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COSMO WG3b: Activity Review

Jean-Marie Bettems / MeteoSwiss

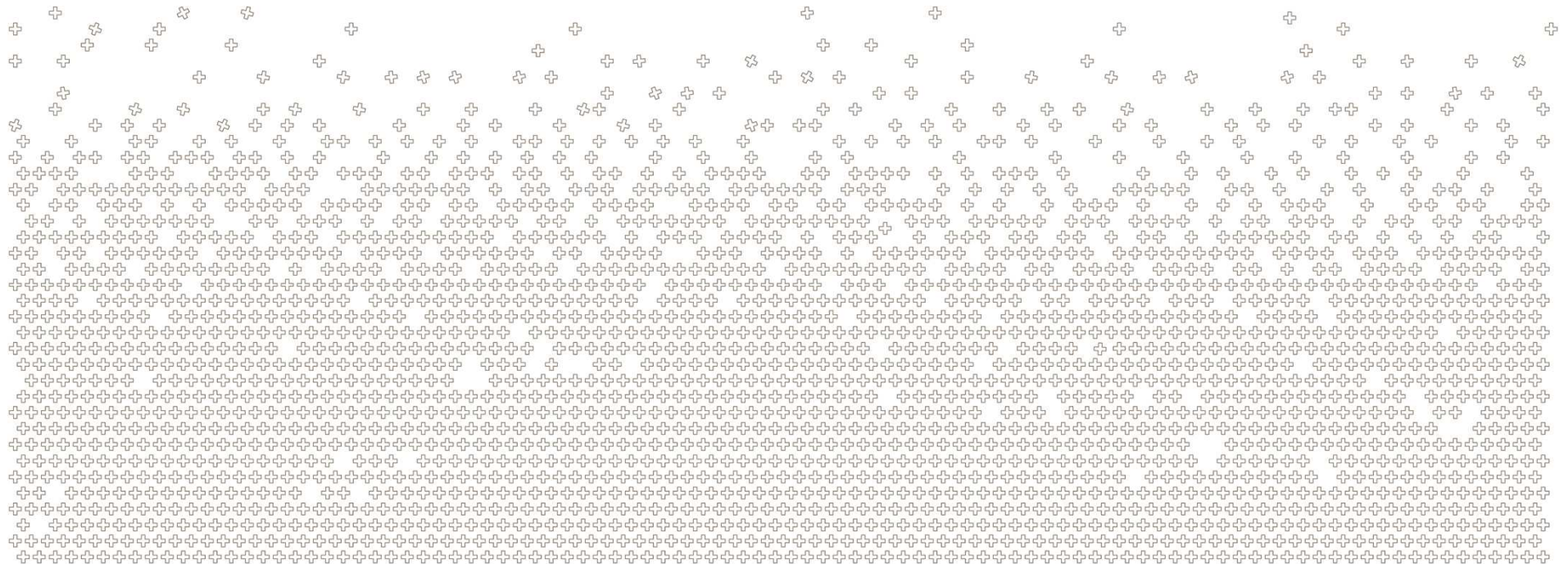
Offenbach, COSMO GM, September 2016



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PP and PT



PP and PT (closed and current)

- **PP CALMO** , 01.2013 – 12.2016, HNMS (*current*)
 - *Deliverable*: method to calibrate model parameters and improve forecast
 - *Open issue*: computing cost of the method (follow-up project?)
- **PT Terra Santa**, 09.2015 – 09.2016, IMS (*closed*)
 - *Deliverable*: updated Terra standalone on COSMO web
- **PT Mire**, 09.2011 – 03.2013, RHM (*closed*)
 - *Deliverable*: improved forecast over mire (e.g. eastern Siberia)
 - *Action pending*: transfer mire code into official COSMO code

PP and PT (closed and current)

- **PT SNOWE, 09.2014 – 09.2015, RHM (closed)**
 - Goal: *improve analysis of snow water equivalent*
 - Key feature: *off line 1D model to compute snow pack density*
 - Benefit: *positive impact on T2m at boundary of snow pack*
 - Deliverable: *full snow analysis package (incl. NOAA snow mask)*
 - Status
 - *Scientific documentation in COSMO Newsletter 16*
 - *Technical documentation and code will be available on COSMO web*

- Snow analysis package used in COSMO: DWD, RHM, MCH...
- Meeting planed at **next CUS** to define requirements and steps towards a possible future unified COSMO snow analysis

PP and PT (new)

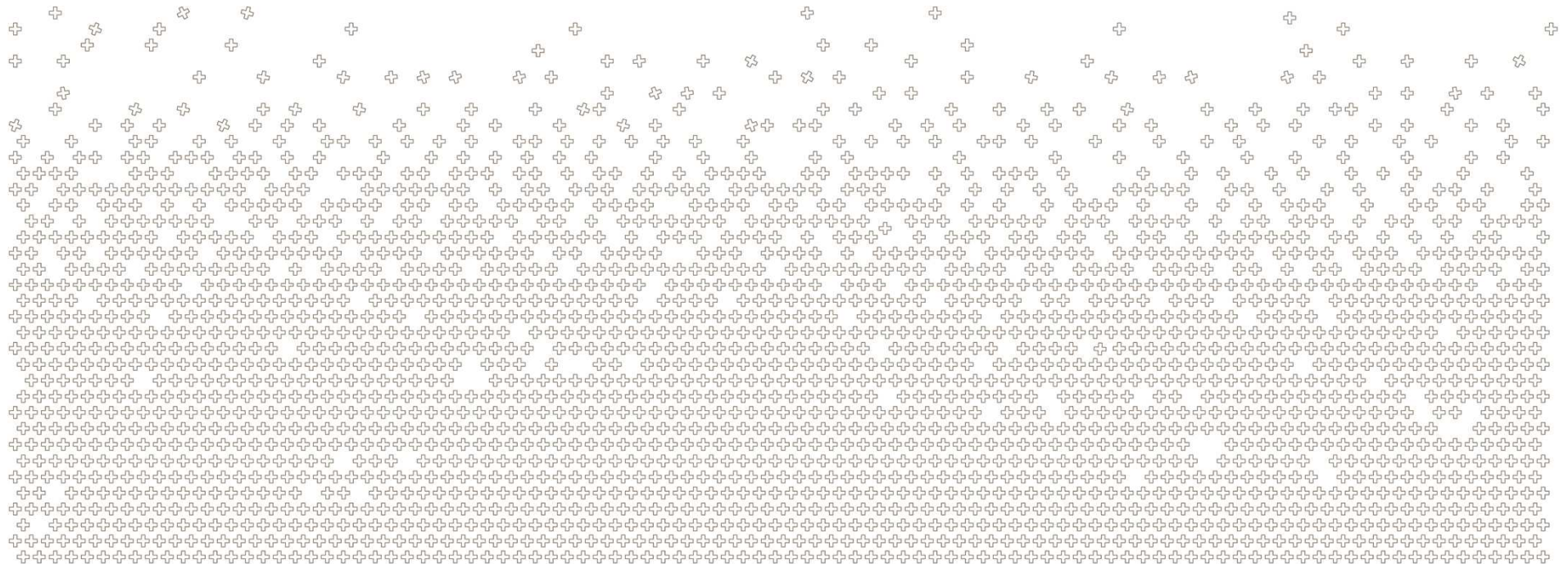
- **PT Terra Nova, 09.2016 – 09.2017, IMS/RHM (new)**
 - Goal: *assess forecast skill of COSMO coupled with the new common ICON / COSMO soil module.*
 - Method:
 - *Multiple domains (central Europe, Israel, NW Russia)*
 - *One summer and one winter period (free run to keep soil memory)*
 - *Standard verification & closer look at new developments (e.g. interception storage)*
 - *Closer look at special land use (e.g. forest, deserts)*
- **Computing resources: ECMWF with MCH billing accounts!**



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TERRA



TERRA

- **Unified COSMO/ICON TERRA in COSMO v5.05 (Q42016)**
 - ... revision of **interception store** (G. Zängl)
 - ... resistance based **bare soil evaporation** (J.-P. Schulz)
 - ... **hydraulic and thermal conductivity** within root zone (J. Helmert)
 - ... some other **tunings** (desert, Greenland)
 - ... *without* tiles
-
- **In addition to some other recent developments...**
 - ... new multi layers **snow model** (lmulti_snow=.t.)
 - ... improved **soil heat conduction** (itype_heatcond=2)
 - ... **exponential root** density profile (itype_root=2)
 - ... advanced **look-up table** for land-use parameters (itype_Indtbl=3)

A new parameterisation of bare soil evaporation for the land surface scheme TERRA of the COSMO atmospheric model

Jan-Peter Schulz¹ and Gerd Vogel²

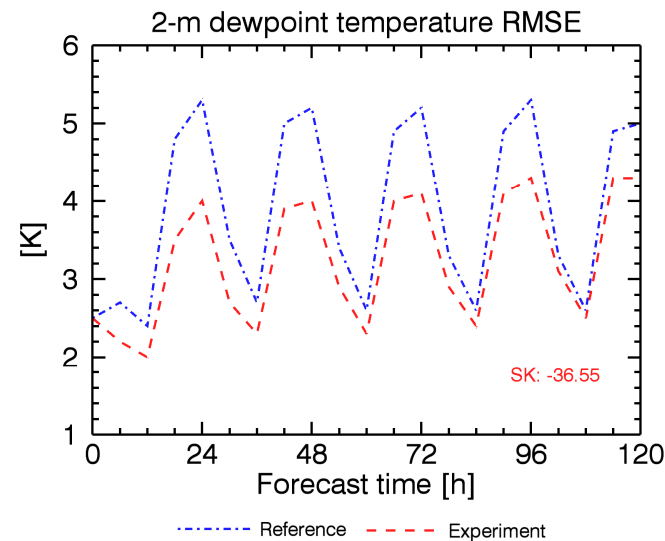
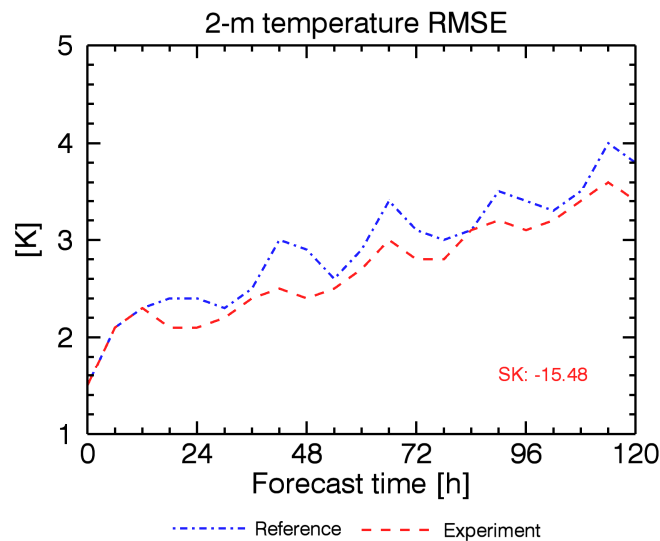
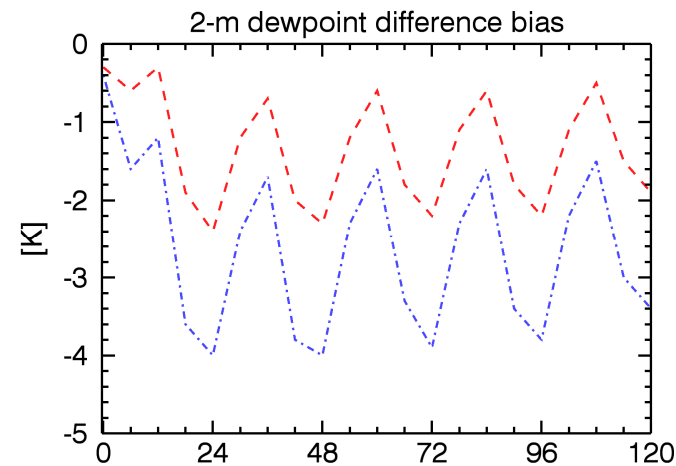
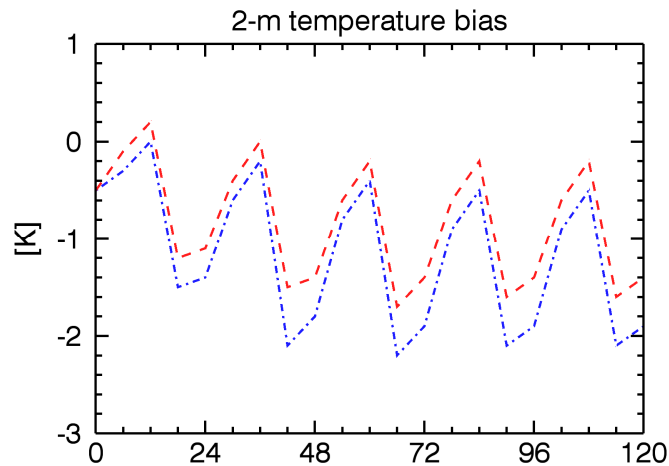
¹Deutscher Wetterdienst, Offenbach, Germany

²Deutscher Wetterdienst, Lindenberg, Germany

COSMO / CLM / ART User Seminar, 7 - 9 Mar. 2016, Offenbach



ICON: NE America, January 2012, 00 UTC



bias

RMSE

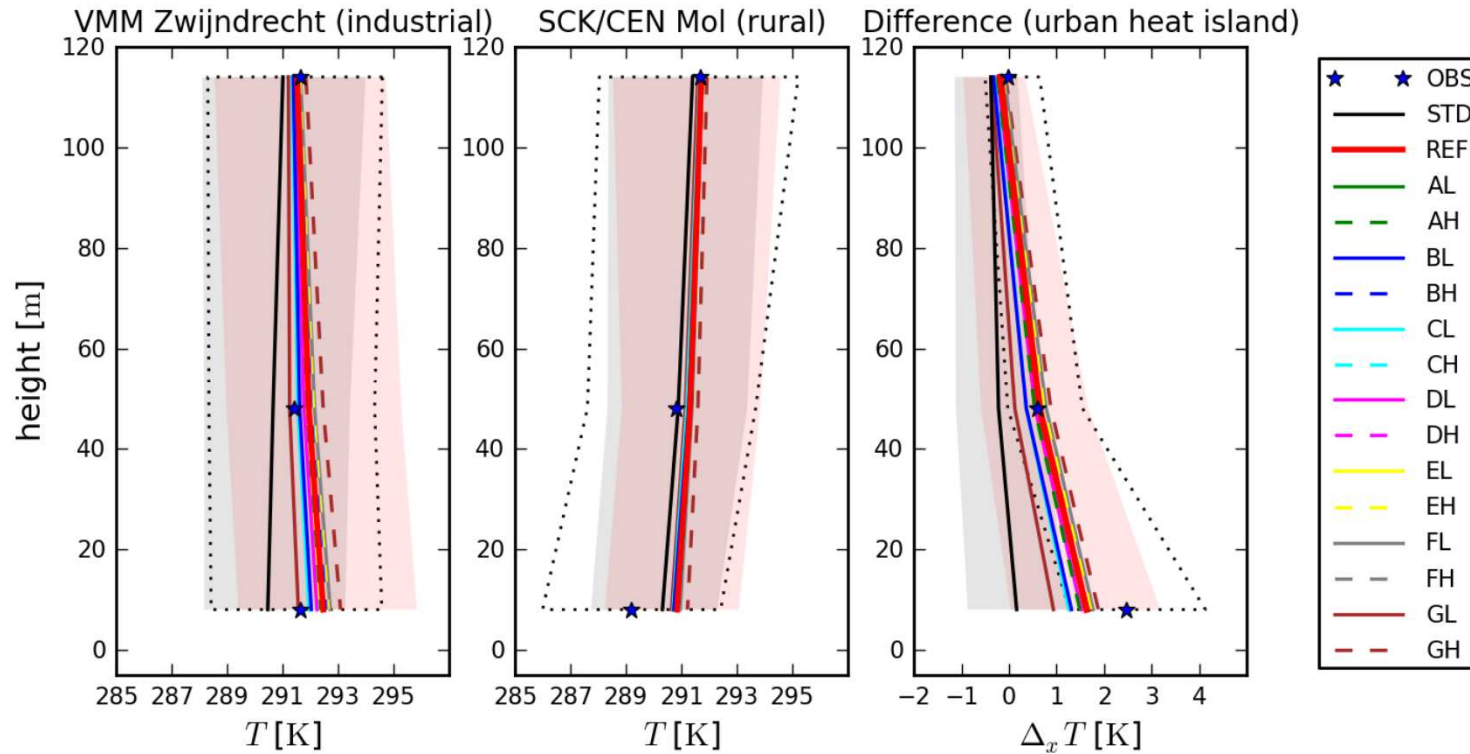
- Cold bias and RMSE of 2-m temperature significantly reduced by resistance equ.
- Moist bias and RMSE of 2-m dewpoint difference substantially reduced



TERRA-URB (*Wouters, H.*)

- Goal: *add cheap but realistic bulk parameterization of urban effects*
- Benefit: *variability of urban heat island well reproduced*
- Status: *peer reviewed paper in 'Geoscientific Model Development'*
two new external parameters in EXTPAR
code will be available in COSMO 5.05
code responsibility by Uli Blahak / DWD
- Evaluation in progress at ARPA-Piemonte (Torino/Cira)
- **A new PT will be proposed to further evaluate/consolidate TERRA-URB**

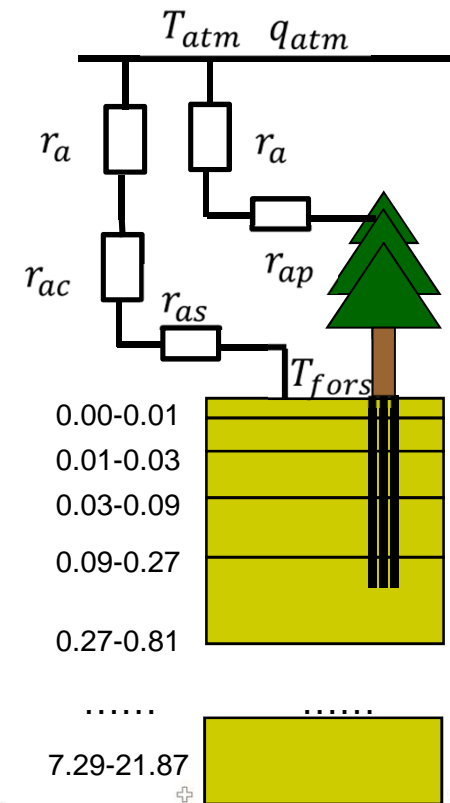
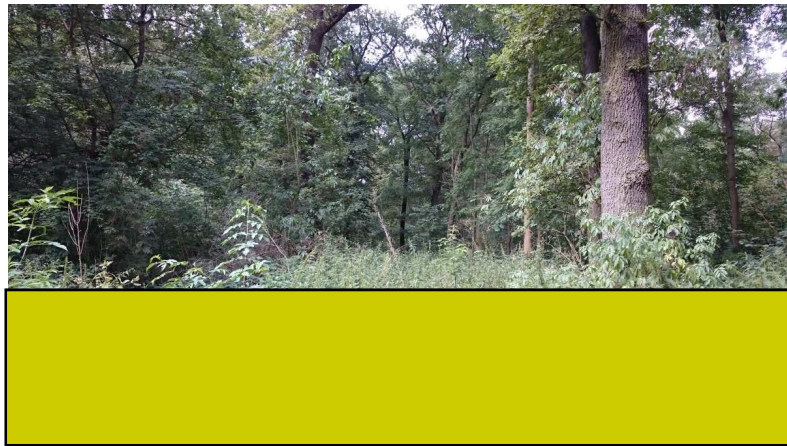
TERRA-URB (*Wouters, H.*)

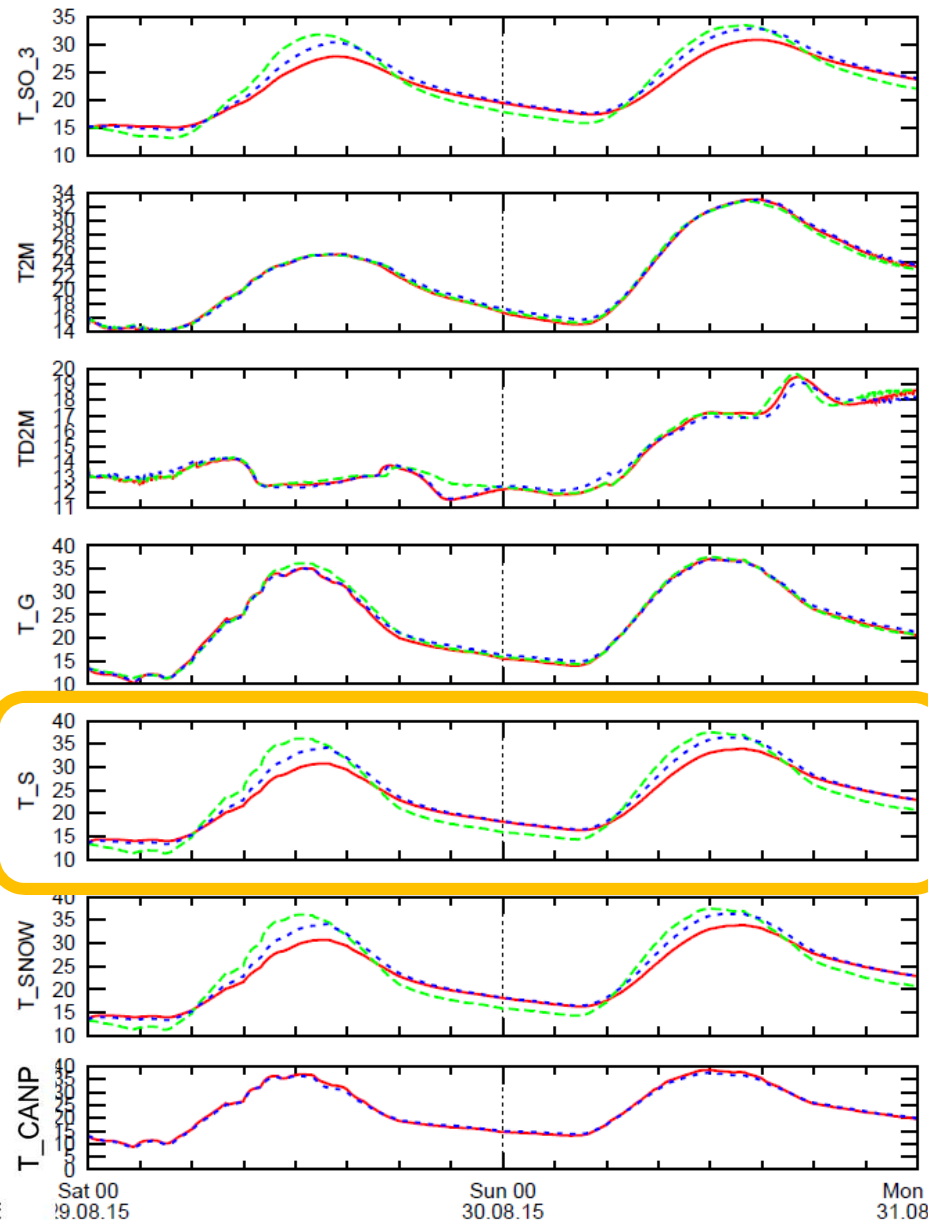
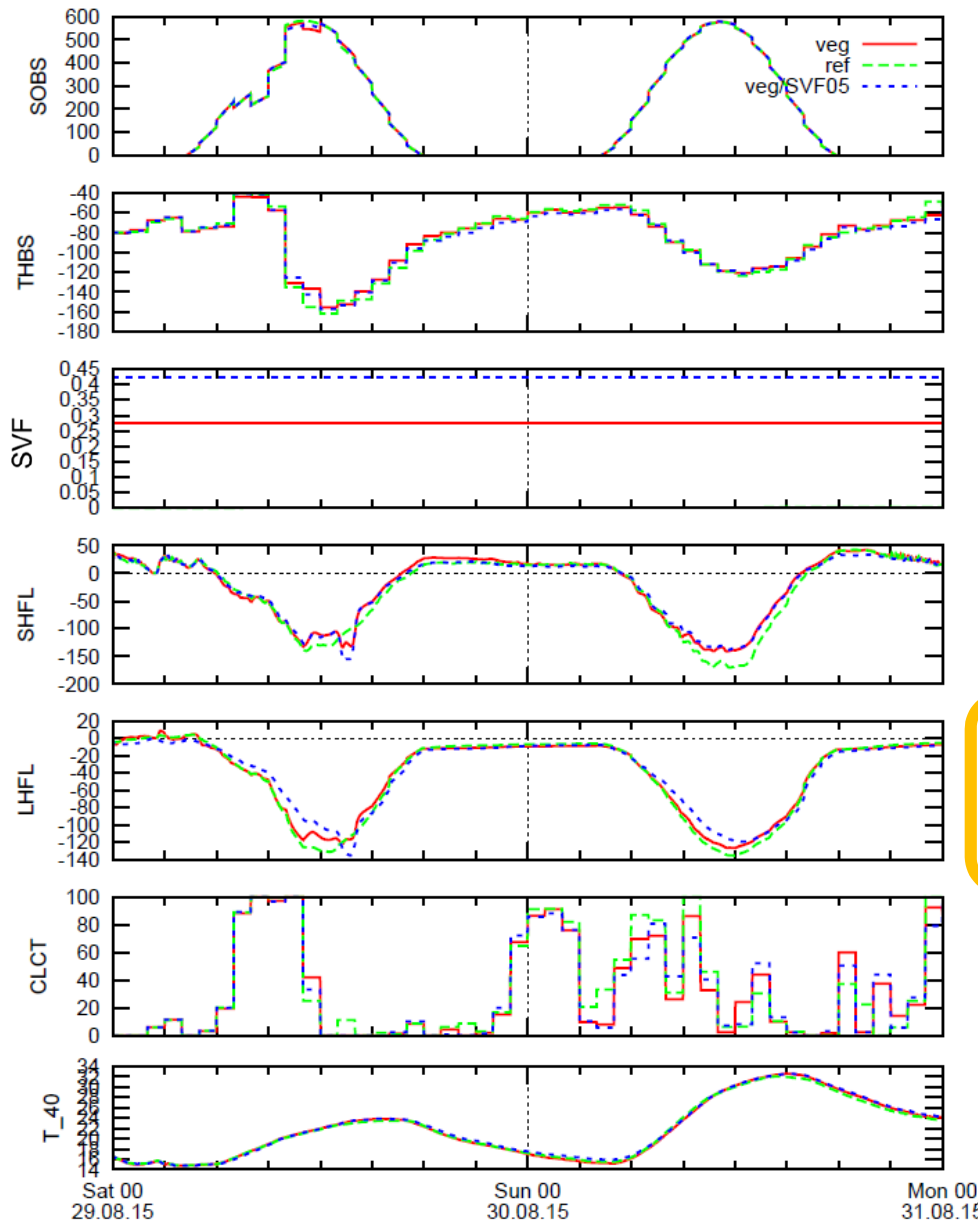


Observed (stars) and modelled (lines) **nocturnal (OH) vertical profiles** for industrial site in Zwijndrecht and the rural site in Mol, averaged for the **summer period 2012/07/21 - 2012/08/20**.

TERRA – Outlook

- New developments based on common COSMO/ICON module
- ... vegetation canopy





Falkenberg: Lat=52.18°N, Lon=14.08°E, H=70 m. Indices 329 357
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TERRA – Outlook

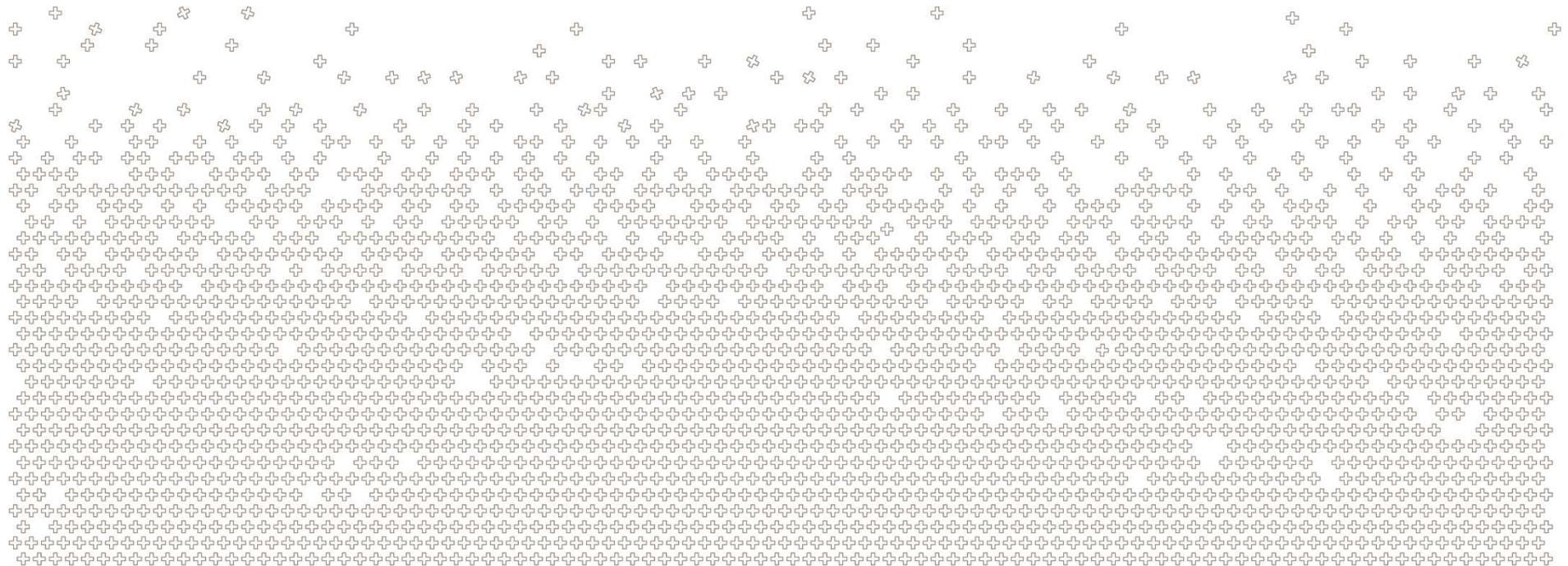
- **Work at IMGW**
 - Revisiting bare soil parameterization in TERRA
 - Peer reviewed paper in preparation (Tellus A)



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Some input from ETHZ



PRUDENCE → ENSEMBLES → EURO-CORDEX

Persistent systematic biases

(e.g., predominance of cold biases, southern Europe warm summer bias, overestimation of summer variability, see e.g. Kotlarski et al., 2014)



**Is land surface processes
representation the weak link in
current RCMs?**

TERRA – EURO-CORDEX

- **EURO-CORDEX: Historical ERAint-driven RCM runs over Europe (0.44 degree)**
Edouard Davin, Eric Maisonnave, Sonia Seneviratne / ETHZ

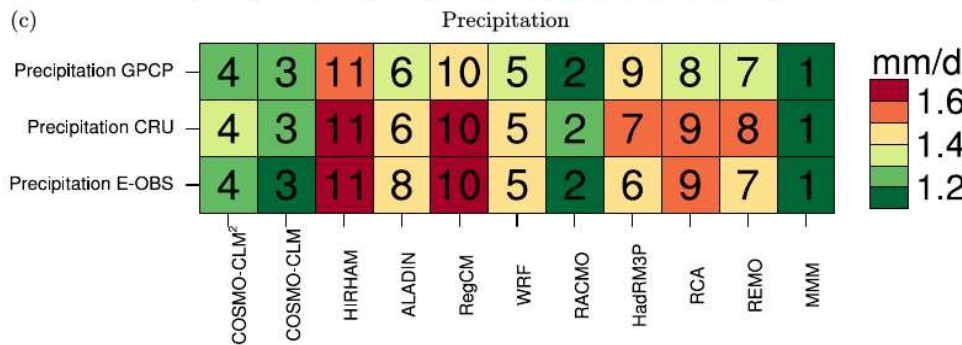
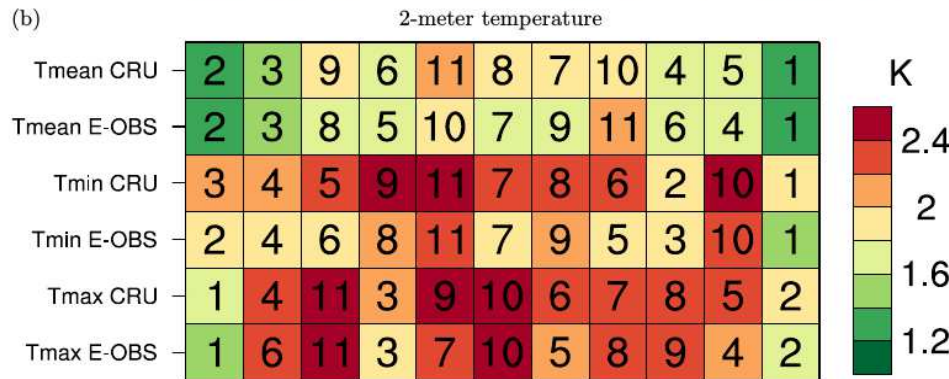
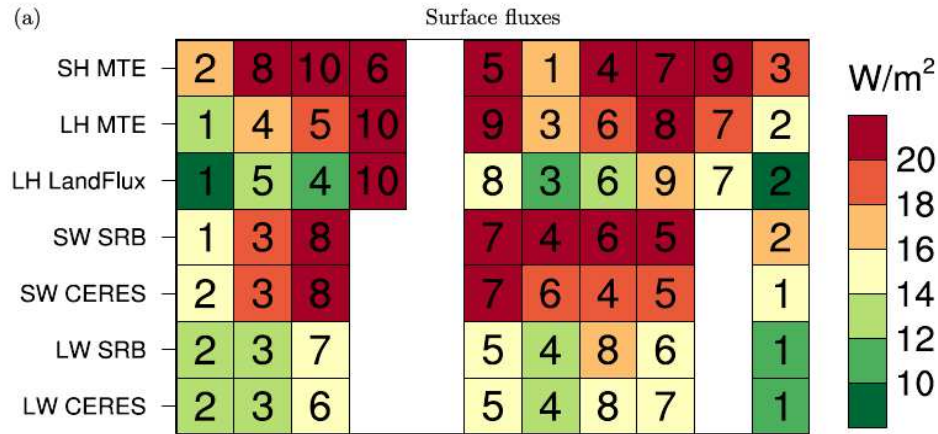
Model	Institution	LSM
ALADIN 5.2	HMS	ISBA (Noilhan and Planton, 1989; Douville et al., 2000)
HIRHAM 5	DMI	(Hagemann, 2002)
WRF 3.3.1	IPSL-INERIS	NOAH (Ek et al., 2003)
RACMO 2	KNMI	(Balsamo et al., 2009)
HadRM 3P	MOHC	MOSES (Cox et al., 1999)
RCA 4	SMHI	(Samuelsson et al., 2006)
REMO 2009	MPI-CSC	(Hagemann, 2002; Rechid et al., 2009)
RegCM 4.3	ICTP	BATS (Dickinson, 1984)
COSMO-CLM 4.8.17	CLM-Community	TERRA_ML (Doms et al., 2011)
COSMO-CLM ²	ETH Zurich	CLM4.0 (Oleson et al., 2010; Lawrence et al., 2011)

TERRA – EURO-CORDEX

- RMSE score integrating spatial and temporal performance (based on monthly means)
- Surface fluxes, temperature, precipitation
- Whenever possible several reference datasets are used

Dataset	Variables	Resolution	Time period	Reference
CRU TS3.22	2-m temperature precipitation cloud cover	0.5x0.5	1990-2008	(Harris et al., 2014)
E-OBS v11	2-m temperature precipitation	0.5x0.5	1990-2008	(Haylock et al., 2008)
GPCP2.2	precipitation	2.5x2.5	1990-2008	(Huffman et al., 2009)
FLUXNET MTE	latent heat sensible heat	0.5x0.5	1990-2008	(Jung et al., 2011)
LandFlux-EVAL	latent heat	1x1	1990-2005	(Mueller et al., 2013)
SRB3.0	shortwave radiation longwave radiation	1x1	1990-2007	(Zhang et al., 2015)
CERES	shortwave radiation longwave radiation	1x1	2001-2008	(Rutan et al., 2015)

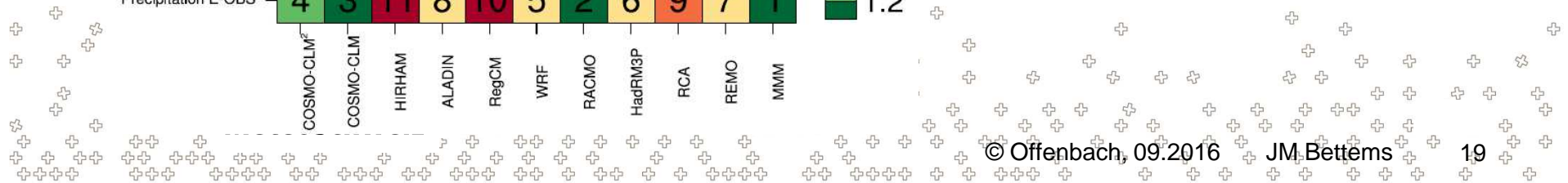
TERRA – EURO-CORDEX



Multi-scores ranking

- COSMO-CLM² outperforms COSMO-CLM and most other RCMs for surface fluxes and temperature

- No improvement for precipitation



Some input from ETHZ...

- Paper in *Environmental Research Letters* by E. Davin et al. clearly makes the point that COSMO-CLM² outperforms COSMO-CLM and most other RCMs for surface fluxes and temperature (without any expert tuning!)
- **How to transfer this knowledge into an improvement of the 'standard' COSMO configuration?**
 - A common project with ETHZ / MeteoSwiss / COSMO would be most welcome by Prof. S. Seniviratne...
 - ... High resolution tests of COSMO/CLM, in NWP mode (concurrently to PT Terra Nova)
 - ... Discussion at ETHZ on October 19th, input welcomed



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Support



EXTPAR

- MACv2 aerosol being implemented by D. Luethi & RHM (in particular for project T2(RC)2)
- Bug found in computation of SSO-THETA when topo smoothing is applied (EXTPAR @ DWD)
- D. Luethi will resign from the function of SCA for EXTPAR after completion of this task. Successor to be defined by StC.

SRNWP data pool

- **NetCDF** format available (work in progress)
- Data set now open to **universities** and **R&D institutions**
- Problems with **data quality** and **availability** for some sites
- **Very limited usage!**
- **Action started at SRNWP level**
(questionary, cost evaluation, EUMETNET resources...)

Thank you for your attention!