

Supplements for

Aircraft measurements of black carbon in the boundary layer over the North China Plain

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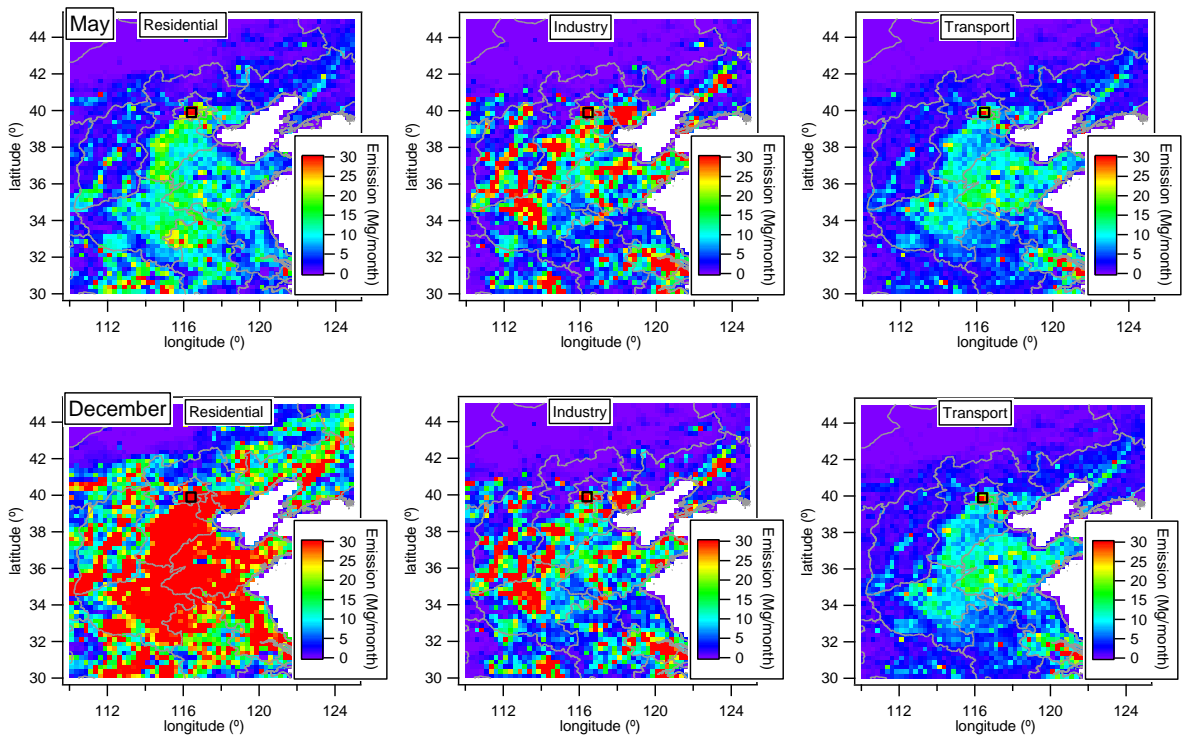


Fig. S1. The 2010 $0.5^\circ \times 0.5^\circ$ BC emission inventories for residential, industry and transportation sectors for May and December. The open square marks the location of central Beijing.

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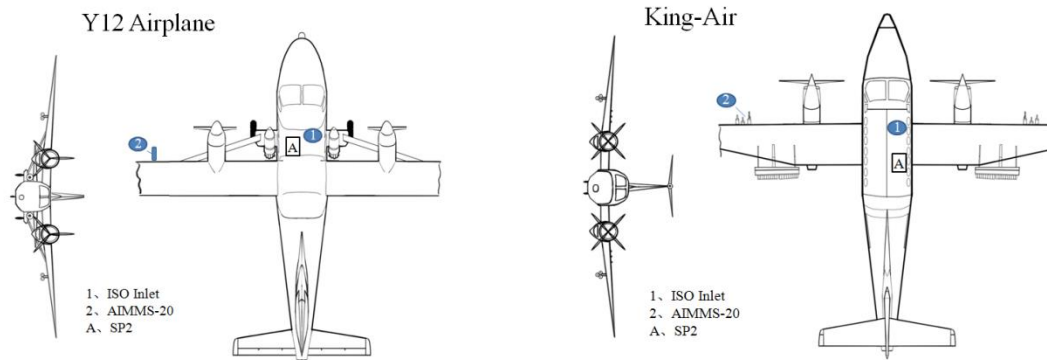


Fig. S2. The side and top sketch of Y12 and King-air aircraft, showing the position of ISO inlet and the SP2.

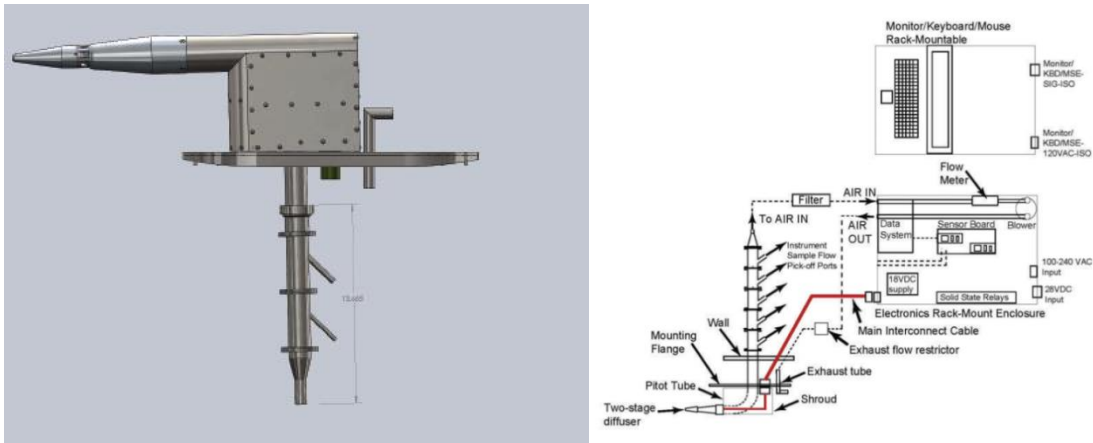
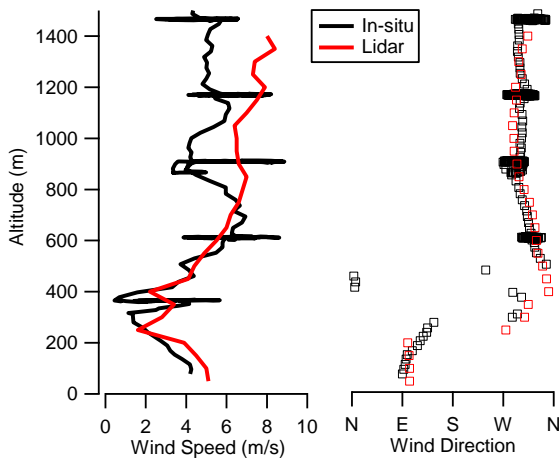


Fig. S3. The picture of the ISO inlet; the schematic of the ISO inlet and the associated flow system in the cabin.



5 Fig. S4. Comparison between the in-situ and radar measured wind vertical profile for the return flight 20161219.

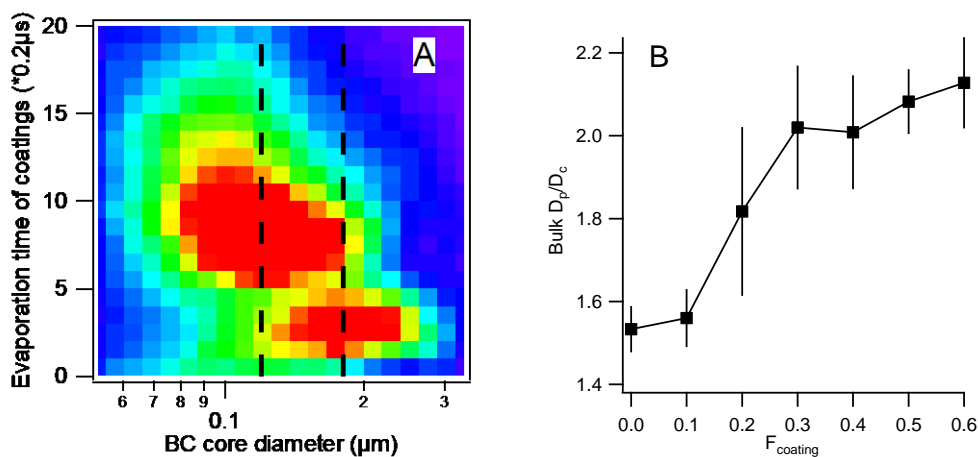


Fig. S5. An example of the methods in determining the BC mixing state for flight 20120417. A) The coating evaporation time as a function of BC core size, colored by the particle number density; B) Comparison between the coating evaporation time and optical sizing methods in determining the BC mixing state from the SP2 measurement.

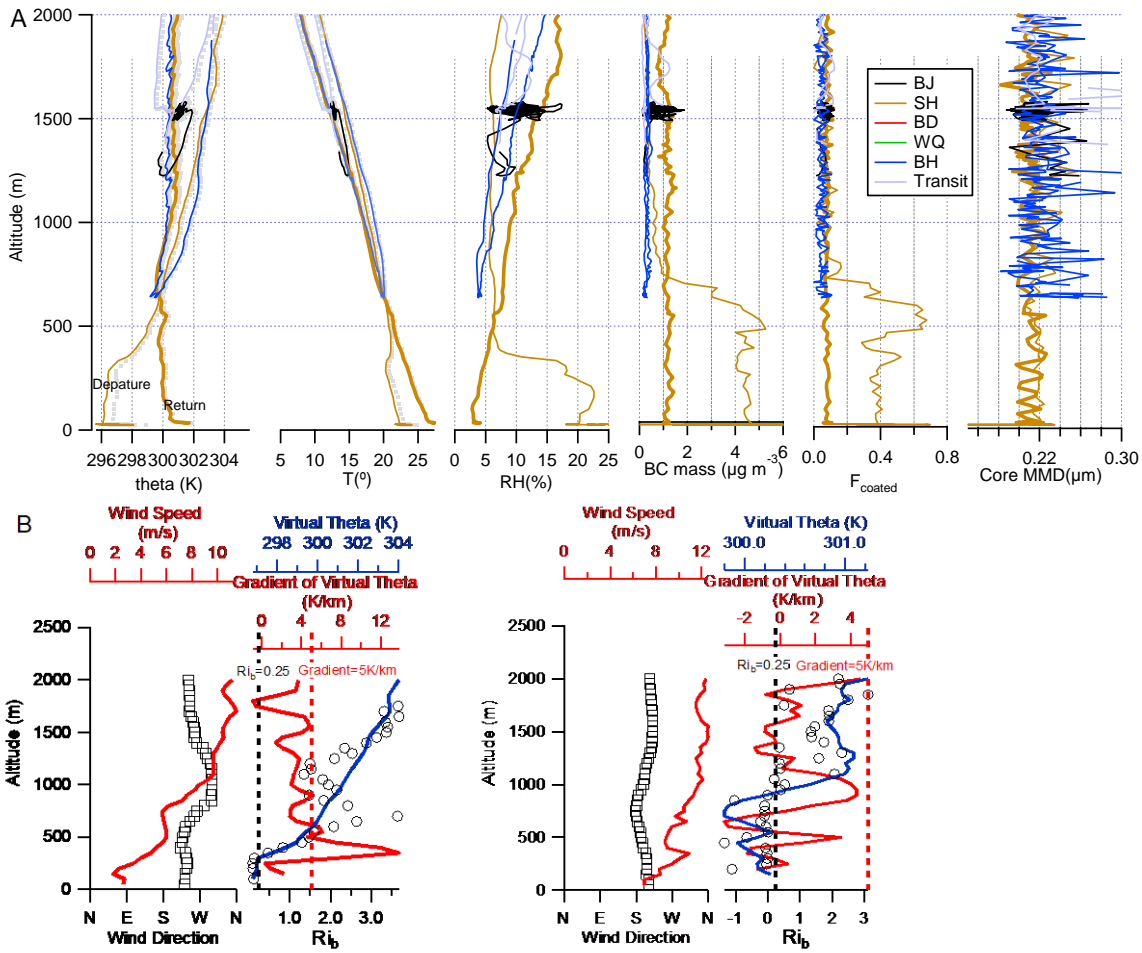
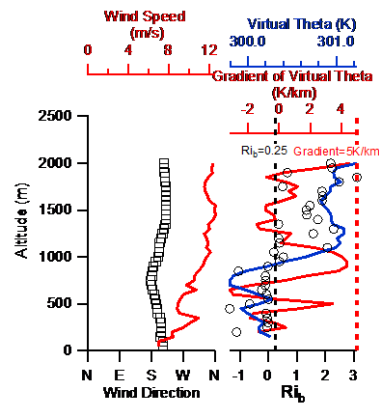
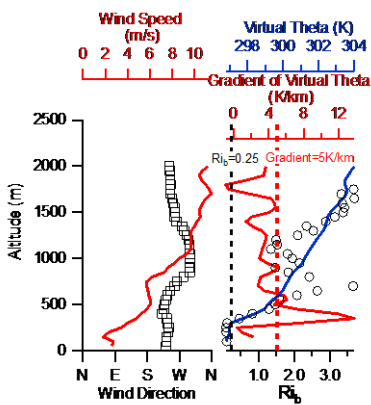
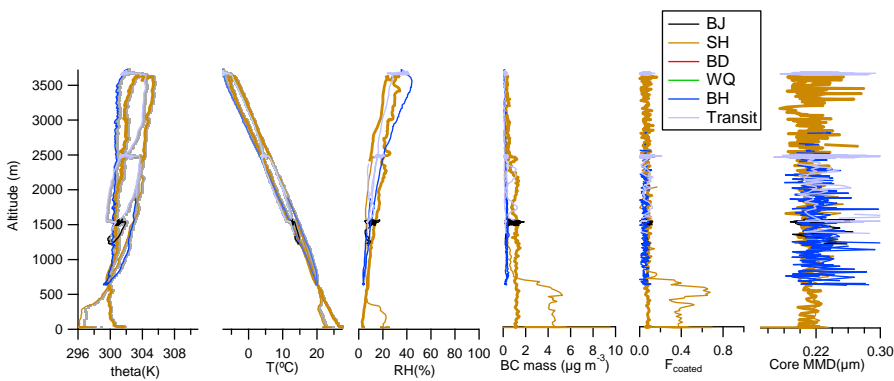
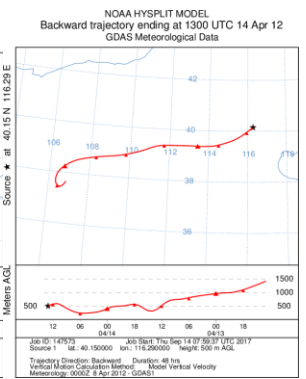
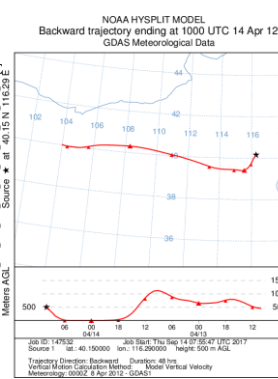
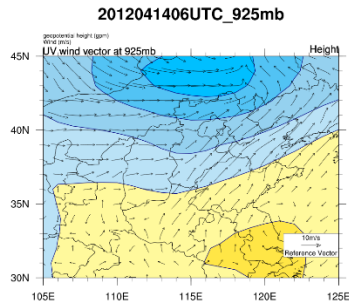
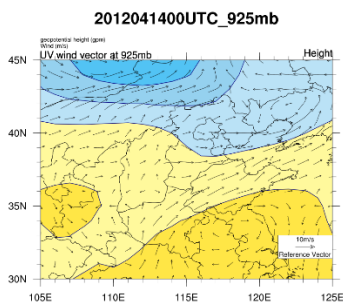
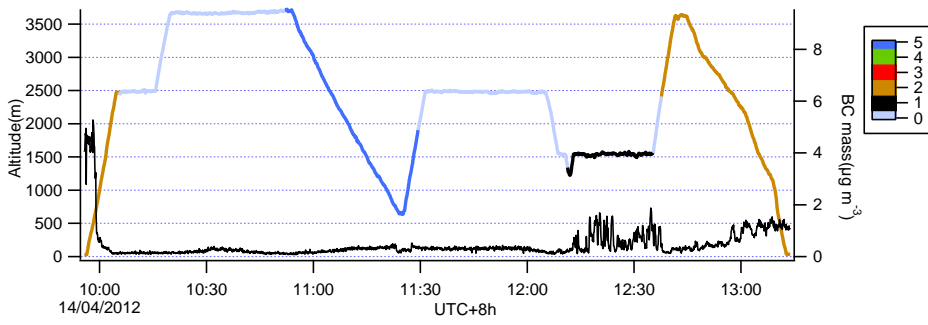


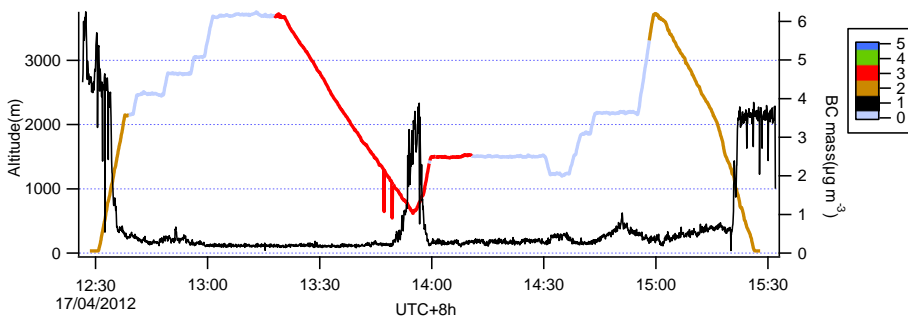
Fig. S6. A) The vertical profiles of meteorological parameters and BC properties for flight 20120414, colored by the locations of aircraft over different regions (marked in Fig. 1B). The thicker lines show the return leg. The flight departure was in the morning and returned in the early afternoon. B) The determination of PBLH for the departure and return legs.

Summer flights

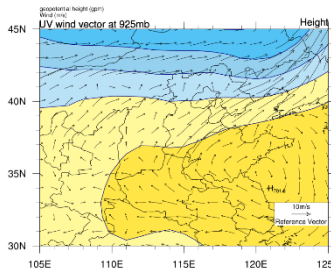
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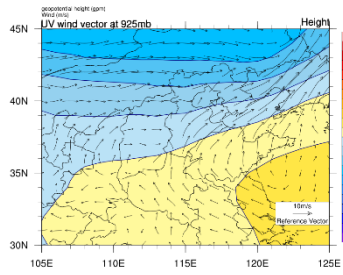
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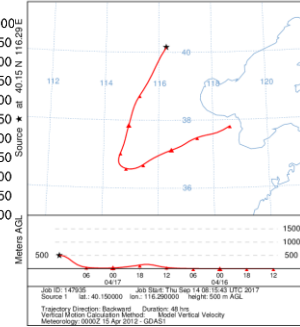
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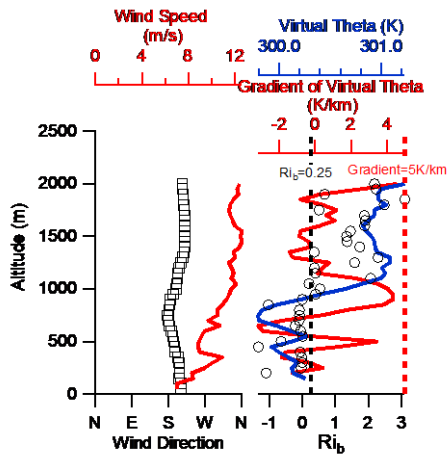
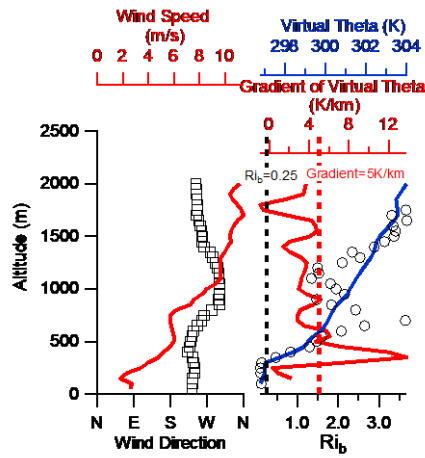
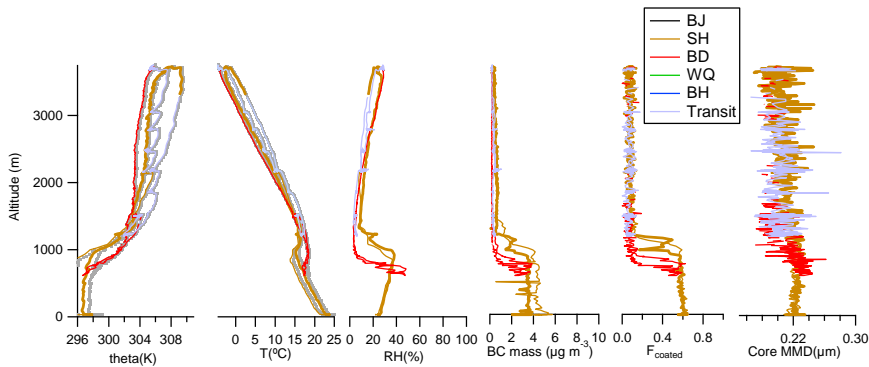
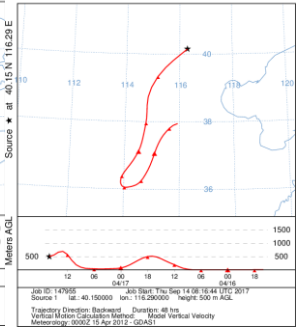
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GDAS Meteorological Data

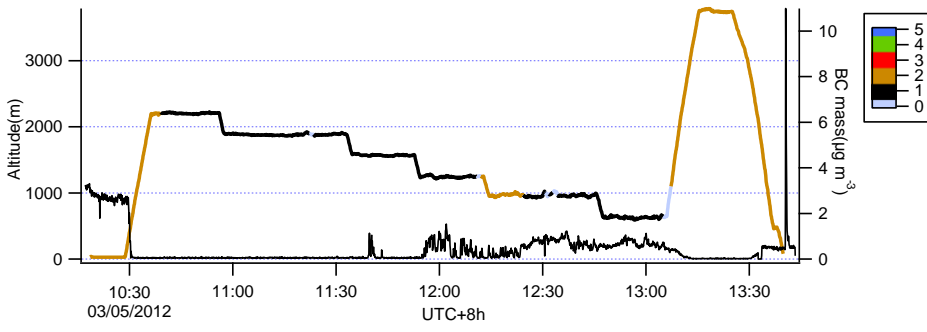


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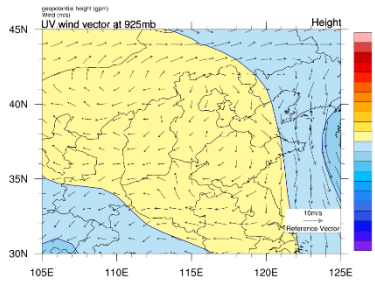


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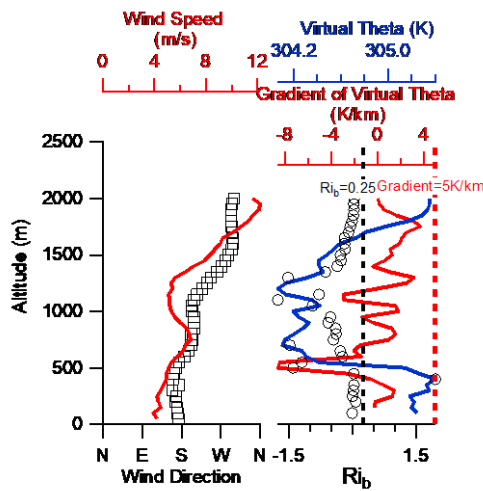
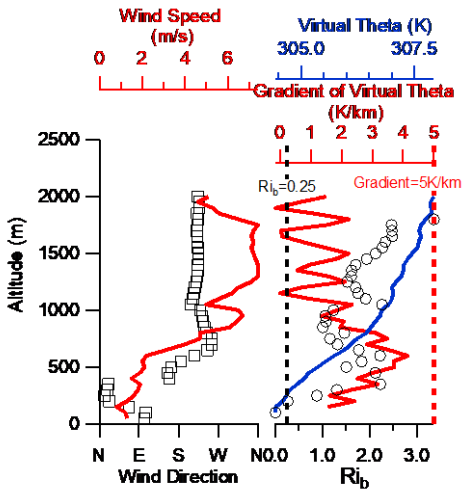
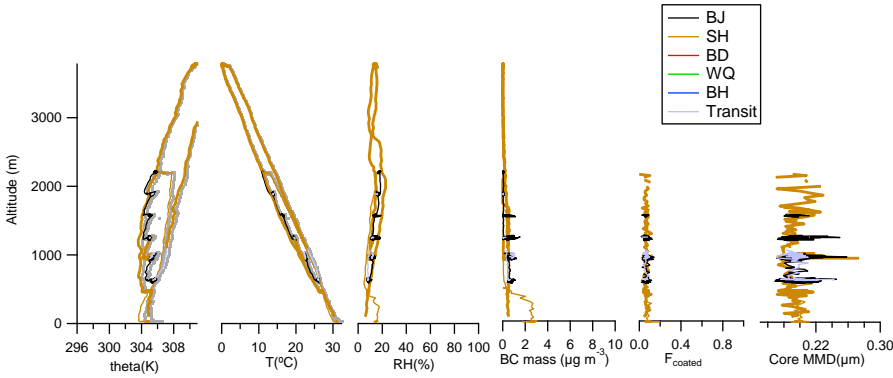
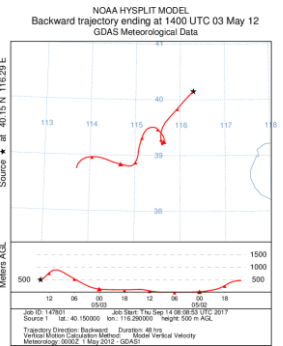
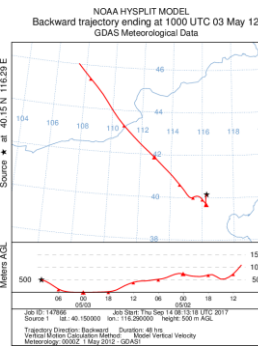
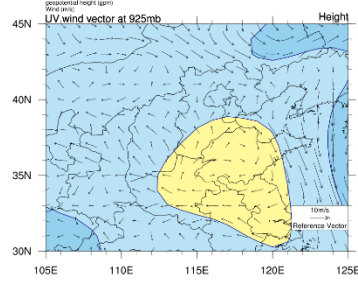
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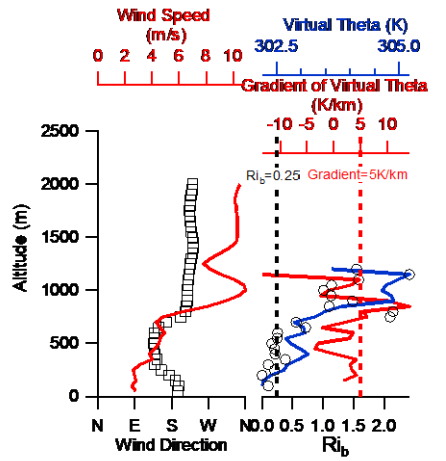
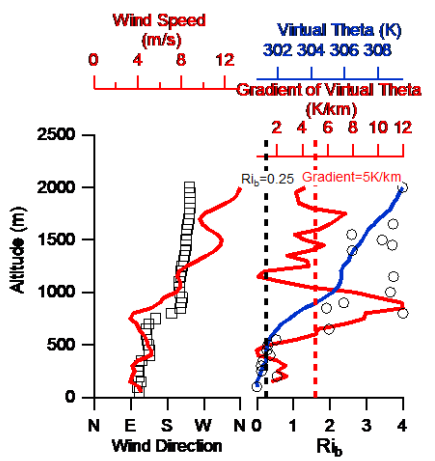
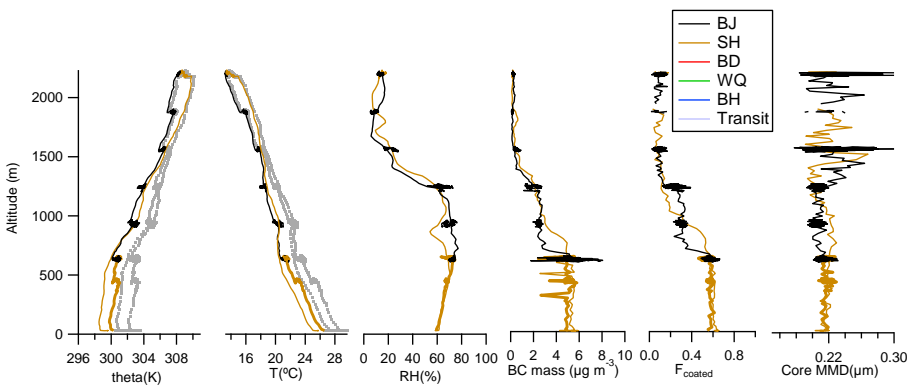
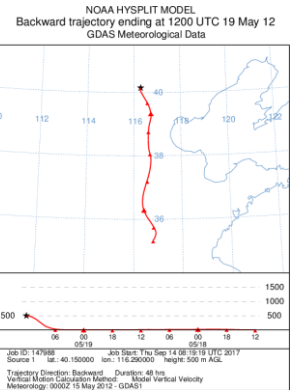
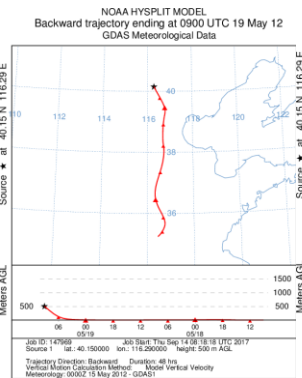
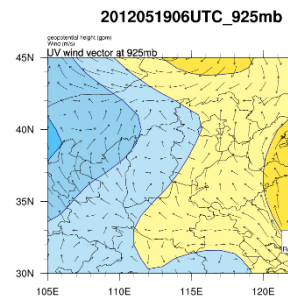
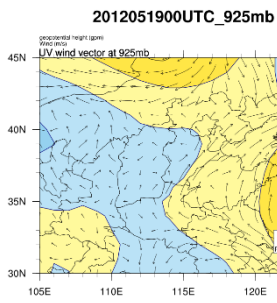
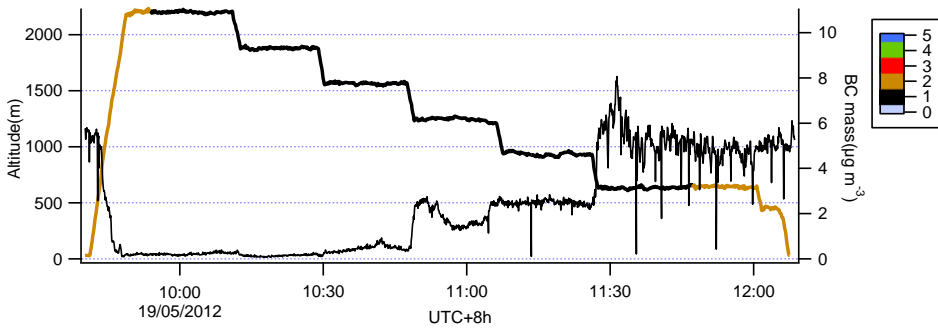
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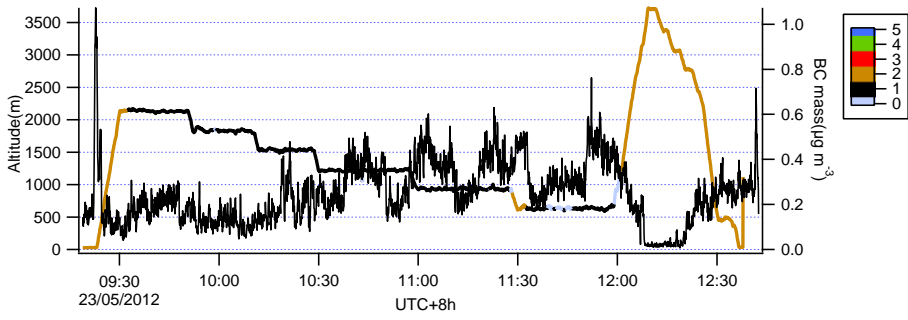


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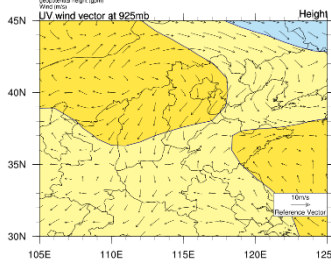


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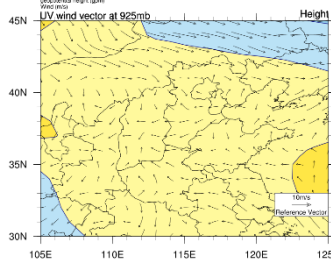
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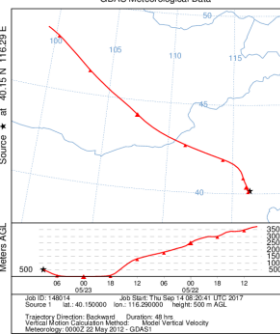
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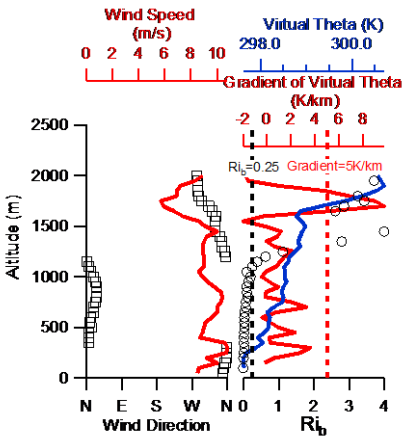
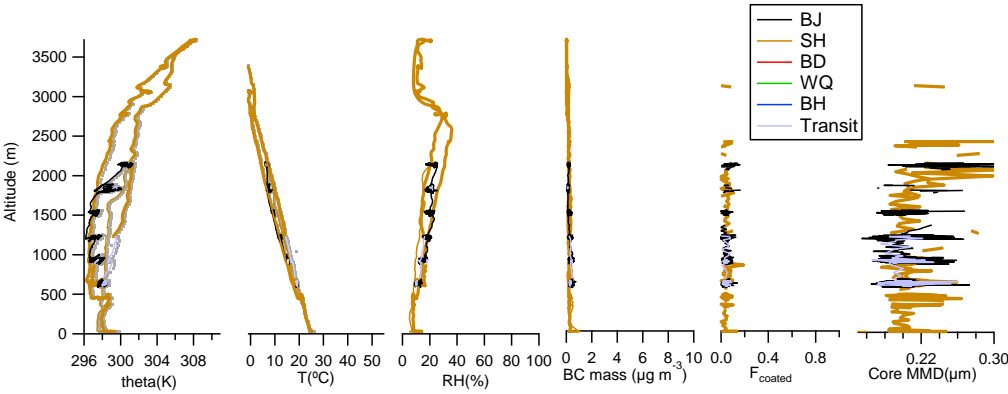
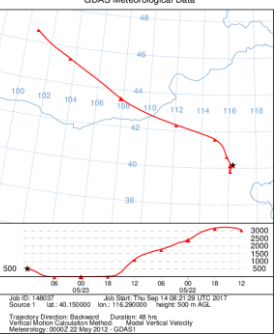
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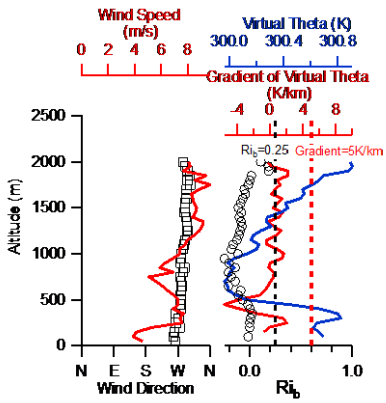
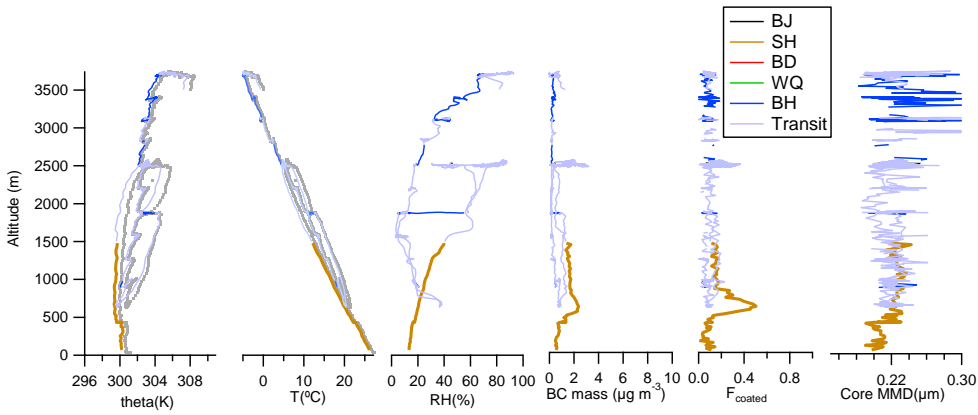
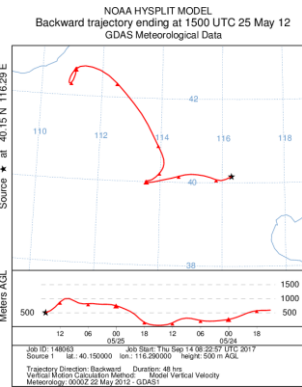
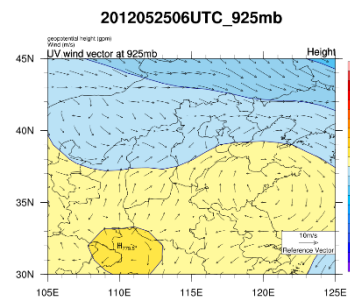
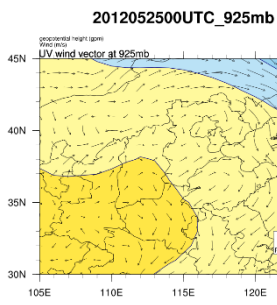
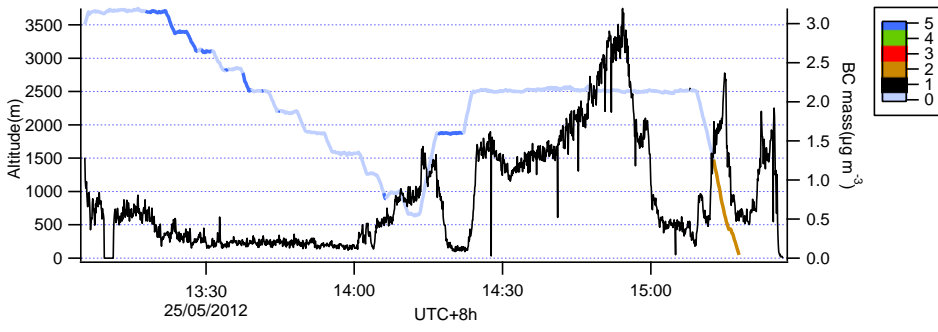
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Backward trajectory ending at 0900 UTC 23 May 12
GDAS Meteorological Data



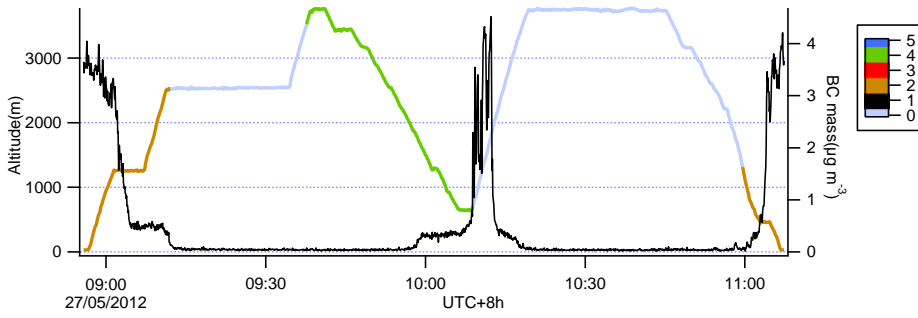
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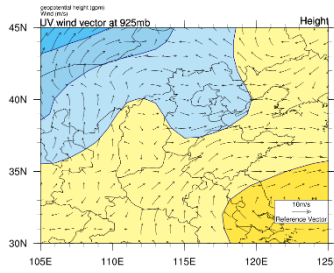
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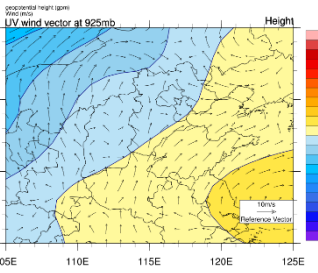
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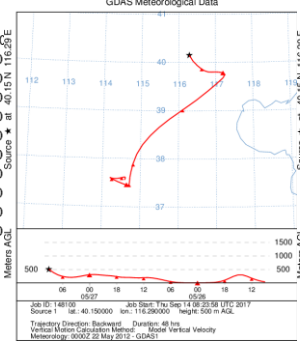
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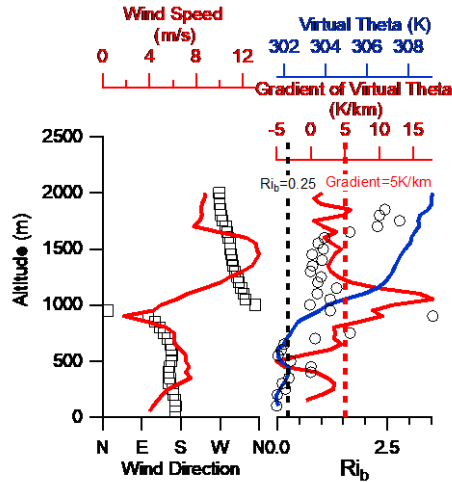
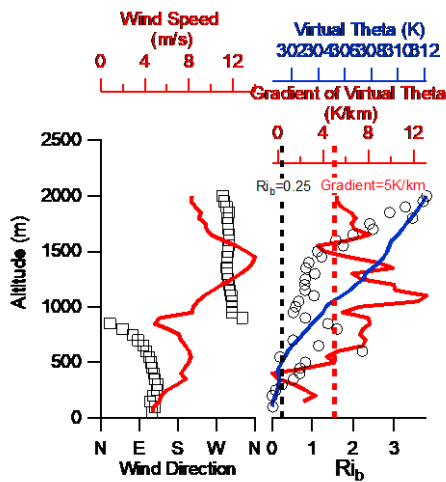
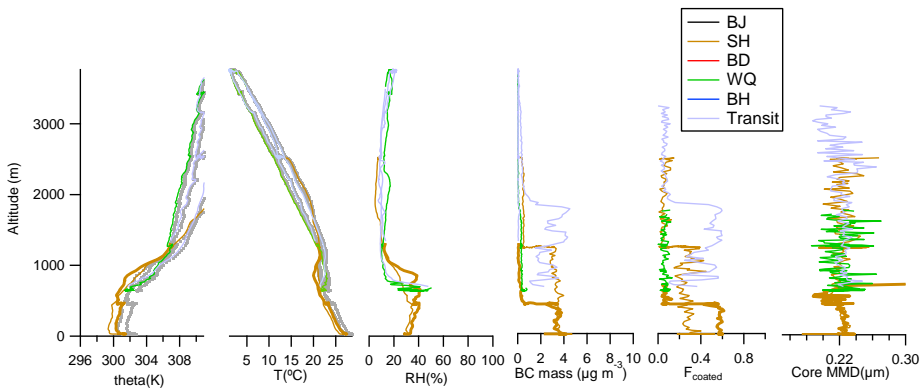
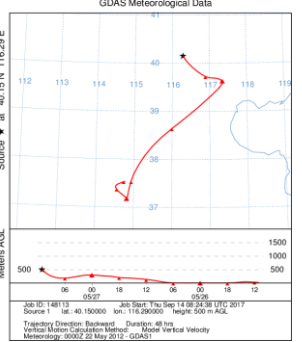
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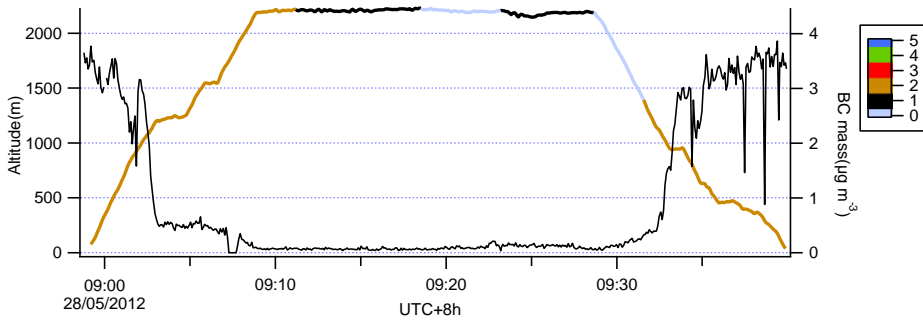
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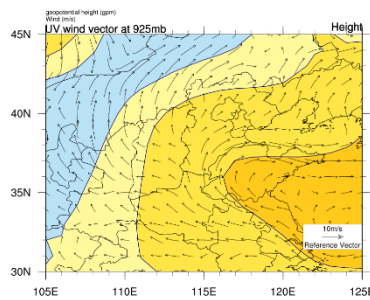
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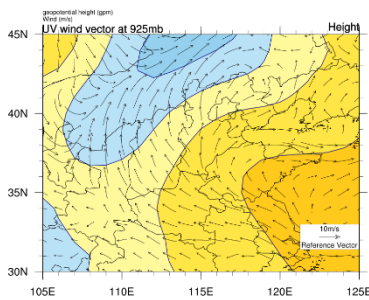
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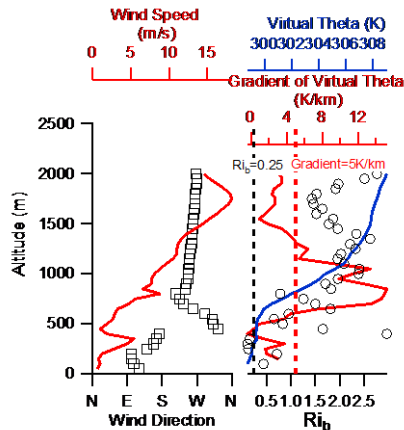
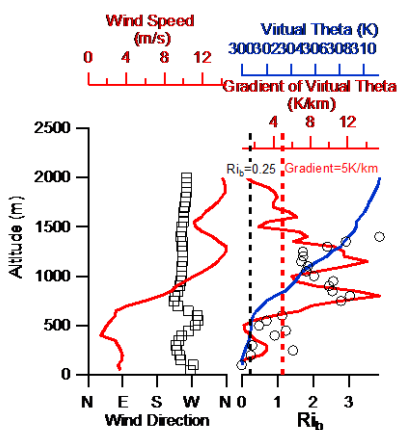
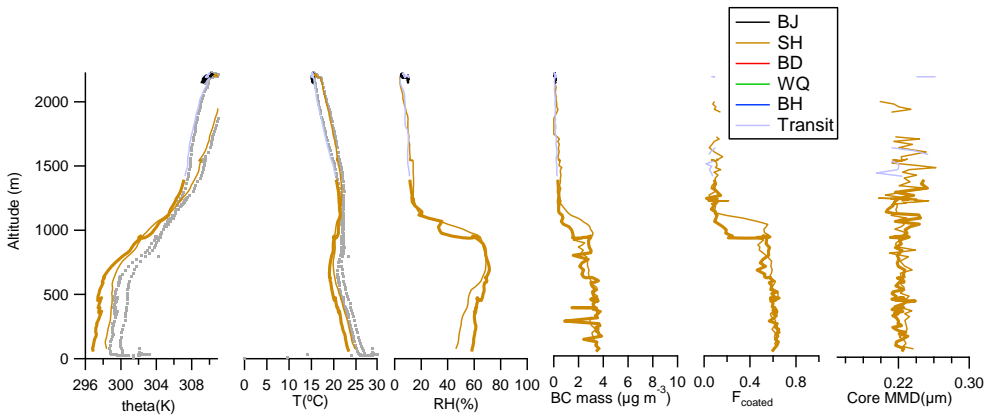
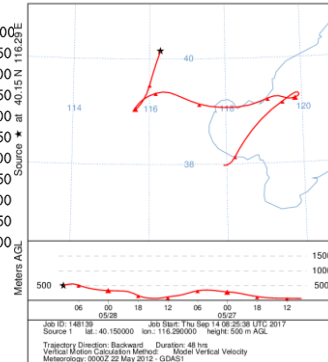
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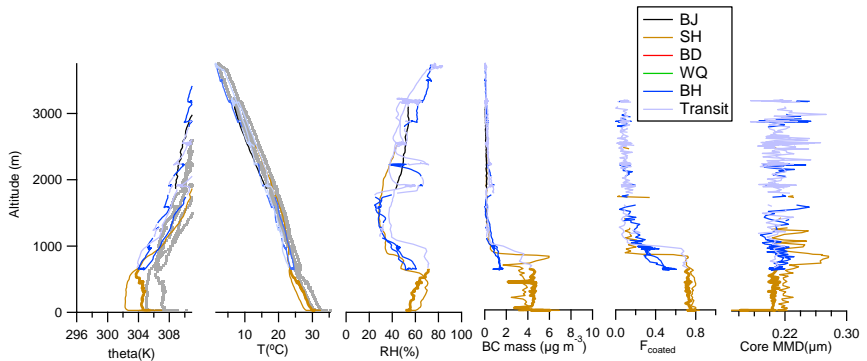
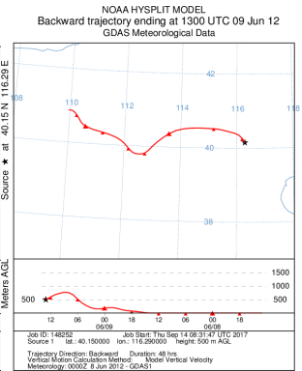
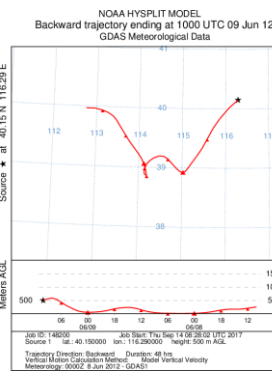
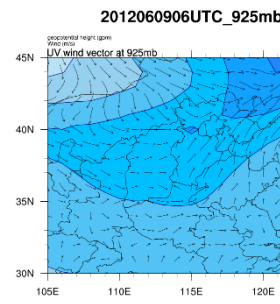
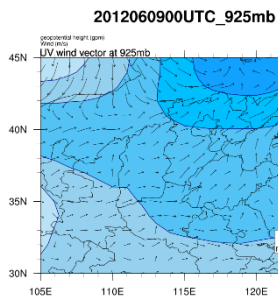
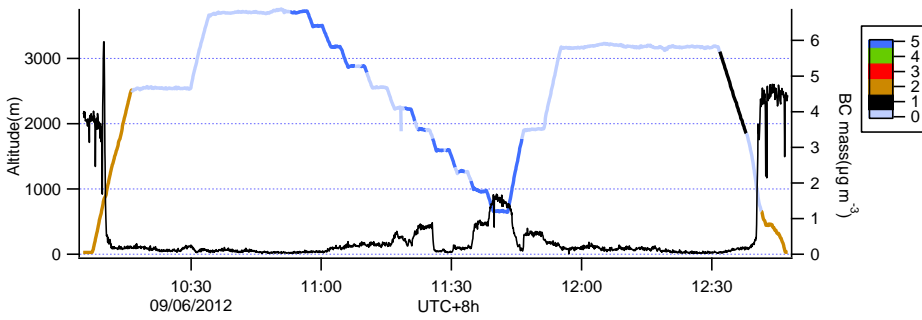


NOAA HYSPLIT MODEL
Backward trajectory ending at 0900 UTC 28 May 12
GDAS Meteorological Data

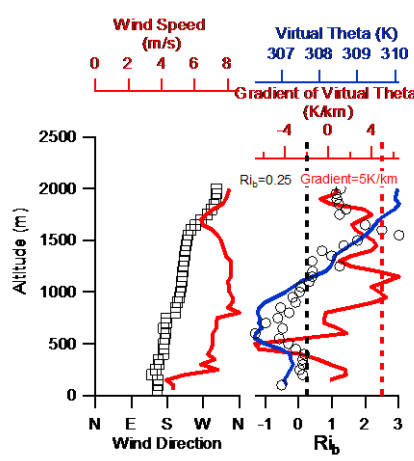
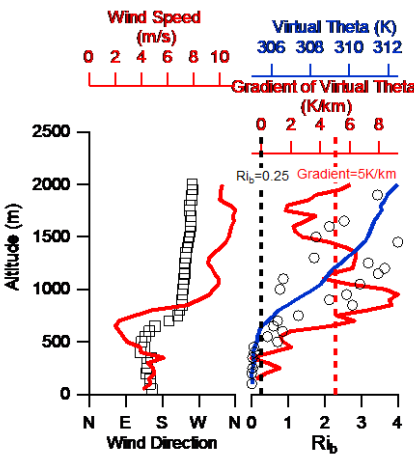


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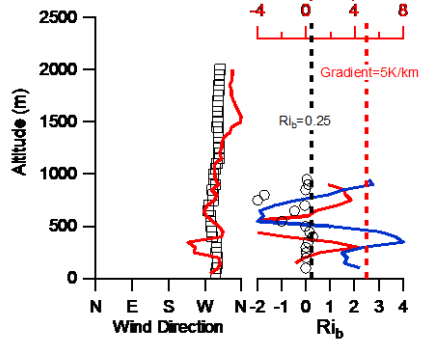
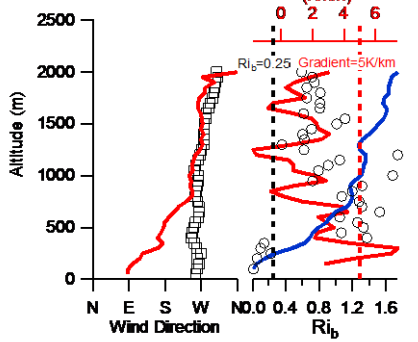
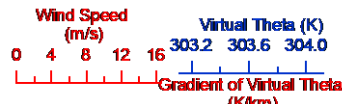
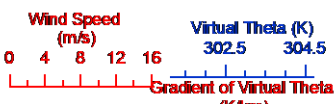
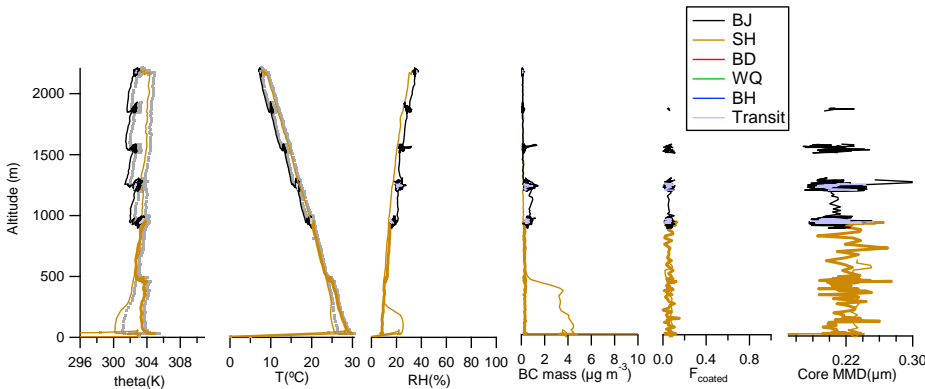
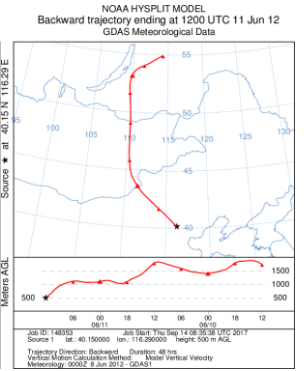
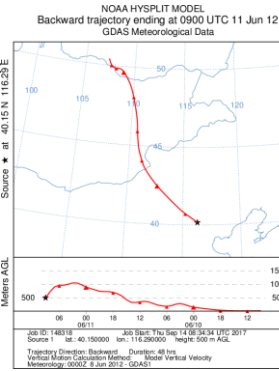
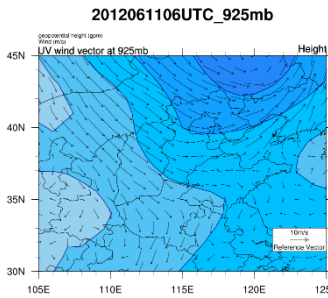
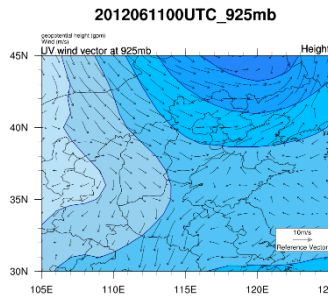
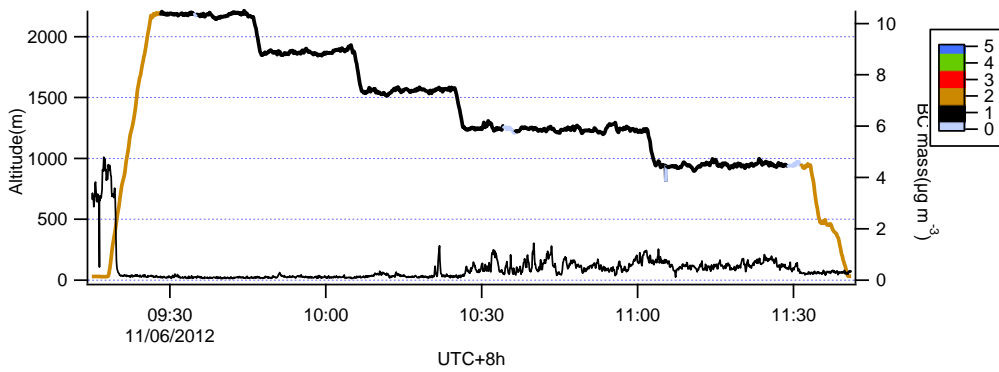
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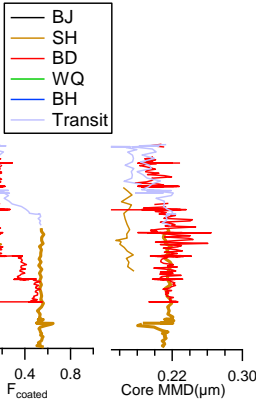
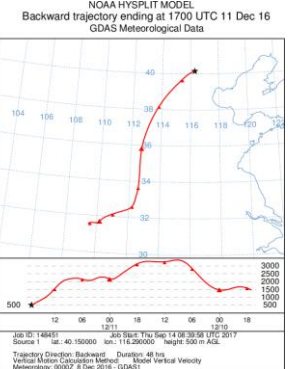
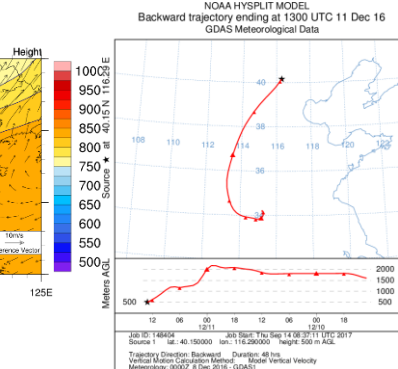
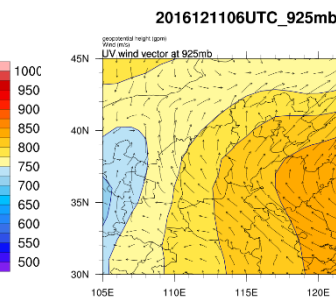
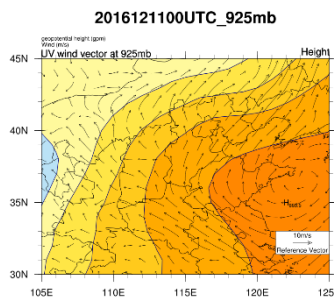
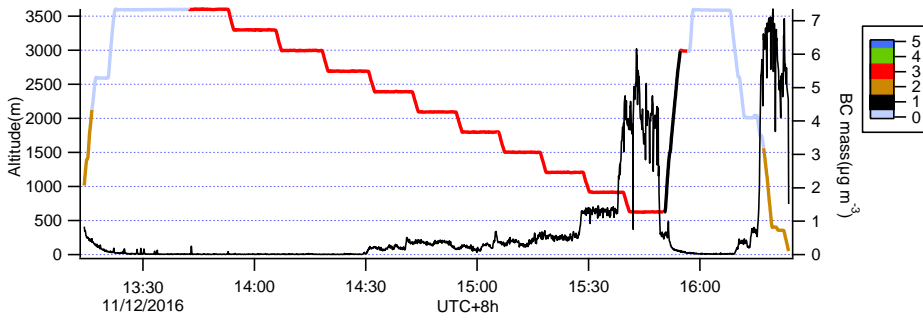


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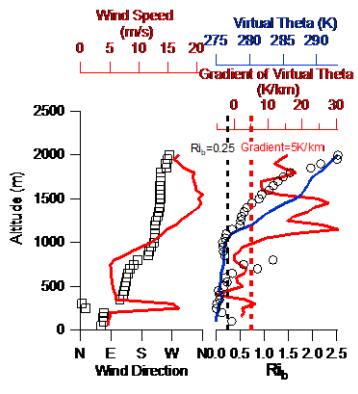


Winter flights

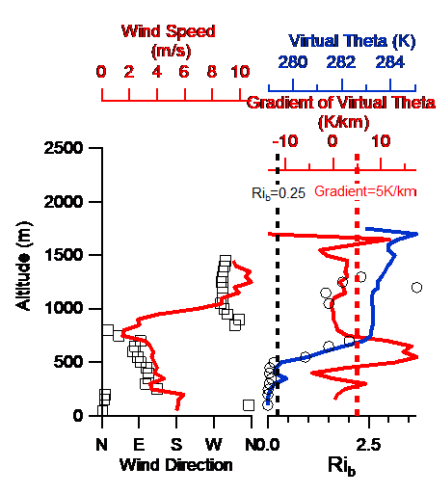
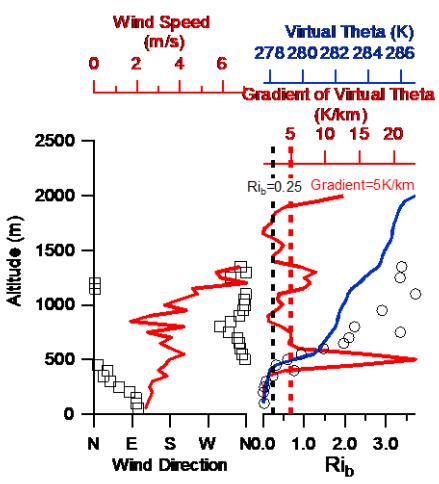
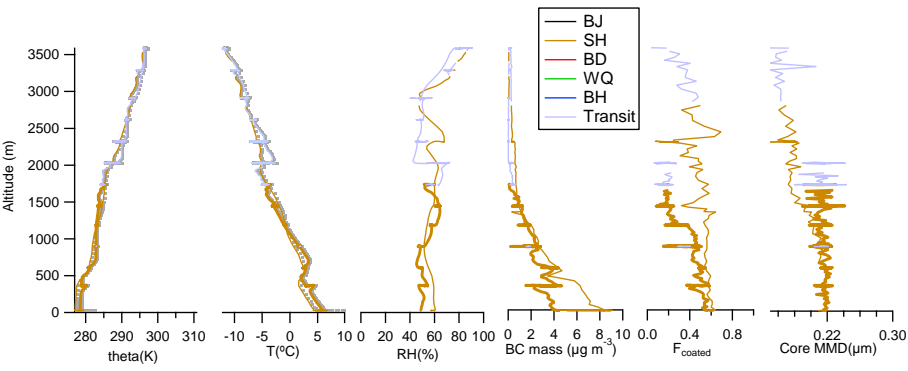
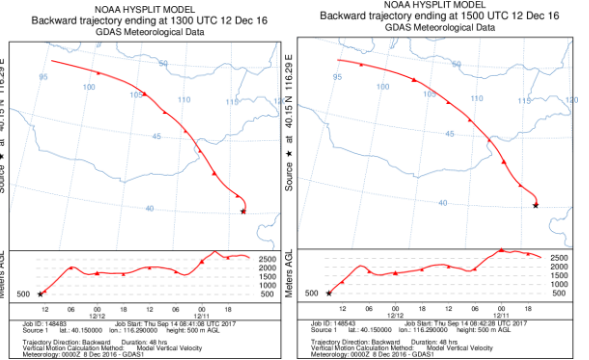
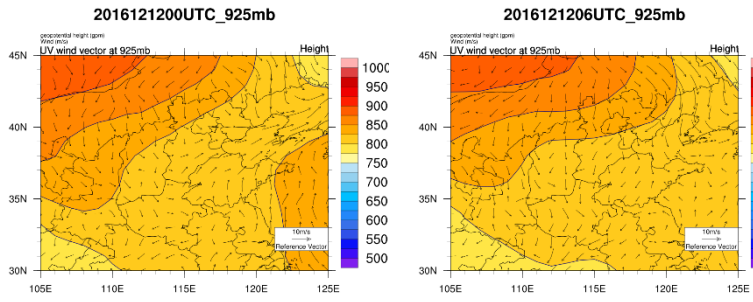
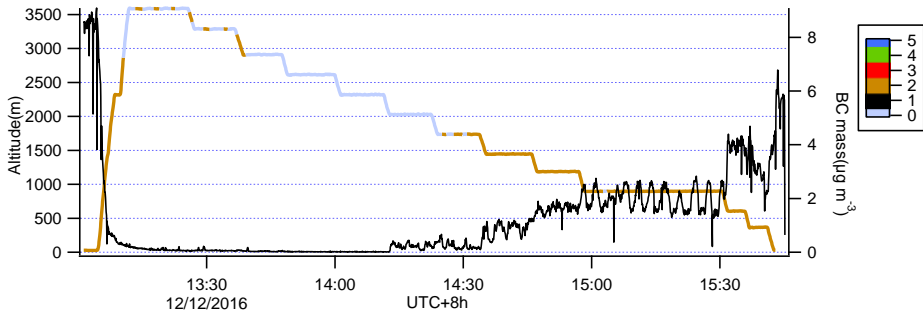
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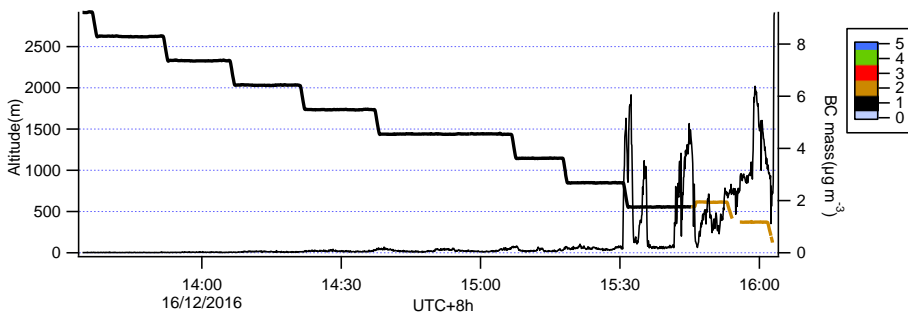


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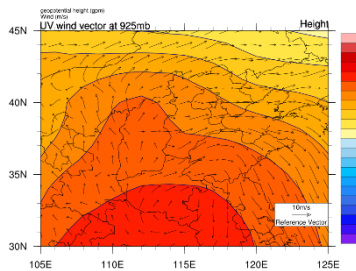


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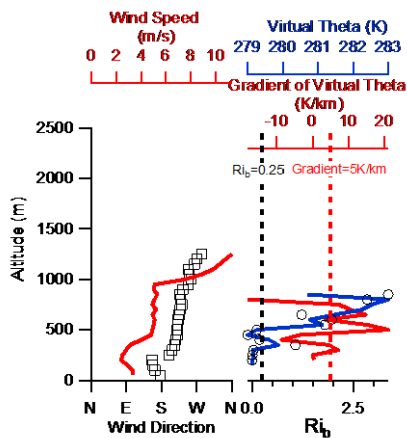
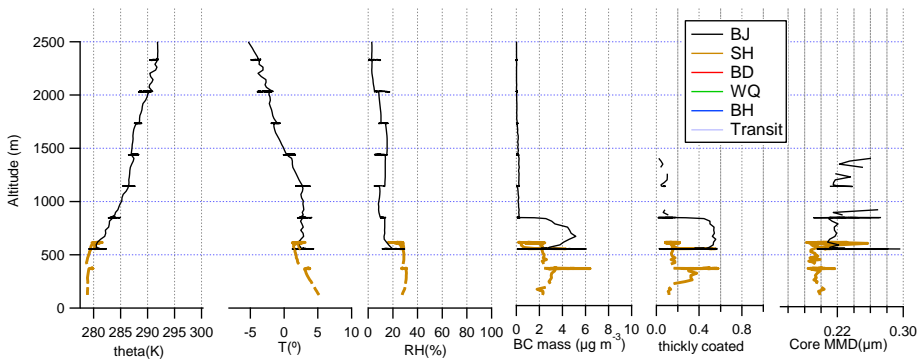
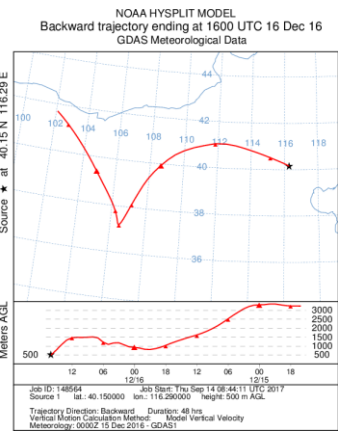
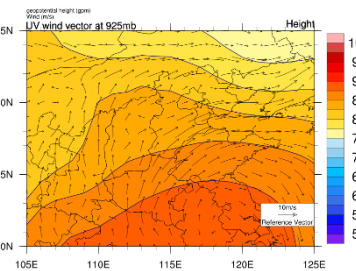
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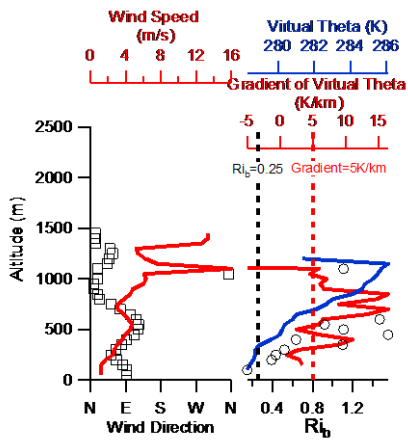
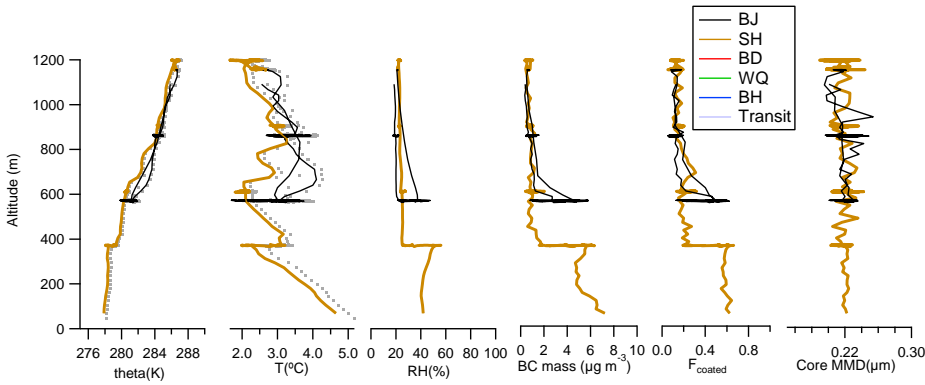
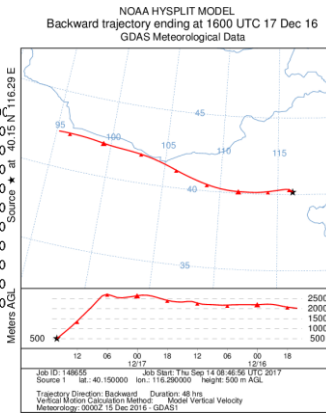
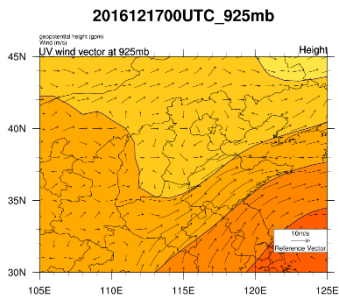
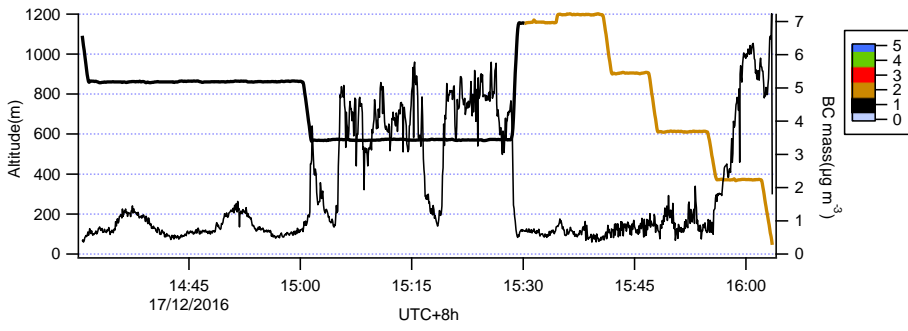


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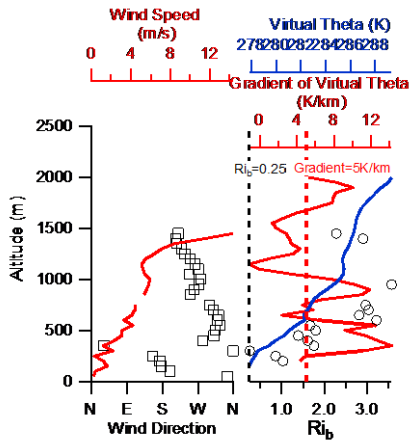
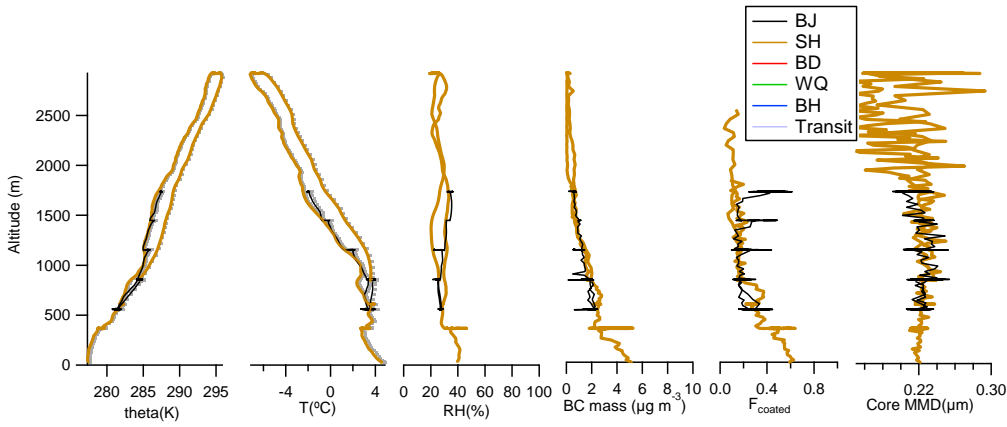
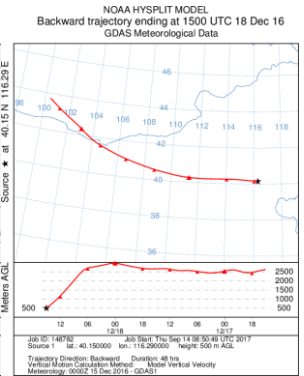
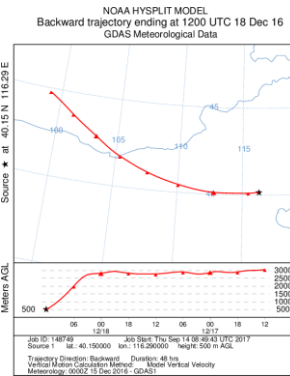
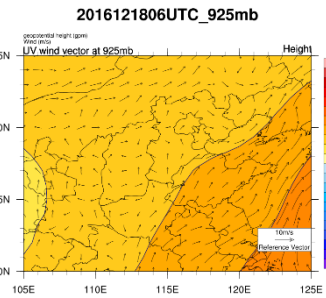
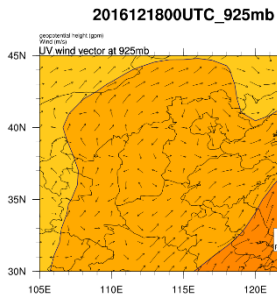
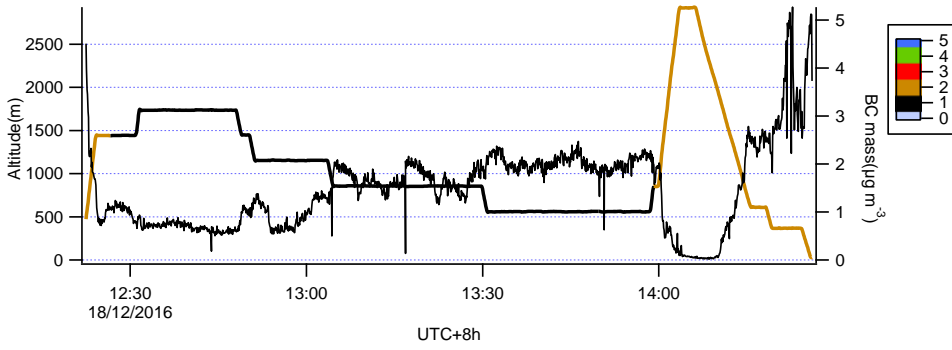


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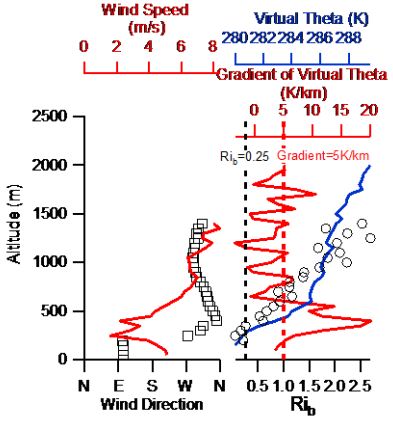
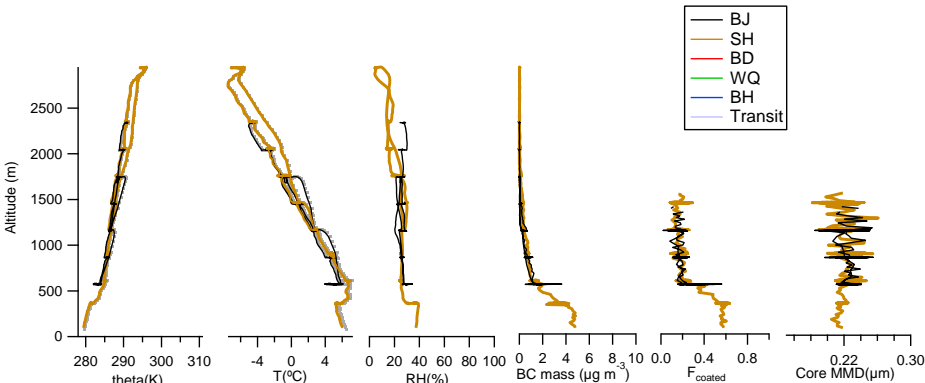
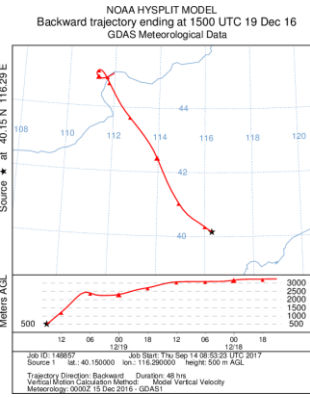
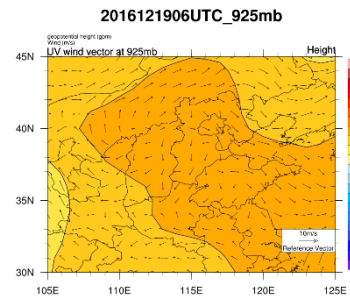
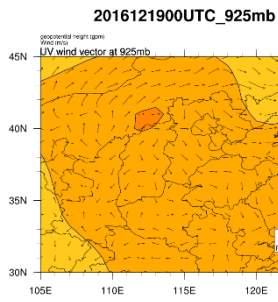
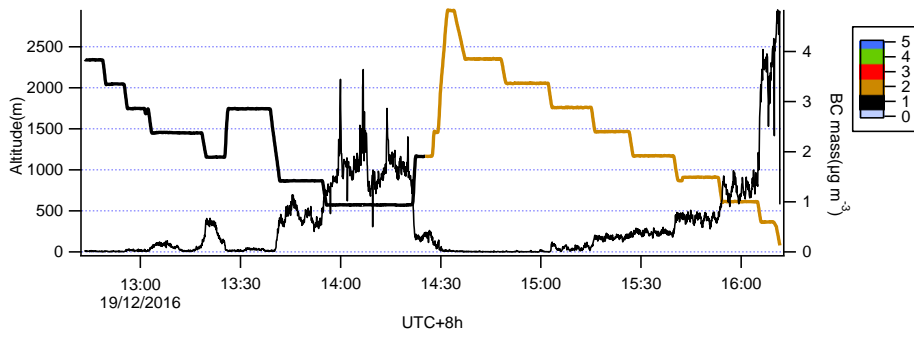
20161217



20161218



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Fig. S7. The identical plots for each flight, from top to bottom: flight track colored by aircraft locations; the synoptic wind field and pressure charts at geopotential pressure 925mbar for flight departure and return respectively; the HYSPLIT

backtrajectories over the last 48 hours initialized at the location of Shahe, 500m a.s.l. for departure and return respectively; the vertical profiles of potential temperature (the dash line is virtual potential temperature), the ambient temperature (the dash line is virtual temperature), RH, BC mass loading, BC thickly coated fraction, BC core mass median diameter (MMD), with the thicker lines indicating the return flight and the thinner ones are departure; the in-situ measured wind direction and wind speed, the right panel shows the criteria to determine the height of the planetary boundary layer, with dash lines showing the vertical gradient $d\theta_v/dz=5K/km$ and critical bulk Richardson number ($Ri_{b,c}=0.25$).

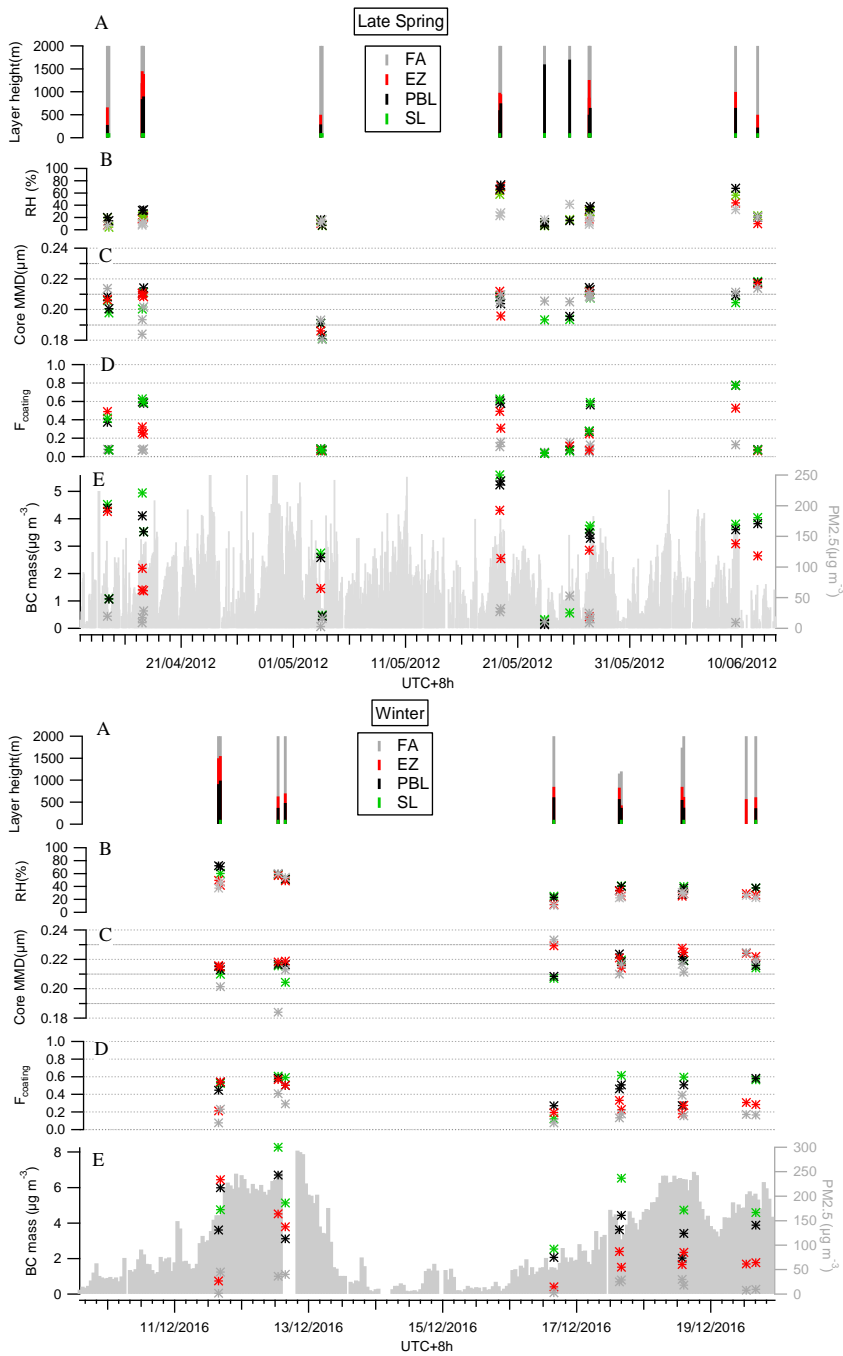


Fig. S8. A) the height of defined layers; B) averaged RH; C) mean BC core MMD; D) $F_{coating}$; E) BC mass loadings at different layers, with right axis showing the surface PM2.5. The top and bottom panel is for late spring and winter flights respectively.