Assimilating cloud-affected satellite observations in the convection-permitting model AROME over Austria

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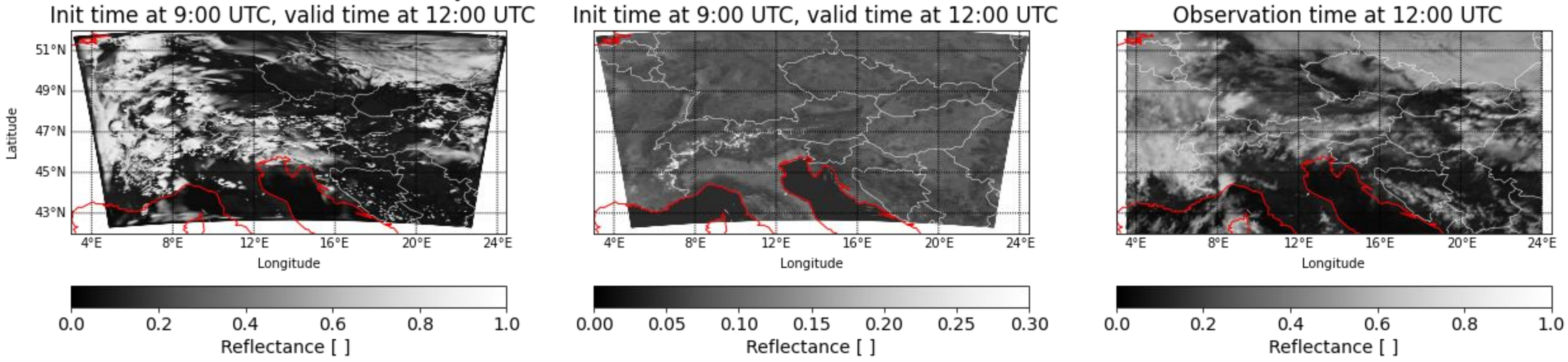

1. Motivation and research questions

Clouds provide high resolution information for Numerical Weather Prediction (NWP) models. And there is a rising interest in "All-Sky" data assimilation, which refers to assimilating observations affected by clouds.

What's new?

- All-Sky assimilation is novel in the operational convection-permitting AROME over Austria and the alpine region.
- Multiple channels of the SEVIRI instrument will be investigated:
  - Reflectance [unitless] - visible channel 0.6 µm
  - Brightness temperatures (BTs) [K] - infrared (IR) water vapor channels 6.2 µm and 7.3 µm

Research question:

- What is the potential impact of assimilating the visible and IR channels?
- How to mitigate the potential ambiguities of each observation type?

2. Data and methods

- Input data used in the RTTOV (Saunders et al., 2018) (version 12.2) offline simulations:
  - Full AROME fields (421x589x90)
  - Cloud liquid water and cloud ice are included as cloud parameters
  - Surface albedo: RTTOV BRDF atlas

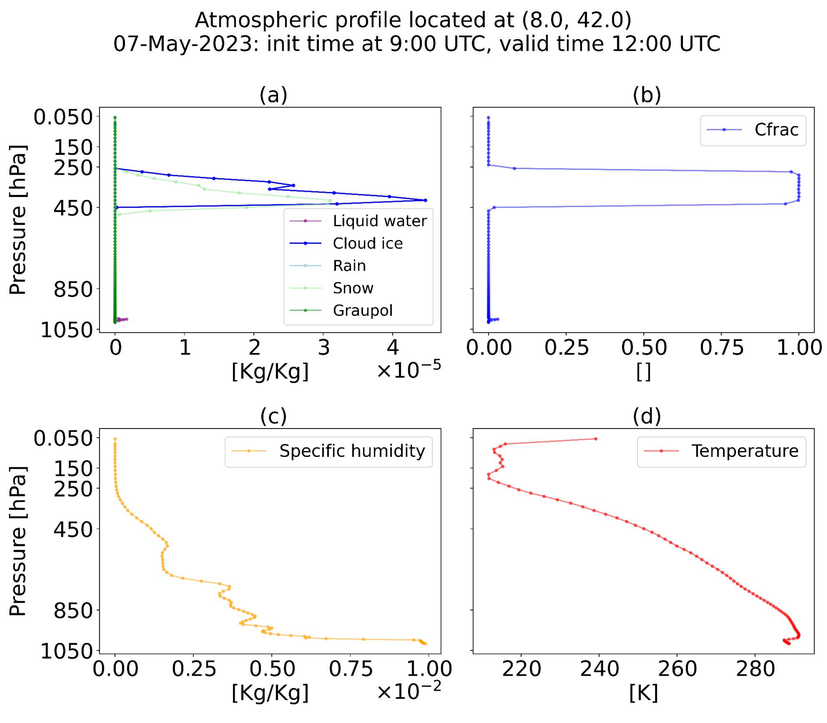

***Figure 2**: a profile snapshot showing AROME hydrometeors, cloud fraction on 0-1 scale, specific humidity, and vertical temperature on pressure level.*

3. A case study - 07.05.2023

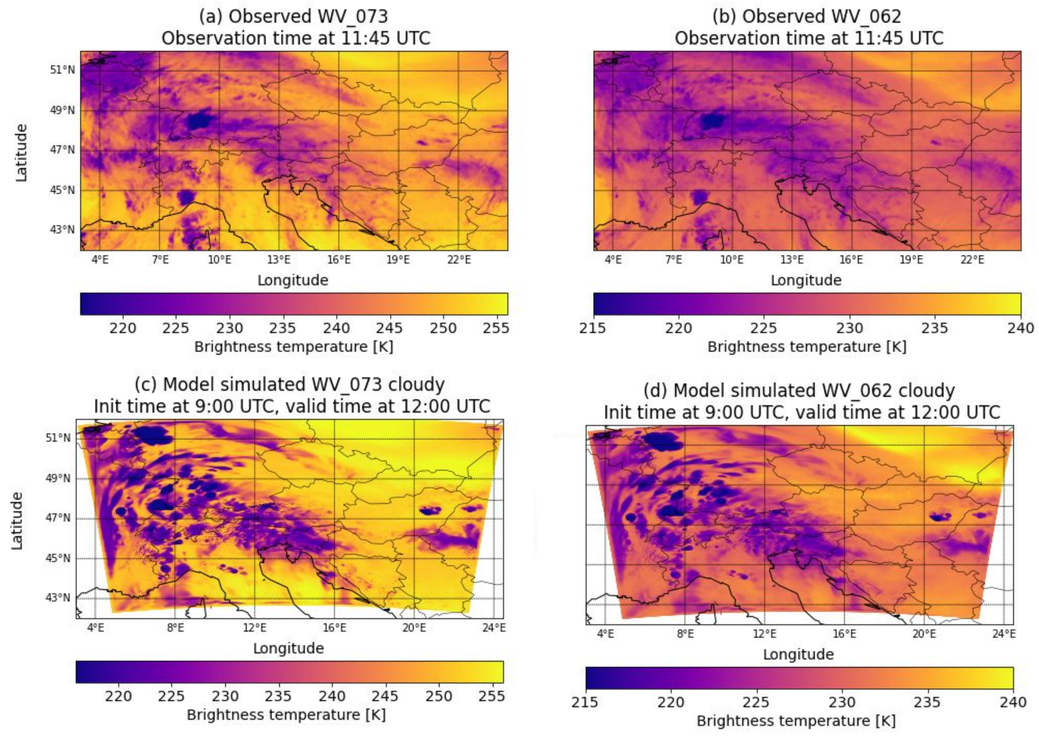

***Figure 3**: observed brightness temperature (a, b) vs all-sky simulations for 7.3 and 6.2 µm channels respectively (c,d).*

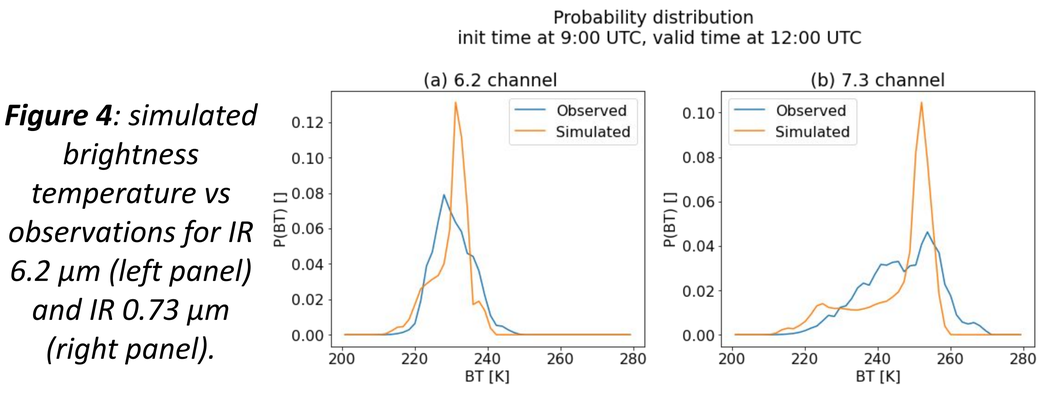

***Figure 4**: simulated brightness temperature vs observations for IR 6.2 µm (left panel) and IR 0.73 µm (right panel).*

4. What's next

1. Test the VISOP operator to quantify the effects of orographic shadowing.
2. Evaluate and mitigate systematic deviations between observations and model equivalents.
3. Test assimilation of cloud-affected satellite observations in AROME.

5. Reference(s)

Saunders, R., Hocking, J., Turner, E., Rayer, P., Rundle, D., Brunel, P., Vidot, J., Roquet, P., Matricardi, M., Geer, A., Bormann, N., & Lupu, C. (2018). An update assimilation on the RTTOV fast radiative transfer model (currently at version 12). Geoscientific Model Development, 11(7), 2717–2737. https://doi.org/10.5194/gmd-11-2717-2018.