Comenius University in Bratislava
Faculty of Mathematics, Physics and Informatics

THESIS ASSIGNMENT

Name and Surname:	Bc. Peter Kuma
Study programme:	Meteorology and Climatology (Single degree study, master II. deg., full time form)
Field of Study:	4.1.1. Physics
Type of Thesis:	Diploma Thesis
Language of Thesis:	English
Secondary language:	Slovak

Title: Broadband approach as a framework for implementation of radiative transfer scheme with selective intermittency – cost versus accuracy study

Aim: Propose, implement and test suitable intermittent strategies for ACRANEB scheme, taking into account particularities of shortwave and longwave radiative transfer calculations.

Literature:
Ritter B, Geleyn JF. 1992. A comprehensive radiation scheme for numerical weather prediction
models with potential applications in climate simulations. Mon. Weather Rev. 120: 303–325,
doi:10.1175/1520-0493(1992)120 0303:ACRSFN 2.0.CO2.
Geleyn JF, Hollingsworth A. 1979. An economical analytical method for the computation of the
interaction between scattering and line absorption of radiation. Contrib. Atmos. Phys. 52: 1–16.
Mašek J, Geleyn JF, Brožková R, Giot O, Achom HO, Kuma P. 2014. Single interval shortwave
radiation scheme with parameterized optical saturation and spectral overlaps. Manuscript submitted for publication.

Annotation: Clouds are main modulating factor of radiative transfer in the Earth's atmosphere. For realistic numerical weather prediction it is thus desirable to have full feedback between radiative transfer and
quickly evolving clouds. Ideally, this would be achieved by making radiative transfer calculations at every gridpoint and every model timestep. Main obstacle to do this is spectral integration. Extremely
high cost of exact line by line computations prevents their use in numerical weather prediction so that cheaper and somewhat less accurate alternatives must be sought. Traditional solutions are
based either on so called k-distribution method, or on broadband approach. The latter is used also in radiation transfer scheme ACRANEB of model ALADIN, for efficiency reasons having just two
spectral bands – one solar (shortwave) and one thermal (longwave). Even with such broad spectral division it is possible to make the scheme accurate enough by parameterizing optical saturation
of shortwave cloud absorption and spectral overlaps between various radiatively active species. In thermal part, problem of multiple emission sources can be

solved efficiently by using net exchanged rate technique. Still, the cost of radiative transfer calculations with above improvements represents
significant part of model CPU time and it is desirable to reduce it by suitable intermittent strategy. Unlike k-distribution method, broadband approach is especially suitable for implementing selective
intermittency where rapidly varying cloud optical properties are updated at every model timestep, while slowly evolving gaseous transmissions only from time to time. Aim of this work is to propose,
implement and test suitable intermittent strategies for ACRANEB scheme, taking into account particularities of shortwave and longwave radiative transfer calculations.

Comment: Vedúci DP je pracovníkom Českého hydrometeorologického ústavu a je špecialistom na danú problematiku

Keywords: radiation scheme, radiative transfer, numerical weather prediction, net exchange rate

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Head of department: prof. RNDr. Peter Moczo, DrSc.

Assigned: 20.01.2015

Approved: 27.01.2015

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Guarantor of Study Programme

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