

Supplementary Material

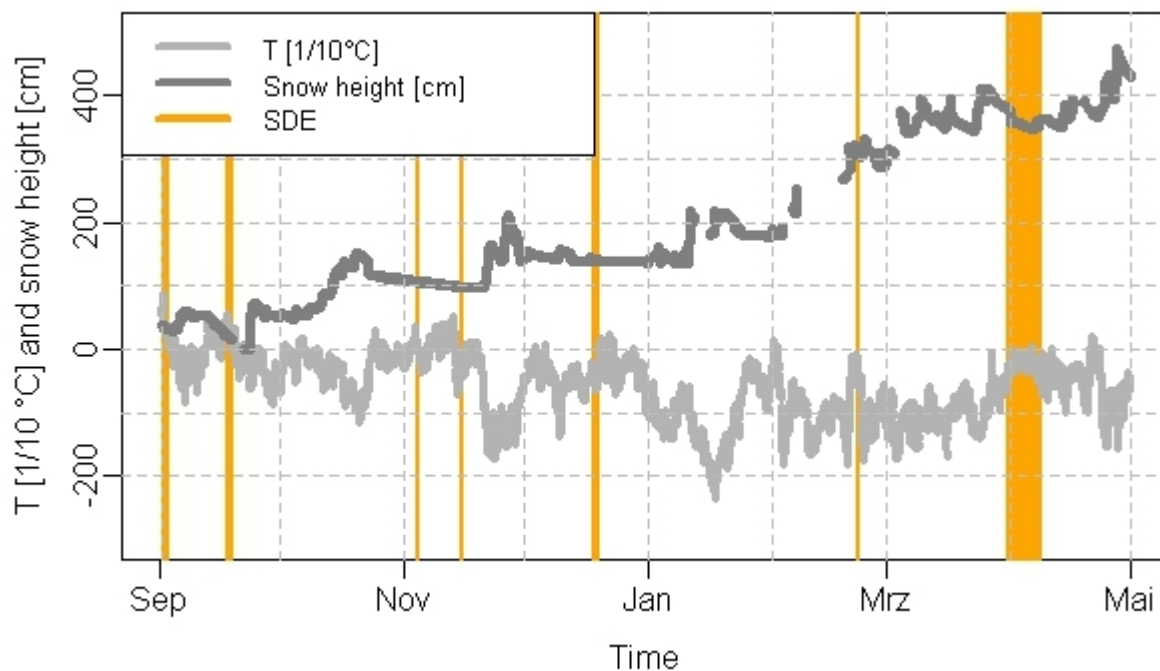
Contribution of Saharan dust to ion deposition loads of high alpine snow packs in Austria (1987-2017)

Marion Greilinger^{1,2,*}, Gerhard Schauer¹, Kathrin Baumann-Stanzer¹, Paul Skomorovski¹, Wolfgang Schöner³, Anne Kasper-Giebl²

*** Correspondence:**

Marion Greilinger

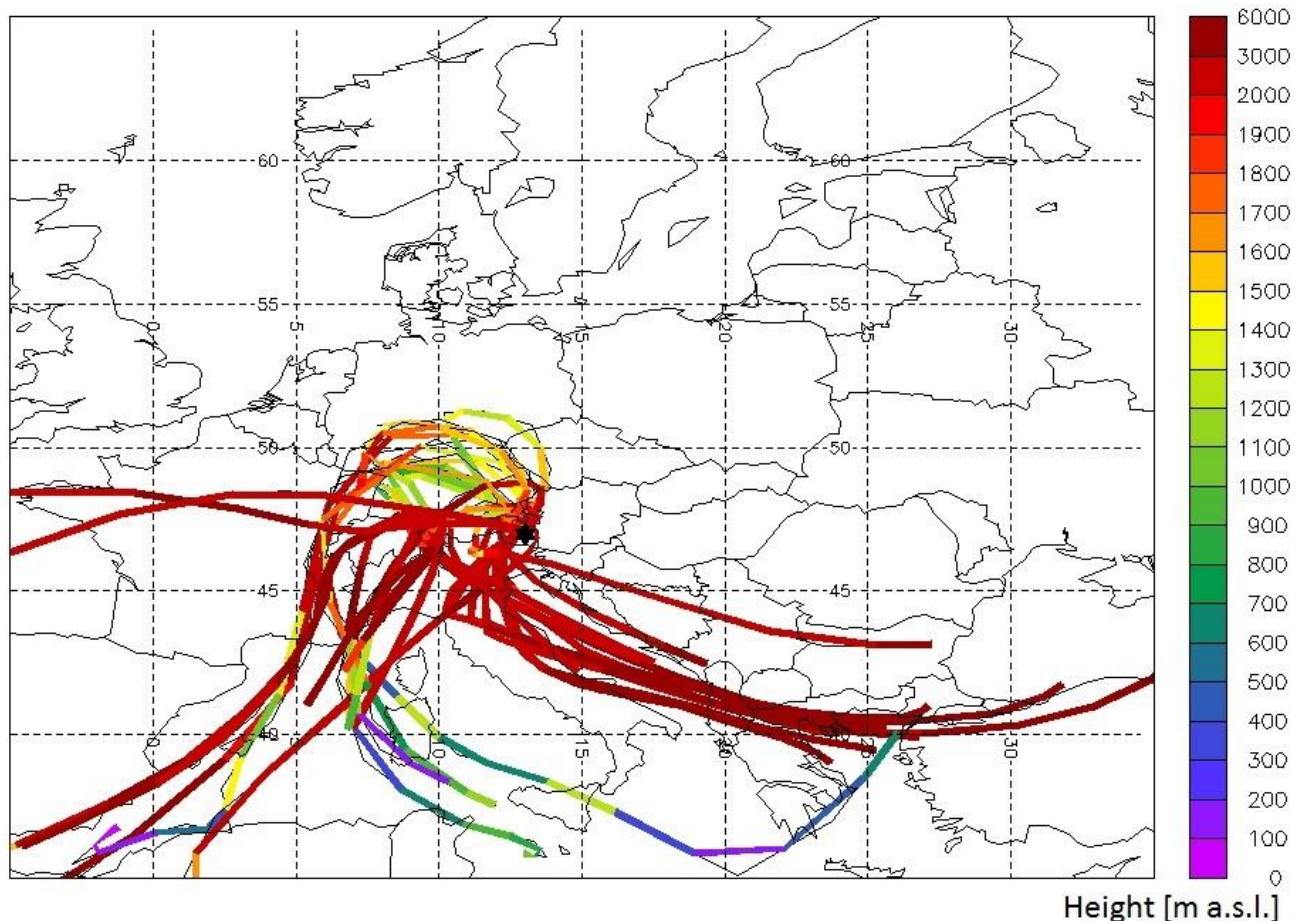
Marion.greilinger@zamg.ac.at



Supplementary Figure 1: Time series of T in [1/10°C] (lightgrey) and snow height in [cm] (darkgrey). SD episodes are marked in orange.

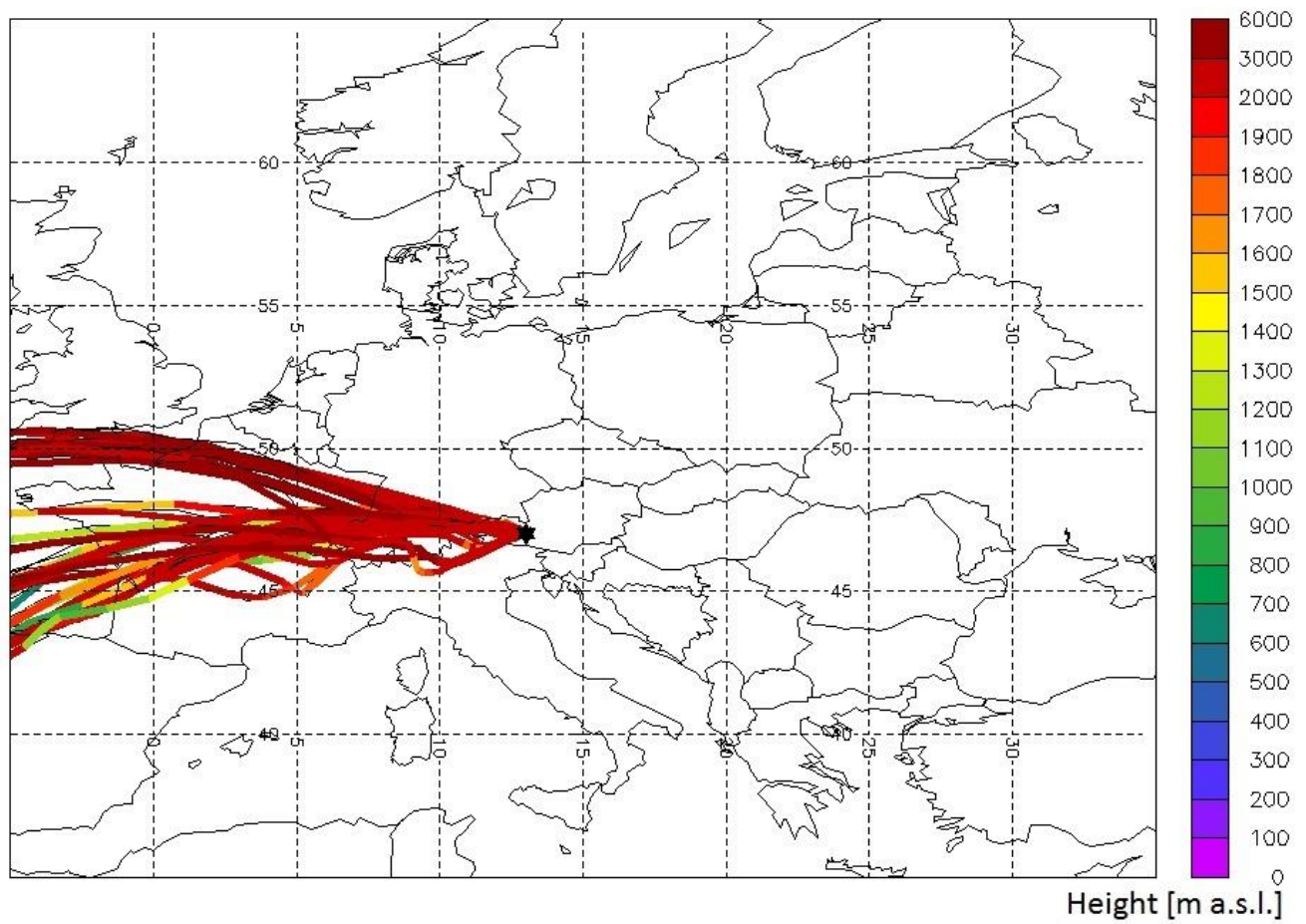
Evaluation of backward trajectories and aerosol measurements for the accumulation period 2015/2016

Backward trajectories indicate an influence of SD from 04.11.2015 until 07.11.2015. On-line aerosol measurements yield a positive DI on 04.11.2015 only, as particulate matter concentration on the following days were too low to allow reliable calculations. Thus trajectories were plotted for the whole time period between 04.11. and 07.11.2015. A number of trajectories originate from the Southwest and reveal that SD occurrence at the sampling site during part of this time period is very likely.

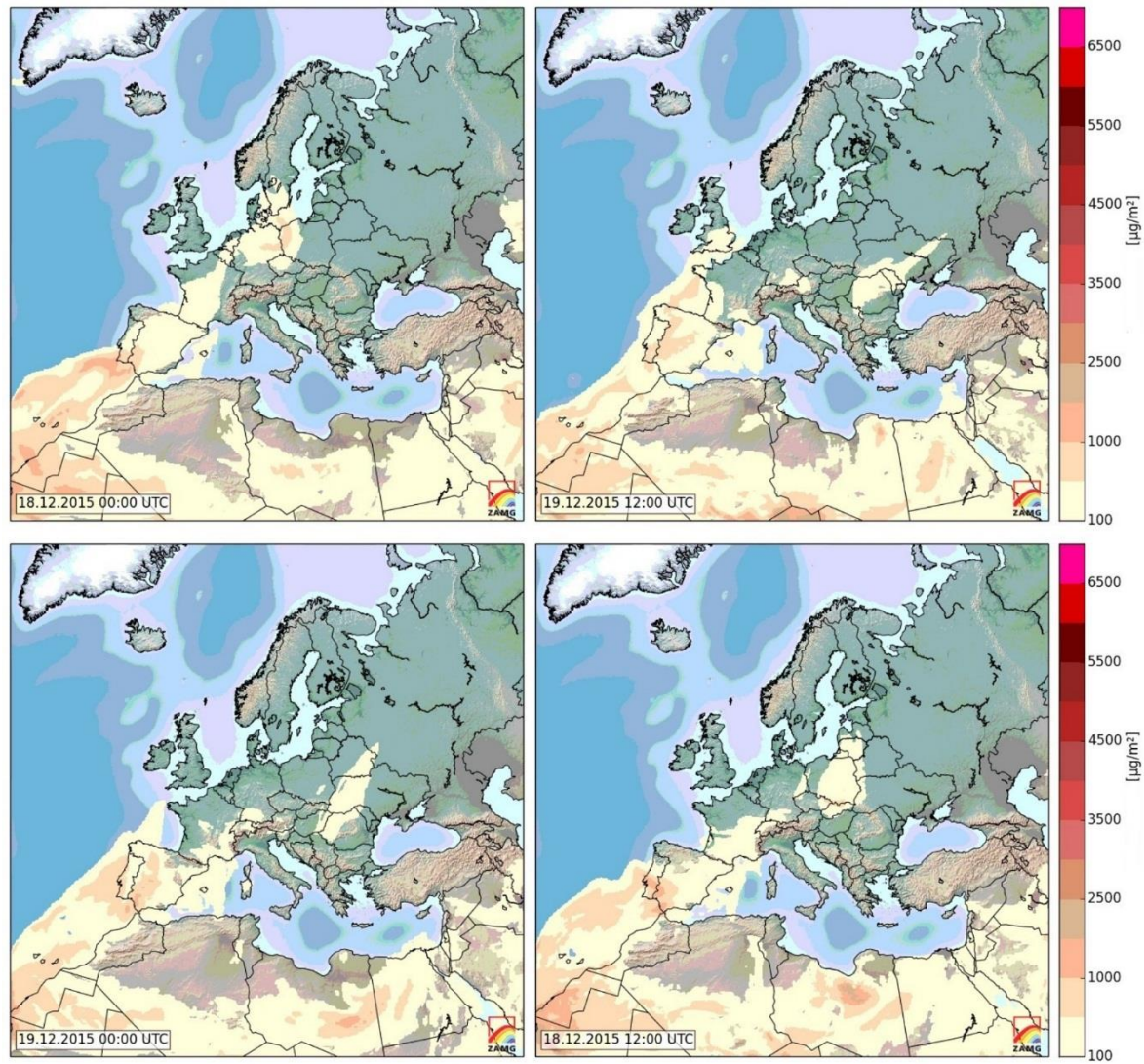


Supplementary Figure 2: 96 hours backward trajectories starting from the Sonnblick Observatory every three hours between 04.11.2015 00UTC and 07.11.2015 21UTC.

Furthermore aerosol measurements give a positive DI for 18.12.2015 and 19.12.2015. During these days backward trajectories show an influence of air masses from the west (Supplementary Figure 3), which seems surprising at a first glance. Comparing these results with the calculations of WRFChem model forecast calculations for these days according to Grell et al. (2005) the transport of SD from the West as shown also by the backward trajectories to western and even northern parts of Europe becomes visible (Supplementary Figure 4). Thus an influence of SD is also likely for the December period.



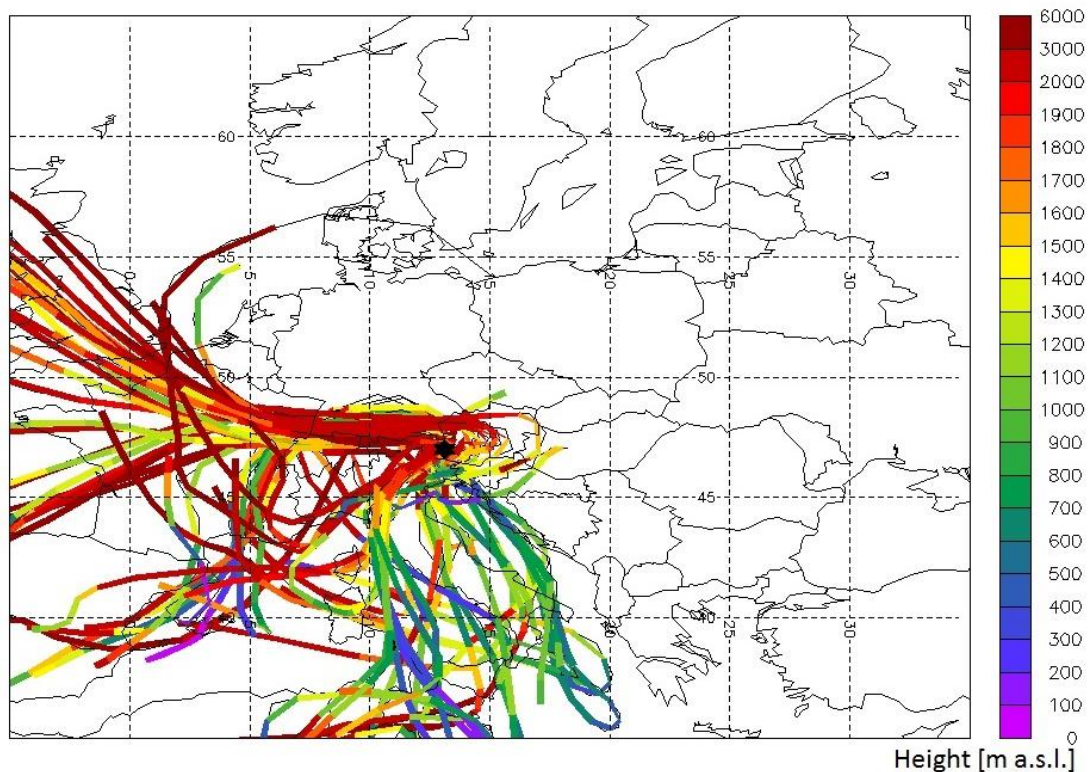
Supplementary Figure 3: 96 hours backward trajectories starting from the Sonnblick Observatory every three hours between 17.12.2015 00UTC and 20.12.2015 21UTC.



Supplementary Figure 4: Dust concentration over Europe (mg/m^2) in the whole air column up to 50 hPa simulated with WRFChem for 18.12.2015 00UTC and 12UTC as well as for 19.12.2015 00UTC and 12 UTC showing a SD influence over Austria or at least over Western Europe.

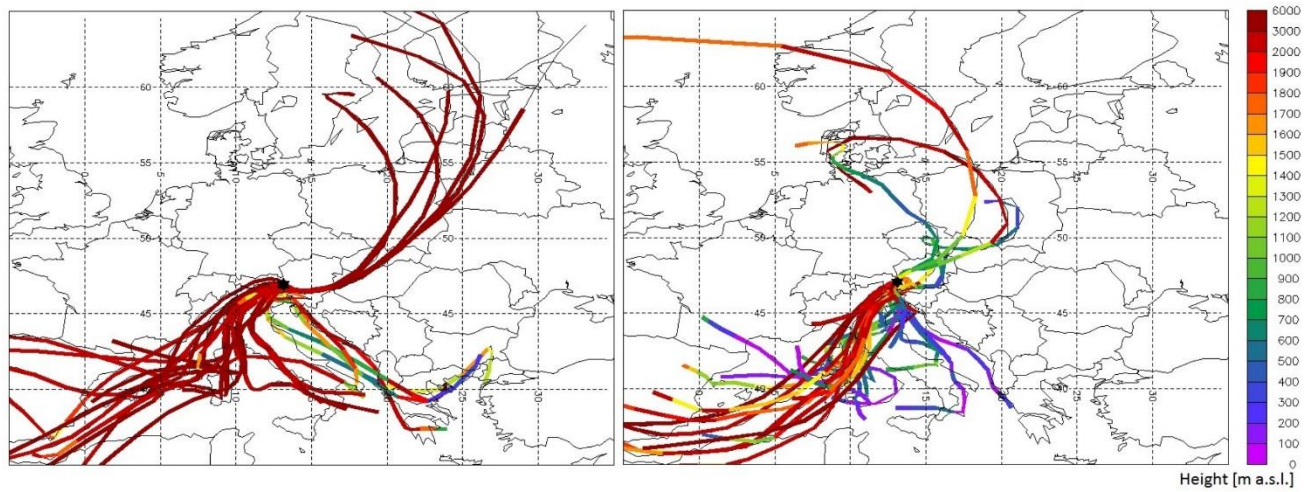
Evaluation of backward trajectories and aerosol measurements for the accumulation period 2016/2017

Backward trajectories as well as aerosol measurements indicate an influence of SD during two time periods in October 2016. Based on aerosol measurements an influence of SD is given on 15.10.2016 and later again on 24.10. and 25.10.2016, while backward trajectories point to slightly longer periods (15.10. - 19.10. 2016 as well as 23.10. - 25.10.2016). Note that the DI determined via aerosol measurements is just reported for mass concentrations above $5 \mu\text{g}/\text{m}^3$. Supplementary Figure 5 summarizes backward trajectories determined for the whole time period of 15.10. until 25.10.2016. Trajectories from the South reveal that SD occurrence at the sampling site during that time is very likely. In between (20.10. – 22.10.2016) trajectories originating from the West are recorded.



Supplementary Figure 5: 96 hours backward trajectories starting from the Sonnblick Observatory every three hours between 15.10.2016 00UTC and 25.10.2016 21UTC.

During spring 2017 trajectory analyses reveal an influence of air masses originating from the South or Southwest for a time period in February 2017 and March 2017 (Supplementary Figure 6). Thus the occurrence of SD at the sampling site again is very likely and is confirmed by on-line aerosol measurements (SDI indicating SD during 12.2.-14.2.2017, as well as on 23.3. and 24.3.2017).

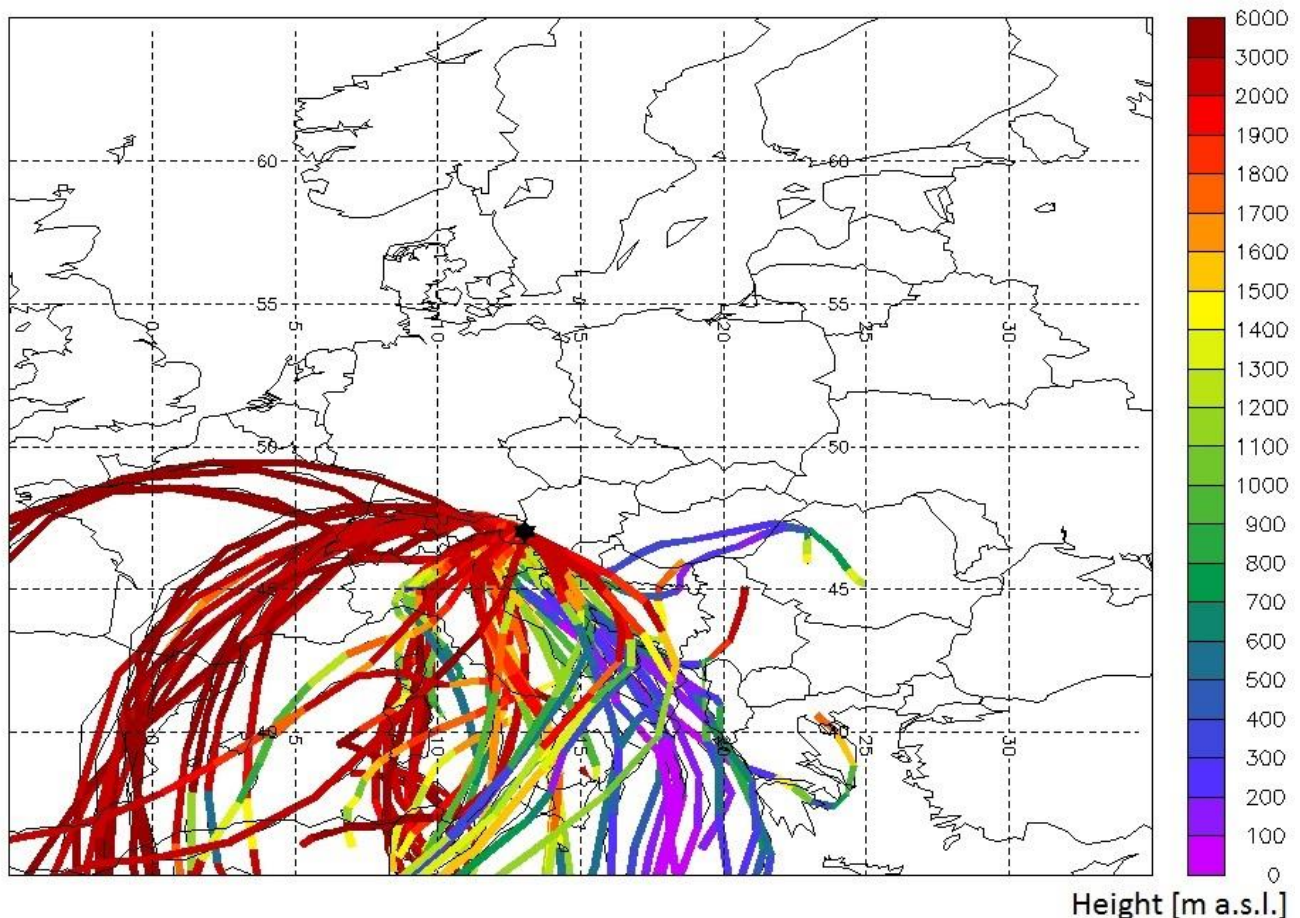


Supplementary Figure 6: 96 hours backward trajectories starting from the Sonnblick Observatory every three hours between 12.02.2017 00UTC - 15.02.2017 21UTC (left) and 23.03.2017 00UTC - 26.03.2017 21UTC (right).

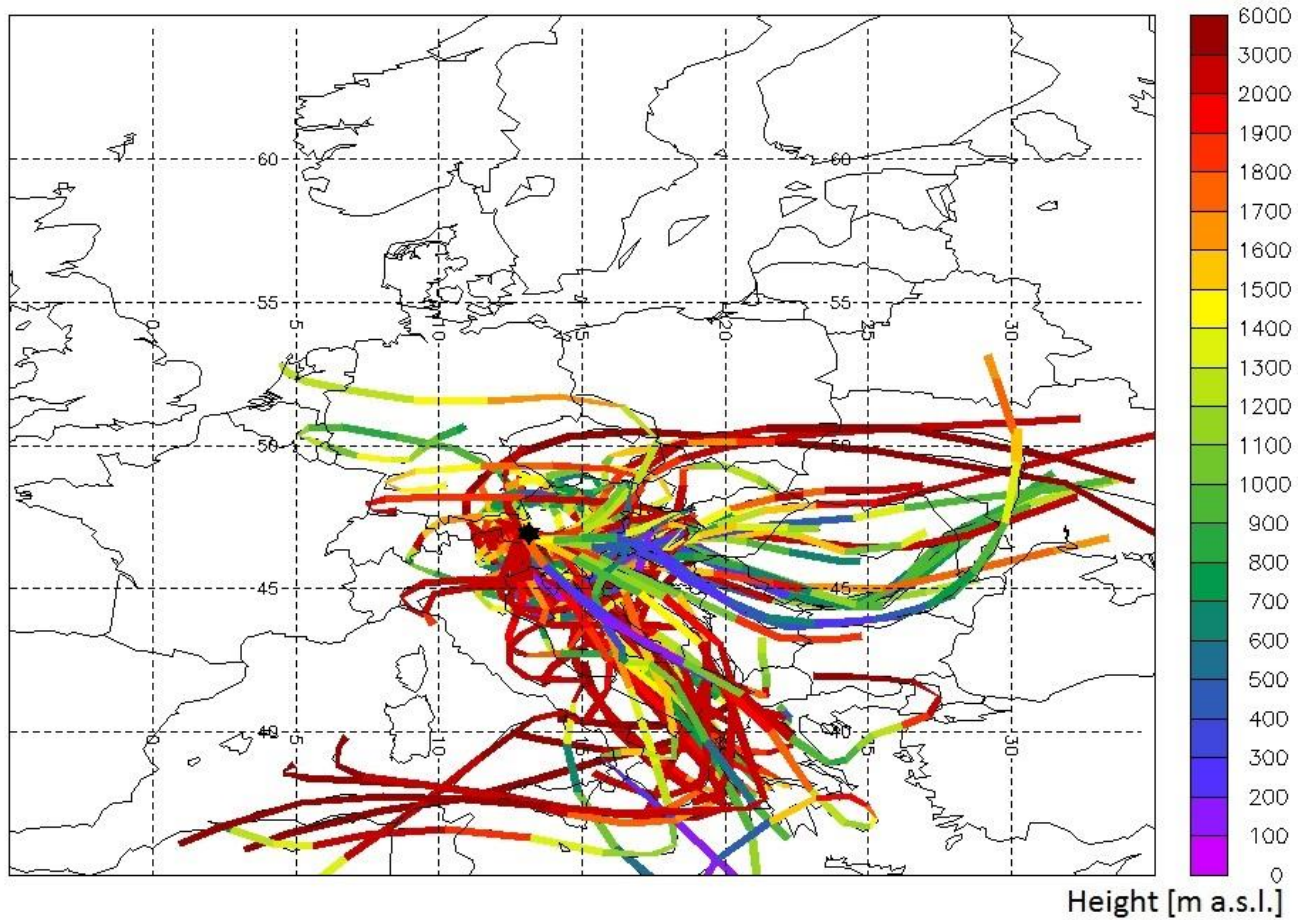
Evaluation of backward trajectories and aerosol measurements for the accumulation period 2014/2015

Backward trajectories as well as aerosol measurements indicate an influence of SD during late November and early December 2014. Supplementary Figure 7 summarizes backward trajectories determined for the time period of 24.11. until 03.12.2014. Most of the trajectories originate from the South revealing that SD occurrence at the sampling site during that time is very likely. The SDI determined by aerosol measurements pointed to SD for most of the days (24.11., 25.11., 26.11., 01.12., 3.12.2014).

Another time period with backward trajectories originating from the South was observed during March 2015. However, the situation during the respective time period (17.3. – 26.03.2015) was less pronounced. Aerosol measurements point to an influence of SD during 18.3., 21.3., 23.3., 24.3. and 25.3.2015.



Supplementary Figure 7. 96 hours backward trajectories starting from the Sonnblick Observatory every three hours between 24.11.2014 00UTC and 03.12.2014 21UTC.



Supplementary Figure 8. 96 hours backward trajectories starting from the Sonnblick Observatory every three hours between 17.03.2015 00UTC and 26.03.2015 21UTC.