THIRD MEDIUM-TERM (2002-2004) RESEARCH PLAN FOR ALADIN

STATUS AT THE END OF OCTOBER 2003

*« marching towards very high resolution and continuous data assimilation
while preserving if not improving the current level of response to operational problems »*

--- high priority, important and/or urgent action   --- situation safe

--- intermediate priority or "medium-term" action   --- situation not that bad

--- low priority or "long-term" action   --- problems !!!

COUPLING

An emerging priority ➡ A lot of work performed

Interaction with orography	"Surface-pressure tendency" coupling	STARTED
	"Orography" coupling	Waiting
Spectral coupling	Use of large-scale spectral information	**IN PROGRESS**
	Interpolation of amplitude and phase-angle	STOPPED
	Combination with Davies'scheme	**IN PROGRESS**
	Case studies and tuning	**IN PROGRESS**
Time-interpolation	Further comparison of the present schemes	DONE -> warning index
New prognostic variables	Design of a strategy for new variables from physics	Waiting
	Introduction whenever required	
Towards higher resolution	Pseudo-radiative scheme	Waiting
	Two-way nesting	Waiting

	Non-hydrostatic variables	Waiting
	Case studies	**IN PROGRESS**
Data assimilation issues	Comparison of present choices	**IN PROGRESS**
	Spectral coupling and 4d-var	Waiting for 4d-var

DYNAMICS

A huge step forward !

Hydrostatic dynamics : improved semi-Lagrangian schemes	Uniformly accelerated scheme Predictor-corrector (P/C) scheme
STOPPED (further studies not required)	
NH dynamics : three-time-level semi-Lagrangian (3TL) schemes	Optimal choice of model variables P/C scheme
NH dynamics : two-time-level semi-Lagrangian (2TL) scheme	Properties of P/C scheme Refinement in the choice of model variables Use of decentering
DONE : efficient and accurate NH dynamics available ! code cleaning and documentation now	
Bottom boundary condition (NH) & related discretisation problems	Optimal discretisation General improvement of the current scheme
almost **DONE** refinements required	

Diabatic forcing)	Strategy for the diabatic forcing Adaptation to the final choice of prognostic NH variables

STARTING

Orographic forcing	Optimal filtering of the orography Resonance problem in NH

Filters available and tested

Resonance : solved

Relaxation of the thin layer hypothesis	Implementation and test in ALADIN Extension to NH

STOPPED : first solution coded and tested, second one (NH) considered, but no impact at present scales

Radiative upper boundary condition	Feasibility study : analysis, academic 2d tests Adaptation to ALADIN NH Control of the hydrostatic version

STARTED

Horizontal diffusion	Horizontal diffusion using semi-Lagrangian interpolators Gridpoint treatment of humidity

PROMISING RESULTS

-> to be further tested and applied to NH

PHYSICS

Initial objectives : Solving identified problems at the present operational resolutions and going towards higher resolution : ~ 5 km
➜ ***Now modified !***

USE OF NEW PROGNOSTIC VARIABLES AND CHANGES IN CONCERNED SCHEMES

Convection	Introduction of a prognostic convection scheme	in progress
	Management of the 4 new variables	
	Validation over an extended set of situations	
	Investigating problems in the triggering of convection	
	Analysis of the closure and hysteresis problem	
Microphysics	Management of 2 or 3 new variables : condensed water	in progress
	Further analysis of the "Functional Boxes" approach	in progress
	Introduction / choice of a semi-complex microphysics	in progress
	Interface with convection	waiting
	Prognostic treatment of falling condensates or not?	waiting

Vertical diffusion, low cloudiness, PBL, ...	Introduction of a prognostic TKE scheme (1 new variable)	started
	Interaction with other developments concerning PBL:	in progress
		SOLVED
	* link between top of PBL fluxes and cyclogenetic activity	started
	* noise in shallow convection	waiting
	* PBL-height dependent mixing lengths	**DONE**
	* developments in the anti-fibrillation scheme	better vertical diffusion
	* improvement of low-level cloudiness (diagnostic scheme)	
General problems	Update of thermodynamics	waiting
	Consistency with the other parameterizations	waiting
	Interface with coupling, dynamics and data assimilation	waiting
	Consistency with regular physics	waiting
	Validation at various horizontal and vertical resolutions	**started**

IMPROVEMENT OF BASIC PARAMETERIZATIONS

Radiation	Refinements of optical depths	**IMPROVED**
	Move (choice, development) to an intermediate scheme	**in progress**
Orography	Improved smoothing of very small scales	**DONE**
	Management of the extension (and coupling ?) zone	improved
	Tuning of the envelope	waiting
	Better description of roughness length	waiting
	Investigation of feed-backs with other parameterizations	waiting
	Study of local circulations	waiting
	Development of new diagnostics	**DONE**
Surface	Parameterization of lakes	waiting

	Improved description of evaporation over sea	waiting
	Revisit of the z0h/z0m ratio over land	waiting
	Improved databases for soil and vegetation	**in progress**
		improved snow cover
Simplified regular physical parameterizations	Tuning of diffusion Improved description of humidity Validation at high resolution Consistency with the "full" physics	Evaluation via sensitivity studies at high resolution
Physics / dynamics interface	Introduction of the new variables Interaction with the predictor / corrector approach Interface with "externalized" parts of the physics	STARTED

VALIDATION

Case studies	Identification and study of "strange behaviour" cases	DONE
	Selection and documentation of extreme situations	waiting
	Validation on a wider range of situations	
New observations	Comparison to satellite data	**in progress**
	Comparison to radar or lidar data	waiting
	Interfaces to new field experiments	**in progress**
New methods	Design of new scores or criteria	waiting
	Use of expert systems to identify fine scale structures	waiting

DATA ASSIMILATION : METHODS

Main objectives for upperair assimilation

Prototype 3d-var ➡ **Operational 3d-var** ➡ **Operational 3d-FGAT** ➡ ~~Prototype 4d-var~~

A lot of work, new ideas, significant progress, but a too ambitious program !

Modelisation of background / forecast errors

Sampling methodology	Evaluation of the different contributions to error covariances	**in progress**
	Ensemble analyses and forecasts with perturbed observations	**In progress**
	Singular vector approach	waiting
Diagnostics	Heterogeneity and anisotropy	**in progress**
	Time-dependence	**in progress**
	Nonlinear effects	
Jb formulation	Approaches based e.g. on diagonal blocks and wavelets	**in progress**
New variables	Taking into account new prognostic variables (NH, cloud water, ...)	waiting

Algorithmic aspects

3d-var	Use of observations at the borders of the domain	waiting
	New minimization algorithms	waiting
	Design of an explicit spectral blending and combination with 3d-var	started
	Improvement of observation operators (vertical interpolations)	waiting
	Choice of the time-window for the selection of observations	waiting
		biperiodicity
		Jk

3d-FGAT	Implementation of a 4d screening	DONE	
	Choice of lateral boundary conditions	waiting	
	Choice of the time-window	waiting	
4d-var	Maintenance of the TL/AD code (for various research purposes)	DONE	
	Coding TL/AD of semi-Lagrangian schemes	waiting	
	Definition of coupling strategies for the various elements	waiting	
	Adaptation of Jc-dfi (to high resolution, to new variables)	waiting	
	Improvement of simplified physics	waiting	
Simplified physics	Evaluation through sensitivity studies	done	
	Evaluation and tuning at high resolution	done	
	Solving incrementality problems	waiting	
	Adapting observation operators to new variables	waiting	
A-posteriori validation	Further tuning of statistics (observations + background) for 3d-var	DONE	
	Extension of diagnostic tools to 4d-var	waiting	
TL/AD tools	Maintenance of the TL/AD code (reminder)	waiting	
	Use in the design of the TL/AD code (e.g. LBC, NH, new variables)	waiting	
	Use to study nonlinearity problems (e.g. in simplified physics)	done	
	Predictability studies	starting	
Var-Pack	Watch	starting	

Cycling

Blending	Maintenance of a reference version of dfi-blending	**DONE**	
	Adaptation to the main changes in the model	waiting	

	Development of double-nested blending	waiting
	Comparison of "dfi" and "explicit" blending for spectral fields	**started**
Assimilation cycle	Investigating the various combinations between 3d-var, dfi and blending	**in progress**
	Combination with surface analysis or surface blending	**in progress**
	Moving to 3d-FGAT	started
	Maintenance of a reference version	waiting
Frequency of 3d-Var	Evaluation through sensitivity studies	waiting

PREDICTABILITY

First work plan ready !

DATA ASSIMILATION : OBSERVATIONS

Work has started !

ODB	Maintenance and documentation	DONE
	Development of new tools	OK
Satellite data	IASI / AIRS: Improved description of surface emissivity	**in progress**
	Raw ATOVS data : use of local data	**done**
	Cloudy ATOVS data : observation operator, Jb	?
	GPS	waiting
	SSM/I	starting
	Profiler data	**done**
Surface observations for upperair analysis	From the less difficult or most important ones to new ones: surface pressure, 2m-relative humidity, 10m-wind, ...	**in progress**

Aircraft data	Use of local data	in progress
Radar	Winds	waiting
	Reflectivities	starting
Pre-analysed data (or pseudo-obs.)	Pseudo-TEMP for relative humidity : case studies	done
	Pseudo-TEMP for relative humidity : regular use	waiting
	Surface data bogus	waiting
Screening	Evaluation for high-density data	in progress
	New data types	waiting
	Time window	waiting
	Time dimension	4D OK
	PBL fields	?
Space consistency of the quality control	Combination with the use of the CANARI quality control	waiting
	Variational quality control	starting

DATA ASSIMILATION : SURFACE

A too intermittent effort !

Analysis of PBL fields, for * Diag-Pack * correction of soil fields	Retuning of statistics (forecast and observation errors)	DONE
	Geographical dependent error statistics (orography, coasts, ...)	Starting
	Analysis of new fields (precipitations, visibility, cloudiness, ...)	Started (precipitations) New tools for Diag-Pack
SST analysis	Retuning	ok
	Use of pre-processed satellite data	DONE (sea-ice)
Snow analysis	Retuning of statistics, for large and small scales	Restarting

	Estimation of the vertical correlations for errors on snow depth	Starting
	Calculation and use of a snow mask derived from satellite data	waiting
		waiting
	Use of pseudo-observations from local networks	To be used !
	Analysis / correction of new fields (albedo)	
	Improved climatological fields	
Assimilation of soil moisture and temperature	Reduction of the horizontal heterogeneity of soil moisture	**something DONE**
	Retuning and implementation in ALADIN	waiting
	Combination with dfi-blending	waiting
	Combination with 3d-var	waiting
	Moving to a variational assimilation	**In progress**
	Use of satellite data	waiting
	Improved climatological fields	To be used !
Diag-Pack	Improvements in observations operators (vertical interpolations)	waiting
	Use of aircraft, profiler, radar-wind data	In progress
	Diagnostics fields (smoothing, new ones)	waiting
Quality control	Retuning screening for surface observations	waiting

APPLICATIONS

Still one of the weak points of ALADIN, but the situation is not that bad

POST-PROCESSING	

♣ forecast : new fields on demand	**DONE +**
♦ research configuration (assimilation) : implementation	NOTHING DONE
AVAILABLE TOOLS FOR OPERATIONS AND RESEARCH	
♠ re-launching the exchange of applications	NOTHING DONE
♦ ensuring portability	**IMPROVEMENT**
♦ design of a management procedure	NOTHING DONE
INTERFACE TO DOWNSTREAM APPLICATIONS	
♦ documentation of existing tools	NOTHING DONE
STATISTICAL ADAPTATION	
♦ more networking, within ALADIN and SRNWP	**?**
DYNAMICAL ADAPTATION	
♠ further research required	NOTHING DONE
MODEL TO SATELLITE APPROACH	
♣ a recent and promising tool	**IMPROVEMENT**
DIAG-PACK	
♦ enhanced exchanges with nowcasting teams	OK
♦ further research required	**CONTROVERSIAL!** **more coordination required**

VERIFICATION

Another weak point of ALADIN (and not only of ALADIN)

Building a coordinated procedure for objective verification	Definition of rules, implementation of the database	**STARTED**
	Routine update of the database	NOT YET

at synoptic scales	Improvements and diffusion of results	NOT YET
Defining a verification procedure for high resolution forecasts	Definition of a working group (modellers and forecasters) Use of satellite and radar data (precipitations) Safe exchange of local observations between ALADIN partners	Nothing done **STARTED** Directors'level