Brown Dwarfs
IAU Symposium, Vol. 211, 2003
E. L. Martín, ed.

CLOUDS–Continuous Observations of Ultra-cool dwarfS

Bertrand Goldman, for the CLOUDS Collaboration

N.M.S.U., P.O.Box 30001, MSC 4500, Las Cruces, NM 88003–8001

Abstract. We have established an international collaboration, named CLOUDS, to investigate atmospheric variability in L and T dwarfs. Our aim is to provide continuous and simultaneous observations over a wide range of wavelengths, using various techniques. We observed 15 targets of types between M9.5 to T6.5, from the optical to the mid infrared, in photometry and/or spectroscopy. Here we present the data set.

1. Introduction

Several groups have reported photometric or spectroscopic variability in L and T dwarfs (Bailer–Jones & Mundt, 2001; Nakajima et al, 2000; among others). The amplitude is generally small, at the 1% level, and of various shapes and periodicity, if any. Most of the studies have been performed in one photometric band, or in a narrow range of wavelengths. Several explanations to these variabilities have been proposed: heterogeneity in the clouds coverage, spots due to magnetic activity, companion influence or disks. Although some theoretical analysis of the atmospheric structure can favor certain causes (Gelino et al, 2002; Marley, in these proceedings), the present data do not allow to exclude any. Monitoring of several absorption bands, known to occur at various depths and temperatures, over a wide range of wavelengths, will help determine the location and nature of the phenomenon causing variability, and is the core of our project.

2. The targets

To obtain 1% photometry in the optical and near infrared (IR) photometry, we first selected L and T dwarfs brighter than $J \approx 16$, and $K_s = 13$ for spectroscopic targets. L dwarfs from the DENIS and 2MASS surveys are generally bright in the I band, while very few Ts are bright enough to be observed in I and were mostly observed in the IR. We then selected targets to cover a wide range of spectral types: a single phenomenon probably does not take place similarly in early Ls up to late Ts, and probing the spectral type dependency should be informative (see Table 1). We favored targets for which variability informations had been published (Bailer–Jones & Mundt, 2001; Clarke, Tinney, & Covey, 2002; Nakajima et al, 2000) or were studied by collaborators (Artigau et al.; Caballero et al.; Gelino et al.; in these proceedings), but half of the sample had not been follow-uped previously. Eventually, we requested two comparison stars in a 2 arcmin field of view (and one in the NIRI field of view of 51 arcsec).

3. The telescopes

We organized our network to get 1) optical and IR photometry and spectroscopy, *simultaneously*, 2) *continuous* observations over several periods. For instance at Mauna Kea the UH telescope provided optical images; UKIRT and Gemini, IR images; the Keck II and IRTF telescopes, optical and IR spectroscopy; for four targets, during one to four nights. In other regions we obtained simultaneous optical and IR photometry over a longer period of time (see Table 1). A number of nights has been lost to bad weather, except in La Silla and KPNO, but relative photometry was acquired for all targets, both simultaneously and continuously.

Table 1. Target and telescope lists, with observatory's longitude.

#	Target	Type	Telescope	Long.	Instrument
1	2MASSW J0832-01	L1.5	Nainital–UPSO	79°E	CCD
2	2MASSI J1047+21	T5	Gurusikhar–PRL	73°E	NICMOS
3	DENIS 1048-39	M9.5	OHP 1.2m	5°E	CCD
4	2MASSW J1108+68	L1	Pic du Midi 1m	0°E	CCD
5	SDSSp J1203+00	L3	Pic du Midi 2m	"	NICMOS3
6	2MASSI J1237+65	T6.5	IAC–80	16°W	CCD
7	SDSSp J1254-01	T2	TCS	"	CAIN-2
8	2MASSW J1300+19	L1	ESO NTT	70°W	SOFI
9	Kelu 1	L2	Mont Mégantic	75°W	MONICA
10	2MASSW J1439+19	L1	APO 1m	105°W	CCD
11	2MASSW J1507-19	L5	APO 3.5m	"	SPIcam
12	Gl 584C	L8	KPNO 2.1m	111°W	SQIID
13	2MASSW J1615+35	L3	2.2m UH	155°W	CCD
14	SDSS J1624+00	T6	UKIRT	"	UFTI
15	2MASSW J1632+19	L8	Gemini	"	NIRI
16			Keck II	"	ESI
17			IRTF	"	SPEX

4. Conclusion

For all our targets, 2% photometry and better is obtained for data taken at a given telescope (e.g. 1.2% at the UH telescope in the I band for SDSSp J1254, 1.2% at the TCS in the J band for Kelu 1). Further work is required to match the photometry obtained from the different observatories. Time series in optical and IR spectroscopy are obtained with a resolution of 20 to 30 min. Together these data will provide an unique tool to explore the late dwarf atmosphere.

References

Bailer-Jones, C.A.L. & Mundt, R. 2001, A&A, 367, 218
Clarke, F.J., Tinney, C.G., & Covey, K.R. 2002, MNRAS, 332, 361
Gelino, C., et al., 2002, to appear in ApJ
Nakajima, T., et al., 2000, PASJ, 52, 87