

SWA Environment Laser Division: Doppler Wind Lidar Documents and Products

Collection of Published Calls for Global Wind Observations

(Steve Greco and Dave Emmitt)

- 1) "Importance of Global Doppler **Lidar Wind** Profiles From Space For Global Change Studies" by Robert Sadourny , Sixth. Symp. On Global Change Studies, Preprints, Amer. Meteor. Soc., (1995)

"After several decades of meteorological observations from space, the **wind** field still appears as the main missing link in our observing machinery. This has important consequences, not only for numerical weather prediction, but also for our knowledge and monitoring of atmospheric dynamics and climate dynamics."

- 2) "Importance of Global Doppler **Lidar Wind** Profiles From Space For Global Change Studies" by Robert Sadourny , Sixth. Symp. On Global Change Studies, Preprints, Amer. Meteor. Soc., (1995)

"...The tropical **wind** belt is obviously the place where direct **wind** measurements are most needed.....the tropical circulation relies heavily on divergent motion and angular momentum dynamics. Both aspects are critical to Global Change studies, as they govern possible changes in Hadley-Walker mass fluxes and meridional extent in a global warming process; still they are so poorly covered by the present observing system, which essentially relies on mass field observations, that the advent of a space-borne, direct **wind** measurement system for the Tropics would be a major step forward."

- 3) "Impact of analysis uncertainty upon regional atmospheric moisture flux" by Muyin Wang and Jan Paegle ; J. of Geophys. Res., Vol. 101, No. D3 (1996)

"**Wind** analyses show substantially better agreement than in earlier ECMWF and NMC analyses, but the relative uncertainty in

the **wind** analysis is significantly larger than the uncertainty in the moisture. These results support the inference that the noise/signal ratio of the moisture budget may be improved more rapidly by providing better wind observations and analyses than by providing better moisture data."

- 4) "The Impact of Omega **Dropwindsondes** on Operational Hurricane Track Forecast Models" by Burpee et al., Bull. Am. Meteorol. Soc., Vol. 77, No. 5. (1996)

"The middle- and lower-tropospheric ODW data produce statistically significant reductions in 12-60 h mean forecast error. The error reductions, which range from 16% to 30%, are at least as large as the accumulated improvement in operational forecasting achieved over the last 20-25 years. This breakthrough provides a strong experimental evidence that more comprehensive observations in the hurricane environment and core will lead to immediate improvements in operational forecast guidance."

- 5) "An Observing System Simulation Experiment for the Laser Atmospheric **Wind** Sounder (LAWS)" by Rohaly and Krishnamurti; J. Appl. Meteor., Vol. 32, (1993)

"The importance of **wind** observations in the specification of the initial state has been documented by several investigators. Daley (1980) speculates that a global observing system based primarily on the observations of the mass field will experience deficiencies in the tropic as well as higher latitudes.....In an analysis of FGGE data, Bengtsson (1981) shows that **wind** observations are the most essential input for numerical models-particularly in the tropics. This finding again supports a need for high- or even moderate-resolution **wind** observations globally"

- 6) "Assessment of the Impact of Simulated **Lidar Wind** and Retrieved 183 GHz Water Vapor Observations on a Global Data Assimilation System" by Hoffman et al., Mon. Wea. Rev., Vol. 118, (1990)

"The addition of lidar **wind** profiles in our **WINDSAT** experiment improved the initial state specification, especially in the Southern Hemisphere extra tropics."

7) "The Relative Importance of Mass and Wind Data in the FGGE Observing System" by Kalnay et al., Proceedings of the NASA Symposium on Global Wind Measurements, (1985)

"It is in this hemisphere (southern) that the use of satellite thermal winds has the largest potential for producing a significant improvement upon the current forecast skill. In the Northern Hemisphere, rawinsonde winds are already somewhat more important than temperatures. However, realistic simulation experiments indicate that lidar wind profiles with a better geographical coverage will result in improved numerical weather prediction in this (northern) hemisphere."

8) "Upper-Tropospheric Winds Derived from Geostationary Satellite Water Vapor Observations" by Veldin et al., Bull. Am. Meteorol. Soc., Vol. 78, No. 2, (1997)

"In particular, wind vectors derived from water vapor image sequences can compliment our existing observing system and provide positive impact on both qualitative and quantitative analyses of the atmospheric state.....Overall, assimilation of the wind information results in a reduction of mean forecast errors by 6%-13% over the 24-72 h forecast period..... The WVV (water vapor wind vectors) applications reported here have demonstrated the potential for analysis impact and make a strong case for enhanced remote sensing capabilities such as the Laser Atmospheric Wind Sounder..."

9) "The Impact of Multispectral GOES-8 Wind Information on Atlantic Tropical Cyclone Track Forecasts in 1995. Part II: NOGAPS Forecasts" by Goerss et al., Mon. Wea. Rev., Vol. 126, (1998)

"Overall, for all four cyclones, the NOGAPS forecasts made with the use of the UW CIMSS winds displayed relative improvement of forecast position error with respect to those made without the use of UW CIMSS winds of 14% at 24 h, and 12% at both 48 and 72 h..."

10) " Observations in Aid of Weather Prediction for North America: Report of Prospectus Development Team Seven" (Meeting Summary) by Emanuel et al., Bull. Am. Meteorol. Soc., Vol. 78, No. 12 (1997)

"Knowledge of the global wind field is widely recognized as fundamental to advancing the understanding and prediction of weather and climate. Several active sensing techniques can be used to detect atmospheric winds. One such technique is Doppler lidar..."

11) " Atmospheric Observations and Experiments to Assess Their Usefulness in Data Assimilation" by Robert Atlas, Journ. Meteor. Soc. Japan, Vol. 75, No. 1B, (1996)

"The assimilation of wind profiles resulted in a larger and more rapid reduction of the errors in the initial state. Most of the impact occurred in the first 24 hours of assimilation. In the Northern Hemisphere, the impact of both types of satellite data was much smaller, but the wind profile data was approximately twice as effective as the temperature data in reducing error analysis."

12) " Atmospheric Observations and Experiments to Assess Their Usefulness in Data Assimilation" by Robert Atlas, Journ. Meteor. Soc. Japan, Vol. 75, No. 1B, (1996)

"These results (LAWS simulations) demonstrate that even with a significant power reduction, a substantial improvement in analysis accuracy relative to the Control in the Southern Hemisphere Extra tropics should result from the assimilation of wind lidar data."

13) "Lidar-Measured Winds from Space: A Key Component for Weather and Climate Prediction" by Baker et al., Bull. Amer. Meteorol. Soc., Vol 76, No. 6, (1995)

"A Doppler wind lidar is the only space-based instrument that can provide direct measurement of the global tropospheric wind field. Such winds would significantly increase the skill of numerical weather forecasts and provide data that are fundamental to advancing the prediction of possible climate change." "...results indicate a significant improvement in forecast accuracy resulting from the assimilation of simulated satellite wind data and showed the wind data are more effective than temperature data in controlling error analysis."

14) "Lidar-Measured Winds from Space: A Key Component for Weather and Climate Prediction" by Baker et al., Bull. Amer. Meteorol. Soc., Vol 76, No. 6, (1995)

"A number of observing system simulation experiments, where simulated Doppler lidar winds have been used in GCMs, have consistently indicated that a dramatic improvement in weather forecasting skill would occur with the addition of lidar winds in data-sparse regions."

15) "A Simulated Future Atmospheric Observation Database Including ATOVS, ASCAT, and DWL" by Becker et al., Bull. Amer. Meteorol. Soc., Vol. 77, No. 10, (1996)

"The main variables that need to be observed in order to provide an adequate description of the atmosphere on scales represented by most of the present global NWP models are the three-dimensional fields of temperature, humidity and wind at 50-100 km resolution in the horizontal.....Space-based observing systems offer realistic hope of meeting the requirements of operational meteorology for global coverage.....The current wind observation coverage is far from the above requirement. One of the promising future instruments is a spaceborne Doppler wind lidar (DWL)."

16) "Study on the Utility of Doppler Wind Lidar Data for Numerical Weather Prediction and Climate" by Ad Stoffelen and Gert-Jan Marseille, KNMI ESA Study Contract Report, (1998)

"The information content of DWL data depends on its quality and coverage. Wind information of a certain accuracy is already present in NWP. DWL data will add to this accuracy either by their abundance or their measurement quality.....Experiments with existing observing systems (OSEs) have shown that good coverage of wind observations is essential to ensure that "precursive" features are represented in the NWP analyses. DWL winds should therefore bring a major improvement to the subsequent NWP forecasts of cyclogenesis (Graham and Anderson, 1996)."

17) Address to the American Geophysical Union by NASA Administrator Daniel S. Goldin (December 6, 1998)

".....We need to fill in the blanks and reduce the uncertainties in our pictures of the global carbon cycle.....the global water cycle...and the global energy cycle. Coupling models together, we can begin to make useful predictions of temperature and precipitation patterns."

18) "Use and Impact of Satellite Atmospheric Motion **Winds** on ECMWF Analyses and Forecasts" by Tomassini et. Al., Mon. Wea. Rev., Vol. 127, No. 6. (June 1999)

"The new satellite **wind** products available in real time on the global telecommunication system (e.g., GOES WVWM and Meteosat HVIS) improve the coverage of the AMW (atmospheric motion **winds**) product over the Pacific and Atlantic Oceans and have been found to bring consistent benefits in the quality of analyses and short-range forecasts in data sparse regions (e.g., southeast Pacific Ocean and the southeast Atlantic Ocean)."

"The results of global observation system experiments, where all the AMW are withheld from the analysis, indicate that they do play an important role also in the medium-range forecast over regions of good data coverage. In particular over North America the experiment withholding ALL satellite **winds** was found to lose almost half a day of forecast skill at 5 days."

"So NASA is developing lidars and radars to reveal the 3-D structure of the atmosphere and measure **winds** in the troposphere—which would be a major step forward in weather prediction."