Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2017-91-RC3, 2017

Geoscientific Model Development Discussions
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EGU

Interactive comment on "The seamless and multi-model coupling between atmosphere, land, hydrology, ocean, waves and sea-ice models based on SURFEX surface model using OASIS3-MCT" *by* Aurore Voldoire et al.

Anonymous Referee #3

Received and published: 24 June 2017

General comments:

The manuscript describes the new coupling interface integrated in the SURFEX surface model. This interface allows SURFEX to communicate through OASIS3-MCT coupler with other models with similar coupling interfaces. After the technical description of the interface, different applications and illustrations are presented. The main criticism concerning the manuscript in my opinion is the irregularity of the global layout and content quality: some sentences are too long or not clear, some acronyms are not detailed and some figures are incomplete or incorrectly referenced. The manuscript gives the feeling

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Discussion paper

that sections have been written by different authors and consequently lacks of consistency and homogeneity. A global and careful correction of the manuscript and the figures must be done by the authors to improve the manuscript reading, comprehension and consistency before publication. The main technical caveat is the lack of discussion about the computational performance of the new coupling interface (OASIS3-MCT in SURFEX) compared to the old one (OASIS3 in the atmospheric model) or to alternative coupling strategies such as the integration of all components in one executable. This could make the manuscript more useful for other modelling groups using different coupling strategies. Some models described in the manuscript allow to do grid-nesting (NEMO with AGRIF, MESO-NH for example). Is the SURFEX coupling interface compatible with such type of coupled model configurations? This possibility or limitation should be discussed in the text. A lot of different models are cited in the text, especially for the atmosphere and the hydrology. A supplementary table summarizing this list by category could facilitate the manuscript reading.

Specific comments:

Introduction: The introduction is not well organized: examples should be given just after describing the corresponding coupling strategy (i.e. add the COAWST model example just after the description of the “one executable” approach). A sketch or a table summarizing and comparing the 3 possible coupling strategies (one executable / multiple executable / integrated application) could help to better understand the strategy detailed in the manuscript.

Section 2: A separate paragraph for the description of OASIS3-MCT coupler is missing in the manuscript. The paragraph in introduction section from l.95 to l.102 could be moved in Section 2 and merged with l.128 to l.134 to create a new subsection describing OASIS3-MCT. A comparison of performances between the old implementation of OASIS3-MCT in ARPEGE-climate and the new version in SURFEX interface could give valuable information and improve the manuscript. A comparison of performances between OASIS3 and OASIS3-MCT version, which doesn’t need to use dedicated pro-

cesses contrary to OASIS3, could also give useful information for the modellers reading the manuscript. It is not clear if SURFEX can be run in coupled mode with an atmospheric model through OASIS3-MCT at different resolutions or not (l.159). If SURFEX need always to be compiled and integrated with the atmospheric model executable at the same resolution, this limitation must be clearly stated somewhere in the manuscript. Regarding the ICE model, (l. 184-l.195) it is not clear if it is coupled as an independent model to SURFEX or if the ICE model is already included in the OCEAN model and then is not coupled directly to SURFEX (such as LIM3 ice model in NEMO for example). This must be clearly stated in the text.

Section 3: A table summarizing the different coupled configurations based on SURFEX, their components and the corresponding versions could facilitate the Section 3 comprehension. The section 3.1 describing how the different components of the ESM are tested and assembled is very interesting but incomplete. A more detailed description of the validation process of the different components before coupling them would greatly improve the manuscript technical interest. For example, a paragraph describing NEMO-SURFEX evaluation before their coupling with the other components. The analysis of the diurnal cycle in CNRM-RCSM6 is interesting. Did you perform any analysis concerning the surface heat budget to understand why the diurnal cycle is overestimated in summer and underestimated in winter? Is it related to turbulent fluxes / radiative fluxes / etc. . . ? The MESONH-SYMPHONIE section is a bit redundant with the AROME-NEMO section because it uses the same dataset from Hymex IOP. Consequently, dataset description and the low-resolution simulations which is not presented in the manuscript can be removed to make this section easier to read. Concerning the Figure 7, a third column presenting the differences between CPL and UNCPL would facilitate the comparison discussed in the text. Concerning the MESONH-NEMO section, the illustration of the coupling effect on the tropical cyclone structure is not clear (and the units are missing). A better illustration would be to present the time evolution of the cyclone intensity or the water content averaged over the domain region.

Technical corrections:

Figure 2: remove “limited-area” from the legend as CNRM-CM6 is global and use the same color bar for all the panels.

Figure 3 is not well numbered.

Figure 6: Panel are not numbered and the white iso-contours are not visible in the lower panels.

Figure 8: Units are missing

l.1: Remove ÂńÂăseamlessÂăÂż from the title which is not adapted in this context

l.46: work done by Hewitt et al. 2016 at Met Office is relevant here

l.47: from the -> from a

l.48-50: Please explain the pro and cons about the fully embedded coupling strategy compared to the multi-executable one to better understand the choices of the different modelling groups.

l.52: communicate -> exchange regrid -> interpolate data into different grids

l.55-59: the sentence should be divided in 2 to improve manuscript readability.

l.76: Ric chi -> Ricchi

l.81: Is there any attempt to use Surfex coupled only to an ocean model (without atmospheric model)? If yes, it can be added here. If no (because of technical restrictions), it must be stated in the text.

l.84: could you give a practical example about Surfex parameterization limitation in stand-alone model to improve the manuscript ?

l. 104: use -> use cases

l. 140-143: are SURFEX “OFFLINE” and SURFEX stand-alone modes the same ? If

yes, please use the same terms everywhere in the manuscript. It is also not clear why SURFEX need to communicate with OASIS in this mode. This should be detailed in the manuscript.

l. 146: called “namcouple”

l.169: typo in the stress equation: Us-Ua-> Ua-Us

l. 210: za -> za

l. 247: regarding the Dis term in the hydrological model, how is it considered by the ocean model? Precipitation?

l. 310: please add the typical value of CMIP5 models SSH drift. Is it possible to determine if this drift is also present in observations or just related to unrealistic water cycle in the model?

References:

Hewitt HT, Roberts MJ, Hyder P, et al (2016) The impact of resolving the Rossby radius at mid-latitudes in the ocean: Results from a high-resolution version of the Met Office GC2 coupled model. Geosci Model Dev 9:3655–3670. doi: 10.5194/gmd-9-3655-2016

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