

**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/](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 ceremony	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 implications	Space Weather: research implications	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	project 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 6<sup>th</sup> and 13<sup>th</sup> 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 questionnaire).

### **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 bred 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
<b>Foreign Participants</b>			
1	A.D. Manjula P. Ranasingh	male	Sri Lanka
2	Davis Odhiambo Athwart	male	Kenya
3	Oyedokun Oluwole Johnson	male	Nigeria
4	Rajavarathan Jenan	male	Sri Lanka
5	Tesfu Tesfay Yemane	male	Ethiopia
<b>Indian Participants</b>			
6	Anshu Kumari	female	India
7	Arghyadeep Paul	male	India
8	Bhupendra Malvi	male	India
9	Biswajit Ojha	male	India
10	Devoiyoti 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	Sindhuj, 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 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