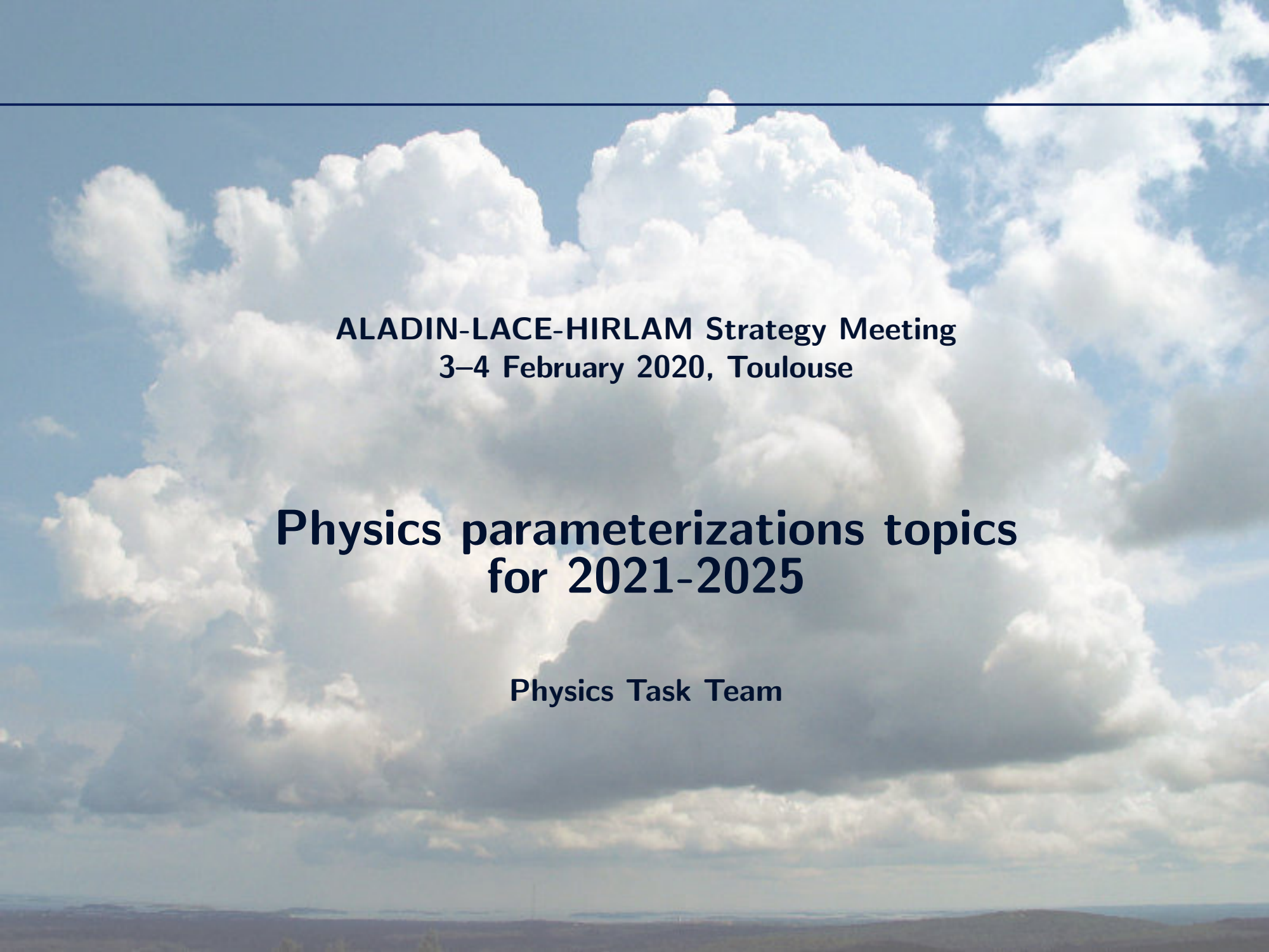

ALADIN-LACE-HIRLAM Strategy Meeting
3–4 February 2020, Toulouse

Physics parameterizations topics for 2021-2025

Physics Task Team

Outline

- Organization in 3 CMC's
- Scientific topics
  - increasing resolution
  - complex phenomena
  - machine learning
  - improving existing parameterizations
- Technical topics
- Concluding remarks

Organization in 3 CMC's

- Physics parameterizations are organized along 3 Canonical Model Configurations:
  - AROME Météo-France
  - ALARO
  - HARMONIE-AROME
- This is commonly appreciated, as it offers freedom for research and operations.
- However, having 3 CMC's also poses a danger for divergence.

  Efforts could be made to further increase convergence at the level of individual parameterizations, i.e. make parameterizations exchangeable between CMC's.

  Note: steps were already taken in this direction, e.g. ACRANEB2 under `apl_arome`, SURFEX in ALARO.

Scientific topics: increasing resolution

- Naively, one could think that increasing resolutions make the parameterization trade easier. However,
  - some phenomena will never be entirely resolved
  - gray zones where phenomena are partially resolved
- Validity range of parameterizations is not always well understood. Before diving into laborious developments, this question should be answered.

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- Validity range of parameterizations is not always well understood. Before diving into laborious developments, this question should be answered.
- Turbulence and shallow convection: gray zone starting at 1-2 km (depending on stability)

  Need for parameterizations that account for partial resolving
- 3D turbulence effects:
  - local effects; seems feasible in current code organization
  - not sure if more urgent than e.g. higher-order turbulence schemes.

Scientific topics: increasing resolution

- 3D radiative effects: starting at 2-5 km resolution
  - Running existing radiation schemes at higher resolutions may not lead to more accurate results

    Run radiation on a coarser grid?
  - True 3D modeling is very challenging because of instantaneous remote effect of radiation
  - Parameterization of 3D effects may be intermediate solution

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  - True 3D modeling is very challenging because of instantaneous remote effect of radiation
  - Parameterization of 3D effects may be intermediate solution
  - Note: accuracy of radiation mainly depends on quality of the input, most notably cloudiness, aerosols, ozone. Improvements on these will probably improve radiative fluxes more than developments on the radiation schemes themselves.

Scientific topics: complex phenomena

- two-moment microphysics schemes (LIMA)
- aerosols
  - interaction with radiation and microphysics (LIMA)
  - use of near-real-time data instead of (outdated) climatology
- parameterization of effect of wind and solar farms
- further development of high-order turbulence schemes

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- Note: work is already ongoing on these topics, but cooperation should be increased, e.g. by dedicated topical meetings.

Scientific topics: machine learning

- Confidence in such techniques to replace physics parameterizations is very limited:
  - problem is too highly dimensional
  - insufficient data to train reliably
  - physical interpretation of results is impossible
- . . . nevertheless, know-how should be built up and developments elsewhere should be followed
- also keep in mind the computational side

Scientific topics: improving existing schemes

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- Improving these schemes and tuning parameters should be a continuing effort
- High-impact weather situations should be the main priority

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- Improving these schemes and tuning parameters should be a continuing effort
- High-impact weather situations should be the main priority
- Is this something to organize at consortium level?

Technical topics

- Code complexity is not considered a big problem at this point (at least not to physics experts. . .)
- MUSC is widely regarded as a valuable tool for development and validation, but its maintenance (of code and input data) is lacking. Support for the 3 CMC's is absolutely necessary
- Hesitation regarding GPU's; more immediate gain is expected from single precision
- Fully-fledged documentation for CMC's is not considered realistic; exchanging commented reference namelists would make a start.
  A common central point to share and exchange documentation is desirable.

Concluding remarks

- Many of scientific topics are already ongoing: LIMA, CAMS, ...
  - Important to keep in mind exchangeability between CMC's
  - Need for better communication and collaboration platforms
- *What would the physics look like in 5 years from now*: probably much the same as today
- Major developments lie ahead, but face severe practical, technical and scientific challenges:
  - maintaining relation with other codes (IFS, ARPEGE, MESO-NH)
  - code restructuring for true 3D physics
  - no guarantee that such developments would lead to more accurate forecasts

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  - maintaining relation with other codes (IFS, ARPEGE, MESO-NH)
  - code restructuring for true 3D physics
  - no guarantee that such developments would lead to more accurate forecasts
- But isn't the role of the LAM community to be on the scientific frontier?

Thank you