The impact of small near-Earth asteroid 2018 LA

American Meteor Society

D. Farnocchia, P. Chodas, E. Christensen, R. Kowalski,
A. Gibbs, L. Denneau, A. Heinze, P. Brown, M. Micheli

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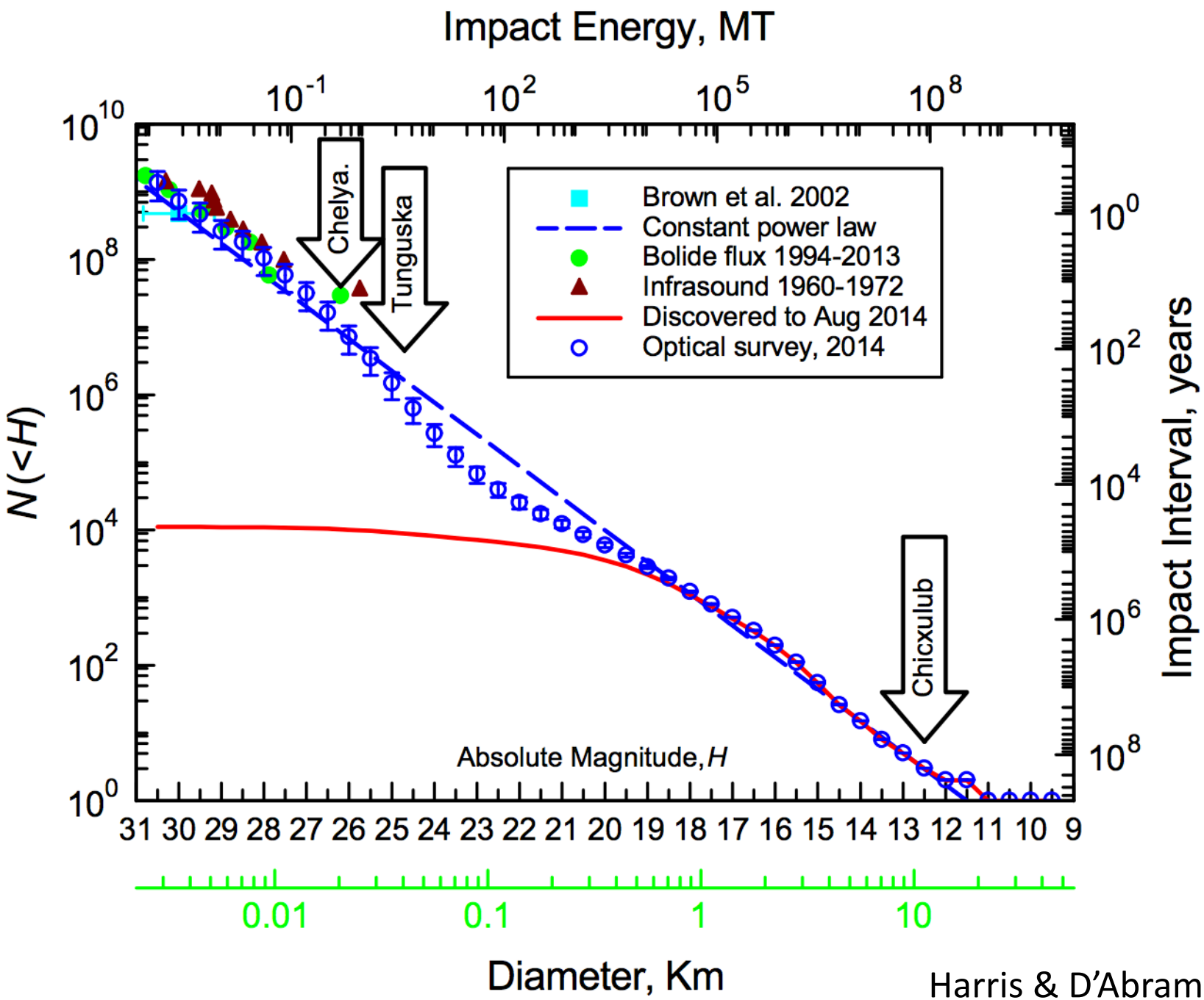
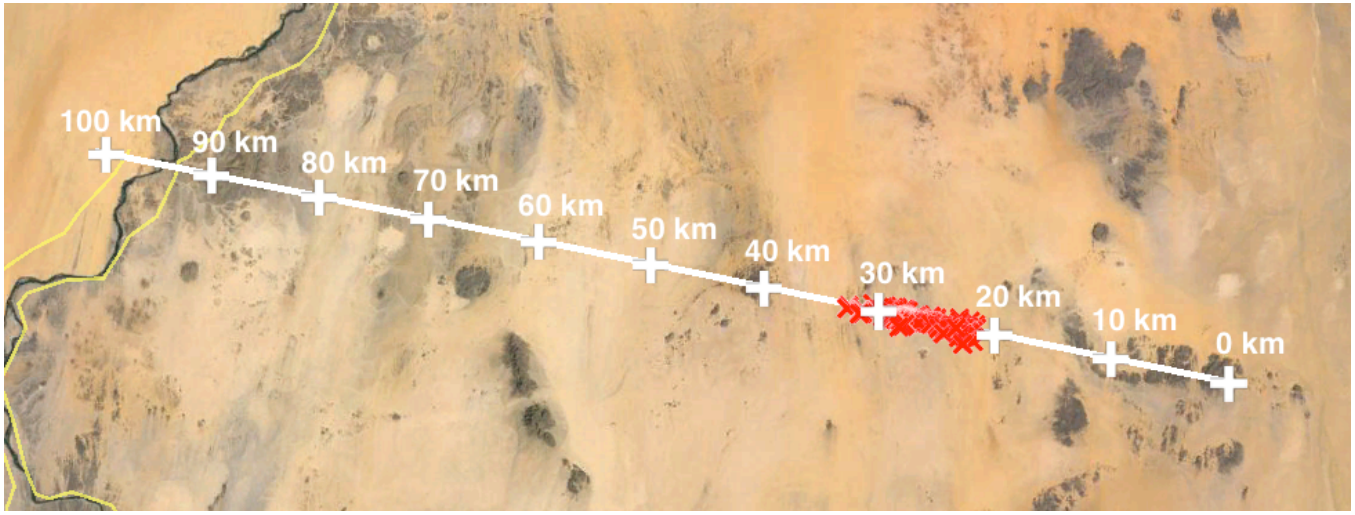
California Institute of Technology

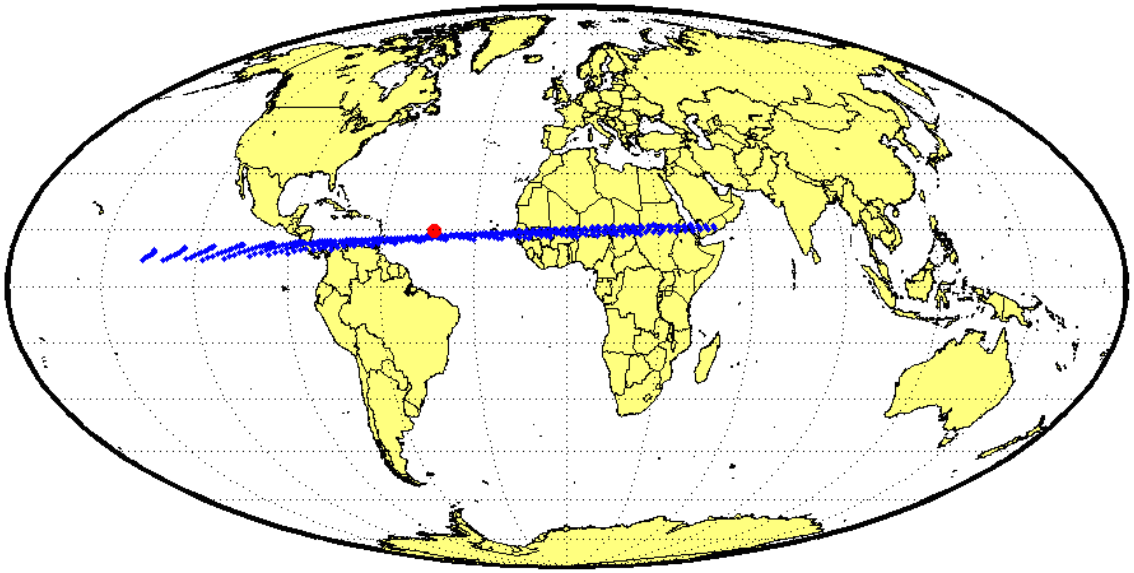


Harris & D'Abramo, 2015

2008 TC_3 Nubian desert, Sudan



2014 AA Atlantic Ocean



Scout: NEOCP Hazard Assessment

Introduction | **Data Table** | Object Data | Ephemeris

Data Table

Scout data are about *unconfirmed objects* and all information should therefore be treated as *potentially unreliable*.

The following table contains NEOCP objects analyzed by Scout. Because of the generally short observation arcs and the uncertain quality of the astrometry, the reported impact ratings and scores are meant to identify interesting objects rather than provide a rigorous probability assessment.

Table Filter: Enter desired filter parameter values then press the "Apply Filter" button.

NEO Score (min)			V-mag (range)			RA (range)		
POS Unc. (range)			Elong. (min)			Dec (range)		
POS Unc.+1 (range)			Rate (max)			Apply Filter	Reset	

Showing 1 to 69 of 69 entries

Search: Search object

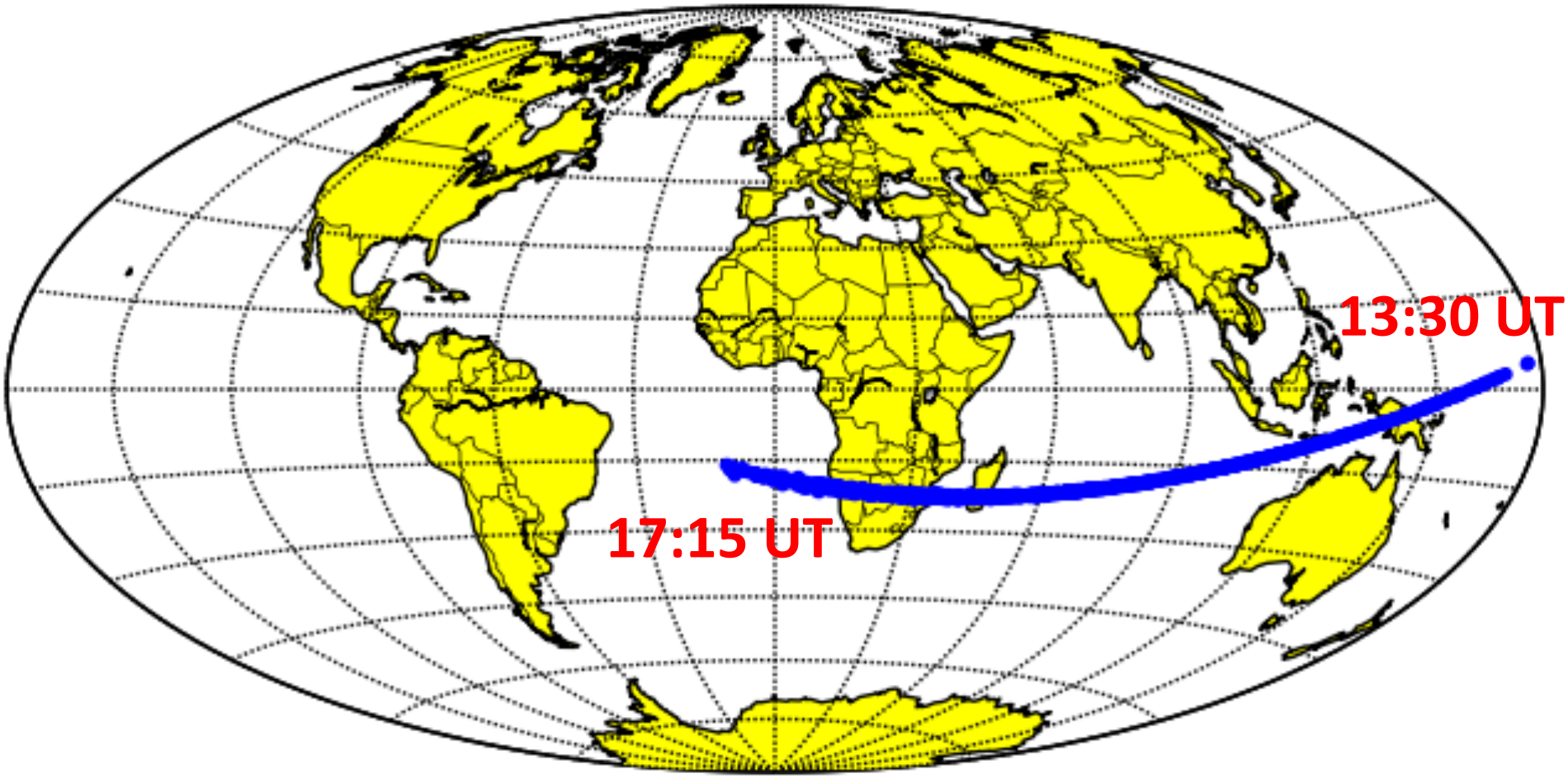
Object	#obs	Arc (h)	RMS	H	Impact Rating	MOID (au)	CA Dist. (LD)	V_{inf} (km/s)	PHA	NEO	NEO > 1km	Geo.	IEO	$T_J < 3$	Last Update (UTC)	RA (hh:mm)	Dec. (deg.)	Elong (deg.
ZTF01Ym	6	1.18	0.31	25.2	1	0.01	6.2	16.0	0	100	0	0	0	45	2018-09-28 18:12	02:12	-39	13
P20Jyx5	3	0.59	0.14	26.3	1	0.006	11	10.9	0	100	0	0	0	36	2018-10-04 16:01	02:47	+13	14
P20Jril	3	0.84	0.22	18.9	1	0.4			0	57	9	0	0	61	2018-10-02 18:06	00:40	+06	17
ZSA598F	4	0.41	0.34	26.8	0	0.01	5.2	10.4	0	100	0	0	0	53	2018-09-30 09:19	03:49	+52	11
ZSA3500	3	0.41	0.37	25.9	0	0.06	24		0	100	0	0	0	43	2018-09-30 07:58	23:12	+17	15
A108U34	4	0.72	0.21	27.9	0	0.0005	0.29	9.6	0	100	0	1	0	51	2018-10-01 13:34	08:53	+13	60
A108Z7p	4	0.72	0.28	27.4	0	0.007	2.7	11.1	0	100	0	0	0	49	2018-10-03 13:00	02:09	-39	13
ZSA1411	8	1.65	0.78	27.6	0	0.009	3.4	16.1	0	100	0	0	0	60	2018-09-30 11:00	09:00	-43	62
ZSA4C92	4	0.41	0.42	29.8	0	0.001	0.59	19.7	0	100	0	0	0	61	2018-09-30 08:49	11:47	-00	14
P20Jurc	3	0.56	0.00	26.7	0	0.01	5.8	21.9	0	97	0	0	0	46	2018-10-03 21:26	00:19	-11	16
P20Jri9	3	0.84	0.01	25.9	0	0.05	19	18.3	0	100	0	0	0	43	2018-10-02 17:07	01:46	-21	15
A108Z7t	3	0.48	0.02	24.7	0	0.01	6.3	29.0	0	100	0	0	0	28	2018-10-03 15:32	00:28	-18	15
A108WON	4	0.77	0.45	23.3	0	0.02	14	14.5	0	100	0	0	0	56	2018-10-02 15:47	02:56	33	13

Text Message
Yesterday 1:32 PM

1 of 2
FRM:JPL Scout System
SUBJ:Scout: ZLAF9B2
MSG:IP = 5%, CA_DIST=6.1 RE,
URL = http://
cneos.jpl.nasa.gov/scout/#/
object/ZLAF9B2

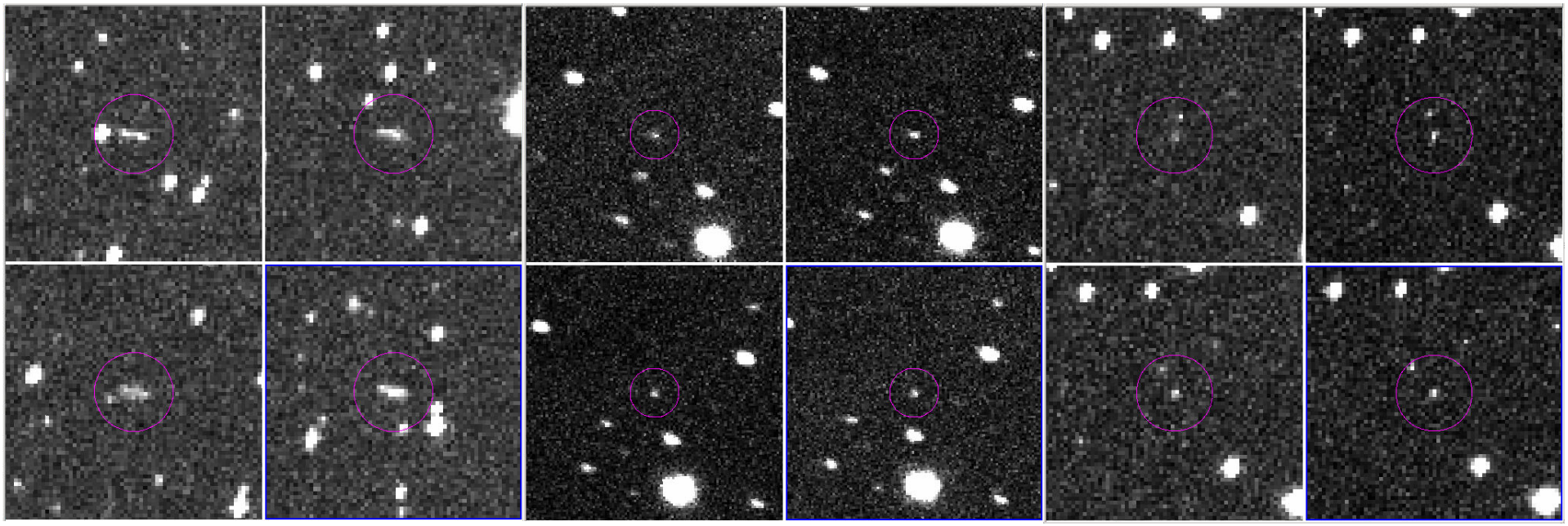
2018 June 2
11:32 UT

ZLAF9B2 = 2018 LA



H between 30.5 and 32.2

Based on 11 observations from Catalina Sky Survey



G96
08:14 to 08:37 UT

I52
09:33 to 09:37 UT

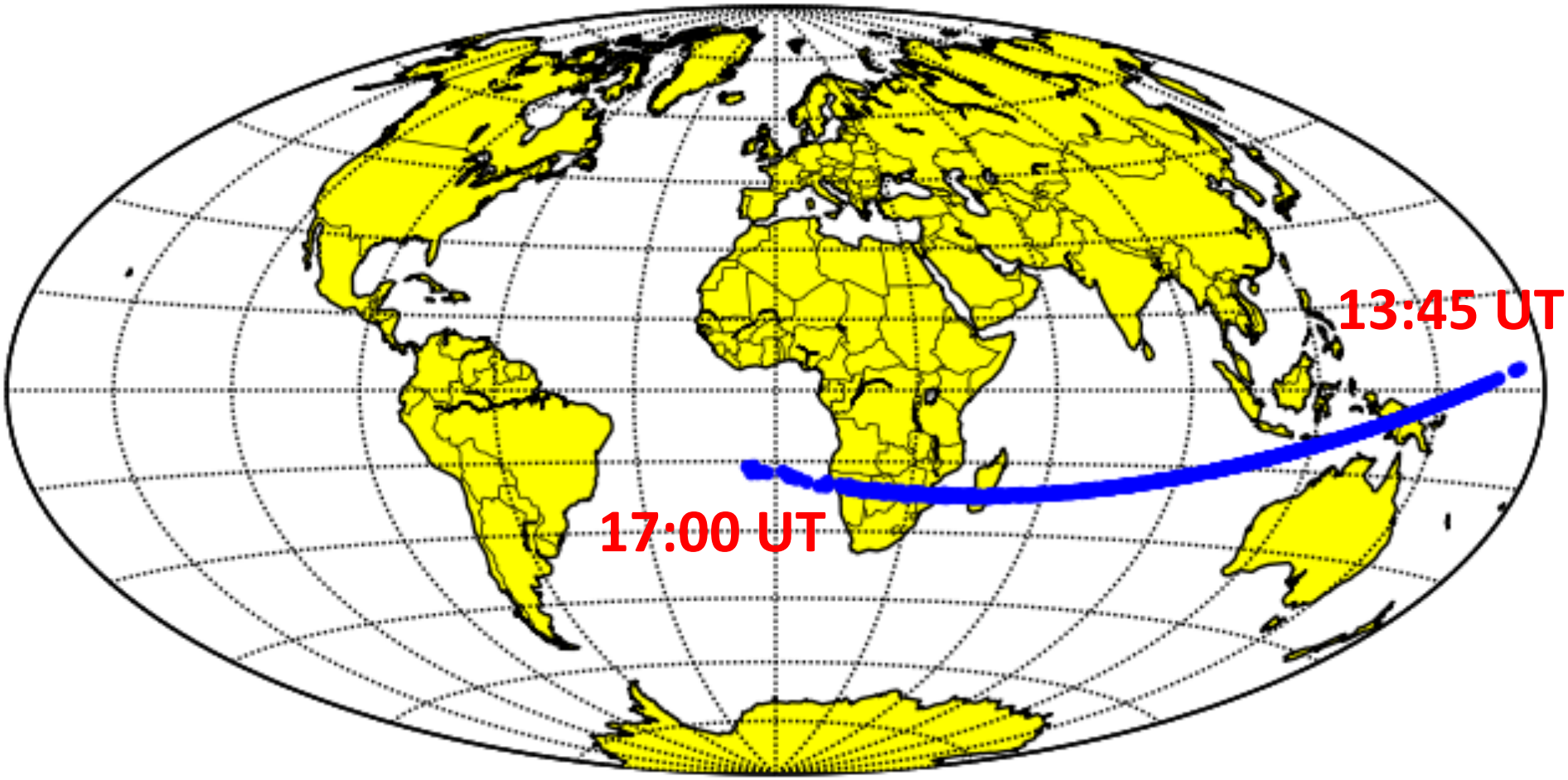
G96
09:39 to 09:40 UT

It’s Kowalski!

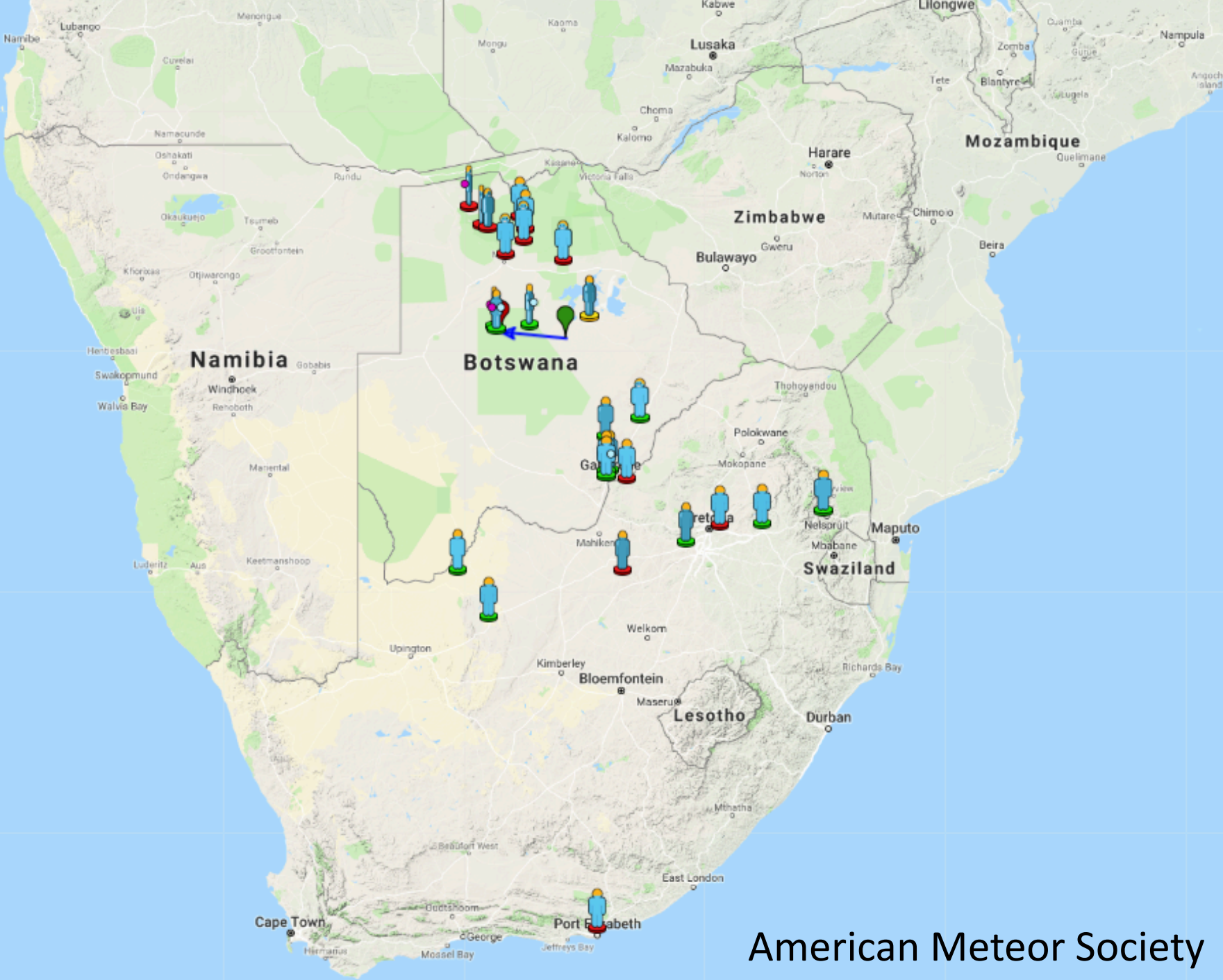
MÖVENPICK
So kann Eis sein.
afri cola
MISSION JUNO

All my friends are dead

12th detection, remeasurements, and data weights



Impact probability 30%



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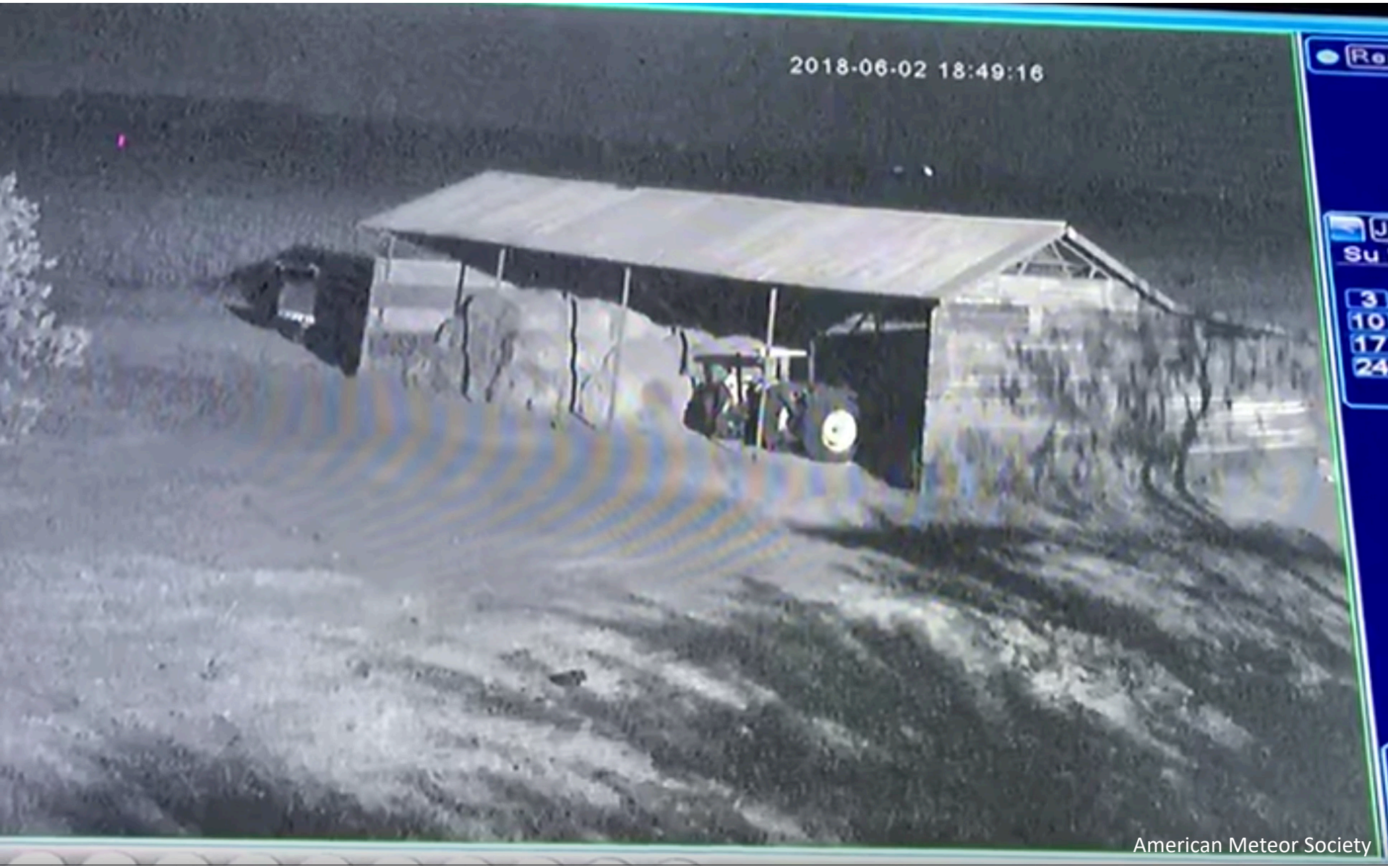

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INTERNATIONAL MONITORING SYSTEM

INFRASOUND NETWORK - CERTIFIED STATIONS AND NON-CERTIFIED STATIONS

22 APRIL 2019

CTBTO PREPARATORY COMMISSION | preparatory commission for the comprehensive nuclear-test-ban treaty organization

STATION STATUS

DATE	22 Apr 2019
TOTAL STATIONS	60
PLANNING	7
UNDER CONSTRUCTION	1
INSTALLED	1
CERTIFIED	51

Sp Primary Seismic | SA Auxiliary Seismic | I Infrasound | H Hydroacoustic | R Radionuclide | R+ Radionuclide w/ Noble Gas | L Radionuclide Lab

The boundaries and presentation of material on this map does not imply the expression of any opinion on the part of the Provisional Technical Secretariat concerning the legal status of any country, territory, city or area or its authorities, or concerning the delimitation of its frontiers or boundaries.

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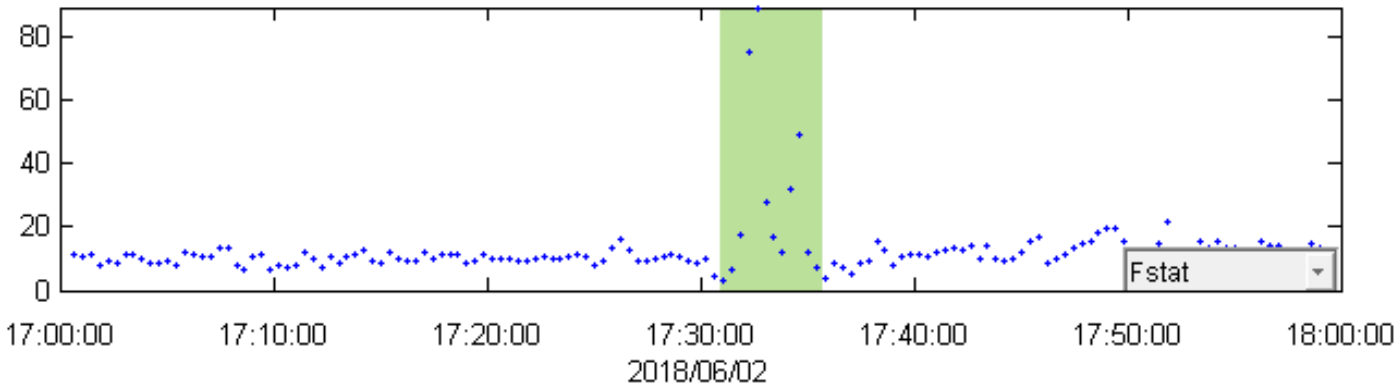

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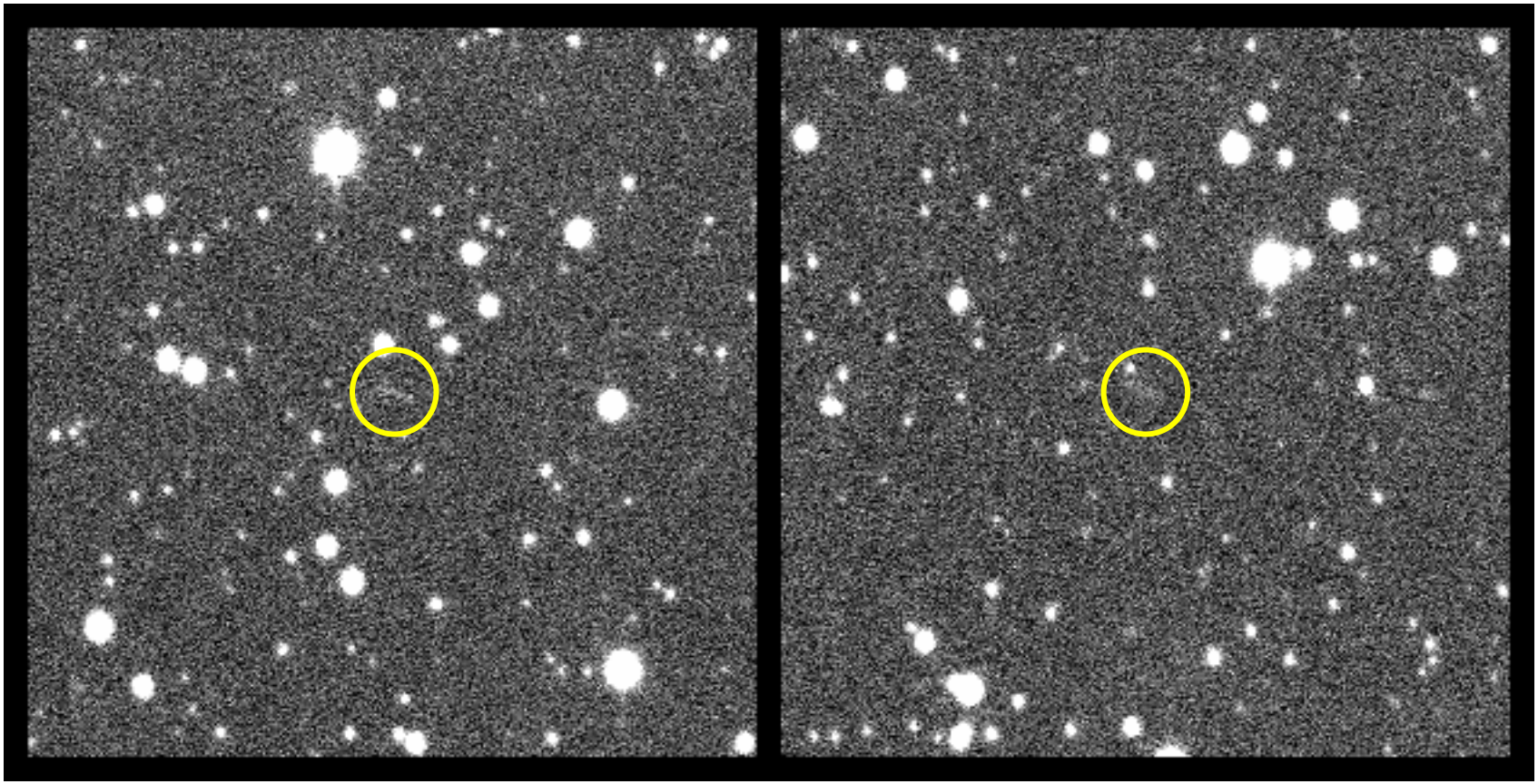
ATLAS pair



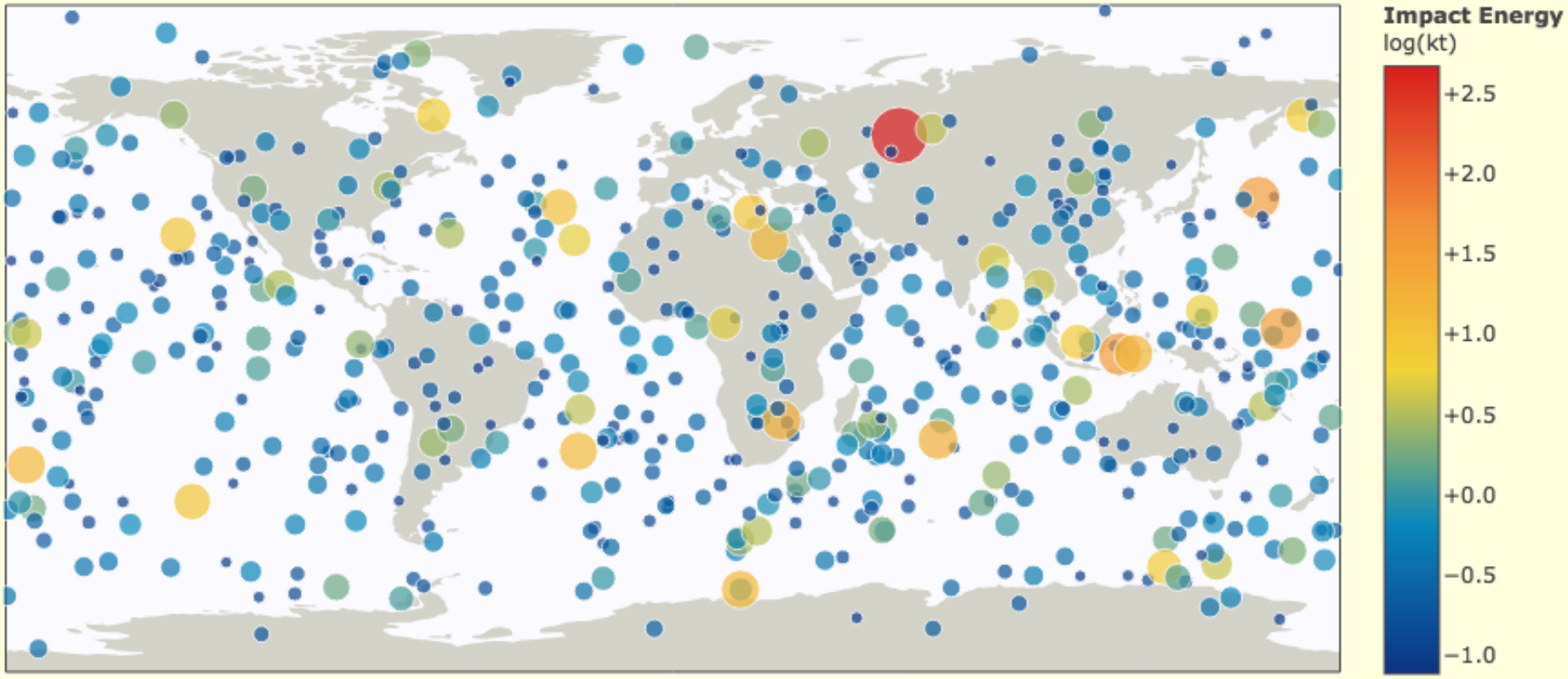
T08

11:49 to 12:01 UT

Democratic Republic of the Congo
Brazzaville
Kinshasa
Lake Tanganyika
Luanda
Lake Bukwa
Angola
Lake Malawi
Malawi
Zambia
Lilongwe
Lusaka
Harare
Okavango Delta
Zimbabwe
Mozambique
Namibia
Windhoek
Botswana
Kalahari Desert
Gaborone
Pretoria
Mbabane
Maputo
Swaziland
Maseru
Lesotho
South Africa
US Dept of State Geographer
© 2018 AfriGIS (Pty) Ltd.
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Google
Imagery Date: 12/13/2015 11°38'02.11" S 3°12'06.08" E elev -18329 ft eye al

Fireballs Reported by US Government Sensors

(1988-Apr-15 to 2018-Sep-25)



https://cneos.jpl.nasa.gov/fireballs/

Alan B. Chamberlin (JPL/Caltech)

USG Fireball Report

Energy 0.98 kt

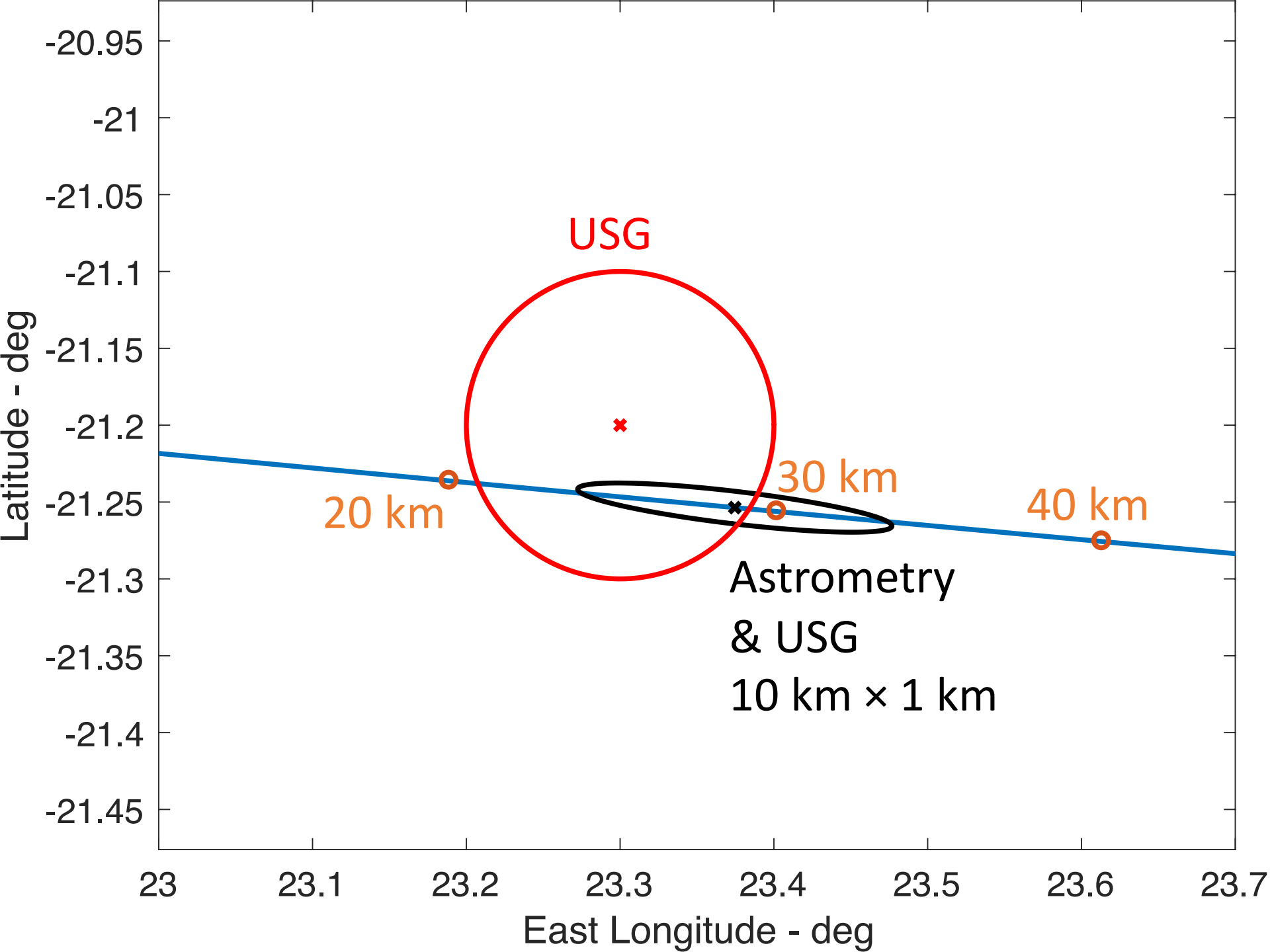
Altitude 28.7 km

Latitude 21.2° S

Longitude 23.3° E

Time 16:44:12 UT

Velocity 17 km/s


USG
20 km
30 km
40 km
Astrometry
& USG
10 km × 1 km
Latitude - deg
East Longitude - deg
-20.95
-21
-21.05
-21.1
-21.15
-21.2
-21.25
-21.3
-21.35
-21.4
-21.45
23
23.1
23.2
23.3
23.4
23.5
23.6
23.7

https://www.seti.org/press-release/fragment-impacting-asteroid-recovered-botswana-0

Conclusions

- The system worked pretty well!
  - System not designed for such small objects
  - Only 8.5 hours between discovery and impact
  - On a Saturday, laptop not readily accessible

- Test case for larger short-term impactors
  - Earlier discovery
  - Impact location estimates within a day or so of discovery
  - Trigger mitigation activities

Jet Propulsion Laboratory
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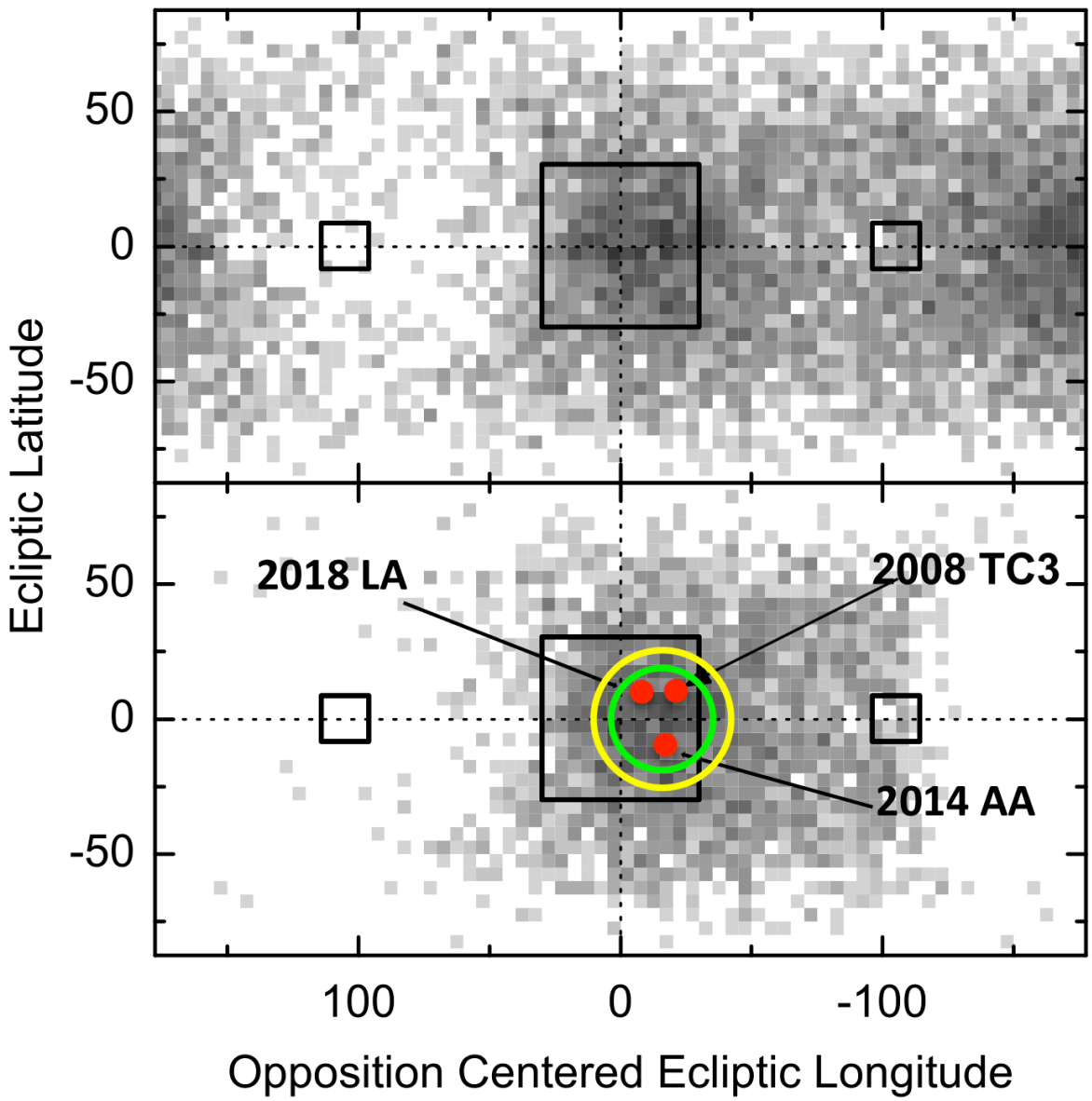
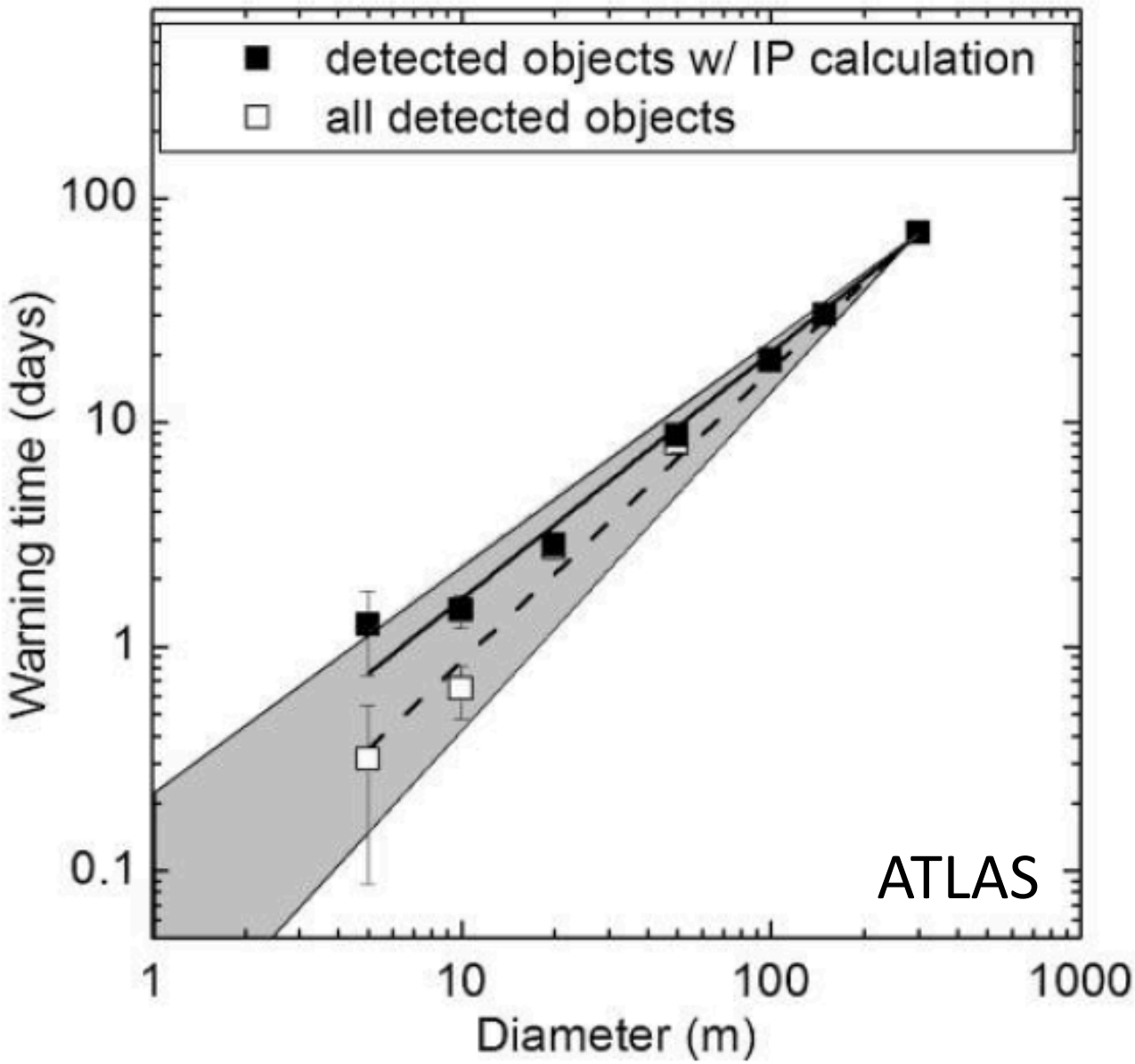
Veres et al. 2009, one day prior to impact



All

V < 22.7
Rate < 12°/day

Veres et al. 2014



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São Tomé and Principe
Democratic Republic of the Congo
Nairobi
Bujumbura
Burundi
Brazzaville
Kinshasa
Tanzania
Lake Tanganyika
Dodoma
Lake Rukwa
Luanda
Angola
Lake Malawi
Comoros
Moroni
Malawi
Lilongwe
Zambia
Lusaka
Harare
Mozambique
Zimbabwe
Okavango Delta
Mozambique Channel
Namibia
Botswana
Windhoek
Kalahari Desert
Gaborone
Pretoria
Mbabane
Maputo
Swaziland
Maseru
Lesotho
South Africa
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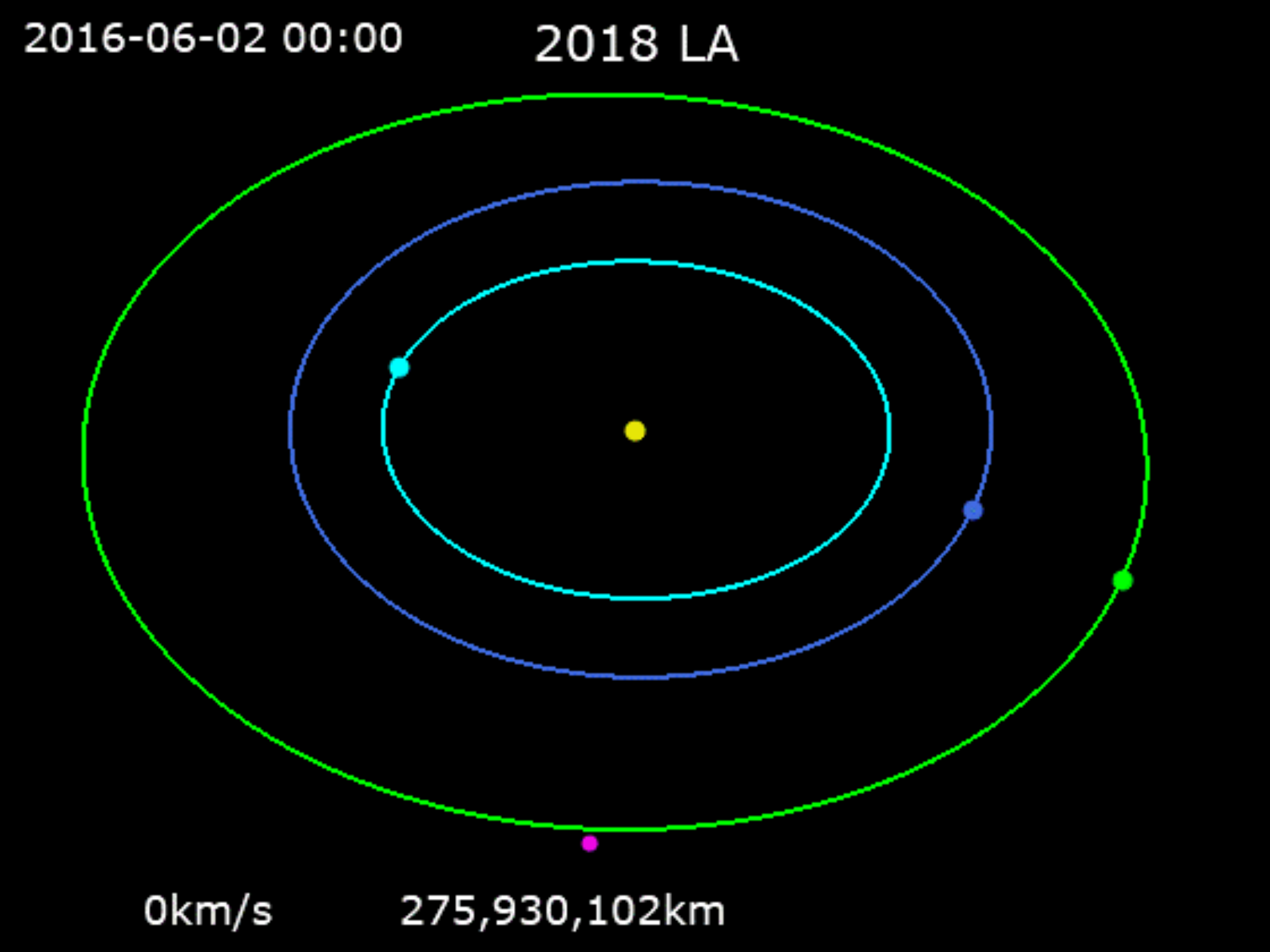
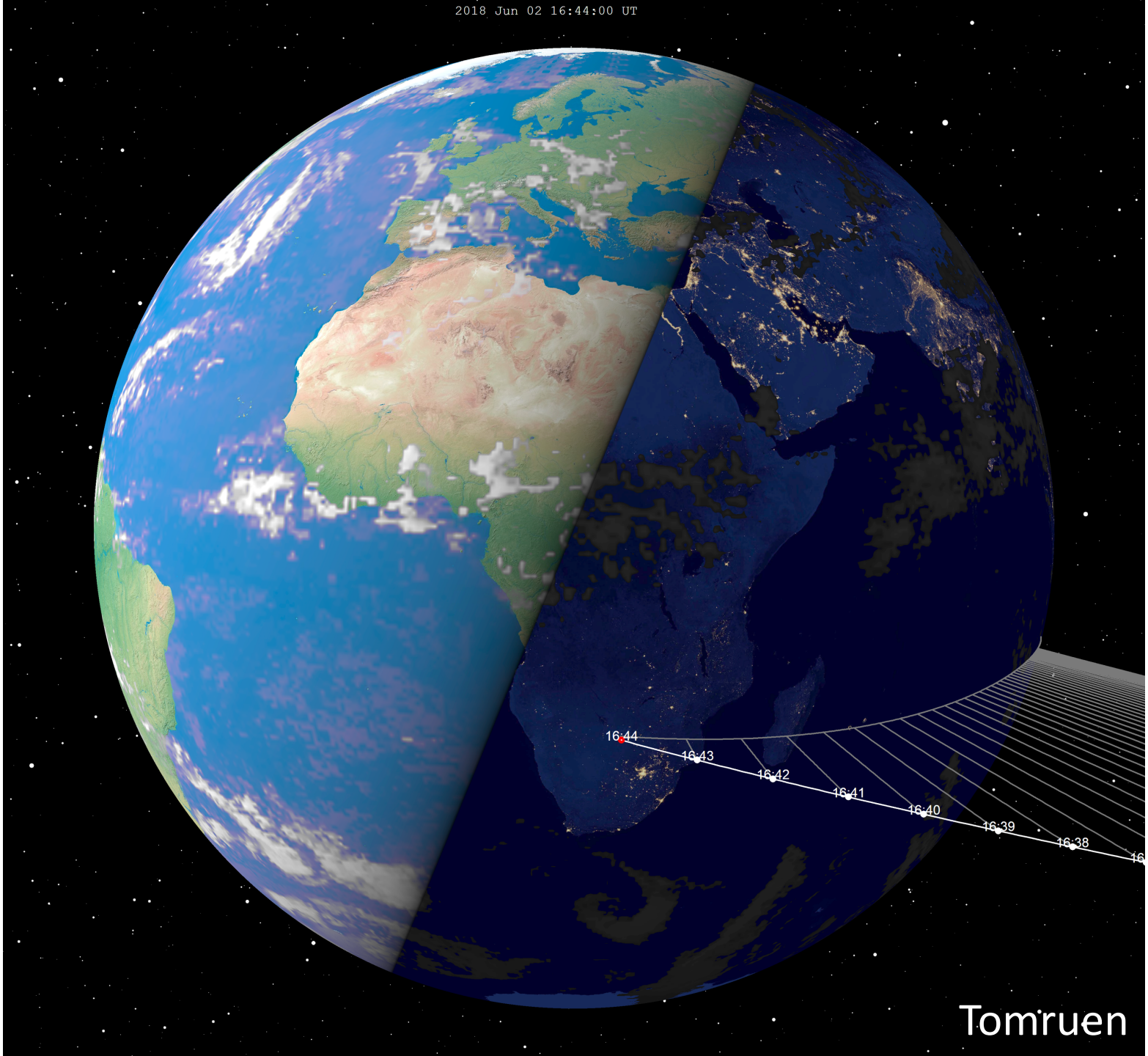
US Dept of State Geographer
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Google E


2016-06-02 00:00
2018 LA
0km/s
275,930,102km


2018 Jun 02 16:44:00 UT
16:44
16:43
16:42
16:41
16:40
16:39
16:38
Tom'ruen

https://www.seti.org/press-release/fragment-impacting-asteroid-recovered-botswana-0