Shortwave Radiation in HARMONIE

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Overview

1. Introduction
2. Radiation schemes in HARMONIE
3. Status
4. Studies with MUSC - 1D HARMONIE
5. 3D experiments
6. Conclusions

Introduction

- The default radiation scheme in HARMONIE is the IFS cy25r radiation scheme

- Starting in 2012, a targeted effort has been to work on testing and improving the radiation scheme

Radiation schemes & aerosols in HARMONIE

- **Radiation schemes:**

  - IFS - ECMWF cy25R1, 2002 - new cloud liquid optics (Nielsen et al., 2014)

  - ACRANEB2 - ALARO v1, 2015 (Mašek et al., 2015)

  - HLRADIA - adapted from HiRLAM, new aerosol treatment (Baklanov et al., 2015)

  (See poster by Gleeson et al. for further details).

- **Aerosols:** Monthly climatologies of AOD at 550 nm (Tegen et al., 1997) and parameterized AOD scalings, SSA and g (Hess et al., 1998)

Radiation schemes & aerosols in HARMONIE

Scheme	Radiation Info	Aerosols
IFS *(IFS Morcrette cycle 25R1,2002)*	• *Several cloud liquid/ice optical property schemes available* • *6 SW bands, 16 LW with 140 k values*	• *Monthly AOD climatologies at 550nm (Tegen et al.); spectral AOD scaling, SSA and g (Hess et al.)* • *Land, sea, urban, desert, stratospheric background and stratospheric volcanic*
ACRANEB2	• *1 SW, 1 LW*	• *Uses the same aerosols as IFS*
HLRADIA - aero_rt6	• *1 SW, 1 LW*	• *Uses the same aerosols as IFS*

Status

Shortwave irradiances

Clear sky

Clouds

Aerosols

Surface coupling

Output variables

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Shortwave irradiances

Clear sky

- *IFS schemes performs excellently (GMD 2014)*
- *hlradia SW clear sky calculation has been adjusted (Gleeson, TBP)*

Clouds

- *IFS liquid cloud schemes (Fouquart & Slingo) found to be sub-optimal*
- *New liquid cloud scheme (GMD 2014)*
- *hlradia SW cloudy sky scheme performs well (GMD 2014)*
- *The Fu (1996) ice cloud scheme should be made default (GMD 2014)*

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Aerosols

- *Tests of climatological and offline input aerosols from C-IFS and SILAM (Velle Toll, several publications already)*
- *Test of aerosols with MUSC (Emily Gleeson et al. -* **see the poster!***)*

Surface coupling

- *Updates made to apl_arome.F90 and radheat.F90 to use the correct spectral albedos for the global radiation calculations (cy 38h1.2).*
- *Implementation of HIRLAM ORORAD (Chr. Wittman's presentation)*

Output variables

- *Direct horizontal and direct normal irradiances (DNI) added as output variables (cy 38h1.2). See also my (Nielsen) poster.*

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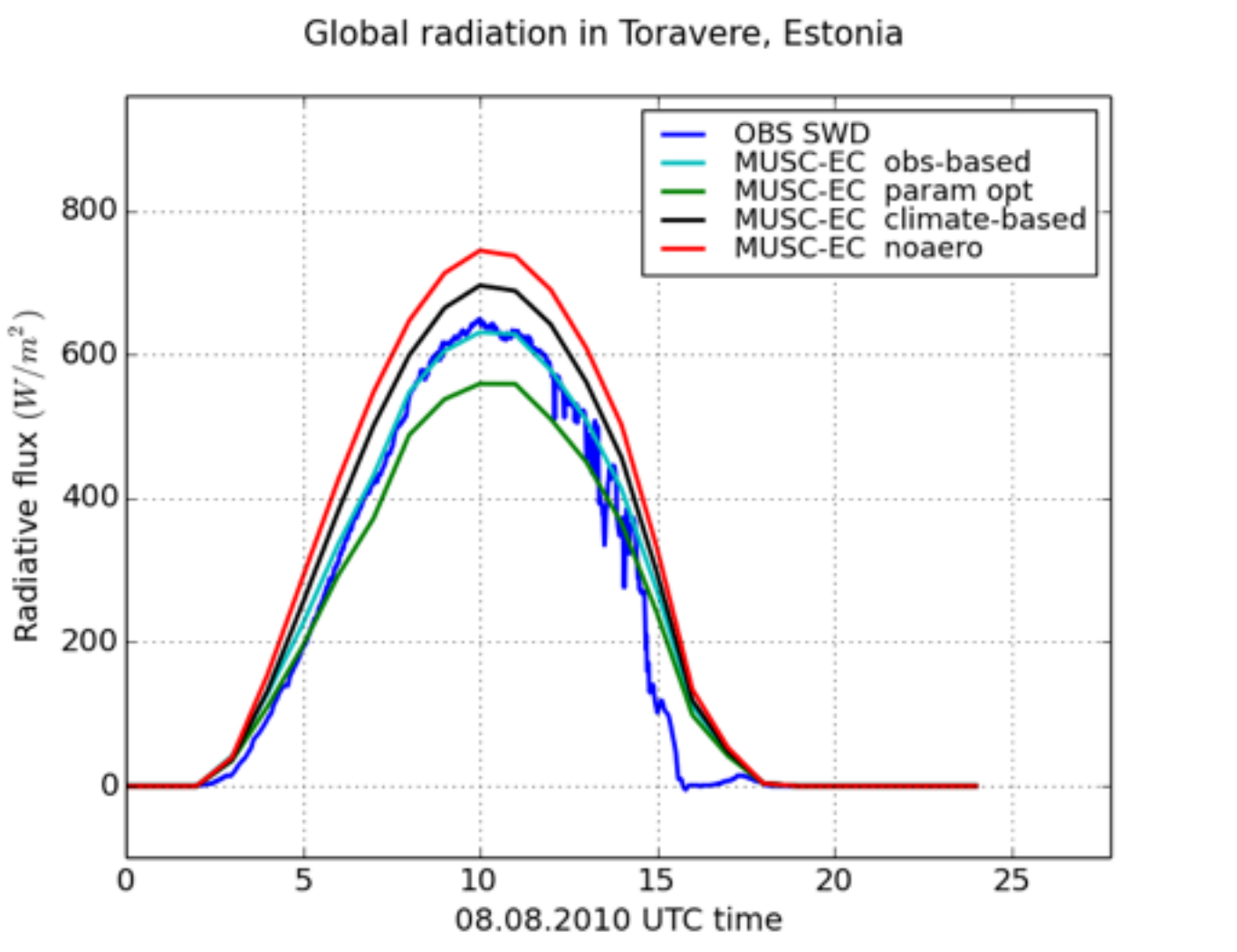
Russian wildfire case

MUSC **IFS** global radiation v.s. BSRN observations



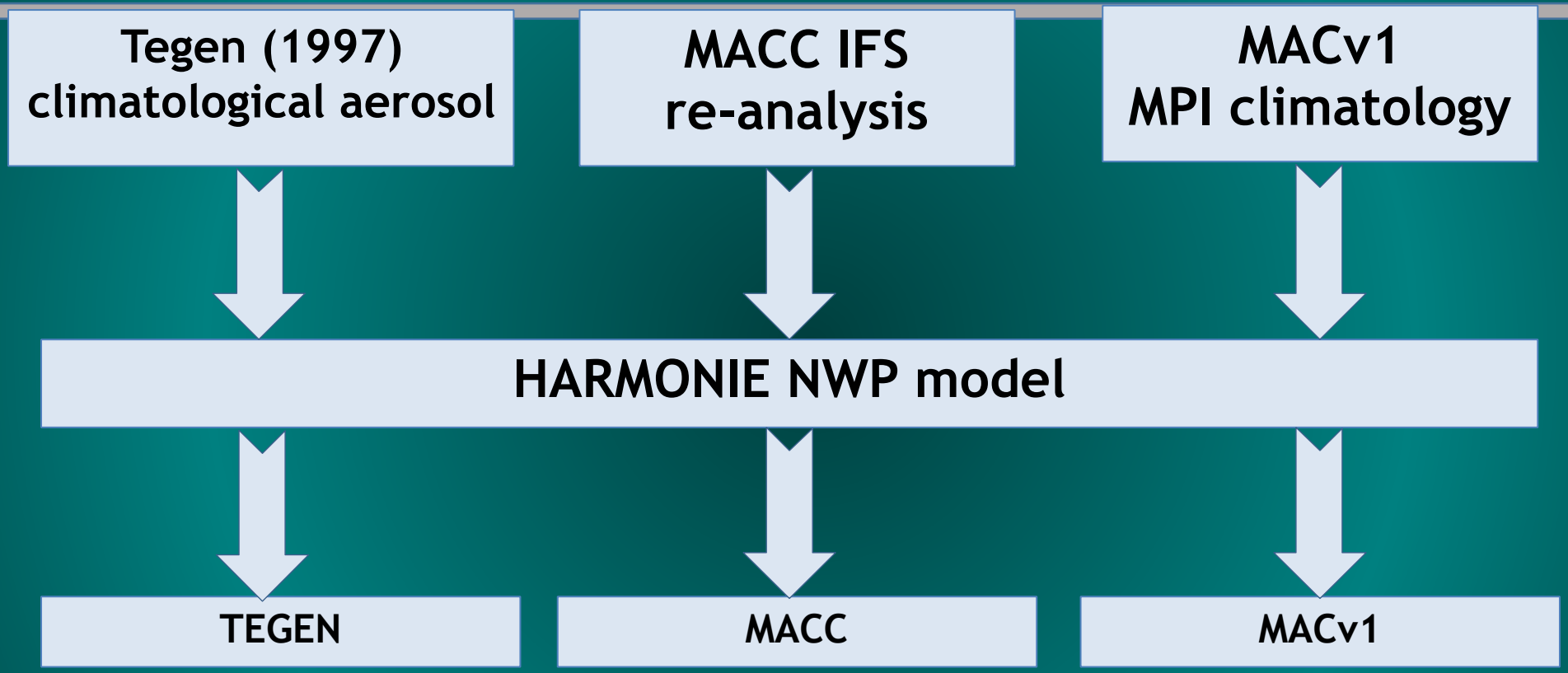
optical properties and AOD 550nm based on observations

parametrized optical properties, observed AOD 550nm land aerosol

parametrized optical properties, climatological AOD 550nm

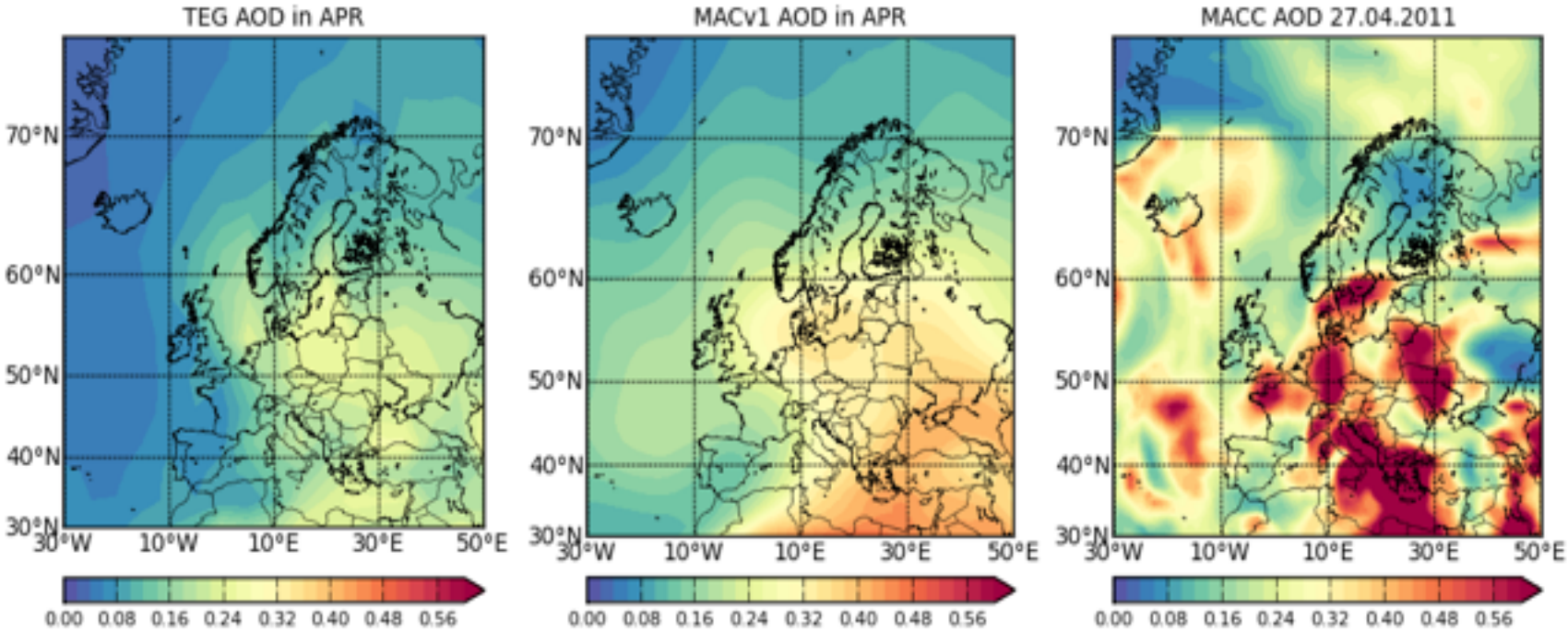
No aerosol

3D experimental design for large-scale experiments



Tegen, MACC IFS and MACv1 output used for simulating the aerosol direct radiative effect with NWP model HARMONIE

Including direct radiative effect of aerosols from different data sets



AOD in April from Tegen et al. (1997) used in HARMONIE by default, from more up to date MACv1 climatology and from MACC reanalysis.

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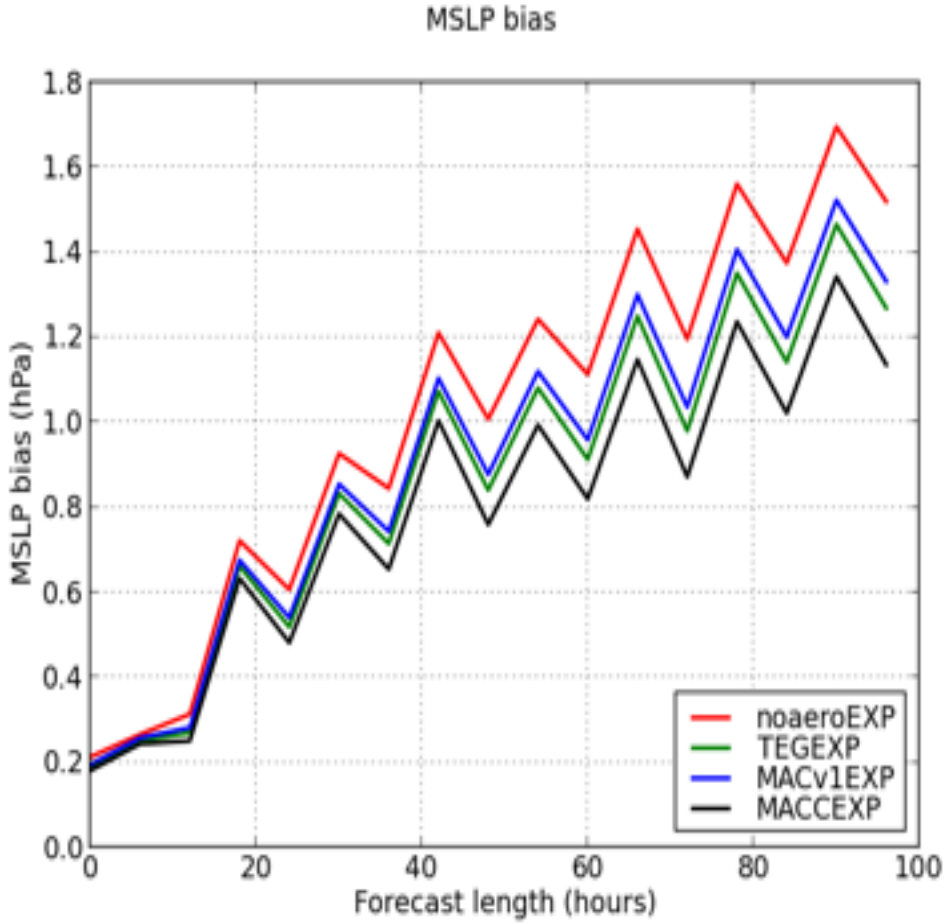
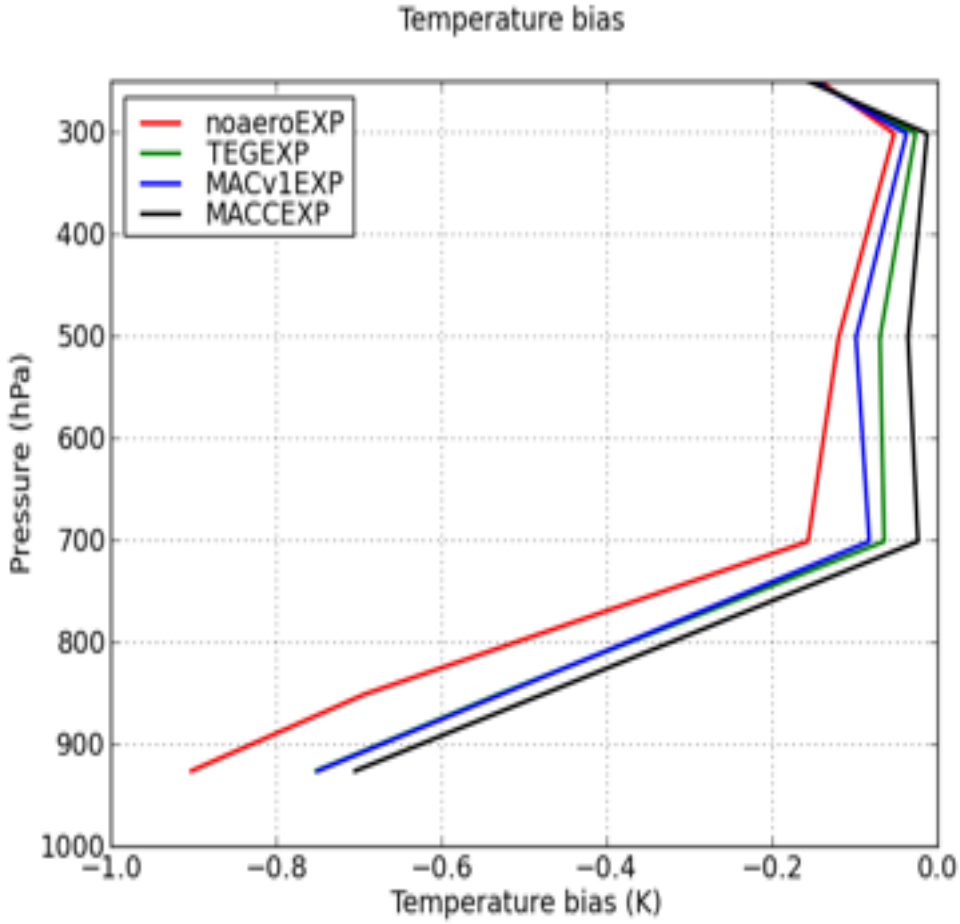




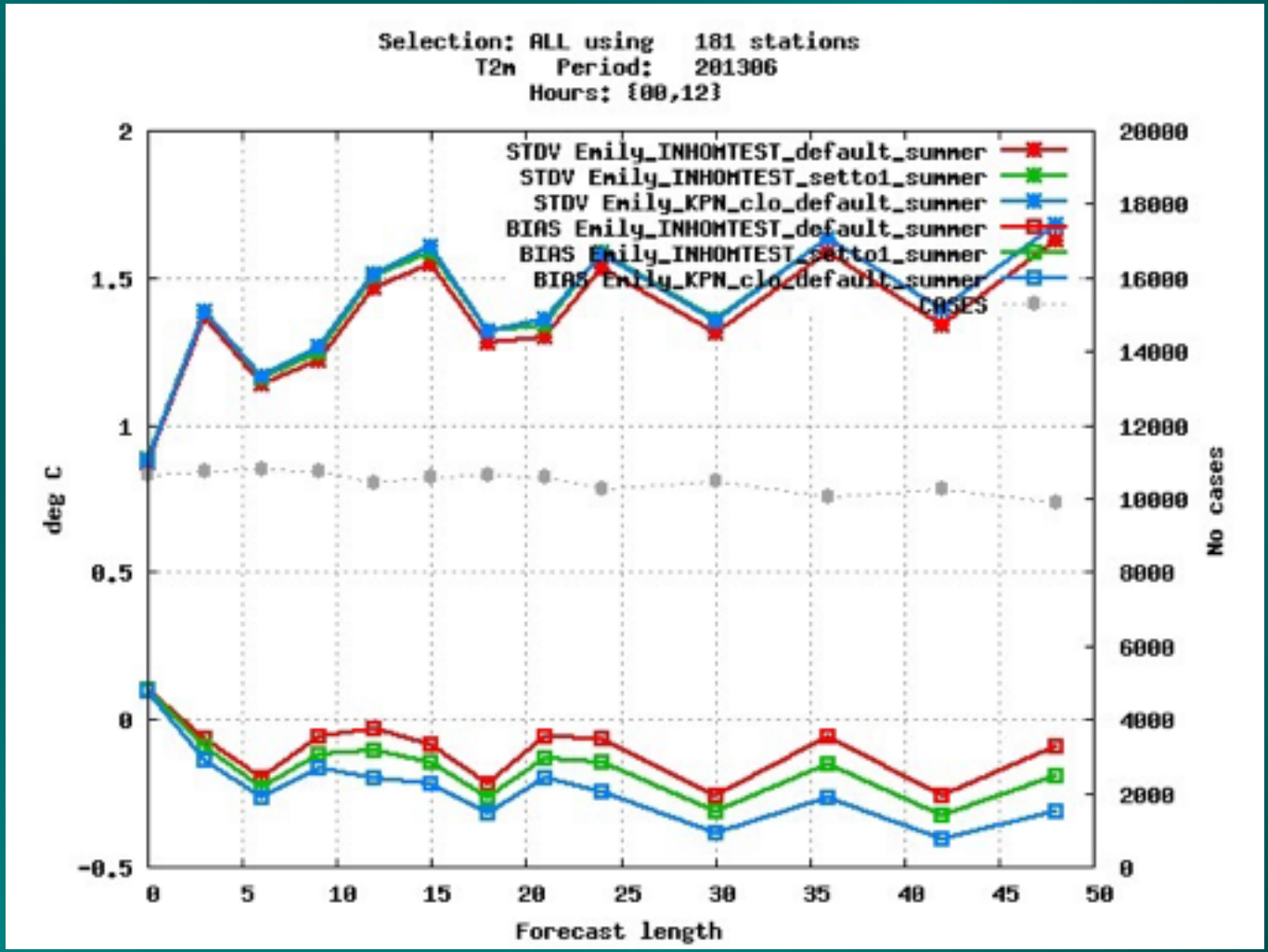
Preliminary results from Ireland and UK HARMONIE 38h1.2 reanalysis

2-meter temperature verification for June 2013.

Default

Cloud Inhomogeneity = 1.0

… and new liquid cloud scheme



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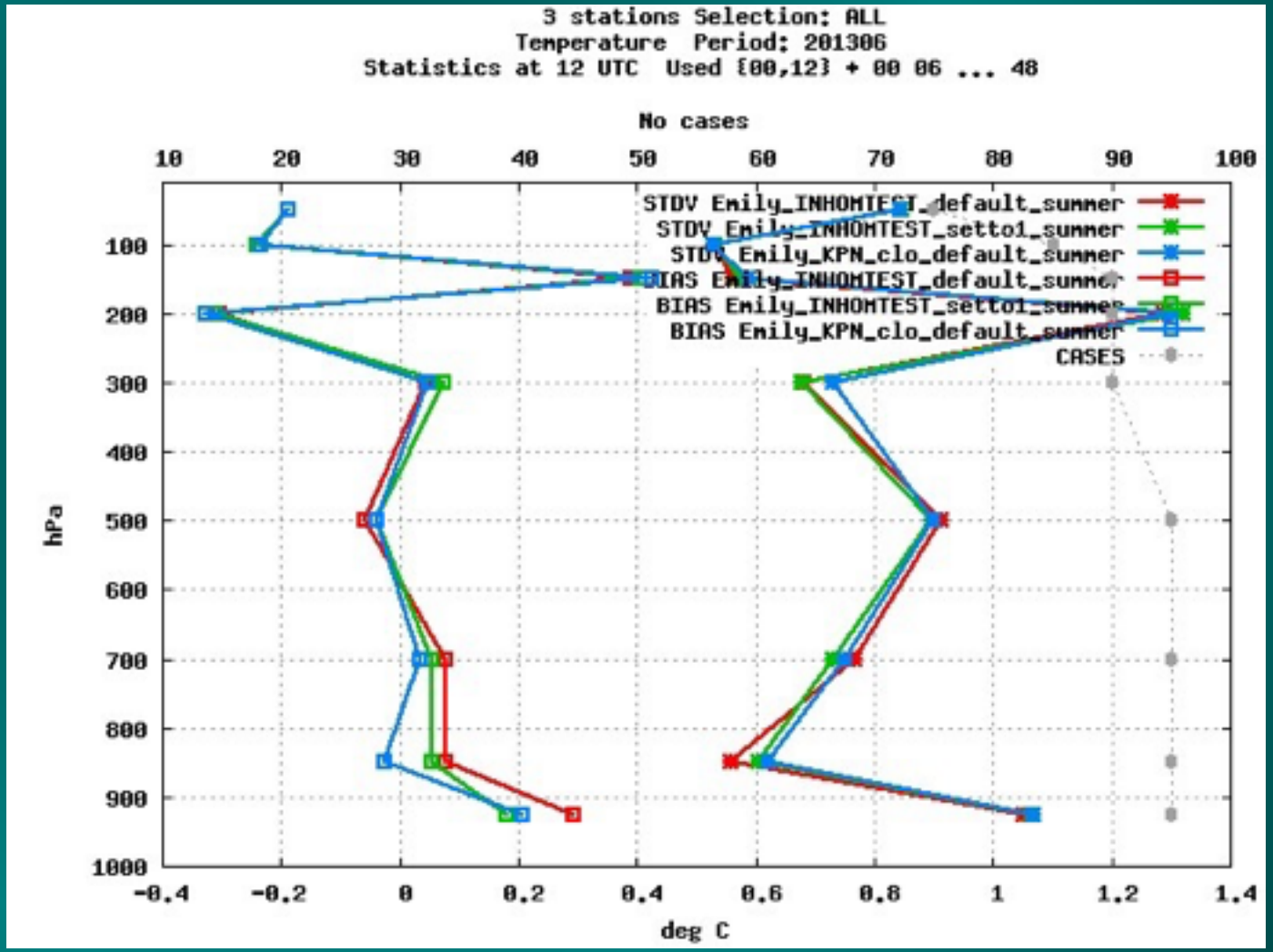
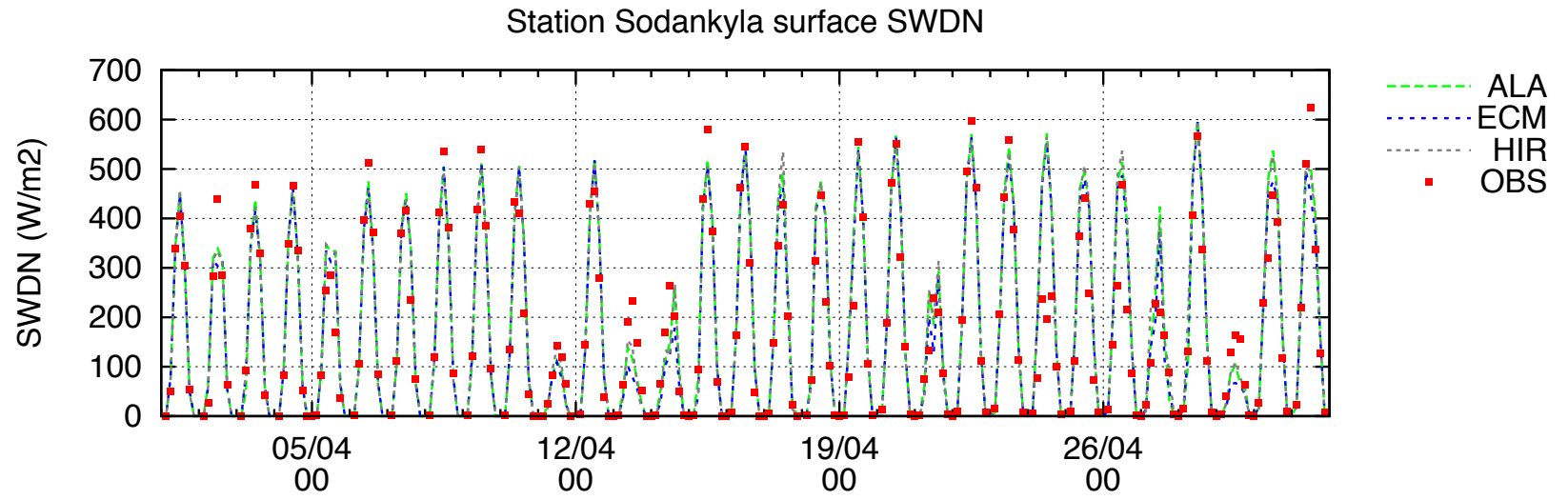
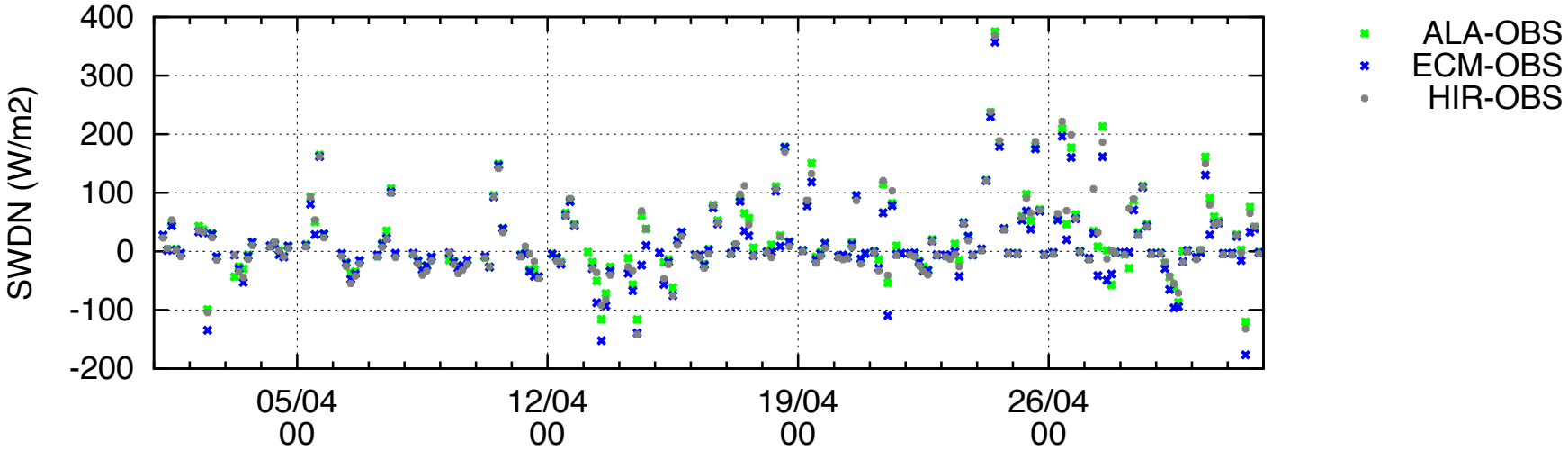


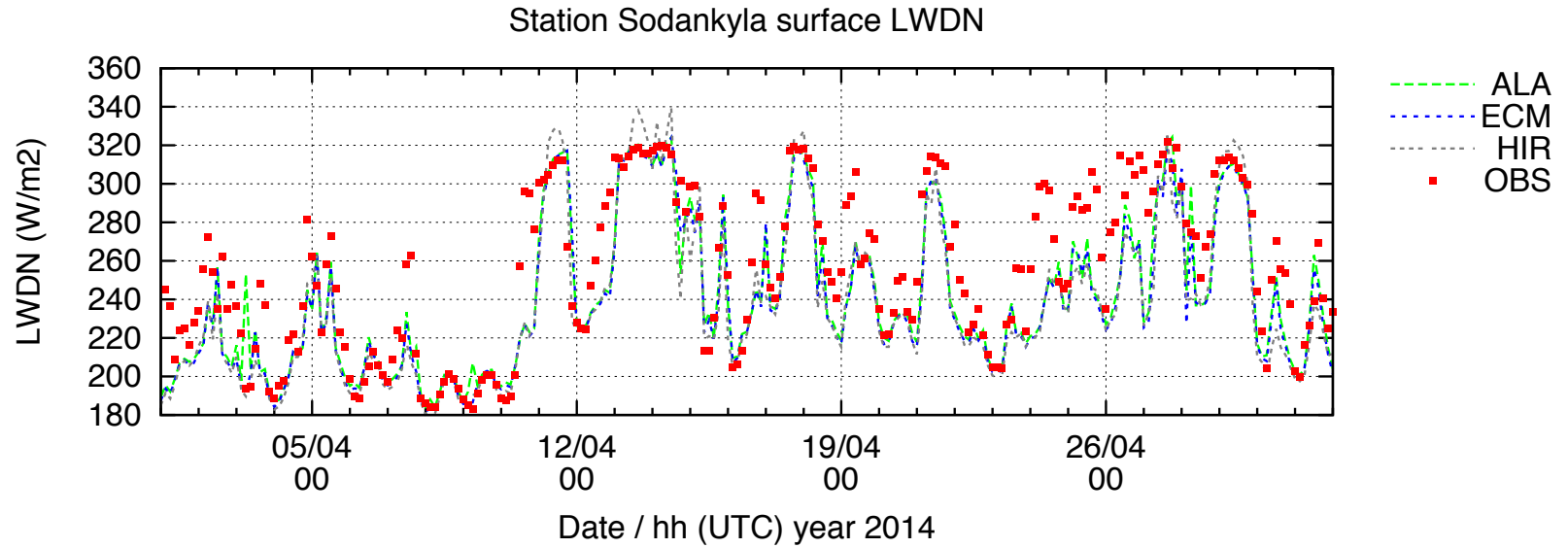
Sodankylä SW verification of the 3 radiation schemes

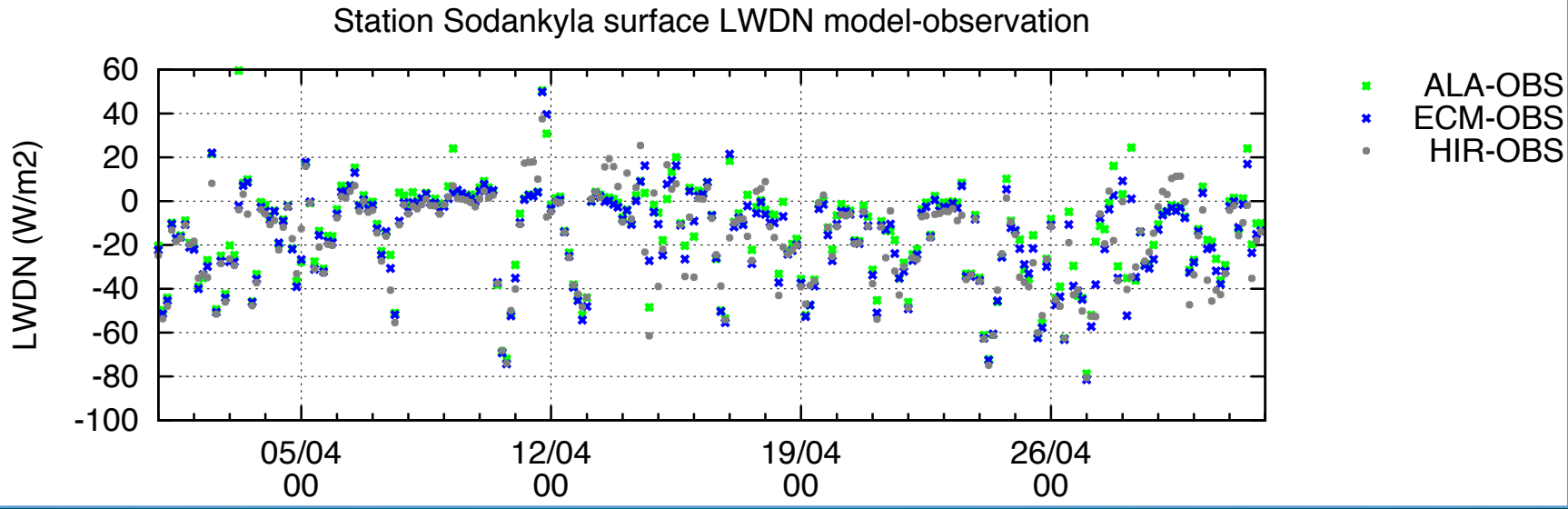


Date / hh (UTC) year 2014



Sodankylä LW verification of the 3 radiation schemes





Summary

- Improvements have been made to the radiation-surface coupling in HARMONIE 38h1.2

- Emily has run aerosol sensitivity tests with MUSC showing the pros and cons of the different aerosol schemes

- Velle has studied the effect of using C-IFS aerosols in HARMONIE rather than climatological aerosols

- A new liquid cloud optical property scheme has been made for HARMONIE 40h

- 3D verification of all the 3 radiation schemes in HARMONIE against Sodankylä radiation measurements have been made


Thank you for listening.
Any questions?