

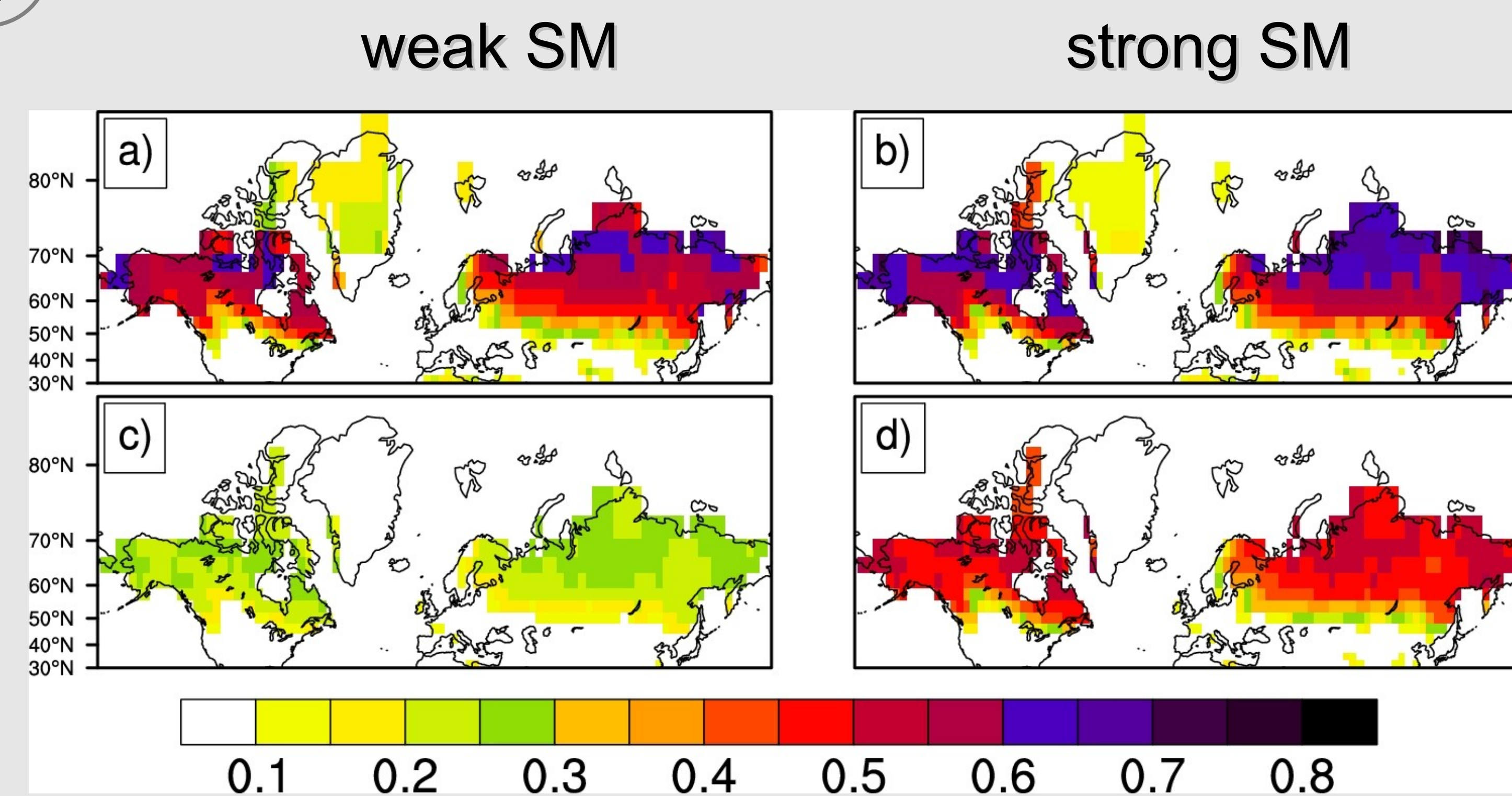
# Strength of forest-albedo feedback in mid-Holocene climate simulations

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1

Reconstructions of the mid-Holocene climate, 6000 years before present, suggest that spring temperatures were higher at high northern latitudes compared to the pre-industrial period. A positive feedback between expansion of forest and climate presumably contributed to this warming. In the presence of snow, forests have a lower albedo than grass land. Therefore the expansion of forest likely favoured a warming in spring, counteracting the lower insolation at the mid-Holocene.

3



Difference between the albedo of grass and the albedo of forest for March. We refer to this difference as strength of snow-masking. The left column shows the snow masking for the parameterisation with weak snow masking separately for (a) evergreen forest and for (c) deciduous forest. The right column corresponds to the snow masking for the parameterisation with strong snow masking separately for (b) evergreen forest and for (d) deciduous forest.

2

**Model:** MPI-ESM consisting of ECHAM5/JSBACH

Two sets of model simulations were performed: (a) with weak and (b) with strong snow masking (SM) by forest.

	weak SM	strong SM
pure contribution of atmosphere-vegetation interaction	$V_w = (AV_w^{6k} - AV_w^{0k}) - (A_w^{6k} - A_w^{0k})$	$V_s = (AV_s^{6k} - AV_s^{0k}) - (A_s^{6k} - A_s^{0k})$

**Summary:**

A doubling of the strength of snow masking increases spring warming by a factor of three. The additional gain of forest is only 13%.

	weak SM	strong SM
$\Delta$ air temperature north of 60° N	0.12 °C	0.34 °C

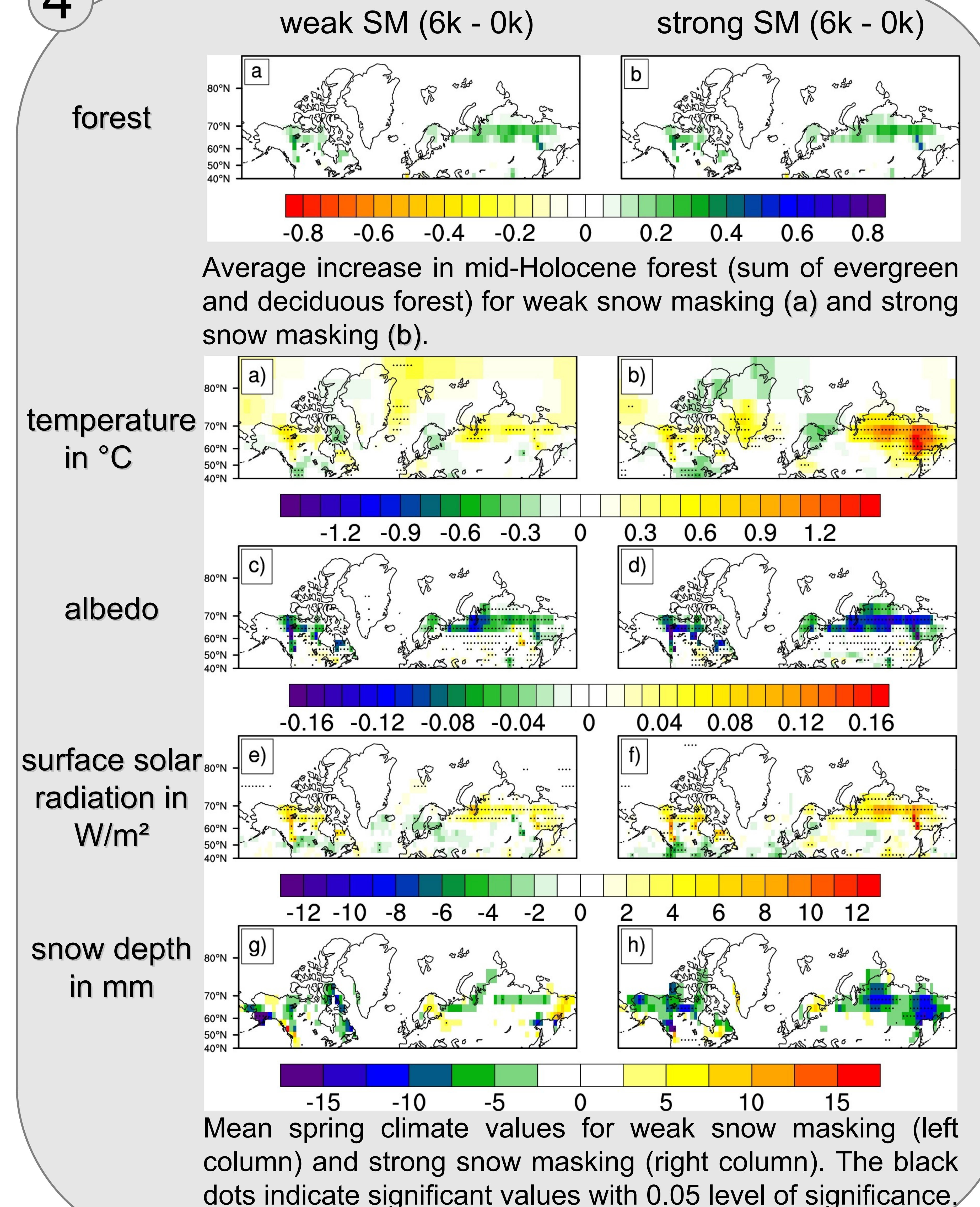
**Conclusion:**

(1) the magnitude of the vegetation-climate interaction simulated by means of the model ECHAM5/JSBACH is smaller than previously discussed (e.g. results of PMIP)  
(2) consequently, modelling vegetation processes more explicitly, i.e. by a dynamic vegetation representation, the climate-vegetation interaction appears to be weaker

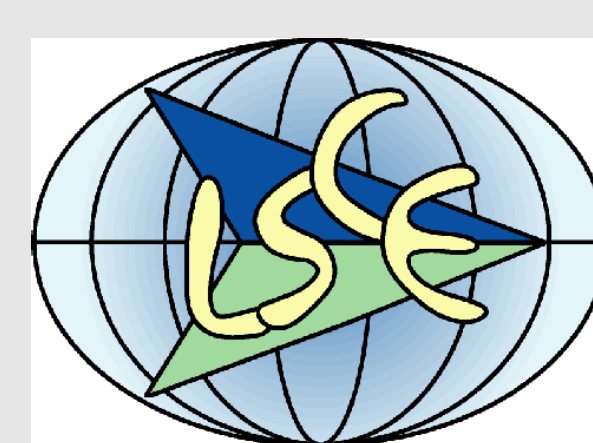
**Reference:**

Otto, J. , Raddatz, T. and Claussen, M.: Strength of forest-albedo feedback in mid-Holocene climate simulations. CPD, 2011, Vol.7, pp. 809-840, SRef-ID: 1814-9359/cpd/2011-7-809

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