Le Monde Physique de l'HARMONIE

Laura Rontu, FMI

with contributions by

Mariken Homleid, Imanol Guerrero, Timo Vihma and others

HIRLAM ASM & ALADIN Wk

7-11 May 2012 Marrakech

A FEW STRATEGIC COMMENTS

Towards scale-adaptive, cross-package physical parametrisations in HARMONIE

Towards integrated operational surface modelling: physiography, data assimilation, prognostic parametrisations

Towards full consistency between physics, dynamics, data assimilation and probabilistic forecasting

UPPER AIR PHYSICS PARAMETRISATIONS

PH1	Convection and turbulence: EDMF, TOUCANS, 3MT, cloud fraction, AROME convection
PH2	Microphysics, radiation, aerosols: ICE3, Straco/-aeros. Rad-aer. Radiation comparison
PH3	Development, diagnostics and validation tools: MUSC, post-pp

SURFACE ANALYSIS AND MODELLING (SU)

SU1	General aspects: SURFEX code design, spatialisation tool, ECOCLIMAP II
SU2	Soil: DA of soil charateristics, soil obs, modelling of soil moisture
SU3	Snow and vegetation: Snow DA and obs, MEB
SU4	Sea ice: DA and obs, implementation of HIGHTSI
SU5	Lakes: Lake depth and climatology DB, Lake DA and obs, FLake
SU6	Orographic effects on radiation and momentum: slopes, SSO in SURFEX
SU7	Urban modelling

TRANSVERSAL ISSUES

TR2	Physics-dynamics interactions
TR3	Preparation orography-related variables for DA, dynamics and physics
TR4	The stable boundary layer: Fog, workshop, GABLS4
TR5	Towards sub-km resolution: gray-zone/LES, slanting radiation

So, finally, the contents of this presentation: comments on

Radiation

Orography

Lakes

Stable boundary layer

HARMONIE RADIATION COMPARISON
(First suggested around 2007)

The aim of the model comparison experiment is to compare and validate HIRLAM-ALARO-AROME radiation parametrizations over complex terrain. The experiment should give information to understand the relative importance in mesoscale models of

1) advanced clear-sky radiation transfer parametrizations (provided by the ECMWF radiation scheme within AROME)

2) accurate handling of **cloud-radiation interactions**, needed time-resolution of radiation calculations

3) improved treatment of **radiation surface-interactions**, including sloping surface parametrizations.

We need to prepare HARMONIE physics to work with any of the three radiation schemes

1. Call ECMWF/HIRLAM/ALARO radiation from apl_arome (or aplpar), pass downwelling surface radiation fluxes to SURFEX
2. **Externalise preparation of cloud and aerosol input from radiation**
3. Install hlororad into SURFEX
4. Create and pass orography fields for radiation to SURFEX
5. Define experiment domain (over Svalbard, Iceland, Antarctica ...)
6. Run experiments and analyse the results

First experiences

HIRLAM and ECMWF radiation **interfaces built to apl_arome** first in MUSC framework – quick and easy environment for development

Tried in **1D and 3D (cy37h1) experiments**:

ECMWF every 15th/every timestep, hlradia at every step,

with differenct cloud crystal effective radia

- same amount of computing time required for EC/15 and HL/1
- differences found in cloud droplet/crystal distribution and SW fluxes
- small impact to the near-surface temperatures

Poster by Kristian Pagh Nielsen et al.

SURFACE ANALYSIS AND MODELLING (SU)	
SU5	Lakes: Lake depth and climatology DB, Lake DA and obs, FLake
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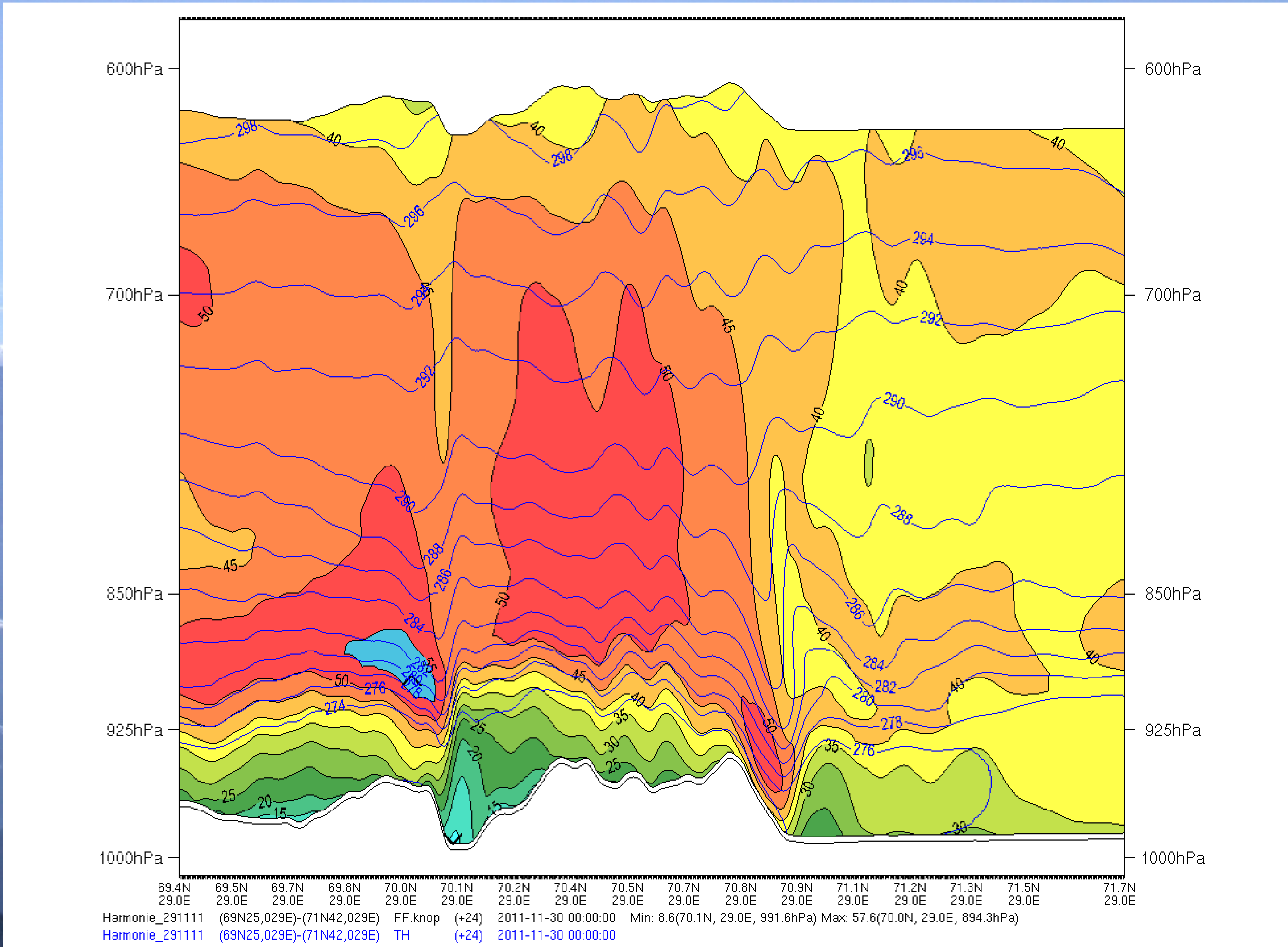
Slide by Mariken Homleid, met.no

IN NORWAY:

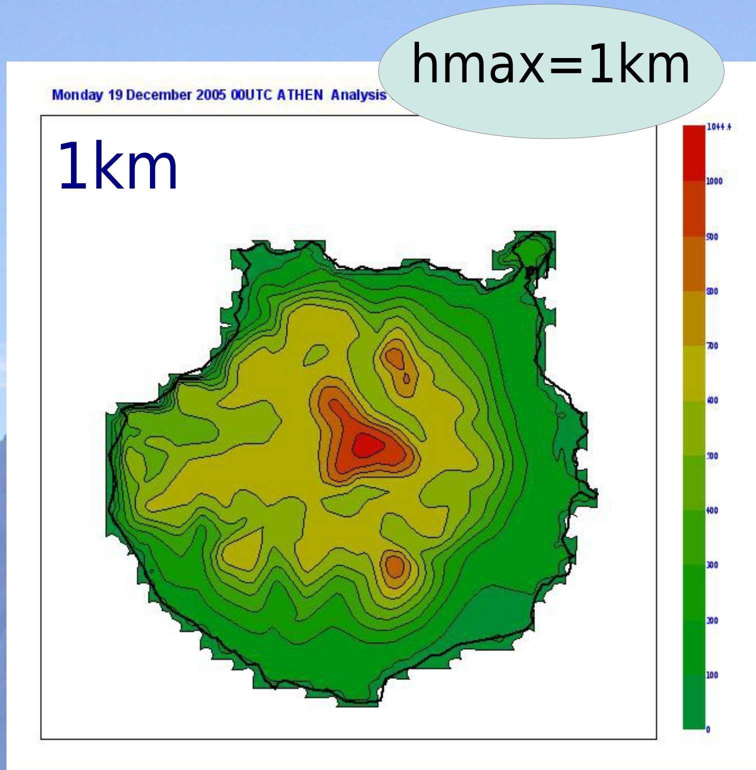
ALARO underestimates 10m wind everywhere
All models except AROME underestimate over mountains
HIRLAMs without orographic parametrisations overestimate
Every model is quite O.K. at coastal stations

Are the problems related to orography/forest?

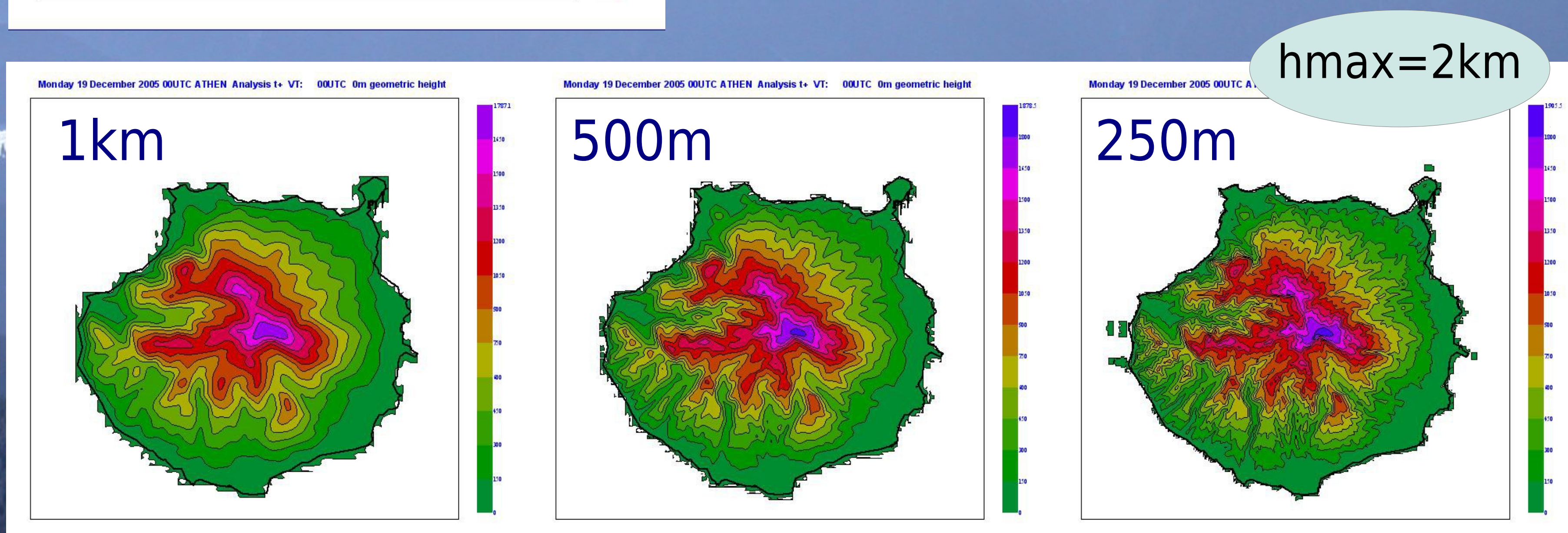


Mountain waves (wind, isentropes) by HARMONIE-AROME
30.11.2011 in NE Norway
Figure by Eirik Samuelsen,met.no

Mountains of **Gran Canaria** as seen by HARMONIE based on two digital elevation maps

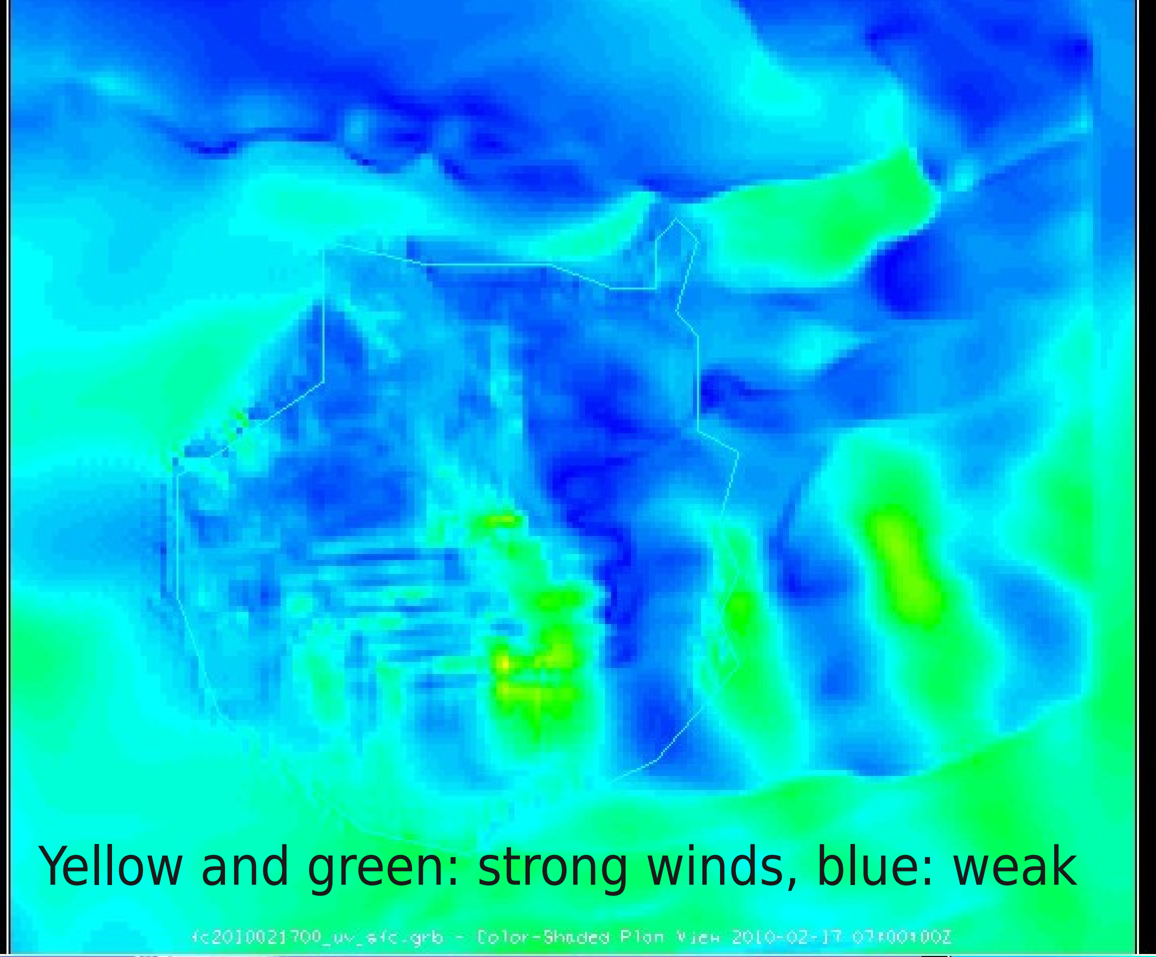


Left: gtopo30”, 1km
Lower panel: MDT-200m averaged to 1km, 500m, 250m



Maps by Imanol Guerrero, AEMET

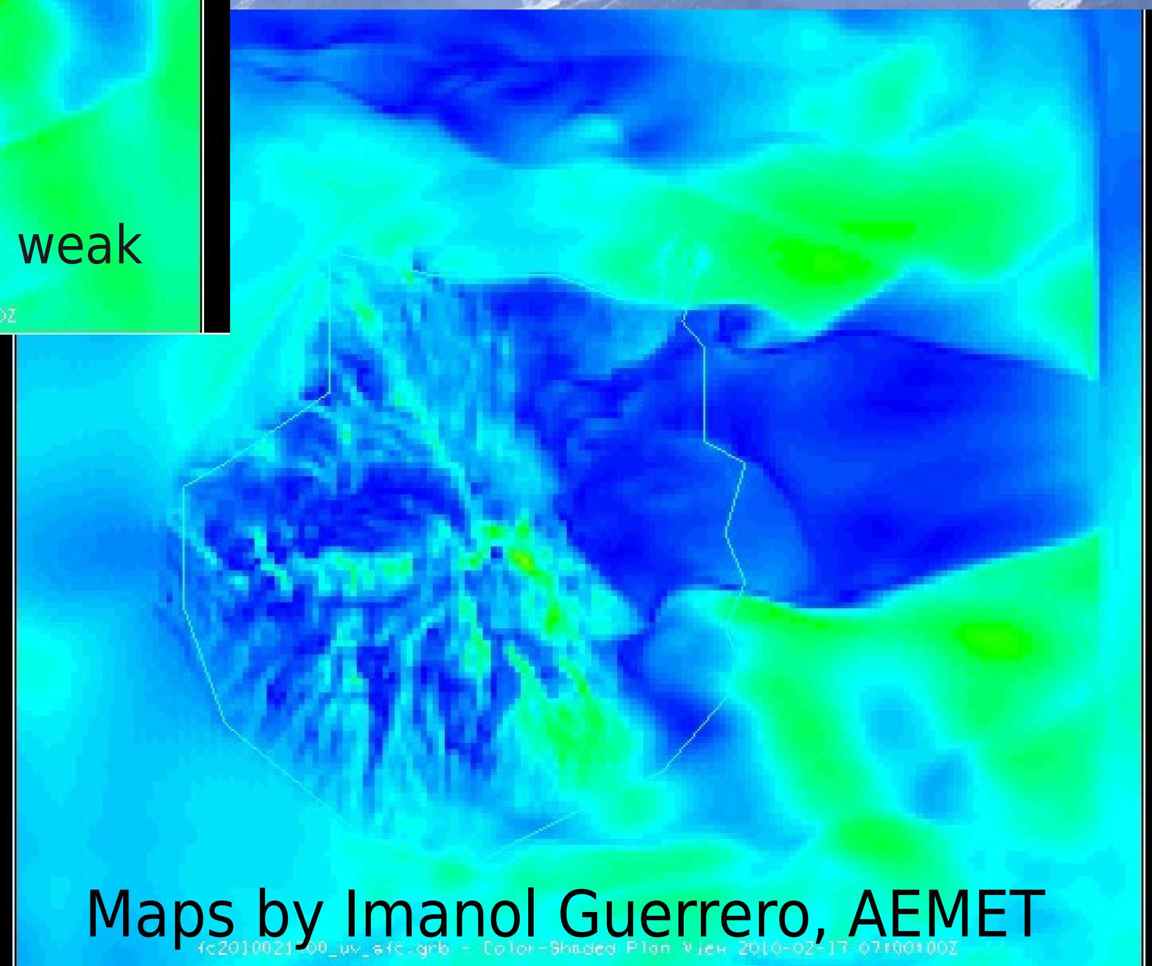
Ten-metre wind speed by HARMONIE-AROME with dynamics + default physical parametrisations



Yellow and green: strong winds, blue: weak

Above: gtopo30”, HARMONIE 500m

Right : MDT-200m, HARMONIE 500m

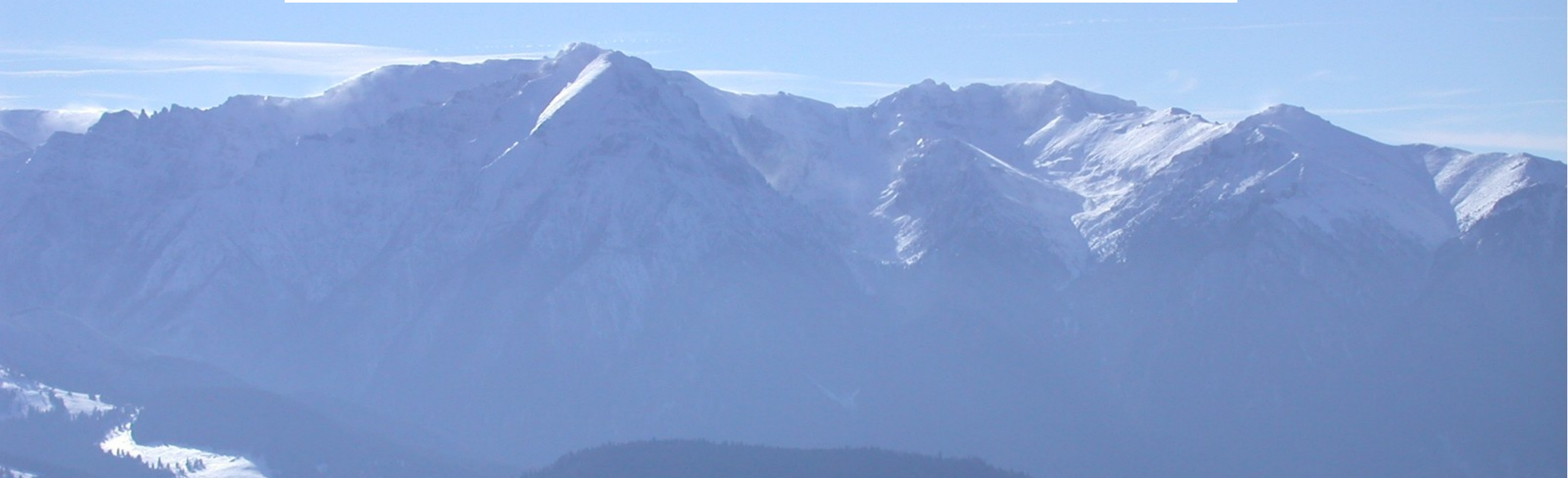


Maps by Imanol Guerrero, AEMET

Report by Yann Seity Christine Lac Valery Masson

About orographic drag options in SURFEX

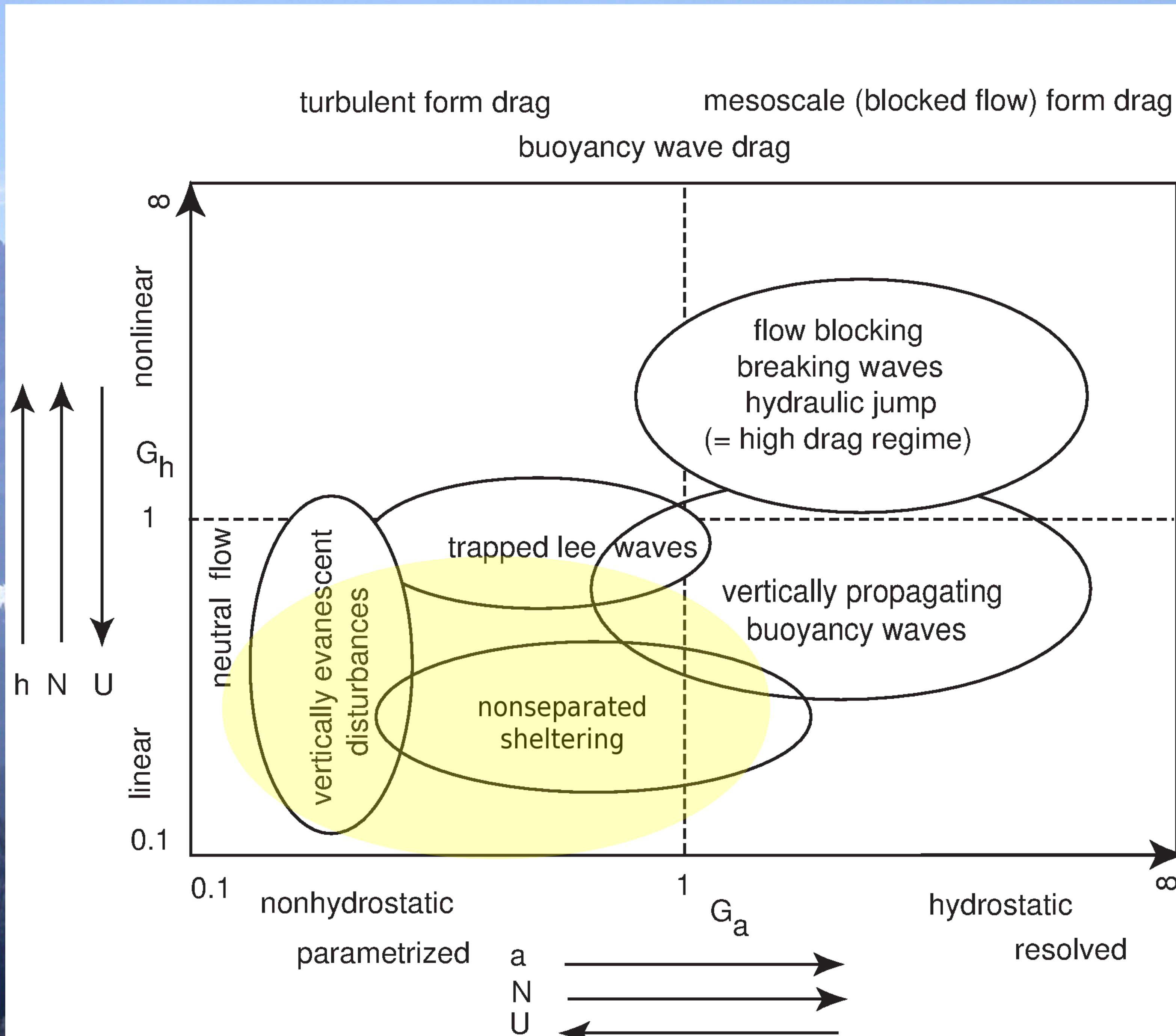
Y. Seity, C. Lac, V. Masson



5) Conclusions and perspectives

Since surfex5, the orographic drag has been externalized from isba. It is the only possible option in case CANOPY SBL scheme is switch on. Different settings of the orographic drag have been tested in AROME and in MesoNH. Compared to the surfex4 Z01D option in ISBA, the one used in AROME deteriorates the 10m wind speeds for Xynthia case (and also wind gusts, but in a lower quantity). On the other hand, the one used in Meso-NH Masdev49 (C_BE04_2), is correct on Xynthia case but deteriorates monthly scores of 10m winds. The addition of LCANOPY_DRAG with some tunings seem promising, even if a deeper evaluation is needed.

Remarks on orography and a bit of theory



Remarks on orography and a bit of theory

J. Fluid Mech. (1993), *vol.* 249, *pp.* 557–596 557

The drag on an undulating surface induced by the flow of a turbulent boundary layer

By S. E. BELCHER, T. M. J. NEWLEY† AND J. C. R. HUNT
Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Silver Street, Cambridge, CB3 9EW, UK

QUARTERLY JOURNAL OF THE ROYAL METEOROLOGICAL SOCIETY

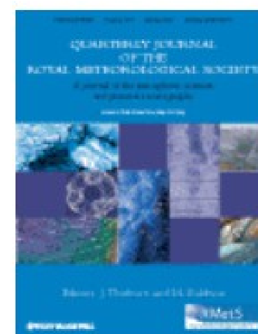
Article

Parametrizing the effects of orography on the boundary layer: An alternative to effective roughness lengths

N. Wood*, A. R. Brown, F. E. Hewer

Article first published online: 19 DEC 2006

Issue



Quarterly Journal of the Royal Meteorological Society
Volume 127, Issue 573, pages 759–777, April 2001 Part A

Q. J. R. Meteorol. Soc. (2004), **130**, pp. 1327–1347 doi: 10.1256/qj.03.73

A new parametrization of turbulent orographic form drag

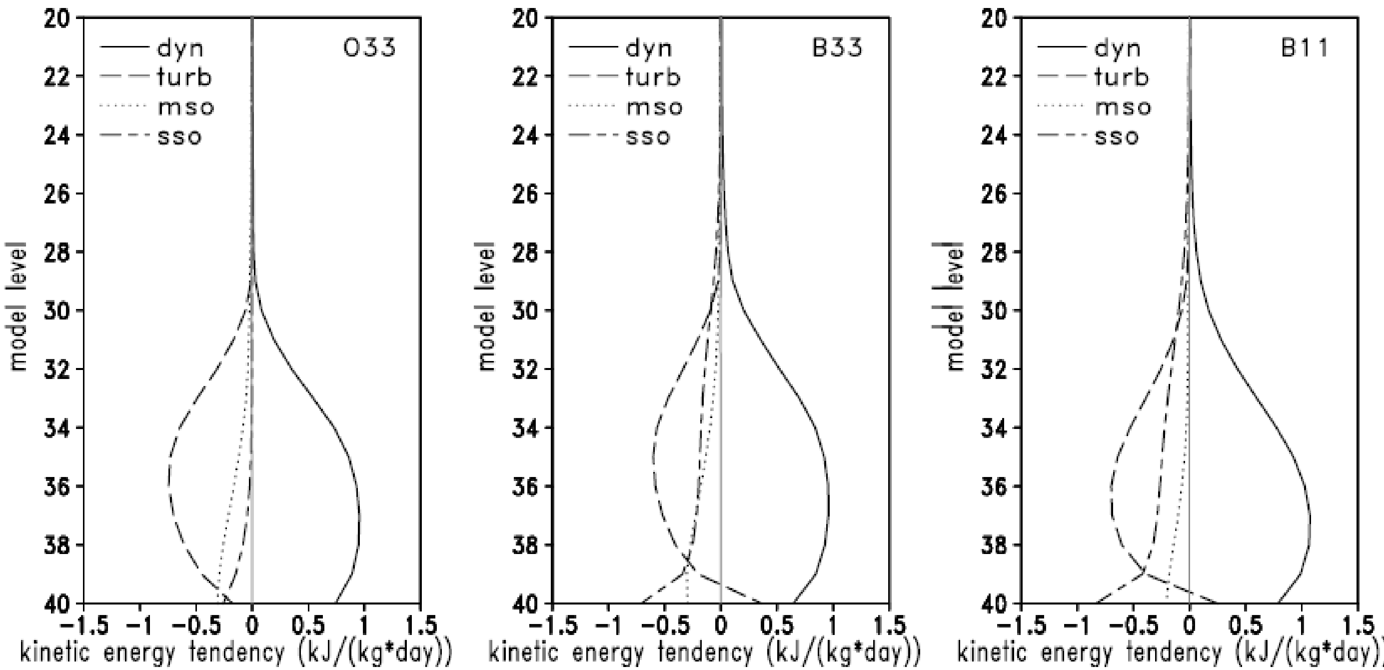
By ANTON C. M. BELJAARS[1*], ANDREW R. BROWN[2] and NIGEL WOOD[2]
[1]*European Centre for Medium-Range Weather Forecasts, Reading, UK*
[2]*Met Office, Exeter, UK*

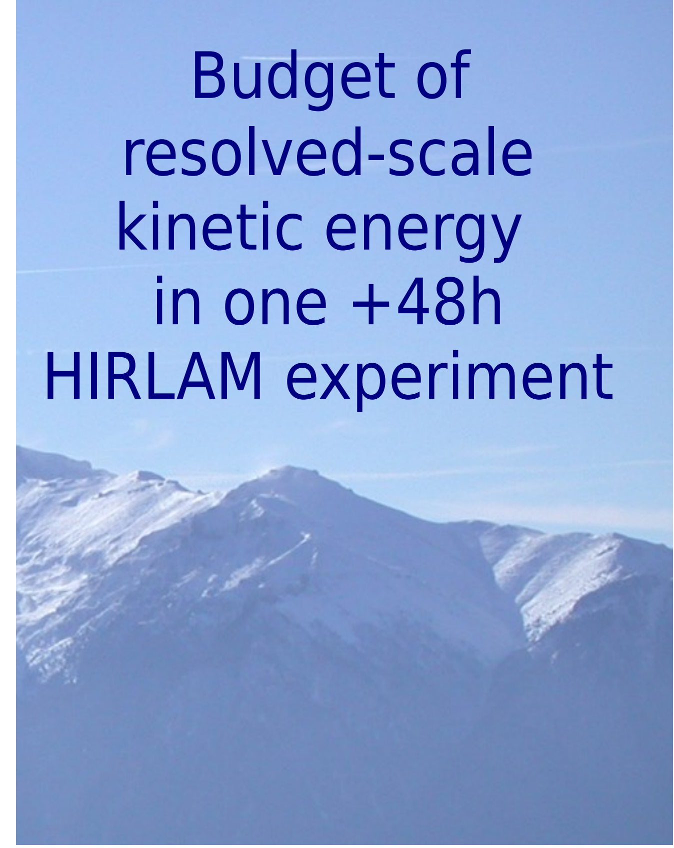
Tellus (2006), 58A, 69–81

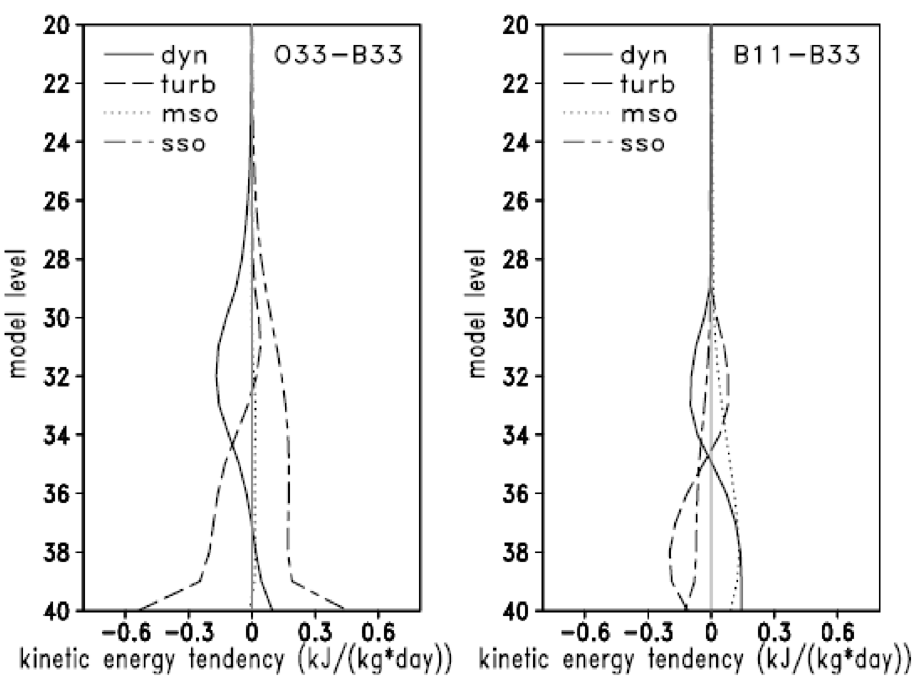
TELLUS

A study on parametrization of orography-related momentum fluxes in a synoptic-scale NWP model

By LAURA RONTU, *Finnish Meteorological Institute, PO Box 503, 00101 Helsinki, Finland*







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TELLUS

A study on parametrization of orography-related momentum fluxes in a synoptic-scale NWP model

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Problematic in the original Beljaars et al.

1. Tied to coarse-resolution source orography
2. Equations and coefficients derived in closed form, in principle not tunable
3. In the ECMWF model, co-exists with the gravity wave & blocking and turbulence parametrisations without analysis of applicable scales

Problematic in the SURFEX application

1. Derivation of the orography standard deviation?
2. Tuning done on ad-hoc basis?
3. In ALARO/ARPEGE, co-existence with GWD?
4. Specific interactions within the CANOPY scheme at surface sublayers?

GENERAL PLAN OF OROGRAPHY

Take the most detailed global digital elevation data (SRTM – ASTER - ?)

Do (spectral) filtering to separate scales for derivation of variables for

- Model dynamics
- Orographic buoyancy wave parametrisations
- Smallest scale orographic effects on momentum fluxes
- Orographic radiation parametrisations

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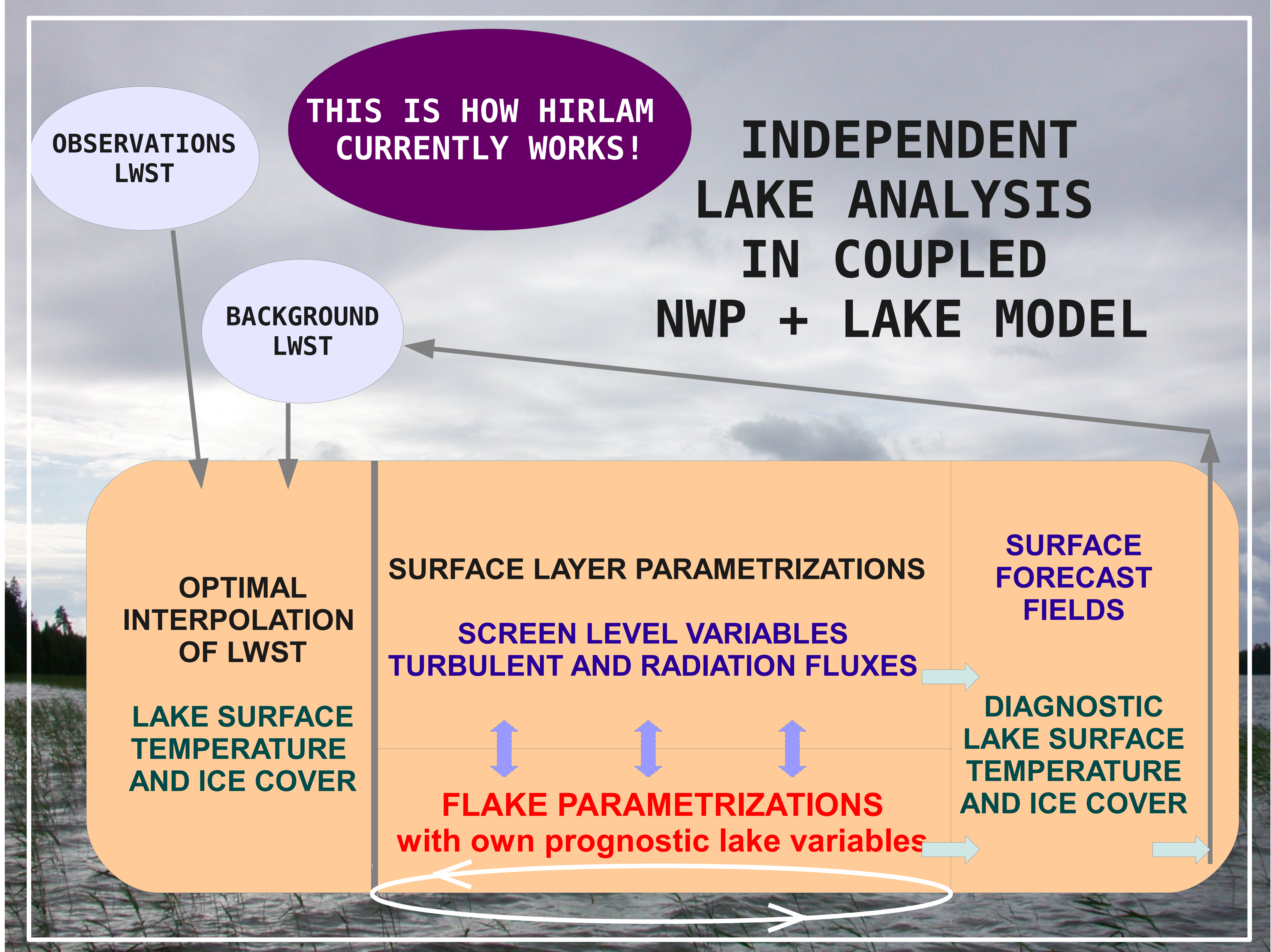
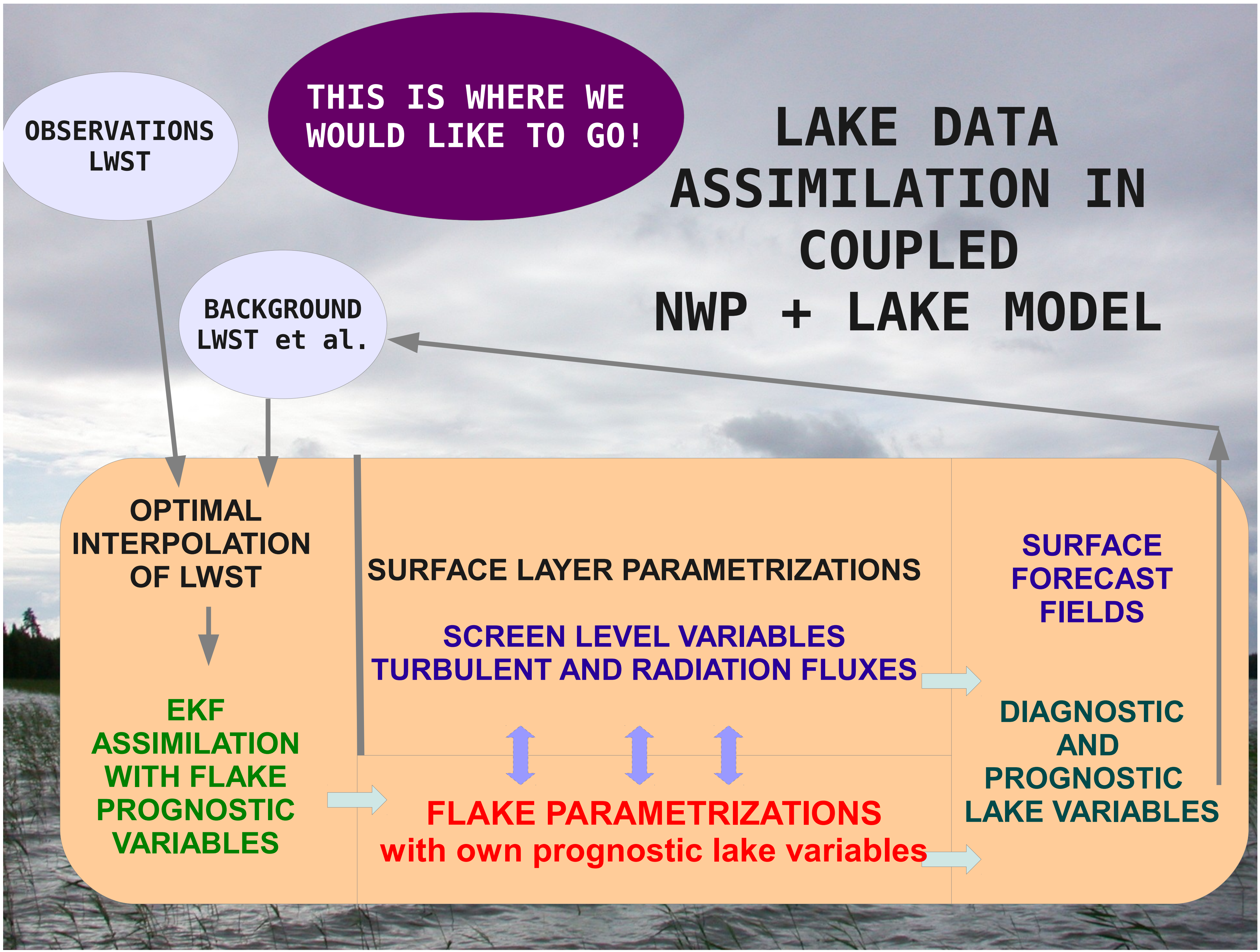

OBSERVATIONS LWST
THIS IS HOW HIRLAM CURRENTLY WORKS!
INDEPENDENT LAKE ANALYSIS IN COUPLED NWP + LAKE MODEL
BACKGROUND LWST
OPTIMAL INTERPOLATION OF LWST
LAKE SURFACE TEMPERATURE AND ICE COVER
SURFACE LAYER PARAMETRIZATIONS
SCREEN LEVEL VARIABLES
TURBULENT AND RADIATION FLUXES
FLAKE PARAMETRIZATIONS
with own prognostic lake variables
SURFACE FORECAST FIELDS
DIAGNOSTIC LAKE SURFACE TEMPERATURE AND ICE COVER

LAKE DATA ASSIMILATION IN COUPLED NWP + LAKE MODEL



http://muscaten.ut.ee/Lake12

norden
MUSCATEN/NordForsk

Third Workshop on

Parameterization of Lakes in Numerical Weather Prediction and Climate Modelling

Sessions on:

- Lake-atmosphere coupling
- External parameters for description of lake properties
- Assimilation of observations on lake surface state
- Model validation and intercomparison
- Processes in fresh-water bodies beyond lake physics

One-day excursion to Lake Sääksjärvi with
a workshop session, swimming, sauna, dinner ...

Registration till 15th June, 2012, no registration fee

Finnish Meteorological Insitute, Helsinki
September 18-20 2012
Nordic Network MUSCATEN

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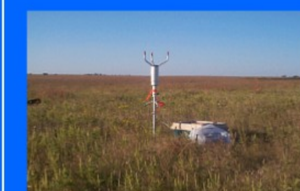
GEWEX Atmospheric Boundary Layer Study GABLS - Preparation of the 4th case over Antarctic

GEWEX Atmospheric Boundary Layer Studies (GABLS) provides platform for model intercomparison and development to benefit studies of Climate, Weather, Air Quality and Wind Energy

GABLS1	GABLS2	GABLS3
		
LES as reference	Data (CASES99)	Data (CABAUW)
Academic set up	Idealized forcings	Realistic forcings
Prescribed T_s	Prescribed T_s	Full coupling *(SCM)* Prescribed T_s *(LES)*
No Radiation	No Radiation	Radiation included
Turbulent mixing	Diurnal cycle	Low levet jet + transitions

LES: Large Eddy Simulation; *SCM:* Single Column Model

Slide from presentation by Bert Holtslag in:
http://www.ecmwf.int/newsevents/meetings/workshops/2011/GABLS/

PLANS FOR GABLS4

Pre-GABLS4

Polar WRF, UM, HIRLAM-HARMONIE 3D experiments for choice of the case and intercomparison

Main GABLS4

Single-column model runs for the chosen case for detailed PBL study and intercomparison

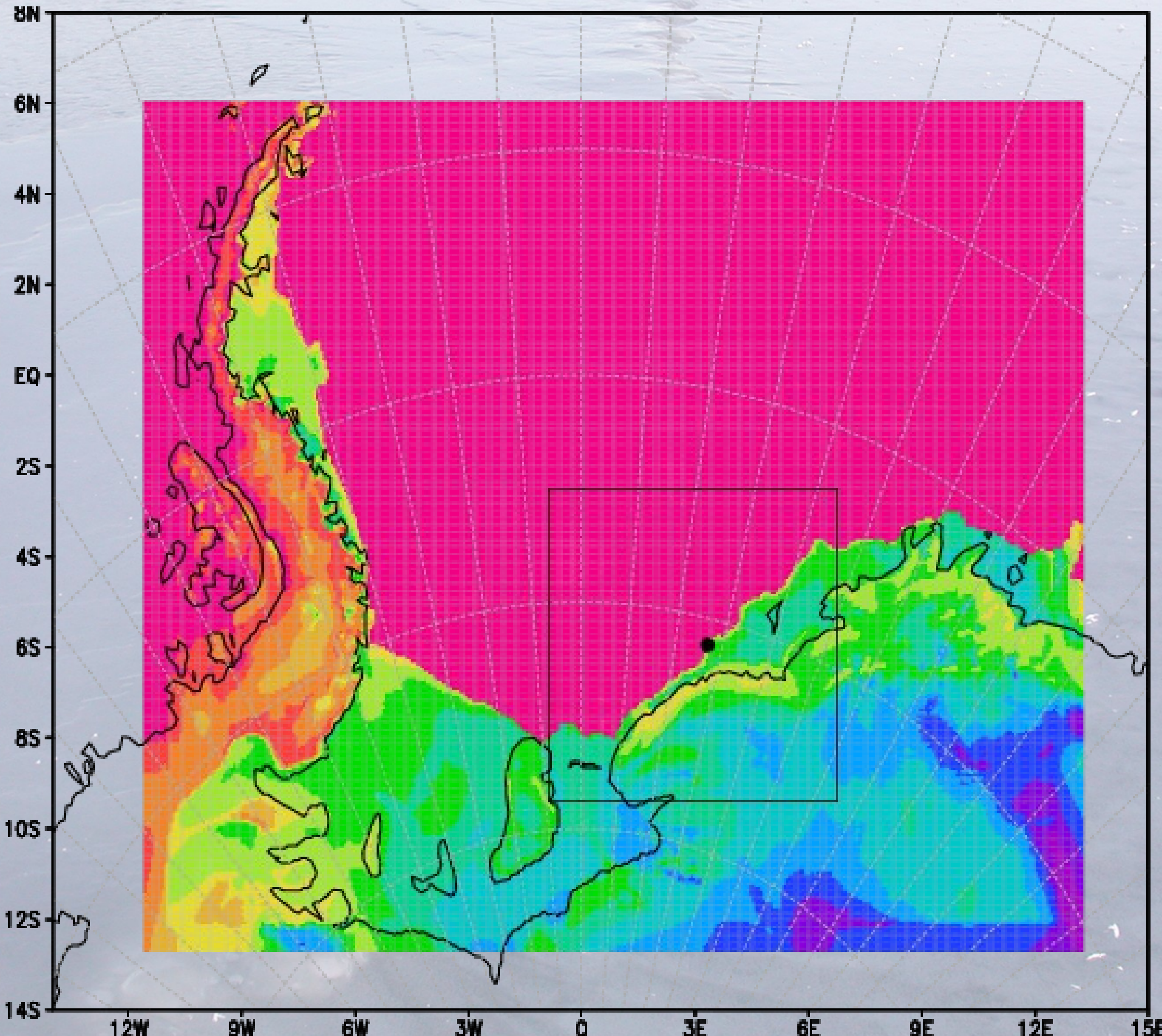
Opportunities for HARMONIE

Learn about very stable Antarctic boundary layer over snow and ice
Enter a strong intercomparison community
Apply 3D models, pick MUSC and SURFEX forcing
Run MUSC and SURFEX experiments, develop parametrisations

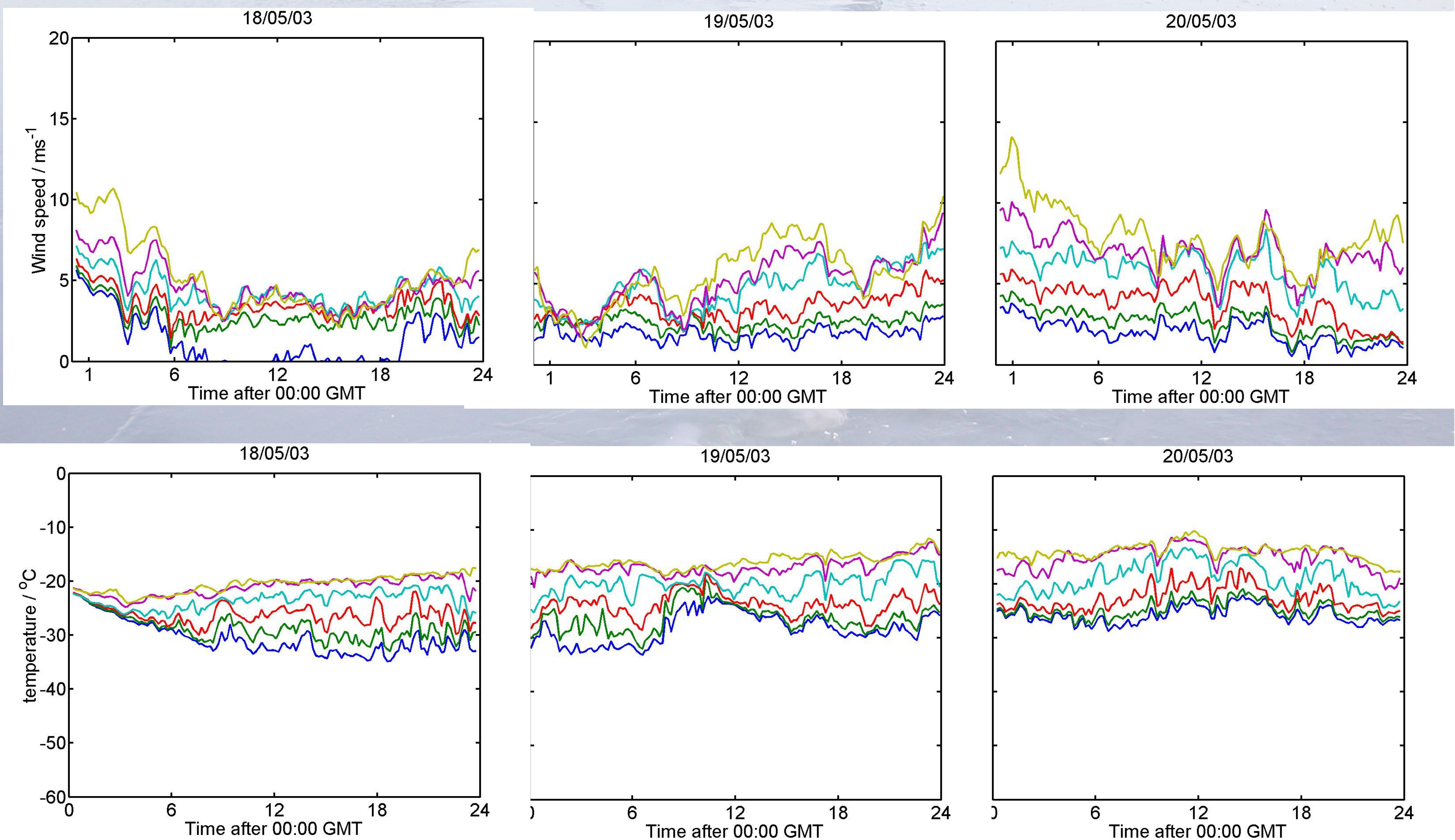
People participating in preparations

Bert Holtslag, Timo Vihma, Tiina Kilpeläinen, Phil Anderson, Andrew Orr, Klara Finkele and others (you are also invited to join!)

GEWEX Atmospheric Boundary Layer Study GABLS - Preparation of the 4th case over Antarctic



SELECTED WIND SPEED AND TEMPERATURE PROFILES HALLEY (26.57W, 75.58S) MAY 2003 METEO MAST 30M



www.antarctica.ac.uk/met/psa/

Stable boundary layer workshop Helsinki, FMI, 3-5 December 2012

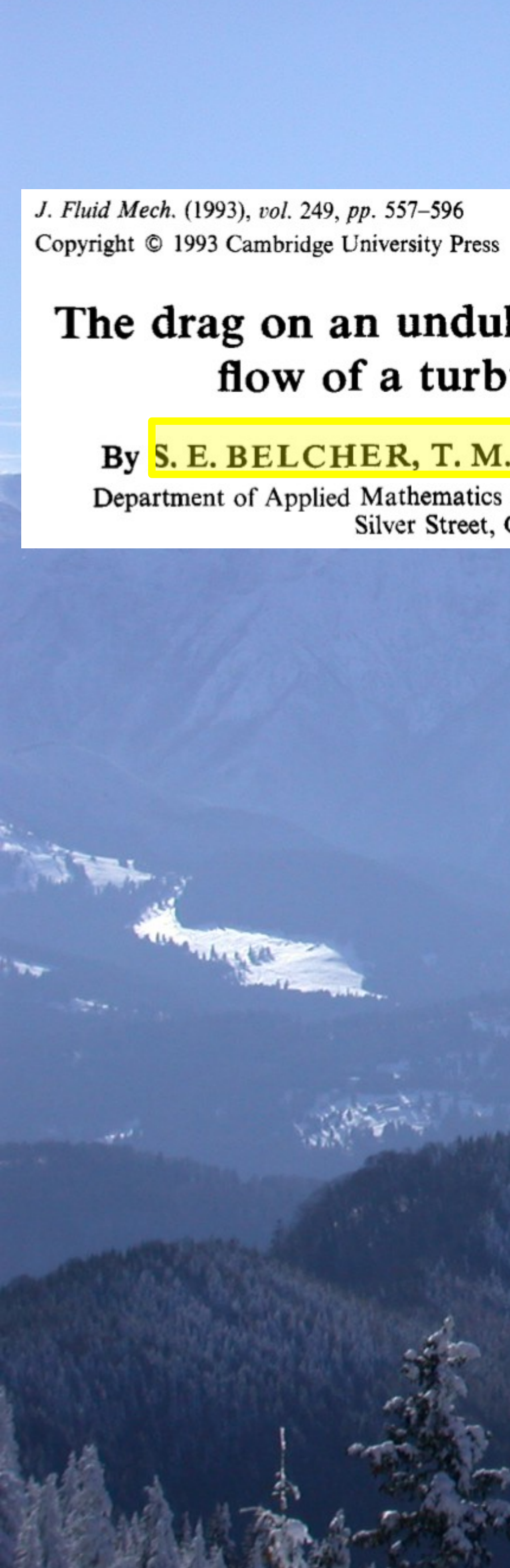
- To discuss how to develop NWP (HARMONIE) parametrisations related to forecast of stable boundary layer conditions
- Bring together researchers, model developers, forecasters
- Three days with presentations and discussions
- Expected outcome: overview of the current problems and ongoing studies, recommendations and coordination of plans

Stable boundary layer workshop Helsinki, FMI, 3-5.12.2012

Suggested topics:

- Models and the Nordic temperature problem
- Forecasting fog, stratus and visibility
- GABLS4 stable boundary layer model intercomparison study over Antarctica
- New developments in turbulence parametrisations

Thank you!



J. Fluid Mech. (1993), *vol.* 249, *pp.* 557–596

The drag on an undul
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By S. E. BELCHER, T. M.
Department of Applied Mathematics
Silver Street, C

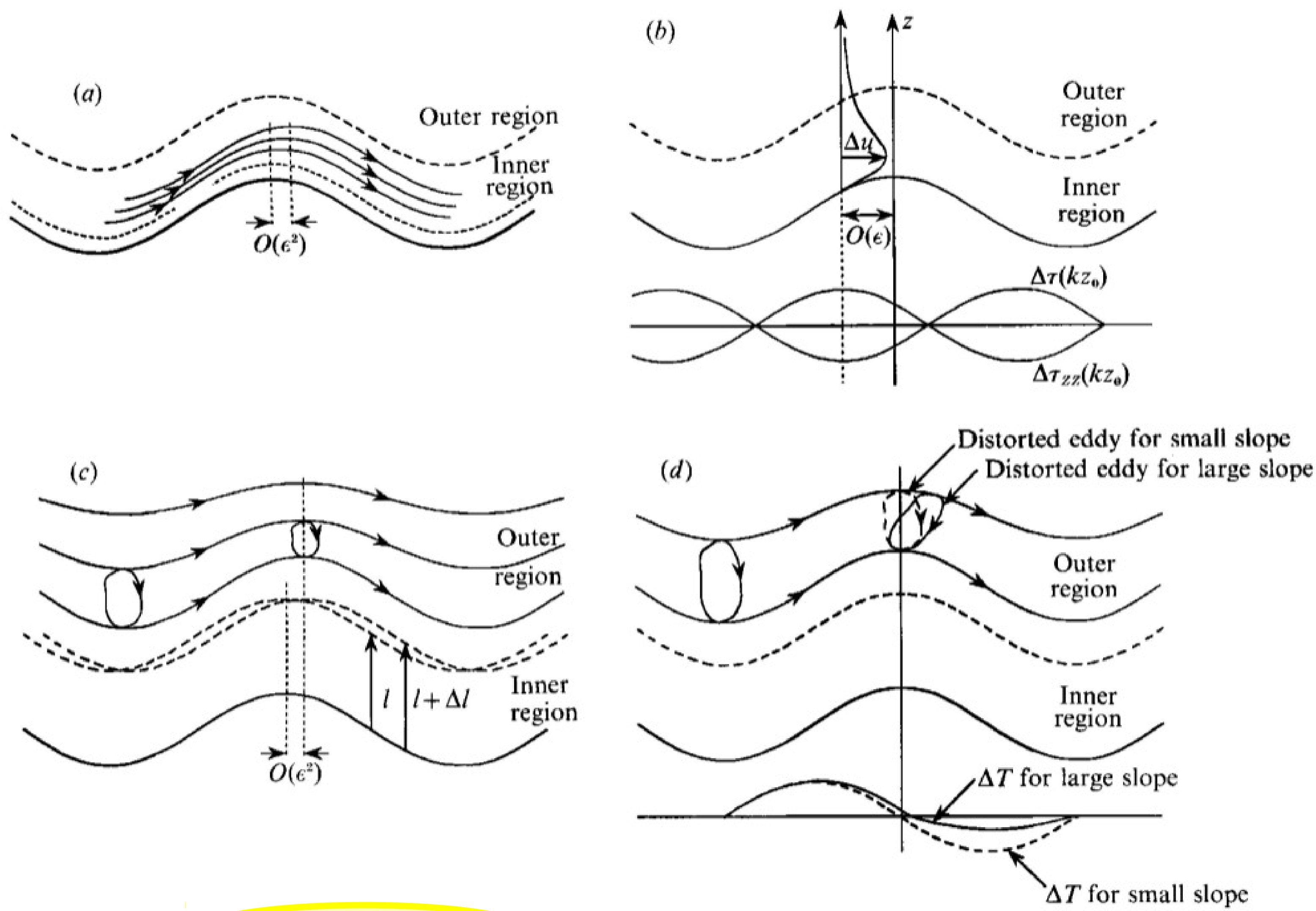
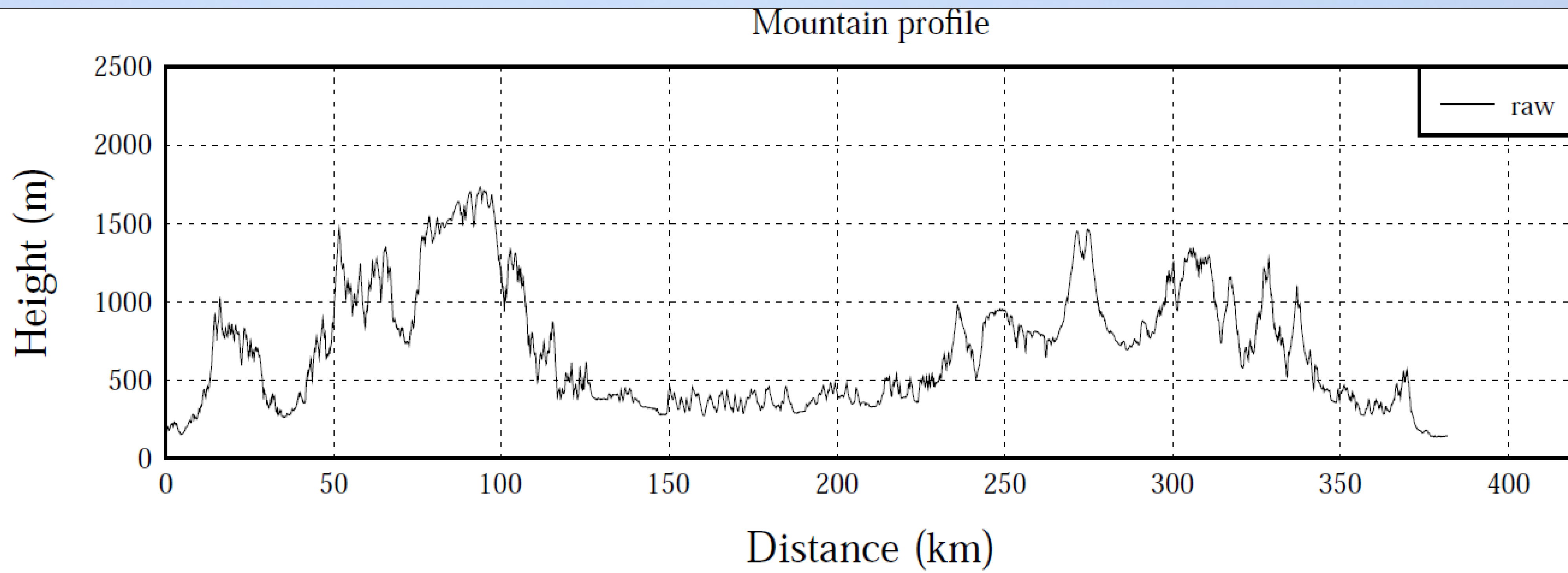
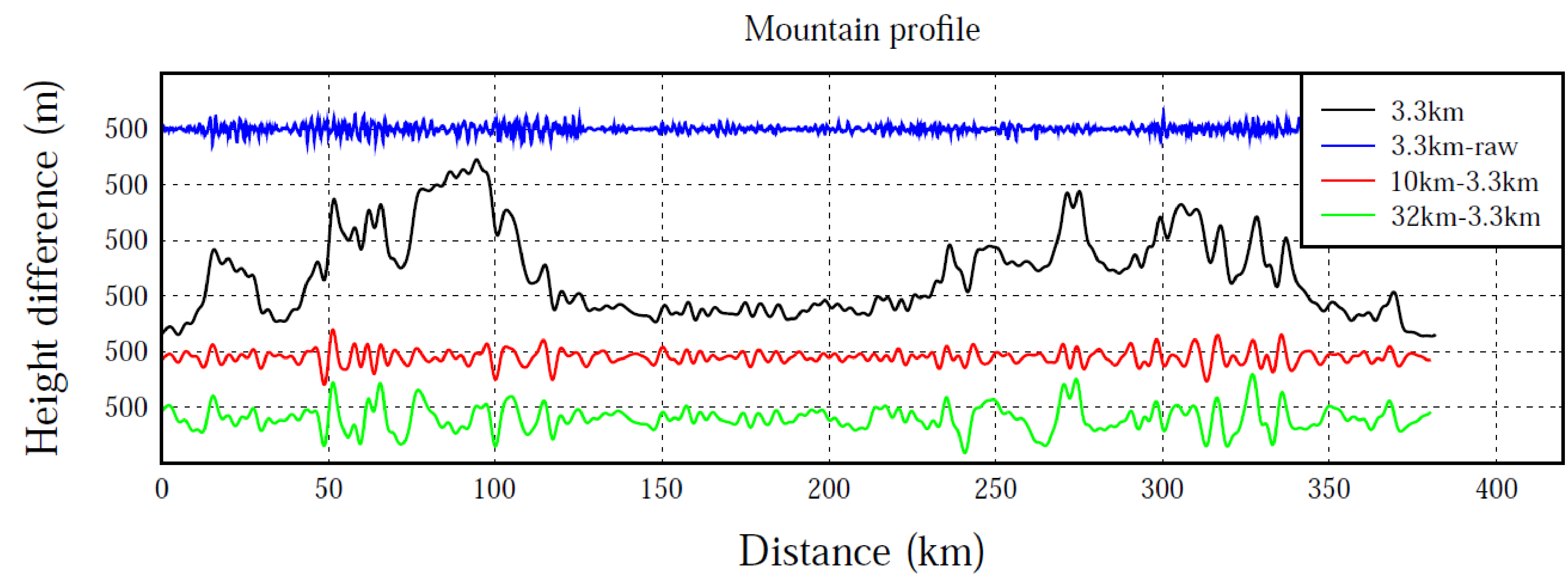


FIGURE 2. (*a*) *Non-separated sheltering.* The perturbed boundary layer thickens on the leeside of the crest due to the action of the shear stress in the inner region; thereby leading to a pressure asymmetry in the outer region. (*b*) *Inner-region Reynolds-stress effects.* Towards the surface the turbulence tends to a local equilibrium structure, so that the Reynolds-stress perturbations are determined by the local velocity gradient. The asymmetry in the inner region leads to perturbations to the Reynolds stresses that are out of phase and hence the Reynolds normal stresses are out of phase at the surface. This changes the drag. (*c*) *Outer-region Reynolds-stress effects.* The 'non-separated' sheltering in the inner region leads to a change, Δl, in the displacement of the largely inviscid outer-region flow. Consequently, the (rapid) distortion of the Reynolds stresses in the outer region is displaced


Mountain profile
raw
Height (m)
Distance (km)


Mountain profile
3.3km
3.3km-raw
10km-3.3km
32km-3.3km
Height difference (m)
Distance (km)