CENTRE NATIONAL D'ÉTUDES SPATIALES

COMPARATIVE DETERMINATIONS OF THE SOLAR DIAMETER FROM LIGHT CURVES TAKEN DURING THE SOLAR ECLIPSES OF NOV. 13, 2012 AND NOV. 3, 2013

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The PICARD mission

Main objective: assess a possible relationship between the Sun diameter and its activity
Launch in June 2010 => April 2014
To be used as a reference for long term ground observations

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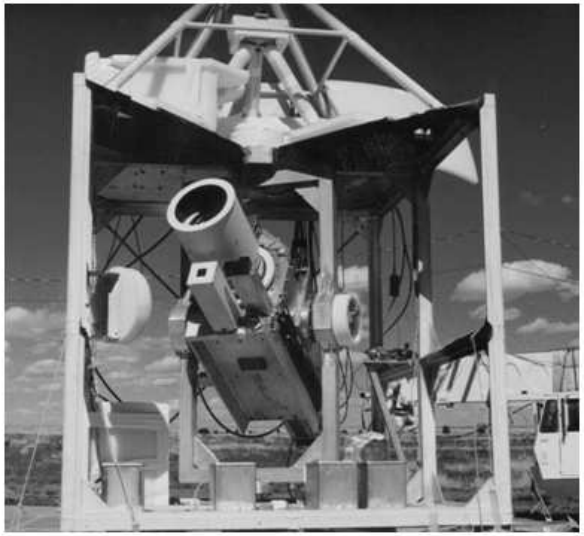


SDS gondola

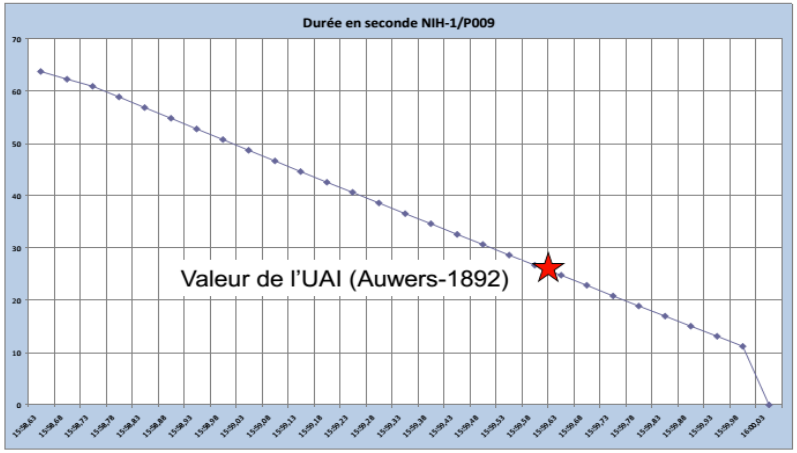
Solar Occultation timing

Based on a timing campaign organized by Sir Edmund Halley during the 15 May, 1715 (22 April) total solar eclipse

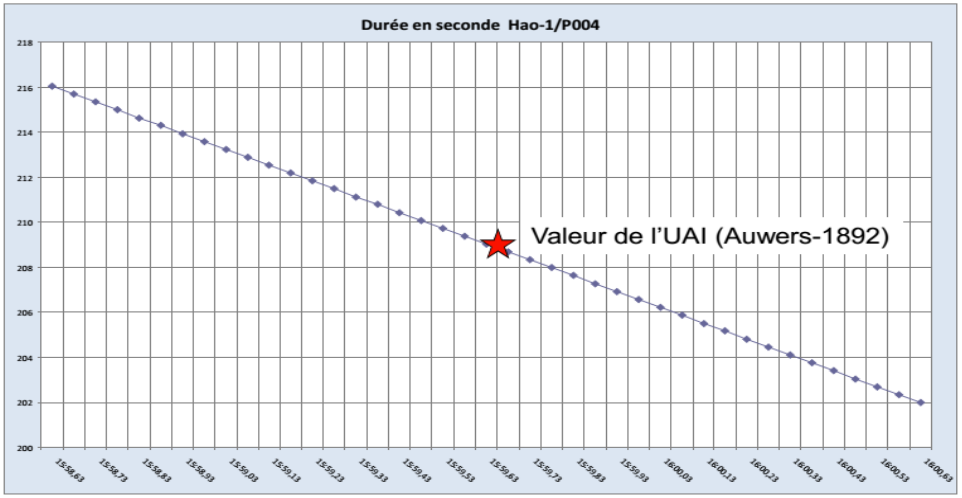
Several campaigns already achieved by IOTA (International Occultation Timing Association) since the '80s

Ref: Dunham, J. B.; Dunham, D. W.; and Flala,
Solar Radius Variations from Observations of Four Eclipses.
Bull. Amer. Astron. Soc, vol. 12, no. 4, 1980, p. 832.

Best efficiency for observations close to the edges

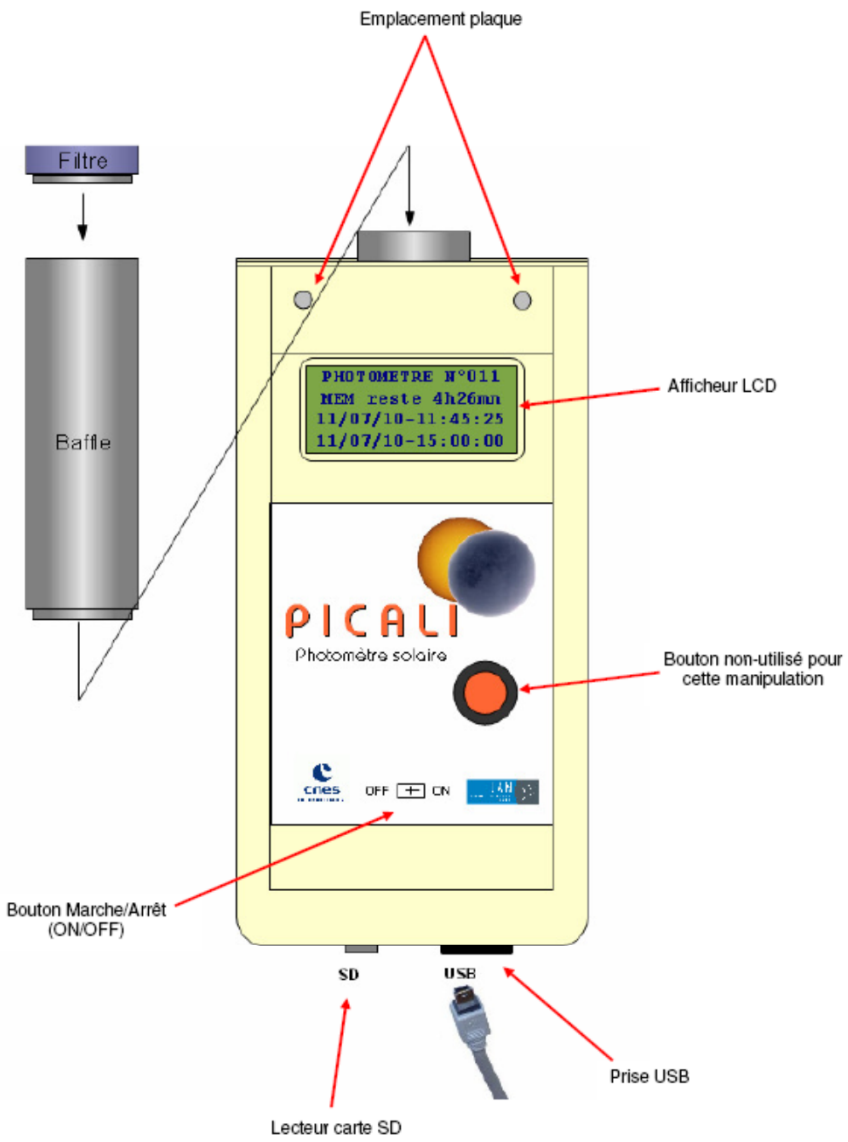


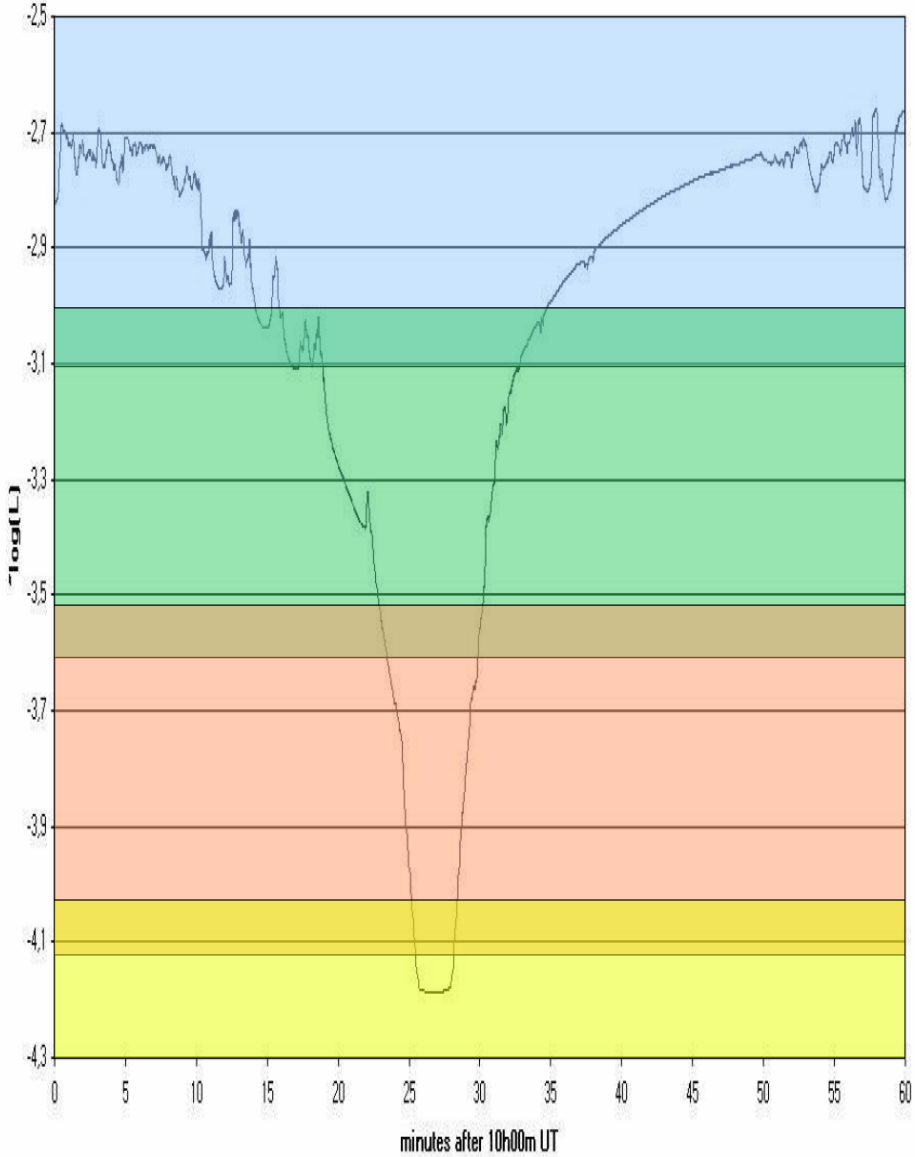
100 ms ⇔ 10 mas



100 ms ⇔ 30 mas

PICALI Photometer





Can be programmed several days in advance to wake up before the 2nd contact

Up to 3 hours of data recording , 100 Hz

Note: a 5th band has been added

July 11, 2010 Total Solar Eclipse in French Polynesia

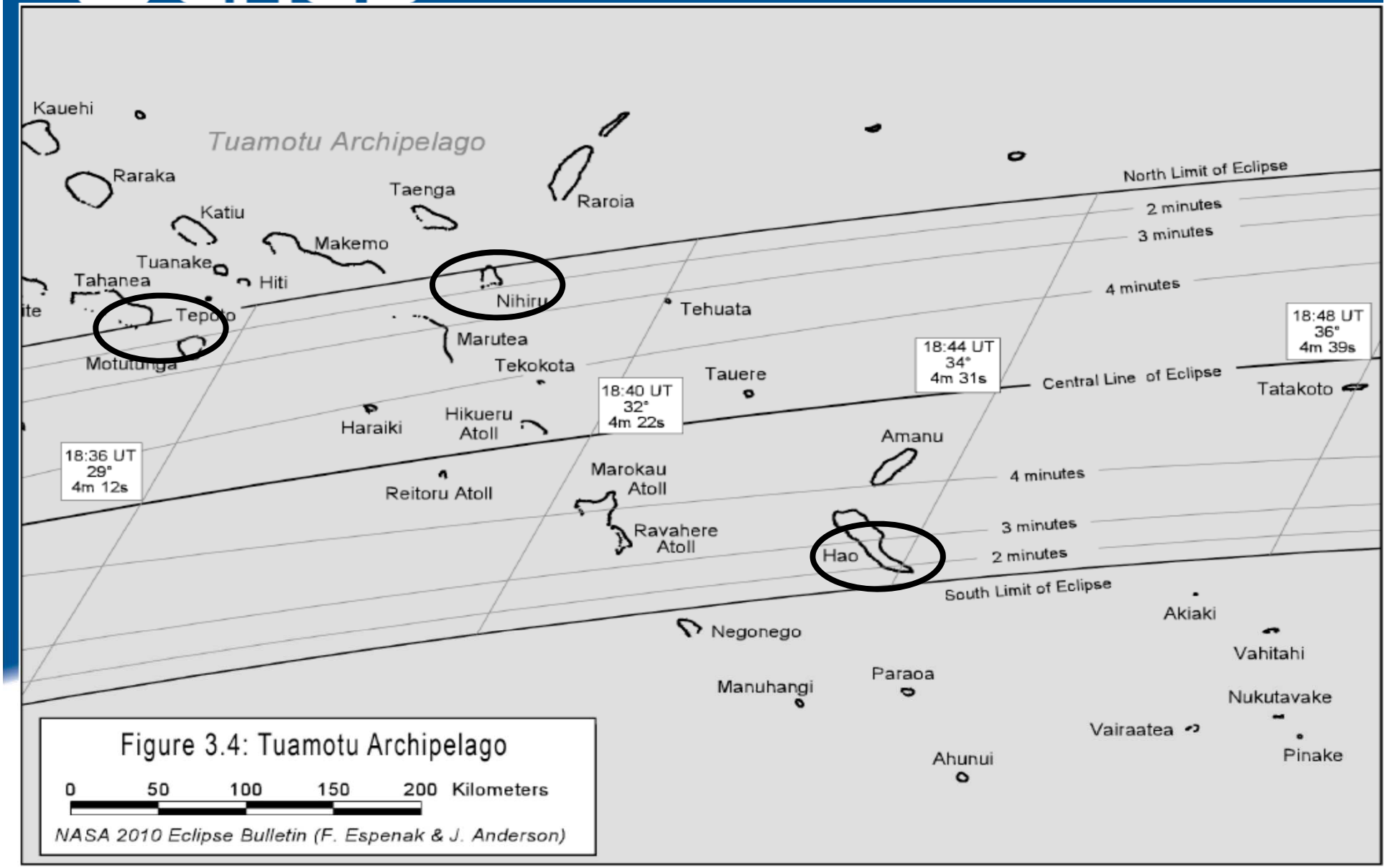
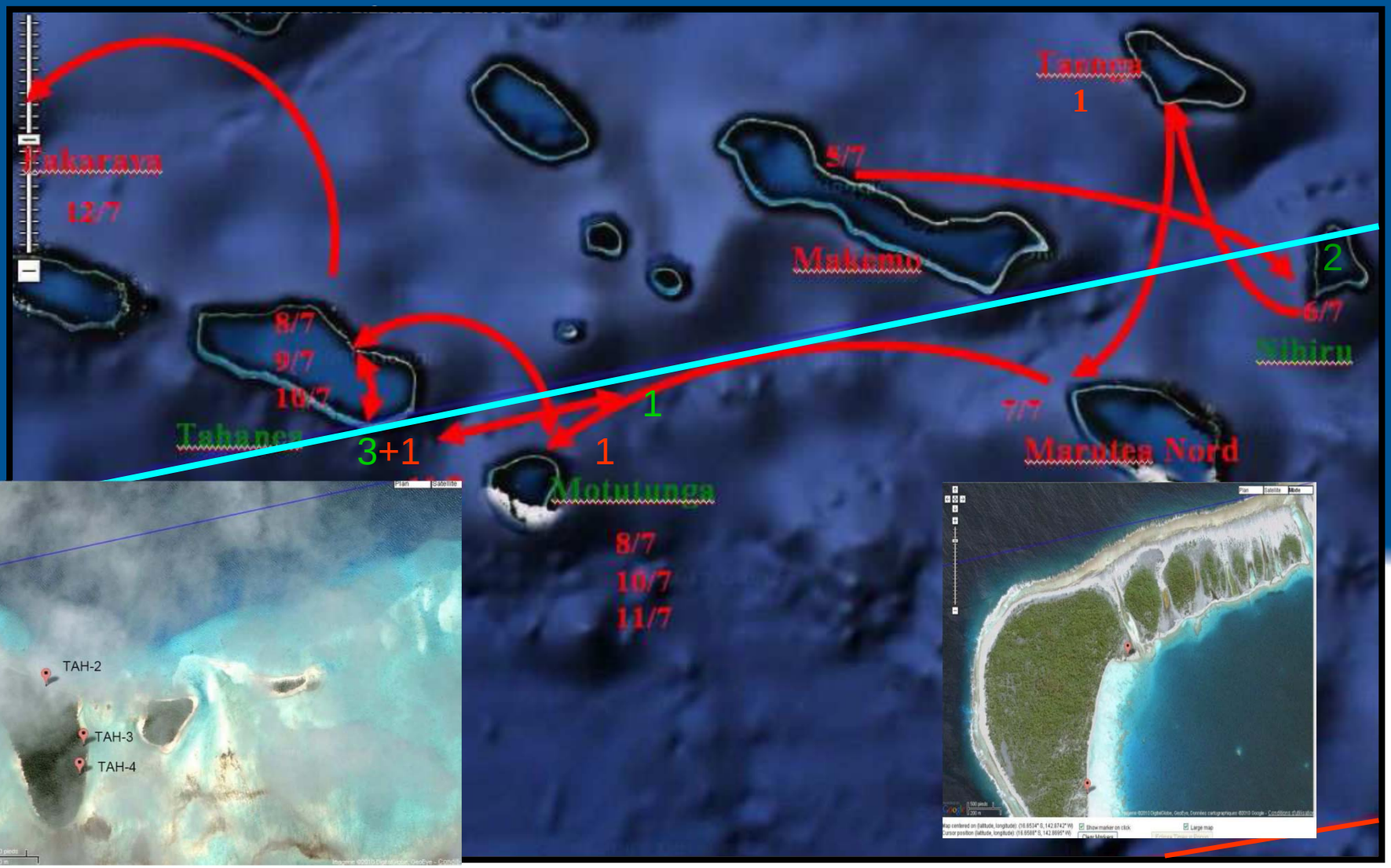
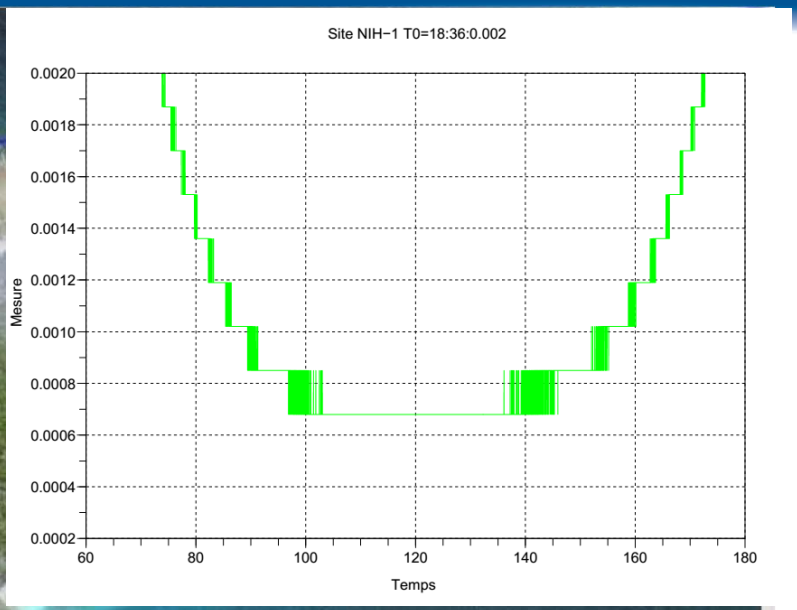


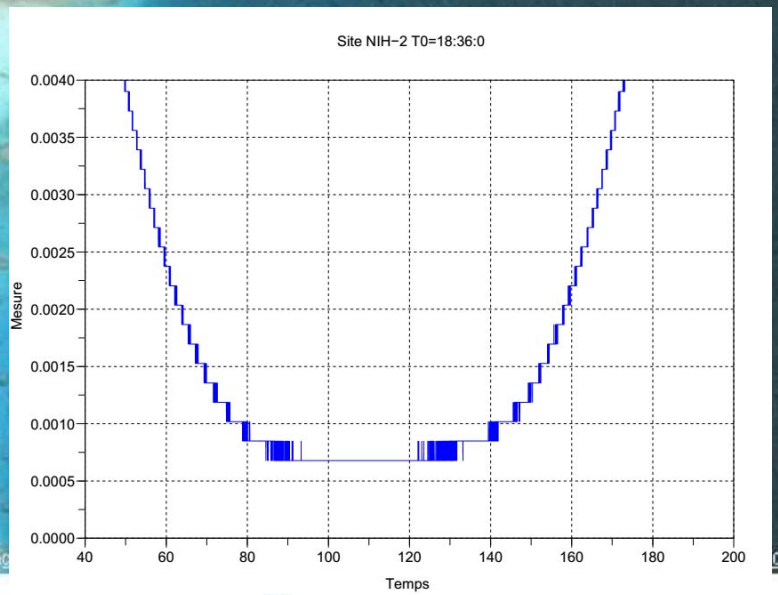
Figure 3.4: Tuamotu Archipelago

Northern Edge campaign



NIHIRU





Map centered on (latitude, longitude): (16.6534° S, 142.8742° W)
Cursor position (latitude, longitude): (16.6588° S, 142.8695° W)

Show marker on click

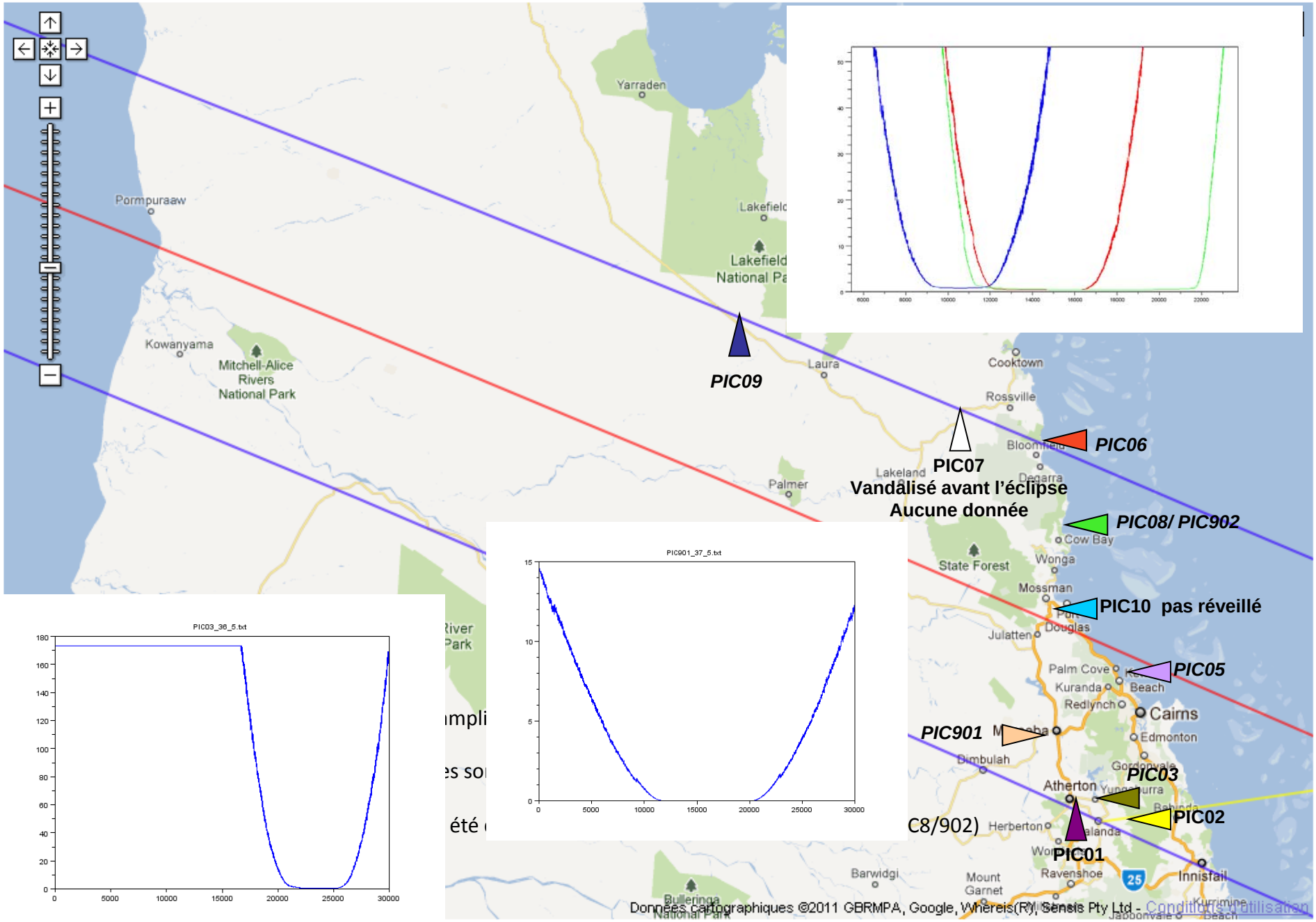
Clear Markers

Large map

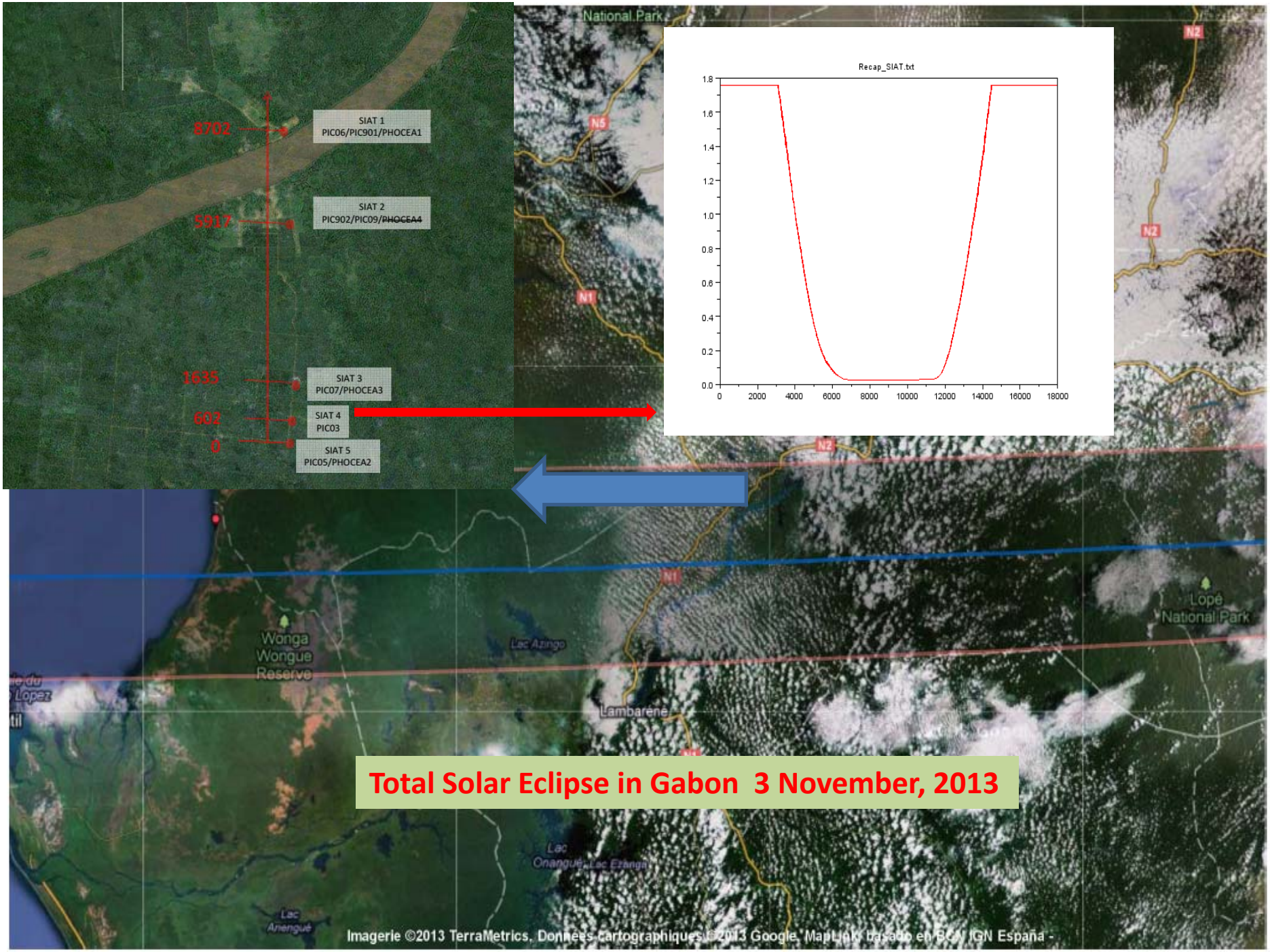
Eclipse Times in Popup

HAO

Queensland 13 November 2012

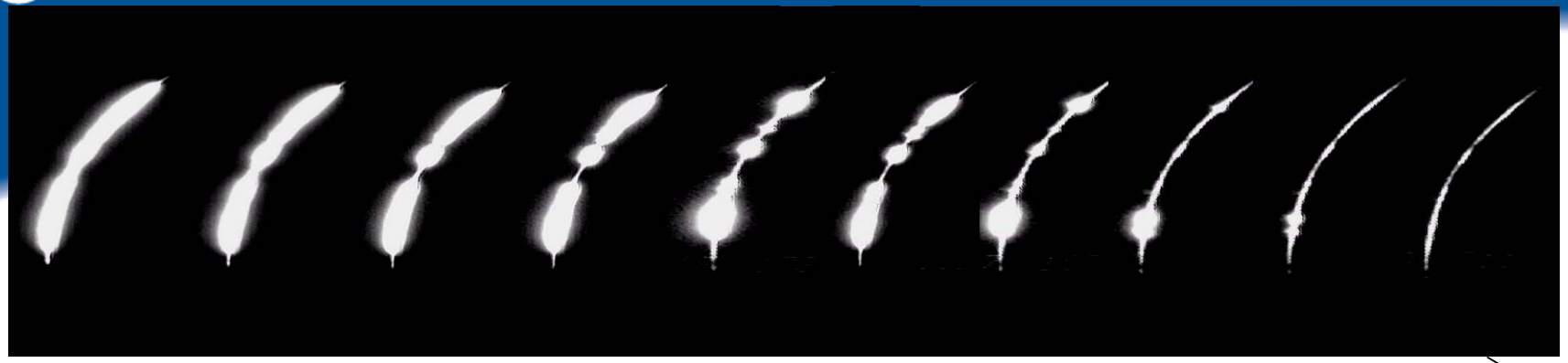



8702
SIAT 1
PIC06/PIC901/PHOCEA1
5917
SIAT 2
PIC902/PIC09/~~PHOCEA4~~
1635
SIAT 3
PIC07/PHOCEA3
602
SIAT 4
PIC03
0
SIAT 5
PIC05/PHOCEA2



Total Solar Eclipse in Gabon 3 November, 2013

Baily beads and lunar profiles



C2-10s 2 nd contact

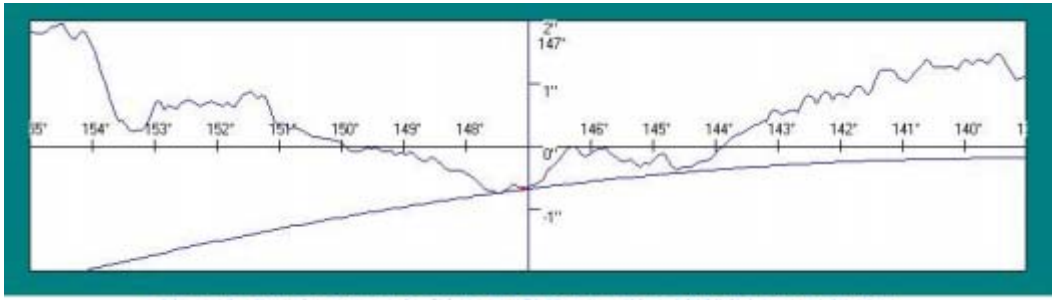
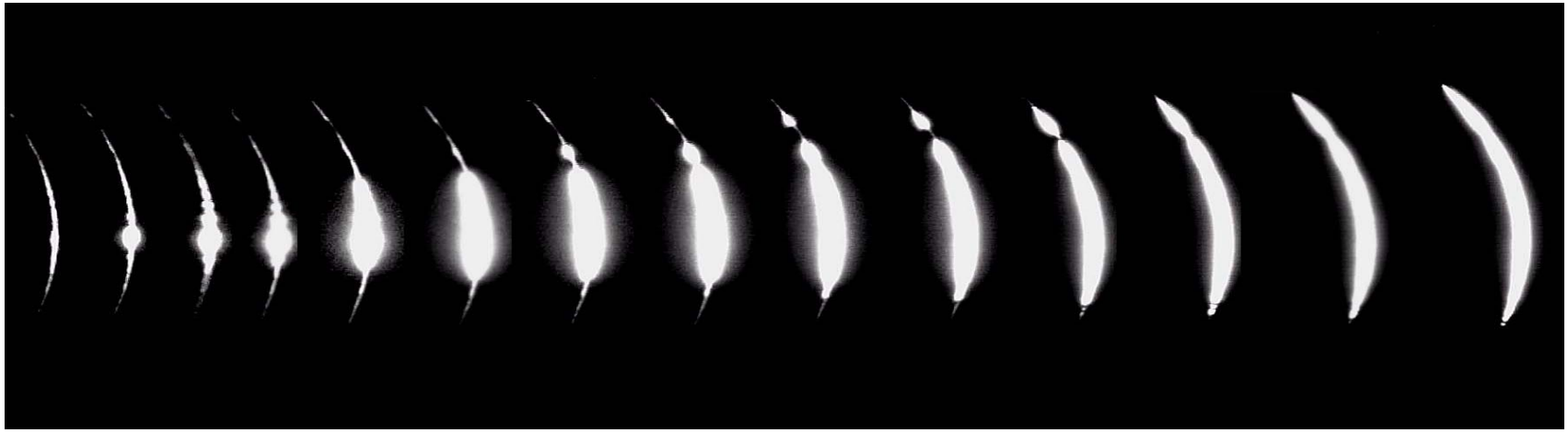
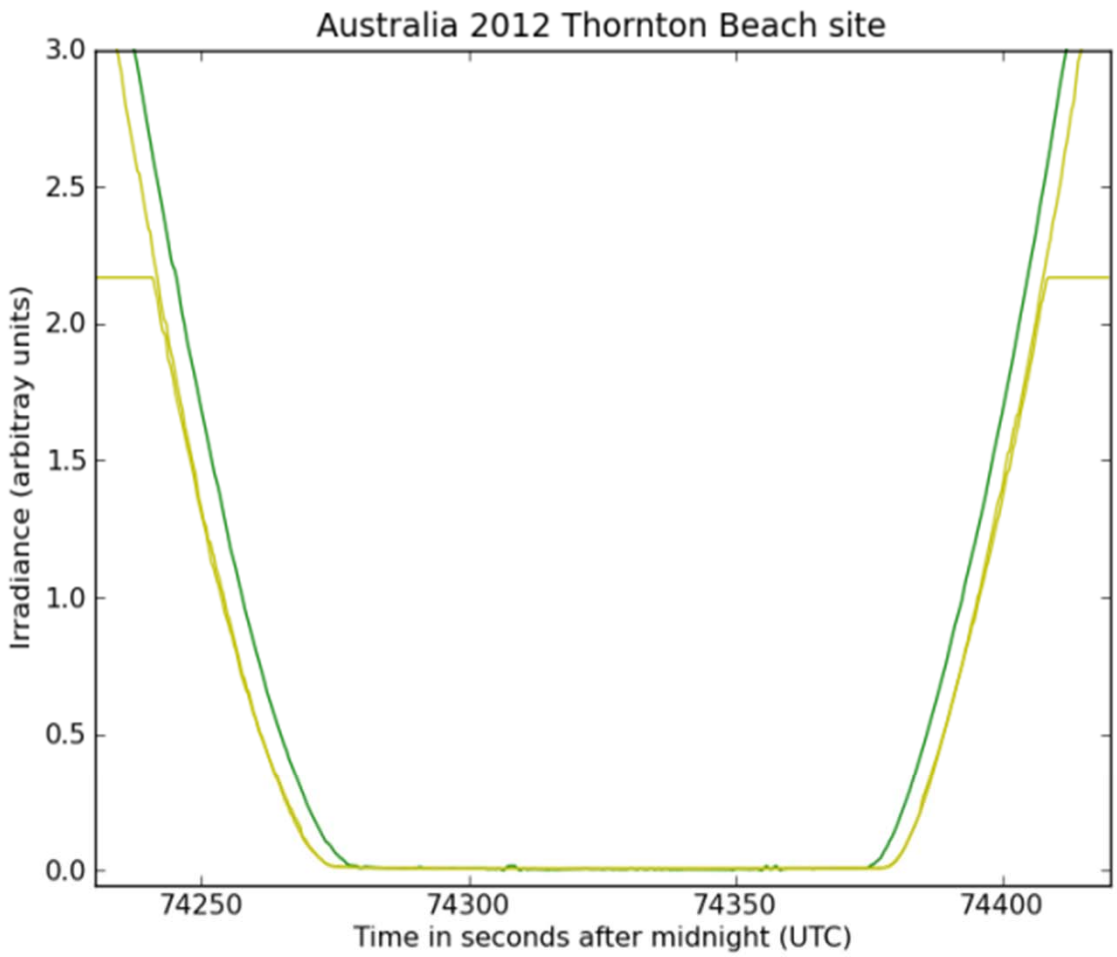


Figure 3 : Premier contact intérieur profil Kaguya (Hao-1/P004) image P. Rocher



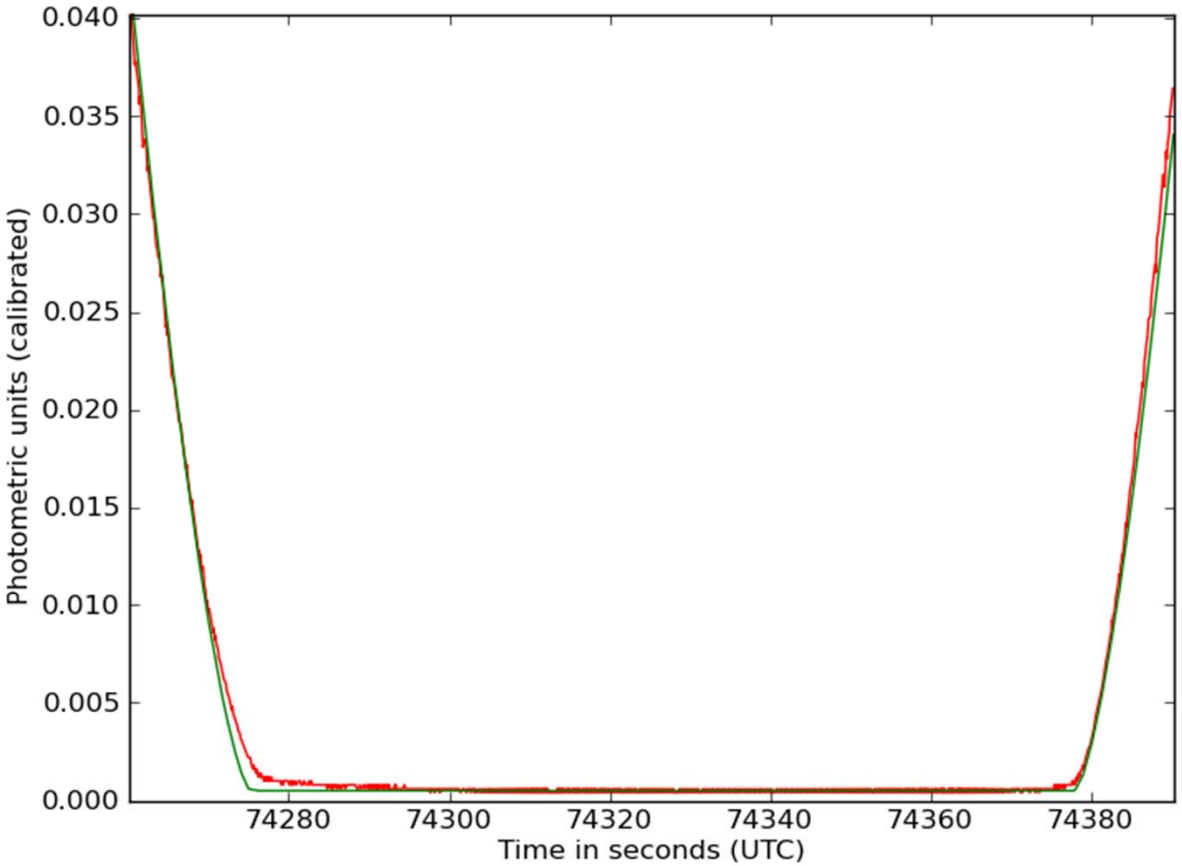
Credit Nugent – IOTA Observation HAO North 3rd contact C3+20s

Lightcurves from three photometers collocated at Thornton Beach in Nov. 2012, two PICALI with Astronomik Green filters (yellow curves, almost indistinguishable) and one MPSP-1 with a Kepler Light Green filter (green curve).



Modelling: Thornton Beach Australia 2012

red: observed, green: model

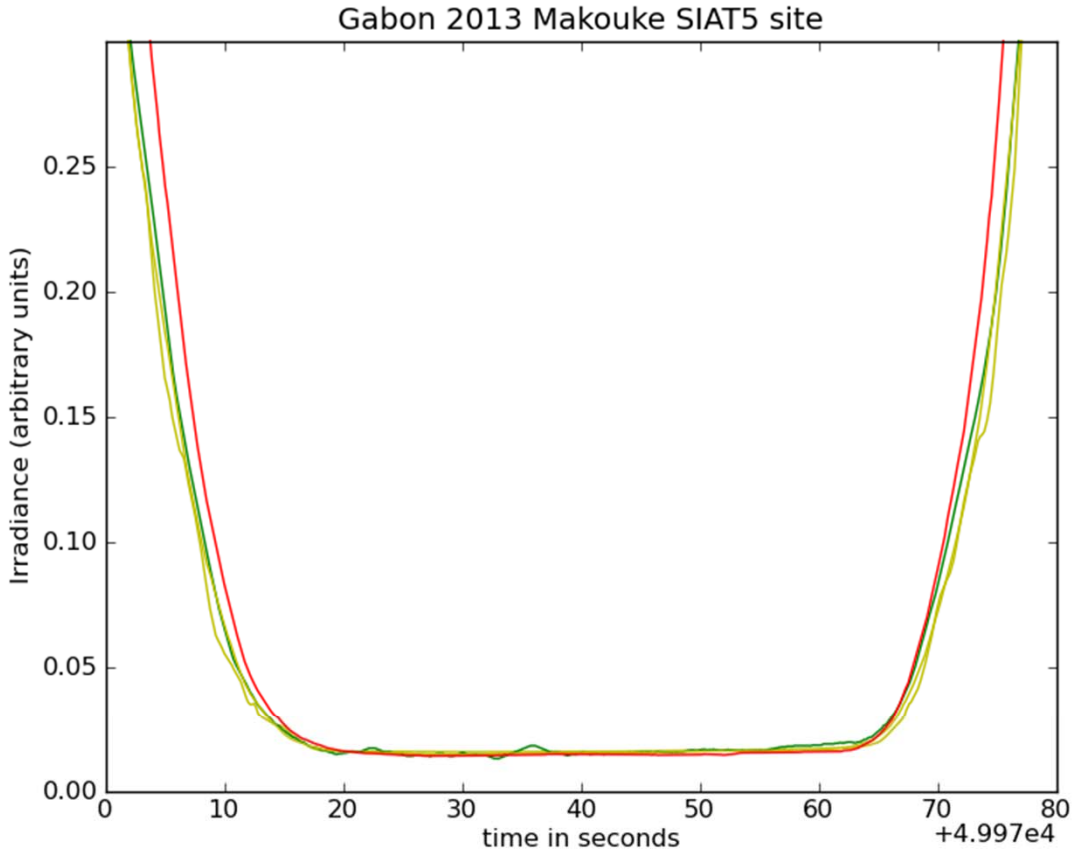


Modelling: Thornton Beach Australia 2012: results

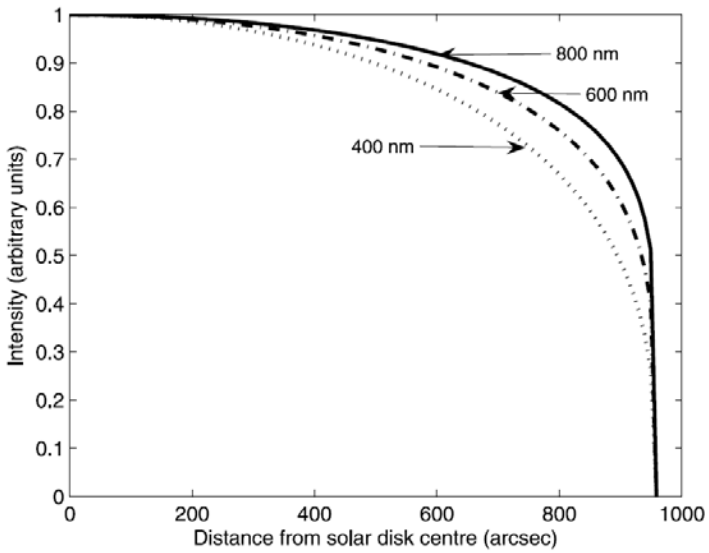
Photometer	Filter	Sun radius (km)	Formal Error (km)	Sun radius (“)	Formal Error (“)
A	58A dark green	695,845	18	959.42	0.08
B	58A dark green	Too noisy	-	-	-
C	56 light green	696,585	21	960.44	0.09
D	96-0.6 neutral	695,374	20	958.77	0.09

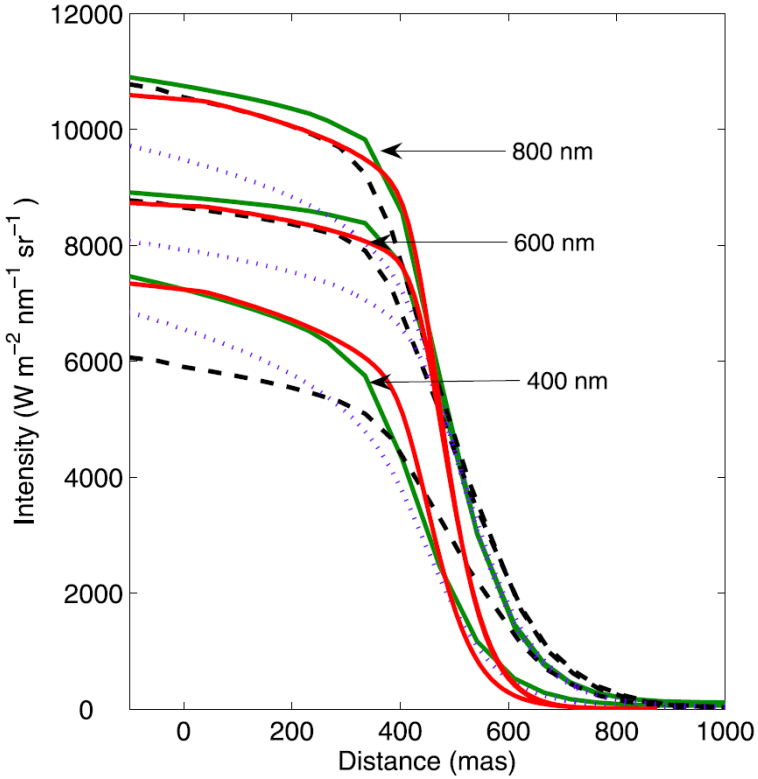
« round » moon: 1736.645 km and Waldmeier Solar LDF

Lightcurves from four photometers collocated at the Makouké village on Nov 3, 2013, one PICALI with an Astronomik Green filter (yellow curve), one MPSP-1 with an an Astronomik Green filter (yellow curve), one MPSP-1 with a Kepler Light Green filter (green curve), one MPSP-1 with an Astronomik Red filter (red curve).



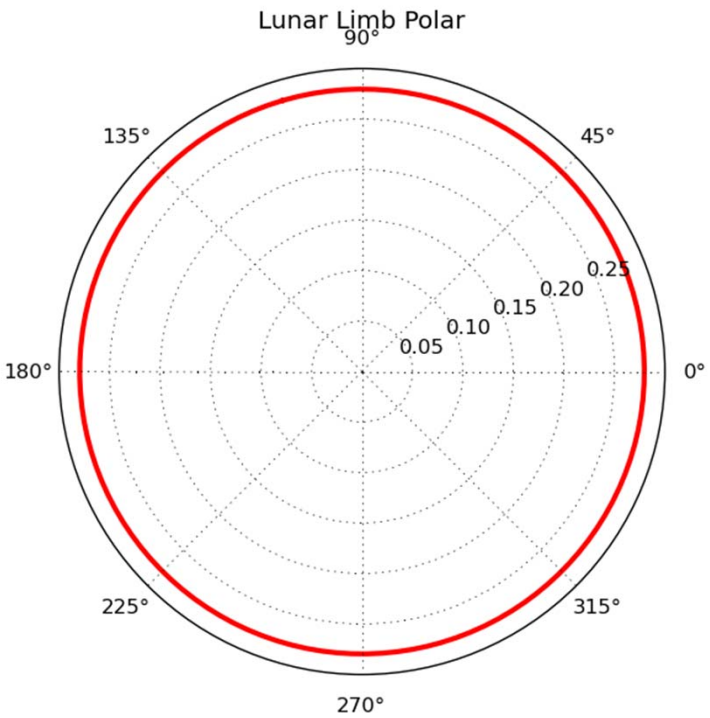
Work in Progress: better LDFs

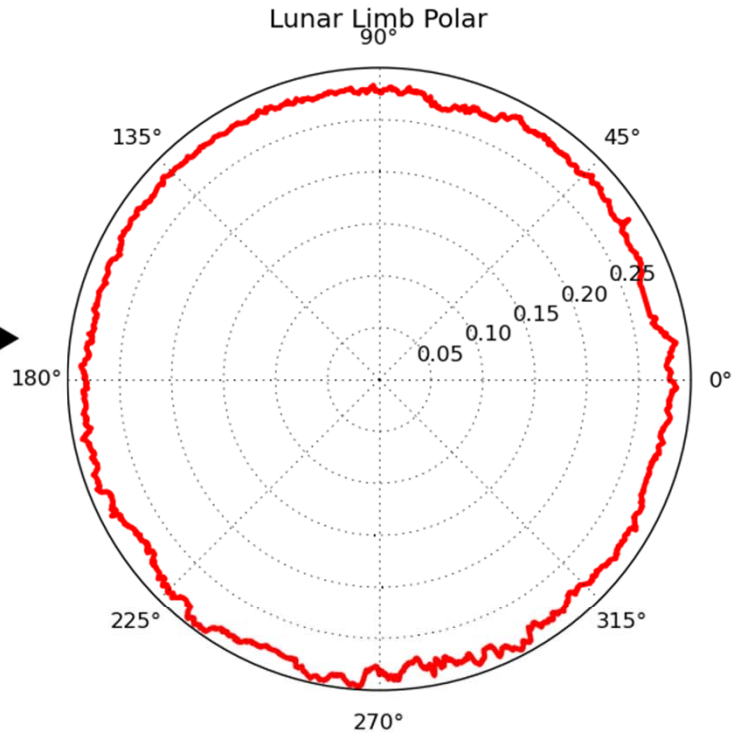




LDFs from Waldmeier (1948) or Hestroffer and Magnan (1998) with abrupt end ➔ **LDFs from SH09 (red), FCH09 (black) and COSI (green), Thuillier et al, 2011**

Work in Progress: Lunar Limb from Kaguya / LRO





« round » Moon ➔ « rough » moon

Conclusions

- The accuracy of the eclipse timing method using photometers can be estimated to be better than a few 10 mas
- The accuracy can only improve with time (LDF, lunar profile, data rate)
- The instruments are simple to specify and manufacture
- The observational data will be easy to compare even if separated by very long periods of time
- The instruments are cheap (<1 k€) and easy to use so can be widely distributed
- The 2 forthcoming opportunities will be in inhabited / remote areas (Svalbard, Malaysia) but in 2017 in the USA
- **=> this method is a very efficient way to monitor on the (very) long term the possible evolution of the solar radius and in parallel improve de characterization of the solar limb**