Kévin Baillié – SF2A Bordeaux 2018
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IMPACTS :
constraining the impact flux across the solar system

Credit :
Leder et al.,
1998

Context

What do we know about the impact flux across the solar system ?

Where ?

Only in the direct vicinity of the Earth (except Cassini CDA) :

- Earth : meteors and meteorites (FRIPON, CABERNET, ...)
- Moon : crater counts and calibration based on Apollo's sample returns

When ?

- Present flux from present observations
- Temporal scale from the craters

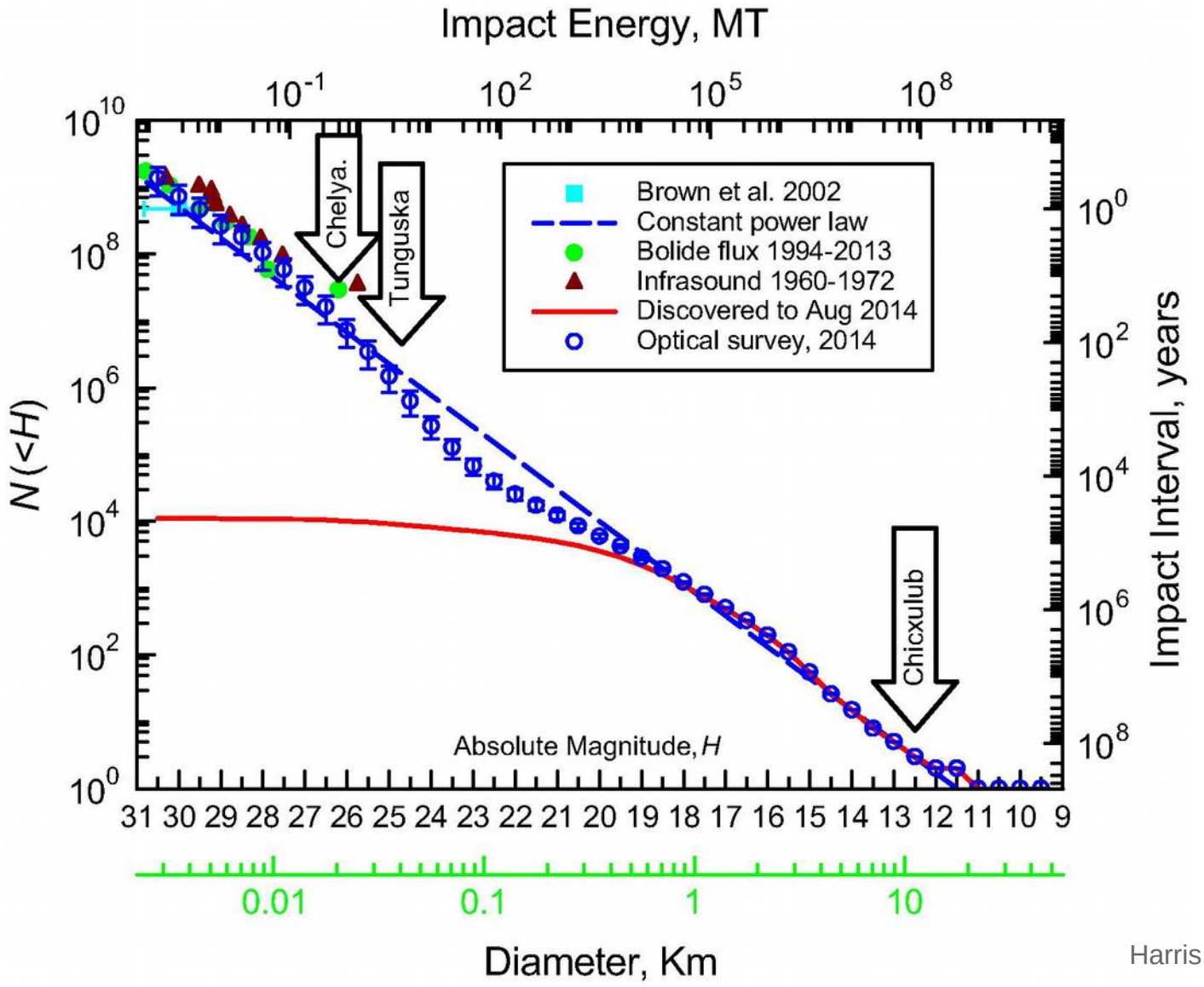
Sizes ?

- Distribution following a power-law in r^{-3}

A dating tool for satellite surfaces, rings, ...

Impacts around Earth

Complementary methods

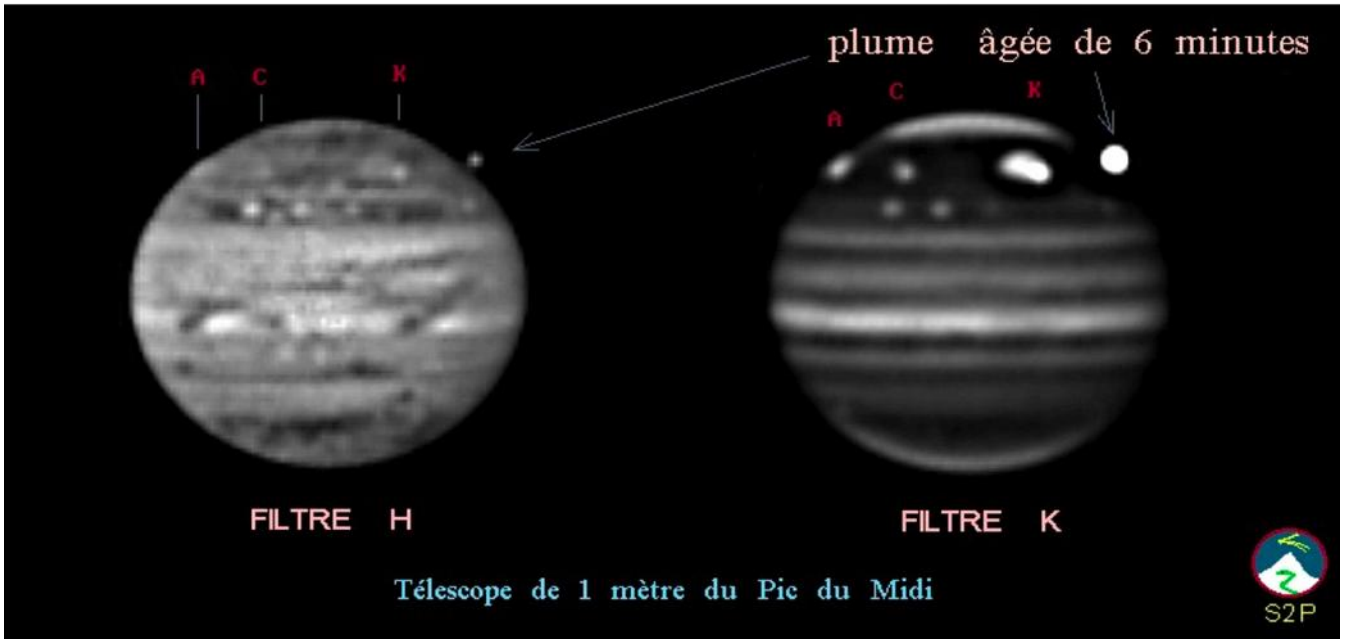


Harris & D'Abramo, 2014

Motivation

Variation of the impact flux with heliocentric distance

Jupiter protects the inner solar system but scatters the impactors inward



Shoemaker-Levy 9, 1994 (Colas et al., 1995)

Objectives :

Estimating

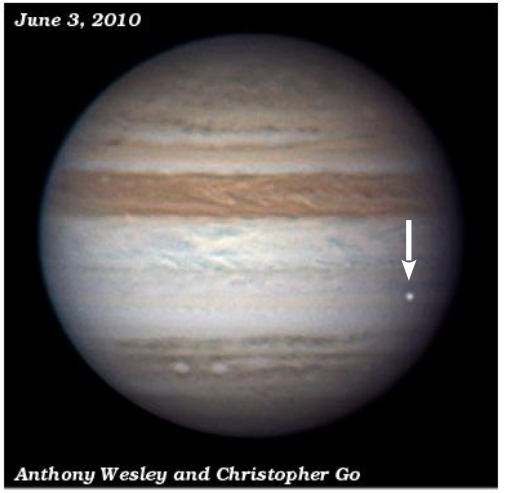
- the impact flux as a function of the distance to the Sun
- the size distribution of these impactors at the giant planet locations

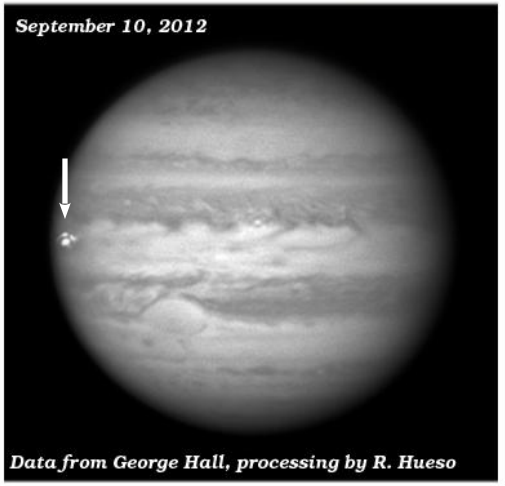
Impacts on Jupiter

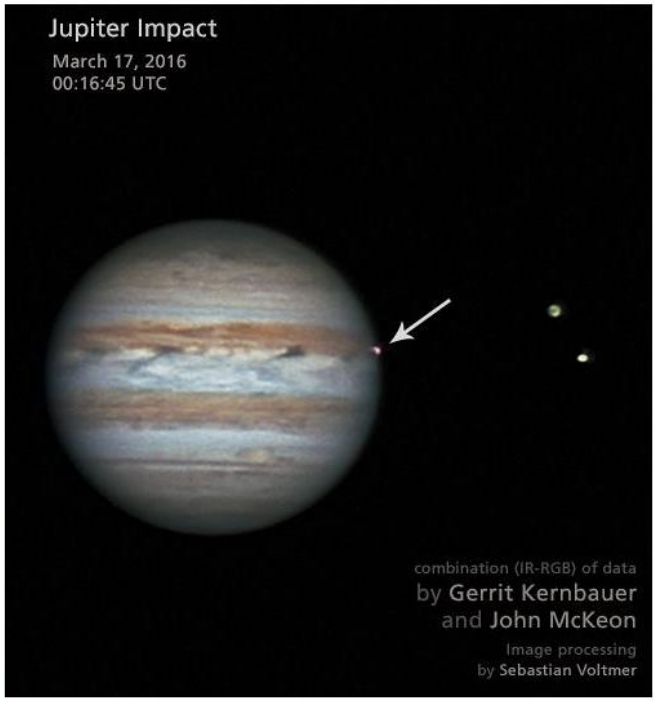
Observations

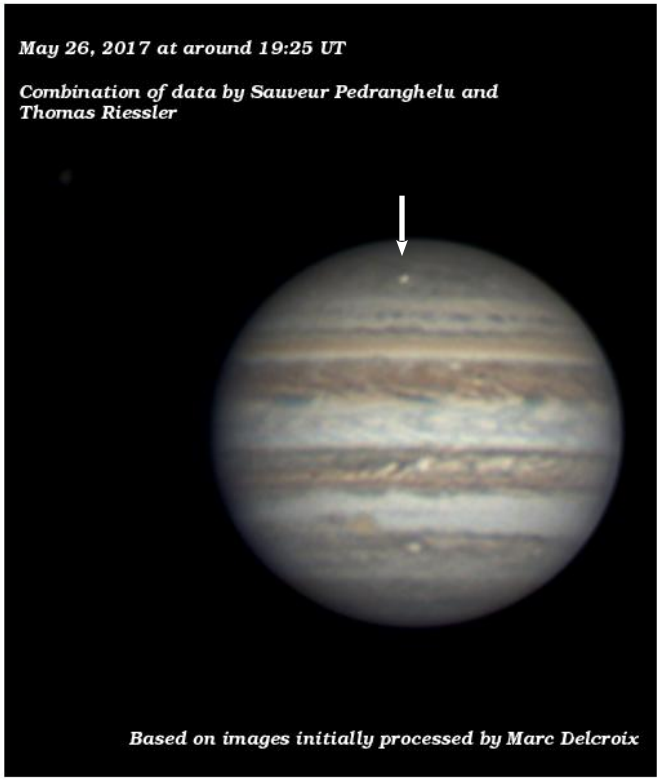
Flashes (> 5 m) :

- 2010 * 2
- 2012
- 2016
- 2017









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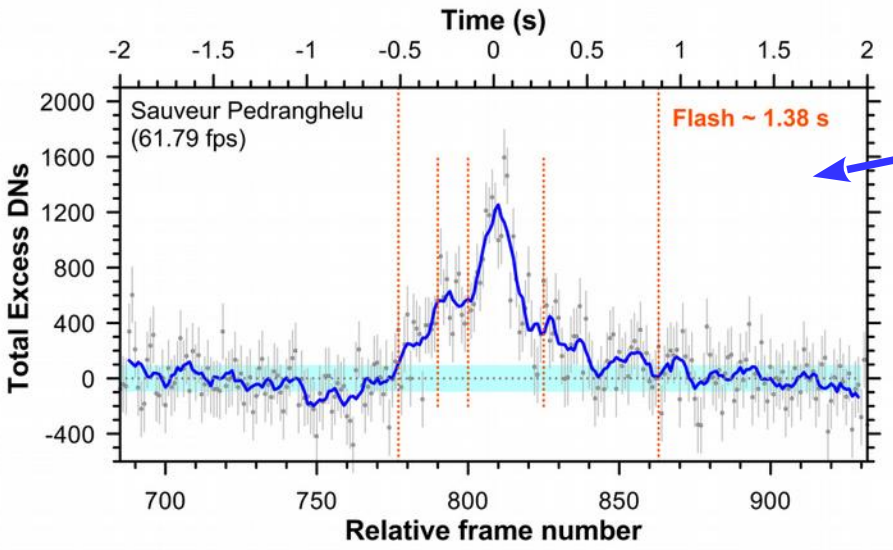

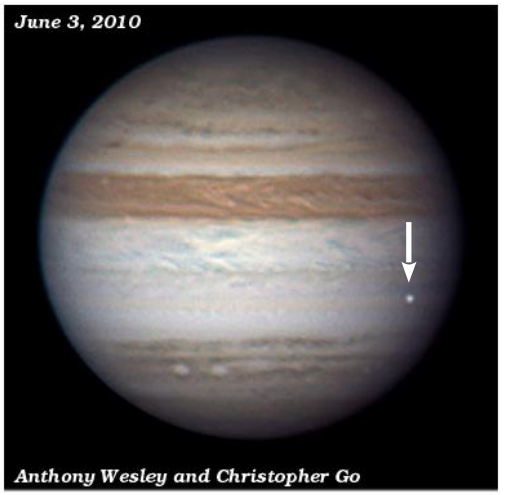

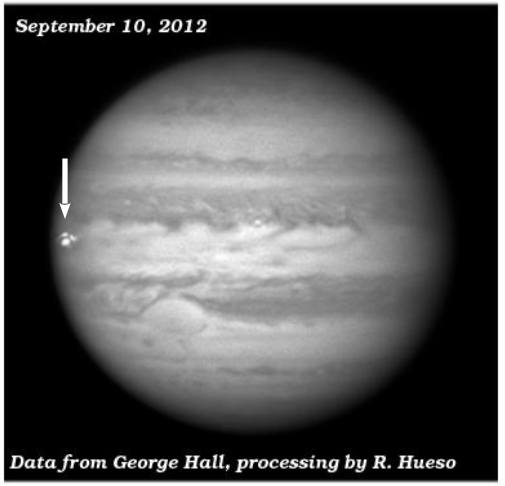

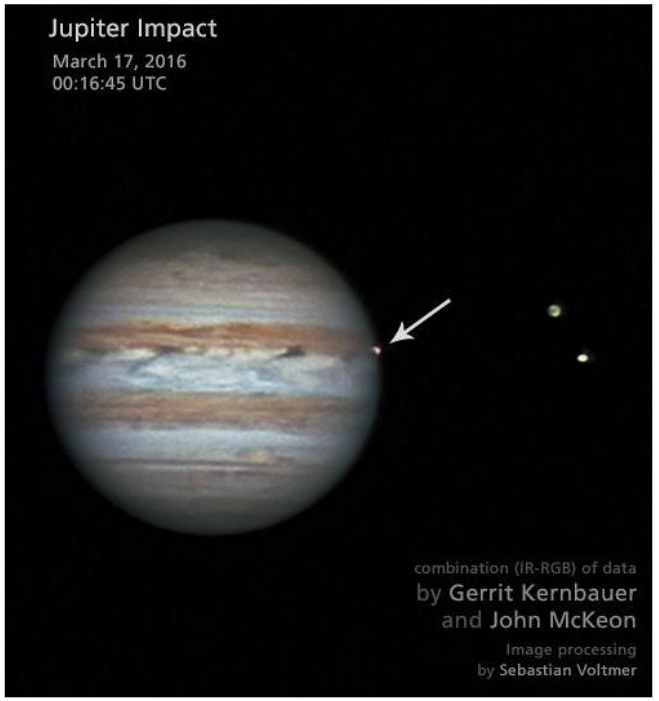

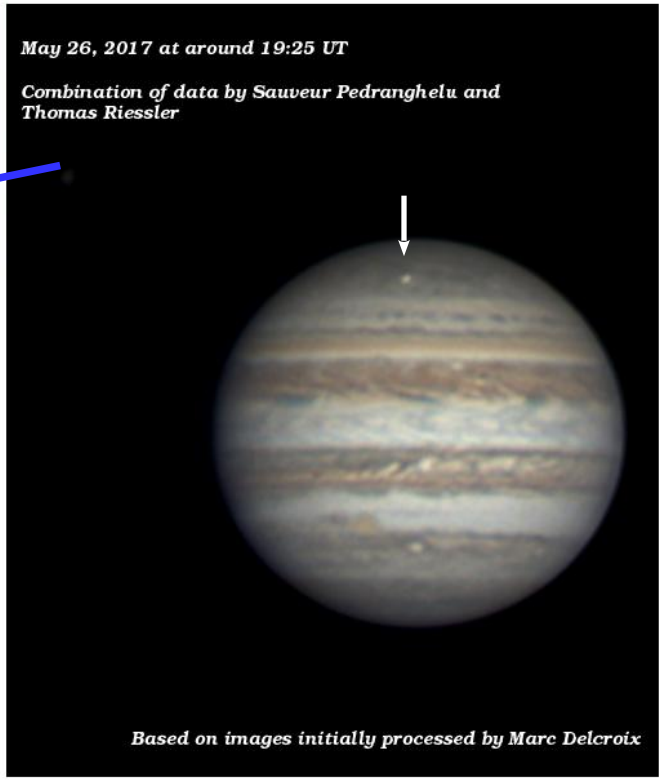

Impacts on Jupiter

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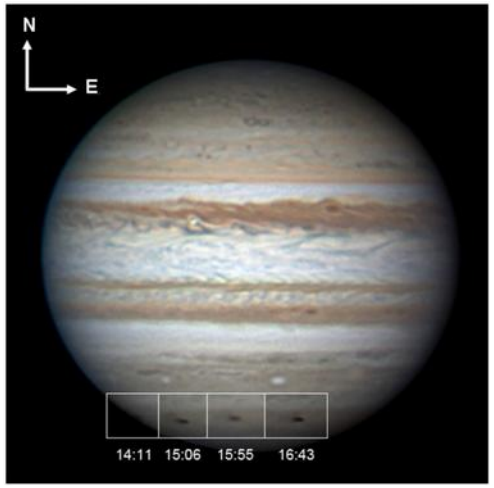
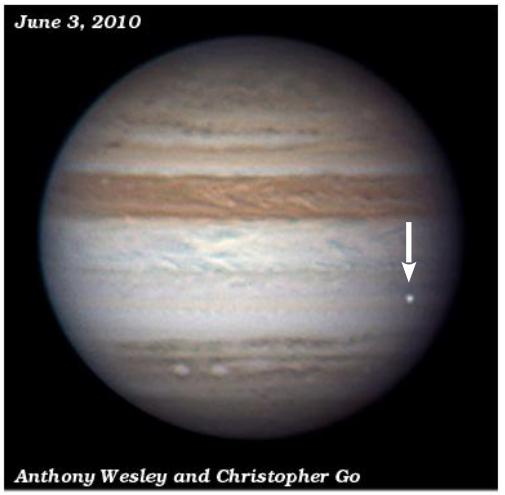
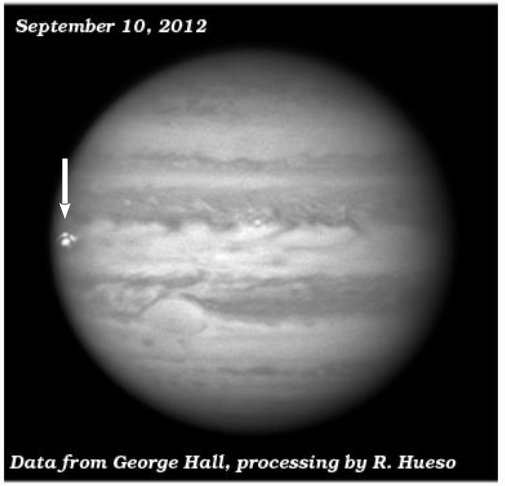
Debris (> 100 m) :

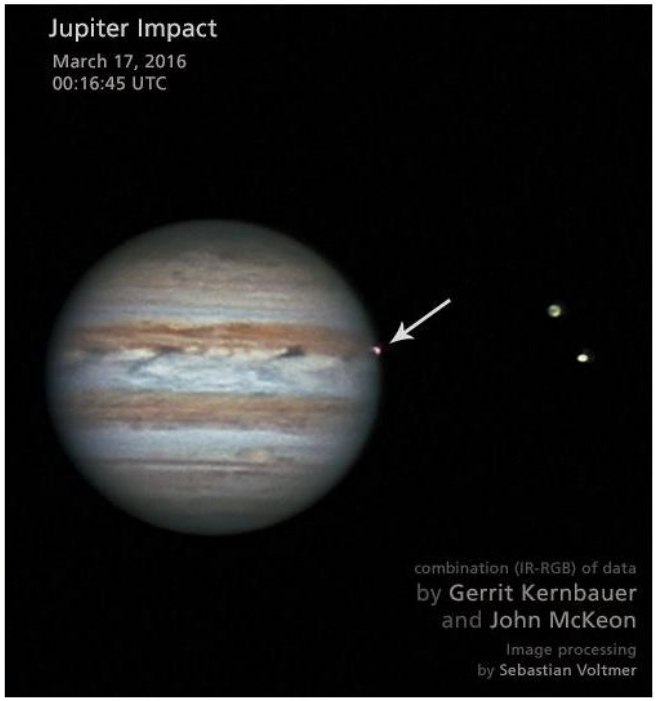
- 1994 (Shoemaker-Levy 9)
- 2009

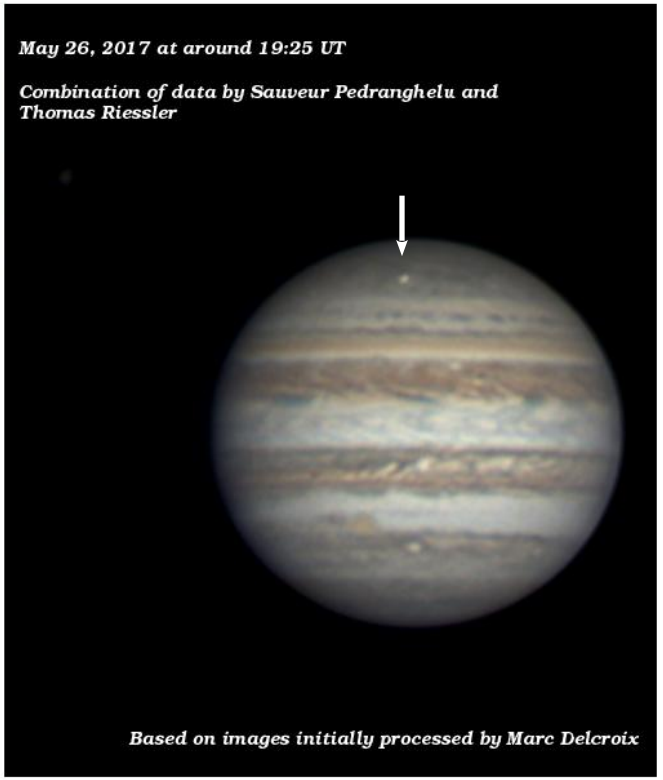


Sanchez-Lavega et al., 2010









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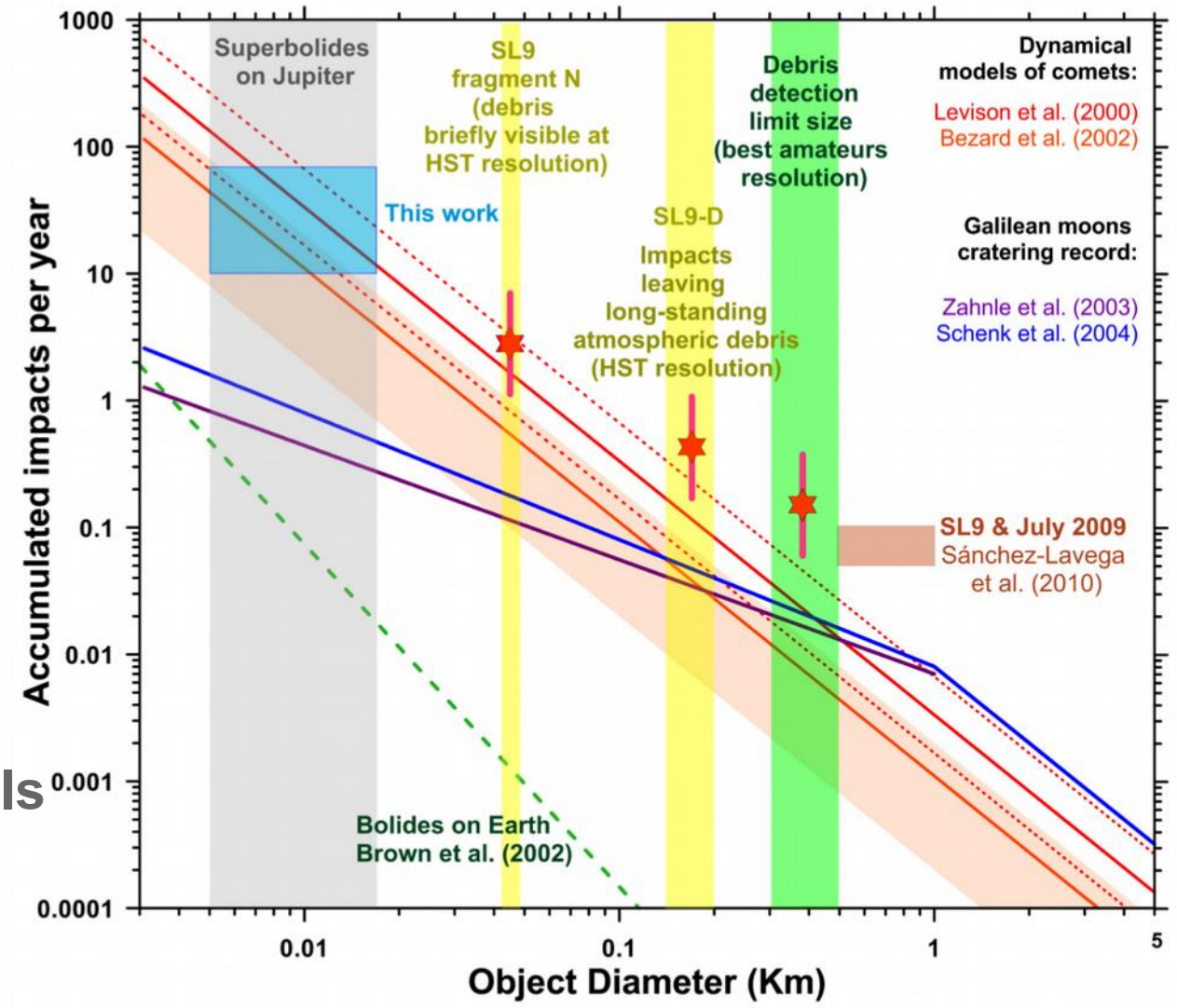
Cometary dynamical models

Galilean craters



Hueso et al., 2018

Need for more observations

The « IMPACTS » project

Impacting
Meteoroids in giant
Planet
Atmospheres
Charac-
Terization
Survey

- Coordination of an observation campaign of **flashes and debris** at Jupiter's surface, involving **both amateurs and professionnals**
- Social networks watch and relay of alerts

  → coordination of residual surveillance in response to flash observations
- Participative international database in order to optimize the temporal and geographical coverage

The « IMPACTS » project

Fundings and observation facilities

- CNRS-Momentum application (PI : Baillié)
- Europlanet Workshop (PI : N. André)

- T1m at Pic du Midi (PI : F. Colas)
- Regular observations of natural satellites (OHP, Pic, ...)
- South hemisphere observations Maroc-Senegal (S. Bouley)
- Amateur telescopes (> 20 cm)
- Residuals observations in CH_4 filter

- Collaboration with the International Outer Planet Watch (PVOL-Bilbao : R. Hueso)
- Flash detection software (DeTeCt : M. Delcroix) → to be automated in pipeline
- Data digging (NAROO, V. Robert)

The « IMPACTS » project

Expected results (Hueso et al., 2018) :

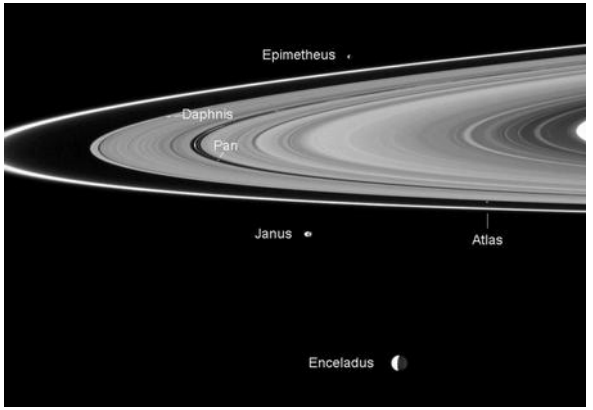
- 12 – 60 flashes of objects > 5 m impacting Jupiter (or > 15 m for Saturn) ; only 5 – 25 observables due to weather and geographical constraints

- 1 object > 100 m every 0.4 to 2.6 years
  all should be detectable (residuals remain visible for several weeks in CH_4)
  → requires at least 1 two-night observation mission every month

Consequences on satellite formation

➢ Already available models

- **Accretion** within the rings (**Baillié** et al., 2013)
- **Viscous spreading** of the rings and accretion beyond the Roche limit (Charnoz et al., 2010)



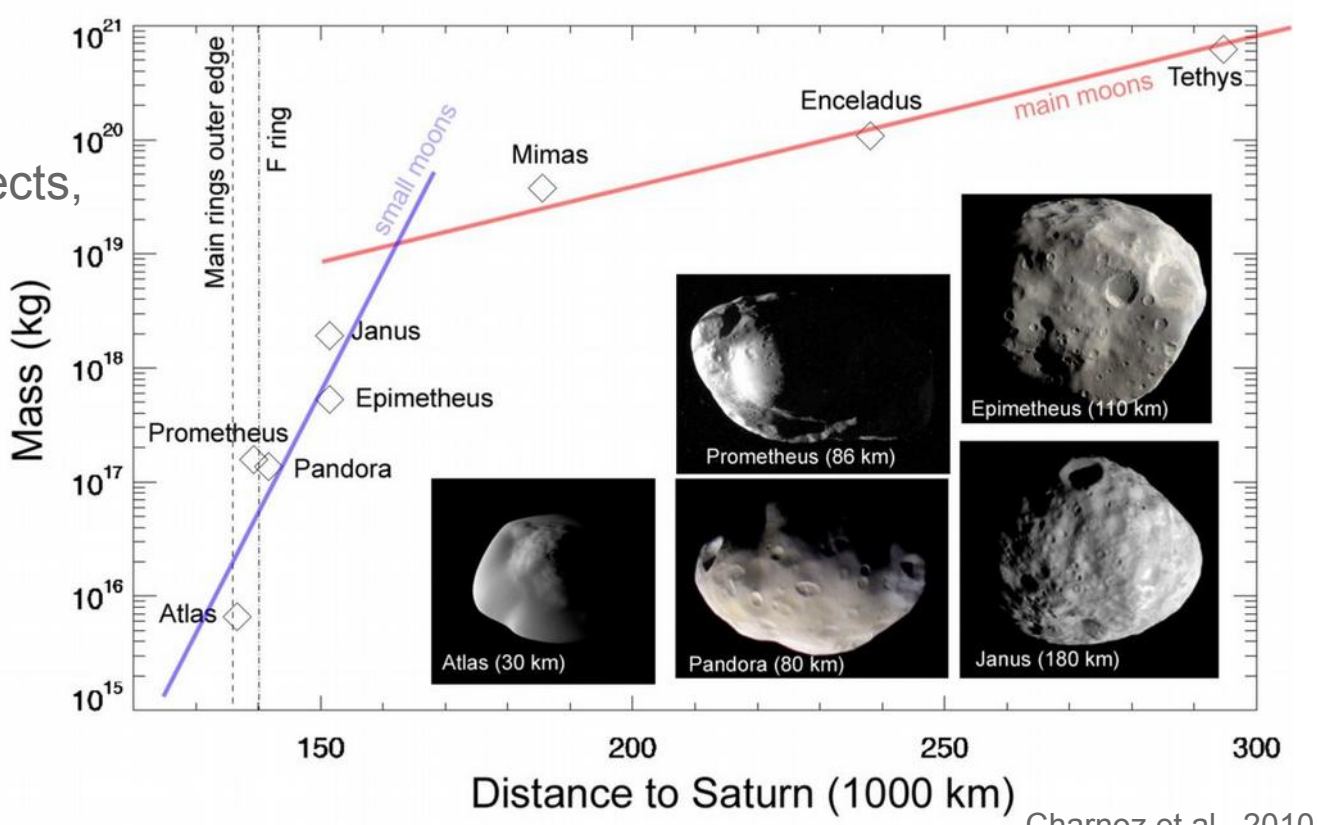
NASA/JPL/SSI

➢ Next steps :

- **Internal heating model**

  Formation of internal oceans by **melting ice shells** (tidal effects, excentricity)

- **Quantifying the survival probability of formed satellites**



Charnoz et al., 2010

Scientific interest

Satellite formation

- Probability of survival during satellite formation ?
- Estimating the age of satellites and their surfaces from calibrated craterization models

Formation and evolution of massive rings

- Impact on a satellite / impactor debris ?
- Quantifying the ballistic transport in the rings → forming structures (CD)

Join us !

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