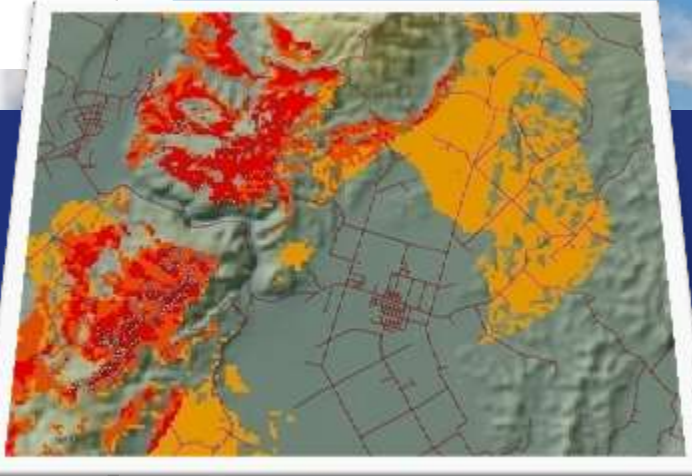


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Wind Development Value Innovation



Background

- In the past six years, Kenex have developed advanced spatial modelling techniques that combine:
 - Mesoscale modelling of wind data from a third party to assess the potential of an area's wind resource.
 - Advanced terrain analysis, land use and social acceptability parameters to define the extent of possible wind farms at regional and country-wide scales.
 - Grid transmission variables to select sites with the best available connections to the grid.
 - More detailed preliminary layout that gives the first real estimation of the economic feasibility of the project
- Our modelling has been successfully used in New Zealand, Australia and Argentina to evaluate new sites for wind farm development and determine the productive efficiency of turbine sites at current projects.



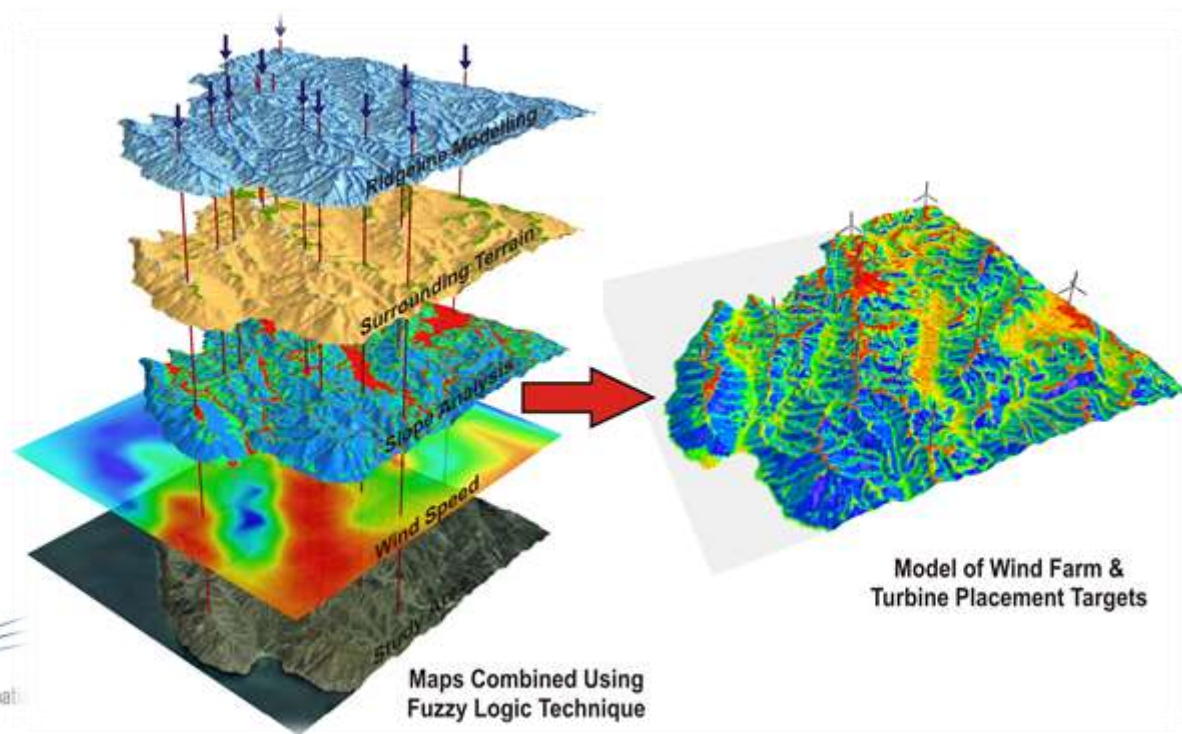
Wind Energy Prospecting and Development

Kenex has completed a number of successful wind project for clients in New Zealand, Australia and Argentina:

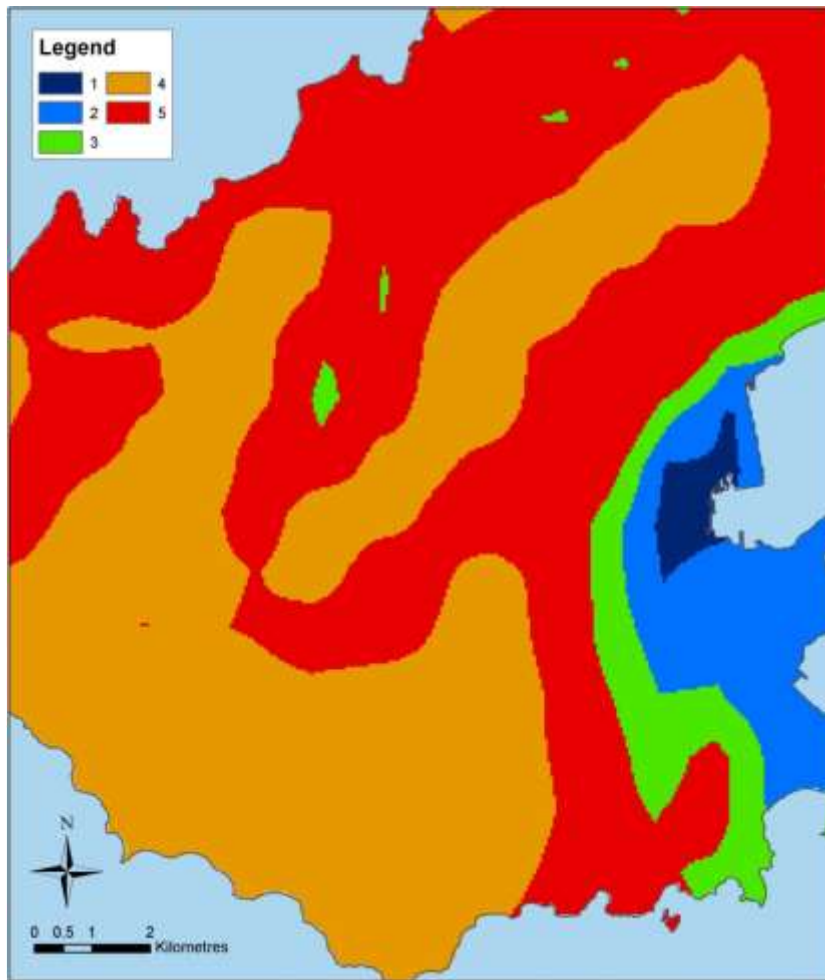
- **Genesis Energy, New Zealand:**
 - National model “Stage 1” for the entire country
 - Regional models “Stage 2” for 8 selected areas from the Stage 1 model
 - Local “Stage 3” model at Castle Hill, Wairarapa
- **Aurecon, Australia:**
 - National model “Stage 1” in New South Wales and Queensland
 - Combined Wind and Transmission grid model in Victoria
- **EEDSA and Neuquen Government, Argentina:**
 - Country-size model “Stage 1” tailored to Argentina energy market
 - Regional models “Stage 2” for selected areas from the Stage 1 model.
 - Neuquen provincial Government selected 4 areas for developing up to a 200MW economic wind resource from Stage 2 model. First wind farm is already under construction.
 - Preliminary layout with the gross annual production and capacity factor estimation for EEDSA Baja Colorada project in the province of Buenos Aires.

Fuzzy Logic approach to Wind farm prospecting






- The Fuzzy Logic model is knowledge-driven: it utilises expert inputs and relevant spatial data to investigate unexplored areas.
- Create a series of GIS maps weighted based on their relative importance and statistically combined to deliver a predictive model of suitable wind farm sites.
- Data-based and transparent modelling process: control the scale and the outputs



Predicting and Mapping the Wind Resource



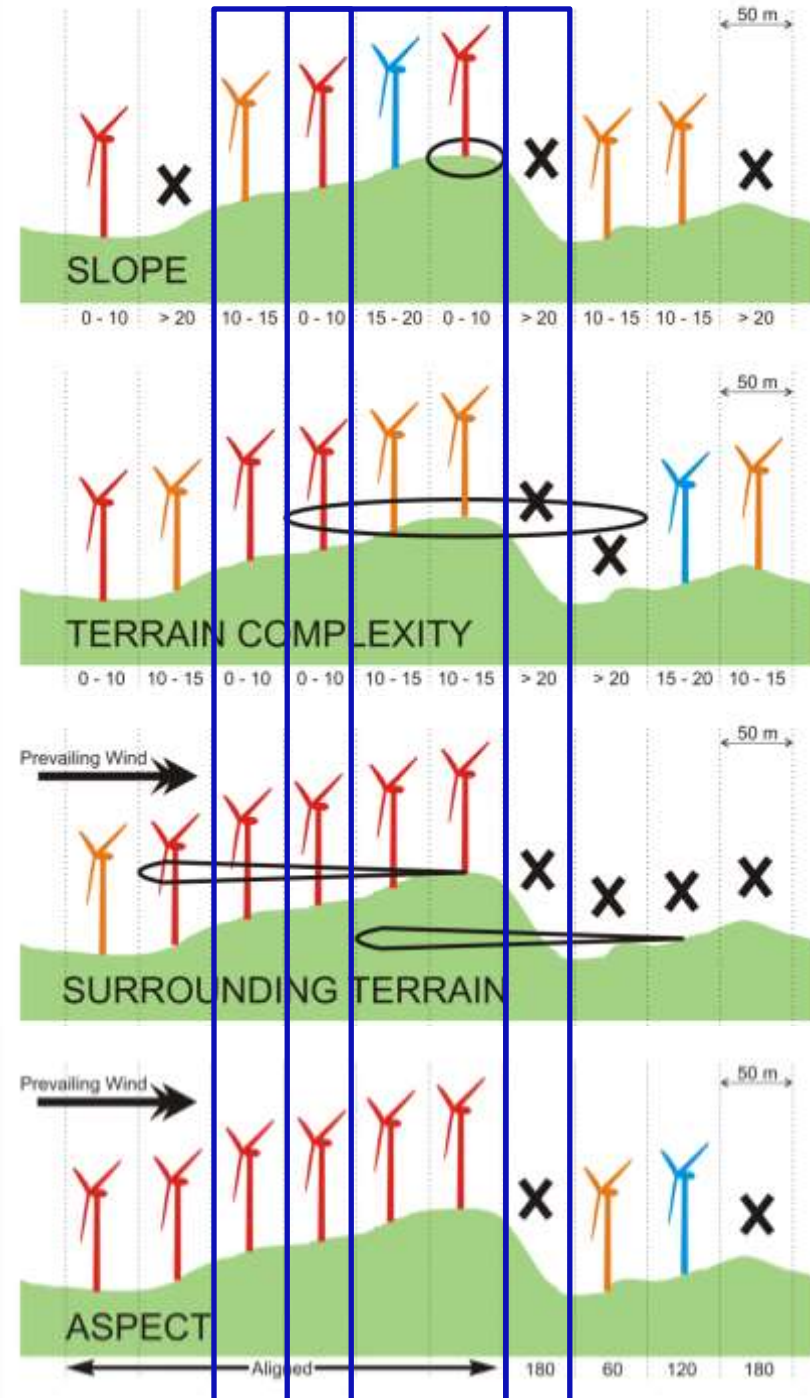
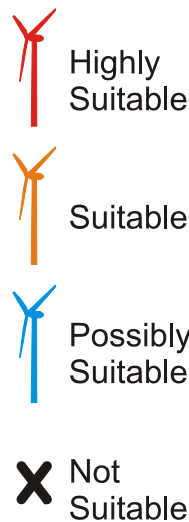
- Creating predictive maps from wind speed data created by Aurecon Mesoscale modelling
- Reclassifying the raster based on its wind speed values
- Assigning weights to the predictive map classes

Class	Description
1 	Not Windy
2 	Slightly Windy
3 	Moderately Windy
4 	Extremely Windy
5 	Very Windy

Mapping Topographic Effects

- Slope at site of turbine
- Maximum rate of change from one cell to the next
- Average of slope over a wider area
- Defines areas of smooth and rough terrain
- Elevation of terrain in the main wind direction
- Identifies sites with no obstructive upwind topographic features
- Alignment of site with the main wind direction

Wind and Terrain model scheme

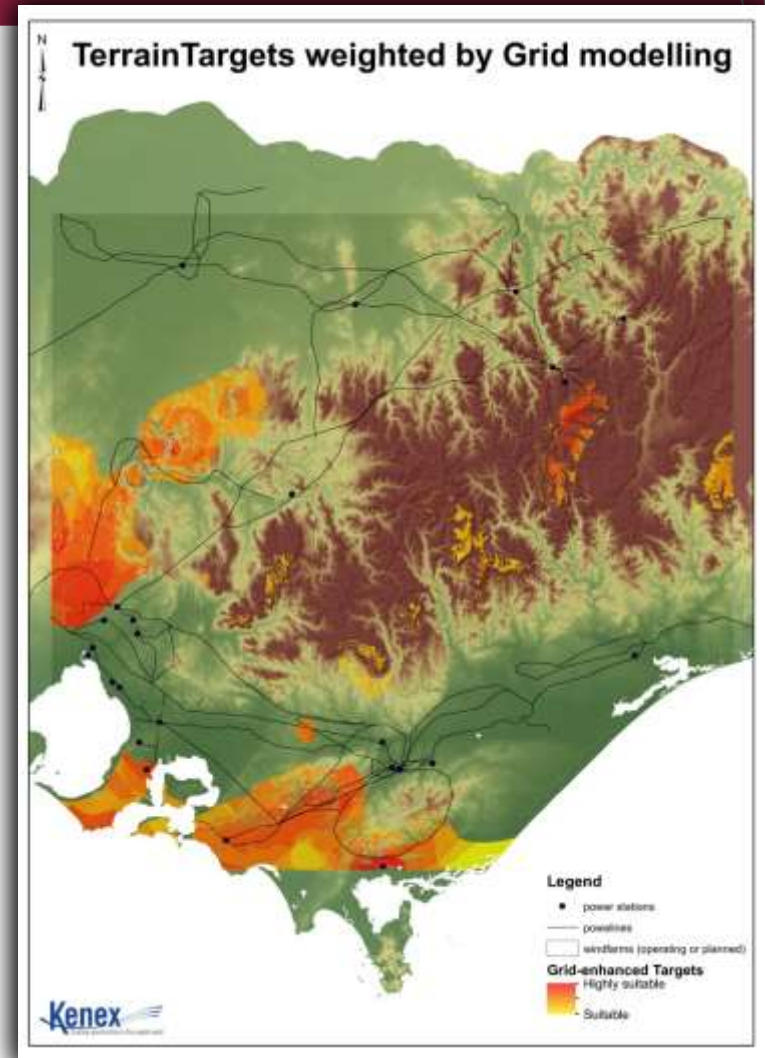


Mapping Social and Cultural Constraints

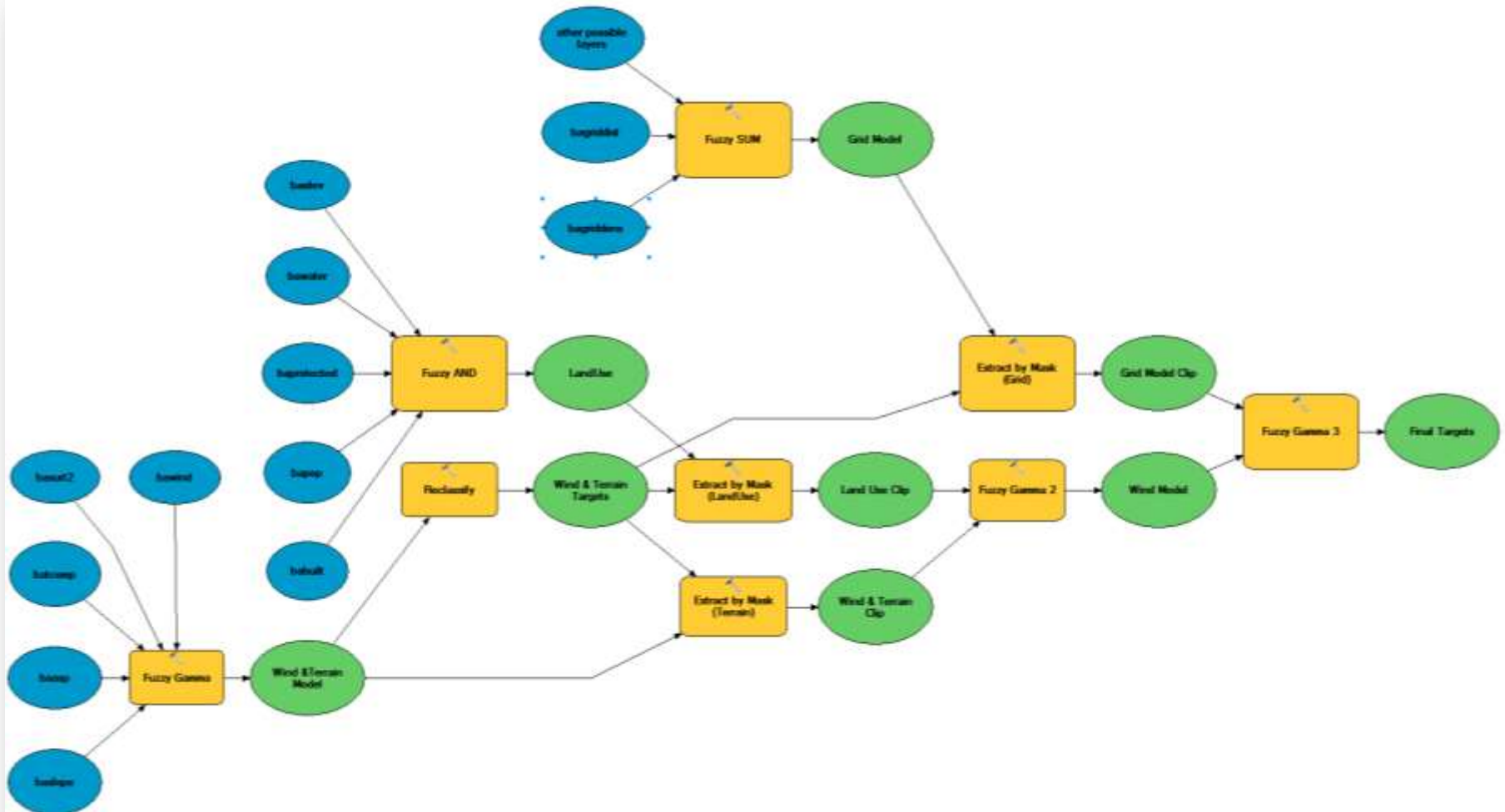
- Other non-technical parameters related to infrastructure, social, land use and environment need to be considered for showing currently suitable areas for wind farm development.
- The layers analysed depend on the data availability, model scale and the area studied. Some of the themes used in our models are:
 - Land use and protected areas
 - Distance from built-up areas
 - Population density
 - Distance from waterways
 - Elevation
 - Proximity to roads

Mapping Infrastructure Constraints

- Accessing a suitable transmission grid is a key factor in wind farm development.
- Availability of data can strongly influence the model
- Basic layers used are:
 - Distance from lines and terminal stations
 - Density of lines and terminal stations
- The aim of the grid model is to rank existing wind and terrain targets in order of probability of gaining a good connection to the grid.



Modelling Wind Resources



Combining Factors to Map Turbine Site Layouts

- Advanced spatial tools can determine the preliminary layout of the proposed wind farm
- A preliminary layout will allow to predict the first estimated annual gross production and capacity factor of the proposed wind farm before local measurements of the wind
- These values give the first real estimation of the economic feasibility of the project, considerably shortening the time frame of the project.
- Takes in account all the local regulations on building a wind farm
- Offers a detailed analysis of the terrain surrounding each turbine, analysing the roughness of the area, eventual obstacles and topographic highs.
- Greatly reduce the time and the cost of the final micro-siting analysis which will be completed after the collection of the wind mast data.
- Finally, a preliminary layout can be use to further develop the project even during the period of mast monitoring.

Example of Mapping a Turbine Layout Plan

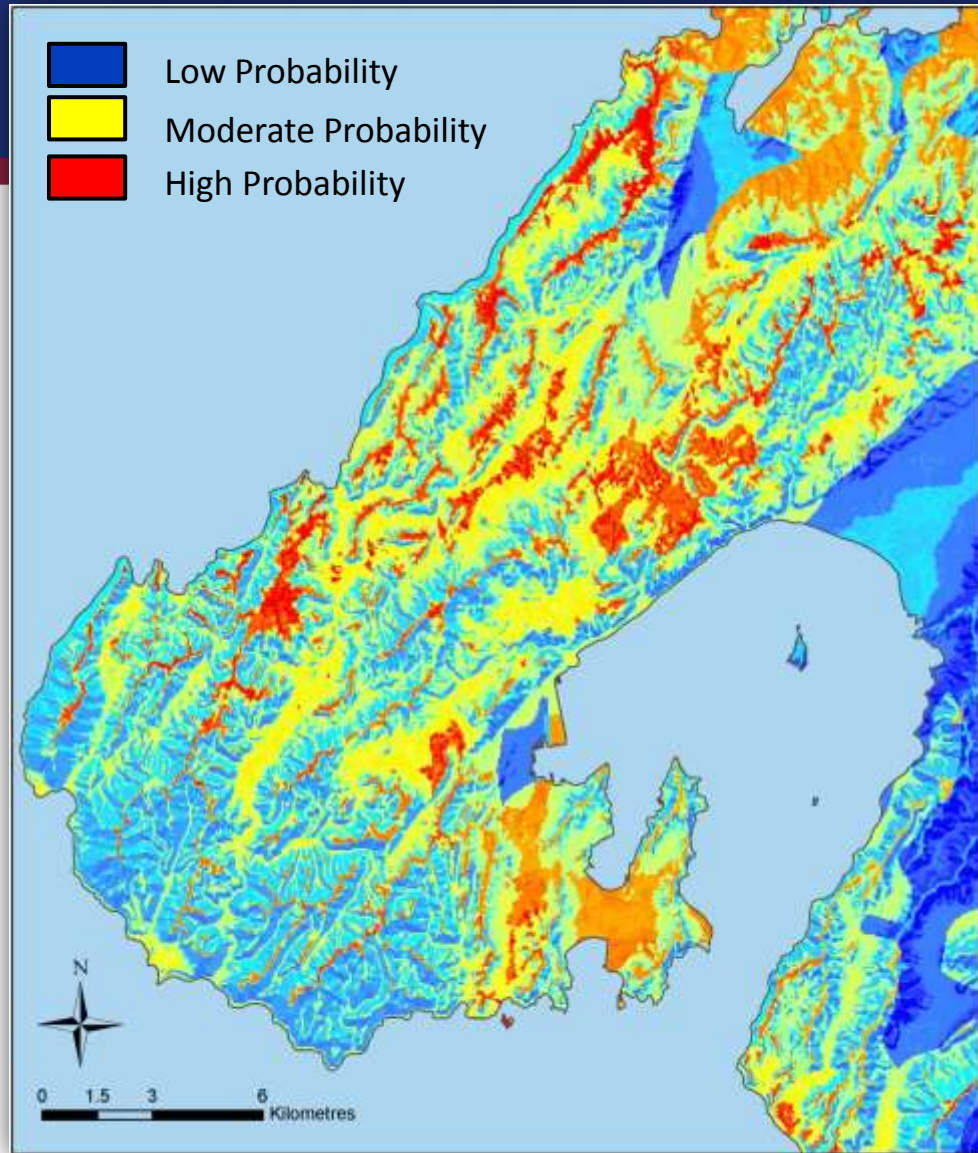
Total Annual Gross Production	Mean WTG Gross Production	Mean Wind Speed	Total Capacity factor
371398.56 MW	7427.97 MW	7.89 m/s	42.4%



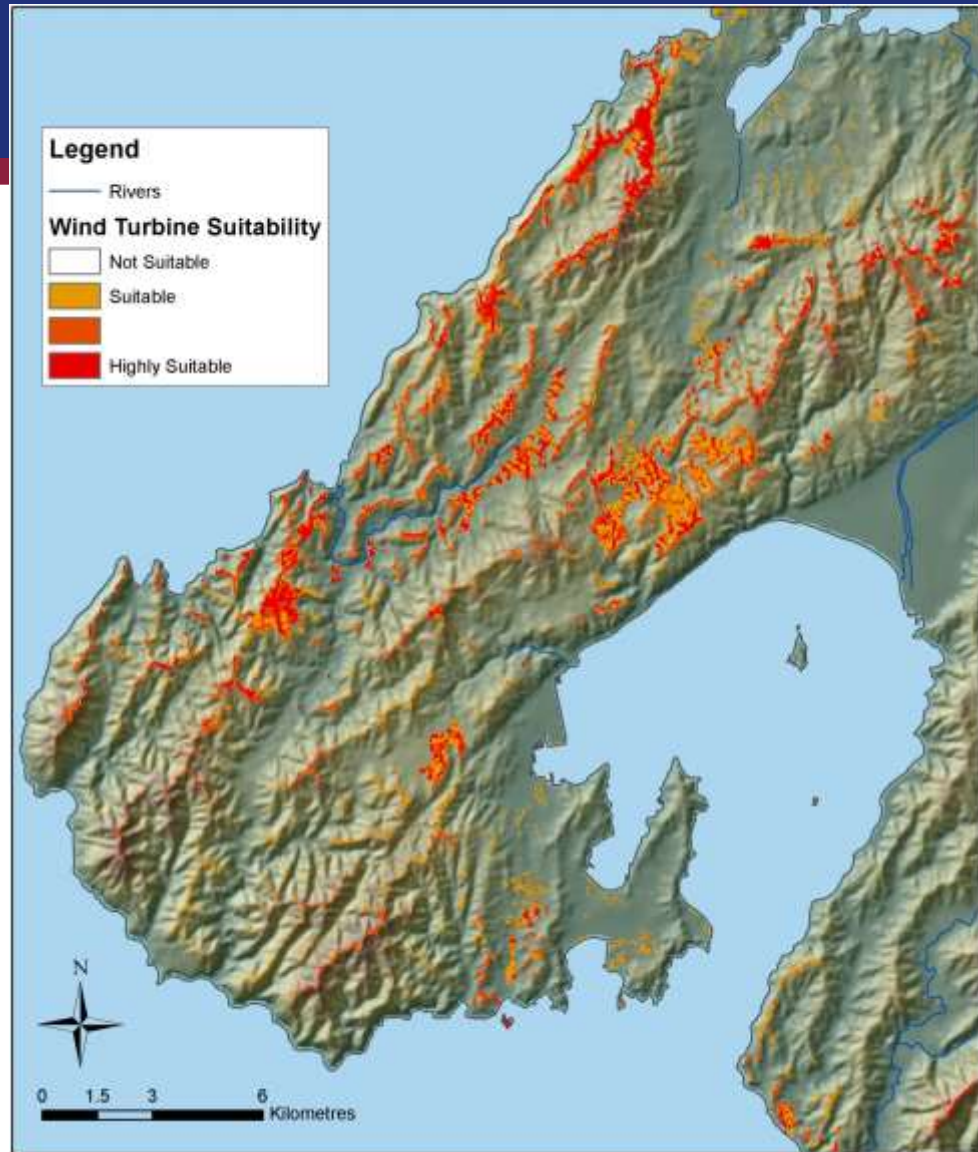
Name	Mean Wind	Annual MW	Capacity %
Turbine 1	7.88	7404.959	42.3
Turbine 2	7.91	7453.096	42.5
Turbine 3	7.91	7453.096	42.5

An Example from the New Zealand models

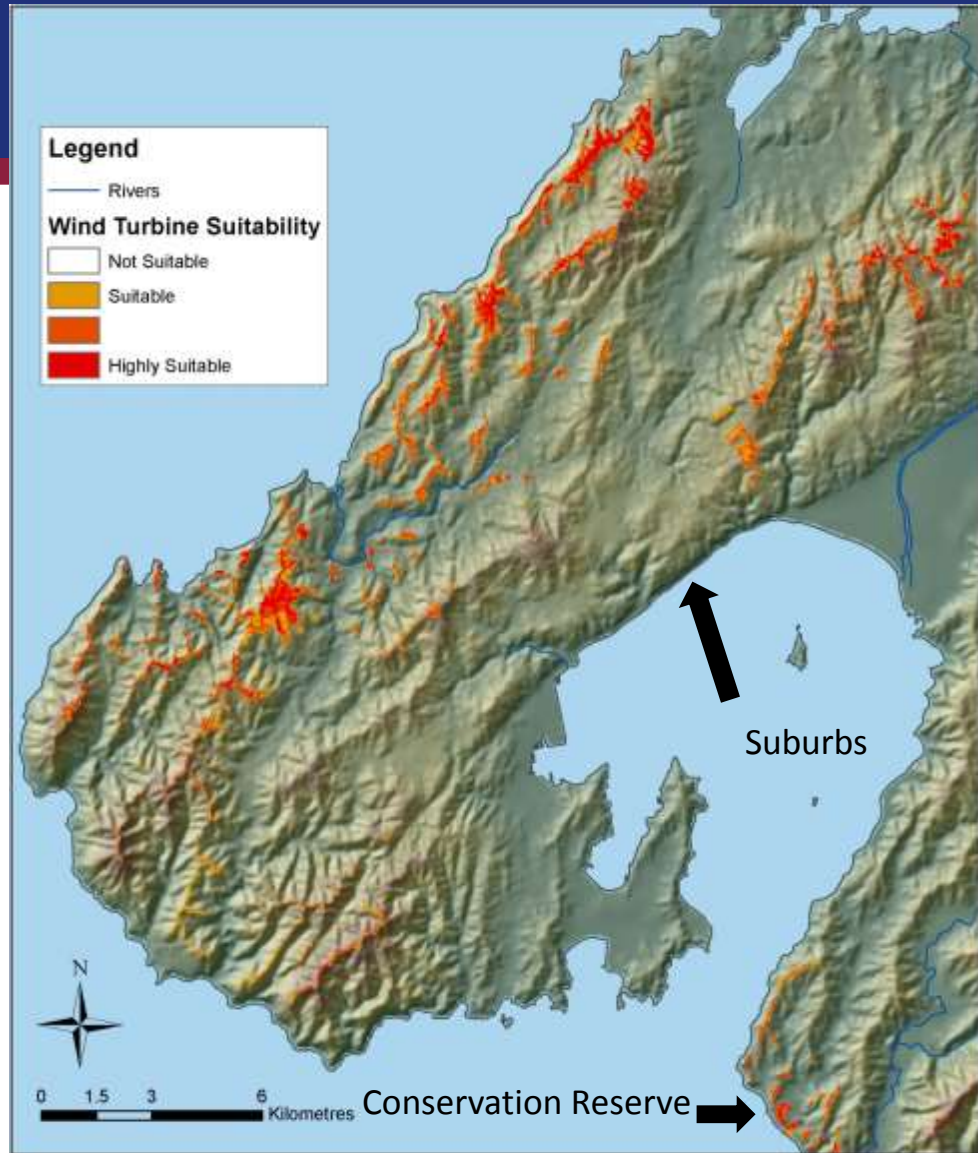
Wind speed and
Terrain parameters
Model Output



Model Target Areas
- Wind speed and terrain
parameters

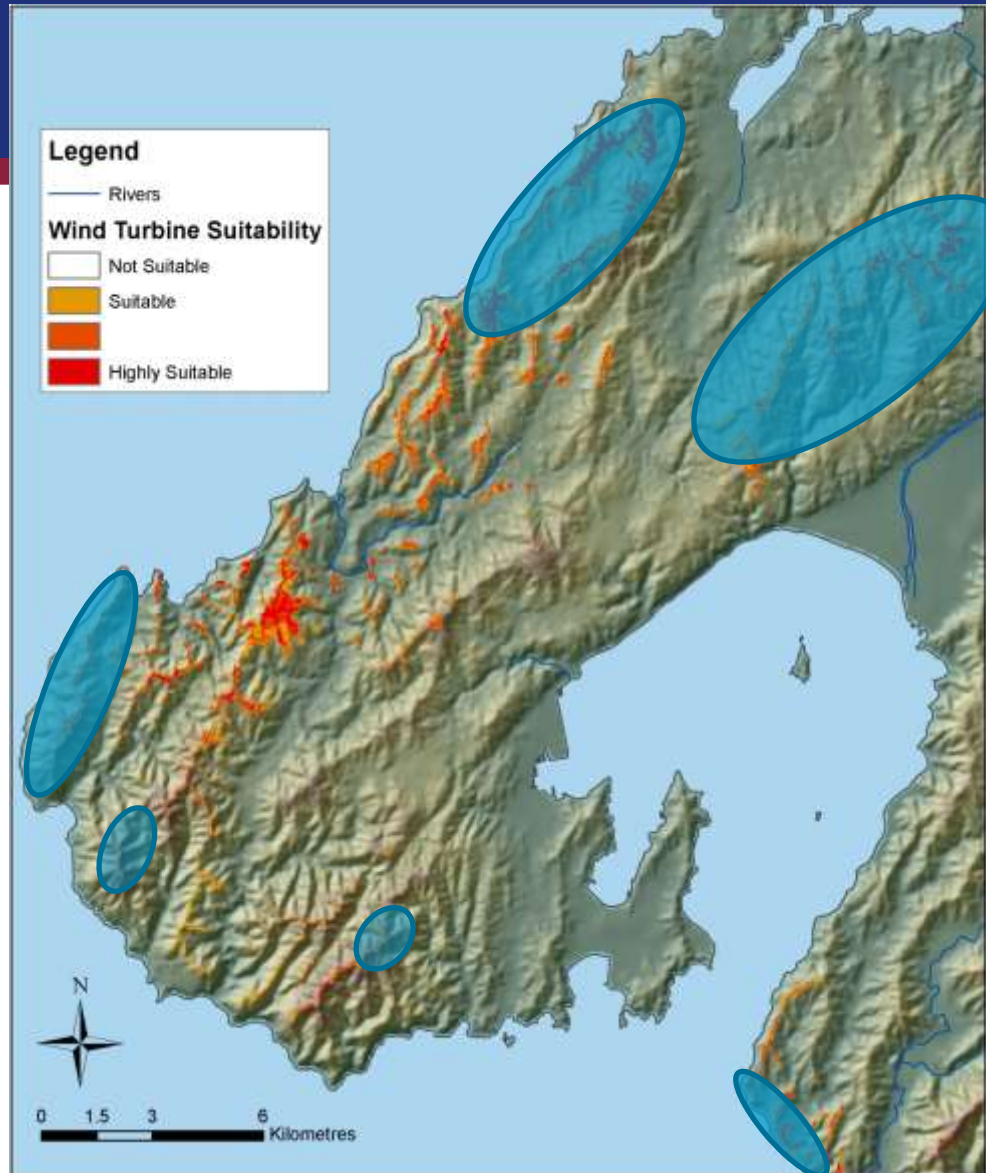


Remodel to exclude built-up areas and unsuitable land use (e.g. ecological areas)



Identification of unsuitable areas not included in the model

- Alternative land uses
- Weather radar stations
- Environmental or archaeological concerns
- Consent issues



Model validated by
existing and planned
turbine locations

