Overview of COSMO WG3a activities

Upper air physical aspects

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Servizio Idro Meteo Clima (SIMC)

The former WG3 has been split:

wg coordinator
Federico Grazzini

Scientists working in Physical Aspects - **Upper air (WG3a)**

Renata Pelosini ARPA-Piedmont
Francesca di Giuseppe ARPA-SIMC
Federico Grazzini ARPA-SIMC
Paola Mercogliano CIRA
Ulrich Blahak DWD
Ekaterina Machulskaya DWD
Dmitrii Mironov DWD
Matthias Raschendorfer DWD
Bodo Ritter DWD
Jan-Peter Schulz DWD
Axel Seifert DWD
Euripides Avgoustoglou HNMS
Witek Interewicz IMGW
Liliana Velea NMA
Tiziano Maestri University of Bologna
Ronaldo Rizzi University of Bologna
Matteo Caggio Univ. of Ferrara

wg coordinator
Jean-Marie Bettems

Scientists working in Physical Aspects - **Soil and surface (WG3b)**

Giovanni Bonafe ARPA-SIMC
Massimo Milelli ARPA-Piedmont
Juergen.Helmert DWD
Ekaterina Machulskaya DWD
Dmitrii Mironov DWD
Bodo Ritter DWD
Martin Lange DWD
Claudia Heret DWD
Gerd Vogel DWD
Grzegorz Duniec IMGW
Jean-Marie Bettems MeteoSwiss
MeteoSwiss
Inna Inna Rozinkina Roshydromet

Alla Yurova Roshydromet

Jan-Peter Schulz DW
Edouard Davin ET
Reto Reto Stoeck
Ekaterina Kazakova Roshydromet

CONSORTIUM FOR SMALL SCALE MODELING
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WG3a activities

- Boundary layer
- Microphysics
- Radiation
- Deep convection and grid scale precipitation
- Interaction between clouds and radiation
- Diagnostic

PBL issues

• **TKE scale separation and interaction terms**. Introducing the concept of scale separation and interaction terms accounting from other sub-grid scale phenomena in the TKE equation. Interactions terms (shear, SSO wake) have already been formulated and tested. This year efforts were concentrated on interaction term from convection *M.Raschendorfer, DWD*

• **Subscale treatment of surface heterogeneity.** It seems absolutely necessary to couple a tiled surface scheme with the PBL turbulence in order to improve the turbulence scheme performance in the stably stratified PBL. *D. Mironov, DWD*

– **Revision of the surface transfer scheme**. *M.Raschendorfer, DWD*

- Unified Turbolence Shallow Convection Scheme (UTCS), attempt to find a unique closure assumption for the whole sub-grid scale spectrum of phenomena. *D. Mironov, DWD*

–Schulz (DWD) has shown that the ground heat flux in the TERRA multi layer scheme is systematically overestimated. It is shown that the soil model can be improved with a **new formulation of the soil thermal conductivity** (in conjunction with WG3b).

Further steps towards a scale separated turbulence scheme:

Aim: General valid (consistent) description of sub grid scale (SGS) processes

Problem: Closure assumptions are constraints additional to the only valid first principals

- General valid closure assumptions can't exist
- SGS turbulence and e.g. convection can't be described by one set of 2-nd order equations

Solution: Scale separation

- A system of closure equations for each scale separated process with specific closure assumptions
  - wake vortices by SSO (sub grid scale orography) blocking
  - horizontal shear vortices
  - surface induced density flow patterns
  - shallow and deep convection patterns

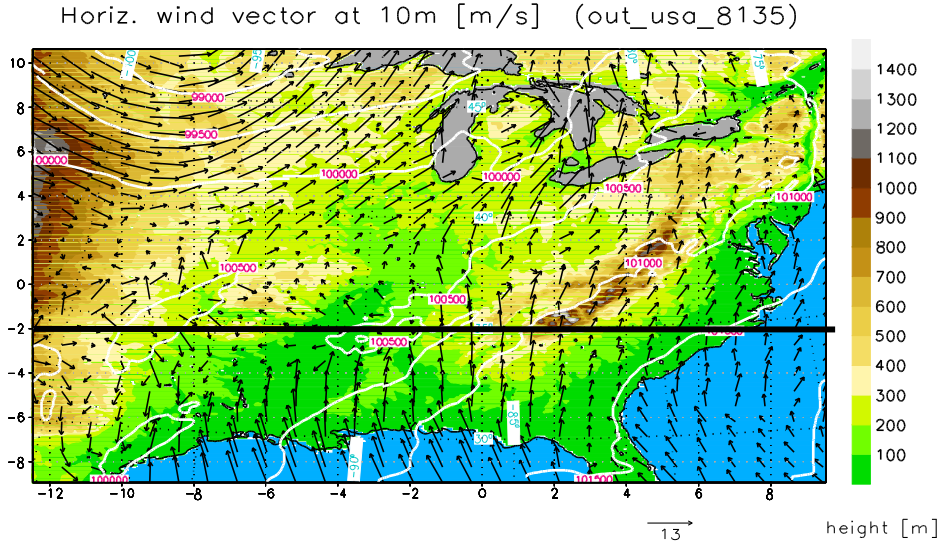
Complication: Larger scale SGS processes are interacting with turbulence!!

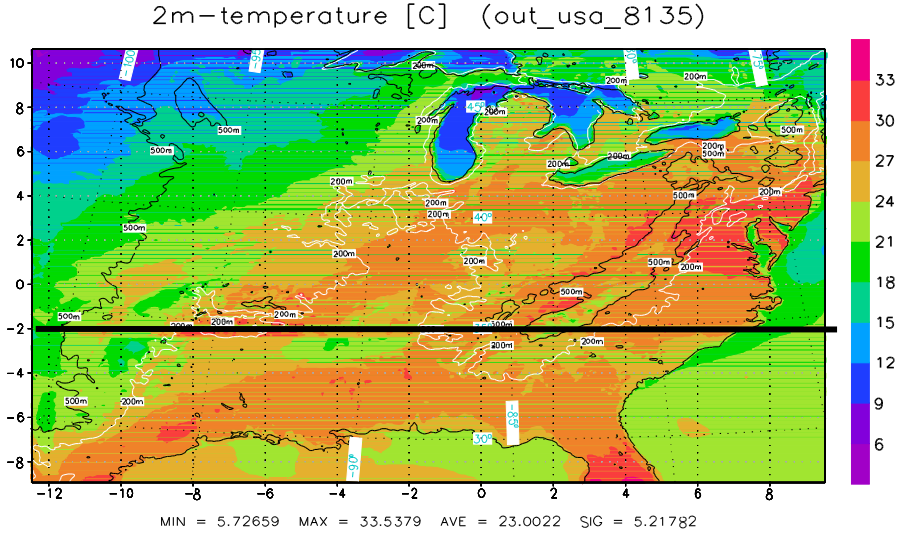
- Scale interaction terms

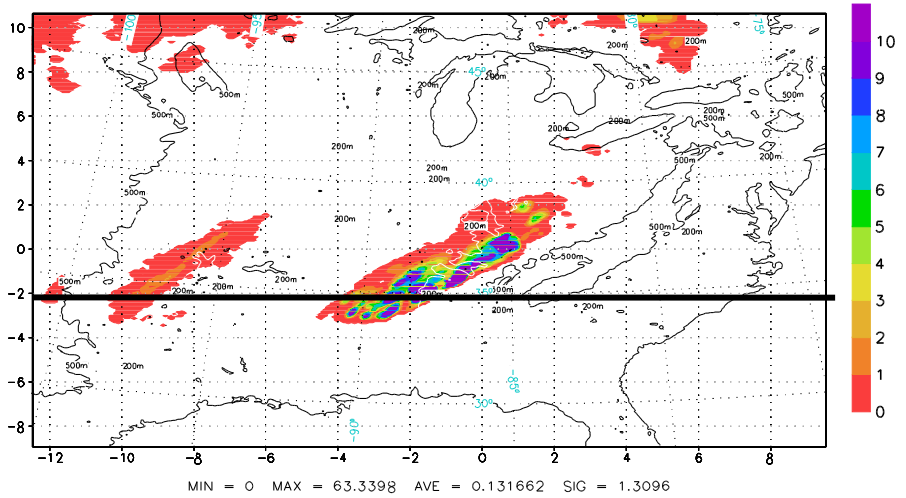
Validation:

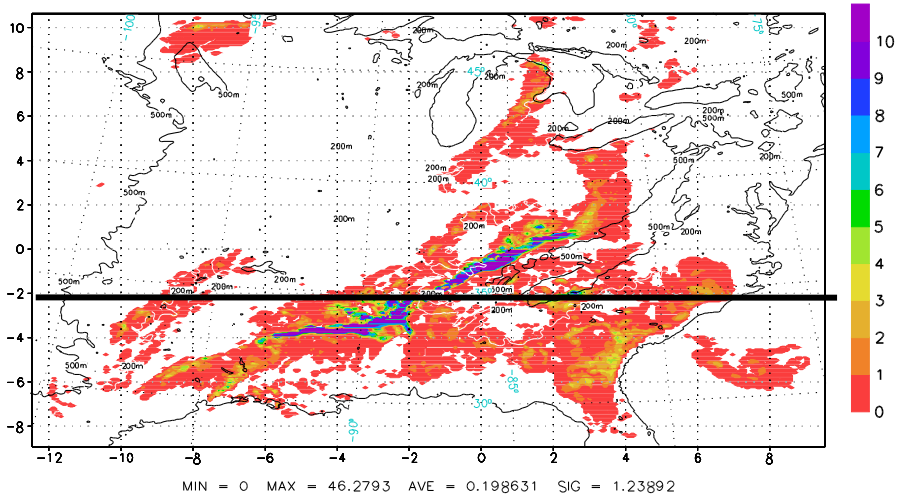
- **Operational verification**
- **Statistical procession with the package TMOS using ACARS turbulence data**

Synoptic distribution near suface









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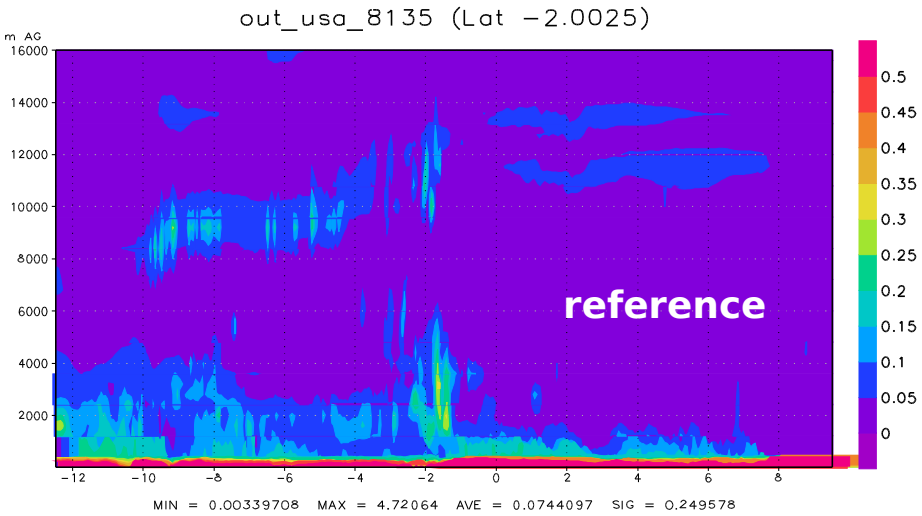
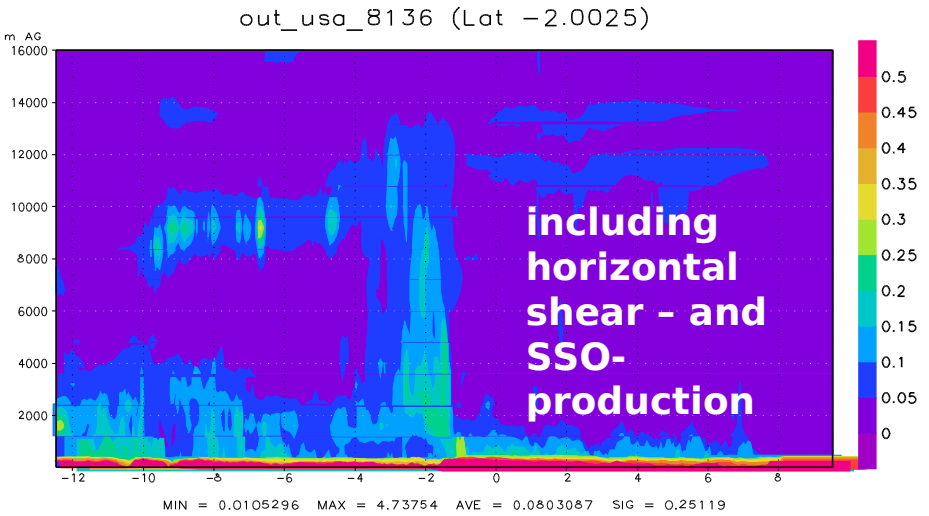
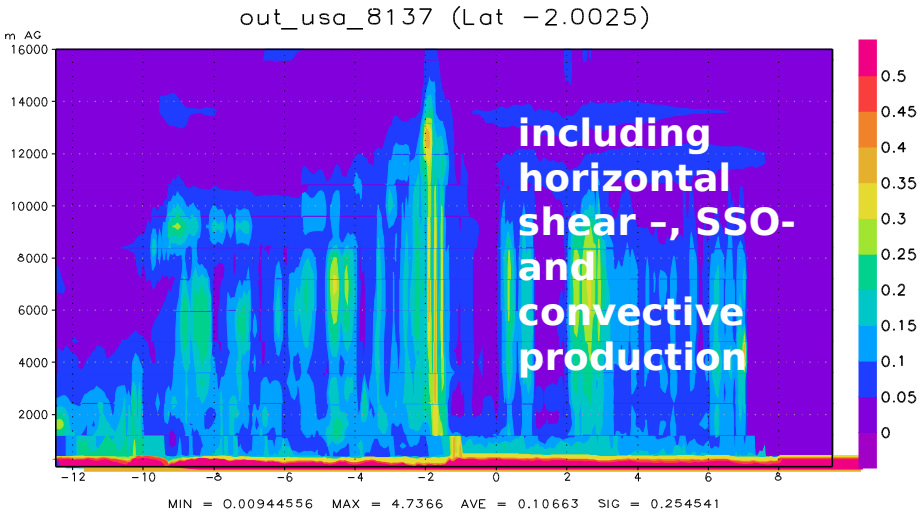
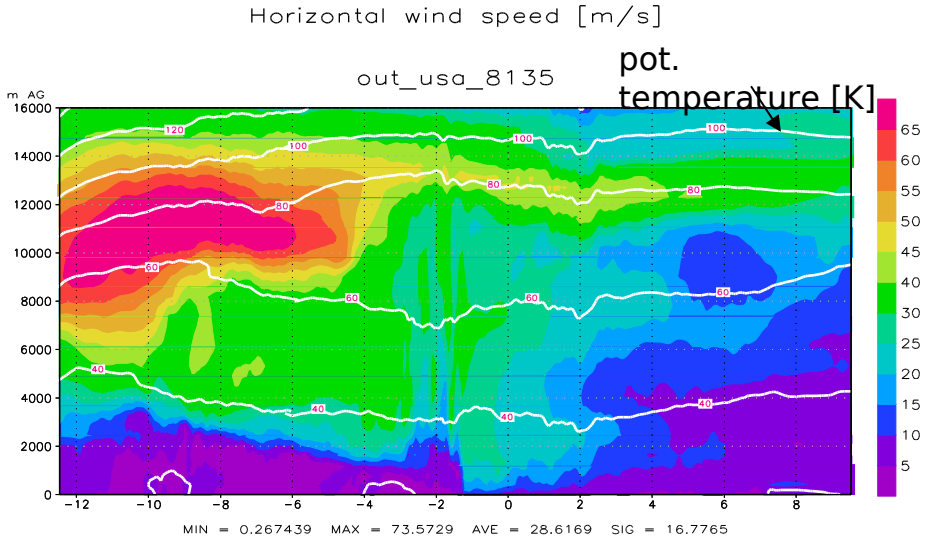
pow_1/3 (eddy dissipation rate (EDR) [m^2/s^3])









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UTCS progress

- The **TKE-Scalar Variance** scheme is **implemented into** the **COSMO** model (new features: prognostic equations for the scalar variances with third-order transport terms and non-gradient corrections to the fluxes of scalar quantities)
- The **new scheme** is being **tested through parallel experiments** with COSMO-EU (ca. 7 km mesh size) and COSMO-DE (ca. 2.8 km) model configurations using COSMO version 4.18 operational at DWD since May 2011. Results from both COSMO-EU and COSMO-DE show sensitivity to the modifications introduced (e.g. the surface-layer in summer seems to be moister). Verification results and conclusive statements as to the effect of the new scheme on the overall COSMO performance will be reported later.
- Preparation of **documentation in progress**
- Parallel experiments are running slower than expected, coding errors (our fault!), work somewhat delayed

UTCS plans for the next year

- Comprehensive testing of the new TKE-Scalar Variance scheme (including transport equations for the TKE and for the scalar variances, a sub-grid scale statistical cloud scheme for non-precipitating clouds, and non-local formulation for the turbulence length/time scale) through numerical experiments within the full-fledged three-dimensional COSMO model
- Analysis of results from numerical experiments, verification of numerical results against observational data
- Full coupling of the new scheme with the tiled surface scheme (tiled scheme c/o Ekaterina Machulskaya and Jürgen Helmert), tuning of the coupled schemes
- Preparation of documentation. Project should be completed by end 2012

Atmosphere – Ocean interaction

Wind generated waves influence the atmosphere and determine the fluxes from the ocean to the atmosphere. At the moment there is no direct effect on the roughness, the model doesn't feel the waves. Parameters that controls the laminar exchanges over sea are not optimally tuned.

Work has been done to couple COSMO (Atmosphere) , WAM (Waves) and ROMS (Currents) models. Preliminary results are encouraging (coupling atm and wam). Some comparison with observed fluxes over marine bounday layer are needed for further tuning. *(L. Torrisi CNMCA, in collaboration with A. Roland-ISMAR and V. Romaniello-INGV)*

RADIATION

RTE contains severe approximations and limitations mostly due to computing time restrictions. The most critical issue in this context originates from the need to integrate solutions of the RTE over all energetically relevant wavelengths

Monte Carlo Spectral Integration. *Bodo Ritter, DWD*

• Adaptive scheme. It combines accurate and fast parametrization making use of spatial and temporal correlation in the atmosphere. *V. Venema, DWD Extramural research*

Microphysics and convection

- ***Testing of 1-Km scale runs***. *Meteoswiss and ARPA-SIMC are running some test and exploring the feasibility of running at very high resolution. Potential benefits are envisaged although a re-tuning of some parametrization might be required. G. De Morsier (Meteoswiss, A. Morgillo ARPA-SIMC)*

- ***New microphysics*** *schemes of different complexity have been developed for the COSMO model (2 moments, adding concentration of raindrops to the actual Graupel-Scheme. New melting scheme is still under development, and has to potential to improve forecasts of precipitation phase and snow density.* ***A. Seifert (DWD)***

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