

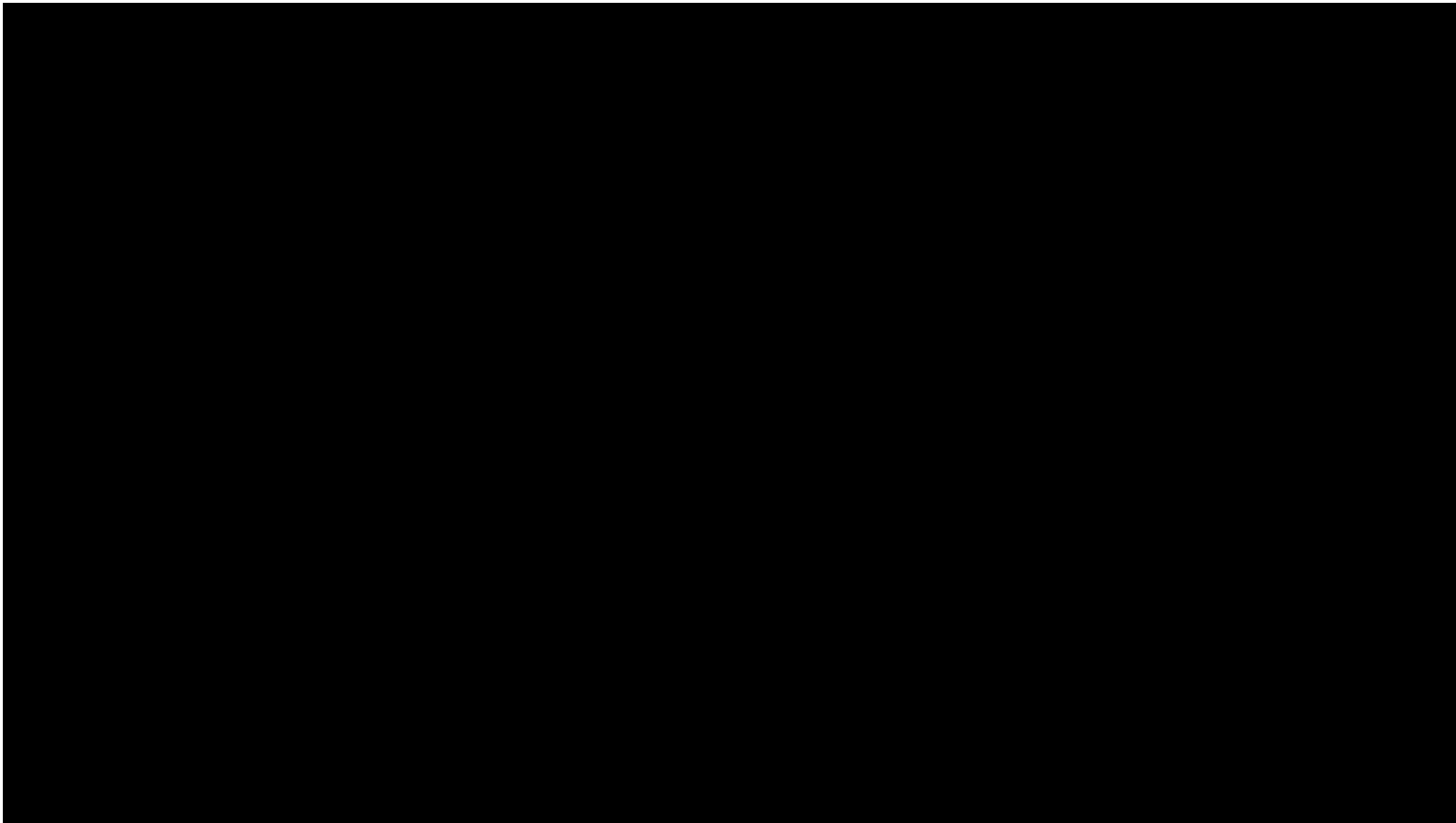


SOLAR ROSSBY WAVES

William Cramer – University of Chicago

Advisor: Scott McIntosh – HAO

WHAT IS A ROSSBY WAVE?



SOME EQUATIONS

$$\beta = \frac{\partial f}{\partial y} = \frac{1}{a} \frac{d}{d\phi} (2\omega \sin \phi) = \frac{2\omega \cos \phi}{a}$$

Φ is latitude, ω is angular rotation speed of the Earth, a is the mean radius of the Earth, and f is the planet's vorticity as a function of latitude (subject to some perturbation)

The Rossby Parameter

If $\beta = 0$ there is NO Rossby wave



SOLAR VS. PLANETARY WAVE

Solar

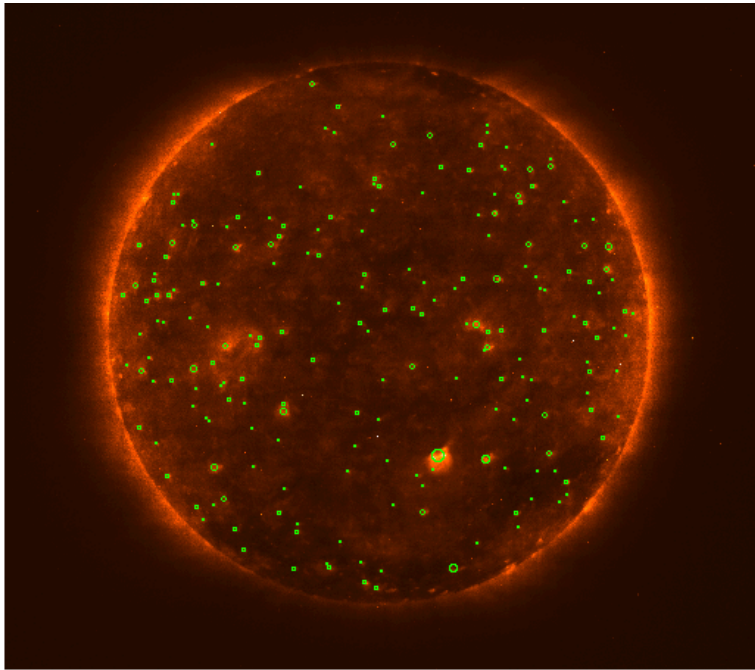
- Origin as of yet unknown.
- Could be result of rotation of the sun, magnetic fields, other factors.
- Most likely a deep rooted phenomenon.
- Could be in different layers (some clusters move in opposite directions!)

Earth

- Results from the Coriolis effect due to rotation of the Earth.
- Emerge due to sheering of fluid/air in the atmosphere and ocean



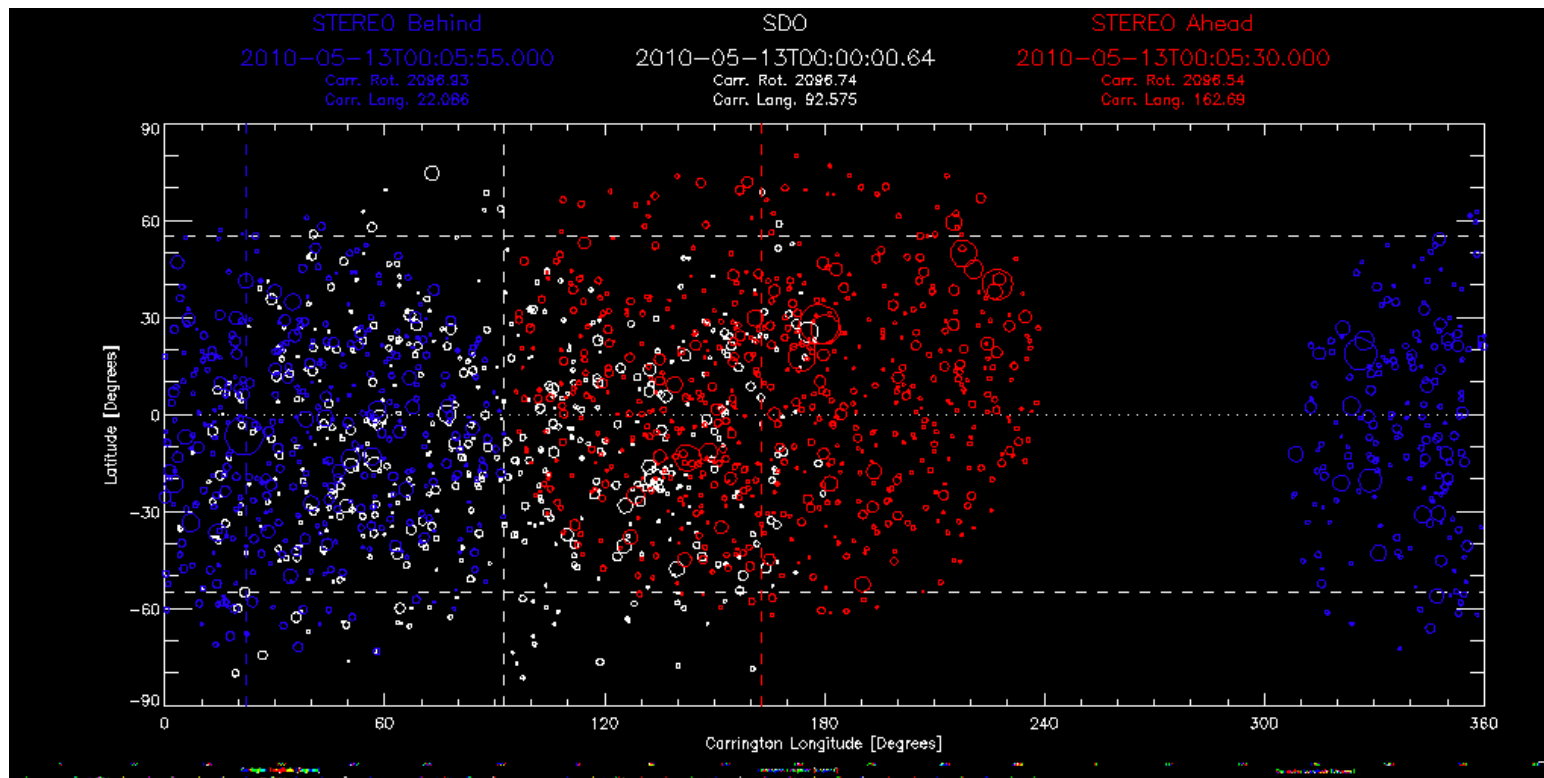
DETECTING ROSSBY WAVES: BRIGHT POINTS



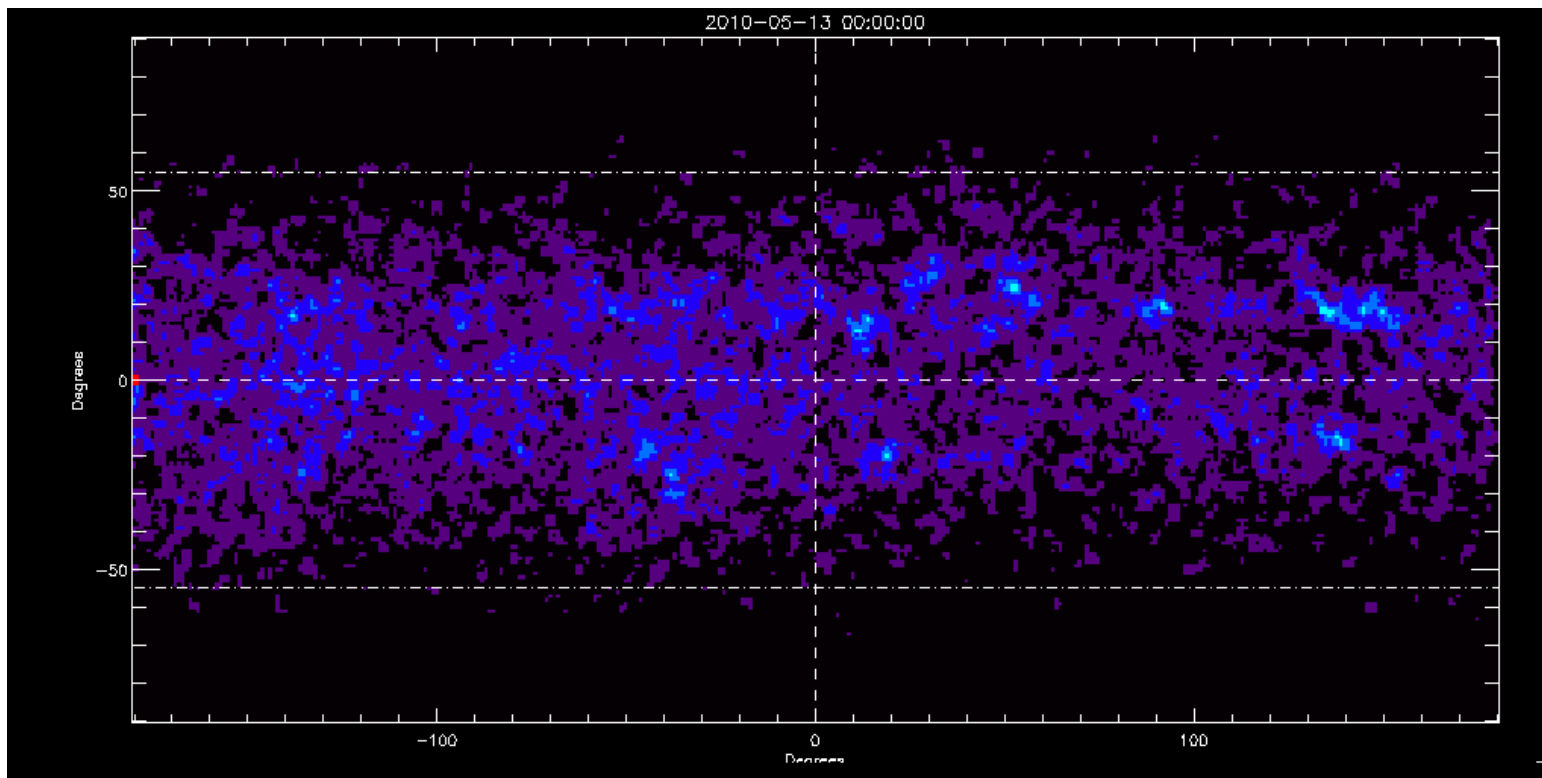
- ~2-5 Mm
- Zones of intense EUV/X-ray radiation
- Clusters found mostly below $\pm 55^\circ$ latitude



STEREO A+B & AIA

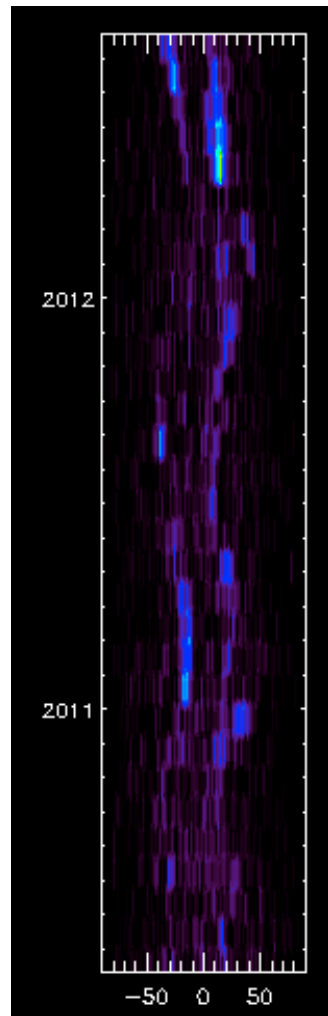


MAKING SENSE OF THE DATA

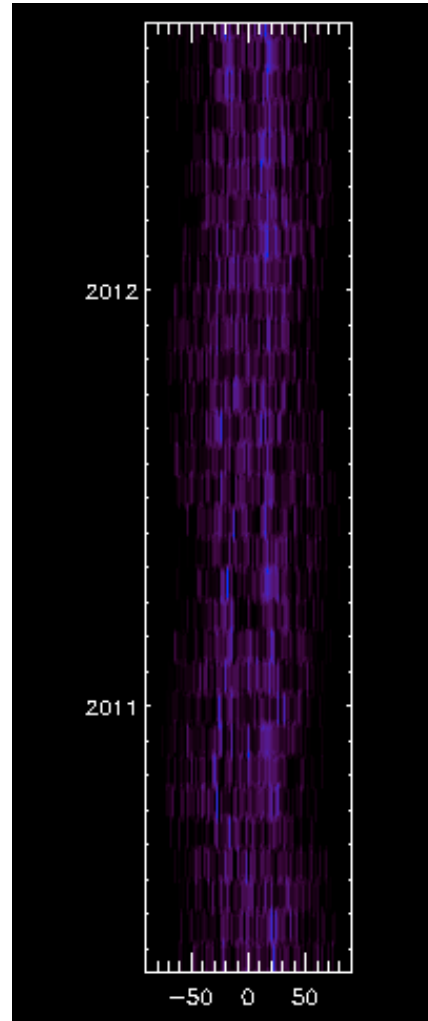


SLICING THE DATA

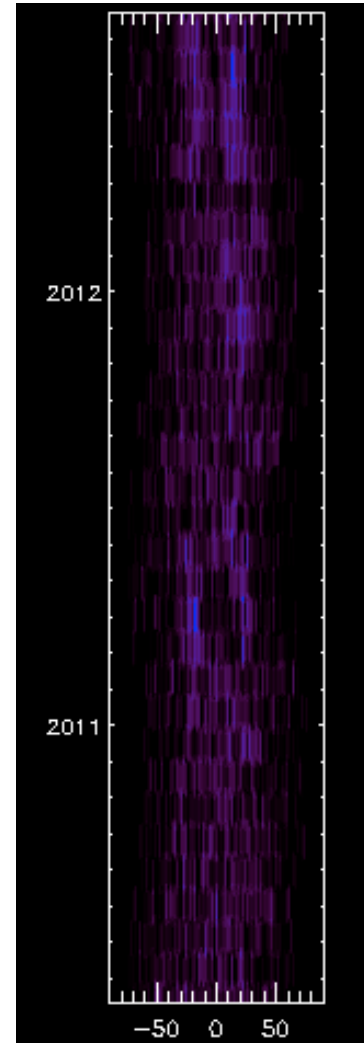
AIA



STEREO A

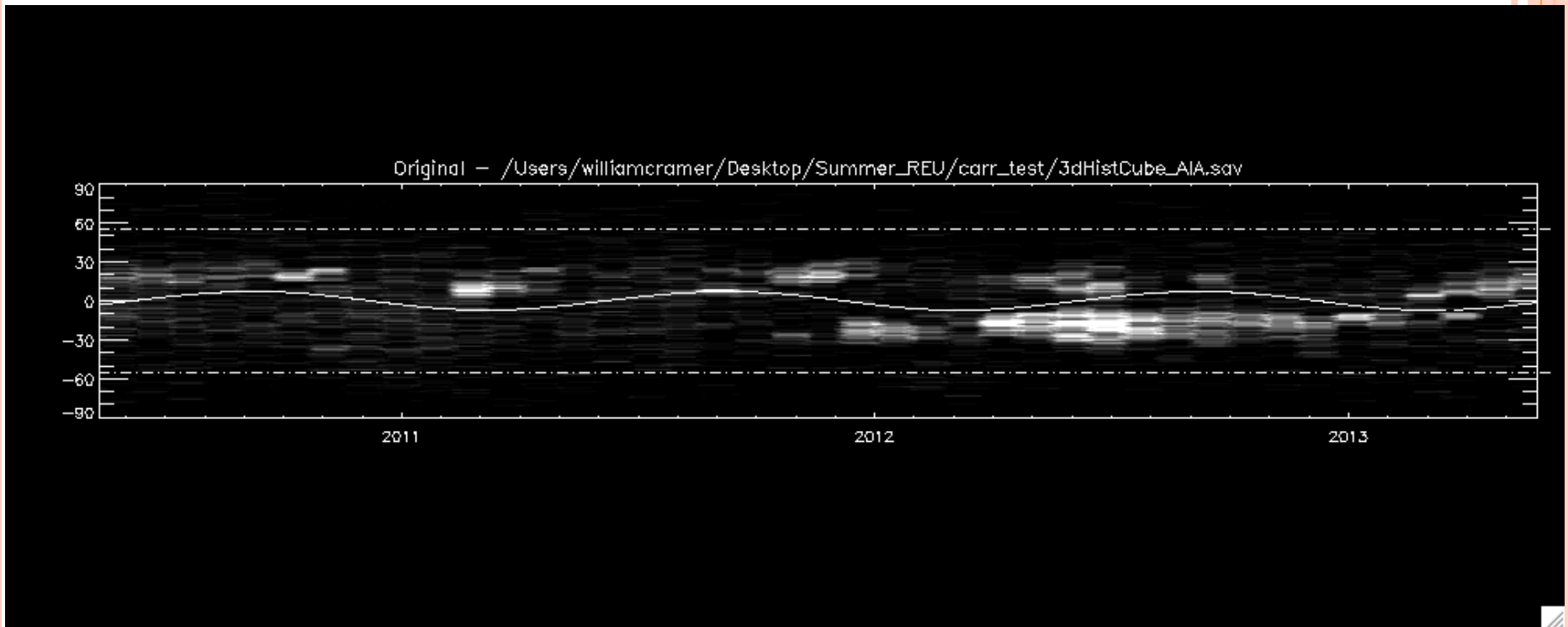


STEREO B



ACCOUNTING FOR THE B-ANGLE

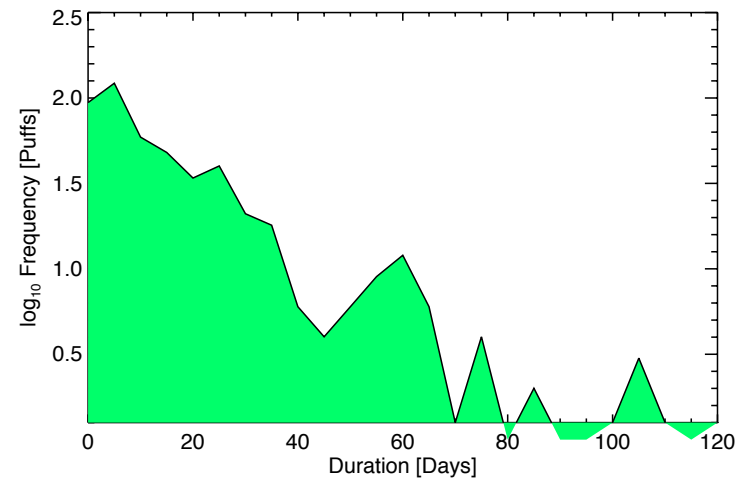
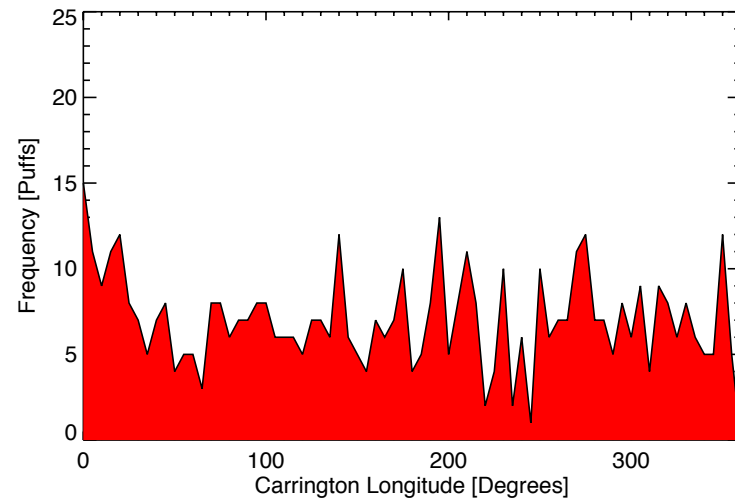
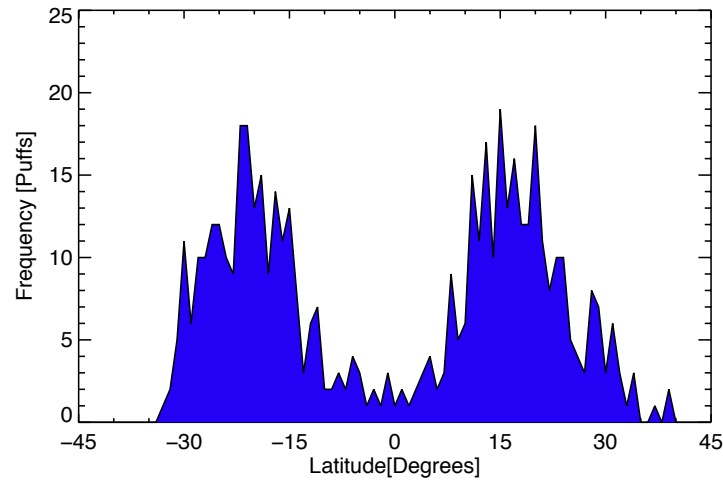
- B-angle is result of tilt of satellite to sun's axis.
- If B-angle is not properly subtracted, wave behavior could be an artifact of this.



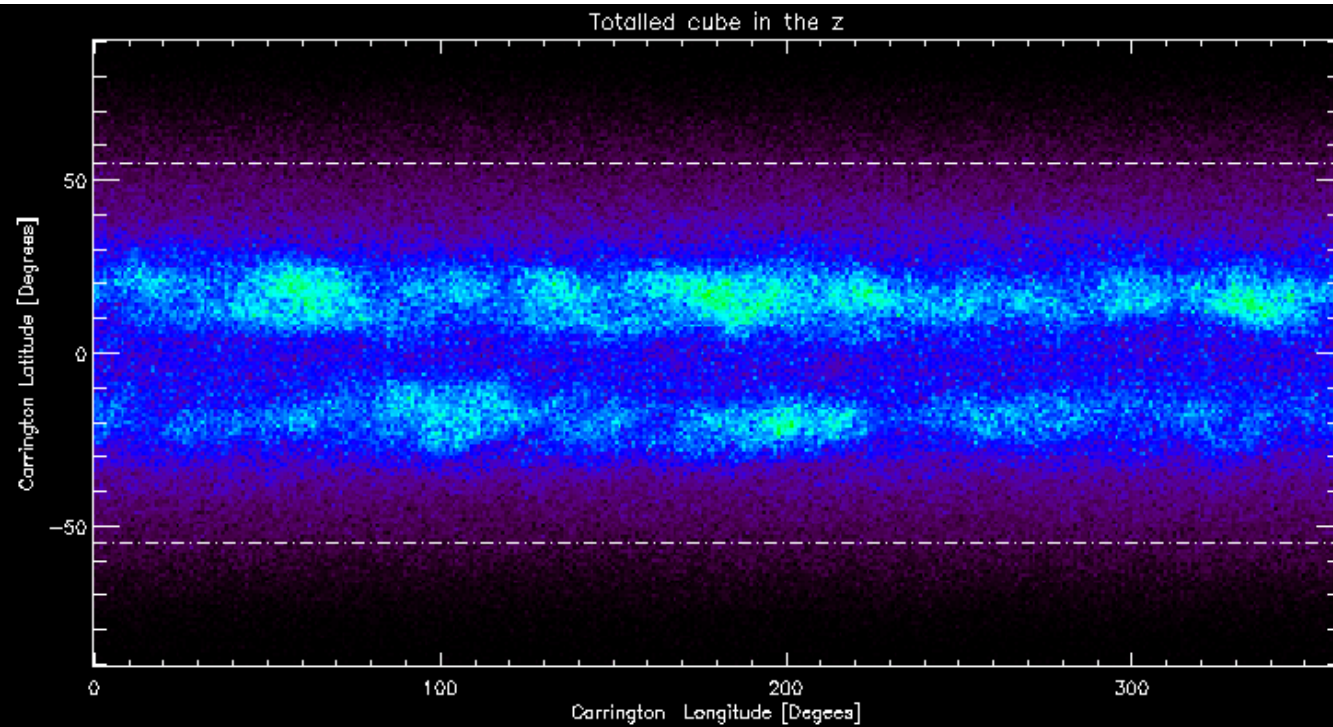
BP CLUSTERS



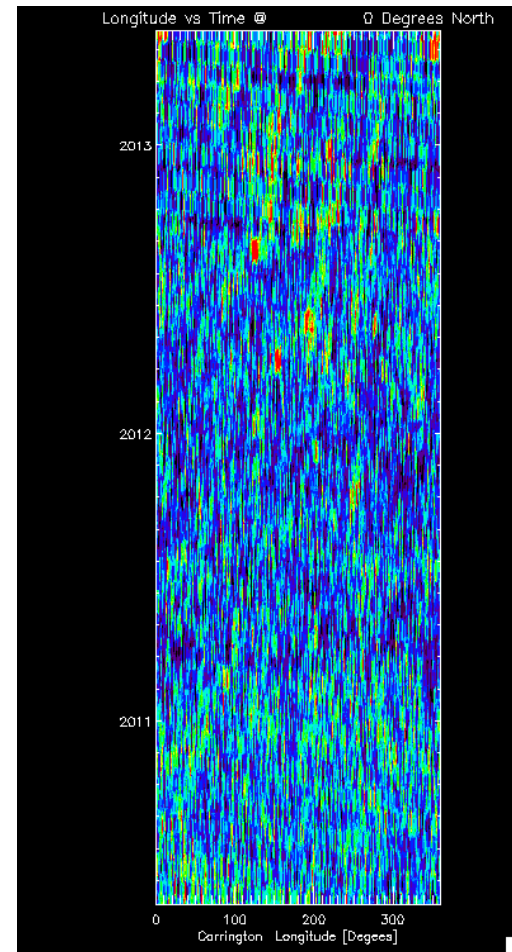
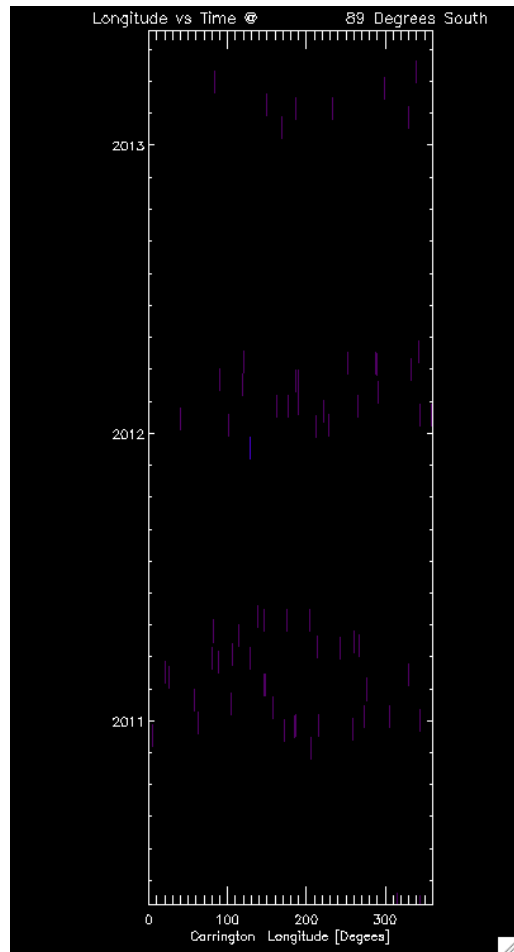
CLUSTER STATISTICS



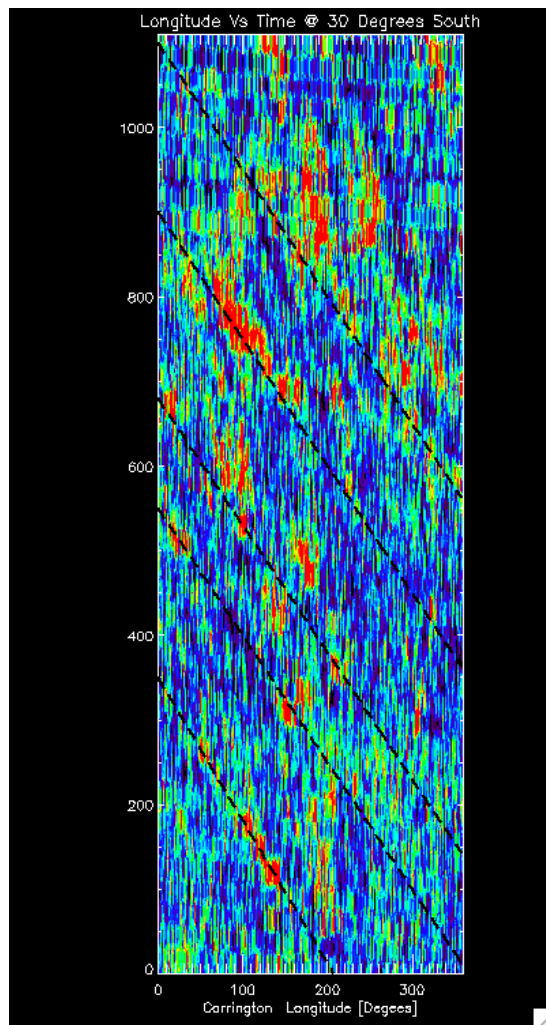
FULL DATA CUBE



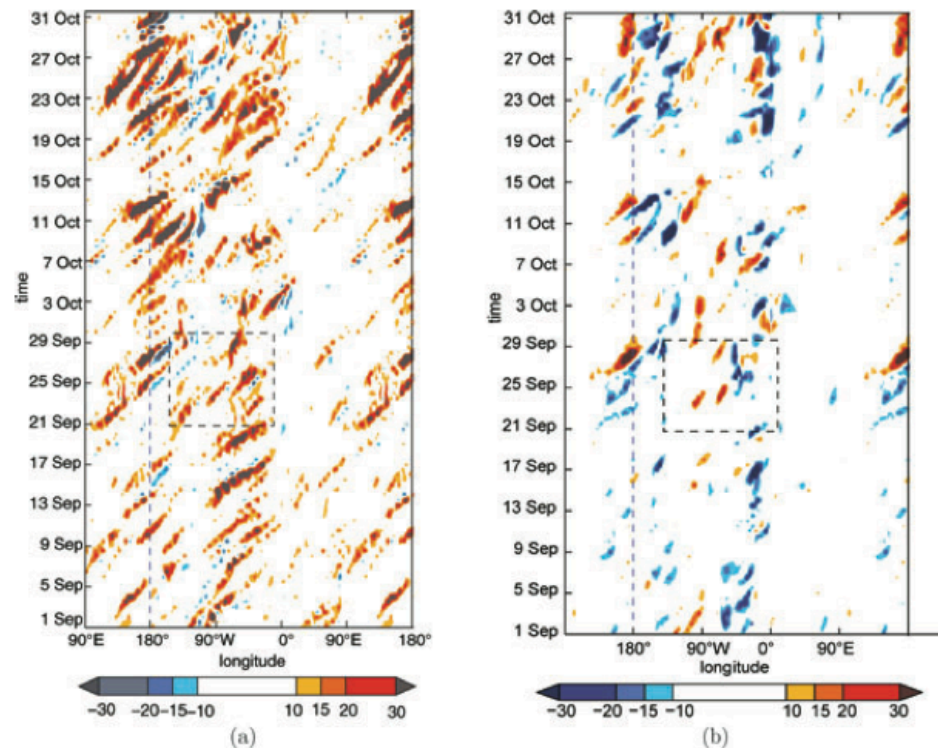
LATITUDE SLICES



HOVMÖLLER DIAGRAMS



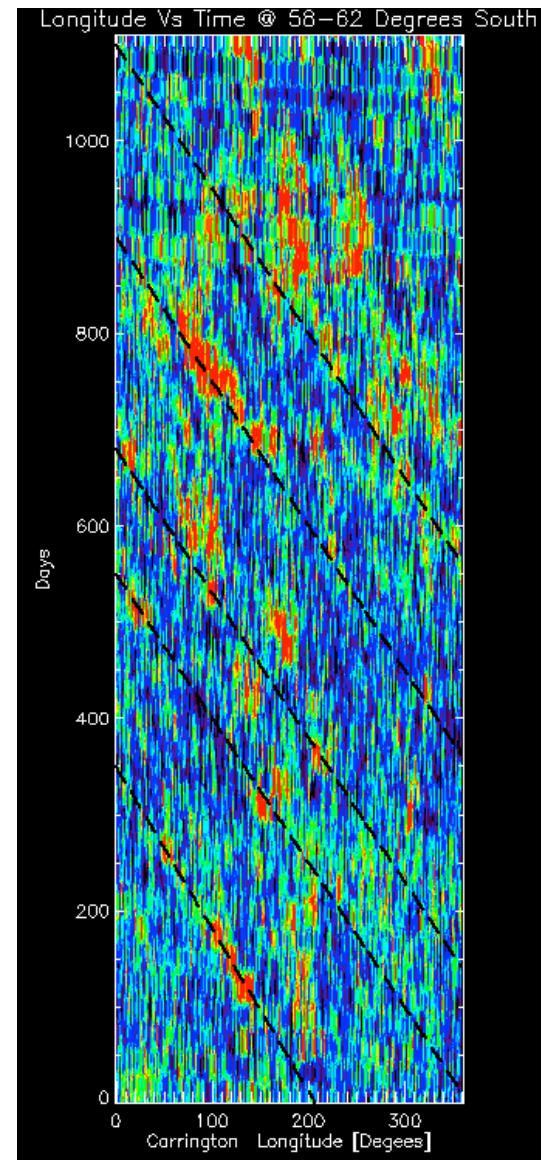
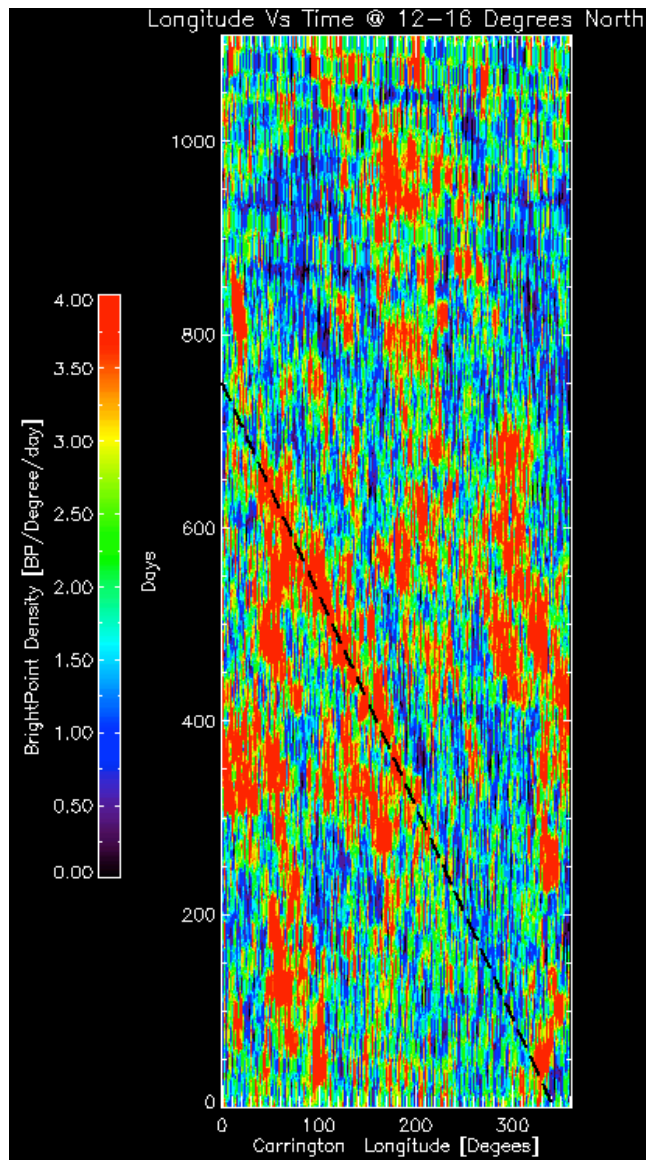
Generation of eddy kinetic energy on Earth



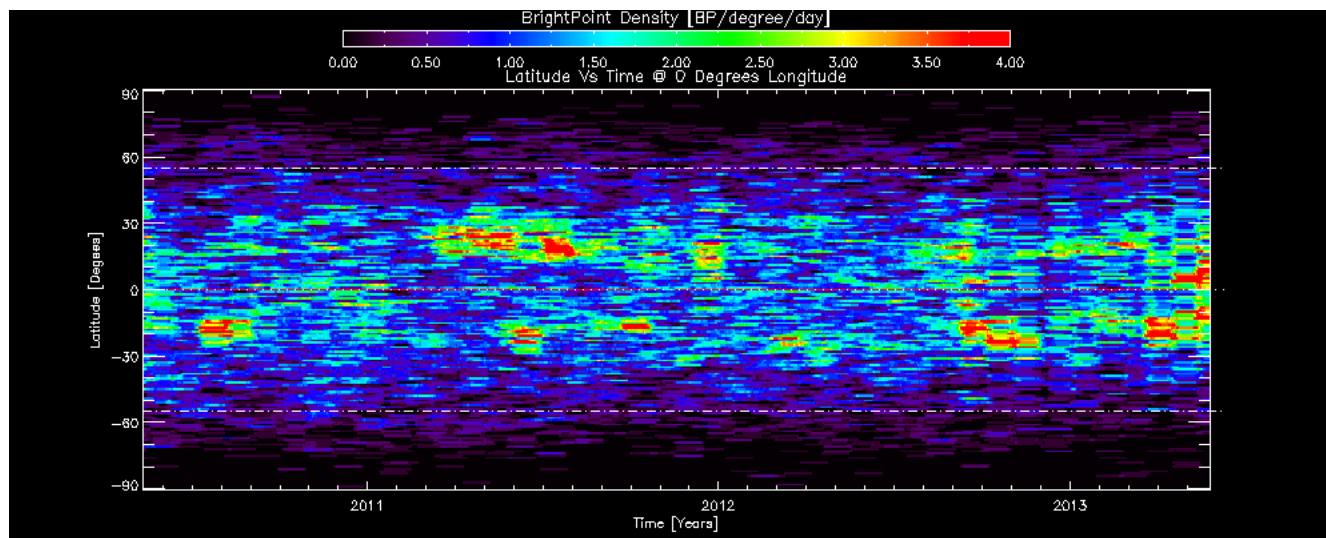
“Arguably, one of the best methods to identify RWTs on weather maps is pattern recognition by the human brain”.

Source: Glatt et. al. *Tellus* 2011

ROSSBY WAVE EVIDENCE



LONGITUDE SLICE



ACKNOWLEDGEMENTS

- Thanks to:
- Scott McIntosh and Rebecca Centeno Elliott
- Marty Snow and Erin Wood
- My erstwhile coworker Manuel Marciano
- Everyone for a wonderful time in Boulder

