

Global wind observational requirements and the hybrid observing system approach

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Abstract

Global forecast models currently assimilate direct wind observations from rawinsondes, ACARS, pibal balloons, surface met stations, buoys and ships. Additional wind information is inferred from scatterometers, cloud and water vapor motions and the modeled mass field. The distribution, accuracy and model utility of these various sources of wind data vary greatly around the globe. Observing System Experiments and Observing System Simulation Experiments continue to confirm that the greatest potential for improving global weather forecasts lies with a more advanced wind observing system(s) that provides global coverage.

As NOAA, NASA and the DoD entertain strategies for obtaining global wind coverage, the fundamental issue of data requirements remains to be resolved. In part, this is due to the fact that there is no reliable experience involving space-based wind observing systems (excluding cloud and water vapor motion winds). In addition, future global model resolution, 4DVAR and the treatment of the air/sea/land interface will make greater demands on direct wind observations than those levied by current global models. This paper will discuss expressing those wind observational requirements in terms of model response rather than stating simple accuracy and coverage thresholds.

For nearly three decades, serious consideration has been given to using laser-based sensors to obtain global tropospheric wind observations. Previous OSSEs have shown the potential for significant impact of such observations on weather forecasts, particularly in the Southern Hemisphere. More recent OSSEs have been designed to provide insight to the sensitivity of the models to varying degrees of global coverage and measurement accuracy. One early suggestion is that full tropospheric soundings of height independent resolution and accuracy may not be cost effective. The issue of cost-effectiveness is, of course, very technology dependent. Given that we are still in the early stages of instrument concept design and technology demonstrations, there is time to significantly impact the course taken to obtain global winds.

Based upon a series of studies funded by the IPO, a reasonable (and likely cost-effective) observing system based upon merging two different lidar technologies can be posed. This hybrid system would use molecules for observing (modest resolution and accuracy) winds under conditions of low aerosol concentrations (mainly mid and upper troposphere) and aerosols/clouds for observing (very high resolution and high accuracy) winds elsewhere (especially the PBL). Such a hybrid system may be able to achieve a very large measure of the "Holy Grail" of model impact in the near future and at a much smaller investment than would be required to obtain similar data products from a single technology system. This paper will argue that global models running routinely with order 10-25 km resolution will be realized before any DWL is launched and thus, resolving the ageostrophic component of the wind field must be considered in the design of any new wind observing systems.