SUMMARY OF RECENT ACTIVITIES ON SURFACE ASPECTS WITHIN SRNWP

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Outline

- Documentation of the current surface characteristics and planned improvements
- Answers to the interoperability requests
- Means for collaboration and exchange of information

Documentation

- the main features of the surface including current status and planned developments (ALADIN/LACE, HIRLAM, UK/JULES, COSMO, ECMWF IFS)
  - modelling components (surface energy balance, coupling with atmosphere, soil transfers, frozen soil, vegetation, snow model, lake model, sea-ice, ocean model, urban areas, chemistry module, surface boundary layer)
  - assimilation (soil temperature and water content, SST, sea-ice content, sea-ice concentration, snow depth, lake, vegetation)
  - physiography (orography, soil types, soil depths, land covers, lake properties. land sea mask)
- References (published papers and internal reports)

Documentation - modelling

Part I : modelling components in ALADIN

Modeling component	Current status	Under development	Suitable references
Surface energy balance	one single surface temperature (bare soil/vegetation/snow)	Tile approach with four separate energy budgets (sea/lake/towns/nature) Patch approach over the nature tile : (up to) 12 different water and energy budgets	Noilhan and Planton (1989)
Coupling with the atmosphere	Implicit (internal)	Implicit (external)	Best et al. (2004)
Soil transfers	2-layer force-restore method – ISBA scheme > 1st layer= 1 cm > 2nd layer = soil depth (between 1 and 3 m)	3-layer force-restore method (for water transfers) > 3rd layer = recharge zone (50 cm)	Deardorff (1977, 1978) Boone et al. (1999)
Vegetation	One-layer – Canopy resistance formulation for transpiration (Jarvis type) – interception reservoir	Two-layers – separate energy balance for high and low vegetation	Noilhan and Mahfouf (1996)
Snow model	One layer – prognostic variables : snow water equivalent, snow density, snow albedo	Three-layer scheme – liquid water in snow pack as an additional prognostic water	Boone (2000)
Lake model	Prescribed surface temperature (analysis)	3-parameter lake model (Flake)	Mironov et al. (2008)

Documentation - physoiography

Part II : physiography in ALADIN

Component	Current status	Under development	Suitable references
Orography	NOAA database resolution 5'	GTOPO30 database resolution 30''	
Soil types	NASA database resolution 1° : fraction of sand and clay	FAO database resolution 10 km : fraction of sand and clay	Webb et al. (1991)
Soil depths	ISLSCP database resolution 1°	ECOCLIMAP database resolution 1 km Lookup table with ecotypes	Sellers et al. (1996) Masson et al. (2003)
Land covers	AVHRR NDVI classification over Europe resolution 2 km Wilson and Henderson-Sellers (1985) classification elsewhere resolution 1° Lookup tables between ecotypes and model parameters	ECOCLIMAP resolution 1 km 255 ecotypes derived from NVDI classification and a set of 12 pure « ecotypes » Lookup tables for pure ecotypes and « flux conserving » averages for mixed ecotypes	Wilson and Henderson-Sellers (1985) Mahfouf et al. (1995) Champeaux et al. (1999) Giard and Bazile (2000) Masson et al. (2003)
Land sea mask	Binary from US NAVY 10' data base	Fractional from ECOCLIMAP database resolution 250 m over Europe (CORINE) resolution 1km elsewhere	Masson et al. (2003)

Documentation - assimilation

Part III : assimilation and analysis in ALADIN

Model parameters	Current status	Under development	Suitable references
Soil temperature and water content	Optimum interpolation based on screen-level analysis increments of T and RH	Extended Kalman Filter (EKF) for use of conventional and satellite observations Offline mode	Giard and Bazile (2000) Mahfouf et al. (2009)
Sea surface temperature	Optimum interpolation using surface observations with a relaxation towards NCEP SST analysis	Optimal interpolation using surface observations and satellite SST products (OSTIA)	
Sea-ice extent	Mask derived from SSM/I radiances	None	
Sea-ice concentration	None	None	
Snow depth	Background values with a relaxation towards climatology from the global model ARPEGE	Optimum interpolation using surface observations + use of satellite MSG snow cover mask	
Lake	Closest point from SST analysis	None	
Vegetation	None	Kalman Filter for surface albedo analysis using LandSAF products	Cedilnik et al. (2009)

Outline

- Documentation of the current surface characteristics and planned improvements
- *Answers to the interoperability requests*
- Means for collaboration and exchange of information

Request from Interoperability

- R1: What surface parameters and surface characteristics each LAM needs to run ?
- R2: What you see as an appropriate way to initialize limited-area models ?
- R3: How surface climatologies are currently incorporated into you own model, and how would you suggest those were handled in terms of the SRNWP Interoperability Programme ?

R1: Surface parameters and characteristics

- primary physiographic parameters provided from high resolution data bases
  Land cover use, Orography, Soil types (textural classes)
- secondary soil and vegetation parameters deduced from the primary ones and averaged at model resolution
  Land sea mask, Lake fraction / urban fraction , Soil depth, Vegetation properties (LAI, fractional cover, albedo, minimum stomatal resistance, root profile,...), Surface roughness, variance of orography, ...
- prognostic variables
  Surface temperature (all types), Soil temperatures and liquid/solid water contents, Sea-ice temperatures, Snow water equivalent, Interception reservoir

R2: Appropriate way to initialize LAMs

- definition of interpolated fields
  Land sea mask, Surface orography and temperature, Soil temperatures and liquid/ice water contents, Sea-ice temperatures, Snow water equiv.
- recommended variables for spatial interpol.
  SWI – textural information and does not depend explicitly upon soil depth
- vertical interpolation on fine intermediate grid
- horizontal interpolation on target grid
  considering the land sea mask (and other surfaces as urban areas, lakes, sea-ice)
- vertical interpolation on target grid
- vertical adjustment to orography (temperatures, snow, soil ice)

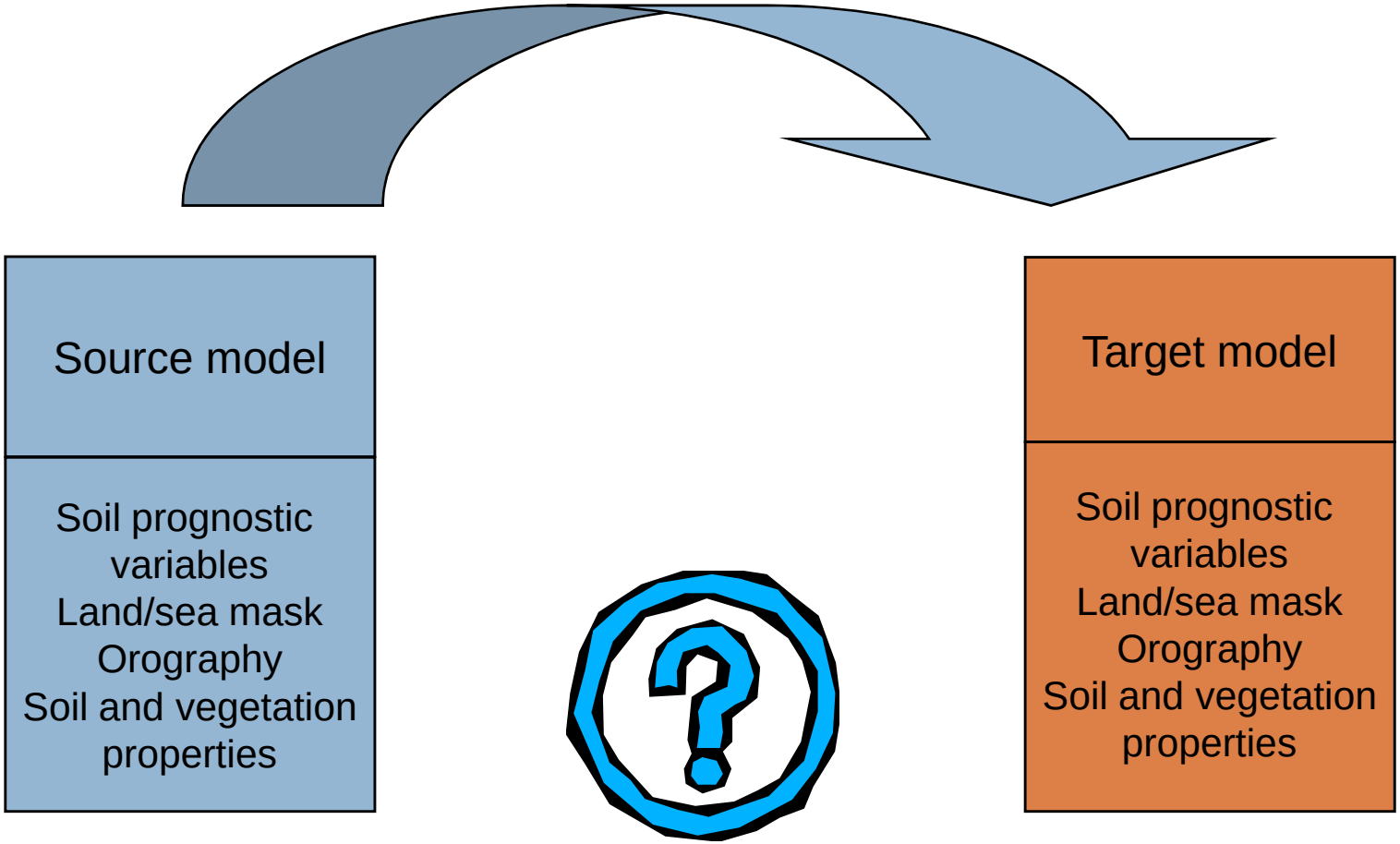
R3: Surface climatologies

- surface temperature
- deep soil temperature
- deep soil moisture content
- snow water equivalent
- surface albedo or surface emissivity
  ("scheme dependent" (separation between bare soil and vegetation types; spectral dependency))

In near future satellite products should be used

- Surface albedo, leaf area index, fractional vegetation coverage, snow cover

Physical and numerical conversions required



General recommendations

- “model dependency” of the conversion
  The more different the surface physics is between the two models, the more difficult (and arbitrary) the conversion will be. Currently the surface parameterization schemes in SRNWP LAM models (+ECMWF) have important similar features that make “physical conversions” possible.
- when possible, the surface from the target model should be kept and only atmospheric fields from the source model should be interpolated to the target model

General recommendations

- number of intermediate steps (interpolations) from the source grid to the target grid should be reduced as much as possible (e.g. the interpolation of the target climatological fields on the source grid as done in the ALADIN consortium with the so-called configuration “E901” is not recommended)
- importance of ancillary data in addition to orography and land/sea mask on both target and source grids has been stressed (e.g. soil and vegetation properties) in order to allow “physical conversion” of the variables that need to be spatially interpolated

Outline

- Documentation of the current surface characteristics and planned improvements
- Recommendation for the interoperability requests
- *Means for collaboration and exchange of information*
  - frequent update of documentation
  - annual “working day”
  - Intercomparisions against is-situ observations
  - ET web page

1st ET meeting in Toulouse

Agenda

- Status and plan of individual consortia
- Discussion of a synthetic documentation of modelling and assimilation components
- Definition of concrete collaborations
- Discussion on other activities

Participants : S. Pullen (UKMO), G. Rooney (UKMO), S. Tijm (KNMI/HIRLAM), F. Bouyssel (MF/ALADIN), P. De Rosnay (ECMWF), W. Lahoz (NILU/HIRLAM), E. Martin (MF/ALADIN), J.-M. Bettems (MeteoSwiss/COSMO), J. Helmert (DWD/COSMO), M. Diez (AEMET/HIRLAM), R. Hamdi (RMI/ALADIN), J. Cedilnik (DMS/LACE), A. Trojakova (CHMI/LACE), L. Kullmann (HMS/LACE), F. Meier (ZAMG/LACE),J.-F. Roujean (MF/ALADIN), J.-F. Mahfouf (MF/ALADIN)

1st ET meeting - collaborations

- validation using NLDAS forcing
- validation at local scales

  - within CEOP (Coordinated Energy and Water Cycle Observations Project) sites already exists (Payerne, Capofiume, Cabauw, Sodankyla, Lindenberg) that could be made available to all consortia members (support letter from A. Horanyi)

  - FMI real time intercomparisons

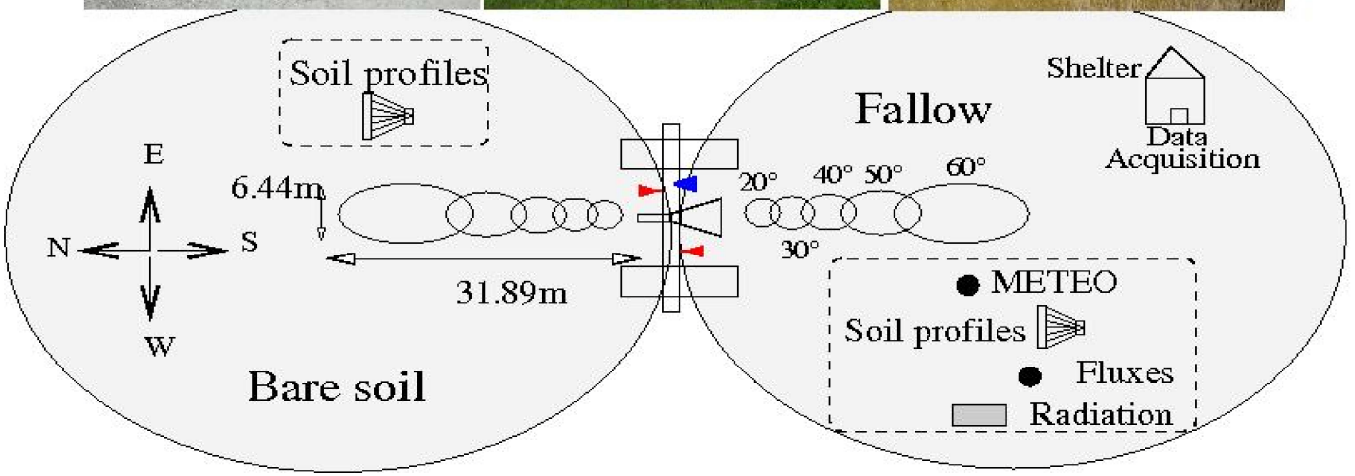
  - SMOSREX (Surface Monitoring Of the Soil Reservoir Experiment) dataset available – data provided to ET members via dedicated web site

SMOSREX

SMOSREX:

Multi–frequency acquisition

- TIR Pyrometers (KT15): at 40° incidence
- VIS to IR Luminancemeters (Cimel) 5–band:
  837(91), 648(53), 549(85), 450(40), 1640(165) nm
- LEWIS: L–band (1.4 GHz)
  L–band radiometer for Estimating Water In Soils



1st ET meeting - collaboration

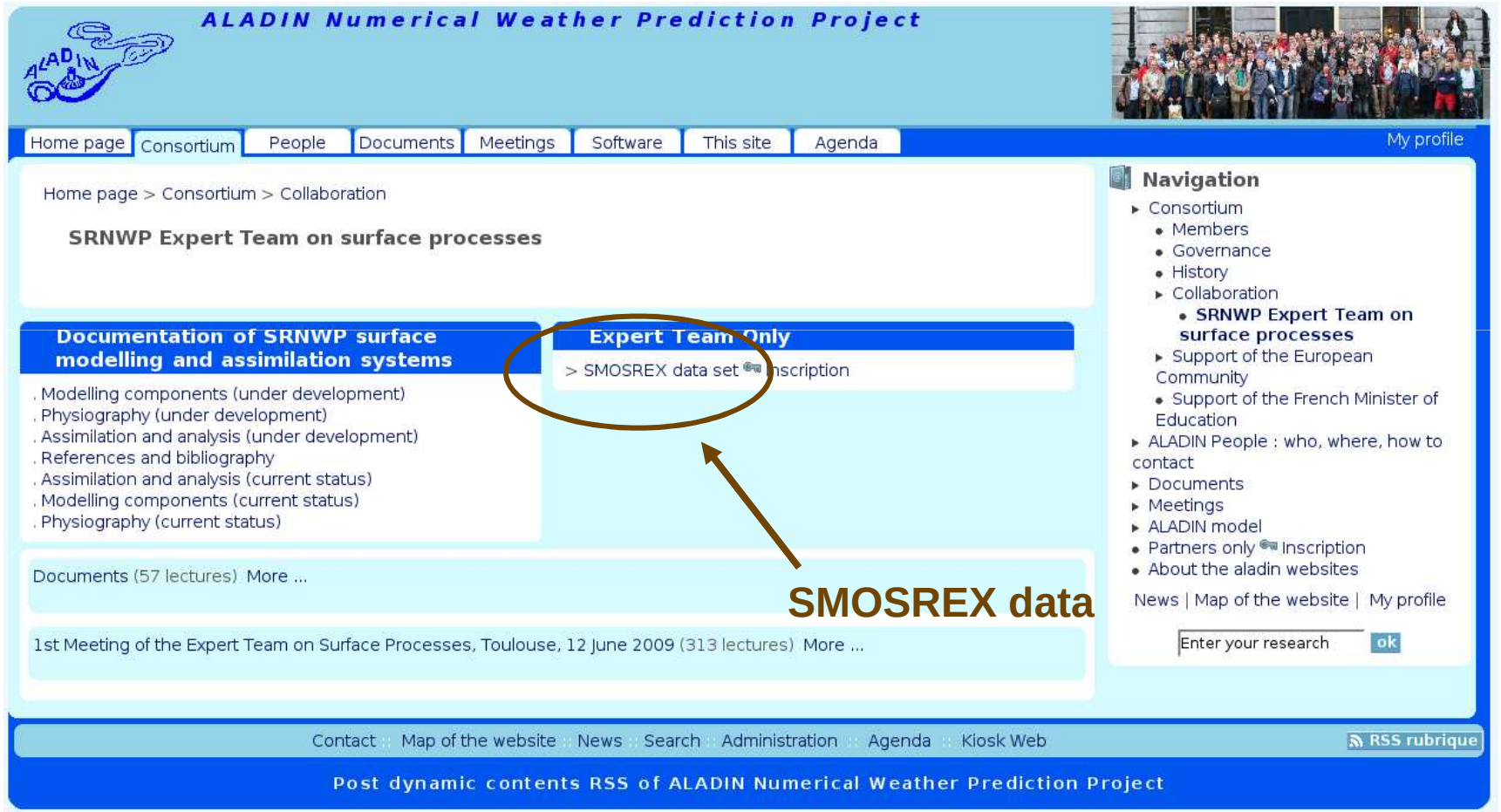
- lake modelling
  need for sharing of information, a web site with contact points, extension of lake databases, lake depth climatology
- snow analysis
  - two products from the LandSAF and the H-SAF. COSMO (MeteoSwiss) has also another snow cover product that has been found superior to the LandSAF

  - need for additional (independent) data set the validation of snow analysis (request to ET on verification)

Next ET meeting ?

- Annual ET meeting suggested (one day) to be coordinated with another workshop
- SRNWP workshop on surface aspects including lakes in 2010/2011 ?

ET web page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ET web page

Assimilation and analysis (current status)

Model parameters	ALADIN	COSMO	HIRLAM	UM/JULES	ECMWF
Soil temperature and water content	Optimum interpolation based on screen-level analysis increments of T and RH	2-dimensional (vertical and temporal) variational technique using 2-m temperature analyses at 12 and 15 UTC Analysed variables : soil moisture of the top 5 soil layers (0-81 cm) at 00 UTC	Optimum interpolation based on screen-level analysis increments of T and RH	Errors in forecasts of screen T and RH used to calculate increments to soil moisture. NAE and M4 use UKPP over UK and interpolated global SMC elsewhere Level 1 T atmospheric increments applied to top soil level in absence of snow	Optimum interpolation based on screen-level analysis increments of T and RH
Sea surface temperature	Optimum interpolation using surface observations with a relaxation towards NCEP SST analysis	Correction method. Background field from GME SST analysis using NCEP 0.5°x0.5° SST analysis that includes satellite data. Observations from SYNOP-SHIP and BUOY.	Successive corrections	Interpolated from OSTIA analysis	Aggregation of the OSTIA SST products based on surface observations and satellite products
Sea-ice extent	Derived from sea-ice concentration (used only to update sea-ice temperature)	Sea ice cover analysis from BSH (German Institute for shipping and hydrology) for the Baltic sea. Resolution lon/lat : 0.167x0.1 degrees, NCEP analysis in other areas	Taken from OSISAF	Interpolated from OSTIA analysis	Aggregation of OSTIA sea-ice products which are the OSI-SAF products (from SSM/I data)
Sea-ice temperature		Interpolated from monthly ECMWF climatology			
Sea-ice concentration	Derived from SSM/I radiances (used only to update sea-ice	None	Taken from OSISAF	None	None
Snow depth	Background values with relaxation towards climatology from the global model ARPEGE	Correction method. Used data : background values from COSMO model, snow depth observations from SYNOP stations, present and past SYNOP weather, precipitation amount, 2-m temperature analysis (+model prediction). Monthly snow depth, climatology from ECMWF for permanently glacial covered areas	OI based on in-situ measurements	Model values corrected using IMS mask	Cressman analysis using surface observations + use of NOAA/NESDIS snow cover extent to correct snow depth observations
Lake	Closest point from SST analysis	Closest point from SST analysis, adapted to model terrain height. Climatological lake temperature for Bodensee and Lake Geneva	None	Generally climatology	Great lakes : interpolation of the NCEP SST products. Other lakes: SST derived from T2m climatology from Legates and Wilmott (1990)
Vegetation	None	None	None	Seasonal LAI climatology derived from MODIS data	None

Home page > Consortium > Collaboration > SRNWP Expert Team on surface processes > Documentation of SRNWP surface modelling and assimilation systems >

Assimilation and analysis (under development)

Model parameters	ALADIN	COSMO	HIRLAM	UM/JULES	ECMWF
Soil temperature and water content	Extended Kalman Filter (EKF) for conventional and satellite observations. Offline mode		First guess T2m and Q2m from open land/snow only (excluding forest)	Addition of ASCAT data. Longer term plan is to develop an EKF scheme that uses screen observations and satellite data	Extended Kalman Filter (EKF) for use of conventional (soil moisture and brightness temperatures). Offline mode
Sea surface temperature	Optimal interpolation using surface observations and satellite SST products (OSTIA)			None	
Sea-ice extent	None			None	
Sea-ice temperature	None	Implementation of bulk thermodynamic sea ice model presently applied operationally in GME		None	
Sea-ice concentration	None			None	
Snow depth	Optimal interpolation using surface observations + satellite MSG swno cover mask	Major revision of snow within COSMO project COLOBOC at Meteo-Swiss. Modifications in calculation of rho_snow, T_snow, additional use of snow observations in the Alpine region		Longer term plans to include SYNOPs and satellite SWE in snow depth analysis	
Lake	None			None	
Vegetation	Kalman filter for surface albedo analysis from LandSAF products			More frequent updates, possibly using LandSAF data. Longer term plan to assimilate LAI within EKF scheme	MODIS assimilation in a simplified 2D-Var

Thank you for your attention