard
- Six Vulnerability Curves for Forest

Other types are:
- Coniferous – Low
- Mixed – High/Low
- Deciduous – High

Least vulnerable –
Deciduous - Low

Most vulnerable –
Coniferous - High
Forest Module

Model Components

- Based on the EuroWind™ 2014 Hazard
- Six Vulnerability Curves for Forest
- Three Risk Locations for the spatial distribution of produced wood (in volume), and Forest Types
Forest Module

Model Components

- Based on the EuroWind™ 2014 Hazard
- Six Vulnerability Curves for Forest
- Three Risk Locations for the spatial distribution of produced wood (in volume), and Forest Types
- Exposure database for Insurable Forest (in cubic meters), based on:
  - CORINE 2012 digital land use database
  - Statistical data from:
    - Skogsstyrelsen - The Swedish Forest Agency (SFA)
    - Finnish Forest Research Institute – (METLA)
Forest Module

Validation – Exposure Database for Standing Stock (in cubic meters)

The Swedish Forest Agency (SFA)
Corine Land Cover 2012

Distribution of Volume
Forest Module

Validation – Erwin

Storms have occurred before...

<table>
<thead>
<tr>
<th>Date</th>
<th>Worst-affected area in Sweden</th>
<th>Storm felled forest (cubic metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Mar 1943</td>
<td>Northeast Götaland</td>
<td>5 million</td>
</tr>
<tr>
<td>3 Jan 1954</td>
<td>Eastern Svealand</td>
<td>18 million</td>
</tr>
<tr>
<td>17–18 Oct 1967</td>
<td>Southeast Götaland</td>
<td>10 million</td>
</tr>
<tr>
<td>22 Sept 1969</td>
<td>Northwest Götaland</td>
<td>25 million</td>
</tr>
<tr>
<td>1 Nov 1969</td>
<td>Eastern Svealand</td>
<td>10 million</td>
</tr>
<tr>
<td>17 Nov 1995</td>
<td>Northern Götaland</td>
<td>5 million</td>
</tr>
<tr>
<td>8–9 Jan 2005</td>
<td>Southwest Götaland</td>
<td>75 million</td>
</tr>
</tbody>
</table>

Winter Storm Erwin (2005)

- Model Results
- Damage -10%
- Damage +10%
- Erwin 2005 Reported
- Erwin 2005 Modelled
- Return Period 70-80y

Return Period (years) vs. Damage (m³) in Millions.
Scenario 1

Single plot - monoculture

Wood production for Spruce on a 5km² plot

Wood Production

Adapted from: Forest Research Notes, Volume 8, Number 2, Second Quarter, 2011
Scenario 1 – Forest Growth and Damage

Single plot – Monoculture – Results

Spruce Wind Damage

Non-linear relationship between forest growth and damage
Scenario 2 – Production Cycle Simulation

Single plot - mixed culture on a forest plot

Total Volume (m³)

<table>
<thead>
<tr>
<th>Time</th>
<th>Total Volume (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 00</td>
<td>590,000</td>
</tr>
<tr>
<td>Year 05</td>
<td>512,500</td>
</tr>
<tr>
<td>Year 10</td>
<td>645,000</td>
</tr>
<tr>
<td>Year 15</td>
<td>435,000</td>
</tr>
<tr>
<td>Year 20</td>
<td>395,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Height</th>
<th>Time</th>
<th>CNF</th>
<th>DCD</th>
<th>MXD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Year 00</td>
<td>25,000</td>
<td>60,000</td>
<td>40,000</td>
</tr>
<tr>
<td></td>
<td>Year 05</td>
<td>60,000</td>
<td>75,000</td>
<td>50,000</td>
</tr>
<tr>
<td></td>
<td>Year 10</td>
<td>10,000</td>
<td>90,000</td>
<td>60,000</td>
</tr>
<tr>
<td></td>
<td>Year 15</td>
<td>15,000</td>
<td>120,000</td>
<td>15,000</td>
</tr>
<tr>
<td></td>
<td>Year 20</td>
<td>22,500</td>
<td>30,000</td>
<td>20,000</td>
</tr>
<tr>
<td>High</td>
<td>Year 00</td>
<td>200,000</td>
<td>40,000</td>
<td>225,000</td>
</tr>
<tr>
<td></td>
<td>Year 05</td>
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<td>281,000</td>
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<tr>
<td></td>
<td>Year 10</td>
<td>75,000</td>
<td>60,000</td>
<td>350,000</td>
</tr>
<tr>
<td></td>
<td>Year 15</td>
<td>125,000</td>
<td>70,000</td>
<td>90,000</td>
</tr>
<tr>
<td></td>
<td>Year 20</td>
<td>187,500</td>
<td>20,000</td>
<td>115,000</td>
</tr>
</tbody>
</table>

Distribution of Volume (m³) by tree types and height
Scenario 3

Multiple plots - Single culture - Spruce

<table>
<thead>
<tr>
<th>Location</th>
<th>Volume (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1737</td>
<td>21,000,000</td>
</tr>
<tr>
<td>2161</td>
<td>26,700,000</td>
</tr>
<tr>
<td>2283</td>
<td>23,700,000</td>
</tr>
<tr>
<td>2284</td>
<td>28,500,000</td>
</tr>
<tr>
<td>2313</td>
<td>24,800,000</td>
</tr>
<tr>
<td>2361</td>
<td>30,000,000</td>
</tr>
<tr>
<td>2482</td>
<td>21,300,000</td>
</tr>
<tr>
<td>2510</td>
<td>26,800,000</td>
</tr>
<tr>
<td>2523</td>
<td>25,100,000</td>
</tr>
</tbody>
</table>

Wind Damage on Multiple Locations

Damage Ratio

Return Period

Damage
Scenario 4

Multiple plots - mixed culture

<table>
<thead>
<tr>
<th>Tree Type</th>
<th>% Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNF - Low</td>
<td>10%</td>
</tr>
<tr>
<td>CNF - High</td>
<td>37%</td>
</tr>
<tr>
<td>DCD - Low</td>
<td>9%</td>
</tr>
<tr>
<td>DCD - High</td>
<td>10%</td>
</tr>
<tr>
<td>MXD - Low</td>
<td>8%</td>
</tr>
<tr>
<td>MXD - High</td>
<td>25%</td>
</tr>
</tbody>
</table>

Wind Damage on Multiple Locations

Damage Spruce only  
Damage Mixed Production

Return Period

Damage Ratio

loc: 1737
loc: 2161
loc: 2283
loc: 2284
loc: 2313
loc: 2361
loc: 2482
loc: 2510
loc: 2523
Use Cases
National Exposure Study

Total Damage to Forest

Contributing part of Coniferous Forest
Exposure Study

Damage of a Storm like Erwin 2005

Difference due to:
- Exposure / Inventory dates
- Modelled results vs Estimates on the Ground

Useful for:
- Quick indication of probable risks
- Assisting in guiding the relieve work (harvesting losses, repairing electricity poles, emergency response)

Damage Ratio based on CoreLogic®'s Exposure Database 2014
Conclusion

- Modelling forest damage is not a straightforward process, there are many aspects involved, like:
  - Measurements (e.g. wind speed observations / failing stations)
  - Statistical data (forest inventories)
  - Land Use data
  - Climate change (increasing storm severity)

- All this information is not static, but highly dynamic, and can change rapidly

- Modelling forest damage from Winter Storm Damage is needed, because there are too many unknowns, and using a Decision Support System to model Damages is one solution to get an understanding on the damage, and therefore the industry losses
Thank you for your attention