Proceedings of 10th Asian-Pacific Regional IAU Meeting 2008, 1–2 (2008) Printed 28 October 2008 (APRIM LaTeX style file v1.0)

Collaborative Site Testing in West China and a New Candidate Site around Barkol

T. Sasaki[1], Y. Yao[2], J.-J. Wang[2], M. Yoshida[3], N. Ohshima[4],
Y. Mikami[5], N. Okada[5], H. Koyanao[3], and H. Ando[6]

[1] *Subaru Telescope, NAOJ, Hilo, Hawaii, USA*
[2] *Site Survey Group, National Astronomical Observatories, Beijing, China*
[3] *Okayama Astrophysical Observatory, NAOJ, Asakuchi, Okayama, Japan*
[4] *ELT Project, NAOJ, Mitaka, Tokyo, Japan*
[5] *Advanced Technology Center, NAOJ, Mitaka, Tokyo, Japan*
[6] *Division of Optical and Infrared Astronomy, NAOJ, Mitaka, Tokyo, Japan*

ABSTRACT

Recent results and progress of an astronomical site testing program conducted under collaboration between China and Japan astronomers are reported. Base camps have been settled at Karasu and Oma in west China. A mid-IR Cloud Monitor camera and micro-thermal sensors are working at Karasu. Using satellite weather databases, a certain area around Barkol shows its excellent in cloudiness less than 40%, where should be another candidate site for site testing.

Key words: telescope site, site test, west China, international collaboration

1 INTRODUCTION

As shown using NOAA archival satellite data on cloud distribution for more than 10 year, potentially good sites seems be in west China (Sasaki et al. 2006). Two sites, Karasu in Xinjiang and Oma in Tibet, are selected according to available local weather statistics and geographical exploration (Fig. 1), where base camps have been settled for site testing (Yao 2005). We are now conducting geographical exploration around northern-west China, where FriOWL weather database (Sarazin et al. 2006) shows a good site.

2 SITE TESTING AT KARASU

A weather station has been deployed at Karasu and weather monitoring observations are continued by observers at the site. Recently we installed a Cloud Monitor camera (CloudMon) (Suganuma et al. 2007) at Karasu. A FLIR A40M camera is used as a cloud-detecting camera in MIR band (7.5-13μm). Sky frames taken with CloudMon are reduced for bias subtraction and flat-fielding. Sky background subtraction is important to reduce atmospheric emission in MIR band. CloudMon sky images show capability to detect as faint cloud as 5% transmission by calibrating with solar image intensity. Continuous observations with CloudMon will reveal the effective cloudiness based on the ground observations .

The fluctuation in the refractive index of the air above the telescope affects the light path to degrade image of stars.

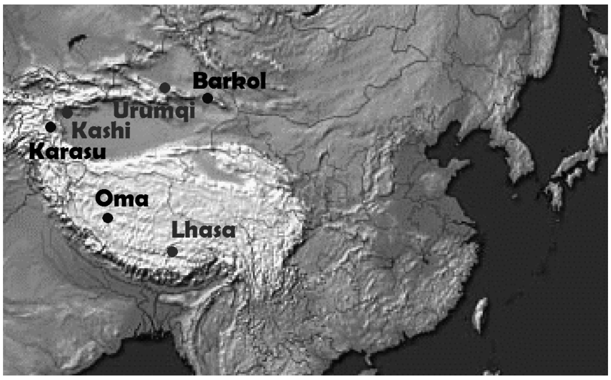

Figure 1. Locations of site testing stations at Karasu and Oma, and another candidate site around Barkol in northern-west China

The refractive index fluctuation is related to its thermal fluctuations, indicated as temperature structure coefficient;

$$C_T^2 = \langle |T(r_1) - T(r_2)|^2 \rangle \cdot r^{-2/3}, \qquad (1)$$

where T is temperature measured with a pair of micro-thermal turbulence sensors at r_1 and r_2 whose separation $r = |r_1 - r_2|$ in meter. Atmospheric turbulence in ground layer is measured (Fig. 2) using 25.4μm nickel wire sensors installed at five heights ($4m, 6m, 10m, 19m, and\ 37m$) on a $40m$-tall tower at Karasu. Seeing distributions can be estimated at each height (Miyashita et al. 1989; Wada et al. 2004) as

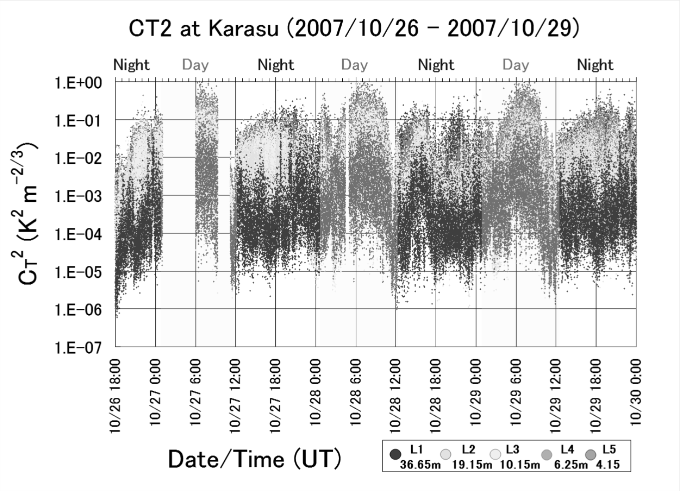

Figure 2. Micro-thermal measurements, C_T^2, at Karasu during Oct.26 and Oct.29, 2008. Higher values at lower hight show indication of the surface layer turbulence. Notes a slight difference between day and night. Karasu is about 4500m high.

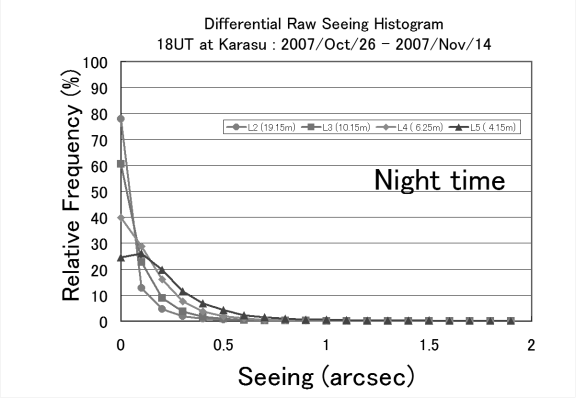

Figure 3. Differential seeing distribution derived from micro-thermal measurements at Karasu during Oct. 26 and Nov.14 during night. Differential seeings are obtained relative to seeing at 37 m ; $\theta(z:z_0) = (\theta(z)^{5/3} - \theta(z_0)^{5/3})^{3/5}$, where $z_0 = 37$ m.

$$\theta(z) = 5.3\lambda^{-1/5}(\frac{7.9 \cdot 10^{-5} P}{T^2})^{6/5}(C_T^2(z) z_h)^{3/5} \qquad (radian), (2)$$

where P is atmospheric pressure in hPa, T an air temperature in K, and z_h is a scale height of C_T^2 variations along z. An average differential seeing size is around 0.12 arcsec between 10m and 37m levels (Fig. 3). Comparison of C_T^2 values shows good coincidence by simultaneous measurements with separate systems for Okayama Observatory and ours at Okayama Observatory in Feb. 2008.

3 NEW CANDIDATE SITE AROUND BARKOL

Satellite weather data shows global cloud distributions for more than 10 year and indicates good sites for astronomical observations. The mainland of China is searched for candidate sites using a satellite weather database FriOWL(ver. 3.1), which is built for investigating best sites for ESO's ELT (Sarazin et al. 2006). A relatively good site near the boarder with Mongolia is found with cloudiness less than 40% (Fig. 4). Geographical exploration is hoped to start to settle another base camp for site testing in near future.

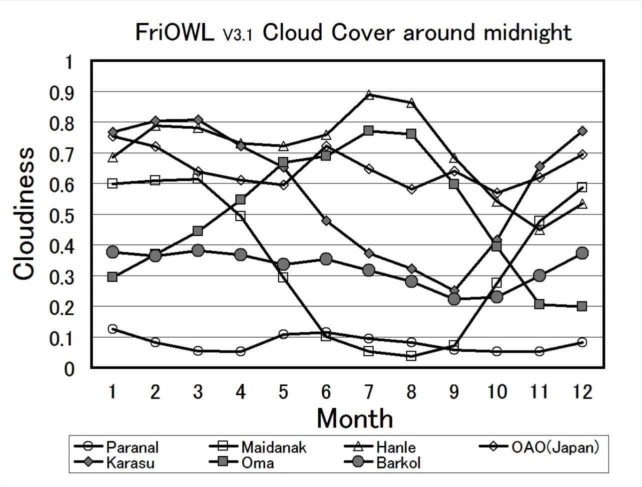

Figure 4. Cloudiness distributions at several astronomical sites from FriOWL weather database. Barkol areas show low cloudiness less than 40%.

4 NEAR-FUTURE PROGRESS

As automated-fashioned continuous monitoring is crucially important for the site testing project, manually-operated DIMMs (Differential Image Motion Monitors) will be improved to be in automatically operation (Uraguchi et al. 2006). New instrument, MASS (Multi-Aperture Scintillation Sensor), will be installed to obtain more accurate turbulence measurement with height resolution. Comparison of measurements with micro-thermal turbulence sensors, DIMM, and MASS enables to investigate height distribution of atmospheric conditions at the sites. Our collaborative site survey project keeps continuous monitoring of the two sites and another possible site around Barkol for a few years to characterize the sites to determine a good site for our communal telescopes.

ACKNOWLEDGMENT

We are grateful to JinLiang Wang and staffs at Kashi office and NAOC for their vigorous supports to conduct the site testing at Karasu and Oma and exploring for new sites around Barkol area. We also thank FriOWL team to permit us to use FriOWL database. One of authors (T.S) expresses deep thanks to Heiwa-Nakajima Foundation for their financial support in 2007.

REFERENCES

Miyashita, A., et al., 1989, Rep.NAOJ, 1, 61
Sarazin, M., et al., 2006, The Messenger, 125, 44
Sasaki, T., et al., 2006, SPIE, 6267, 62671B
Suganauma, M., et al., 2007, PASP, 119, 567
Uraguchi, F., et al., 2006, SPIE, 6267, 62670N
Wada, S., et al., 2004, Rep. NAOJ, 7, 29
Yao, Y., 2005, J. Korea Astron. Soc., 38, 113