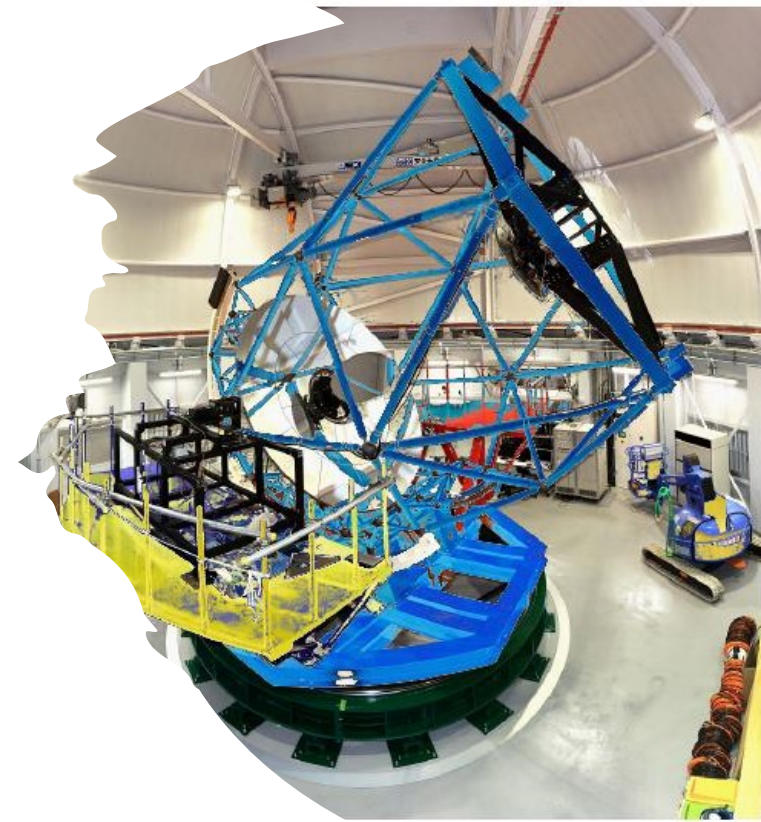


BRIN

BADAN RISET
DAN INOVASI NASIONAL

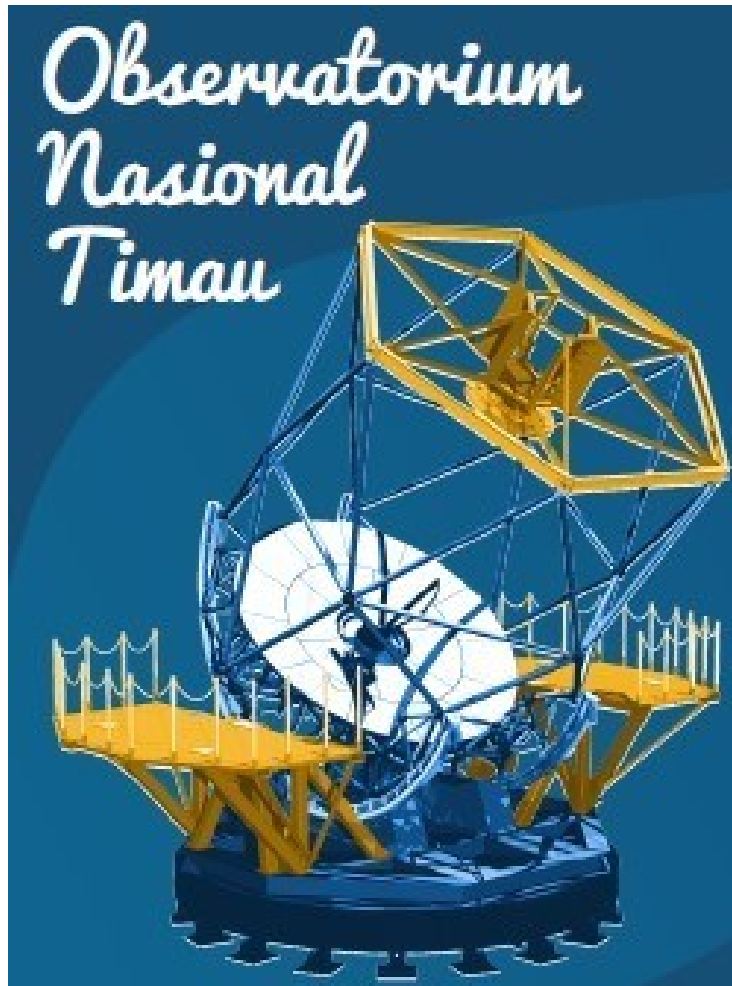


Indonesia's Astronomical Observatory: A Novel Global Platform for Space Research Enhancing Peaceful Applications and Space Situational Awareness

Emanuel Sungging Mumpuni

STSC 61, 31/01/2024

National Astronomy Observatory of Timau



Developing Indonesia from the vicinity

New center for astronomy facility in the eastern part of Indonesia



Located in the conservation forest, at the base of Mount Timau

Conditions:

- Located slightly to the south of the equator;
- Favorable annual climate and weather;
- Located in conservation areas, far from the residential area;
- Located in an area of 34 Ha which is dedicated to the observatory;
- Received permission from Japanese astronomers (Kyoto University) to use their telescope;

National Astronomy Observatory of Timau

Major Facility: Optical telescope 3.8 meter with segmented mirrors & light weight structure (Kurita et al., 2010, 2020),

PROGRAM:

1. Astrophysics
2. Space Debris
3. Space Weather
4. Islamic Calendar
5. Inter-disciplinary study

The observatory is expected to be part of Dark Sky Park, to conserve the environment by designing a unique education & tourism area for Astro-tourism, and to boost economic development for society.



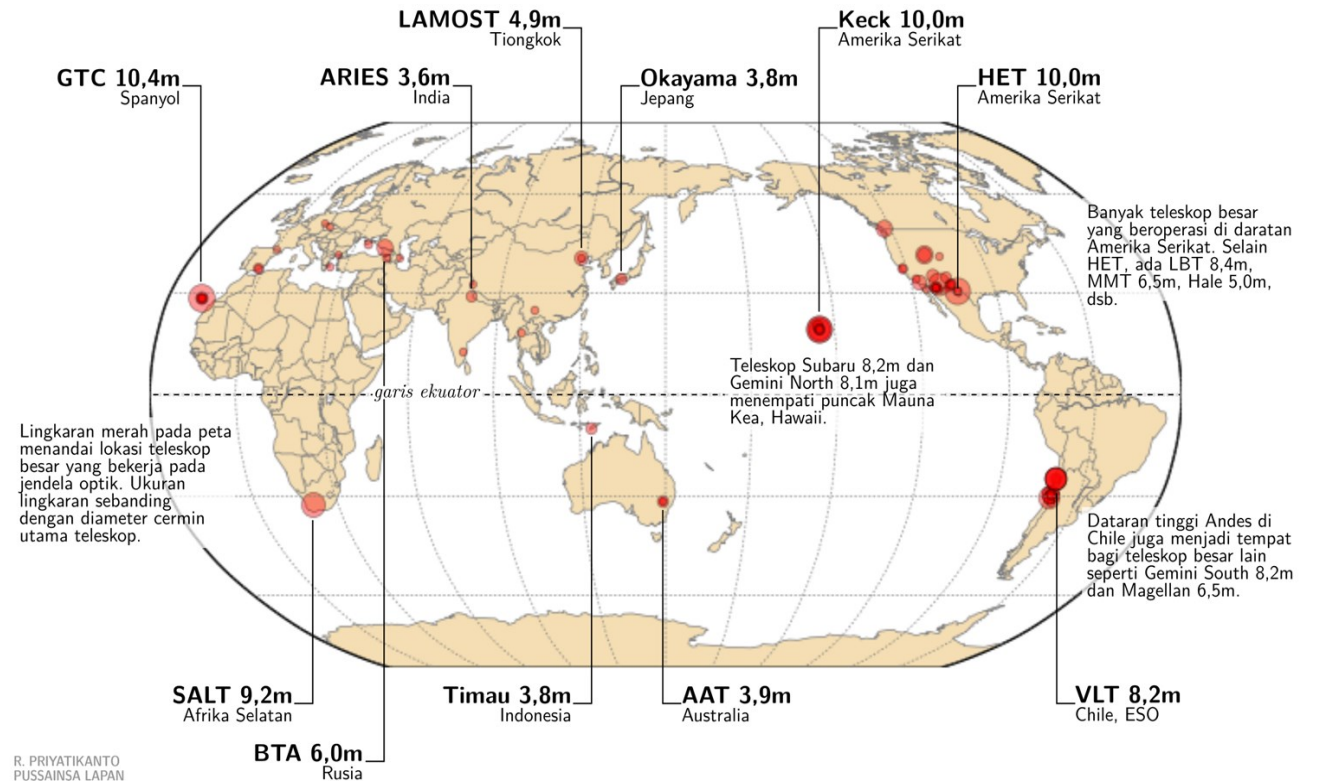


While the telescope is used for general purposes, it is prioritized for time-domain astrophysics (*supernova*, stellar flare, etc.). Besides, near-earth objects are another important aspect of collaborations (IAWN, APAON, or other network).



TELESKOP 380 cm hopefully can join international endeavor:

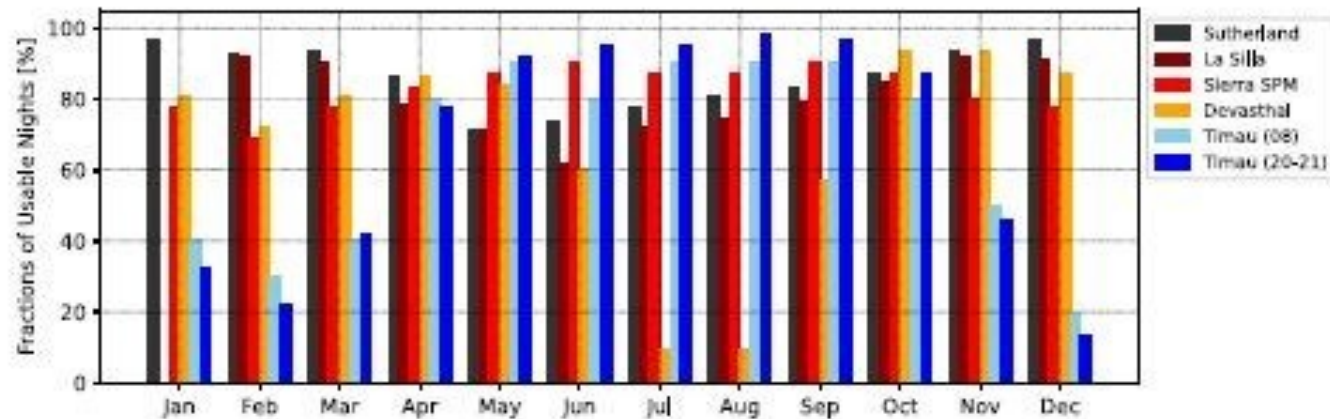
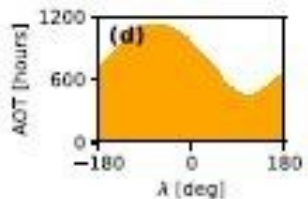
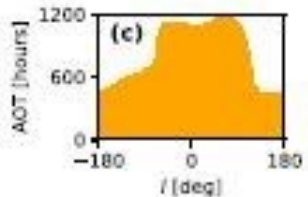
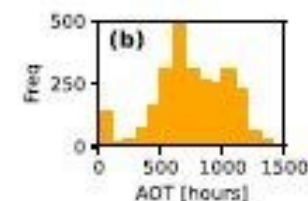
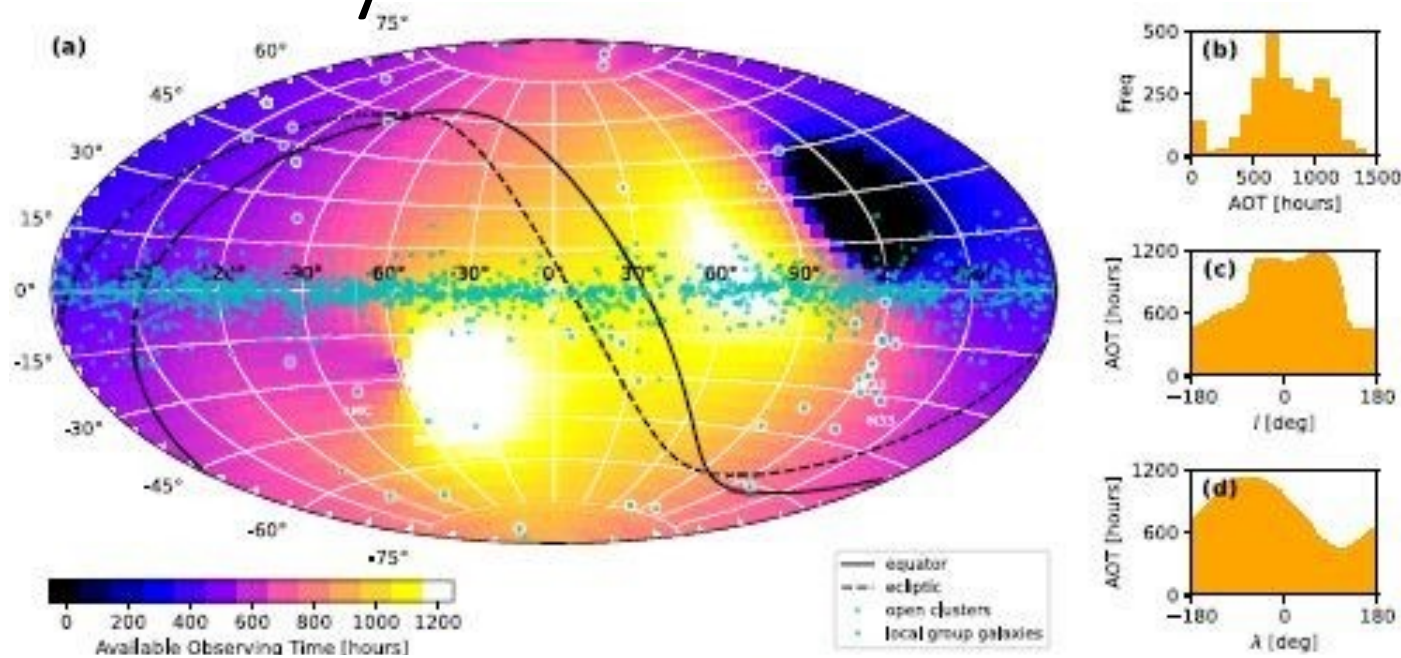
- Teleskop Ritchey-Chretien with **18 segmented mirror supported by active optic** with light structure to support the *agility (for fast respond study)*.
- **2 Nasmyth focus** for first generations:
 - Simultaneous imaging **sdss optic** (g, r, i) (Maruo, 2020),
 - NIR with filter wheel (Y, J, H).
- Current design is optimized to meet photometry & astrometry study,



First Generation Instruments

Name	Specs	Expected Studies
3OPTIKA / trɪ-op-tɪ-ka: / (see: Maruo, 2020)	450-820 nm in sdss g,r, and i, 12'×12'	Time domain astrophysics Astrometry Generic Photometry
NIRKA / nɪr-ka: /	Filter wheel Y (1020 nm), J (1220 nm), H (1530 nm) 8'.74 × 8'.74	+ NIR domain, + 'cool objects',

Why Timau?



<https://doi.org/10.1093/mnras/stac3349>

Monthly Notices

of the
ROYAL ASTRONOMICAL SOCIETY
MNRAS 518, 4073–4083 (2023)

<https://doi.org/10.1093/mnras/stac3349>

Characterization of Timau National Observatory using limited *in situ* measurements

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ABSTRACT

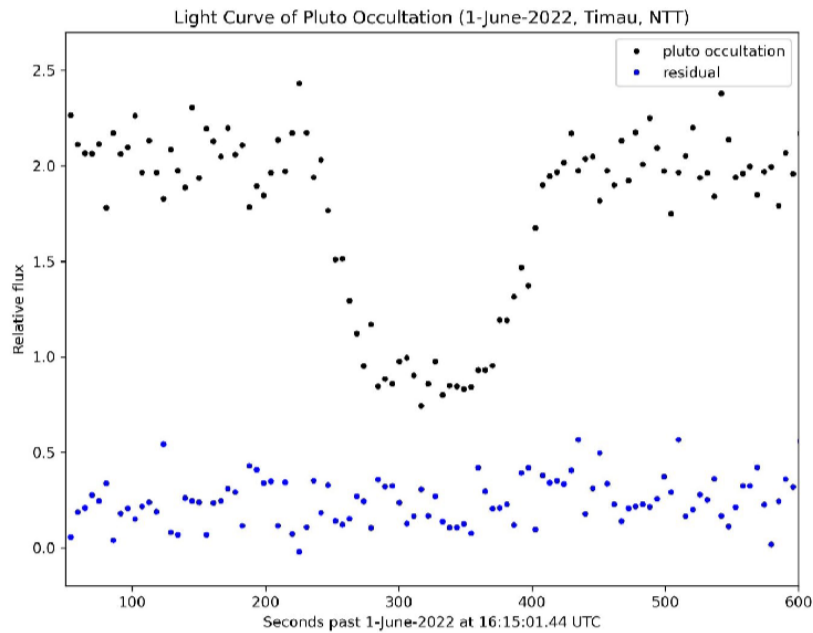
A new astronomical observatory in south-east Asia will host a 3.8-m telescope for optical and near-infrared observations. The site needs to be appropriately performed instruments for comprehensive site testing. For available for almost 2 yr. Based on the data acquired during the site testing, we evaluate the mean level of scattering on site. We find an elevated level of scattering. It is considered regular for an equatorial area. The brightness and infrared images from *Himawari-8* and the yearly average percentage of usable nights analysis correlate with $R = 0.82$. In terms of time, during the wet season (November–April), the due to the limited capability of *Himawari-8* in Timau to complement other observatories great

Key words: atmospheric effects – methods: data analysis

Highlight:

- Analysis from 2020–2021.
- 66% night/year, 8h/night is expected.
- 40% photometry night,

Multi Purpose Photometry Measurement



- Pluto occultation (international collaboration), Mumpuni et al, 2023),
- Photometry for space debris, (Rachman et al., 2023),
- National space debris cooperation is already discussed among several local smaller observatories (ITERA, Pontianak station in Kalimantan),
- Development of a robotic facility for Space Situational Awareness (Rachman et al., - see next)

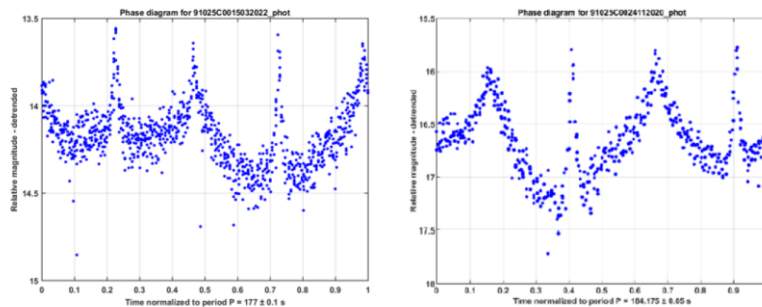


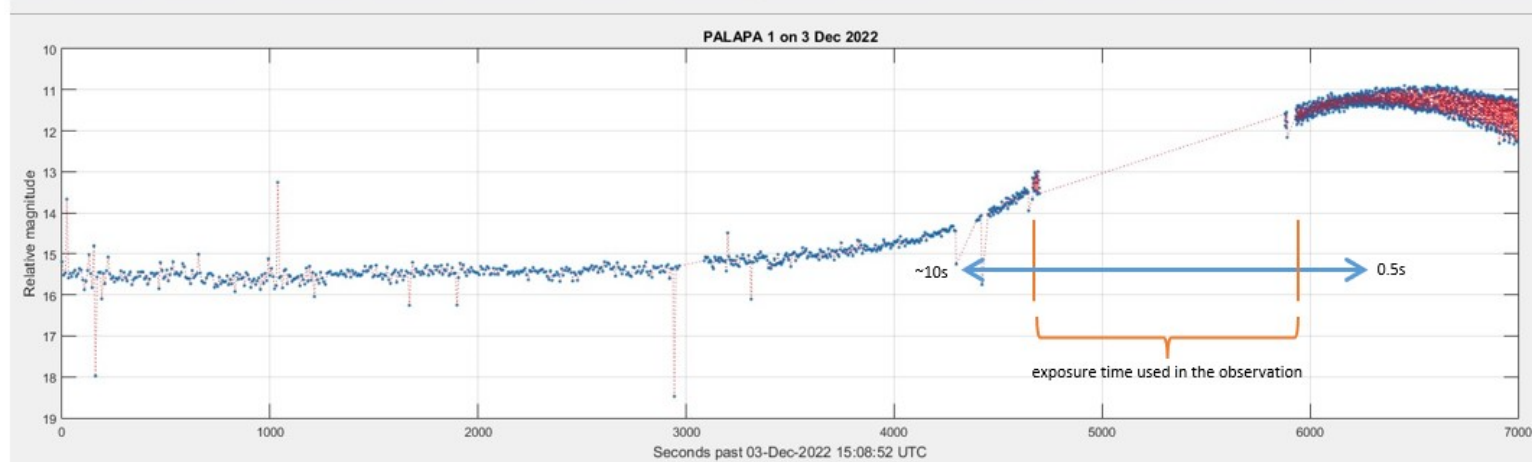
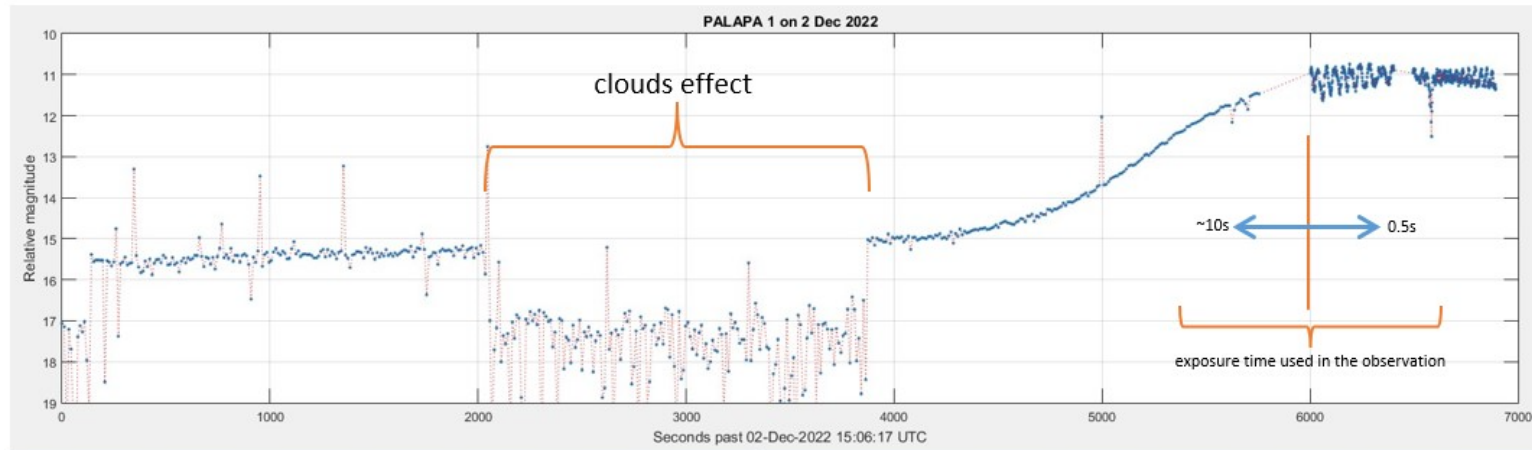
Figure 5. Phase diagrams of the light curves for case 1 produced by this study (left) and the one from the AIUB database (right).

Two light curves of PALAPA A1 satellite obtained from BRIN station at Tilong, Kupang in Dec 2022

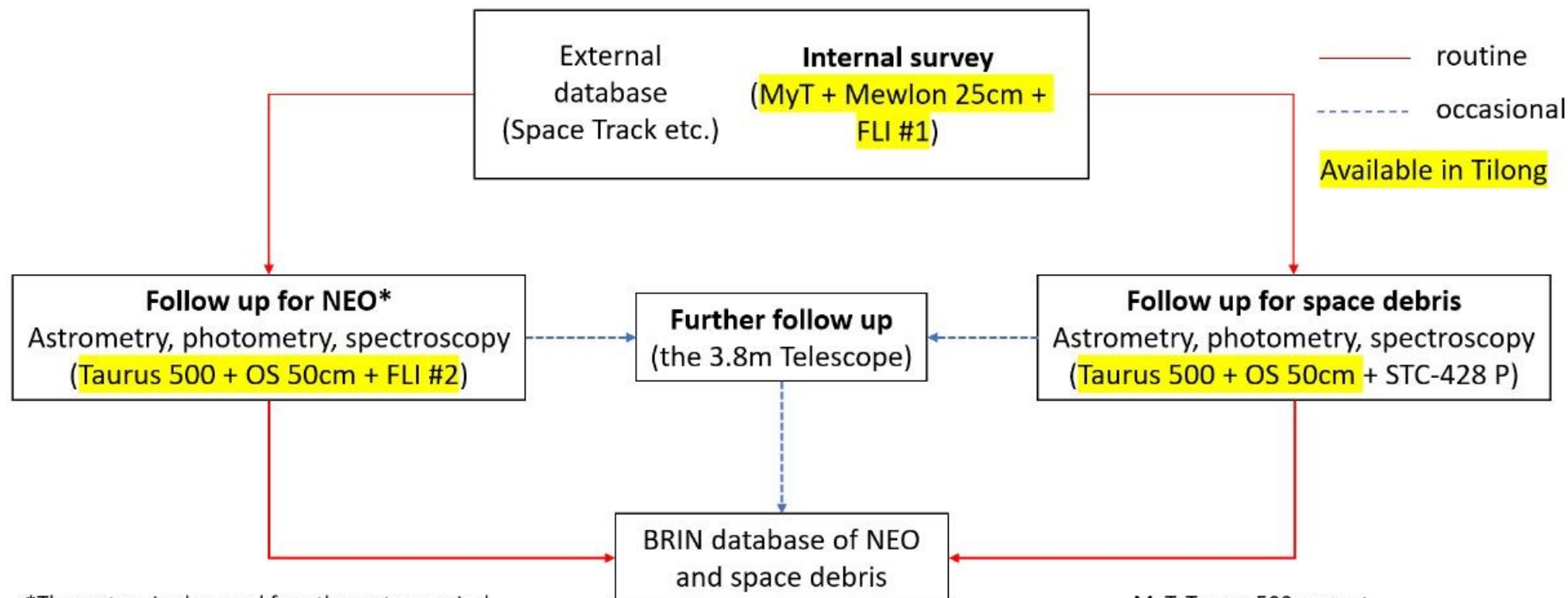
The satellite is the first Indonesian satellite which was launched in 9 July 1976 and in operation until the end of 1983.



Telescope system used
in the observation



Robotic Telescope Utilization for NEO and Space Debris at TNOI



*The system is also used for other astronomical observations such as stellar occultations, extrasolar planets, etc.

MyT, Taurus 500: mount
Mewlon 25cm, OS 50cm: OTA
FLI, STC: camera

Astronomy & Society Studies



- From the Astro-tourism study (Mardita & Perwitasari, 2023), it is difficult to determine new Astro-tourism areas due to several overlaying stakeholders:
 - Conservation forest under the Ministry of Forestry and Environment – central government
 - Rural area in the vicinity – regency of Kupang
 - Enclave – residential areas inside the forest area belong to the natives
 - Native People
- The Importance of Dark Sky Park to Support Sustainability: A Philosophical View of Technology, (Wibowo),
- Ethno-astronomy study on indigenous people cosmology, started in 2023



Anak-anak Kupang membaca buku-buku edukasi yang disediakan di EKUATOR.
(Sumber: Tim EKUATOR)



Kegiatan pemutaran planetarium di Desa Oh'Aem, Kecamatan Amfoang Selatan.
(Sumber: Harti Umbu Mala)



EKUATOR: Mobile Planetarium Education

(Edukasi Ilmu Astronomi dan Antariksa untuk Timor/Space and Astronomy Education for Timor)

(see: Mumpuni et al., 2017, 2018a),



International Collaboration

- Continues support from Japan, The Kyoto University on the preparation for operation of the large 380 cm telescope, with the preparation of several young Indonesian students to study in Japan, specifically in Seimei Observatory.
- New collaboration is also on the table with China, with the discussion between USTC, NIAOT & BRIN on the development of the new spectrograph for the 380 cm in Timau for the second phase,
- Collaboration with UK on observatory, education, and instrumentation is expected to be continued with UK, like LJMU (Liverpool Robotic Telescope), as well on issue on decolonization of astronomy with Leicester University,
- Collaboration with The Netherland on the communicating astronomy to the general public is also prepared with the Leiden Observatory, with the activity will be focused on the community around the Observatory.



Thank You Very Much

Let us collaborate, and please visit us in Indonesia. Contact prantariksa@brin.go.id , +62 811-1064-6830