

Convective Asymmetries in Tropical Cyclones: The Effects of Vertical Wind Shear and Storm Motion

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*** Talk was transferred from original transparencies**

Introduction

- **Use lightning flashes from the National Lightning Detection Network (NLDN) to investigate the convective structure of tropical cyclones**
- **In previous studies, flash counts have been found to be lowest in the northwest quadrant of the storm**
- **Proposed explanations for this distribution were the directions of vertical wind shear and storm motion**
- **Examine 24 Atlantic basin tropical storms from 1985-1997 to explore the relationship between the azimuthal distribution of flashes, vertical wind shear and storm motion**

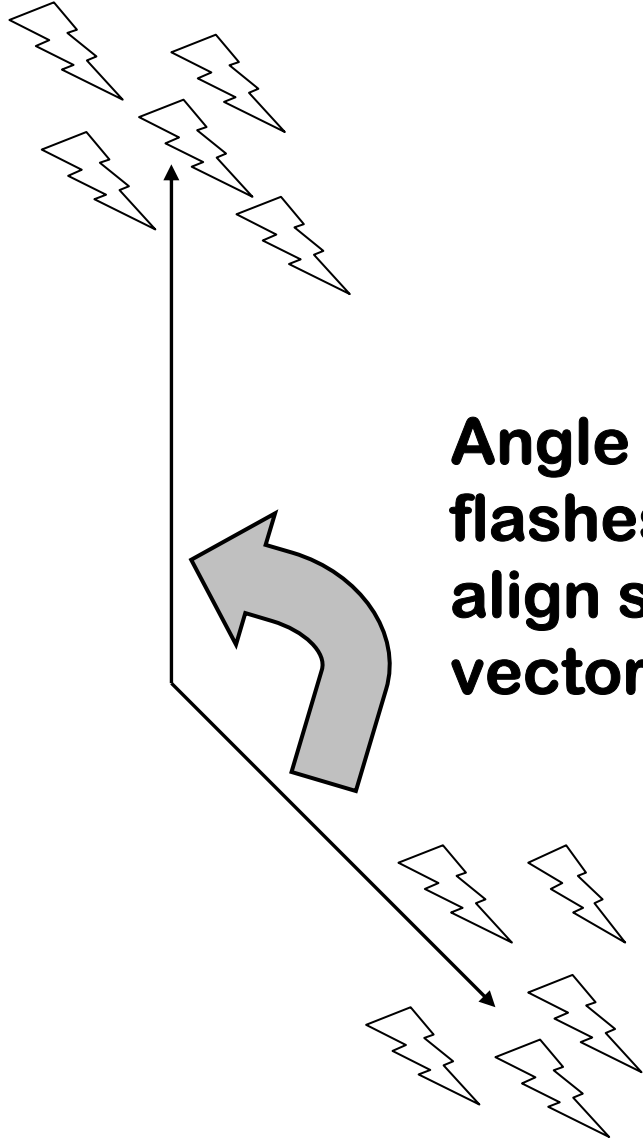
Data

- **NLDN archived flash data**
- **ECMWF uninitialized gridded analyses**
- **National Hurricane Center “best track” data set**

Methodology

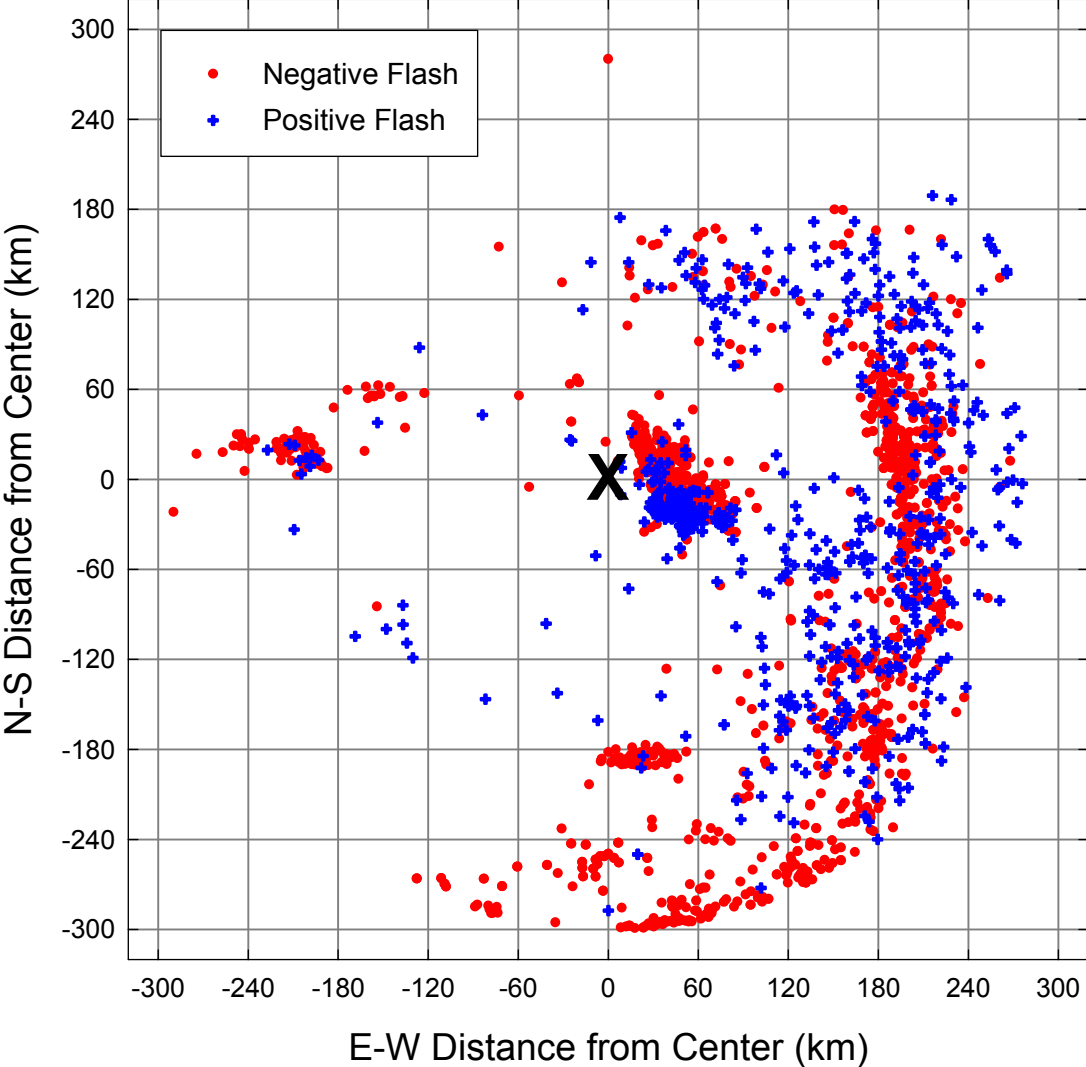
- Separate inner 100 km (core) and 100-300 km ring (rainbands) regions are examined
- Flashes occurring in the 12 hour period centered on 00 and 12 UTC are totaled and plotted with respect to the interpolated hourly storm center position
- Each flash is then rotated around the storm center through an angle equal to that required to align the shear/motion vector for that 12 period with due north
- These periods were then grouped as

<i>Weak</i>	<i>Moderate</i>	<i>Strong</i>	shear
< 5 m/s	5-10 m/s	>10 m/s	
<i>Slow</i>	<i>Medium</i>	<i>Fast</i>	motion
<3 m/s	3-6 m/s	>6 m/s	

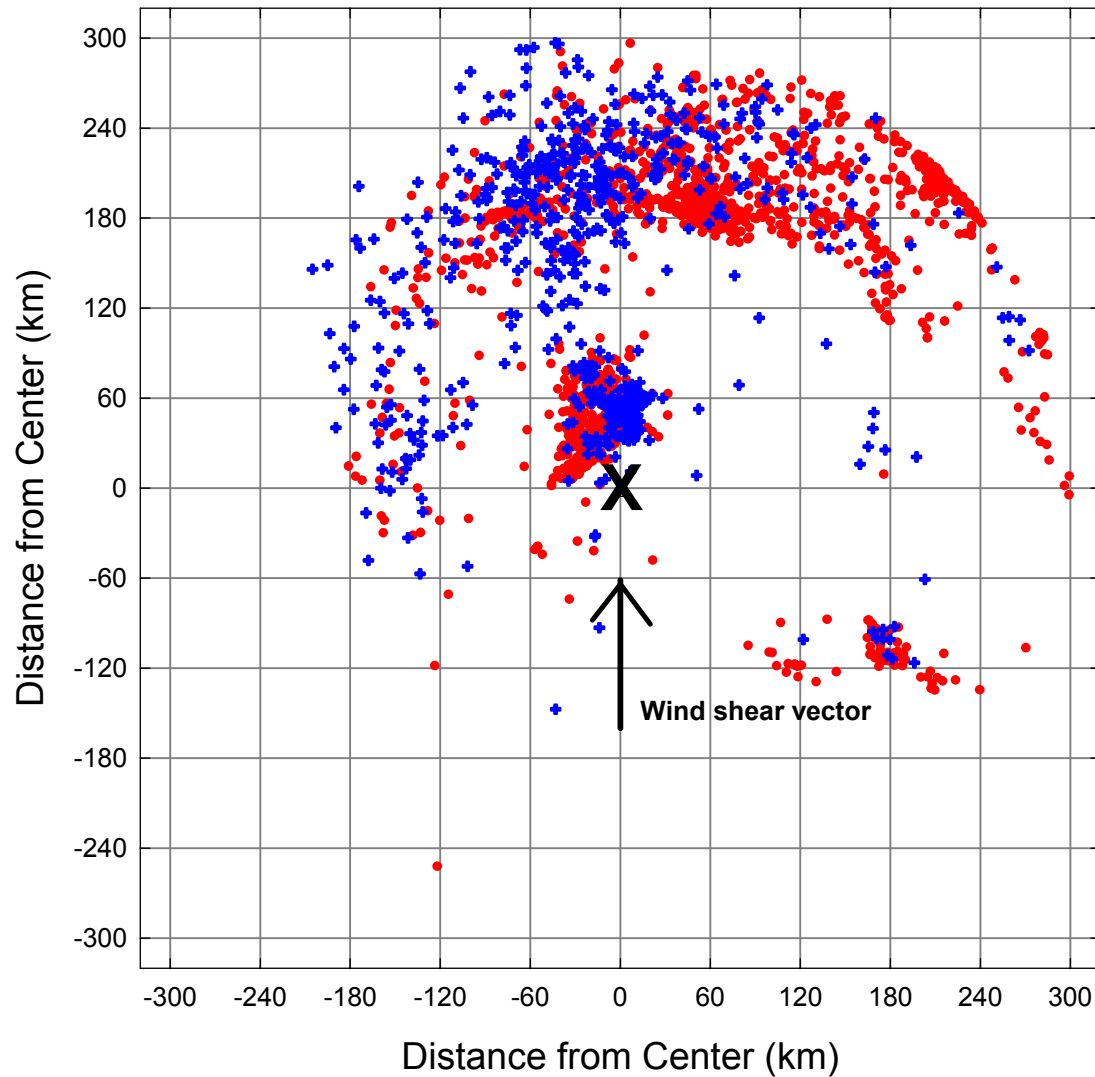


**Angle through which
flashes are rotated to
align shear/motion
vector with due north**

Bertha 1996 - 54 hours Unrotated Flashes



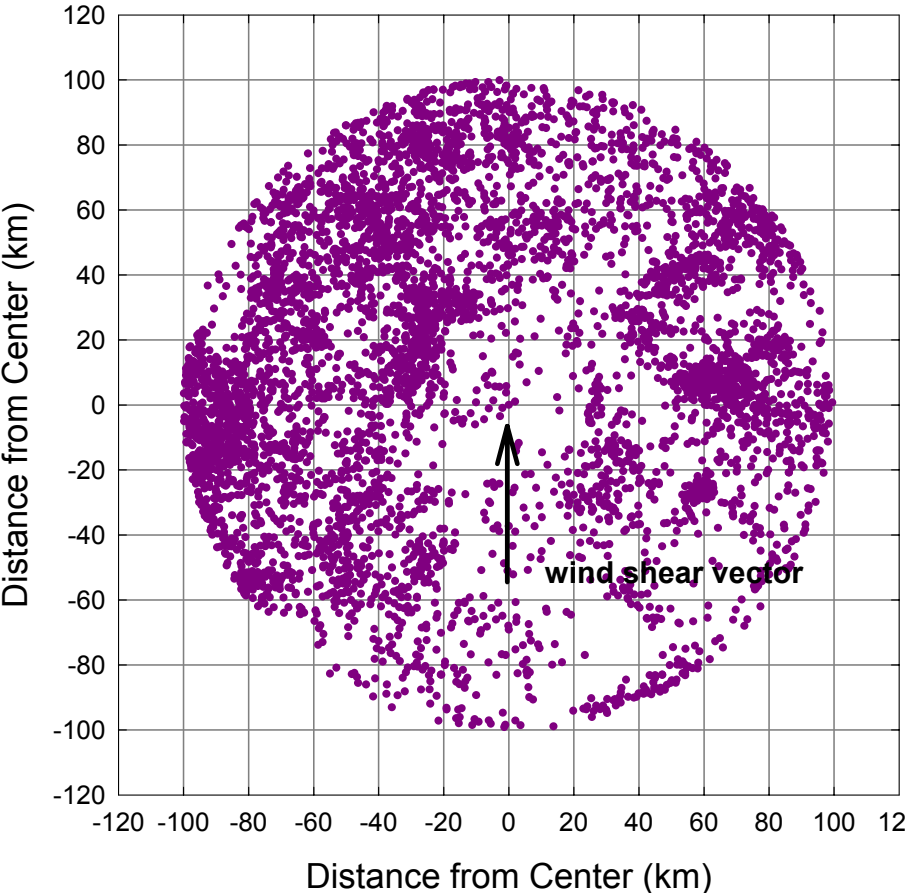
Bertha 1996 - Flashes Rotated With Respect To Shear Shear Vector Pointing Due North



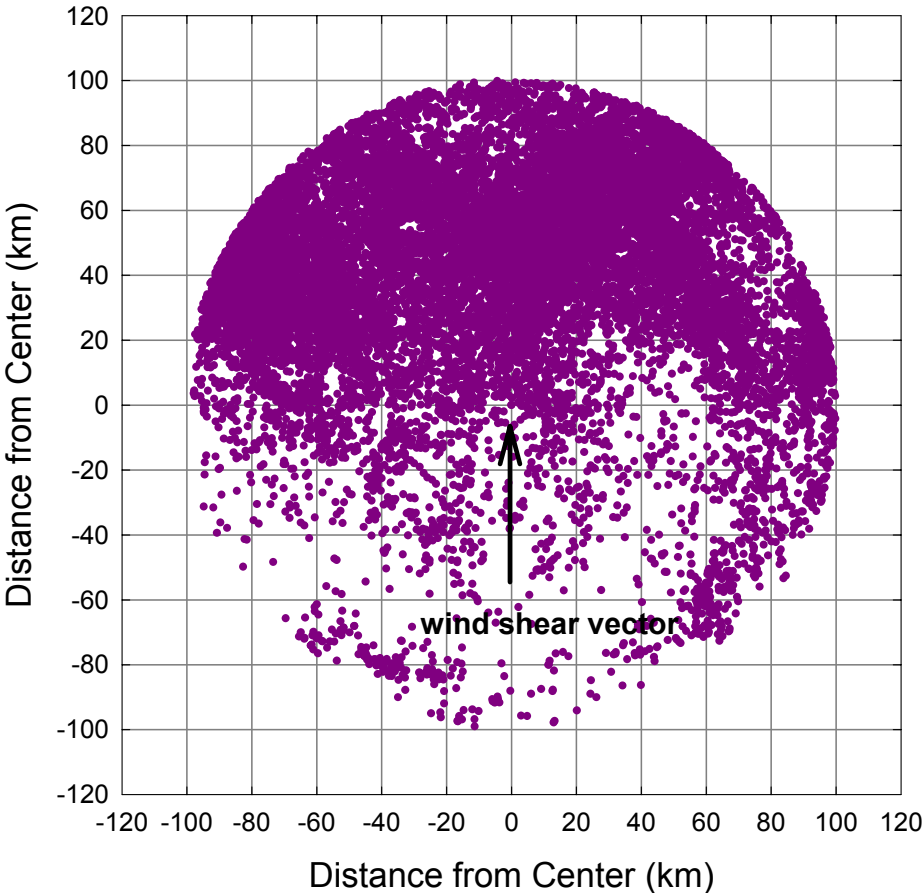
All inner core lightning in 24 TCs studied

Grouped based on strength of vertical wind shear

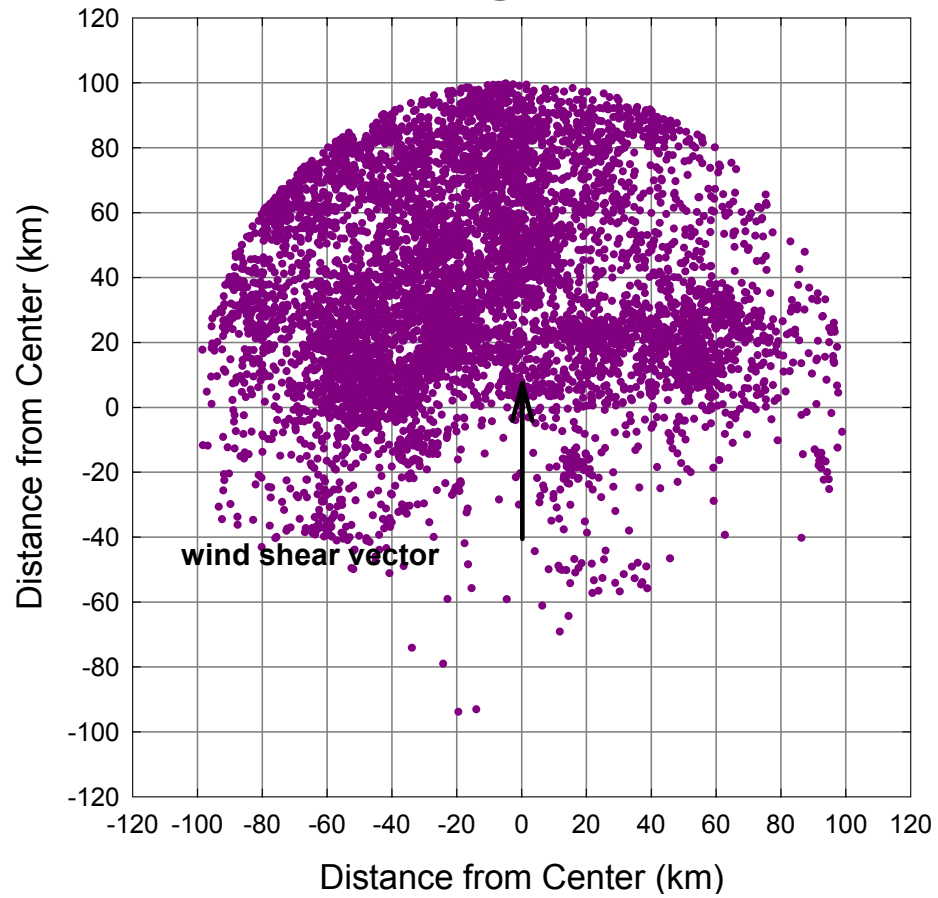
Weak Shear



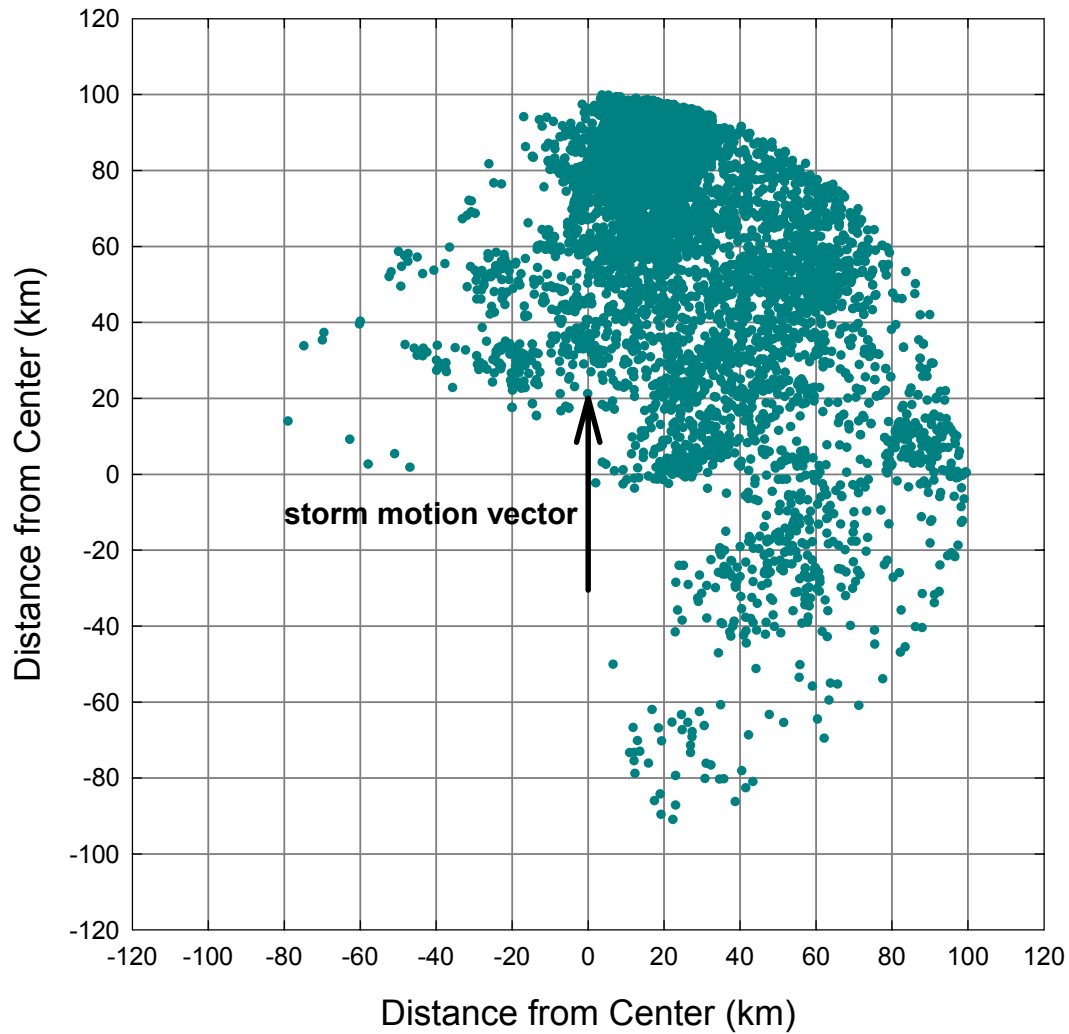
Medium Shear



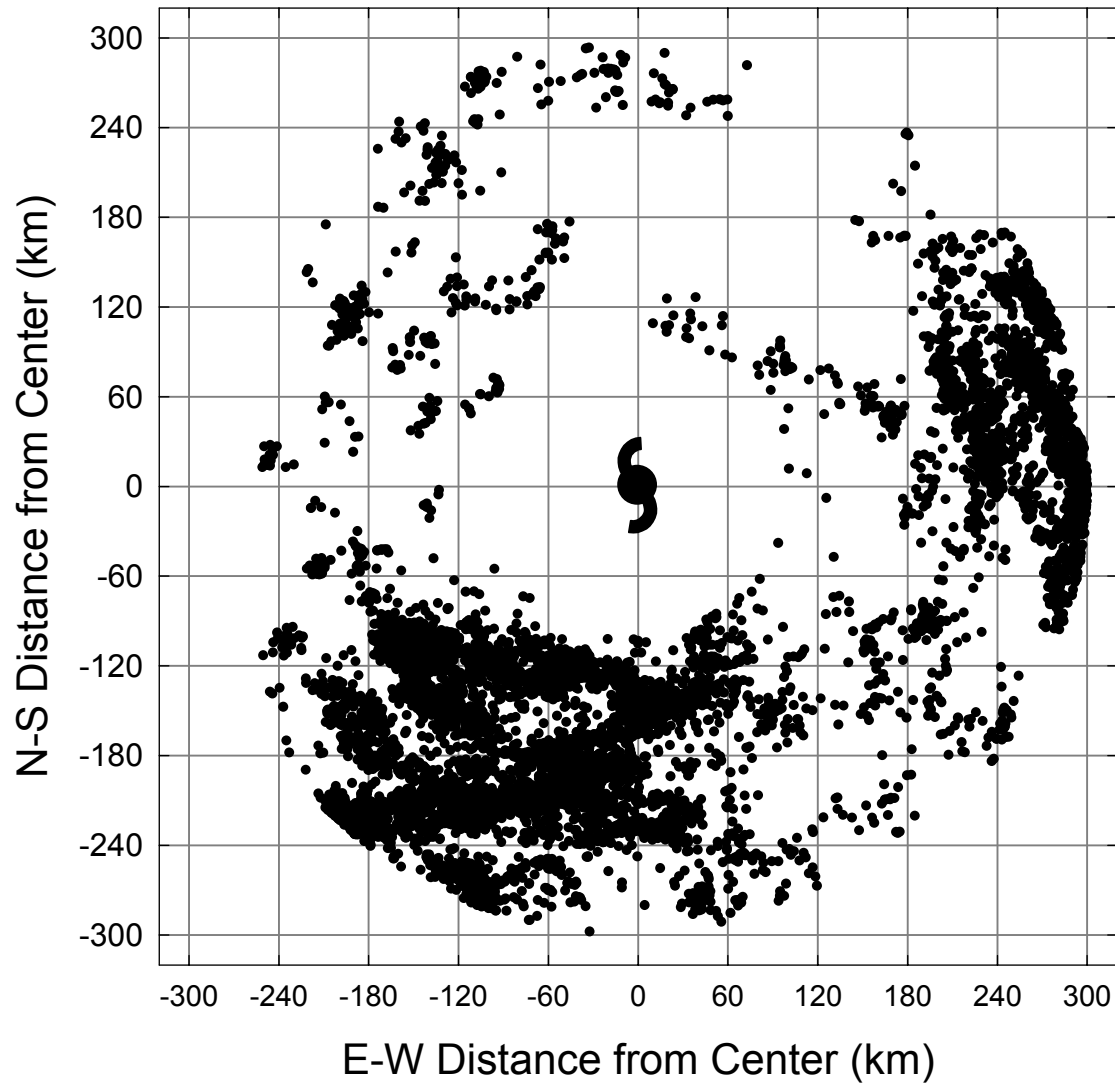
Strong Shear



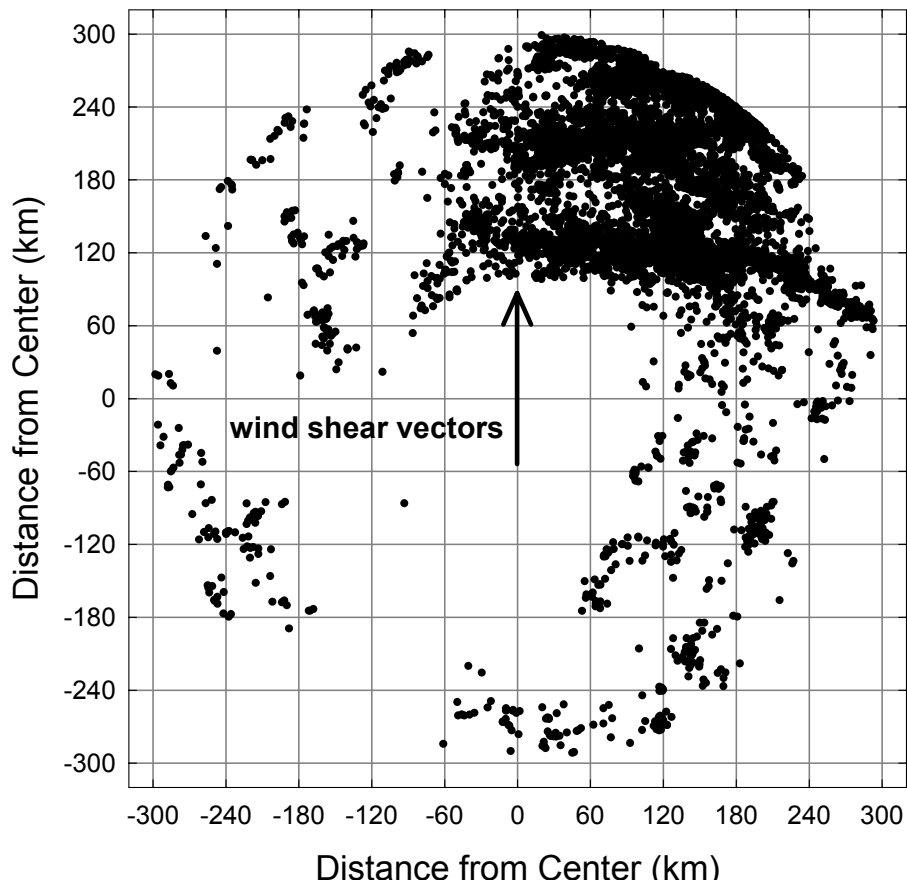
Bob (1985) 36 hours of flashes rotated with respect to motion



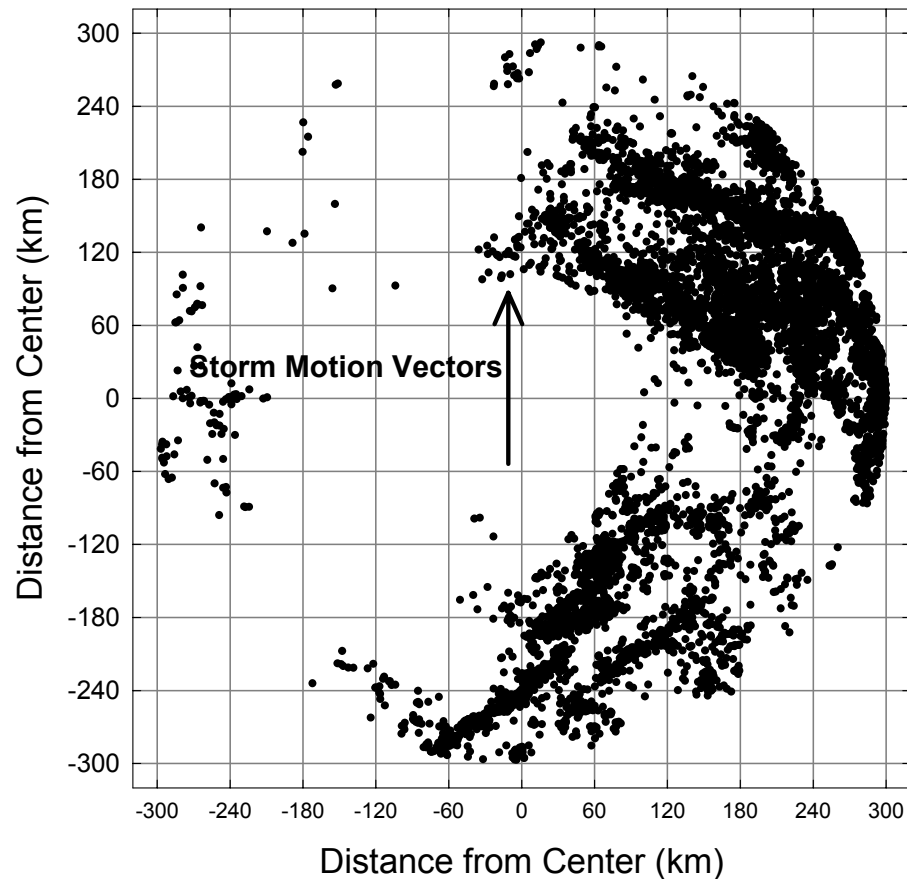
Flashes 100 to 300 km from the center of Alberto(1994) 18 to 06 UTC on August 2-3, 4-5 and 5-6.



Alberto 1994 Shear Rotated Flashes



Alberto 1994 Motion Rotated Flashes



Summary

- **Definite relationships exist between the azimuthal distribution of lightning and the directions of vertical wind shear and storm motion**
- **With respect to storm motion: Inner 100 km flashes favor the right front right quadrant; 100-300 km Ring flashes prefer the right rear quadrant in response to boundary layer convergence under the translating storm**
- **With respect to vertical wind shear: Inner 100 km flashes are displaced downshear left; 100 – 300 km flashes downshear right, as updrafts are generated downshear due to differential vorticity advection of the vortex**
- **The angle between the shear and motion vectors is the preferential quadrant for lightning in the core, while in the rainbands, the preferential region for electrified convection is to the right of both vectors**