



Near-Earth Object Information Plan - Distribution of information for a credible asteroid impact threat

ESA SSA-NEO team

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1 INTRODUCTION

Near-Earth objects (NEOs) are asteroids or comets with sizes ranging from metres to tens of kilometres that orbit the Sun and whose orbit comes close to that of the Earth's. Of the more than 600,000 known asteroids in our Solar System, more than 13,000 (status October 2015) are NEOs.

NEOs could potentially hit our planet and, depending on their size, produce considerable damage. While the chance of a large object hitting the Earth is very small, it could produce a great deal of destruction. There is the potential, however, to minimise harm because of the predictability of such events, and the opportunity to establish a coordinated response with the international community. For larger objects, in the size range above 100 m, a typical warning time of years would be expected.

This Information Plan defines communication lines and the actions that the European Space Agency (ESA) will take in the event of a credible NEO impact threat to communicate with Member States and other authorities. Although communication with the media and the public will be an important part of the effective distribution in the case of a credible threat, it is addressed separately in a so-called ESA SSA-NEO Crisis Media Communication Plan, which is still to be written.

Two UN-mandated groups, the International Asteroid Warning Network (IAWN) and the Space Mission Planning Advisory Group (SMPAG), are currently defining thresholds for warnings and decisions, and are addressing coherent content of information releases. ESA is an active member of both groups and plans to keep this Information Plan in line with the recommendations of those two groups.

1.1 SSA Programme's responsibilities

ESA's Space Situational Awareness (SSA) programme, and specifically its NEO Segment, is mandated to provide warnings to ESA Member States on potential asteroid impact hazards, including discovery, identification, orbit prediction, and impact effects.

A detailed list of the segment goals is given in the System Requirements (RD01). The document here addresses the following two of them:

- Issue NEO impact warnings and news releases.
- Provide high-priority information. This includes potentially sensitive information such as the corridor of impact locations on ground or the expected energy release.

The SSA Programme's NEO-related activities and products are of purely civil nature. It works in an open scientific environment, syndicating and federating observational data from a large number of European and international sources. The SSA-NEO Segment shares and receives data within this NEO community on observations, orbit predictions and impact risk monitoring.

All data acquired or handled by the SSA-NEO Segment are considered non-classified. No measures or procedures to handle classified data are foreseen. The distribution of high-priority information¹ could be restricted to national authorities of ESA member states.

1.2 Reference documents

RD01: SSA-NEO System Requirements Document, SSA-NEO-ESA-RS-0004/1.5, 12 Dec 2013.

RD02: ESA SSA-NEO Contingency Management Plan - to be written. This will be an ESA internal (restricted) document that sets out the internal ESA processes for information flow and approval. It will also contain contact information for those individuals or organisations that will be informed in the case of a credible impact threat.

1.3 Other related documents

This Information Plan is part of a set of documents that together provide an overview of the services that ESA provides during a credible NEO impact threat. These documents are not yet available. They will be prepared in the near-future.

- NEO Background booklet (working title): Background information on NEOs, terms used by ESA, and relevant entities involved.
- ESA Data Policy of the SSA-NEO Segment: Describes the rules for accessing databases of the NEO Coordination Centre and personal information.
- ESA SSA-NEO Contingency Management Plan: Describes how the SSA-NEO segment interacts with other ESA-internal entities and their data distribution, in particular how data destined for the public are distributed to the Communication Department, and to the International Relations Department (to inform non-ESA member states). This document will also contain the list of contact points in case of an impact warning.
- ESA SSA-NEO Crisis Media Communication Plan: Internal ESA document that contains processes, procedures and timelines for communication to media and public during a credible NEO threat.

¹ 'High priority information is defined in the System Requirements Document (RD01) as: (a) Impact warnings (in advance w.r.t. normal users), (b) Location of impact as a function of time and path including related uncertainties, (c) Impact severity (the amount of energy released by the impact and its associated uncertainties), (d) Maximum Probable Loss incurred by the impact, (e) Mitigation analyses/plans.

2 APPROACH

2.1 Applicability of procedure

2.1.1 *Impact warning*

Informing about a credible impact threat is called “impact warning”. An impact warning will be generated in the following cases:

Discovery of any object with a predicted 1 % or greater Earth impact probability within the next 50 years, whose entry into the Earth’s atmosphere would likely generate a release of energy that could affect:

- Populated areas
- Infrastructure
- Bodies of water or land features
- Satellites, aviation, shipping and other forms of transportation.

The procedure will be active from the identification of the threat until shortly after the impact.

2.1.2 *Information release*

ESA will consider issuing a so-called information release in the following cases:

- Any object whose discovery and/or orbit prediction has generated inaccurate and potentially harmful public information or media attention.
- Any object predicted to impact the Earth’s atmosphere and create a visible phenomenon, but which does not generate a release of energy sufficiently high to cause potential impact damage.
- Any object that makes a close approach to Earth that could be of special interest, e.g. if it passes within the geostationary distance or becomes easily visible from the ground.
- Any object with an impact probability greater than 1 % and an impact within the next 50 years, with regard to a body other than Earth (e.g. Moon, Mars, Jupiter, etc.).
- Observation of very bright fireballs that have caused public or media attention.
- Any object deemed of sufficient scientific/media/public interest by the SSA-NEO Segment, if needed in coordination with the applicable ESA services.

In all other cases, ESA will distribute information on an object in its usual way, i.e. in accordance with the Data Policy.

Depending on the outcome of discussions within the IAWN, the related ESA criteria for the release of impact information could be modified in the future.

2.2 Guiding principles

Given the open nature of the NEO community, with information and observations shared via public platforms, it has been shown that the NEO community and media learn quickly about any potential impact threat.

ESA's role is to provide factual and reliable information with which the scientific community, political entities and national disaster management agencies in Member States can make informed decisions. The actual response to the threat will be the task of the emergency response agencies of the Member States.

Information distribution will be handled strictly in collaboration with Member State national or international bodies.

ESA will handle communication on a NEO impact threat differently depending on the time to impact and the scale of the potential damage, as outlined in 2.3 and 2.4.

ESA will offer technical assistance and ensure that political entities and disaster management agencies are provided with relevant information.

This plan is based on the general principle that communication to ESA Member States and their designated bodies (national emergency response agencies, civil protection authorities, etc.) is the responsibility of the SSA Programme, while communication to the general public and media is the responsibility of the ESA Communication Department.

2.3 Procedure in the event of a credible impact threat

In the event of a credible NEO impact threat as defined in Section 2.1.1, the following procedure will be applied:

1. When a credible impact threat is identified, the data are validated by an independent source (e.g. NASA's Jet Propulsion Laboratory (JPL) or another independent European source) before publication.
2. The SSA-NEO segment publishes orbital information for the NEO and information on a potential impact (at least the impact probability and time) on its website <http://neo.ssa.esa.int>. This will be essentially the same information provided for all known NEOs with non-zero impact probability.

3. The SSA-NEO segment calculates the potential impact zone on ground and the expected energy release, including uncertainties. If possible, the results will be validated by an independent source before publication.
4. The SSA-NEO segment calculates impact effects on ground including uncertainties (as far as its capabilities allow). Best and worst cases will be given.
5. The SSA-NEO segment prepares information for each of the following target groups:
 - I. The relevant political entity(ies)²
 - II. Emergency response agencies
 - III. The media/public.

The following information (including uncertainties) can be expected from ESA. In some cases, only part of this information will be available:

- (a) Orbit prediction
- (b) Astrometric (position) measurements
- (c) Impact probability
- (d) Impact time
- (e) Size/mass estimation
- (f) Impact velocity
- (g) Impact energy estimation
- (h) Spectroscopic observations / estimate of material
- (i) Predicted impact zone on ground
- (j) Potential impact effects on ground.

6. This information will be distributed as an 'impact warning'.
 - a. For the dissemination of NEO threat information for target groups I and II, ESA will follow a previously-established internal process as described in RDo2. These target groups will be provided with priority with all available information (a) to (j).
 - b. For any communication to media/public (target group III), information items (a) to (f) may be provided in accordance with the Crisis Media Communications Plan.
7. ESA will subsequently provide updated information regularly on the impact threat in coordination with other cooperating NEO and related organisations³. The update intervals will depend on the time until impact:

² 'relevant political entities' are decision makers, e.g. government agencies that decide in coordination with their emergency response agencies on mitigation measures.

If the impact is more than 3 months away, information will be generated whenever new information is available.

For times closer than 3 months, the following rules are defined in the System Requirements Document: (RDo1):

- (a) At least every 24 hours if the impact threat is less than 3 months and more than 1 month away.
- (b) At least every 12 hours if the impact threat is less than 1 month and more than 2 weeks away.
- (c) At least every 3 hours if the impact threat is less than 2 weeks away.

It will not always be possible to provide new information on a regular basis. In that case, an estimate of when new information will be available will be given.

8. After the impact has happened, ESA will provide, within the SSA-NEO Segment's area of expertise, technical assistance to Member States and their nominated disaster management agencies. In particular, the following information will be provided:
 - Confirmation of the precise time and location of the impact
 - Estimate of the size and energy release of the impactor
 - Possible other measurements available to ESA.
 - ESA will hold a 'lessons learned' debriefing with emergency response agencies.
9. In all of the above steps (1. - 8.), the ESA Communication Department will maintain a close liaison with the SSA Programme, in particular the SSA-NEO segment manager and the SSA Programme Manager, and conduct relevant communication activities and release relevant information to media and general public as authorised by the Head of ESA Communication.

2.4 Procedure for an information release

In the case of an information release as defined in Section 2.1.2, the following procedure will be applied:

1. The SSA-NEO segment calculates relevant information on the object. This could be the closest fly-by distance or impact point/time, depending on the type of the object. It could also be a confirmation that no special event is expected.

³ At least the UN-sanctioned International Asteroid Warning Network (IAWN); the NASA NEO office; agencies dealing with disaster management at European or UN level, air traffic controllers.

2. The SSA-NEO segment prepares information for each of the following target groups, if needed:
 - I. The relevant political entity(ies)⁴
 - II. Emergency response agencies
 - III. The media/public.
3. This information will be distributed as an information release. This could be a special item on the SSA-NEO technical web portal, on the ESA portal, or directly sent to affected parties.

2.5 Distribution of information

ESA will establish and maintain distribution lists for impact warnings and information releases. These lists will be part of RDO2 and include:

- Points of contact per Member State, including points of contact in the relevant national disaster management agency or other organisation, as identified by the Member State delegation
- IAWN members
- Other national or international bodies, e.g. agencies dealing with disaster management at European or UN level, air traffic controllers.

ESA will appoint a single contact point within the Agency who will act as the interface for the above authorities.

2.6 Information to non-member states

In the case that a non-Member State could be affected by a credible impact threat, ESA will make available relevant information to its contacts in the non-Member State in question via the International Relations Department.

2.7 Liability

ESA makes data and expertise generated in the frame of the SSA optional research and development programme available to Member States entities on a non-exclusive basis, but will not assume the role of a service provider. While ESA's own management objective is a maximum level of technical availability, performance and accuracy of the information provided,

⁴ 'relevant political entities' are decision makers, e.g. government agencies that decide in coordination with their emergency response agencies on mitigation measures.

- There is no guarantee of permanent availability of space hazard information,
- Space hazard information is provided “as is”, and ESA disclaims any and all warranties, either express or implied, as to the condition or suitability of the information and services, or their fitness for a particular purpose.

Furthermore, the nature of space hazard predictions implies that they describe varying degrees of risk rather than events and consequences that are certain to occur. The ESA NEO Segment as part of the SSA programme can at best predict with varying degrees of confidence that a certain area may be affected by an impact. Any announcement will therefore contain language explaining the initial uncertainties and the tentative nature of any predictions of the NEO’s trajectory and shall be described in varying degrees of risk rather than events and consequences that are certain to occur. The sole responsibility for interpretations, conclusions and consequences drawn from ESA-provided information lies with the user. ESA will in no event be liable to users or to any third party for any direct or indirect damage resulting from any use or misuse of this data.

Overall, the aim will be to avoid placing unnecessary constraints on users concerning the information provided by ESA. Yet there may be certain limitations, in particular concerning the redistribution of the alert information (non-commercial, acknowledgment of source).

3 CONCLUSIONS

With the progressive growth of its NEO segment, ESA’s SSA programme acquires the capacity to issue warnings on potential asteroid impact hazards, including discovery, identification, orbit prediction and civil alert capabilities. This Information Plan defines cases in which impact warnings or other related information would be issued, the type of information to be provided, and the addressees. The internal approval process and detailed distribution lists are defined in a separate internal ESA document (RD02).