Terra Stand-Alone is back to life

P. Khain, I. Carmona, Y. Levi

Thanks to J.M. Bettems, Petra Baumann, G. de Morsier, J. Toedter, J. Helmert

Outline

1. Overview
    a. What is TSA ?
    b. Current status
    c. Plans
2. Sanity check
    a. Experiment setup, results example
    b. Averaging Method
    c. Results
3. Summary

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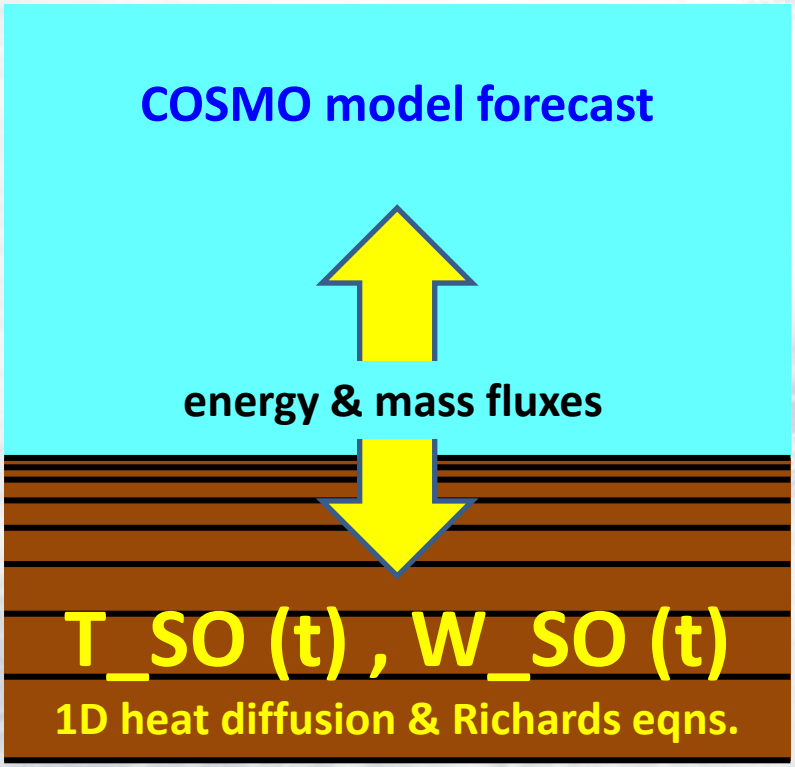
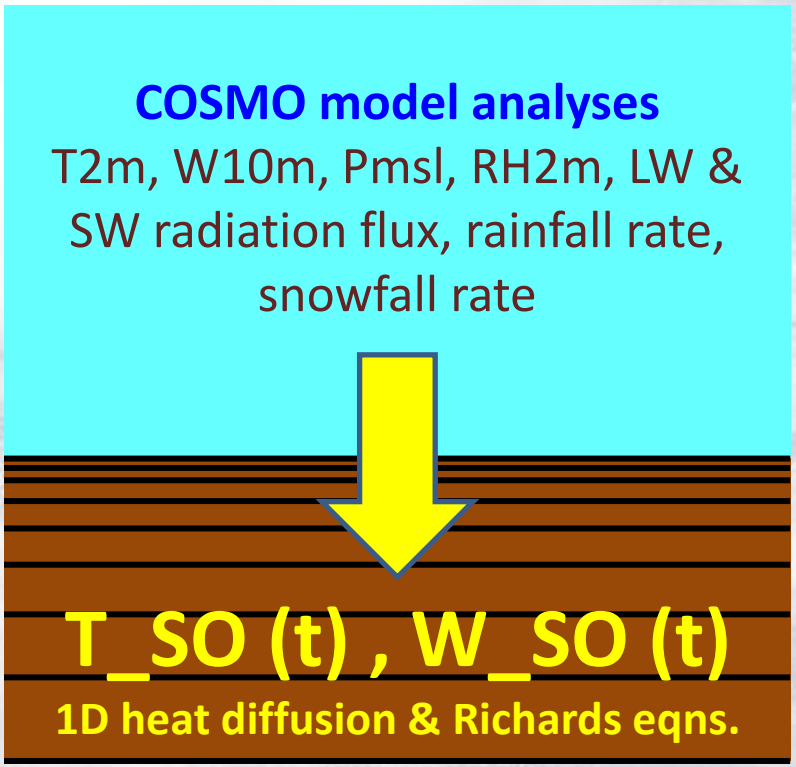
What is TSA ?

TERRA – soil & land surface scheme of COSMO which supplies the lower boundary condition

TSA – decoupled version of TERRA that can be used without an atmospheric model. It requires atmospheric forcing as boundary data, e.g. COSMO analyses



TERRA



TSA

What is it good for?

Efficient multi-years soil spin-up → initial conditions for 3D model runs

Efficient experiments with different soil parameterizations.

Examination of soil related parameters for hydrology and agriculture.

Capability to isolate soil related problems without the complex interactions of a full 3D model

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Current status

First version: Felix Ament (Uni Hamburg) during his PhD thesis (2006)

COSMO PP COLOBOC →
TSA 4.13 – Based on TERRA from COSMO 4.13 (last official TSA version - 2010)
Available at www.cosmo-model.org (Guy de Morsier)

Goethe Univ. Frankfurt (GUF)
TSA-GUF added: option for heterogeneous soil, slightly revised Louis transfer scheme to deal also with larger roughness lengths, full NetCDF I/O, bugfixes, external parallelization, **but** multilayer snow model is not working as in 4.13
Bodo Ahrens, Frank Kalinka, Jan-Peter-Schulz, Jana Schroder, Julian Todter

Recently: TSA 5.01 and TSA 5.01 with revised hydr. conductivity (based on TERRA from COSMO 5.01), for CALMO PP, *_not official_
Pavel Khain, Itzhak Carmona, Yoav Levi
Support from: Jean-Marie Bettems, Guy de Morsier, Julian Todter

Probably there are more versions which I am not aware of …

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Priority Task – TERRA Stand Alone

Task Leader: Yiftach Ziv (IMS)

Goal: Bring TERRA Stand Alone (TSA) source code up to speed with COSMO last version in both aspects of physical schemes and coding standards.

Priority Task TSA

- **Task1: Consolidation of TSA Source Code**

  Deliverables: Mapping and prioritizing discrepancies in all aspects between TSA and latest COSMO TERRA module and a rewrite of the code accordingly.

- **Task2: Review and Possible Revision of the Transfer Scheme implemented in TSA.**

  Deliverables: Comparison of different transfer schemes and decision about implementation of an enhanced transfer scheme to TSA.

- **Task3: Estimating Spin-Up Time of TSA**

  Deliverables: Defining TSA spin-up time.

- **Task4: Verification of TSA and COSMO TERRA vs. observations**

  Deliverables: Report on skill scores for TSA and COSMO-TERRA and on TSA limitations.

- **Advising: J.M. Bettems; M. Raschendorfer; P. Khain**

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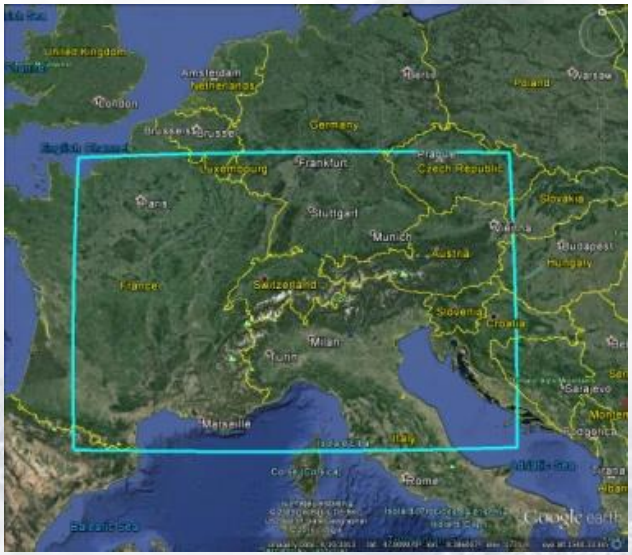
Experiment setup

Setup:

Which versions?

- TSA 4.13 (2.2km)
- TSA 5.1 original (2.2km)
- TSA 5.1 (2.2km) Revised Hydraulic conductivity

3 year run:
2010/01/01 -2013/01/01



COSMO 6.6km MCH analyses archive

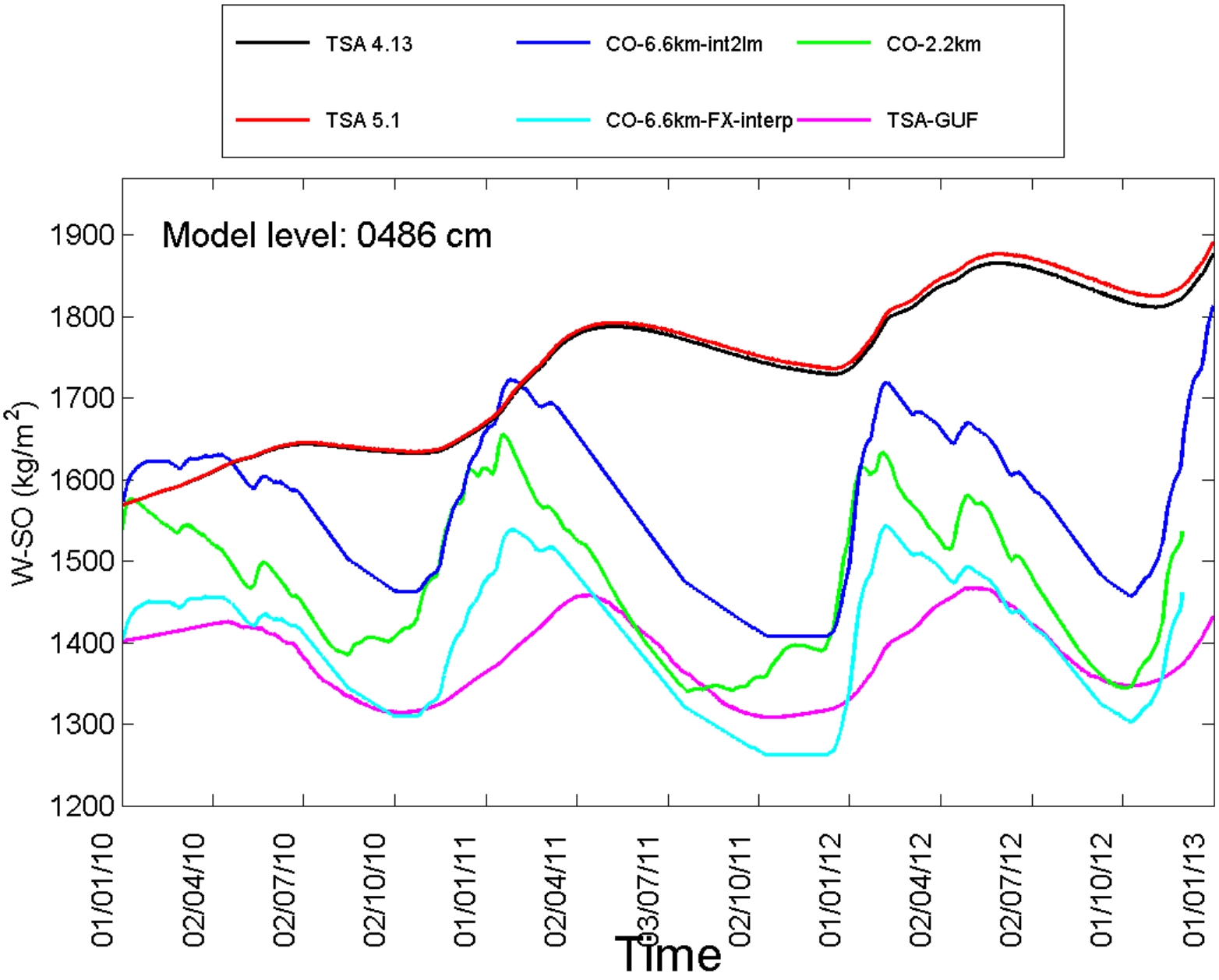
Interpolation by Int2lm + FieldExtra

- Initialization
- Upper boundary conditions

Truth to compare with:

- CO-2.2km - COSMO 2.2km analyses
- CO-6.6km-FX-interp – FieldExtra interpolation of COSMO 6.6km analyses
- CO-6.6km-int2lm – Int2lm interpolation of COSMO 6.6km analyses

Example: soil moisture at depth 486cm at grid point: 8.11ºE 47.35ºN



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Averaging method

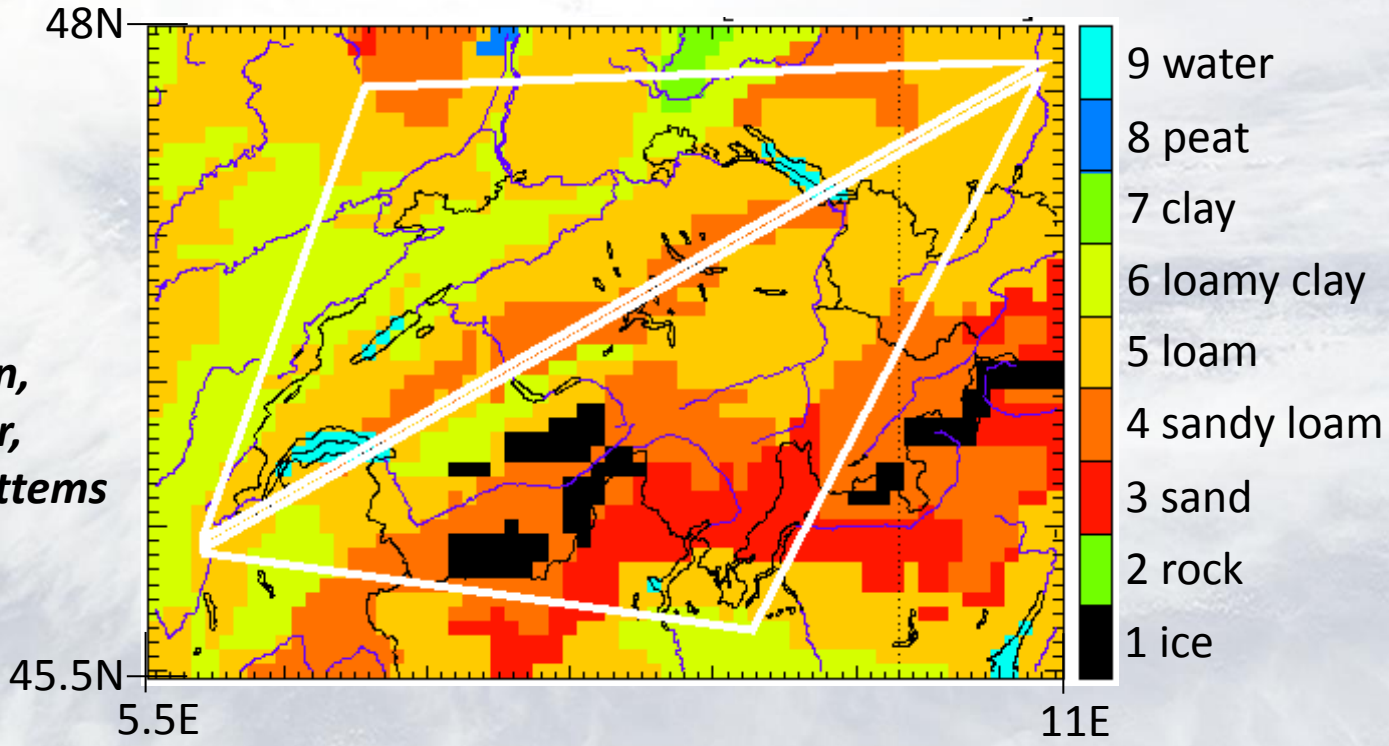
2 regions: north and south to the main Alpine crest

5 different soil types

3 depth ranges: 0-10cm, 10-100cm, 100-2187cm

$$W\_SO(\%) = 100 \times \frac{W\_SO\left(\frac{kg}{m^2}\right) - PWP}{FC - PWP}$$

PWP - Permanent Wilting Point
FC - Field Capacity.



Thanks to:
Petra Baumann,
Guy de Morsier,
Jean-Marie Bettems

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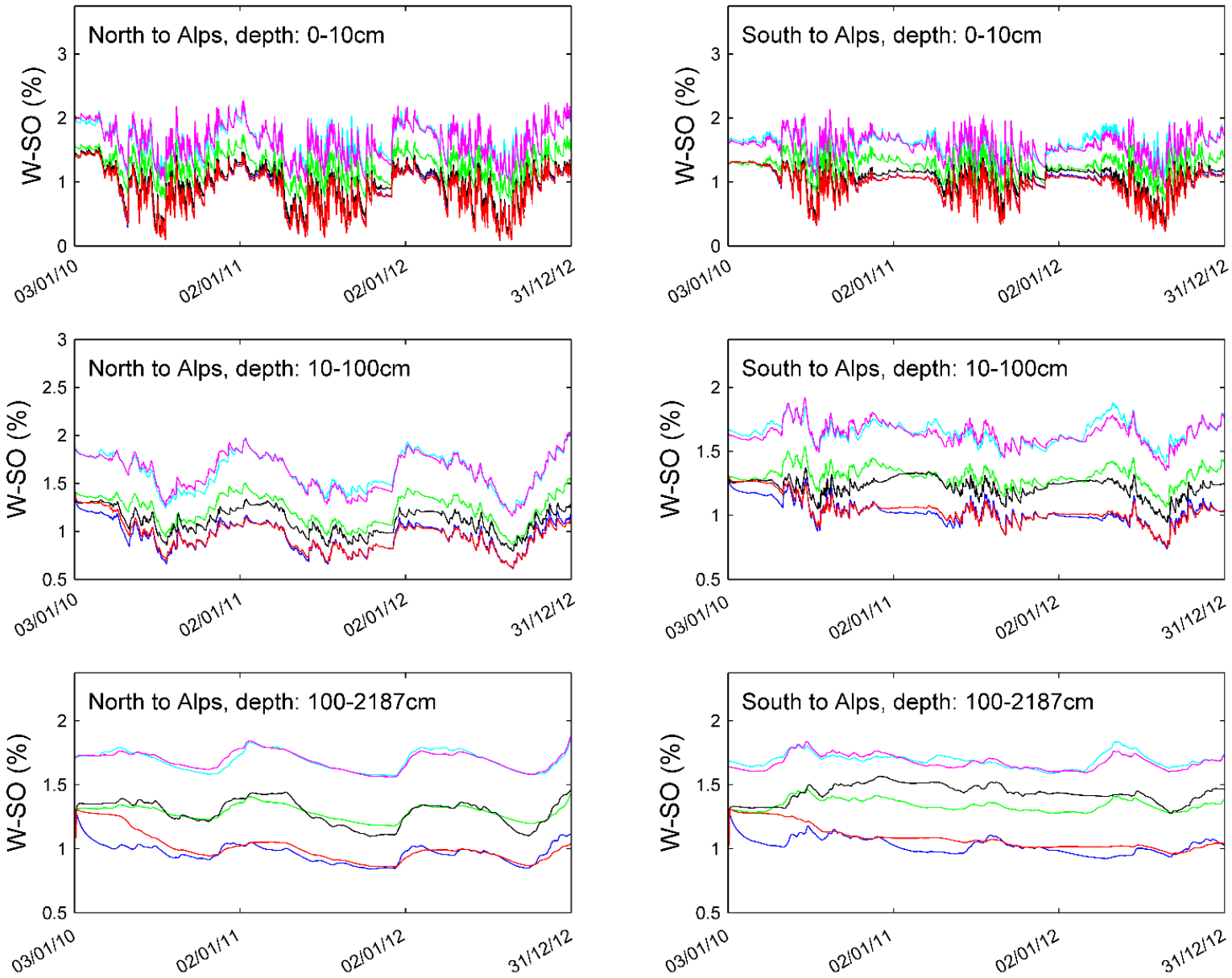
New hydraulic conductivity - Jürgen Helmert

itype_hydcond, &! type of hydraulic conductivity
! 0: standard
! 1: exponential profile of saturated hydraulic conductivity
!<JH
!fc=2 1/m Exponential Ksat-profile decay parameter, see Decharme et al. (2006)
zkw3 (i,j,kso) = zkw3 (i,j,kso)*EXP(-kexpdec*(zmls(kso)-rootdp(i,j)))
!>JH

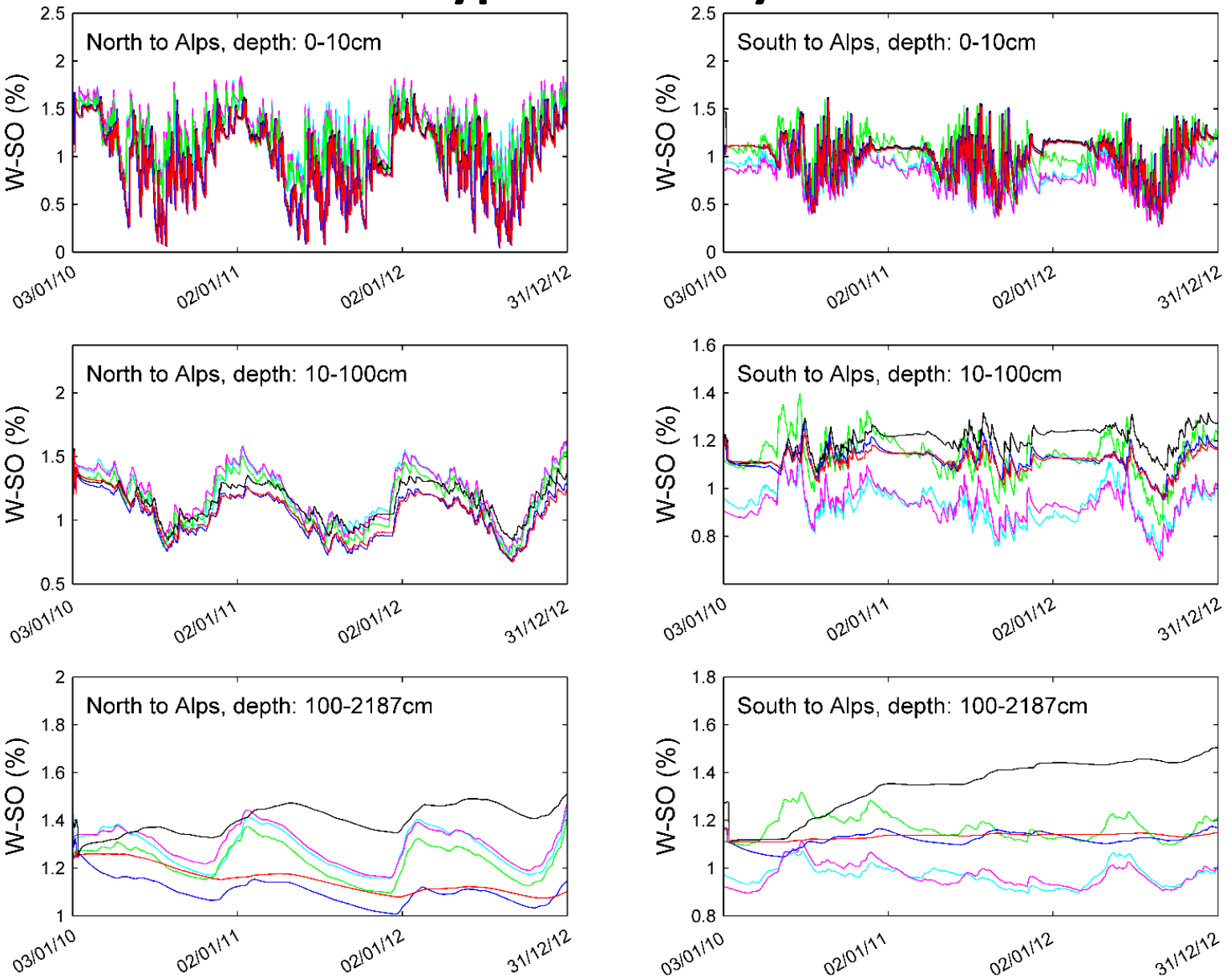
2

Below the roots → exponential decay of Hydr. Conductivity → less soil moisture

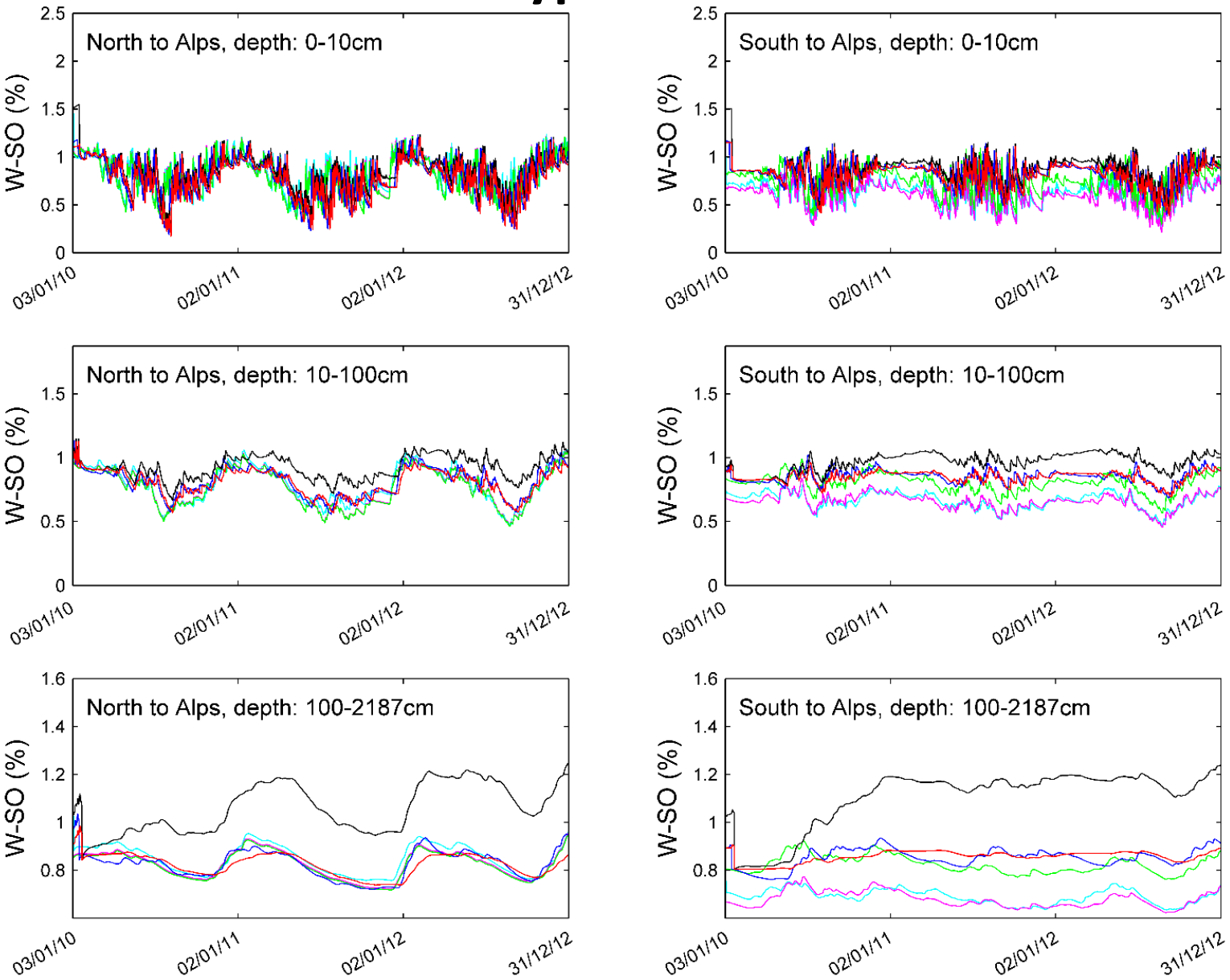
Soil type 3: Sand



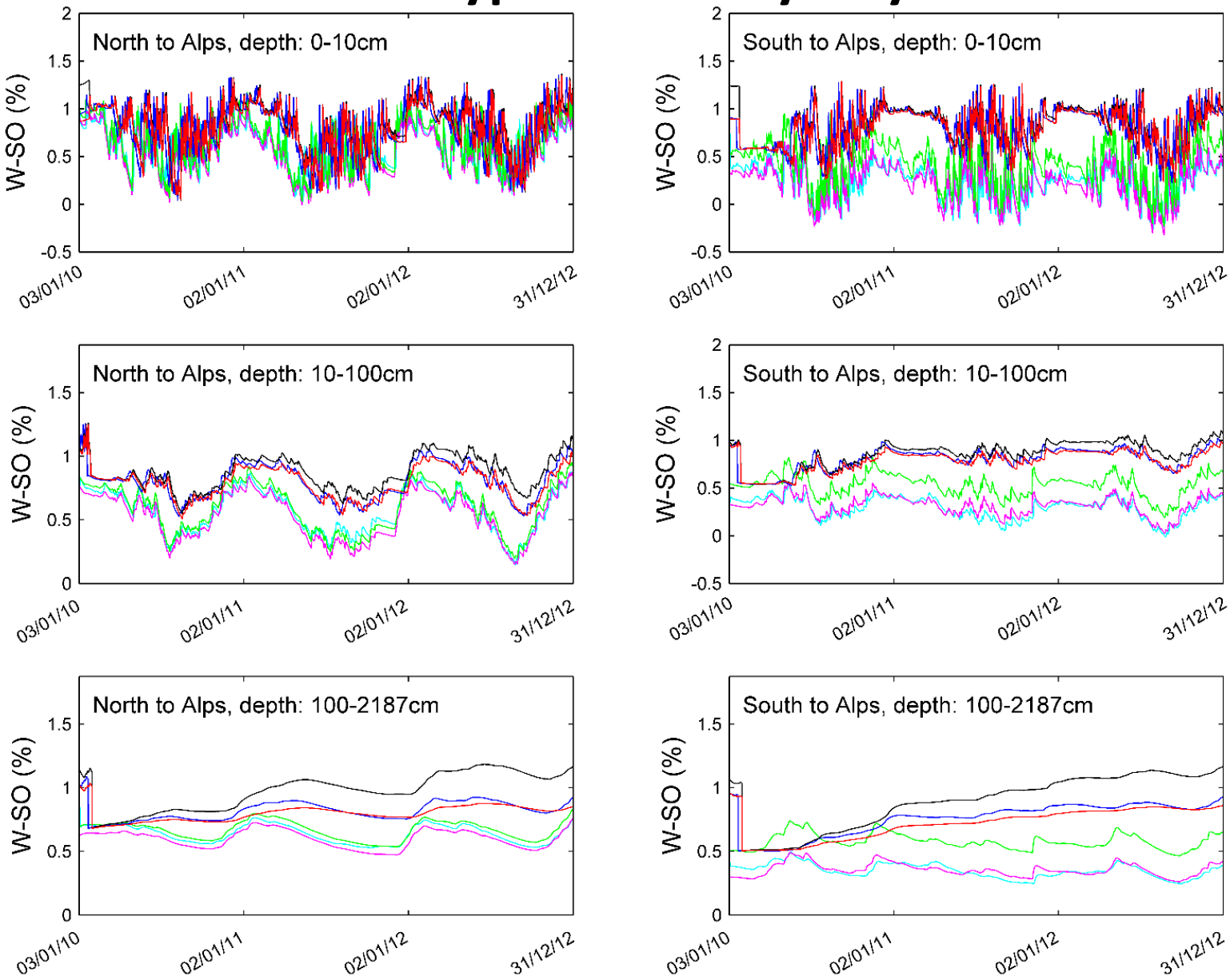
Soil type 4: Sandy loam



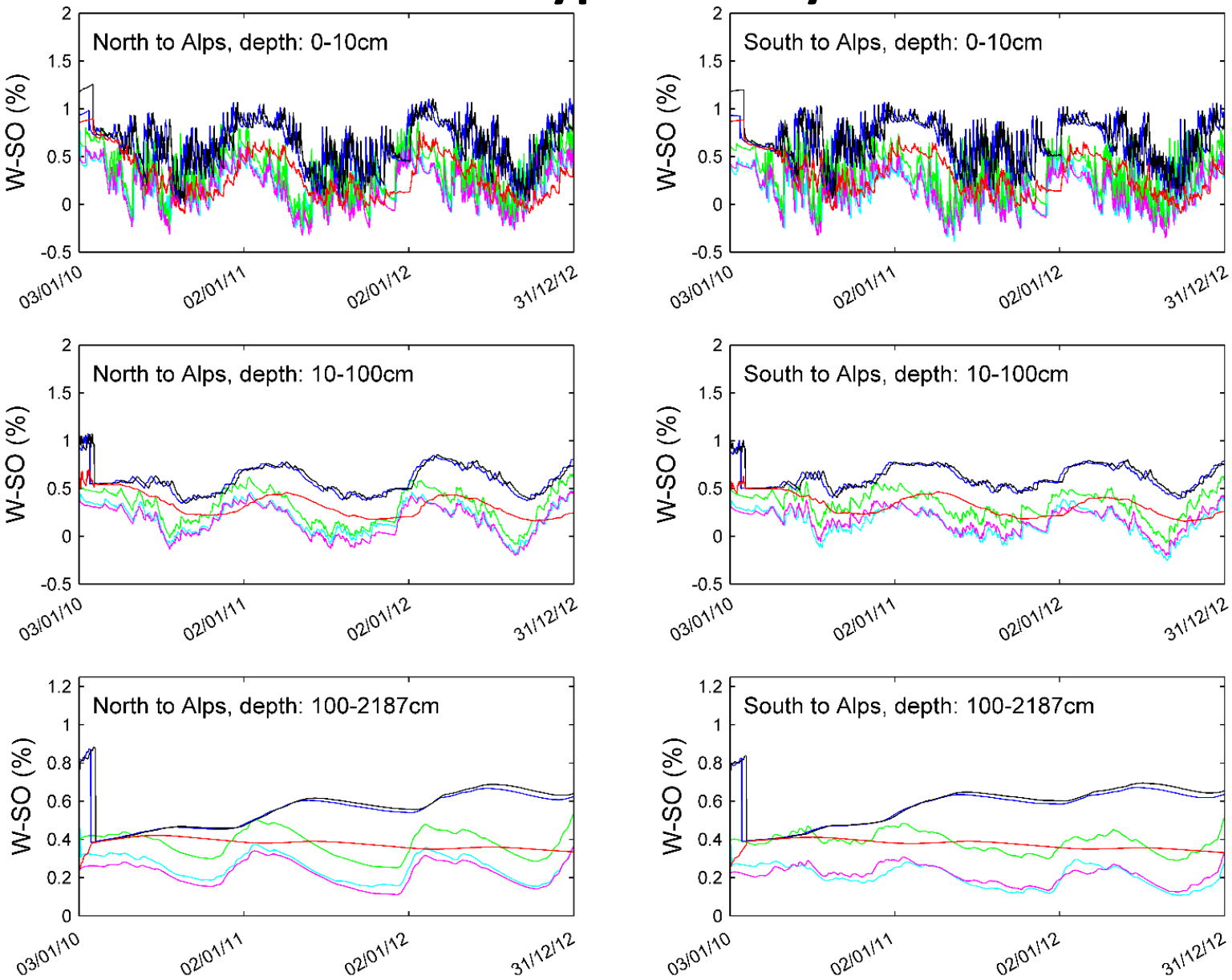
Soil type 5: Loam



Soil type 6: Loamy clay



Soil type 7: Clay



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