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Introducing a soil freezing scheme in a land-surface model

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Underlying 25% of northern hemisphere soils with notable extents in northern Eurasia, permafrost is a major feature of arctic climate, though by far still absent from most climate models.
We plan to introduce a physically-based parametrization of frozen soils in the land-surface scheme ORCHIDEE, which is part of the IPSL-CM4 climate model. Frozen/unfrozen water partition within the soil is accounted for using soil-type dependant freezing characteristic curves ; this partition is used to compute thermal and hydrological soil properties and effects of freeze-thaw cycles on discretized temperature and water diffusion schemes. Thermal insulation and water storage by a surface organic layer are also to be introduced.
Those developments are expected to improve the model's performances in arctic regions, especially on arctic river discharge volumes and seasonality. They should later lead to a quantification of permafrost-related feedbacks on boreal and global climate through the coupling with a carbon cycle model.