

# Comparison of thermospheric winds measured by GOCE and ground-based FPIs at low and middle latitudes

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MARCH<sup>7, 8</sup>, CHRISTIAN SIEMES<sup>8</sup>

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# GOCE

Inclination:  $96.7^\circ$

Sun synchronous orbit

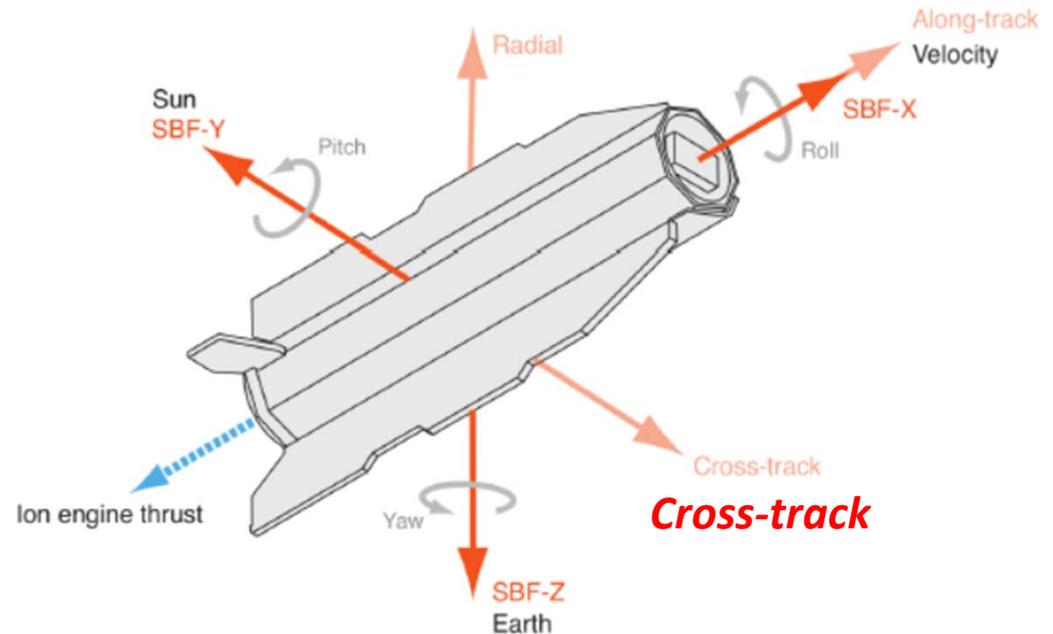
Mission period:

Mar. 2009 - Nov. 2013

Local times of GOCE measurement:

Dusk (Ascending):  $\sim 18:30-19:30$  LT

Dawn (Decending):  $\sim 06:30-07:30$  LT

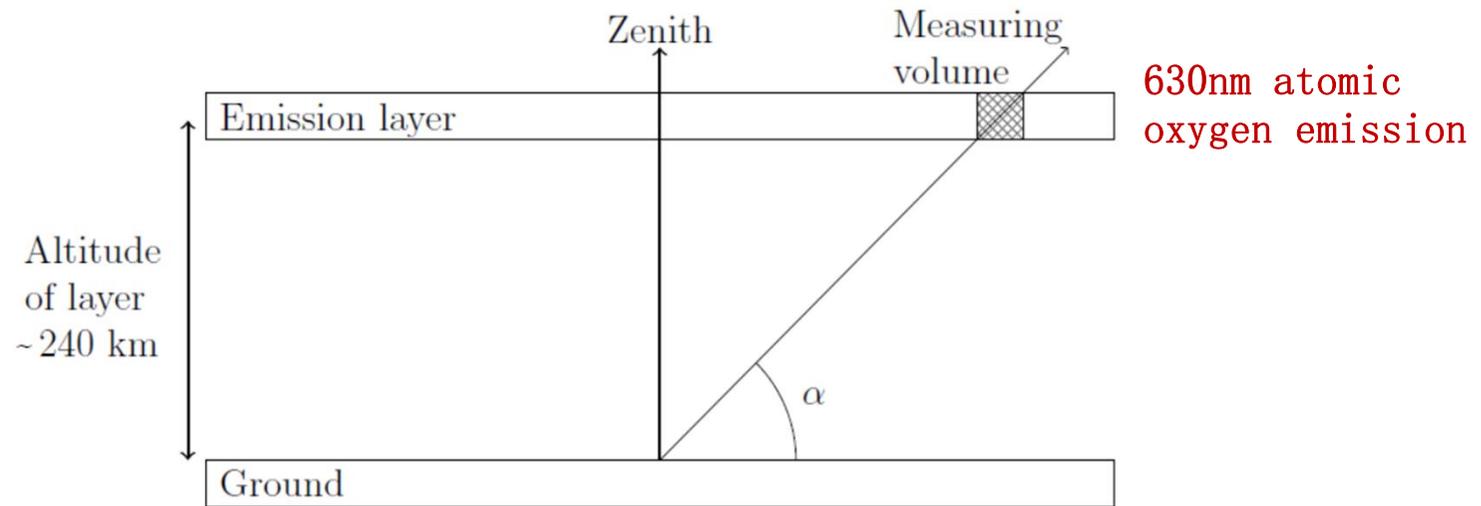


accelerometers

**GOCE cross-track wind:  $\sim 220$  km - $260$  km**  
**An in-situ wind at a specific altitude;**  
**The altitude positioning is much more accurate.**

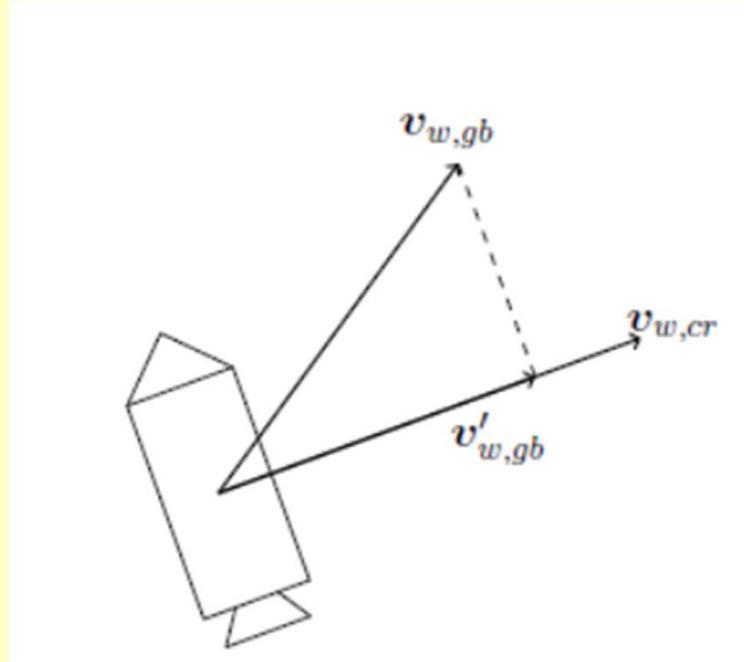
**GOCE crosswinds represent the cross-track part of the winds,**  
**not the full vector zonal or meridional winds (Doornbos, et al., 2013).**

# FPI



**FPI wind:  
Height-integrated measurement  
(centered at ~ 250 km)**

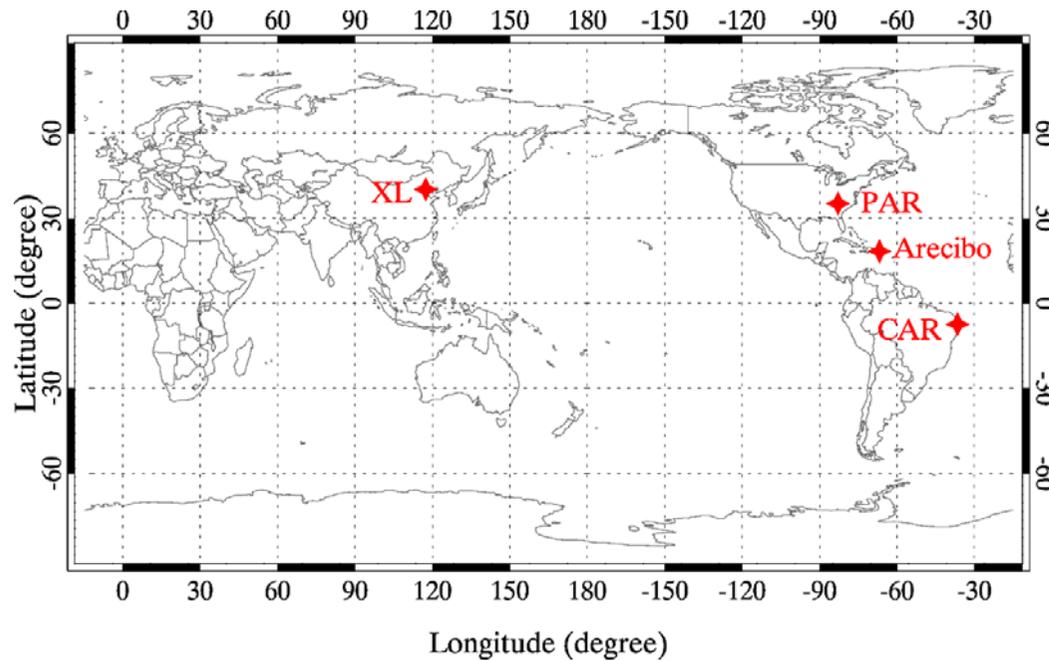
## Geometry of projection of ground-based wind vector onto crosswind



$v_{w,gb}$  : the velocity of the ground-based wind

$v_{w,cr}$  : the velocity of the crosswind.

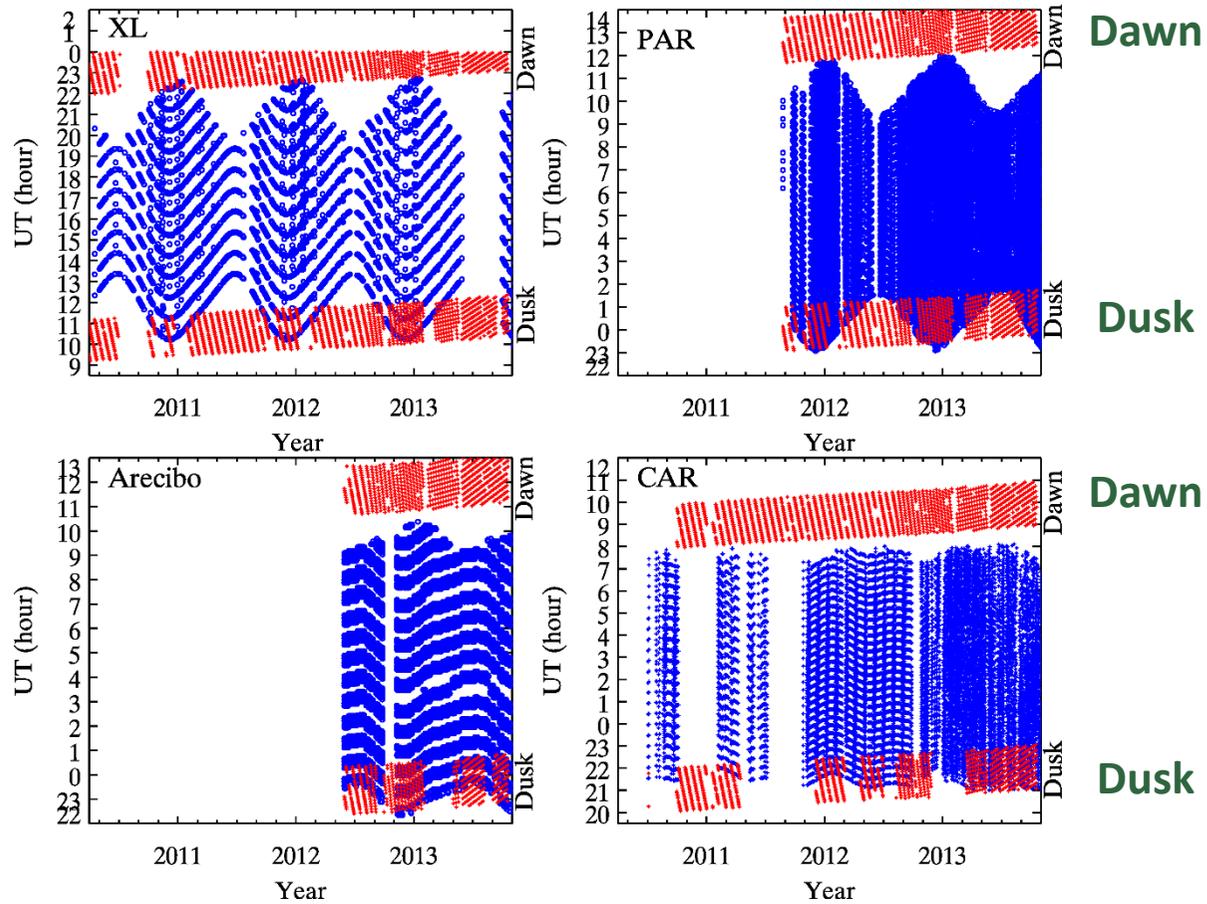
# The locations of FPIs



**Table 1**  
*Data Sets of Ground-Based FPIs Used in This Paper*

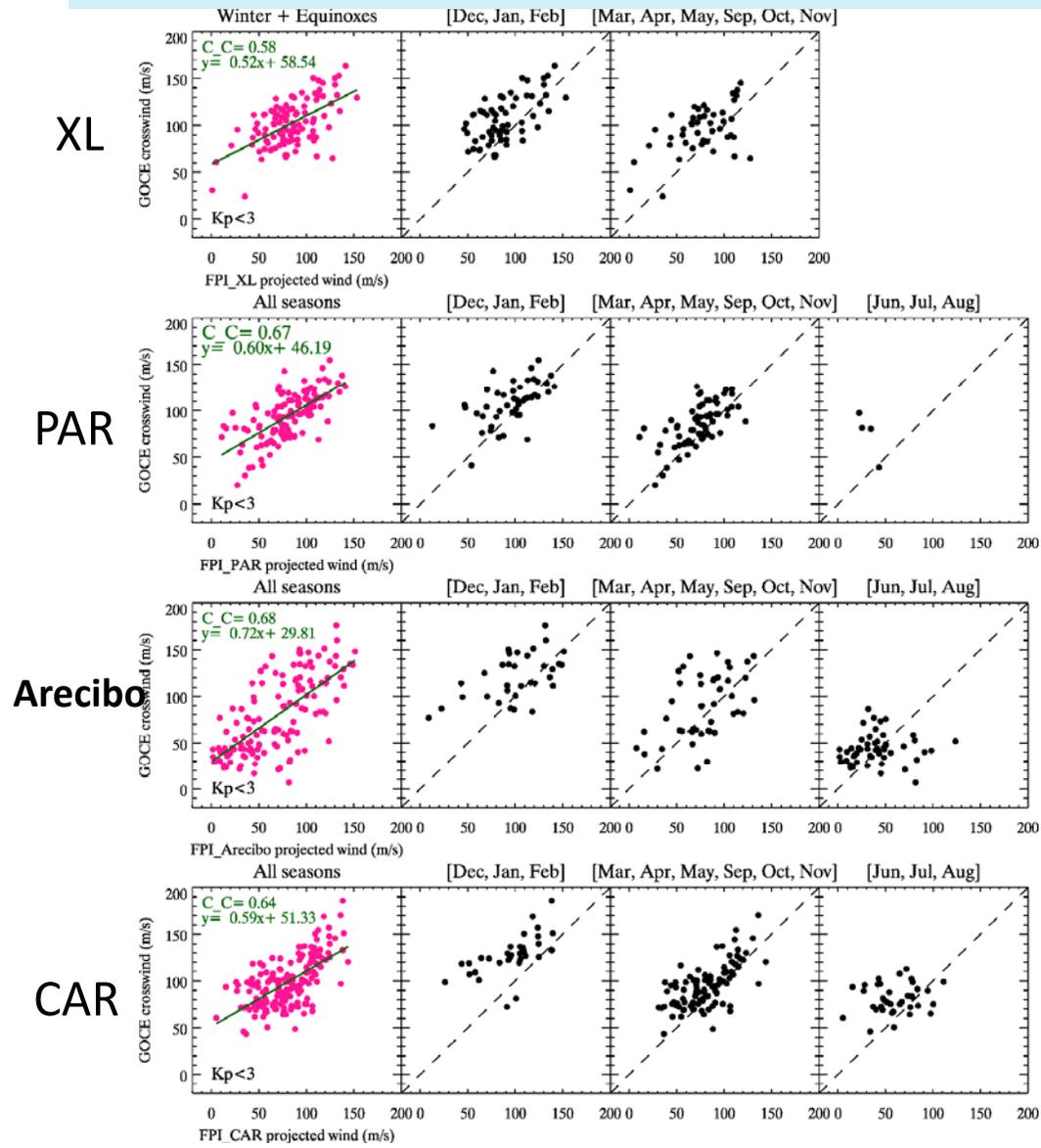
Station	Geographic location	Geomagnetic latitude	Years of data	Detection wavelength (nm)/Height (km)
XL	40.2°N, 117.4°E	35°N	April 2010–November 2013	630.0/250
PAR	35.2°N, 82.85°W	45.8°N	June 2011–November 2013	630.0/250
Areclbo	18.35°N, 66.75°W	27.1°N	May 2012–November 2013	630.0/250
CAR	7.38°S, 36.52°W	11.74°S	July 2010–November 2013	630.0/250

# The paired wind databases distribution with year and universal time



Choose the winds at **dusk side**

# Scatterplot of GOCE crosswinds and FPI projected winds during geomagnetically quiet time



**The correlation coefficients:**

**XL: 0.58**

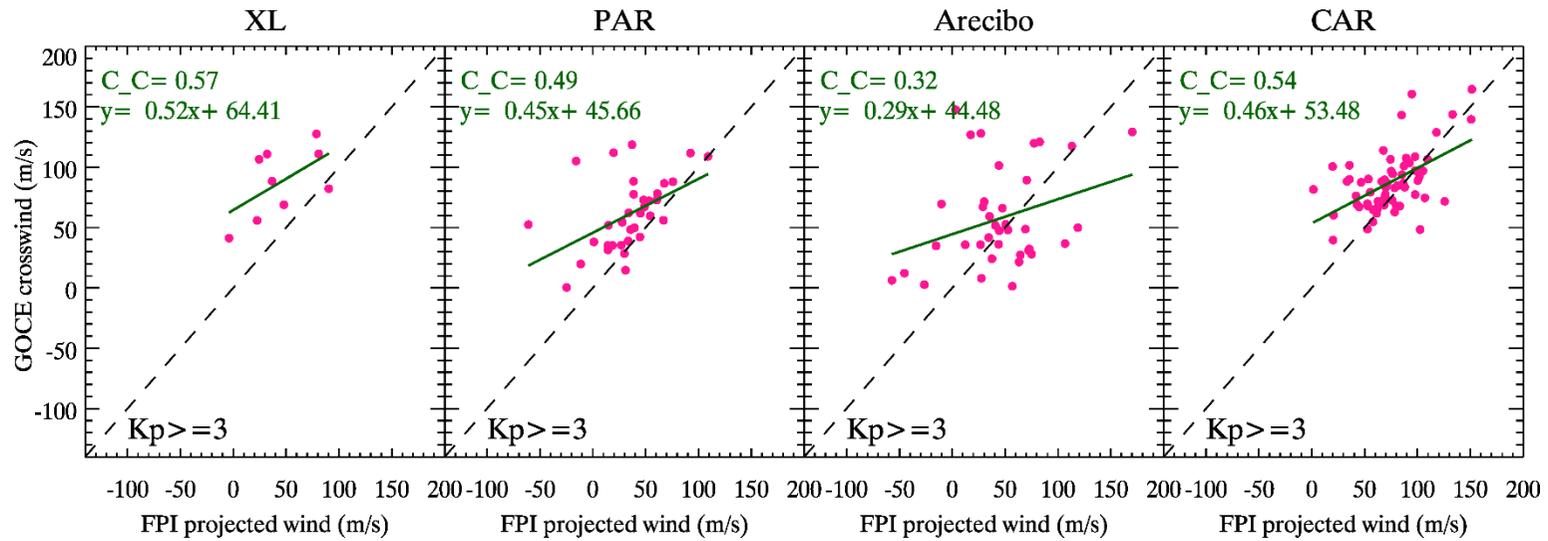
**PAR: 0.67**

**Arcibo: 0.68**

**CAR: 0.64**



# Scatterplot of GOCE crosswinds and FPI projected winds during geomagnetically active time



**C\_C=0.57**

**0.49**

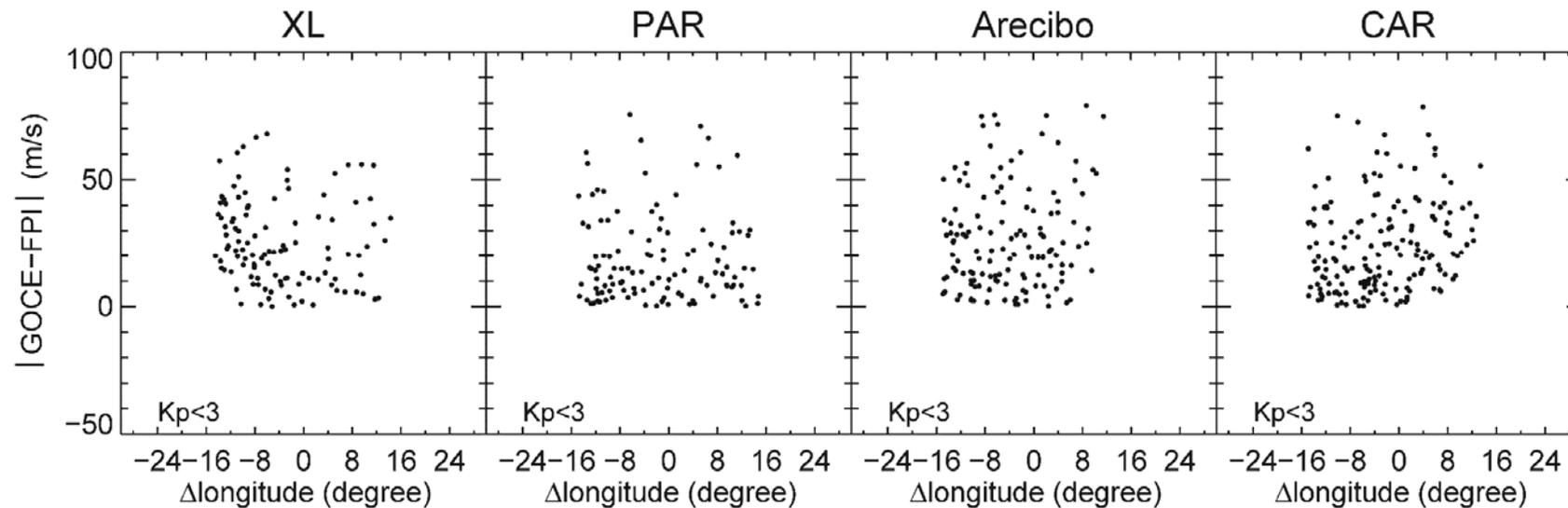
**0.32**

**0.54**

## The Averaged Ratio and Difference Between GOCE Crosswinds and FPI Projected Winds at Dusk Side.

FPI stations	Kp<3		Kp≥3	
	$\overline{GOCE/FPI} /$ STDDEV	$ GOCE - FPI $ / STDDEV (m/s)	$\overline{GOCE/FPI} /$ STDDEV	$ GOCE - FPI $ / STDDEV (m/s)
XL	<b>1.69</b> / 3.20	25.03 / 17.00	<b>0.85</b> / 4.35	44.35 / 24.63
PAR	<b>1.37</b> / 0.93	19.41 / 17.83	<b>2.17</b> / 5.92	28.44 / 29.93
Arecibo	<b>1.44</b> / 4.24	26.82 / 20.31	<b>2.15</b> / 7.69	40.06 / 31.90
CAR	<b>1.42</b> / 1.02	24.15 / 18.07	<b>2.15</b> / 6.50	21.82 / 20.65

## The scatterplots of the absolute value of GOCE-FPI wind difference and their horizontal distances



No clear dependence of the wind differences is found with the longitudinal separation.

# Summary

## 1. Geomagnetically quiet periods

- GOCE crosswind on the dusk side presents consistent signatures of annual variations that compare well with those derived from ground-based FPIs, showing largest speed around December and lowest speed around June.
- Despite the similarity, the GOCE wind is generally larger than the wind derived from FPIs, with average ratios around 1.37–1.69. The correlation coefficients reach 0.58 for XL, 0.67 for PAR, 0.68 for Arecibo and 0.64 for CAR.

## 2. Geomagnetically active periods

- the correlation coefficients between GOCE crosswinds and FPI horizontal winds are poor. But still the absolute value of the wind derived from GOCE is larger than that of the FPIs, except for the station at Arecibo during June solstice months.

3. The discrepancies between the wind data sets from GOCE accelerometer and FPIs should mainly lay in the different measurement principles of the two techniques.