Coupling CALIOP observations and regional simulations at 20km resolution: is that a good candidate to study cloud variability at the regional scale?

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This work aims to study the clouds' role on regional climate variability. At first order, European climate is driven by large scale circulations. However, clouds are known to have two major radiative effects impacting the surface temperature: the greenhouse effect and the albedo effect. These effects are strongly dependent on macrophysical and microphysical properties of clouds. It is then necessary to consider the vertical distribution of clouds to better understand their impact on regional climate.

Since June 2006, A-train observations are available and allow the description of this vertical distribution and of other microphysical properties. However, the sampling is limited and considering small scale variability is not possible. To complete these observations, we use a regional climate model which may allow to extend the period of study and to better understand the link between clouds and surface temperature. In this study we address the ability of our tools to study impacts of clouds on European climate at a resolution suitable to take into account the complex terrain of this area. Seasonal and inter annual clouds variability is presented for observations and simulations. We also evaluate the amplitude of clouds variability in the simulations and the uncertainties linked to the satellite sampling.

**B. Effect of satellite under sampling**

**Evaluation of CALIPSO sampling using the WRF+COSP simulations**

- Vertical structure of clouds (40 levels)
- Products comparable to GCM data
- Measurement frequency: every 16 days
- 30-60m vertical resolution
- Horizontally track resolution 330m

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**C.2. Model evaluation: inter annual variability**

**Amplitude of variability (Fig. 8):**

- Winter: same shape for obs and simu with more variability for high clouds than low clouds.
- Simulations tend to overestimate high cloud inter-annual variability.
- Summer: observations show less variability than winter, especially over the sea. Model overestimates the high cloud variability and underestimate the lower layers’ one.

Cloud variability well simulated over the Mediterranean Sea in winter => quid of year to year variability (Fig. 9)

**D.2 Discussion #2**

**Conclusion and Perspectives**

Deeper investigations and improvements are needed but results show:

- Sat. sampling: Not enough tracks over a season to study interannual variability or anomaly in each grid point. 2 km (6% of the grid points) profiles by grid points. It is significant when studying interannual variability at specific levels.
- WRF models underestimate high clouds: the result is amplified with lidar simulator.
- Low cloud detection (amplified by the use of lidar simulator) and overestimation of high clouds: difficult to evaluate simulation low clouds against CALIPSO data.

To be done: Clouds radiative impact of simulating with A-train observations

- Radiative circuit cloud variability to large scale dynamic processes (North Atlantic oscillation)
- Understanding cloud impact over the continent (mesoscale variability).

**References and Acknowledgements**

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