ALARO

status of developments and introduction into operational service

Plan of presentation

- Pre-ALARO
  - ‘Dry’ physics.
- ALARO-0, step 1
  - Equations and interface;
  - Resolved microphysics;
  - Radiation;
  - Turbulence;
  - Cloudiness issue.
- ALARO-0, step 2
  - 3MT and perspectives.

Pre-ALARO part (~ 2003, 2004)

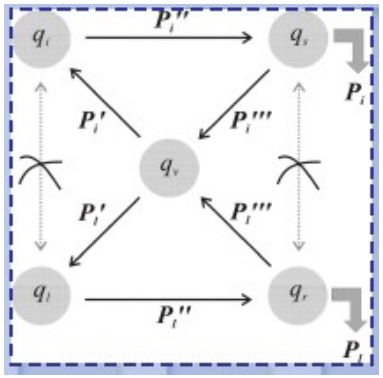
- Demand of MFSTEP project
  - Good parameters for coupling shelf-models:
    - Wind (breeze)
    - Temperature and humidity
    - Solar and thermal radiation flux
    - Cloudiness
    - Heat flux (sensible, latent)
- Demand of forecasters
  - Improve low-level cloudiness and temperature

Pre-ALARO developments

- SLHD => more realistic diffusion (sea cyclogenesis);
- Gustiness => more realistic boundary layer over sea;
- Mean orography and new GWD parameterization => better description of the coastal areas and winds;
- Radiation scheme and Cloudiness scheme (inversion-layer clouds, tunings, geometry) => better radiation fluxes
- *Reference (Brožková et al., 2006)*

ALARO-0, step 1 developments (1/7)

- Governing equations => drive the interface to the dynamical core; *Reference: Catry et al., 2007*
  - Set of standard simplifying hypothesis;
  - Mass weighted (barycentric) system;
  - Microphysics: phase changes pass by QV
  - Loss of mass due to precipitation is considered;
  - Thermodynamic equation is derived for both HPE and compressible EE equations;
  - Flux conservative form of equations gives rules for interfacing (CPTEND_NEW in the code).



ALARO-0, step 1 developments (2/7)

- Sequential cascade and parallelism in calling parameterization routines
  - Flux-type interface (// in output) can cope with the two approaches (seq. or // in input).
  - The routines do not need “to know” in which context they are called.
  - Negative values of water species (advection) are handled also by “fluxes of negative values corrections” quite easily.
  - The existing example of the cascade: 3MT
    - Causality is taken into account via the cascade;
    - The output is done in a parallel way.

ALARO-0, step 1 developments (3/7)

- Resolved microphysics
  - Method of development:
    - Start from the operational diagnostic scheme (ACPLUIE);
    - Respect constraints of the governing equations: 5 prognostic water species (qv, ql, qi, qr and qs);
    - Add new processes;
    - Look for efficient algorithms: PDF-based sedimentation, *reference Geleyn et al., 2007*;
    - Prepare for future mixed use (resolve and convective in 3MT): include clouds- and precipitations geometry;
    - Stay modular in all possible aspects.

ALARO-0, step 1 developments (4/7)

- Resolved microphysics
  - Operational status:
    - Auto-conversion (ACACON): Sundquist functions + Wegener-Bergeron-Findeisen effect;
    - Collection (ACCOLL): similar to Lopez et al., 2002;
    - Evaporation/melting of falling precipitation (ACEVMEL): like in the pre-ALARO scheme;
    - Pseudo-graupel effect (mechanical), also ACPLUIE-like;
    - Statistical sedimentation.
  - Modularity so far: statistical sedimentation makes it easy
    - At the level of processes (ARPEGE alternative coded; MESO-NH features might be included as options, too);
    - At the level of cloud geometry (maximum/random or random overlap options coded);
    - At the level of falling speed (constant or precipitation density dependent options coded);
    - At the level of the PDF choice for sedimentation.

ALARO-0, step 1 developments (5/7)

- Radiation
  - Goal: to get reasonably cheap but realistic scheme
  - Method:
    - Choice of NER formalism (first implementations made within the pre-ALARO phase)
    - Separate the issues of clear-sky computations and interaction with clouds
    - Improvement of cloud optical properties (new saturation cloud model already operational)
    - Improvement of the statistical model in the application of NER method and introduction of Voigt effect (operational; *references: Geleyn, Bénard and Fournier, 2005; and Geleyn, Fournier, Hello and Pristov, 2005*)
  - Still lot of to do (transmission functions, intermittency strategy, …)

ALARO-0, step 1 developments (6/7)

- Turbulence
  - Method: similar to the microphysics – start from the operationally proven numerics and create a modular backbone
  - First realization: pseudo-prognostic TKE scheme, bridging diagnostic and prognostic issues (operational; *reference: Geleyn et al., 2006*)
  - Next steps:
    - Introduce more sophisticated dependency on stability conditions;
    - Use alternative mixing lengths from full TKE-schemes;
    - Mimick complete TKE equation while profiting from the numerical advantages of p-TKE.

ALARO-0, step 1 developments (7/7)

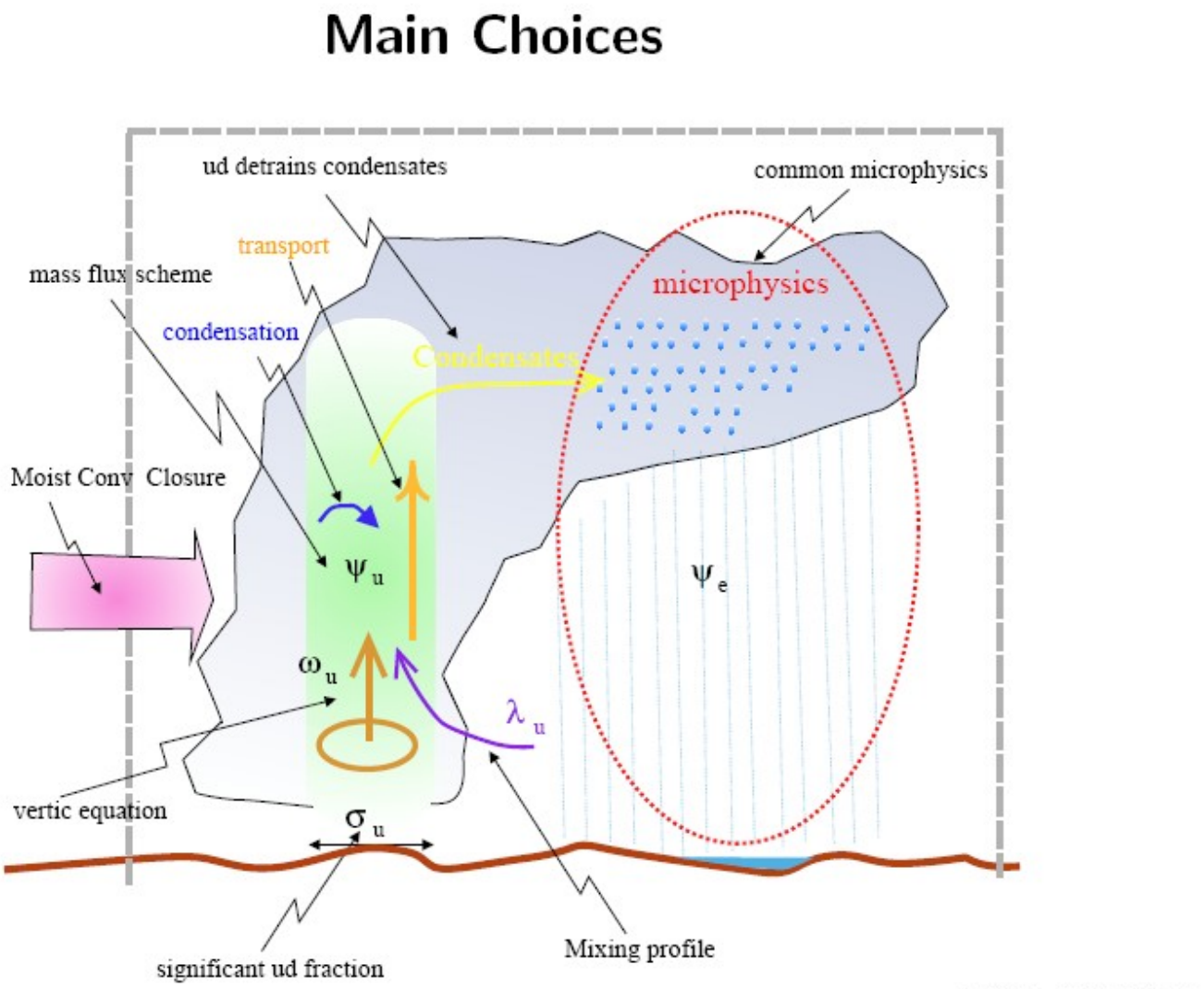
- Cloudiness issues
  - Cloudiness for here and there, computed by this and that: could we find an unifying concept?
- Cloudiness computations:
  - For resolved condensation/evaporation scheme (“resolved cloudiness”)
  - For diffusion of moist conservative variables (optional)
  - For microphysics
  - For convection (prognostic scheme in 3MT)
  - For radiation - all processes (sources): resolved (diagnostic or prognostic), convective, inversion => currently there is effort to start reconciliation from there.

ALARO-0, step 2: 3MT scheme

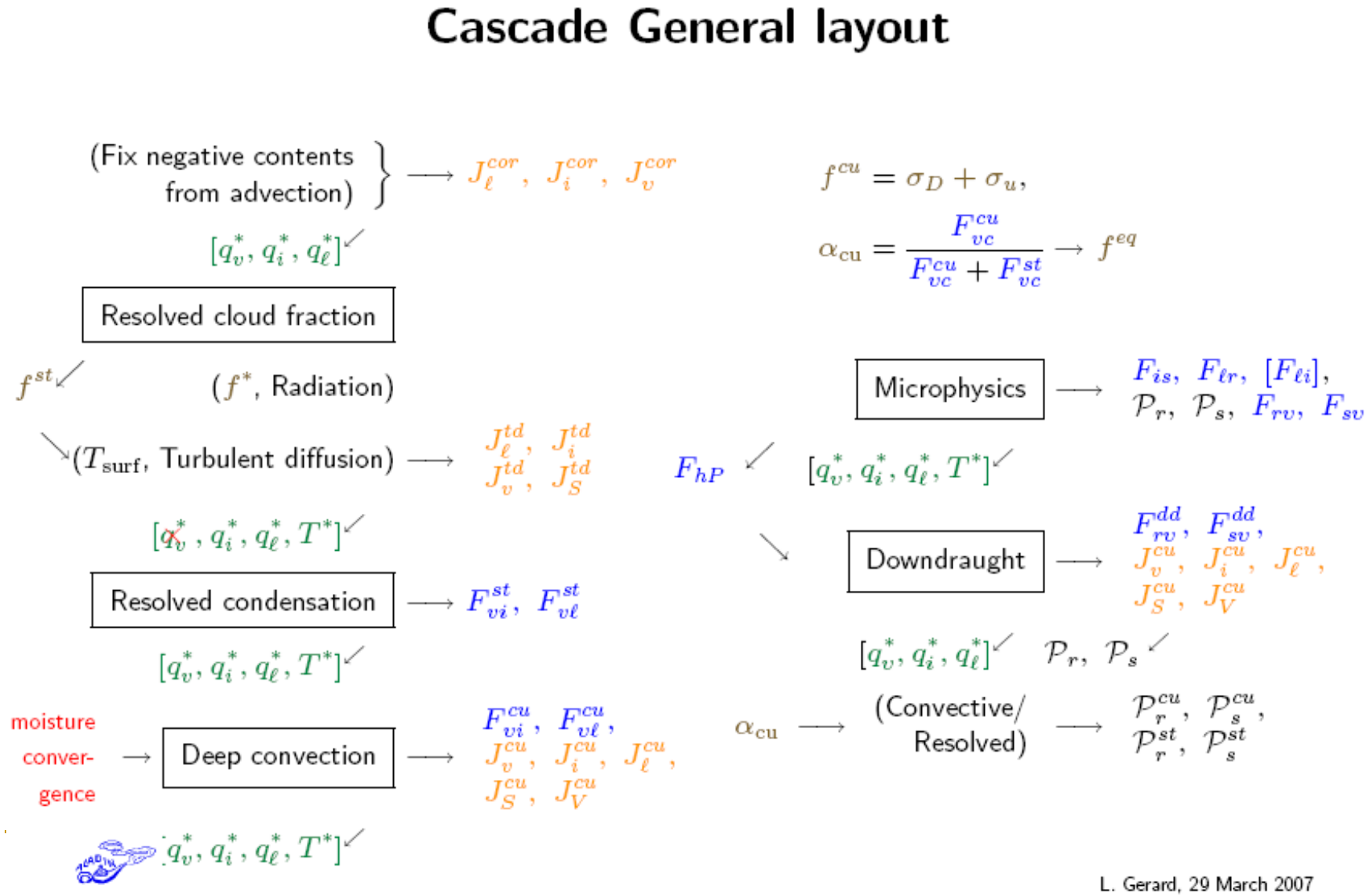
- Grey zone challenge;
- Concept of separating Transport and Microphysics;
- Combination with prognostic convective scheme.
- Goal: to reach the operational status while having the same level of modularity as for resolved precipitation process, turbulence and radiation.

- *References: Piriou et al., 2007; Gerard, 2007; Gerard and Geleyn, 2005*

ALARO-0, step 2: 3MT scl



ALARO-0, step 2: 3MT

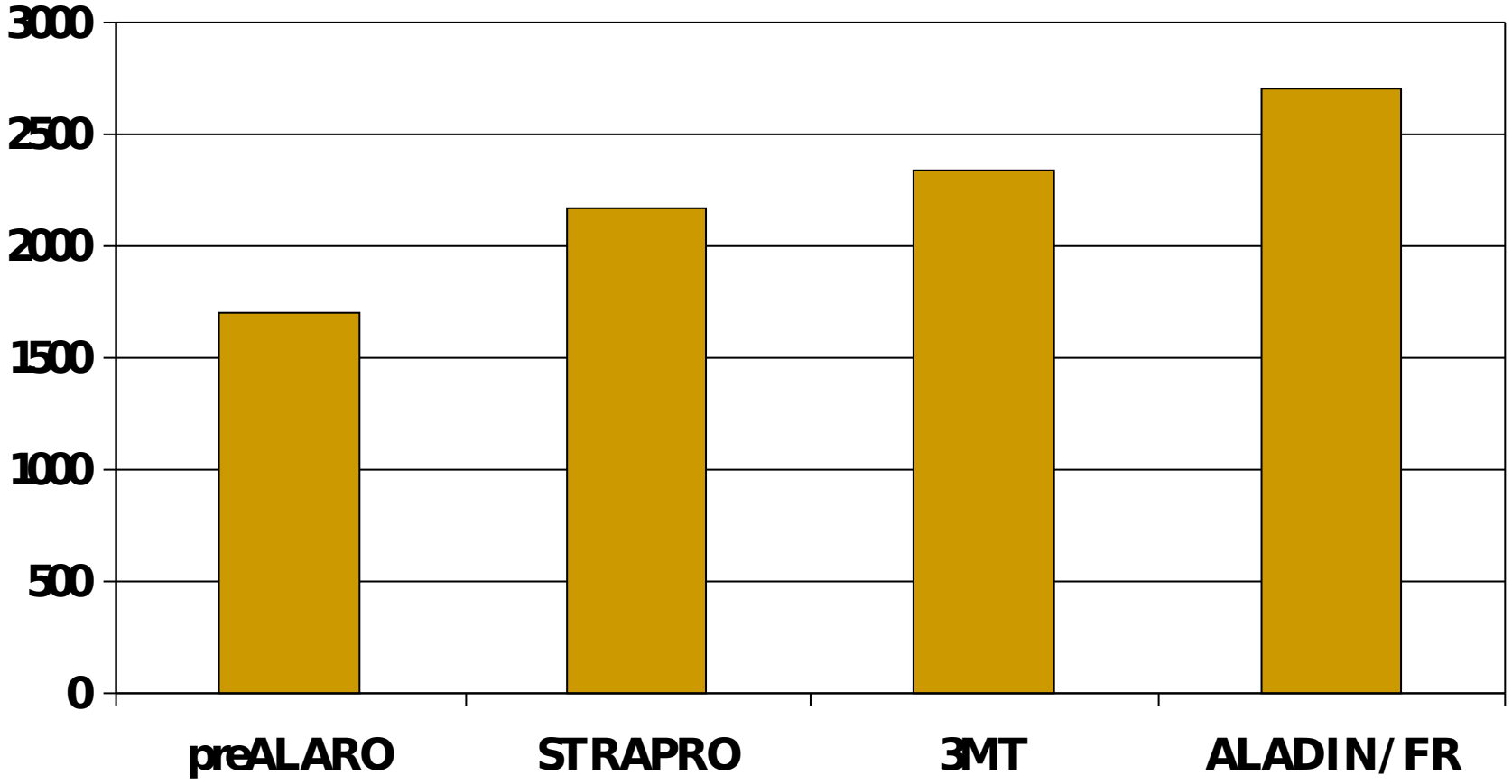


L. Gerard, 29 March 2007

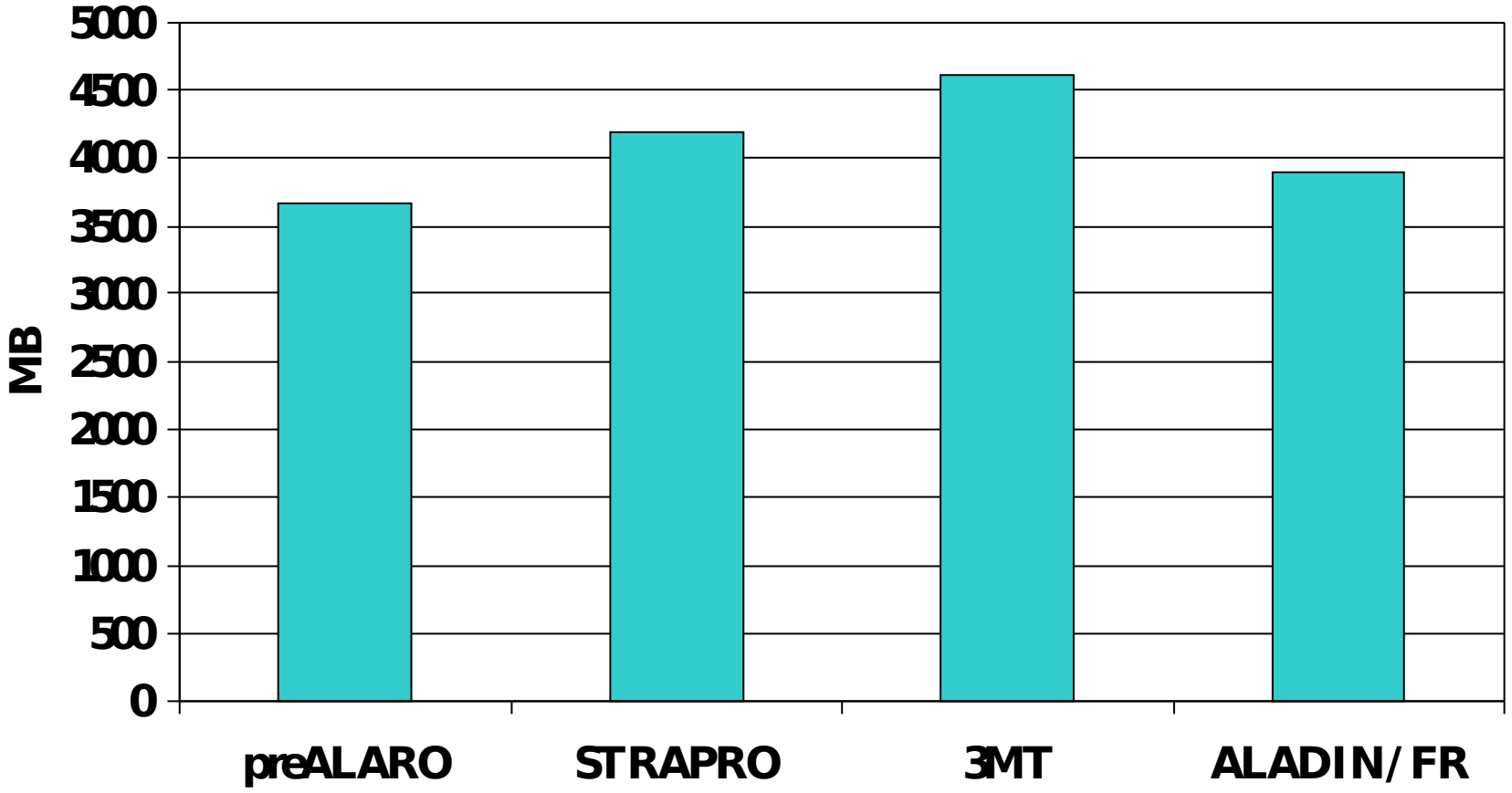
ALARO-0, step 2 developments

- SURFEX issues
  - Split of ACDIFUS
  - Better coupling

Cost issue (benchmark of pre-cy32t1 on NEC/SX68)



Memory use


MB
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
preALARO
STRAPRO
3MT
ALADIN/FR

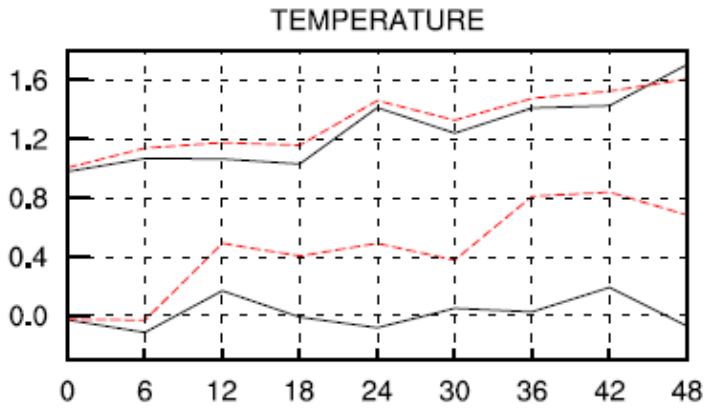
Some scores

- ALARO-0 (step 1) was checked against pre-ALARO: quite satisfactory results, especially for precipitation;
- But what about another reference?
- Now there is better possibility of cross-checks using cy32t1;
- First ‘orientation test’ was done for central European region, winter and summer periods, in comparison with ARPEGE (ALADIN/France) options => these results should not be however taken as something absolute.

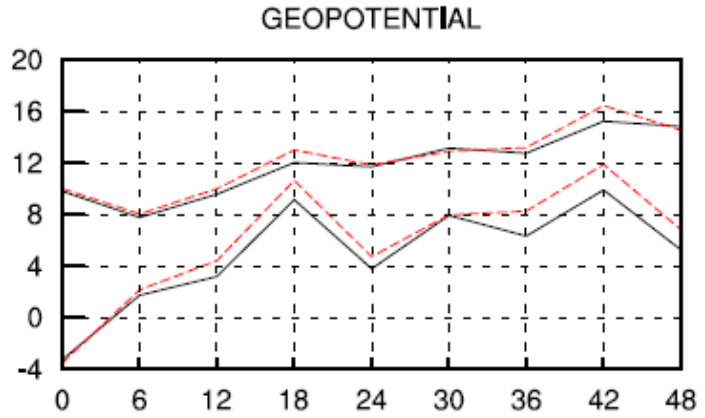
Some scores: summer

STRAPRO=solid black
AL/FR= red dashed

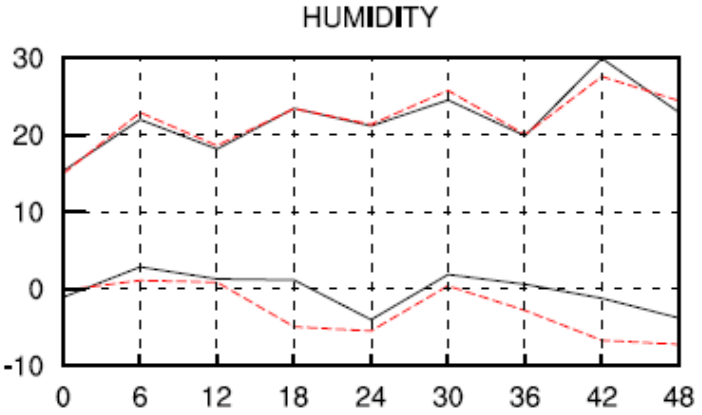
T 850 hPa



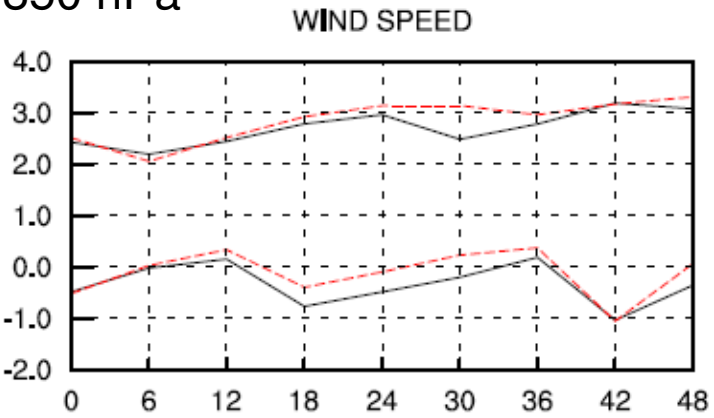
Z 500 hPa



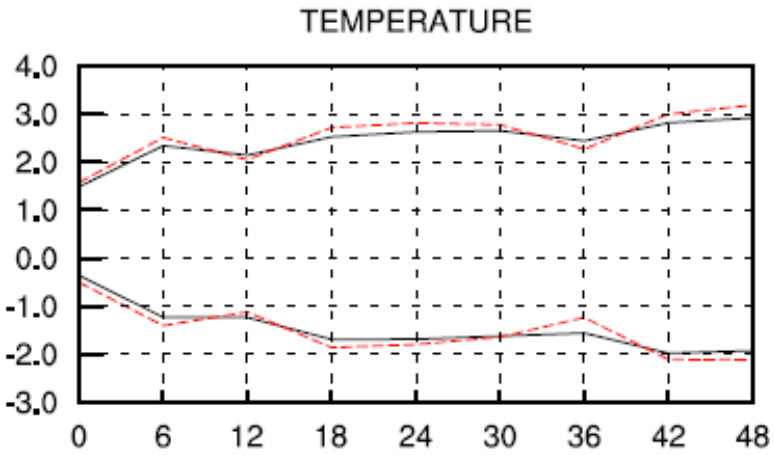
RH 700 hPa

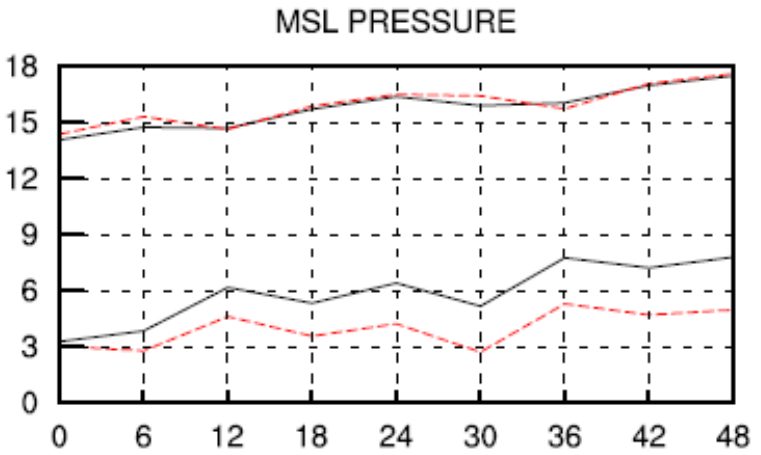


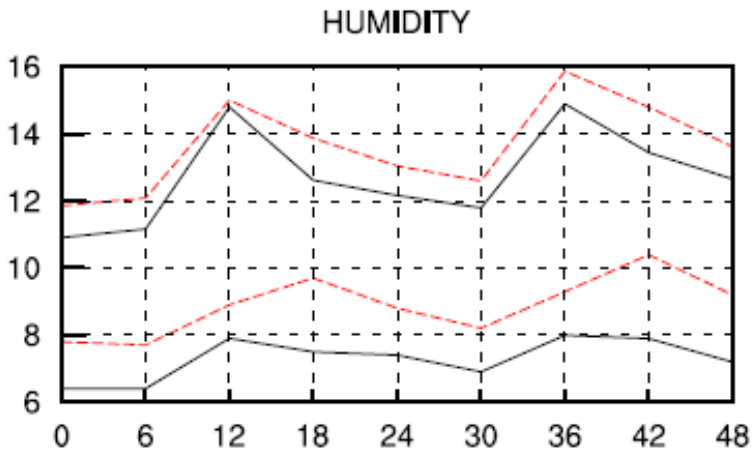
W 850 hPa

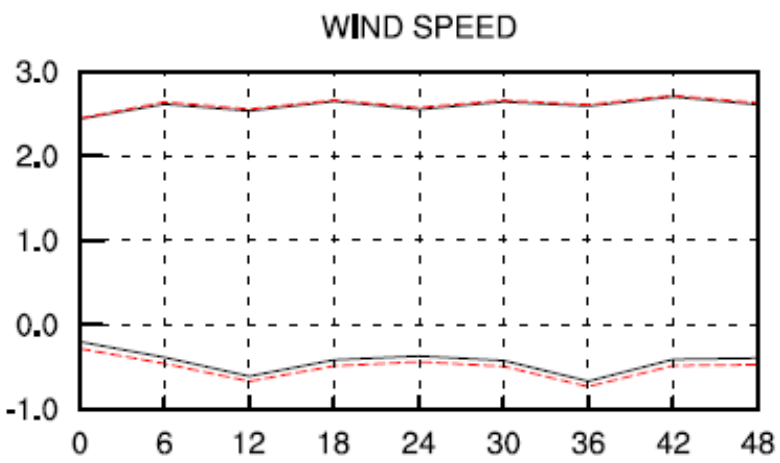


Some scores: winter (screen









Development targeted for the grey zone, care for efficiency, modularity in preparing further steps and good intermediate results => confidence

A0/AD	*Winter*					*Summer*				
RMS		**V**	**Phi**	**T**	**Hu**		**V**	**Phi**	**T**	**Hu**
	250	0	-	-	+	**250**	+	-	0	0
	500	-	-	-	-	**500**	+	+	+	+
	700	-	0	+	+	**700**	-	-	++	+
	850	+	-	++	+	**850**	+	-	+	+
	Surf	0	+	+	++	**Surf**	+	-	+	+
Bias		**V**	**Phi**	**T**	**Hu**		**V**	**Phi**	**T**	**Hu**
	250	-	-	0	+	**250**	-	+	-	0
	500	--	-	-	-	**500**	-	+	+	+
	700	-	+	+	--	**700**	-	+	++	++
	850	+	-	++	++	**850**	0	--	++	++
	Surf	+	--	+	++	**Surf**	-	--	+	+