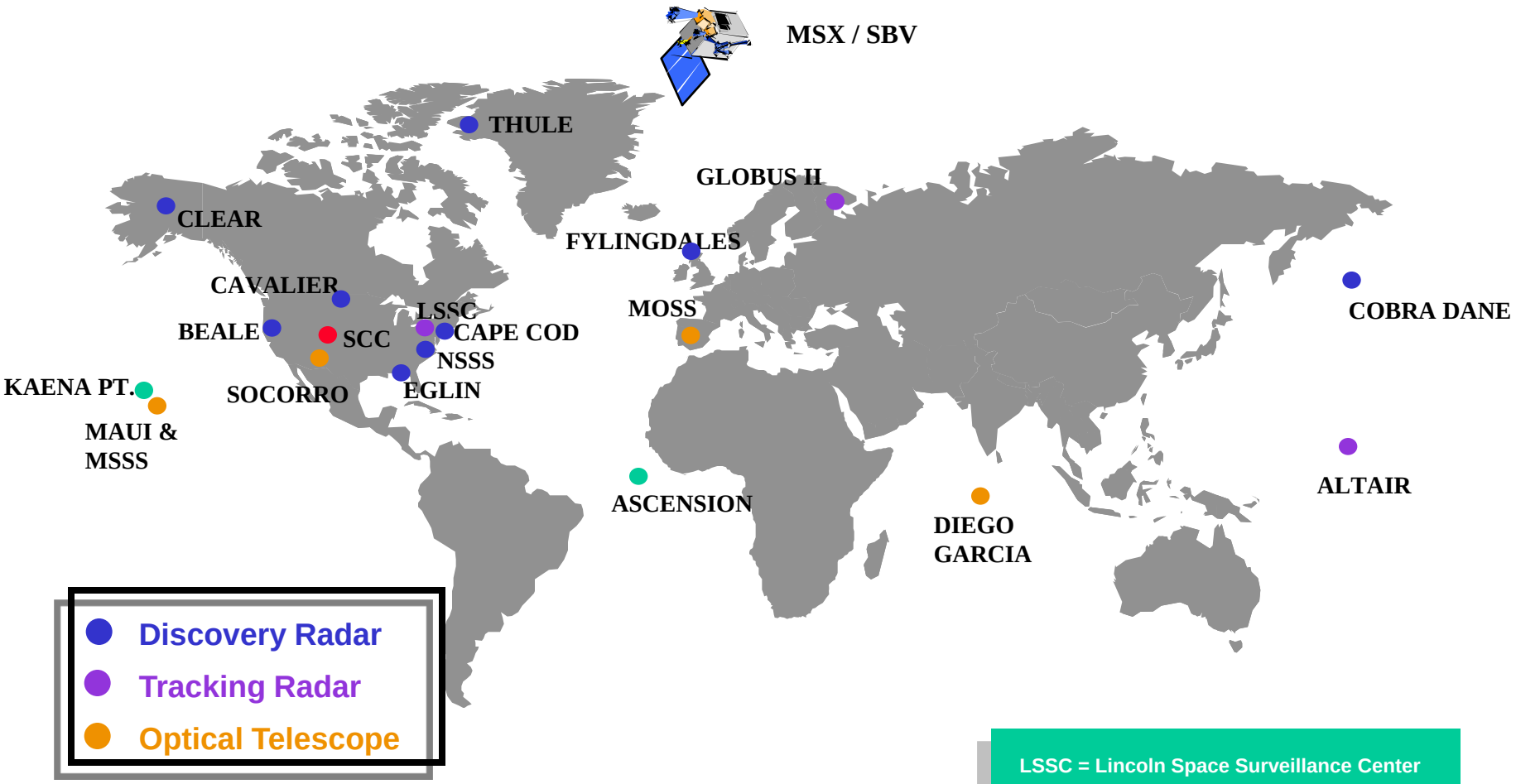
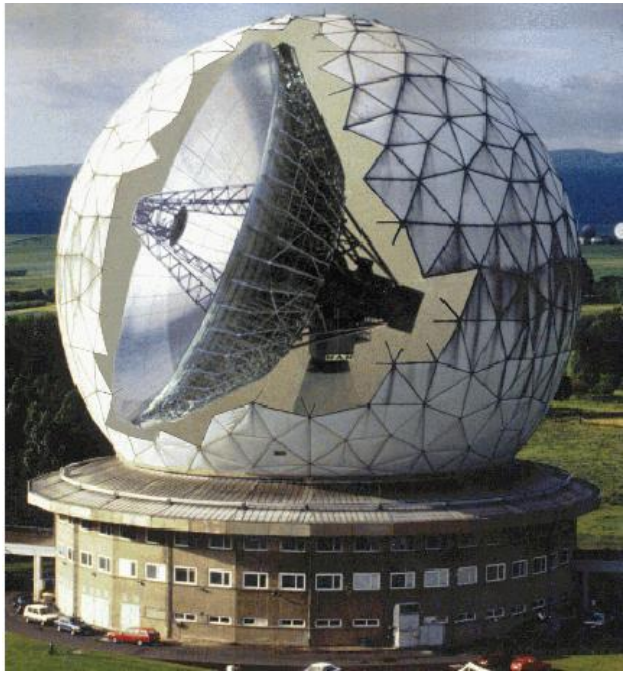
Debris Detection and Observation Systems

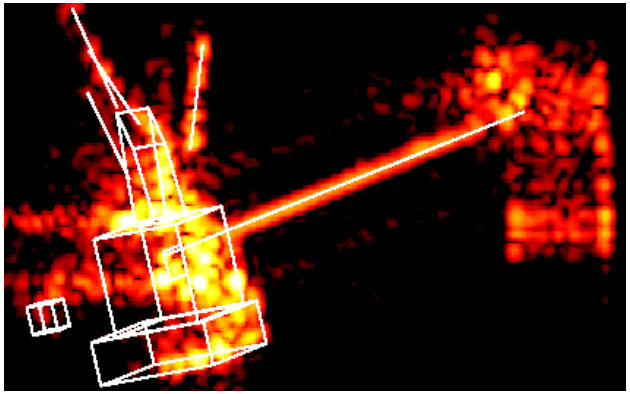
Rüdiger Jehn
ESA/ESOC, Robert-Bosch-Str. 5, 64293 Darmstadt, Germany,
Email: ruediger.jehn@esa.int

Space Surveillance Network (SSN)



LSSC = Lincoln Space Surveillance Center
Millstone, Haystack, HAX
MSSS = Maui Space Surveillance System
(former AMOS/MOTIF site)
NSSS = Naval Space Surveillance System





FGAN/TIRA radar (Wachtberg/Germany):

- operated by FGAN (Research Establishment for Applied Science)
- antenna: 34 m parabolic reflector in a 49 m radome
- tracking radar: L-band (1.333 GHz), 1.5 MW peak power, 0.45º 3 dB beam-width, 1 ms pulse length, 30 Hz pulse repetition, **~2 cm objects at 1,000 km**
- imaging radar: Ku-band (16.7 GHz), 13 kW peak power, 0.031º 3dB beam-width, 256s pulse length, 55 Hz pulse repetition, ~15 cm range resolution
- Space Debris Applications: tracking support during risk object re-entries (Skylab, Salyut-7, Mir); conjunction event verification
- imaging support: S/C emergencies (e.g. Adeos); verification of S/C integrity (e.g. Salyut-7, Mir)

The ESA Space Debris Telescope (Tenerife/Spain)

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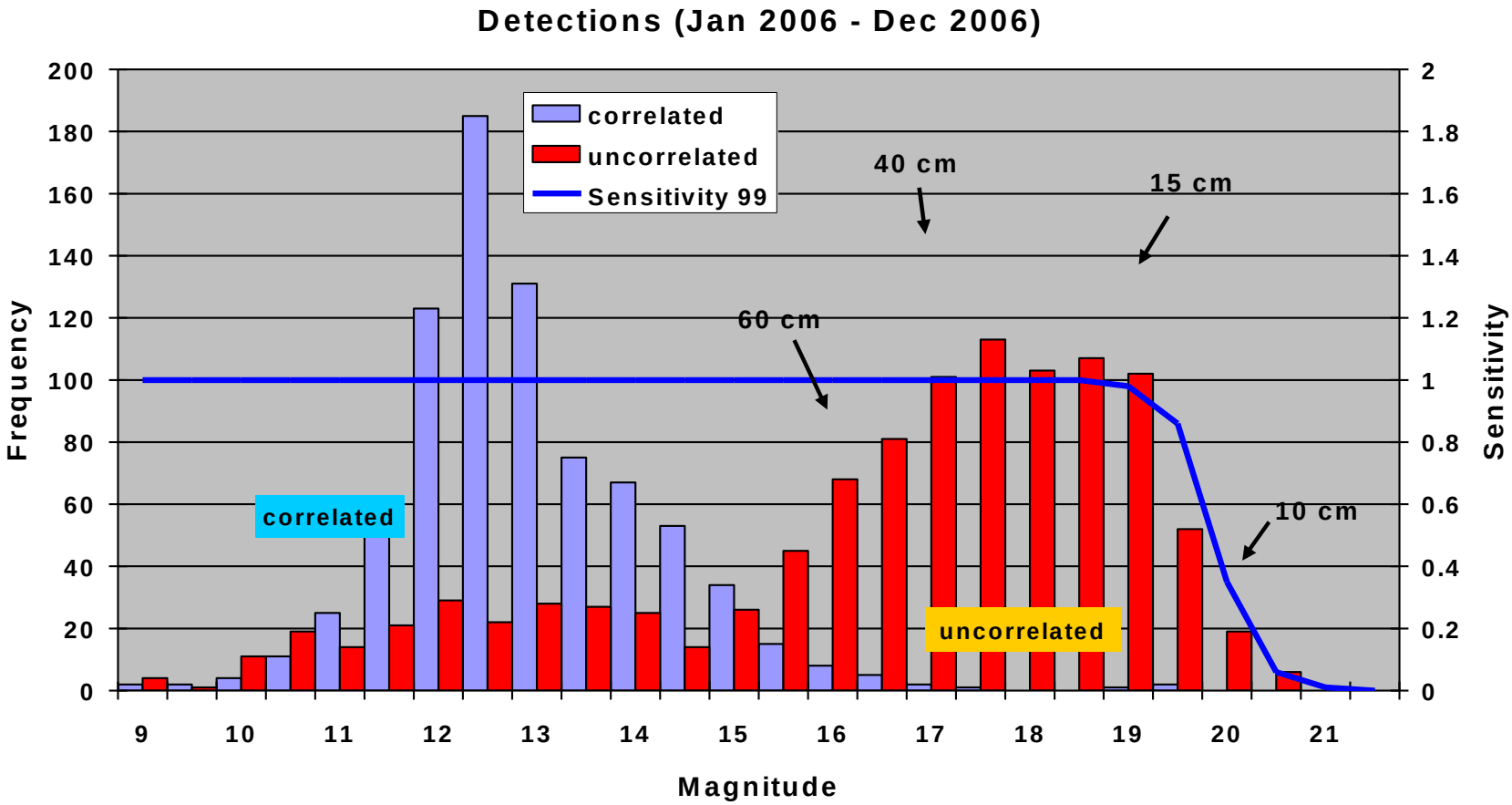
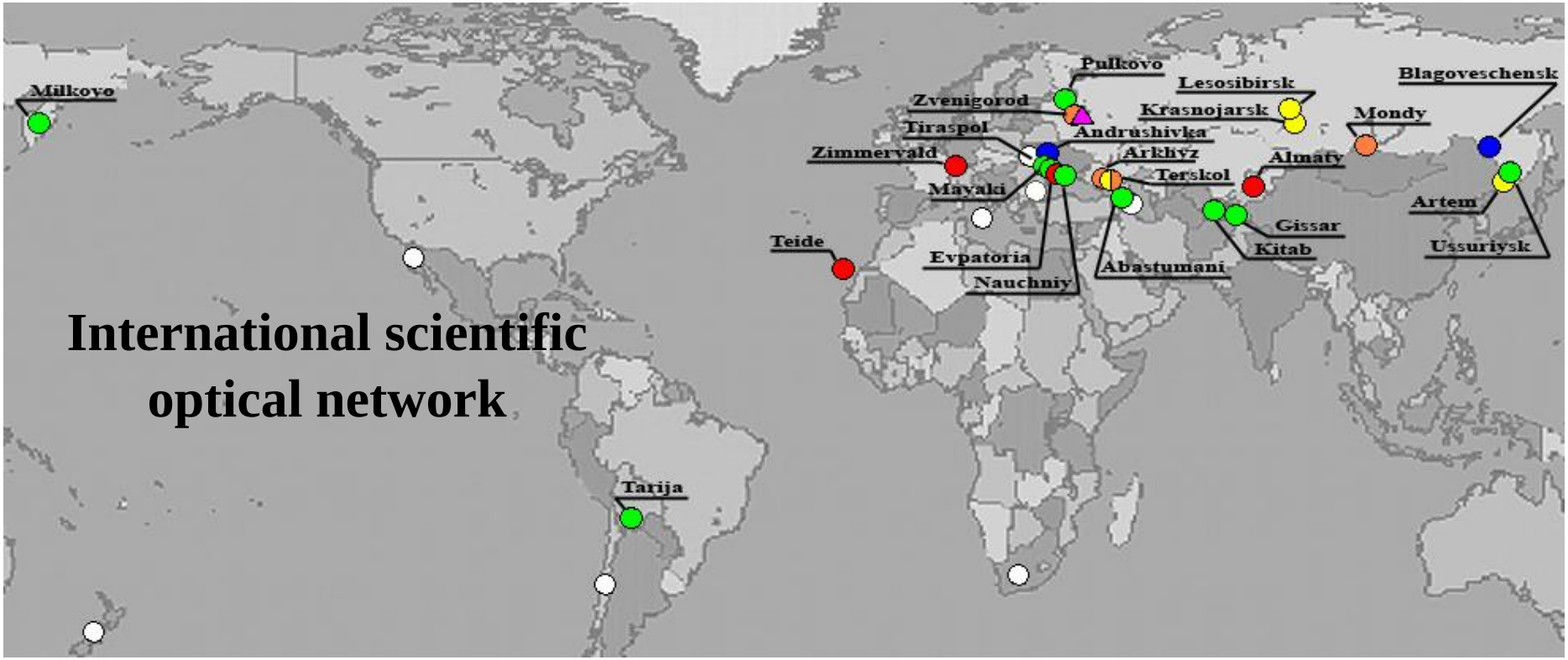




International scientific optical network

Legend:

Green circles – ISON observatory working in the project during few years already.

Blue circles – ISON observatories working first year only.

Yellow circles – ISON observatories where preparatory work are carried out.

Red circles – observatories – foreign partners of the ISON.

Orange circles – observatories – Russian partners of the ISON.

Search and survey subsystem for studying of the bright GEO-objects consists of 11 telescopes of 22-cm aperture with FOV of 4° and 5.5°

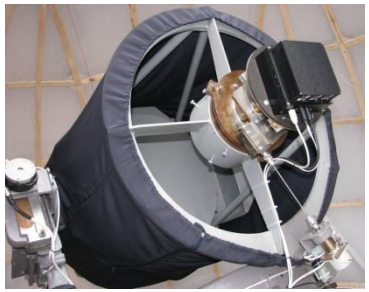






Subsystem for high altitude faint space debris detection and tracking consist of telescopes of 0.4-2.6 m apertures

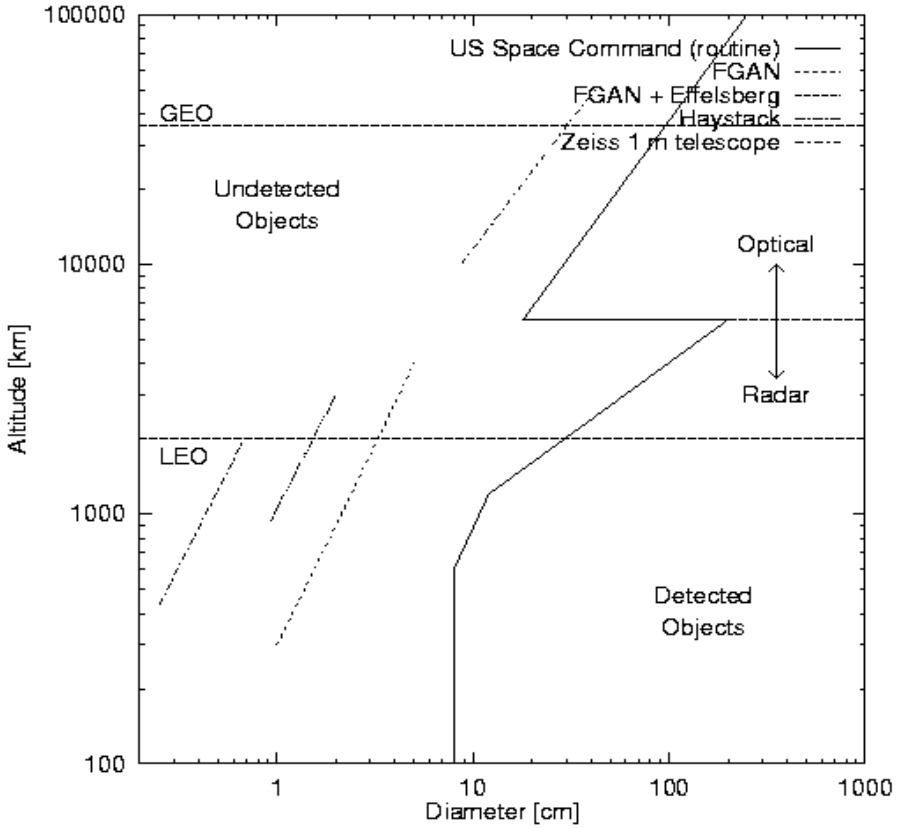


Search and survey subsystem for studying of the bright HEO and LEO objects will consists of 4 telescopes of 12.5-cm aperture with FOV of 15° and 10 telescopes of 25-cm - with FOV of 3°

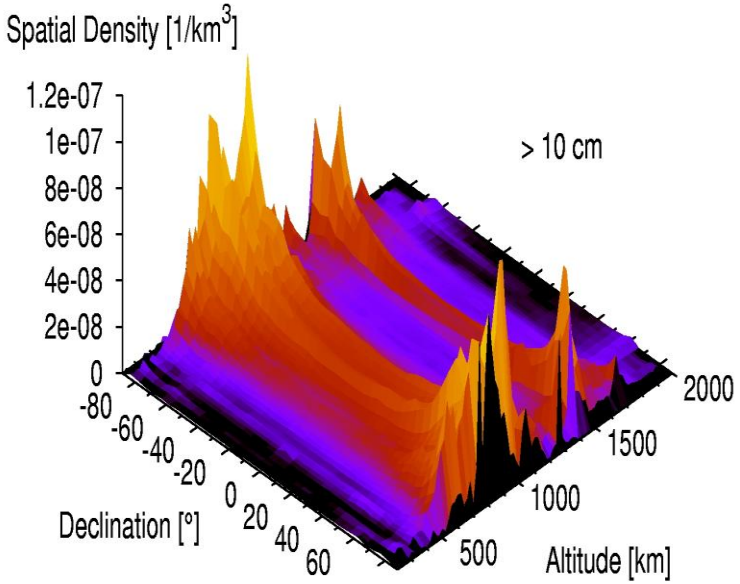


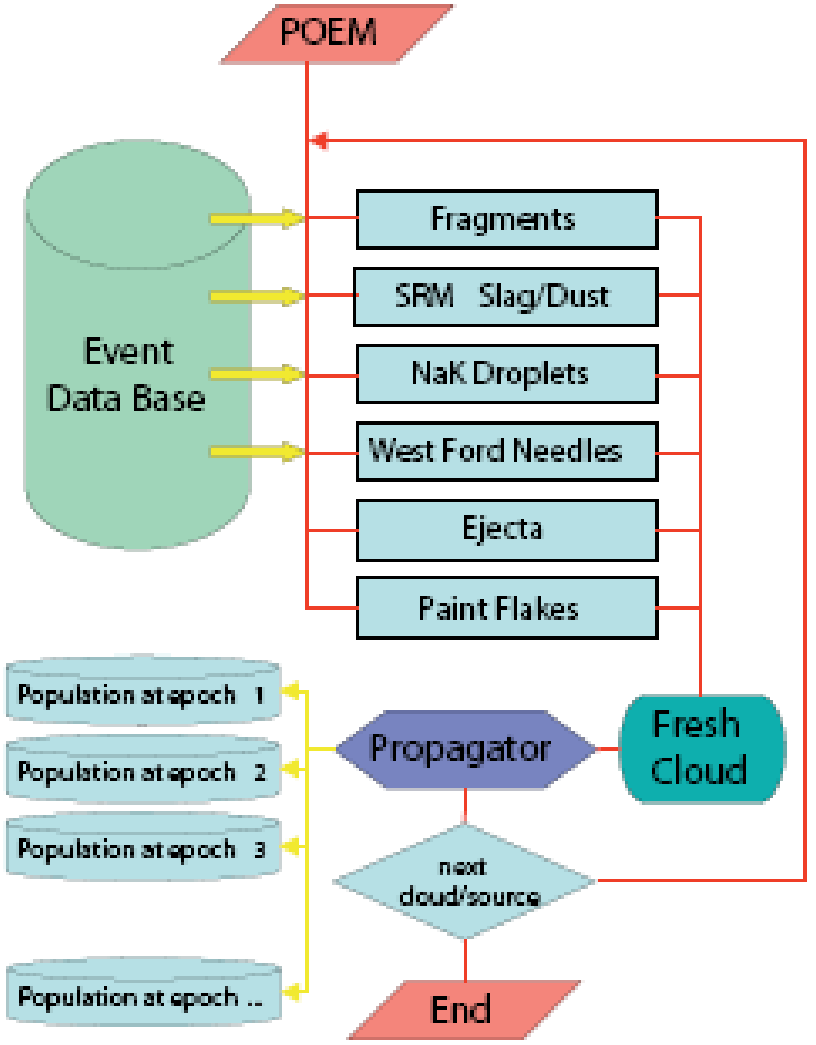

Telescope versus radar



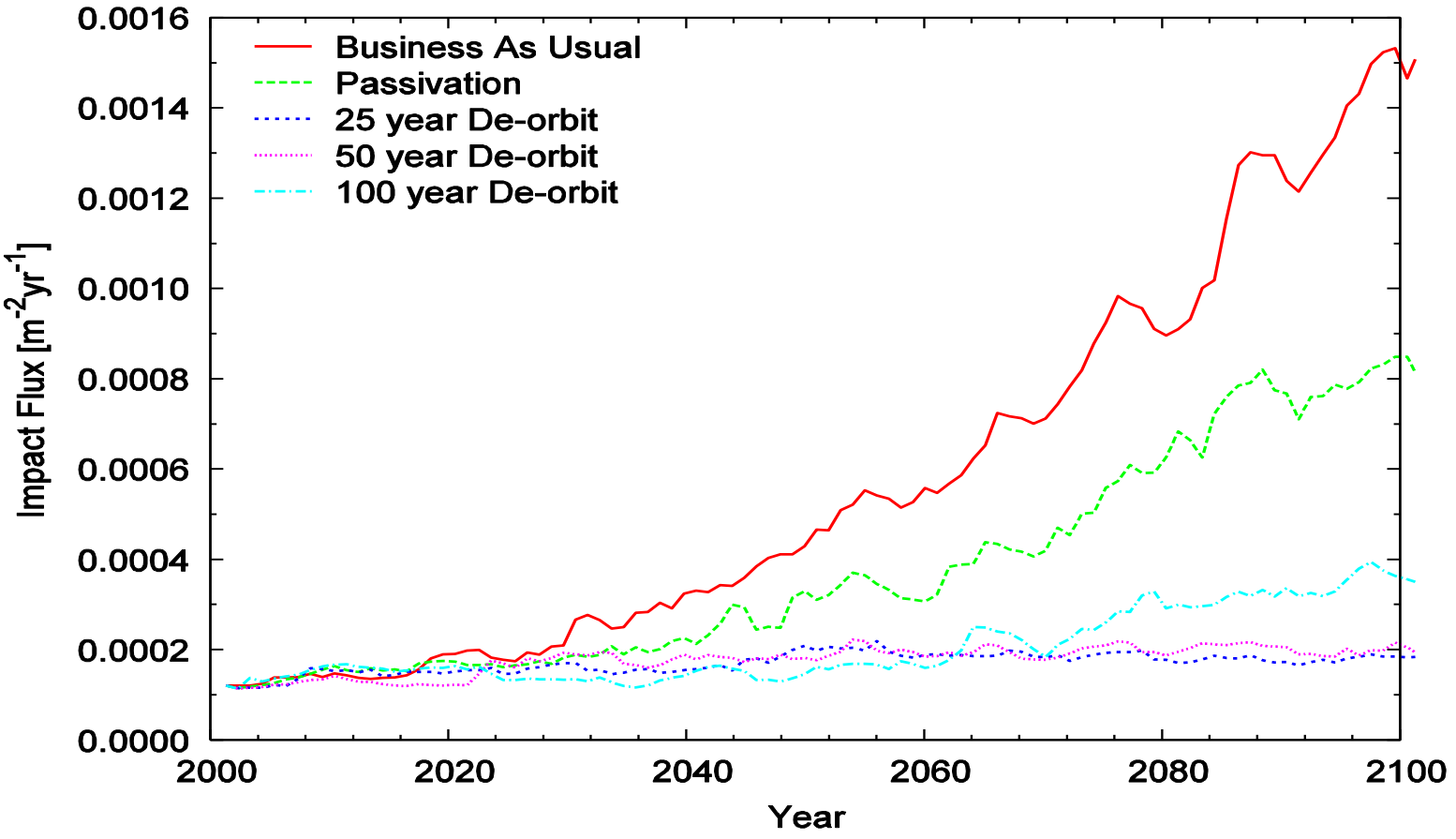
- The use of radar for space debris detection is most efficient below 5,000km
- Above this altitude, especially for debris in GEO, optical methods are used
- In-situ detectors can be flown everywhere, but cover only the orbit of the host satellite and are normally limited in sensitive area

Meteoroid And Space debris Terrestrial Environment Reference Model (MASTER)

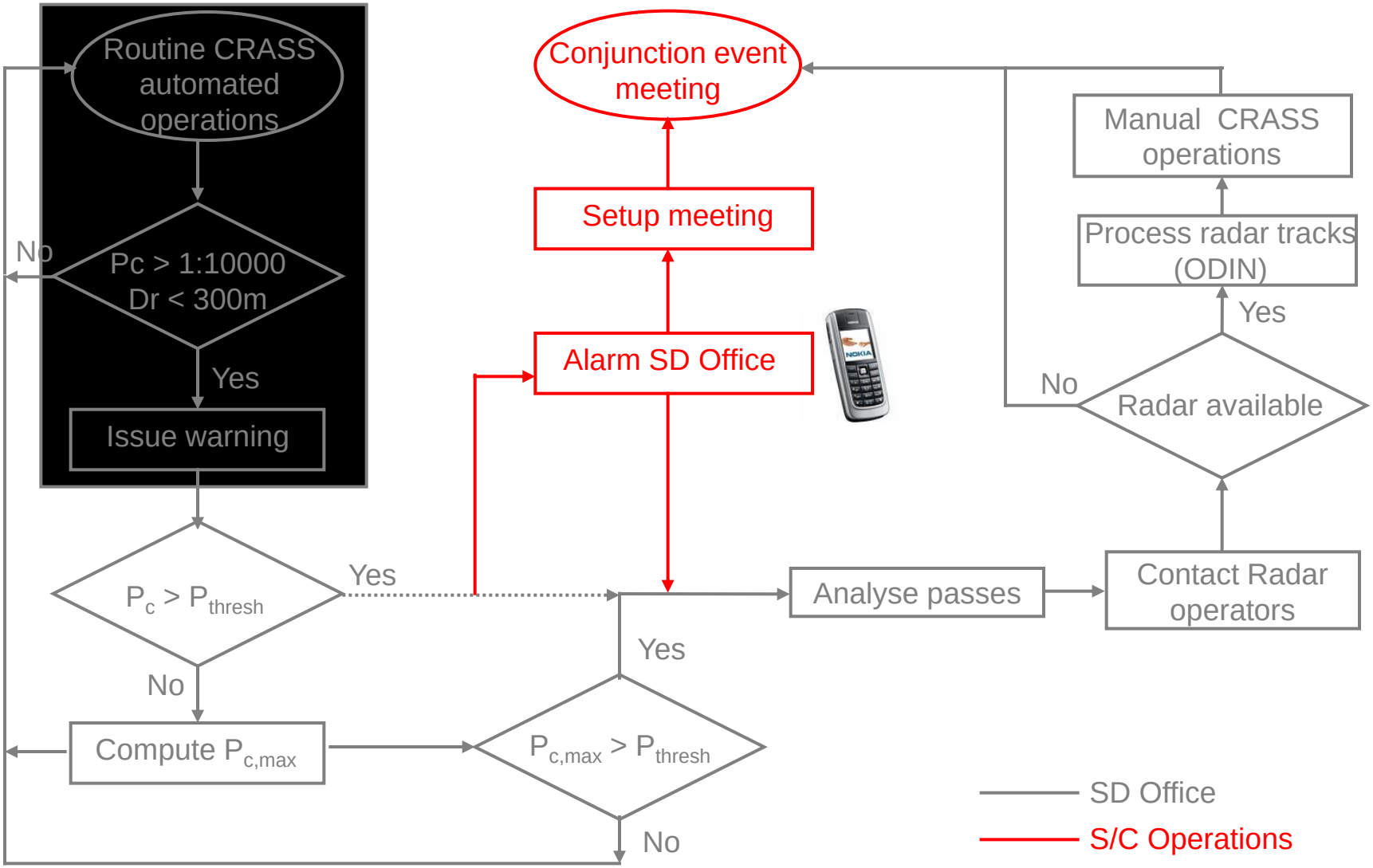




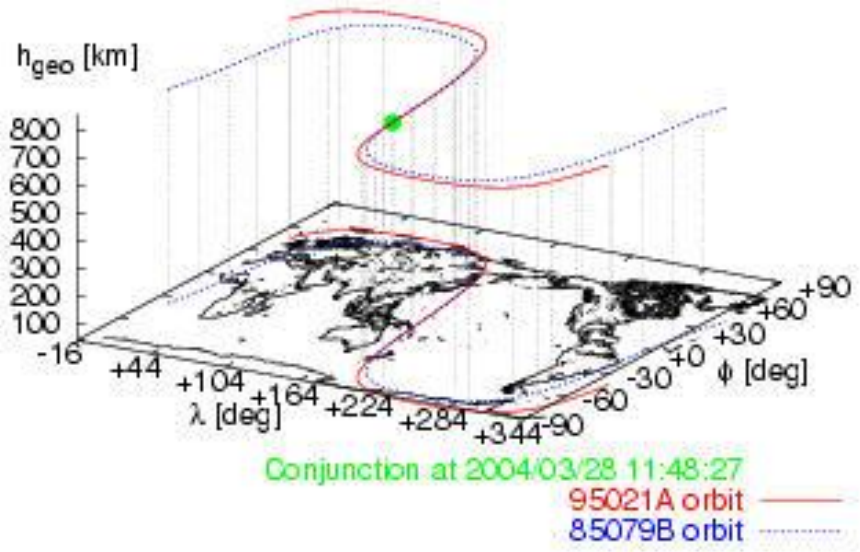
SDM predictions: Impact Flux on a Radarsat orbit (1 cm objects)



Collision Avoidance at ESA



Collision avoidance



- Daily checks for our remote sensing satellites ERS-2 and ENVISAT
- Predicted flyby of ERS-2 at a Kosmos-3M upper stage (1.4 t) at a distance of **170m** on 18 March 2004 at 11:48.
- Collision velocity of 14.8 km/s.
- Avoidance manoeuvre (change in velocity 4 x 6.5 cm/s); new miss-distance > 600 m

Useful web-pages

- **Inter-Agency Space Debris Coordination Committee (IADC):** http://www.iadc-online.org
- **Space debris activities at ESA:** http://www.esa.int/SPECIALS/ESOC/SEMU2CW4QWD_0.html
- **Orbital debris research at NASA/JSC:** http://www.orbitaldebris.jsc.nasa.gov
- **Center for Orbital and Reentry Debris Studies (The Aerospace Corporation):** http://www.aero.org/capabilities/cords/index.html
- **Homepage of ISTI, Italy:** http://apollo.cnuce.cnr.it/debris.html
- **Jonathan's Space Report:** http://www.planet4589.org/space/jsr/jsr.html
- **Space Track:** http://www.space-track.org **(Two-Line-Elements)**
- **ADELTA Legal Space Law:** http://www.spacelaw.com.au