



## 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.CO;2.  
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



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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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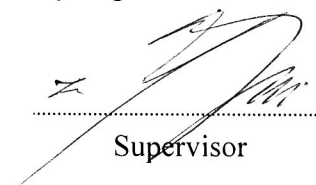
**Assigned:** 20.01.2015

**Approved:** 27.01.2015

  
prof. RNDr. Milan Lapin, CSc.  
Guarantor of Study Programme



Student

  
Supervisor