

Research Using High Vertical-Resolution Radiosonde Data

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Background

- Radiosonde data historically recorded at mandatory and significant levels for meteorological purposes.
- Intrinsic resolution much higher.
- Utility of high-resolution data for research purposes highlighted by Allen and Vincent [1995], inspiring SPARC to promote routine archival of high-resolution data worldwide [Hamilton and Vincent, 1995].
- US high-resolution data archived by NOAA at 6-second (~30 m) beginning 1995 – purchased by M. Geller (using NSF funding) and made publicly available at SPARC Data Center <http://www.sparc.sunysb.edu> (through NASA funding).
- In 2005 NOAA began upgrading the US upper air network to RRS, archiving data at 1-second (~5 m) resolution facilitating improved analysis and new applications

Applications

Access to high-resolution data has facilitated research in many areas leading to peer-reviewed publications.

- Gravity waves
 - Spatial and temporal variations of wave parameters [Wang and Geller, 2003; Wang et. al., 2005; Zhang et. al., 2010]
 - Spectral characteristics [Gong et. al., 2008; Geller and Gong, 2010; Gong and Geller, 2010]
 - Planetary waves [Wang et. al., 2010]
 - Momentum flux (Figure 1)

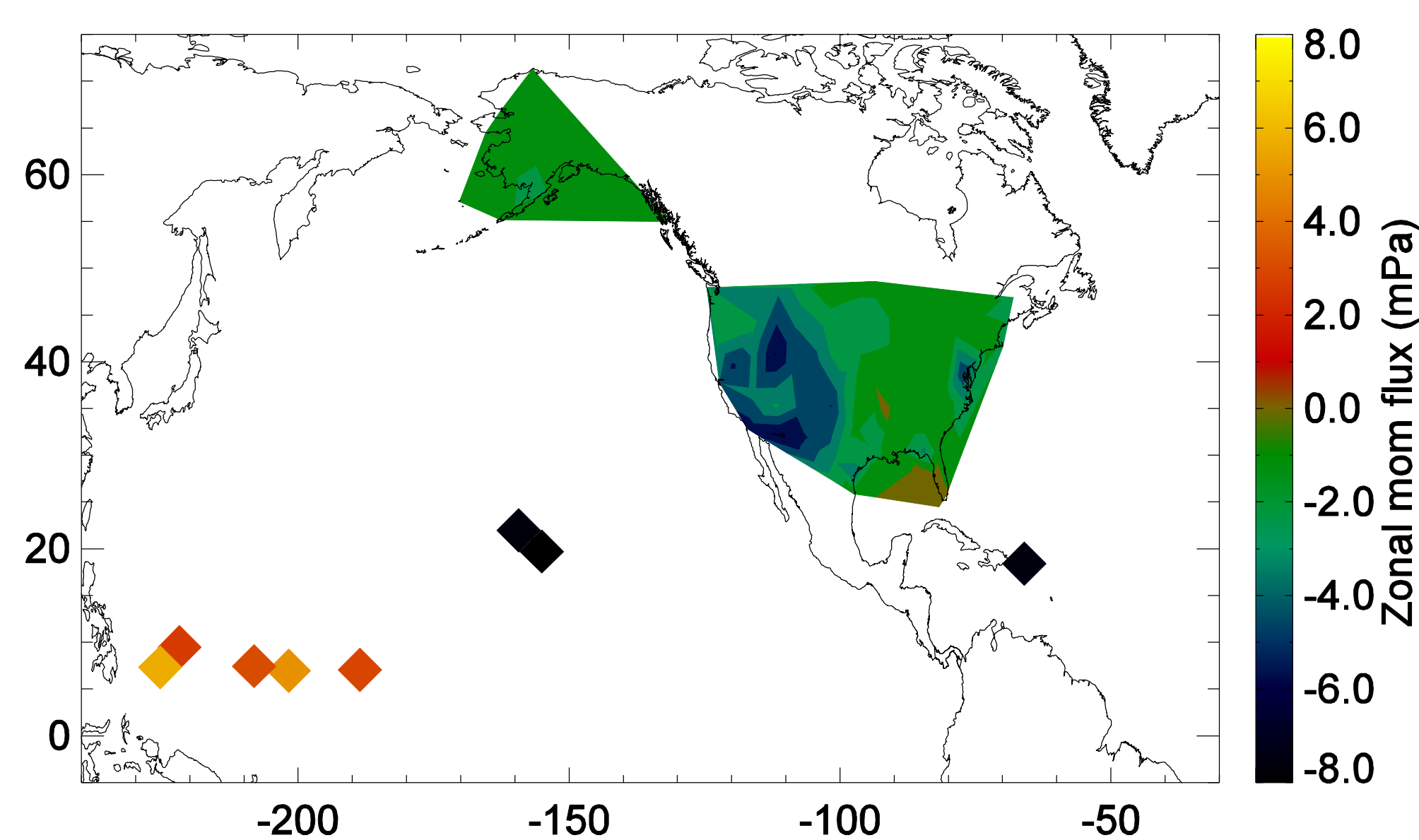


Figure 1. Distribution of zonal gravity wave momentum flux at 18-25 km from US upper air stations during the period March-May, 2006.

- Structure of the tropopause [Birner, 2006; Bell and Geller, 2008] (Figure 2)
- Tropical convection in relation to mass flux and water vapor budgets [Folkins and Braun, 2003; Folkins and Martin, 2005]
- Parameterization validation [Folkins et. al., 2006]
- Troposphere-stratosphere transport [Corti et. al., 2005; Corti et. al., 2006]
- Ability of GCMs to resolve key features of the tropical tropopause layer [Gettelman and Birner, 2007]
- Validation of satellite observation techniques [Hayashi et. al., 2009]
- Pyrocumulonimbus processes [Fromm et. al., 2010]
- Polar regions [Zhang and Seidel, 2011]
- Effects of geomagnetic storms on the lower atmosphere [Mansilla, 2011]

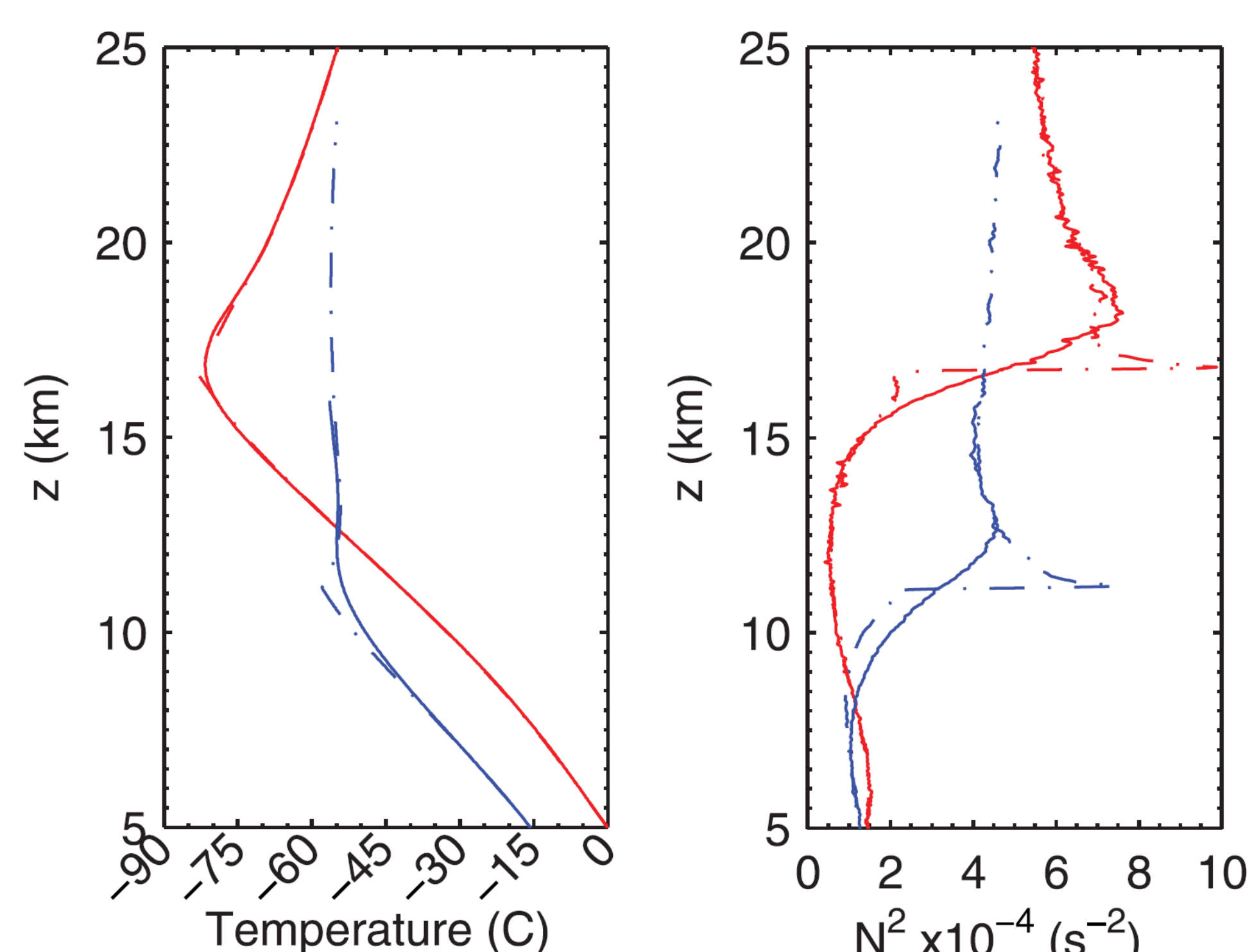


Figure 2. High-resolution radiosonde climatologies (1998–2004) of (left) temperature and (right) stability for Yap Island, 9.48N, 138.8E (red), and Quillayute, WA, 47.95N, 124.55W (blue). Dashed profiles are averages with respect to the tropopause level, and solid lines are with respect to the ground.

New Research Potential

- Very high-resolution data permit analysis of turbulence parameters [Clayson and Kantha, 2008] (Figure 3)
- New applications in fields such as boundary layer research.
- Move from regional to global analyses.

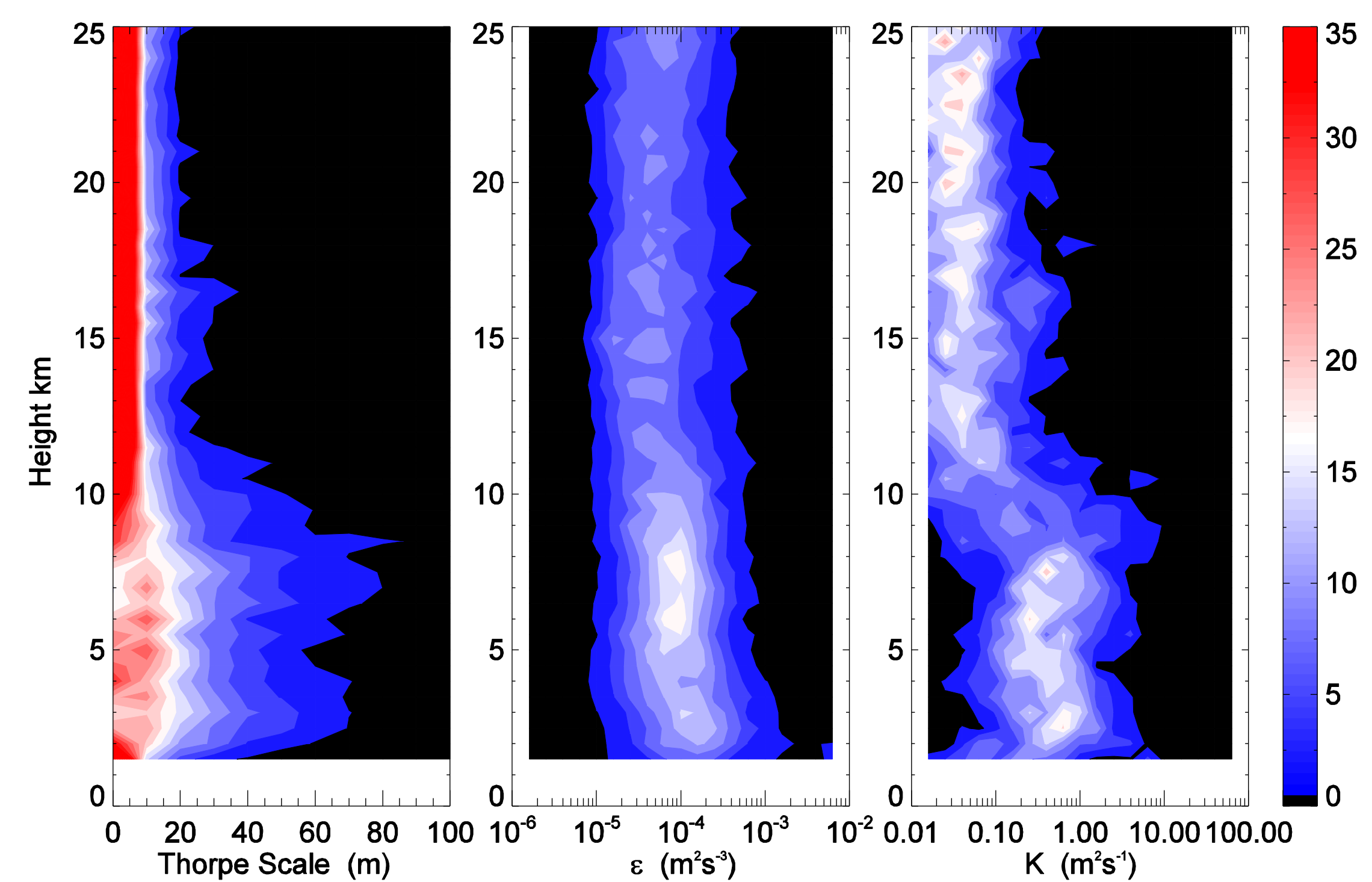


Figure 3. Probability densities (in %) of turbulence parameters derived from three months of 1-second resolution radiosonde soundings at Riverton, WY, in winter 2007. (a) The Thorpe scale (m) calculated from the potential temperature profile, which is taken to be proportional to the Ozmidov scale, (b) eddy dissipation rate, and (c) eddy diffusivity.

Availability

- US high-resolution radiosonde data for 1998-2011 available at SPARC Data Center
- <http://www.sparc.sunysb.edu/http/hres>
- Transition to RRS complete 2012 (Figure 4)

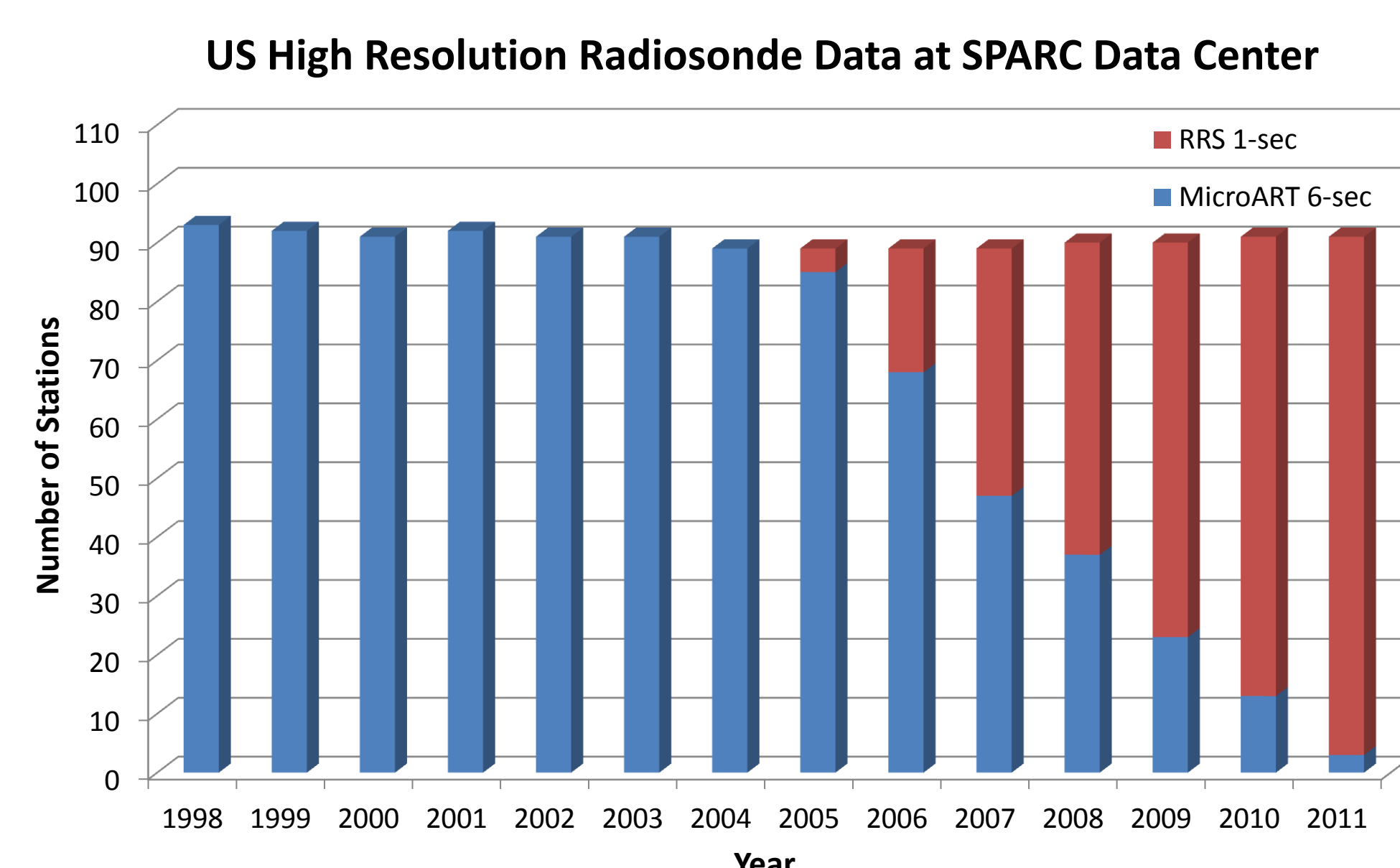


Figure 4. Number of US stations from which 1-second and 6-second resolution radiosonde data are available at SPARC Data Center.

Workshop

The SPARC DC will be hosting a workshop on research applications of high-resolution radiosonde data.

- May 27-29, 2013
- Stony Brook University, NY
- Topics for discussion
 - New applications made possible by increase to 1-second (or higher) resolution
 - Improvements to existing analysis techniques
 - Uncertainties and limitations
 - Collaborations for regional inter-comparison or global studies
 - Establishment of collective repository

Acknowledgements

The SPARC Data Center is supported by NASA. US high-resolution radiosonde data were purchased from NOAA with support of and the National Science Foundation (award AGS1101258).

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