#### Paper n. 781

AMS Annual Meeting 2013, 4th Conference on Weather, Climate, and the New Energy Economy

# Global distributions and temporal variations of Low-Level Jets (LLJs) for Airborne Wind Energy (AWE) applications

Cristina L. Archer University of Delaware carcher@udel.edu



### JANUARY



Figure 3. Properties of LLJs in January (left) and July (right) during 1985-2005: a) average wind speed at the jet; b) average height above ground at the jet; c) average wind power density at the jet; and d) frequency of LLJ occurrences and average position of the ITCZ (dashed line).

Luca Delle Monache NCAR/RAL lucadm@ucar.edu

### ABSTRACT

We analyze 21 years of global, high-resolution (40 km), hourly wind data from the National Center for Atmospheric Research's Climate Four Dimensional Data Assimilation reanalyses to characterize lowlevel jets (LLJs), broadly defined here as wind speed maxima located below 3000 m. We find that LLJs are more ubiquitous than previously thought and have high wind power densities (up to 15,000 W m<sup>-2</sup>). They can form over land (e.g., the US Great Plains), over the oceans (e.g., the descending branches of Hadley cells), or nearshore (e.g., the Somali jet offshore of the horn of Africa, the strongest and most persistent LLJ in the summer). If airborne wind energy (AWE) systems could be deployed to reach the LLJs, then the global technical wind power potential in LLJs, assuming an intermediate number of AWE systems per unit of land area, would be at least 7.5-9 TW (1 TW =  $10^{12}$  W), more than enough to power humanity.

### **TECHNICAL WIND POWER POTENTIALS IN LLJS**

	Density	Density of AWE devices (m <sup>2</sup> km <sup>-2</sup> )		
	100	1000	10,000	
	(Low)	(Intermediate)	(High)	
Janua	ry 0.8 TW	7.5 TW	75.4 TW	
July	0.9 TW	9.0 TW	90.1 TW	

#### JULY

Wind speed 10 14 18 22 Wind speed (m/s)

Great Plains

Figure 4. Scatter plots of percentiles of LLJ wind speed and wind power density versus height for the Great Plains in January (left) and July (right) by time period. For example, the 5<sup>th</sup> percentile plots show pairs of height and wind speed that are exceeded 95% of the time. More locations experience LLJs in July than in January in the Great Plains.

Daran L. Rife GL Garrad Hassan Daran.Rife@gl-garradhassan.com

## **AEROSTATS AND RIGID-WING AWE SYSTEMS**



on-board.



### THE GREAT PLAINS LLJ