WEATHER CHARACTERISTICS AT OBSERVATORY CANDIDATE SITES IN WEST TIBET

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ABSTRACT

The high plateaus in west China may provide suitable sites for astronomical observations with the institute’s middle-range telescopes and possibly with larger telescopes. Under China-Japan collaborations for site survey in west China, we have been conducting searches for good sites and monitoring their characteristics over several years. As recent results of our site survey show, sites in west Tibet are revealed with a high possibility of good astronomical observations.

Weather characteristics at Gar in Ali, Tibet, show its high clear-sky ratios, especially in winter, comparable to Mauna Kea, Hawaii. But it has some wind problem in winter, where stronger wind speeds, over 20m/sec, occur frequently even though the sky is clear. To find calmer sites, we have conducted numerical simulations for the Ali area using the Japan Meteorological Agency NonHydrostatic Model. We have found another site, named ZoZo Hill, near Gar. We will continue to monitor the Gar site to clarify weather characteristics over the whole year and hopefully start to negotiate for site monitoring at ZoZo Hill this year.

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

1. WEST TIBET AS AN IMPORTANT LONGITUDINAL LOCATION FOR GLOBAL ASTRONOMICAL OBSERVATION NETWORK

As west China is indicating its importance in playing a role for the global astronomical observation network (Yao 2005), we have been conducting astronomical site-monitorings at three sites in west China; Karasu (Xinjiang Uighur), Oma (Tibet) and Gar/Ali (Tibet) under a China-Japan Astronomical Collaboration since 2007 (Sasaki et al., 2008; Yao et al., 2011; Sasaki et al., 2011).

2. ASTRONOMICAL SITE MONITORING

Several astronomical site-monitoring instruments have been deployed at the sites. At the Oma and Gar site, cloud monitoring cameras have revealed excellent sky conditions, especially in winter. Gar has shown better weather conditions than Oma.

On the other hand, strong winds that have been observed at the current monitoring site, Gar, in winter may seriously affect the number of observable nights (Figure 1), as the imaging capabilities of telescope optics would be reduced due to turbulence caused by stronger wind inside the telescope dome by applying the criteria for wind speed 1.

3. ANOTHER CANDIDATE SITE NEAR ALI AND WEATHER NUMERICAL SIMULATION

We are looking for other candidate site(s) around Ali, as the Ali area is of the best areas with clear sky conditions. A certain hill on a wide basin 2 seems like a nice location for an astronomical observatory (Figure 2). The hill is temporarily named ZoZo Hill as it is located near ZuoZuo town, 90km from Ali.

To clarify their weather characteristics, we have conducted numerical simulations for Gar and ZoZo Hill, using Weather Research and Forecast (WRF) and Japan Meteorological Agency NonHydrostatic Model (JMA-NHM). JMA-NHM simulations at Gar shows the same tendency for wind speeds measured by a weather station settled on the 10m dome at Gar in Dec., 2012 to Feb., 2013. Daily variations of wind speed at Gar and ZoZo

1 Operational requirements on Subaru Telescope are for outside wind speed less than 14 m/sec to protect the telescope itself and normal operation guaranteed under wind speed of 7 m/sec as turbulence over the mirror surface should be less than 1-2 m/sec.
2 The radius of the basin is about 20km.
Figure 1. Clear sky ratios at Gar, except for unknown summer season, are around 70%, which are nearly comparable to ratios at Mauna Kea, Haleakala (Hawaii), and Chajnantor (Chile). OAO (Okayama Astrophysical Observatory) is located at one of the best sites in Japan. Wind restriction on astronomical observation at Gar may seriously reduce available observing nights, which results in observing conditions similar to OAO (Suganuma et al., 2007, Miyata et al., 2008).

Figure 2. Location map in Ali, Tibet. Gar (5632m above sea level) of current monitoring site, ZoZo Hill (4619m) of new candidate site, and other reference peaks, Peak#1 (5849m) and peak#2 (5769m), in west Tibet. Hill are shown in Figure 3, for which ZoZo Hill is shown to be less than half of the wind speed than at Gar in the nights.

As some turbulence in the higher atmosphere affects seeing size at the telescope site, vertical wind profiles are shown in Figure 4 using JMA-NHM simulations with the referenced higher peaks on windy and calm nights at 18h UT (locally around midnight). Wind speeds higher than 7000m at four sites converge on each other, though Gar is much more windy near the ground surface on windy nights. Wind speeds at ZoZo Hill stay relatively calm throughout the simulated periods as shown in Figure 3.

4. SITE MONITORING IN THE NEAR FUTURE

As weather simulations show that the vertical wind speed profiles at Gar and ZoZo Hill continuously merge around 7000m and higher into the atmospheric layer with strong winds, higher mountains do not look suitable for achieving nice observatory conditions for astronomy in west Tibet.

We should continue to monitor the Gar site to clarify weather characteristics throughout the whole year and hopefully start to negotiate for site monitoring at ZoZo Hill. We would especially like to measure atmospheric disturbance of up to 2000m above the ground, possibly using the site-monitoring instrument SODAR (Businger & Cherubini, 2011).

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