# Orographic radiation parameterization

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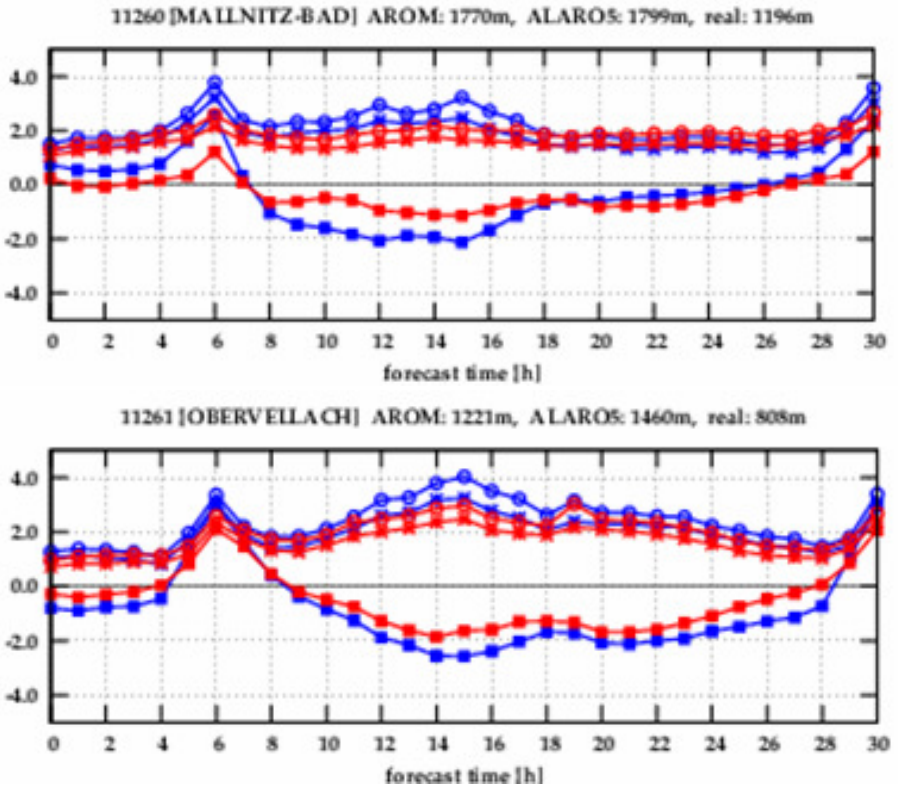
# Motivation



- Temperature verification showed a strong positive BIAS at some stations in small Alpine valleys
- This BIAS occurred predominantly in the morning after sunrise
- Investigation showed that radiation shadowing is responsible for this behaviour
- Sunshine in the model; orographic shadowing in reality
- In the atmospheric radiation parameterization of numerical models each gridsquare is assumed flat and effectively homogeneous




BIAS, MAE and RMSE for AROME (blue) and ALARO (red) at the valley stations of Mallnitz and Obervellach for summer 2013.

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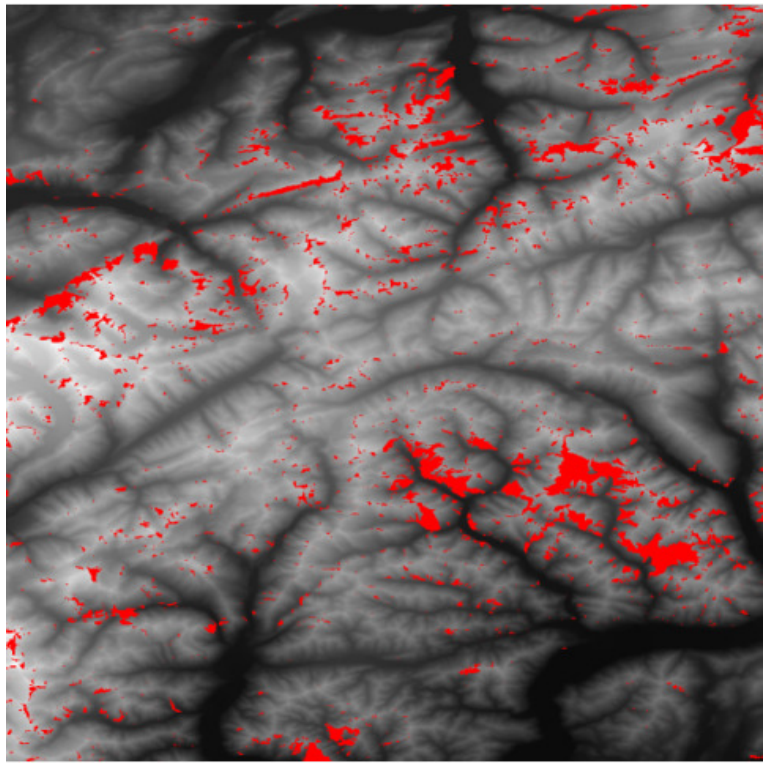
# Objectives



- Goal: Implementation of orographic effects on radiation into SURFEX
- Basis: high-resolution surface elevation source data (SRTM=90m, ASTER=120m, etc.)
- Derivation of orographic parameters necessary for radiation calculations in the Alpine domain
- Implementation of orographic radiation parameterizations for short-wave and long-wave radiation fluxes
- Validate the parametization with respect to primary (radiation, temperature) and secondary (convection, low stratus, local circulation) effects



Example of SRTM data in the Alps, red areas are void

# Requirements

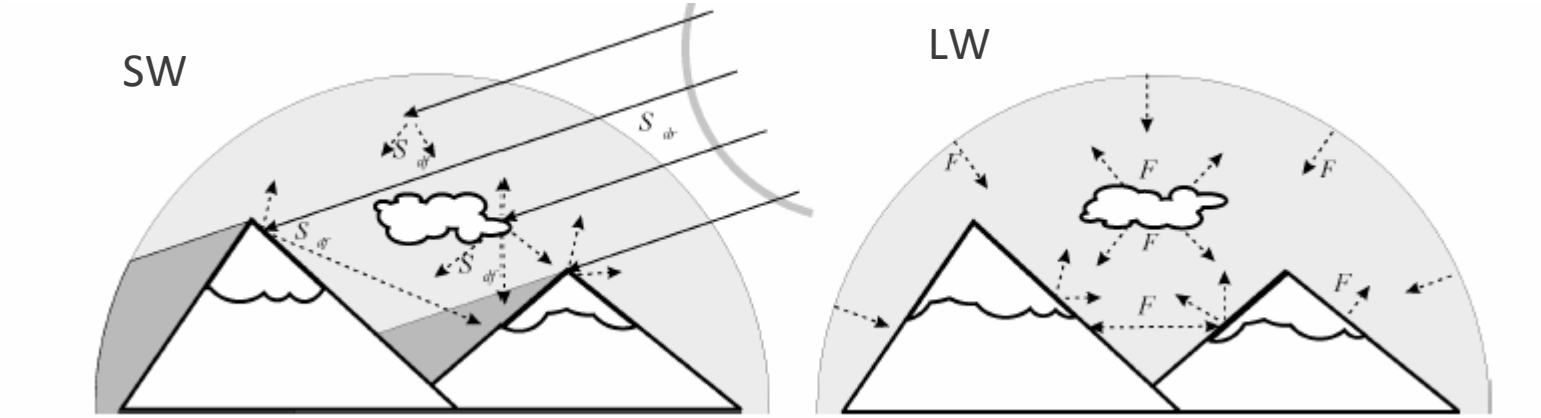


- The scheme should utilize the most detailed orography information available
- In the parameterization radiation fluxes should be averaged, not orography
- The orographic effects on radiation are estimated by modifying the SWR and LWR fluxes at the surface level provided by the basic radiation scheme
- The scheme is formulated in the framework of the physical parameterizations of the NWP model
- Paramaterizations schould be scale-independent, flexibly adapting to any NWP model domain, space and resolution
- In the operational environment the additional radiation calculations should be formulated optimal in order to avoid a significant increase of computing resources

# Method



- Method is based on a paper of Müller and Scherer, 2005: „A Grid- and Subgrid-Scale Radation Parametization of Topographic Effects for Mesoscale Weather Forecast Models.“ (Monthly Weather Review, 133)
- It has already been implemented into HIRLAM (Senkova et al., 2007: „Parameterization of orographic effects on surface radiation in HIRLAM“, Tellus 59A)
- Slope angle and direction, relief shadow influence the short wave radiation budget sky view factor influnces both long and short wave radiation budget
- For parameterization of the orographic effects on radiation, slopes and local horizon in different directions are required

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# Implementation



- Properties determining the slope, shadow and sky-view factor are derived from high-resolution orography data (e.g. SRTM data)
- Derivation of orographic parameters on source resolution stay external (have to be calculated only once)
- Aggregation to model grid with PGD
- Creation of a branch in the SURFEX repository for the development work
- Import the externalized fields into SURFEX
- Implementation of radiation calculations in/before SURFEX call
- Build the interfaces between atmospheric radiation parameterizations and SURFEX for the renewed physics-dynamics interfaces of cycle 40
- Evaluate the impact of the horizontal resolution jump between orography source data and targeted model data (study at various model horizontal resultions)

# Timeline and outook



- Obtain the fine resolution source data (SRTM) for the Austrian domain
- Create a wiki page for information transfer https://hirlam.org/trac/attachment/wiki/ororad/
- Calculation of necessary orographic parameters (GDAL tool, scripts)
- Adaptation of parameters to model resolution with PGD
- Implementation of radiation calculations in/before SURFEX call
- Study the sensitivity and validate the parameterization
- Reporting and publication

**Partially done**
**May 2014**

**Stay at MeteoFrance**
**Sep., Oct. 2014**

**Autumn 2014**

**Winter 2014/15**

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