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Forecasting the weather
- ensemble techniques
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Seasonal forecast of High Altitude Wetland phenology in the tropical Andes based on MODIS snow cover and TRMM precipitation data

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High Altitude Wetlands of the Andes (HAWA) are unique types of wetlands within the semi-arid high Andean region. HAWA belong to an exceptional group of peatlands in the world surrounded by arid grasslands of the central Andes. HAWA sites in southern Peru can be situated in the most arid part of their range from 4000 m a.s.l. on the western slopes of the Andes up to more than 5000 m a.s.l. within the sub-humid parts of the eastern Cordillera. These peatlands are extremely fragile water features sensitive to climate changes and human disturbances such as livestock grazing playing a critical role for breading of Andean camelid species like Alpaca (Vicugna pacos). But climate conditions of the high Andean region are very rough and although situated in the tropics snow events can regularly occur in these altitudes. Snow cover records of the last decade indicate high variability of snow fall with very strong events as e.g. during the cold spell of 2003 in southern Peru (locally known as *friaje*). During the cold spell HAWA sites have been covered by snow making grazing impossible. Forced to go without food for days at a time, Alpacas have become weak and susceptible to disease affecting smallholders whose livelihoods depend completely on raising them. Usually small snow fall events of only a few hours duration occur and snow cover below the permanent snow line melts within a day or two due to in general high solar insolation in the tropics. Results of the study indicate a strong correlation between snow fall in austral winter (dry season) and HAWA phenology derived from Normalized Differenced Vegetation Index (NDVI) of the Moderate Resolution Imaging Spectroradiometer (MODIS). Although the immediate effect of strong snow fall events during cold spells in austral winter is negative, the effect on HAWA phenology could be positive in the following austral summer (wet season). The study also shows that precipitation measured by the Tropical Rain Measurement Mission (TRMM) is correlated to HAWA phenology indicating that mean precipitation in austral summer is relevant to phenology of specific HAWA areas at the end of wet seasons (May). In general NDVI measurements correlate well with precipitation measurements with a lag of about four to six weeks depending on the HAWA site.
Since information is derived from remote sensing imagery over the last decade results of the study are of high spatial and temporal coverage within a remote and data sparse region allowing an estimation of phenological dynamics of HAWA between 6 months and few weeks in advance. At decadal time scale it is possible to derive sensitivity of single HAWA sites with regard to climate change in a region probably facing a future scenario of increasing temperature, decreasing precipitation and increasing water demand.