ΕΘΝΙΚΗ ΜΕΤΕΩΡΟΛΟΓΙΚΗ ΥΠΗΡΕΣΙΑ
HELLENIC NATIONAL METEOROLOGICAL SERVICE

CONSORTIUM FOR SMALL SCALE MODELING
COSMO

CALibration of the COSMO MOdel CALMO -MAX

Athens, Workshop

7-9.01.2019

Monday 07.01.19

09:00-09:05 Opening-Agenda (A. Voudouri)
09:05-10:00 Status of CALMO-MAX project (A. Voudouri)
10:00-10:30 CALMO and CALMO-MAX @ MeteoSwiss (J. M. Bettems)
10:30-11:00 Coffee Break
11:00-12:00 Experimental design (E. Avgoustoglou)
12:00-13:00 Status of the MM (I. Carmona)
13:00-14:00 Lunch Break
14:00-14:30 Joint effort with ETHZ (S. Soerland)
14:30-15:30 Technical issues on model simulations (A. Voudouri)
15:30-16:00 Performance scores (IMS, all)
16:00-17:00 Open Issues of the PP (all)

Tuesday 08.01.2019

08:30-09:30 CALMO-MAX @ CIRA, COTTBUS (E. Bucchignani, A. Will)
09:30-10:30 Optimization of CALMO-MAX methodology (all)
10.30-11.00 Coffee Break
11.00-12.30 CALMO-MAX @ECMWF (HNMS, CIRA, MeteoSwiss, IMS)
12.30-13:00 Lunch Break
13:00-14:30 Discussion
14:30-16:00 CALMO-MAX Roadmap

Wednesday 09.01.2019
(Database of unconfined model parameters)

08:30-09:00 Introduction on parameters used within CALMO & CALMO-MAX (A. Voudouri)
09:00-09:30 COSMO PPs using/inducing unconfined model parameters (all)
09:30-10:30 Updating existing list of unconfined model parameters (CALMO group/Model developers)
10.30-11.00 Coffee Break
11.00-12.30 Definition of a protocol for the unconfined parameters (all)
12.30-13:00 Lunch Break
13:00-14:15 Decision on steps for the maintenance of parameter lists (all)
14:15-14:30 Closure

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Status summary

CONSORTIUM FOR SMALL SCALE MODELING COSMO

- The project is on-going at least until September 2019, **possible extension until September 2020 to be discussed**
- Computing resources on Daint / CSCS no longer available (apply for resources???).
- Calibration of COSMO-1 for 5 parameters, after sanity check of the proposed configuration (48TB already generated).
- Collaboration with ETHZ and University of Cottbus
- **Documents and deliverables**
  - A second paper was published in Atm. Res.
  - Part of the work was presented at an International conferenced (COMECAP -http://comecap2018.gr/)
  - Meta model available @ https://github.com/COSMO-ORG/CALMO-MM

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CONSORTIUM FOR SMALL SCALE MODELING COSMO

Meta Model Status summary (IMS contribution)

- A perturbed initial condition run was made to estimate the internal model variability. This is used to screen out cases where internal model variability is larger that parameter dependency.
- Spatial verification for precipitation (FSS) has been included in the performance score
- 2m dew point temperature (from INCA) has been introduced in the performance score to reduce the risk of over fitting the temperature.
- Included sunshine duration in the performance score, using Frei et al. (2015) km-scale gridded dataset, is under consideration
- MatLab code efficiency
- Matlab to Octave?

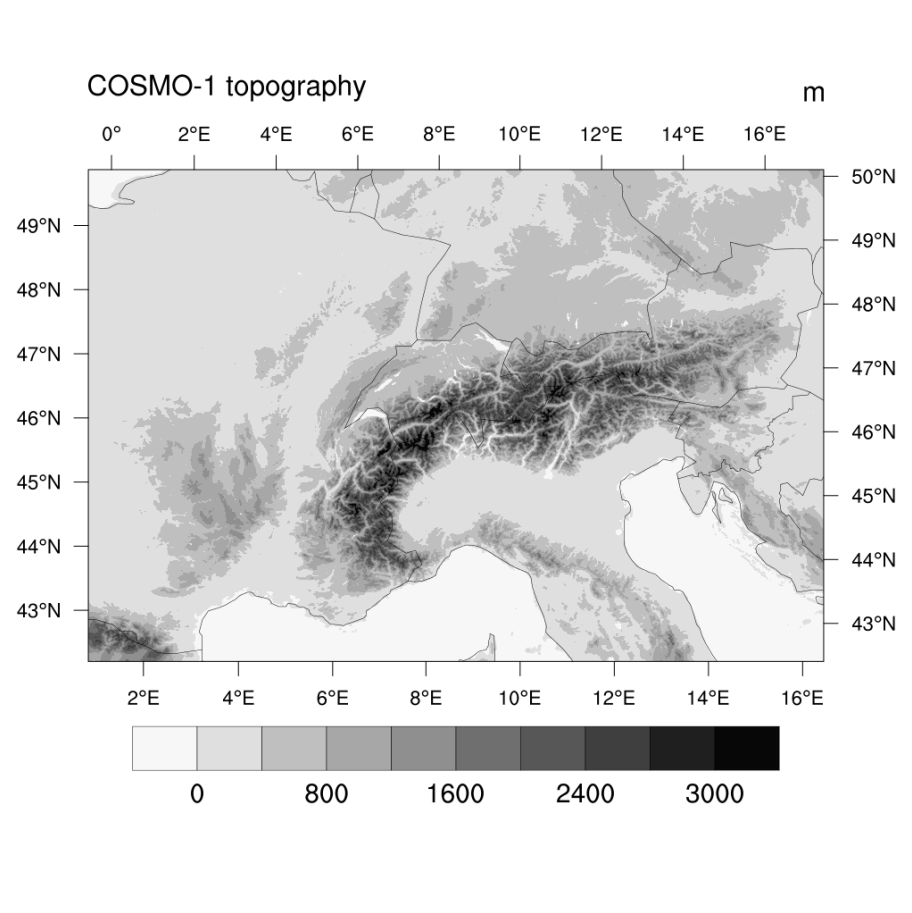
Parameter list

Acronym	Parameter	Value
Minimal diffusion coefficient for heat	tkhmin	[0. 1 ,**0.4**,1]
Factor for laminar resistance for heat	rlam_heat	[0.1,**1**,2]
Parameter controlling the vertical variation of critical relative humidity for sub-grid cloud formation	uc1	[0,0.8,1]
Uniform factor for root depth field	root_dp (fac_root_dp)	[0.5,**1**,1.5] [0.1 ….in src_soil.f90)
Factor for vertical velocity of snow	v0snow	[10,20,30]
Fraction of cloud water and ice considered by the radiation scheme	radfac	[0.3,**0.6**,0.9]
Factor for hydraulic conductivity	kexpdec** Replace with gamma	[**1, 2**]

Model set-up

COSMO-1 calibration Meteoswiss operational version of COSMO (v 5.0_2016.5, STELLA 1.04)

```
&LMGRID
  startlat_tot=  -4.4,
  startlon_tot= -6.8,
  pollat=43.0,
  pollon=-170.0,
  dlon=0.01,
 dlat=0.01,
  ie_tot=1158
 je_tot= 774,
ke_tot=80
```



Remaining simulations

Max rlam_heat- Min uc1	11.11.2013	40 days missing
Max rlam_heat- Min v0snow	08.11.2013	42 days missing
Min tkhmin- Min radfac	05.09.2013	117 days missing
Min tkhmin- Max rlam_heat	06.09.2013	116 days missing

Cost reduction goal
Automatization of the procedure

- Reduce the computational cost by performing minimum number of simulations to fit the MM
- Accuracy of the MM depends on the interaction terms used. Different methods of selection are possible :
  - Sensitivity experiments for each parameter
  - Use first guess of the MM
- In most cases both methods are equivalent.

$$S_{COSI-p} = \frac{1}{N_m \sum_{\Psi=1}^{N\Psi} \omega_\Psi} \left\{ \sum_{\substack{\Psi=1 \\ \Psi \neq 3}}^{N\Psi} \omega_\Psi \sum_{m=1}^{N_m} \left[1 - \frac{\sum_{r=1}^{N_r} \sum_{d_m=1}^{N_{d_m}} (F_{p,\Psi,r,m,d_m} - O_{\Psi,r,m,d_m})^2}{\sum_{r=1}^{N_r} \sum_{d_m=1}^{N_{d_m}} (O_{\Psi,r,m,d_{m-1}} - O_{\Psi,r,m,d_m})^2} \right] + \omega_3 \frac{\sum_{m=1}^{N_m} \sum_{r=1}^{N_r} \sum_{t=1}^{N_t} ETS_{p,r,m,t}}{N_m N_r N_t} \right\} \quad (4)$$

where the equitable threat score (Gilbert skill score) $ETS_{p,r,m,t}$ for a particular parameter combination p, region r, month m and threshold index (with N_t standing for the number of selected thresholds) is defined as

$$ETS_{p,r,m,t} = \frac{H - \frac{(H+F)(H+M)}{N_{d_m}}}{H + M + F - \frac{(H+F)(H+M)}{N_{d_m}}} \quad (5)$$

Work in progress

- **Parameter sensitivity evaluation**
  - ➢ permanent COSMO task, workshop at HNMS
- **MetaModel modifications**
  - ➢ MatLab to Octave, code optimization
- **Minimize computational cost**
  - ✓ Selection of one interaction term needed to fit the MM- Check with ETHZ!
  - ✓ Run model over a limited area
  - ➢ Quantify the final cost of the method
- **Costs/benefits of the methodology**
  - ✓ Is Parameters optimum clearly a function of weather and season????
  - ➢ A yearly independent verification for COSMO-1 is needed to consolidate benefits
- **COSMO platform**
  - ➢ Establish a demonstration platform at ECMWF
  - ➢ Apply method over a Mediterranean domain

Parameters currently perturbed in the COSMO ensembles and their values (operational configurations only). FEEDBACK FROM C. MARSIGLI- DWD

COSMO-LEPS (Arpae for COSMO)

	parameters						
name	tur_len	pat_len	crsmin	rat_sea	rlam_heat	mu_rain	cloud_num
default	500	500	150	20	1	0.5	5.00 e08
assigned values	150, 500, 1000	500, 2000	50, 150, 200	1, 20, 40	0.1, 1, 5	0.5, 0	5.00 e08, 5.00 e07

COSMO-DE-EPS (DWD)

	parameters										
name	tur_ len	a_ stab	c_diff	radqi_ fact	radqc_ fact	rlam_ heat	entr_sc	q_crit	tkh min	tkm min	lhn_ coef
default	150	0	0.2	0.5	0.5	1	0.0003	1.6	0.4	0.4	1
Assigned values	150, 500	1	0.1, 0.2, 2	0.5, 0.9	0.5, 0.9	0.1, 1, 10	0.0003, 0.002	1.6, 4	0.2, 0.4, 0.7	0.2, 0.4, 0.7	0.5, 1

TLE-MVE (IMGW)
Perturbation of c_soil ("Surface-area index of the evaporating fraction of gridpoints over land").
Default: 1.0.
Perturbation: from 0.1 to 2.0. Amplitude of perturbation depends on type of soil (big for light soils, like sand, small for heavy ones, like peat).