

# REQUEST FOR A SPECIAL PROJECT 2010–2012

**MEMBER STATE:** Austria

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**Project Title:**  
Advanced Investigation Methods for Foehn (AIM:Foehn)

If this is a continuation of an existing project, please state the computer project account assigned previously.	<b>SP</b>	
Starting year: <small>(Each project will have a well defined duration, up to a maximum of 3 years, agreed at the beginning of the project. For projects started before 2009, please state 2009 as the start year.)</small>	2010	
Would you accept support for 1 year only, if necessary?	YES <input type="checkbox"/>	NO <input type="checkbox"/>

<b>Computer resources required for 2010-2012:</b> <small>(The maximum project duration is 3 years, therefore a continuation project cannot request resources for 2012.)</small>	<b>2010</b>	<b>2011</b>	<b>2012</b>
High Performance Computing Facility (units)	180000	130000	70000
Data storage capacity (total archive volume) (gigabytes)	800	1000	1100

An electronic copy of this form **must be sent** via e-mail to: *special\_projects@ecmwf.int*

Electronic copy of the form sent on (please specify date):  
04/14/09

*Continue overleaf*

<sup>1</sup> The Principal Investigator will act as contact person for this Special Project and, in particular, will be asked to register the project, provide an annual progress report of the project's activities, etc.

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High resolution ( $O(< 1\text{km})$ ) numerical models simulate flow features which are of finer-scale than can be observed by existing networks. Large field campaigns provide measurements at such a fine scale but usually do not completely cover the domain over which the phenomena of interest occur. To gain further insight into the phenomenon, common practice has been to use numerical simulations which start from larger-scale initial conditions. The model parameters are then tuned in order to lead “model reality” close to the spatially patchy “truth” from observations. Generally, however, only a fraction of the additional measurements is used for tuning the model.

We want to use a different approach by combining (almost) *all* field observations with a data assimilation scheme to provide a consistent and complete data set for studying a small-scale phenomenon.

The phenomenon we choose is foehn, which we have been studying intensely and for which we have access to field campaign data.

Our goal is to maximize the value and usability of the field campaign data sets by constructing four-dimensional probabilistic analyses of foehn flow through the **Ensemble Kalman Filter** (EnKF) approach using most of the available measurements. Containing uncertainty information, such analyses allow a probabilistic insight into temporal and spatial foehn structures and coherences, and provide improved initial state conditions crucial for high resolution modelling. The EnKF assimilations are performed with the WRF model at 1 km horizontal resolution. EnKF has so far been mostly applied as data assimilation procedure for larger scales. Smaller scales are a new frontier.

We will use measurements from field campaigns, in which we took part: the Terrain-induced Rotors Experiment (T-REX) in 2006 (Grubisic et al., 2008), bora studies (Gohm and Mayr, 2005; Gohm et al., 2008), and the Mesoscale Alpine Programme (MAP) in 1999 (Bougeault et al., 2001),

In addition to the field campaign data, large-scale assimilations from the ECMWF and other centres (which are stored at ECMWF) will be used.

These 4D-analyses will be used to

- identify the impact of data from individual observation platforms (e.g. dual Doppler lidar, airborne and sounding observations, surface weather stations) on the quality of the 4D flow field of foehn (Torn and Hakim 2008, Liu and Kalnay 2008). Along with the localization of ‘hot spots’ of spatial uncertainties in order to find out where observations would have the largest impact, this knowledge can provide guidance for planning observation missions of upcoming field campaigns or targeted observations.
- study the role of up- and downstream conditions determining foehn flow. Ensemble covariances provided by EnKF reveal relationships between all locations and all variables (Hakim and Torn, 2008).
- quantify the (spatial) importance of various foehn influencing terms in the numerical model (e.g. pressure gradient, wind speed at crest level, advection of kinetic energy, and friction) by volume-averaged budgets (e.g. Jaubert and Stein, 2003; Gabersek and Durran, 2006).

## References:

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