Regional Cooperation for
Limited Area Modeling in Central Europe

LACE
nwp central europe

ALARO status overview with emphasis on ACRANEB2 radiation scheme

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DHMZ

ZAMG

ROMANIA ANM

Talk outline

- ALARO status overview
  - first ALARO-1 version available
- Radiation scheme ACRANEB2
- Physics activities inside RC LACE
- Outlook

ALARO short recall

- One of the physical parameterization package inside ALADIN/HARMONIE system
- Characteristics, development concept:
  - clean governing equations for moist physics (barycentric and conservative system)
  - prognostic schemes; consistency and unification of all formulations as a goal
  - keep modular while having consistent interface to the model dynamics
  - code stability, numerical efficiency
  - multi-scale: parameterizations being as scale-independent as possible and giving physically consistent results over a wide range of model resolutions (in particular 10 km to 1 km)

ALARO status

- In the operational use in ALADIN countries
  - ALARO-0: at, be, hr, hu, ro, sk, si, tr
  - ALARO-1vA: cz, po

  model resolution between 8 km – 4 km, 2km

National posters

- In EPS systems
  - ALADIN-LAEF, GLAMEPS, EPS at HMS
  - HarmonEPS convection-permitting ensemble system

Presentation Martin Belluš

Presentation Lisa Bengtsson

- In climatological simulations
  - be, cz, se

Lindstedt et al. 2014, Tellus

ALARO status

- ALARO-1 Working days

  12-14 May 2014, Vienna, ZAMG
  - A status overview, spread knowledge, planning
  - 30 participants
  - at,be,hr,cz,fr,hu,pt,ro,se,si,sk,tr, hirlam,ru
- www.rclace.eu/?page=148

ALARO-0 experiences

- Selected messages
  - extreme precipitation events relatively well
  - overestimation of convection over orography
  - minimum temperature in summer too high
  - 2m temperature above snow cover in warm advection
  - too much cloudiness in summer, especially at higher levels and over night
  - not enough clouds in winter, especially low level clouds
  - “similar” models sometimes give completely different forecasts (operational simulations gathered onwww.rclace.eu)
  - inconsistency in consequent forecasts

First version of ALARO-1

- Assembling
  - Turbulence and shallow convection scheme TOUCANS
    - Prognostic TKE and TTE
    - Parameterization of moist third order moments
    - Turbulent diffusion of cloud condensates
    - *Mixing length (same as in pTKE)*
    - *Shallow convection (same as in alaro-0)*
  - Radiation ACRANEB2
    - Significantly improved
  - Microphysics
    - Improved rain drop size distribution
    - More sophisticated vertical geometry of cloud and precipitation
- Retuning (significant effort needed)

Presentation
Ivan Bastak

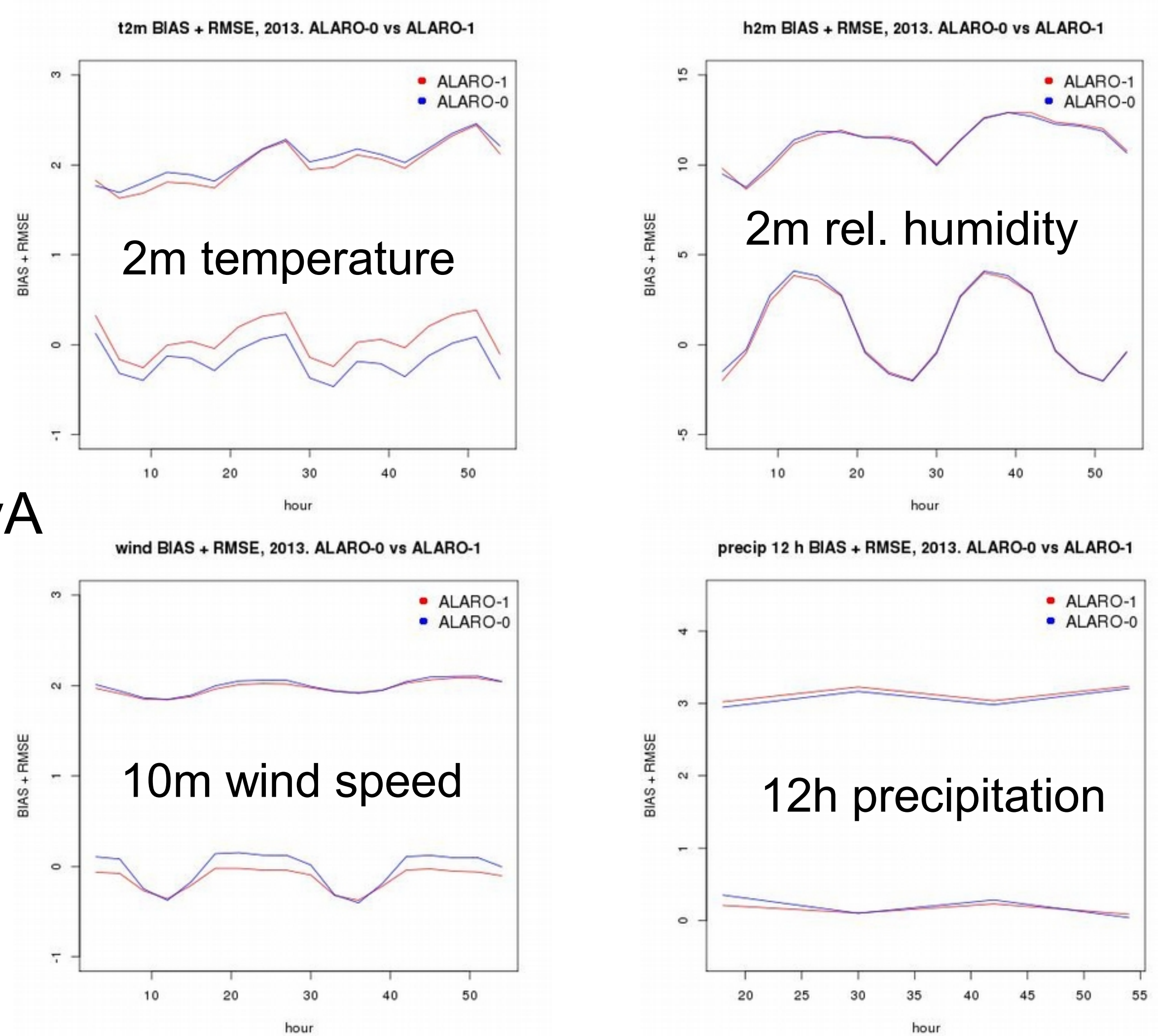
Presentation
Radmila Brožkova

First version of ALARO-1

- source code for the export CY38T1.bf3 and documentation available in February 2015
  - ALARO related information http://www.rclace.eu/?page=74
- operational
  - at CHMI on 22 January 2015
  - at IMGW on 1 April 2015
- validation ongoing in several services

ALARO-1vA verification

Poland: Comparission of ALARO-0 and ALARO-1vA
year 2013
stations in Poland



ALARO-1 with SURFEX

- Coupling SURFEX_V7.2 to ALARO-1 (cy38t1op3 in Prague)
  - implementation
  - TOUCANS with SURFEX
    - same stability functions in upper air and at surface
    - interface via average drag coefficient
    - modifications are done and tested

Poster
Rafiq Hamdi

- ACRANEB2 radiation scheme
  - What is new since the last workshop
  - Operational use
  - Solar eclipse on 20 March 2015

ACRANEB2 novelties

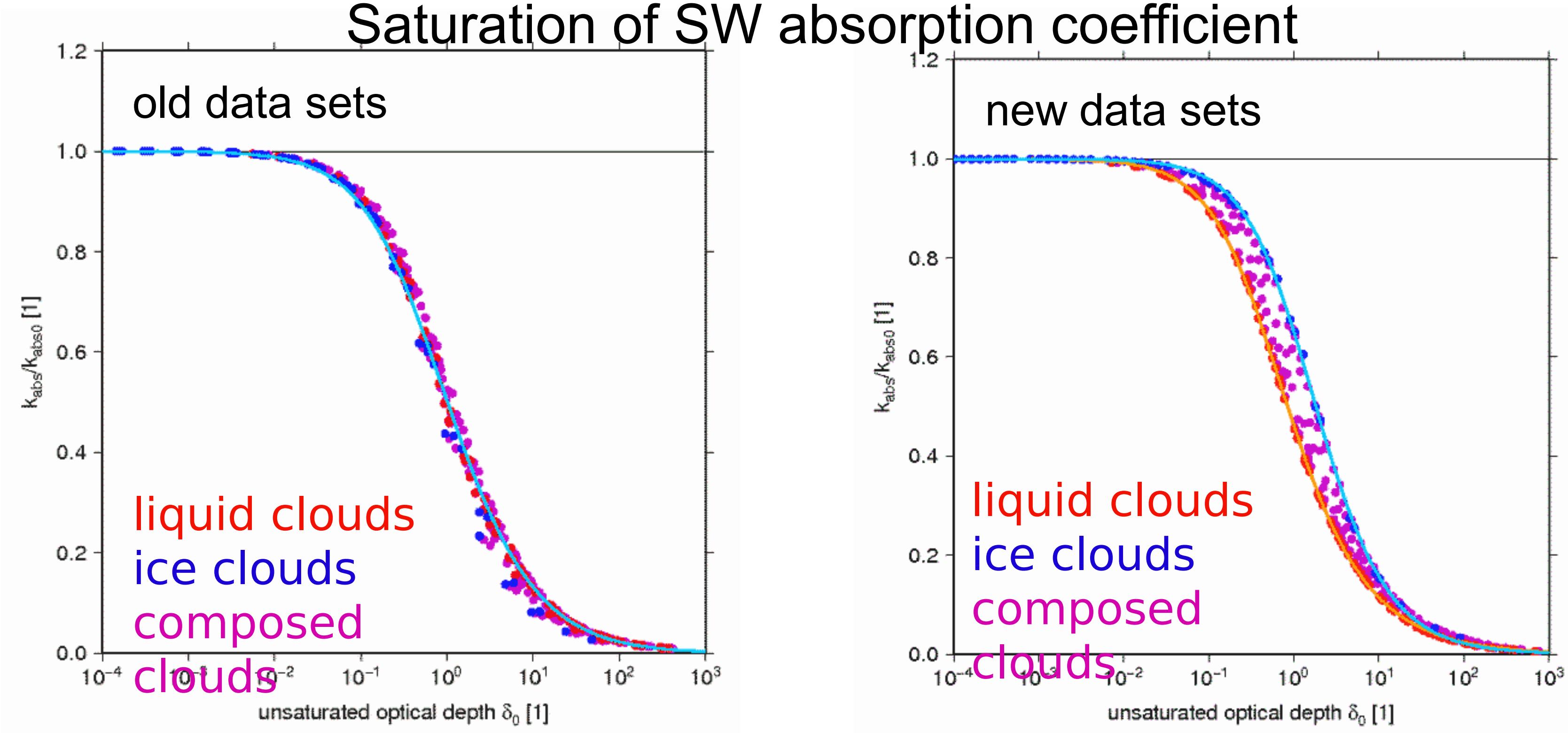
- intermittent update of SW gaseous transmissions was introduced (solar intermittency)
  - simple time interpolation of SW optical depths taking into account changing sun elevation
  - CPU cost: with 1 hour SW intermittency is possible to save few % CPU in ALADIN/CHMI

- fits of single scattering cloud optical properties were redone against more recent high resolution datasets
  - for all liquid/ice and SW/LW *(Hu and Stamnes 1993 for liquid clouds, Key et al. 2002 for SW ice clouds, Yang et al. 2005 for LW ice clouds)*

ACRANEB2

- Revised cloud optical saturation (use of the new cloud data sets):
  - optical saturation of ice clouds is weaker than of liquid one
  - necessary to separate optical saturation of liquid and ice clouds

Saturation of SW absorption coefficient



ACRANEB2 novelties

- SW narrowband reference was generalized to contain not only gaseous absorption, but also Rayleigh scattering and clouds
  - needed to identify and solve remaining SW problems

- concept of effective cloud optical depth was revisited
  - better justified vertical dependency

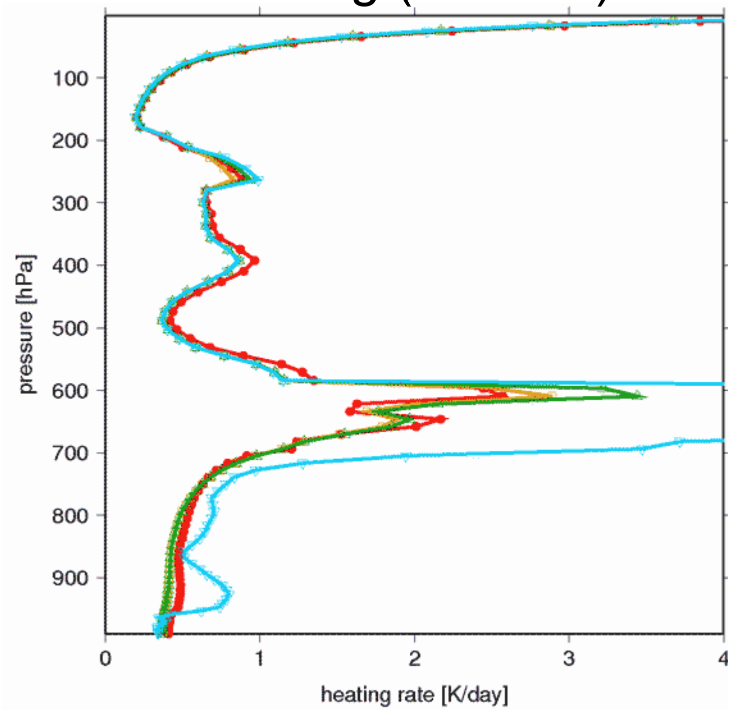
- parameterization of SW gas-cloud overlap is included
  - SW absorption is reduced due to competition between water vapour and clouds

ACRANEB2

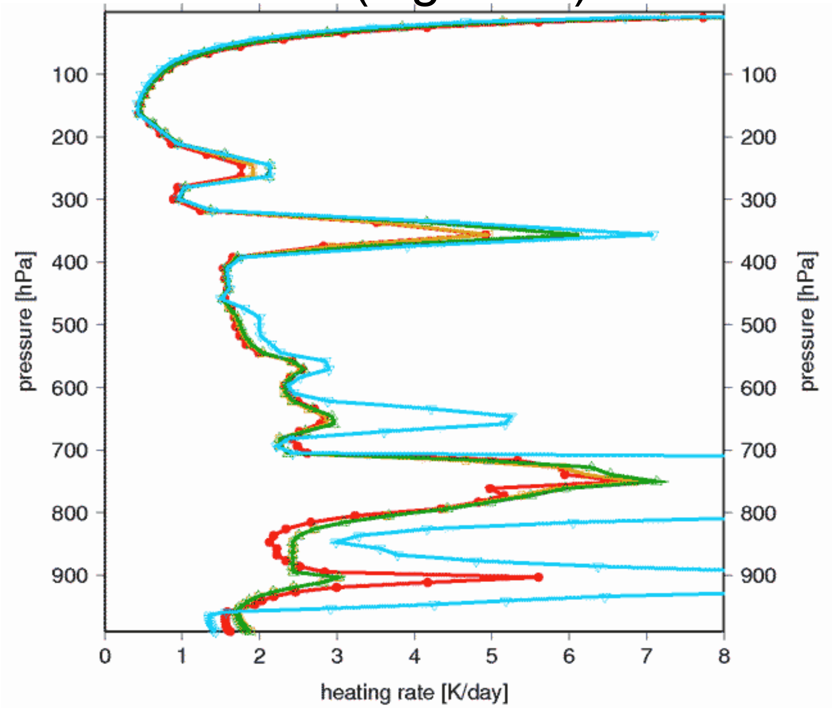
- Accuracy of the new SW radiation

SW heating rates for summer convection day in Prague (29 June 2009)

morning (low sun)



noon (high sun)



narrowband reference

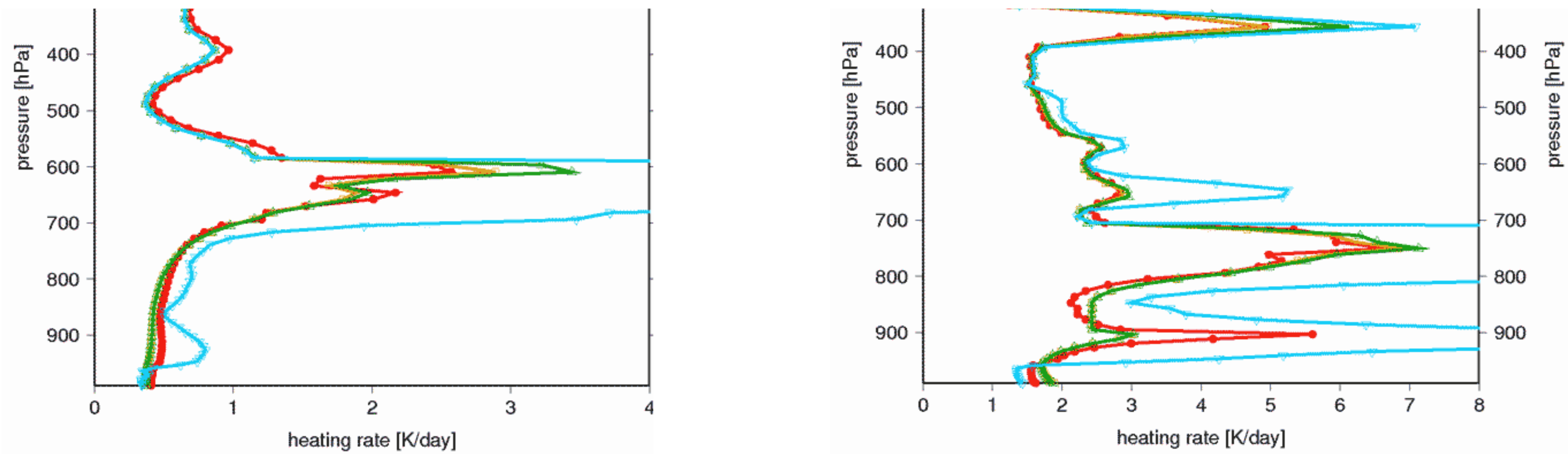
ACRANEB2 (broadband)

ACRANEB2 no gas-cloud overlap

ACRANEB2 no cloud optical saturation

ACRANEB2

- Accuracy of the new SW radiation
  - Cloud optical saturation is crucial
  - Gas-cloud overlap minor improvement
  - Typical error of ACRANEB2 against narrowband reference is 0.1K/day for clear sky and below 1K/day for cloudy
  - Few % for fluxes at surface and at top of atmosphere



narrowband reference
ACRANEB2 (broadband)
ACRANEB2 no gas-cloud overlap
ACRANEB2 no cloud optical saturation

ACRANEB2 novelties

- accuracy of delta-two stream choice used in ACRANEB/ACRANEB2 was evaluated with respect to Monte Carlo reference, proving its competitiveness to other choices (e.g. delta-Eddington used in IFS radiation)

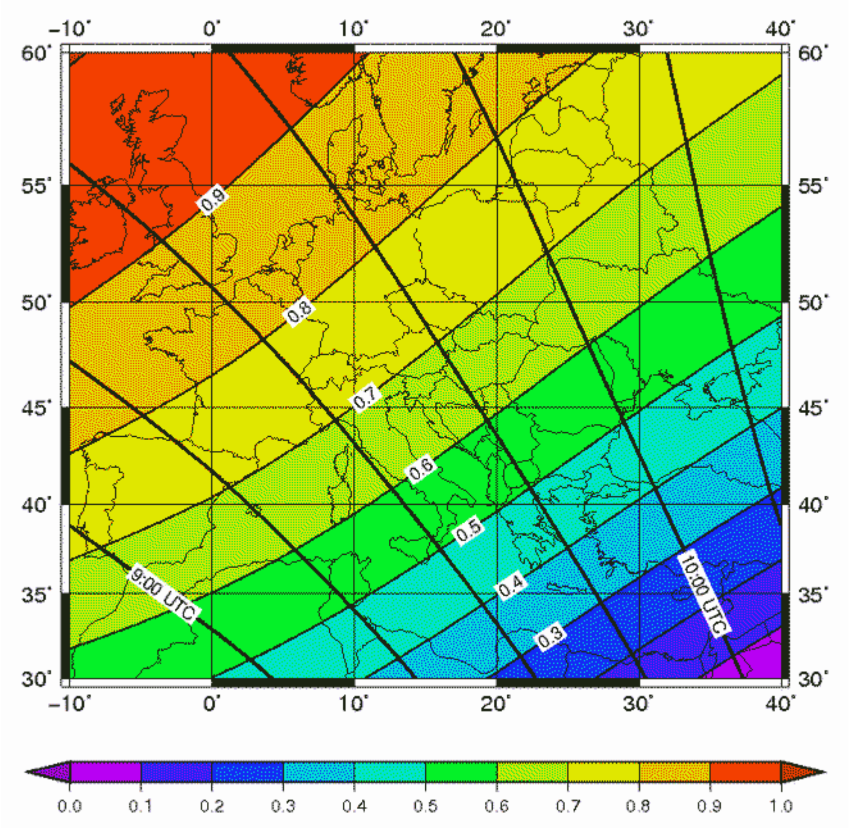
- paper describing SW part submitted to QJRMS

ACRANEB2 for the operational use

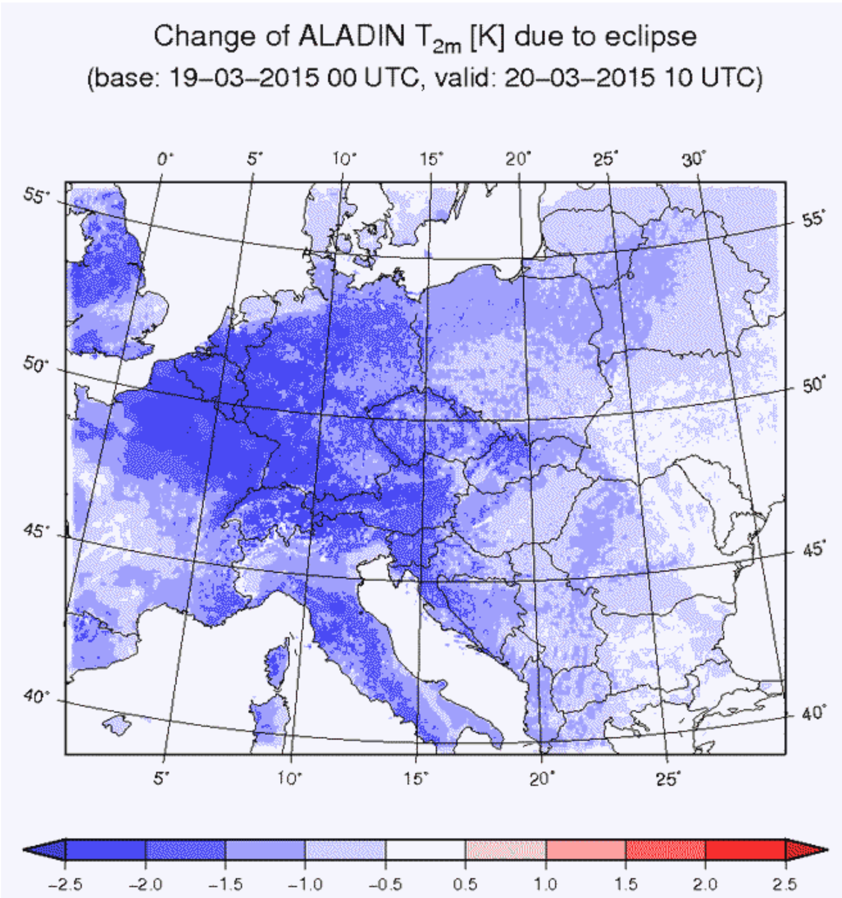
- Tunings and adaptations
  - due to interactions with other schemes and the new turbulence scheme (TOUCANS),
  - vertically dependent modulation of resolved radiative cloud cover needed
- Outcomes
  - diurnal cycle of convective precipitation is significantly improved
    - this is possible because cloud optical properties are updated at every time step
  - weak point: underestimated low inversion cloudiness in the cold season strongly influences radiative fluxes

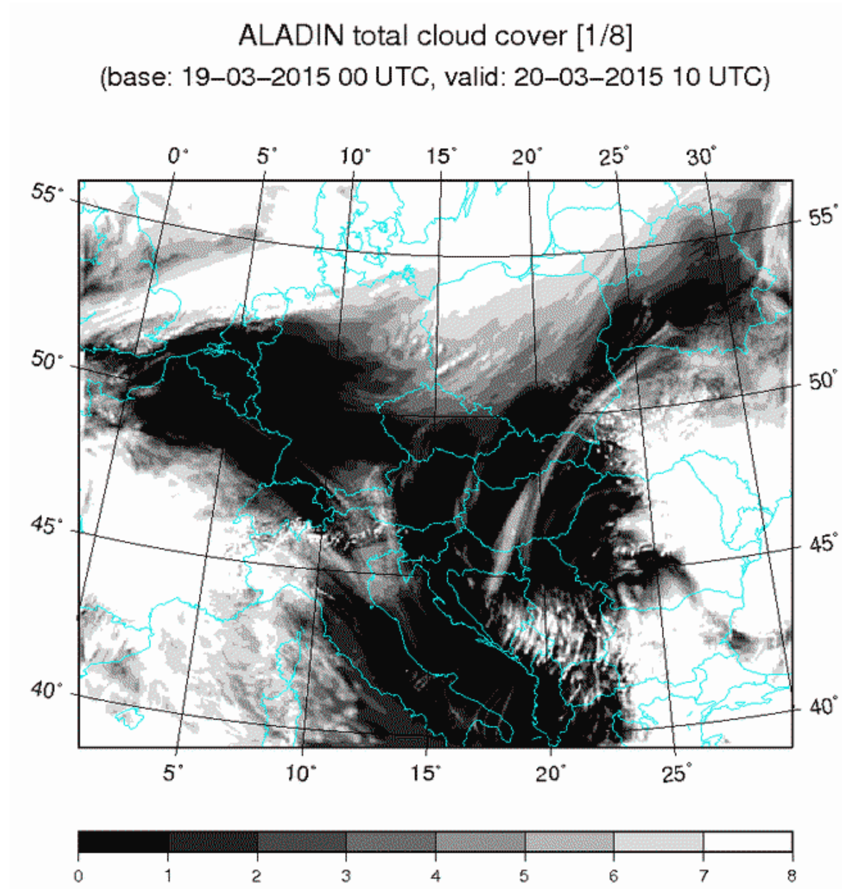
Solar eclipse on 20 March 2015

- eclipse was implemented in operational version of ALADIN/CHMI
- incoming solar radiation at the top of atmosphere was modulated according to actually covered part of solar disc



Solar eclipse on 20 March 2015



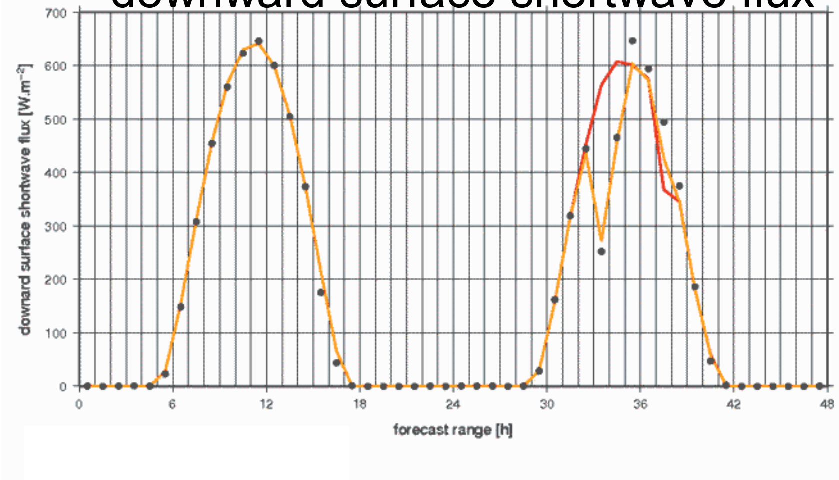


Czech area: 1h sum of surface global radiation was reduced by ~ 50%,
daily sum by ~10%, impact on T2m exceeded -1K

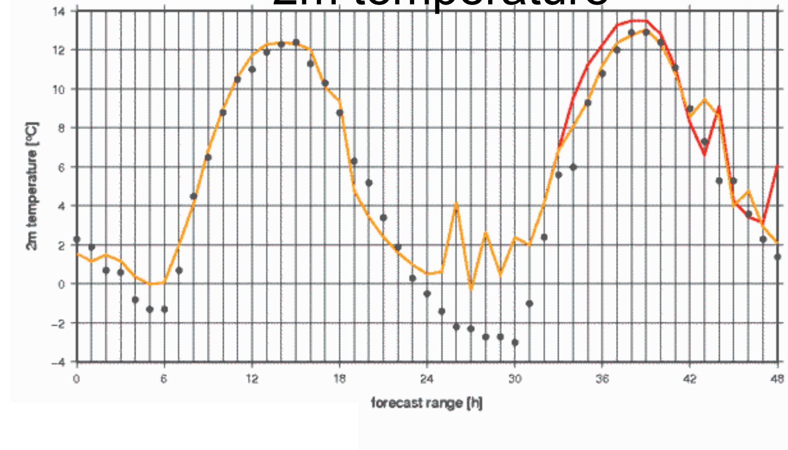
Solar eclipse on 20 March 2015

2 days ALADIN forecast and observation for Prague

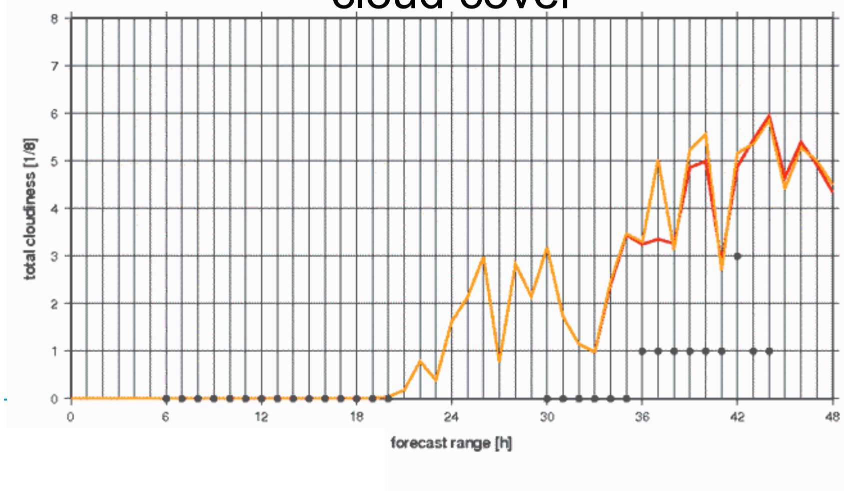
downward surface shortwave flux



2m temperature



cloud cover



control run without eclipse

operational run with eclipse

observation

Other physics related topics in LACE

- Interfacing physics parameterizations
- Orographic effect parametrization for radiation

  Presentation
  C. Wittmann
- Study of turbulence in grey zone

  Presentation
  David Lancz
- Convection diagnostics

Interfacing physics parameterizations

- Cross-use of equivalent schemes
- Reorganization and cleaning of ALARO computations inside APLPAR routine
  - ACRANEB2 done
    - Used as feasibility study
    - grouping of aerosol, albedo, cloudiness, ozone, co2 in dedicated subroutines
  - TOUCANS (started)
    - Analysis of turbulence computations under APLPAR
    - Identification of computational “blocks”
    - Proposal and test of new organization under separate switch

Convection diagnostics

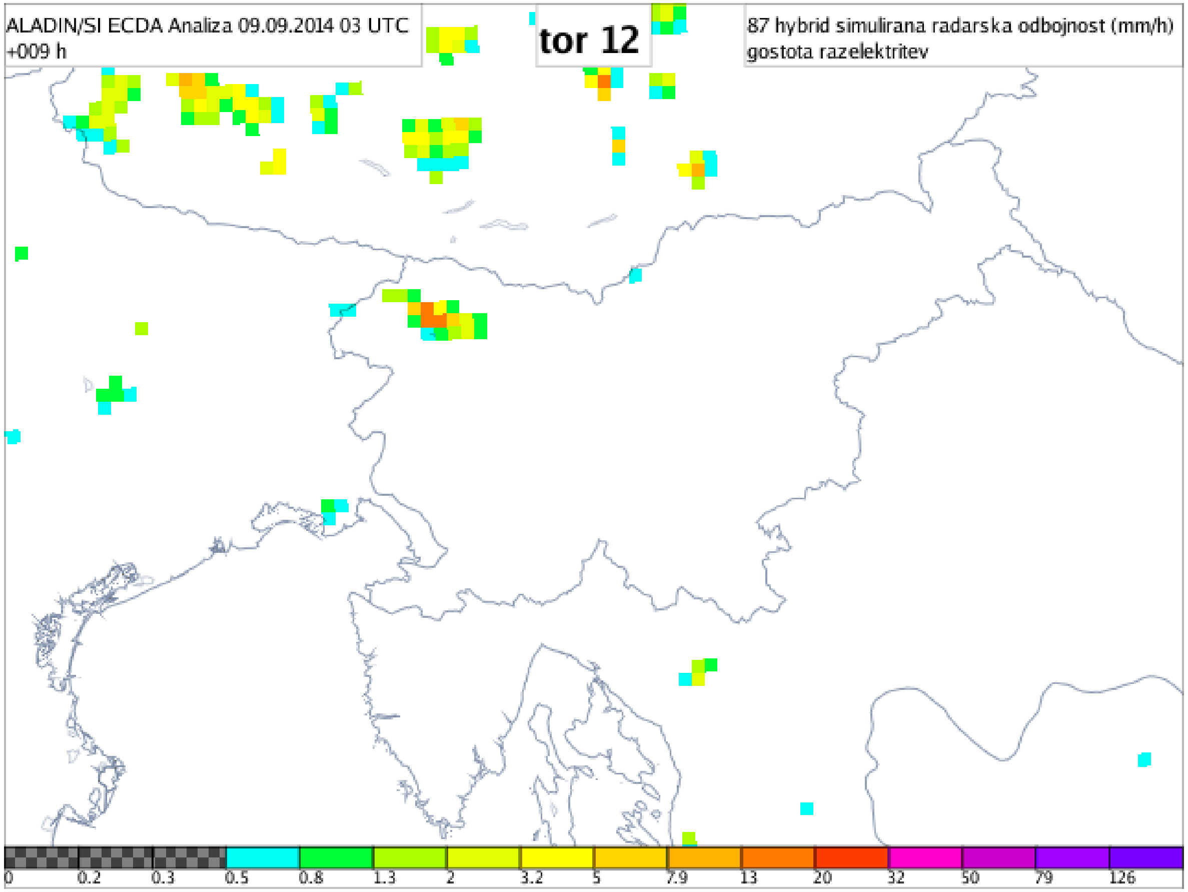
“convection package” for cy38t1_bf3 prepared
available at http://www.rclace.eu/?page=12
validation by users needed

- mixed layer CAPE
- storm motion vector, relative helicity,
- deep layer shear, low level shear
- temperature lapse rate (vertical temperature gradient)
- lightning diagnostics
  - 4 different methods in test
  - as an instantaneous or as an accumulated flux ?

Lightning diagnostics

Simulated radar reflectivity

Lightning density



- Type of the process
- Location and timing can differ from reality

Plans

- ALARO-1 next steps
  - Focus on:
    - unsaturated downdraft
    - prognostic graupel
    - Shallow Convection Cloudiness and prognostic mixing length in TOUCANS
    - unified cloud cover treatment in radiation, shallow convection, thermodynamic adjustment and 3MT
    - linking with SURFEX
  - To come:
    - complementary sub-grid drafts (CSD),
    - TOUCANS evolution,
    - Cellular Automaton some adaptations needed

Presentation
Luc Gerard