Modelling spatio-temporal dynamics of snow depth and large herbivore's winter habitat selection

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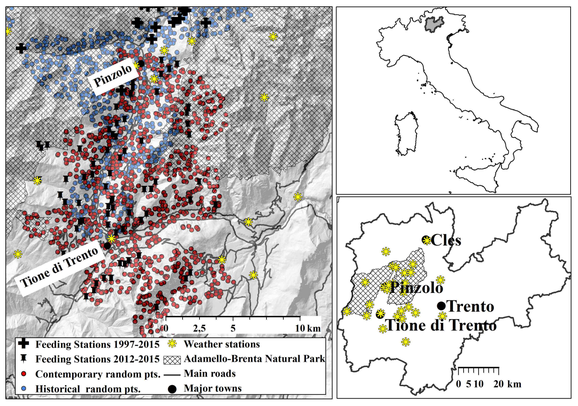
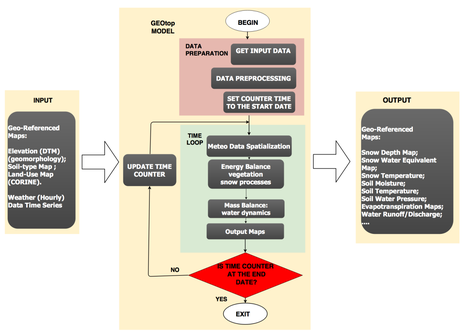
Foreword

Winter snowy conditions and the wildlife management strategies they encourage play a critical role in governing the spatial distribution of ungulates in temperate ecosystems. Snow depth severely restricts roe deer distribution due to the limitations resulting from their small body mass (18-49 kg: Lister and Sumner (1998)) and short legs (50-60 cm: Holand and Linnell (1998)). Large roe deer living in snowy areas, employ a partial migration strategy, with all individuals overwintering in ranges characterized by less extreme snow conditions. Snow occurrence constites a proxy for animal spatial detections and, due to the observed variability of climate and snow conditions in the recent years, **a high-esolution and topography-accounted spatio-temporal modelling of snow cover is required.**



Hydrological modelling

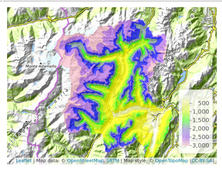
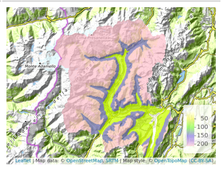
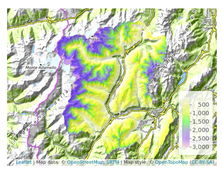
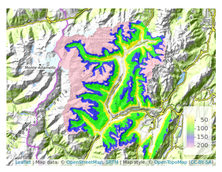
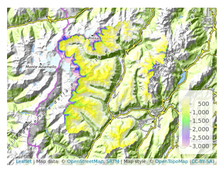
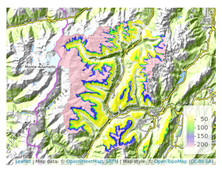
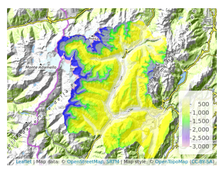
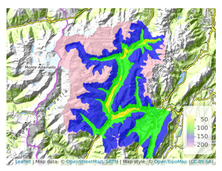
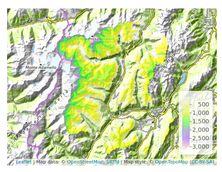
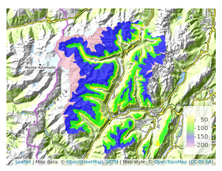
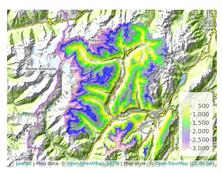
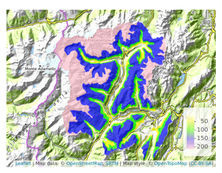
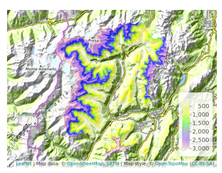
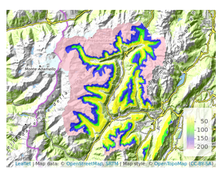
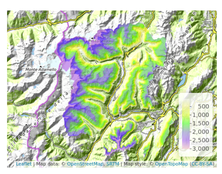
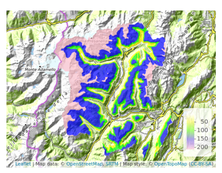
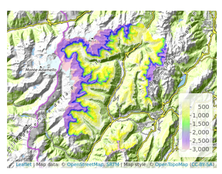
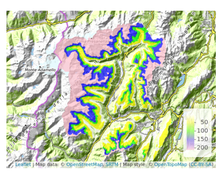
GEOtop 2.0 Hydrological Model (Endrizzi et al. (2014), www.geotop.org) is a physically-based *spatially distributed* model solving water and energy balance differential equation, **producing snow depth area maps from meteorological data by taking into account snow melting process**.

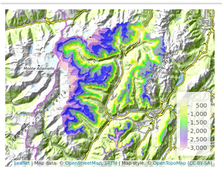
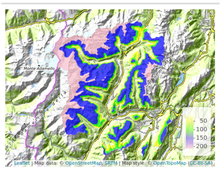
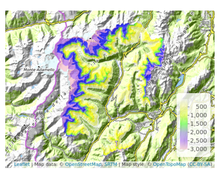
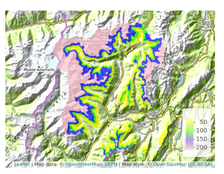


Input weather forcings (25-year long):

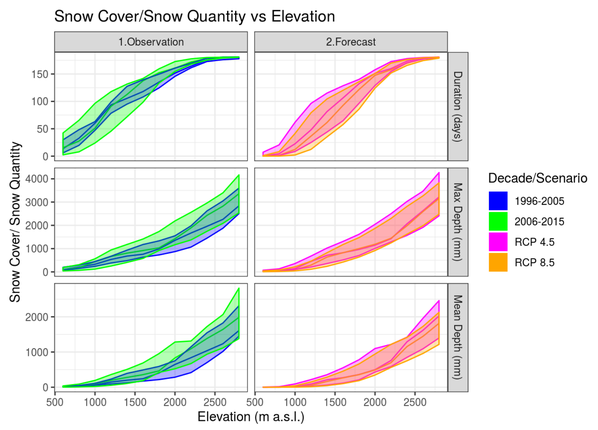
- Observed time series in the weather stations (wwww.meteotrentino.it) (1 scenario);
- Downscaled data by regional climate model projections (Rockel, Will, and Hense (2008), *courtesy of Emanuel Eccel and CMCC*) (IPCC scenarios RCP4.5 and RCP 8.5) (2 scenarios).

Snow mean depth and snow cover has been aggregated from daily to seasonal scale (NDJFMA)(Cordano (2019)). RCP4.5 ns RCP8.5 illustrated scenarios are created with weather forcings having patterns similar to both 2013-2014 and 2014-2015 observed seasons, but modified accordingly to the projections.

Winter	Mean Depth [mm]	Duration [days]
1990-1991		
1996-1997		
2001-2002		
2005-2006		
2006-2007		
2013-2014		
2014-2015		
RCP45-2014		
RCP45-2015		

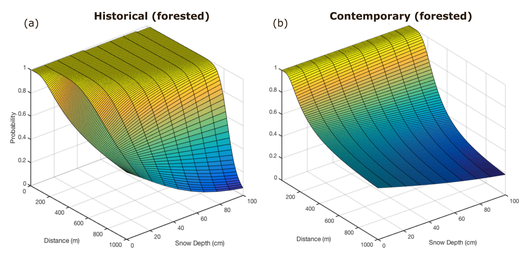
Winter	Mean Depth [mm]	Duration [days]
RCP85-2014		
RCP85-2015		

Higher variability on snow occurs at medium and low elevations , .i.e *snow depth > 5 cm*, in the decade 2006-2015 (latest year of the analysis) than in the past decade 1996-2005. Future climate projections confirm this.



Ecological modelling

Roe deer in presence of snow strongly try to select zones with canopy cover and avoided places with high snow depths. Snow modelling results have been coupled with ecoogical campaign periods (1999-2002: (a); 2012-2015: (b))(see prediction plots of relative probability of use of forested habitats during ,*Bright Bross at al, Article in preparation*)



Concluding remarks

1.Climate and snow variability is a challenge for researching on habitat selection by roe deer (Capreolus capreolus) in an alpine area;

2.Physically-based modelling allows to estimate snow depth in a gridded spatio-temporal covarage accounting for topographical datails from weather observations;

3. In the study snow depth variability increases with climate change projections.

References

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