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Ground-based Rayleigh-Mie Doppler wind lidar: design, observations and proposal for ADM-Aeolus cal/val

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A unique Rayleigh-Mie Doppler wind lidar, measuring Doppler shift between the emitted and backscattered light by means of a Fabry-Perot interferometer is deployed at Observatory of Haute-Provence (Southern France) and at Reunion island (tropical Indian Ocean). The technique was shown capable of wind measurements between 5 and 50 km with accuracy better than 1 m/s up to 30 km. The system consists of a monomode Nd:Yag laser operating at 532 nm, three telescopes and a double-edge Fabry-Perot interferometer. The laser light is sent alternatively in the vertical as well as zonal and meridional directions at 45° from the zenith using a rotating mirror. The two components of the horizontal wind are obtained from the measurement of the Doppler shift of the return signal spectrally filtered by a double-edge Fabry-Pérot etalon. The vertical pointing is used to obtain zero Doppler shift. After demonstration of the method in 1989 at Observatory of Haute-Provence the measurements were used for studying mesoscale wind fluctuations and intertia-gravity waves in the mid-stratosphere as well as for constructing wind climatology up to 50 km altitude. A new system, featuring a more compact design was installed at Maïdo observatory at Reunion island (22° S). The design of the instrument, the results of observations and comparisons against GPS radiosondes are presented.
The European Space Agency (ESA) Atmospheric Dynamic Mission (ADM-Aeolus) aimed at providing global observations of wind in the lower and middle atmosphere using 355 nm Doppler lidar ALADIN is expected to be launched in late-2015. A similarity of the measurements techniques exploited by ALADIN system and by the French ground-based Doppler lidar makes the latter an attractive mean for Aeolus validation. We present a proposal for ADM-Aeolus cal/val activities based on the operations of two wind lidars operating at mid-latitude and tropical sites. These activities include a pre-cal/val phase aimed at development of a spatial-temporal collocation criteria for gound-based/satellite measurement match. An advantage of the Doppler lidar with respect to conventional GPS radiosondes is that the lidar provides continuous high-resolution wind measurements that can be used to determine temporal collocation criteria for validation of ADM-Aeolus. The spatial collocation criteria will be defined using a dense radiosonde network in Europe.