Scale Effects on the Controls on Mountain Grassland Leaf Stomatal and Ecosystem Surface Conductance to Water Vapour

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Background Stomata are the major pathway by which plants exert control on the exchange of trace gases and water vapour with the aerial environment and thus provide a key link between the functioning of terrestrial ecosystems and the state and composition of the atmosphere. Understanding the nature of this control, i.e. how stomatal conductance differs between plant species and ecosystems and how it varies in response to external (abiotic) and internal (biotic) forcings, is key to predicting any feedback plants may be providing to changing climatic conditions. The objective of this paper is to compare the controls on leaf- and ecosystem-scale conductances to water vapour at a mountain grassland site in Austria.

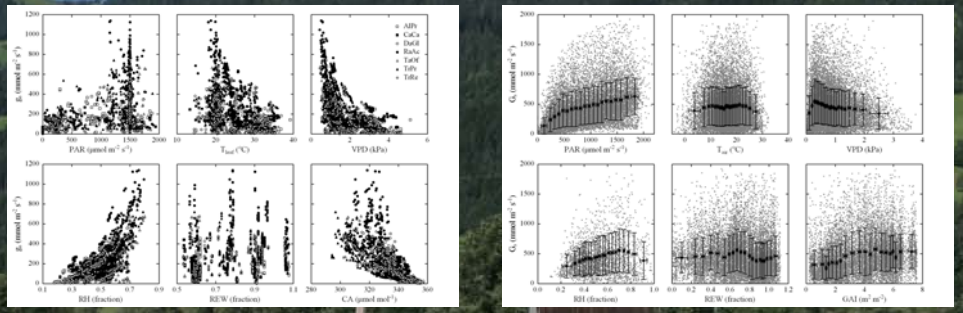

Figure 1 Leaf stomatal conductance (gs) and ecosystem surface conductance (Gs) as a function of incident photosynthetically active radiation (PAR), leaf/air temperature (Tleaf/air), vapour pressure deficit (VPD), relative humidity (RH), relative extractable soil water (REW) and CO_2 mole fraction (CA), respectively green area index (GAI). Different plant species are identified by different symbols in the left panel, grey symbols represent half-hourly values, large solid symbols bin-averaged data in the right panel.

Methods Leaf stomatal conductance was measured *in situ* by means of gas exchange methods and ecosystem surface conductance by inverting six years of eddy covariance evapotranspiration estimates.

Results & Conclusions Our major findings were: (*i*) Abiotic controls differed in their importance for leaf stomatal and ecosystem surface conductance (Fig. 1) - air humidity and carbon dioxide mole fraction were most important at the leaf level, while incident photosynthetically active radiation explained most of the variability in ecosystem surface conductance. This is concluded to reflect vertical within-canopy gradients in environmental conditions, from which follows that correlations with abiotic controls do not represent scale-independent models. (*ii*) Photosynthesis explained most of variability both in leaf stomatal and ecosystem surface conductance (Fig. 2). This is concluded to reflect similar correlations between leaf stomatal/ecosystem surface conductance and leaf/canopy photosynthesis which obviously hold across scales.

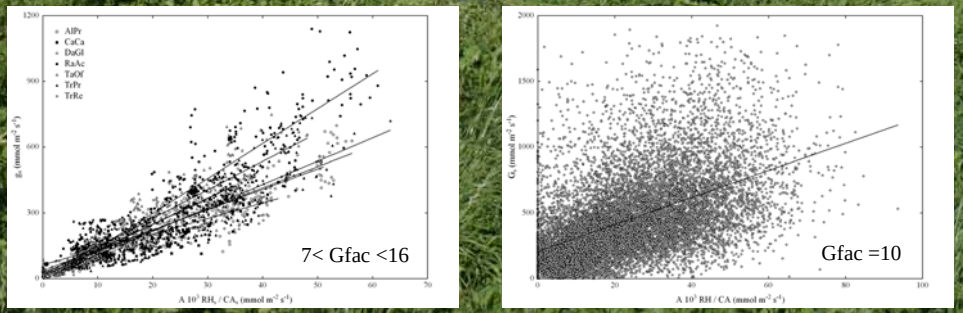

Figure 2 Parameterisation of the Ball et al. (1987) model for leaf stomatal (gs, left panel) and ecosystem surface conductance (Gs, right panel).

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