EMS Annual Meeting Abstracts,
Vol. 6, EMS2009-607, 2009
9th EMS / 9th ECAM

9th EMS Annual Meeting
9th European Conference on Applications of Meteorology
High resolution meteorology
- applications and services

Planetary Boundary Layers – Physics, Modelling and Role in Earth System: Summary of New ERC Grant (2009-2013)

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This project started on 1 January 2009 aims to systematically revise the planetary-boundary-layer (PBL) physics accounting for non-local effects of coherent structures (long-lived large eddies especially pronounced in convective PBLs and internal waves in stable PBLs). It focuses on the key physical problems related to the role of PBLs in the Earth system as the atmosphere-land/ocean/biosphere coupling modules: the resistance and heat/mass transfer laws determining the near-surface turbulent fluxes, the entrainment laws determining the fluxes at the PBL outer boundary, the PBL depth equations, and turbulence closures. In the project the first round of revision will be completed, the advanced concepts/models will be empirically validated and employed to develop new PBL parameterization for use in meteorological modelling and analyses of the climate and Earth system. The new parameterizations and closures will be implemented in state-of-the-art numerical weather prediction, climate, meso-scale and air-pollution models; evaluated through case studies and statistical analyses of the quality of forecasts/simulations; and applied to a range of environmental problems. By this means the project aims to contribute to better modelling of extreme weather events, heavy air pollution episodes, and fine features of climate change. It summarises and further extends last-decade works of the project team in the PBL physics: discovery and theory of the new PBL types of essentially non-local nature: “long-lived stable” and “conventionally neutral”; quantification of the basic effects of coherent eddies in the shear-free convective PBLs including the non-local heat-transfer law; physical solution to the turbulence cut off problem in the closure models for stable stratification; and discovery of the stability dependences of the roughness length and displacement height.