The Icelandic System and Stochastic Modelling in Power System

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Workshop
23-24th of March 2016


Iceland

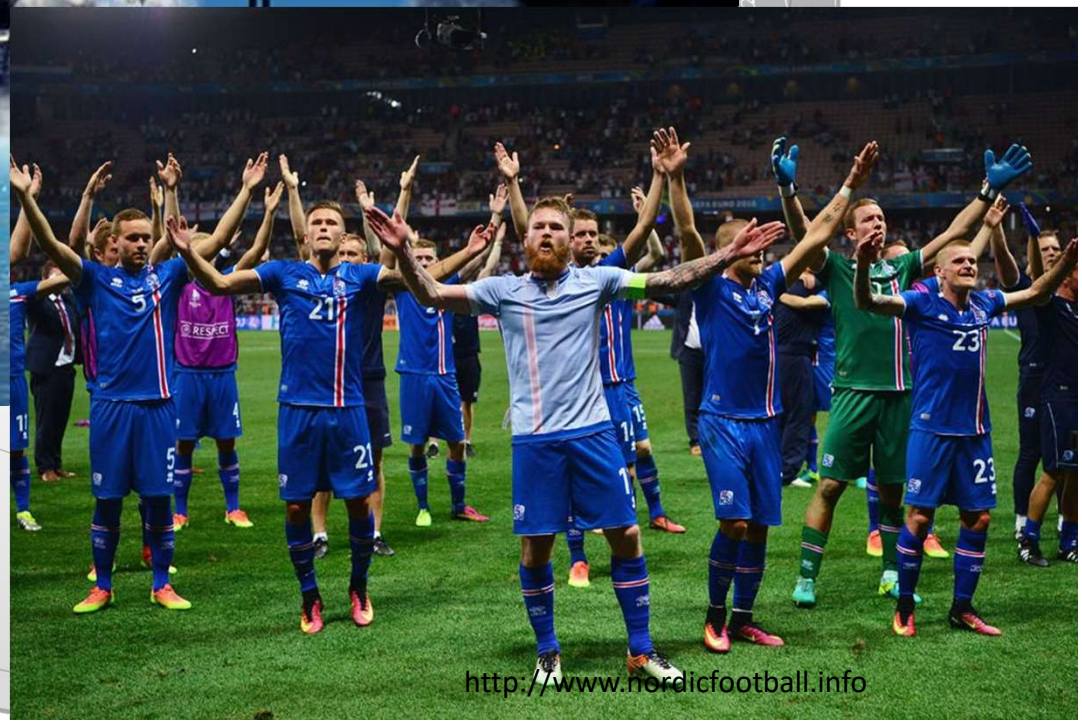
Eyjafjallajökull


Eyjafjallajökull

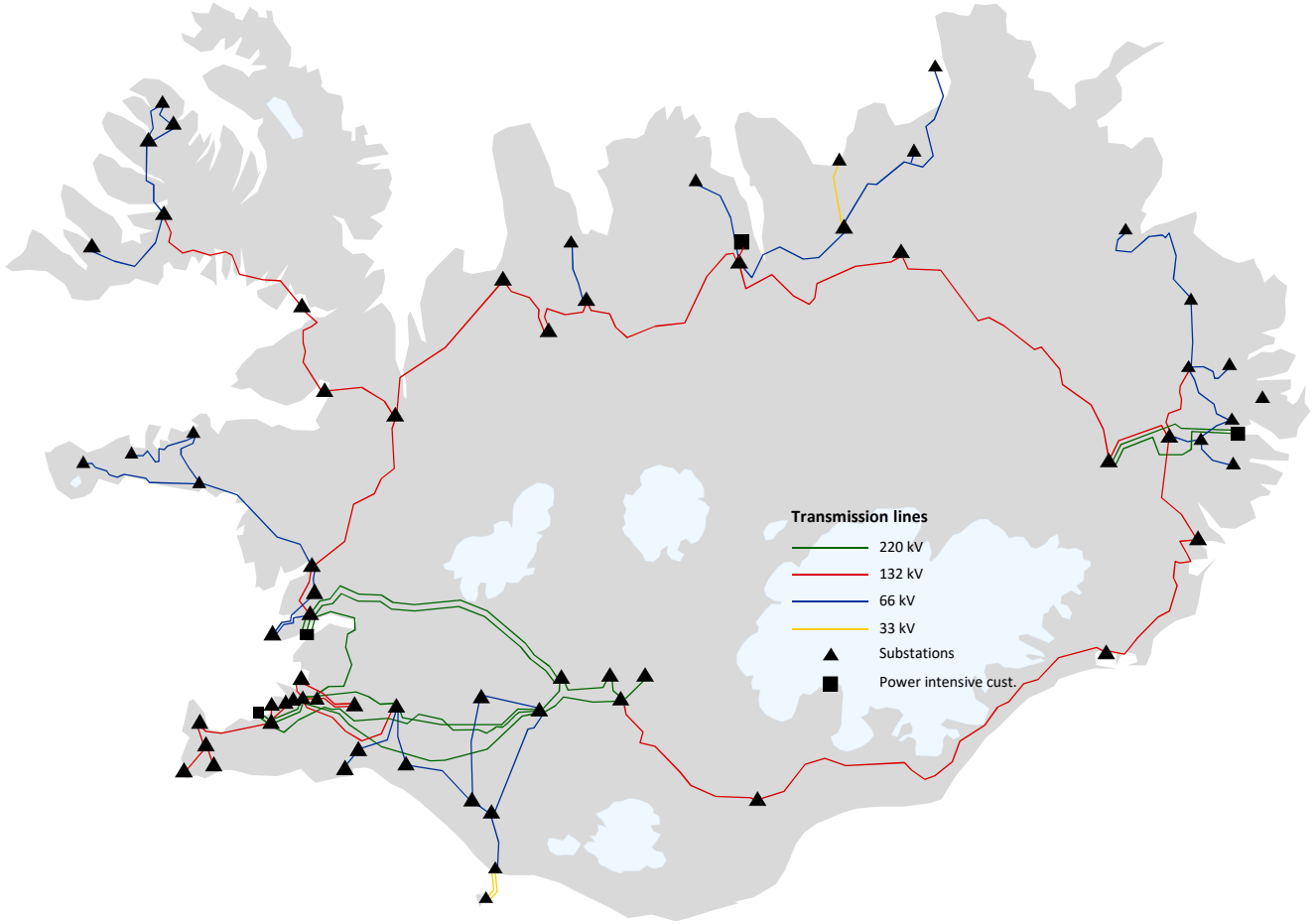

Blue Lagoon


Eyjafjallajökull


Blue Lagoon


http://www.nordicfootball.info

The Icelandic Power System



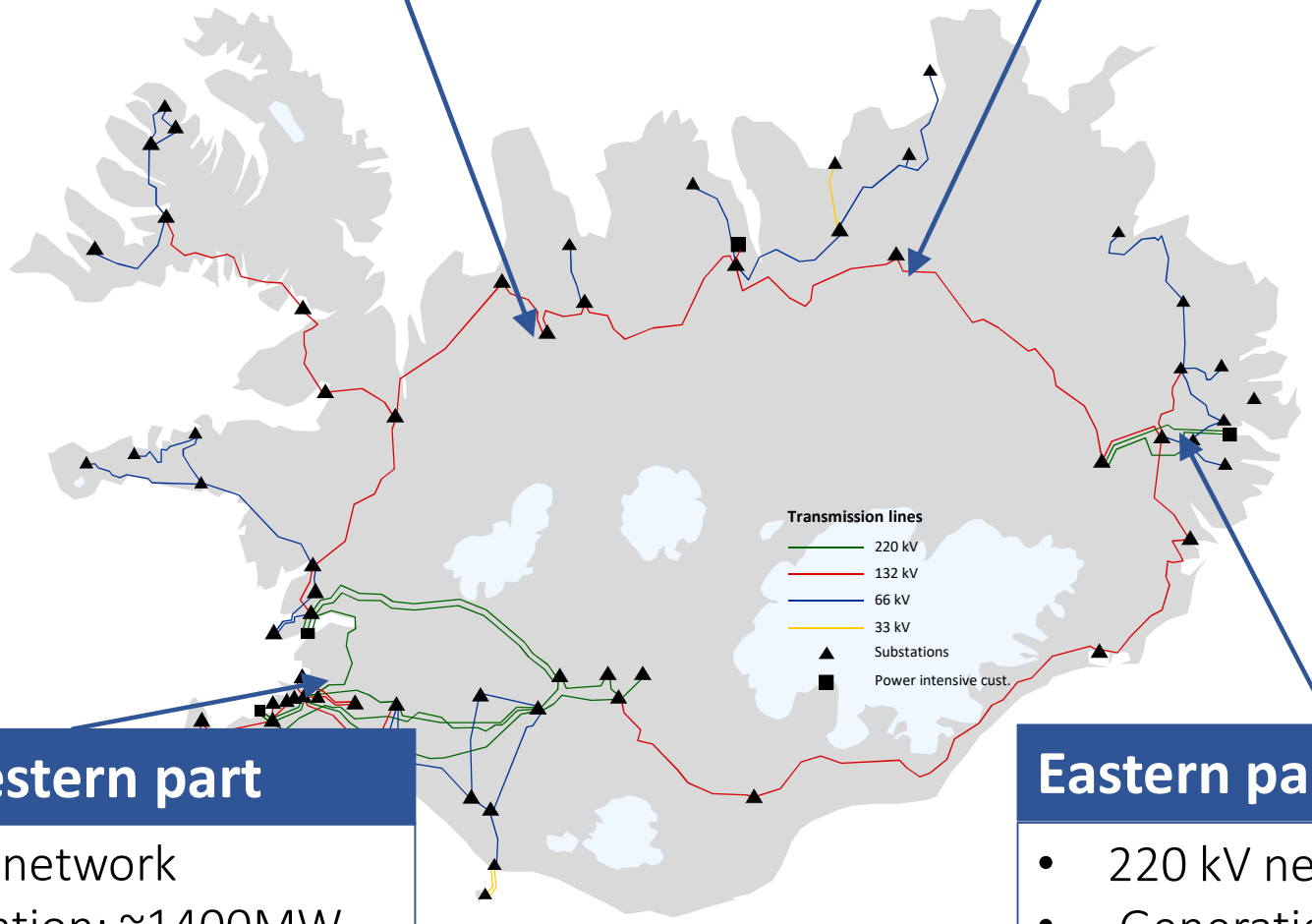
www.landsnet.is

Blanda

- Hydro generation: 150MW

Krafla

- Geothermal generation: 60 MW



Southwestern part

- 220 kV network
- Generation: ~1400MW
- Load: 2 aluminium smellters and the capital area

Eastern part

- 220 kV network
- Generation: 690 MW
- Load: Aluminium smelters

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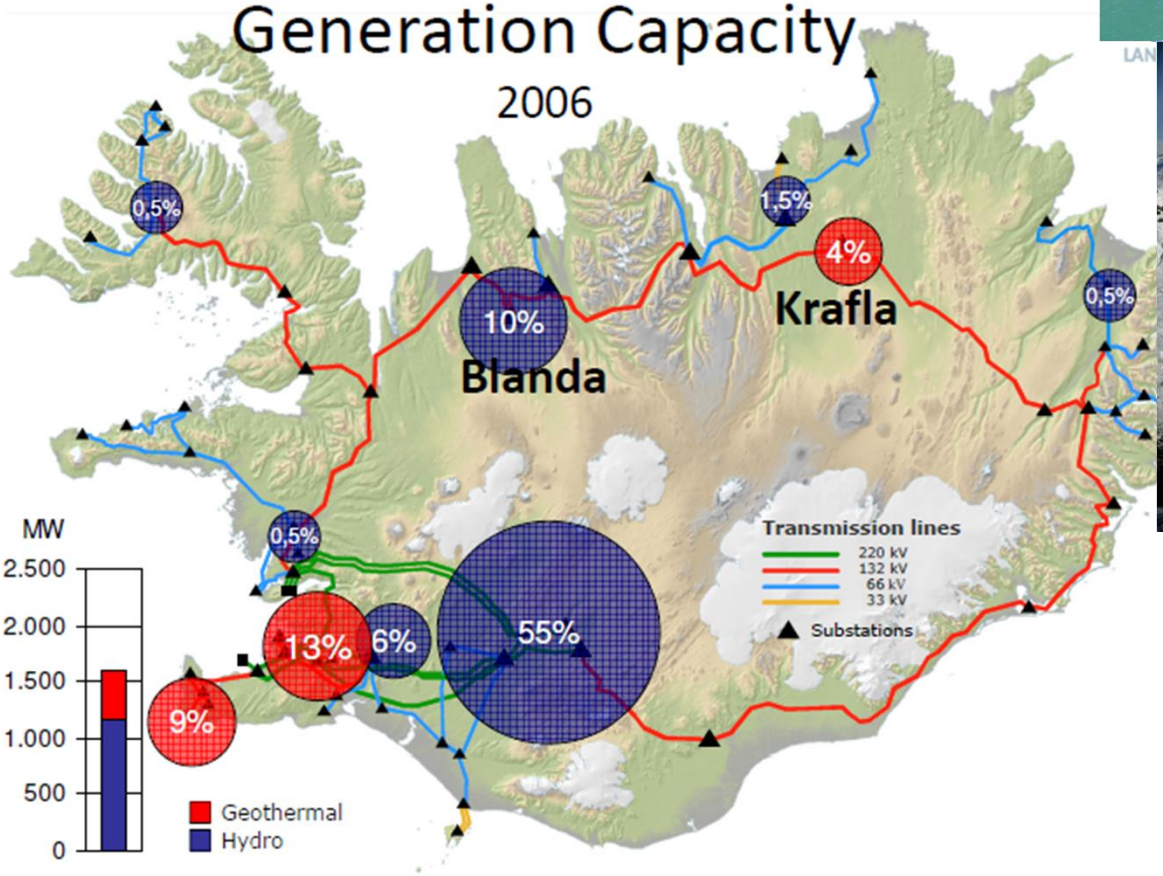
The Icelandic Power System



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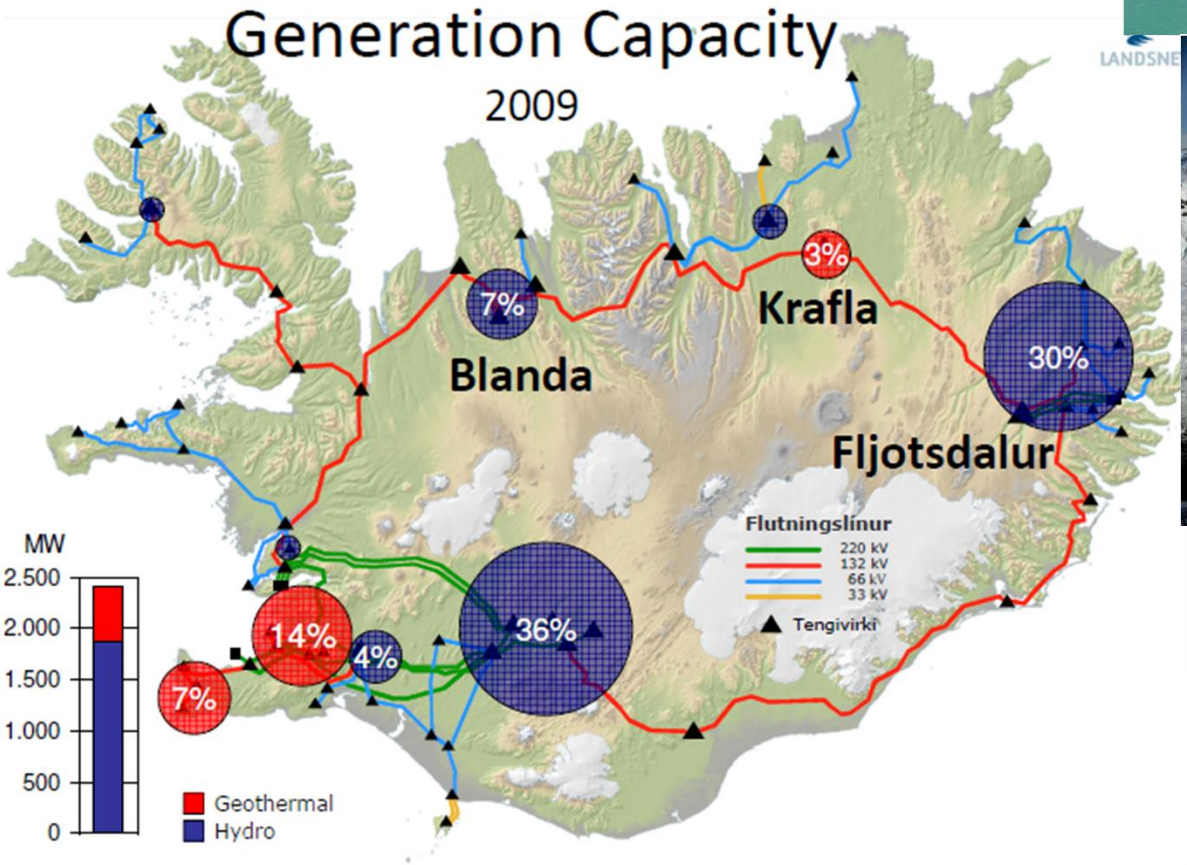
The Icelandic Power System



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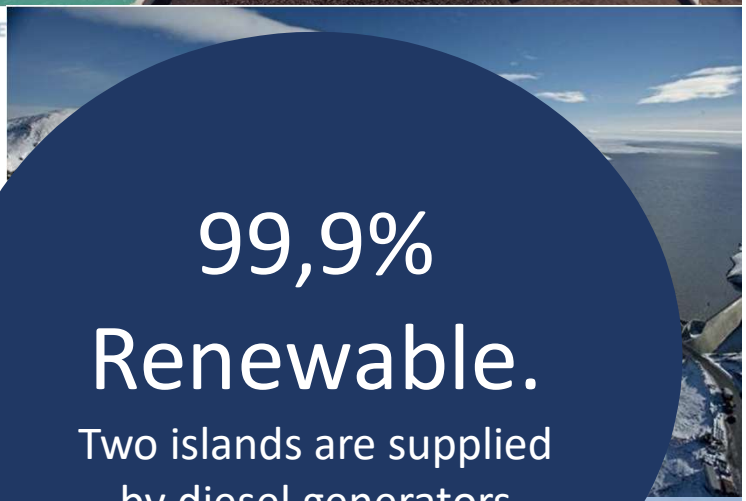

99,9%
Renewable.

Two islands are supplied by diesel generators

Two wind mills installed in 2012 that generate 1.9MW

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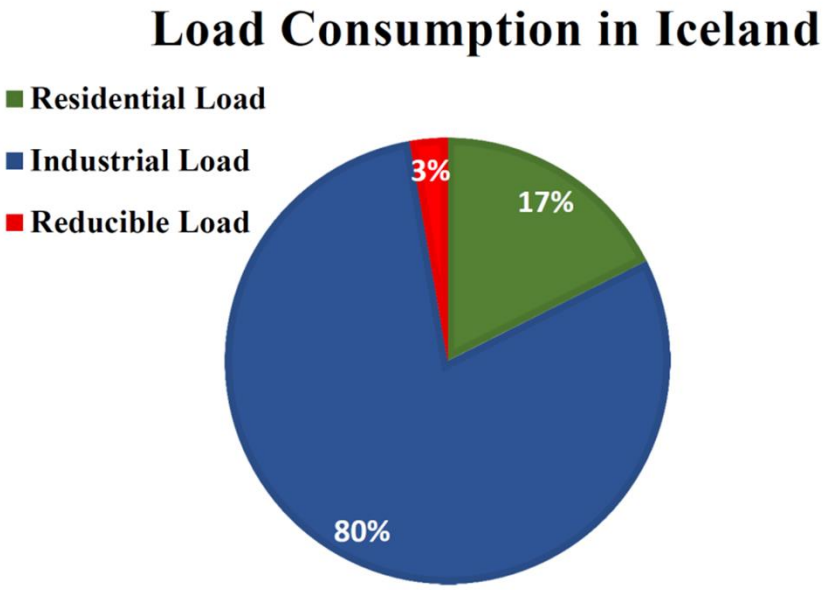

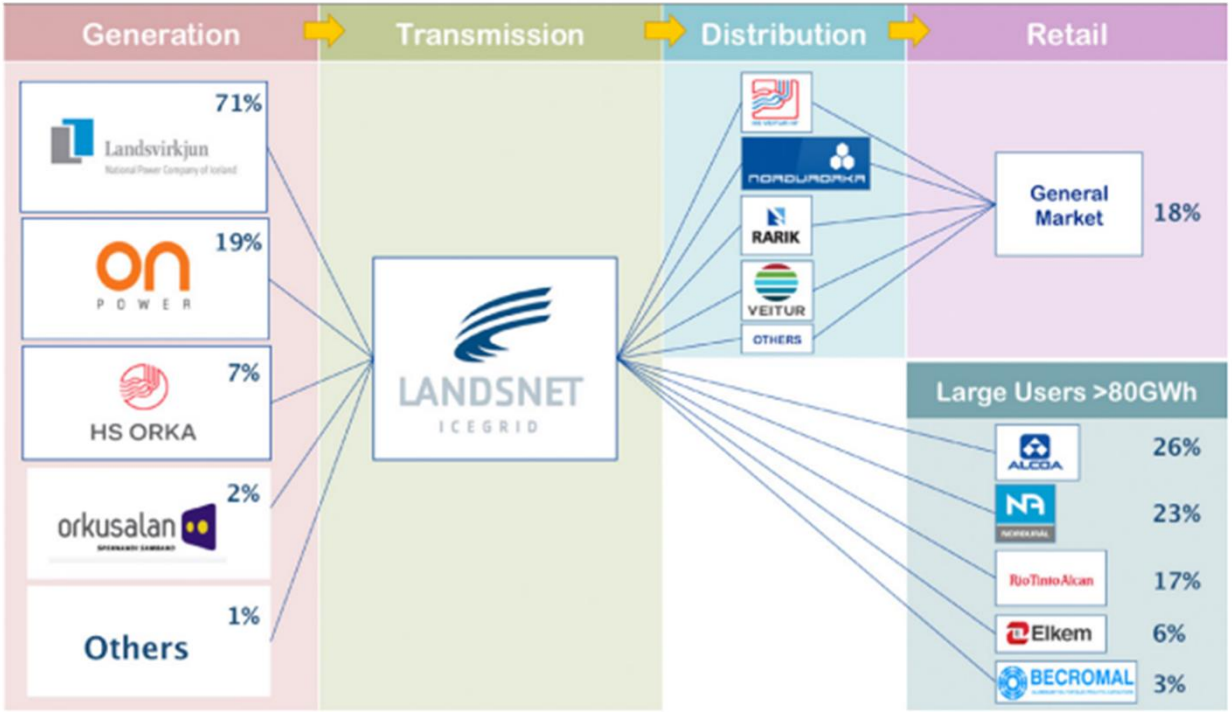

FIG 2.1: *Schematic diagram of the whole sector*

Source: KPMG Iceland

www.landsvirkjun.is, www.landsnet.is

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The Icelandic Power System

Iceland may be green battery for Britain

By **David Twomey** - *January 10, 2013* 881 0

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The head of Iceland's state-run electricity producer says it may build the world's longest subsea power cable by around 2020 to take advantage of its abundant geothermal energy to supply Britain with green power.

"We can serve as a green battery for Britain," Hordur Arnarson, the chief executive of Landsvirkjun said in an interview with Reuters Newsagency.

http://econews.com.au/24530/iceland-may-be-green-battery-for-britain/

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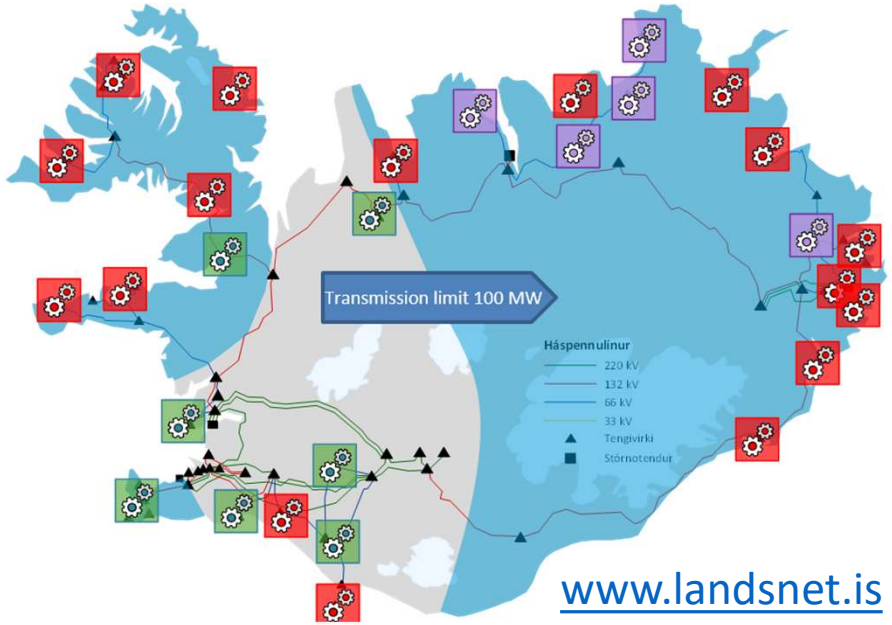
The Icelandic Power System



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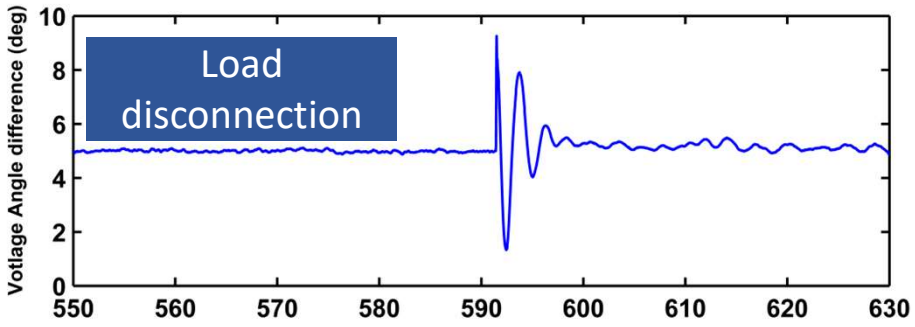

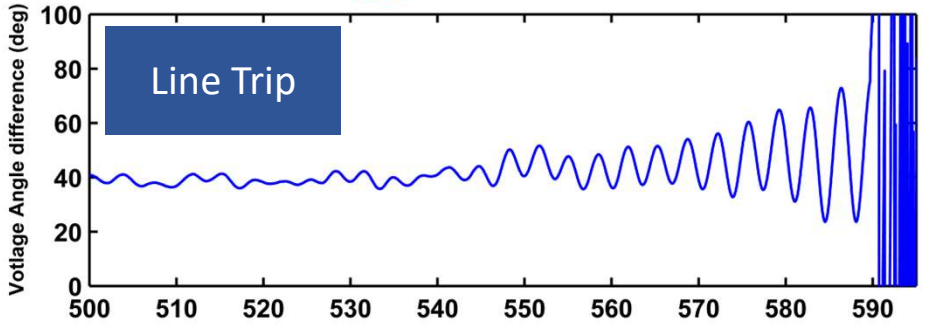

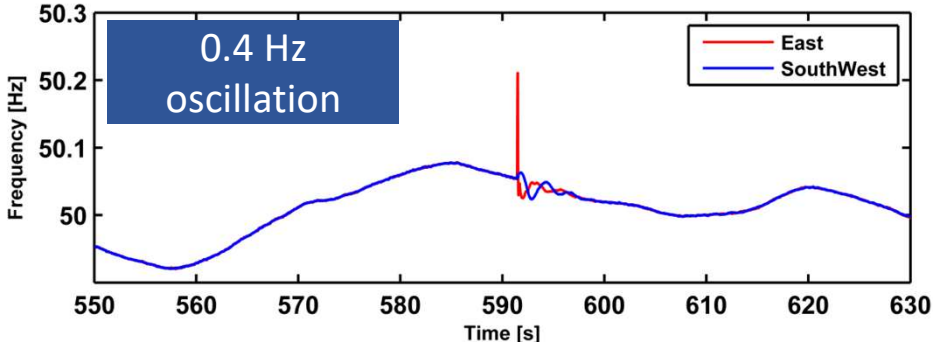

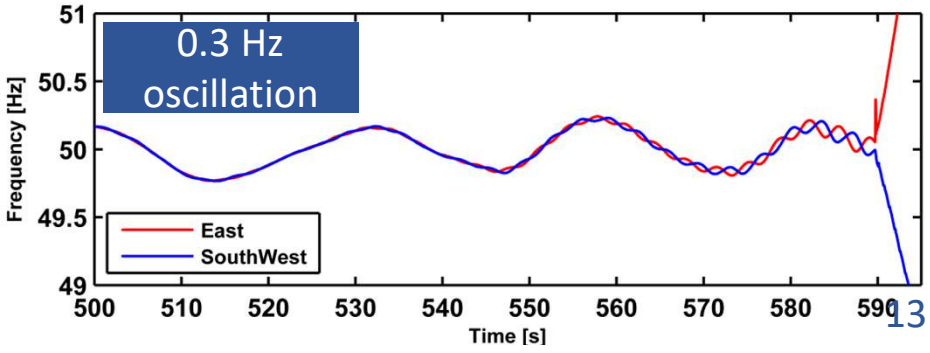

Stochastic modelling

Stochastic parts of the power system:

- Load
- Wind Generation
- Solar Generation

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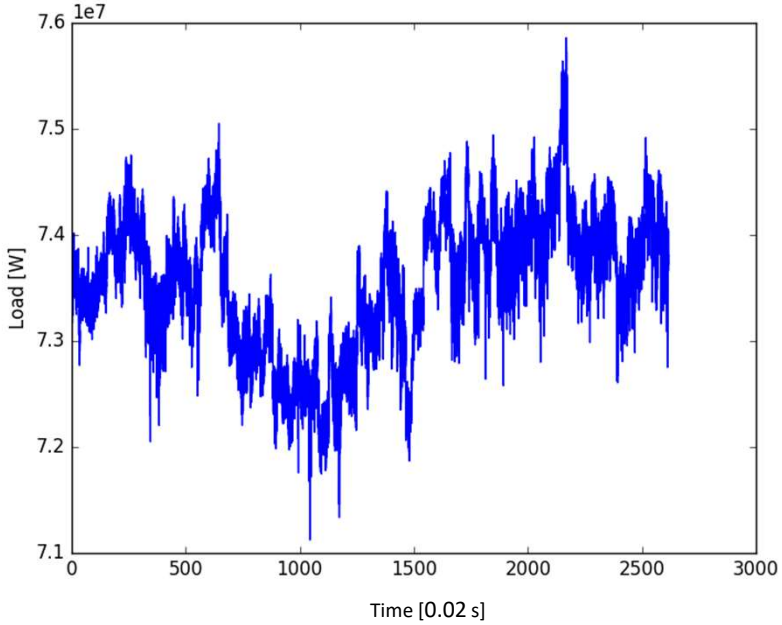
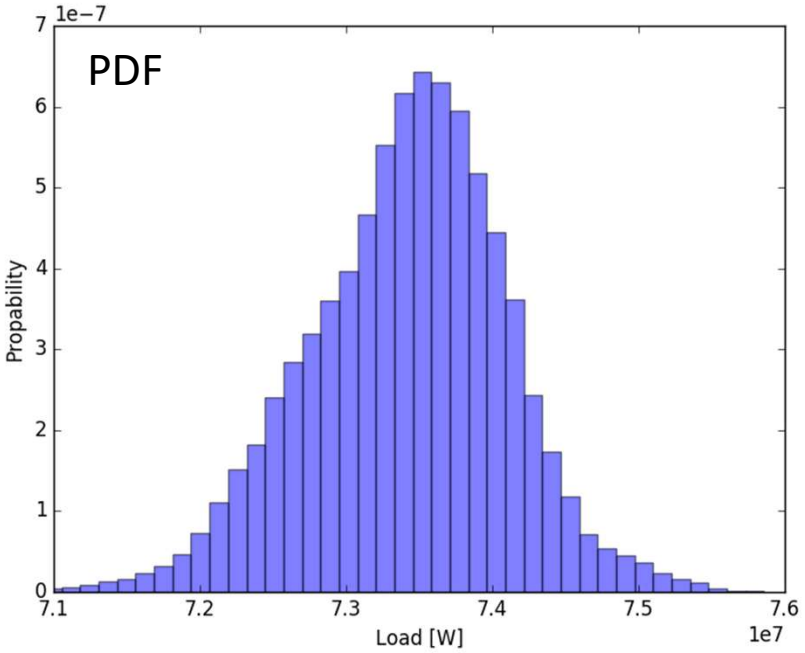
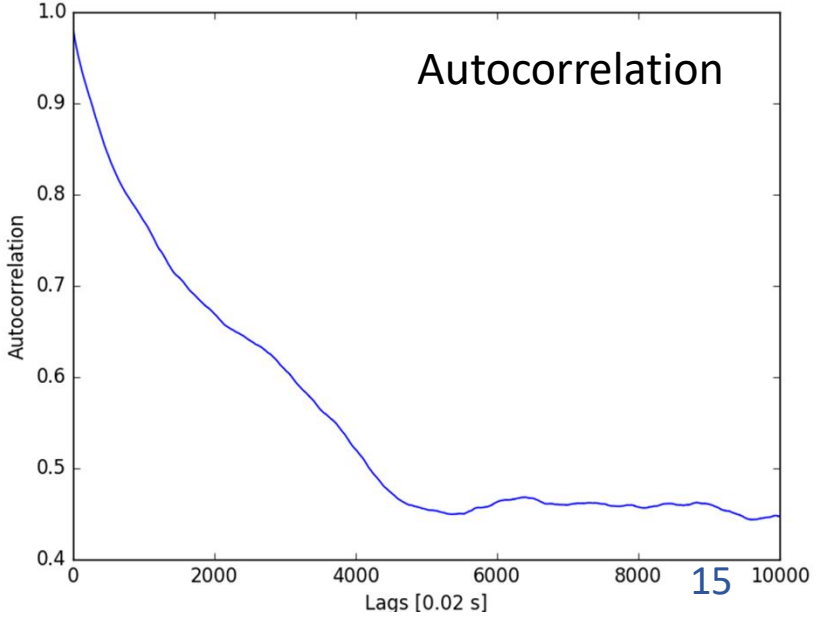
Load Active Power Consumption







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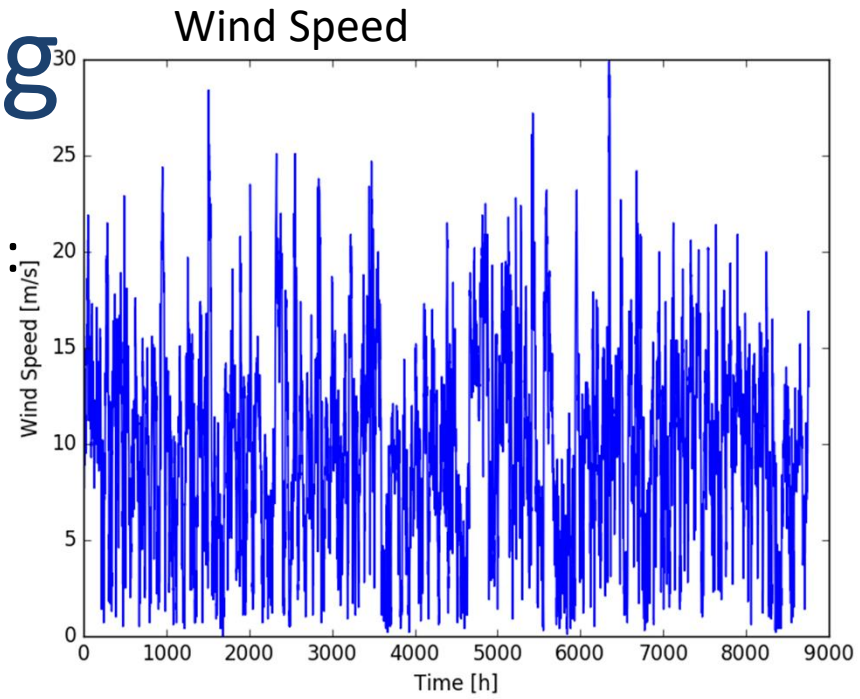

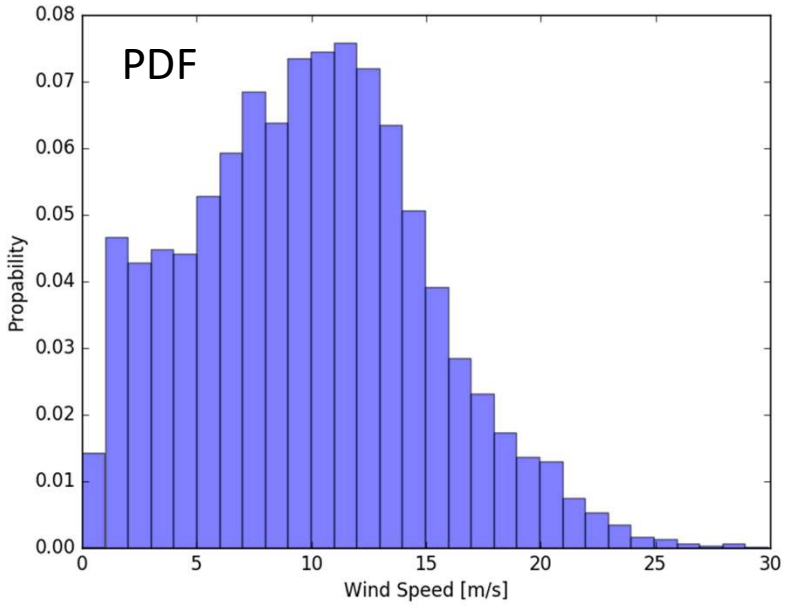

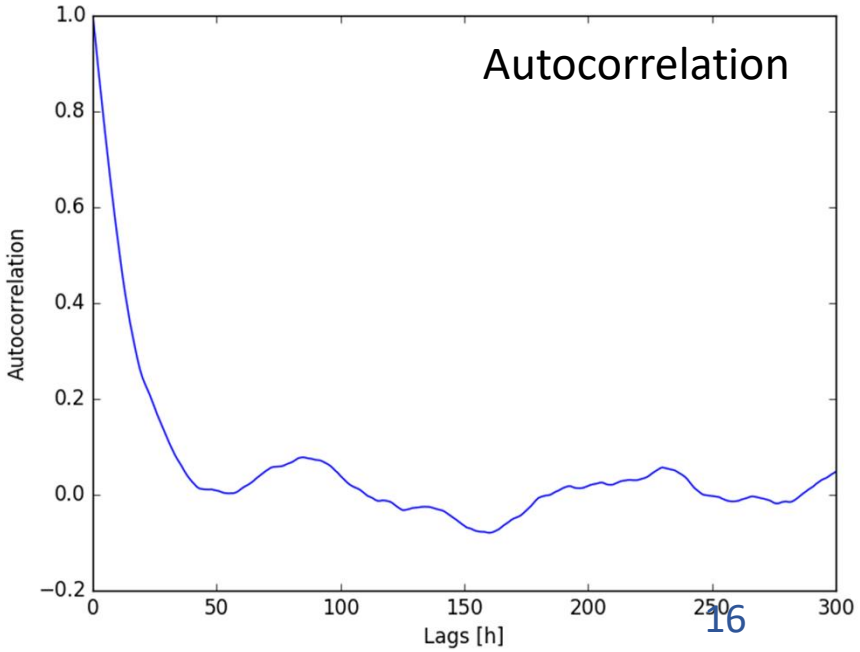

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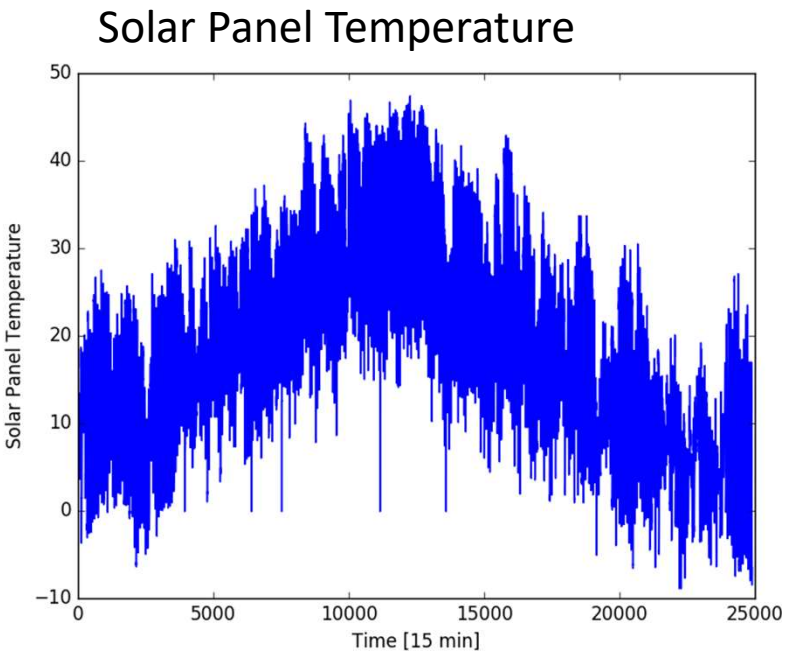

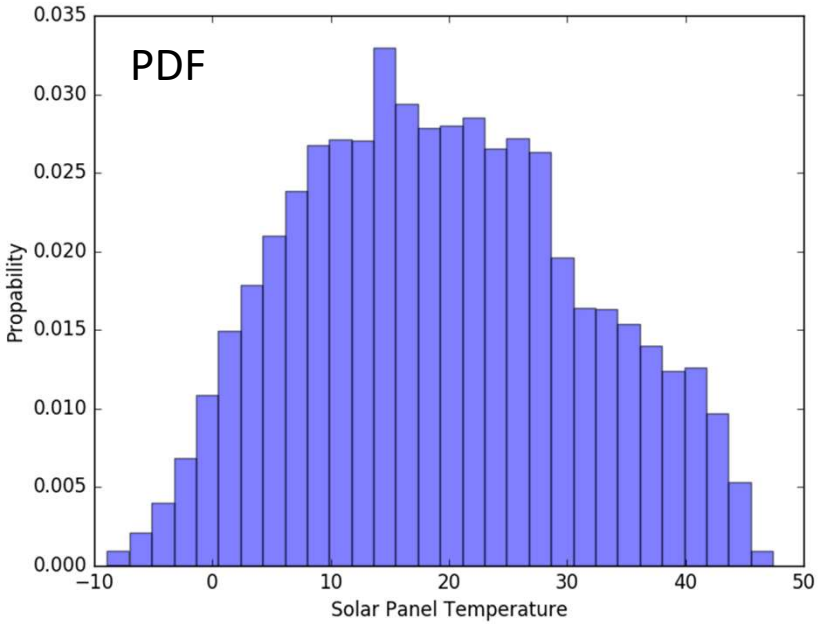

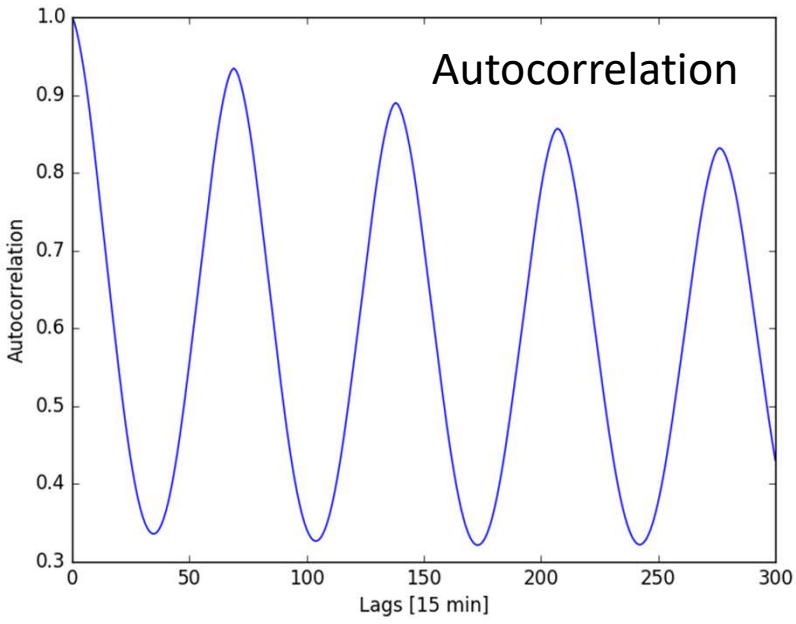

Stochastic modelling

Continuous-Time

Stochastic differential equations

$$dX_t = a(X_t, t)dt + b(X_t, t)dB_t$$

Advantages:
- Can be used to fit sparse data.
- Is a mathematical model.

Disadvantages:
- Need to discretize to simulate numerically.

Discrete-Time

Autoregressive Moving Process

$$X_t = c + \varepsilon_t + \sum_{i=1}^{p} \varphi_i X_{t-1} + \sum_{i=1}^{q} \theta_i \varepsilon_{t-i}$$

Advantages:
- Easier to fit to data since is a statistical model.
- More research.
- Already discrete

Disadvantages:
- Require a fixed time-step.

Stochastic modelling

Continuous-Time

Stochastic differential equations

$dX_t =$

Discrete-Time

Autoregressive Moving Process

$\sum_{i=1}$ $\sum_{i=1}$ ε_{t-i}

Which one should we use?

Advantages:
- Can be used to fit sparse data.
- Is a mathematical model.

Disadvantages:
- Need to discretize to simulate numerically.

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Continuous-Time

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Advanta
- Can b
- Is a n

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Discrete-Time

Autoregressive Moving Process

ε_{t-i}

$i=1$ $i=1$

tatistical

- More research.
- Already discrete

Disadvantages:
- Require a fixed time-step.

Which one should we use?

Is there anyway we can connect these two to take advantage of both?

Stochastic modelling

Continuous-Time	Discrete-Time
Stochastic differential equations	Autoregressive Moving Process

$dX_t =$ ε_{t-i}

$\sum_{i=1}$ $\sum_{i=1}$

Which one should we use?

Is there anyway we can connect these two to take advantage of both?

Bridge between ARMA and SDE: Continous ARMA (CARMA)

Advanta
- Can b
- Is a n

tatistical

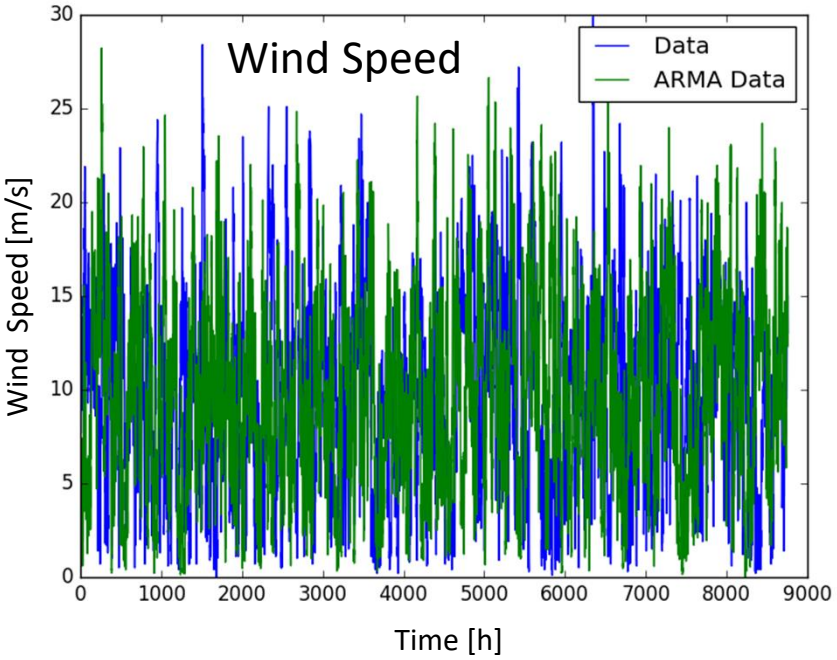
- More research.

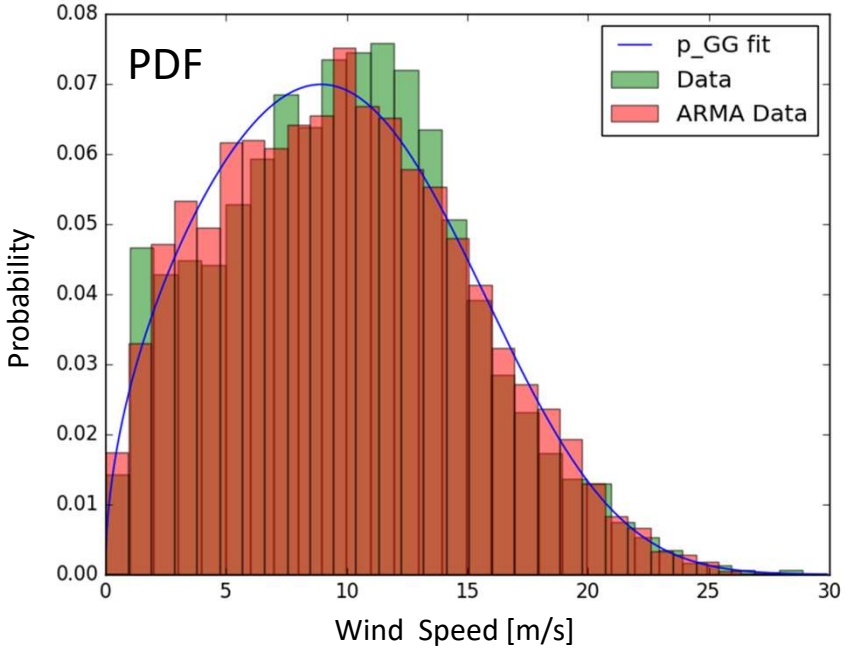
Disadva
- Need numerically.

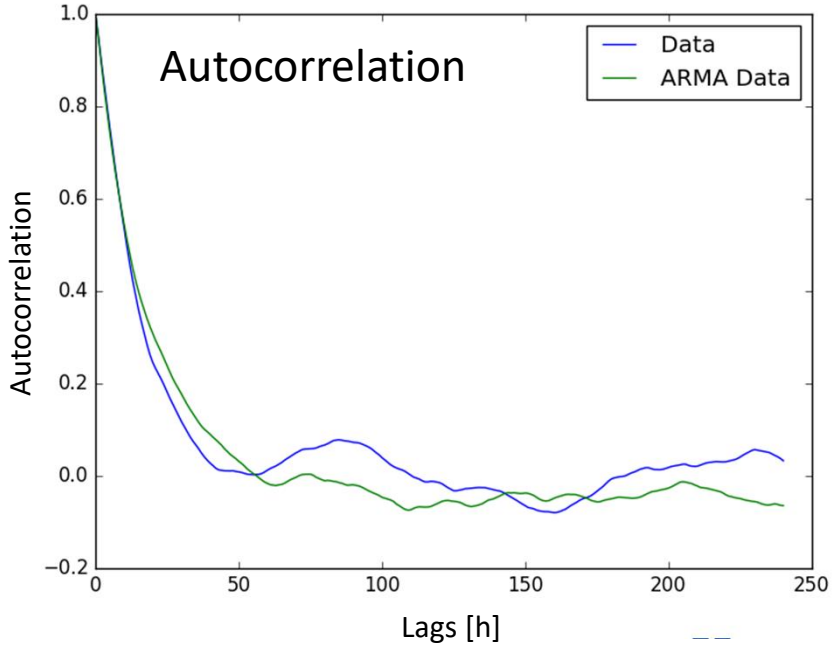
Stochastic modelling

Example:

Wind speed data that has a **Generalized Three-Parameter Gamma** probability distribution function fitted with a **autoreggressive process of order 2 (AR(2))**.







Thank you!

Any Questions?