EMS Annual Meeting Abstracts
Vol. 14, EMS2017-322, 2017


# Trends in airborne atmospheric observations

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The atmosphere is a very dynamic three-dimensional subject and the underlying earth surface is full of relevant details. Only platforms able to either probe the atmosphere on different altitudes (in-situ), or observing the surface and the atmosphere by remote sensing methods, are able to provide enough information for process studies, or to feed and verify numerical models.
The list of standard methods for such four-dimensional observations is well known (satellites, precipitation radars, wind profilers, LIDAR for wind, aerosols and other constituents, balloon soundings, etc.). Also the use of aircraft of different sizes for such observations is known since more than 100 years.
When looking into the fleet of research aircraft in Europe (e.g. via EUFAR), or worldwide, we see an enormous variability of platforms, sensors and topics for which these platforms are used. Most applications are for episodic process studies. However, some of them are serving for systematic observations such as AMDAR, daily drop sondes, or frequent observations of the earth's surface.
This talk will give an overview from the perspective of a group of scientists operating small research aircraft since more than 30 years. Which were the main achievements during the last decade? Which applications might be replaced by satellites or RPAS (Remotely Piloted Airborne Systems, also known as UAV or 'drones') in the near future? Which might be the remaining strong applications, where neither satellites, ground based remote sensing nor RPAS could cope with? What are the new options we would have when combining classical airborne observations using manned aircraft with autonomous systems?
One of the advantages of small environmental research aircraft (or some other classical airborne platforms) are the high flexibility and short reaction time, which became evident, when successful measurements were possible within the volcanic ash cloud spreading over Europe in April 2010.
Another strong application with relevance for society is estimating the emissions of Green House Gases (GHG) from individual sources, or regions.
The progress in numerical analysis and forecasting, with increasing resolution on a widening spacial and temporal scale has further increased the need for precise data. This might even be the trigger for new automated observation systems based on RPAS.
Finally, a new application realized with the small research aircraft METAIR-DIMO will be presented: An airborne wind LIDAR able to measure wind and turbulence (50 Hz) 50 m below the aircraft.