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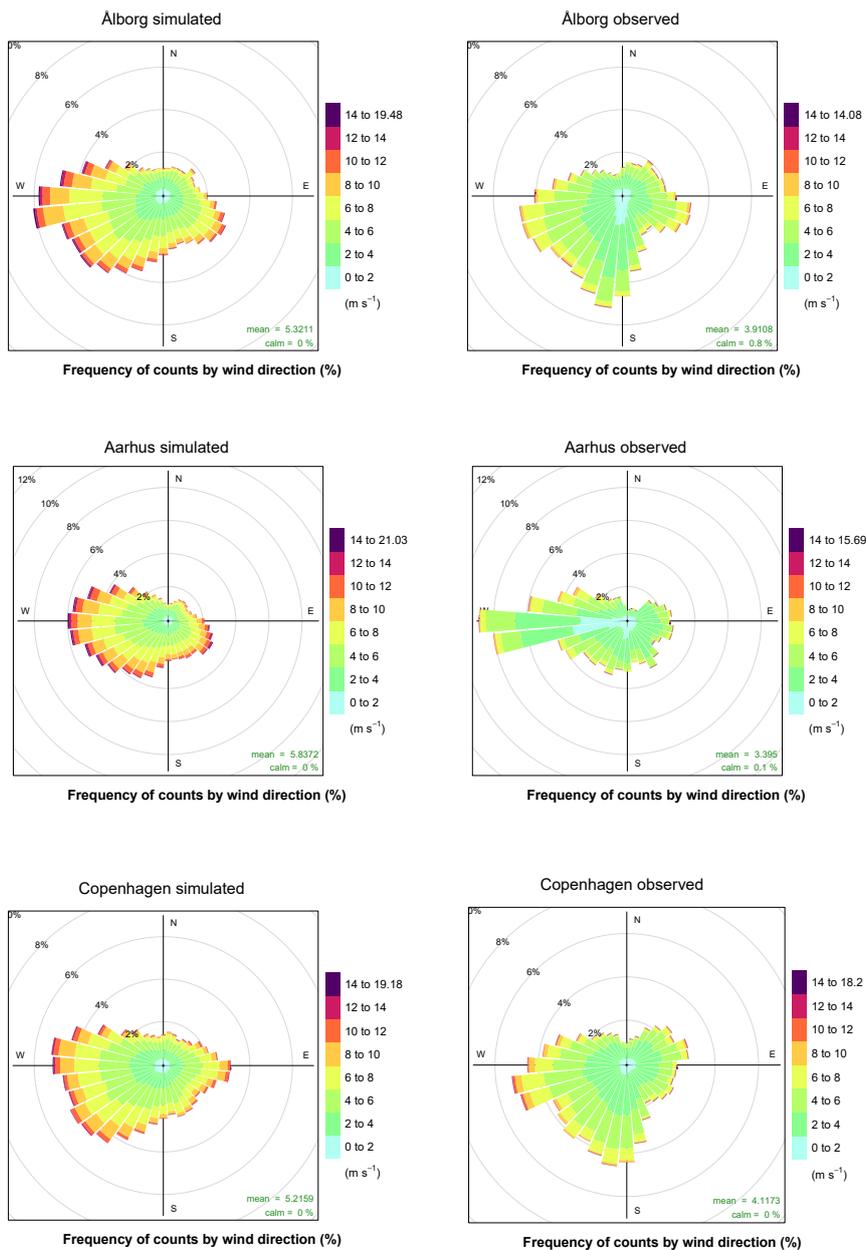
*Supplement of*

## **Simulating the atmospheric CO<sub>2</sub> concentration across the heterogeneous landscape of Denmark using a coupled atmosphere–biosphere mesoscale model system**

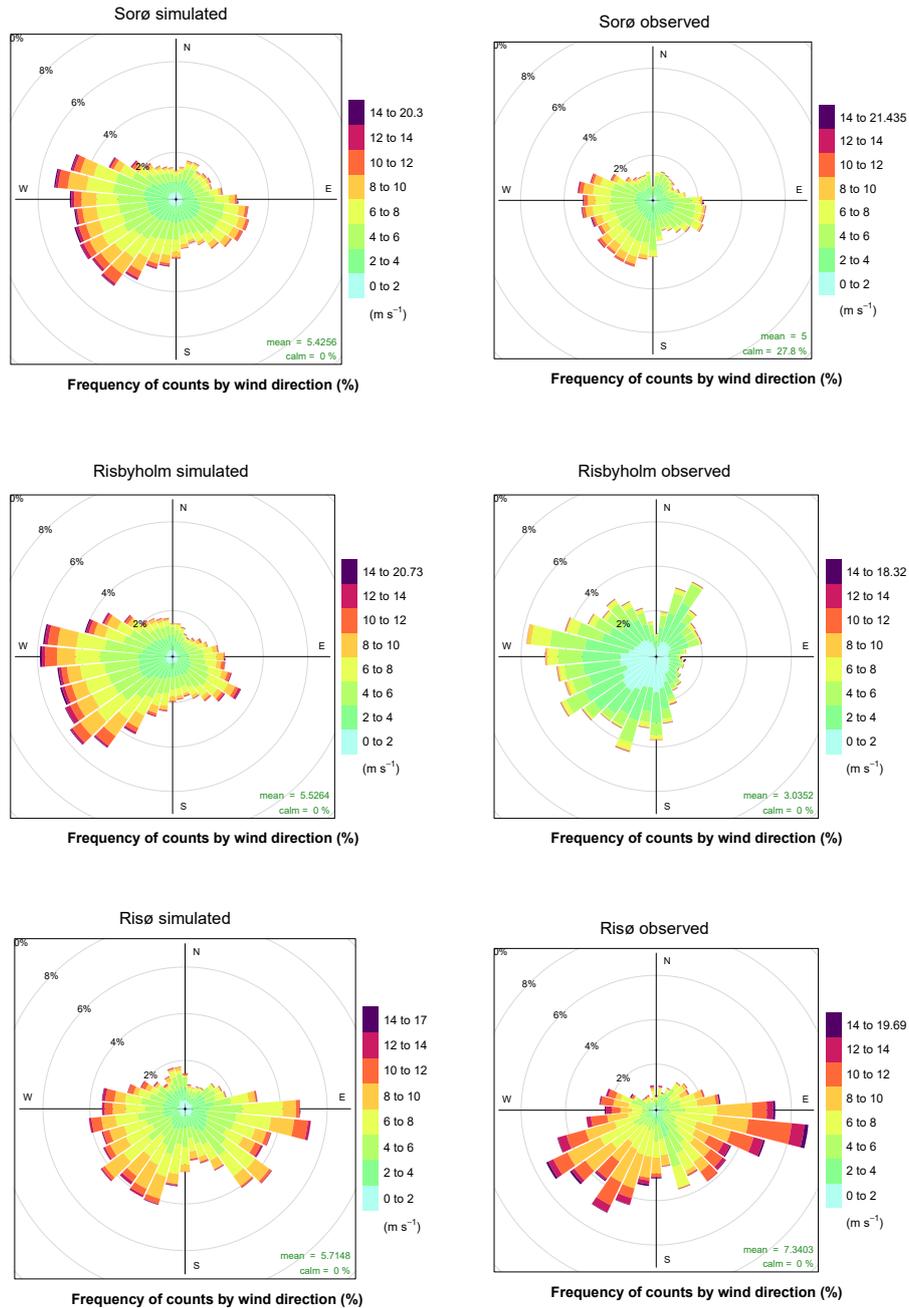
**Anne Sofie Lansø et al.**

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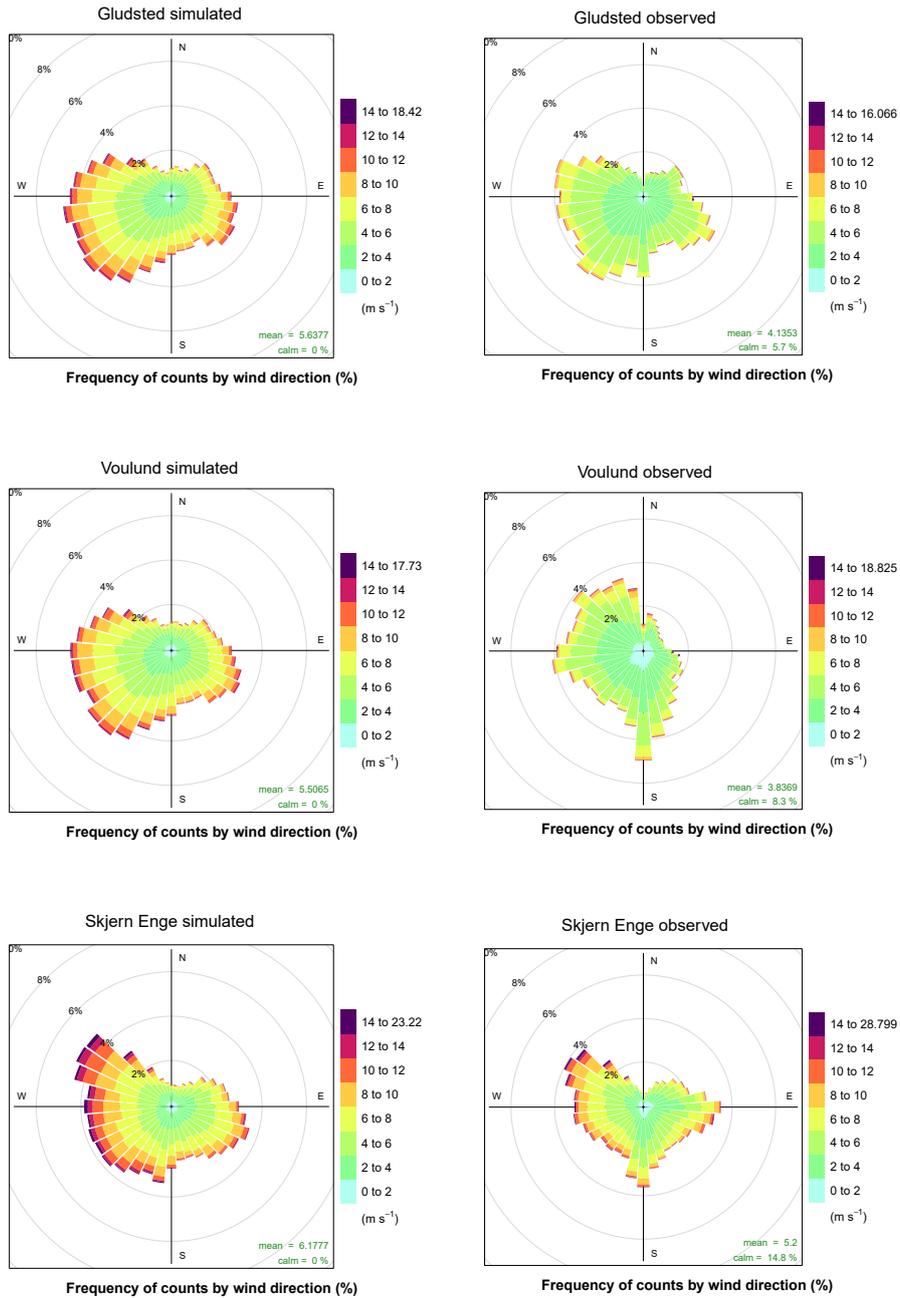
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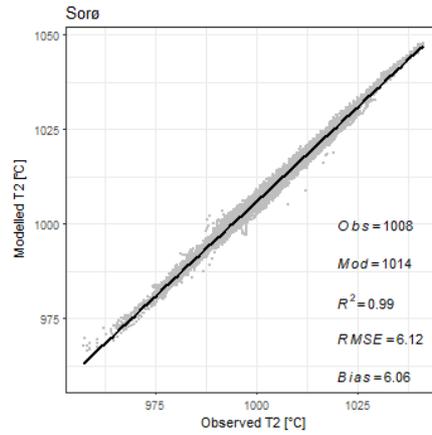
**Figure S1.** Wind roses made from simulated and measured wind velocities and direction for the Ålborg, Aarhus and Copenhagen air pollution monitoring sites.



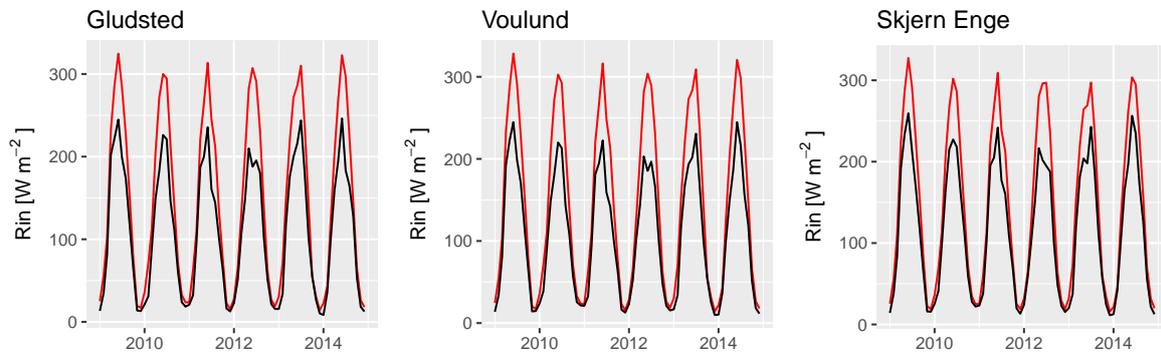
**Figure S2.** Wind roses made from simulated and measured wind velocities and direction for the Sorø, Risbyholm and Risø campus tower FLUXNET sites.



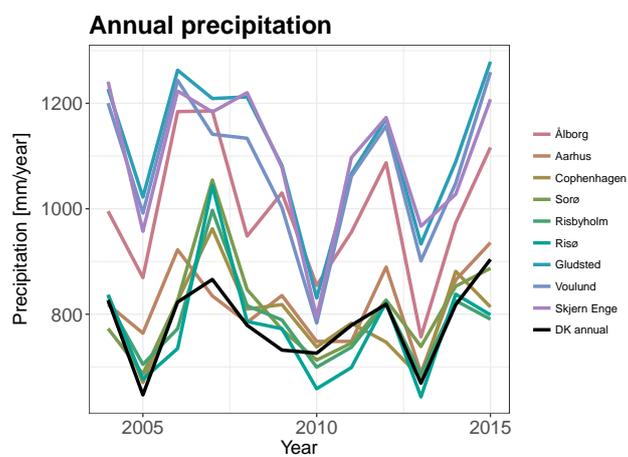
**Figure S3.** Wind roses made from simulated and measured wind velocities and direction for the Gludsted, Voulund and Skjern Enge HOBE sites.



**Figure S4.** Scatter plot of measured versus modelled surface pressure at Sorø. Hourly average values are used for both simulated and measured surface pressures. Observed average surface pressure (obs), simulated surface pressure (mod), correlation squared ( $R^2$ ), root mean square error (RMSE) and bias are shown.

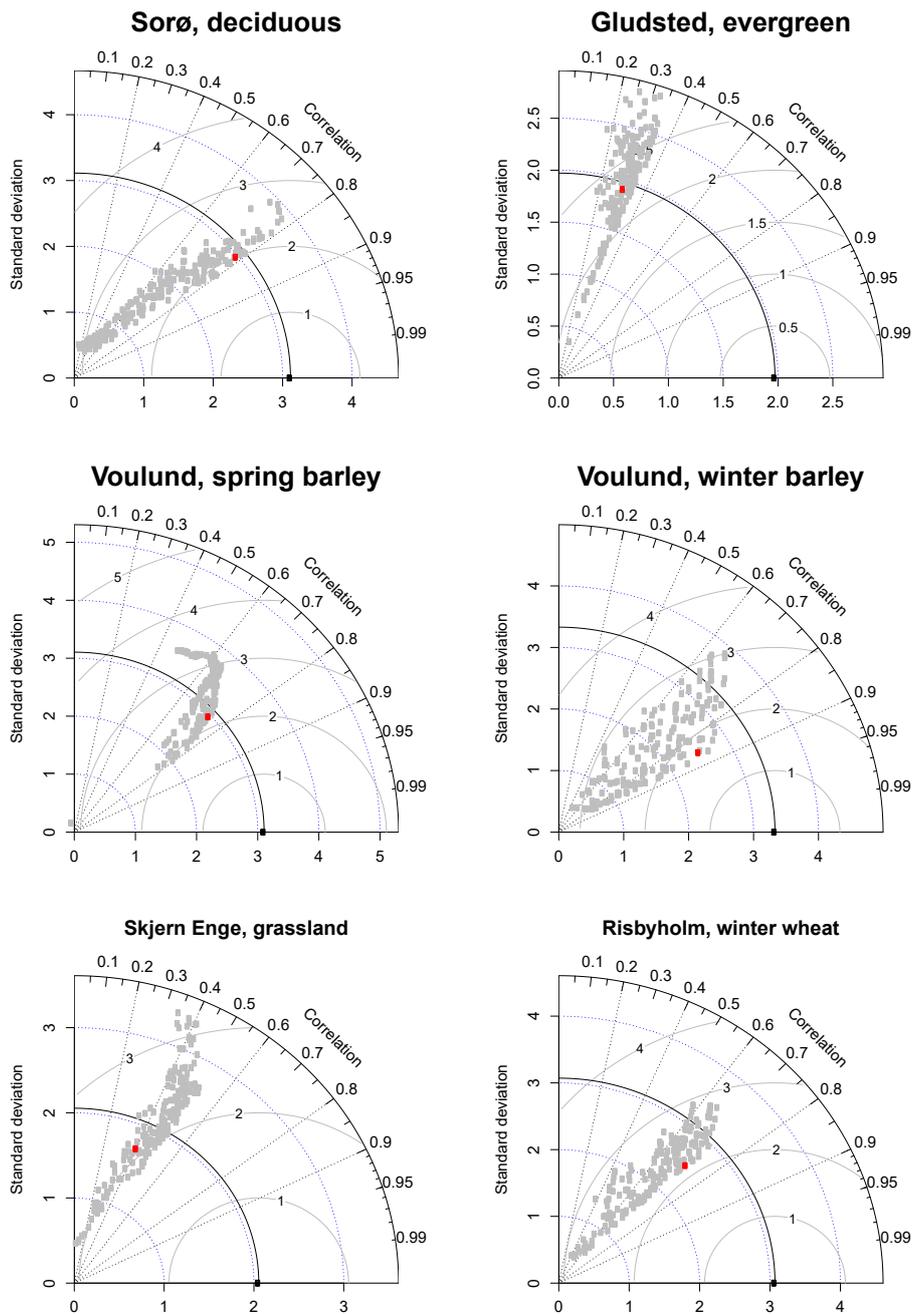


**Figure S5.** Monthly time series of simulated and measured incoming radiation ( $R_{in}$ ) at the three HOBE sites.

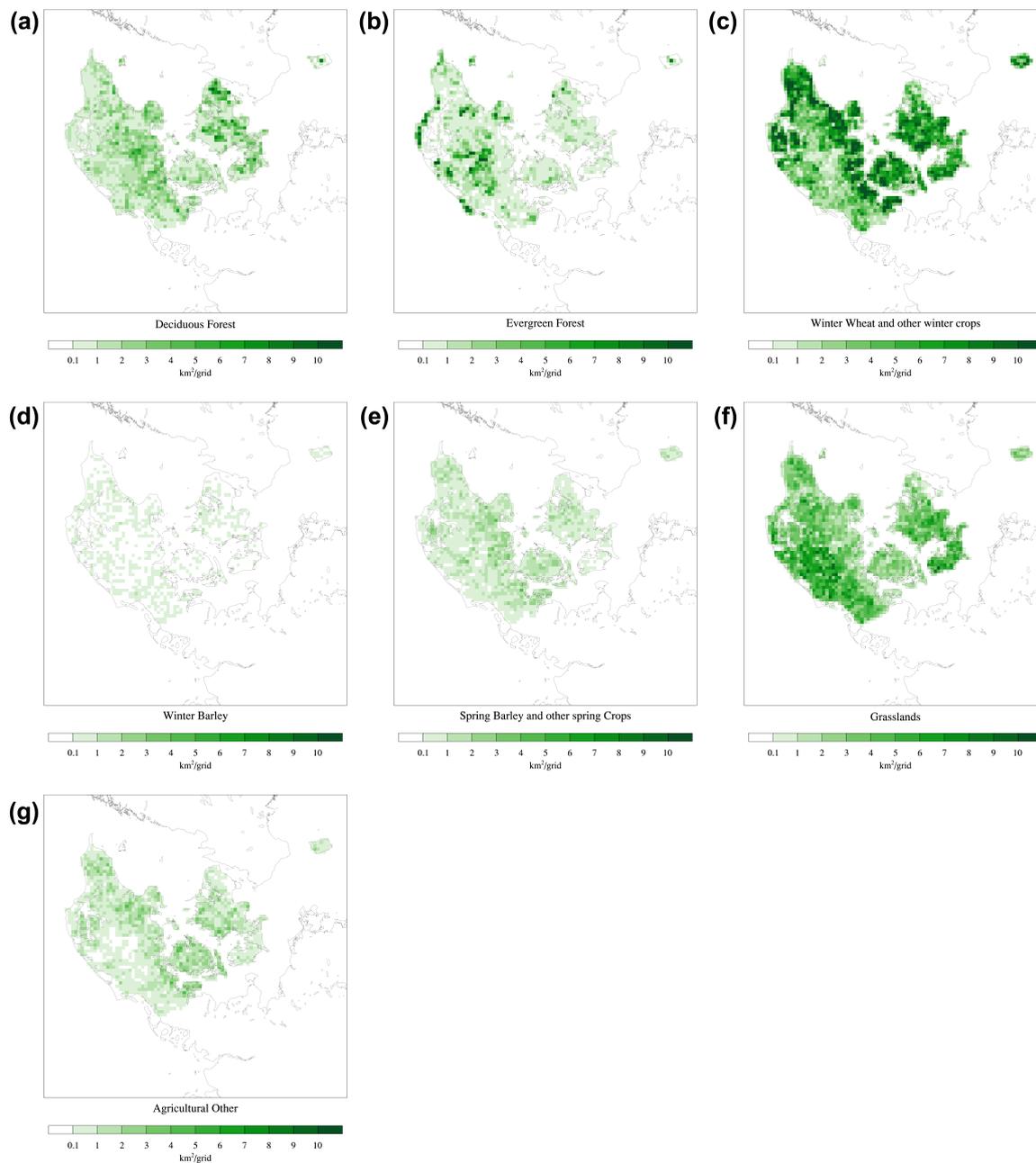


**Figure S6.** Simulated annual accumulated precipitations at the nine sites used for evaluation of the meteorological drivers together with the measured country-wide annual accumulated precipitation (DK annual).

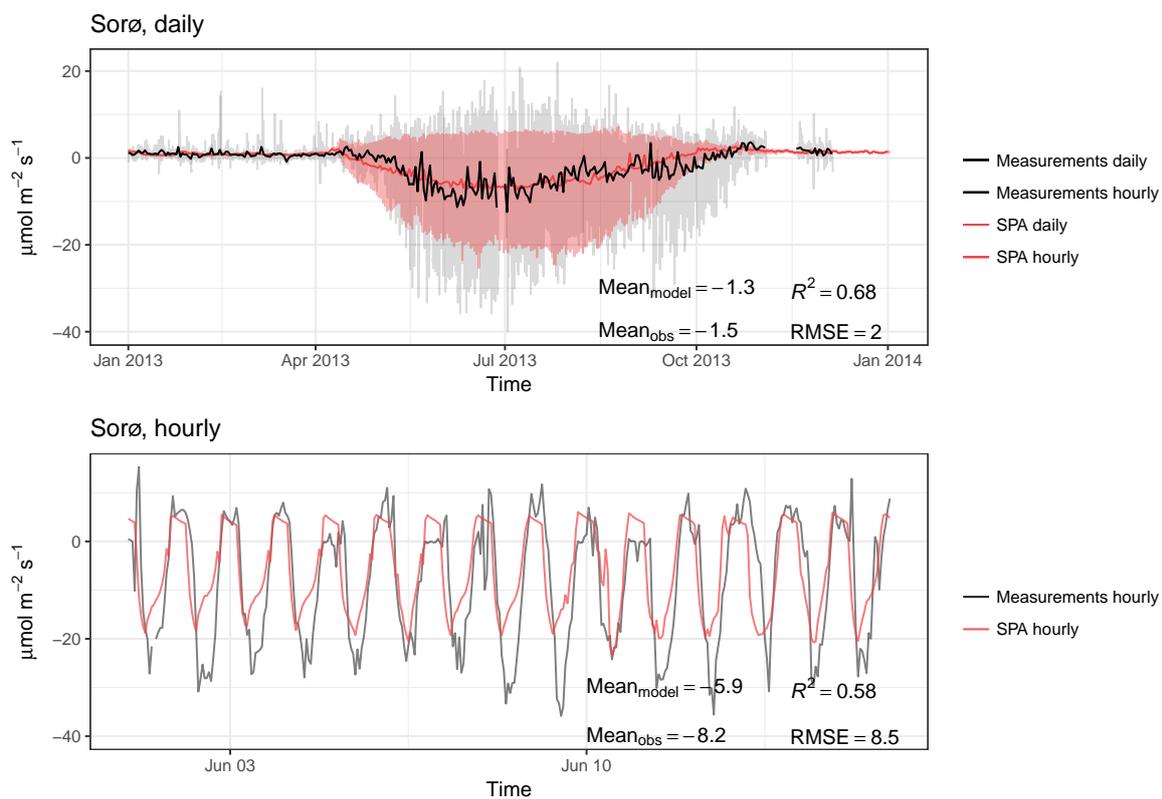
## SPA parameterization



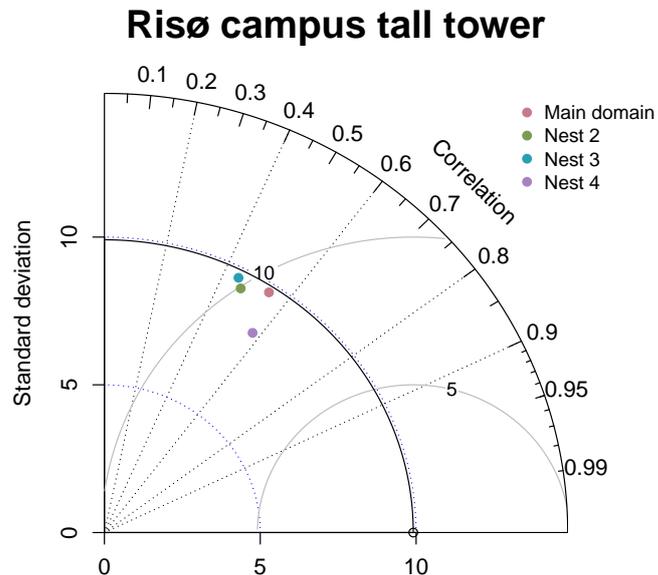
**Figure S7.** Taylor diagrams of simulated and observed NEE from the parameter tests made for SPA for each land cover classification. Each grey dot corresponds to a test with a parameter set, while the the red corresponds to the parameter set used within the DEHM-SPA modelling framework. The Taylor diagram contains information on correlation, standard deviation and centered root mean square difference.



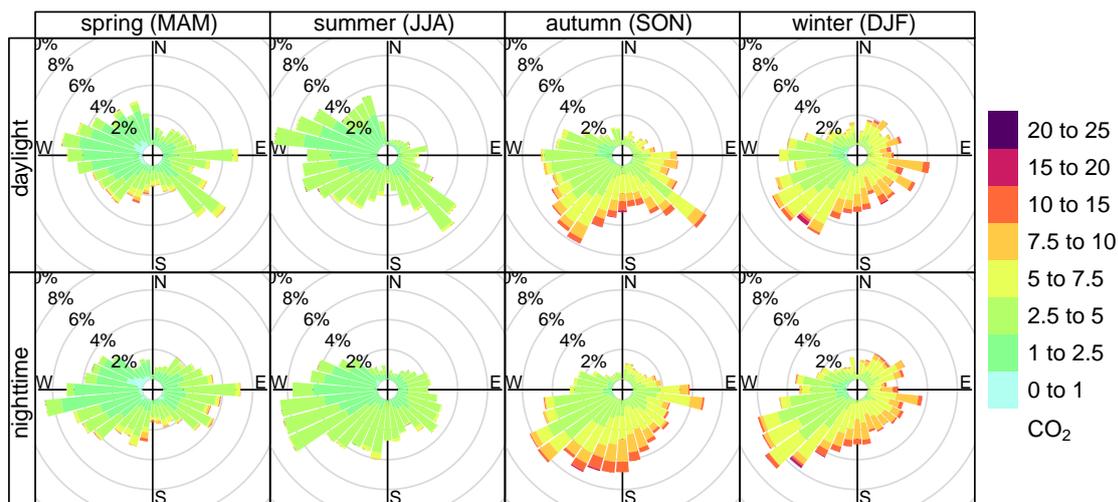
**Figure S8.** Square kilometers of each landcover classification contained in each model grid of the smallest DEHM nest, i.e. the resolution is  $5.6 \text{ km} \times 5.6 \text{ km}$  with  $31.2 \text{ km}^2$  contained in each grid.



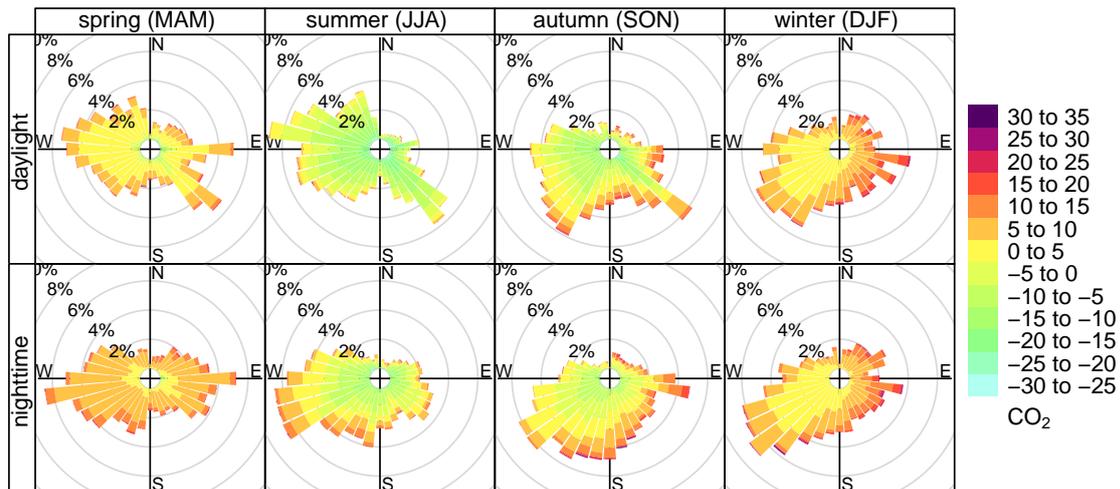
**Figure S9.** Daily and hourly values of simulated and measured NEE at the Sorø deciduous forest site. The model mean ( $\text{Mean}_{\text{model}}$ ), observational mean ( $\text{Mean}_{\text{obs}}$ ), correlation squared ( $R^2$ ) and root mean square error (RMSE) are shown for the two selected time periods for daily and hourly values (2013 and June 2013, respectively).



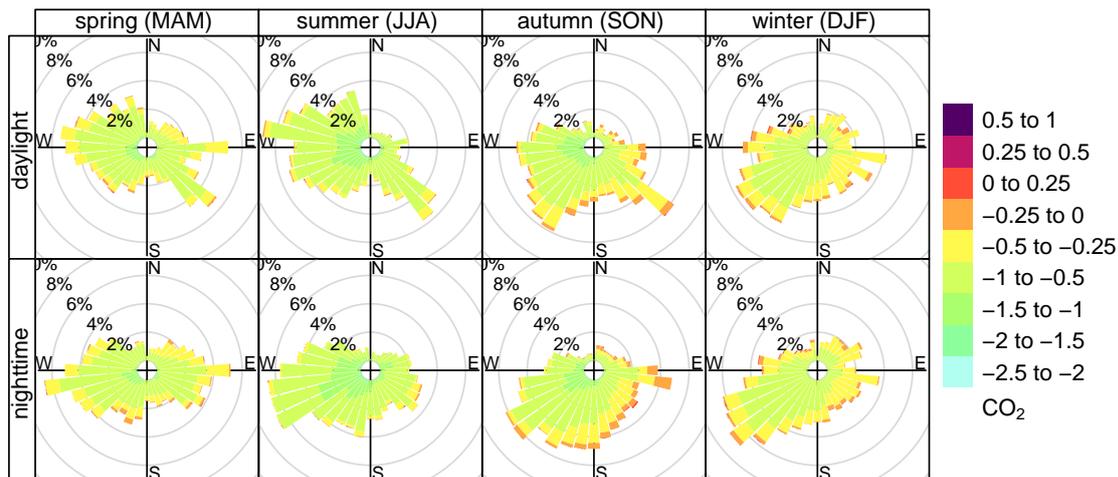
**Figure S10.** Taylor Diagram of atmospheric CO<sub>2</sub> concentration at the Risø campus tower site as simulated by the main domain and the three nests in DEHM in comparison to the observations for the period June 2013 to December 2014. The Taylor diagram contains information on correlation, standard deviation and centered root mean square difference.



**Figure S11.** Concentration roses of the fossil fuel emission contribution to the modelled atmospheric CO<sub>2</sub> [ppm] at the Risø site for 2011-2014. The wind direction is split into 10° intervals and the frequency indicated by the concentric circles. The colours indicate the CO<sub>2</sub> contribution that have been transported to the site from the given wind directions.



**Figure S12.** Concentration roses of the biospheric contribution to the modelled atmospheric CO<sub>2</sub> [ppm] at the Risø site for 2011-2014. The wind direction is split into 10° intervals and the frequency indicated by the concentric circles. The colours indicate the CO<sub>2</sub> contribution that have been transported to the site from the given wind directions.



**Figure S13.** Concentration roses of the oceanic contribution to the modelled atmospheric CO<sub>2</sub> [ppm] at the Risø site for 2011-2014. The wind direction is split into 10° intervals and the frequency indicated by the concentric circles. The colours indicate the CO<sub>2</sub> contribution that have been transported to the site from the given wind directions.