ALARO Code Status

Martin Janoušek

People involved in phasing

- Martin Belluš
- Radmila Brožková
- Jure Cedilnik
- Martin Janoušek
- Oldřich Španiel
- Martina Tudor
- phasing support team of Météo-France

in alphabetic order!

ALARO code evolution

- cy28t3@chmi: “Prague physics”
  - early version of pre-ALARO physics (so called Prague physics) (cloudiness, diffusion, GWD)
- cy29t2@chmi:
  - **stratus**: ported local developments from cy28t3, further work on cloudiness
  - **mxl**: PBL developments
  - **alr00**: ALARO-0 code (early 3MT), back-phased APLPAR from cy31t1, GFL modset
- cy31t1@meteo.fr:
  - several phasing actions of technical infrastructure of ALARO-0 into ClearCase (calling tree, GFL modsets, etc.)
- cy32t1@meteo.fr:
  - phasing of all physics of ALARO-0 from cy29t2
  - further fixes and developments
  - an export version scheduled to April 07
- cy29t2@chmi:
  - **alr00_3mt**: back-phasing of pre-cy32t1 into cy29t2, introduced new and suppressed old routines with respect to cy29t2alr00

Current ALARO cycles

- cy29t2alr00_3mt
  - components:
    - the original cy29t2 export (M-F)
    - + alr00 library (CHMI) – ALARO-0-minus3MT, operational at CHMI
    - + _3mt branch (CHMI) – back-phased from a pre-CY32T1 version (snapshot from the end of February), missing some latest fixes
  - recommended for ALARO tests and validations (**both with or without 3MT**)
- cy32t1
  - cy32t0 + alaro
  - complete ALARO-0 code
  - currently a ClearCase branch, export due in April
  - the basis for further ALARO development

cy32t0_alaro modset (→cy32t1)

- AC_CLOUD_MODEL
- ACACON
- ACCDEV
- ACCOLL
- ACCVIMP
- ACCVIMP_V3
- ACCVIMPGY
- ACCVUD
- ACDIFUS
- ACEVMEL
- ACMODO
- ACNEBCOND
- ACNEBN
- ACNEBR
- ACNPART
- ACPLUIE
- ACPLUIS
- ACUPD
- ACUPM
- ACUPU
- APLMPHYS
- APLPAR
- CGR1
- CPCHET
- CPFHPFS
- CPG
- CPG_DIA
- CPOZO
- CPTEND
- CPTEND_NEW
- CPUTQY
- CUN1
- CVA1
- HL_APLPAR
- INITAPLPAR
- MF_PHYS
- NAMPHY
- NAMPHY0
- SU0PHY
- SUALLO
- SUDIM1
- SUHLOPTION
- SUPHY0
- YOMPHY
- YOMPHY0

Where I find ALARO in the code

- new prognostic/historic GFL fields
- physics/dynamics interface
- parameterization subroutines under APLPAR
- (setup)

New GFL fields

- activating existing (AROME or Lopez) fields: cloud water and ice, rain, snow, TKE (5)
- *3MT added: up-/down-draft velocity and mesh fraction, updraft entrainment rate, convective cloudiness (6)*
- all must be activated via namelist (NAMGFL), including their handling (advection, SLHD, …) via attributes:
  - YTKE, YL, YI, YR, YS, *YUOM*, *YUAL*, *YDOM*, *YDAL* are grid-point and advected (SLHD applied on YTKE, YL, YI, YR, YS only)
  - *YUEN*, *YUNEBH* are grid-point and **not** advected

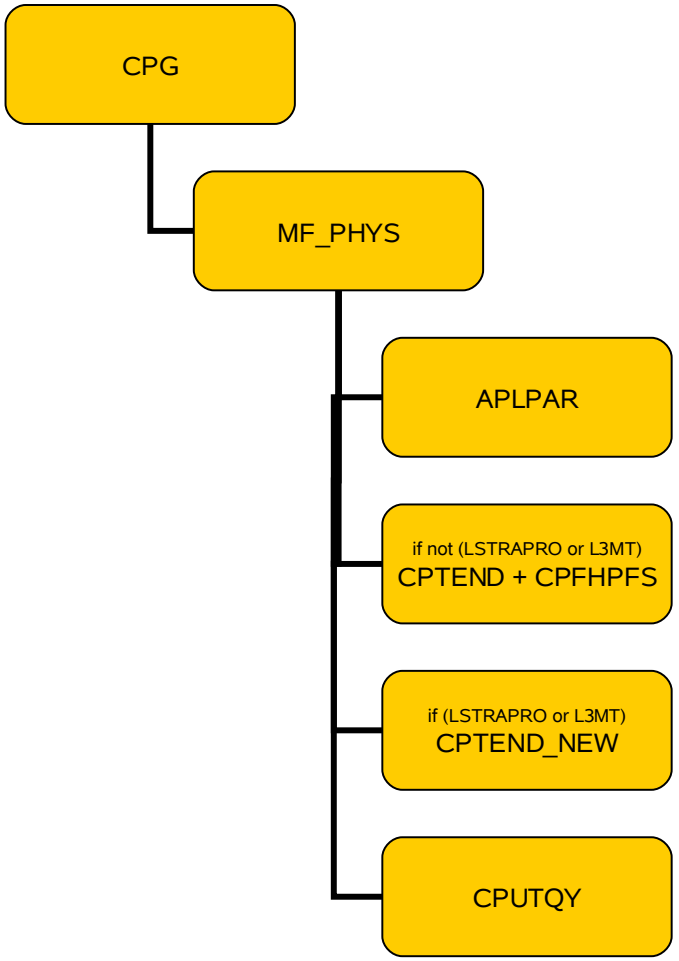
NAMGFL example

```
&NAMGFL
 YQ_NL%LGP=.F.                    YUOM_NL%LGP=.T.
 YQ_NL%LADV=.T.                   YUOM_NL%LADV=.T.
 YQ_NL%LSLHD=.T.                  YUOM_NL%NREQIN=0
 YQ_NL%LQM=.F.                    (UAL,DOM,DAL)

 YL_NL%LGP=.T.                    YUNEBH_NL%LGP=.T.
 YL_NL%LADV=.T.
 YL_NL%NREQIN=0/1                 YUEN_NL%LGP=.T.
 YL_NL%LSLHD=.T./.F.             /
 (I,R,S,TKE)
```

Physics/dynamics interface

- CPTEND_NEW: barycentric (temporary…) version of CPTEND (including δ_m=1)
- CPG, MFPHYS, CPUTQY (interfaces, new prognostic and historic fields, new fluxes, δ_m=1 modifs)



The realm of APLPAR

- new routines for prognostic microphysics and up/downdraft schemes
- local variables for q_v, q_l, q_i, q_r, q_s, T for cascade (ZQV, ZQL, ZQI, ZQR, ZQS, ZT)
- some cleanings of unused code

cy29t2alr00_3mt, cy32t1

LSTRAPRO=.TRUE.

- *setup and negvalcor of local q_v,q_l,q_i,q_r,q_s*
- ACTQSAT (saturation calc.)
- ACSOL (surface exchange params.)
- ACHMT, ACMIXLENZ, ACCOEFK
- *ACNEBCOND (critical humidity for condensation)*
- ACNEBN (cloudiness), *ACNPART*
- ACRANEB (radiation)
- ACDIFUS (vertical diffusion)
- *update of negvalcor fluxes*
- ACDRAG (GWD)
- *ACCDEV (resolved condensation and precipitation)*
  - *Xu-Randall scheme*
  - *APLMPHYS (microphysics)*
    - *ACACON (autoconversion)*
    - *ACOLL (collection)*
    - *ACEVMEL (evaporation and melting)*
- ACCVIMP (convection)

L3MT=.TRUE.

- *setup and negvalcor of local q_v,q_l,q_i,q_r,q_s*
- ACTQSAT (saturation calc.)
- ACSOL (surface exchange params.)
- ACHMT, ACMIXLENZ, ACCOEFK
- *ACNEBCOND (critical humidity for condensation)*
- ACNEBN (cloudiness), *ACNPART*
- ACRANEB (radiation)
- ACDIFUS (vertical diffusion)
- *update of T,q_l,q_i and negvalcor; update of negvalcor fluxes*
- ACDRAG (GWD)
- *ACCDEV (resolved condensation)*
  - Smith-Gerard scheme
- *update of T,q_l,q_i and negvalcor*
- *ACTQSAT*
- *ACCVUD (updraft)*
- *update of T,q_l,q_i and negvalcor*
- *ACUPU (internal state update after ud,…)*
- *APLMPHYS (microphysics)*
  - *ACACON (autoconversion)*
  - *ACOLL (collection)*
  - *ACEVMEL (evaporation and melting)*
- *update of T,q_v,q_l,q_i,q_r,q_s and negvalcor q_r,q_s*
- *ACUPM (internal state update after microphysics)*
- *ACMODO (downdraft)*
- *update of negvalcor fluxes*
- *ACUPD (internal state update after dd)*

cy29t2alr00 vs. cy29t2alr00_3mt

cy29t2alr00 *(LSTRAPRO=.T.)*

- *setup and negvalcor of local q_v,q_l,q_i,q_r,q_s*
- ACTQSAT (saturation calc.)
- ACSOL (surface exchange params.)
- ACHMT, ACMIXLENZ, ACCOEFK
- ACNEBN (cloudiness)
- ACRANEB (radiation)
- ACDIFUS (vertical diffusion)
- *update of negvalcor fluxes*
- ACDRAG (GWD)
- *ACPLUIE_PROG (resolved condensation and precipitation)*
  - *Xu-Randall scheme*
  - *APLMPHYS (microphysics)*
- ACCVIMP (convection)

cy29t2alr00_3mt *(LSTRAPRO=.T.)*

- *setup and negvalcor of local q_v,q_l,q_i,q_r,q_s*
- ACTQSAT (saturation calc.)
- ACSOL (surface exchange params.)
- ACHMT, ACMIXLENZ, ACCOEFK
- *ACNEBCOND (critical humidity for condensation)*
- ACNEBN (cloudiness)
- ACNPART
- ACRANEB (radiation)
- ACDIFUS (vertical diffusion)
- *update of negvalcor fluxes*
- ACDRAG (GWD)
- *ACCDEV (resolved condensation and precipitation)*
  - *Xu-Randall scheme*
  - *APLMPHYS (microphysics)*
- ACCVIMP (convection)

NAMPHY/NAMPHY0 issues

- namelist changes from cy29t2alr00 to cy29t2alr00_3mt:
  - move keys from YOMCLOUD to NAMPHY and from YOMCLOUD0 to NAMPHY0
  - remove LSRCON and LSRCONT
  - for LSTRAPRO=.T. add LXRCDEV=.T.
  - for validation tests with pre-ALARO runs add LNEWSTAT=.F.

Hints for ported code validation

- Check GP norms of input parameters and fluxes at NSTEP=0
  - beware, norms of up/downdraft parameters norms at NSTEP=0 do not correspond to the initial values (PUDOM, PUDAL, PDDOM, PDDAL are already t'+Δt on exit from APLPAR)
  - beware, PTKE=max(PTKE,ε_{PTKE})

- Sources of norms diffs between cy29t2alr00 and cy29t2alr00_3mt
  - moving of part of APLMPHYS code to ACACON, ACCOLL and ACEVMEL
  - ACNEBN requires QXRR=0.25 and QXRDEL=0.5
  - ACDIFUS (generalization of NUPTKE)
  - reorganization of CPTEND_NEW
  - LNEWSTAT=.T. by default

- Sources of norms diffs between cy29t2alr00_3mt and cy32t1
  - changes in geography and setup (standard atmosphere etc.)
  - ZVETAH/ZVETAF calculation in APLPAR

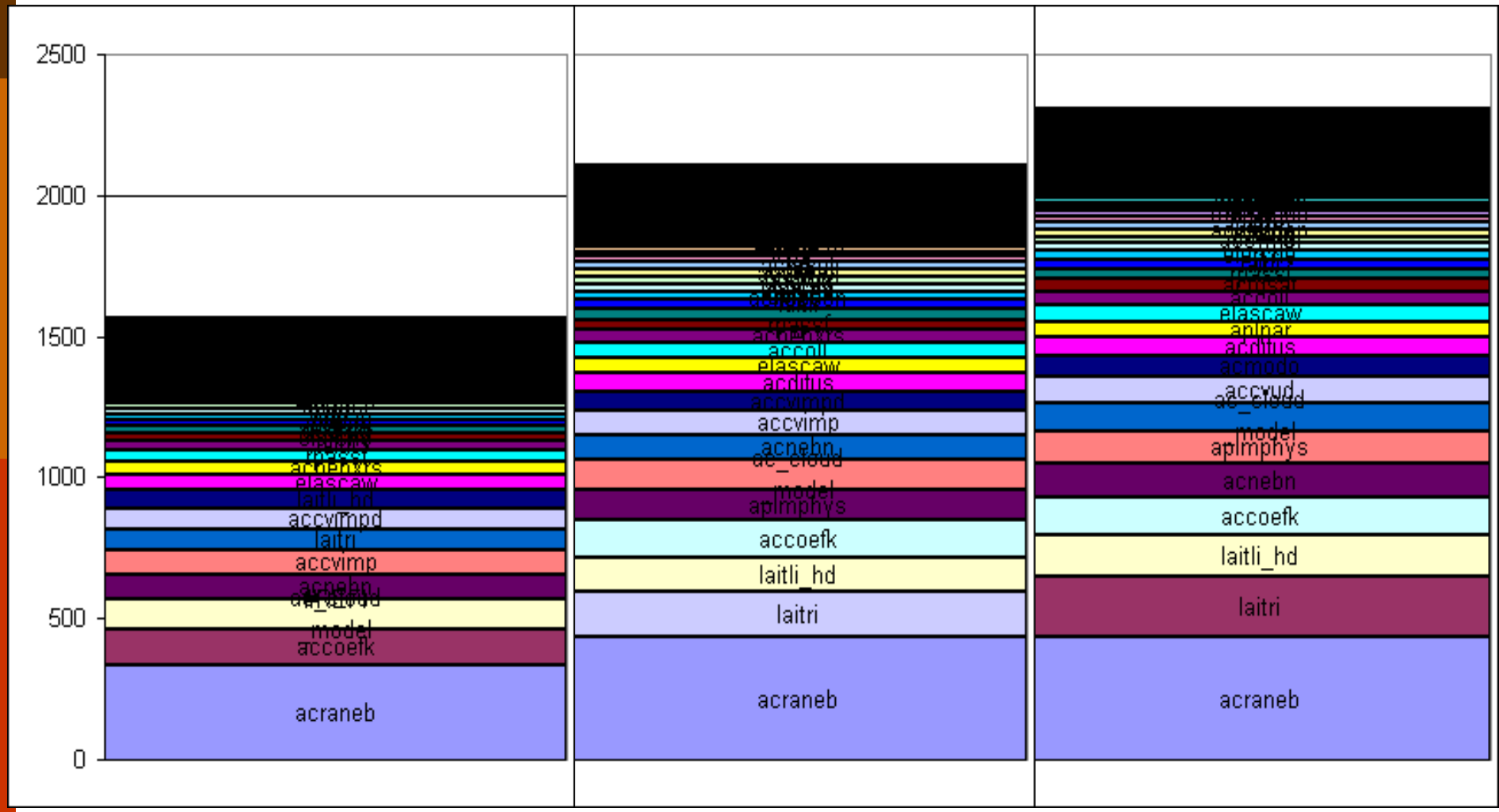
File size issue

- all new GFL fields are grid-point → poor compression → large size
- Yxxx_NL%LREQOUT=.TRUE. consequence:
  - 50.33MB+**7.94MB** (+**16%**)
- consider on-line fullpos to store only interesting fields (still to be validated and maybe debugged)

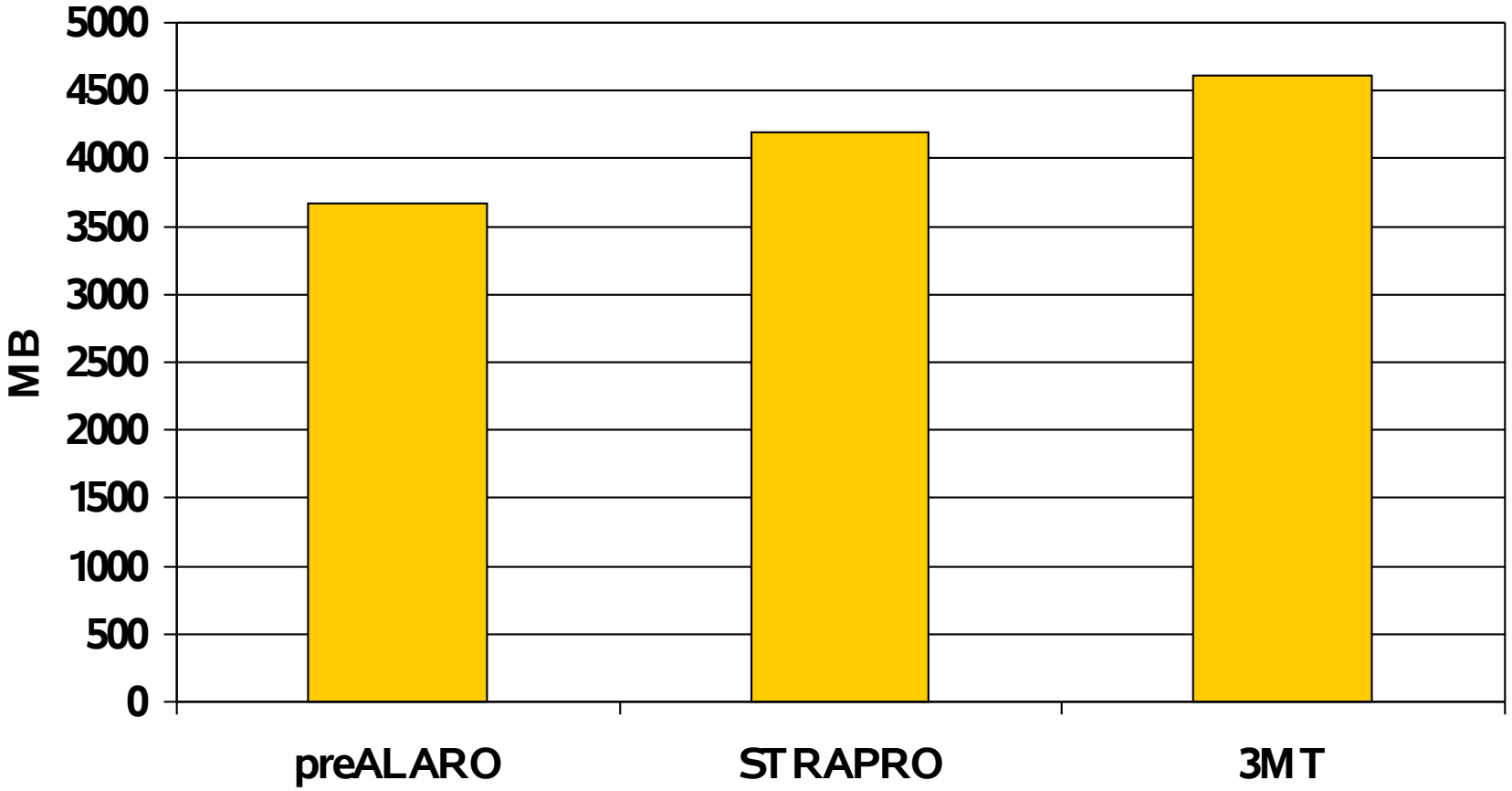
„Benchmark“ results

- pre-cy32t1 on NEC SX-6 @CHMI
- 24h forecast on LACE domain (9km mesh size, 43 levels)

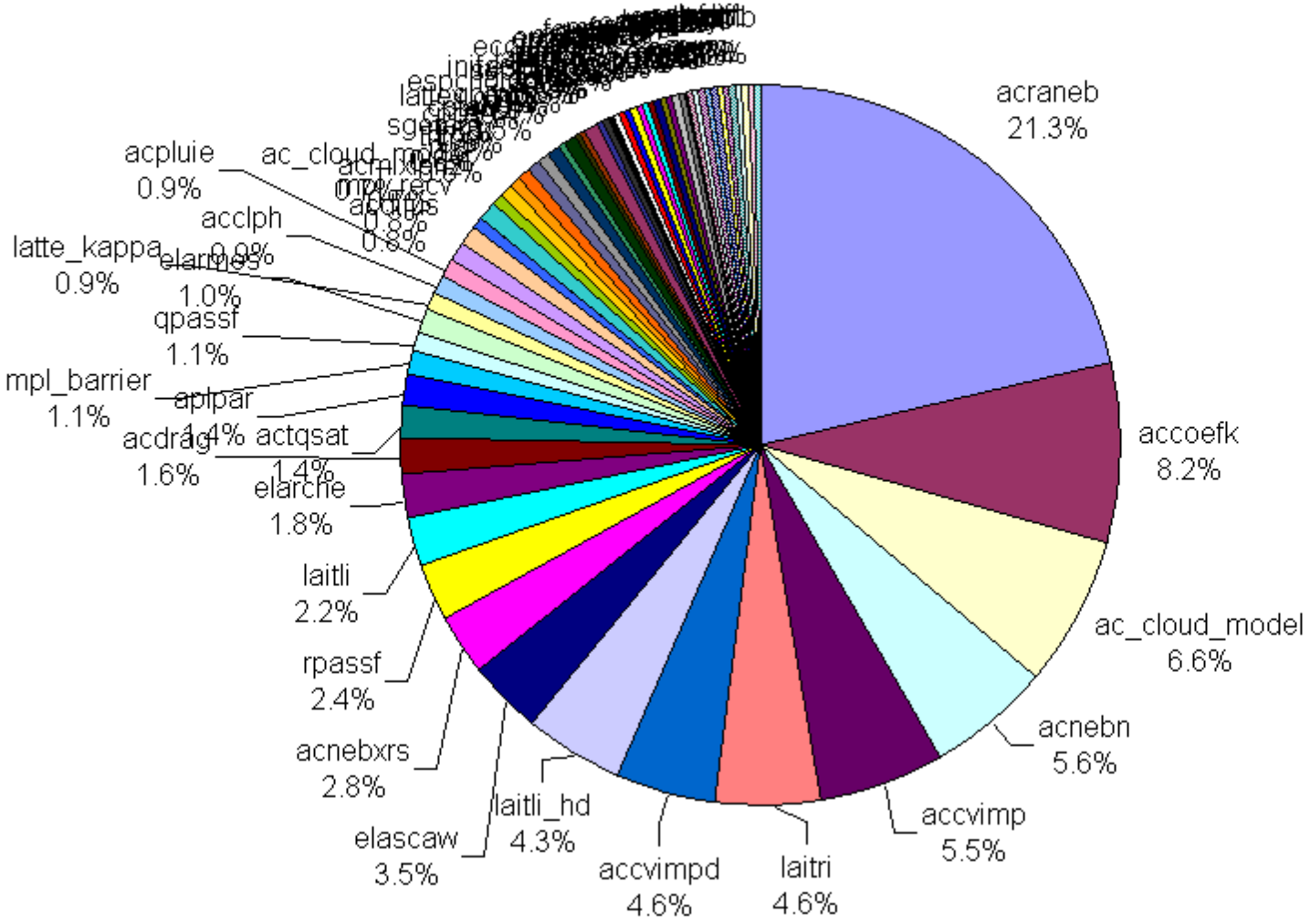
preALARO - STRAPRO - 3MT



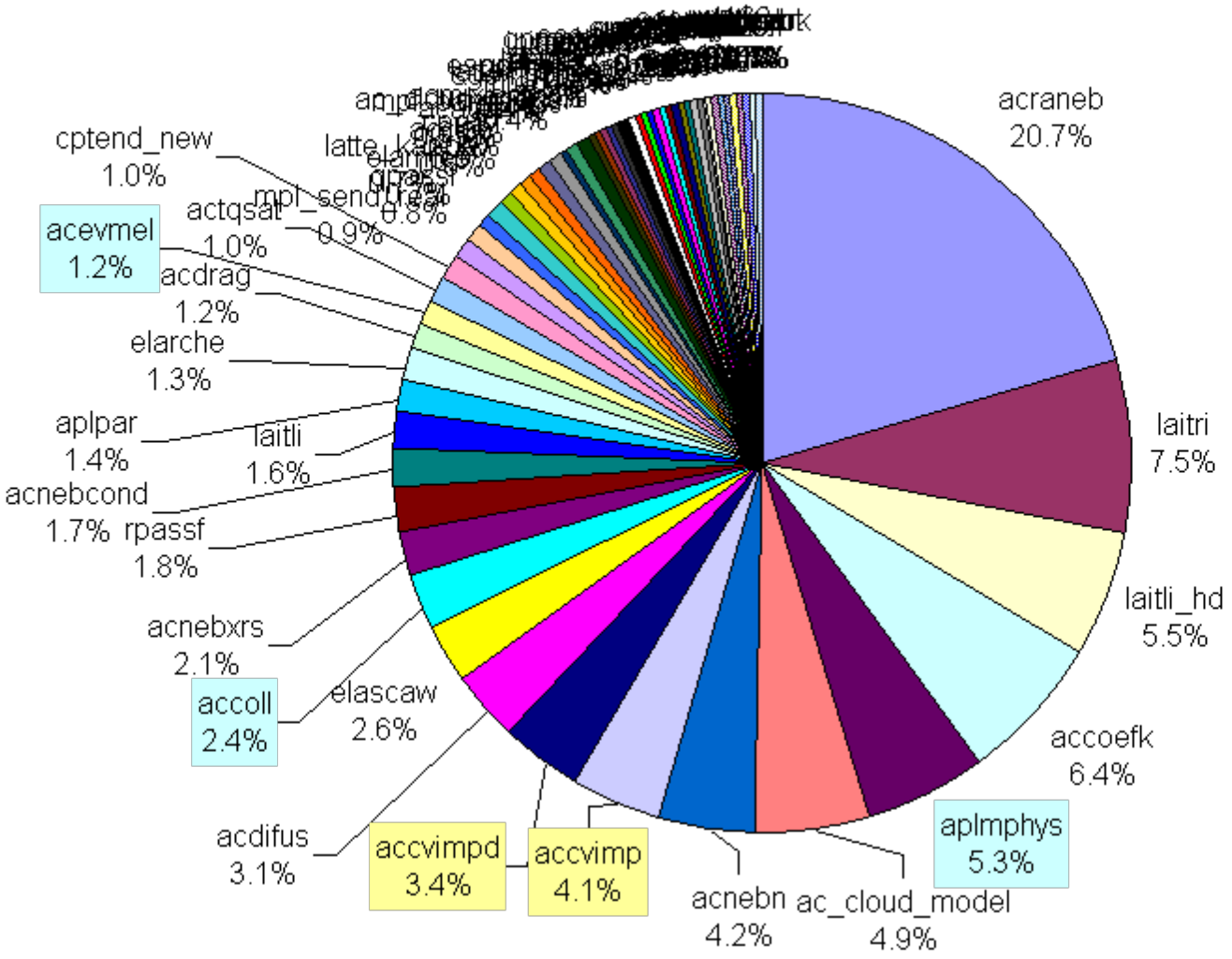
Memory cost


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

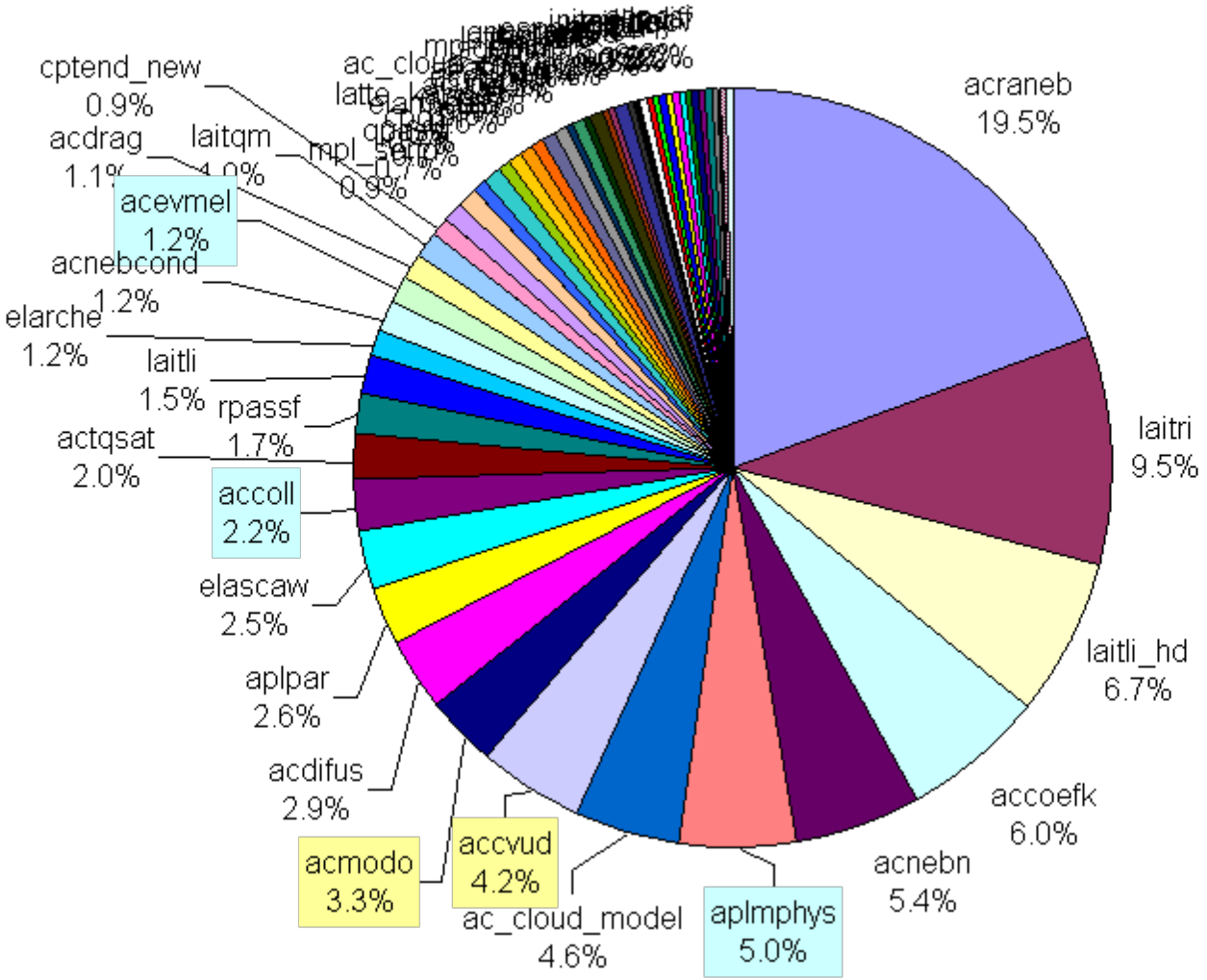
Pre-ALARO profile (cy32t1)



LSTRAPRO profile (cy32t1)

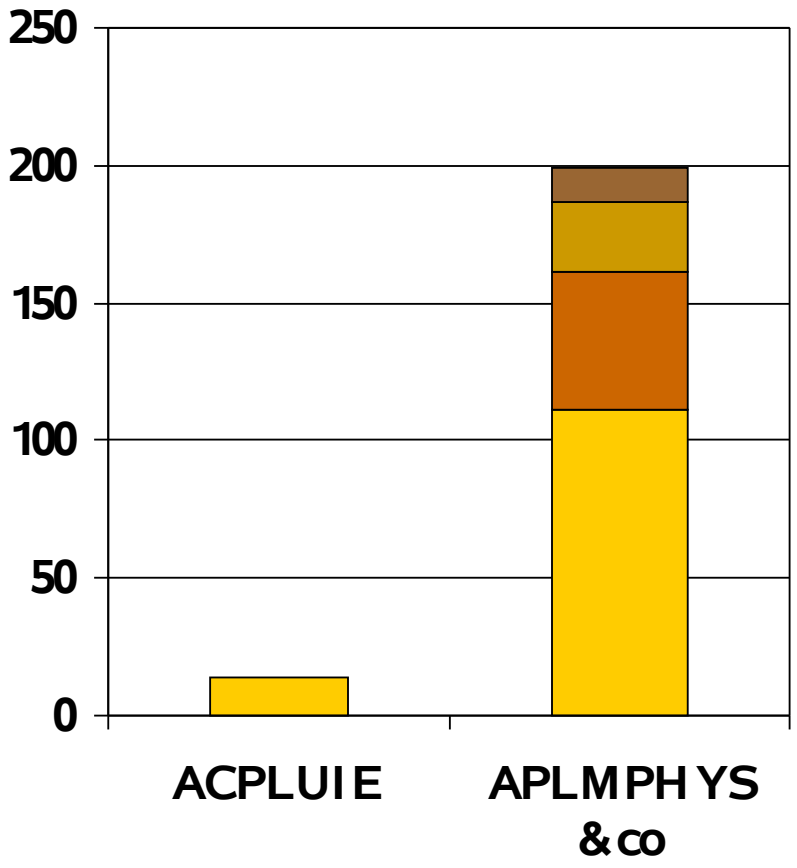


3MT profile (cy32t1)



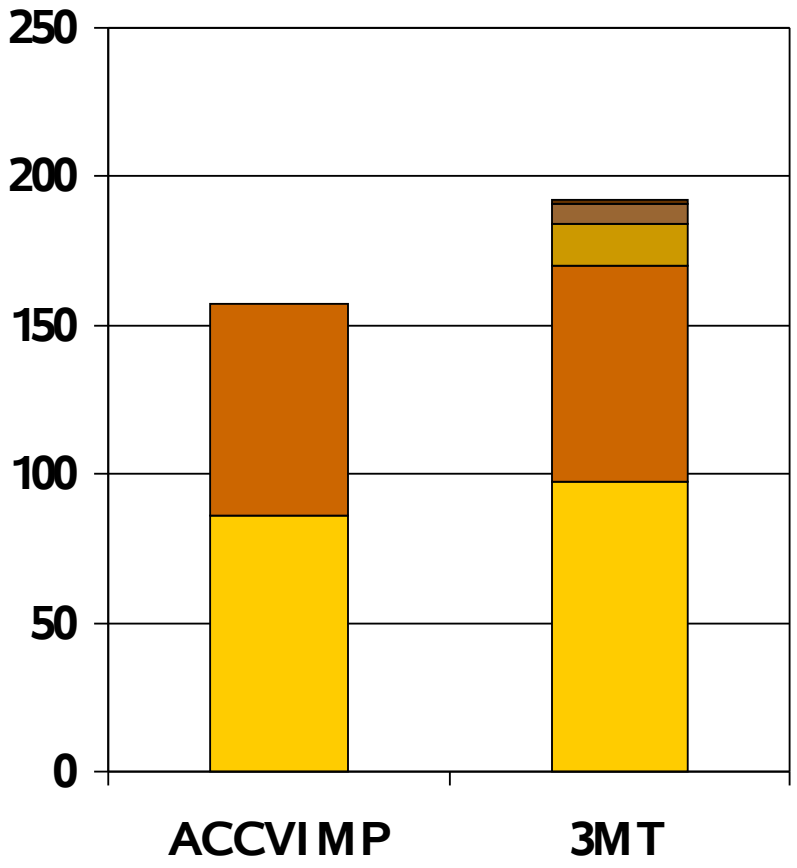
Microphysics cost

- ACPLUIE: 13.5s
- APLMPHYS+ACACON+ACCOLL+ACEVMEL: 199 s



ACVIMP vs 3MT convection costs

- ACCVIMP+ACCVIMPD: 157 s
- ACCVUD+ACMODO+ ACUPU+ACUPM+ ACUPD: 188 s



Further code evolution and maintenance

- Once CY32T1 export is released it should be installed, especially for the further code development
- Till then there may be one more common patch of CY29t2alr00_3mt (latest 3MT modifications, small fixes)
- Phasing action towards CY32T2 has started – open chance for bugfixes?