COSMO Priority Project COLOBOC

christoph.schraff [at] dwd.de
Offenbach, Germany

(mostly) based on slides from Jean-Marie Bettems, Project Leader COLOBOC

jean-marie.bettems [at] meteoswiss.ch

Contributions from:

J. Helmert, H. Asensio, G. Vogel (DWD)

G. Bonafe (ARPA- SIMC)

E. Machulskaya (Roshydromet)

G. Duniec (IMGW)

M. Buzzi, G. De Morsier, R. Stöckli, J.-M. Bettems (MeteoSwiss)

CLM Community

COLOBOC (Consolidation of Lower Boundary Conditions)

Main goal (Sept. 2008 – Aug. 2010):

- incorporate all activities related to the lower boundary conditions which have already reached an advanced state,
- and to consolidate these developments into well tested and documented software packages readily usable by the COSMO community.

Task 0:	Document observations sets available for SVAT model validation
Task 1:	Tools – Consolidation of TERRA standalone code (SVAT model of COSMO)
Task 2.	Tools – Software for generating external parameters
Task 3:	Revision of external parameters (raw data sources for generation of external parameters for COSMO & GME)
Task 4:	Revision of TERRA and the associated look-up tables
Task 5:	Revision of snow representation (snow model and snow analysis)
Task 6:	Urban model (Fuhrer, EPFL)
Task 7:	Parameterisation of land surface heterogeneity by the tile / mosaic approach

jean-marie.bettems [at] meteoswiss.ch
christoph.schraff [at] dwd.de

COLOBOC , Task 0: Data sets for SVAT model validation

Deliverables:

- survey and documentation of data sets' characteristics
  → info available on COSMO web site
- extend cross-model validation at available sites
  → use wikispace

Actions (e.g.):

- Collect full set of data from the 6 observation sites:
  Lindenberg (D), Payerne (CH), Capofiume (I),
  Sodankylaä (FI), Cabauw (NL), Toulouse (F)
  - Provide complete documentation of these sites
  - Question for SRNWP (ET surface and soil, coordinator):
    Would it be possible to find an agreement with data providers to make these data available for all COSMO members / … for the SRNWP community ?
- Contact with SRNWP ET surface and soil and with MeteoFrance to share additional data

jean-marie.bettems [at] meteoswiss.ch
christoph.schraff [at] dwd.de

COLOBOC , Task 0: Data sets for SVAT model validation

- **SMOSREX** (Surface Monitoring Of the Soil Reservoir EXperiment):
- in operation since January 2001 in Mauzac, near Toulouse in France.
- Continuous ground measurements of meteorological variables, soil moisture and temperature profiles over bare soil and a grass plot left fallow.

- **NEW**: Some data are made available by MeteoFrance:

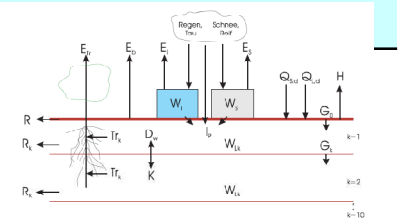
  Dear ET member,

  Please find below the link to get local **validation dataset from SMOSREX (near Toulouse) over a 3 year period**:
  http://www.cnrm.meteo.fr/aladin/spip.php?rubrique43
  since **we agreed in June to share observational datasets for common validations of our land surface schemes**.

  This is a first step in that direction.

  If some of you have data that they could share, we could put them at the same location or think about what Jean-Marie suggested (to be hosted under the COLOBOC web site).

  Jean-François Mahfouf / SRNWP ET Soil and Surface



Deliverable:

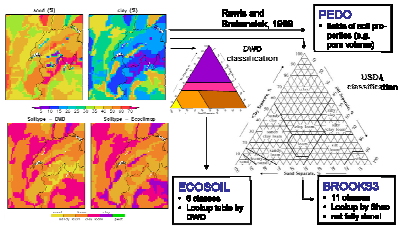
- stable and consolidated code,
  incl. tools (e.g. pre-processing of input data) and documentation

  → bug corrections (mostly done, except: not all info is correctly initialized when cycling TERRA stand-alone runs)

  → new features (temporal gap filling for missing atmospheric BC files, new namelist parameters to pre-process atmospheric input, more diagnostics …)

jean-marie.bettems [at] meteoswiss.ch
christoph.schraff [at] dwd.de

COLOBOC , Task 2: Consolidate software to generate external parameters



Deliverables:

- consolidate code to process external parameter raw data
  - support of variable domains (incl. poles) on the earth
  - addition of further external parameters should be feasible
  - NetCDF I/O additionally to Grib, output data with additional info on pre-processing / input raw data (reproducibility)
  - technical documentation with doxygen (HTML/LaTeX style by ‘tags’ from comments in F95 / F2003 source code)
- reference system deployed at DWD, accessible for all COSMO users
  - direct use via Web interface
  - run from a shell on own system

jean-marie.bettems [at] meteoswiss.ch
christoph.schraff [at] dwd.de

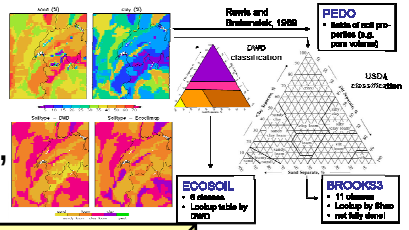
COLOBOC , Task 2: Consolidate software to generate external parameters

Additional external parameters:

Current external parameter fields for COSMO, totally 15 fields

HH, FR_LAND,
SOILTYP, Z0,
SSO_STDH, SSO_GAMMA,
SSO_THETA, SSO_SIGMA,
PLCOV_MN, PLCOV_MX,
ROOTDP, LAI_MN, LAI_MX,
FOREST_D, FOREST_E

Planned extensions, totally 30 fields



HH, FR_LAND,
SOILTYP, Z0,
SSO_STDH, SSO_GAMMA,
SSO_THETA, SSO_SIGMA,
PLCOV_MX,
ROOTDP, LAI_MX,
FOREST_D, FOREST_E

NDVI, NDVI_MX, NDVI_RATIO,
AER_BC, AER_DUST, AER_SO4,
AER_SS, T2M_CL, URBAN,
PRS_MIN, EMISS_RAD,
FR_LAKE, DEPTH_LK,
SLOPE_ASP, SLOPE_ANG,
HORIZON, SKYVIEW

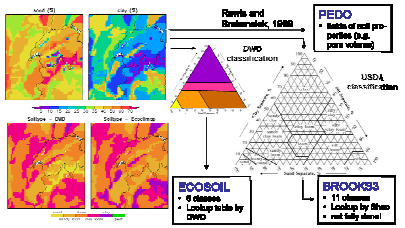
Aerosols:

- current radiation scheme in COSMO uses constant aerosol values for desert, sea, land and urban areas
- new, monthly mean of the following aerosol types can be read from the external parameters:

  AER_SO4: Tegen (1997) aerosol type sulfate drops
  AER_DUST: Tegen (1997) aerosol type mineral dust
  AER_ORG Tegen (1997) aerosol type organic
  AER_BC: Tegen (1997) aerosol type black carbon
  AER_SS: Tegen (1997) aerosol type sea salt

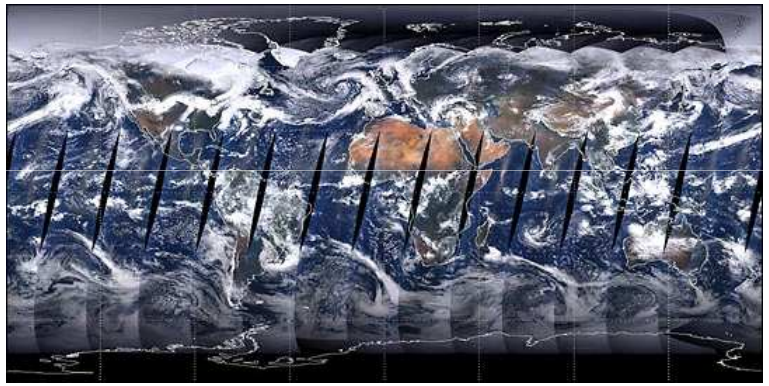
jean-marie.bettems [at] meteoswiss.ch
christoph.schraff [at] dwd.de

COLOBOC , Task 3: Revision of external parameters (raw data sources)



Deliverables:

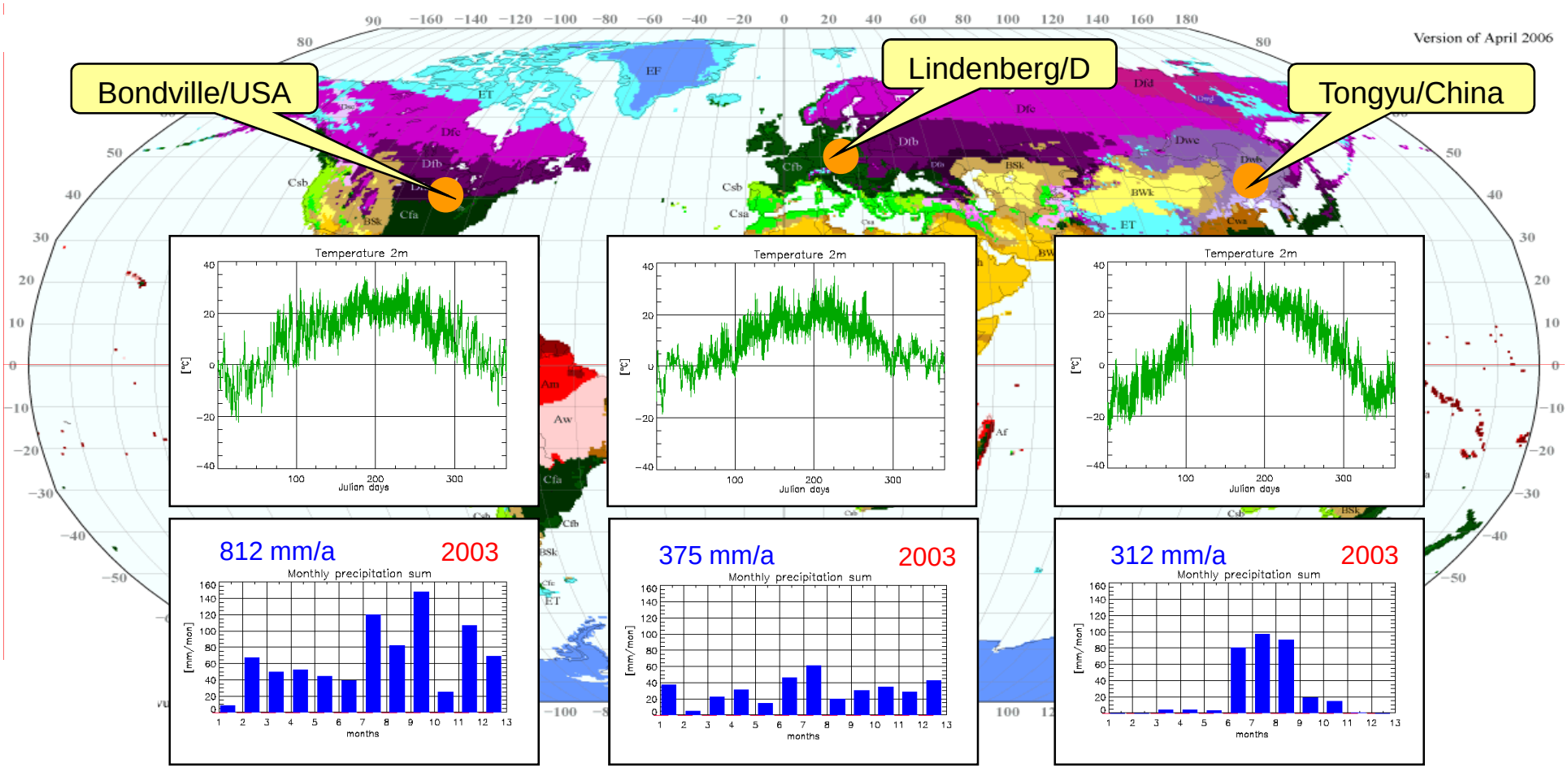
- document external parameter set
  - available on COSMO web site
- consolidate external parameter set
  - revise existing external parameters
  - extend set of external parameters,
    e.g. Modis data for albedo



  - evaluate results for alternative soil type data sets in Europe
    - e.g. Harmonized World Soil Database (global, 30 arcsecs (~ 1km @ mid-latitude))
    - first evaluation with CLM community, only first steps within COLOBOC
  - evaluate MODIS derived vegetation characteristics (for inter-annual variability, using prognostic phenology model with parameters constraint by MODIS data, Stöckli 2008)

jean-marie.bettems [at] meteoswiss.ch
christoph.schraff [at] dwd.de

Simulations with TERRA stand-alone



snow, fully humid, hot summer (Dfa)

warm temperate, fully humid, warm summer (Cfb)

snow, winter dry, hot summer (Dwa)

Simulations with TERRA stand-alone

tested options and assumptions …. and various combinations of them

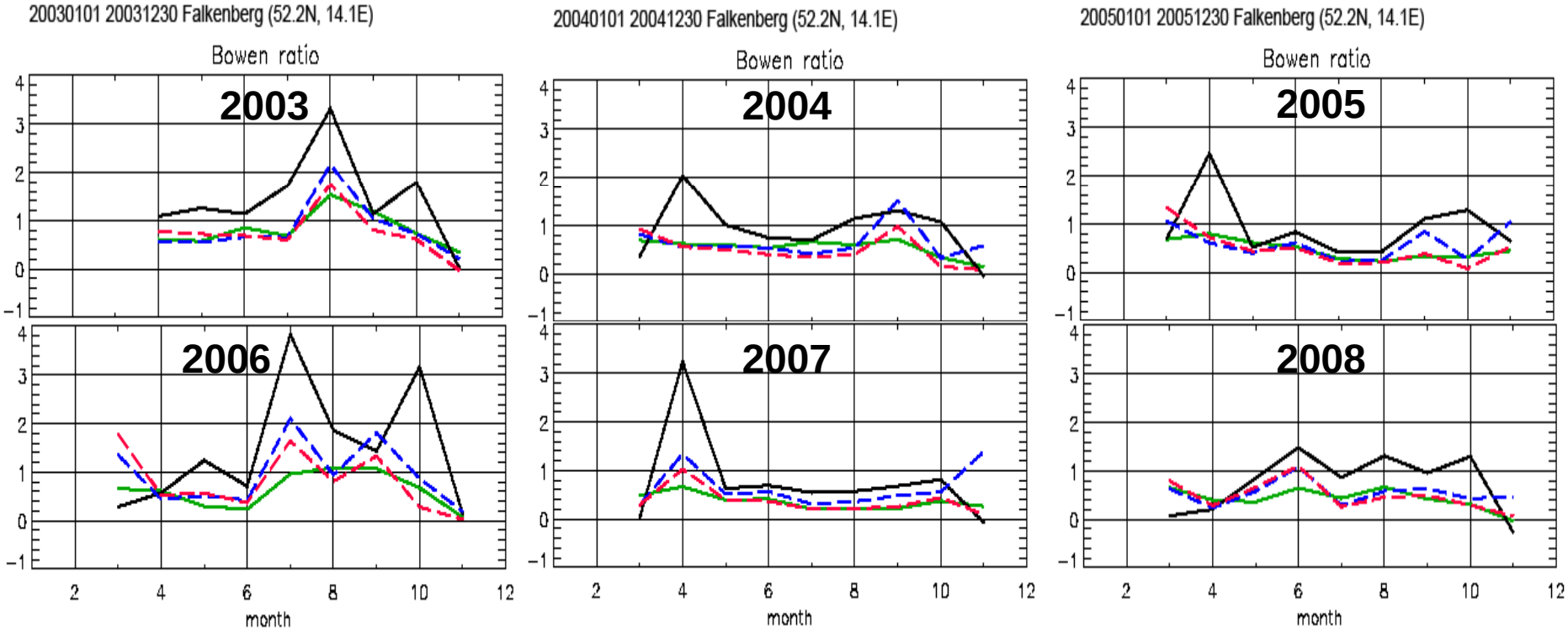
- **Reference conditions for different soil types (sand, silty sand, loamy sand, sandy loam and loam)**
- **Impermeable lower hydrological boundary (“rigid lid”)**
- **Ground water as lower boundary condition**
- **Depletion of root density with depth**
- **Bare soil evaporation according to *Noilhan & Planton (1989)***
- **Reduction of root depth (0.2m)**
- **Revised parameterization of infiltration allowing higher infiltration rates**
- **Moisture drainage and diffusion parameterization according to *Brooks & Coorey* (DWD soil types)**
- **Soil heat conductivity does not depend on soil moisture**
- **Satellite derived LAI and plant cover (climatol. annual cycle)**
- **Variation of surface roughness**
- **Variation of stomatal resistance and wilting point**

jean-marie.bettems [at] meteoswiss.ch
christoph.schraff [at] dwd.de

Simulations with TERRA stand-alone

yearly cycles of Bowen ratio at Falkenberg (near Lindenberg)

measurement
standard TERRA
1st set of options (RigidLid , RootD, BS_evap, SatVeg)
2nd set of options (GroudWater, RootD, BS_evap, SatVeg, eInfilt)

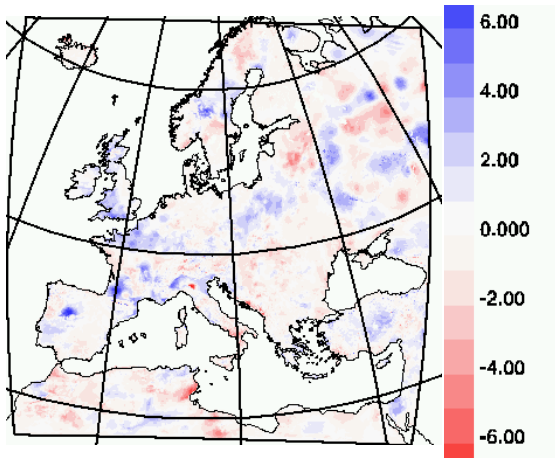


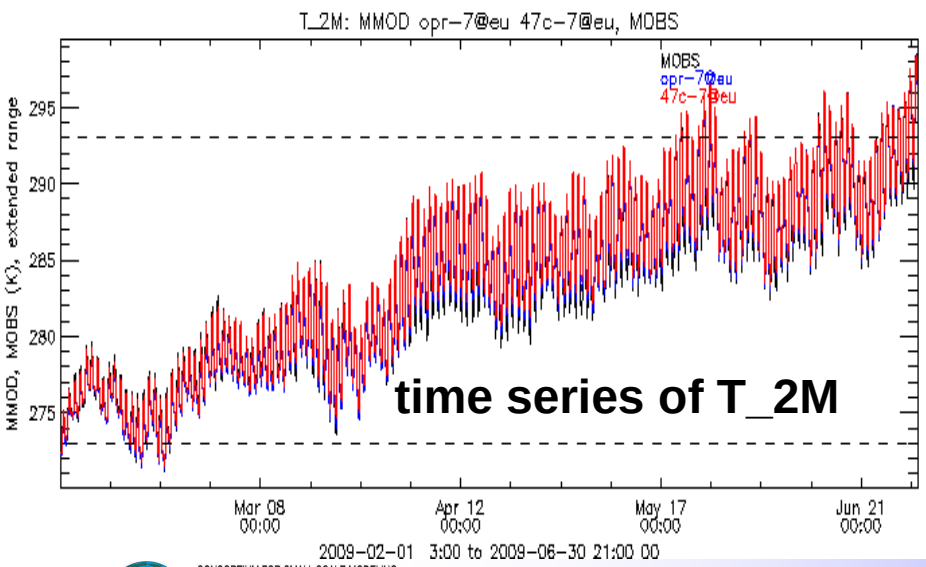
increased performance of Bowen ratio

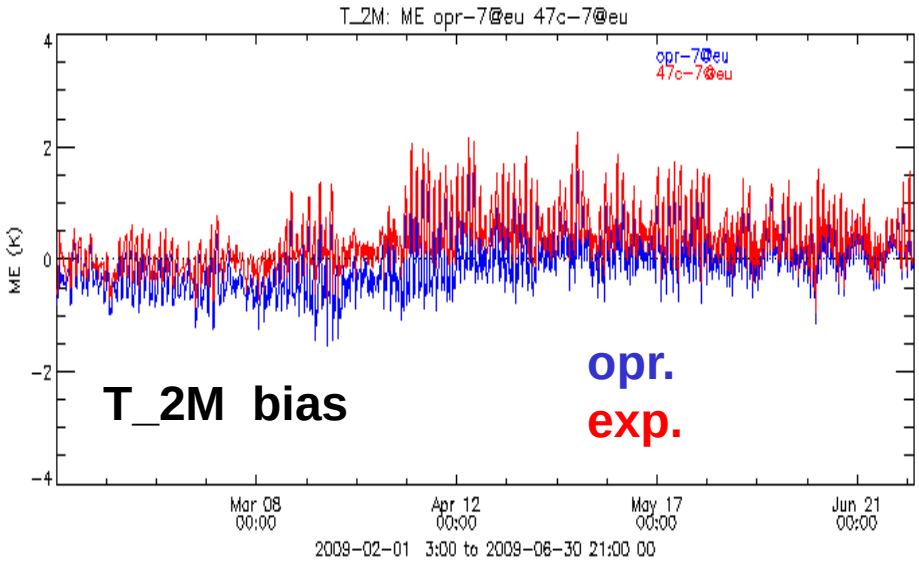
jean-marie.bettems [at] meteoswiss.ch
christoph.schraff [at] dwd.de

Simulations with (full) COSMO

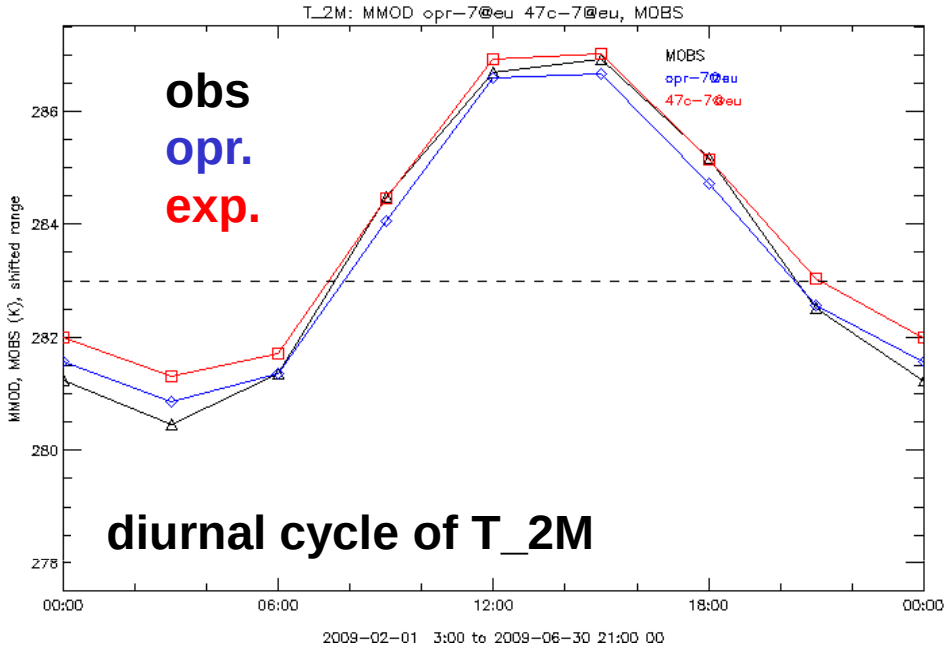
- Experiments with COSMO-EU (DWD) and COSMO-7 / COSMO-2 (MeteoSwiss)
- Configuration of experiment
  - Ground water with upward diffusion
  - Non-uniform root distribution (RD)
  - Bare soil evaporation after Noilhan and Platon, 1989
    - former Dickinson, 1984
  - HeatCond: Soil moisture dependent heat conductivity
  - No sat. vegetation climatology (int2lm not yet ready)

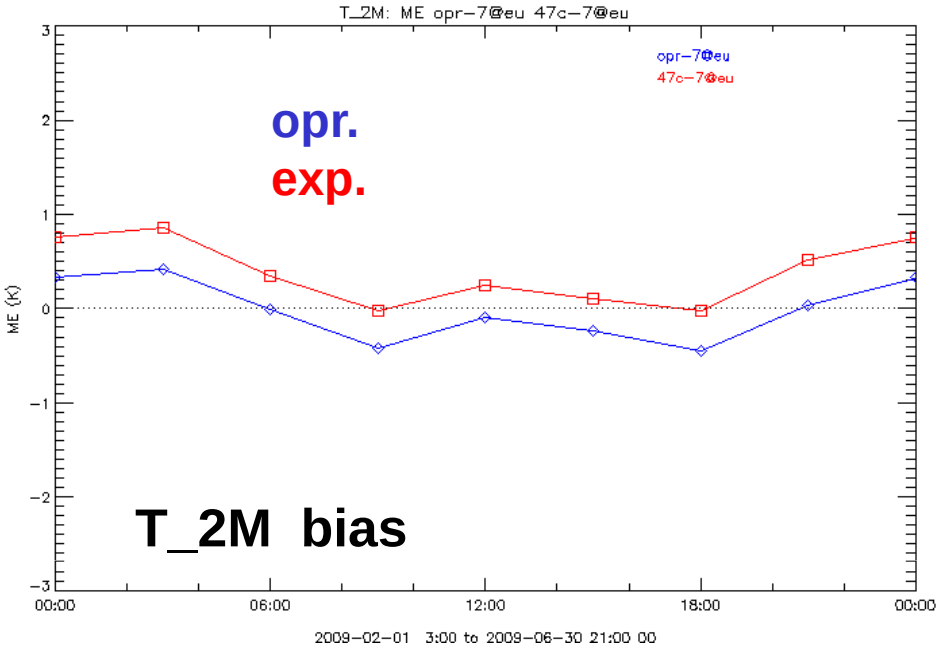






Simulations with (full) COSMO





- Exp: degrades T_2m & TD_2m biases in all model configurations (COSMO-EU, -7, -2) :
  - T_2m : increased positive bias except near / in Alps
  - Td_2m : wet bias → dry bias

  wrong effect from right cause ?

jean-marie.bettems [at] meteoswiss.ch
christoph.schraff [at] dwd.de

COLOBOC , Task 4: Revision of TERRA and associated look-up tables

- work goes on to get optimal configuration of TERRA (look-up tables, add ext. param., etc.)

- need to understand how much the evolution of the soil (and of the snow pack) differs between TERRA stand-alone and the full COSMO
  - simplified transfer scheme (Louis)
  - no feedback loop between soil and atmosphere

  → single-column model of COSMO

- also need to look at impact of adaptations in TERRA on variational soil moisture analysis (SMA) in COSMO-EU (DWD)

jean-marie.bettems [at] meteoswiss.ch
christoph.schraff [at] dwd.de

COLOBOC , Task 5: Revision of snow representation (snow model and snow analysis)

Deliverables:

- finalize & verify the improved snow analysis developed at MeteoSwiss
  (uses surface obs & snow mask derived from SEVIRI (temporal composite))
  → merge MeteoSwiss and DWD modifications
  → adapt snow analysis for new snow model
- verify & consolidate the new multi-layer snow model developed at Roshydromet

Validation experiments : Winter from September 2007 to May 2008

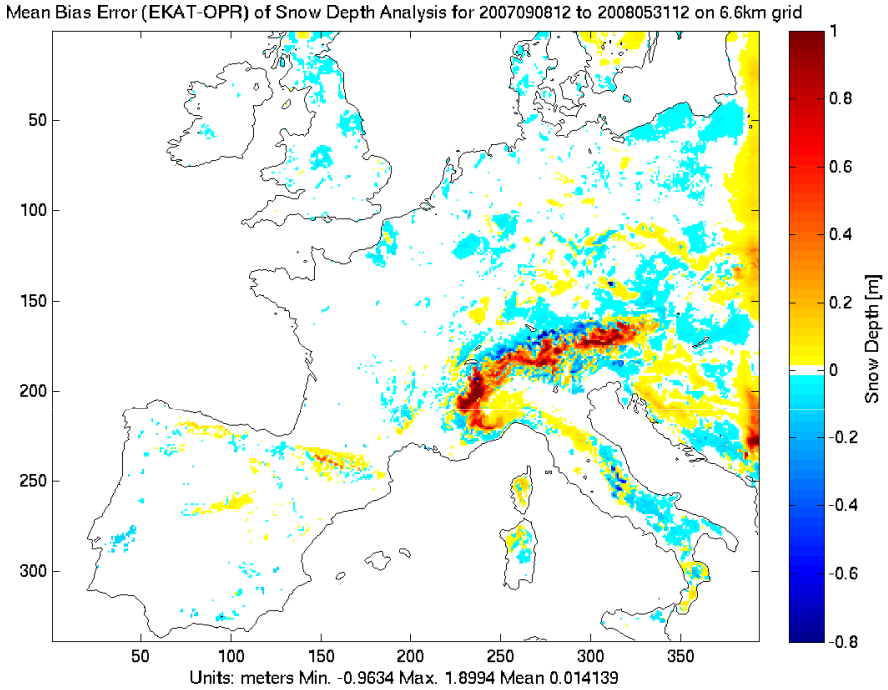
- **COSMO-7** : operational data assimilation incl. a **daily** merge of the **snow analysis**
- **TERRA REF** : TERRA stand-alone driven by **hourly** atmospheric analyses **without** snow analysis
- **TERRA 2LSM** : Same as reference but with new **2 layer snow model** (**2LSM**)

jean-marie.bettems [at] meteoswiss.ch
christoph.schraff [at] dwd.de

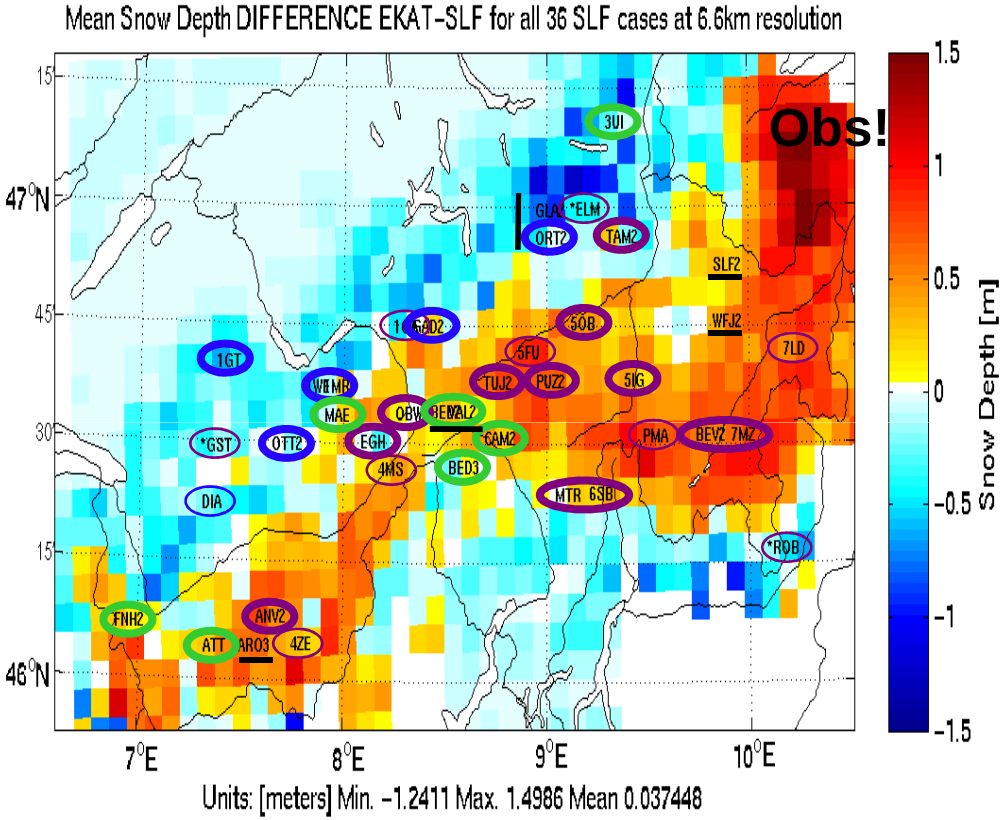
Validation experiments

Bias (2LSM – REF) [m]

(REF: TERRA stand-alone w/o snow analysis)



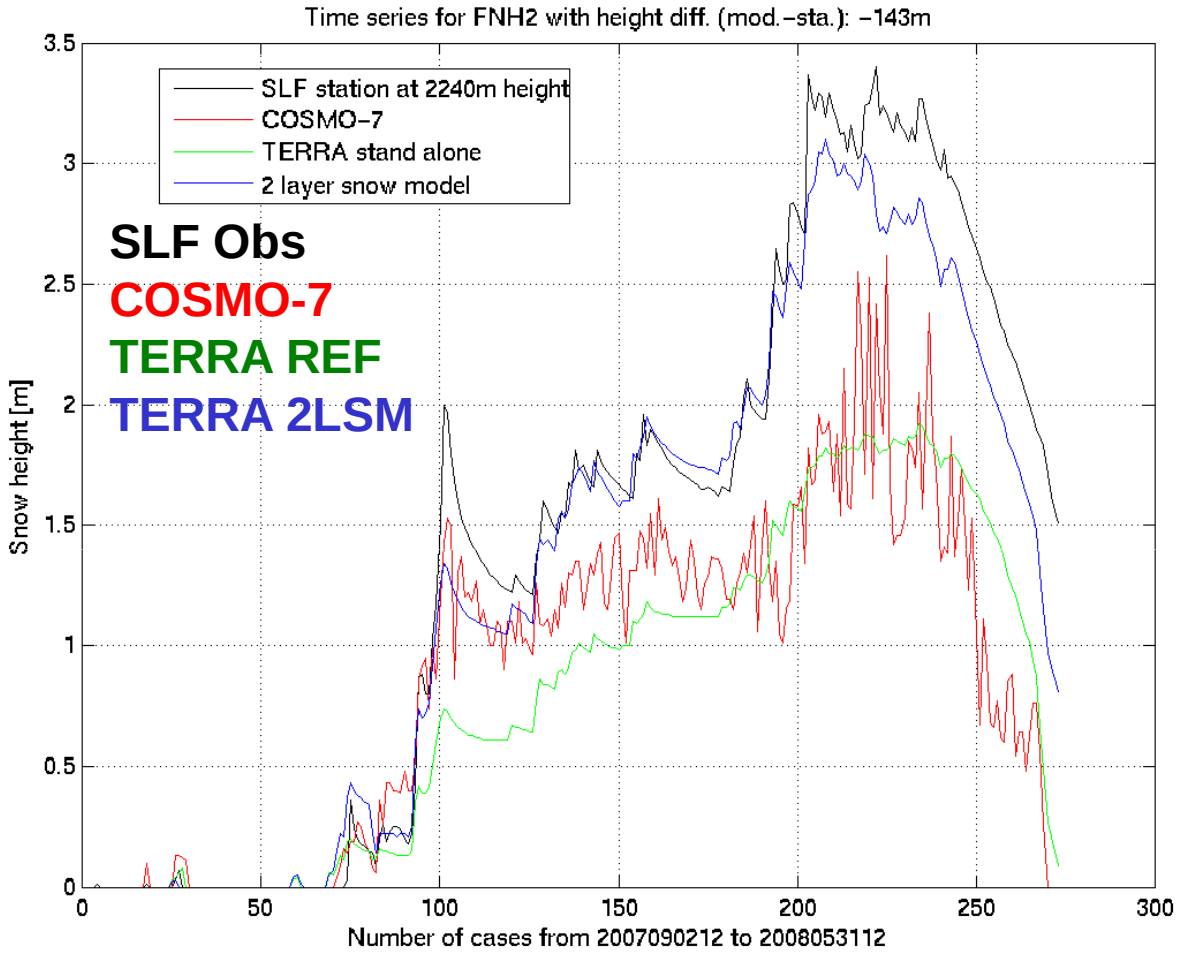
Bias (2LSM – SLF) [m] ZOOM



: OK Period: Sept. 2, 2007 to May 31, 2008

: + : - EVERY day : |Δh|>300m

Validation experiments



Station at **2240m** in the Western Alps

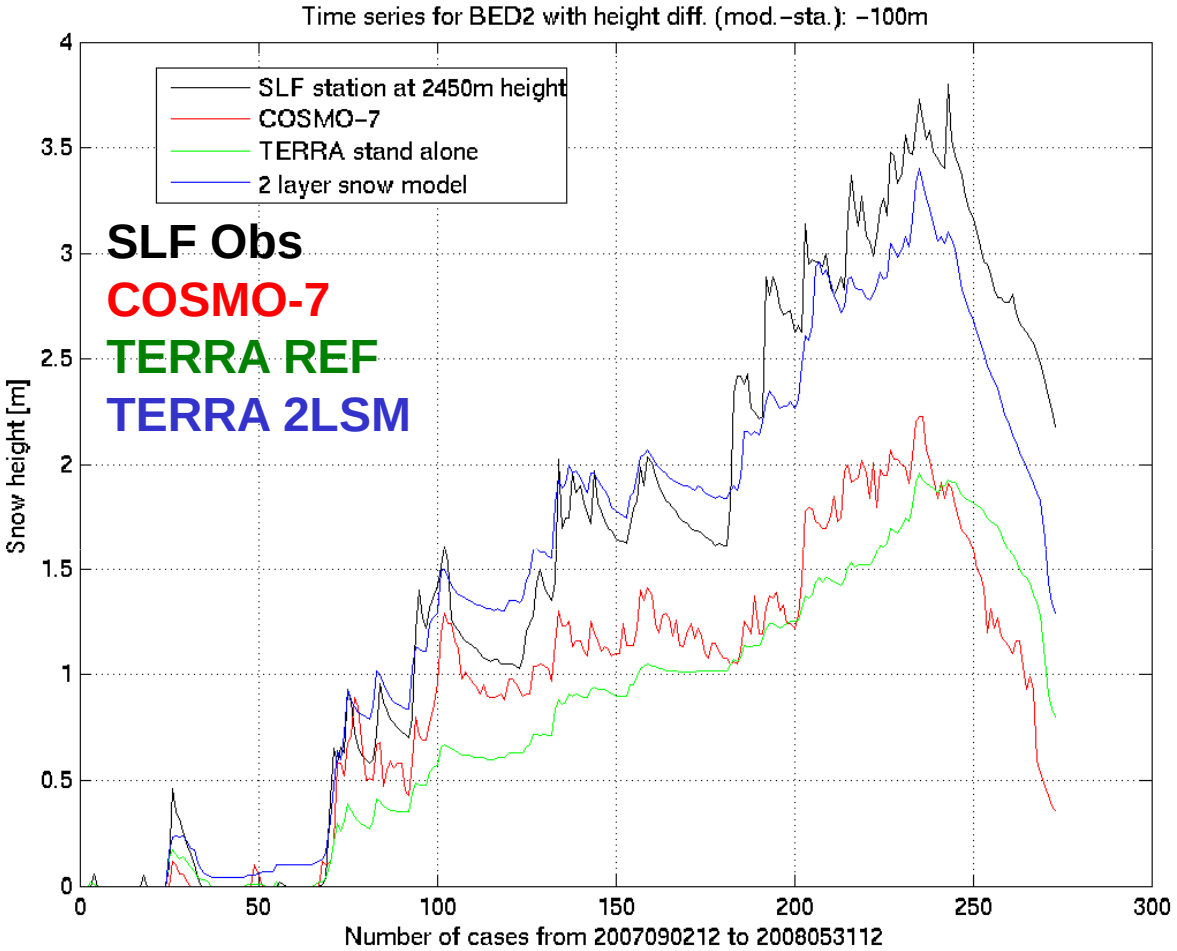
Model at **2097m**

Δh = -143m

OK

Period: September 2, 2007 to May 31, 2008

Validation experiments



Station at **2450m** on the southern slope of the Alps

Model at **2350m**

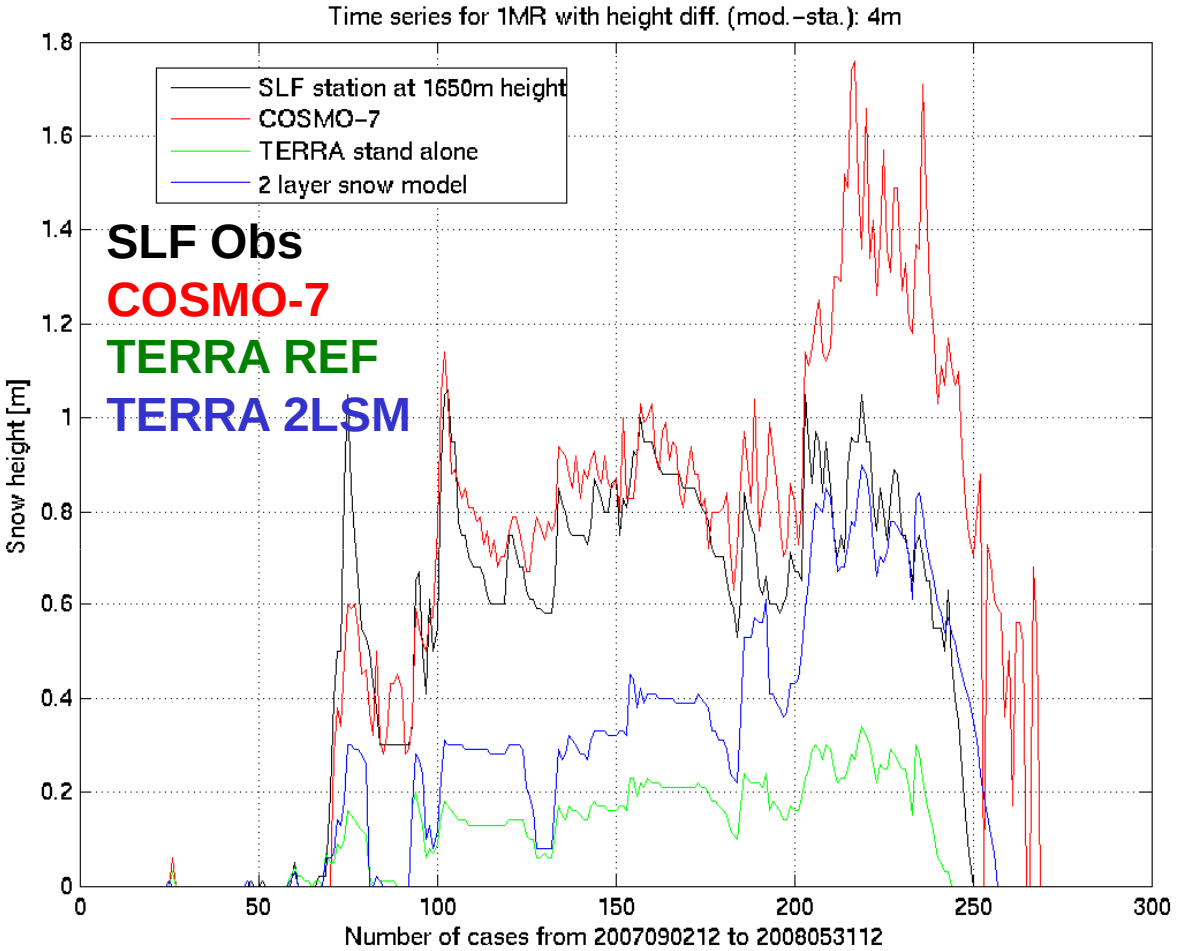
Δh = -100m

OK

Period: September 2, 2007 to May 31, 2008

jean-marie.bettems [at] meteoswiss.ch
christoph.schraff [at] dwd.de

Validation experiments



Station at **1650m** on the North Western slope of the Alps

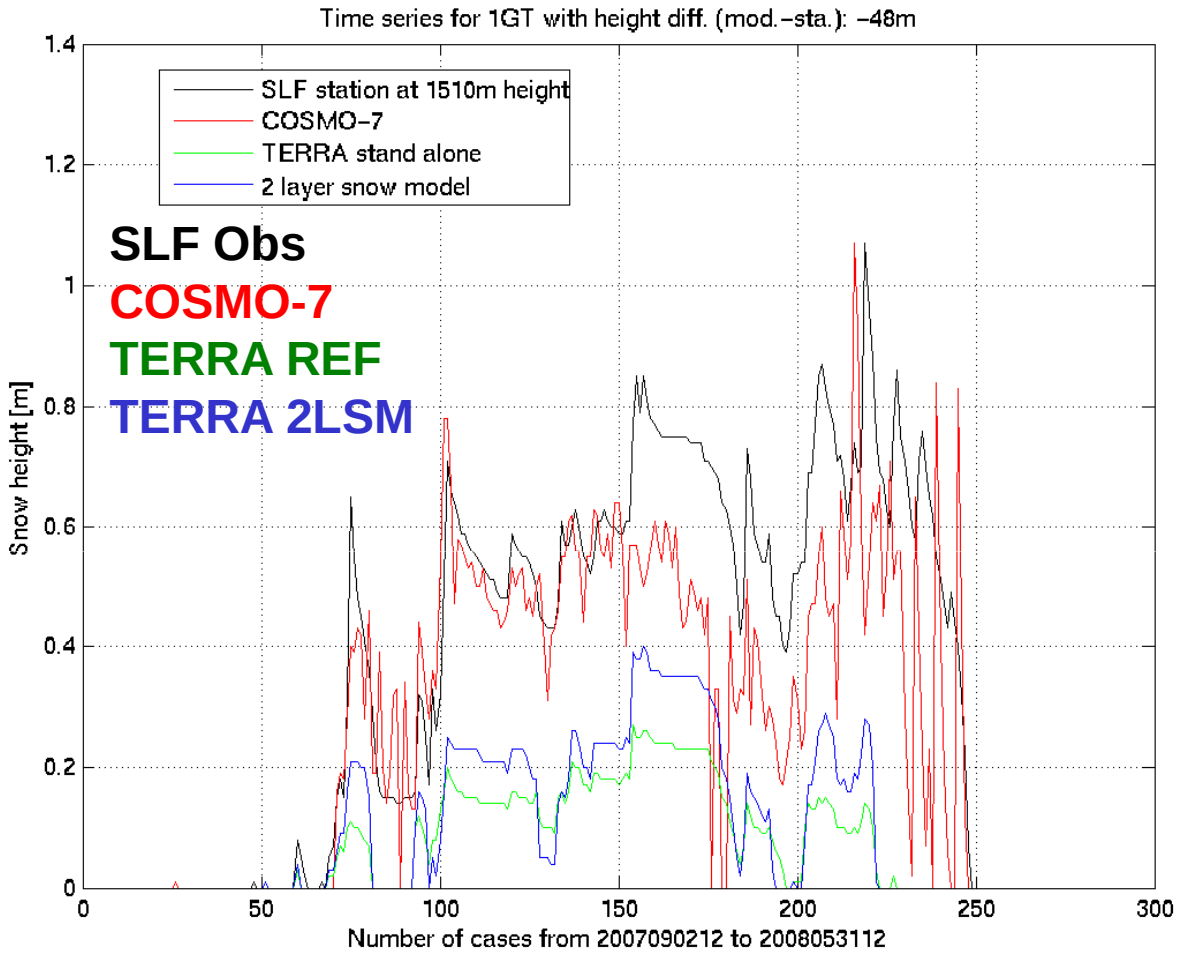
Model at **1654m**

$\Delta h = 4m$

Too little but good ablation

Period: September 2, 2007 to May 31, 2008

Validation experiments



Station at **1510m** on the North Western slope of the Alps

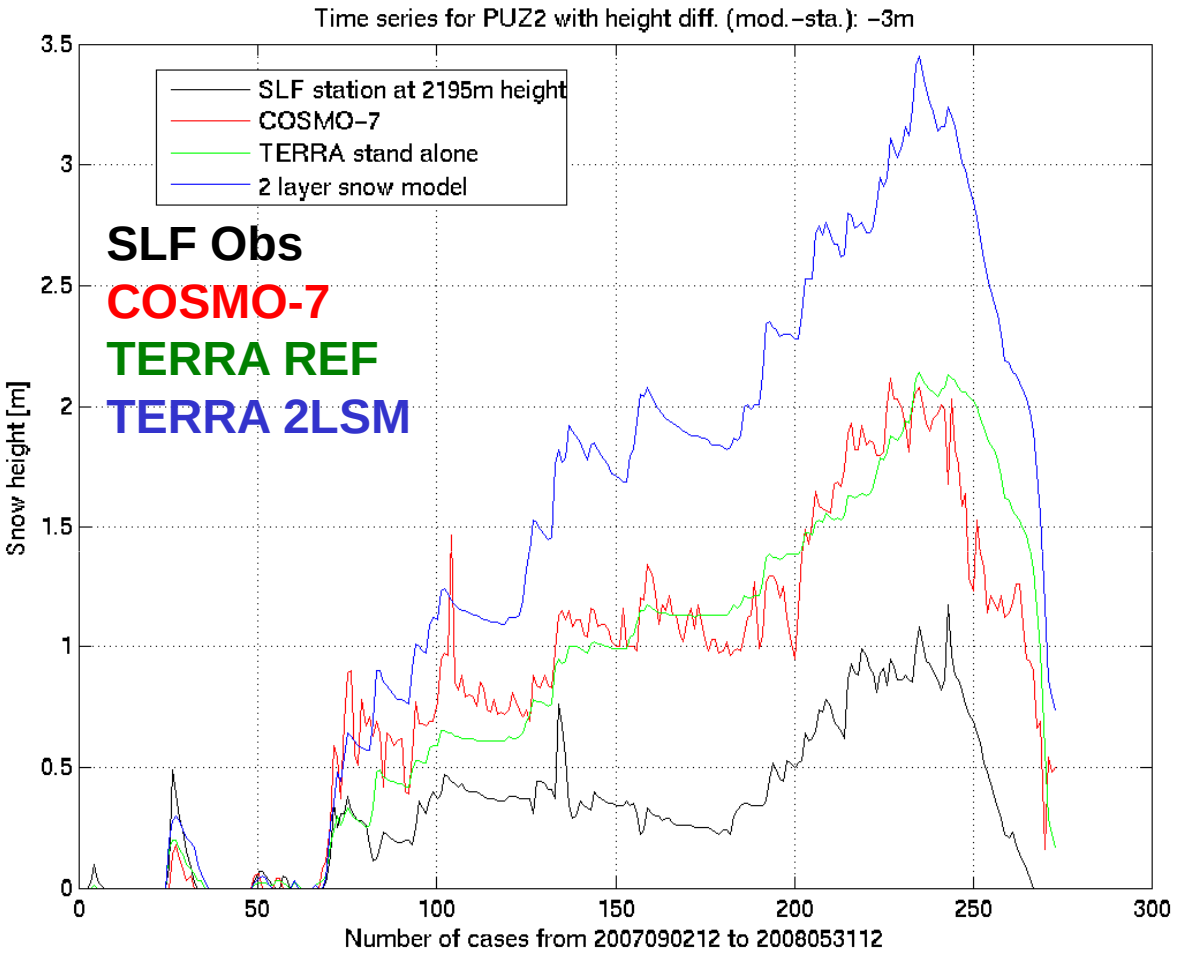
Model at **1462m**

Δh = -48m

Too little!

Period: September 2, 2007 to May 31, 2008

Validation experiments



Station at **2195m**

Within the Alps

Model at **2192m**

Dh = -3m

➔ **dubious** observations!

➔ possible wind ablation

Obs!

Period: September 2, 2007 to May 31, 2008

Validation experiments : conclusions

- Northern Europe: slightly better **snow / no snow** with multi-layer snow model
- Eastern Europe & over orography: new snow model produces **larger** snow depth
- Alpine region: The multi-layer snow model
  - largely **removes** systematic **underestimation** of snow height by original snow model
  - works **well** at different altitudes but might **overestimate** the snow height in some areas
  - better represents the ablation period (spring)

Outlook

- check other snow model variables (snow water content (liquid & total), snow temperature)
- look at wet and dry periods
- evaluate temporal evolution with in-situ observations also **outside of the Alps**
- compute winter 2007-2008 **with full 3D model** with COSMO-7 and COSMO-2
  - without analysis
  - in particular evaluate effect of higher resolution

jean-marie.bettems [at] meteoswiss.ch
christoph.schraff [at] dwd.de

thank you for your attention

jean-marie.bettems [at] meteoswiss.ch
christoph.schraff [at] dwd.de