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Variations of northern George VI Ice Shelf Front Linked to Ocean and Atmosphere Variations (2008-2011)

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During the last couple of years several ice shelves have shown ongoing thinning and even disintegration has occurred. That these processes are caused in general by abnormal ocean and/or atmosphere variations is widely recognized. Nevertheless, every ice shelf interacts different with the ocean and the atmosphere, therefore they have to be studied separately.

In case of George VI ice shelf mainly oceanographic parameters like upwelling deep water, ocean currents, salinity and sea surface temperature (SST) play a key role and have a huge influence on its front variations.

Information about the aerosol optical thickness (AOT) over Marguerite Bay and George VI Sound is incorporated in order to correlate intensity of the solar radiance at the ground and sea surface temperature. In addition, due to the fact that the ice shelf is principally fed by glaciers from Alexander Island and Palmer Land flowing into George VI Sound, also land surface temperature (LST) data is considered.

SST, AOT at 869nm and LST data from the Moderate Resolution Imaging Spectroradiometer (MODIS) in the corresponding bands and at a spatial resolution of 4km is analyzed.

The ice shelf front itself is monitored using data from the ASAR (Advanced Synthetic Aperture Radar) instrument on board of the ENVISAT satellite. It is operating at C-band (5,3 GHz) and, when working in Wide Swath Mode (WSM), it permits data acquisition at medium spatial resolution (150m).

During antarctic summer 2008/09 two notable horizontal rifts of about 5,96km and 16,73km length have developed. Two more rifts (length of about 8,93km and 5,6km) are identifiable in the WSM data acquired during antarctic fall 2009. Break-off along these rifts happened during summer 2009/10 and a total area of about 60sqkm was lost. In antarctic summer 2010/11 a second, but smaller break-up event started at the western part of the northern ice shelf front. Until late winter 2011, about 10,18sqkm were lost. During that time no new rifts have developed.

Regarding seasonal SST and AOT in George VI Sound and Marguerite Bay and mean LST at the coasts of Alexander Island and Palmer Land nearby George VI ice shelf, the following values have been observed (values correspond to events mentioned above in chronological order):

- SST: 272K; 271,5K; 273,5K; 272K
- AOT: 0,03; 0,02; 0,04; 0,05
- LST: 277K; 280K; 285K; 285K

In conclusion, the main break-up event in antarctic summer 2009/2010 was a result of new rift formation during previous summer and fall. Their development on the one hand occurred independent of SST or LST anomalies. On the other hand AOT was low and therefore have enhanced the possibility of new rift formation. However, the break-off events itself have to be related to abnormal high sea and land surface temperature in the close vicinity of the northern George VI ice shelf front. AOT also showed elevated values what in contrast forced a time delay of these events.