Overview on the Numerical Weather Prediction System HARMONIE

Laura Rontu

FMI, Meteorological Research
International HIRLAM-B programme,
Physical parametrisations

MUSCATEN Summer school 2011
OSENU, Odessa, 3-9 July 2011

In this presentation

Introduction

Data assimilation

Nonhydrostatic dynamics

Physical parametrisations

A Lithuanian example (by Martynas Kazlauskas)

System and experimenting

Relations between NWP and ACT

Hirlam

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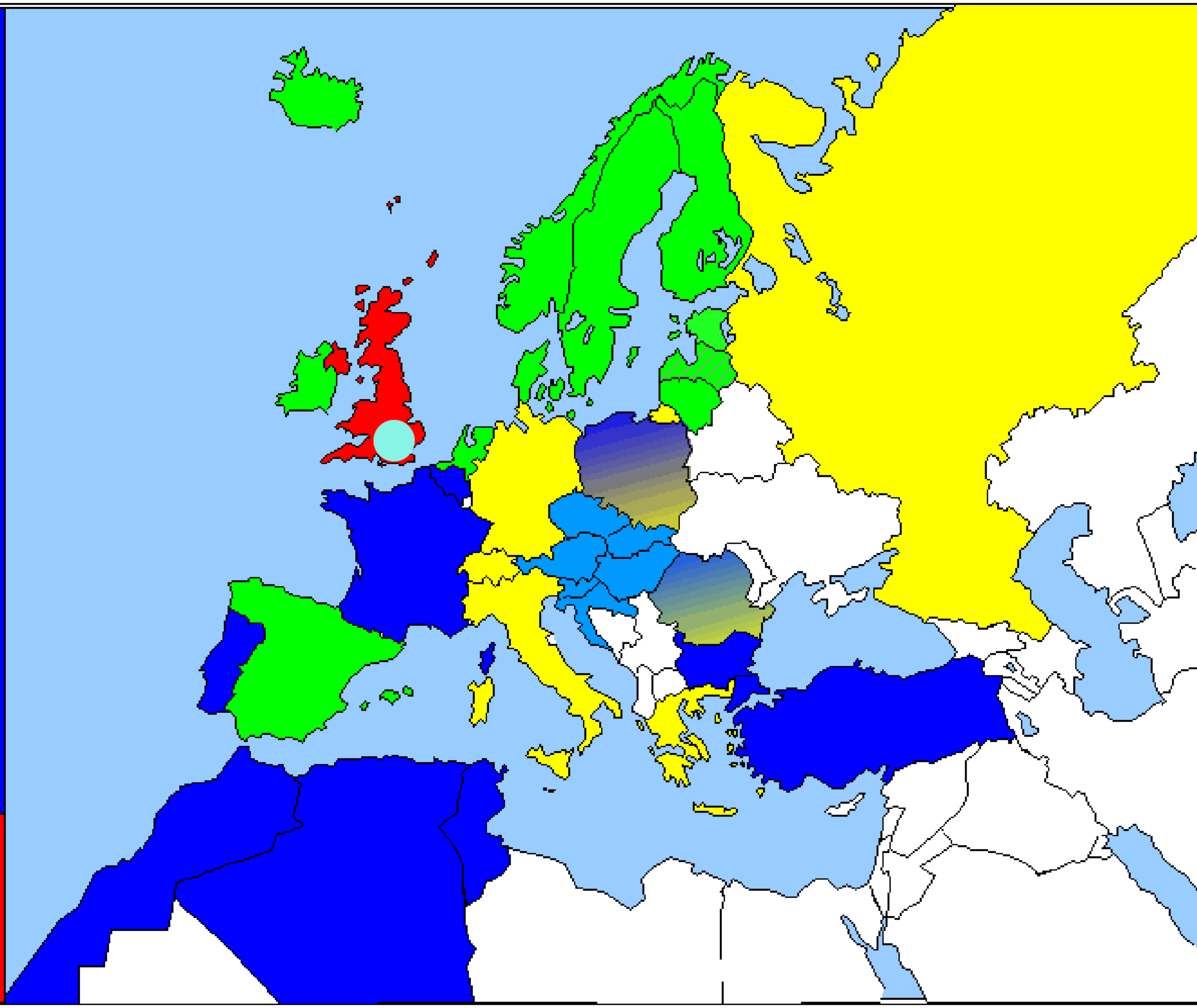
SRNWP Consortia in Europe

Map by Andras Horany, SRNWP

ALADIN
Algeria
Belgium
Bulgaria
France
Morocco
Poland
Portugal
Tunisia
Turkey

Austria
Croatia
Czech Rep.
Hungary
Romania
Slovakia
Slovenia
LACE

UKMO
United Kingdom



HIRLAM
Denmark
Estonia
Finland
Iceland
Ireland
Lithuania
Netherlands
Norway
Spain
Sweden
(Latvia)

COSMO
Germany
Greece
Italy
Poland
Romania
Russia
Switzerland

SRNWPP = Short Range Numerical Weather Prediction, an EUMETNET programme

HARMONIE =

HIRLAM **A**LADIN **R**ESEARCH for **M**ESOSCALE **O**PERATIONAL **N**WP **I**N **E**UROPE

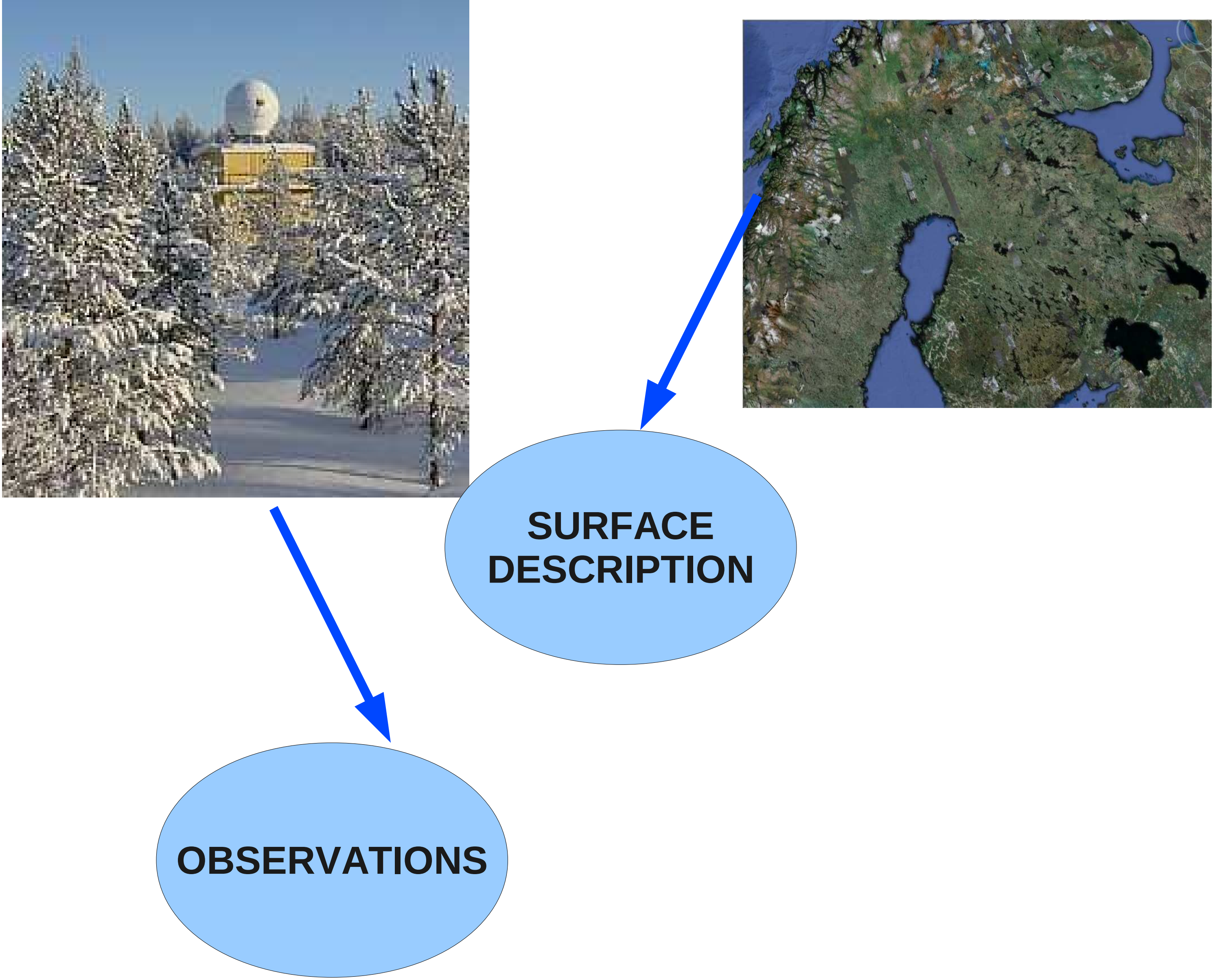
	HIRLAM 1985 - 2015	HARMONIE 2005 - ...
Typical resolution forecast lead time	**Synoptic scale 5 – 15 km** two-three days	**Meso-scale 0.5 – 3 km** nowcasting – 1 day
Dynamical core	**Hydrostatic** semi-lagrangian semi-implicit gridpoint	**Non-hydrostatic** semi-lagrangian semi-implicit spectral
Data assimilation Atmosphere/Surface	4D variational DA Optimal interpolation	3D variational DA Optimal interpolation
Physical parametrizations Atmosphere Surface	Radiation, microphysics, turbulence, convection Integrated surface parametrizations	Radiation, microphysics, turbulence **Resolved convection!** SURFEX externalised framework

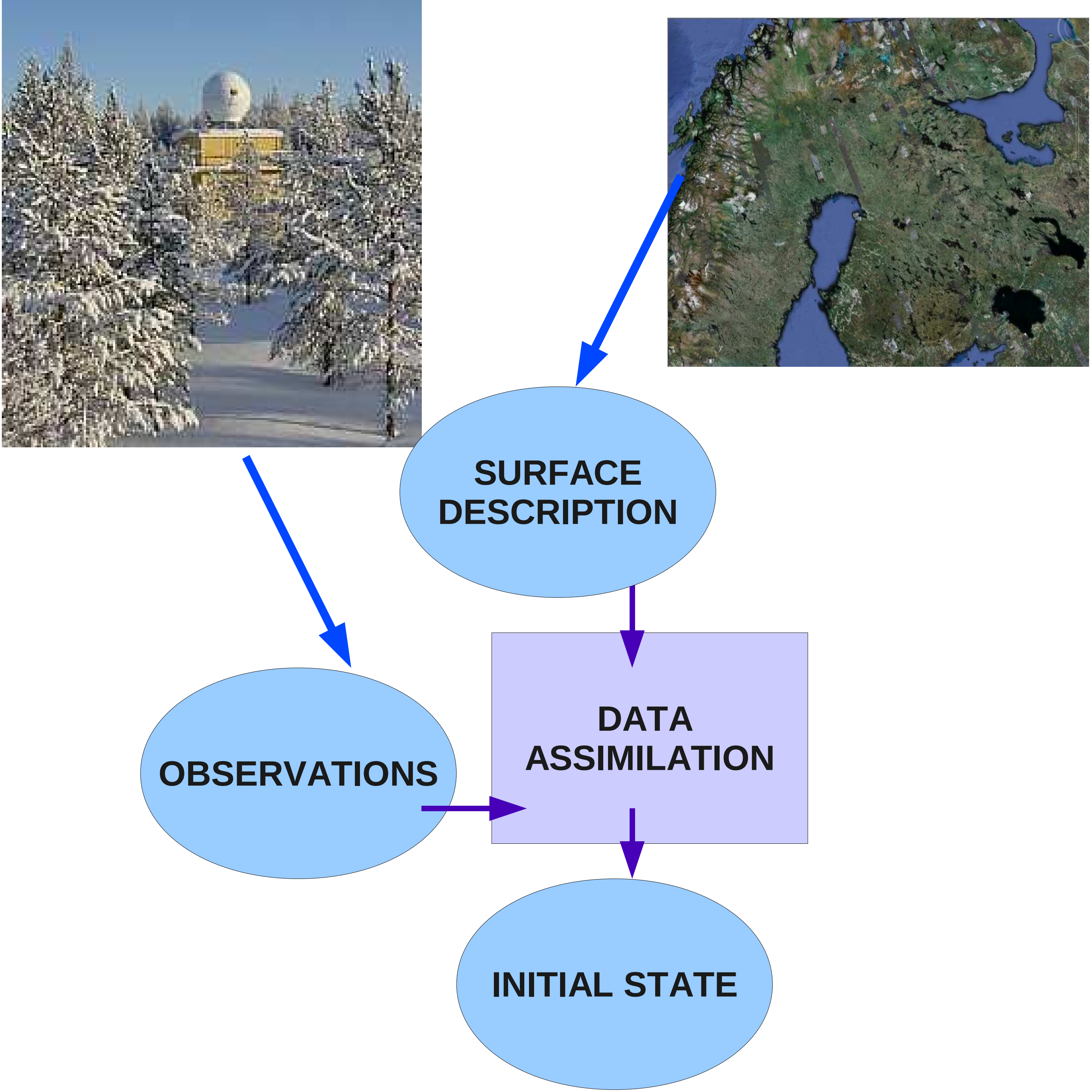
During the HIRLAM-B programme 2011-2015 we aim to move all NWP model development from HIRLAM to the HARMONIE framework

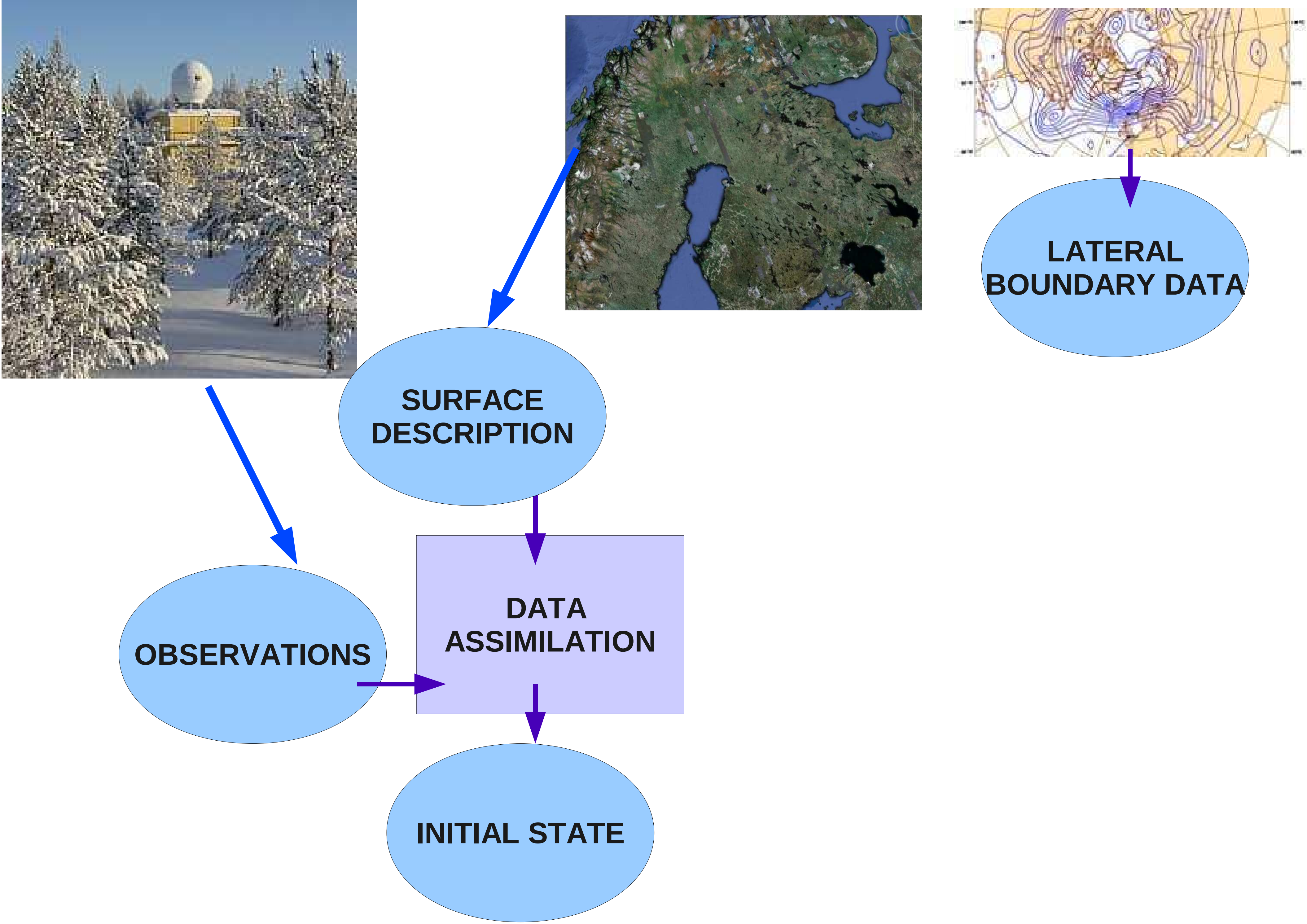
How to transfer our HIRLAM-based experience to the world of HARMONIE? What would happen to the HIRLAM-based applications like Enviro-HIRLAM or Rossby centre climate model?

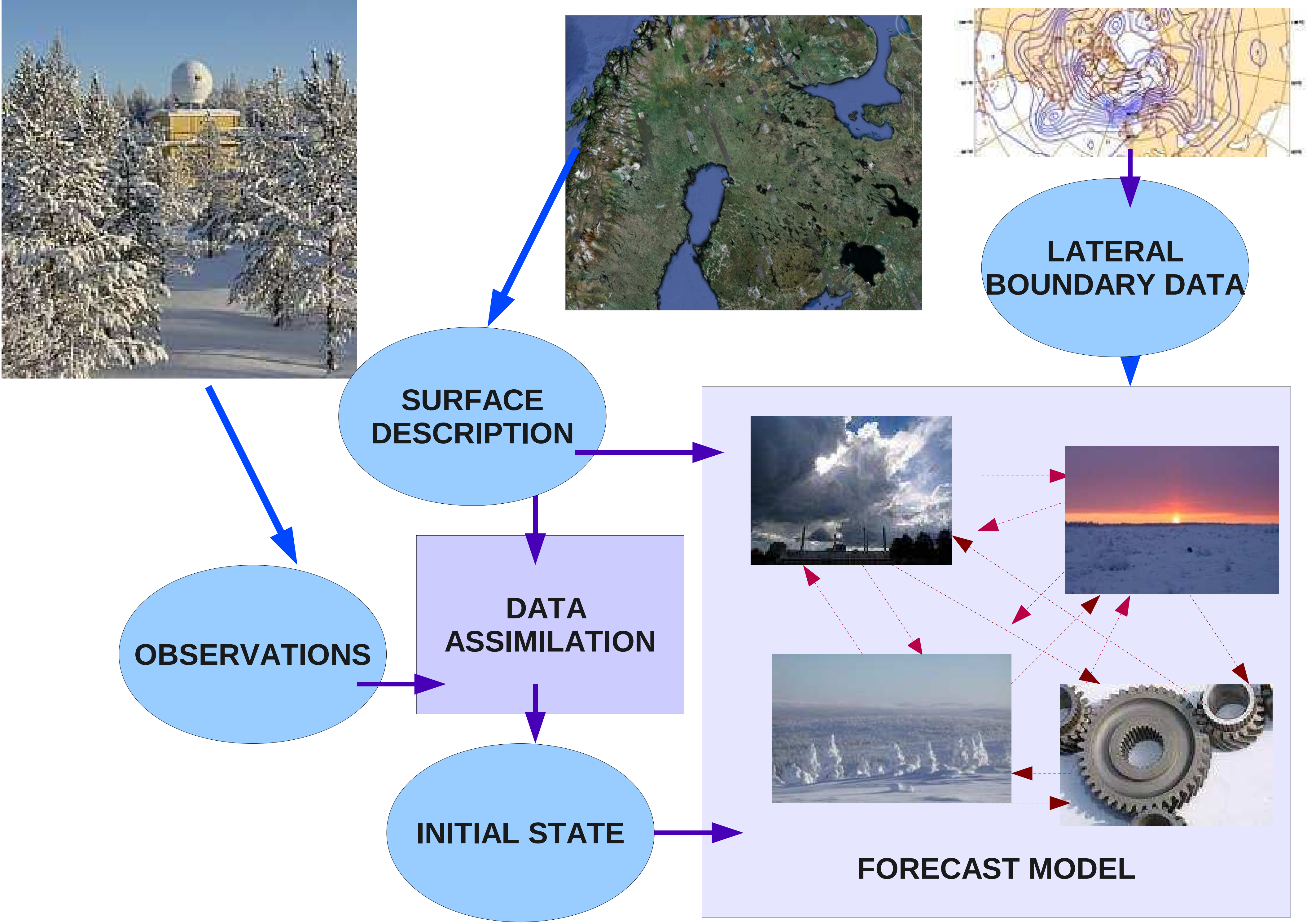
Coming back to these questions later in the presentation or during the school week!

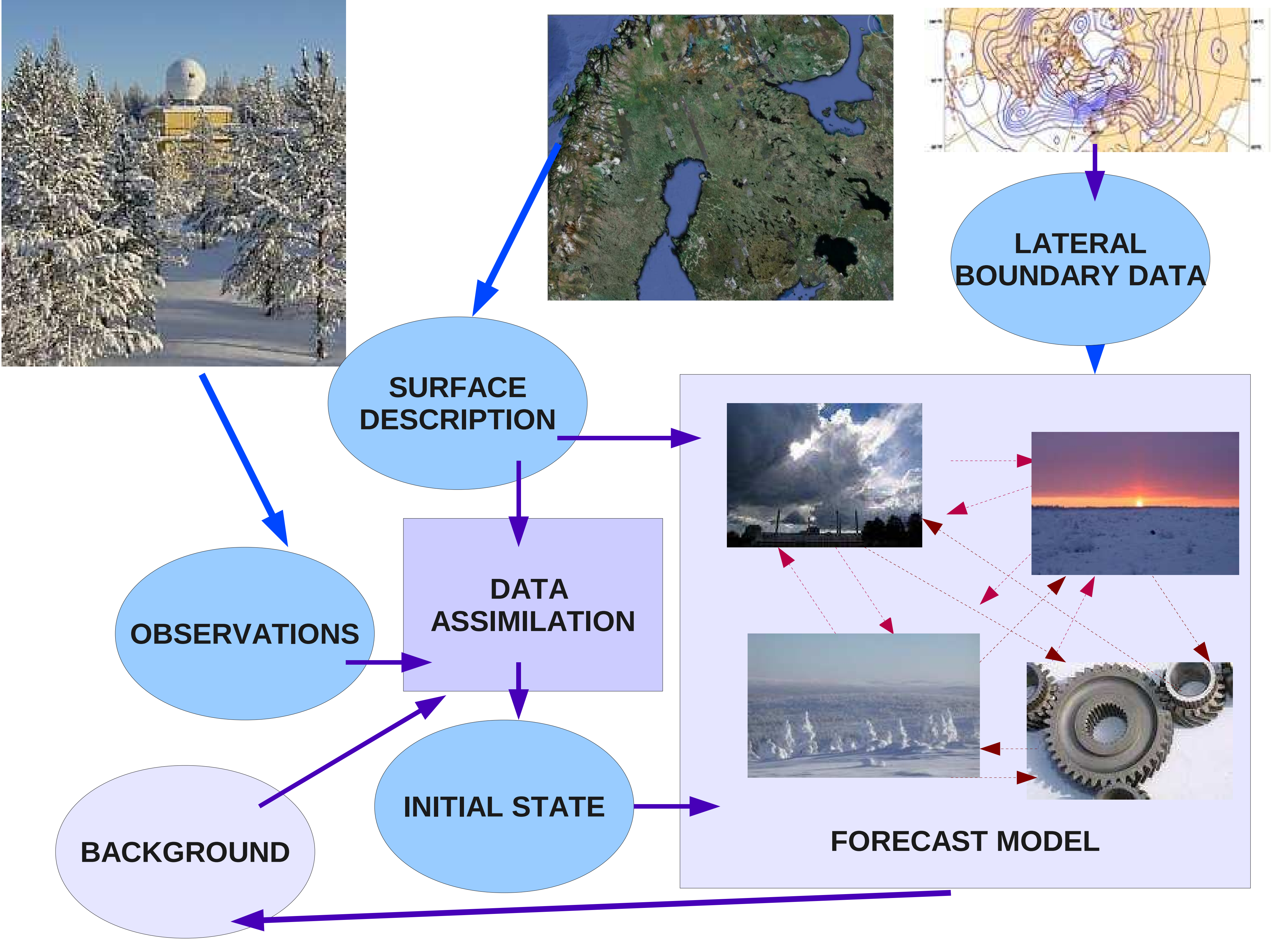
OBSERVATIONS


SURFACE
DESCRIPTION
OBSERVATIONS


SURFACE DESCRIPTION
OBSERVATIONS
DATA ASSIMILATION
INITIAL STATE


LATERAL
BOUNDARY DATA
SURFACE
DESCRIPTION
OBSERVATIONS
DATA
ASSIMILATION
INITIAL STATE


LATERAL BOUNDARY DATA
SURFACE DESCRIPTION
DATA ASSIMILATION
OBSERVATIONS
INITIAL STATE
FORECAST MODEL


LATERAL
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SURFACE
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DATA
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BACKGROUND
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SSS06

http://netfam.fmi.fi/SSS06

St.Petersburg Summer School 2006
on
Nonhydrostatic dynamics and fine scale data assimilation

11-17.6.2006 Sanatorium Dunes, Sestroretsk

Time	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	BASIC DYNAMICS	BASIC NUMERICS	DYNAMICS TOPICS	DATA-ASSIMILATION	DATA-ASSIMILATION	LAST DAY
10:00-11:00	Opening of the workshop - rector of RSHU, prof. Lev Karlin Delopment of fine-scale NWP systems - Jeanette Onvlee	Split explicit methods - Almut Gassmann	Boundary conditions: lateral, upper, lower - Mihail Tolstyh	Methods of data assimilation - Reima Eresmaa	Surface data assimilation - Francois Bouyssel	Final discussion and closure
11:00-11:20	Coffee	Coffee	Coffee	Coffee	Coffee	Coffee
11:20-12:20	Basic equations, vertical coordinates, simplifications - Hans-Joachim Herzog	Semi-implicit, semi-lagrangian methods - Rein Room	Spectral formulation of nonhydrostatic model - Pierre Benard	Data assimilation in operational LAM's - Roger Randriamampianina	Remote sensing + new observations - GNSS - Reima Eresmaa Radar - Kirsti Salonen	
12:20-12:30	Short break	Short break	Short break	Short break	Short break	
12:30-13:30	Test cases for nonhydrostatic effects - Rein Room	Numerical stability and smoothing - Pierre Benard	Turbulence and physics/ dynamics interactions - Semion Sukoriansky	Simulation of analysis errors - Simona Stefanescu	Satellite radiances - Per Dahlgren	
13:30-15:00	Lunch	Lunch	Lunch	Lunch	Lunch	
15:00-17:30	Introduction to dynamics exercises (1) (2) - Aarne Männik Dynamics exercises start	Dynamics exercises continue	Dynamics exercises continue; discussion on results	Introduction to data assimilation exercises - Per Dahlgren 2D DA exercises start	Discussion on mesoscale data assimilation challenges - introduction + chaired by Jeanette Onvlee - comments and questions by participants	
17:30-17:40	Short break	Short break	Short break	Short break	Short break	
		Semi-lagrangian				

The purpose of data assimilation

Essentially, data assimilation is the procedure for importing the information content of observations into the numerical modelling system

The output of data assimilation

- is *a maximum likelihood estimate* of atmospheric state
- is called *analysis*
- serves as *the initial condition* for the deterministic forecast

DEVELOPMENT OF DATA ASSIMILATION IN HARMONIE

ATMOSPHERE

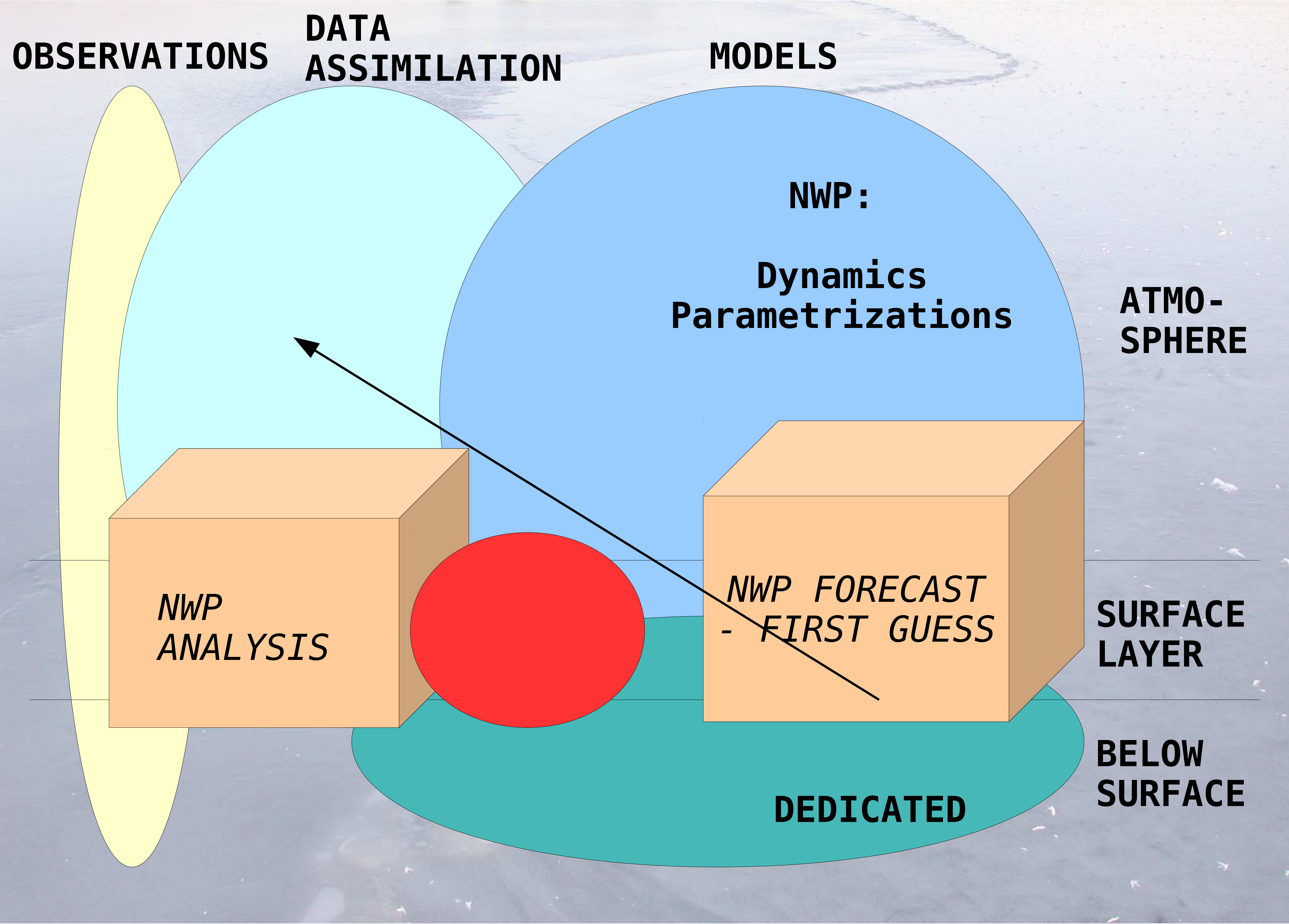
Three-dimensional variational assimilation

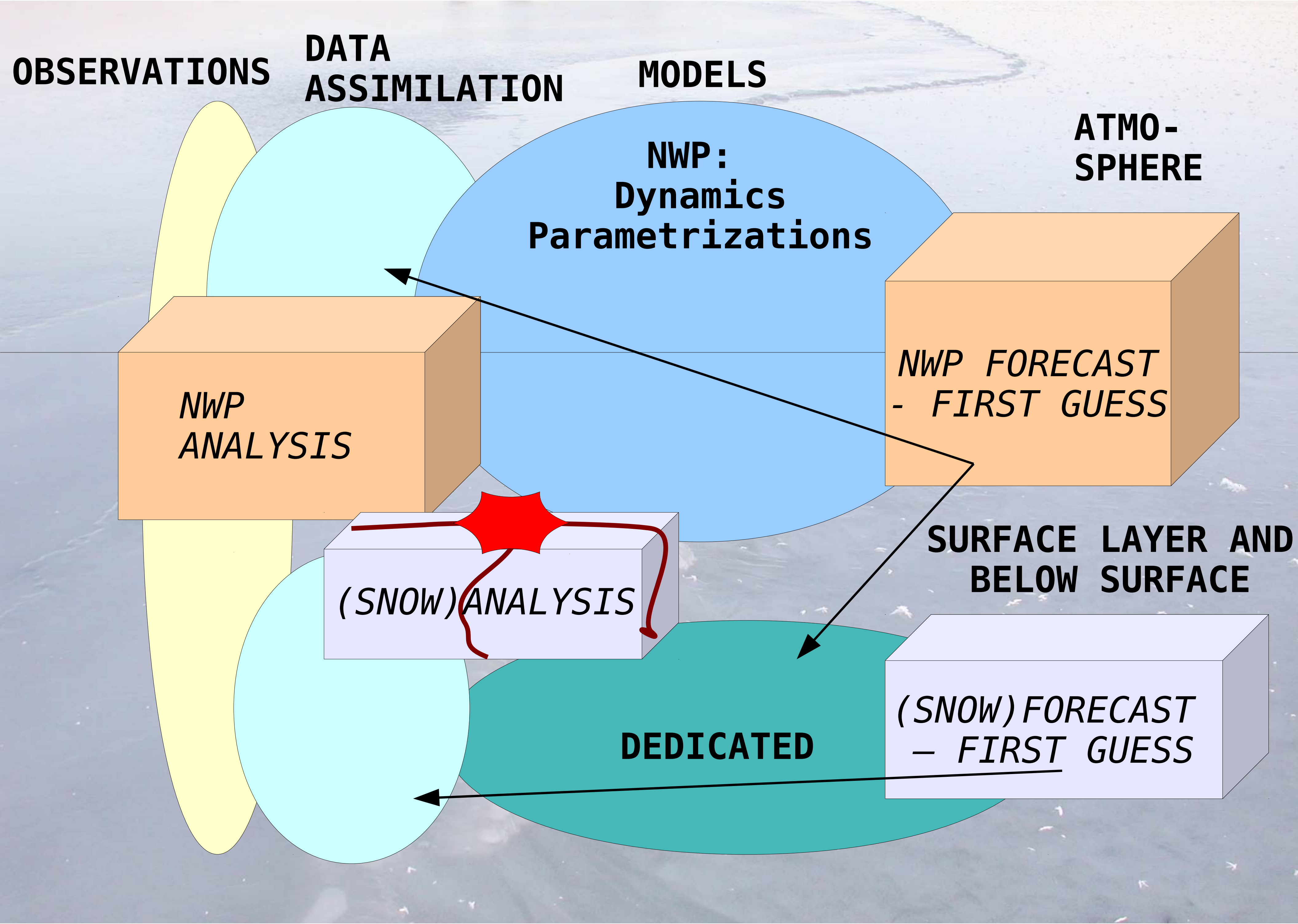
Focus on local observations, e.g. radar wind and reflectivity

SURFACE

Spatialisation by optimal interpolation:
temperature, humidity, snow, ice …

Variational methods for the analysis of soil moisture and temperature


OBSERVATIONS
DATA
ASSIMILATION
MODELS
NWP:
Dynamics
Parametrizations
ATMO-
SPHERE
NWP
ANALYSIS
NWP FORECAST
- FIRST GUESS
SURFACE
LAYER
BELOW
SURFACE
DEDICATED


OBSERVATIONS
DATA ASSIMILATION
MODELS
NWP:
Dynamics
Parametrizations
ATMO-SPHERE
NWP FORECAST - FIRST GUESS
NWP ANALYSIS
(SNOW)ANALYSIS
SURFACE LAYER AND BELOW SURFACE
(SNOW)FORECAST – FIRST GUESS
DEDICATED

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Quarterly Journal of the Royal Meteorological Society Q. J. R. Meteorol. Soc. 136: 155–169, January 2010 Part A

Royal Meteorological Society

Dynamical kernel of the Aladin–NH spectral limited-area model: Revised formulation and sensitivity experiments

P. Bénard,[a*] J. Vivoda,[b] J. Mašek,[b] P. Smolíková,[c] K. Yessad,[a] Ch. Smith,[d†] R. Brožková[c] and J.-F. Geleyn[a,c]

[a] *Météo-France, Toulouse, France*

[b] *Slovak Hydro-Meteorological Institute, Bratislava, Slovakia*

[c] *Czech Hydro-Meteorological Institute, Prague, Czech Republic*

[d] *Met Office, Exeter, UK*

*Correspondence to: P. Bénard, CNRM/GMAP, 42 Avenue G. Coriolis, F-31057 Toulouse Cedex, France. E-mail: pierre.benard@meteo.fr

ALADIN NONHYDROSTATIC KERNEL

Fully elastic Euler equations

Semi-implicit, semi-Lagrangian transport

Horizontal spectral representation

Terrain following, pressure-based vertical coordinate

Next: two slides by Hans-Joachim Herzog, NetFAM 2006 summer school in Sestroretsk

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2.5 Simplified scheme towards filtered equations

hydrostatic equations

$$\tilde{D}u - f\,v + \frac{\partial p}{\partial x} = 0$$

$$\tilde{D}v + f\,u = 0$$

$$\left(\frac{\partial}{\partial z} + \Gamma\right)p - \frac{g}{c_p}\frac{\theta}{\overline{\overline{\theta}}} = 0$$

$$\frac{1}{c_s^2}\tilde{D}\,p + \left(\frac{\partial}{\partial z} - \Gamma\right)w + \frac{\partial u}{\partial x} = 0$$

$$\tilde{D}\left(\frac{g}{c_p}\frac{\theta}{\overline{\overline{\theta}}}\right) + N^2 w = 0$$

full equations

$$\tilde{D}u - f\,v + \frac{\partial p}{\partial x} = 0$$

$$\tilde{D}v + f\,u = 0$$

$$\mu\tilde{D}w + \left(\frac{\partial}{\partial z} + \Gamma\right)p - \frac{g}{c_p}\frac{\theta}{\overline{\overline{\theta}}} = 0$$

$$\frac{1}{c_s^2}\tilde{D}\,p + \left(\frac{\partial}{\partial z} - \Gamma\right)w + \frac{\partial u}{\partial x} = 0$$

$$\tilde{D}\left(\frac{g}{c_p}\frac{\theta}{\overline{\overline{\theta}}}\right) + N^2 w = 0$$

anelastic equations

$$\tilde{D}u - f\,v + \frac{\partial p}{\partial x} = 0$$

$$\tilde{D}v + f\,u = 0$$

$$\tilde{D}w + \left(\frac{\partial}{\partial z} + \Gamma\right)p - \frac{g}{c_p}\frac{\theta}{\overline{\overline{\theta}}} = 0$$

$$\left(\frac{\partial}{\partial z} - \Gamma\right)w + \frac{\partial u}{\partial x} = 0$$

$$\tilde{D}\left(\frac{g}{c_p}\frac{\theta}{\overline{\overline{\theta}}}\right) + N^2 w = 0$$

$$\tilde{D}w \Rightarrow 0 \qquad \tilde{D}\,p \Rightarrow 0$$

$$\tilde{D}\left(\frac{\partial u}{\partial x}\right) - f\frac{\partial v}{\partial x} + \frac{\partial^2 p}{\partial x^2} = 0$$

$$\tilde{D}\left(\frac{\partial v}{\partial x}\right) + f\frac{\partial u}{\partial x} = 0$$

$$\tilde{D}\left(\frac{\partial^2}{\partial z^2} - \frac{1}{4H^2}\right)p - N^2\frac{\partial u}{\partial x} = 0$$

$$\tilde{D}\left(\frac{\partial u}{\partial x}\right) \Rightarrow 0$$

$$\tilde{D}\left\{\frac{\partial^2 p}{\partial x^2} + \frac{f^2}{N^2}\left(\frac{\partial^2}{\partial z^2} - \frac{1}{4H^2}\right)p\right\} = 0$$

geostrophic potential vorticity equation
- advective mode only

with $$\frac{N^2}{f^2}\frac{\partial^2 w}{\partial x^2} + \frac{\partial^2 w}{\partial z^2} - \frac{1}{4H^2}w = 0$$

Nonhydrostatic model equations		Hydrostatic (primitive) equations
Compressible/elastic	***Incompressible/anelastic ****	
equations with full physical structure	***reduction of equation set due to*** $\frac{dp}{dt}=0 \rightarrow \left(\frac{\partial}{\partial z}-\Gamma\right)w+\frac{\partial u}{\partial x}=0$	***reduction to hydrostatic equation*** $\frac{dw}{dt}=0 \rightarrow \left(\frac{\partial}{\partial z}+\Gamma\right)p-\frac{g}{c_p}\frac{\theta}{\bar{\theta}}=0$
full set of prognostic variables	***filter condition:*** $\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial z^2}\right)p-\Gamma^2 p=F(x,z);\ \forall t$ ***boundary value problem constitutes a diagnostic relation for p***	***filter condition:*** $\frac{\partial^2 w}{\partial z^2}-\frac{1}{4H^2}w=G(x,z);\ \forall t$ ***boundary value problem constitutes a diagnostic relation for w***
Internal acoustic and gravity waves are completely contained. ***Hydrostatic and geostrophic adaptation***	***Internal gravity waves are completely contained, acoustic waves are filtered out.*** ***Hydrostatic and geostrophic adaptation***	***Internal gravity waves are contained, but insufficiently presented*** $\left(L_x^2 >> L_z^2\right)$ ***acoustic waves excluded.*** ***Geostrophic adaptation***
Damping/filtering of acoustic waves due to an appropriate numerical scheme (split-explicit , semi-implicit-semi-Lagrange) ***Models: MM5, LM, WRF-NCAR, UK-Unified Model, etc. ...*** ***WK78 , Cullen, Gassmann***	***Numerical treatment of elliptic pressure equation is difficult and needs to be done with care (terrain-following coordinate).*** ***An excellent research model is EULAG (Grabowski, W.W.,P.K.Smolarkiewicz, 2002,MWR 130, 939-952.)***	***Most operational global and limited area models are hydrostatic.***

*** refinements of anelastic approximation: P.B.Bannon,1996, J.Atm.Sc. 53, No.23, 3618-3628.***

$$\frac{\mathrm{d}\mathbf{V}}{\mathrm{d}t} + \frac{RT}{p}\nabla p + \frac{1}{m}\frac{\partial p}{\partial \eta}\nabla \phi = \mathcal{V}, \qquad (3)$$

$$\frac{\mathrm{d}\mathbf{d}}{\mathrm{d}t} + g^2 \frac{p}{mR_\mathrm{a}T}\frac{\partial}{\partial \eta}\left(\frac{1}{m}\frac{\partial (p-\pi)}{\partial \eta}\right)$$

$$- \quad g\frac{p}{mR_\mathrm{a}T}\frac{\partial \mathbf{V}}{\partial \eta}.\nabla w$$

$$- \quad \mathbf{d}(\nabla.\mathbf{V} - D_3) = -g\frac{p}{mR_\mathrm{a}T}\frac{\partial \mathcal{W}}{\partial \eta}, \qquad (4)$$

$$\frac{\mathrm{d}T}{\mathrm{d}t} + \frac{RT}{C_\mathrm{v}}D_3 = \frac{Q}{C_\mathrm{v}}, \qquad (5)$$

$$\frac{\mathrm{d}\hat{q}}{\mathrm{d}t} + \frac{C_\mathrm{p}}{C_\mathrm{v}}D_3 + \frac{\dot{\pi}}{\pi} = \frac{Q}{C_\mathrm{v}T}, \qquad (6)$$

$$\frac{\partial \pi_\mathrm{s}}{\partial t} + \int_0^1 \nabla.(m\mathbf{V})\mathrm{d}\eta = 0, \qquad (7)$$

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The AROME-France Convective-Scale Operational Model

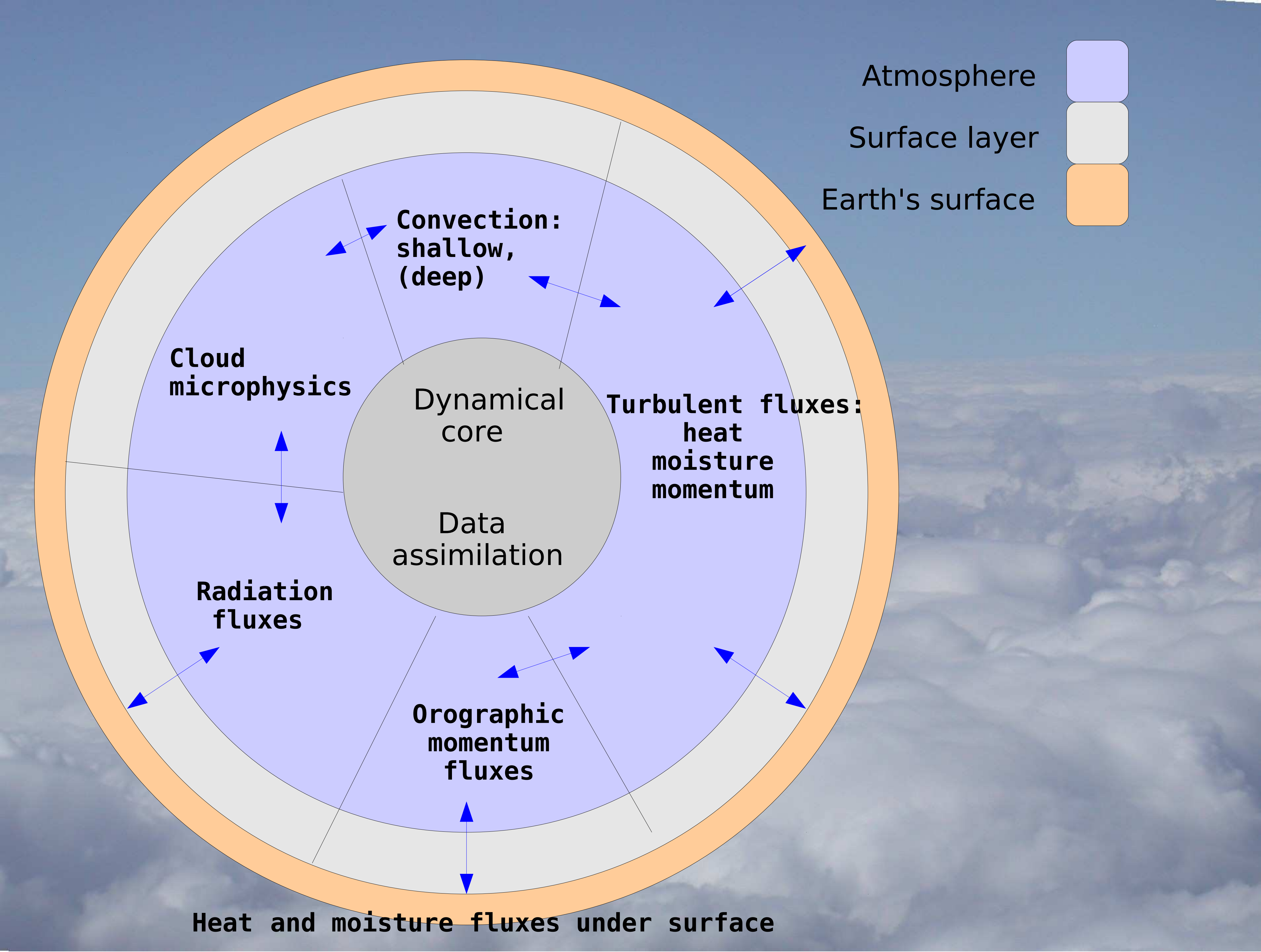
Y. SEITY, P. BROUSSEAU, S. MALARDEL, G. HELLO, P. BÉNARD, F. BOUTTIER, C. LAC, AND V. MASSON

Météo-France CNRM-GAME, Toulouse, France

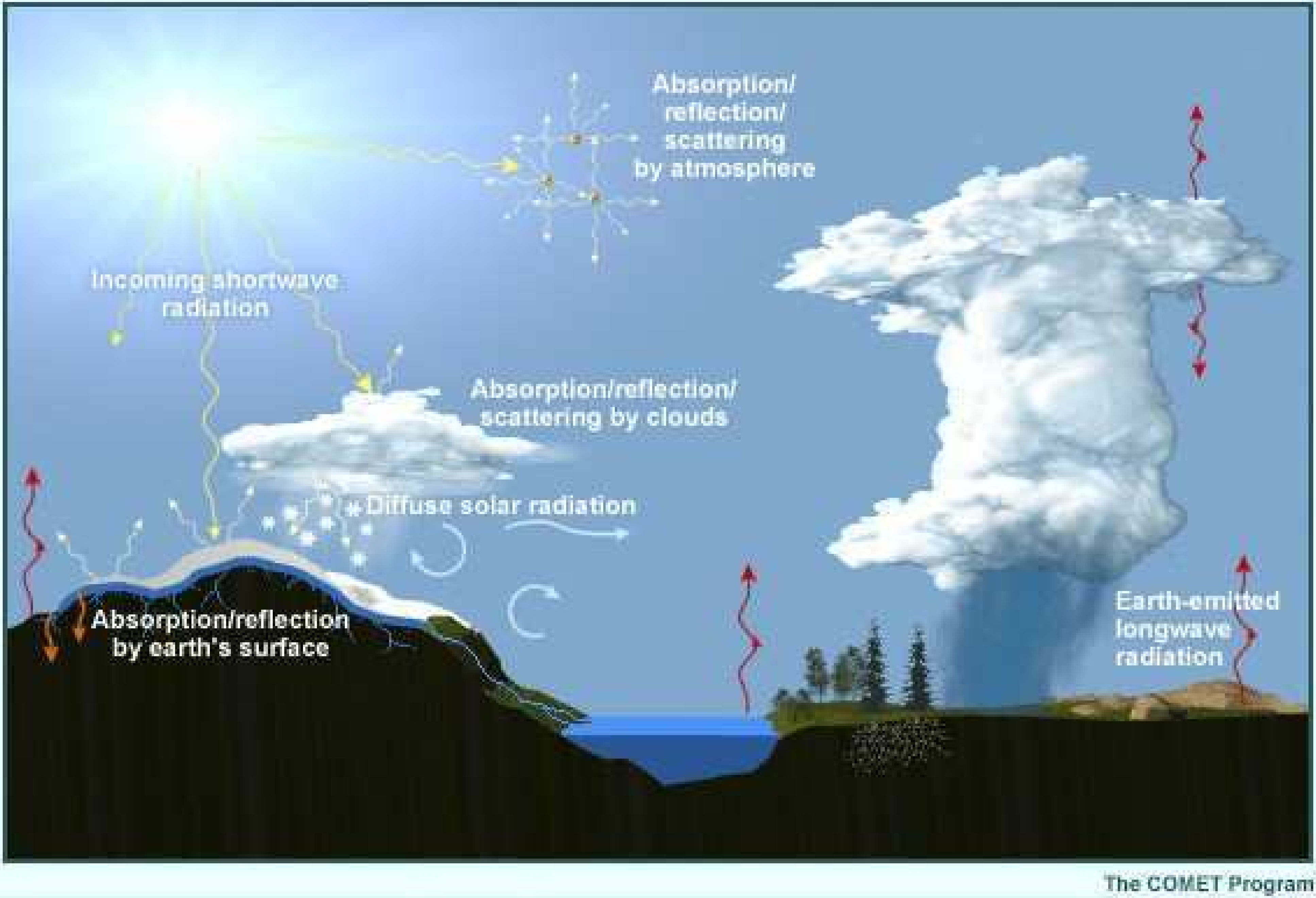
(Manuscript received 19 March 2010, in final form 29 September 2010)

ABSTRACT

After six years of scientific, technical developments and meteorological validation, the Application of Research to Operations at Mesoscale (AROME-France) convective-scale model became operational at Météo-France at the end of 2008. This paper presents the main characteristics of this new numerical weather prediction system: the nonhydrostatic dynamical model core, detailed moist physics, and the associated three-dimensional variational data assimilation (3D-Var) scheme. Dynamics options settings and variables are explained. The physical parameterizations are depicted as well as their mutual interactions. The scale-specific features of the 3D-Var scheme are shown. The performance of the forecast model is evaluated using objective scores and case studies that highlight its benefits and weaknesses.


Atmosphere
Surface layer
Earth's surface
Convection:
shallow,
(deep)
Cloud
microphysics
Dynamical
core
Turbulent fluxes:
heat
moisture
momentum
Data
assimilation
Radiation
fluxes
Orographic
momentum
fluxes
Heat and moisture fluxes under surface

RADIATION PARAMETRISATIONS



DEEP CONVECTION

CLOUD MICROPHYSICS

SHALLOW CONVECTION

TURBULENCE

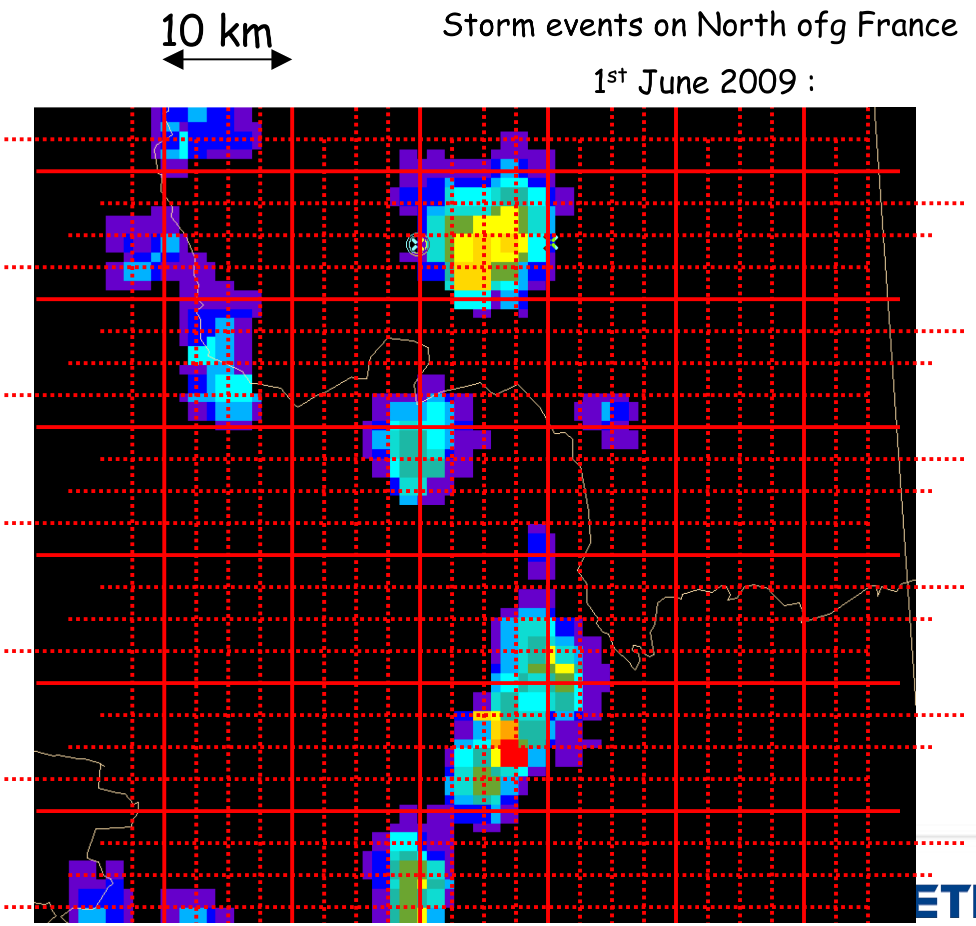
- four slides by Valery Masson, Meteo France, 15 July 2011 at FMI

Deep Convection : parameterized vs explicit

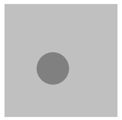
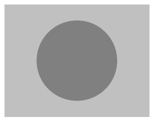
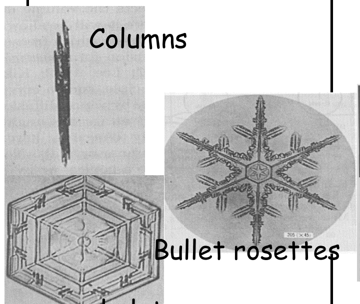
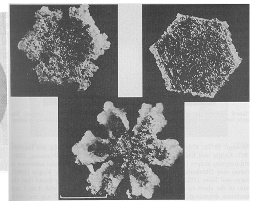
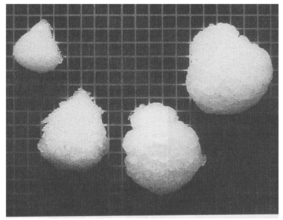
Prognostic variables represent a mean state on the mesh grid.
The high resolution allows to avoid some parametrizations : convection

Cumulonimbus are 'sub-grid' in former generation Numerical Weather Prediction models (e.g. ALADIN)

They are **explicitly** resolved in AROME

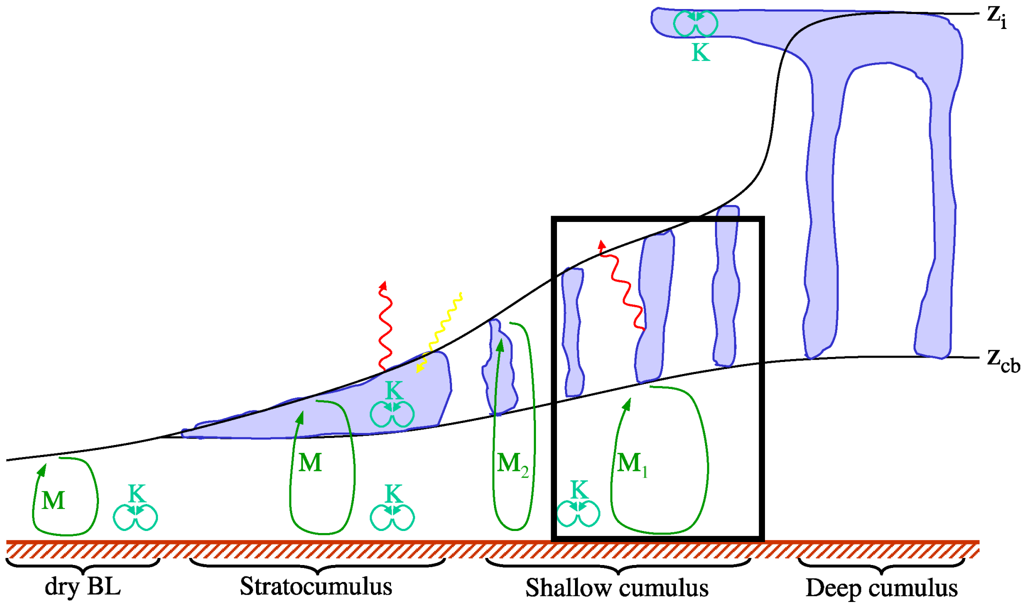


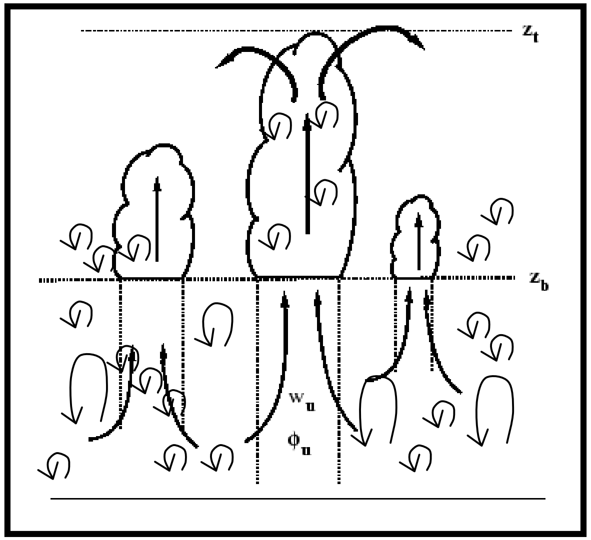
New Microphysics adapted for high resolution models

Cloud	Rain	Pristine ice	Aggregates and snow	Graupel and hailstone
				

Liquid water contents : Fog < $0.1 g/m^3$. Sc : $0.1 g/m^3$ to $0.5 g/m^3$.
Cumulus : from $0.5 g/m^3$ (early stage) to $1 g/m^3$ (later stage). Cb : Up to $14 g/m^3$

Shallow convection need to be parameterized





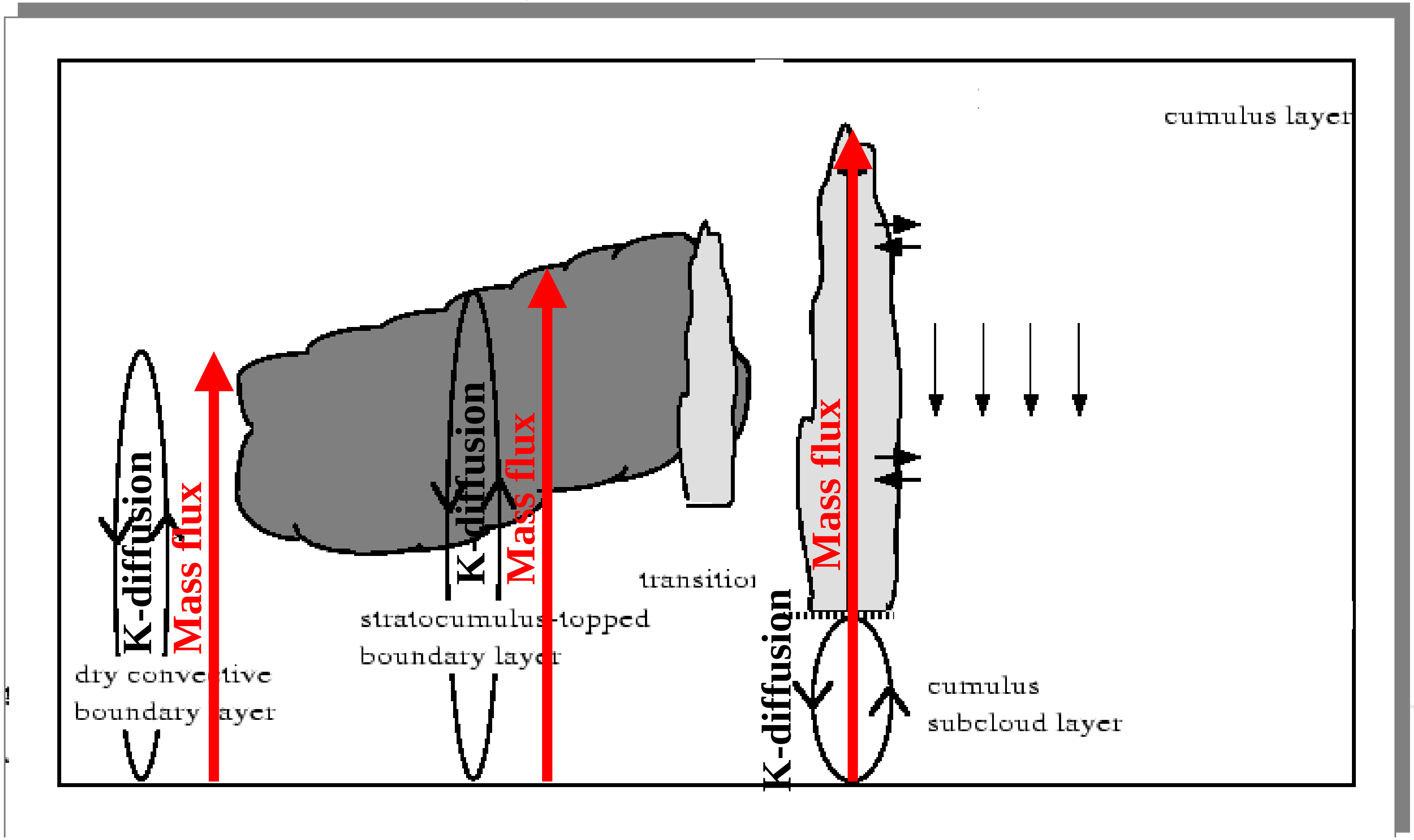
- SHALLOW CONVECTION : : Nécessary until Δx ~1km – 500m
- 2 approches :

    - classical shallow convection scheme (Kain-Fritsch-Bechtold)
    - EDMF-type scheme (Pergaud et al 2009)

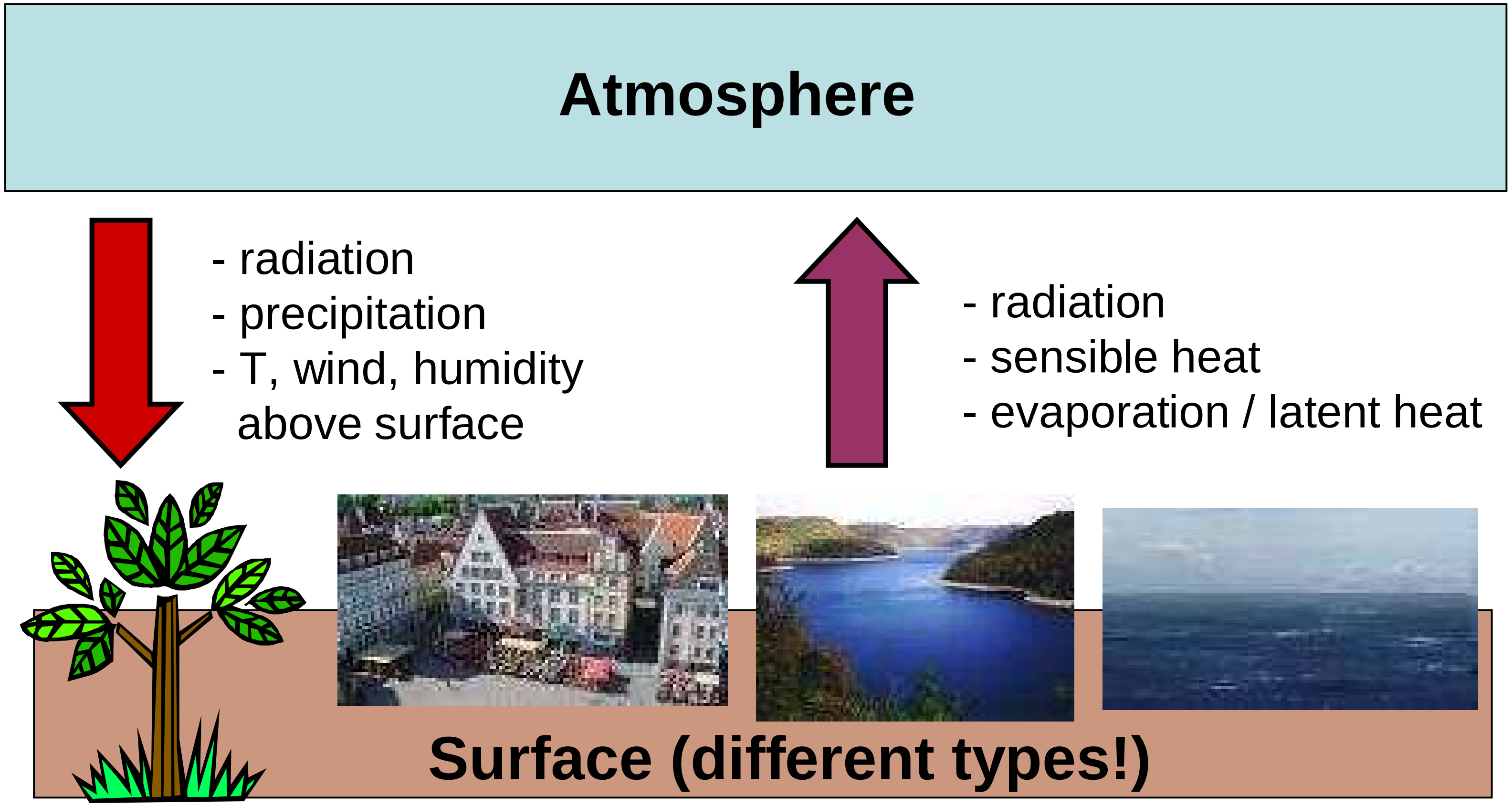
Principle of Eddy-diffusivity Mass Flux scheme

An EDMF-type scheme treats **both** the boundary layer and the cloud !

K-diffusion $\overline{w'\phi'} \cong -K \frac{\partial \overline{\phi}}{\partial z}$ $\overline{w'\phi'} \cong M_u(\phi_u - \overline{\phi})$ **Mass-Flux**

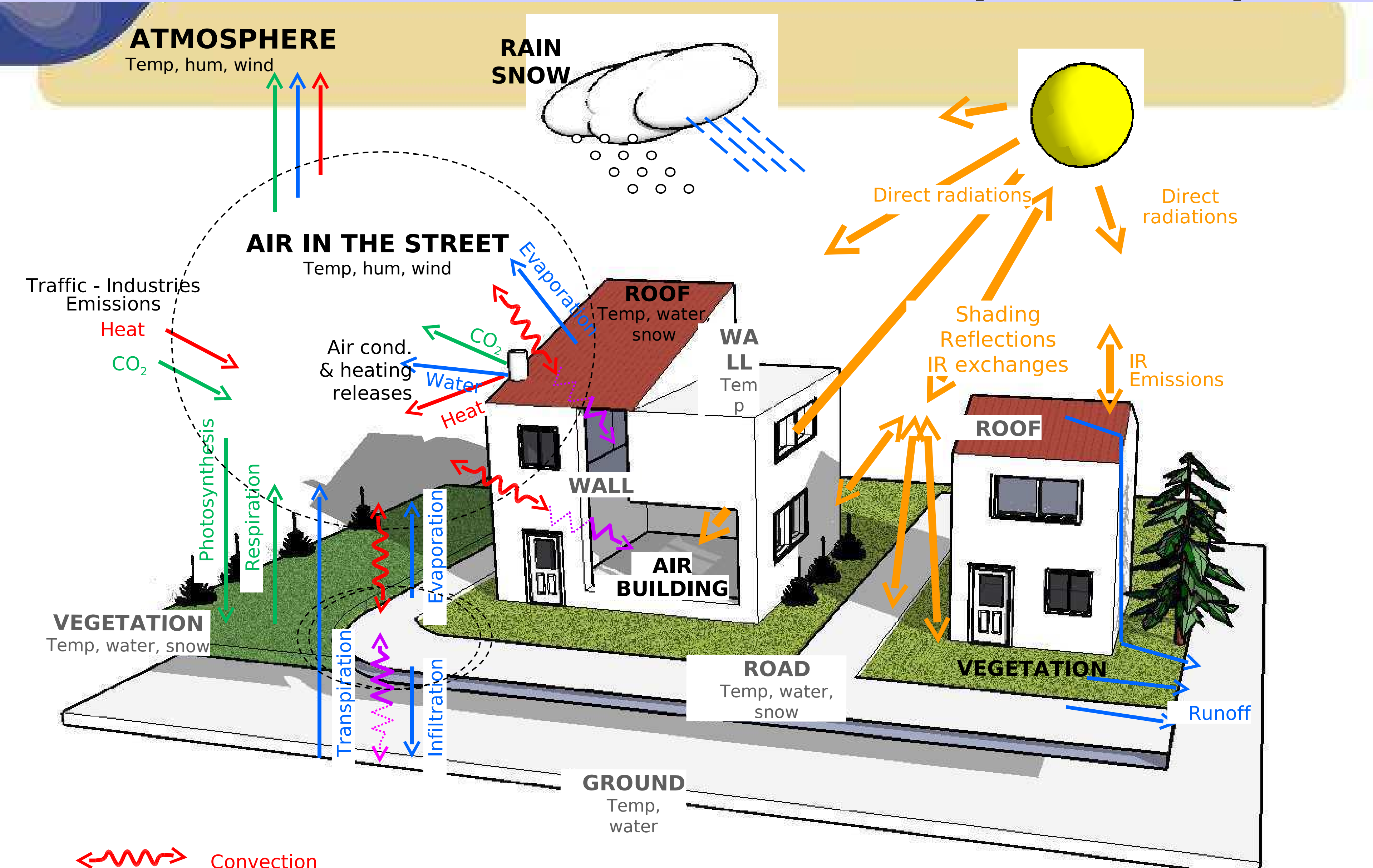


SURFEX = SURFace EXternaliseé



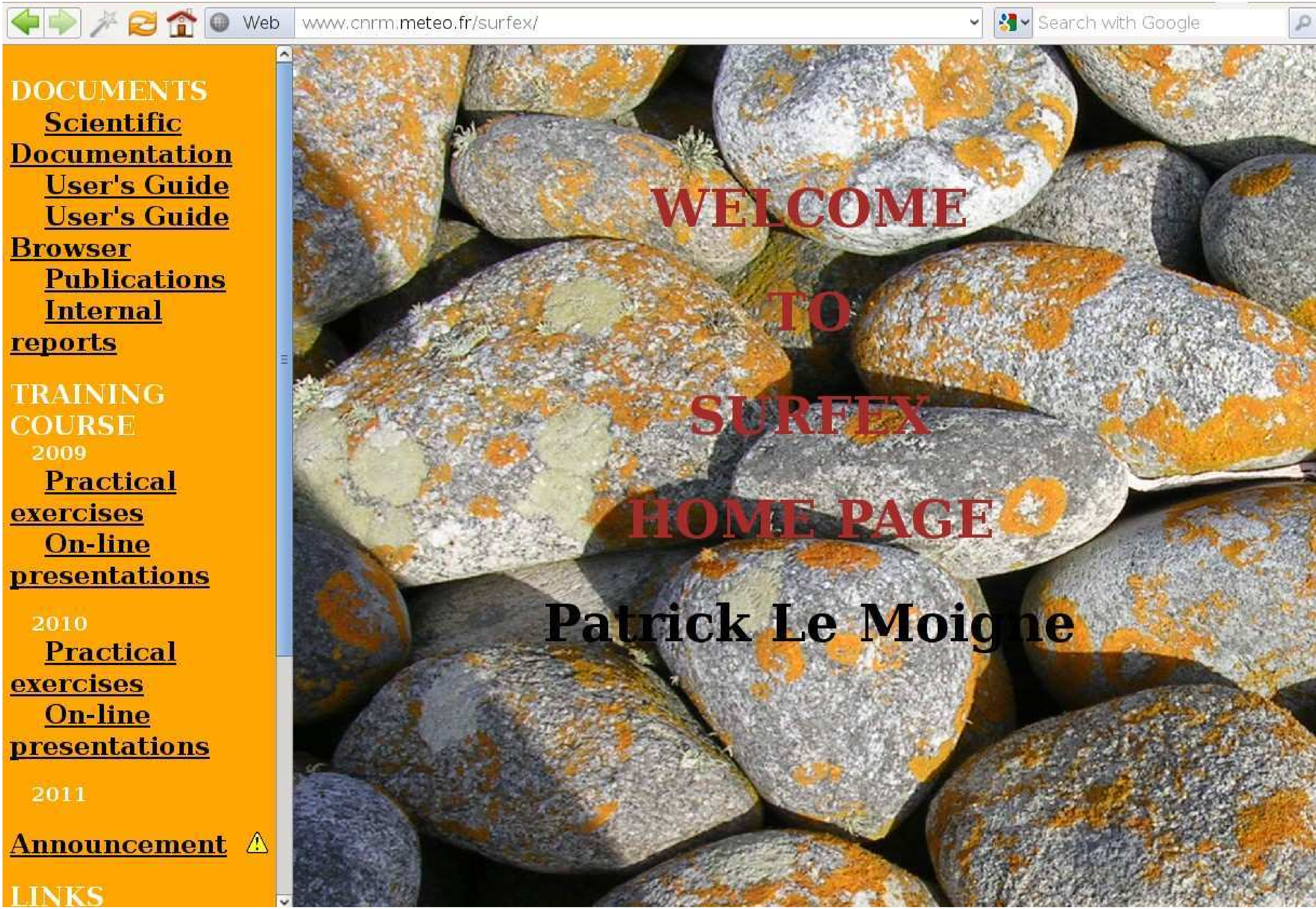
Given the meteorological **FORCING** from the atmosphere, SURFEX
(1) calculates the **FLUXES** from the surface to atmosphere,
(2) predicts the evolution of many **SURFACE QUANTITIES** (e.g., soil moisture), and
(3) diagnostically computes some **"SURFACE AIR" METEOROLOGICAL PARAMETERS** (e.g., 2m temperature over different surface types))

Processes taken into account in the SURFEX model for a complex urban landscape



On going implementation :
Direct radiation through windows, air conditioning releases, vegetation in the street, road orientation, ground water infiltration, CO_2 emissions.

METEO FRANCE
Toujours un temps d'avance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Scientific Documentation
User's Guide
User's Guide Browser
Publications
Internal reports
TRAINING COURSE
2009
Practical exercises
On-line presentations
2010
Practical exercises
On-line presentations
2011
Announcement
LINKS
WELCOME
TO
SURFEX
HOME PAGE
Patrick Le Moigne

Introduction

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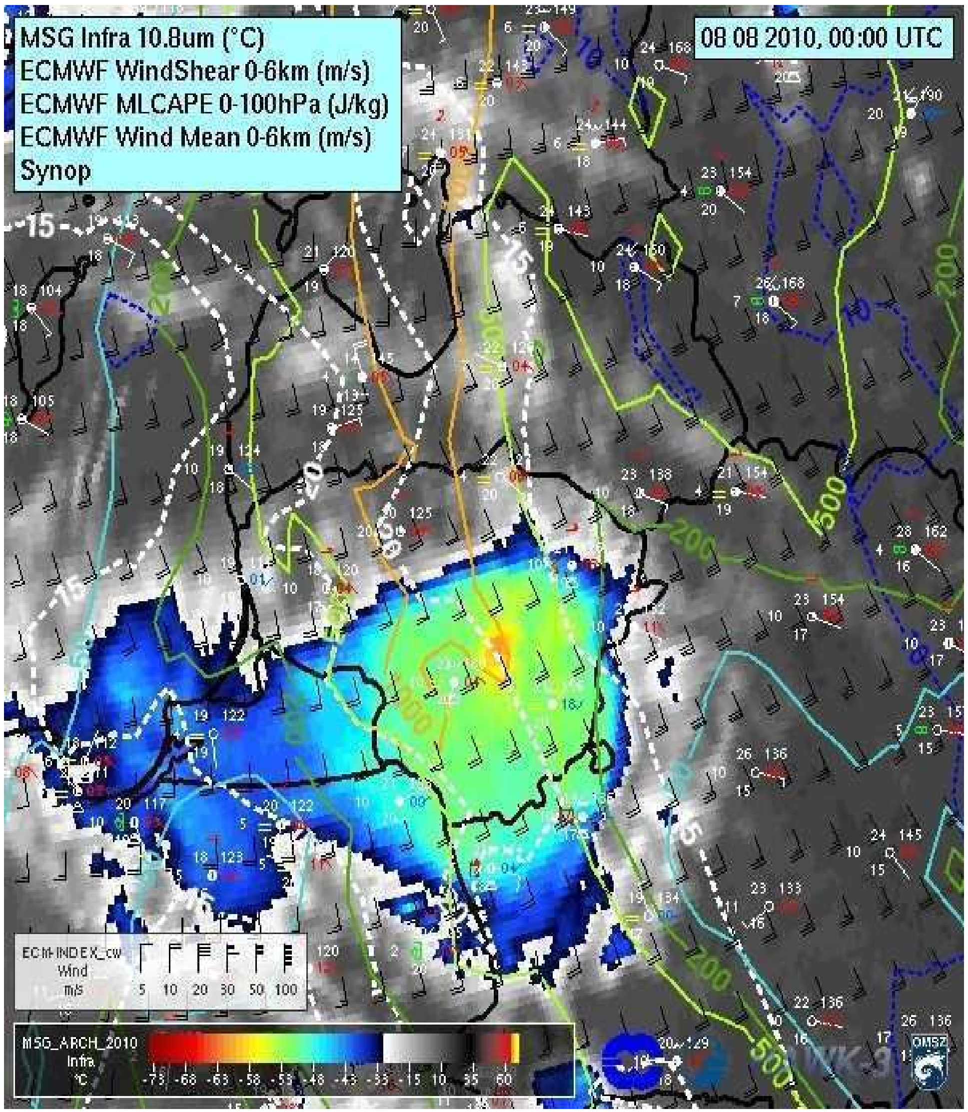
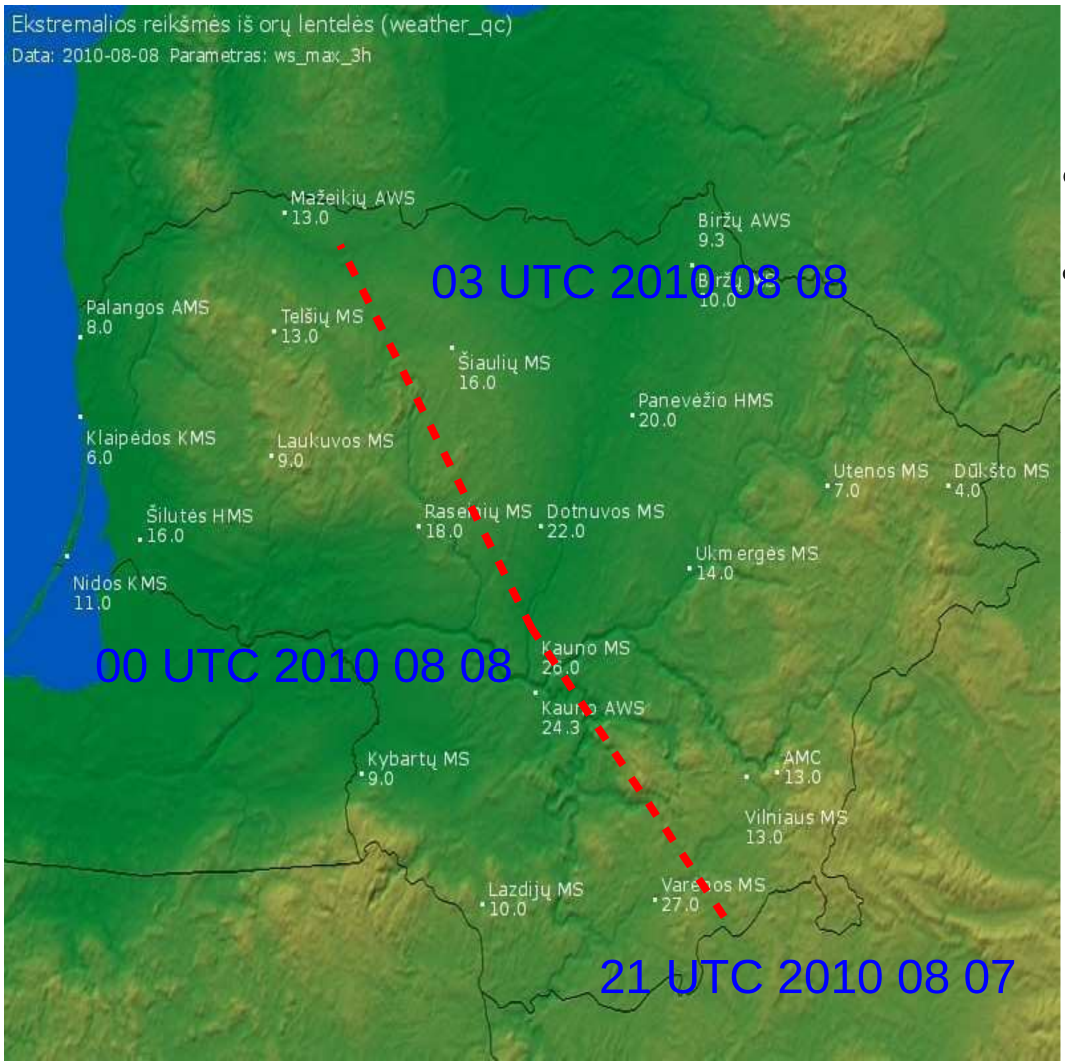
The august storm case (1)



- Intense convective event developed ~ 2010-08-07 21 UTC – 2010-08-08-03 UTC
- Wind speeds up to 27 m/s measured in synop network

Image : Ecmwf/Eumetsat/met.hu/Lhms

The august storm case (2)



Wind speeds from LHMS SYNOP network
(2010-08-07-21 / 2010-08-08-03 UTC)

- Most intense at 00 UTC 2010-08-08
- Amount of damage done in several areas indicates that higher wind speeds occurred / were missed by the station network (see next slides)

Some extra things

- The storm has caused > 5 mln. Eur (~ 4 mln. for forests + agriculture) of damage.
- Murphy's law in action: LHMS weather radar down for extended maintenance before the event... (which means almost no coverage from neighboring Belarus/Russia/Poland, and Latvian radar covering only the very northern part of Lithuania)

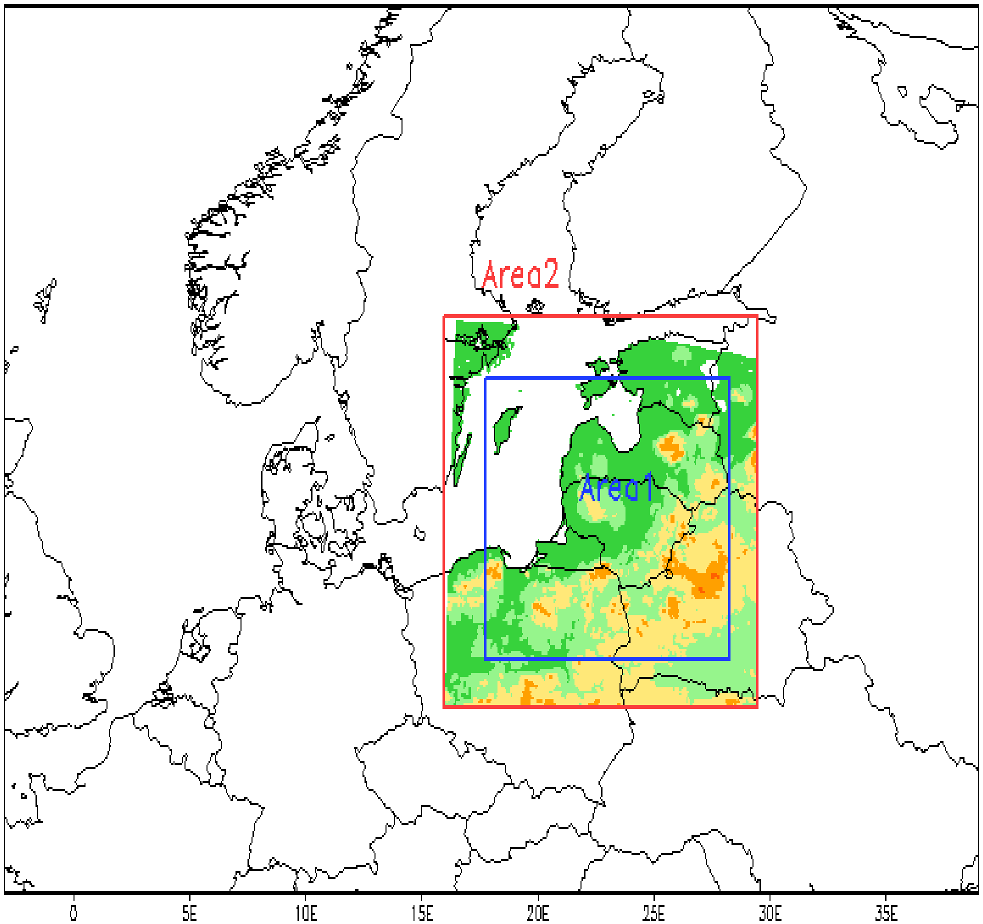
Image : Lithuanian dept. of Civil defense
Forest leveled down to the ground in southern part of Lithuania



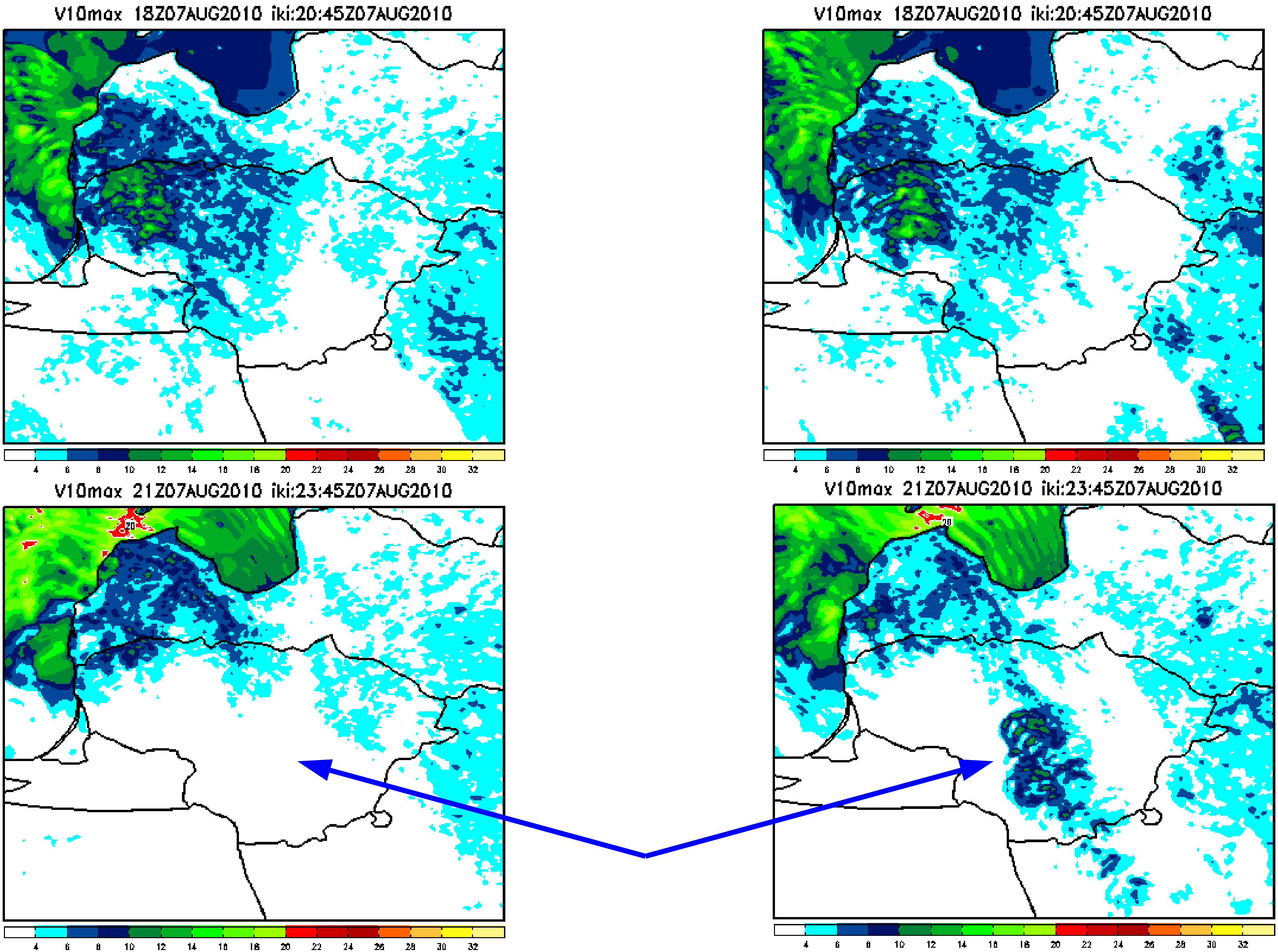

Images : Lithuanian dept. of Civil defense

Harmonie model experiments

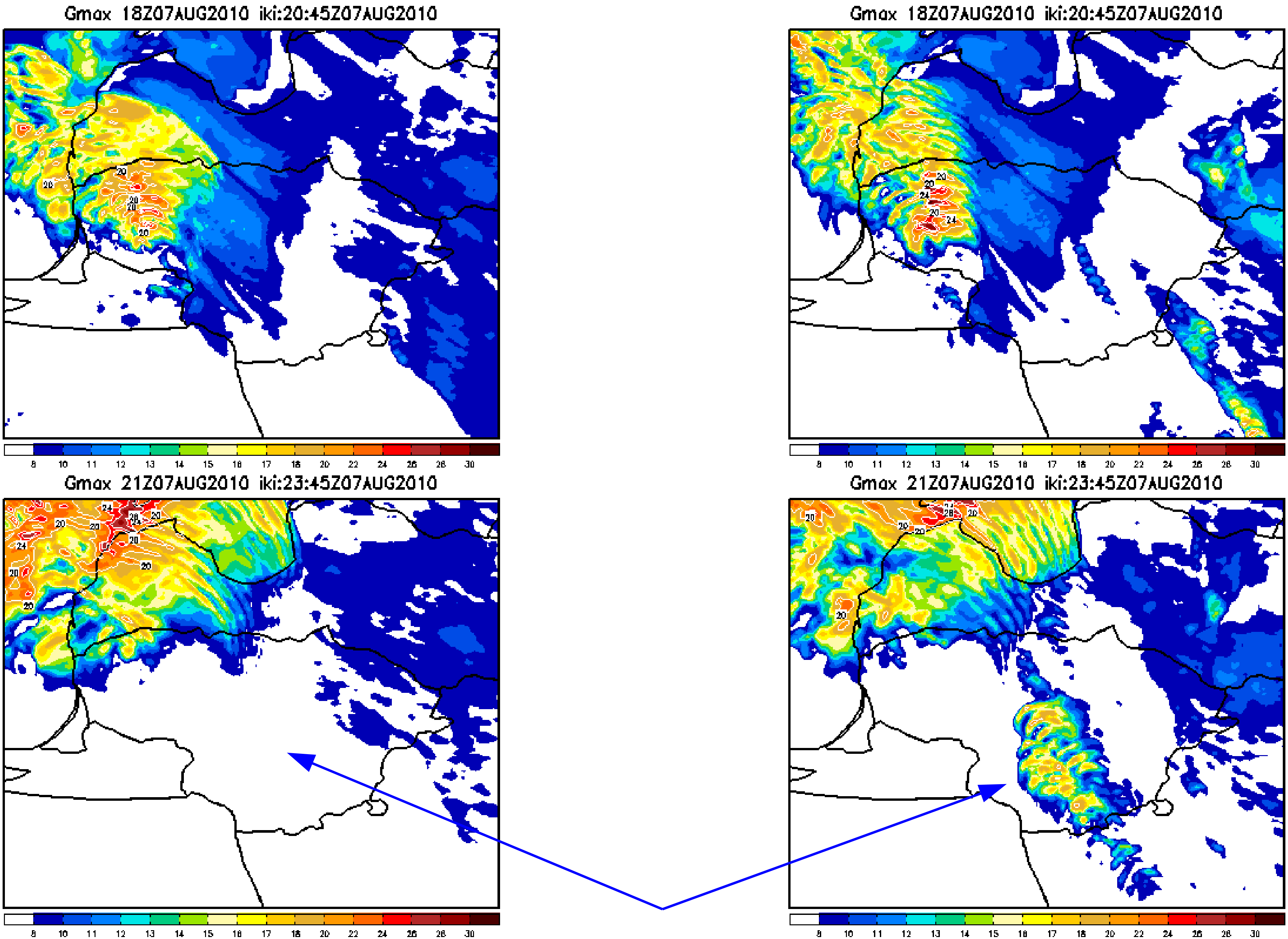
- 2 similar setups / Area2(red) Area1 (blue)
- Area1 300X300 / Area2 400X400 gp.
- Arome 2.5 km
- Cycle 36h1.3
- 6 hourly cycling (start at 2010-08-07-06 UTC)
- Blending + Surface DA
- ETDFK / CANARI_OI_MAIN
- 3 hourly coupling
- In this presentation (shortened):
  - Area size impact (Area1 v.s Area2) (Host model - IFS)



12 UTC 2010 08 07 Arome runs max 10 m. wind speed (3 h.)
Area1 – Left, Area2 - right



12 UTC 2010 08 07 Arome runs max wind gusts (3 hourly)
Area1 – Left, Area2 - right



Introduction

Data assimilation

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MUSCATEN Summer school 2011

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HARMONIE = mesoscale IFS

IFS = Integrated Forecast System

Created by ECMWF, nowadays shared and maintaned together with ALADIN and HIRLAM consortia

The comprehensive earth-system model developed at ECMWF forms the basis for all the data assimilation and forecasting activities. All the main applications required are available through one integrated computer software system (a set of computer programs written in Fortran) called the Integrated Forecast System or IFS.

Default Repository

Visit: View revision:

Name ▲	Size	Rev	Age	Author	Last Change
▷ branches		9451	13 hours	uandrae	Ulf Andrae: Rename boundary strategy operational to simulate_operational - ...
▷ tags		9375	5 weeks	trygveasp	Files have been renamed to .F90 in an temporary place to keep history
▽ trunk		9452	13 hours	xiaohua	adjust up resource requirement for forecast model
▷ contrib		9438	43 hours	uandrae	Ulf Andrae: Add missing VMASS flag in al37t1 mitraillette namelists
▽ harmonie		9449	15 hours	trygveasp	odbsql seems to be needing hdf5 and should be used instead of mandalay
▷ config-sh		9439	43 hours	uandrae	Ulf Andrae: Change JOBOUTDIR for HARMONIE at ECMWF
▷ const		8838	6 months	xiaohua	provide a sample set of strfun for AROME configuration
▷ msms		9414	8 days	trygveasp	First attempt to run cycle 37. ALADIN_3DVAR AROME and AROME_3DVAR run ...
▷ nam		9414	8 days	trygveasp	First attempt to run cycle 37. ALADIN_3DVAR AROME and AROME_3DVAR run ...
▷ scr		9439	43 hours	uandrae	Ulf Andrae: Change JOBOUTDIR for HARMONIE at ECMWF
▷ sms		9449	15 hours	trygveasp	odbsql seems to be needing hdf5 and should be used instead of mandalay
▷ src		9440	43 hours	uandrae	Ulf Andrae: Correct missplaced and missing (DE)ALLOCATIONS
▷ util		9449	15 hours	trygveasp	odbsql seems to be needing hdf5 and should be used instead of mandalay
▽ hirlam		9452	13 hours	xiaohua	adjust up resource requirement for forecast model
▷ config-sh		9447	16 hours	uandrae	Ulf Andrae: Change JOBOUTDIR in hirlam to the new perm file system
▷ data		9378	4 weeks	xiaohua	port changeset 9054. watch for B0000990602.TXT and D0000990602.TXT which ...
▷ grads_scripts		9378	4 weeks	xiaohua	port changeset 9054. watch for B0000990602.TXT and D0000990602.TXT which ...
▷ scripts		9452	13 hours	xiaohua	adjust up resource requirement for forecast model
▷ src		9443	22 hours	rontu	[HIRLAM trunk] Updating FLake-related code for preparation of 7.4beta, src
▷ util		9378	4 weeks	xiaohua	port changeset 9054. watch for B0000990602.TXT and D0000990602.TXT which ...
▷ vendor		9419	7 days	toon	Tag vendor/aladin/current as vendor/aladin/cy37t1.05.

Repository Index

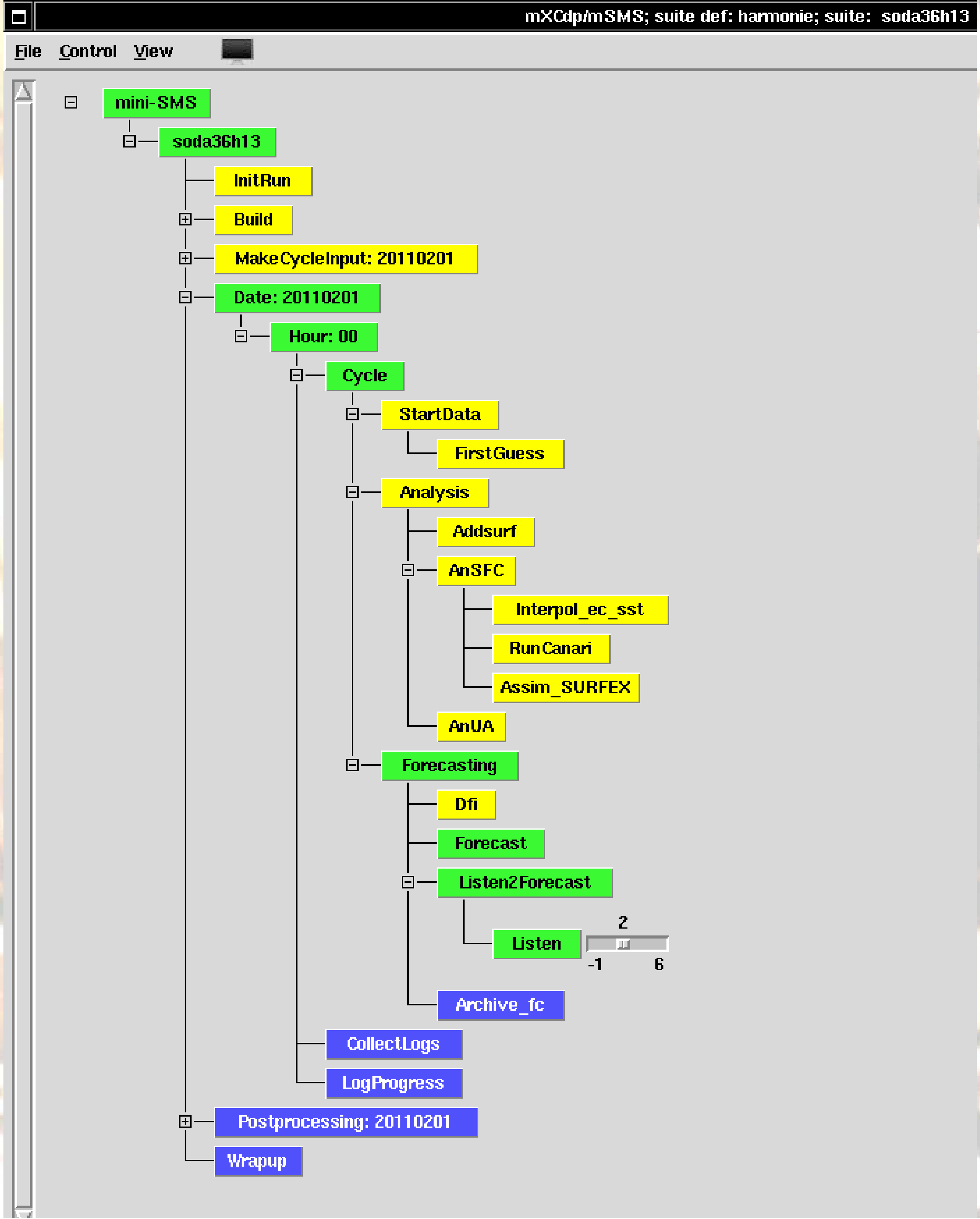
Name ▲	Size	Rev	Age	Author	Last Change
▷ GLAMEPS		fc6da40	3 months	ksa	suite version 0.8.3 Signed-off-by: Kai Sattler <ksa@...>

Note: See TracBrowser for help on using the repository browser.

View changes...

Visit: | View revision:

Name ▲	Size	Rev	Age	Author	Last Change
../					
CHEM		8456	9 months	xiaohua	port [8453]
chemgas		8456	9 months	xiaohua	port [8453]
gasphase		7519	18 months	xiaohua	bugfix to declare logical CHEMISTRY
cisdmi		7306	20 months	xiaohua	maintenance adaptation to enable run at xt5
climate		9300	7 weeks	uandrae	Ulf Andrae: Climate branch config for ECMWF
DMI		9074	4 months	kpn	Reverting changes from 9060
eucos		7557	18 months	xiaohua	eucos update to trunk and modifications according to Nils Gustafsson
FMI		9070	4 months	niko	To obtain authority, possibly
gl_grib_api		9365	5 weeks	uandrae	Ulf Andrae: C1A config updates for gl_grib_api.
harmonie-31h1		5122	4 years	towil	Port [5121] from trunk/harmonie to branches/harmonie-31h1
harmonie-35h1		9137	3 months	xiaohua	Mariano Hortal: Introduce ECPHY physical parameterisation option ecphy ...
harmonie-35h2		7334	20 months	ovignes	Branch off in preparation for cy36 in trunk
harmonie-36h1		9451	13 hours	uandrae	Ulf Andrae: Rename boundary strategy operational to simulate_operational - ...
harmonie-36h1.3_radar		9363	5 weeks	mridal	Martin Ridal: Changes to Bator in order to read radar data in polar ...
harmonie-36h1ecphy		9204	3 months	xiaohua	correct syntax following that of [8655]
harmonie-36h2		8370	10 months	ovignes	Merge vendor/aladin/cy36t2 into branches/harmonie-36h2
hirlam-7.0		4822	5 years	xiaohua	apply [4768] from trunk
hirlam-7.1		6865	2 years	xiaohua	typo fix
hirlam-7.2		8469	9 months	xiaohua	increase memory request for Verify
hirlam-7.3		9360	5 weeks	martynas	Add Lhms configuration
intercomp		5303	4 years	xiaohua	port changeset [5299]
LACE		8474	9 months	uandrae	Ulf Andrae: Create entry for LACE branches
METIE		9407	2 weeks	eoin	Make some local changes to METIE branch. scr/include.ass: structure ...
metie_hirlam-7.2		9364	5 weeks	eoin	Update met.ie operational LBC processing scripts
METNO		9408	2 weeks	metnosvn	Post-process total snow and prepare for radiance assimilation
newsnow		7534	18 months	xiaohua	update to trunk [7399:7533]
oldsurf		7761	16 months	xiaohua	update to trunk at [7756]
orsula		9281	8 weeks	rontu	[HIRLAM orsula] Quite many things seem to work after some last fixes?
overhaul		5110	4 years	jwp	get rid of unused local vars
refdmi		7031	2 years	xiaohua	correct local LBC data path
rttov8		5444	4 years	xiaohua	Frank Tveter: define global max_rtm_nrchan to distribute to all processes ...
SMHI		9323	6 weeks	uandrae	Ulf Andrae: Merge [9319] to SMHI branch
SURFEX		9318	6 weeks	psamuels	Modified altitude in Col_de_Porte/OPTIONS.nam



mini-SMS interface

Used for monitoring and controlling a HARMONIE Experiment

This example is from the ECMWF computing system, but would look similar also in a local environment

SURFEX

Part of the HARMONIE NWP system

with surface description, surface data assimilation,

prognostic process models

+

Stand-alone software

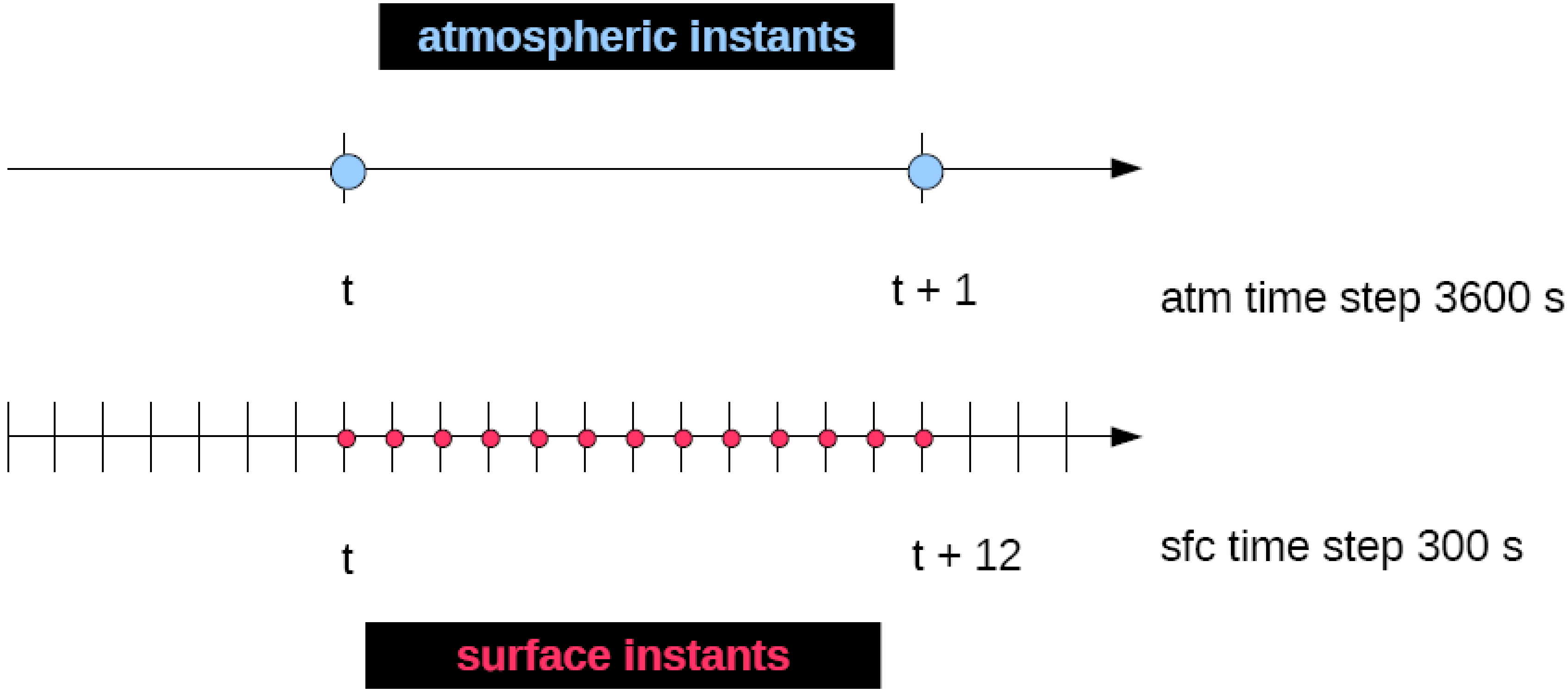
for climate, urban, lake, forest … research

stand alone surfex

Run an experiment where the atmosphere is imposed :

air temperature, humidity, wind speed and direction, precipitation (liquid+solid), shortwave and longwave incoming radiation

1. prepare physiography
2. prepare initial conditions for the run
3. run the model



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THANK YOU
for attention!

Many thanks for contributions:
Valery Masson, Martynas Kazlauskas,
Patrick LeMoigne, Jouni Räisänen, Andras Horany.
Reima Eresmaa, Hans Joachim Herzog