

Instrumented car for mobile mean wind and turbulence measurements

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Initial motivation

⌘ Mapping the (very) stable ABL

- ⌘ Taylor's hypothesis not applicable for point measurements
- ⌘ ABL motions more horizontal with stability
- ⌘ Need measurements of the horizontal structure
 - ⌘ Aircraft?

Why car?

[illegible]

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Aircraft	Car
Vertically displaced by turbulent motions	Not influenced by turbulent motions
Difficult to maintain constant height above varying terrain	Always at the same height above the ground – stable ABL!
Large aircraft cannot fly close to the ground	Close to the ground – surface fluxes and stable ABL!
Low-level flights restricted to daytime	Daytime or nighttime – stable ABL!

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Many degrees of freedom of motion	Constrained motion with smaller amplitude

Say it works – further applications

- ‡ Mapping the (very) stable ABL
- ‡ Transects through cold pools
- ‡ Horizontal flow structure in forest canopy or at the edges of forests
- ‡ Flow and turbulence variability within urban canyons

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Does it work?

Instrumented car

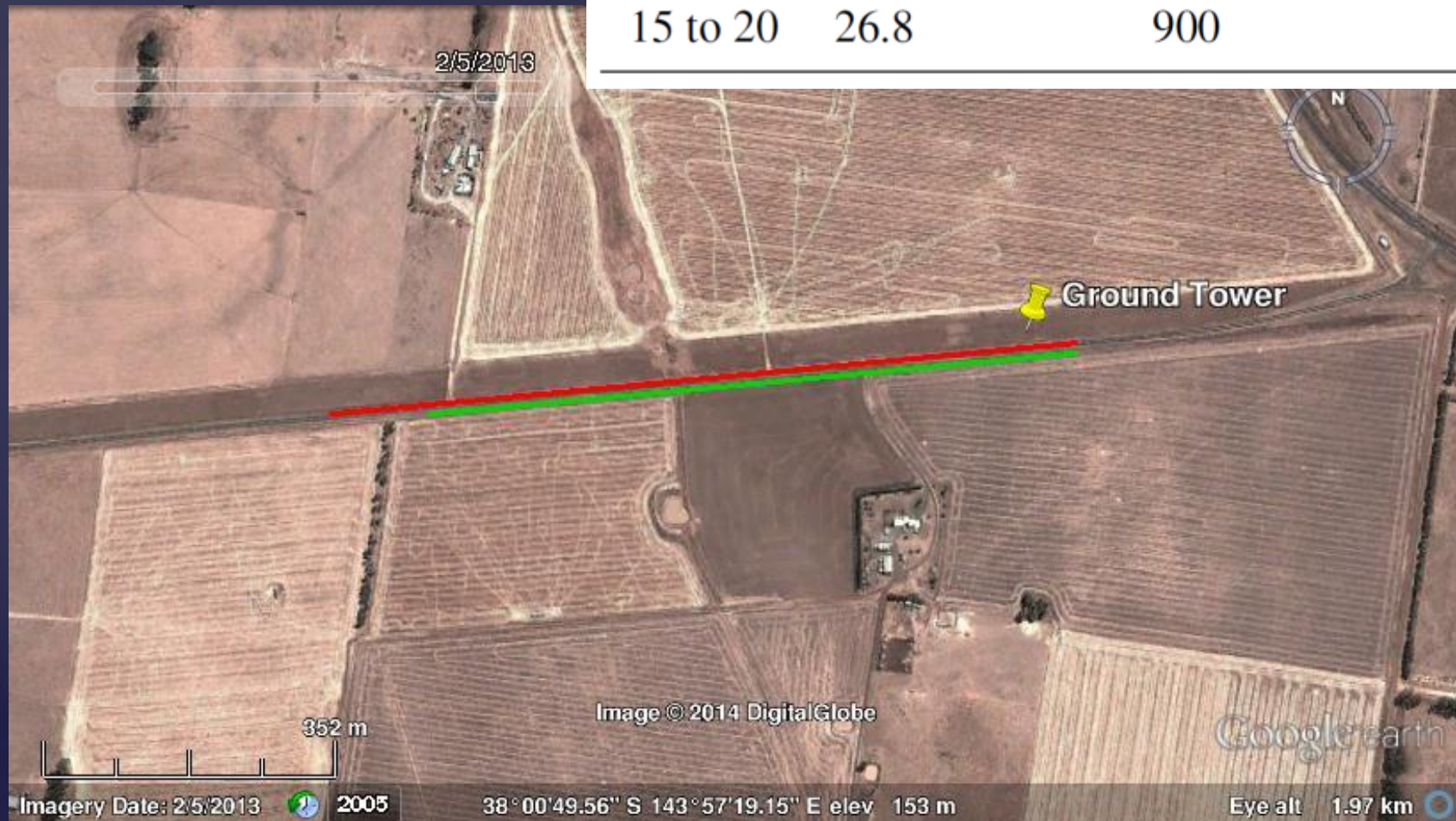


INS-
GPS



Field experiment

Tracks	$ V_{INS}^h $ (m s ⁻¹)	Length of tracks (m)
1 and 2	13.2	780
3 to 6	15.9	900
7 to 14	21.2	900
15 to 20	26.8	900

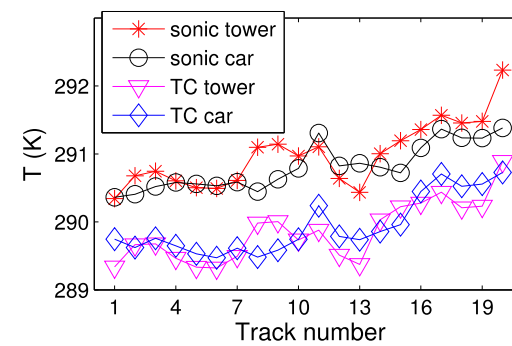
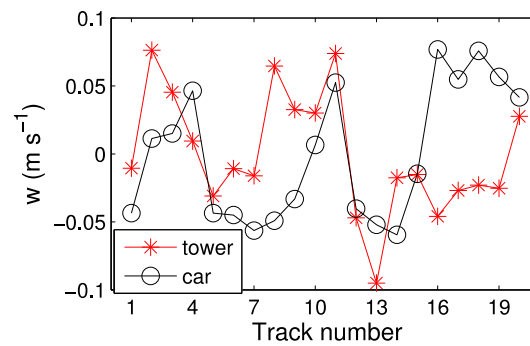
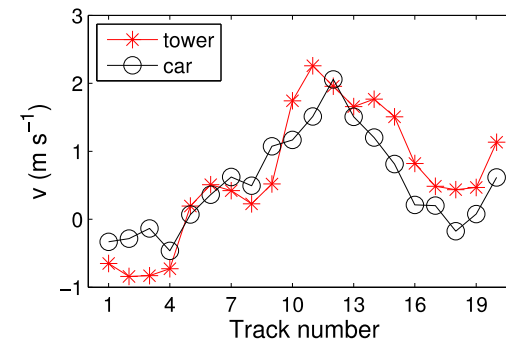
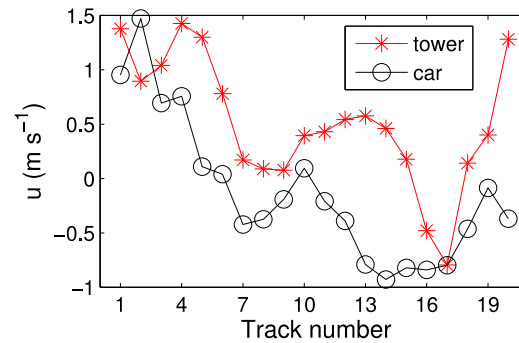
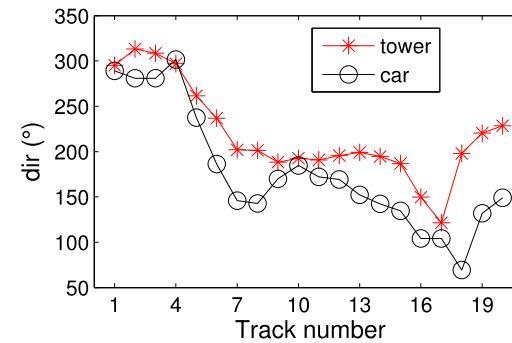
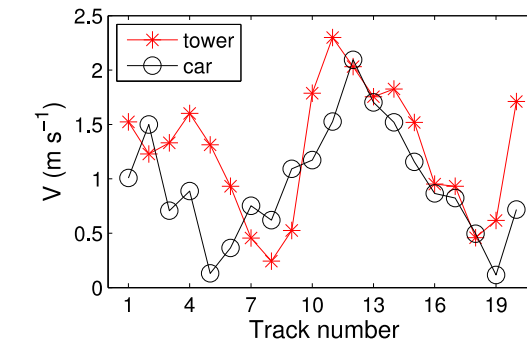


Coordinate system

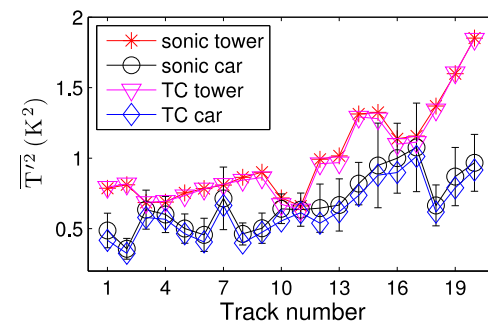
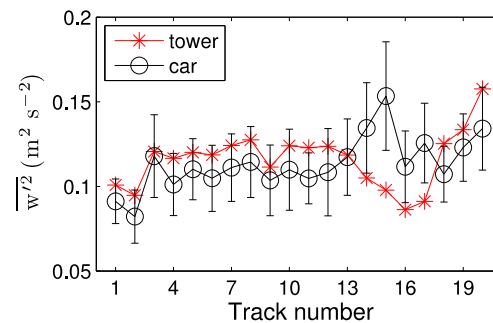
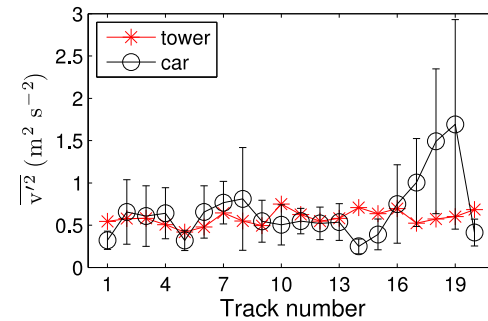
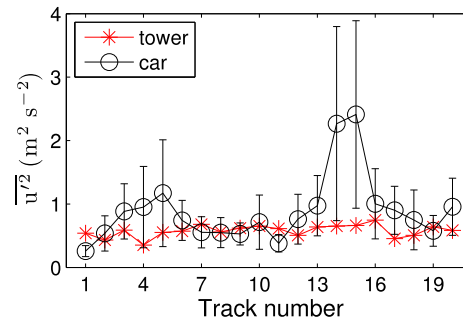
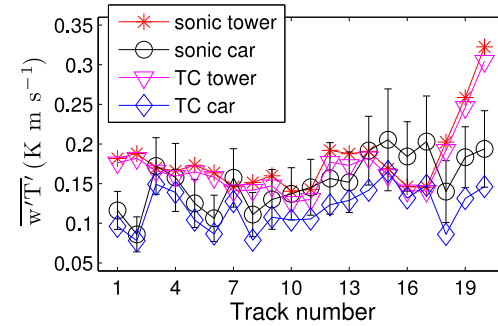
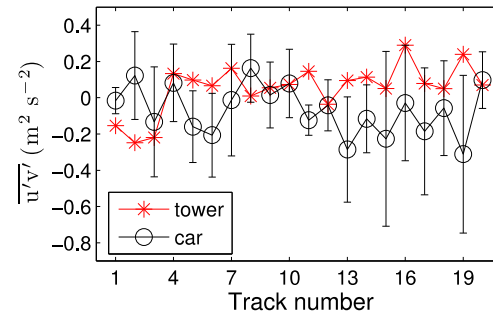
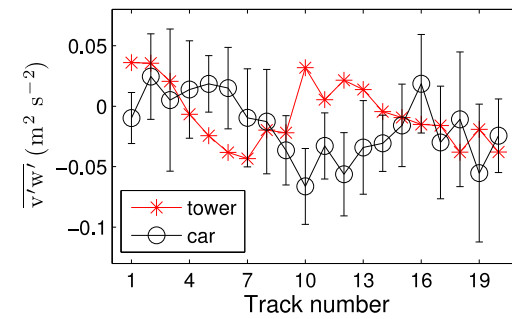
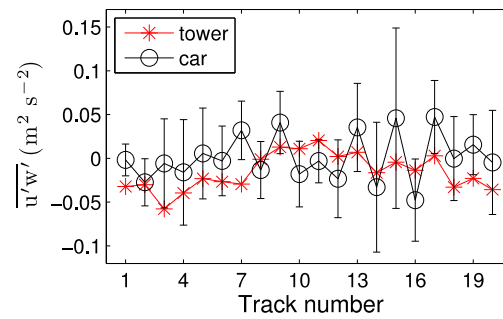
- ⌘ Terrain-following by nature

- ⌘ Only 2D rotation (heading) – simple!

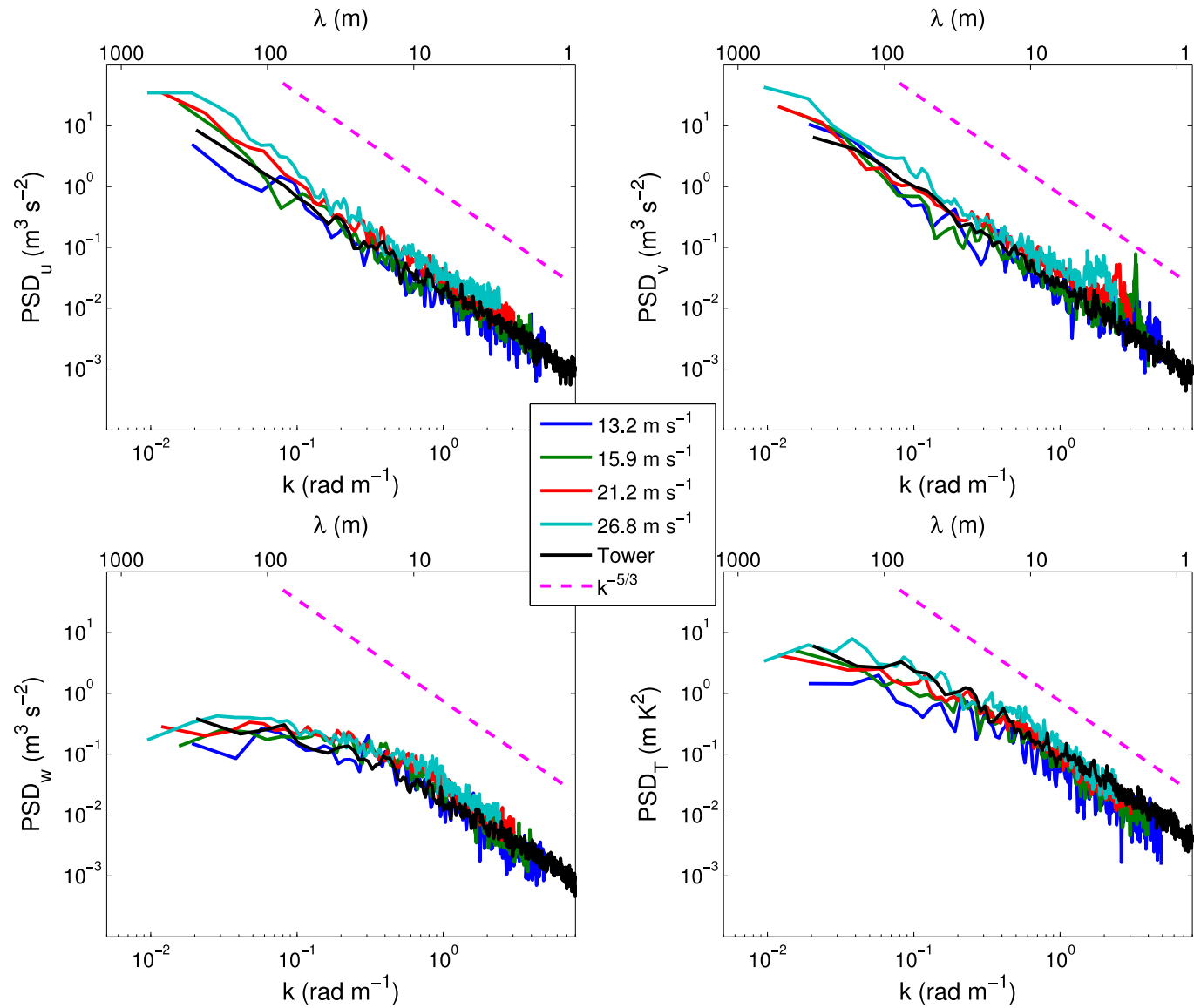
Mean



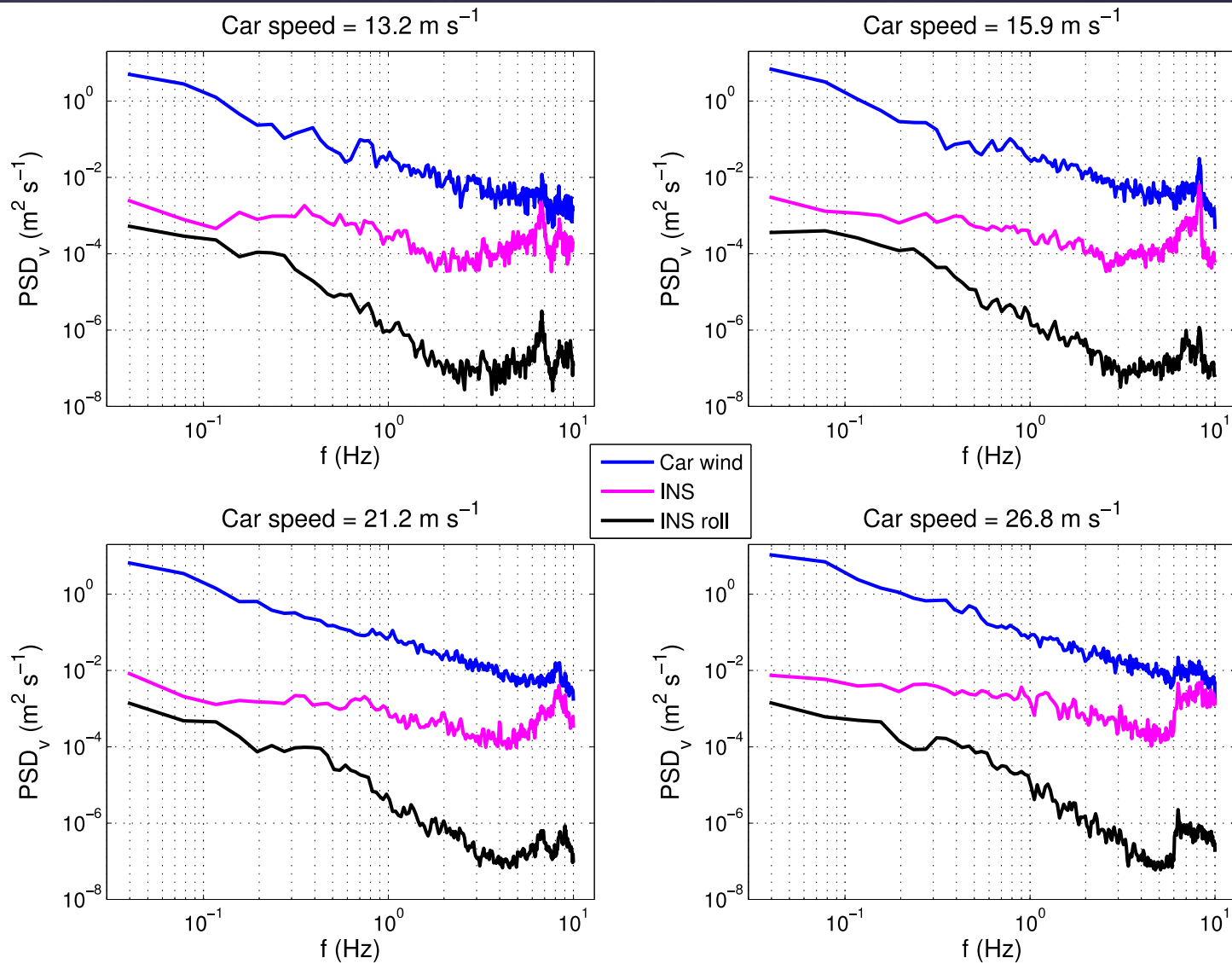
Turbulence



Spectra



Spectra



Conclusions

- ⌘ Works well!
- ⌘ Platform motions are small → need to perform only a subset of the usual aircraft corrections:
 - ⌘ Car speed
 - ⌘ Flow distortion for w
 - ⌘ Rotate to meteorological coordinate system (terrain following if desired!)
- ⌘ A decent road = measurements
- ⌘ Use 4WD and go even further (salt lakes, outback...)
- ⌘ Could provide important data for a number of previously uncharted phenomena