DE LA RECHERCHE À L'INDUSTRIE

Different aggregations of Corine land cover for WRF simulations of a pre-Alpine valley

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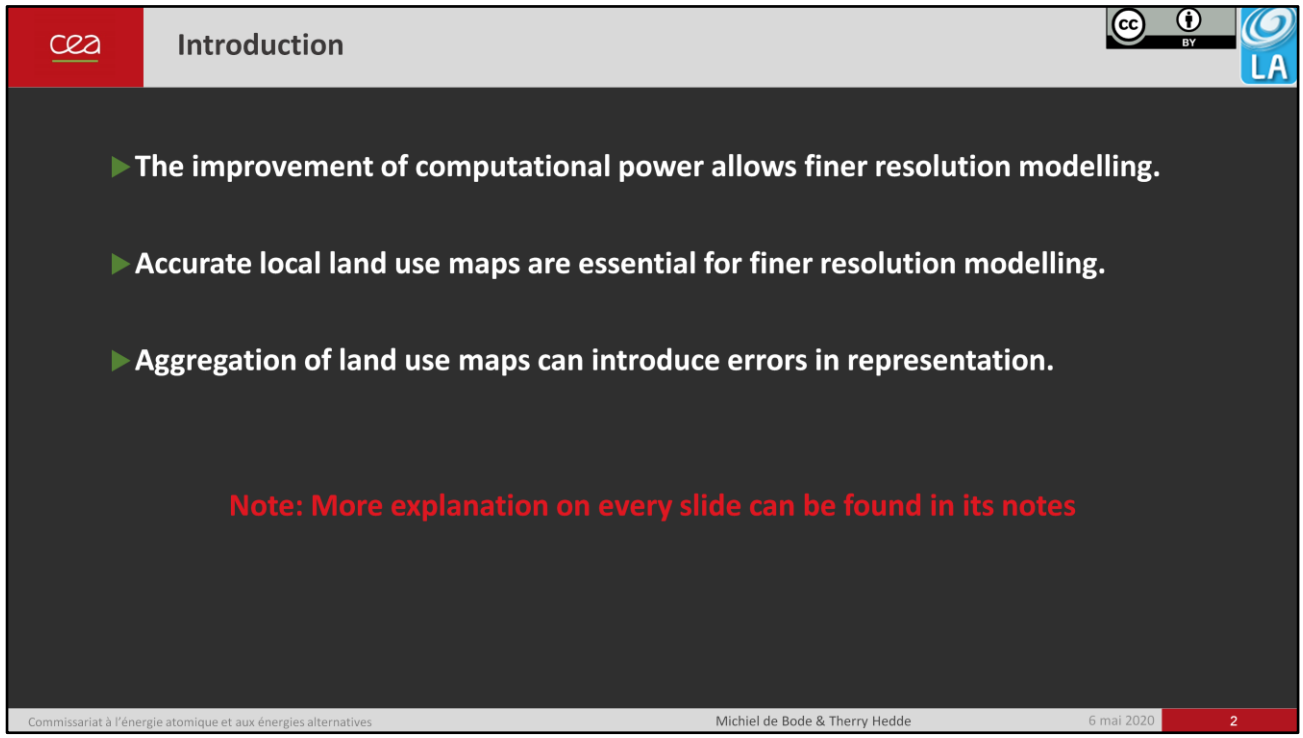
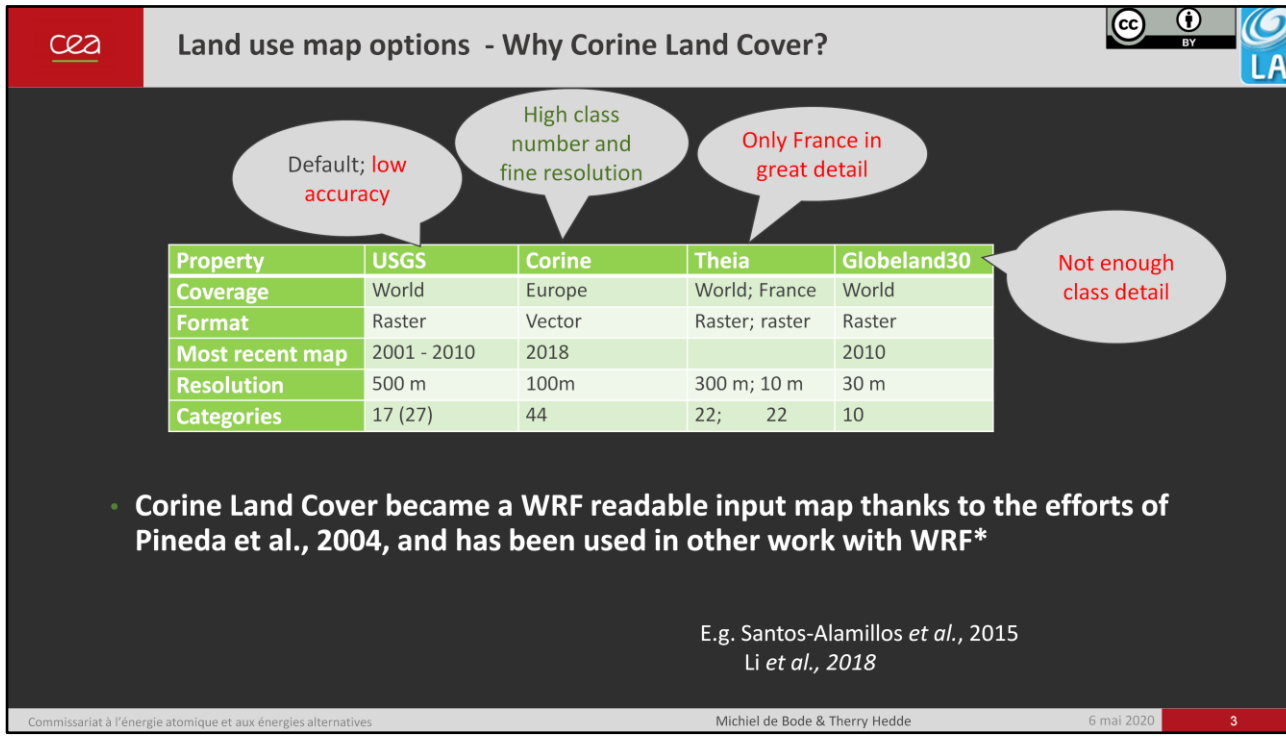
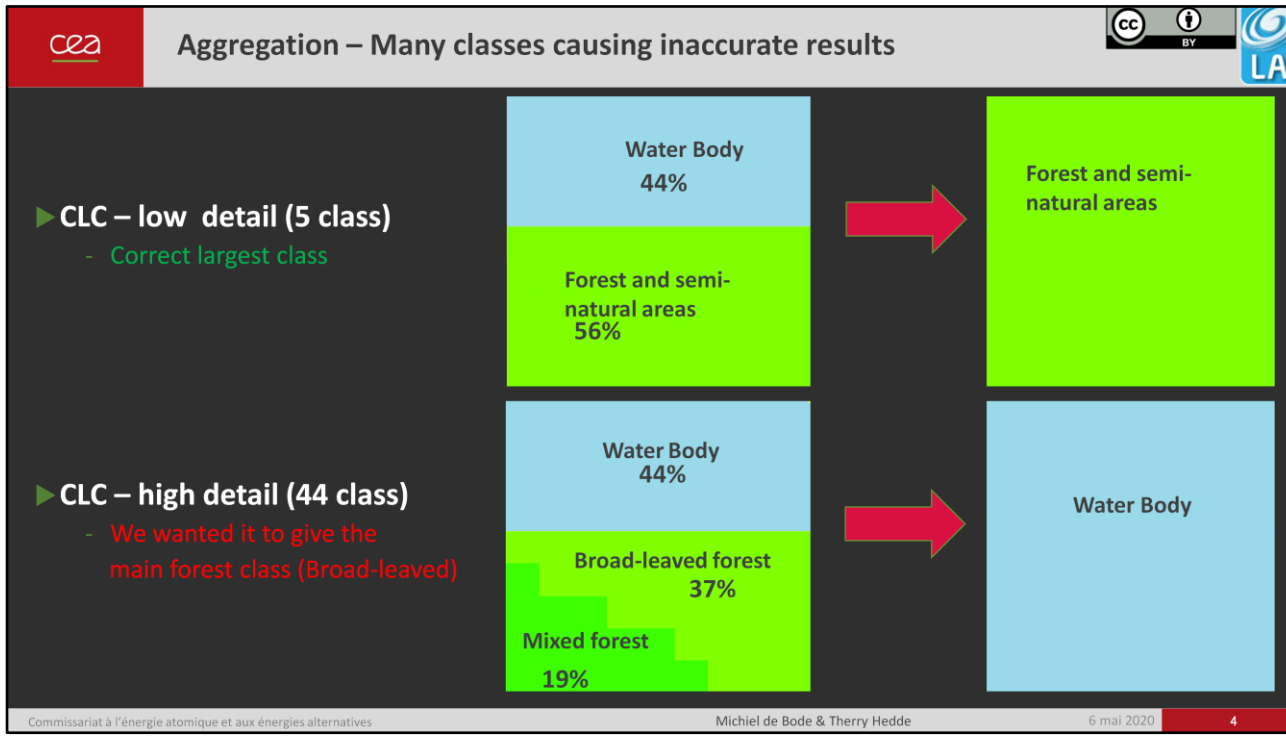


The land cover defines what is on the earth's surface. For atmospheric research, land cover is a leading influencer of surface exchange rates, roughness length and the surface heat flux. Nowadays, with finer resolution, the importance of land cover being correct increases. Especially over heterogeneous terrain, as gradients created by short-distance variability can influence local meteorology. For processing purposes, land covers maps group all land covers in classes based on certain conditions. Every land cover map has different classes and conditions to serve their purpose best.
The land cover map USGS is the default map for weather simulations with WRF. Since Pineda et al., 2004 developed a method to convert the Corine Land Cover (CLC) to a WRF readable format, is CLC available for simulations over Europe. CLC is a land cover map that focuses primarily on the EU and a few collaborating countries.



Out of several options for land-use maps, we selected to use the Corine Land Cover (CLC). CLC gives an accurate representation of Europa with great detail in classes. It uses a fine resolution in the vector map.
The WRF default land use map, USGS, gives a poor representation over Europe and has a relatively coarse raster resolution.
Theia has a great detail over France, but a moderate amount of classes.
Globeland30 has excellent resolution but lacks detail in the number of classes available.
CLC has excellent detail in both resolution and number of classes, but it is a vector map. Vector maps resemble real areas better than raster files would. However, only a small amount of models accepts a vector field as input. For this reason, the vector data needs conversion to raster data.

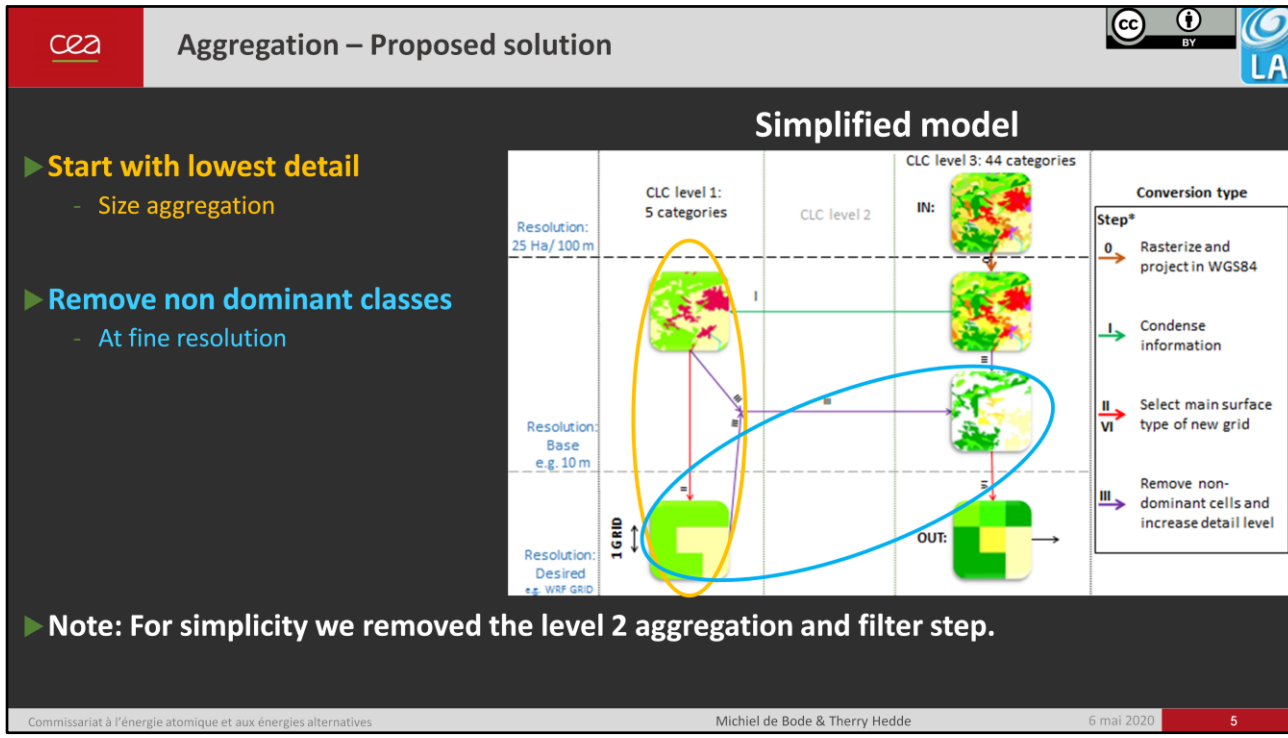


The image illustrates mode aggregation for a selected area. Mode aggregation implies the area is selected to represent the area after aggregation.

Aggregation is the process of combining detailed information to a less detailed form. With land-use maps, this can be the resolution size of grids or the number of classes to fewer classes.
For size aggregation several methods exist, on categorical data, only two of them work without creating errors, namely: “mode” and nearest “neighbour”. “Mode” takes the most common land cover (as shown in on the slide), while “nearest neighbour” takes the closest grid point to the centre of the new grid.
On the other hand, class aggregation is relatively simple with 3 levels of detail incorporated in the CLC land-use map.

We chose to use mode aggregation as that would give us the best

representation for the areas that we aggregate. CLC has a detail-structure of existing out of three levels giving more and more information about the starting 5 categories to 15 and in total 44 categories at the most detailed level, see the picture on the right (based on information from https://land.copernicus.eu/Corinelandcoverclasses.eps.75dpi.png/view).
The example illustrated on the left shows an area of which consists out of 44% water and 37% broad-leaved forest and 19 % mixed forest. If we look at the most detailed level, the grid will get assigned the water body value, even though 56% of the area consists of forest, at the least detail level. To still end up with the Broad-leaved forest as the assigned value, we propose a new method of aggregation.



This is a simplified representation of the steps we take, to make it more comprehensive

After step **1**, we are left with a map with only 5 dominant classes of CLC “Artificial surface”, “Agricultural land”, “forest and semi-natural areas”, “wetlands” and “water bodies”, this is the maps with the lowest detail on the categories. We also have a map with a moderate amount of categorical data, and this is used in step 2.
Step **2**, in red, is a mode size aggregation, from the finest grid with 5 categories to the required grid size.
Step **3**, in light blue, is a filtering step. Here we compare the aggregated maps. We got from step **2** to its original. On the places where the categories match, we fill it with the more detailed map of CLC (with 15 categories). Otherwise, we give the area an N/A value.

Aggregation – Difference between methods

Mismatch between traditional and proposed aggregation techniques for the CLC12 maps.

Domain resolution	Total cells (max)	Northwest corner	Southeast corner	Mismatch
~100 m	262440000	5 E, 44.5 N	6.5 E, 43.5 N	0,03 %
~300 m	194400	5 E, 44.5 N	6.5 E, 43.5 N	1,4 %
1 km*	37433886	25.3 W, 71.4 N	44.8 E, 34.3 N	5,3 %
3 km	21600	3 E, 46 N	9 E, 42 N	11,3 %
9 km	24480	4 W, 48 N	13 E, 38 N	10,9 %

* 1km maps is Europa wide, other maps are specifically for our case

High mismatch with coarse resolution

In preparation for a case study, we prepared the areas with both mode aggregation techniques. The 1km map contains the whole of the European mainland, Iceland and the islands in the Mediterranean sea. We did not make larger resolutions maps for the whole of Europe because of time restraints. With coarser resolution, a higher mismatch exists between the two mode-functions.
More different categories can be available, making the selection of the most representative category more difficult.

Conclusions

- The difference in mode aggregation for structured land use category systems becomes larger than 1% around a resolution size of 300 m and further increases to ~11% around 3 km resolution.

- New method of aggregation creates an improvement for all parameters

References

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- Dupuy, F. (2018). *Amélioration de la connaissance et de la prévision des vents de vallée en conditions stables: expérimentation et modélisation statistique avec réseau de neurones artificiels* (Doctoral dissertation, Université de Toulouse, Université Toulouse III-Paul Sabatier).
- Pineda, N., Jorba, O., Jorge, J., & Baldasano, J. M. (2004). Using NOAA AVHRR and SPOT VGT data to estimate surface parameters: application to a mesoscale meteorological model. *International journal of remote sensing*, *25*(1), 129-143.