Surface modelling and analysis

Status of work in COSMO and recent developments at DWD

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

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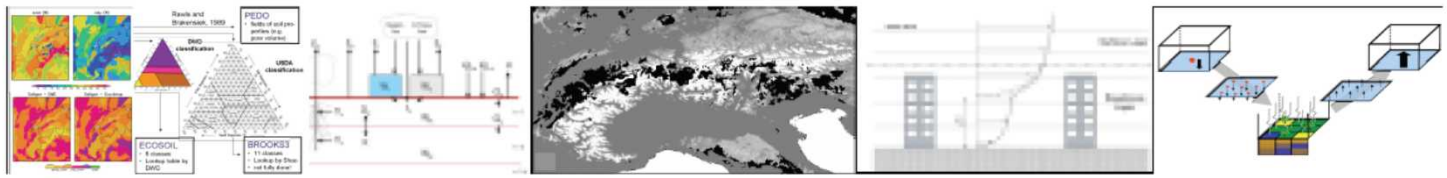
CONSORTIUM FOR SMALL SCALE MODELING
COSMO

COLOBOC
Project Status

Jean-Marie Bettems / MeteoSwiss

COLOBOC/SOILVEG Workshop
Langen, February 28th , 2011



Review – COLOBOC, task 0

Observation sets for SVAT model validation.

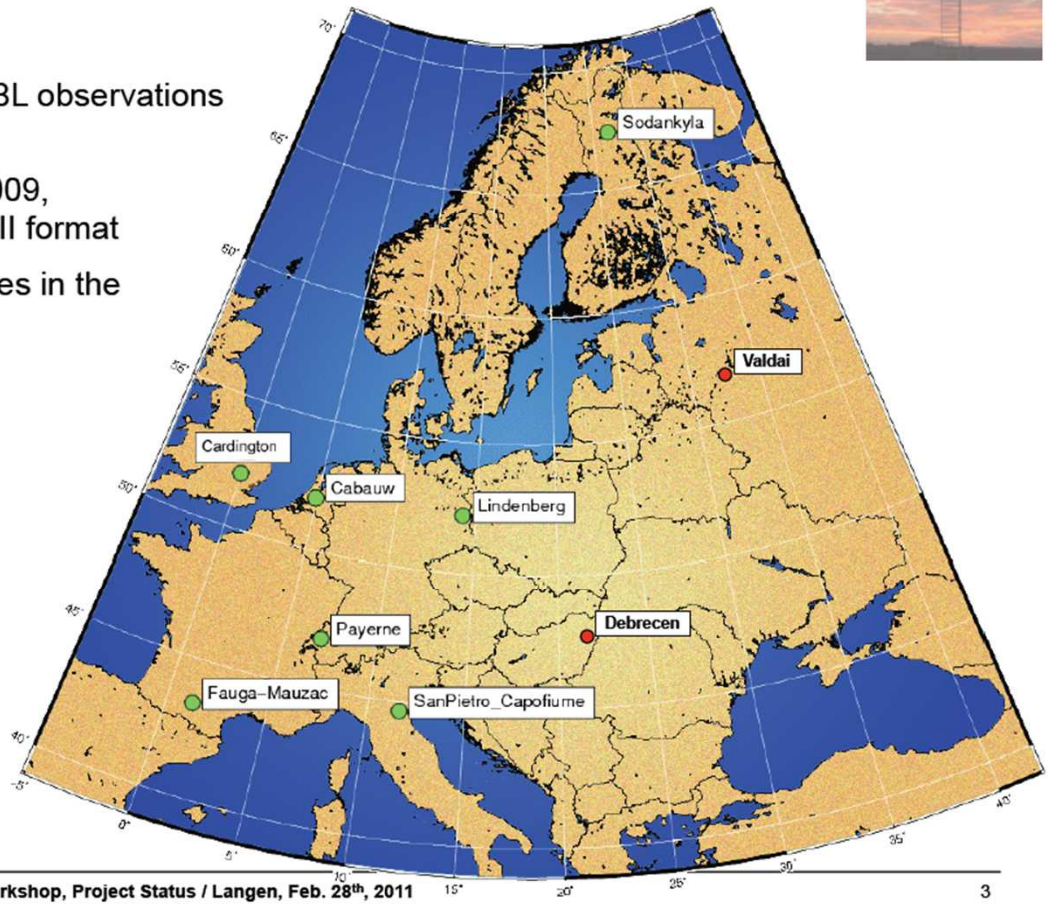
- **Documentation** of various data sets on the COSMO web site.
- **New permanent instruments at Payerne**
  Measurement of turbulence @ 10m, in activity since spring 2009.
  Soil moisture and temperature.
- **SRNWP data pool action**
  Convenient access to recent operational high quality measurements, representative for different climate and different type of soils

Review – COLOBOC, task 0

SRNWP data pool

- Soil, surface and BL observations
- Currently 7 sites, data from 2006-2009, in a common ASCII format
- Possibly 2 new sites in the near future: **Debrecen** (Hu), **Valdai** (Ru)

Agreement!



COLOBOC/SOILVEG Workshop, Project Status / Langen, Feb. 28th, 2011 3

Review – COLOBOC, task 0

- **Promote usage within the COSMO Community**
  → extend default set of COSMO model meteograms
  → integrate in soil & BL developments (WG3)
  → routine inter-comparison of soil and surface fluxes (WG5)
  ……
- **Make this effort sustainable**
  → permanent action within COSMO?

Stand-alone TERRA

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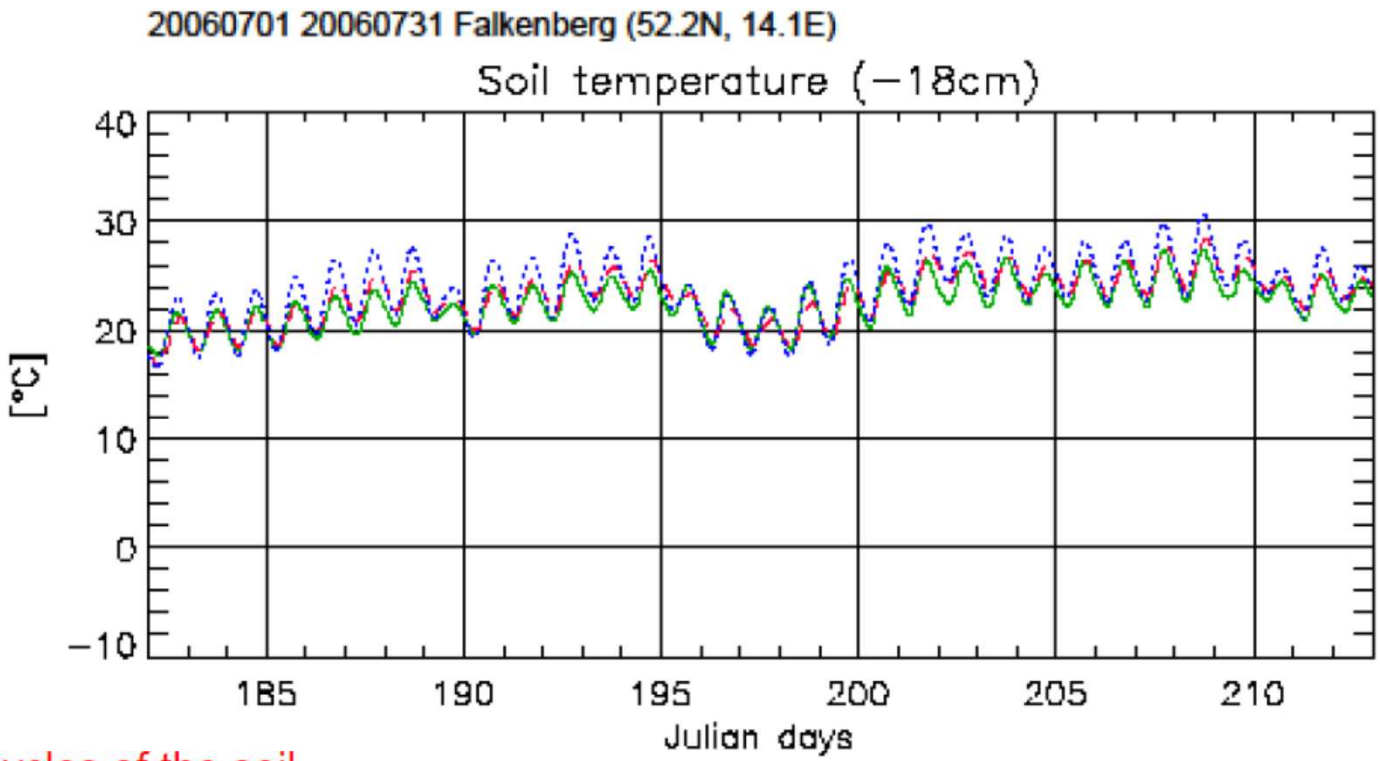
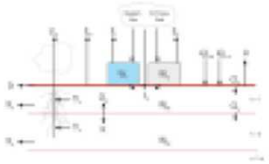


The diurnal cycles of the soil temperature are much reduced in the experiment and fit better to the observation.

measurement
TERRA reference
TERRA experiment

Review – COLOBOC, task 1

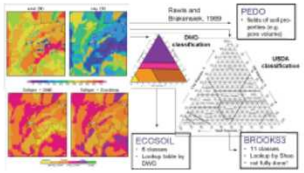


Externalized TERRA module.

- Package including tests and documentation available on COSMO web, **but not maintained** (no committment by MeteoSwiss)
- Code remains fragile when used in a non tested configuration (code limitations are documented)
- Usefull functionality for e.g. soil spin-up, efficient experiments with snow model, measurement driven soil moisture analysis

- **Extend COSMO SCM framework to include the functionality currently offered by Terra standalone (→ M. Raschendorfer) ?**

Review – COLOBOC, task 2



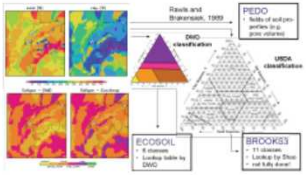
Consolidate software for generating external parameters.

- New **code** for the aggregation and interpolation of the raw data to the target grid is ready (EXTPAR v1.1), and will be made available on the **COSMO web site**.
- **Reference system** at DWD, accessible through a Web interface is in test phase. A link will be put on the COSMO web site.

Last modifications (now V1.5)

- Glc 2000 -> Globcover 2009
- Filter for orography
- Bug Correction for lakes generated at cost lines

Review – COLOBOC, task 3



Consolidate external parameters data set.

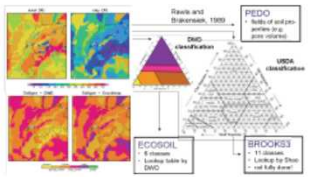
- New external parameters available now for any domain:
  monthly NDVI climatology, ***minimum stomatal resistance***,
  bare soil emissivity, ***deep soil temperature***,
  lake *fraction and lake depth* (for FLake module),
  urban *fraction* (for urban module),
  monthly climatology for ***aerosols*** *optical thickness (5 species)*

- Documentation of datasets available on the COSMO web site

- Planned till end of project
  MODIS derived ***solar albedo*** *(MPI Hamburg)*
  tests with MODIS calibrated ***real time phenology***
  computation of ***topography smoothing*** *in EXTPAR (instead of INT2LM)* √

Review – COLOBOC, task 3

Real-time phenology



- Historical records of vegetation characteristics reveal a substantial inter-annual variability of the start of season, which may limit the usefulness of a climatology based data set.
- A framework has been developed by R.Stöckli et al., using a prognostic phenology model with parameters constraint by MODIS data, which can provide an offline gridded forecast of the vegetation characteristics taking into account the actual evolution of the weather [Stöckli 2008].
- Basically a statistical approach is used, relying on an ensemble Kalman filter to define the optimal parameters of the phenology model, for a specified set of meteorological data predictor (e.g. from a NWP model).

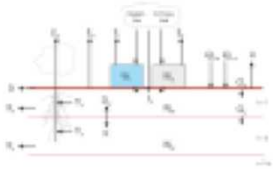
Review – COLOBOC, task 4

Revision of TERRA and the associated look-up tables.

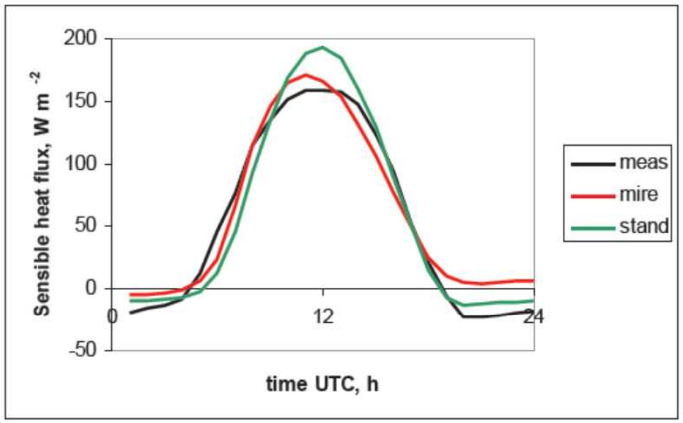
- Experiments at DWD and MCH to evaluate the modified land-surface scheme (TERRA parametrizations, external parameters, look-up tables).

Review – COLOBOC, task 4

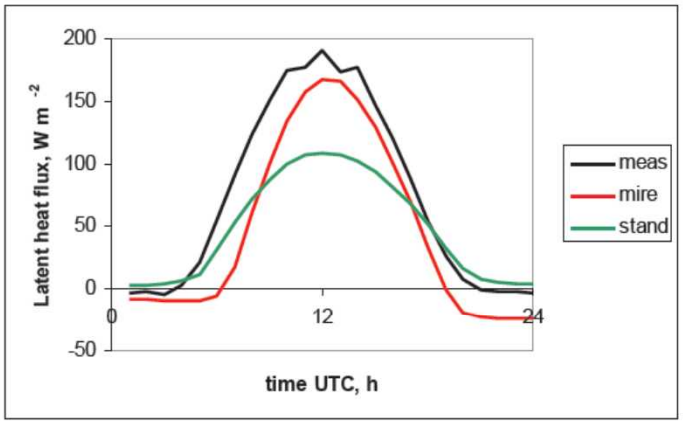
Mire parametrization



Components of the **heat balance** from the eddy-flux measurements, standard model simulation (stand), and simulation with a new model (**mire**). Degero Srormyr mire, Sweden



Sensible heat



Latent heat

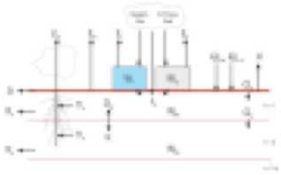
Review – COLOBOC, task 4

TERRA versus NCAR CLM

- Different studies (E.Davin/ETHZ, R.Orth/ETHZ, G.Vogel/DWD, F.Di Giuseppe/ ARPA-SIM) have shown some significant limitations of TERRA
  - missing grass layer (no specific treatment of canopy vegetation),
  - inexact temporal evolution of vegetation in spring (representation of inter-annual variability),
  - inconsistent temporal evolution of root depth and vegetation,
  - missing representation of vertical soil structure (in particular depth of active soil),
  - incorrect Bowen ratio (too much latent heat) .

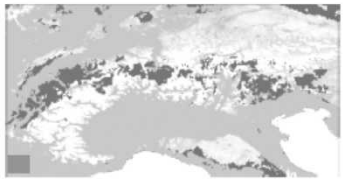
- COSMO coupled with NCAR CLM improves on some of these features
- Many of the elements being developed for TERRA already exist within the CLM (e.g. tile, multi-layers snow model, urban module)
- CLM offers additional functionality in direction of environmental modeling (biochemical emissions)

Review – COLOBOC, task 4



- **Development of mire parametrization by Roshdromet : priority task in COSMO WG3 ?**
- **Interest of the COSMO community to have CLM as an alternative SVAT model within the official COSMO code ?**

Review – COLOBOC, task 5



New multi-layer snow model

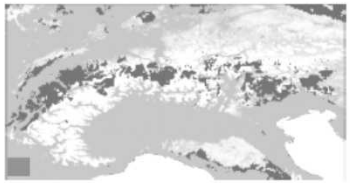
- **Code is available** in latest COSMO release
- Ongoing tests at DWD, Roshydromet and MeteoSwiss

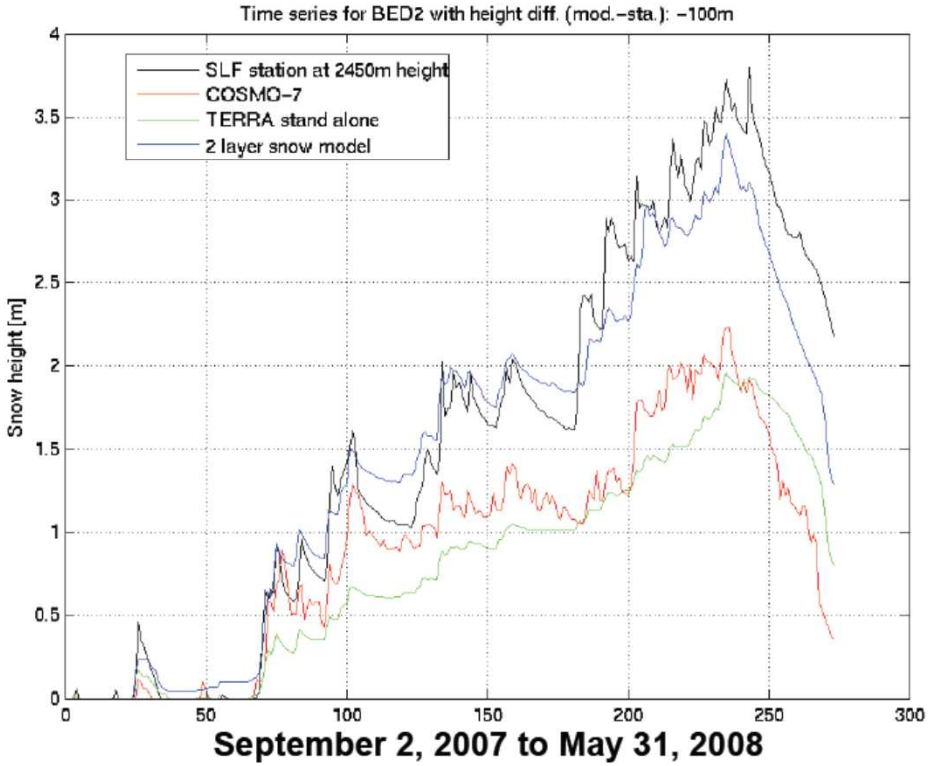
Snow analysis

- DWD and MeteoSwiss codes have been merged

Review – COLOBOC, task 5

New multi-layers snow model



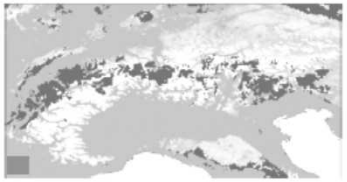


Station at **2450m** on the southern slope of the Alps

Model at **2350m**

Dh = -100m

Review – COLOBOC, task 5.1



In pipe

- (DWD) Finalize multi-layers snow model
- (A.Will) Tests in **climate** mode

- (RH) Investigate / correct **fresh snow density** and **snow density ageing** issues (important because of the interaction with the snow analysis step)
- (RH) Improve **albedo** in relation with snow and forest (dynamic evolution of snow over forest canopy)

- Improve **partial snow cover** representation, in particular by using the tile and/or mosaic approach (dynamic tile). This should have an important impact on the correctness of T_2M (currently a single soil surface temperature is allowed, even in presence of partial snow cover).
  ➨ See task 7

- **Fresh snow density to investigate in WG3**

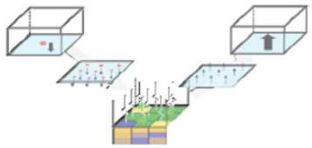
Review – COLOBOC, task 6

Urban module.

- Available and documented, **but not maintained**
  (no committment by MeteoSwiss, see new rules for COSMO code)

- **What to do with this piece of code ?**

Review – COLOBOC, task 7



Tiles and mosaic

- On going at DWD, incl. dynamic tile for partial snow cover

Is there a life after COLOBOC?

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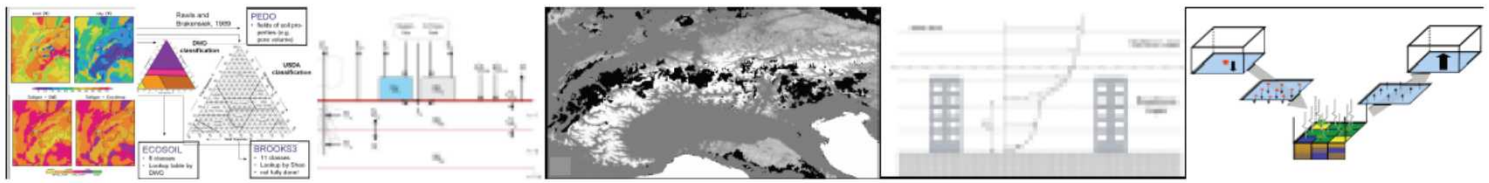
- **Priority Project** :
  The COLOBOC project definitly **ends** at the next COSMO GM (09.2011 in Roma).
- **Working Group** :
  A proposal for splitting COSMO WG3 into WG3a and **WG3b**, with WG3b taking care of soil and surface aspects, has been made by the COSMO SMC to the COSMO StC.
  → Federico Grazzini remains WG3a coordinator.
  → A new coordinator for WG3b is nominated.
  → Decision by StC in April.
- **Collaboration** :
  Close collaboration with COSMO-CLM, and in particular SOILVEG, should continue.



Recent developments at DWD

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- Sea ice model + flake
  - Implemented in C_EU march 2011, Tests with Flake in C-DE
- New Ice mask for baltic sea (BSH)
  - Appr. double resolution two times per week 11x11km -> 4,6x7,6km
- Multilayer snow analysis
  - Experiments run with two layer snow model, prognostic h_snw, rho_snw, t_snw
- SMA for GME
  - Operational since march

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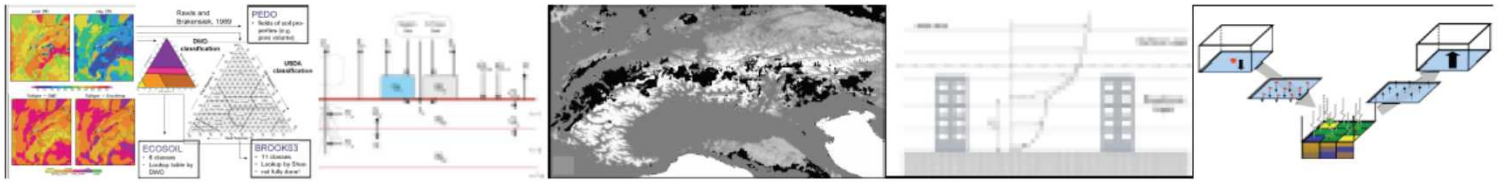
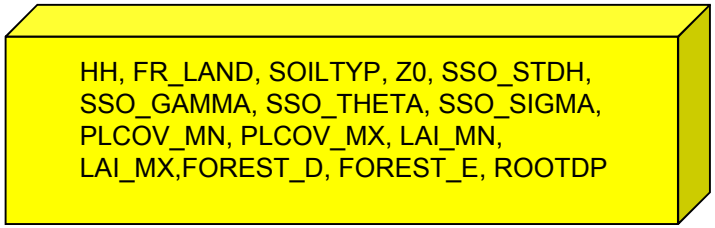
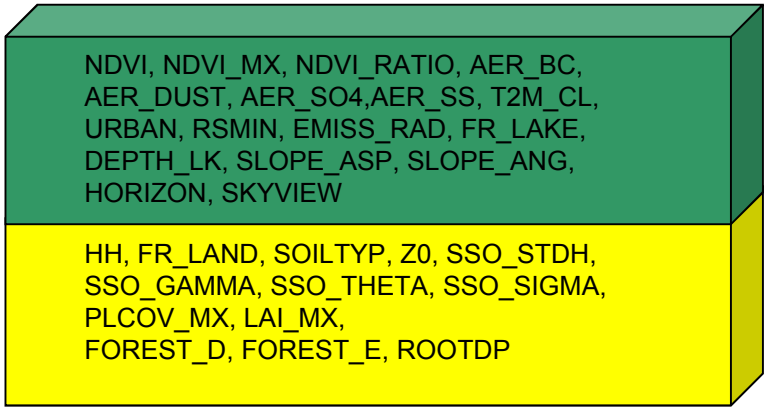
Thank you for your attention!





15 external parameter fields



planned total 30 fields

Project tasks and actions

Proposed Actions:

These are the seven proposed actions of the priority project:

- Consolidate tools of general interest: externalized TERRA module (task 1), software for generation of external parameters (task 2)
- Facilitate verification tasks: facilitate access to and usage of soil/surface observations (tasks 0 & 1)
- Consolidate and extend external parameters database (task 3)
- Find and validate an optimal configuration of TERRA with its associated external parameters and look-up tables (task 4)
- Revision of snow analysis and snow model (task 5)
- Deployment of urban module developed at EPFL/Switzerland (task 6)
- Consolidate parameterization of land surface heterogeneity (task 7)

Tasks

Work has been separated into these distinct tasks:

Task L	Project leadership
Task 0	Document observations sets available for SVAT-model validation
Task 1	Tools - Consolidation of TERRA standalone code
Task 2	Tools - Software for generating external parameters
Task 3	Revision of external parameters (Raw data sources for the generation of external parameter for the numerical weather prediction models COSMO and GME)
Task 4	Revision of TERRA and the associated look-up tables
Task 5	Revision of snow representation
Task 6	Urban model
Task 7	Parameterization of land surface heterogeneity by the tile/mosaic approach