Titan Wind Analysis using Lagrangian Coherent Structures

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Lagrangian Coherent Structures

- Local maxima of the FTLE field, where FTLE measures the amount of stretching about the trajectory of a point in the domain/how fast neighboring particles diverge from that point as time evolves.
- LCS are separatrices between regions with very different dynamical behavior.
Ls 270 (northern winter) at 10km
Ls 270 (northern winter) - 5km

-180 to 0 longitude

0 to 180 longitude

North Pole

South Pole
Ls 270 (northern winter) - 1km

-180 to 0 longitude

North Pole

0 to 180 longitude

South Pole
Conclusions

- Thick band of LCS surrounding the North Pole – a Montgolfiere would be trapped if deployed at the North Pole
- Smaller transport barriers at 1km altitude- vertical control can be utilized to minimize need for horizontal actuation
Time-dependence of LCS?

Frame 1, $t=0$

Frame 25, $t=2$
Titan days or 32
Earth days
Drifter plots

Frame 1, t=0
Titan days or 64 Earth days

Frame 50, t=4
Titan days or 128 Earth days

Frame 100, t=8
Titan days or 128 Earth days
The process

Binary data output from TitanWRF

Matlab programs

.dat files

Newman code

.raw files

raw2tec

Tecplot file
Goals

Experiment with:
- Integration time
- Backward time integration
- Resolution

How robust are LCS to noise?
(qualitative/quantitative measure)

More drifter plots