In order to address issues relating to the use of output from short period forecast of the UKV as 'truth', and to the absence of moist variables, the author has made use of the Copernicus European Regional ReAnalysis (CERRA) dataset, produced by a ~ 5.5 km formulation of the Harmonie Aladin assimilation-NWP system with boundary conditions from ERA 5 (Schimanke et al. 2021). Essentially the same timeframe was used, with 24 hour means calculated up to 18Z 15th December, but 19Z in the case of moist variables due to a constraint on write-out times. The CERRA reanalysis output may be deemed more acceptable as a source of pseudo observations, though its lower resolution makes it unsuitable for the small-scale detail important to the case. The output provides support for the UKV forecast used in the paper, and for inferences drawn about snow production in the column downstream of the Isle of Man.

1. Verification

See below a temperature-height plot from the UKV and CERRA systems for a point in the Irish Sea. This shows a close correspondence between the fields from the two models, giving confidence in the UKV output. Choosing a point over land gives more noticeable differences principally in the boundary layer due to the coarser orography in CERRA. Note that CERRA also supports the near-isothermal layer between 1500 m and 2000 m drawn attention to in the paper.

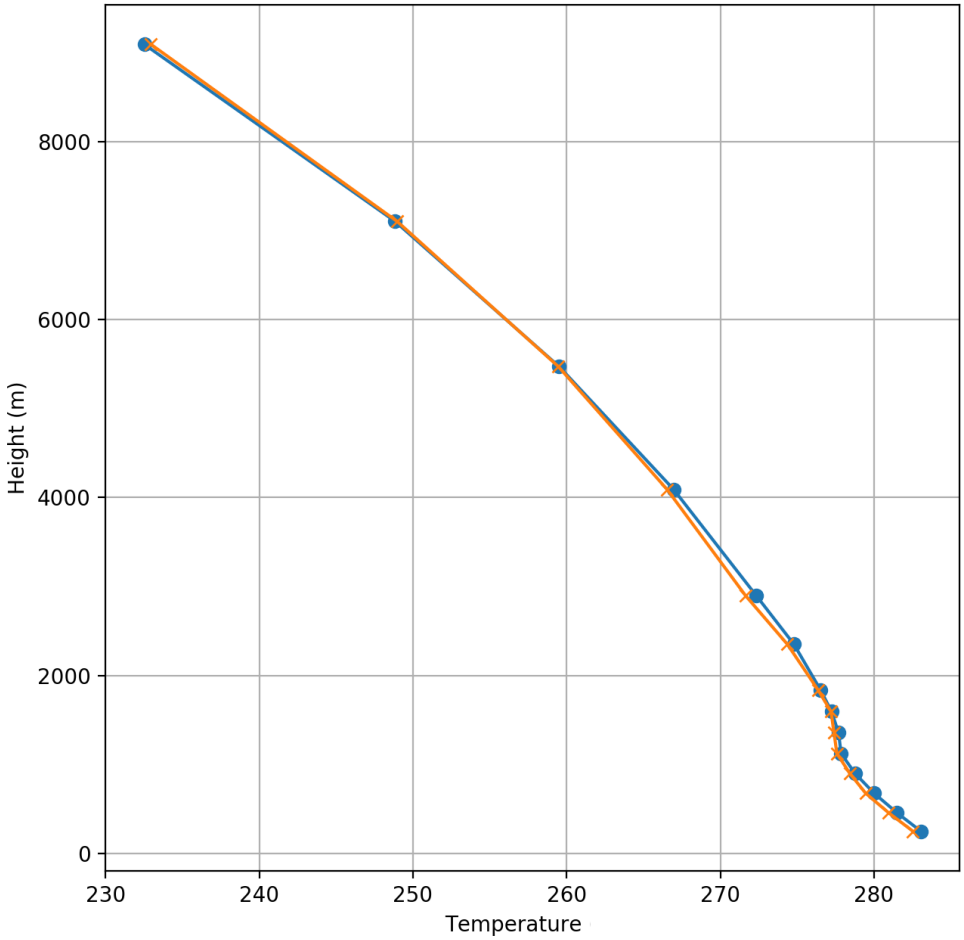

Fig. 1 CERRA (crosses) and UKV (circles) temperature vs height for point in Irish Se. Mean during 24 hrs to 18Z 5 Dec 2015.

2. Snow

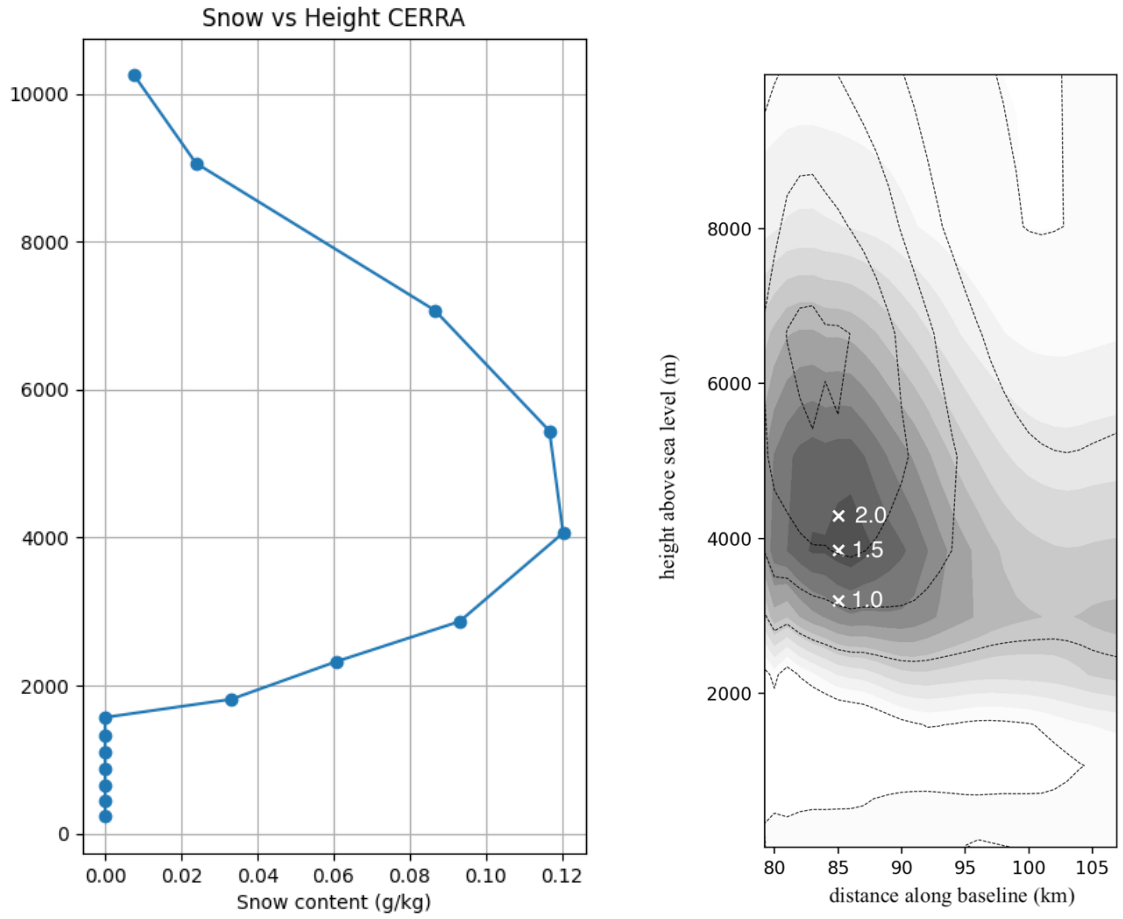

Fig. 2 Left: CERRA Vertical profile of snow content (24 hr mean to 19Z 5 Dec 2015) at distance 85km on cross section baseline. Right (From Fig. 7 in paper). Vertical velocity (contours) and estimated condensation rate (shaded) from UKV 24 hr mean to 18Z 5 Dec 2015. Origin points of precipitation falling as rain near Honister with different snow fall speeds indicated.

CERRA snow content is defined as 'the mass of snow (aggregated ice crystals) produced from large-scale clouds that can fall to the surface as precipitation'. Its profile (located just downwind of the Isle of Man) agrees qualitatively well with the pattern of condensation rate estimated from w dqsat/dz in the paper, peaking at 4000 m, decreasing slowly above, more quickly below. Whilst values seem numerically quite small, it should be remembered that these are interpreted as ice seeds forming in ascent and growing significantly downstream by riming etc. and that some of the condensation is partitioned into cloud ice, cloud water and rain.

Schimanke S., Ridal M., Le Moigne P., Berggren L., Undén P., Randriamampianina R., Andrea U., Bazile E., Bertelsen A., Brousseau P., Dahlgren P., Edvinsson L., El Said A., Glinton M., Hopsch S., Isaksson L., Mladek R., Olsson E., Verrelle A., Wang Z.Q., (2021): CERRA sub-daily regional reanalysis data for Europe on single levels from 1984 to present. Copernicus Climate Change Service (C3S) Climate Data Store (CDS), DOI: 10.24381/cds.