

# Use of a planetary boundary layer model to estimate wind power potential of the Gulf of Finland.

Использование модели пограничного слоя для оценки ветроэнергетического потенциала Финского залива.

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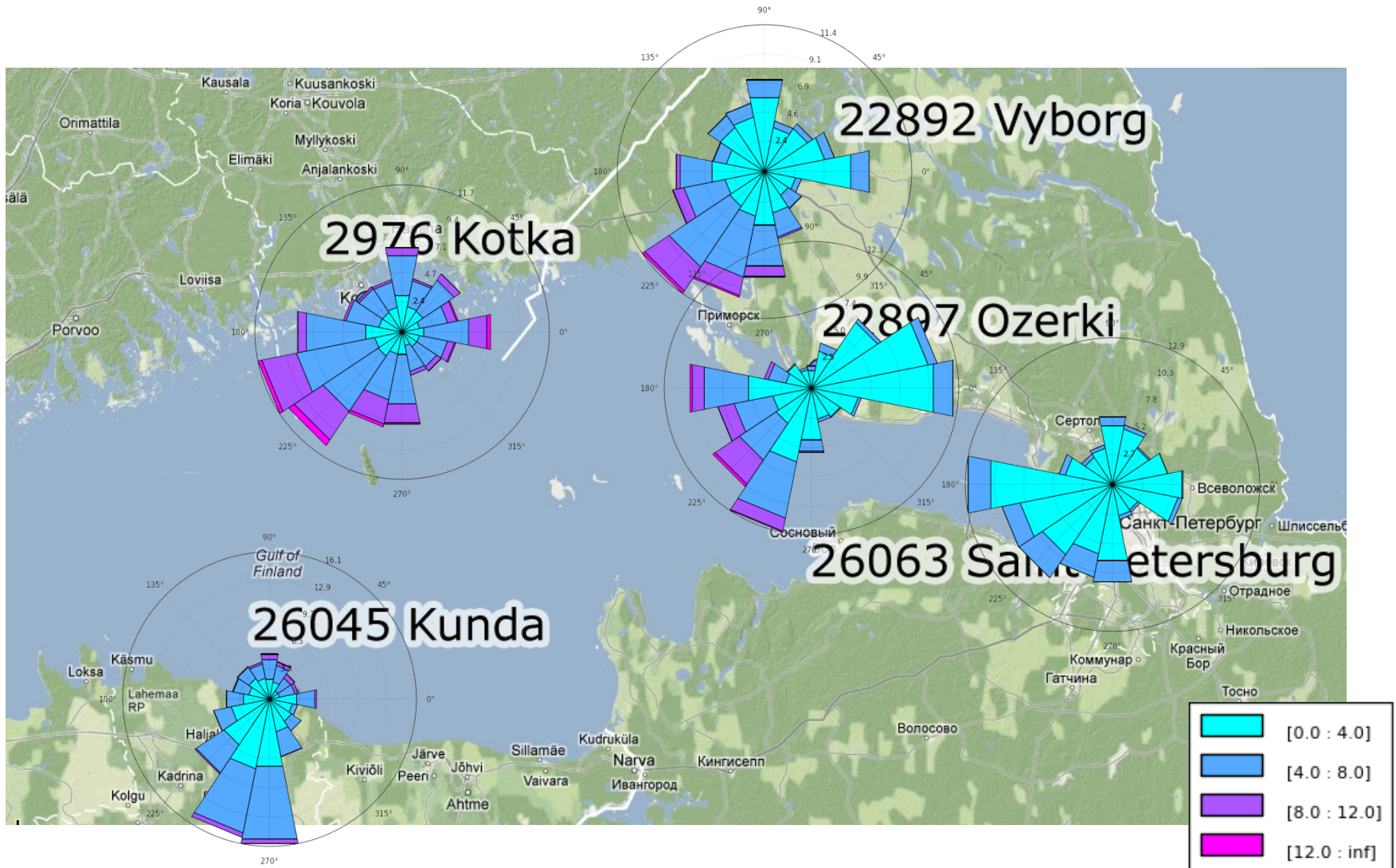
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# Study Area

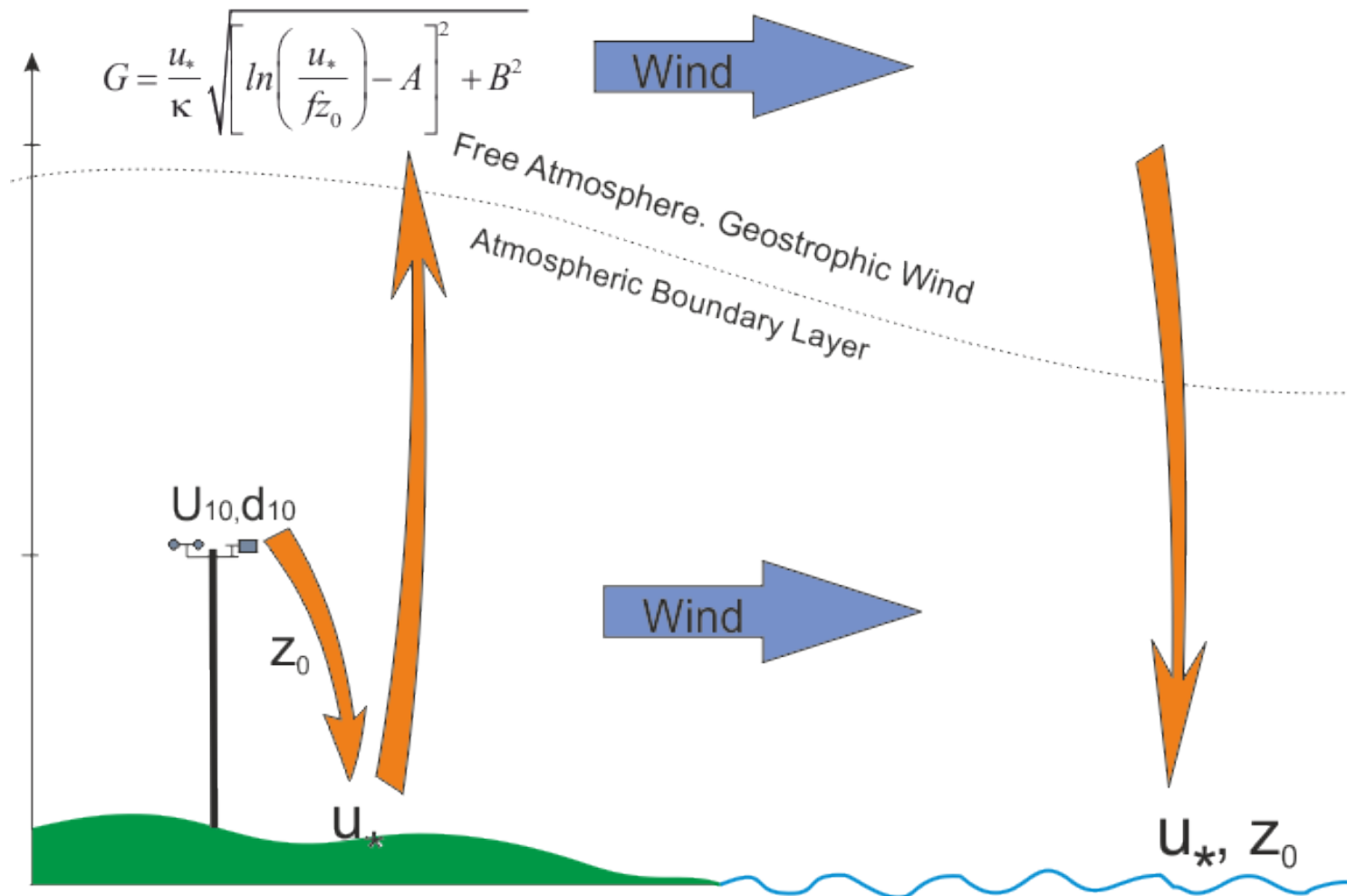


~ 10 years measurement data

# Methodology

Method for assessing wind resource at a site, based on measurements from a nearby weather station

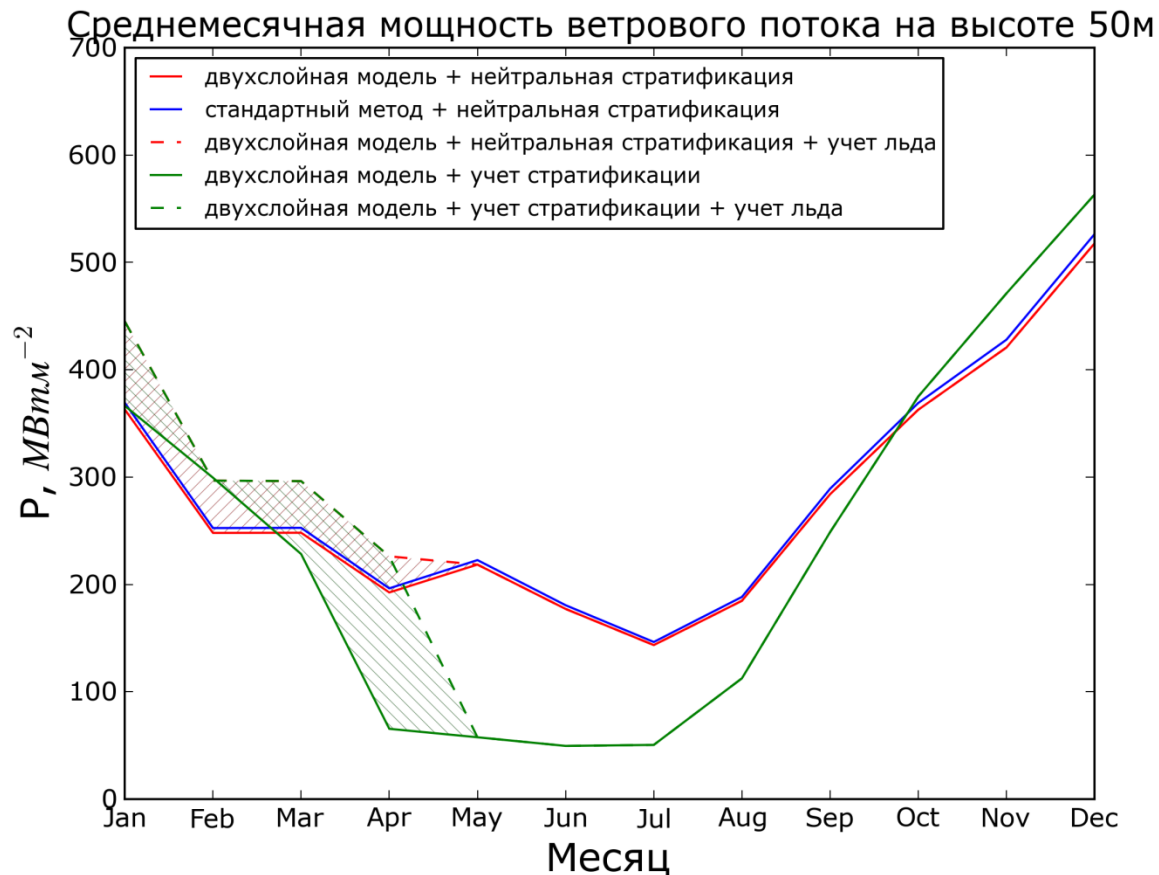
A, B – functions of stratification



# Results

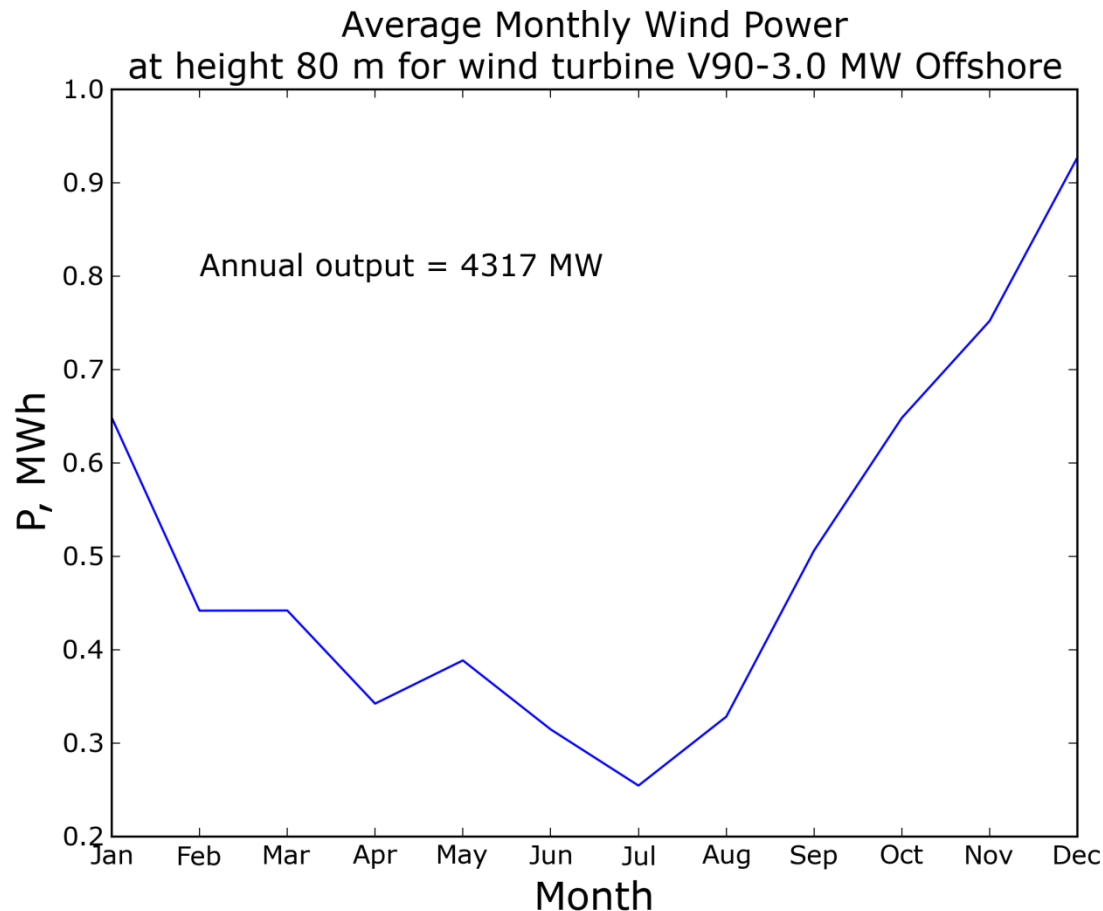
$$P = \left\langle \frac{1}{2} \rho U^3 \right\rangle$$

Annual wind production at 50 m over the Gulf of Finland



# Turbine power output

$$P_T = \frac{1}{2} \times \text{air density} \times \langle U^3 \rangle \times \text{swept area} \times C_p$$





# Turbine power output

## Central CHP

Installed capacity of electricity generation = 75,5 MW  
Electricity generation in 2011 = 438263 MWh



**X 101**

## North CHP

Installed capacity of electricity generation = 500 MW  
Electricity generation in 2011 = 2317602 MWh



**X 536**

## Leningrad NPP

Installed capacity of electricity generation = 4000 MW  
Annual generation = 21,208 GWh



**X 6500**

# Conclusions and Future Work

- This research resulted in the first approach of wind atlas for the eastern part of the Gulf of Finland area, which contains information about wind distribution and wind power density at different hub heights and its seasonal variations.
- Calculations of the wind power potential take into account effect of the atmospheric stratification over the water surface and peculiarities of the surface roughness in the presence of ice cover.
- Evaluations of the number of wind turbines needed to «replace» electricity production by typical CHP plants and Leningradskaya NPP are given.

## **Next Step:**

- Taking into account effect of fetch and sheltering on the wind energy assessment on the basis of joint analysis of SAR wind field data and numerical simulation.
- Development of the simplified “engineering” approaches and algorithms for practical application.



Thank you for attention!