Figure S1. Ash column load on 14 May at 15 UTC for the four models (from left to right: FLEXPART, MATCH, MOCAGE, WRF-CHEM). Top panel shows the 4 model outputs with a priori source terms. The 3 other rows show respectively (from top to bottom) the 4 model outputs with the lower limit of the a posteriori source term, the best estimate a posteriori source term, and the upper limit of the a posteriori source term. The blue lines are the cross sections shown in Fig. S2 and the *F* points out where the FAAM flights made the lidar measurements that are used in the article.
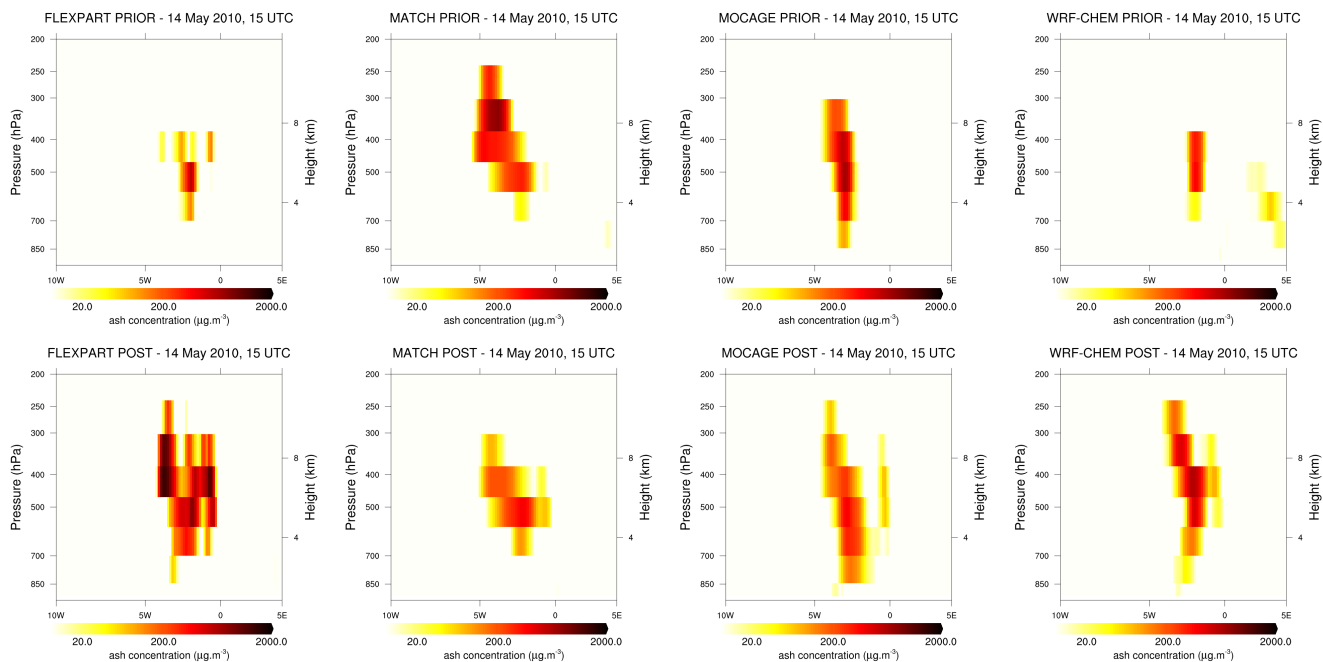
Figure S2. Ash mass concentrations on 14 May 2010 at 15 UTC for the four models (from left to right: FLEXPART, MATCH, MOCAGE, WRF-CHEM) with a priori source terms (top), and with a best estimate a posteriori source term (bottom), across the horizontal section shown in the panels of Fig. S1.
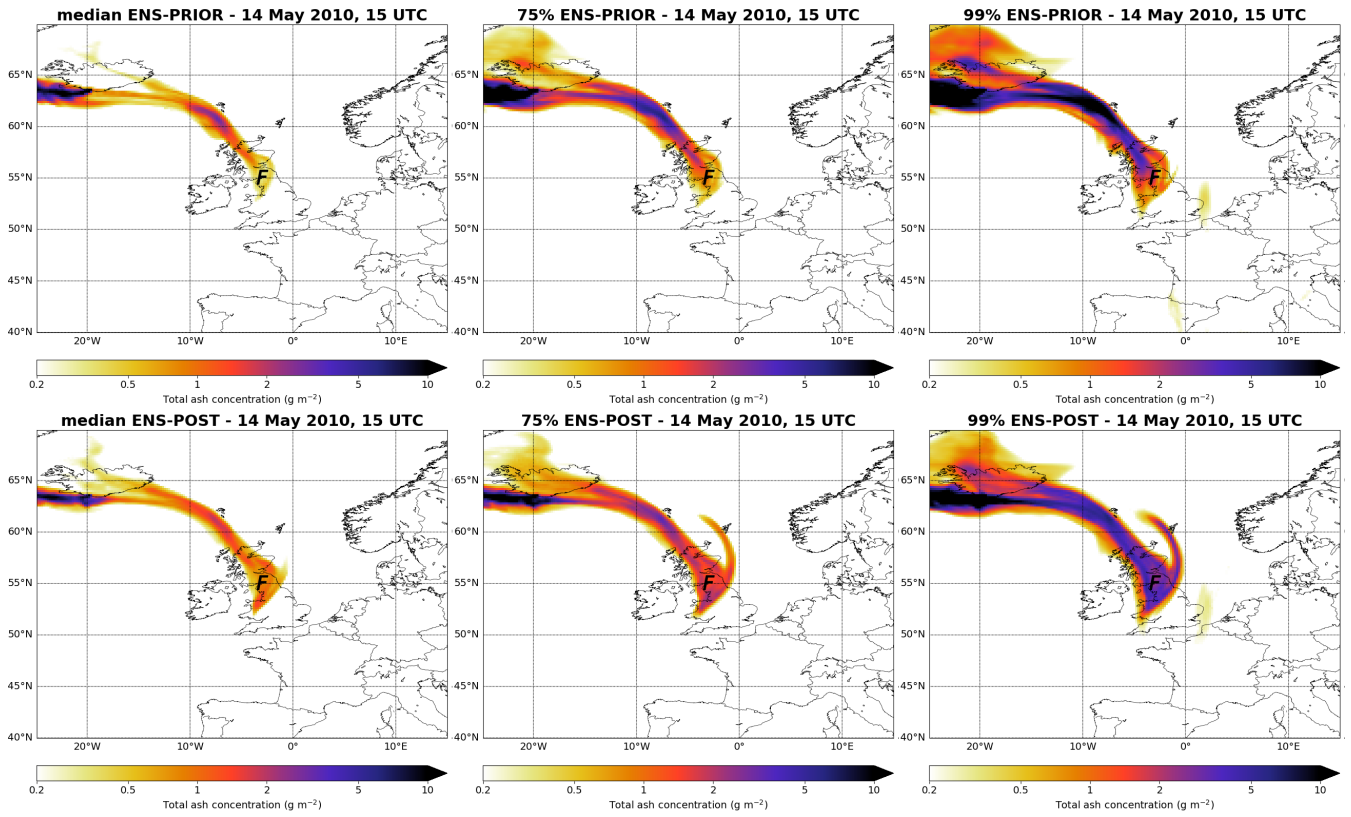
Figure S3. Ash column load on 14th May at 15 UTC for the a priori (top) and for the a posteriori (bottom) ensembles. The ensemble median, 75 % and 99 % are respectively displayed from left to right. The *F* letter is the same as in Fig. S1.
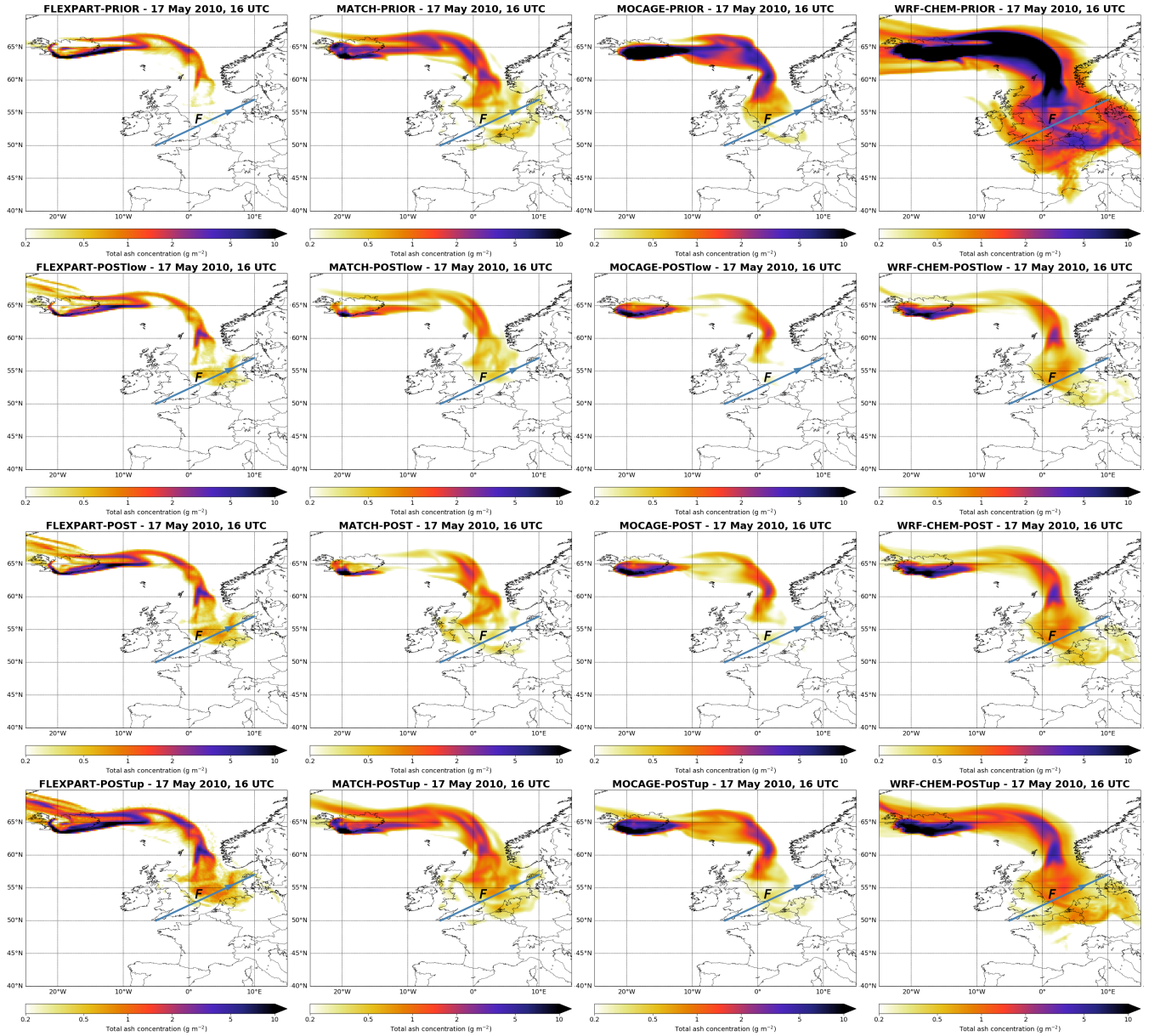
Figure S4. Same legend as Fig. S1 on 17th May at 16 UTC. The blue lines are the cross sections shown in Fig. S5.
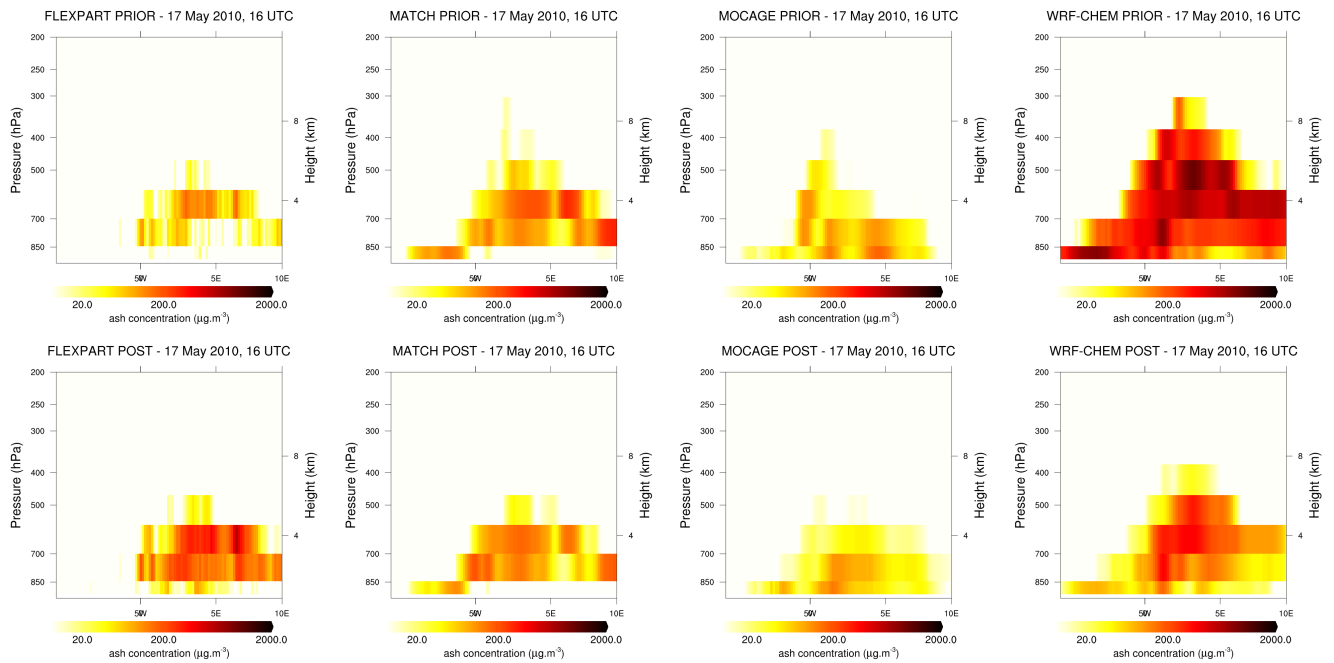
Figure S5. Same legend as Fig. S2 on 17 May at 16 UTC, along the cross section shown in Fig. S4.
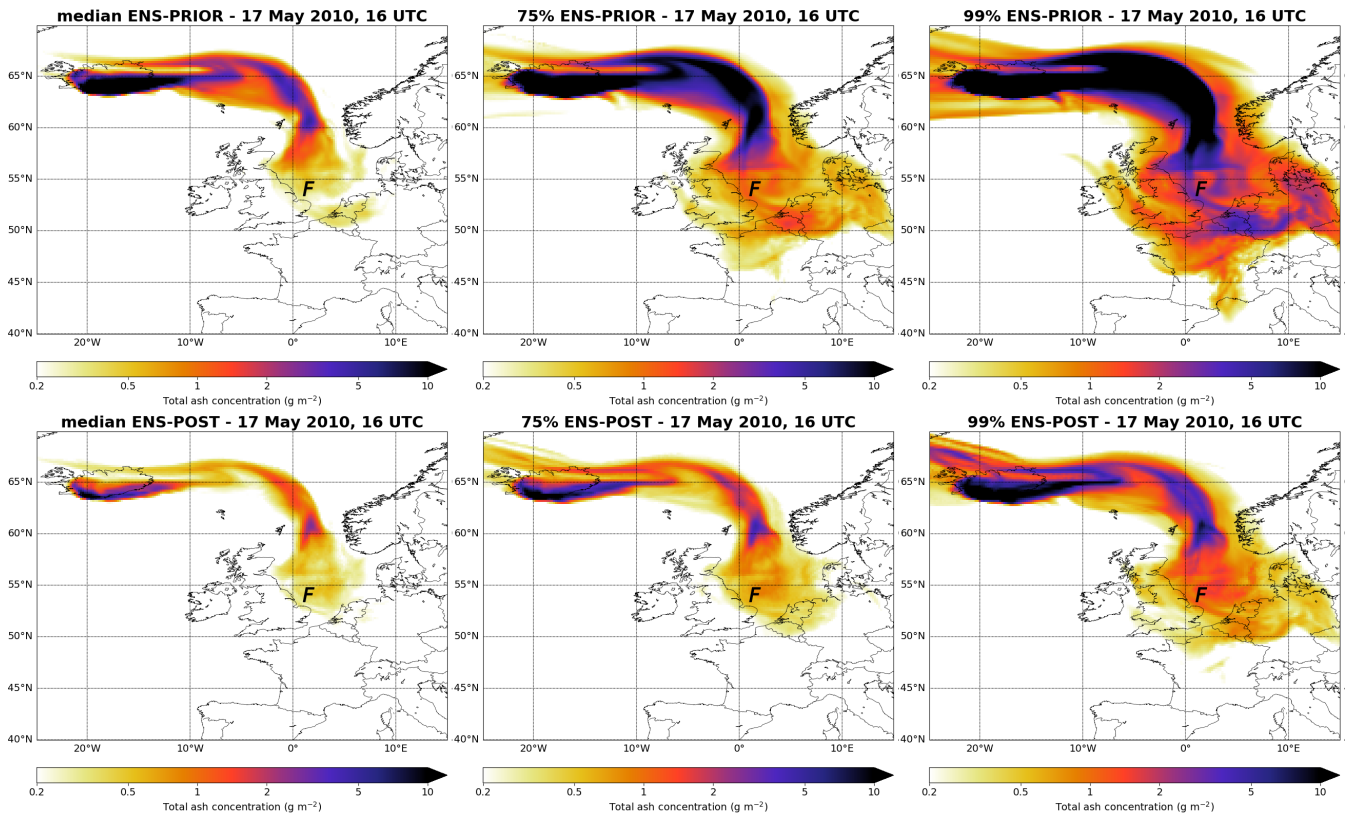
Figure S6. Same legend as Fig. S3 on 17 May at 16 UTC.