



Space Weather Monitoring in Pakistan

Muhammad AYYAZ Ameen
(SUPARCO)

Space Weather

Conditions on the sun, in the solar wind, and within Earth's magnetosphere, ionosphere and thermosphere

Can influence the performance and reliability of space-borne and ground-based technological systems and can endanger human life or health

UNISPACE+50 Thematic Priority No 4 of UNCOPUOS: International framework for space weather services

It is a permanent agenda item of STSC

Space Weather Monitoring

We are working in three major domains

01

Ionospheric research

Using ionosondes, SIDs,
TEC/Scintillation receivers

02

Study of geomagnetic field variations

Using magnetometers and absolute measurements

03

Solar atmosphere monitoring

Using Web-based data of ACE,
SOHO, GOES, SDO, STEREO etc

Timeline



1970s

Installation of British ionosondes

1983

Installation of Canadian Magnetometer

1987

Installation of Digisonde

1990s

Ionospheric monitoring at 3 locations

2008

- Installation of DPS-4
- Establishment of 2nd Geomagnetic Observatory

2012

The 1st OIC Workshop

2013

Installation of 2 SIDs donated by ISWI

2014/15

Installation of 2 CALLISTO and GNSS TEC/Scintillations Receivers

2016

Procurement of 2 DI Flux Magnetometers

2017

Real-time connectivity and establishment of PSWC

2018

The 2nd OIC Workshop

Way to become RWC

Pakistan Space Weather Centre (PSWC)



Equipment

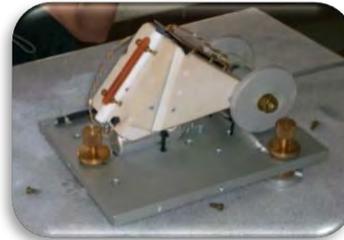
Ionosonde



CALLISTO



Variometer



TEC Receiver



Web Portal

Space Weather Conditions (Summary)								
Radio Blackouts			Solar Radiation Storms			Geomagnetic Storms		
-48 Hr	-24 Hr	Current	-48 Hr	-24 Hr	Current	-48 Hr	-24 Hr	Current
No Data	R0	R5	S2	S5	No Data	G1	G2	G4

Space Weather Conditions

Sunspot number:

Geomagnetic activity

- Current: Kp= 4
- 24 hours max: Kp= 4

Interplanetary magnetic field

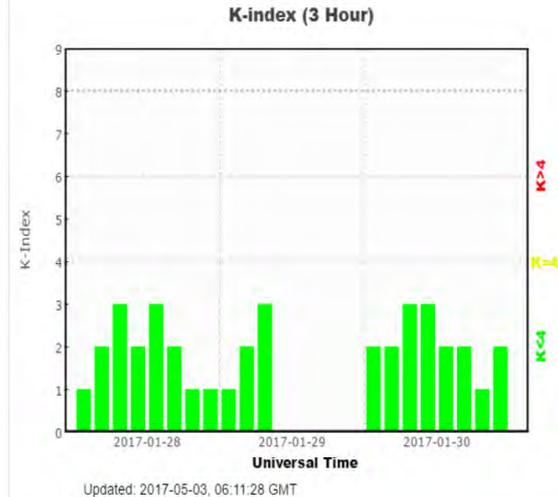
- B Total: nT
- Bz: nT

Solar wind

- Speed: km/s
- Density: protons/cm3

[Dashboard](#)

[Sensor Location](#)



[K-Index](#)
[Magnetograms](#)
[Ionogram](#)
[Fof2](#)

Space Weather Forecasts

Radio Blackouts			
	0-24hr	24-48hr	48-72hr
G1-G2	-%	-%	-%
G3	-%	-%	-%

Solar Radiation Storms			
S1-S2	-%	-%	-%
S3	-%	-%	-%

Geomagnetic Storms			
R1-R2	-%	-%	-%
R3	-%	-%	-%

[Live Streaming](#)

Daily Space Weather Summary

This is one of our space weather services being provided to users

Local Ionospheric conditions over Pakistan

Local ionospheric data along with usable frequencies are mentioned at the time of summary

Local Geomagnetic conditions over Pakistan

This section of the summary reports total field values from the Geomagnetic observatories in the country

Daily Space Weather Summary (SUPARCO)								
Monday, January 06, 2020, 14:54 UT								
LOCAL CURRENT IONOSPHERIC CONDITIONS OVER PAKISTAN*								
Virtual Height of F2 layer (h'F2)	5.0 MHz							
Critical Frequency of F2 layer (f _o F2)	283 kHz							
Total Electron Content (TEC)	15 TECU							
Maximum Usable Frequency (MUF) and Optimum Traffic Frequency (OTF) for various distances								
Distance (km)	100	200	400	600	800	1000	1500	2000
MUF (MHz)	6.1	6.4	7.2	8.6	10.1	11.6	15.0	20.3
OTF (MHz)	5.2	5.4	6.2	7.8	8.6	9.8	12.7	17.3
Local ionospheric conditions are normal with slightly depressed MUF conditions.								
LOCAL GEOMAGNETIC CONDITIONS OVER PAKISTAN**								
K-index	2 (max Kp in 24 hrs: 4)							
Total Field Value (F)	45370/88872 nT							
Declination (D)	2.47/0.59 degrees							
The local geomagnetic field is quiet at the moment.								
LATEST SOLAR CONDITIONS								
Sunspot Number (SN)	11							
Solar radio flux (F10.7)	71 sfu							
Solar wind speed	337 km/sec. (varied in the past 24 hrs between 356 & 374 km/s)							
Solar X-ray fluxes	0.1-0.2 (max flux in the past 24 hrs: @ 4.3 Sec4 @ 7hr 06)							
Interplanetary Magnetic Field (IMF)	1.2 nT (varied in the past 24 hrs between 1.3 nT & 54.3 nT)							
Total Field (Bz)	+3.1 nT (varied in the past 24 hrs between +34.1 nT & -11.3 nT)							
Solar conditions are at low levels with background X-ray flux at B-class level. Local HF working frequencies are normal as compared to monthly average predicted values.								
Daily Sun: 6 January 2020								
There are no active regions on the sun capable of producing strong solar flares.								
D1: Coronal Hole (CH) is detected on the southern solar limb at the moment.								
DISCUSSION:								
Solar activity is at low levels. The solar wind speed is currently at moderate to strong levels. Quiet to unsettled geomagnetic conditions are expected today with a chance of moderate active periods due to coronal hole influence. Local HF conditions are slightly depressed.								

Latest Solar conditions

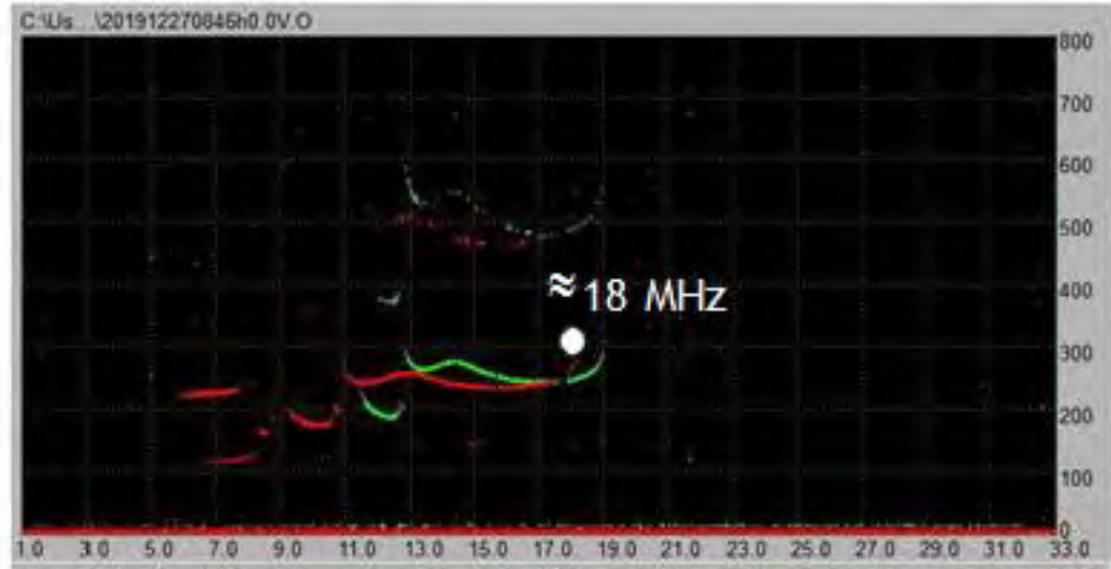
SSN, flare, solar radio flux and related latest information is provided in this part of summary

Latest Solar image

The most recent available solar image is processed using KSWC ASSA software and active regions are identified

Credits: www.spaceweather.go.kr;
www.sws.bom.gov.au

Ionospheric Monitoring during recent annular solar eclipse 26-Dec-19



Few Users

Following local users are provided data and services

Space Agency

SUPARCO as Satellite developer and operator needs space weather data

Occasionally

Broadcaster

Pakistan Broadcasting Corporation is the national radio which uses radio circuits for broadcasting

Monthly

Aviation

Pakistan International Airline uses VHF and HF bands for plane to control tower communication

Seasonally

Academia

Local universities use our data for student projects and theses

Regularly

International Cooperation (1/2)

Pakistan is the member of following

AOSWA

Asia-Oceania Space Weather Alliance

INTERMAGNET

International Real-time Magnetic Network

ICTSW/IPT-SWISS (WMO)

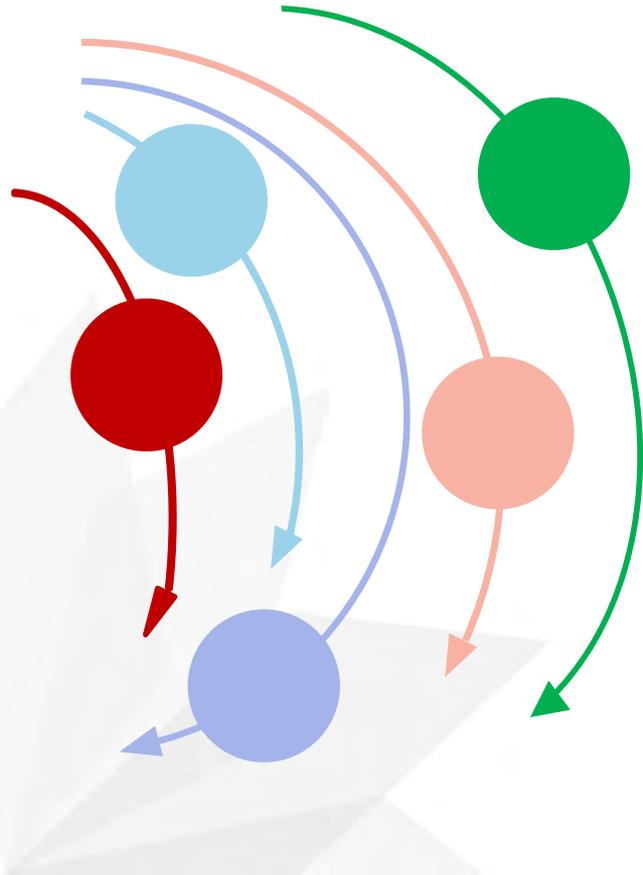
Inter-program Coordination Team on Space Weather
(renamed as) Inter-Programme Team on Space Weather Information Systems
and Services

UNCOPUOS

Space weather Expert Group of STSC

APSCO

Asia Pacific Space Cooperation



International Cooperation (2/2)

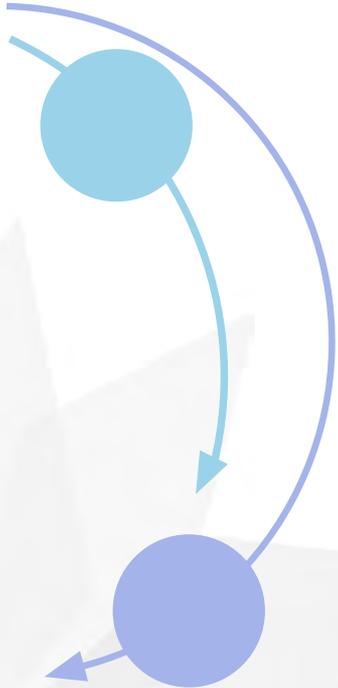
Pakistan is actively participating in the following projects of APSCO

Earthquake Research Project

Determination of Ionospheric Precursors of Earthquake – Phase I completed recently and Phase-II in progress

Ionospheric Modeling Project

Ionospheric Modeling through Study of Solar Activity and Radio-wave Propagation – Phase I completed recently and Feasibility Study of Phase-II is in progress



Capacity Building



International Workshop (1/3)

The 1st International Workshop on Geomagnetic Observatories and their Applications for OIC member countries was held at Islamabad

Workshop duration 11-days: 03-13 April, 2012 at Geomagnetic Observatory, Islamabad

Collaborators: Royal Meteorological Institute of Belgium (IRM), Islamic Network on Space Sciences and Technology (ISNET) & National Centre for Physics (NCP)

Participants: 24 including 15 foreigners from 7 countries



International Workshop (2/3)



The 2nd International Workshop on Geomagnetism & Ionosphere for OIC member countries was held at Sonmiani

Workshop duration 8-days: 10-17 Nov, 2018 at Abdus Salam Geomagnetic Observatory, Sonmiani

Collaborators: Royal Meteorological Institute of Belgium (IRM) and Islamic Network on Space Sciences and Technology (ISNET)

Participants: 38 including 18 foreigners from 9 countries

International Workshop (3/3)



The 2nd International Workshop on Ionosphere & Geomagnetism for OIC member countries was held at Sonmiani



SUPARCO-Academia Collaboration



Research projects/theses of institutes/universities students are supervised by Space Weather experts



Future Plans



Setup of ground receiving terminal of space-borne solar monitoring observatory

Development of skills for space weather forecasting under AOSWA & bilateral collaboration

Joining the network of International Space Environment Services (ISES) as one of the Regional Warning Centers (RWC) to mutually share data and space weather alerts in the light of UN recommendations and international outreach



Thank you



SUPARCO