Legal Aspects on the Use of Satellite Images for Disaster Relief and Humanitarian Services

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Although no case law has occurred related to misinterpretation of satellite images causing damage or harm to a person in Europe, the inappropriate or lack use of information to respond to disasters and protect citizens has been presented at court such as the Aquila Case in Italy. This risk is more present as satellite images can now be at the disposal to any actor, due to the open and free of charge data policy in place by the Copernicus Programme (former GMES) or the US Landsat Programme. Possibilities of risks such as misinterpretation of data or other possible mistakes due to human error could rise if this interpretation is not done properly.

This paper focuses on the interpretation of the law and its legal grounds on the use of satellite imagery by public services aimed to respond to security of citizens in case of a natural disaster occurs and the possibility of failure to do so. The Aquila case law will be used as a law precedent on liability applied to public security services and how its adjudication could affect emergency services that use satellite imagery, such as the Copernicus Program Service on Emergency Response the EMS. due to its nature of open data policy and emergency service provision.

Keywords: Space law, earth observation, Copernicus, liability, disaster, refugees.

1. Introduction

The nature of digital imagery easily exposes satellite data to intentional and unintentional errors.[1] In some cases, if image enhancement and interpretation is manipulated manually, human errors could come into place related to image processors assumptions and interpretation.[2] The process of satellite imagery analysis and map production requires a high level skill and expertise for effective and accurate data dissemination. Moreover, on disaster relief

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1 Ito, A, Legal Aspects of Satellite Remote Sensing, Martinus Nijhoff Publishers, Leiden, 2011.

2 *Ibid.*

and humanitarian aid phases, the process is technically challenging because of the strict time constraints and special skill sets demands, at the same time as coordination among disaster responders.[3]

In addition, the lack of an international legal framework on unified mechanisms, or standards on the reliability of satellite imagery process related to collection and interpretation of information could lead to risks on reliability of the accuracy validation and information generation. As a consequence, it could impact on the situational understanding and decision-making, due to the fact that information is the foundation on which decision making is developed for a coordinated and effective response on disaster response.[4]

The main phases of satellite imagery manipulation known globally by satellite emergency mapping are 1. Satellite image acquisition and pre-processing (provided by satellite operators, in our case the Sentinel constellation and its contributing missions), 2. Image analysis and information extraction and 3. Elaboration of geo-information products or value added products[5] (provided by emergency institutions). The last two phases are key phases on the incurrence of possible inaccurate information or misinterpretation that can lead to delays or damages on a crisis management.

2. Satellite Imagery Process and Interpretation: Mistakes Are Human

Regarding misinterpretation interfering with the efficient development of assistance, it is useful to refer to the Pakistan flood in 2010 example, when several satellite based emergency mapping products were produced by different initiatives. The main concern of the users was the accuracy during the recovery phase or post-disaster phase due to the inconsistency of the products by showing different extents of affected areas, such as the extend of flooding.[6] In this case, no reported damage or legal claim was reported. Another example on distributing inaccurate information occurred in Huaraz, Peru when NASA misinterpreted a satellite image raising false alarm of a flood threat originated by a possible ice avalanche's falling into the Lake Palcacocha, Peru. This alarm originated panic to the population causing economic damage of around US$ 20 million in the regional tourism industry.[7]

3 Voigt, Stefan et al., Global trends in satellite-based emergency mapping, Review (2016) 247-260.

4 Mashfiq, K, Efficient Emergency Response Using Earth Observation, UNITAR. International Training Workshop on Natural Disaster Reduction (2016).

5 Idem.

6 Voigt, Stefan et al., Global trends in satellite-based emergency mapping, Review (2016) 247-260.

7 Orlove, Ben et al., Darkening Peaks, Glacier Retreat, Science and Society, University of California Press, Los Angeles, 2008.

Despite the damages caused, no legal claims were held on the previous cases. Despite the assumption that emergency services shall not be held liable in case of damages of harm due to its humanitarian nature under good faith, a lawsuit was presented on the national courts of Italy holding liable civil workers who supported the Italian Civil Protection Agency during an earthquake evaluation.

In considering a possible claim on liability against disaster relief services it is important to refer to the case Barberi e a., Giud. Billi (known as the L'Aquila earthquake case) on the 2009 earthquake in the province of L'Aquila. An earthquake of 6.3 on scale Richter occurred in L'Aquila, Italy, in which seven scientists of Italy's National Institute of Geophysics and Volcanology (INGV), organization that works closely with the Civil Protection Agency, were held liable of homicide and multiple injuries[8] by the public prosecutor facing the charge of incorrectly reassuring information.[9]

This is the first time a lawsuit was placed to scientists (defendants) members of an emergency relief institution during an emergency relief management. We consider important to analyse the legal reasoning of the court regarding emergency services liability adjudication and how this judgement could influence in a future case involving satellite imagery information management.

3. The Role of Law in Emergency Services

3.1 L'Aquila Case Law

In 2012 the Italian First Instance Tribunal (Tribunale di L'Aquila) held seven scientists liable for homicide to six years of imprisonment and perpetual interdictions from public offices under their failure to follow their responsibility to conduct a proper analysis and risk assessment as fundamental to provide *proper information* in respect of civil protection[.] An appeal was filed to the Supreme Italian Court reverting the initial judgement holding favorable six of the seven defendants. The court's decision held one defendant guilty for two years of imprisonment.

On 31 March 2009 before the earthquake, the seven scientists were required to explain to the civil protection[10] authorities in first instance, to deliver an objective assessment and prediction based on the available information at hand in order to discuss and provide guidance on warnings to the population.

The president of the Major Risks Committee assisting the Civil Protection Agency Mr. De Bernardinis and Barberi, made a public media announcement

8 Barberi e a., Giud. Billi., Tribunal di L'Aquila, 22 October, 2012.

9 Corte d'Appello dell'Aquila, sent. 10 novembre 2014 (dep. 6 febbraio 2015), n. 3317, Pres. Francabandera, imp. Barberi e.a.

10 Idem.

reassuring the residents of L'Aquila of no threat of a shock and therefore no need for the population to evacuate their homes. De Bernardinis and Barberi, acting president of the Major Risks Committee, an expert group that advises the Civil Protection Agency on the risks of natural disasters, held a press conference in L'Aquila stating: "the scientific community tells us there is no danger, because there is an ongoing discharge of energy. The situation looks favorable".

This press conference took place a day before the earthquake that killed 309 and 1,600 injured originating an estimated economic loss of €10bn.[11] Survivals argue that due to this inaccurate public announcement, the victims decided to stay indoors instead of evacuating their homes.

In order to determine non-contractual liability on the defendants, the Court raised the question, which is particularly of our interest, did the conduct of the defendants violate their obligations regarding their responsibility and liability on accurate prediction, prevention and risk analysis?

The Court determined two profiles of responsibility to determine the liability of the defendants. The first profile was *the quality of the content* of the scientific analysis carried out by the defendants during the meeting held with the civil protection authorities and the second profile, was the possible liability of *information activities* to the population. Our interest is to focus on the description and analysis of the first profile.

The Court evaluated the *quality of the scientific analysis and assessment* carried out by the defendants based on the question can the assessment of the defendants *be evaluated* as scientifically wrong and therefore unduly reassuring? To answer this, the Court held a "correct scientific assessment"[12] taken by the defendants during the meeting with the civil protection members and limited themselves to base their answer regarding the matter of forecasting earthquakes on the historical data collected. The minutes of the 31 March meeting reveal the statements of the defendants: "no danger" of a big quake. "A major earthquake in the area is unlikely but cannot be ruled out," Boschi said.

Selvaggi is quoted as saying that "in recent times some recent earthquakes have been preceded by minor shocks days or weeks beforehand, but on the other hand many seismic swarms did not result in a major event". Eva added that "because L'Aquila is in a high-risk zone it is impossible to say with certainty that there will be no large earthquake". Summing up the meeting, Barberi said, "there is no reason to believe that a swarm of minor events is a

11 Codogno, Lorenzo, Italy's earthquake: estimating the economic and financial damage, 8 August 2016 http://blogs.lse.ac.uk/europpblog/2016/08/31/italy-earthquake-financial-damage-economic/ (accessed at 12.09.2017).

12 Corte d'Appello dell'Aquila, sent. 10 novembre 2014, n. 3317, Pres. Francabandera, imp. Barberi e a. p. 182.

sure predictor of a major shock",[13] and therefore revoking the public prosecutor accusation of providing "generic, ineffective and approximate" information.[14] Hence, the court declared there was *no prove of fault* of the defendants as per lack of evidence on misconduct on their provision of their obligations,[15] but only the fault of the public civil servant Bernardo De Bernardinis who communicated in a negligent and imprudent way to the population by providing such announcement without sufficient knowledge under his nature of having an 'operating role' without technical skills.[16] Moreover, the Supreme Court reaffirmed the judgement of the Appeal Court by declaring "there was *no causal link* nor concrete elements of investigation able to formulate reliable and concrete predictions about the use of any causal connections between suspicious conduct and incidental events".[17]

In the case at hand, the public prosecutor of the Italian First Instance Tribunal focused their main argument on the role of the use of all information possible as a key tool in case of emergencies. In the court's reasoning, the lack of availability of information, among other factors, could have been the causality of damage or injury of a person, as the defendants disposed of it but used it inefficiently. Even though this case is ruled by criminal law, it is of our attention to review the informal reasoning of a court in Europe regarding the use of information as a causality of harm or damage.

On the other hand, the Supreme Court rejected the arguments of the First Tribunal finding them not liable, declaring the defendants behaved properly and managed information accordingly to all the scientific knowledge at their disposal. If we do forward thinking and create a hypothetical case in which a damage or harm is occurred by an emergency service based on a satellite imagery, it would the under the judge discretion to make the judgement based on the current norms and legal cases rationales. On the next section we will explore which regulatory framework regarding EO technology a judge dispose in order to adjudicate a case of this nature.

3.2 Adjudicating Liability for Misinterpretation of Satellite Information: Looking for Suspects

Despite the belief that neither the provider nor the distributer could be held liable for any damage or harm derivate from any risk on the processing and analysis of the images, due to the nature of the service, which is humanitarian, based on good faith and the nature of the satellite imagery by being free and accessible, it will depend on the discretion of national courts

13 Nosengo, N, Italy puts seismology in the dock, 22 June 2010. www.nature.com/news/2010/100622/full/465992a.html (accessed at 12.09.2017).

14 Corte d'Appello dell'Aquila, sent. 10 novembre 2014, n. 3317, Pres. Francabandera, imp. Barberi e a. Section 5.

15 Idem.

16 Idem, Corte d'Appello dell'Aquila, section 4(a).

17 Cass., sez. IV, sent. 19 novembre 2015, n. 12478/16. Barberi e a. p. 46.

to determine a non-contractual liability, as currently there has been no case law of this nature. Furthermore, there is no EO legal framework that regulates nor supervise EO activities.

One of the consequences on this is the uncertainty particularly on the development and distribution of EO value-added products. Users as well as third parties face risks of damage arising from possible incorrect data.[18] The lacunae of space law might be originated due to the progressive use of EO activities impacting social activities that were not before.

On an international law regime, the Outer Space Treaty (OST) Article I[19] provides among other principles the freedom of scientific investigation in outer space, including the Moon and other celestial bodies, as well as international cooperation among States, meaning while the moment of drafting the Treaty it was interest of states to keep away military activities on space. EO activities are under the scope of Article I as they implicitly should be carried for peaceful purposes and be allowed to take place under the principle of freedom of scientific activities by states while enhancing international cooperation among other states.

OST Article III[20] provides the legal framework of space activities in accordance with international law for peaceful and security purposes. We can say it relates to EO activities not only because they should be carried out for peaceful purposes but also it gives the possibility of being used for security purposes. The security concept has been advanced progressively changing aspect on its definition in the recent years. It can be said that EO activities can be pursued under security purposes as is the case of Copernicus falling under the justification of OST Article III but once more it does not say how this should be regulated.

Regarding responsibility and liability of space activities, the OST under its Article VI[21] establishes the state as being responsible in conducting such activities that could lead into international liability for damage caused to other states. The liability topic will be further developed under the 1972 Convention on International Liability for Damage Caused by Space Objects (The Liability Convention).[22] The only liability regime that involves space technology use is established under this legal document, which regulates any damage caused by a space object as per Article III, in which this will not be

18 Ito, A, Improvement to the legal regime for the effective use of satellite remote sensing data for disaster management and protection of the environment, Journal of Space Law Vol. 34 No. 1, University of Mississippi School of Law (2008) p. 45-67.

19 United Nations, Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. 1966.

20 Idem.

21 Idem.

22 Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972.

applicable for EO activities as is not considered satellite images as a space object.

The OST indeed provides a regulatory framework for the justification and use of EO activities, but not for the liability of their products in order to protect victims. The same case as the Liability Convention which provides a framework for activities taken by space objects but not its derived products, such as satellite images and value-added products. The only space legal document referring specifically to EO activities will be the UN Remote Sensing Principles. However, it provides *only* to states the legitimacy to carry out remote sensing activities by providing to other states data availability under a non-discriminatory manner to all states as per its Principle IV "[r]emote sensing activities shall be conducted in accordance with the principles contained in article I of the Outer Space Treaty (…)". However, the *Corpus Juris Spatialis* remains silent on a possible risk of damage arising from incorrect EO data, leaving unprotected data suppliers bearing the liability risks to them.

Liability still remains an obscure topic due to the inexistence of a legal framework for EO activities. Nowadays, it still remains the ambiguity over the responsibility and liability arising from supply and/or use and misuse of data from value-added products.[23] Hence, in case of a damage occurred by a value added product derived from satellite information, the only legal resource possible will be national laws under their civil liability legal systems held by the discretion of the judge.

On a regional law regime, it is worth to mention the case of the EU as it involves the Copernicus Programme and its relationship on the use of EO. The EU is the only regional regime with a EO regulatory framework for the Copernicus Programme under a set of regulations and EU Directives related to the share and management of digital information. However, national legislations prevail in terms on regulation of EO activities based on the nation's interests and capabilities. Therefore, in a possible liability case in Europe, the lack of the international and regional regulatory regime could lead the judge to use national legislation. As a consequence, it will cause uncertainty of legal verdicts due to the plethora of Member States' legislations.

On the next section we will focus our attention on the EU technological efforts on the development of emergency services and its legal implications regarding possible non-contractual liability and the transposition of how a court could adjudicate a liability case based on the Italian national judgment of L'Aquila.

23 Ito, A, Improvement to the legal regime for the effective use of satellite remote sensing data for disaster management and protection of the environment, Journal of Space Law Vol. 34 No. 1, University of Mississippi School of Law (2008) p. 45-67.

4. The Copernicus Case Hypothesis

Liability issues can come from the misuse of the provided information at a later stage on the dissemination[24] phase, in which decisions could be made based on erroneous information. In practice, we will take as an example the Copernicus Emergency Service (EMS) of the Copernicus Programme due to its nature of open and free data policy for emergency services in case of natural and human made disasters. The Copernicus Programme services and its open data policy is stated on its the EU Regulation, No 377/2014 or the Copernicus Regulation ((EU) and its Regulation (EU) No 1159/2013 establishing registration and licensing conditions for users and defining criteria for restricting access and service information.[25]

The Copernicus Emergency Management Service (EMS), is one of the six services of the Copernicus Programme[26] under the management of the European Commission and the Joint Research Centre (JRC). The EMS creates mapping services and value added products distributed freely without restrictions to its registered users.[27] It provides assistance to actors involved in the management of natural disasters, man-made emergency situations and humanitarian crises, with timely and accurate geospatial information.

Some factor that can contribute to legal aspects different from a normal value added product development are: 1) *The quality of the data*: In normal situations, developers have extended amount of time to pass through a quality control while producing the products without time restriction. In emergency relief situations, time is crucial and therefore the quality process could be at risk. Even though there is not a homogeneous standard for satellite value added products, institutions who produce them comply with a quality standard such as the ISO 9001 certification and 2) *The temporality of the data*: linked with the previous factor, the satellite images received and the desirable immediate time of response to disasters lead to few validation process.

In our case, it will be likely that the JCR be in charge of the EMS complies with a quality standard in order to provide reliable value-added products. Certainly the JCR and the EC comply with levels of control and validation throughout the production process. 2) *The temporality of the data*: linked

24 Voigt, Stefan, *Supra* idem.

25 European Commission, Regulation (EU) No 1159/2013 of 12 July 2013, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32013R1159 (accessed 10.8.2017).

26 The Copernicus Programme services take information from its satellite constellation the Sentinels and also with the aprox. 30 contributing missions from the Union's member states EO assets and other third party mission operators [27] on a sustained basis, reliable and timely basis [28].

27 European Commission, Copernicus Emergency Management Service, http://emergency .copernicus.eu/, (accessed at 9.9.2017).

with the previous factor, the satellite images received and the desirable immediate time of response to disasters lead to few validation process like other Copernicus services. As the disclaimer mentions: "(…) It is our goal to minimize disruption caused by technical errors. However, some data or information on our site may have been created or structured in files or formats that are not error-free, and we cannot guarantee that our service will not be interrupted or otherwise affected by such problems. The Commission accepts no responsibility with regard to such problems incurred as a result of using this site or any linked external sites".[28]

Geo-reference maps should be produced in short term time creating a risk of liability to providers in case of partially incomplete or inaccurate information in the phases of analysis and map production could be generated and distributed. The EMS states this risk under the waiver of liability if "the information is not necessarily comprehensive, complete, accurate or up to date."[29]

To respond to these risks, the Copernicus Programme services provides a disclaimer for each services under its legal notice. It should be noted that not all the disclaimers are the same, but are provided by the EC to the EEE's published under their dissemination platforms. On these disclaimers, the EC accepts no responsibility or liability whatsoever with regard to the information on their EEE's dissemination sites.[30] It hence, exalts the no *contractual (expressed or implied) warranty* on the quality and suitability for any purpose of the products as per the Regulation (EU) No 1159/2013 Art. 3 and 9 as well as on the Legal notice on the use of Copernicus Sentinel Data and Service Information of the EC. However, it is of our attention to note that the "best effort" clause usually used for these kind of emergency services reaffirming only a moral duty of a state to contribute in humanitarian reliefs and avoiding any possible legal duty to do so is not stated on the EMS disclaimer nor on the Copernicus Regulation.

The only legal solution a judge could review related to emergency services is the Aquila case law providing a solution on a claim where the failure on protecting welfare of citizens was at stake. The reasoning of the court holding liability was based on the elements: 1. *the scientific quality* of the content carried out and 2. *the level of scientific assessment* taken.

Furthermore, if this case is taken into a national court, the elements the judge will look after are likely to be the non-contractual liability elements: 1. determining fault, 2. foreseeability of harm, 3. reasonableness of the alleged party causing damage, 4. scope and definition of defences (force majeure, disclaimers).

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28 European Commission, EMS Disclaimer, https://ec.europa.eu/info/legal-notice_en, (accessed 10.8.2017).

29 Idem.

30 Idem.

The foreseeability of harm is highly unlikely to be predicted in matters of emergency relief. The reasonableness causing damage is also unlikely as satellite information is a tool given to assist in a decision making process. It is important to note that it is not the satellite information that will cause a damage *per se*, therefore not the satellite data provider nor the geo-referenced map-maker, only the interpretation and management of the information, as per the Aquila case reasoning. In this element, it would be a possibility that the process on how the satellite information was processed, analysed and if producers have in hand the possibility to see if a foreseeable care was at their disposal under a quality process. However, there is no regulation that gives the provision of a data structure process. The EMS institutions should possess a high level of care and international standards that involve the analysis and production of value added products. Finally it will be under the discretion of the court to determine if the waiver of liability of EMS in which states no liability in case of damage as is information without a guarantee nor specific purpose will be sufficient. All these elements could be taken into consideration by a judge in case of adjudication of fault.

5. Conclusions

The EC has shown its engagement on the environmental and security issues, such as the flux of immigrants and protection of environment. To this end, the EC along with ESA established a technical programme, such as the Copernicus Programme with 6 services, in which the Emergency Management Service is located for disaster relief and humanitarian aid. Due to its open access data policy the satellite imagery of the Sentinels and the contributing missions is available free of cost for registered users only, which usually are civil protection and governmental institutions.

Value added products are the main tools end users will be based on while elaborating their decision making during humanitarian crisis and disaster management. Therefore, the process of image analysis and elaboration of value added products is crucial for efficient responses. However, mistakes can arise on these two phases originating in inaccurate interpretation and misinterpretation. Other possible causes can origin in harm or damage such as possession of information that could have helped in a disaster response and couldn't be distributed on time.

In this paper we explored the hypothesis of liability in case of damage or harm based on the argument of management of information based on the Aquila lawsuit in Italy, and transposed it to a possible scenario using satellite imagery and value added products under the EMS. As there is no legal regime that regulates EO activities, neither in the international law, nor on European level and not on the Copernicus legal framework, it is likely that a non-contractual liability case will be ruled under national laws under their civil liability legal systems held by the discretion of the judge and possibly under

the EU Directives. This option will lead to the uncertainty of legal verdicts due to the plethora of Member States' legislations.
In case of the possibility of EMS third party liability, the possibilities of holding liable a provider or distributor of a value added product will be less likely as it should have to be determined the fault of the distributor, the reasonableness of the alleged party causing damage, foreseeability of harm and scope of defences. Determining fault and foreseeability of harm is likely to be difficult to prove. Regarding the reasonableness to cause damage, we base our reasoning on the possible fact the institutions comply with a high level of care through the commitment of quality standards in order to minimize any possible error on the processing and analysis of satellite imagery. Lastly the disclaimer stated on the EMS will be up to the discretion of the judge to give value or not to it. Until there is no regulatory regime, at least under the Copernicus programme, which remains silent to this aspect, it will be up to the discretion of the judge to adjudicate non-contractual liability, or not to the stakeholders of Copernicus.

6. Appendix: A EMS Disclaimer

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