Chasing the shadows, a trip to spice island

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Abstract. The 2016 Total Solar Eclipse provided us an opportunity to introduce astronomy to a much wider audience. The path of totality crossed the Indonesia from Sumatra to the Maluku Islands and ended its journey in the Pacific Ocean. Its path crossed over 4 major islands, 12 provinces and many cities. Most of the cities have minimum exposure to astronomy. langitselatan travelled to observe the eclipse and to do astronomy outreach at the eastern most island under the eclipse path. We chose Maba, a small village in East Halmahera, North Maluku as our site to observe the eclipse as well as conduct a workshop for teachers and students. The aim of the workshop is to introduce astronomy taking advantage of the eclipse as well as raise awareness and curiosity among students. In this paper, we will share a short report regarding the whole trip and event in Maba.

1. Introduction
Astronomy is a unique and unusual scientific topic for a high school in Indonesia. It may be interesting to many people but it is uncommon as a scientific discipline at school. In most high schools in Indonesia, astronomy is not a standalone subject in curricula but a small part of Geography and Physics.

Indonesia has some astronomy clubs for students and the general public in several big cities but the overall interest in Astronomy is still low. Interest in astronomy in general has grown notably since the International Year of Astronomy 2009. Most of the astronomy enthusiasts in Indonesia are interested in “sky shows” such as meteor showers, lunar and solar eclipses, comets or asteroid passing by and even lunar perigee / apogee.

March 9, 2016 was a very special day for Indonesia public as the Moon crossed the face of the Sun and a good portion of the country experienced total darkness for a few minutes. On average, total solar eclipse is visible every 18 months at any particular region on Earth [1]. Previous total solar eclipse passed over Indonesia on October 24, 1995, hence make the one on March 9, 2016 very special,
especially those who live along the path of totality. The Total Solar Eclipse event also provided a good opportunity for science education especially in remote regions where science resources are often lacking.

We planned the trip a year in advance and choose North Maluku as the observation and public outreach location. North Maluku or Spice Island has had a rich history due to the presence of the valued spices indigenous to the area. We conducted a survey in 2015 to several cities in North Maluku to look for the optimal location for observation as well as for education and public outreach (EPO).

2. The plan
The Total Solar Eclipse (TSE) March 9, 2016 project targets primarily high schools students and teachers as our main subject for the EPO. Our main target are high school students since they have highest probability to sharing information with parents, friends and siblings and have the highest amount of science background than other age groups in the area. The purpose for doing outreach is to introduce solar eclipse and safe observation techniques with tools from available materials.

As for the locations, after considerations for seeing, weather probabilities and audience size we choose Maba, East Halmahera, North Maluku as our observation site. Maba is the eastern most city in TSE central line to pass through Indonesia before the Sun heads to the Pacific Ocean affording Maba has the longest totality time on land. Maba was also convenient for observational purposes as the Sun is well above the horizons (> 30º) at the time of first contact. At the time of the survey and the subsequent decision making time, North Maluku had the best predicted weather and cloud cover at time of eclipse.

Education and Public Outreach in Maba was done through TSE Introduction workshop prior the eclipse and TSE observation on the eclipse day. We collaborated with SMKN 1 Maba (a vocational school) to be our main contact and venue for the EPO session. The workshop itself will cover the introduction of the TSE, safe observation techniques, and hands-on activities to build safe observation tools from available material. The latter is important as it will be difficult for people in Maba to access solar filter and astronomical instruments.

3. The tools
At TSE Observation, langitselatan also welcomed the public to join and experience the eclipse. Telescopes were not the only tools that we took with us, we also provide several other tools that can be used for solar observation. All our telescopes are equipped with solar filters but we also prepared tools with simple projection techniques for the public. The purposes of the tools are eye safety. The easiest tool we provided for TSE observation was the Pinhole Box, which is easy to build using available material. This pinhole box was also part of our Do It Yourself workshop for teachers and students. The goal of this project is to introduce simple optics to the students.

Thousands of international and domestic tourists visited many places in Indonesia, including Maba to view this eclipse. This was the reason for us to provide an Eclipse Viewer called the KacaMatahari. KacaMatahari is not only for eye safety during TSE but also as a way to introduce Indonesia’s unique culture to the tourist and designed as a Barong Mask equipped with solar filter to view the Sun. Barong is a lion-like creature and character in the mythology of Bali, Indonesia. langitselatan provided 1000 KacaMatahari which was supported by ITB’85, NAOJ and IAU OAO. We also received 300 eclipse glasses from Cosmoquest and another 200 from Sydney Observatory. All eclipse viewer were distributed at the observation site and several other region in Indonesia.

"You are Galileo!" telescopes for children, were also provided during this event. This is a small telescope which is the same size Galileo Galilei used for his observations. The idea of this telescope is so that children can have fun looking at celestial objects. Even though this telescope is not designed for solar observation, we added solar filters for safe viewing. We used this telescope as a tools to introduce basic principles of telescopes and lenses for students.

Another tool for solar observation was the Solar Scope. It has larger field of view and is based on the principles idea of a pinhole and a small telescope, hence it is safe to use for solar observation. The Public will never have to look to the sun directly, but instead at its projection.
Last but not least, **langit**selatan had also planned to broadcast the eclipse from telescope onto the screen. This will cut the queue/ line to telescope and the public can see the whole eclipse from a larger screen. To do so, we built a cheap streaming tool using raspberry pi and the pi-cam. The main driver for this project is to show that ‘broadcasting’ is not expensive and anyone can build the streaming tools easily. The development of this tool is reported in separate paper in this issue.

![Figure 1. TSE Workshop at SMKN 1 Maba. Photo Credit: Fikry Maulana / Wicak Soegijoko / Ferry M. Simatupang / langitselatan](image)

4. The execution
**langit**selatan conducted the TSE 2016 workshop in Maba, in collaboration with SMKN 1 Maba. We invited 8 schools from Maba and nearby towns. Each school sent their physics / science teachers along with several students. Out of 8, we had 6 nearby schools who attended the workshop.

Through the workshop we aimed to (i) introduce Solar Eclipse and its observation tools; (ii) build astronomy awareness among teachers and students in Maba and its vicinity; (iii) build a network with schools in Maba; and (iv) prepare teachers and students as ambassadors to share the knowledge to the rest of the school as well as their families and friends. In order to achieve our targets, we divided the workshop into following sessions:

- Solar Eclipse introduction: to understands eclipse and sun earth interaction.
- Safe Observation: to introduce how to do safe solar observation and why it is dangerous to observe the sun directly without any protection.
- DIY Pinhole Projectors: to learn simple optics and participants can build their own tools at home without any special equipment.
- You Are Galileo telescope: to learn basic telescope and how to build a telescope.
- Testing the tools: participants use the tools including the small telescope to see the sun. All “You Are Galileo” telescope has its own solar filter.

During the workshop, **langit**selatan also provided several telescopes for students to observe the Sun. Teachers and students whose not attended the session choose to have on location discussion and observation with astronomer from **langit**selatan.

On March 9, 2016, we observed Total Solar Eclipse from SMKN 1 Maba. Many students and public also joined the session even though it was cloudy. We did not broadcast (streaming) the observation due to weather problems but the public were able to observe the solar eclipse using Solar Scopes, KacaMatahari, pinhole projectors and the telescopes we provided in the location. As for the eclipse itself, the sun played hide and seek with us but we were able to capture most of the moments leading up to and including totality.

5. Lesson learned
Post TSE Workshop and Observation, **langit**selatan had several notes as lessons learned that we need to improve in the future especially if the venue is in remote area. The first one was an education gap between what we observed and what we are accustomed to. It is understandable that such gaps exist
between the city and remote sites, especially in science, math and language arts. We need the ability to be able to customize the material quickly as we better understand the audience and its culture. A common core with the capability to be customized, standard teaching material for teachers and students is required to overcome this gap. Simplification of concepts and less technical sounding terms are needed. Longer workshop time is needed to cover the whole material including theory, tools, do it yourself sessions and observation.

Distance constraints for covering schools in a larger areas with longer travel time has effect on schedule and logistics. This applies for langitselatan as well as for the teachers and students who traveled some distance to see us. langitselatan needs to be mindful of these issues in the future, some of the attendees travelled more than 2 hours to partake in the workshop.

We have observed that we should start the day with a combination of observation & shorter indoor sessions. This combination will help participants have a better understanding of the topic as well as maintaining their focus on the workshop. If time constraints is not the issue, then it is better to divide the workshop over a few days to cover the whole material and having more time for hands on and discussion (Q&A) session.

As much as possible send workshop material (including basic science) ahead of time and have them available on the langitselatan website so students and teachers can download and absorb the material at their own pace and have questions ready.

We have found that Internet access is a necessity, however at remote sites this requirement might become difficult logistically or financially. Internet access will help us not only to broadcast and share our activities live to the global community, but it also can help students and teachers to have access to distant learning in the future.

6. Conclusion
The workshop session was successful. Many students and teachers have became even more curious about astronomy. We do not have the data to support this, but we can see from their curiosity and from the variety of questions they ask during the sessions and at TSE observation day. Despite rain on TSE-day, a large number of students and teachers showed up and took part in the observations. Even though we choose Maba as our EPO and Observation site, we also supervised similar workshop and observation in another city. TSE workshop were conducted in Ambon and Padang in collaboration with Amboina Astronomy Club and sekolahalam Minangkabau under supervision of langitselatan.

TSE 2016 also afforded large media coverage of langitselatan activities. This has helped langitselatan to establish itself as a prominent astronomy communicator in Indonesia. In continuation, langitselatan will provide more education material through the website to help teachers and students to learn astronomy.

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