

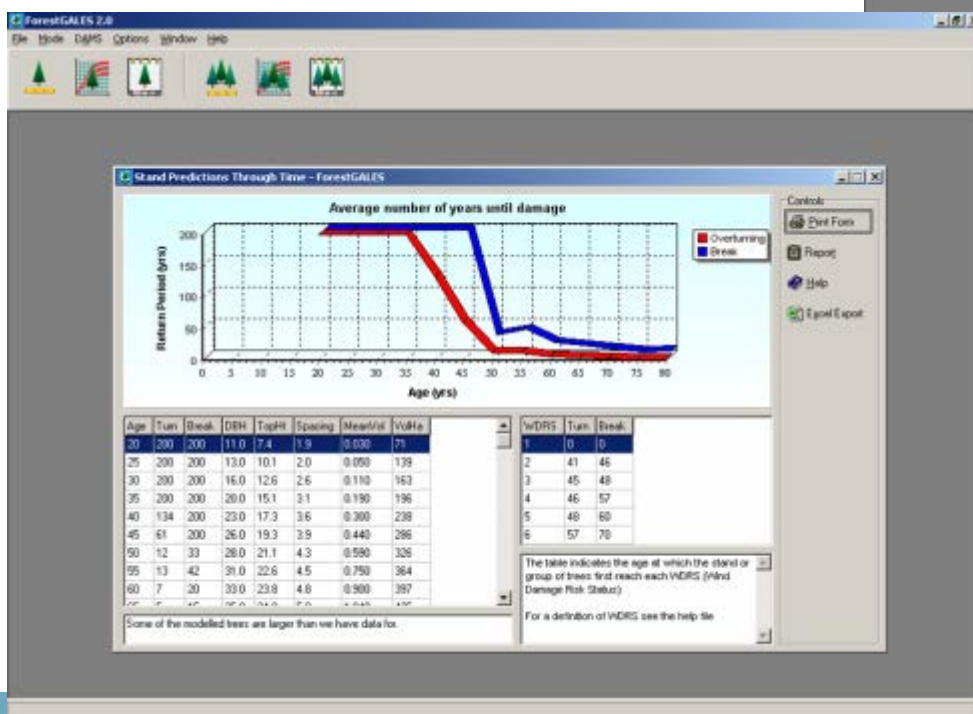
Adaptation of the Wind Risk Model ForestGALES to the Basque Country

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European Forest Institute, Cestas, France
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Forest Research, Scotland



ForestGALES Wind Risk Model

ForestGALES 2: A Wind Risk Management Model (WRMM)



ForestGALES 2.0

File Mode DAMS Options Window Help

Single stand predictions using field measurements

Stand Characteristics:

- Stand ID: ForestGALES
- Cultivation: Notched Planting
- Drainage: Poor drainage
- Soil type: Peaty/Gley
- Current Spacing (m): 3.2
- Current Stocking (N/m²):

Tree Characteristics:

- Species: Sitka Spruce
- Top height of stand (m): 25.5
- Mean DBH (cm): 32.2

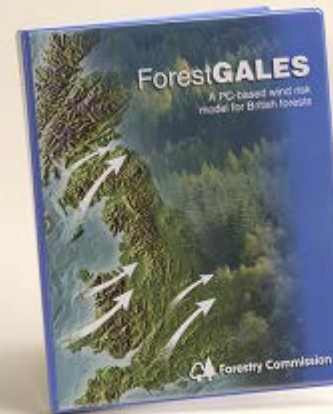
DAMS:

- Grid Preference: ☒ Calculation
- NH160150 Apply DAMS Score: 15

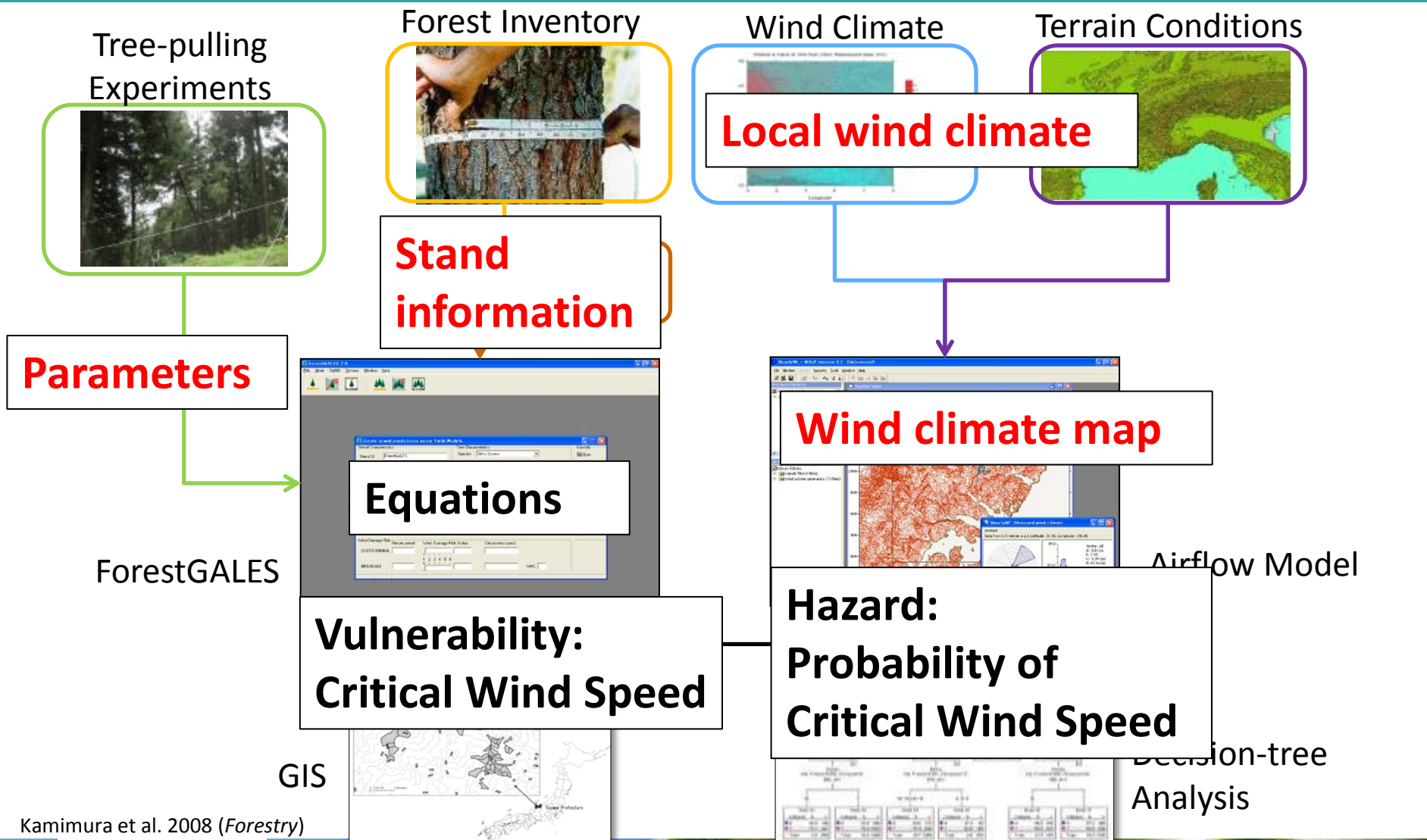
Wind Damage Risk:

- Return period: 5
- Wind Damage Risk Status: Status 6
- Critical wind speed: 19 m/s
- Breakage: 28
- Status: 4
- Critical wind speed: 22 m/s
- WDR: 5

Controls: , , , , , , ,



ForestGALES: Information Flow



Kamimura et al. 2008 (Forestry)



Basaize Workshop
GALDAKO

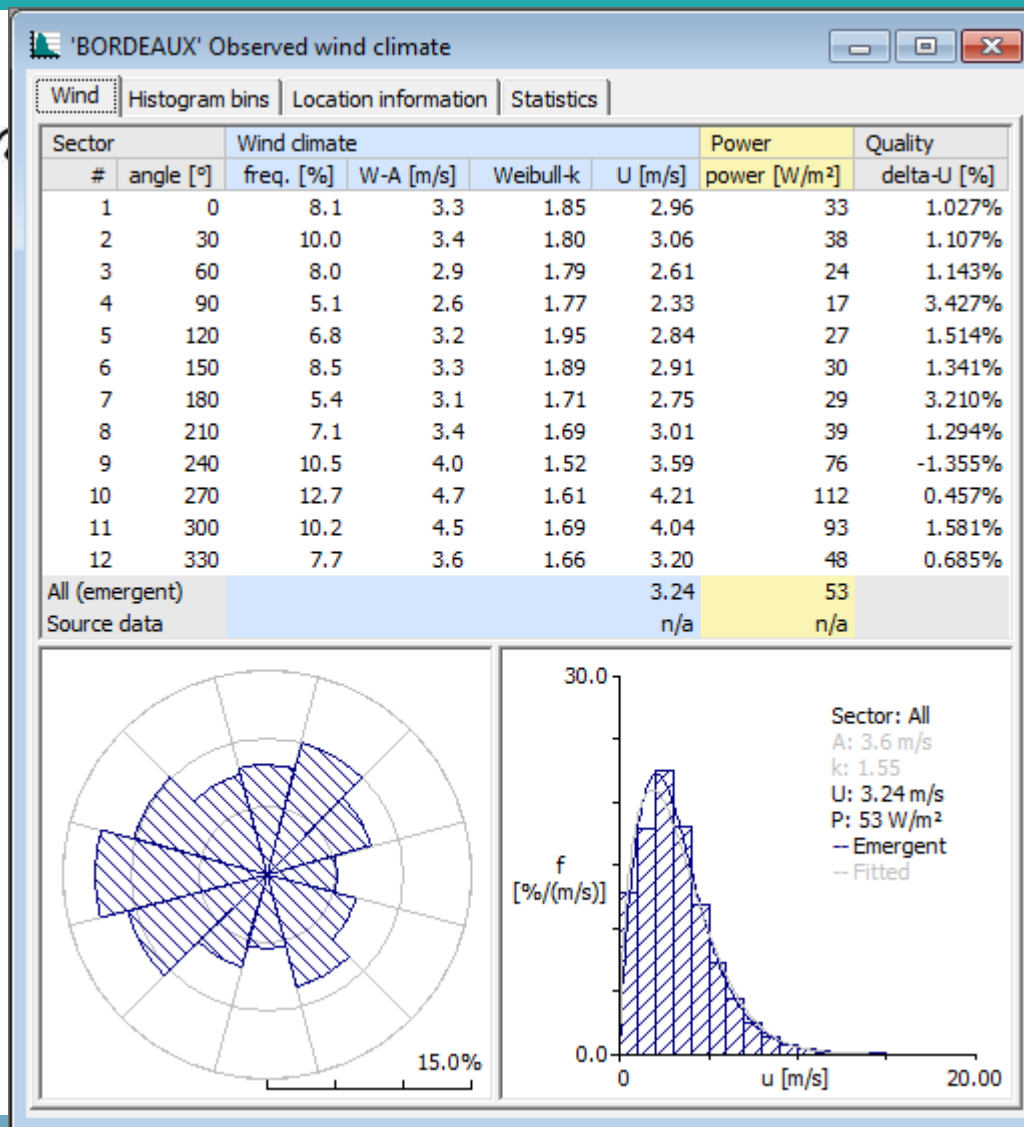
ForestGALES: Inputs and Outputs

- Inputs
 - Tree species
 - Tree height
 - Tree diameter (1.3 m)
 - Spacing
 - Soil type
 - Rooting Depth
 - Latitude and Longitude (for wind climate information)
- Outputs
 - Critical wind speed for overturning
 - Critical wind speed for breakage
 - Return period for overturning (if wind climate data available)
 - Return period for breakage (if wind climate data available)
- Other Requirements (in external parameter files)
 - Crown width equation
 - Crown depth equation
 - Stem taper equation (for calculating stem weight)
 - Wood Modulus of Rupture (MOR)
 - Wood Modulus of Elasticity (MOE)
 - Wood density (for calculating stem weight)
 - Rooting resistance (function of tree size, rooting depth and soil type)

Parameterising ForestGALES: Wind Climate Data



ForestGALES: Wind Climate Data for Basque Country



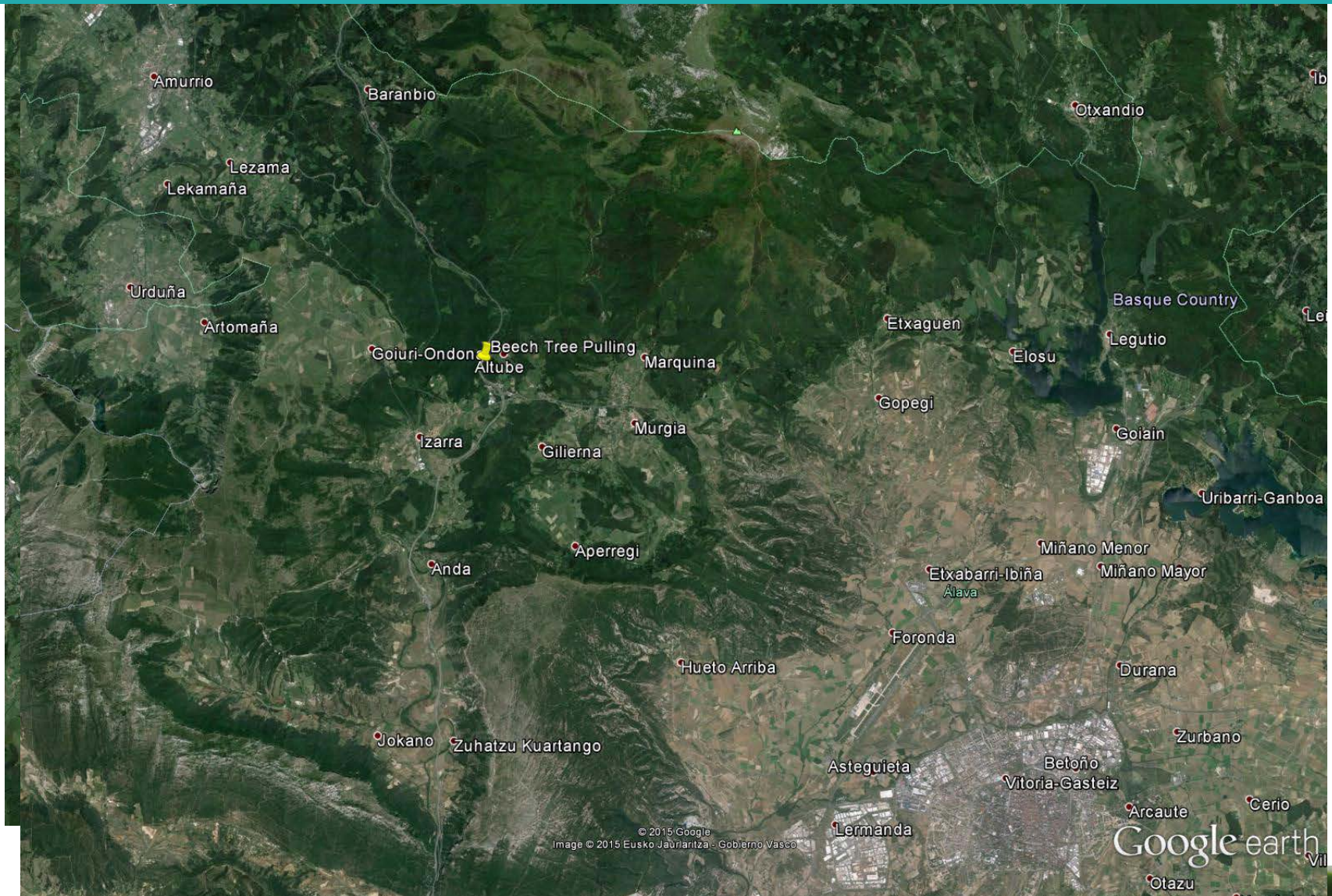
ForestGALES: Wood Strength Data



ForestGALES: Tree Pulling



ForestGALES: Tree Pulling



ForestGALES: Tree Pulling



ForestGALES: Tree Pulling of Eucalyptus



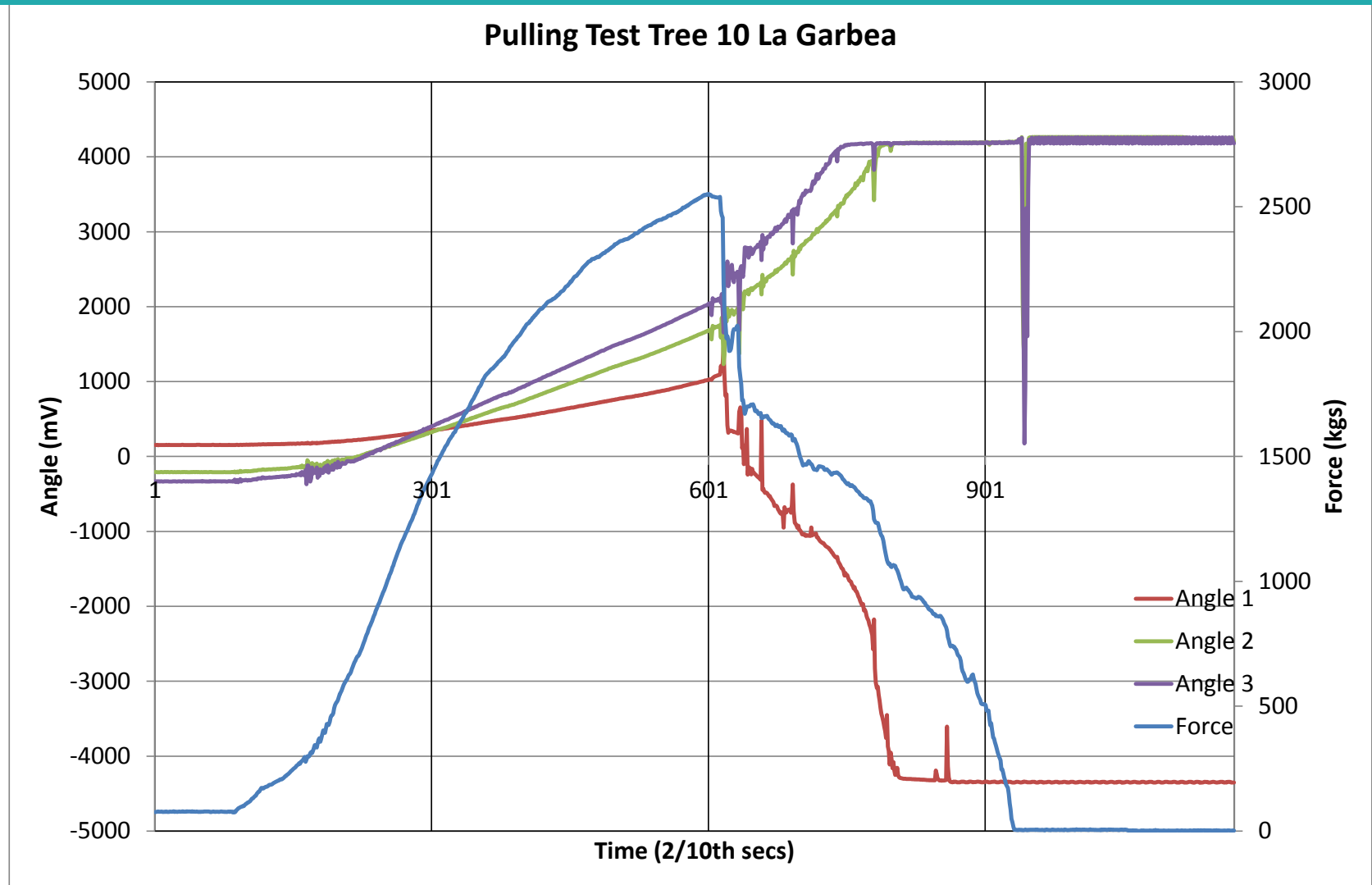
ForestGALES: Tree Pulling of Radiata Pine



ForestGALES: Tree Pulling of Beech

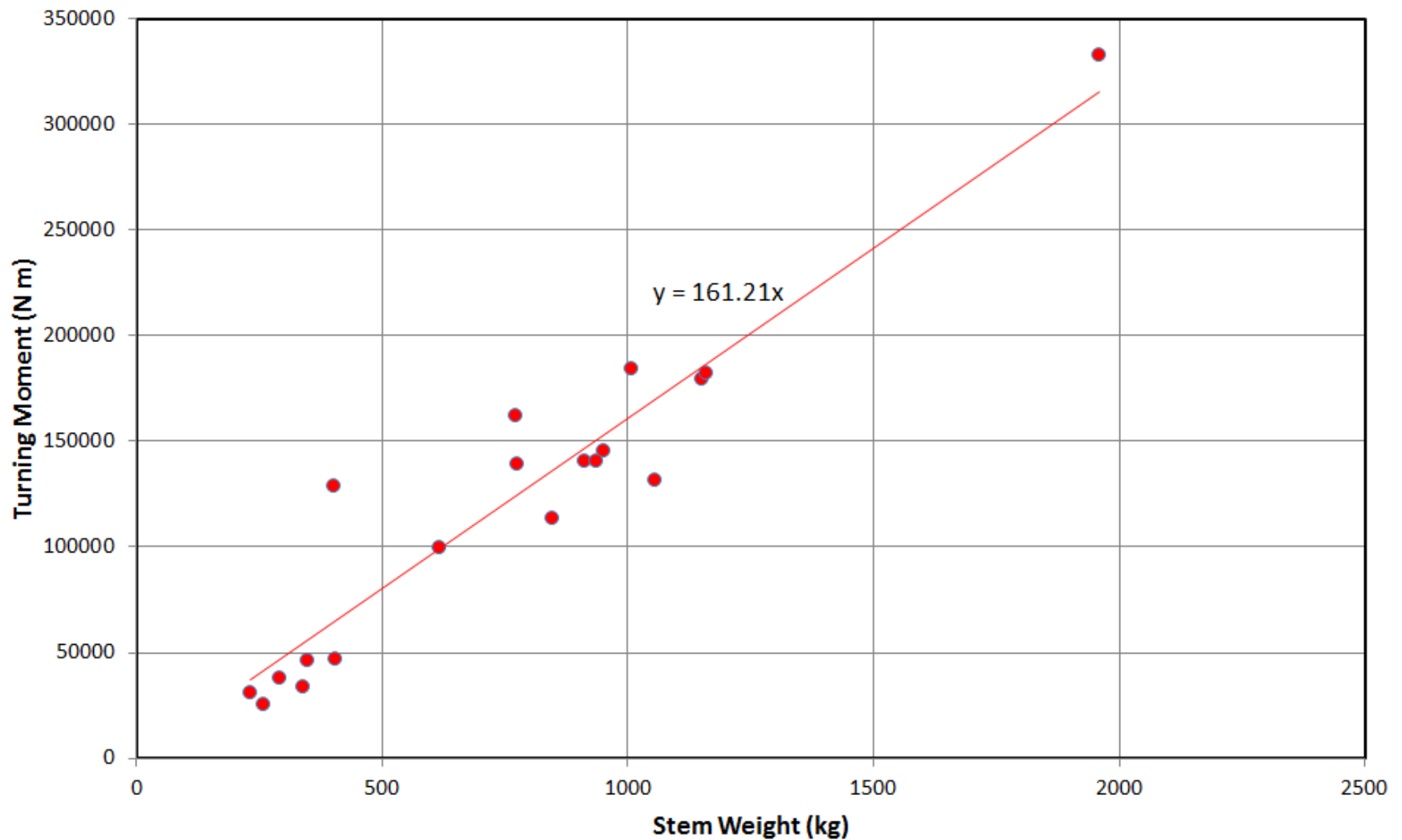


ForestGALES: Tree Pulling Example



ForestGALES: Tree Pulling Results

Radiata Pine, Basque Country



Species Parameter Files

File Explorer window showing the directory structure and the contents of the selected file, U2Parameters.txt.

Directory path: Lovie_Austin > Alberta_Hunter (C:) > Program Files (x86) > Forest Research > ForestGALES_2.5 > SpeciesParamFiles

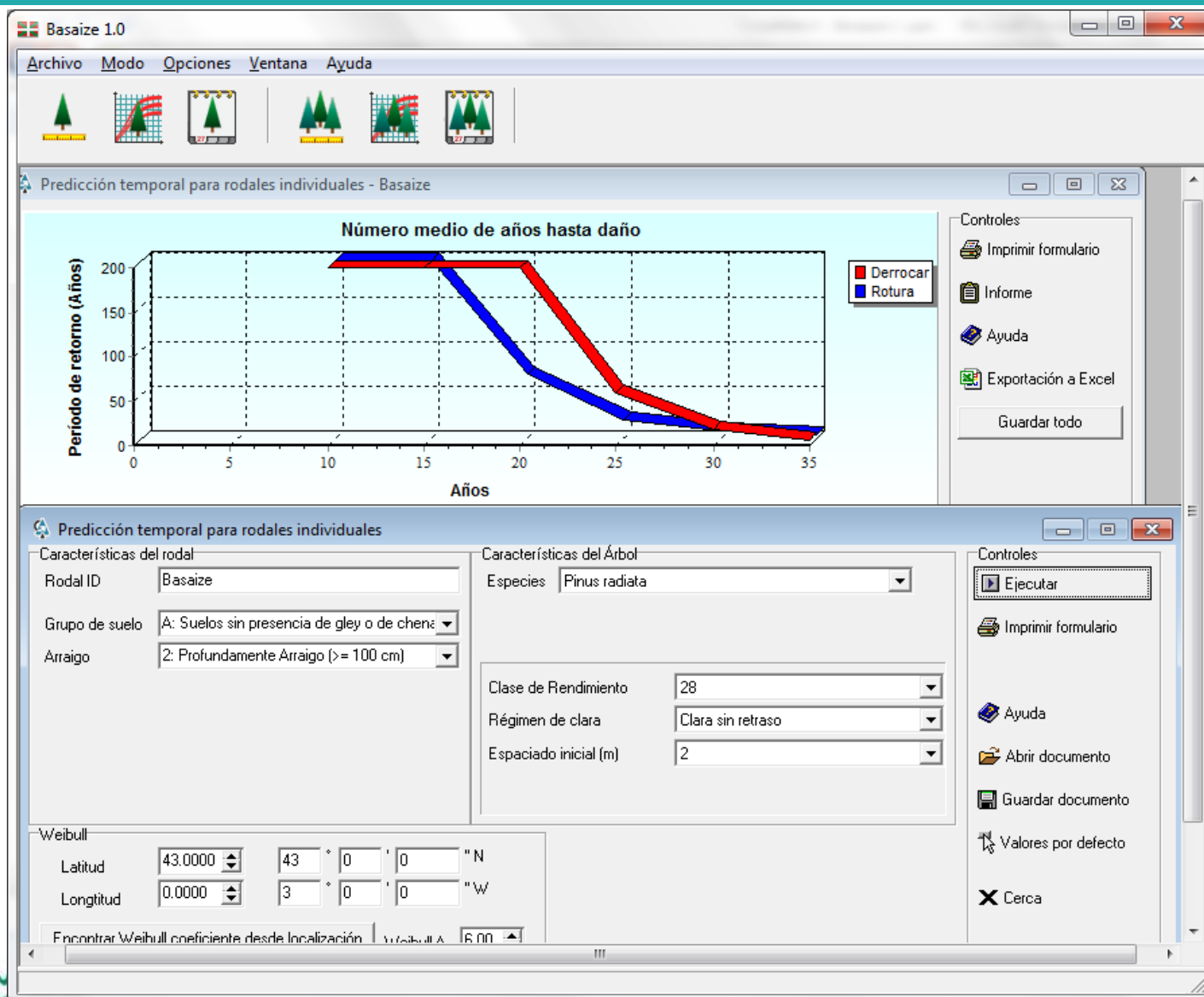
File list (Name, Date modified, Type, Size):

- BEParameters.txt, 16/11/2016 21:22, Text Document, 2 KB
- BPParameters.txt, 16/11/2016 21:17, Text Document, 3 KB
- CPPParameters.txt, 28/01/2015 15:07, Text Document, 2 KB
- DFParameters.txt, 28/01/2015 15:07, Text Document, 2 KB
- ELParameters.txt, 28/01/2015 15:07, Text Document, 2 KB
- ExampleSpeciesParameters.txt, 28/01/2015 15:05, Text Document, 2 KB
- GPPParameters.txt, 28/01/2015 15:07, Text Document, 2 KB
- HLPParameters.txt, 28/01/2015 15:07, Text Document, 2 KB
- ILParameters.txt, 28/01/2015 15:07, Text Document, 2 KB
- LPPParameters.txt, 28/01/2015 15:07, Text Document, 2 KB
- NFPParameters.txt, 28/01/2015 15:07, Text Document, 2 KB
- NSPParameters(WindFall).txt, 22/07/2016 11:37, Text Document, 2 KB
- NSPParameters.txt, 27/03/2017 13:51, Text Document, 2 KB
- OKParameters.txt, 03/04/2017 18:59, Text Document, 2 KB
- SPPParameters.txt, 28/01/2015 15:07, Text Document, 2 KB
- SSParameters.txt, 16/08/2017 14:32, Text Document, 2 KB
- ULParameters.txt, 28/01/2015 15:07, Text Document, 2 KB
- U2Parameters.txt**, 25/09/2016 14:06, Text Document, 2 KB
- U3Parameters.txt, 28/01/2015 15:07, Text Document, 2 KB
- U4Parameters.txt, 25/08/2016 16:16, Text Document, 3 KB
- U5Parameters.txt, 25/08/2016 16:35, Text Document, 3 KB
- U6Parameters.txt, 25/08/2016 14:34, Text Document, 2 KB
- WHParameters.txt, 28/01/2015 15:07, Text Document, 2 KB

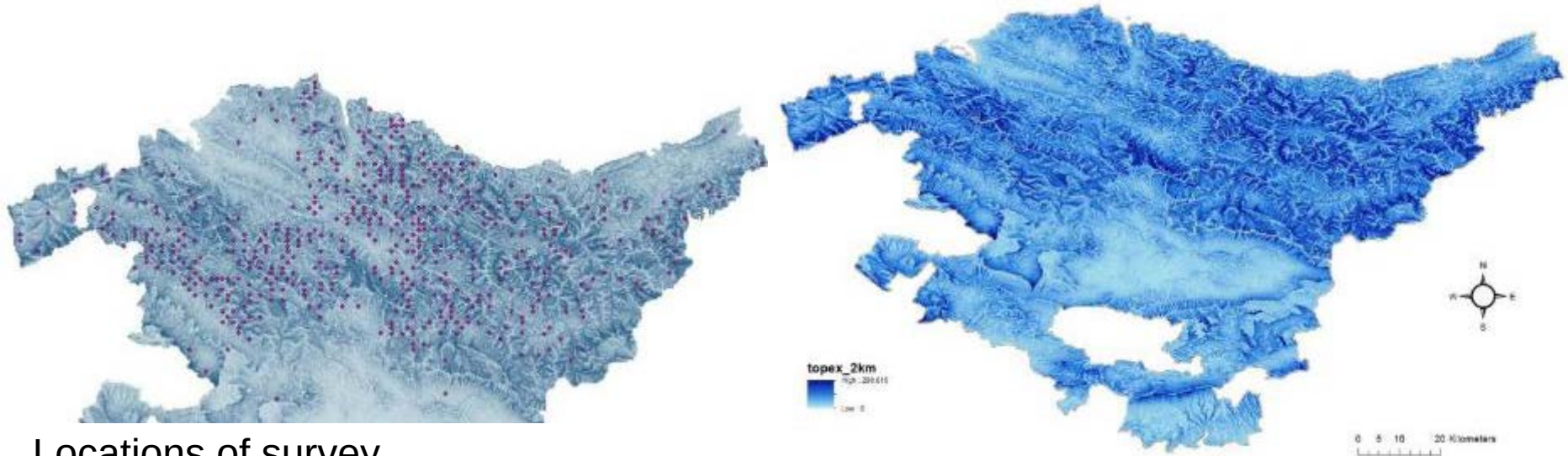
Contents of U2Parameters.txt:

```
# ForestGALES 2.5res Radiata pine parameter file (from John Moore and
Alejandro cantero)
U2
# L3 conversion top height (m) to mean height (m): Meant = Multiplier*topet
+ intercept
# Multiplier
1.018952117
# intercept
-2.463317709
# L8 canopy breadth (m) as function of dbh (cm).
# Equation form: 1 linear: Param1*DBH*100 + param2; 2 Power: Param1
*DBH*Param2 + Param3
1
# Param1
0.0043
# Param2
2.9506
# Param3
0
# L17 canopy depth (m) as function of height (m)= Multiplier*Height +
intercept; (m).
# Equation form: 1 linear: Param1*Height + param2; 2 exp: Param1*exp(param2
*Height)
1
# Param1
0.9244
# Param2
-0.5586
# L24 Stem Density (from NZ tree pulling data)
1002
# Canopy Density (from Scots pine)
2.5
# Modulus of rupture (from NZ tree pulling data)
3.2e7
# L30 knot factor (assume knot factor incorporated in MOR because it was
derived from broken trees during tree pulling)
1.0
# Modulus of elasticity [from G.M. Lavers, The strength Properties of Timber,
BRE Report]
6.8e9
# L34 Streamlining parameters (based on power law fits to Mayhead's original
data 1973)
# C
2.35
# N
0.51
# L39 Root bending term: RootBendK = Ks/Kr in Table 4 of Neild and Wood
(1999) tree Physiology 141-151. Values range from 0 - 0.2 typically
0.0
# L41 overturning moment Multipliers: (from radiata tree pulling in Basque
Country, Spain. Assuming soil is well-drained brown earth with rooting >
80cm)
# Soil-A; Rooting depth 1,2,User
138.7
101.2
141.4
# Soil-B; Rooting depth 1,2,User
122.9
142.9
125.4
# Soil-C; Rooting depth 1,2,User
134.2
136.1
136.9
# Soil-D; Rooting depth 1,2,User
152.7
177.6
177.6
```


Basaize 1.1 Wind Risk Model



ForestGALES: Validation in Basque Country



Locations of survey plot

TOPEX (Distance limited=2km)



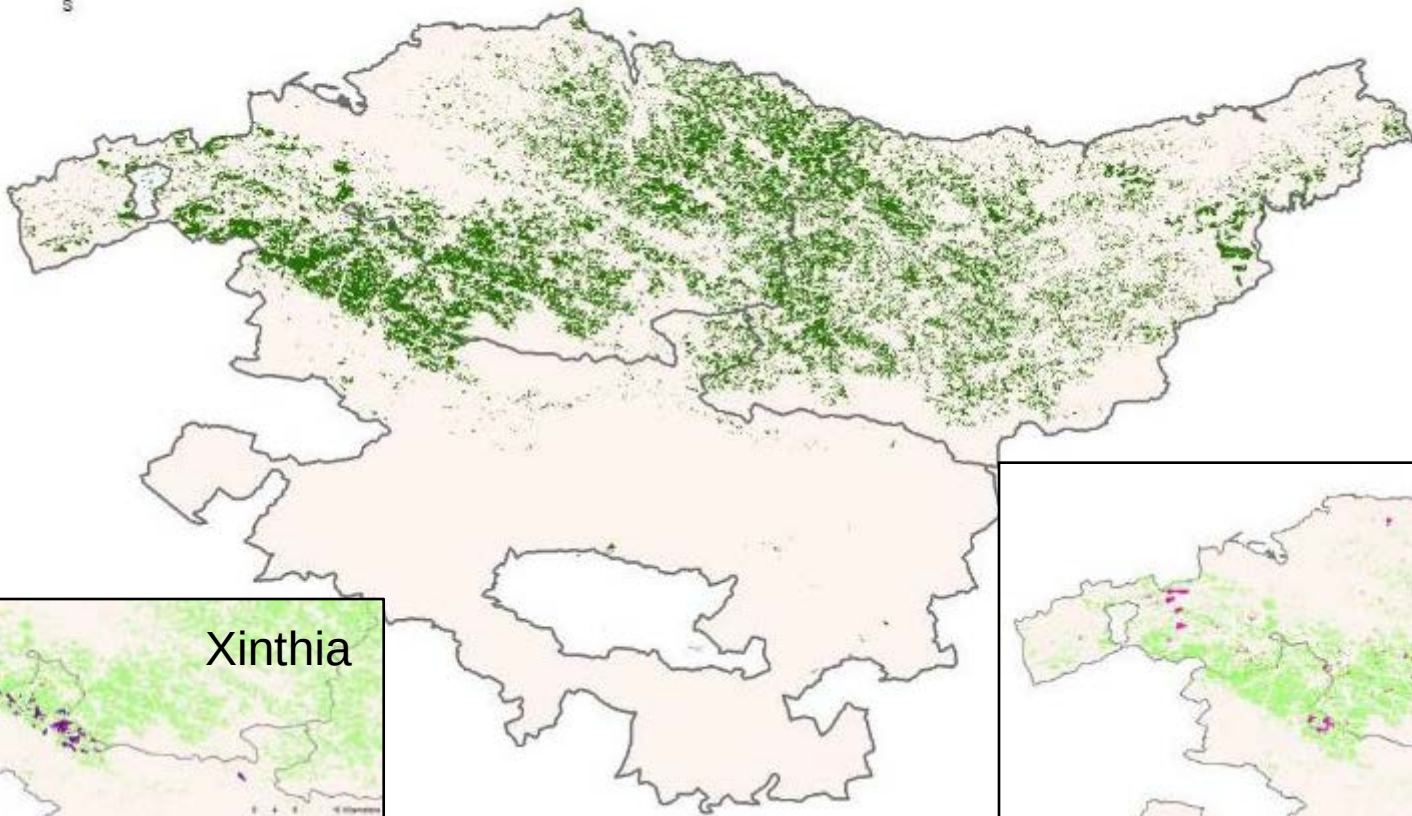
Locations of meteorological station

ForestGALES: Validation in Basque Country

Planted forests of Radiata pine



■ Plantation_radiata



Xinthia

Klaus

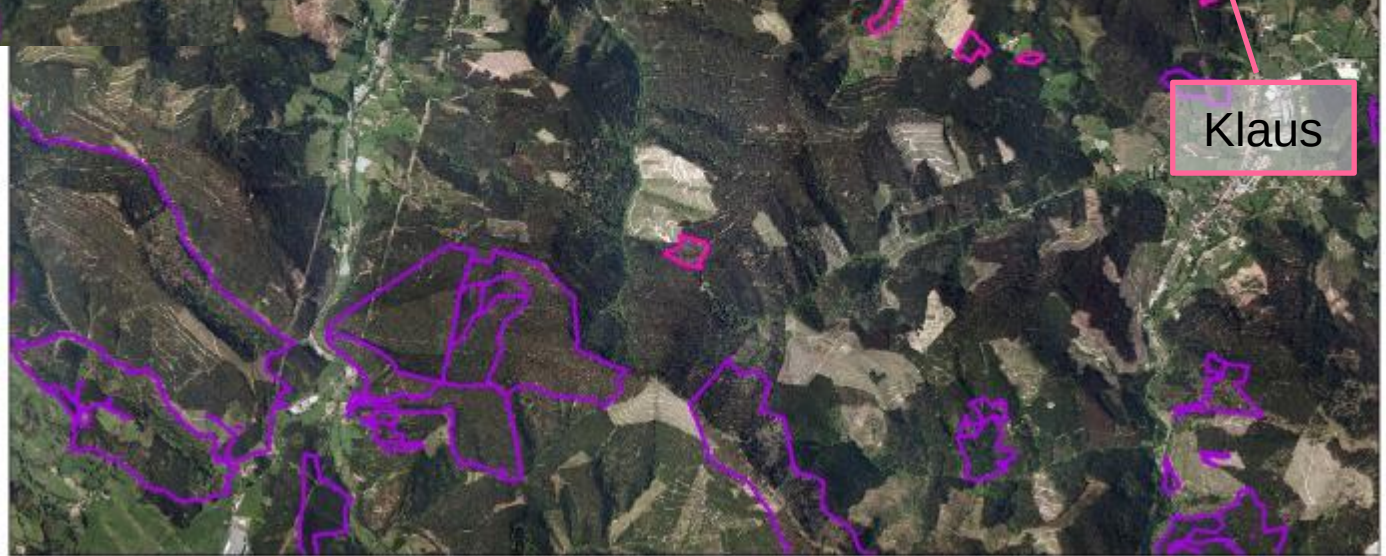
ForestGALES: Validation in Basque Country



Xynthia

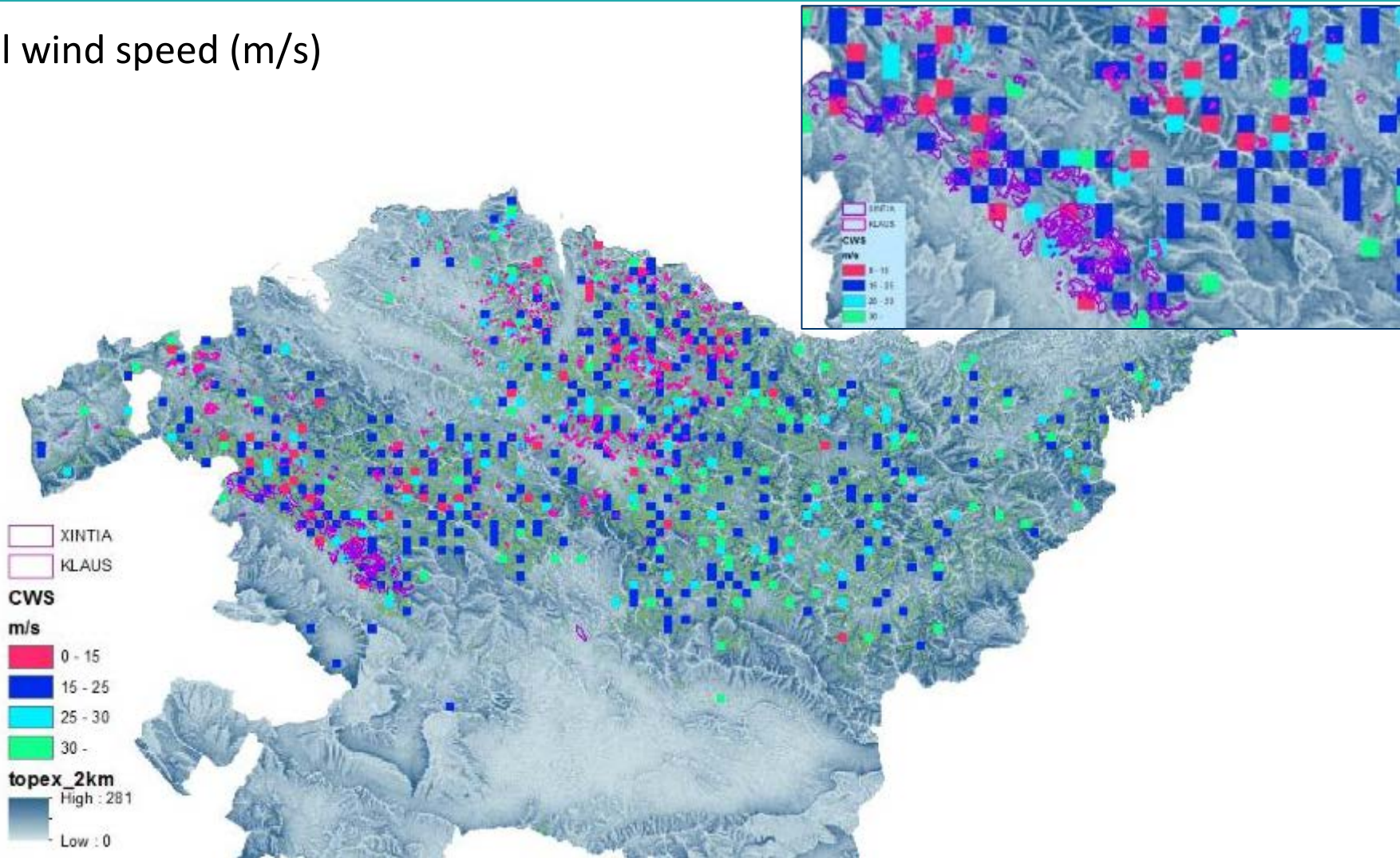


Klaus

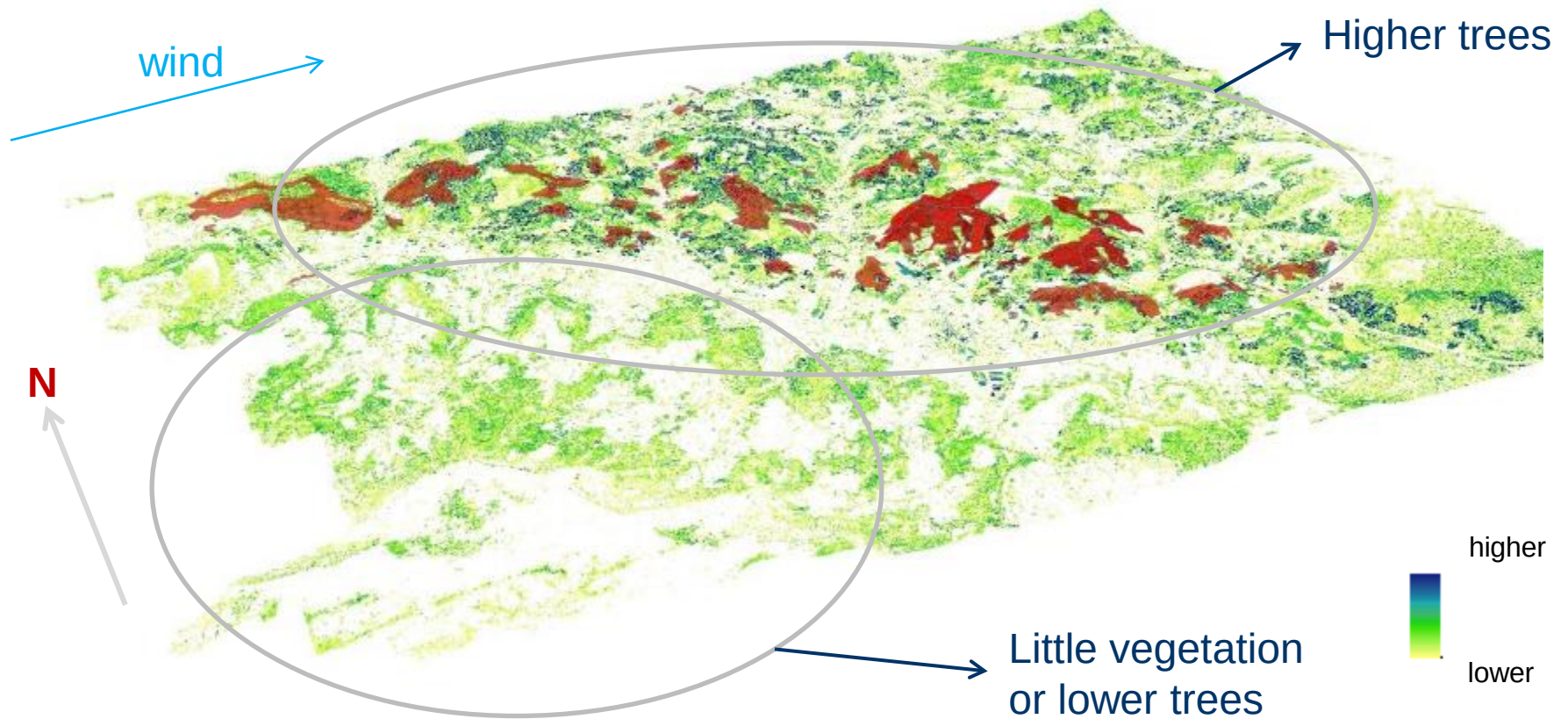


ForestGALES: Validation in Basque Country

Critical wind speed (m/s)



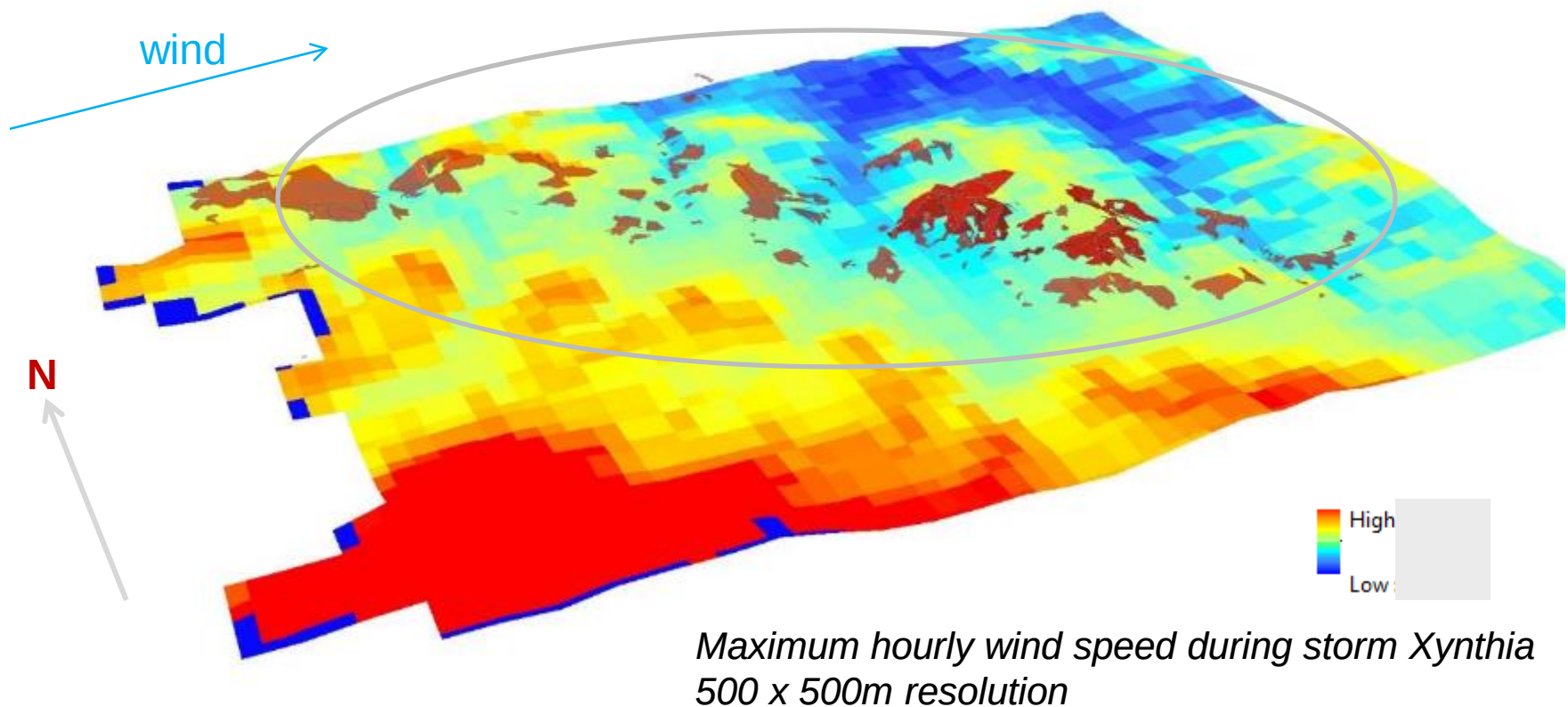
Vegetation height and damage caused by Storm Xynthia



ForestGALES: Validation in Basque Country

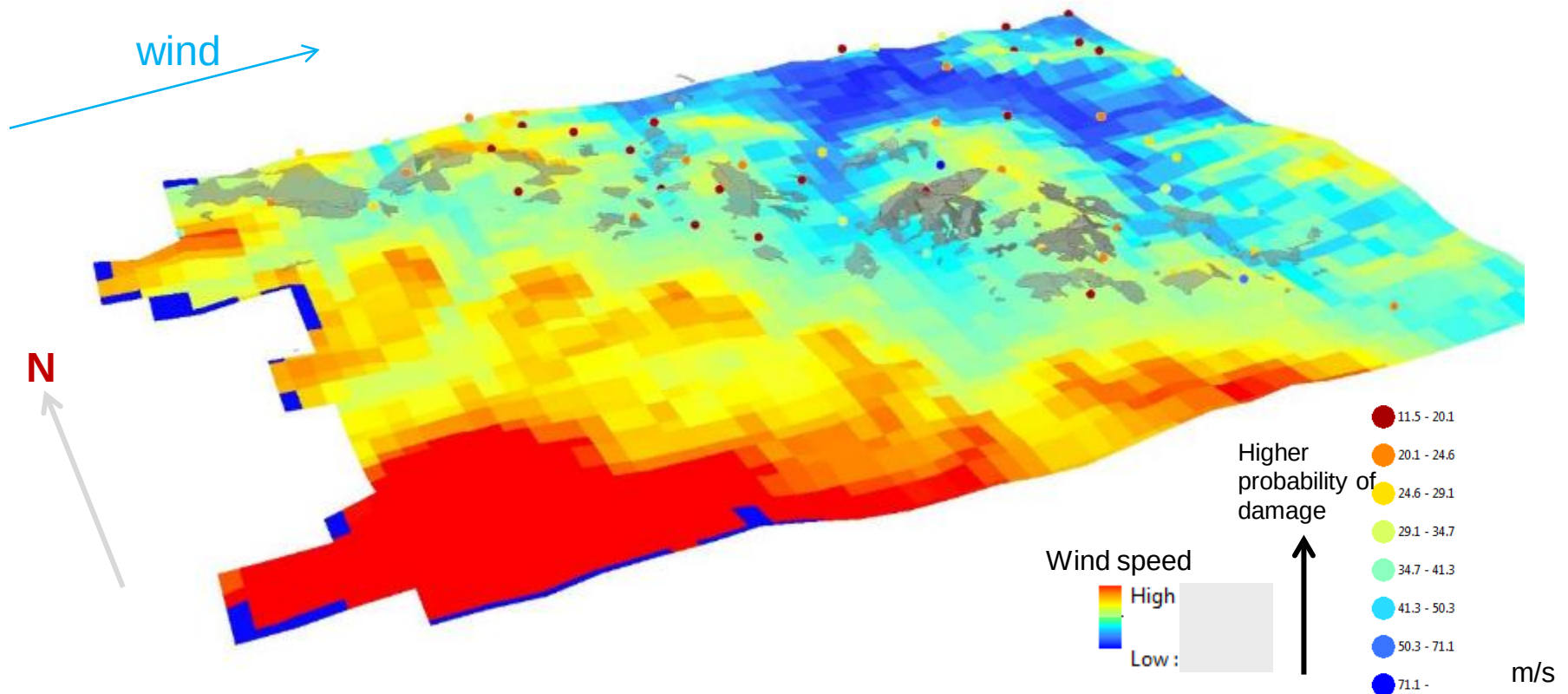
Wind speed and damage caused by Storm Xynthia

Gaztelumendi et al., 2011

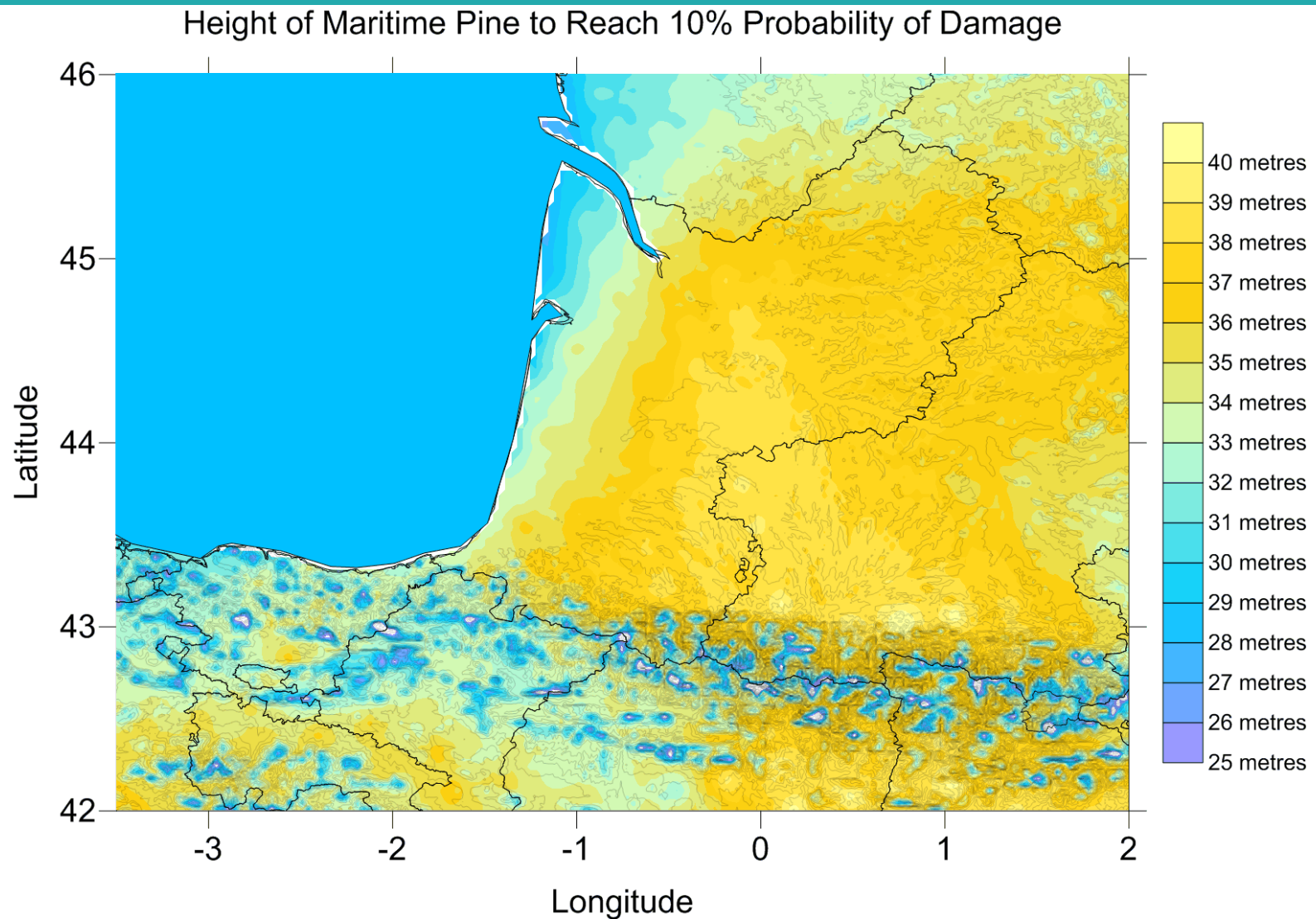


ForestGALES: Validation in Basque Country

Wind speed and critical wind speed (CWS) by Basaize



Modelling Wind Risk at Regional Level



Summary

To Date

1. ForestGALES 2.5 has been modified to work in the Spanish Basque Country and the new model is called Basaize 1.1
2. Tree pulling experiments in Northern Spain of radiata pine and *eucalyptus globulus* have been used to parameterise the model.
3. Tree pulling of *fagus sylvaticus* in North-eastern France have been used to parameterise the model for beech.
4. Other species parameterisations based on data from other tree pulling experiments
5. Map of Weibull A and Weibull k wind climate parameters for the Basque Country produced from more than 70 meteorological stations (function of elevation, topographic shelter & distance from the sea)
6. Initial validation of Basaize using wind damage to radiata pine from storms Klaus and Xynthia

Future

1. Further tree-pulling *Fagus sylvaticus* in Basque Country.
2. Full validation of Basaize with data from Storms Klaus and Xynthia

THANK YOU



EFIATLANTIC

