Surface aspects in HIRLAM

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EWGLAM/SRNWP meeting,
Helsinki, 8-12 Oct. 2012

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Hirlam

Introduction: HIRLAM ... HARMONIE

- **HIRLAM** - operational limited area model: 1985 – 2015, v.7.4
- **HARMONIE** - pre-operational local NWP system based on ALADIN-AROME used and developed within HIRLAM consortium since 2005

Operational status

- **HIRLAM v.7.4**

DA: span

in hor: OI for screen level temperature and relative humidity (anisotrophy due to land-sea and orography), SST and SWE

in ver: OI to get soil temperature and soil moisture

obs: SYNOP, ECMWF SST (OSTIA), LST from SYKE

Operational status

- **HIRLAM v.7.4**

physiography: GLCC+CORINE, FAO soil map, GTOPO, lake depth database

surface layer fluxes: Louis formulation

surface schemes: 5 tiles – water(sea/lakes), sea ice, bare soil, low vegetation, high vegetation; land tiles may be covered by snow, ISBA 2L, newsnow scheme (1.5 layer in snow, snow on high vegetation), FLake, orographic radiation effects

Operational status

- **HARMONIE-36**

DA: CANARI + OI_MAIN

in hor: OI for screen level temperature, relative humidity and SWE, bilinear interpolation for SST

in ver: OI to get soil temperature and soil moisture

obs: SYNOP, OSTIA

Operational status

- **HARMONIE-36**

physiography: ECOCLIMAP2, FAO soil map, GTOPO

surface layer fluxes: CANOPY

surface schemes: SURFEX6.2

3 tiles – water, urban, nature; nature tile may be covered by snow
ISBA 3L, 1 layer in snow

Ongoing and planned R&D. Technical developments

SODA:

SURFEX

Offline

Data

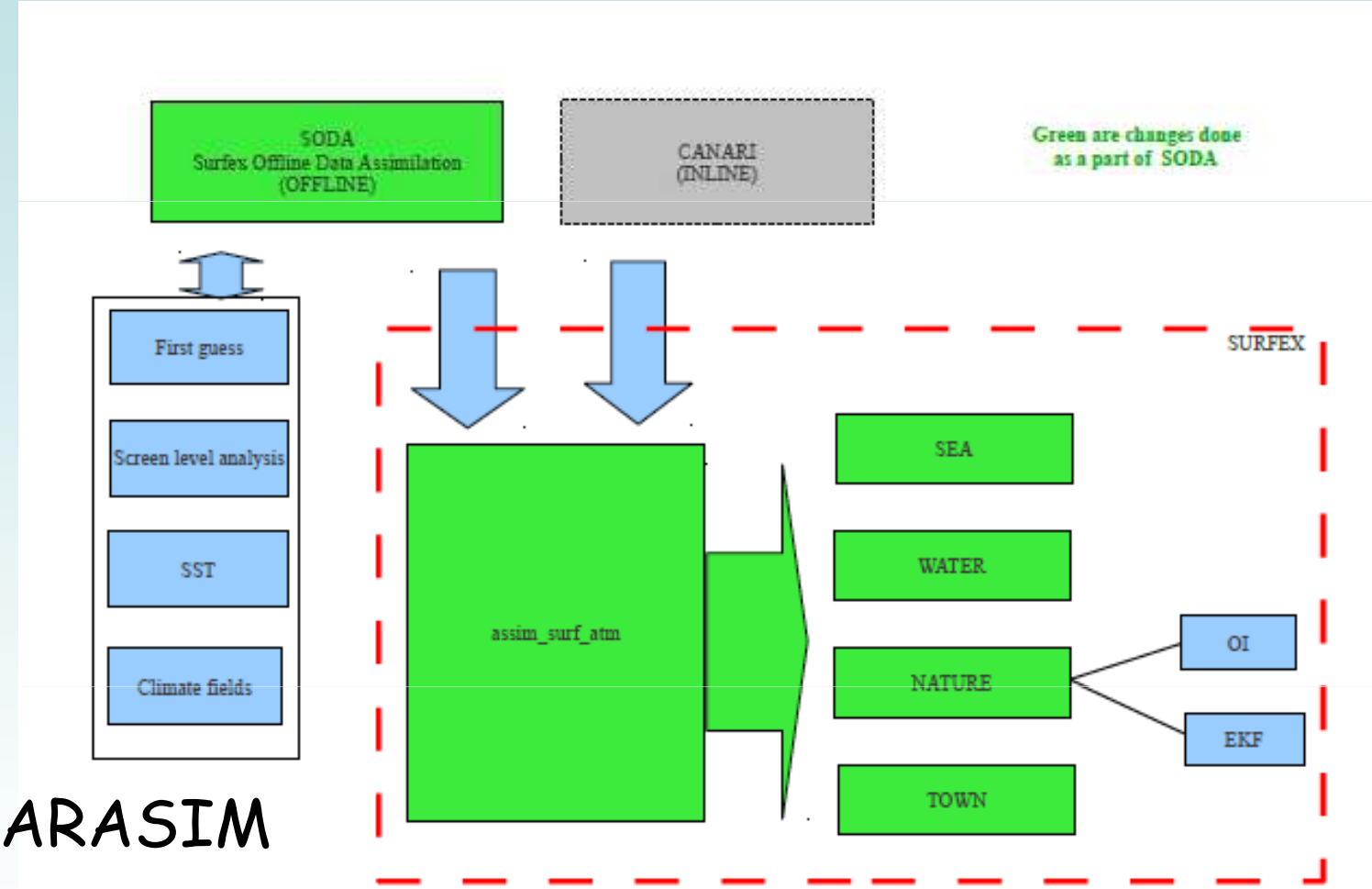
Assimilation

off-line

parallel system

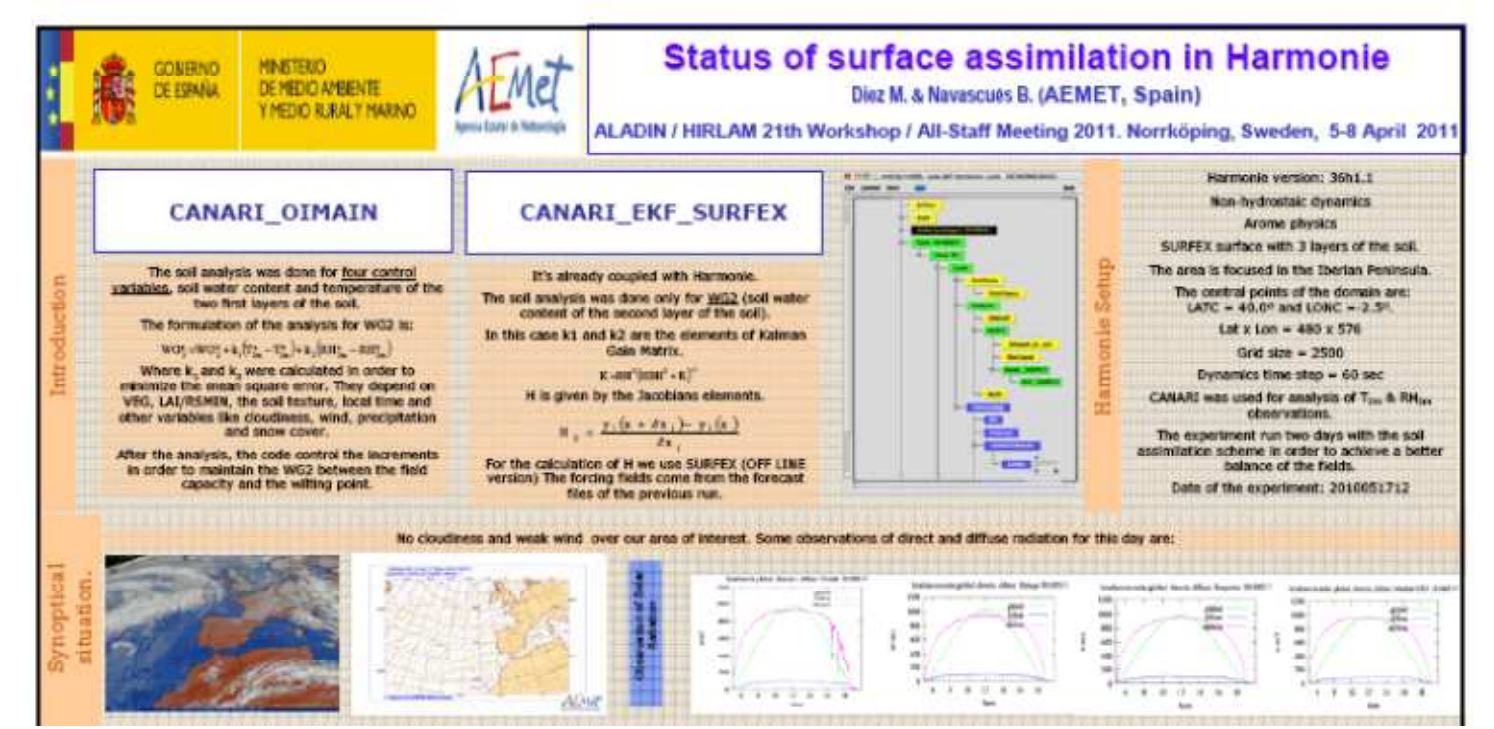
with CANARI

and SURFEX/VARASIM



Ongoing and planned R&D.
Soil and vegetation

Testing of soil moisture analysis with EKF …
Contribution from NILU: EnEKF, particle filter, ASCAT and SMOS data …
EURO4M



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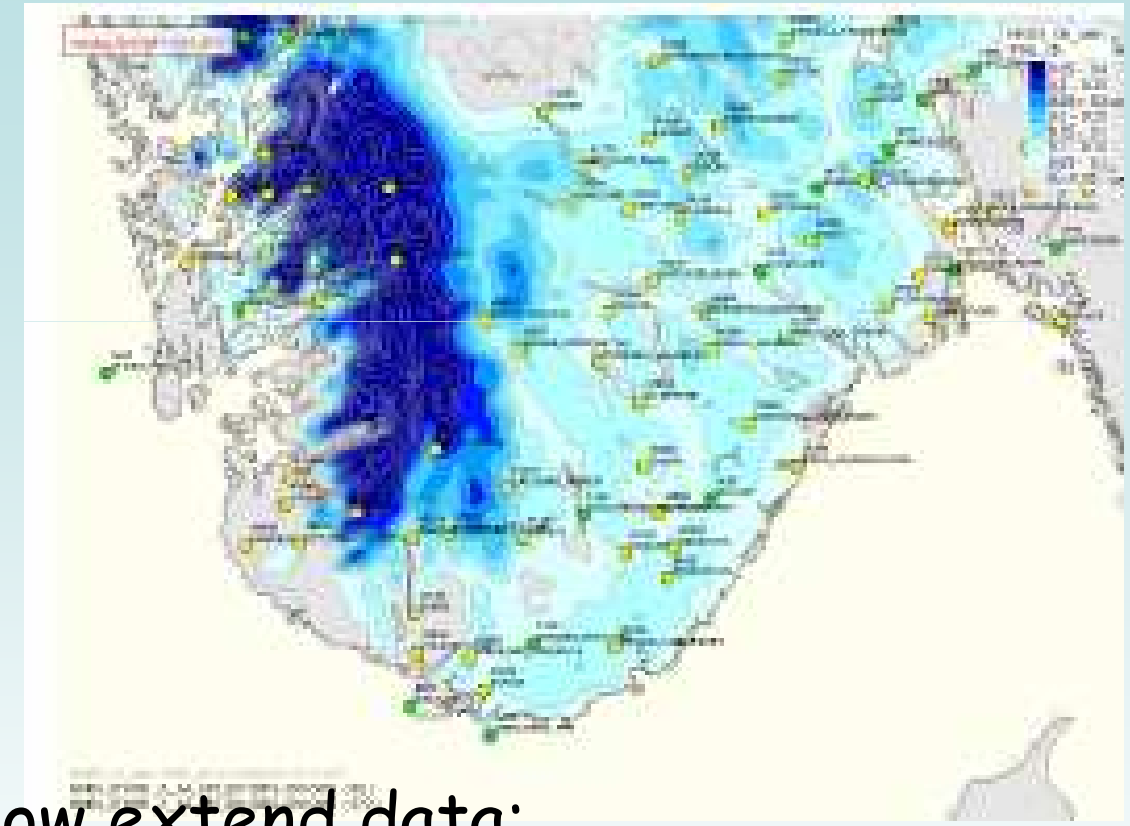
Ongoing and planned R&D.
Snow, DA



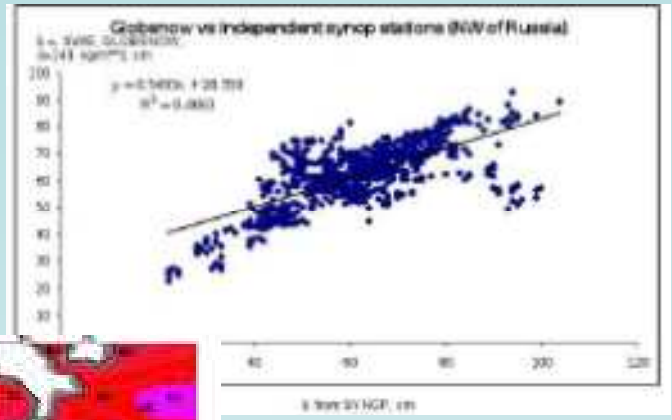
Obs:

Precipitation stations

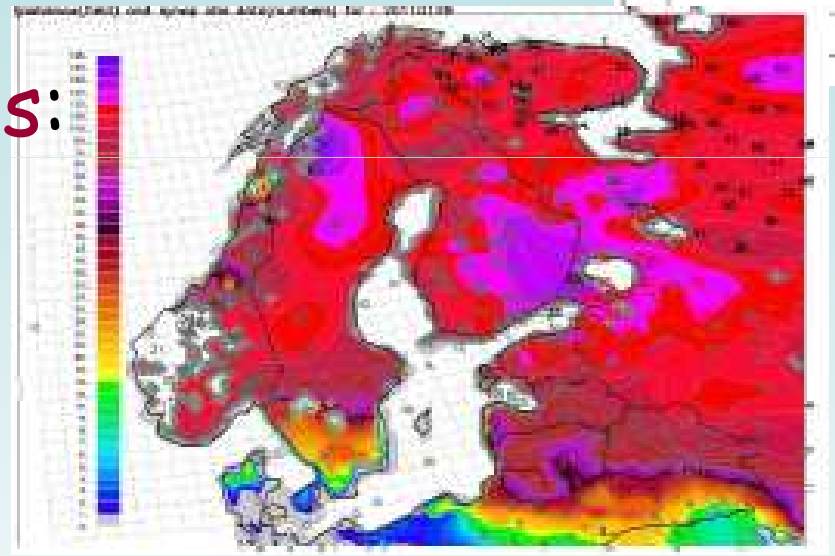
Candidates of satellite snow extend data:
- CryoRisk satellite data, 15 km resolution
- NOAA/NESDIS data
- LANDSAF data

HIRLAM

Ongoing and planned R&D.
Snow, DA



Satellite SWE obs:
GLOBSNOW



Verification against independent SYNOPs and careful analysis show that GLOBSNOW data are not applicable in the present form. Modification of the algorithm is needed … to make first steps forward to assimilate brightness temperatures

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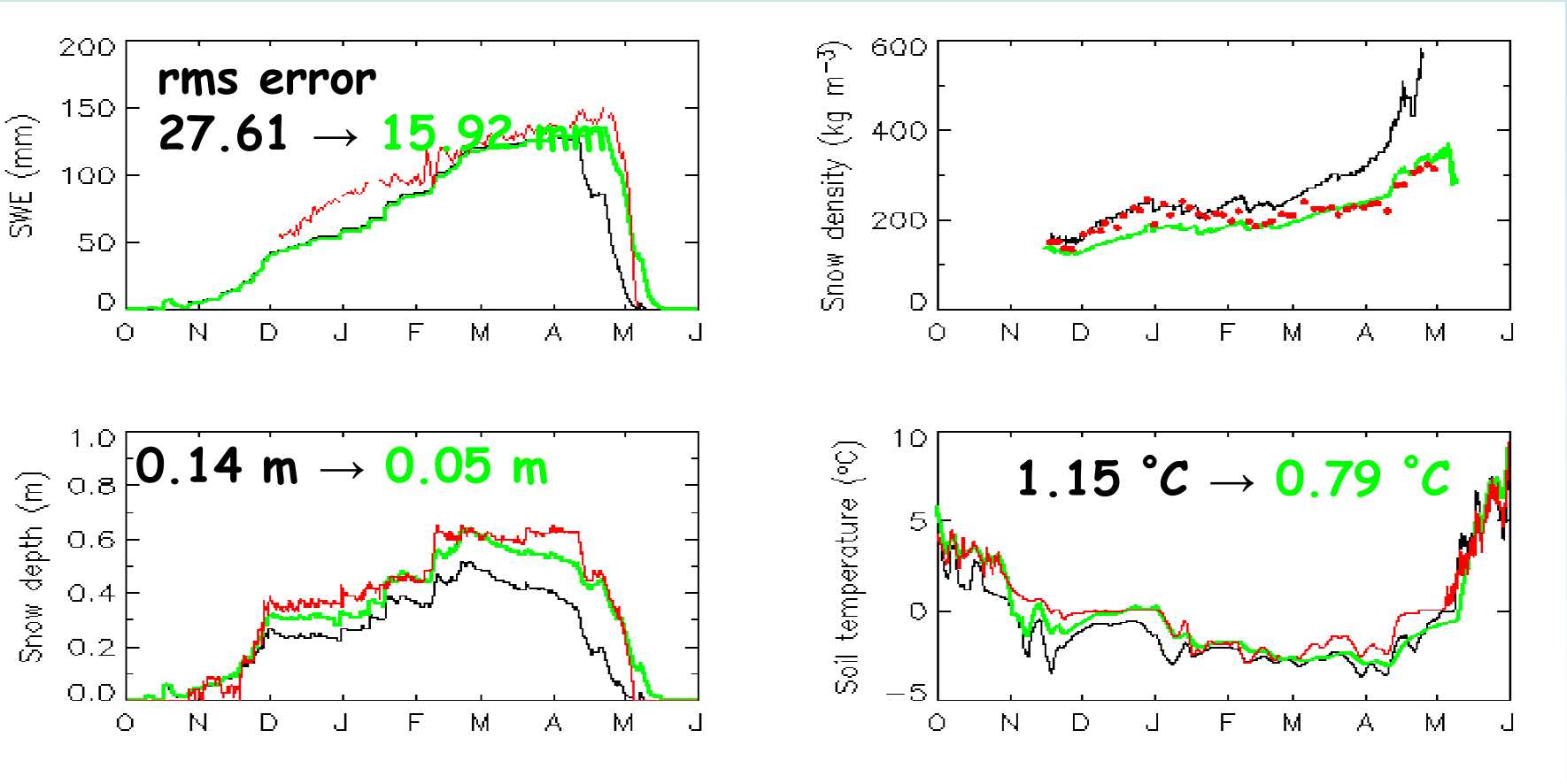
Ongoing and planned R&D.
Snow, DA

in ver.: to assimilate snow depth with EKF using experience of R. Essery with JULES



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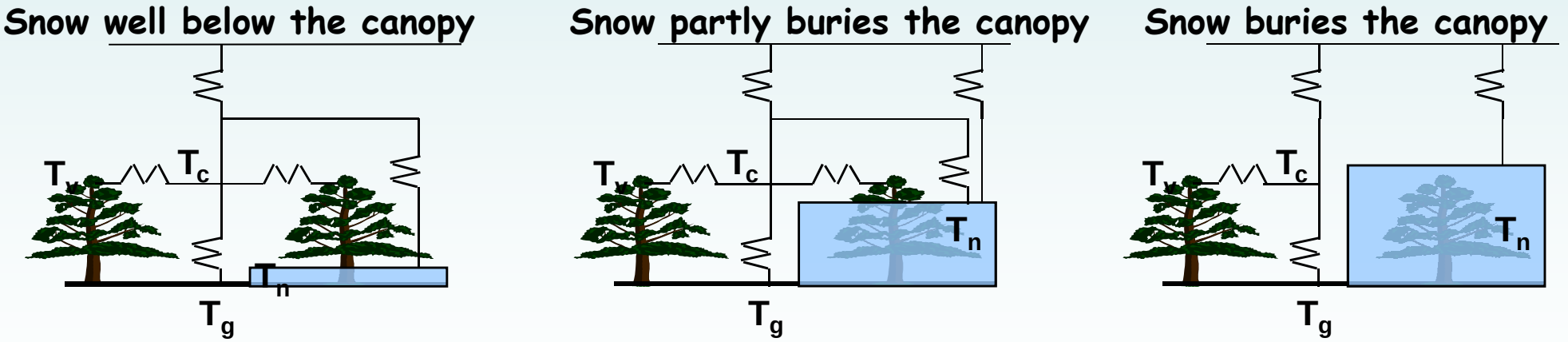
Ongoing and planned R&D.
Snow modelling

MEB:
Multi
Energy
Balance
scheme

Explicit canopy vegetation energy balance (temperature)!



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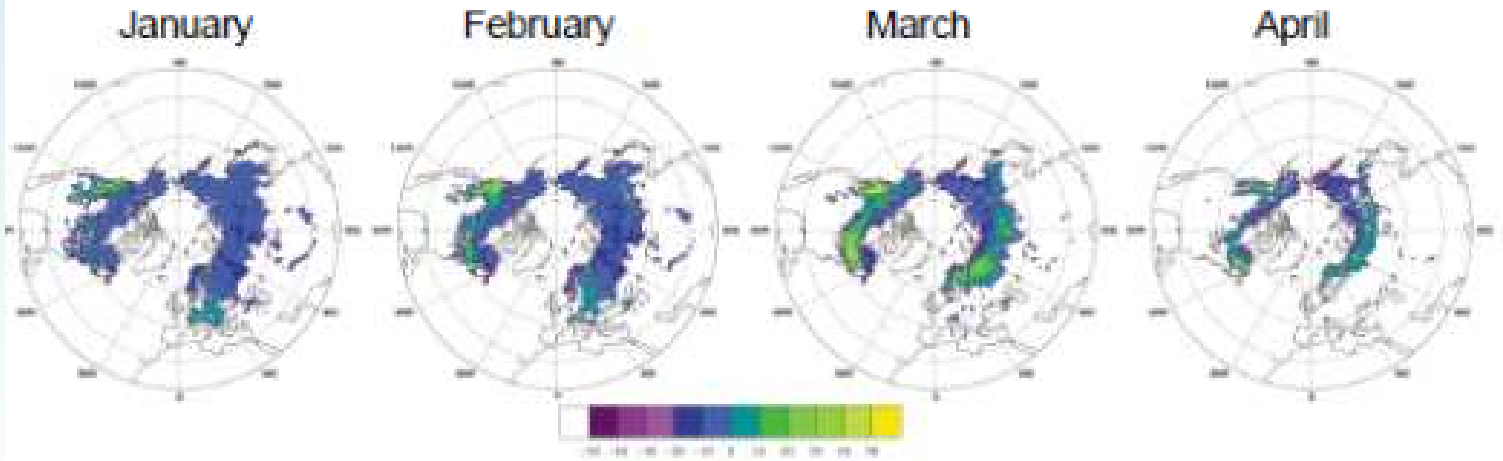
Ongoing and planned R&D.
Snow modelling

MEB:

2D offline experiment – Snow Water Eq. SMHI

With MEB:
- Less snow in forested areas in mid winter (10-20 kg m^{-2}) due to snow interception
- More snow in forested areas late in winter (20-50 kg m^{-2}) due to a combination of radiation and turbulence effects
- The melting is delayed



Difference SWE ISBA-MEB – ISBA
Average over 1978-2008 in kg m^{-2}

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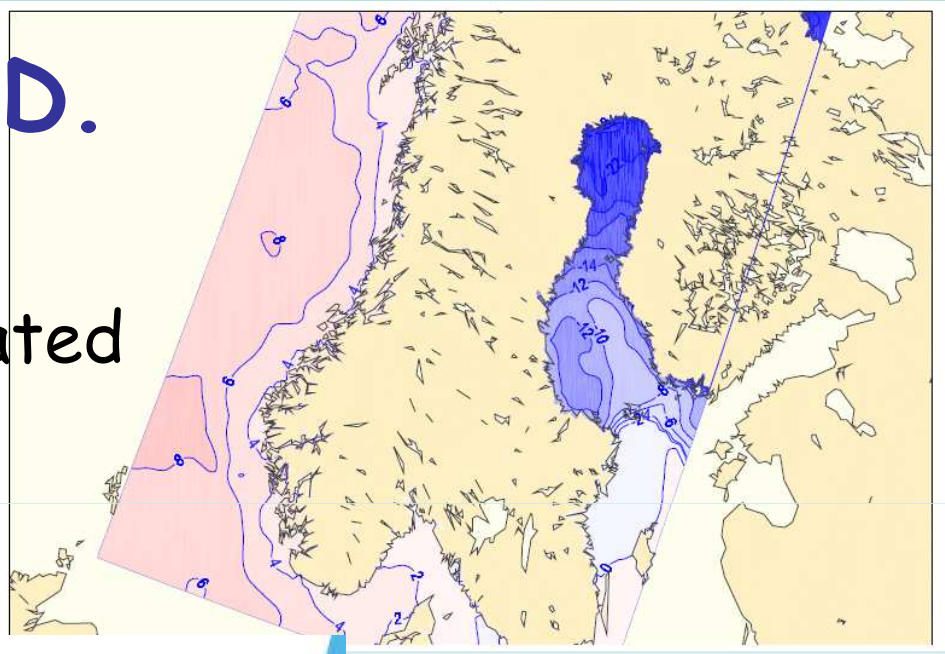
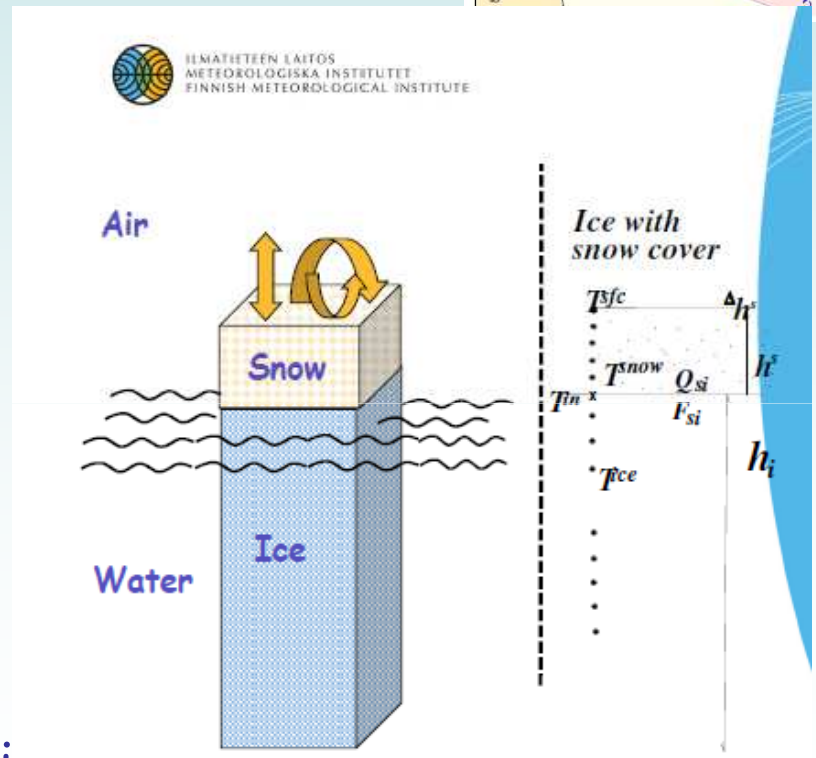
Ongoing and planned R&D.

Sea ice

ECMWF SST optimally interpolated
Detect ice if SST < 271.2 K



HIGHTSI:
High
Resolution
Thermodynamic
Ice
Model



HIGHTSI: One dimensional snow/ice model

First step:
simple 2L
HIRLAM
sea ice
scheme

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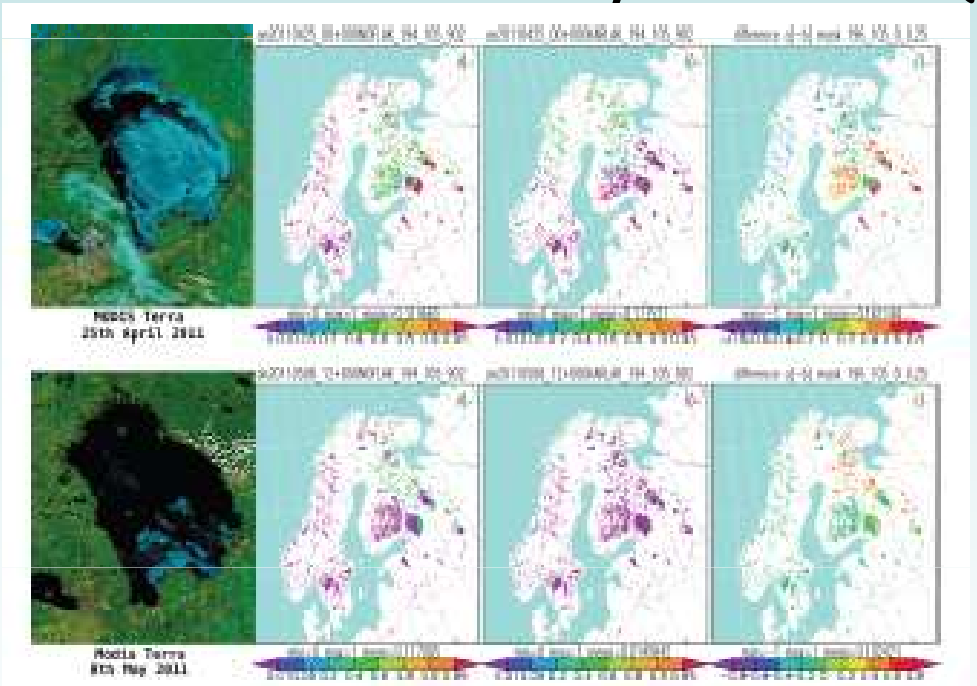
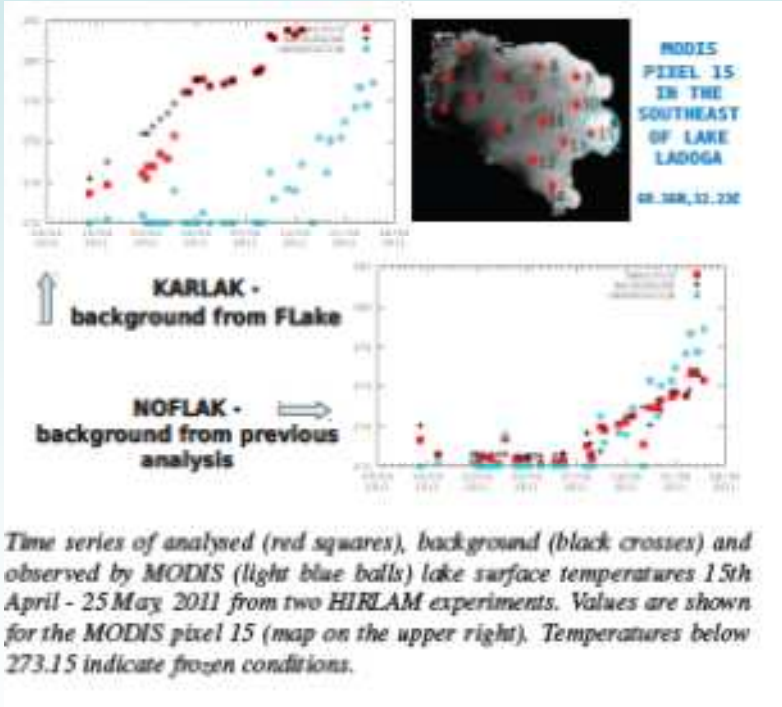
Ongoing and planned R&D.

Lakes

DA of LST in hor: experiments to assimilate MODIS data with currently used OI (developed for SST)



MODIS Terra image over Ladoga (left) and analysis of ice fraction (0..1) from two HIRLAM analyses: a) NOFLAK with first guess from previous analysis, b) KARLAK with background diagnosed from FLake +6h forecast, c) difference. Upper panel: 25th April, lower: 8th May, 2011.



Time series of analysed (red squares), background (black crosses) and observed by MODIS (light blue balls) lake surface temperatures 15th April - 25 May 2011 from two HIRLAM experiments. Values are shown for the MODIS pixel 15 (map on the upper right). Temperatures below 273.15 indicate frozen conditions.

Ongoing and planned R&D.
Lakes

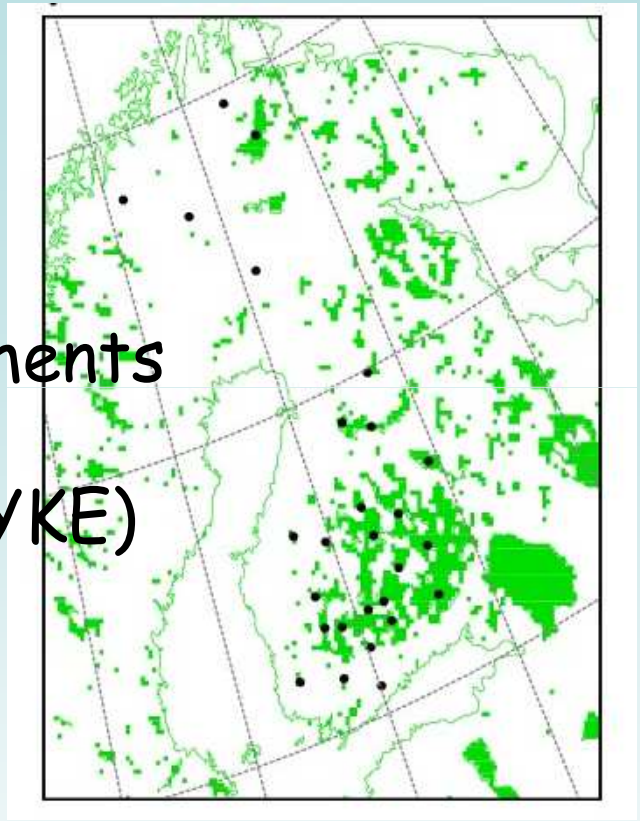
DA of LST in ver:

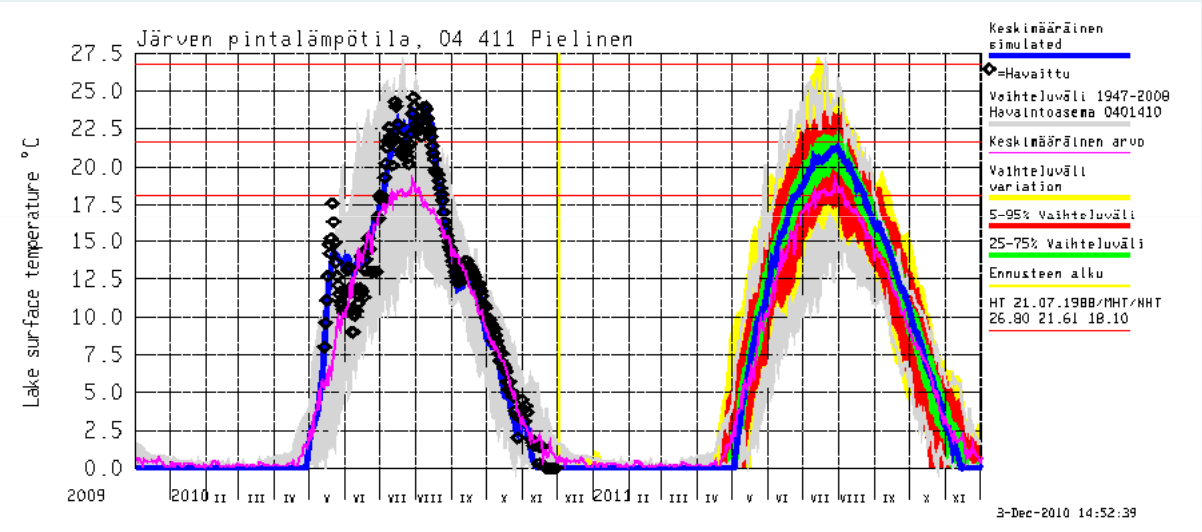
EKF to assimilate in-situ LST measurements

operational obs.

from Finnish Environmental Institute (SYKE)

27 lakes in Finland





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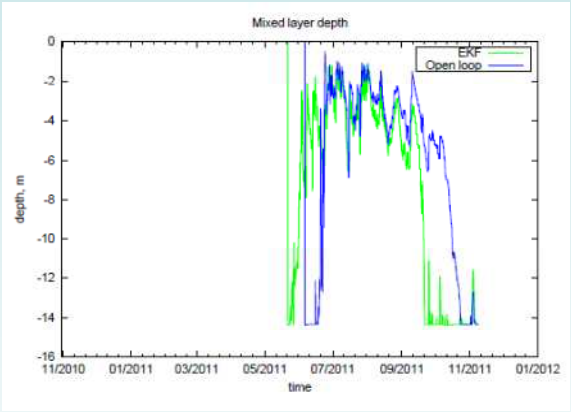
Ongoing and planned R&D.

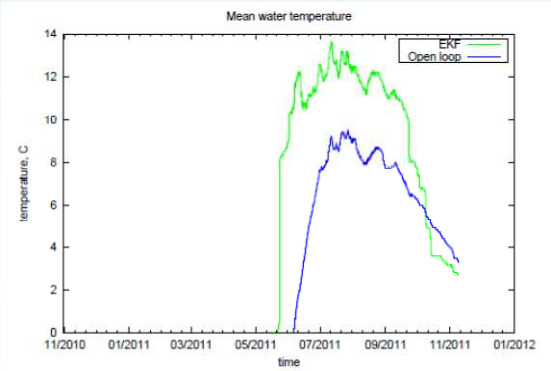
Lakes

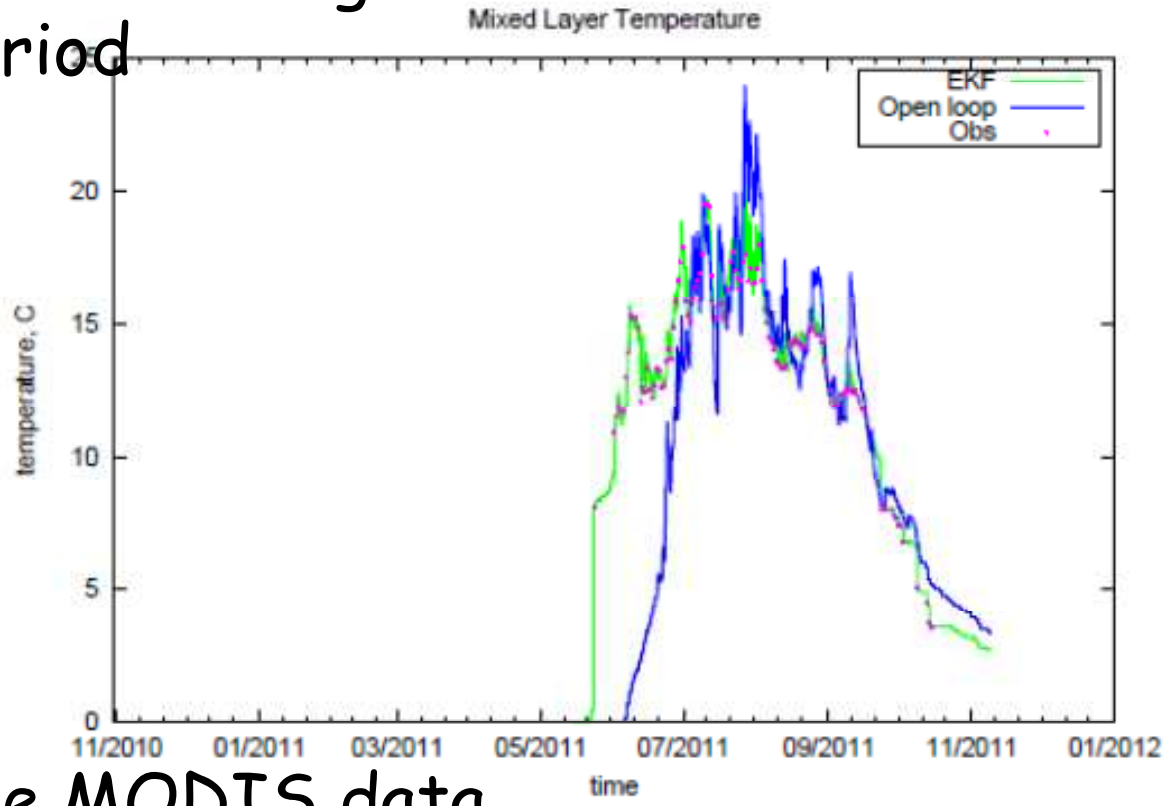
DA of LST in ver:

EKF for mixed and non-mixed regime
for ice-non-ice period

Lake Inari







use MODIS data,
include into SODA and HARMONIE

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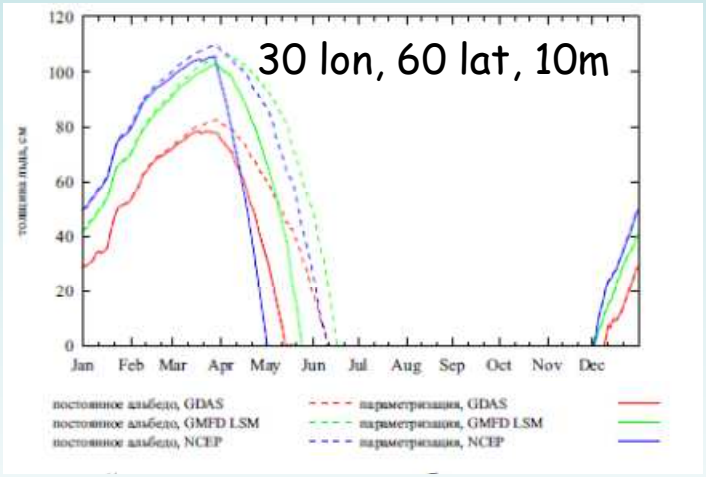
Ongoing and planned R&D.

Lakes

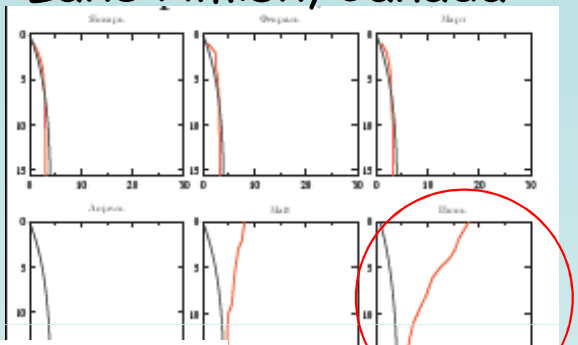
Improved lake model climatology

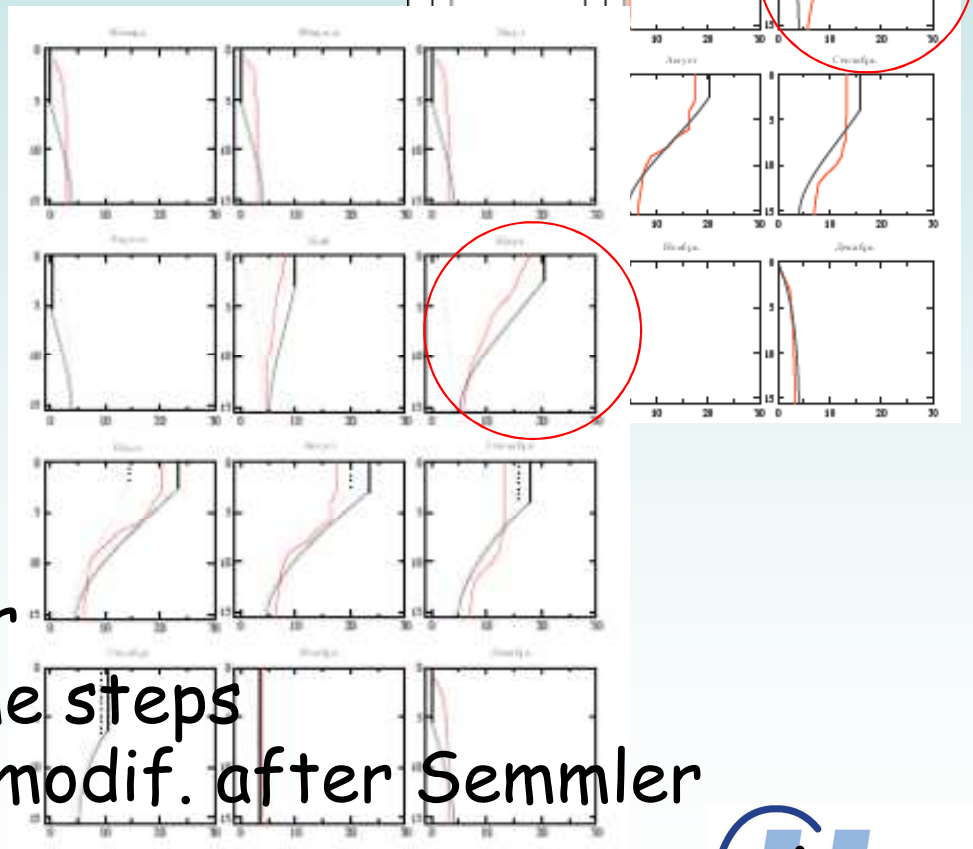
Intensive experiments to find reasons



Errors in spring!

Lake Amisk, Canada





- -forcing from NCEP
- -albedo after Mironov-Ritter
- -Euler scheme with small time steps
- -snow scheme included with modif. after Semmler

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Ongoing and planned R&D.

Urban

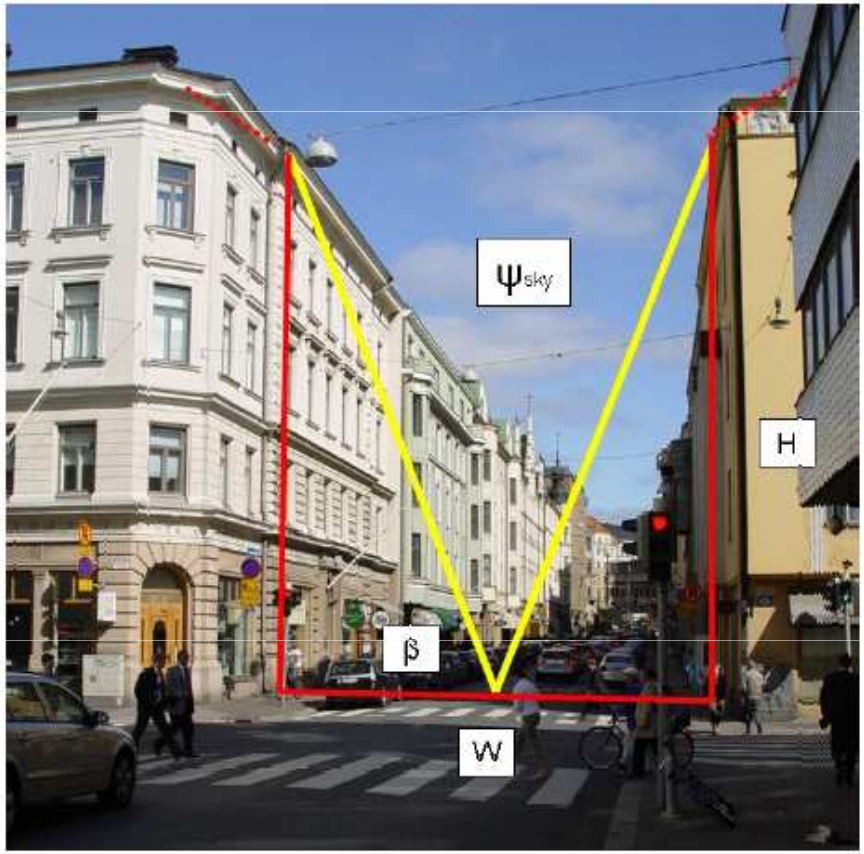
High Resolution Town Description

Testing of TEB

ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

Central Helsinki in a nutshell

- On the coast, 60.2 N, 25.9 E
- Minor orographic variations
- Population: 600 000, 1 M in Helsinki metropolitan area
- Fairly closed streets
- Building height 20-30 m
- Mostly built in the early 20th century
- brick, concrete, steel frame
- street surfaces mostly asphalt and granite setts
- Photo: Uudenmaankatu, Achim Drebs



http://urban.fmi.fi/index.html

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Ongoing and planned R&D.

Surface layer

Stable boundary layer problem

GABLS4

GEWEX

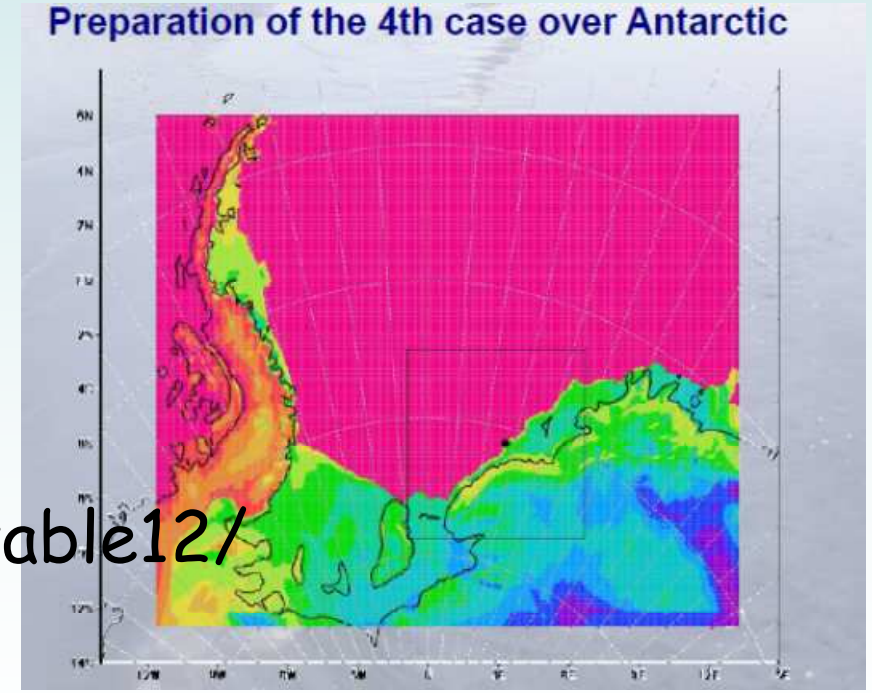
Atmosheric

Boundary

Layer

Study

Study of the very stable Antarctic PBL with all schemes available in 3D model, MUSC and SURFEX offline.



http://netfam.fmi.fi/Stable12/

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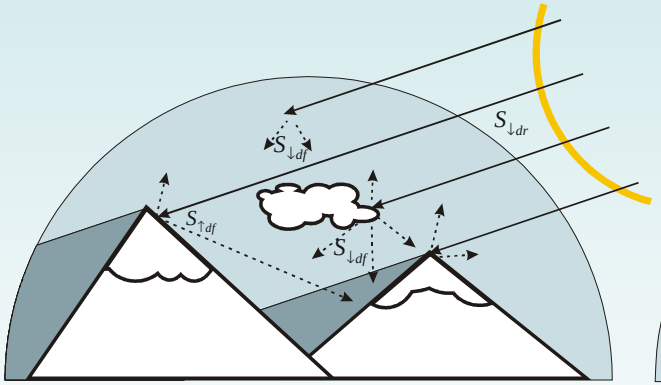
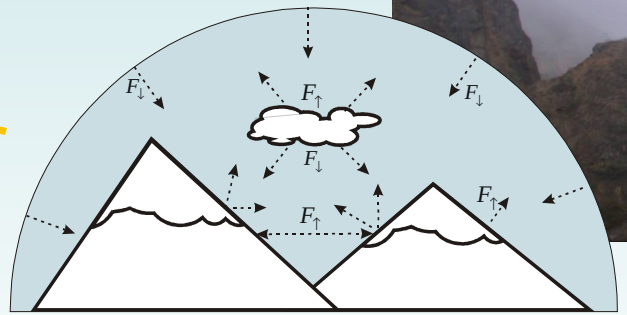
Ongoing and planned R&D.
Orography

Parametrisation of orographic radiation effects in SURFEX





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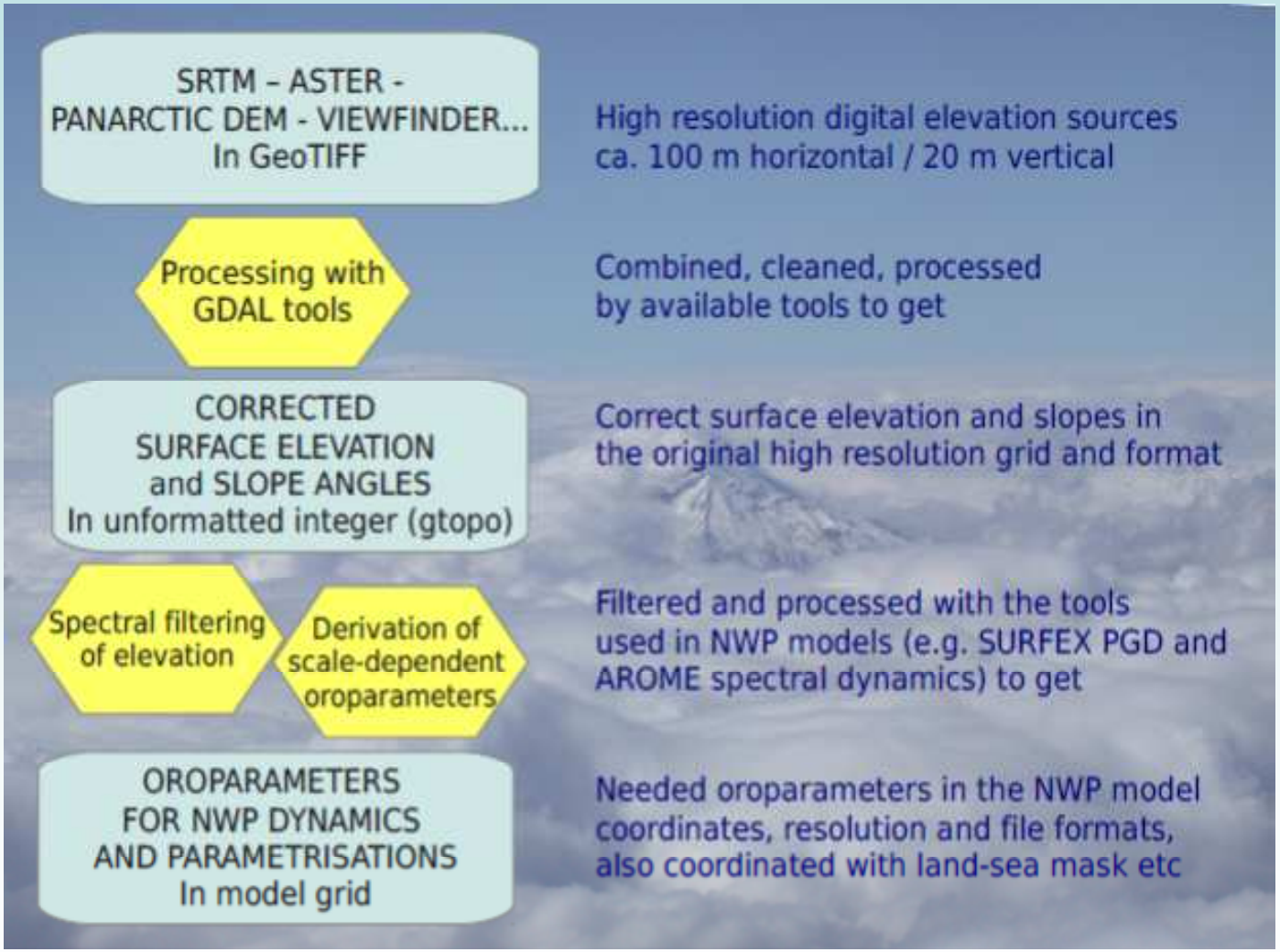
Ongoing and planned R&D.
Orography … very fine resolution data



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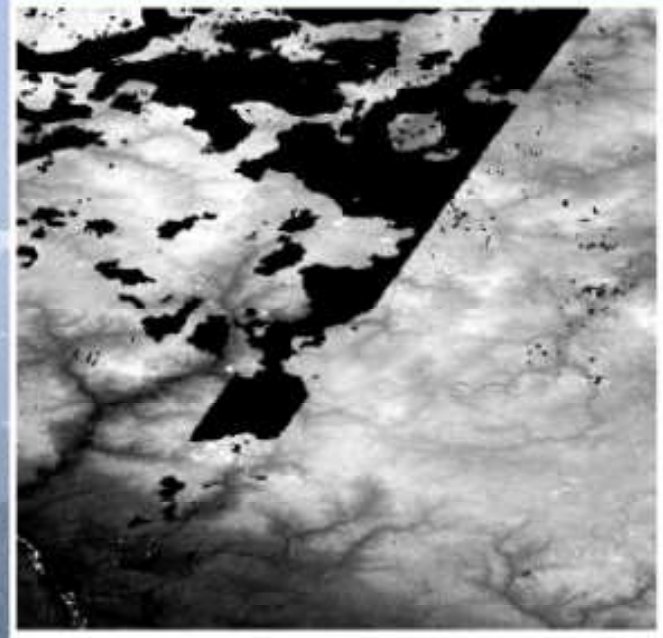
Ongoing and planned R&D.
Orography … very fine resolution data

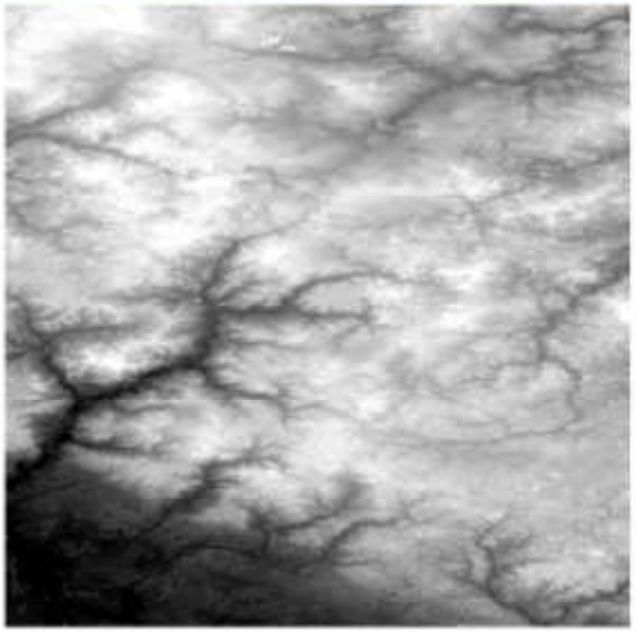
PROBLEMS OF (GLOBAL) DEM SOURCES

Limited geographical extent 55 S – 60 N (max 82 N)

Gaps, artifacts, errors



Raw ASTER tile : N62E045



ASTER tile N62E045 corrected

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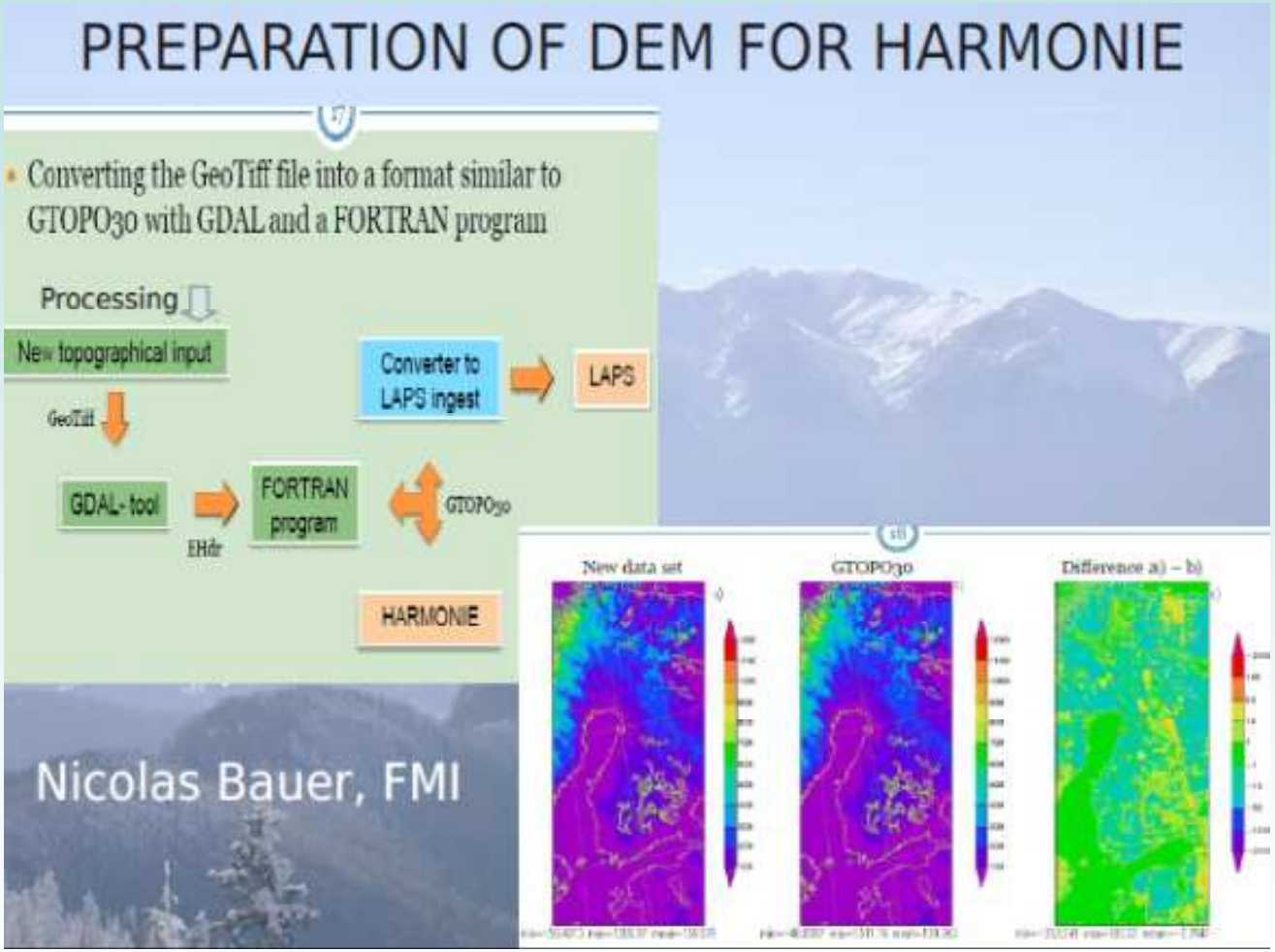
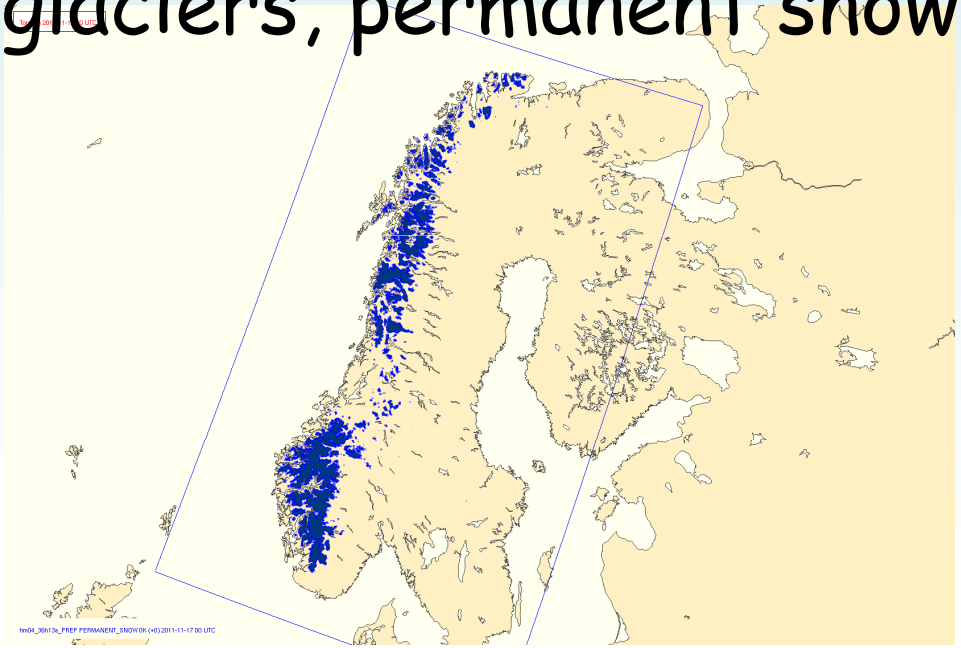
Ongoing and planned R&D.
Orography … very fine resolution data



Ongoing and planned R&D.
Physiography

New high resolution data on percentage of sand and clay: to test over Nordic domain and to use in HARMONIE

To compare ECOCLIMAP with local datasets: glaciers, permanent snow, etc.



Ongoing and planned R&D.
Physiography

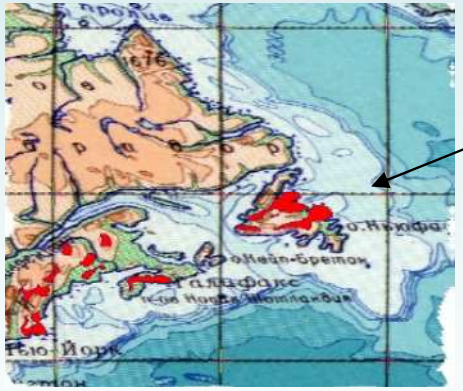
GLDB v.2

Global

Lake

Database

141 region



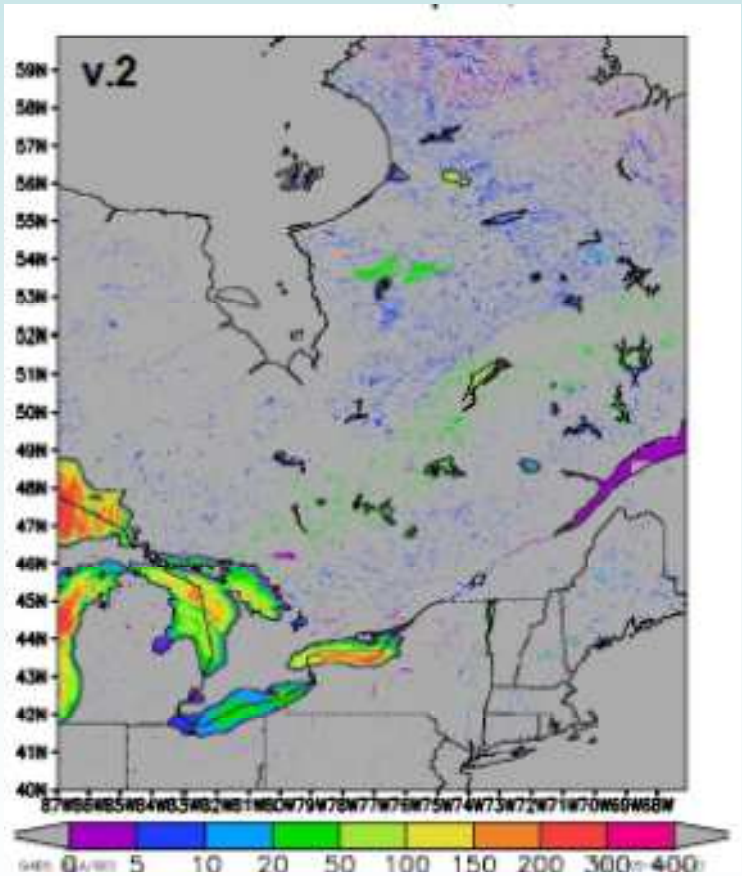
№	Adress					
	Numbers			Words		
	Plat	Platefor m	Lay er	Plate	Plateform	Layer
1	2	7	44	Americ an	BaicalCaledonianFolding _1	Intersect_MagmFluv
2	2	7	46	Americ an	BaicalCaledonianFolding _1	Intersect_MagmLedn
3	2	7	49	Americ an	BaicalCaledonianFolding _1	Intersect_MagmMorsk
4	2	7	52	Americ an	BaicalCaledonianFolding _1	Fluv
5	2	7	53	Americ an	BaicalCaledonianFolding _1	Ledn
6	2	7	54	Americ an	BaicalCaledonianFolding _1	Magm
7	2	7	56	Americ an	BaicalCaledonianFolding _1	Morsk
8	2	7	57	Americ an	BaicalCaledonianFolding _1	Osad
9	2	8	55	Americ an	BaicalCaledonianFolding _2	Merzlota
10	2	9	53	Americ an	Fault_1	Ledn
11	2	9	57	Americ an	Fault_1	Osad

Typical lake depth depending on the geological origin of lakes in the region

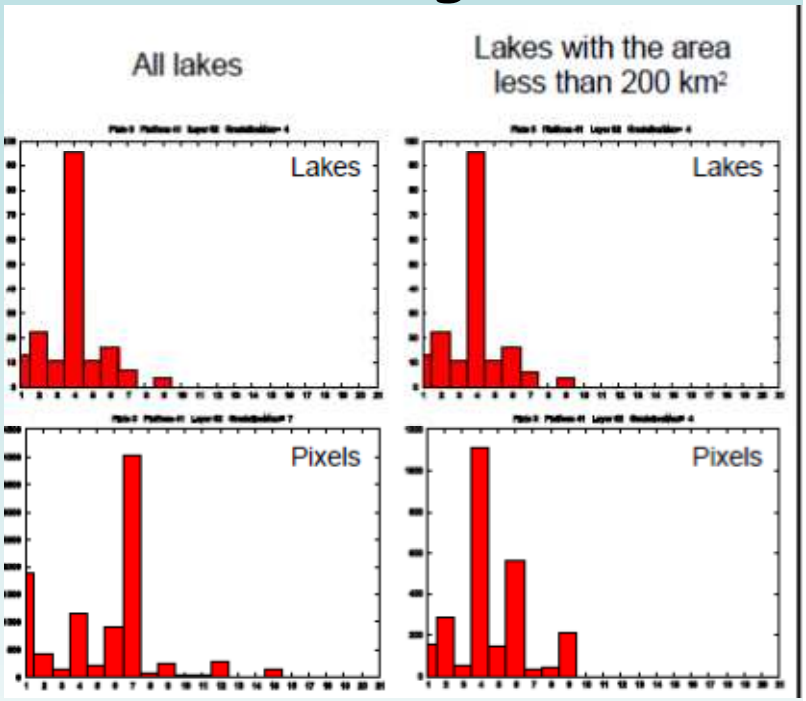
Ongoing and planned R&D.

Physiography

GLDB v.2



Statistical analysis for each region



Typical lake depth

№	Adress						Depth
	Numbers			Words			
	Plate	Plateform	Layer	Plate	Plateform	Layer	
1	2	7	44	American	BaicalCaledonianFolding_1	Intersect_MagmFluv	7
2	**2**	**7**	**46**	**American**	**BaicalCaledonianFolding_1**	**Intersect_MagmLedn**	**7**
3	2	7	49	American	BaicalCaledonianFolding_1	Intersect_MagmMorsk	7
4	2	7	52	American	BaicalCaledonianFolding_1	Fluv	10
5	2	7	53	American	BaicalCaledonianFolding_1	Ledn	10
6	2	7	54	American	BaicalCaledonianFolding_1	Magm	5
7	2	7	56	American	BaicalCaledonianFolding_1	Morsk	10
8	2	7	57	American	BaicalCaledonianFolding_1	Osad	10
9	2	0	55	American	BaicalCaledonianFolding_2	Merzlota	Kitaev
10	2	9	53	American	Fault_1	Ledn	22
11	**2**	**9**	**57**	**American**	**Fault_1**	**Osad**	**22**
				American			

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Thank you!

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