Tropospheric/lower stratospheric radar winds for rocket launch support at the Andøya Rocket Range

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17th ESA Symposium on European Rocket and Balloon Programmes and related Research, Sandefjord, Norway, 30 May - 2 June 2005.

Introduction

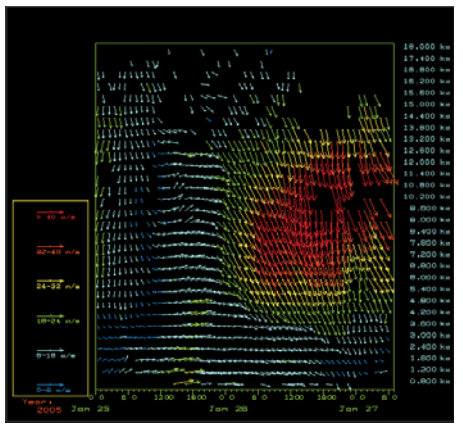
Andoya Rocket Range (ARR) is the world's northernmost permanent launch facility for sounding rockets and scientific balloons and is responsible for all scientific-related balloon and rocket operations in Norwegian territory. The high latitude location (69°N) provides favorablel conditions for studying various atmosphere and ionosphere phenomena using rockets, balloons, aircraft and ground-based instruments. The ground-based instruments comprise various lidar experiments as well as radar systems in the MF, HF, and VHF range which cover altitudes from the tropo/stratosphere up to the mesosphere/lower thermosphere.

One of these ground-based instruments is the ALWIN MST radar at 53.5MHz . The system was installed in 1998 to investigate the dynamics and structure of the tropo/stratosphere and especially the mesosphere during summer time. The ALWIN radar performs real time wind measurements in the lower atmosphere between about 1.2 km and 16 km from the very beginning of its operation at Andenes. Winds are measured in a continuous mode using the Doppler beam swinging technique (DBS) or the spaced antenna (SA) method.

Since December 2004 hourly radar wind profiles are automatically sent to ARR launch control. The wind profiles are used in Launch Control to monitor the launch conditions and possible wind changes.

In January 2005 the ROMA campaign for studies of the thermal and dynamical structure of the middle atmosphere in winter was carried out at Andenes. One part of the campaign was the so called LEWIZ salvo which was focussed on the observation of inertia-gravity waves generated by a tropospheric jet stream during a Rossby wave breaking event. Such an event was predicted for January 25 with a maximum at about 18:00 UT. Difficult weather conditions combined with strong ground winds prevented the launch of the meteorological rockets again and again and extended the observations of this long lasting event until January 27.

The wind situations between 1 and 16 km was completely monitored by the ALWIN radar using different methods for estimation of wind speed and direction. The reliability of the height profiles of the radar winds have been validated by insitu wind measurements using co-located radiosonde and Rawinsonde soundings.



Comparison of wind measurements by radar and co-located radiosondes during the ROMA campaign in January 2005

Estimation of horizontal winds by different techniques

- FCA: spaced antenna winds (Full Correlation Analysis)
- DBS-m: 5-beam Doppler winds (spectral moment)
- DBS-s: 5-beam Doppler winds (spectral fit)
- RS: Radiosonde (sippican)

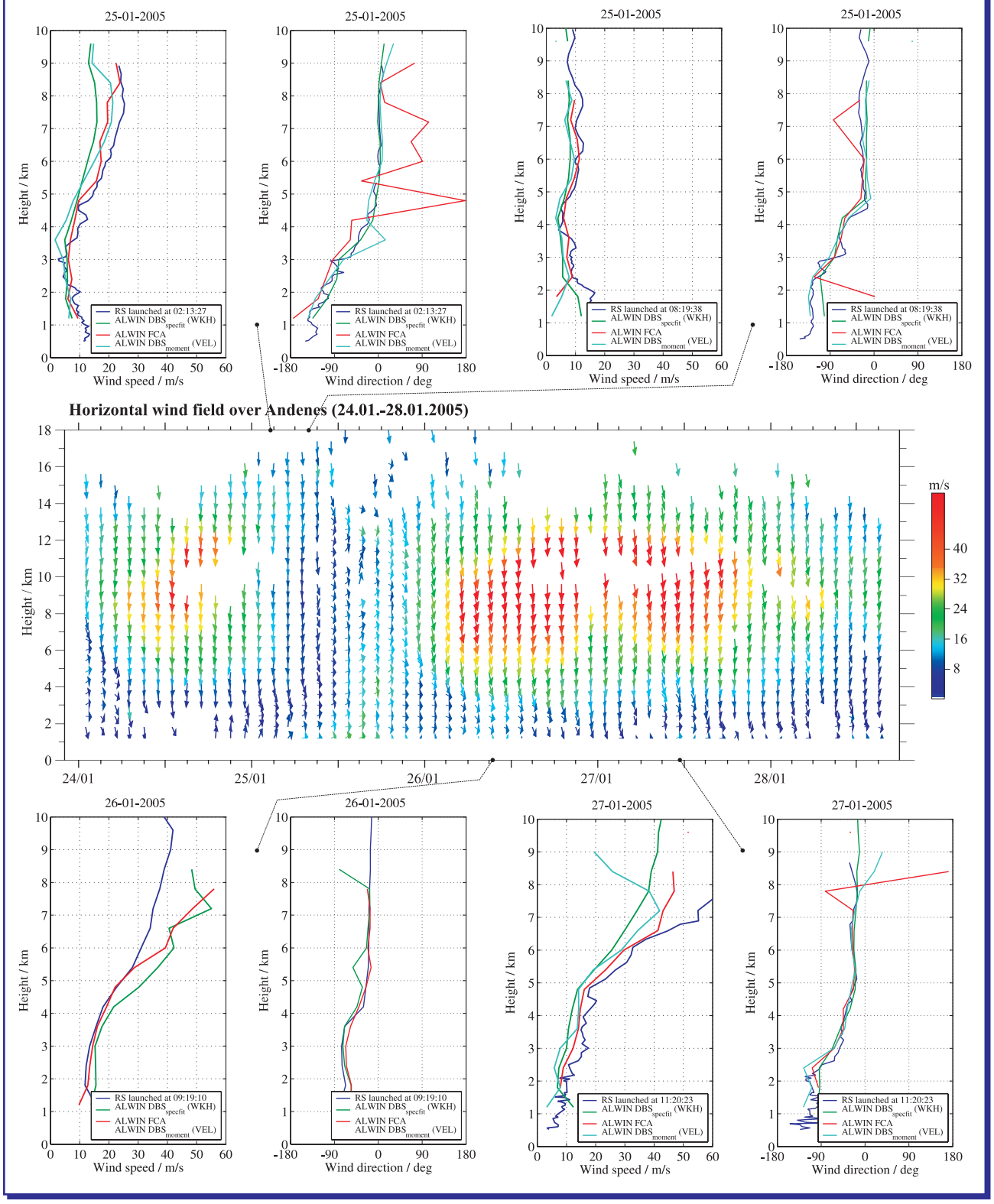
Wind speed

The magnitude of radar winds is in good agreement with insitu winds at low wind speeds (25 January).

The magnitude of radar winds is in most cases lower than the insitu winds at altitudes above about 6 km (27 January) but exceptions exist (26 January).

Wind direction

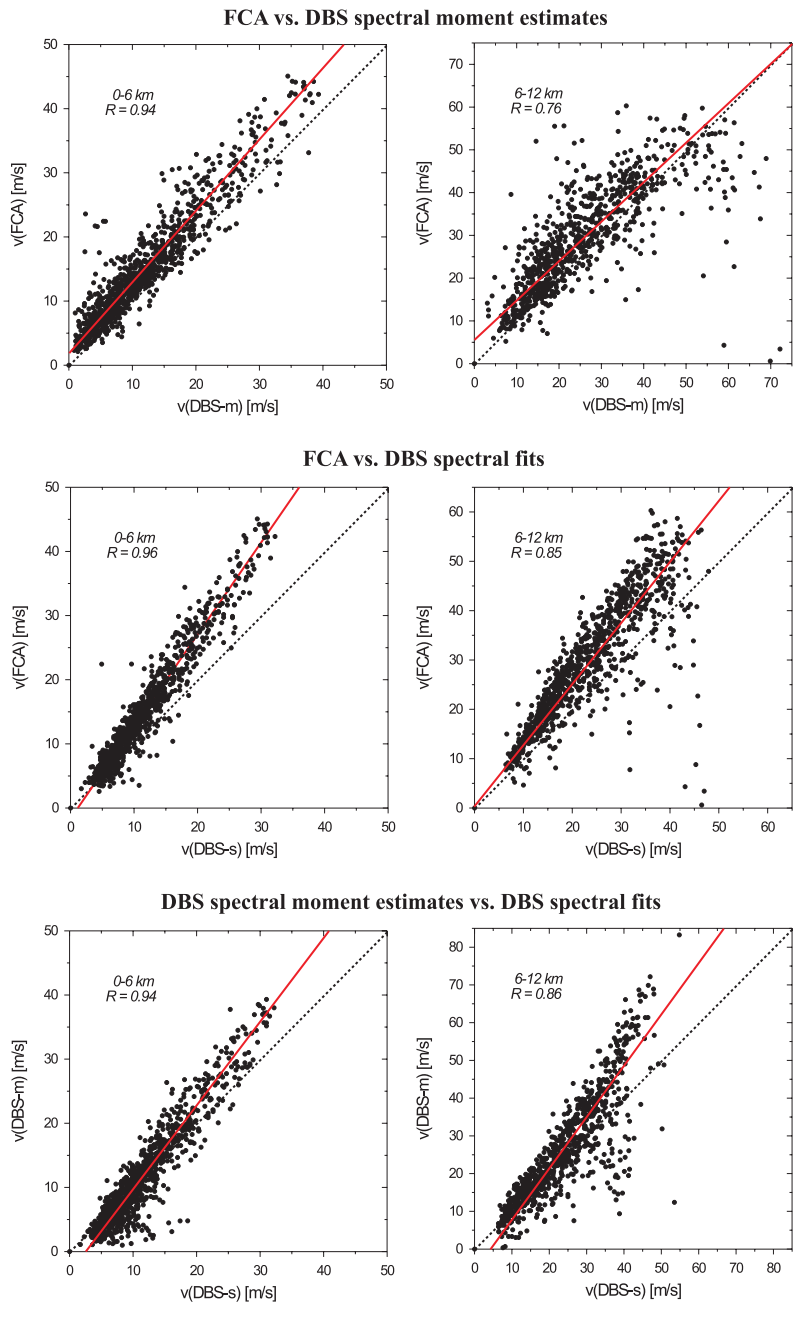
The wind direction determined by all radar techniques is at all altitudes in good agreement with the insitu observations.



Inter-comparison of different radar methods to estimate horizontal winds

Continuous wind measurements applying the spaced antenna method (FCA) and the Doppler method using spectral moment estimates (DBS-m) and spectral fits (DBS-s) are compared for the period from 24 to 28 January 2005.

Scatter plots of hourly mean winds are presented for two altitude ranges 1.2 to 6 km and 6 to 12 km in total 900 data points for each region.



The wind magnitude determined by the three methods is in good agreement for wind speeds lower than about 20 m/s at altitudes below 6 km and lower than about 25-30 m/s at altitudes between 6 and 12 km.

During the period under investigation the spaced antenna technique provided the highest magnitude.