Yale 耶鲁大学–南京信息工程大学大气环境中心

Yale-NUIST Center on Atmospheric Environment

Drivers of temporal and spatial variations of lake albedo

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YNCenter video conference, Nanjing

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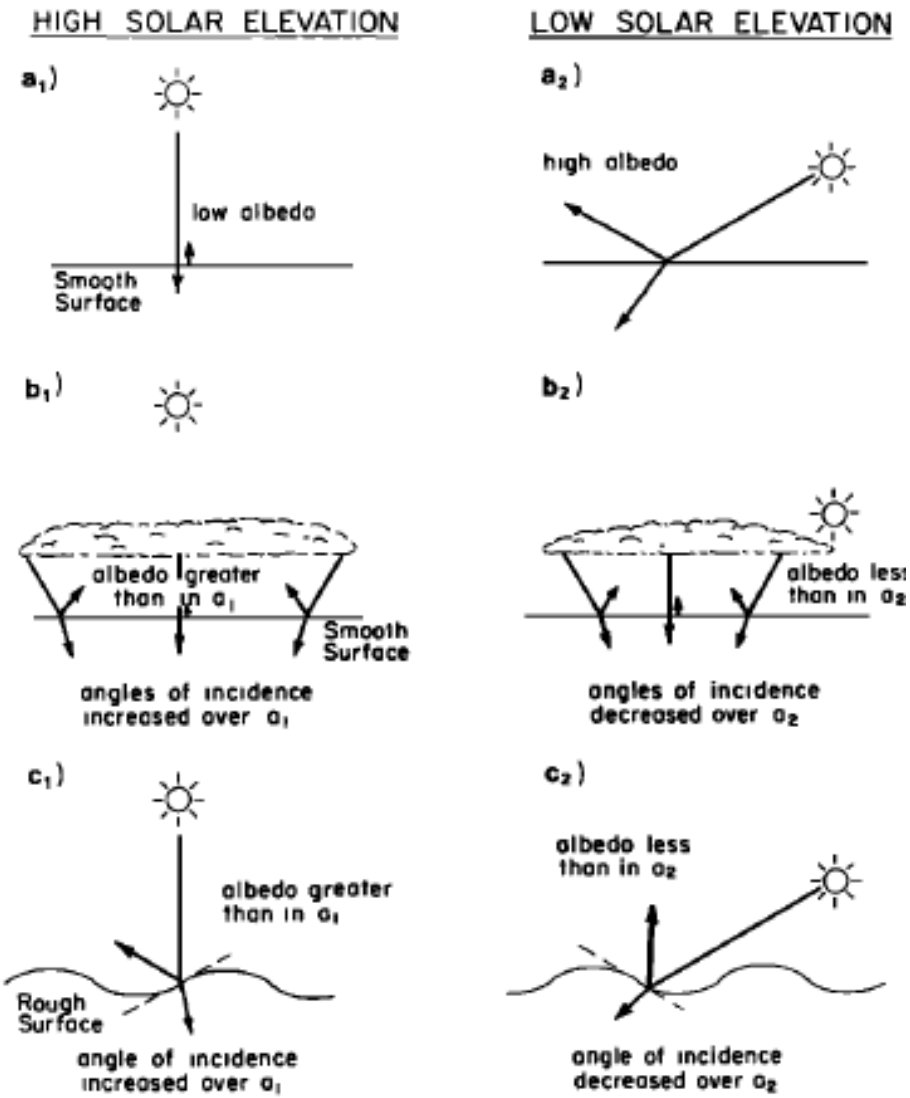
Outline

- Background
- Objective
- Method
- Results
- Discussion

Background



(Kristina et al.,1985)

- **Albedo of lake can be affected by many factors:**

(1) Climatic factors: solar elevation angle and diffuse radiation

(2) Wave: wind speed

(3) Water quality: turbidity

- **Lake Taihu is heavily affected by pollution caused by human activity and thus its biological process is also changed (such as eutrophication episode).**

Objective

- To find out how sun elevation angles, cloudiness, water turbidity and wind speed affect the albedo of Lake Taihu and thus further try to make albedo as a proxy for its biological attributes.

Method

- Five sites on Lake Taihu

Site Name	Period Inclued
MLW (Meiliangwan)	14/6/2010-2/9/2013
DPK (Dapukou)	18/8/2011-2/9/2013
BFG (Bifenggang)	16/12/2011-1/9/2013
XlS (Xiaoleishan)	28/11/2012-2/9/2013
PTS (Pingtaishan)	7/6/2013-2/9/2013

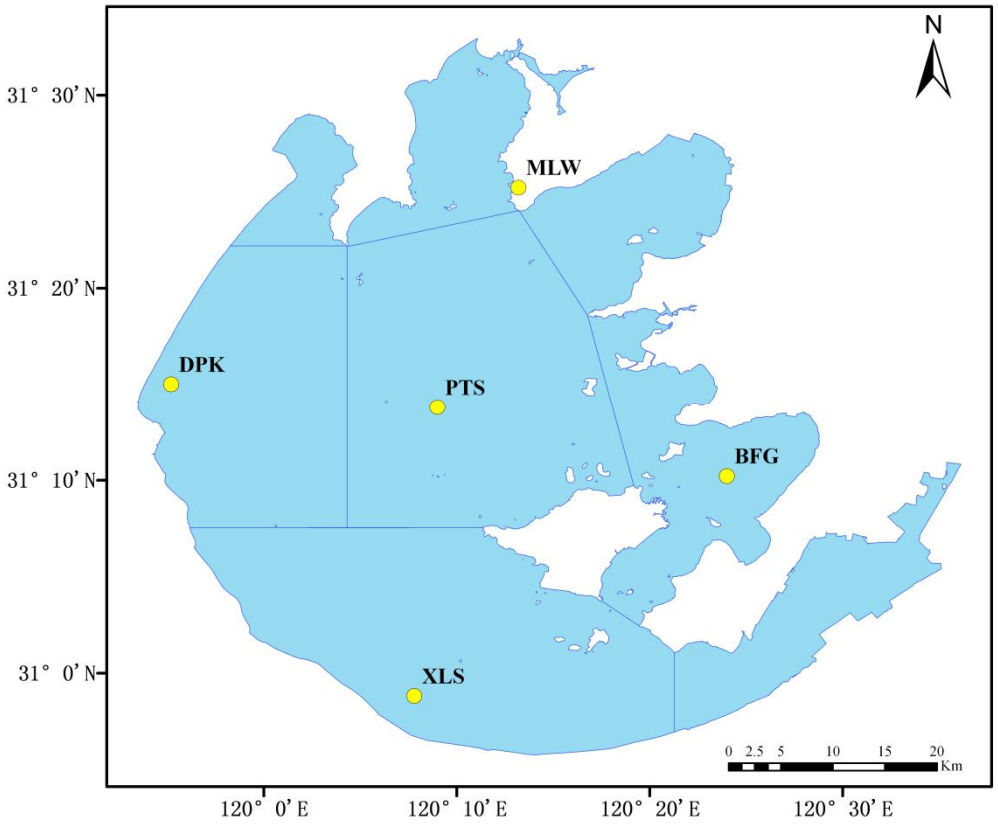


Figure.1 Site information

- Radiometer

Kipp & Zonen CNR4

- Water quality data: Turbidity and chlorophyll

- Daily albedo $\alpha = \sum Rs_{out} / \sum Rs_{in}$
- Clearness index

$$k_t = S / S_e$$

$$S_e = S_{sc}[1 + 0.033\cos(360 t_d / 365)]\sin\beta$$

k_t : clearness index

S :global solar radiation received at the surface

S_e :extraterrestrial radiation at the TOA

S_{sc} : the solar constant (1370W/m^2)

t_d : the day of the year

β :the solar elevation angle

(Gu et al., 1999)

Results

Table.1 Seasonal albedo for 5 sites on Lake Taihu

Site Name	Year	Spring(3-5)	Summer(6-8)	Autumn(9-11)	Winter(12-2)
MLW	2010			0.081	0.100
	2011	0.063	0.060	0.063	0.071
	2012	0.055	0.061	0.075	0.077
	2013	0.055	0.079		
DPK	2012	0.083	0.063	0.084	0.098
	2013	0.075	0.062		
BFG	2012	0.085	0.069	0.108	0.127
	2013	0.083	0.065		
XLS	2012				0.129
	2013	0.095	0.077		
PTS	2013		0.081		

Cloud effect

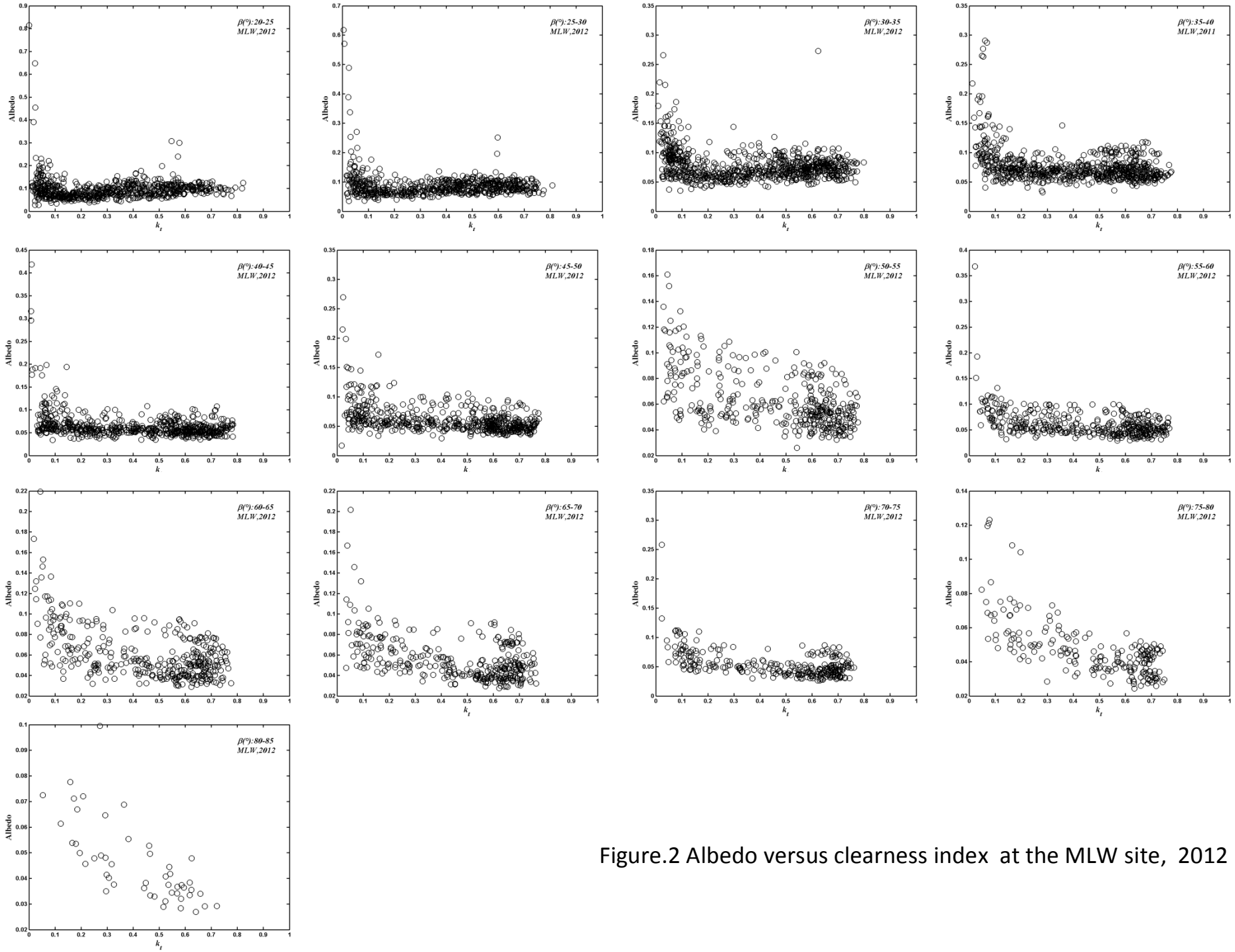


Figure.2 Albedo versus clearness index at the MLW site, 2012

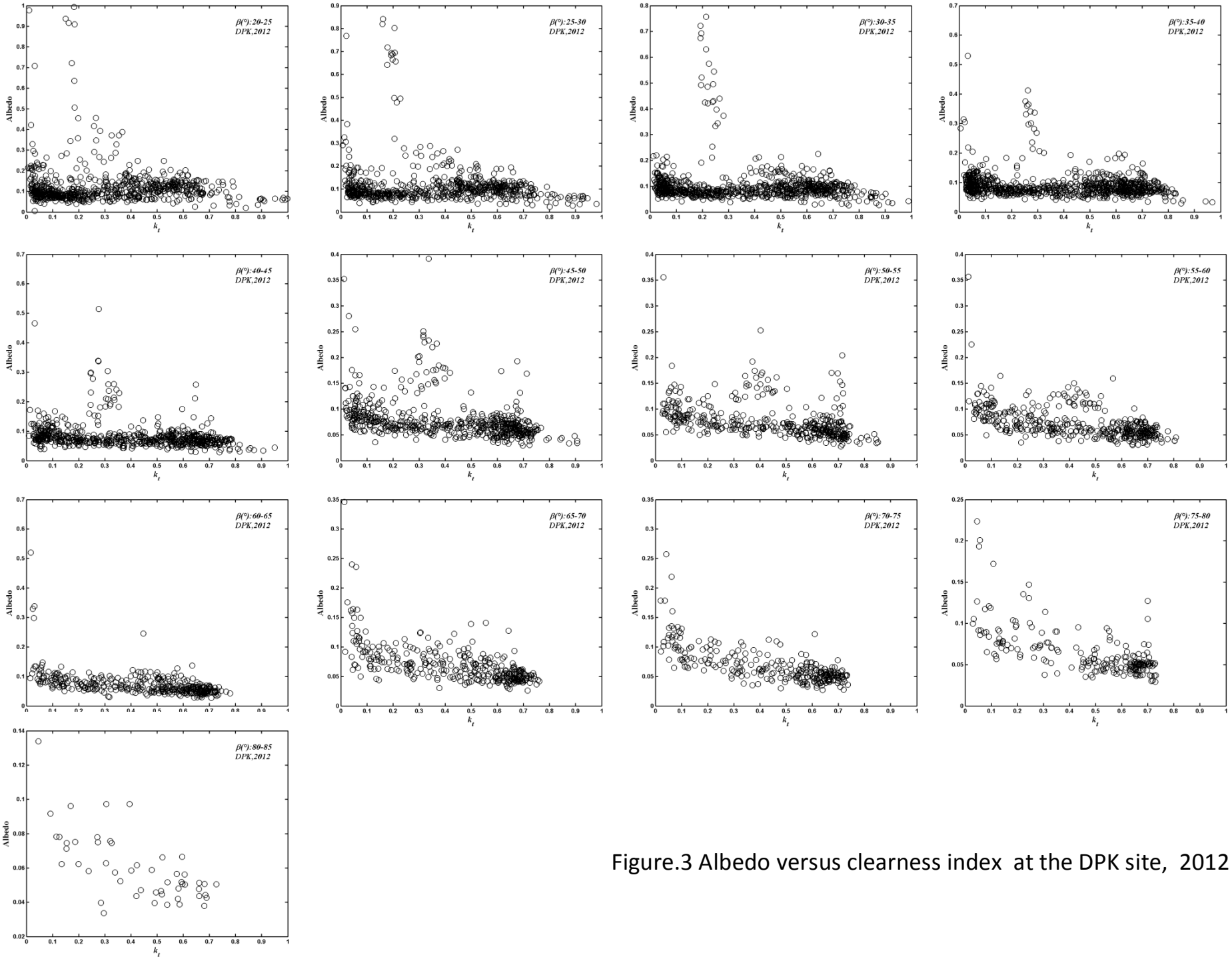


Figure.3 Albedo versus clearness index at the DPK site, 2012

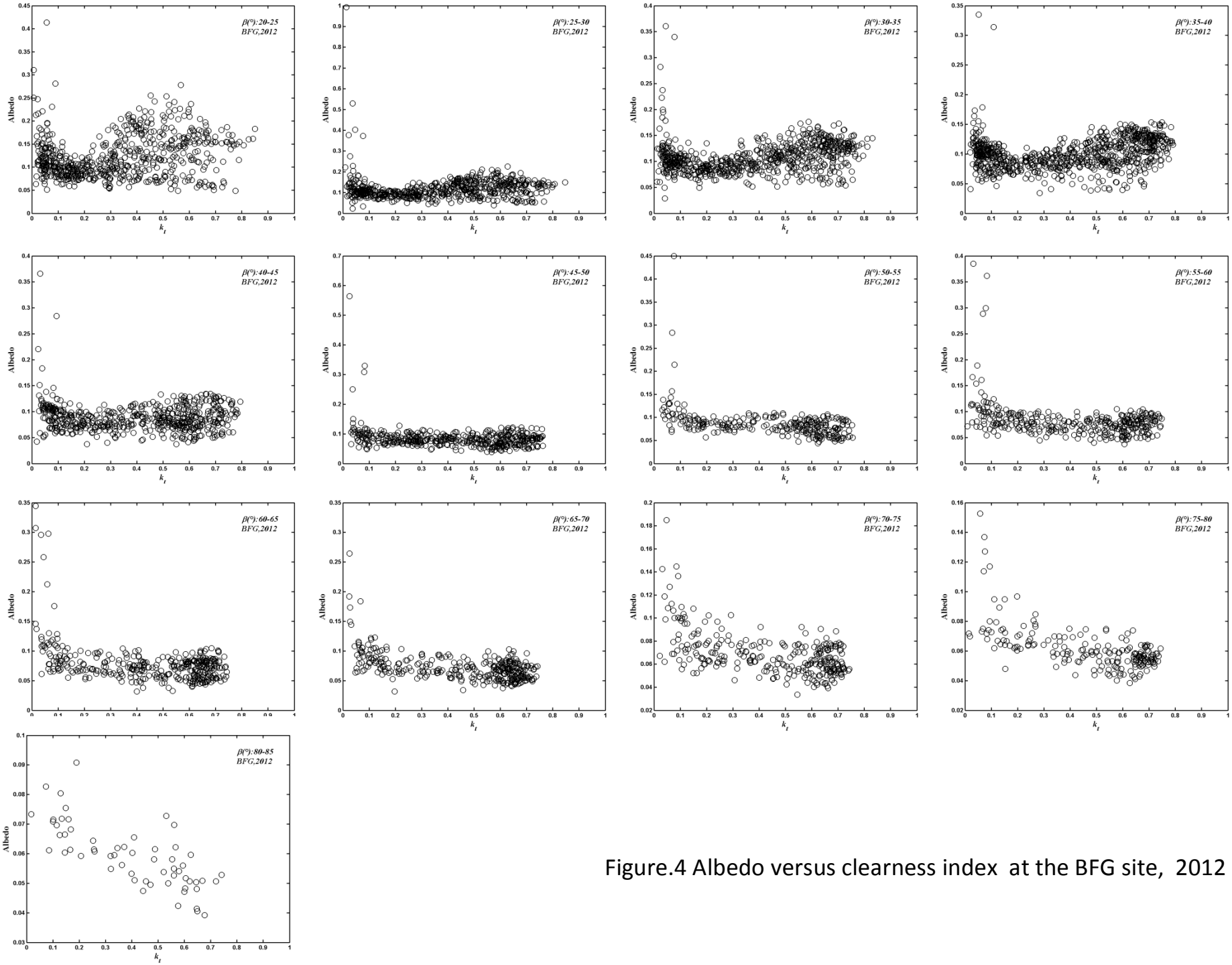


Figure.4 Albedo versus clearness index at the BFG site, 2012

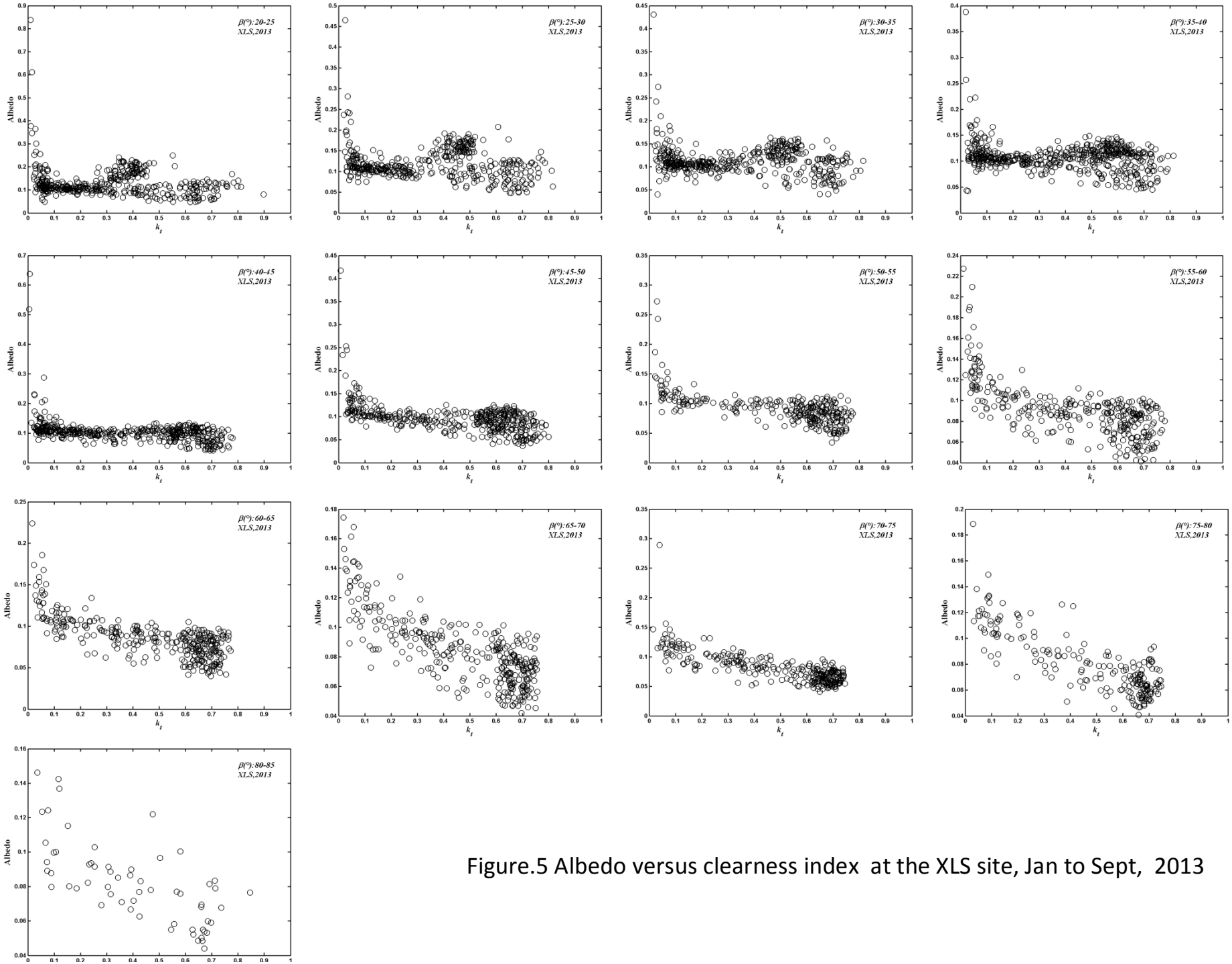


Figure.5 Albedo versus clearness index at the XLS site, Jan to Sept, 2013

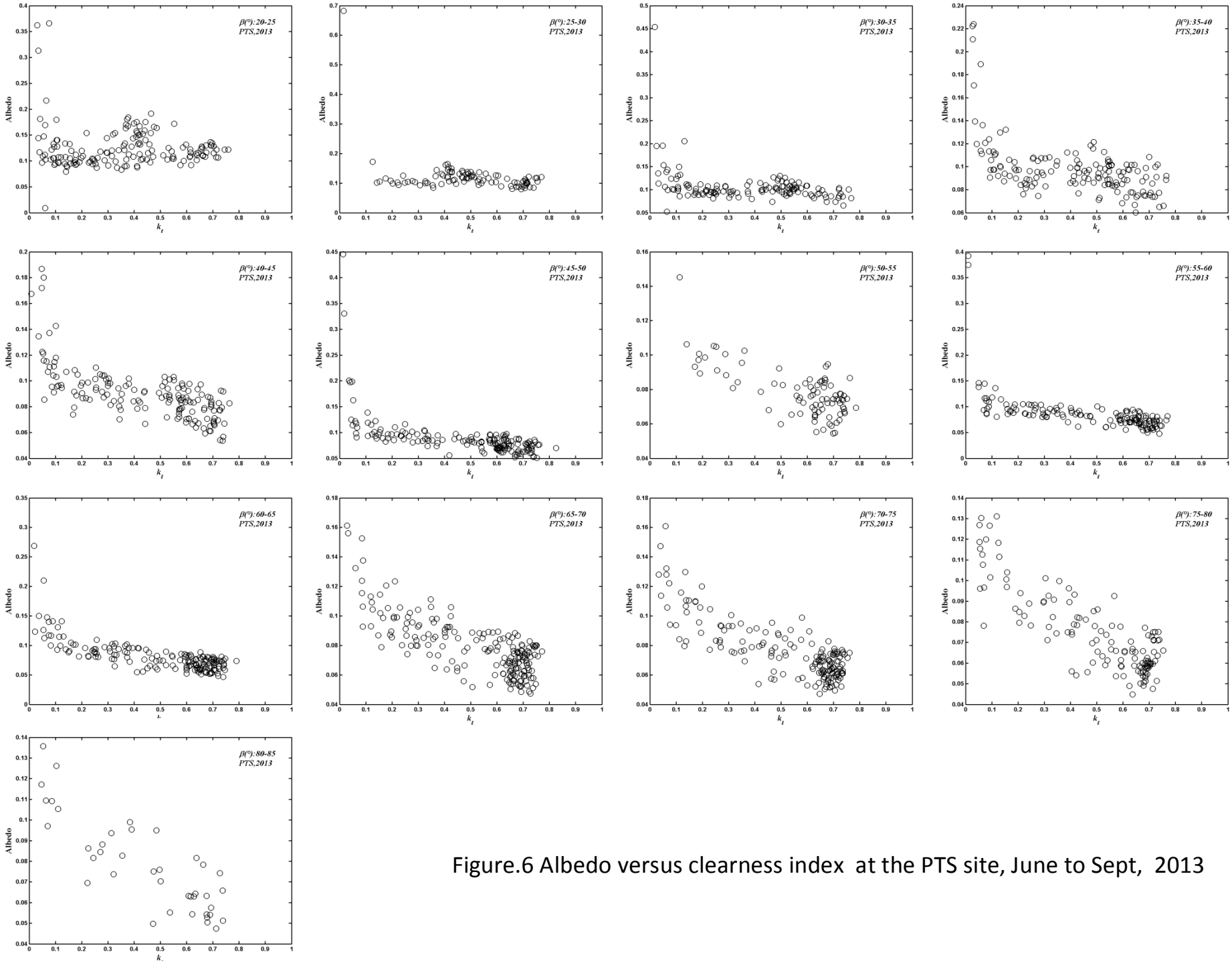


Figure.6 Albedo versus clearness index at the PTS site, June to Sept, 2013

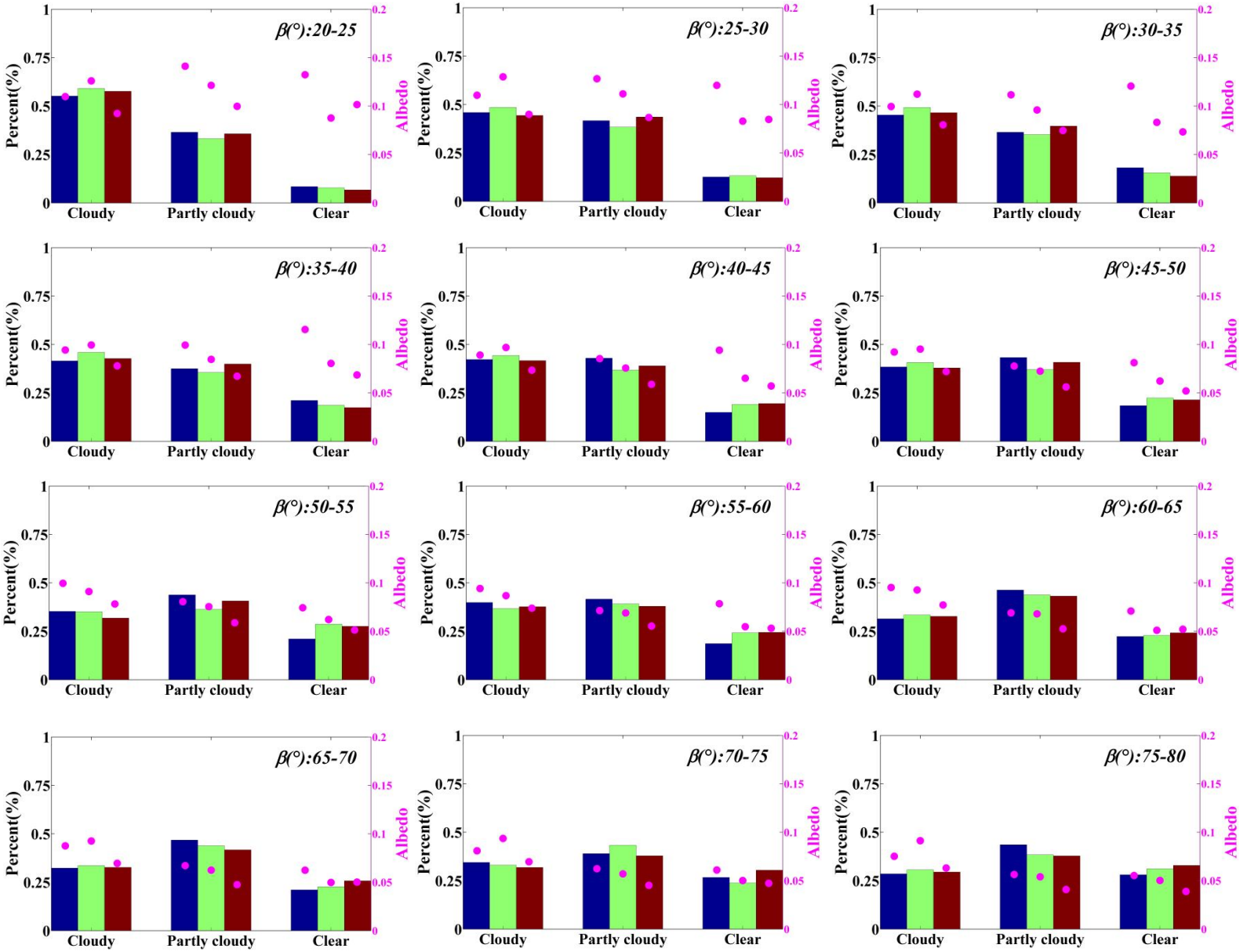


Figure.7 Albedos under varying cloud cover for the 3 sites in 2012: blue bar (BFG), green bar (DPK), red bar (MLW)

Wind effect

- Midday solar elevation
- Clear days (kt>0.65)

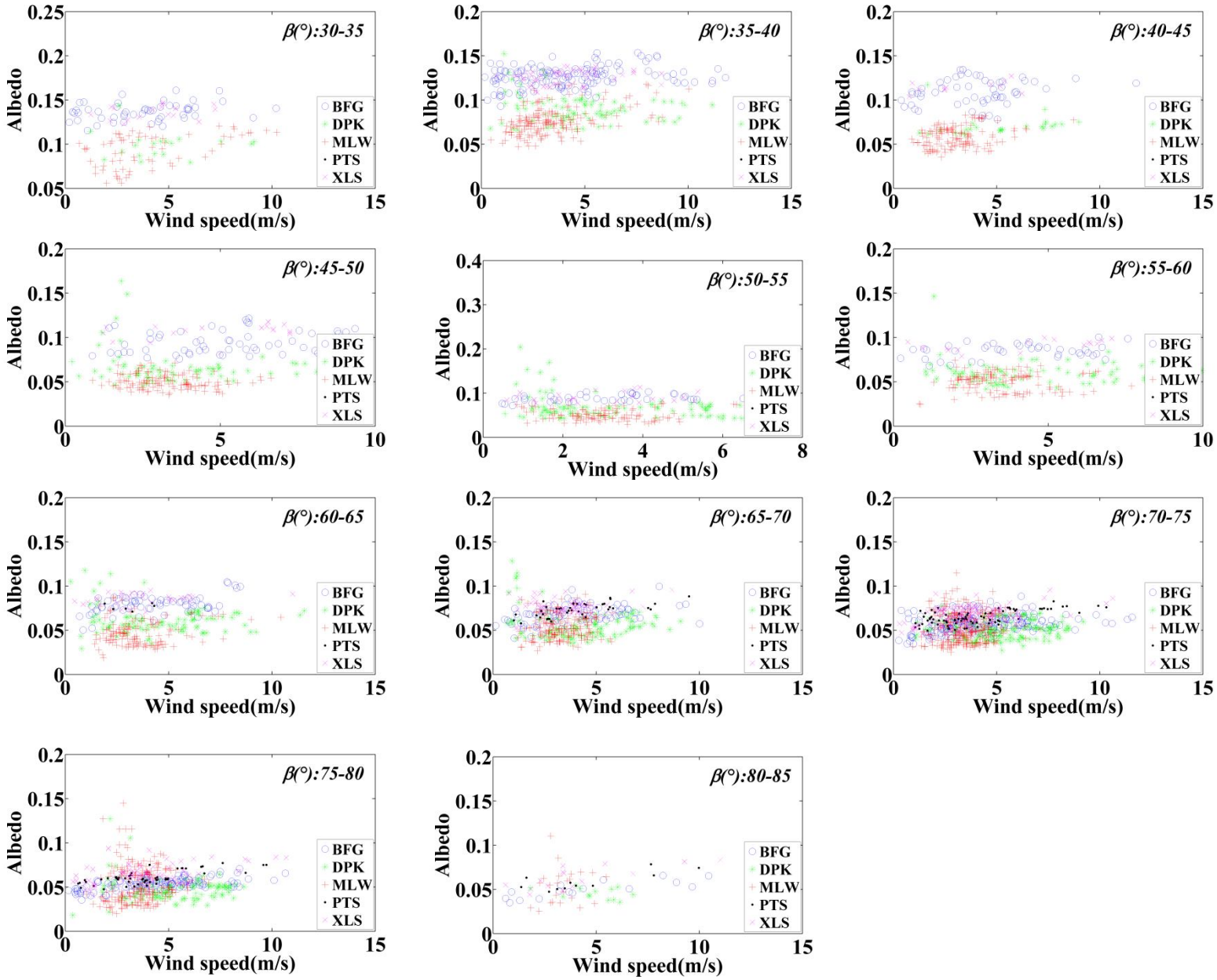
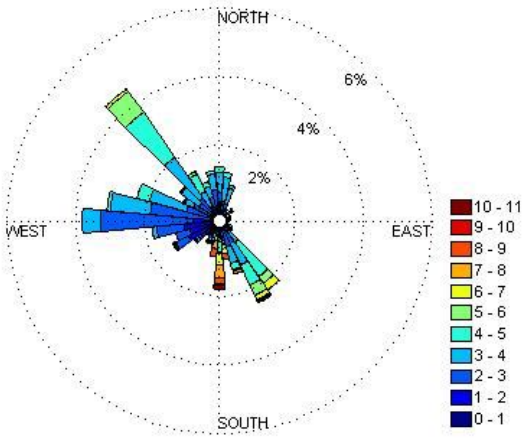


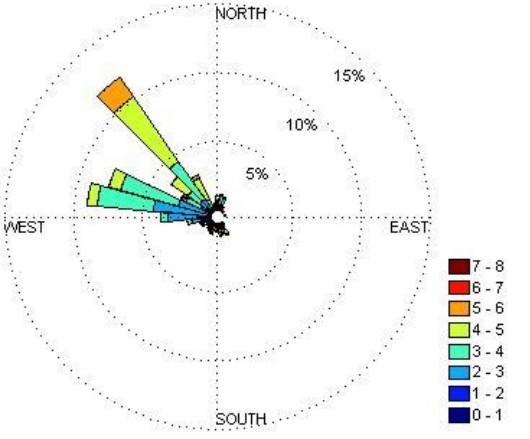
Figure.8 Albedos plotted against wind speed for the 5 sites

β:30-65°

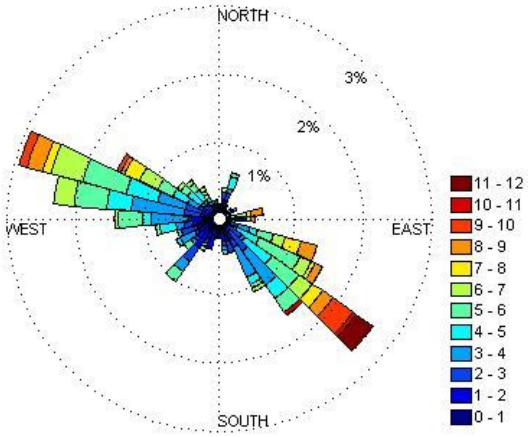


MLW

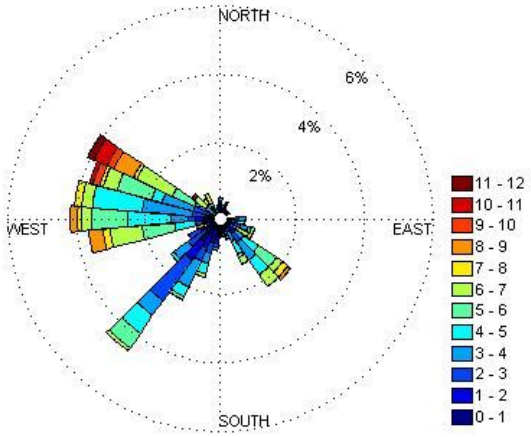
β:65-85°



MLW



BFG



BFG

Figure.9 Wind rose for the 5 sites

Water quality effect

- Midday solar elevation
- Clear days (kt>0.65)

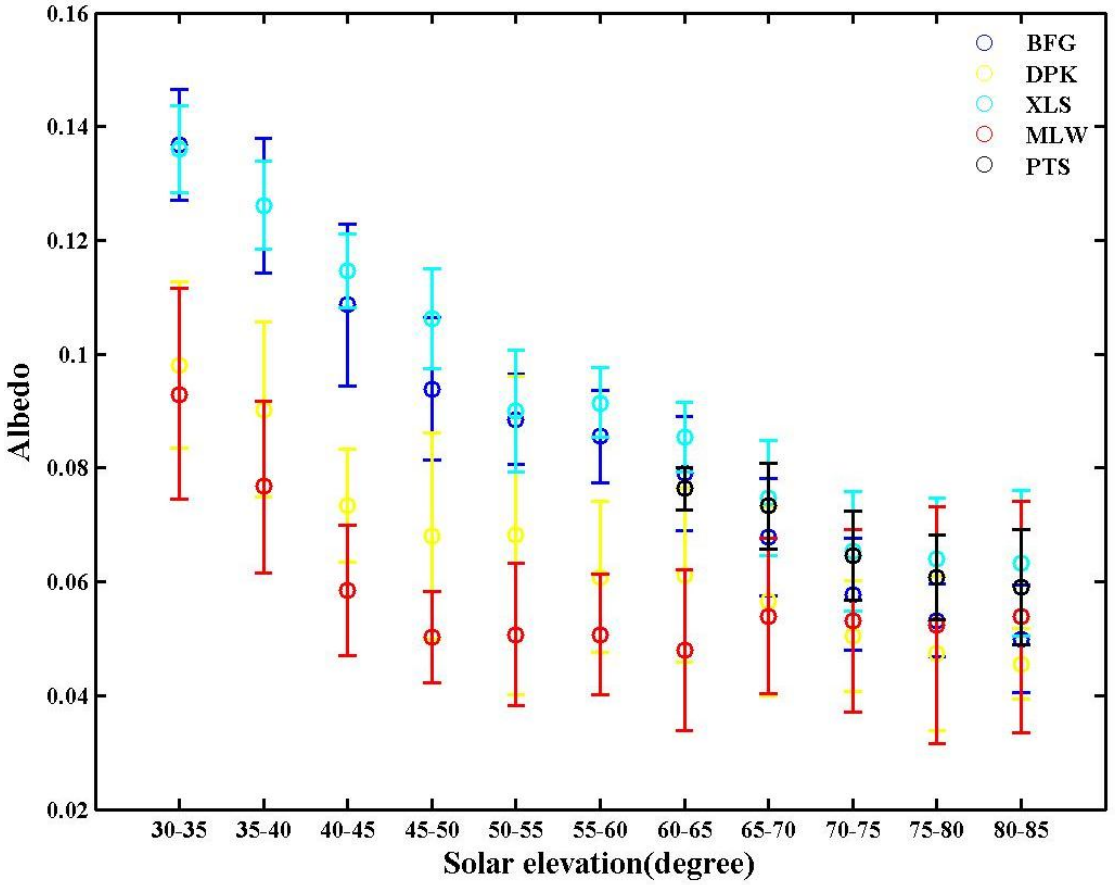


Figure.10 Albedos for the 5 sites

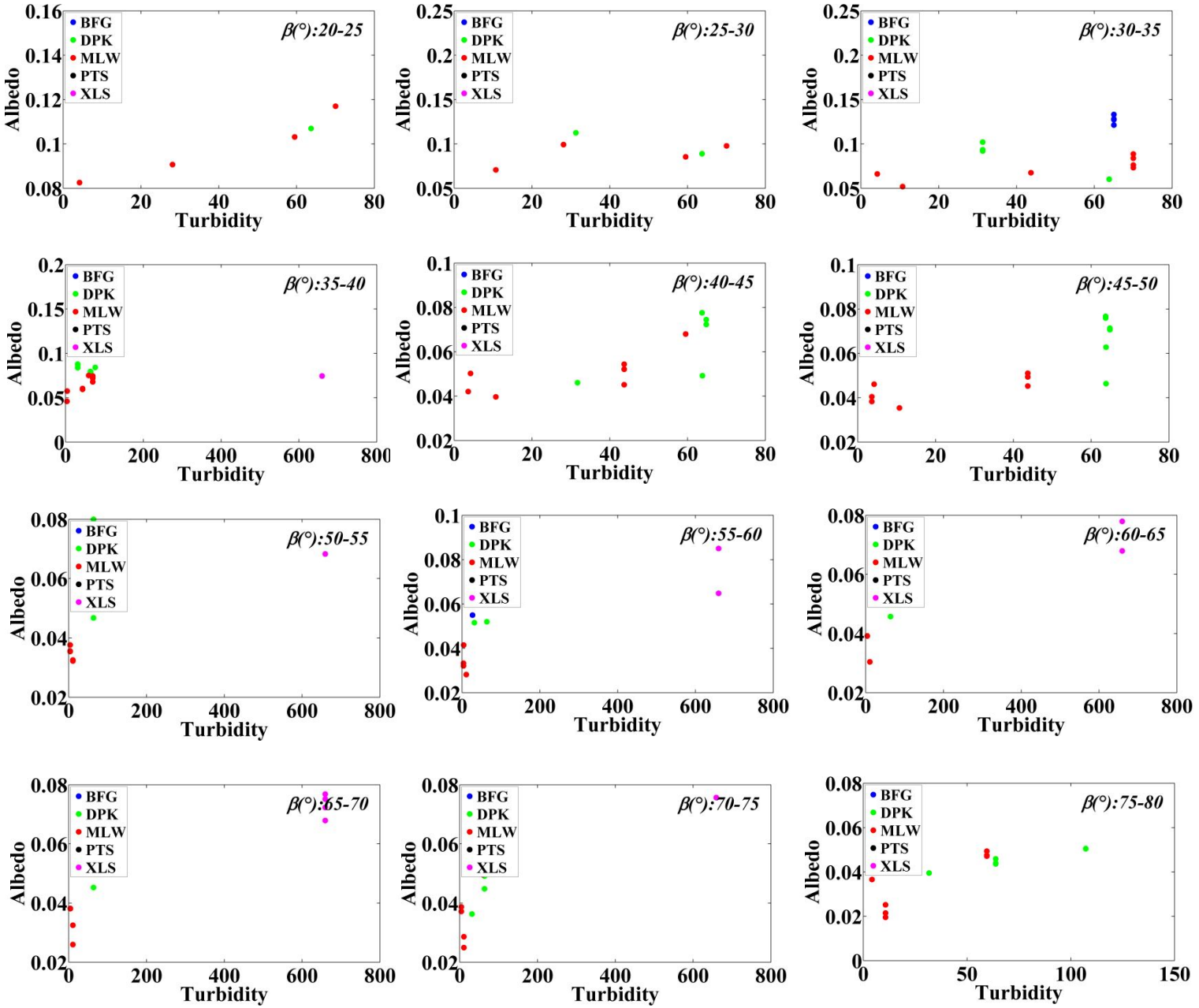


Figure.11 Albedos versus turbidity for the 5 sites

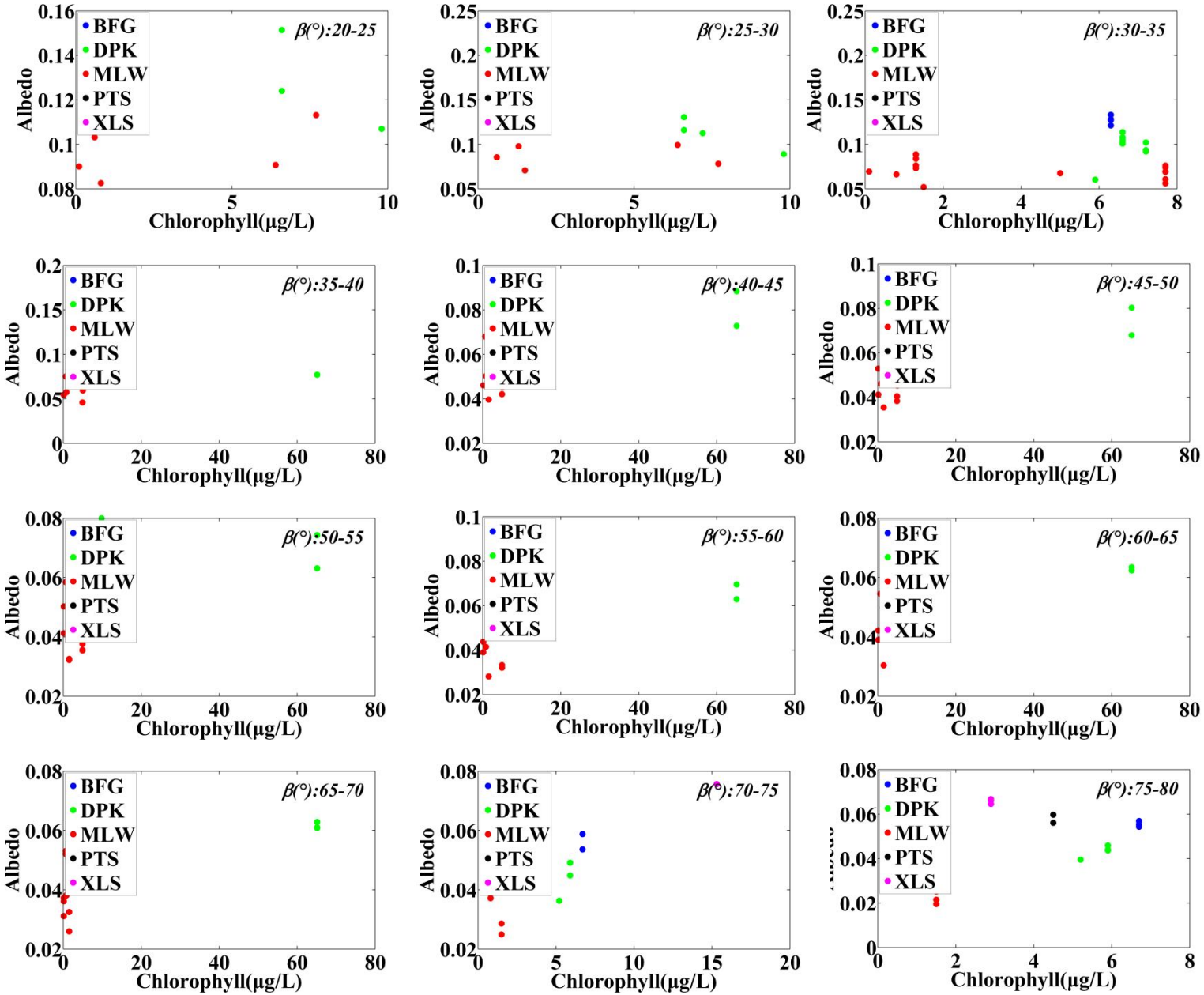


Figure.12 Albedos versus chlorophyll for the 5 sites

Discussion

- Water quality and wind speed have influence on water albedo. But how to further use them to further study their relationship quantitively?

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