Report on the COSPAR Capacity Building Workshop "Coronal and interplanetary shocks: analysis of data from space and ground based instruments" in Kodaikanal, Tamil Nadu, India - January 2020

Raffaella D'Amicis – COSPAR Panel for Capacity Building

I – Introduction

The workshop took place in Kodaikanal Solar Observatory (KSO) Indian Institute for Astrophysics (IIA) from January 6th to 17th 2020. Primarily organized by COSPAR, it received support from international organisations, like the space agency NASA, the Science Committee on Solar-Terrestrial Physics (SCOSTEP), the International Space Weather Initiative (ISWI), as well as from local sponsors, IIA, the Space and Engineering Research Board (SERB) Department of Science and Technology (DST) Gov. of India.

The workshop was proposed and locally organised by Prof. Kathiravan, a former participant of the COSPAR CB workshop on "Coronal and Interplanetary Shocks: Analysis of Data from SOHO, Wind, and e-CALLISTO" in Ethiopia in 2018.

The main aim of this workshop was to introduce young astrophysicists (PhD students and post-docs) to the basic structure of the Sun and solar corona transient phenomena such as Coronal Mass Ejections (CMEs) and shocks detected using remote sensing observations from GOES, SOHO, STEREO, SDO and in-situ measurements from STEREO, ACE, WIND. Data were supplemented with ground based observations such as the ones from the Gauribidanur radioheliogram and spectral data obtained with the e-CALLISTO network (one antenna is located in KSO). The students were also introduced to Python lectures to process and combine observations taken from different instruments and missions.

Details about the workshop can be found under the Capacity Building Program pages (http://cosparhq.cnes.fr/events/cospar-capacity-building-workshops/) and under the local web pages (http://www.iiap.res.in/COSPAR_KSO2020/).

II – Participants

A total of 44 applicants (15 Foreigners and 29 Indians) were selected out of a total of 113 candidates (18 Foreigners + 95 Indians). 66% of the selected students were from India while the others from Africa (3 from Ethiopia, 1 from Egypt, 1 from Nigeria, 1 from Kenia, 1 from Ghana, 1 from Mozambique, 1 from Ivory Cost) and from other Asian countries (3 from Sri Lanka, 2 from Mangolia) and 1 from South America (Argentina).
However, the number of foreign students attending the workshop reduced to one third for the following reasons. Six of the selected students were not able to attend for lack of local financial support not able to provide the remaining 25% of the total flight cost not covered by the workshop. One of the originally chosen students had to withdraw his participation due to the beginning of his postdoc in the same days and being denied the permission and funding to attend. Three of the originally selected students could not fly due to delay in passport renewal. Finally, one of the local students only participated in the first week of the school for personal reasons.

At the basis of the low number of foreign participants is mainly the poor regional character of the workshop that would have avoided problems with high travel costs and the consequent difficulty for students cover the travel costs they had to find themselves (around 25% of the travel costs). This is a lesson to be learned. There were neither Chinese students nor from close Asian countries applying, pointing to a problem probably related to the advertising of the event.
Gender showed a 44/56% female/male students distribution. The full list of students including affiliation and nationality is given in Appendix A.

III – Inauguration
The inauguration program included the following speeches:

- a welcome address by A. Subramaniam, Director of IIA;
- an overview of the observational and research facilities of IIA by G. C. Anupama, Dean of the IIA;
- an overview of KSO by E. Ebenezer, Scientist in-charge of KSO;
- an inaugural address by R. D'Amicis, on behalf of the PCB;
- a description of the COSPAR CBW and its objective by N. Gopalswamy (GSFC-NASA);
- a vote of thanks by C. Kathiravan of IIA.

IV – Lecturers
The list of lecturers including affiliation follows:

- R. D'Amicis, INAF, Italy (Co-Chair)
- O. Divya, NCRA, India
- E. Ebenezer, IIA, India
- N. Gopalswamy, NASA, USA (Chair)
- C. Kathiravan, IIA, India
- P. K. Mahoharan, NCRA, India
- P. Makela, NASA, USA
- C. Monstein, IRSOL, Switzerland
- S. Nandita, PRL, India
- P. K. Rajaguru, IIA, India
- K.B. Ramesh, IIA, India
- R. Ramesh, IIA, India
- A. Shanmugaraju, Arulanandar College, India
- P. Subramanian, IISER, India
- G. Thejappa, NASA, USA
- S. Yashiro, NASA, USA

Five of the lecturers including myself had participated in the previous CBW on coronal and interplanetary shocks in Ethiopia: Monstein, Gopalswamy, Yashiro, Makela, D'Amicis. The local organizer who was also one of the lectures (Kathiravan) was a former participant of the same workshop. For all the others this was their first experience at all with the COSPAR CB, although all of them had previous experience with teaching at international schools and at university. One of the lecturers (O. Divya) gave his lectures through teleconference because he fell ill suddenly.

V – Program

From the program (see Fig. 1) it can be read that the school was structured as usual in these workshops with approximately 40% of the time dedicated to science lectures, 10% to lectures and hands-on activities on Python and 50% to the projects the students had to carry out (See Fig.1 below). As in previous occasions, some lecturers acted also as projects' supervisors as indicated in Appendix C.

For the hands-on sessions, students were requested to download Python 3.7. Precise instructions for installation were given before the workshop and the lecturer supervising this activity (C. Monstein) asked as a proof a screenshot with the outputs of the first script in order to avoid waste of time due to installation issues during the workshop.

Time	9.00 - 10.00	10.00 - 11.00	11.00 - 11.15	11.15 - 12.15	12.15 - 13.15	13.15 - 14.15	14.15 - 15.15	15.15 - 16.15	16.15 - 16.30	16.30 - 17.30
6 Jan - Mon	opening cerimony	basic of MHD	Tea break	plasma oscillations	solar interior	Lunch break	python	python	Tea break	python
7 Jan - Tue	solar photosphere and cromosphere	plasma physics	Tea break	solar corona	instruments	Lunch break	radio bursts	CMEs and radio burst	Tea break	shocks and associated
8 Jan - Wed	non-linear processes	CME initiation	Tea break	CME propagation	CME imaging	Lunch break	CME and shocks parameters	Rankine Hugoniot equation	Tea break	solar wind
9 Jan - Thu	ICMEs	solar wind demo	Tea break	Solar Energetic Particles	Solar Energetic Particles	Lunch break	Space Weather: research inplications	Space Weather: research inplications	Tea break	e-CALLISTO
10 Jan - Fri	CME, flare, type-II burst	CME, flare, type-II burst	Tea break	radio imaging of the solar corona	CME interactions	Lunch break	Rankine Hugoniot equation	IP observations of CMEs and shocks	Tea break	IP observations of CMEs and shocks
11 Jan - Sat	radio imaging of the solar corona	Solar Radio Astronomy	Tea break	Solar Radio Astronomy	Solar Radio Astronomy	Lunch break	Introduction to NASA CME Catalog	CME event analysis examples	Tea break	groups formation and events assignment
12 Jan - Sun	free day - excursion to nearby Kodaikanal									
13 Jan - Mon	Introduction to event analysis	event analysis	Tea break	event analysis	event analysis	Lunch break	event analysis	event analysis	Tea break	event analysis
14 Jan - Tue	progress report	event analysis	Tea break	event analysis	event analysis	Lunch break	event analysis	event analysis	Tea break	event analysis
15 Jan - Wed	progress report	event analysis	Tea break	event analysis	event analysis	Lunch break	event analysis	event analysis	Tea break	event analysis
16 Jan - Thu	progress report	event analysis	Tea break	event analysis	event analysis	Lunch break	event analysis	event analysis	Tea break	event analysis
17 Jan - Fri	ptroject presentations		Tea break	project presentations		Lunch break	end of workshop			

Figure 1. The program

VI - The projects

The traditional way for CB workshops is to let the students define their projects themselves as far as possible. However, in this case (and also in the CBW in Ethiopia and Brazil held in 2018) the definition of the project was driven by the scientific committee who identified 12 interesting events to be given to students for full analysis and characterization. Students were divided into 6 group (see Appendix B) and each group was assigned two different events.

Two persons from NASA introduced students to the CDAW webserver containing several data related to instruments derived from different missions to be used in the event analysis. All the data related to the events selected were available also on memory sticks that were provided to each group.

As already mentioned in Section V, students were asked to install Python 3.7 before arrival with the support of C. Monstein. Students mainly used the Python routines learned during hands-on activity but they also used sometimes other software (e.g. Matlab and/or IDL) for further support.

Progress report were given by students and presented to the audience each day of the second week in order to share their results but also to stimulate discussion and have comments/suggestions/corrections by students and lecturers.

VII- Results

During the second week, each student had the opportunity to present part of his/her group result. Indeed, progress reports were presented each day. At the end of the workshop, two students from each group gave a short presentation (15 minutes in total) summarizing the results obtained during the week on the two events assigned. A list of the events assigned to each group is given in Appendix C. Mainly all the participants understood the methodologies of the work in the field and most of them are in principle able to work with data and tools of at least one of the many missions discussed after returning to their home institutes. Some of the students had previous experience in this field and drove the others with the data analysis. The results were very good and Prof. Gopalswamy proposed to evaluate the possibility to publish the most interesting results. This is still under discussion.

VIII – Venue

The workshop took place in facilities of the Kodaikanal Solar Observatory (KSO) Institute for Indian Astrophysics (IIA).
A meeting room for about 50 people was available, equipped with a projector. Then two smallest rooms adjacent to the first one were used especially during the second week to accommodate two of the working groups. One of the smallest room was equipped with a printer. The LOC gave IT and administrative support while a local technical staff provided help and assisted for technical issues.
At the bottom of that, the internet connection was very efficient and worked extremely well everywhere and allowed students to consult bibliographic references, have access to data and exchange the results of their analysis during the development of the project.

IX – Breakfast, Lunch, Dinner and Tea Breaks

Breakfast, lunch and dinner were held at a dedicated building in the observatory, managed by local staff. The food consisted of local plates. Tea breaks were served twice per day in another building close to the meeting room.

X – Banquets and special events

On 6th and 13th January, two banquets were organized in two different restaurants downtown in Kodaikanal: at The Carlton accompanied by a classical concert and at Le Poshe accompanied by an acrobat show. See photos in appendix D.

A dedicated observation was reserved to the Lunar Eclipse occurred on January 10. Students gathered around a bonfire with prof. Gopalswamy. See photos in Appendix D.

Excursion (see section XII and Appendix D for photos).

We had the opportunity to celebrate the Pongal festival with our Indian colleagues. It is a typical festival in Tamil Nadu that can recall somehow the American Thanksgiving. See photos in Appendix D.

A surprise party was organized for my birthday, which included a cake and a sari as a gift. See photos in Appendix D.

XI – The Residence of Kodaikanal Solar Observatory

All students and lecturers were accommodated in the observatory even if in different buildings but not far apart. The students were accommodated in double rooms while the lecturers in single rooms. The accommodation was acceptable (see answers to quedtionnaire).

XII – The excursion

On Sunday, almost all the students and lecturers went to Mannavanur Sheep & Rabbit farm and Mannavanur lake. Mannavanur lake is a scenic beauty which is surrounded by hills and is about 35 km from Kodaikanal main town. They hiked around the lake across the hills for around 5-6 km. People enjoyed boating in the lake.

Then they went to Southern Regional Research Center (SRRC), which is a regional center of the Central Sheep & Wool Research Institute (CSWRI). Here, various types of sheep and rabbits are breed for wool and meat. They were introduced with various breeds of sheep and rabbits by the scientists there. They had lunch at this institution, and then went to the Kodaikanal Lake, a manmade lake, which is the most popular attraction of Kodaikanal.

XIII - General evaluation

We prepared and distributed among the students an evaluation sheet (Appendix C), for getting feedback concerning the different aspects of the workshop, obtaining 26 answered evaluation sheets (~ 76 %). Overall, the opinions mainly converge towards a positive evaluation of the workshop in general. There is a good level of satisfaction with the lecturers and supervisors personally. The scientific lectures were considered extremely useful although some students would have preferred to include also more hands-on activities on specific topics, instrument lectures and CME geo effectiveness or dedicated time to space weather.

The Python lectures were very appreciated although some of the students had preferred more time dedicated to this topic.

Students reported great satisfaction with the data analysis related to the project. A large majority of the participants think they will be able to use this kind of data in their future research. They unanimously feel they benefitted significantly from attending the workshop.

Although most of the attendees consider the financial support sufficient, see section II for issues related to foreign students not able to attend.

Again, we would like to thank all the people (especially the local organisation committee and the lecturers) and the institutions that have substantially contributed to making possible this event: COSPAR, NASA, SCOSTEP, ISWI, IIA, SERB, DST.

Raffaella D'Amicis

Appendix A - List of participants

No.	Name	gender	Affiliation and Count
	Foreign Participants		
1	A.D. Manjula P. Ranasingh	male	Sri Lanka
2	Davis Odhiambo Athwart	male	Kenya
3	Oyedokun Oluwole Johnso	male	Nigeria
4	Rajavarathan Jenan	male	Sri Lanka
5	Tesfu Tesfay Yemane	male	Ethiopia
	Indian Participants		
6	Anshu Kumari	female	India
7	Arghyadeep Paul	male	India
8	Bhupendra Malvi	male	India
9	Biswajit Ojha	male	India
10	Devojyoti Kansabanik	male	India
11	Hannah Blessy, W.	female	India
12	Harikrishnan Aravindaksha	male	India
13	Jayalekshmi, G. L.	female	India
14	Kamalam Thillaimaharajan	female	India
15	Ketaki Deshpande	female	India
16	Komal Martand Choraghe	female	India
17	Mahender Aroori	male	India
18	Maya Prabhakar	female	India
19	Muskan Shinde	female	India
20	Pankaj Kumar Soni	male	India
21	P. Pappa Kalaivani	female	India
22	Patel Binal Dineshkumar	female	India
23	Ranadeep Sarkar	male	India
24	Samriddhi Sankar Maity	male	India
25	Satabdwa Majumdar	male	India
26	Selvarani, G.	female	India
27	Shirsh Lata Soni	female	India
28	Sindhuja, G.	female	India
29	Srikar Paavan Tadepalli	male	India
30	Suresh, K.	male	India
31	Urmi Doshi	female	India
32	Vasantharaju, N.	male	India
33	Vijayalakshmi, P.	female	India
34	Zubair Shaikh	male	India

Appendix B – Projects

The participants were divided into 6 groups. To each group, two events were assigned to be fully characterized and analysed:

Group	Event #1	Event #2
G1	02/07/2012	22/08/2015
G2	02/05/2013	28/08/2015
G3	05/10/2013	11/02/2014
G4	25/10/2013	20/02/2014
G5	10/11/2013	20/03/2014
G6	26/01/2014	05/11/2014

The supervisors were:
N. Gopalswamy (NASA, USA)
C. Kathiravan (IIA, India)
R. D'Amicis (INAF, Italy)
E. Ebenezer (IIA, India)
S. Yashiro (NASA, USA)
P. Makela (NASA, USA)
Moreover, C. Monstein (Switzerland) supervised and assisted with the Python codes all the groups.

Appendix C. Results from evaluation forms

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Workshop Evaluation Form

General

	5	4	3	2	1
The website told me all I needed to know about the workshop	18	8	0	0	0
The application form was easy to fill in	18	8	0	0	0
Applications were efficiently handled	20	5	1	0	0
I had time enough to make my travel arrangements	14	9	1	1	1
The financial support I got was sufficient	11	8	3	0	0

5=strongly agree
4=agree
3=no strong feeling
2=disagree
1=strongly disagree

Comments

i) It was a great management. But, we have written a project propposal before coming here. It will be great if kindly informed about how can we proceed with that project proposal. ii) everything managed very well. iii) Applications form was easy but I didn't understand the meaning of asking project before the worksop.

Science Lectures

		5	4	3	2	1
These lectures were for me personally the most useful part of the workshop		16	7	2	1	0
The time spent on the lectures was too long	*Answer only one of these*	1	1	0	0	0
Or the time spent on the lectures was too short		0	0	0	0	0
Or the time spent on the lectures was just right		14	8	1	0	1
The lectures were at too high a level	*Answer only one of these*	0	3	0	0	0
Or the lectures were at too low a level		0	0	0	0	0
Or the lectures were just right		14	8	1	0	0
The lectures were well presented		16	9	1	0	0
The lectures were stimulating		14	10	1	0	0
The lecturers responded well to questions		19	7	0	0	0
I found it easy to get on with the lecturers		11	12	3	0	0
The lecture room was comfortable		16	7	3	0	0

5=strongly agree
4=agree
3=no strong feeling
2=disagree
1=strongly disagree

Comments

Were there any other topics you would have found especially useful?

i) the interaction with Lecturers on the topics like CMEs, shocks and solar wind, was very useful. ii) I did not have any experties in solar radiations, CMEs, Shocks etc. Now , I can certainly say about the knowledge I got from this workshop. It was very much helpfull. iii) Radio burst topics were good and it will be beneficial also. iv) Since i am just starting in the field, it was a very benefecial session for me personally. The lecturers were extremely knowledgeable in their resective fields and explained the doubts with great patience. v) 1. MHD lectures + Instrument lectures + Radio. vi) The hands on sessions. vii) All lectures were crucial for me. viii) A little more detailed lecture on the Insitu parameters and a lecture on understanding and deriving their signatures from data would have helped. ix) Please include some interplanetary and space weather part in the workshop. x) More sessions and hands-on for radio burst events,cme-cme interaction,SEPs and Geomagnetic activity. xi) Yes, the topics like type 2 radio burst and band splitting features that observed were found extremely interesting. It is also interesting to study about the effects of weak and strong turbulence cause by the solar. xii) Tracking of CMEs and its geo effectiveness. xiii) was not famillary with this field but after lectrures I am very intersted to work in this field. xiv) 1. MHD lectures + Instrument lectures + Radio. xv) Lectures were good. But some lectures were not to the point as their lecture title.

Other comments?

i) Thanks for providing good learning environment. Lecturers are very patient with the silly questions thrown at them. We are very grateful for that. ii) There could be more hands on tutorials in 1st week. iii) There could be more hands on tutorials in 1st week.

Software Lectures

		5	4	3	2	1
These lectures were for me personally the most useful part of the workshop		12	12	1	0	0
The time spent on the lectures was too long	Answer only one of these	0	0	1	0	0
Or the time spent on the lectures was too short		0	6	2	0	0
Or the time spent on the lectures was just right		10	5	1	0	0
The lectures were at too high a level	Answer only one of these	0	1	0	0	0
Or the lectures were at too low a level		1	0	0	0	0
Or the lectures were just right		15	9	0	0	0
The lectures were intelligible		15	9	0	0	0
The lectures were well presented		16	9	1	0	0
The lectures were stimulating		13	8	3	0	0
The lecturers responded well to questions		19	5	2	0	0
I found it easy to get on with the lecturers		15	8	2	0	0

5=strongly agree
4=agree
3=no strong feeling
2=disagree
1=strongly disagree

Comments

I was introduced to the python programming by the lecturers. I consider this workshop laid the foundation of my programming in python. ii) I beleive that some more time should have been spend on explaining the script and showing us how to write one. Apart from that, it was great, the scripts were very useful and helpful. iii) The python software lectuerer assisted us deligently. iv) After the event analysis, I found out that I had far more doubts in python programs for specific events. It would have been better if there was another python session. v) Some prior training of python programs through online just before one or two weeks of the starting of the workshop will be more useful. So the person will get more familiarised , practice it and can ask doubts about what he really doesn't know. vi) The basic of python was very good and the . lectures on that were really helpful.

Projects		5	4	3	2	1
The project was for me personally the most useful part of the workshop		18	5	1	0	0
The time spent on the projects was too long	*Answer only one of these*	0	0	1	0	0
Or the time spent on the projects was too short		1	5	0	0	0
Or the time spent on the projects was just right		13	5	0	0	0
The instruction I received to install software before the workshop were appropriate		17	9	0	0	0
The lectures did not prepare me adequately for the projects		0	2	3	3	16
I would have preferred to have a PC provided than using my laptop		1	2	2	7	12
I would have preferred to have an own laptop instead of using the provided PC						
I had difficulty using Linux		3	5	0	0	9
The help I got with my project was adequate		14	10	0	2	1
I found the supervisors helpful and easy to get on with		15	6	2	0	0
I realized too late which the ultimate scope of the project is		3	2	1	7	11

5=strongly agree
4=agree
3=no strong feeling
2=disagree
1=strongly disagree

Comments

i) Projects definitely helped us to develop the data analysis skills. ii) I take this opportunity to thank Prof. Makela for his guidance and support through out the project. His meticulous observations and resulting conclusions were inspiring and extremely motivating. It been a great pleasure and an honor to work with such a stalwart. iii) It was a very nice experience to do project with a group of people and present it what we have done. iv) Event given to us are already published. We were not awere with this so we spend time to get result and found that we were reproducing the results. So we get less time to get new results. v) It would have been good if it the raw data is provided for the event analysis, as we will get to know the processes of calibration and preliminary data analysis.

Accommodation and Venue	5	4	3	2	1
The airport transport was efficiently done	14	5	1	0	0
The rooms at KSO Guest House were good	8	10	7	0	0
The food at KSO Guest House was good	15	8	2	0	0
Generally, the accomodation environment was good	12	12	2	0	0
The KSO was a good place to hold this workshop	13	10	1	0	0
The internet connection was acceptable	16	8	1	0	0
The excursion was good	17	9	0	0	0
The special dinner at The Carlton was good	18	7	0	1	0
The special dinner at Le Poshe was good	19	6	1	0	0

5=strongly agree
4=agree
3=no strong feeling
2=disagree
1=strongly disagree

Comments

i) overall it was great ii) It was really great management. Iii) The dance performance at la poshe was a bit too dangerous for my taste. Apart from that, it was a great evening and the food was great too. Iv) It may be good to be accomodated in separate rooms. v) The speed of the internet connection could be improved. v) KSO is a very nice place to carry out workshop. Ambience over there is so positve that we forgot about coldness and try to learn and do as much as we can. vi) It should be better if KSO authority provide a single room to each participant.

The Future	5	4	3	2	1
I will be able to use the same data in my future research	14	9	1	1	0
I have learned enough to do this without much extra help	2	16	4	1	1
If I have problems, I know where to go for help	15	9	1	0	0
I have benefitted significantly from attending the workshop	22	4	0	0	0

5=strongly agree
4=agree
3=no strong feeling
2=disagree
1=strongly disagree

General Comments (on anything whatever to do with the workshop)

i) thank you for providing opportunity. ii) strongly helpful workshop. I have learnt a lot from this. Looking forward strongly to persue research on these topics. Got great exposure. Thank you very much COSPAR for selecting me as a participant and providing me an environment to grow up further. iii) I just want to thank the organisers(LOC and SOC both) for organising this wonderful workshop. I have nothing mut gratitude for you all. I am grateful that you provided me the opportunity to learn so many new things. Al in all, it was a great and productive event. Thank you all. iv) The COSPAR commitee and KSO organizers were very enthusiastic. v) I take this opportunity to thank COSPAR to conduct this work shop in India and giving me an opportunity to be one of the participants. I wish to attend such similar workshops and meetings/conferences, globally to be able to meet the peers and learn from the experts as many times as possible.Request you to kind me keep in the loop to know about the upcoming programs by COSPAR. vi) the data that was given to us was already used in other papers. Still that there would be no data like these available on the internet makes me feel that the workshop could have provided us data like dynamic spectra of radio bursts. vii) It will great if the COSPAR provides some arrangements to publish our projects. vii) In future, I request to COSPAR to arrange this type of workshops. It will help the access of resource persons who knows each and every corner of data analysis in a specific field. So through hands on, we can use satellite data efficiently, make friends of the same research area. Big thank you to COSPAR.

Appendix D – Photos

1 – Group photo


2 – The inauguration ceremony (left), the Pongal festival (middle), me wearing a sari (right).


3 - During a lecture (left), classical concert (right).

4 – The library

5 –Welcoming the COSPAR delegates at Le Poshe restaurant (left), Interviewing prof. Gopalswamy (right).

6 – Excursion