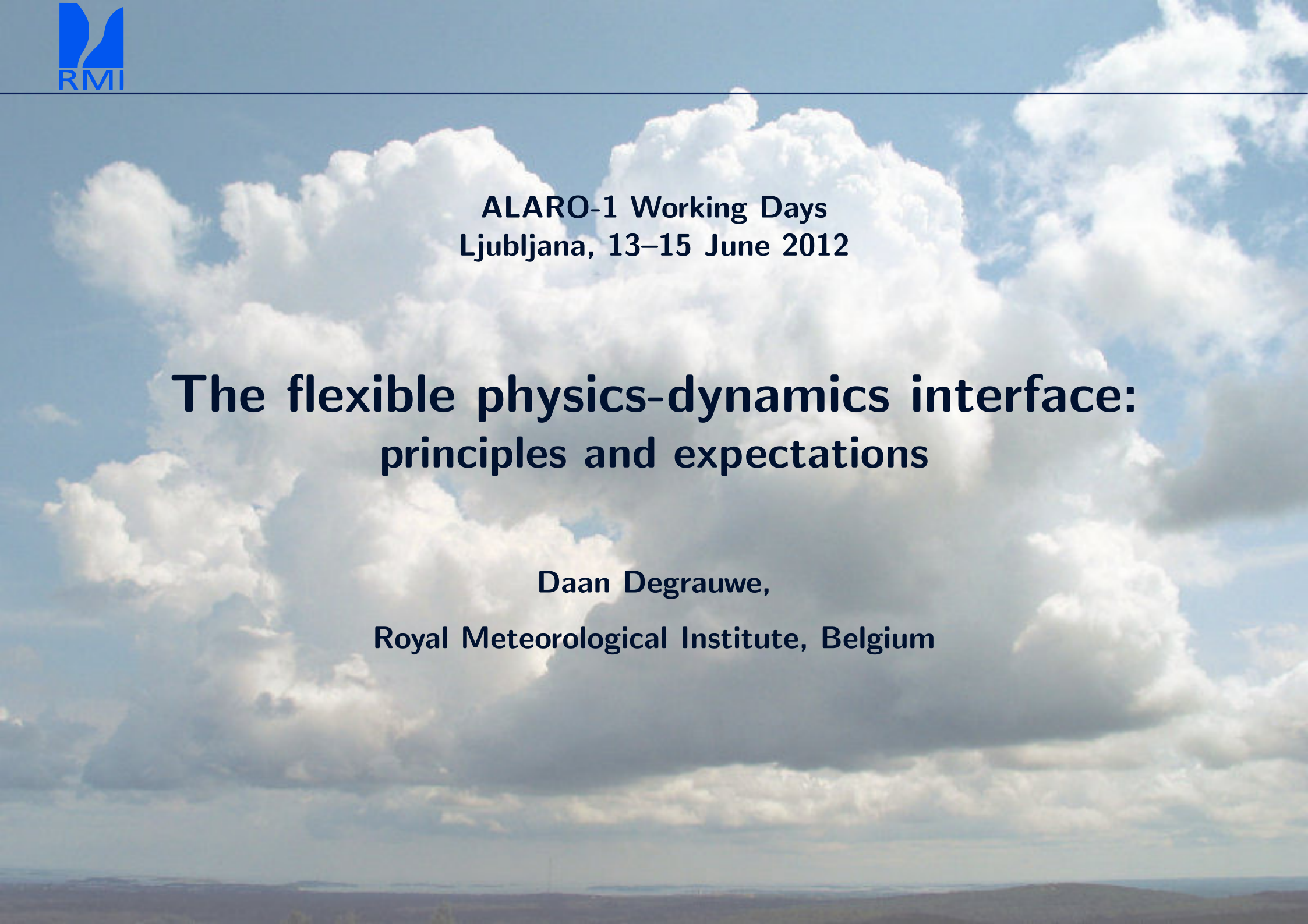

ALARO-1 Working Days
Ljubljana, 13–15 June 2012

The flexible physics-dynamics interface:
principles and expectations

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Context

- The physics-dynamics interface handles the contributions of physics parameterizations to the prognostic variable tendencies:
  - momentum
  - specific humidities
  - temperature
  - ...

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Context

- The physics-dynamics interface handles the contributions of physics parameterizations to the prognostic variable tendencies:
  - momentum
  - specific humidities
  - temperature
  - ...
- Currently, ALARO and AROME use different interfaces (`aplpar/cptend_new/cputqy` and `apl_arome/cputqy_arome`)
- One of the convergence actions is to create a joint interface:
  - consistent treatment of different parameterizations
  - (in principle) parameterizations become exchangeable
  - at least a fair comparison is possible
  - more flexibility w.r.t. future developments
  - integration with diagnostics
- Especially relevant in view of the overhaul of `aplpar` and `apl_arome`

Principles

The interface is based on a set of rules

- barycentric system: motions w.r.t. mass-center
- latent heat calculations are done by the interface
- local processes are described by fluxes and/or *local* tendencies
- GFL-based: consistency between switches and GFL attributes!

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Generic equations for any number of hydrometeors.

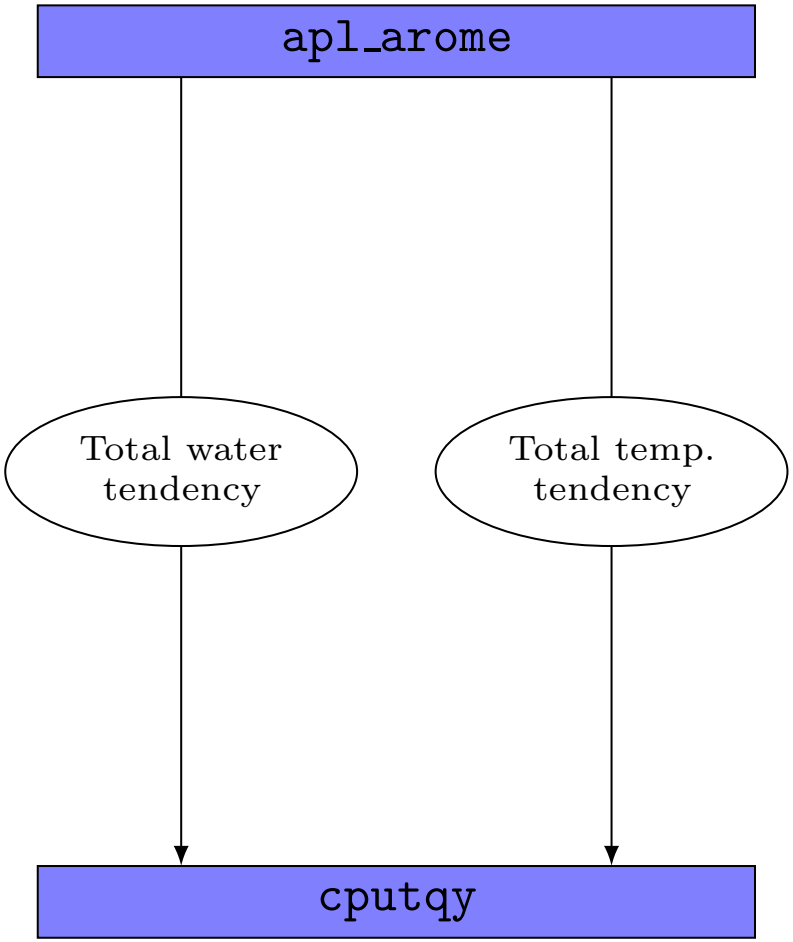
Implementation

- Organization with derived data types (no global variables, so OpenMP-safe)
- Development of `cptend_flex`
- (Temporary) conversion routines `aplpar2intflex` and `apl_arome2intflex`

  Note that AROME returns
  - total species tendencies (precipitation+phase changes)
  - total temperature tendency (including latent heat effects and heat diffusion)

  So some reverse calculations are required:
  - determine local species tendencies by subtracting precipitation from total
  - determine a diffusive heat flux *such that* the final temperature update remains the same.

This looks crazy!



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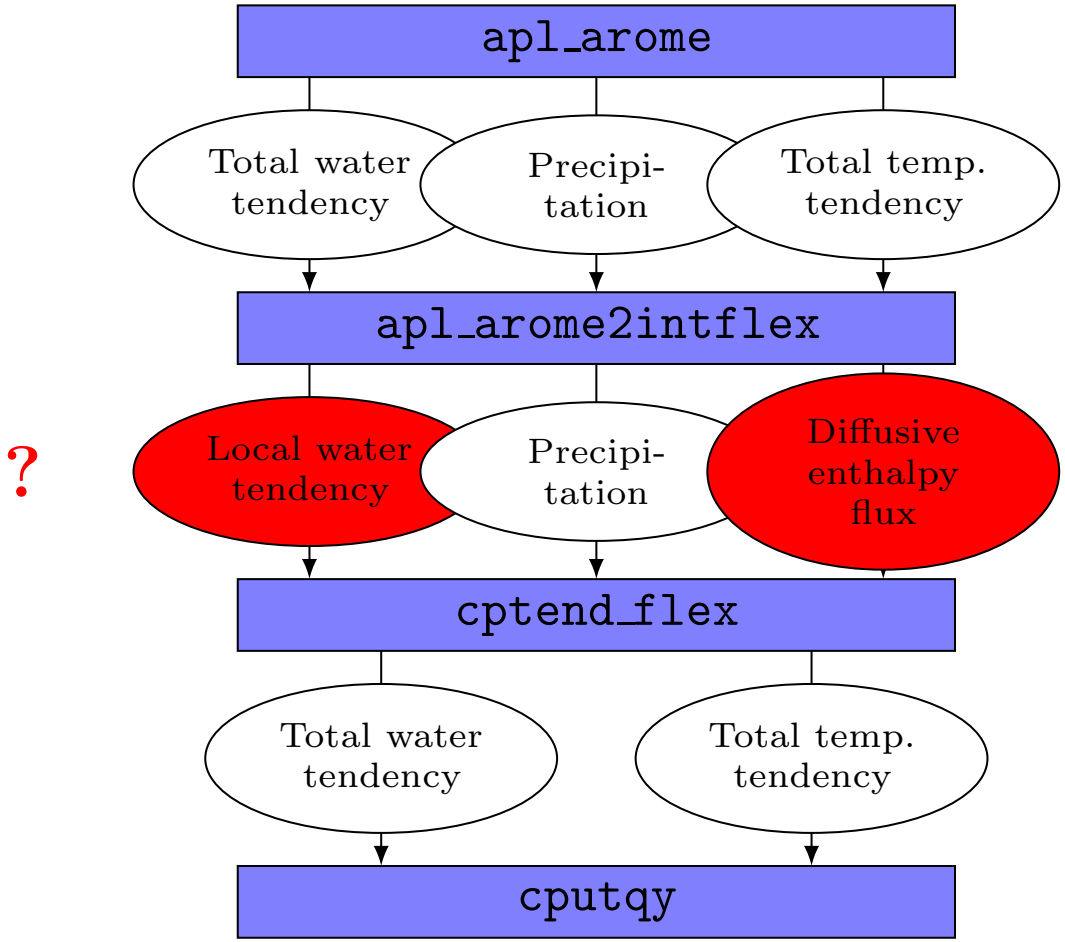

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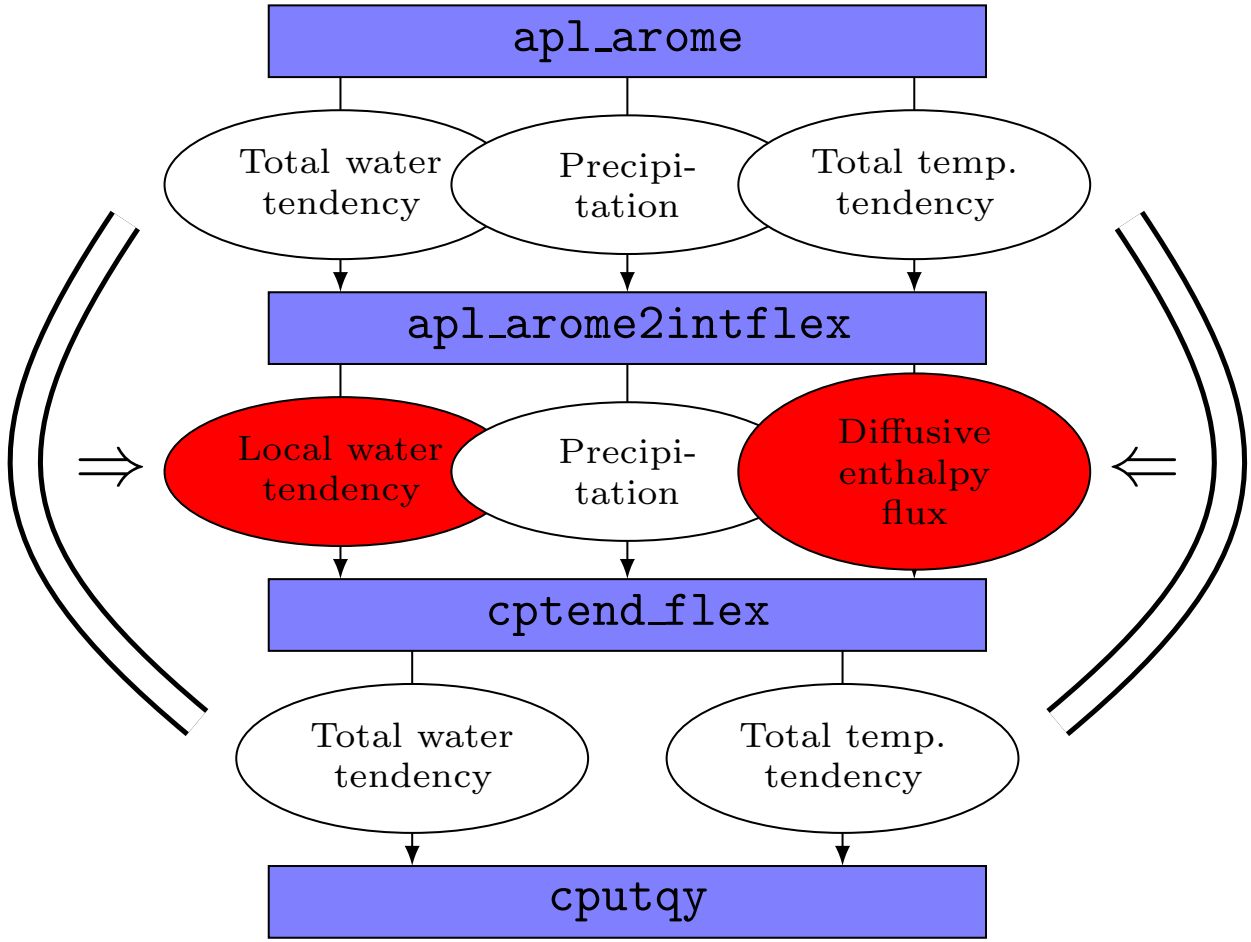

Missing terms are calculated such that the final result isn't affected (even if you pass garbage. . .)

AROME breakdown

This changes if we consider the subprocesses of AROME separately!

- Adjustment
  local $\Rightarrow$ no reverse calculations
- Radiation
  local
- Surface
- Shallow convection
  enthalpy diffusion, but no phase transitions
- Turbulence
  enthalpy diffusion, but no phase transitions
- Microphysics
  water transport

This becomes interesting, both *technically* (GIGO: garbage in, garbage out) and *scientifically* (final result may change)

AROME breakdown

Preliminar testing revealed following sources for scientific differences:

- inconsistent choice of which c_p is used to calculate temperature tendency (radiation, adjustment, microphysics)
- vertical divergence in z-coordinates (precipitation)
- heating/cooling by precipitation is missing
- sum of temperature tendencies $\neq$ sum of enthalpy fluxes (stability impact)

Anyhow, the use of the common interface ensures consistency!

More detailed testing, in collaboration with AROME staff, is required to check the importance of these differences.

Conclusions

- The envisaged interface is sound and flexible
- It should enter the common code soon
- Invitation to take advantage of its features
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Thank you !