Phasing of convection diagnostics postprocessing

LACE stay report

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1. Introduction

The intention of this stay was to obtain an overview and try to consolidate all existing code parts related to specific (e.g. LACE - related to ZAMG and ARSO) convection diagnostics existing for cycles 40, 43 and 46.

The larger part of the code contributions in question were written by Christoph Wittmann and myself for cycles 38t1 and before. They included lightning diagnostics computation and some parameters associated to severe thunderstorm outbreak potential linked to vertical wind and temperature distributions (vertical temperature gradient, helicity, deep layer shear, low level shear, storm motion diagnostics and mixed layer CAPE computation...).

Two years ago, most of this code was phased to 40t1 and with help from Polish colleagues (Bogdan Bochenek, Piotr Sekula) part of the code also to cycle 43t1. However, due to various reasons they never entered a common cycle.

The particular goal of this stay was to produce a contribution related to convection diagnostics and prepare in order to have it ready for autumn phasing for cycle 46t1.

2. Description of code modifications

First, two other separate and independent packs were investigated (independent to contributions related to this report): an addition of biometeorological parameters (e.g. mean radiant temperature) by CZ team and a pack from Ingrid Etcheviers (MF) computing visibility parameter within physics. Both were on the basis of cy43t1, the algorithm by CZ team was independent on choice of physics while the visibility is coded in such a manner that AROME or ARPÈGE microphysics is required. The aim of this was to understand how a comparable task (e.g. introducing new diagnostics) was done on other examples. It was also speculated on what would need to be done on the ALARO part to accommodate the visibility code within it.

Finally, coming to the original pack, the list of concerned routines in the basic set is rather short:

```
yomafn
yomcape
yomfpc
sufpc
```

`suafn1,`
`suafn2,`
`suafn3`
`phymfpos`
`endpos`
`fpcica`

and some new routines:

`fpdiagflash` – to compute diagnostics of lightning
`fpsrh` – storm relative helicity
`fpshear` – low and deep layer shear
`fpstrmm` – storm motion diagnostics

and could be further enlarged in case of implementing cumulative flux for lightning diagnostics, as opposed to only instantaneous, which is coded now (the cumulative flux for lightning diagnostics was coded in cy40t1 but only when using AROME microphysics).

During the process of moving from cy43 to cy46 code, the following generalities had to be followed when using more complicated Fortran structures

```
TFP_* => YDAFN%TFP%*,
```

for example for vertical temperature gradient:

```
TFP_VTG => YDAFN%TFP%VTG
```

and the same for `FLASH, STRMMU, STRMMV, DLS, LLS, SRH`

This means that those structures are defined in module `YOMAFN` not anymore as `TFP_FLASH`, but rather only as `FLASH` within the corresponding `YDAFN%TFP` structure. Some other similar structures were introduced. They present changes merely from a notation point of view, not functional. But it still makes it a rather tedious job.

3. Conclusion

Finally, it wasn't possible to efficiently compile the code (the cy46t1 version) and run some tests in Prague before the end of the stay (issues related to local code management and

gmkpack). But it was possible to have a working branch based on cy43t1 and to prepare more or less all the code for cy46t1 with the intention of further running and debugging it in Toulouse.

4. Appendix: Follow up at home, after the stay

Unfortunately the phasing process took longer than anticipated and the contribution hasn't successfully validated through Mitraillette tests in Toulouse. Later the contribution was split in two parts (only instantaneous lightning diagnostics and separately the other parameters) and even though they have both passed through Mitraillette testing, the results were not satisfactory in physically sane way.

For example the computation of vertical temperature gradient only works for model grid, not on pressure levels or other levels or on a different geometry of a target domain.

The problem was that it wasn't possible to produce tests with cy46t1 in Ljubljana as the code hasn't successfully compiled with gmkpack (it just froze after the odb precompilers generation).

The result as of March 2019 is that there exist the following branches of the code:

- one based on 43t1 that can be used on top of export version bugfix 10 of cy43t1 which contains the instantaneous lightning diagnostics,
- a separate branch with accumulated lightning diagnostics for cy43t1 (originally Christoph's work),
- a branch (actually two of them) similar to the first line, but for cy46t1 which has been successfully validated through Mitraillette in Toulouse, but its functionality is questionable and needs to be looked into further. But I haven't had the time to do it in the recent months yet.