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Explanation of the extreme low surface mass balance over the Greenland ice sheet in 2010 with the help of a regional climate model and a circulation type classification.

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The regional climate models MAR and RCMO show that the surface mass balance (SMB) rate of the whole Greenland ice sheet (GrIS) is the lowest in 2010 since 50 years. This record is a combination of an abnormal dry year and an exceptional melt in summer confirmed by ground measurements and satellite-derived observations. An automated circulation type classification (CTC) is used for detecting anomalies in the daily atmospheric circulation at 500hPa over the Greenland ice sheet during 2010. The CTC reveals that the low snow accumulation is due to the general circulation (negative NAO index) while the record melt in summer is rather a consequence of the well known surface albedo-temperature feedback induced by

1. a warmer and thinner than normal snowpack above the bare ice at the end of the spring.
2. an earlier beginning of the melt season.
3. a drier summer.
4. an exceptional persistence of atmospheric circulations inducing warm and dry conditions over the GrIS.

All these anomalies induced in summer 2010 an exceptional time exposure of bare ice areas (with a lower albedo than snow) over the GrIS which impacts the surface melt. Sensitivity experiments carried out by the MAR model allow to estimate the importance of each anomaly in the record simulated melt of summer 2010.