Project: **981**

Project title: **Sensitivity and Response of the Treeline Ecotone in Rolwaling Himal, Nepal, to Climate Warming (TREELINE)**

Project lead: **Juergen Boehner**

Report period: **2017-01-01 to 2017-11-01**

As detailed in submitted research plans, a fully-compressible non-hydrostatic, Weather Research and Forecasting (WRF) model in its latest version (3.9.1.1) has been compiled in DKRZ HPC Mistral. It is a widely used model for meso/micro-scale climate simulations due to its features to use large number of physical parameterizations for downscaling climate variables across a variety of horizontal and vertical scales.

Utilizing both the existing WRF setup in DKRZ as well as the old set up in University of Hamburg, Regionales Rechenzentrum (RRZ) server, we completed the one year simulations in three nested domain D1, D2 and D3 configured at 25, 5 and 1 km horizontal grid spacing (with default land use and topography), respectively using ERA Interim forcing in 2016. The simulated outputs were validated against the 7 in-situ meteorological stations established under the same project and stations from other organizations in the region. The **simulation results are already published in the form of a research article in the Journal Earth System Dynamics (Karki et al. 2017, https://www.earth-syst-dynam.net/8/507/2017/) now.**

As the land use/land cover and topography are the crucial factors for climate modelling, **the number of sensitivity runs utilizing new Shuttle Radar Topography Mission (SRTM) digital elevation model (DEM in 30m, as the default topography is over smoothed and limited to 30 arc second only) and modified land use (glacier area is highly underestimated in default, Fig. 1)** data set were also tested in the new WRF setup. These sensitivity tests further motivated us for the planed WRF run in sub-kilometer scale with more realistic representations of topography and land use to better understand the physical processes in the complex mountain terrains of Nepal.

We have completed the 1.5 years (2014- 2015) run at 15, 3 and 0.6 km spatial resolution so far in 2017 with these modifications and validating it against in-situ meteorological observation stations established under the same project. **There is improvement in 0.6 km compared to 1 km but still there seems some deficiencies to properly simulate the mountain valley wind and convections either due to poor representation of land-surface processes or inadequacy of resolution or parameterization related deficiency for planetary boundary layer.**

We have enclosed some figures from our latest experiments herewith for the reference.

Publication:

Karki, R., ul Hasson, S., Gerlitz, L., Schickhoff, U., Scholten, T., and Böhner, J.: Quantifying the added value of convection-permitting climate simulations in complex terrain: a systematic evaluation of WRF over the Himalayas, Earth Syst. Dynam., 8, 507-528, https://doi.org/10.5194/esd-8-507-2017, 2017.
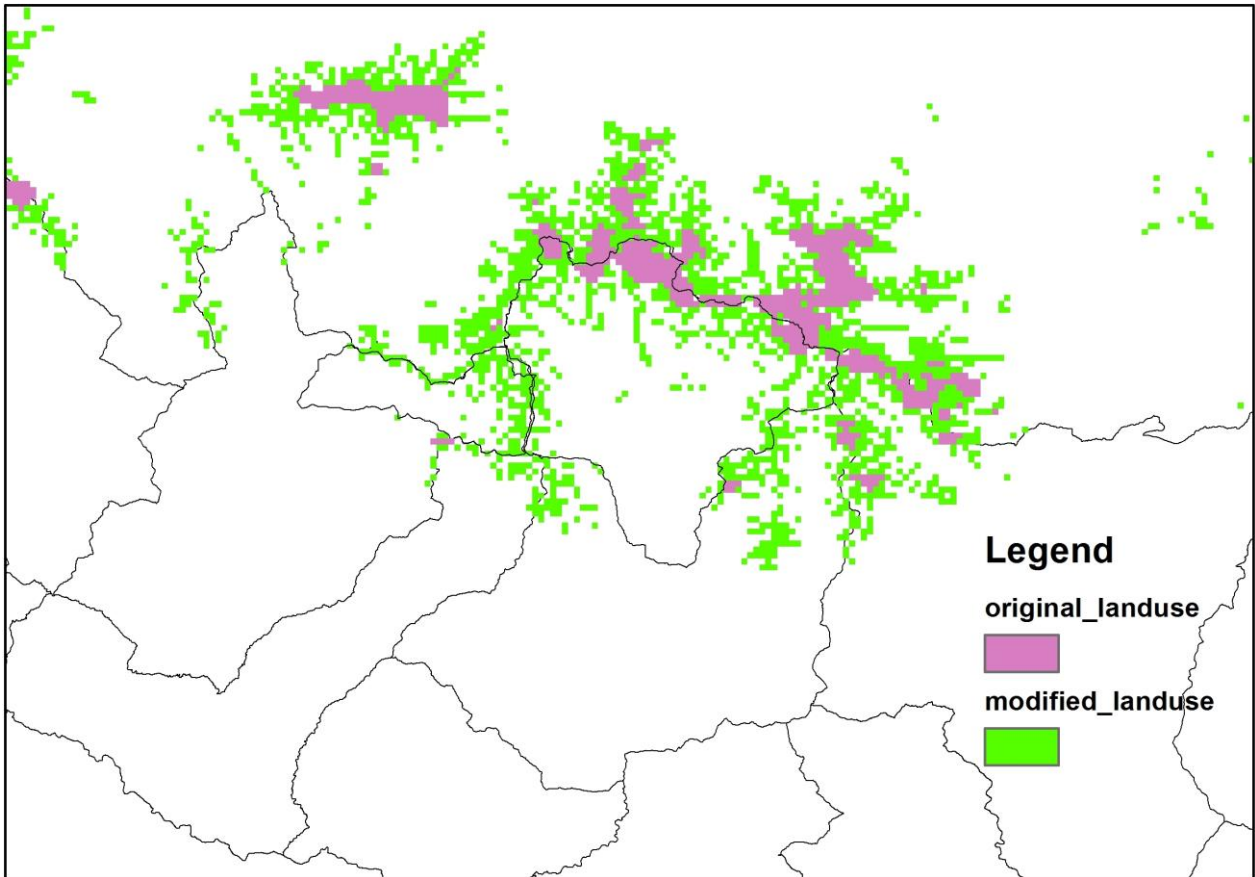
Fig. 1: Glacier representation in original wrf land-use and land-use after modification in recent runs.

(original landuse is overlaid in modified so it is laid in back but it is to be noted that modified land use covers all that are visible in original land use plus large glacier area which is not in the original land use)
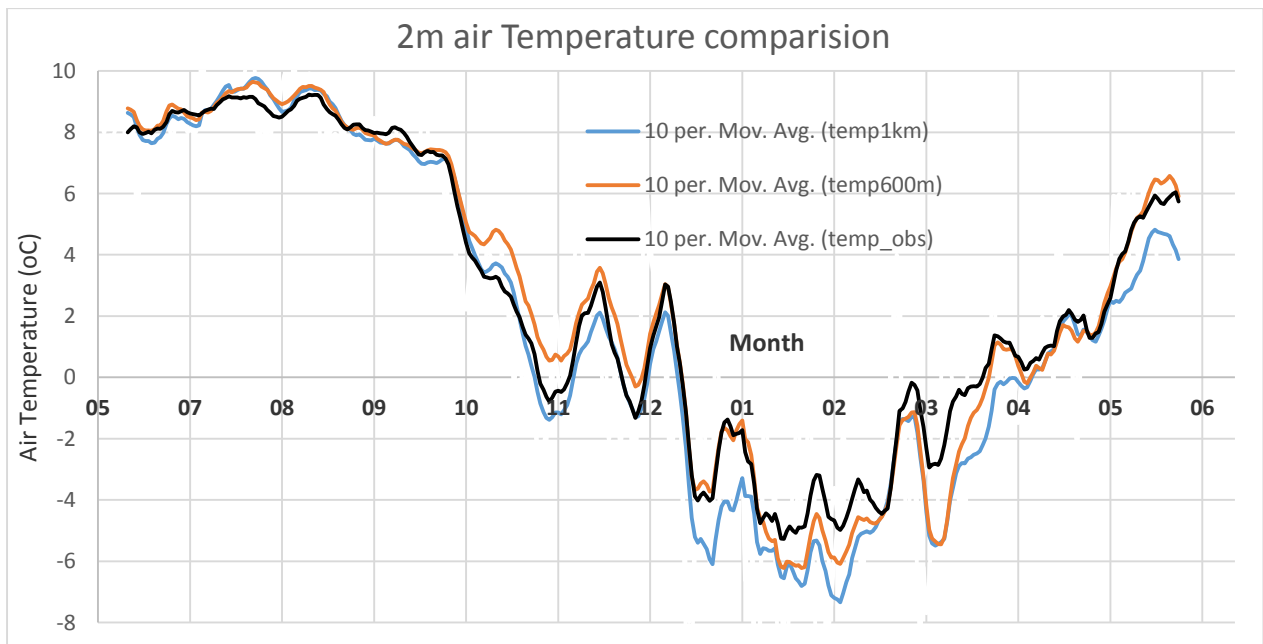

Fig.2: Air temperature comparision between 1km, 600m and observations in Rolwaling.
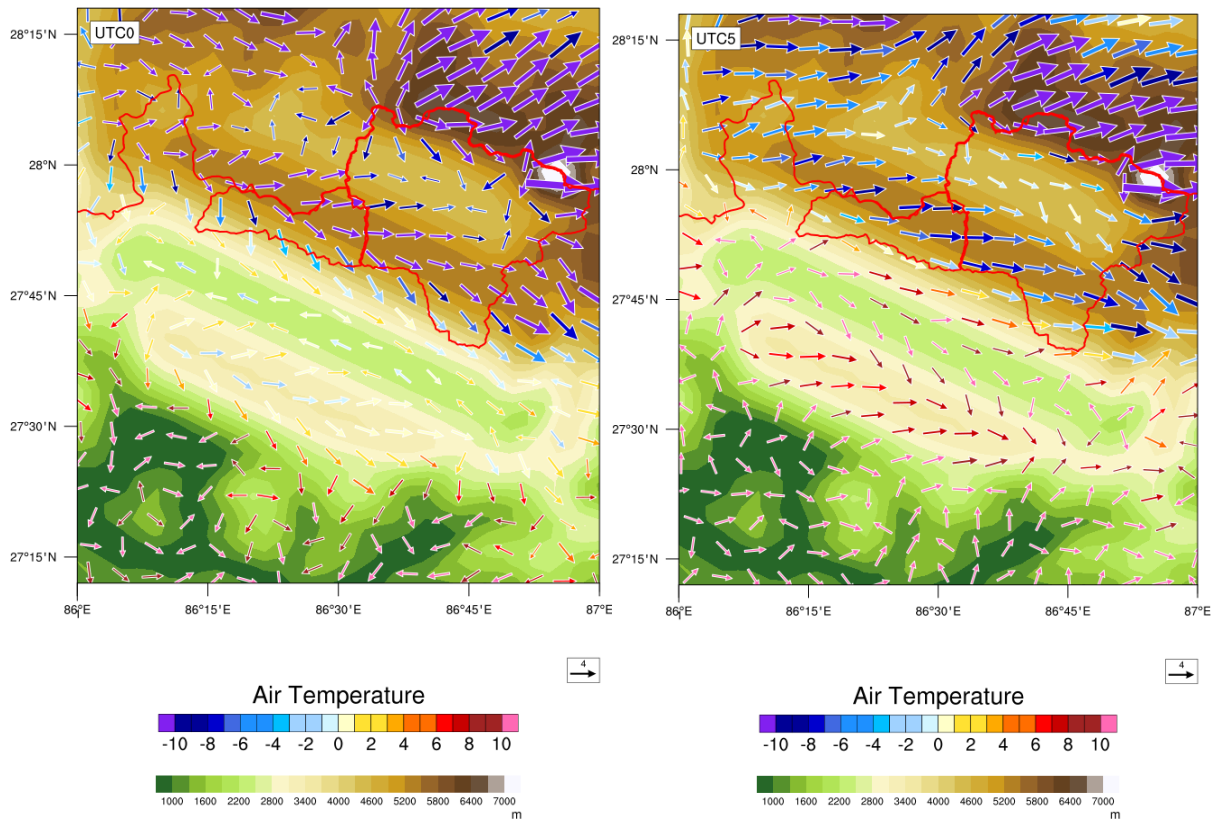
Fig. 3: Colorized (2 m temperature) surface wind vector plot simulated in idealized terrain with WRF (0 and 6 UTC plot of December 2014) to illustrate the cold air pooling process.
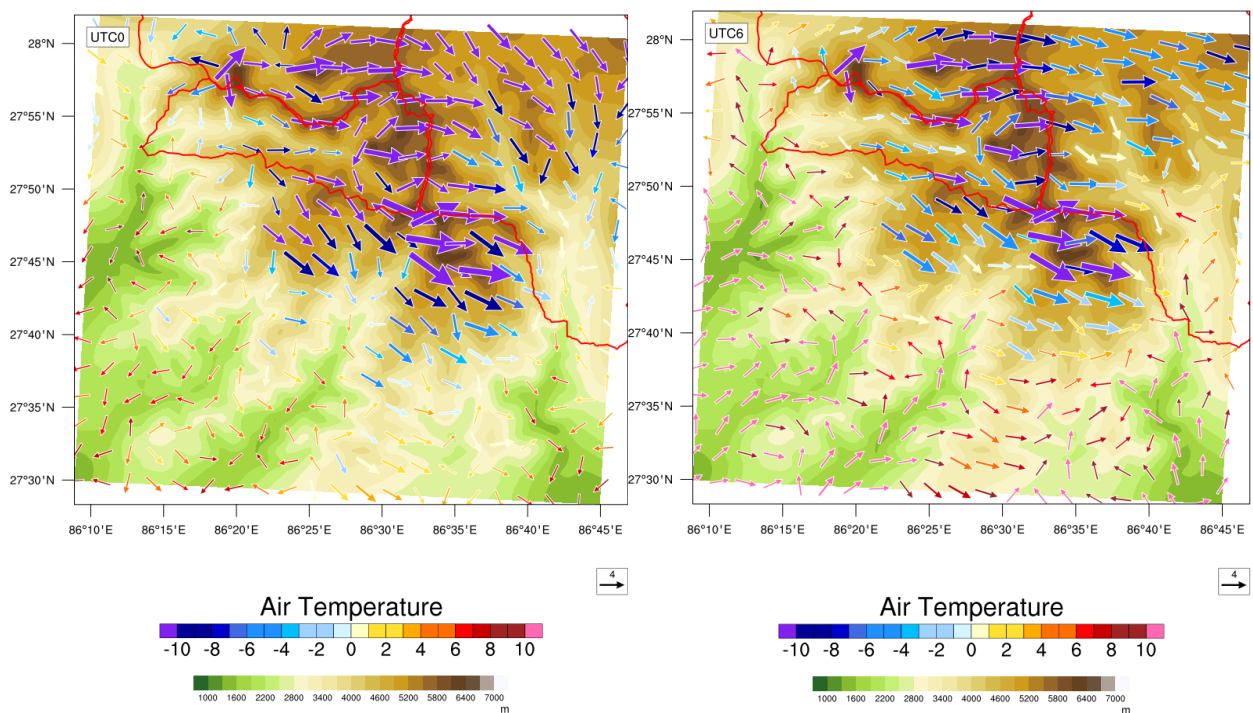

Fig. 4: Colorized (2 m temperature) surface wind vector plot simulated in real terrain with WRF (0 and 6 UTC plot of December 2014).