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Comparison of permafrost mean annual ground temperature derived from two different satellite-based schemes: land surface temperature based (ESA CCI+ Permafrost) versus surface status (Metop ASCAT)

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Different approaches exist for a satellite-based estimation of mean annual ground temperature (MAGT). Landsurface temperature can be ingested by transient models. Surface status information (frozen/unfrozen days) has been shown to be applicable for the estimation of ground temperature as well. Such approaches are based on an empirically defined relationship. Both approaches have been evaluated with in situ bore hole measurements, but not yet compared with each other.

A comparison between yearly arctic mean temperatures, derived from the advanced scatterometer (ASCAT) and data from ESA's CCI+ Permafrost project was carried out. The used ASCAT record is available from 2008 (first full year) onwards while the latest CCI+ Permafrost data is available from 1997 to 2018. The ASCAT data was recorded by satellites whose measurements are only intermittently available as one flyover over the whole arctic north of 60°N takes two days on average. To fill in the missing values exponentially weighted moving averages (EWMA) were used. From the number of frozen days an expected average temperature was derived based on Kroisleitner et al. (2018).

The CCI+ Permafrost data incorporates modelled MAGT for depths between the surface down to a depth of 10 meters. These data points were extracted from the raster files (~1km resolution) and averaged over polygons representing an approximation of the ASCAT grid (footprint approximation). Single polygon areas range from 150-160 km². Only footprints for which data is available in both records (and thus permafrost presence) have been eventually compared.

The CCI+ Permafrost data shows an average surface temperature of -1.42 °C for the areas analyzed between 2008 and 2018 while the statistically padded ASCAT data suggests a mean temperature of -1.18 °C over the same time period. The ASCAT retrieval corresponds to a general MAGT whereas CCI+ Permafrost values are available for certain depths. Water fraction within ASCAT footprint also affect the quality of the derivation of frozen days. New calibration considering certain depths and water fraction is suggested.