Performance of cloud amount of three satellite cloud climate date records over the Tibetan Plateau

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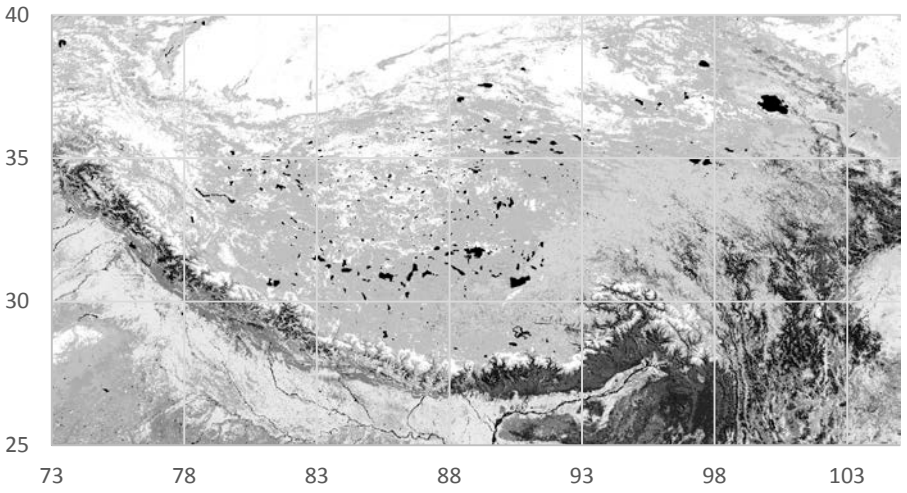
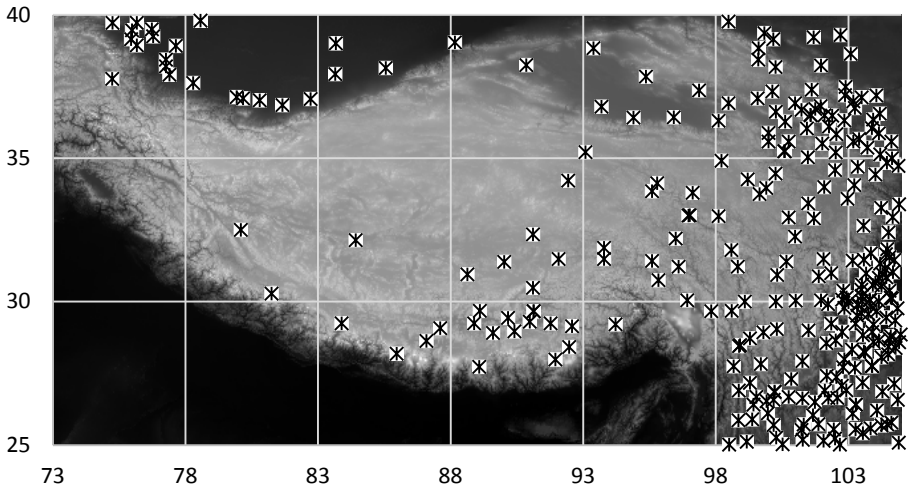
Outline

1. Motion
2. Data
3. Results
4. Conclusion

1. Motion

- The Tibetan Plateau(TP) is called the third pole of the world. The Tibetan Plateau affects not only the monsoon circulation in the region, but also the energy and water cycle in Asia.
- TP has complex surface characteristics.
- There are not enough meteorological stations . And most stations locate in the northern and eastern of TP and few stations are located in the central part of TP.



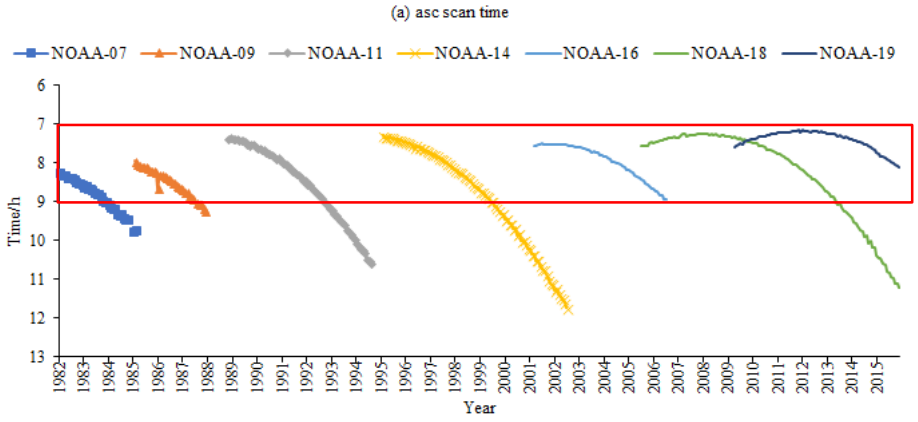


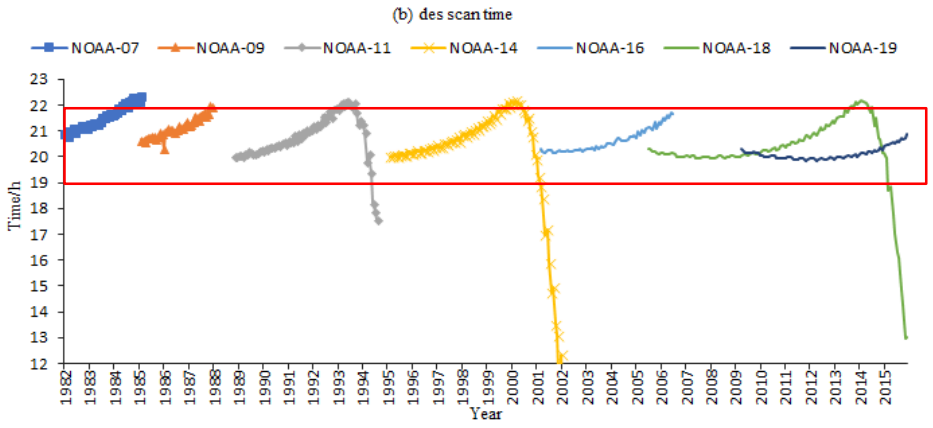
1. Motion

- The satellite data used in the TP cloud study mainly came from ISCCP (Wei and Zhong 1997, Wang et al. 2001, Yu et al. 2004, Liu et al. 2004, Liang et al. 2010) or
- early MODIS data (Gao et al.,2003, Chen and Liu,2005, Naud et al.,2015).

2. Satellite Data

	PATMOS-x	CLARA-A2	Aqua/MODIS
Time period	1982-2015	1982-2015	2003-2015
	NOAA afternoon orbit series		
Spatial resolution	0.1°	0.25°	0.05°
Temporal resolution	orbit		





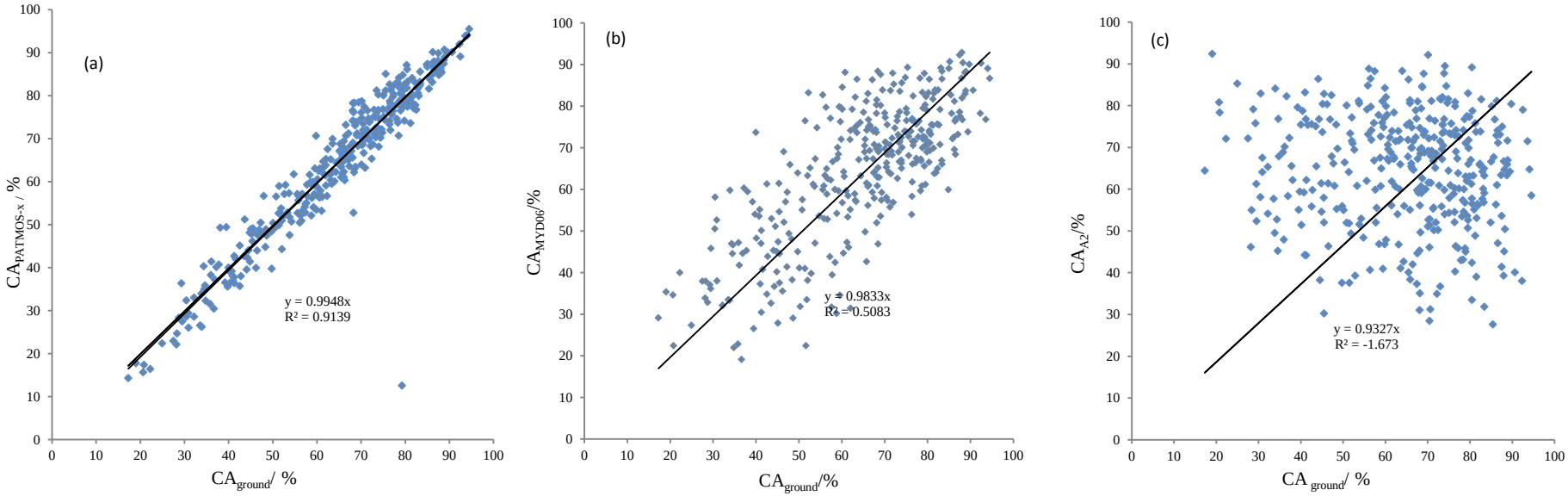
3. Results

- PATMOS-x/NOAA-18, CLARA-A2/NOAA-18, MYD06 & ground observation
- from 2006 to 2014

	SYNOP	Patmos-x	CLARA-A2	MYD06
mean	62.33	61.84	63.875	62.54
S.D.	0.302	0.313	0.253	0.267
bias	17.732	18.398	14.816	16.07
Min.	5.01	0	11.08	8.738
Max.	97.069	95.98	100	93.22
samples		3450	3439	3608

	MAM	JJA	SON	DJF
ground	64.79	74.13	60.71	49.17
PATMOS-x	65.91	73.66	58.73	48.78
CLARA-A2	63.75	62.79	63.66	64.73
MYD06	65.32	74.04	56.30	53.63

comparison with ground based observation



The cloud amount scatter diagram between satellite and surface observation in 2008 based on instantaneous observation data. Linear trend is overlapped and corresponding fitting function is shown (a) PATMOS-x/NOAA-18 and ground (b) MYD06 and ground (c) A2/NOAA-18 and ground

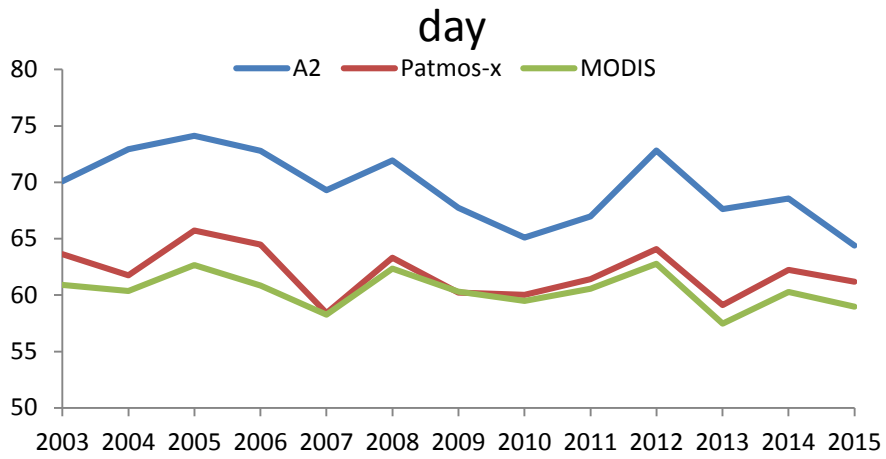
satellite CA & ground based observation

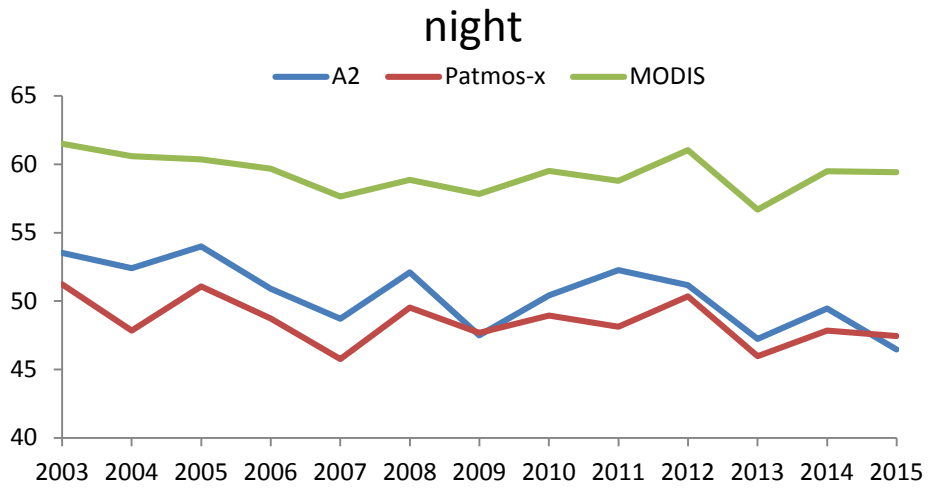
the CA correlation between satellite and ground observation in annual and season from 2006 to 2014. Correlation coefficient was calculated based on instantaneous observations.

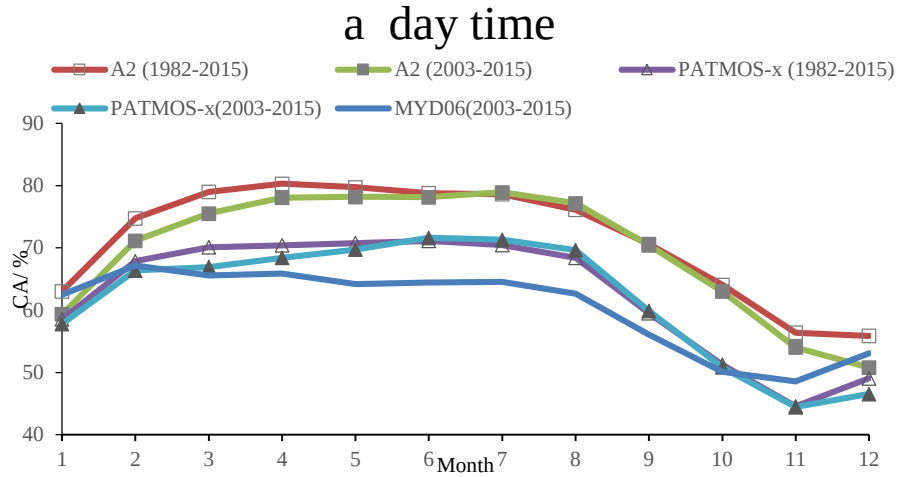
	MYD06& ground					PATMOS-x& ground					A2& ground				
	annual	MAM	JJA	SON	DJF	annual	MAM	JJA	SON	DJF	annual	MAM	JJA	SON	DJF
2006	0.67	0.58	0.65	0.53	0.68	0.96	0.96	0.97	0.97	0.93	-0.13	0.26	-0.27	-0.1	-0.30
2007	0.74	0.76	0.50	0.75	0.63	0.95	0.94	0.96	0.98	0.84	0.1	-0.07	-0.11	0.39	0.02
2008	0.76	0.58	0.54	0.82	0.82	0.96	0.96	0.84	0.98	0.98	-0.1	0.15	-0.21	-0.06	-0.11
2009	0.73	0.49	0.67	0.71	0.73	0.98	0.97	0.98	0.99	0.97	0.02	-0.26	0.04	0.26	-0.18
2010	0.8	0.73	0.65	0.69	0.72	0.97	0.96	0.83	0.98	0.95	-0.15	-0.07	0.12	-0.31	-0.19
2011	0.71	0.64	0.70	0.78	0.60	0.97	0.95	0.97	0.98	0.97	-0.04	-0.04	0.09	0.14	0.01
2012	0.60	0.21	0.28	0.64	0.58	0.94	0.86	0.96	0.96	0.90	-0.02	-0.04	-0.08	0.05	-0.24
2013	0.79	0.63	0.79	0.85	0.71	0.94	0.94	0.84	0.98	0.94	-0.1	-0.10	0.10	0.03	-0.04
2014	0.75	0.56	0.63	0.79	0.77	0.90	0.86	0.67	0.93	0.89	0.06	-0.03	-0.04	0.09	0.20
average	0.73	0.58	0.60	0.73	0.69	0.95	0.93	0.89	0.97	0.93	-0.04	-0.02	-0.04	0.05	-0.09

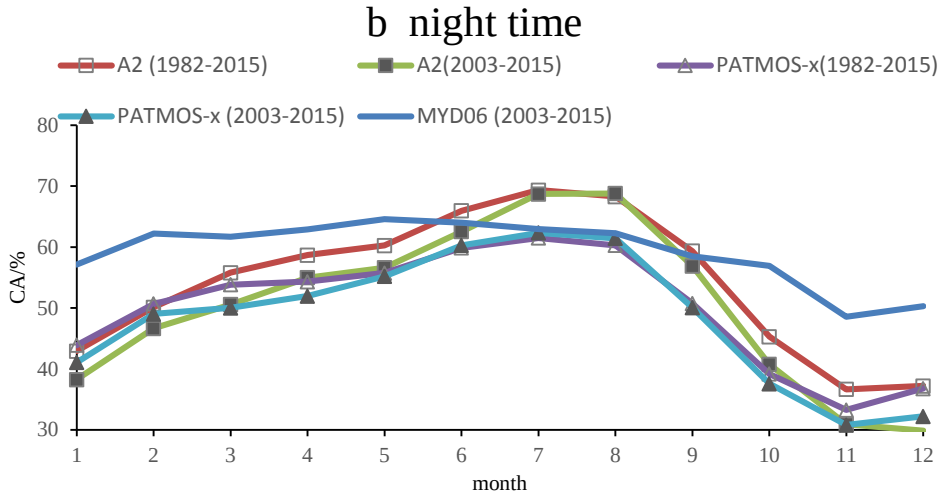
annual mean cloud fraction for 2003-2015

Annual mean	Patmos-x	CLARA-A2	MYD06
Day time	61.96%	69.58%	60.4%
Night time	48.5%	50.47%	59.34%

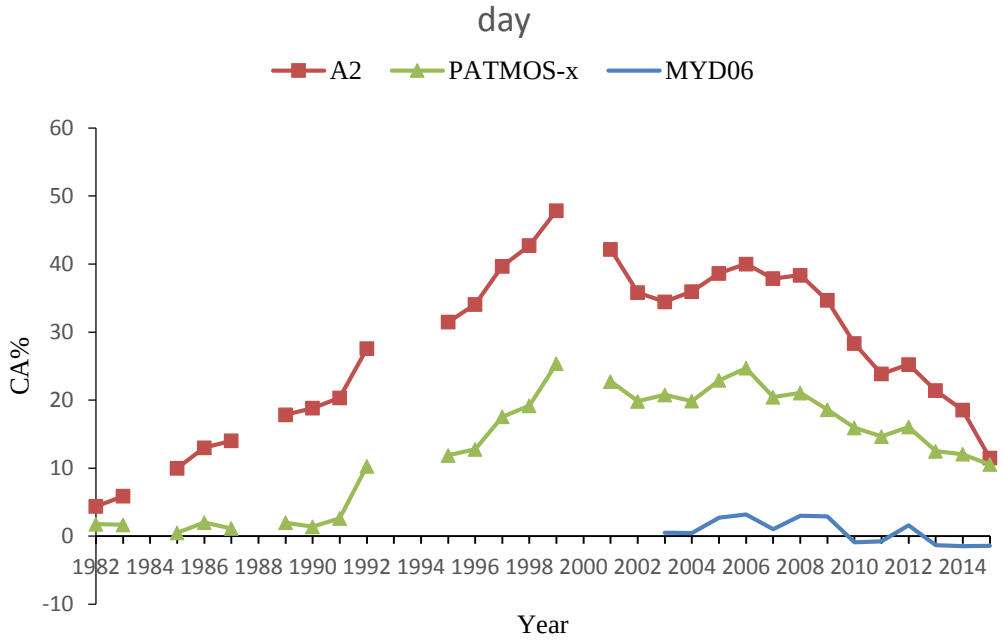








The accumulate bias of cloud fraction



The Max bias in 1992

CLARA-A2 78.67%, 7.22% ↑

PATMOS-x 70.34%, 7.66% ↑

The Min bias

PATMOS-x 58.42% 4.26% ↓ in 2007

CLARA-A2 64.39%, 7.06% ↓ in 2015

The Max bias in 1983

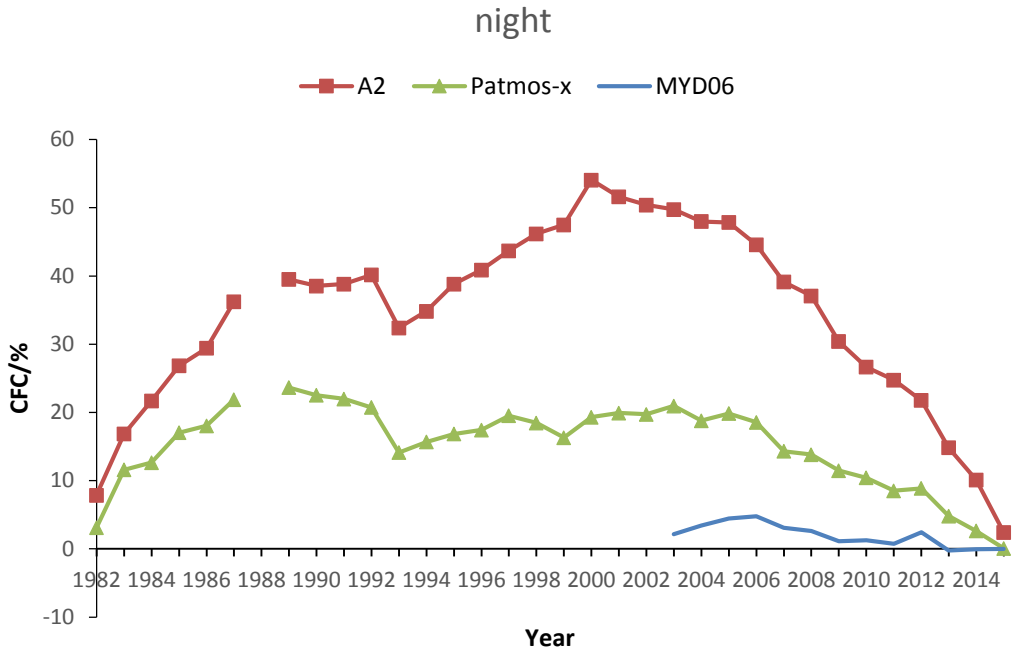
CLARA-A2 63.14%, 8.98% ↑

PATMOS-x 58.49%, 8.47% ↑

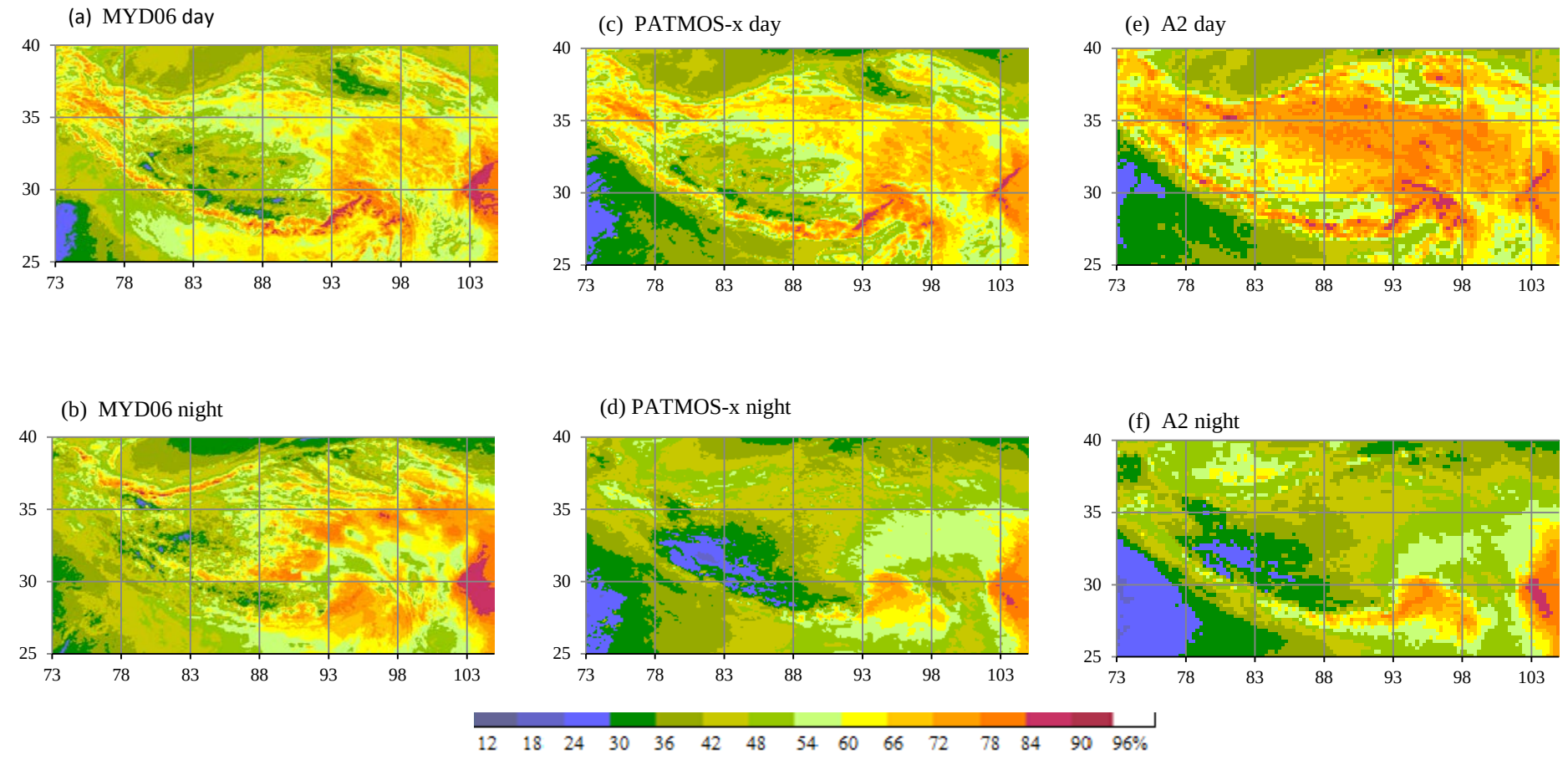
The Min bias

PATMOS-x 45.76% 4.26% ↓ in 2007

CLARA-A2 46.39%, 7.7% ↓ in 2015

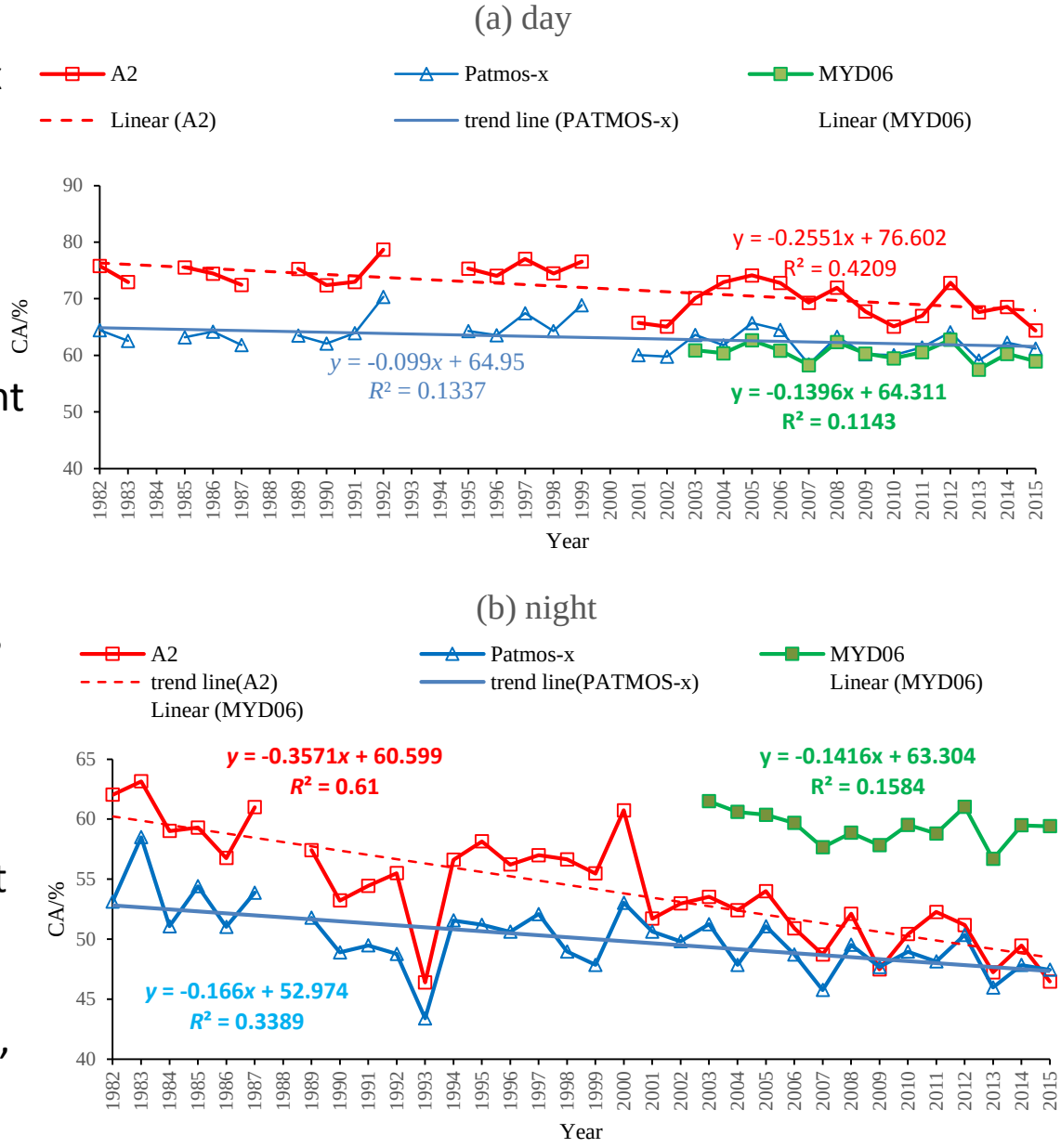


annual mean cloud fraction for 2003-2015

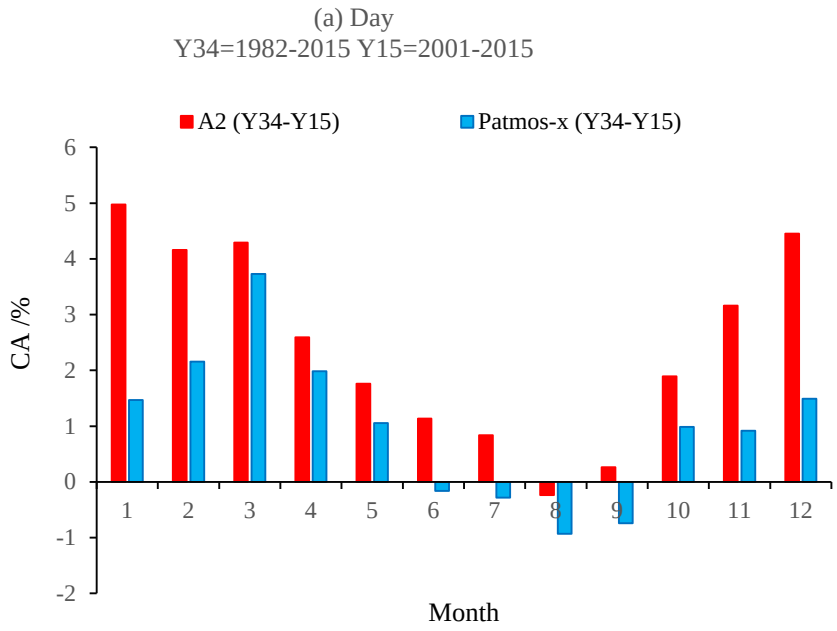


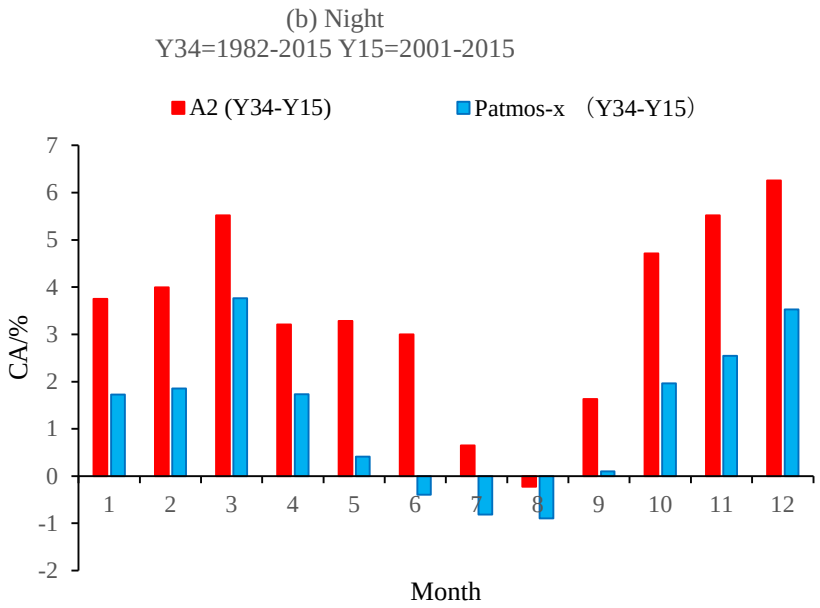
cloud fraction trend

- The annual mean CA of PATMOS-x and A2 shows decreasing trend based on the data from 1982 to 2015.
- The decreasing trend of CA at night is more obvious than that of daytime.
- Compared with A2, PATMOS-x has a weaker trend, especially in the daytime.
- The results were the same as that obtained by ground observation cloud data (Wang and Wang,2009, Duan and Wu, 2006).



cloud fraction trend



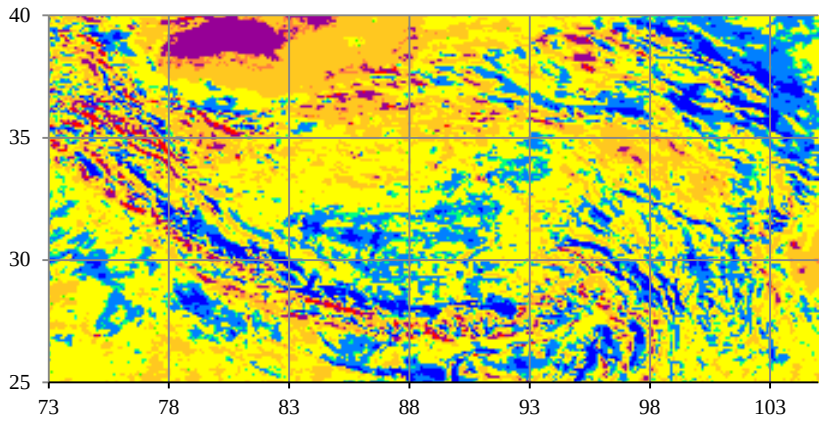


the difference cloud fraction between two periods for each month for PATMOS-x and A2. The first one is from 1982 to 2015. The second period is from 1982 to 2001 (a) day (b) night

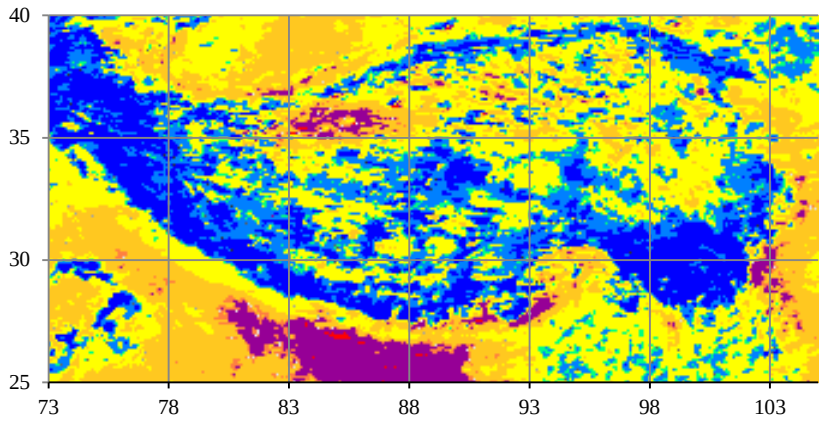
PATMOS-x

- PATMOS-x day CA from 1982 to 2015.
- correlation coefficient & significance level.

annual day CA

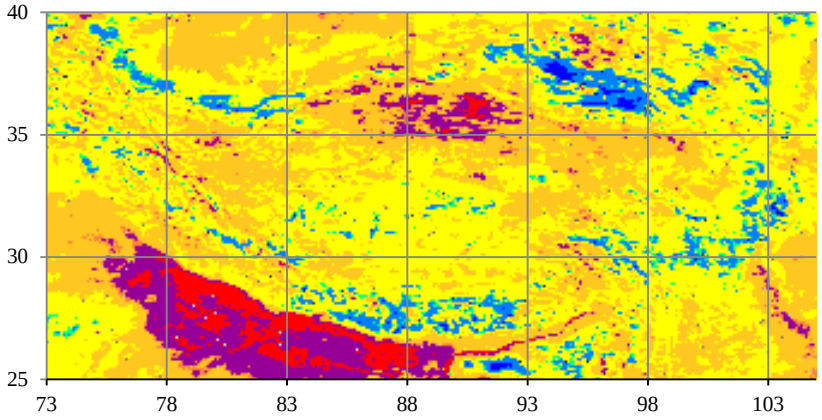


annual night CA

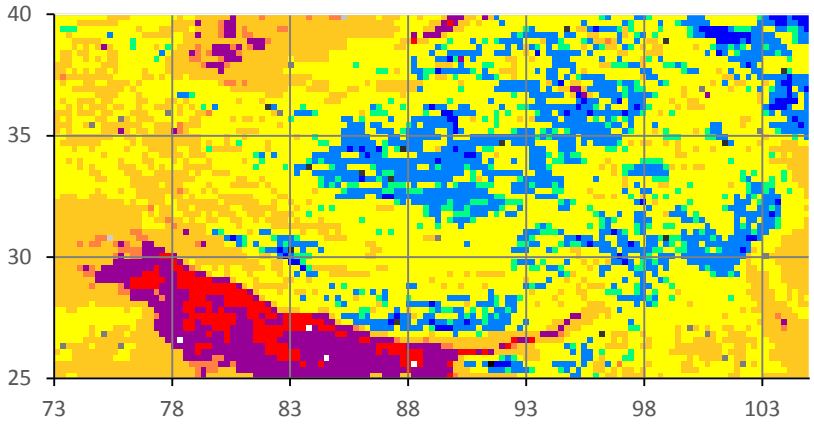


cloud fraction trend in January

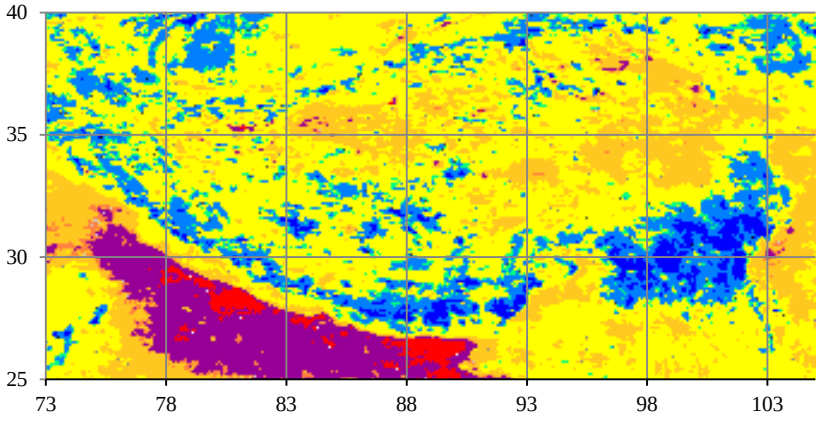
Patmos-x day CA in January



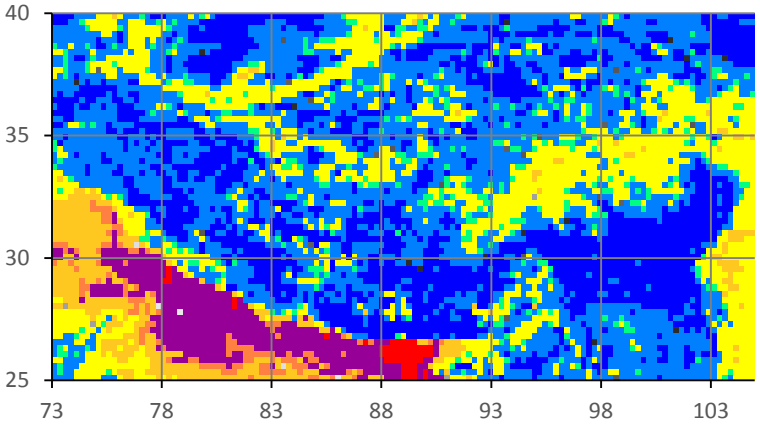
CLARA-A2 day CA in January

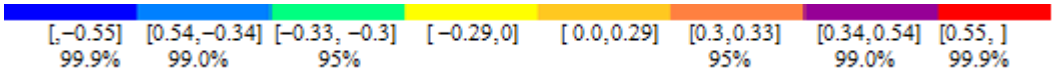


Patmos-x night CA in January



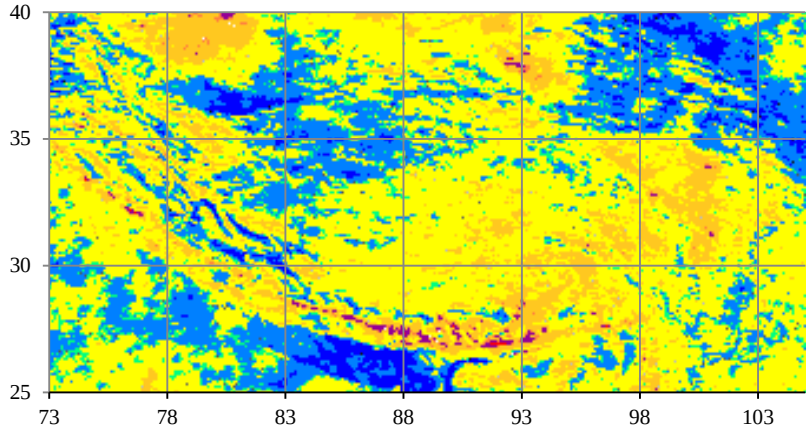
CLARA-A2 night CA in January



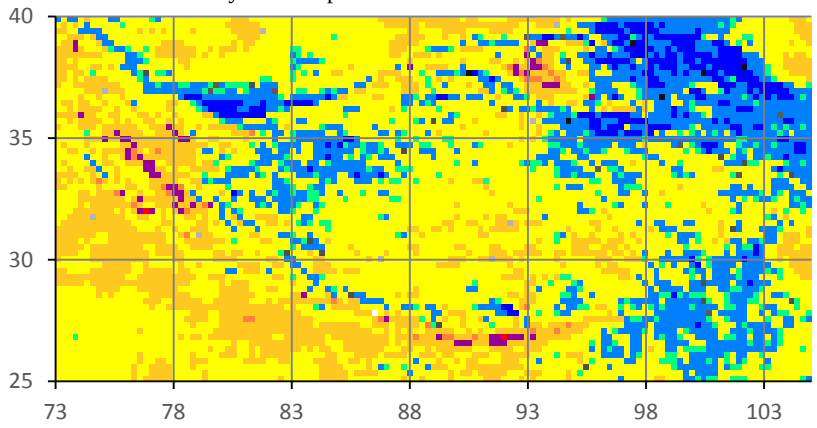


cloud fraction trend in April

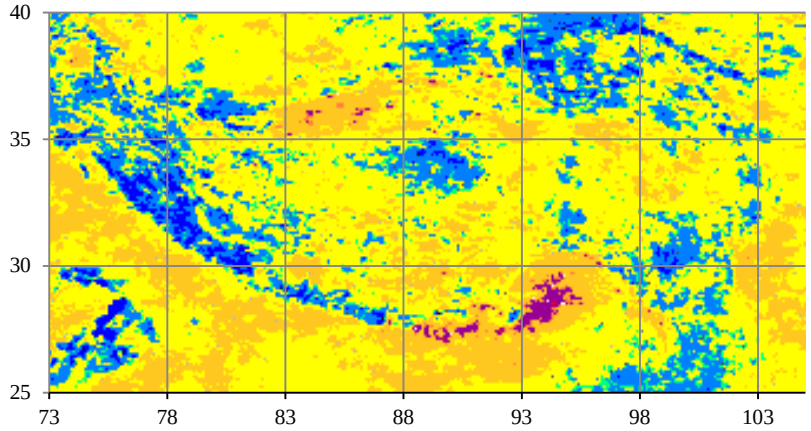
Patmos-x day CA in April



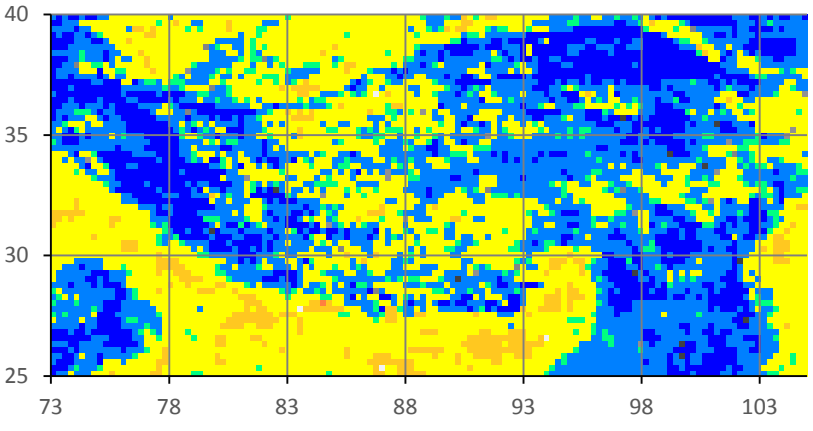
CLARA-A2 day CA in April

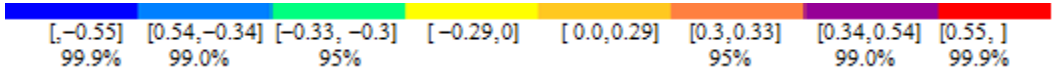


Patmos-x night CA in April



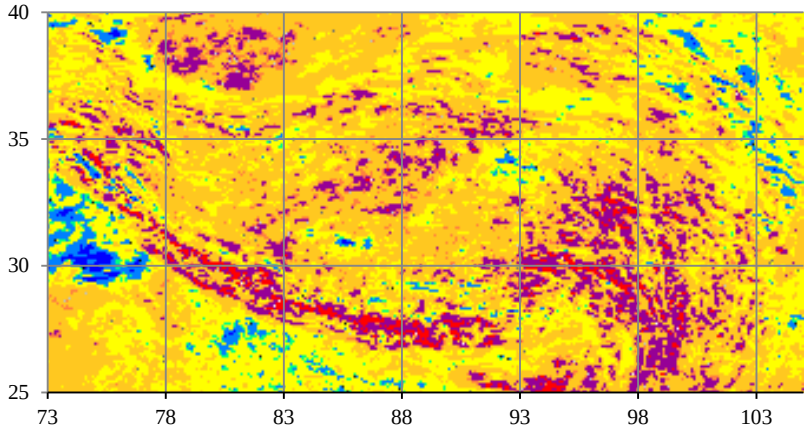
CLARA-A2 night CA in April



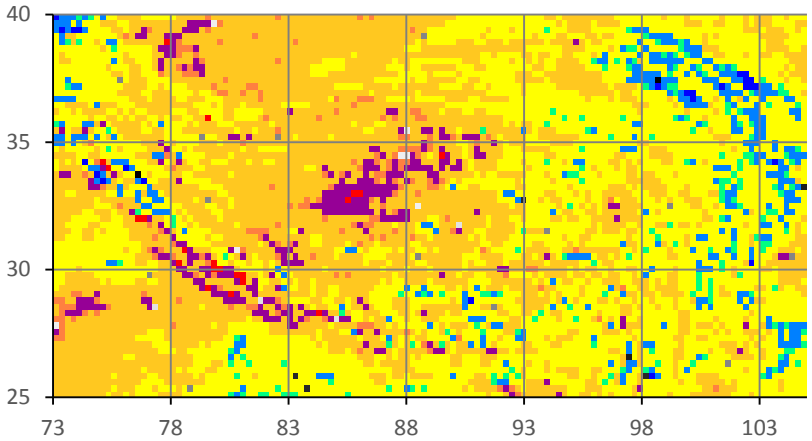


cloud fraction trend in July

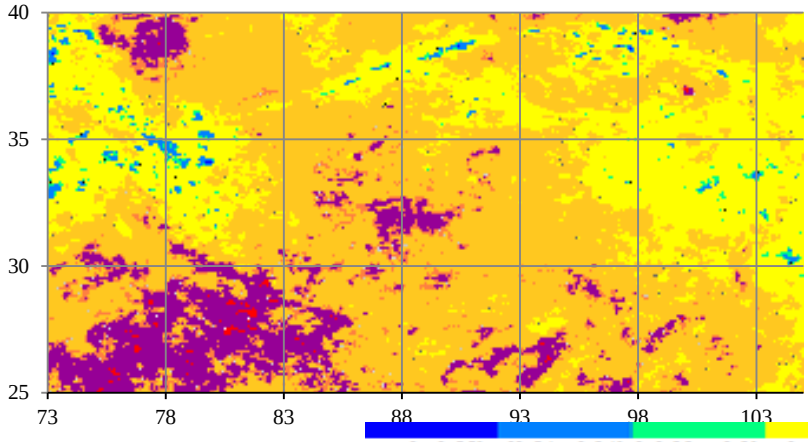
Patmos-x day CA in July



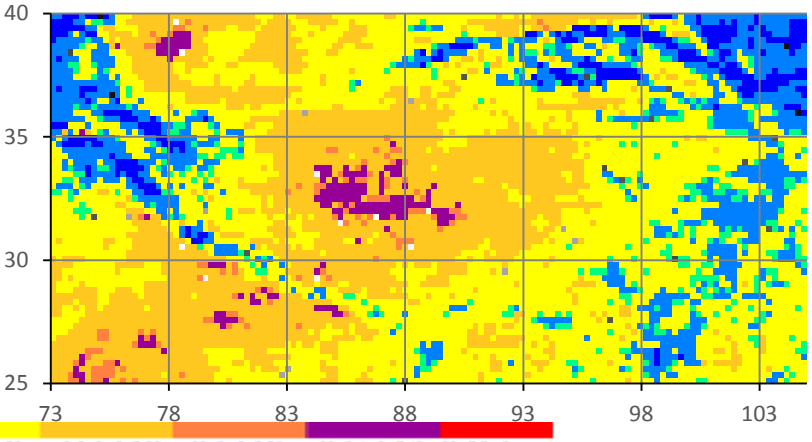
CLARA-A2 day CA in July

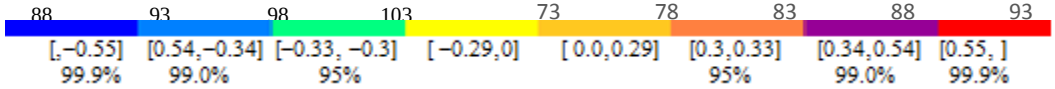


Patmos-x night CA in July



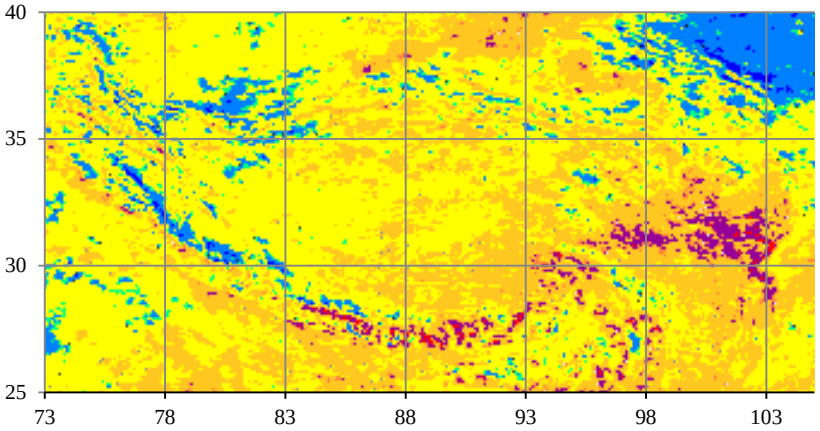
CLARA-A2 night CA in July



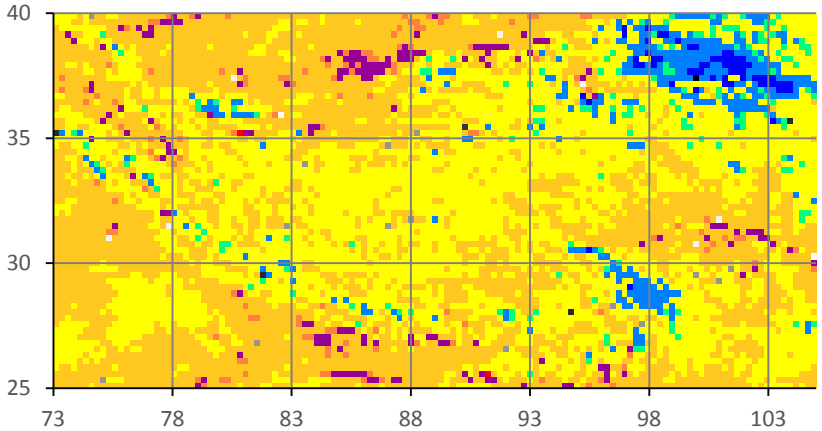


cloud fraction trend in October

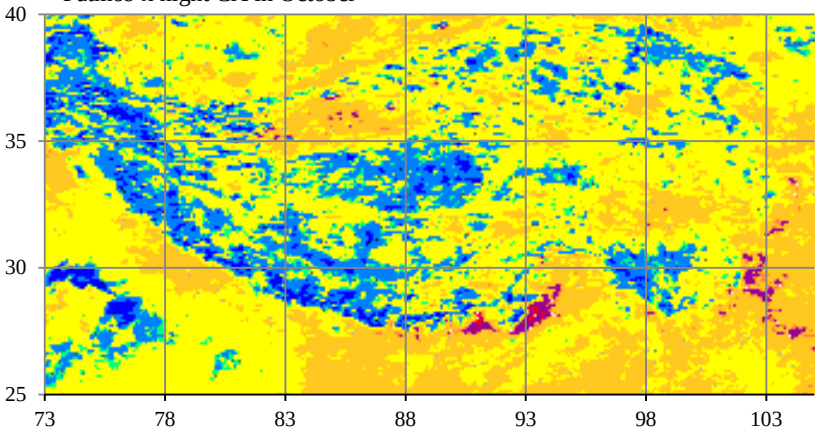
Patmos-x day CA in October



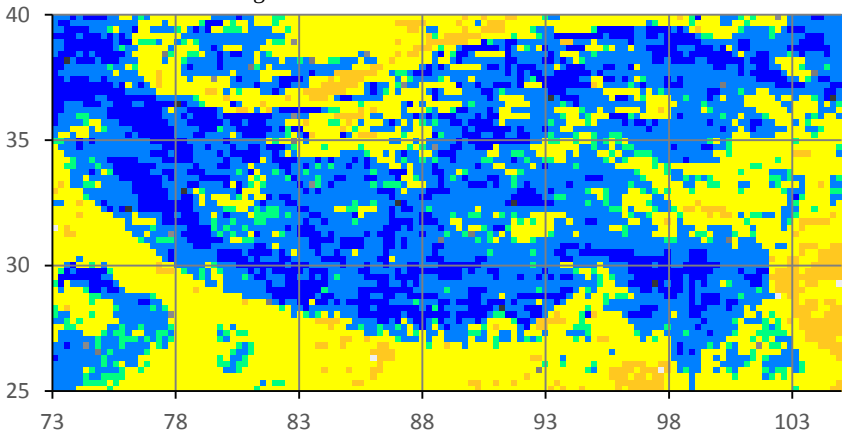
CLARA-A2 day CA in October

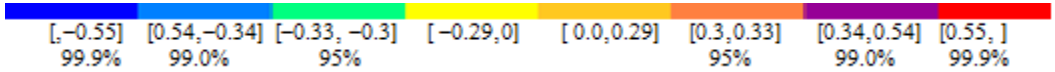


Patmos-x night CA in October



CLARA-A2 night CA in October





4. Conclusion

- compared with ground observation from 2006 to 2014. The comparison results show that PATMOS-x agreed well with ground observation. The correlation relationship between CLARA-A2 and ground was weaker and Aqua/MYD06 had good relationship in autumn and less correlation in spring and summer.

- Three kinds of satellite retrieval cloud fraction data agree well in spatial and temporal distribution pattern. Three kinds of cloud fraction all overestimates cloud in the ridge area of Plateau.

4. Conclusion (con.)

- monthly average CLARA-A2 has more cloud than PATMOS-x and the difference between two kinds of cloud amount in the daytime is more than at night.

- Aqua/MODIS has less cloud than PATMOS-x and CLARA-A2 except in winter in day time and has more cloud than PATMOS-x and CLARA-A2, except in summer at night time.

- the trend of annual and monthly mean cloud fraction of PATMOS-x and CLARA-A2 agree well. CLARA-A2 has stronger trends than that of PATMOS-x.

Thanks for your Attention