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Meeresbiologischer Kurs - Helgoland

Alfred-Wegener Institut
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3. Vertical wind speed profile

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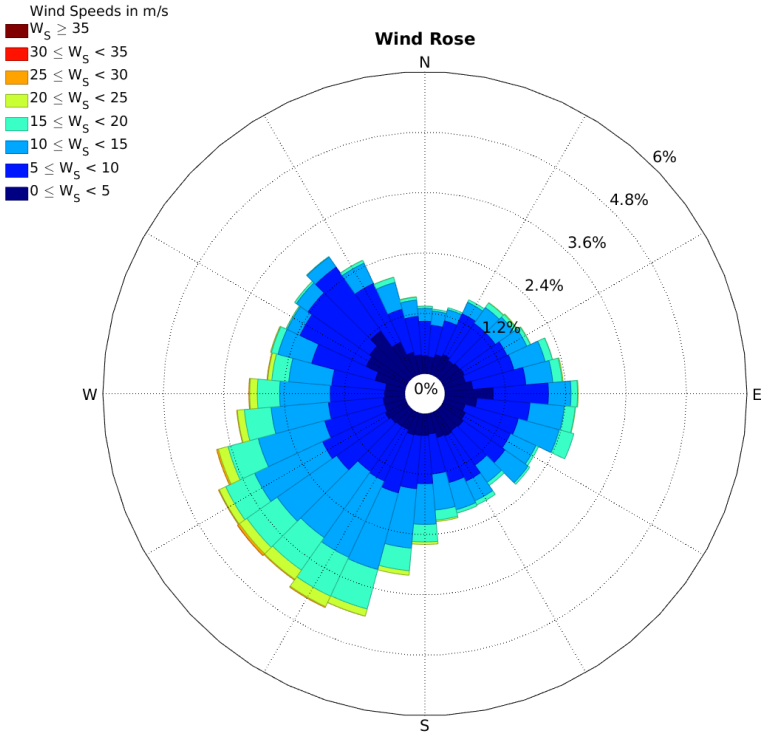
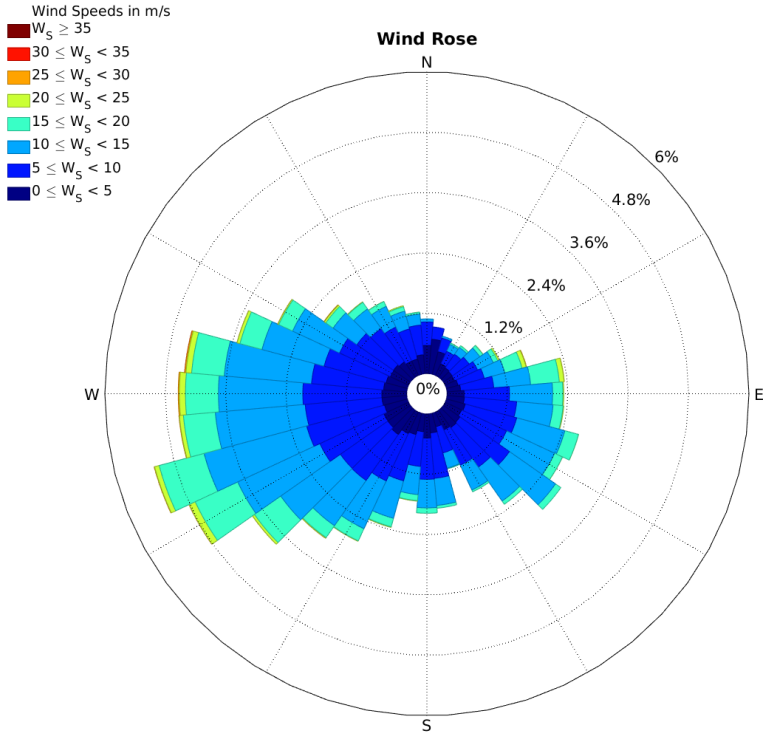
Wind Roses

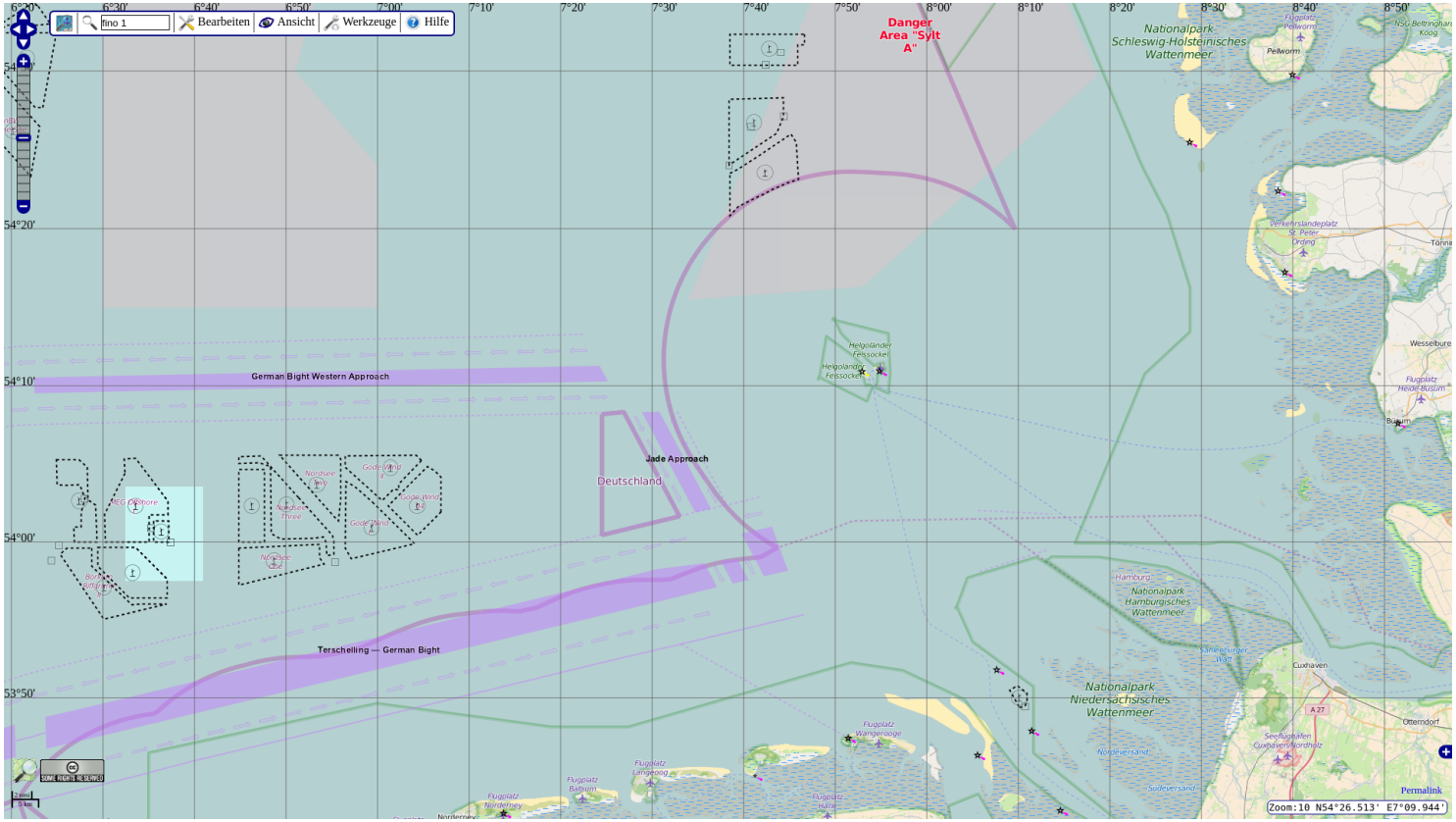
Fino 1



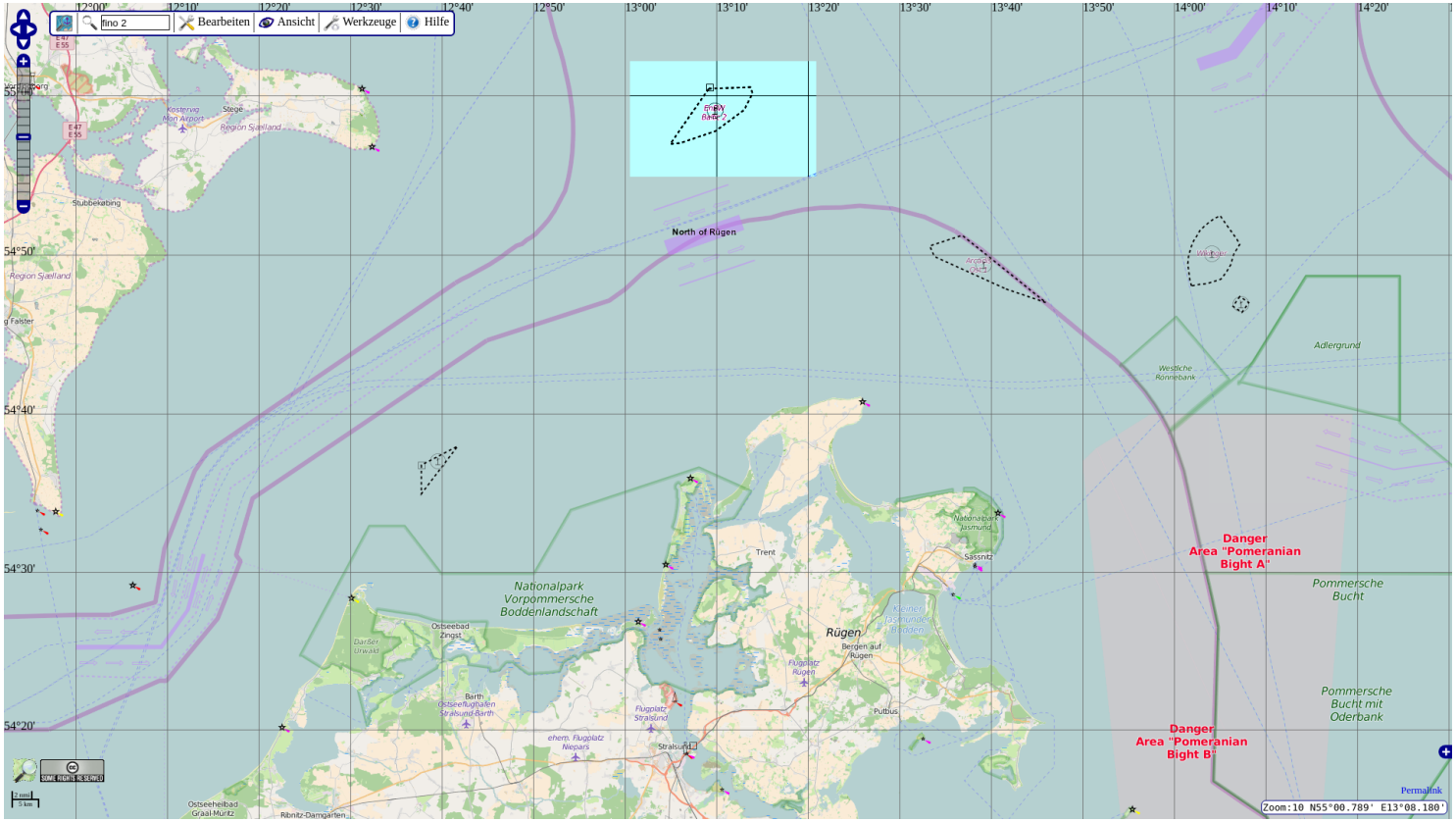
Fino 2



Location Fino 1

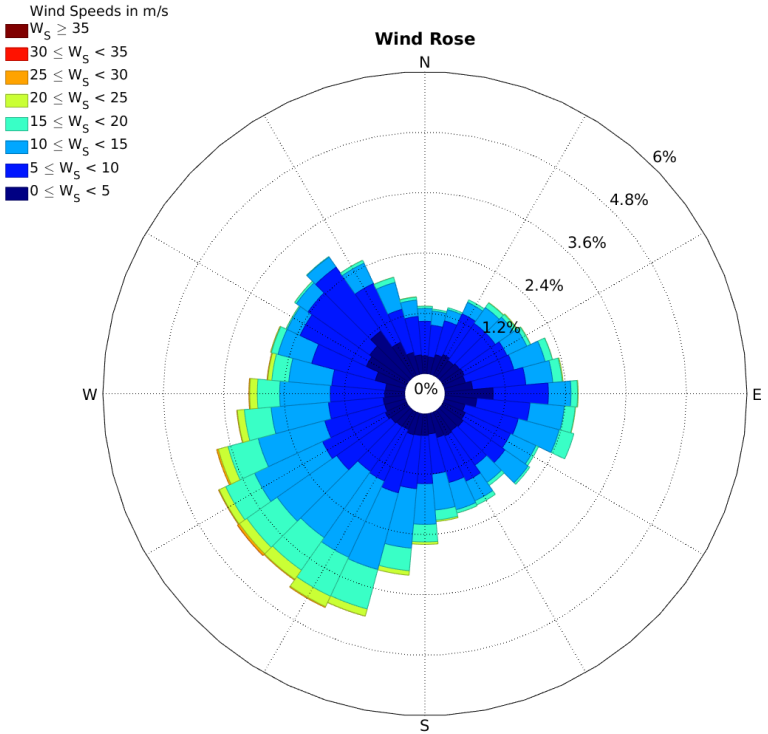


Location Fino 2

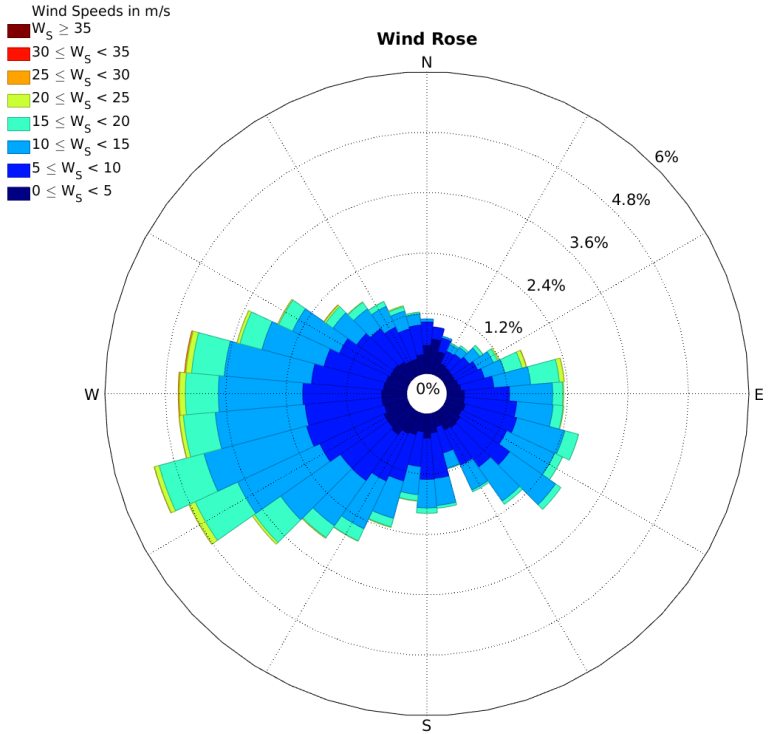


Wind Roses

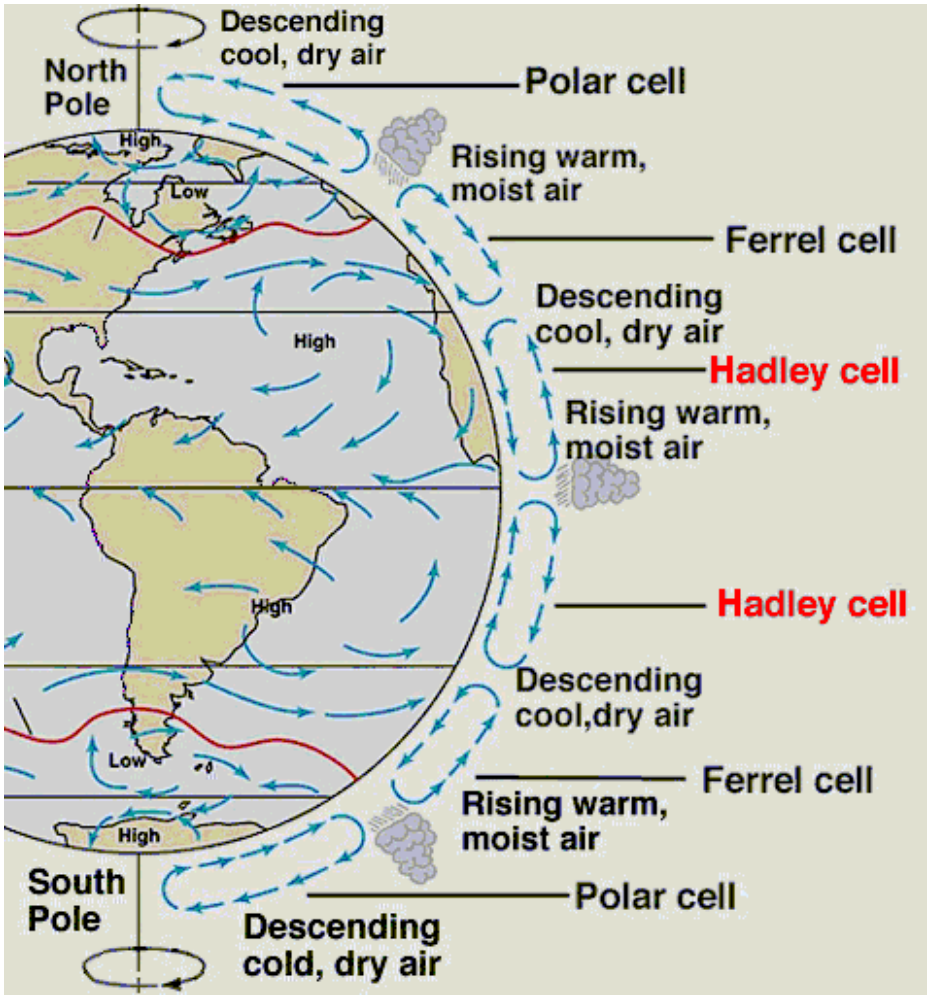
Fino 1



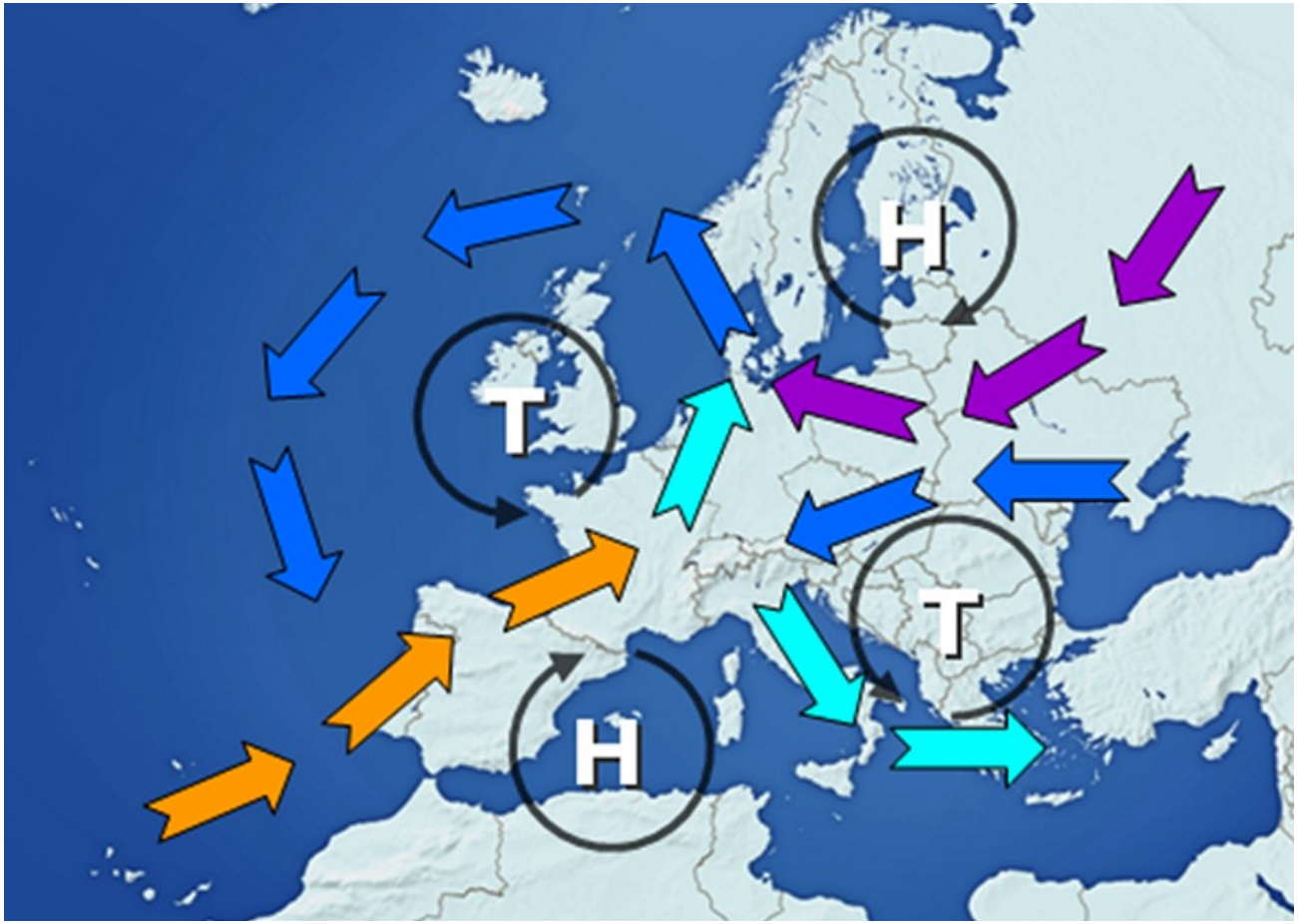
Fino 2



Differences



Differences



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Computation of Weibull parameters

$$\mu = \lambda \cdot \Gamma\left(1 + \frac{1}{k}\right)$$
$$\sigma^2 = \lambda^2 \cdot \left(\Gamma\left(1 + \frac{2}{k}\right) - \Gamma\left(1 + \frac{1}{k}\right)^2\right)$$

By substitution:

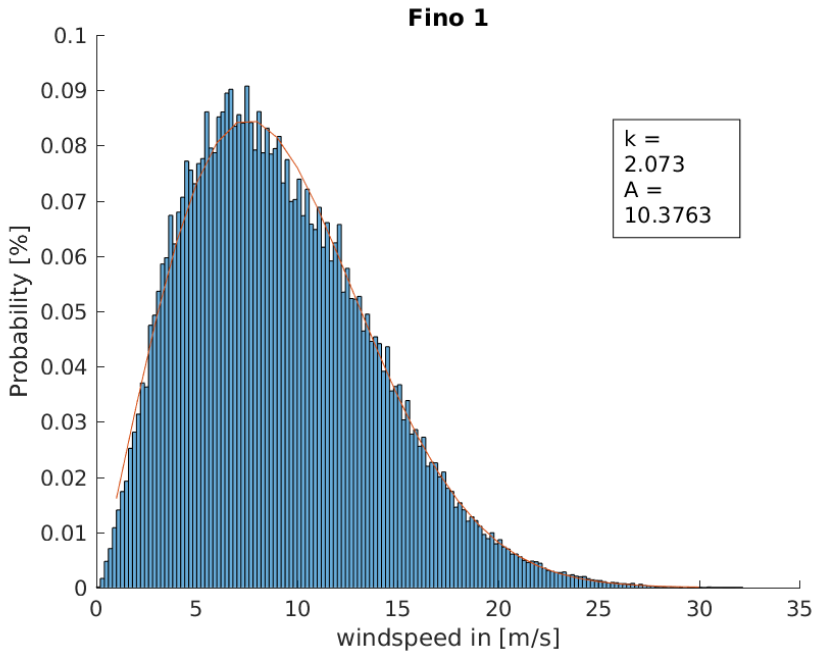
$$\sigma^2 = \left(\frac{\mu}{\Gamma(1 + \frac{1}{k})}\right)^2 \cdot \left(\Gamma\left(1 + \frac{2}{k}\right) - \Gamma\left(1 + \frac{1}{k}\right)^2\right)$$

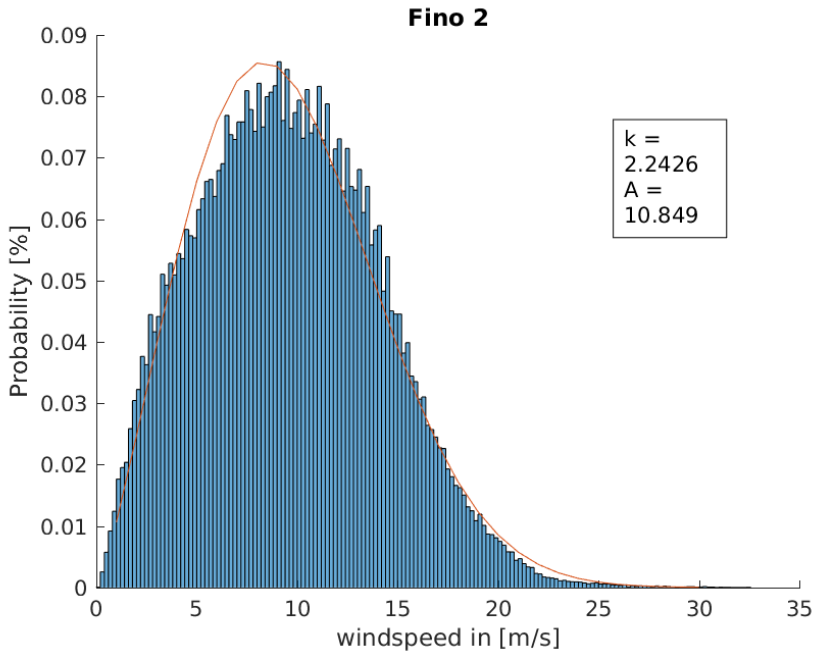
Function to solve:

$$0 = \left(\frac{\mu}{\sigma}\right)^2 \cdot \left(\frac{\Gamma\left(1 + \frac{2}{k}\right)}{\Gamma\left(1 + \frac{1}{k}\right)^2} - 1\right) - 1$$

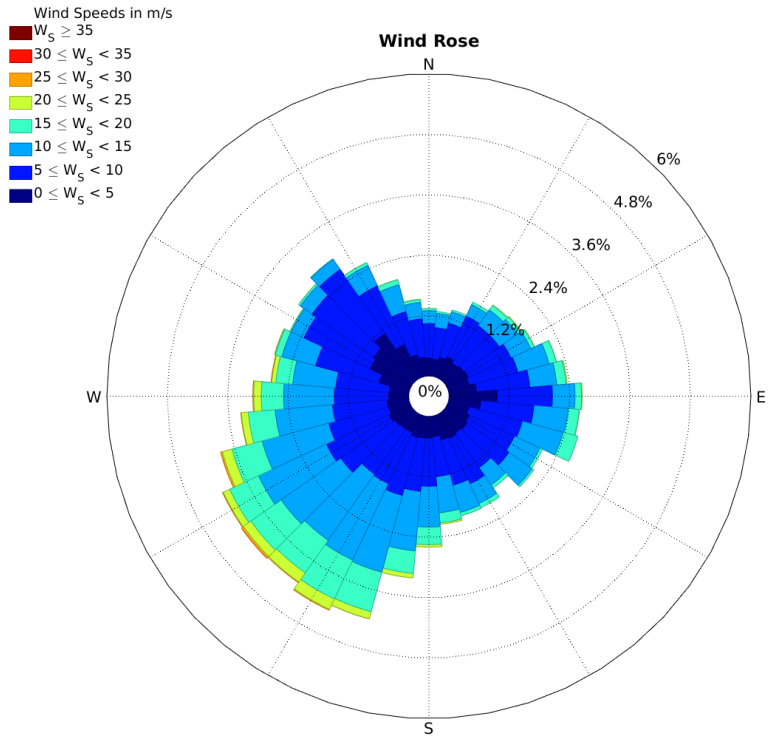
Weibull Distribution

```
k_Fino1 = 1;
Func_Fino1 = @(k_Fino1) (mean1*mean1/(dev1*dev1))* ...
    ((gamma(1+2/k_Fino1))/(gamma(1+1/k_Fino1))^2-1)-1
k_Fino1 = fsolve(Func_Fino1,k_Fino1);
A_Fino1 = mean1/gamma(1+1/k_Fino1);
weibull_Fino1 = wblpdf(1:30,A_Fino1,k_Fino1);
```

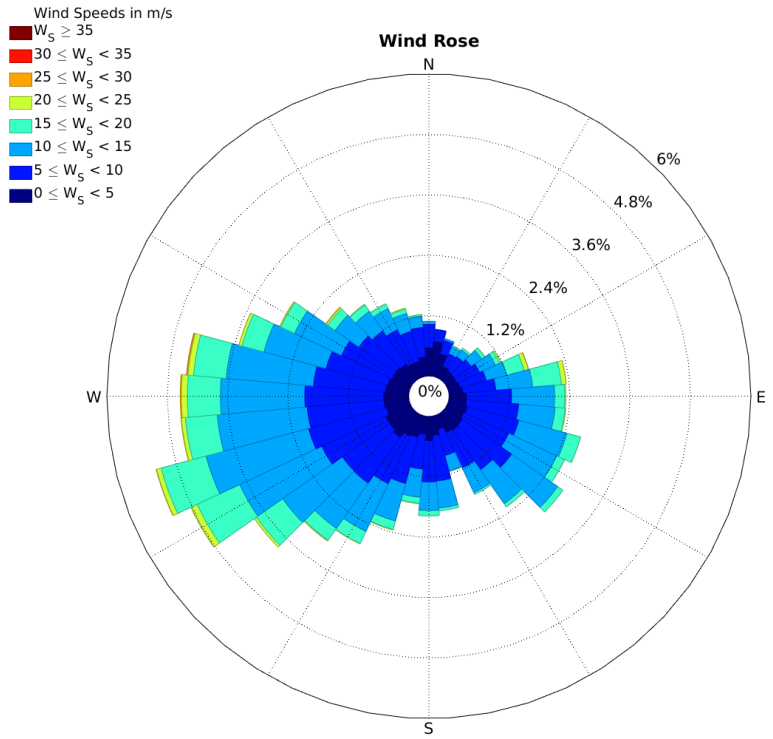




Fino 1



Fino 2



5y AEP	Fino 1	Fino 2
Vestas V90 1.8 MW	39,3 GWh	42,6 GWh
Enercon E82 3 MW	46,4 GWh	50,4 GWh

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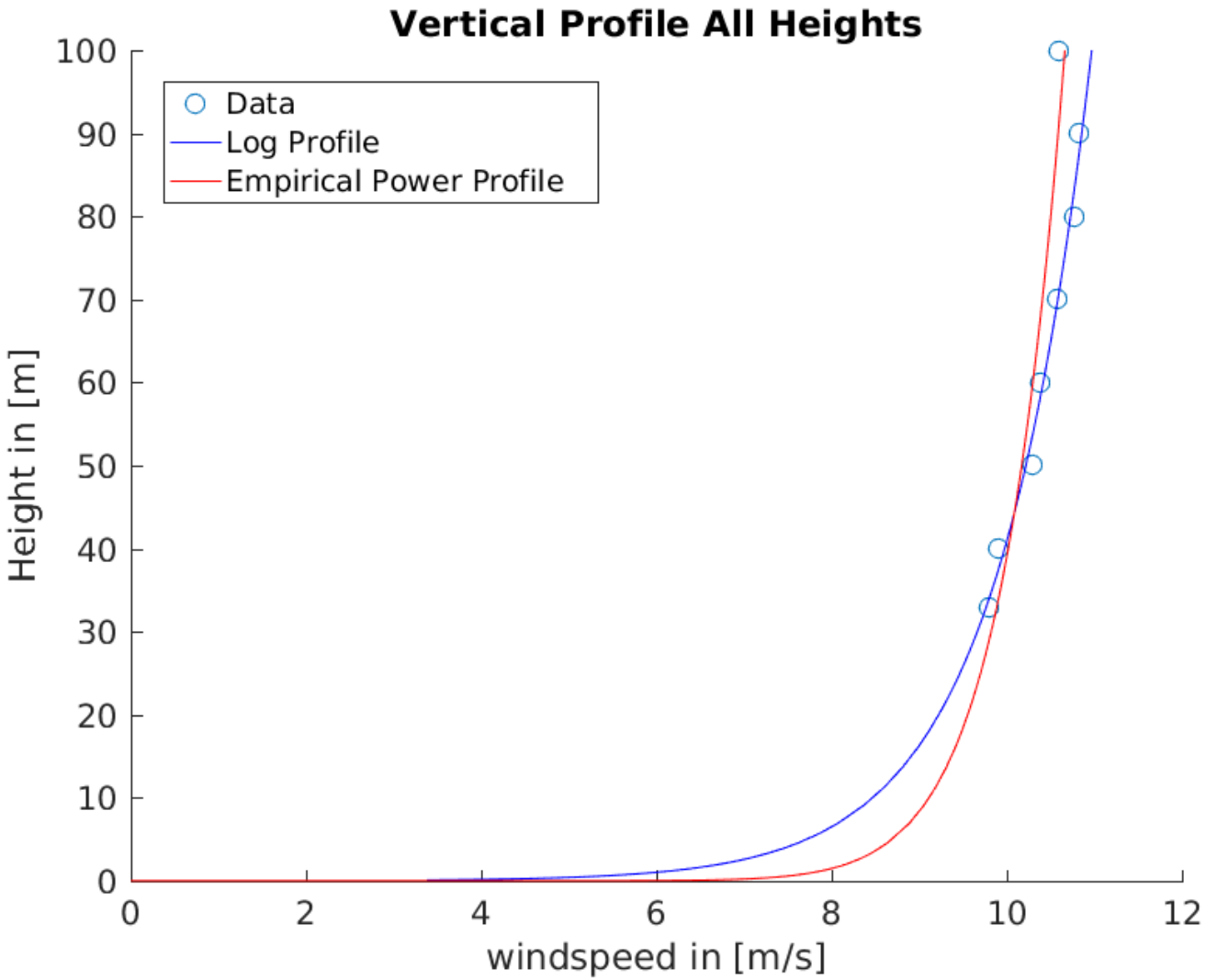
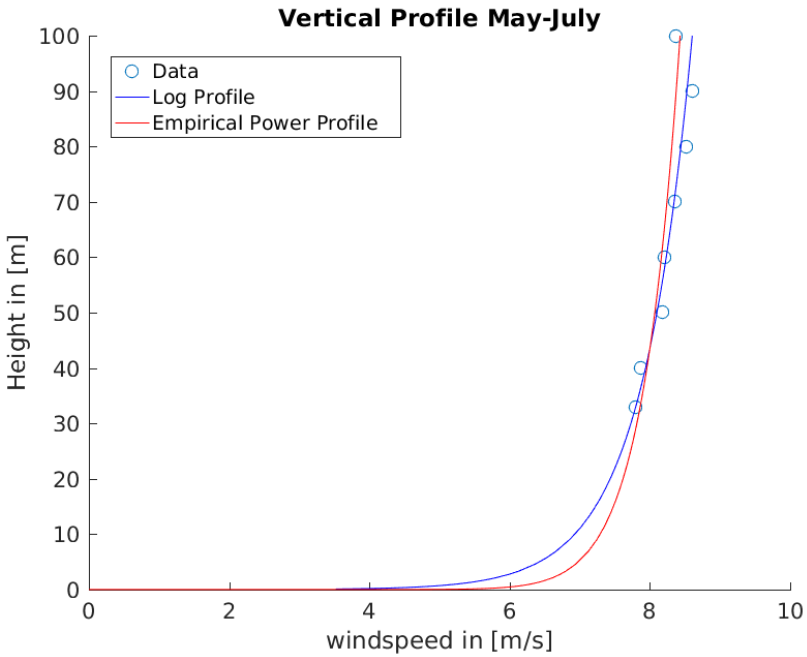
Non-linear regression of vertical profile

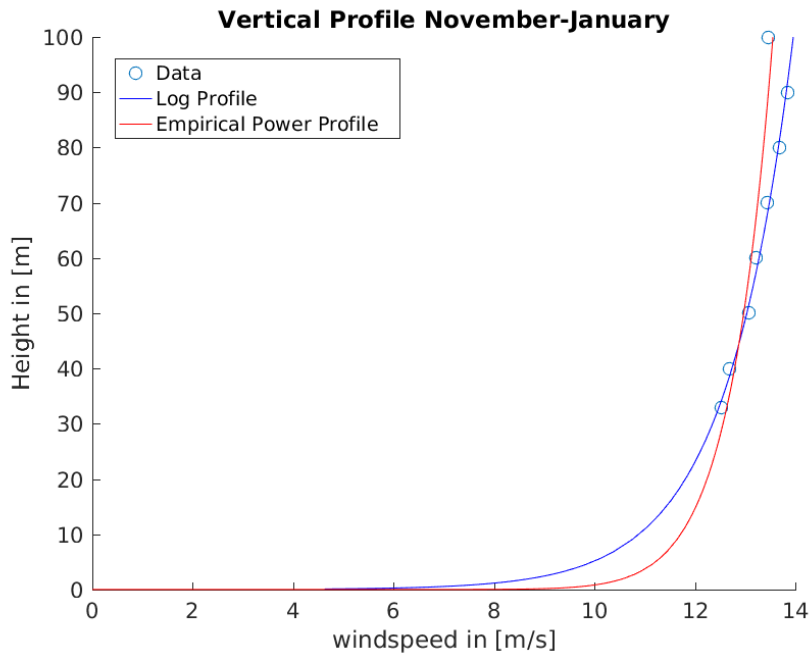
```
logProfileModel = @(b,z) b(1)/0.4 *(log(z/b(2)));
logProfileCoeffs = nlinfit([33,40,50,60,70,80,90,100],avgPerHeight,
    logProfileModel,[0.2,10^-6],opts);
[x,y]=fplot(@(z) logProfileCoeffs(1)/0.4 *(log(z/logProfileCoeffs(2))),[0 100])

empPowerModel = @(c,x) avgPerHeight(8)*((x/90).^c(1));
empPowerCoeff = real(nlinfit([33,40,50,60,70,80,90,100],avgPerHeight,
    empPowerModel,[0.11],opts));
[x,y]=fplot(@(z) avgPerHeight(8)*(z/90)^(empPowerCoeff),[0 100]);
```

Verticale Profiles for FINO 1

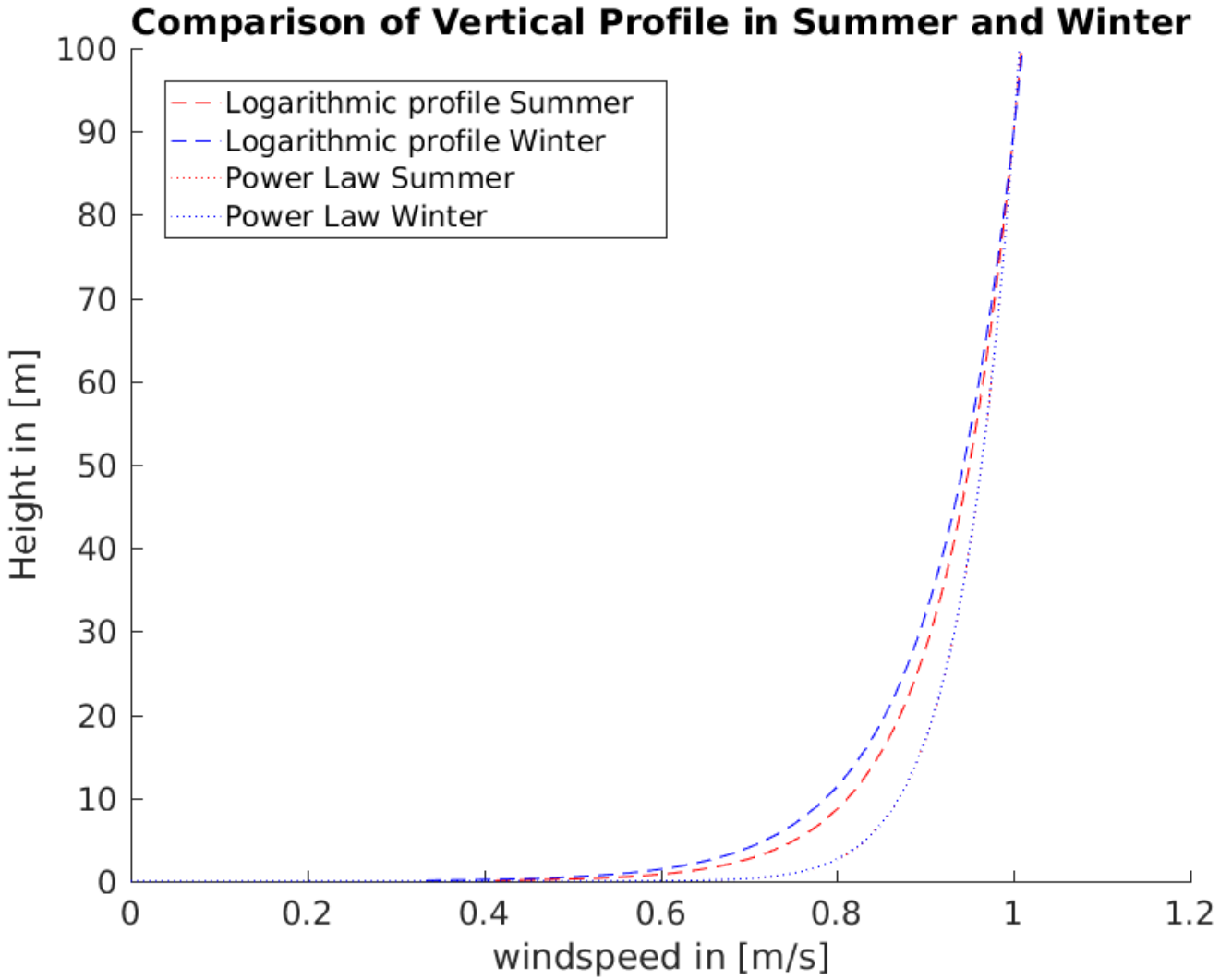


Seasonal analysis of vertical profile





Comparison of regression models



Thanks!