Correlation between *foEs* and disturbed zonal wind over mid-latitudinal region using Horizontal Wind Model

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Correlation between f_oE_s and zonal winds over Rome, Okinawa and Townsville using Horizontal Wind Model (HWM14) during solar cycle 22

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Extension Of Research:

Focused Region: Mid-latitudes

- Spatio temporal coverage increased.
- 5 Stations and 2 solar cycles approx. (1996 to 2019)

- Correlation Coefficients were calculated for 7 different Values of Ap
- Ap= 27, 48, 80, 132, 207,300, 400 (Kp ranging from 4 to 9)

HWM 14
provides average horizontal winds
Empirical model

day of year τ + solar local time δ + colatitude θ + longitude φ + altitude z fr om the ground to the exobase. = $U(\tau,\delta,\theta,\varphi,z)$

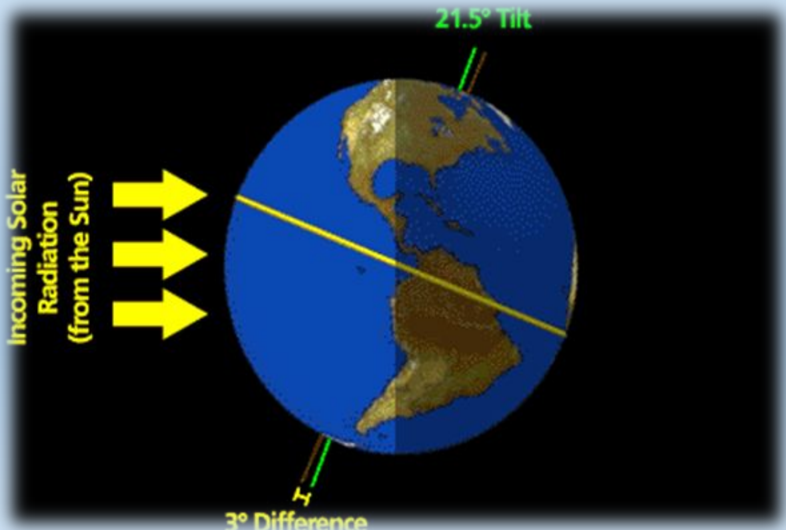
$$U(\tau, \delta, \theta, \phi, z) = \sum_j \beta_j(z) u_j(\tau, \delta, \theta, \phi),$$

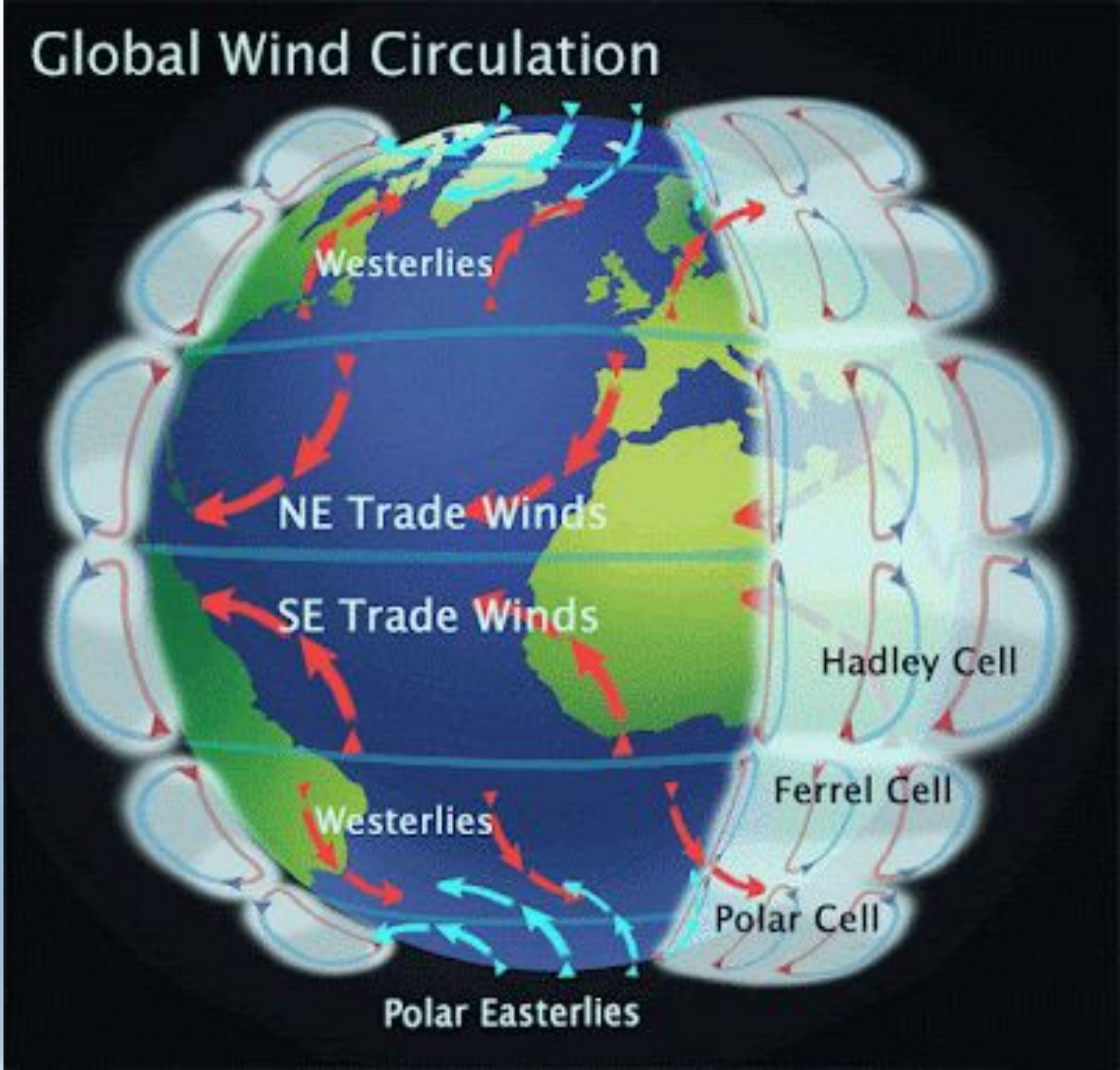
HWM14:

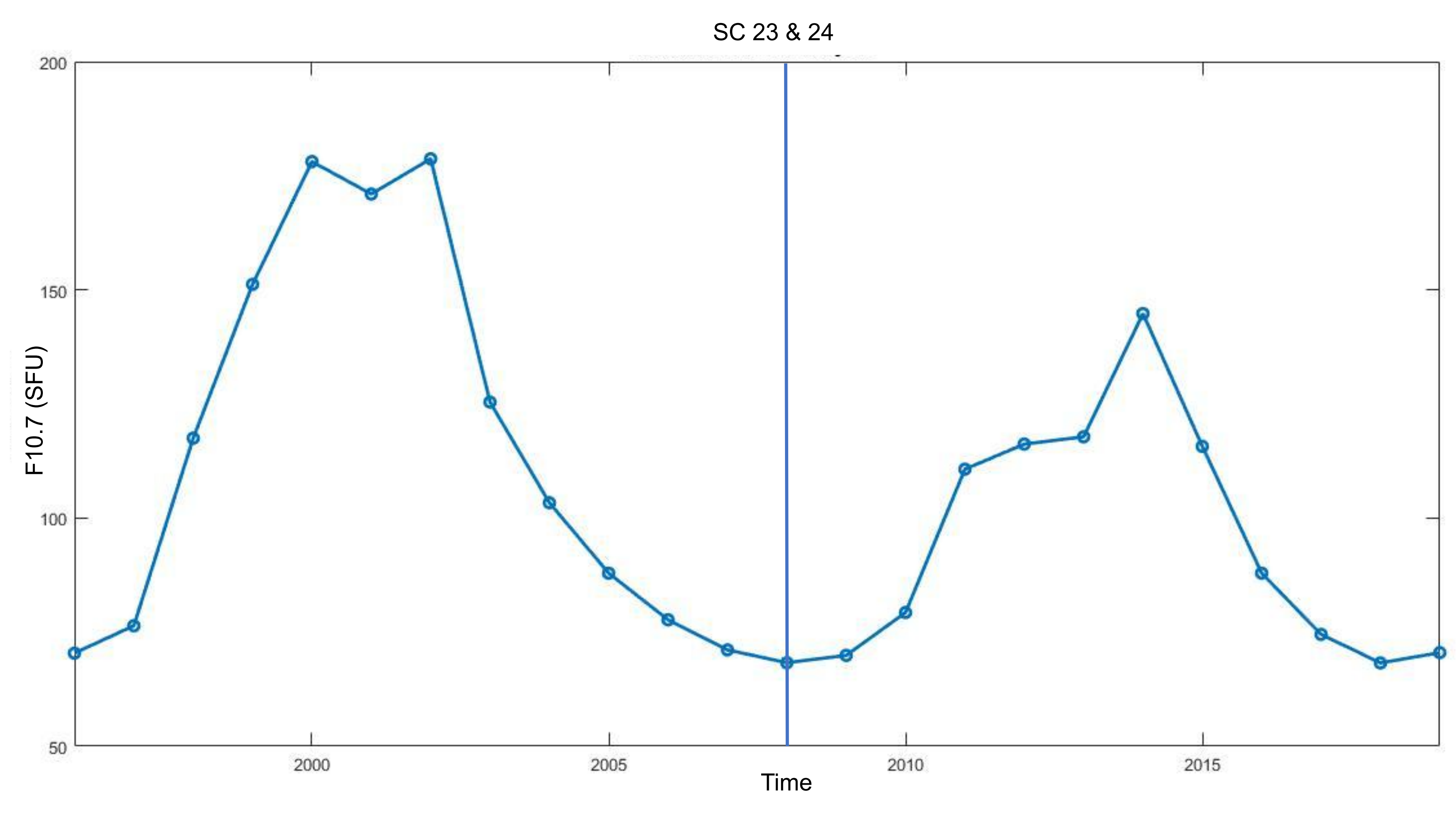
```
subroutine hwm14(iyd,sec,alt,glat,glon,stl,f107a,f107,ap,w)
     implicit none
     integer(4),intent(in)  :: iyd    ! year and day as yyddd
     real(4),intent(in)     :: sec    ! ut(sec)
     real(4),intent(in)     :: alt    ! altitude(km)
     real(4),intent(in)     :: glat   ! geodetic latitude(deg)
     real(4),intent(in)     :: glon   ! geodetic longitude(deg)
     real(4),intent(in)     :: stl    ! not used !!!
     real(4),intent(in)     :: f107a  ! not used !!!
     real(4),intent(in)     :: f107   ! not used !!!
     real(4),intent(in)     :: ap(2)  ! ap(1) not used !!!, ap(2) current 3hr
     real(4),intent(out)    :: w(2)   ! w(1) +northward, w(2) +eastward, (m/s)
```

Zonal flow= westerly's generally flow from due west to east.

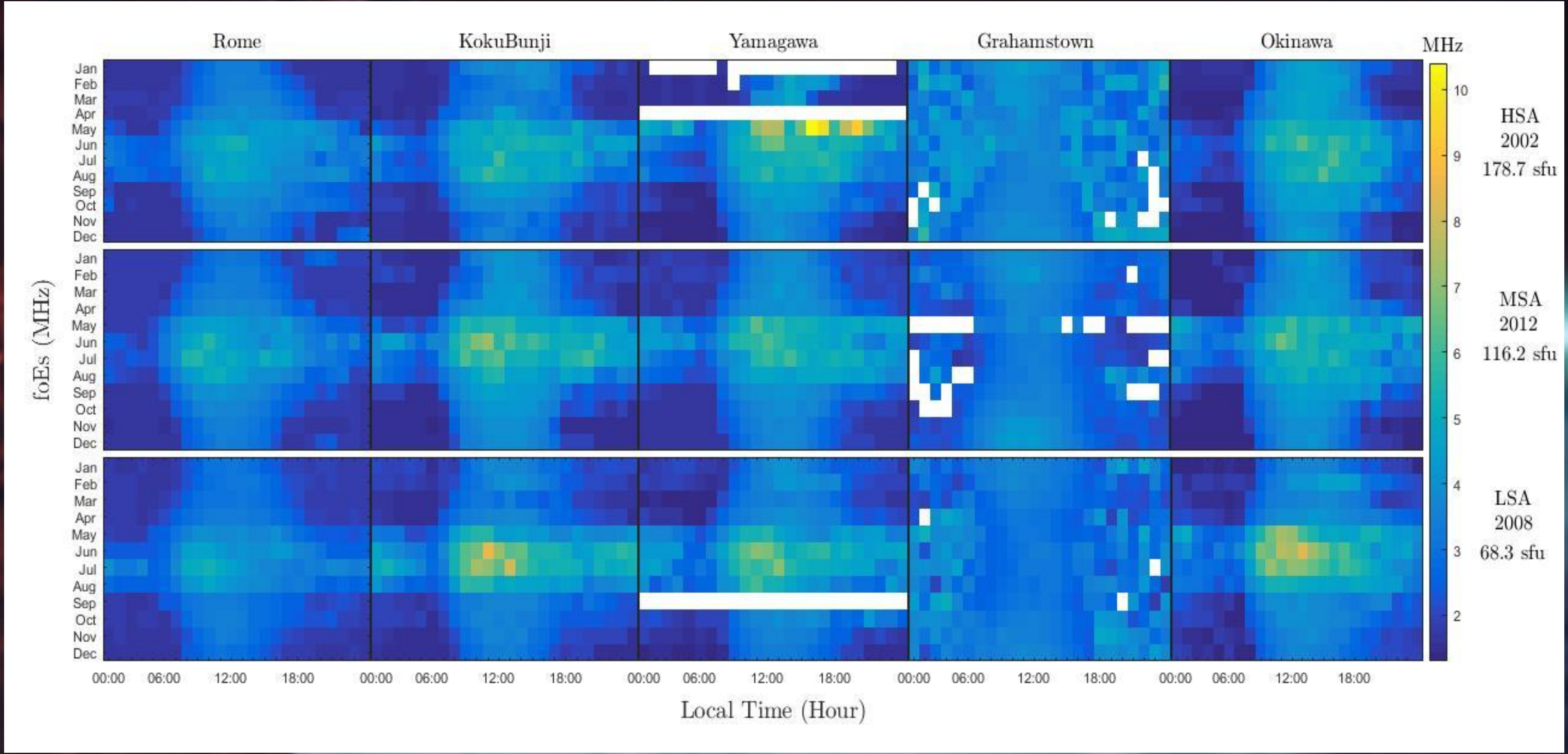
Zonal winds in the northern hemisphere are due to significant thermal gradient between the north winter pole and the equatorial region.






SC 23 & 24
200
150
100
50
F10.7 (SFU)
2000
2005
2010
2015
Time

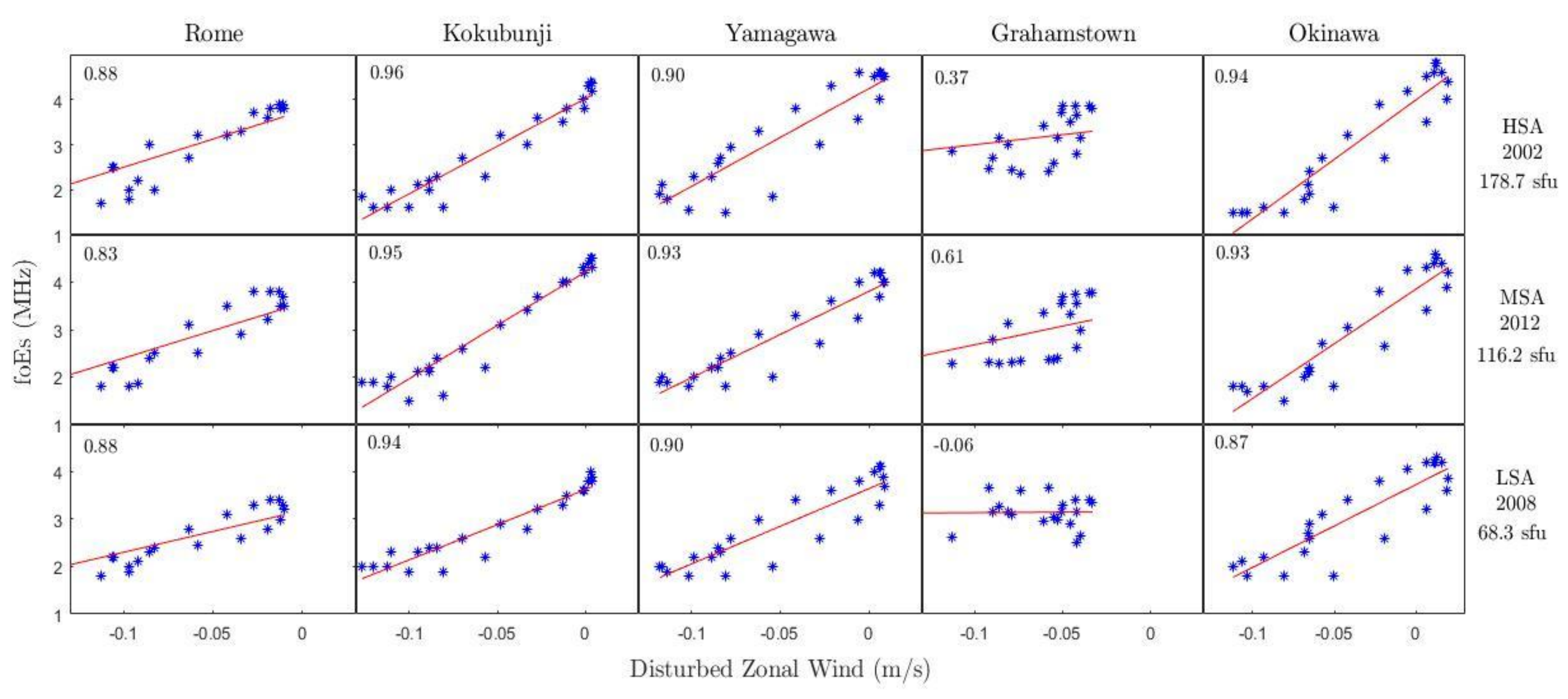
Diurnal Pattern observed



Correlation coefficients are generally higher at mid-latitude stations in the northern hemisphere (Ap=80)

$$f_oE_s = a \times dzw + b$$

$$r = \frac{\sum(x_i-\bar{x})(y_i-\bar{y})}{\sqrt{\sum(x_i-\bar{x})\sum(y_i-\bar{y})}}$$



Slope ‘a’ is greatest during HSA at each station corresponding to greater value of ‘b’. Lowest values are observed during LSA.

	a	*b*
Rome		
(2002) HSA	10.919	3.6582
(2012) MSA	10.076	3.4721
(2008) LSA	7.6926	3.1202
Kokubunji		
(2002) HSA	20.489	4.0073
(2012) MSA	21.822	4.2005
(2008) LSA	14.32	3.615
Yamagawa		
(2002) HSA	21.57	4.2406
(2012) MSA	17.974	3.8044
(2008) LSA	15.638	3.6427
Grahamstown		
(2002) HSA	3.9049	3.4162
(2012) MSA	7.7711	3.4615
(2008) LSA	-0.3898	3.13
Okinawa		
(2002) HSA	26.639	3.9944
(2012) MSA	23.238	3.8557
(2008) LSA	17.562	3.7329

A comparison of the correlation coefficients of a single station's during SC 23 & 24

SC 23	Kokobunji		Planetary geomangnetic Index (Ap)				
year	27	48	80	132	207	300	400
1996	0.74	0.90	0.94	0.93	0.86	0.86	0.86
1997	0.75	0.90	0.94	0.93	0.85	0.85	0.85
1998	0.75	0.91	0.95	0.94	0.87	0.87	0.87
1999	0.77	0.92	0.95	0.94	0.87	0.87	0.87
2000	0.82	0.95	0.97	0.95	0.88	0.88	0.88
2001	0.79	0.93	0.96	0.95	0.88	0.88	0.88
2002	0.78	0.92	0.96	0.94	0.86	0.86	0.86
2003	0.77	0.91	0.95	0.93	0.86	0.86	0.86
2004	0.79	0.93	0.96	0.94	0.86	0.86	0.86
2005	0.76	0.91	0.95	0.94	0.88	0.88	0.88
2006	0.78	0.92	0.95	0.93	0.86	0.86	0.86
2007	0.80	0.92	0.95	0.92	0.84	0.84	0.84
Max Value	**0.82**	**0.95**	**0.97**	**0.95**	**0.88**	**0.88**	**0.88**

SC 24	Kokobunji		Planetary geomagnetic Index (Ap)				
year	27	48	80	132	207	300	400
2008	0.75	0.90	0.94	0.93	0.86	0.86	0.86
2009	0.68	0.86	0.92	0.93	0.87	0.87	0.87
2010	0.79	0.93	0.96	0.94	0.87	0.87	0.87
2011	0.75	0.91	0.95	0.94	0.87	0.87	0.87
2012	0.80	0.93	0.96	0.94	0.86	0.86	0.86
2013	0.79	0.93	0.96	0.94	0.85	0.85	0.85
2014	0.78	0.93	0.96	0.94	0.86	0.86	0.86
2015	0.80	0.93	0.96	0.94	0.87	0.87	0.87
2016	0.80	0.93	0.96	0.94	0.87	0.87	0.87
2017	0.75	0.90	0.94	0.93	0.86	0.86	0.86
2018	0.62	0.81	0.87	0.87	0.82	0.82	0.82
2019	0.41	0.64	0.73	0.76	0.76	0.76	0.76
Max Value	**0.80**	**0.93**	**0.96**	**0.94**	**0.87**	**0.87**	**0.87**

Concluding Remarks:

- Long Term Effects?
- From “Climate” to “Weather”?
- Hemispheric effects on the correlation coefficients?
- Predictions through ANN?

Thank you