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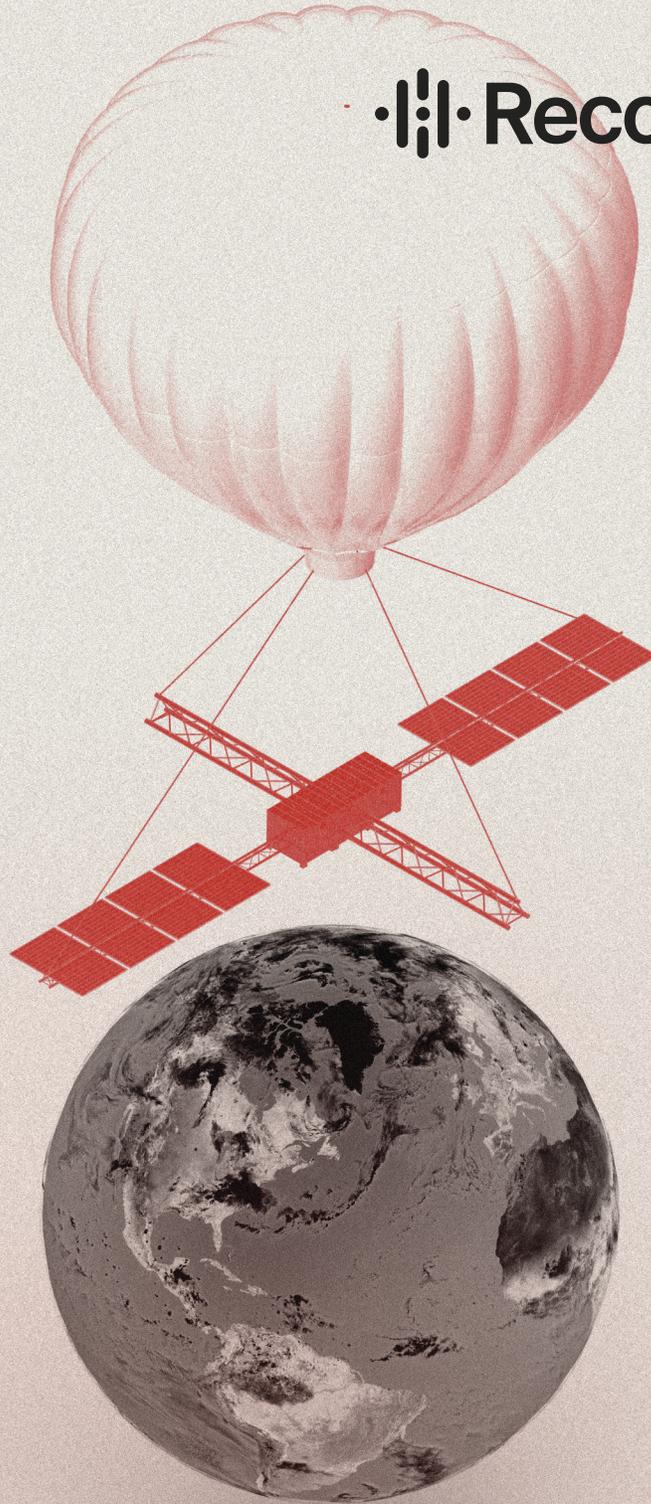
CHINA

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By Insikt Group<sup>®</sup>

September 26, 2023

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# Near-Space in China's Military Strategy: Strategic Reconnaissance, Precision Strike, and Battlefield Advantage

## Executive Summary

The appearance of a Chinese high-altitude surveillance balloon over United States (US) Minuteman III strategic intercontinental ballistic missile silos in Montana in early 2023 put a spotlight on People's Liberation Army (PLA) interest in the use of new and non-traditional platforms for military activities in near-space — the region between 20 km and 100,000 km above Earth's surface. Since at least 2005, PLA and Chinese defense industry analysts have proposed deploying near-space flight vehicles (NSFV), including balloons, aerostats, and hypersonic platforms, to support military intelligence, surveillance, and reconnaissance (ISR). NSFVs are further valued for their direct and indirect roles supporting precision strike operations, and Chinese analysts argue they should be used for electronic warfare, communications, and logistics. All told, the demonstrated and theoretical capabilities of NSFVs likely have the potential to enhance PLA lethality, increase operational flexibility, and strengthen Chinese military resilience.

The PLA almost certainly operates a fleet of surveillance balloons, aerostats, and super- or hypersonic reconnaissance drones that contribute to China's strategic reconnaissance and early warning capability, working in tandem with reconnaissance aircraft, satellites, and other collection means. NSFVs also almost certainly facilitate the PLA's efforts to establish a persistent, all-weather reconnaissance system of systems, which at the campaign level<sup>1</sup> aids battlefield perception and joint operations. In particular, NSFVs likely offer the PLA a redundant option within this system in case China's satellites are destroyed or disrupted during a conflict.

In peacetime, NSFV ISR operations likely support strategic objectives such as monitoring adversary force posture along the first island chain, major foreign military exercises, and keeping China's leadership abreast of military capabilities around the world. The dozens of alleged Chinese high-altitude balloon operations since 2018 or 2019 — 14 confirmed or likely operations are identified in this report — were likely undertaken for such purposes or to test relevant technologies. Facilities and institutions targeted during such operations likely face a legitimate intelligence collection threat.

China's high-altitude balloon operations to date demonstrate the maturity of the PLA's technology for near-space ISR. However, with the exception of their role in precision strike, the ability of NSFVs to deliver on their other battlefield potential is less clear to Insikt Group. Governments and militaries following China's military development should further assess the various roles of China's NSFV technology, its level of maturity, and whether any of the near-space capabilities discussed in this report may provide the PLA with notable advantages in a conflict. If advantages are found, the priority should be to ensure allies, partners, and warfighters have access to effective destructive or disruptive countermeasures.

## Key Findings

- PLA and Chinese defense industry analysts identify 2 categories of NSFV based on their speed of movement: low-dynamic (LD) platforms such as balloons and high-dynamic (HD) platforms such as hypersonic vehicles.
- The PLA almost certainly has access to a range of both LD- and HD-NSFVs, including balloons, aerostats, airships, and super- or hypersonic glide vehicles, developed by a mix of private companies, research organizations, and state-owned enterprises.
- These NSFVs can almost certainly be equipped to enable collection of imagery intelligence (IMINT), signals intelligence (SIGINT), communications intelligence (COMINT), and electronic intelligence (ELINT).
- Although the PLA has large fleets of both reconnaissance aircraft and satellites, Chinese analysts assert NSFVs overcome limits to the capabilities of these more traditional ISR platforms; NSFVs are also valued for their agility, flexibility, maneuverability, and stealth characteristics.
- LD- and HD-NSFVs can almost certainly support collection of strategic-, campaign-, and tactical-level intelligence and contribute to PLA efforts to build a persistent reconnaissance system of systems that facilitates integrated networked warfare and joint operations.
- By collecting on the plans, positions, and equipment of an adversary, as well as the geography and meteorology of a potential battle space, NSFVs can support PLA force development and posture, PLA readiness, and operational planning for effective outcomes.
- Beyond their ISR functions, Chinese analysts envision NSFVs supporting precision strike, electronic warfare, communications, and logistics; such capabilities would likely enhance the success rate of PLA offensive operations and bolster PLA resilience.
- Confirmed or likely Chinese LD-NSFV operations as of this writing, and those involving lower-altitude surveillance balloons or aerostats, almost certainly represent activities to test technologies and collect strategic-level intelligence on global military trends and capabilities.
- Confirmed or likely Chinese high-altitude surveillance balloons or aerostats have been spotted in or passed over Canada, Costa Rica, Colombia, India, Japan, the Philippines, Nicaragua, the US, Venezuela, the South China Sea, and Taiwan.
- If PLA and Chinese defense industry analysts are evaluating the outcome of the balloon flight over the US in early 2023, they will likely conclude that the window for exploiting LD-NSFV stealth characteristics against a sophisticated target like the US is closing, among other findings.
- PLA LD-NSFV peacetime surveillance operations are likely to continue after a pause following the international political reaction to the balloon over the US.

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## A Balloon Over America

In late January and early February 2023, a high-altitude, remote-controllable surveillance balloon from China flew over the continental US (**Figure 1**).<sup>2</sup> Its appearance prompted significant political and media attention on China's use of near-space for military ISR and other activities.<sup>3</sup> The US government attributed the balloon to the PLA based on evidence that its manufacturer had a "direct relationship" with the Chinese military,<sup>4</sup> and the US Department of Defense (DoD) revealed China has operated a global "surveillance balloon program" for multiple years.<sup>5</sup> Although which PLA organizations are specifically responsible for this activity is unclear in public sources — likely contenders include the PLA Strategic Support Force and PLA Air Force — the US government's attribution is supported by the Chinese military and defense industry's long-standing but recently resurgent interest in balloons, aerostats, and other near-space capabilities.<sup>6</sup> According to one assessment by Kevin Pollpeter, an expert on the PLA and China's space program with the Center for Naval Analyses, "China's spy balloon program likely represents a continued effort by the PLA ... to develop asymmetric means to counter or overcome U.S. military capabilities".<sup>7</sup>



**Figure 1:** Chinese high-altitude surveillance balloon over the central US (Source<sup>8</sup>)

Investigation into the Chinese surveillance balloon based on satellite imagery, weather patterns, and remarks by anonymous US officials indicated it was launched from the southern province of Hainan Province, China, in early January 2023. After entering US airspace over the Aleutian Islands and southern Alaska in late January, the balloon flew over a portion of Canada and was then spotted in

northern Idaho; Montana, reportedly over Minuteman III launch facilities and the city of Billings; St. Louis, Missouri; and Virginia.<sup>9</sup>

Despite the Chinese government's claims the balloon was a civilian airship for meteorological testing,<sup>10</sup> an American F-22 fighter jet ultimately shot down the balloon from its operating height at between 60,000 and 65,000 feet — just below near-space — off the coast of South Carolina.<sup>11</sup> The US Department of Commerce's Bureau of Industry and Security also placed 6 Chinese companies on its Entity List for materially supporting the PLA's high-altitude surveillance balloon efforts.<sup>12</sup>

According to anonymous sources speaking with news outlets after the balloon's wreckage was retrieved, the balloon was equipped with "a satellite-like device with sensors, solar panels for power and other devices to scoop up photos, take videos and capture radar data".<sup>13</sup> The devices reportedly consisted of commercially available US technology "interspersed with more specialized Chinese sensors", as well as means to transmit (almost certainly via satellite) collected data to China.<sup>14</sup> Earlier comments by anonymous US officials based on photographs of the balloon "taken by high-altitude U-2 planes" suggested the balloon's payload included "multiple antennas ... likely capable of collecting and geo-locating communications" and "solar panels large enough to produce the requisite power to operate multiple active intelligence collection sensors".<sup>15</sup> The balloon also had propellers for maneuverability.<sup>16</sup> However, the US DoD assessed "the collection capabilities of this balloon were not of more advantage to other capabilities that we know they maintain".<sup>17</sup>

Whether the balloon's incursion into US mainland airspace was intentional or accidental remains unclear. The balloon's operators likely intended to surveil and collect intelligence from American military bases in Guam — which it did pass over<sup>18</sup> — but the balloon "may have been" blown "off course", according to anonymous US officials.<sup>19</sup> This conclusion is supported by an analysis of abnormal weather patterns at the time,<sup>20</sup> but sightings of the balloon near strategic sites like the Minuteman III facility appear more purposeful than lucky. It is possible the initial penetration of Alaska was not in the operator's plan, but the operator may have assessed an opportunity once over the US mainland.

Another question is whether the balloon collected any information. On June 29, 2023, Pentagon press secretary Brigadier General Pat Ryder gave the most authoritative statement on this issue, asserting that "we assess [the balloon] did not collect while it was flying over the U.S".<sup>21</sup> However, it is unclear if this is because the sensors were inactive — which would support the assessment that its incursion was accidental — or because its sensors were successfully jammed. During the overflight, the US made efforts to "mitigate the potential collection of information" and "obscure the balloon's ability to pick up their electronic signals by stopping them from broadcasting or emitting signals".<sup>22</sup> Furthermore, Ryder's assertions contradicted the commentary of anonymous US sources after the balloon wreckage was retrieved. These sources claimed the balloon either "took in data" but did not transmit back to China or collected information and "was able to transmit information" to China.<sup>23</sup>

Despite lingering questions about the balloon, its activities, and the PLA's initial intentions, the incident illuminated a significant strain of thinking among PLA and Chinese defense industry analysts, as well as

an evolution in China's use of balloons and other non-traditional platforms for ISR. Chinese companies and research organizations have developed tethered and untethered relatively low-altitude aerostats with aerial imaging and remote sensing capabilities since at least the 1970s or 1980s.<sup>24</sup> Many of the platforms available in China have likely been applied to, or thought of as useful for, domestic security, counterterrorism, and local or regional military ISR requirements, among other civilian applications like tourism.<sup>25</sup> However, likely reflecting lessons adapted from Russian and US military high-altitude technologies — including the US's Defense Advanced Research Projects Agency and US Air Force's joint Integrated Sensor is Structure program — the balloon that appeared over the US demonstrates the maturity of China's ability to deploy balloons, aerostats, and other near-space platforms for military purposes far from home.<sup>26</sup>

## NSFVs in China's Military ISR Strategy

NSFVs almost certainly enable collection of strategic, campaign, and tactical intelligence that, together with other capabilities, can help the PLA deter, prepare for, or win a conflict. PLA doctrine began focusing on the central importance of technology in modern wars in the early 1990s, especially the collection and effective use of information — including intelligence — for military purposes.<sup>27</sup> As part of the paradigm often referred to as “informatized” (信息化) warfare,<sup>28</sup> the PLA almost certainly seeks to establish a multi-layered reconnaissance system of systems that enables collection of strategic-, campaign-, and tactical-level intelligence. NSFVs are one capability among many — including reconnaissance aircraft,<sup>29</sup> satellites,<sup>30</sup> cyberspace capabilities,<sup>31</sup> overseas SIGINT collection stations,<sup>32</sup> and dual-use infrastructure such as Chinese state-owned and operated overseas ports<sup>33</sup> — that contribute to this goal.

Authoritative Chinese military textbooks stress the importance of a persistent reconnaissance system of systems. According to the 2006 text *Science of Campaigns*, military reconnaissance should be “multi-directional, multi-domain, multi-tiered, all-weather” and combine “long-, medium- and short-range” and “high-, medium- and low altitude” platforms to achieve coverage across all domains: land, air, sea, and outer space.<sup>34</sup> More recently, the 2020 edition of *Science of Military Strategy* emphasizes the importance of “space information support capabilities” as “essential to joint operations”, asserting these capabilities are formed through the use of military aerospace equipment to provide “all-weather, all-hour, near real-time space reconnaissance and surveillance” of enemy targets, the combat environment, combat progress, combat effectiveness, and other factors.<sup>35</sup>

Although neither of the aforementioned textbooks discusses near-space ISR systems specifically, Chinese military and defense-industry analysts highlight NSFVs as an “information support” capability and discuss them as contributing to similar goals.<sup>36</sup> They describe NSFV activities as — or advocate that NSFV activities should be — coordinated and linked with other military sensors and platforms, including aircraft and satellites, to achieve “every-aspect, all-period comprehensive reconnaissance and surveillance” during peacetime and wartime.<sup>37</sup>

Some Chinese sources also explicitly position NSFVs within China's military strategy by referencing the PLA Air Force's "integrated air and space operations" (空天一体作战) concept adopted in the early 2000s.<sup>38 39</sup> This concept emphasizes the "seamless battlespace" extending vertically from the Earth's surface to outer space, in which air and space platforms will network to facilitate PLA Air Force operations such as "information, air, and space superiority; precision strike; rapid maneuver; and multidimensional support", as well as joint PLA operations more broadly.<sup>40</sup> Regarding precision strike — an important non-ISR function of NSFVs — the 2013 edition of *Science of Military Strategy* particularly emphasizes the need to develop a medium- and long-range precision strike system that features "near-space strength ... possessing actual-combat capability".<sup>41</sup>

## NSFV Roles in ISR Activities

Since at least 2005, PLA and defense industry-affiliated academic and news articles have nearly uniformly recognized the potential of NSFVs for providing intelligence and information support to the armed forces.<sup>42</sup> Similar to the aforementioned surveillance targets mentioned in the 2020 edition of *Science of Military Strategy*, a 2019 study by an analyst affiliated with PLA Unit 31511 identifies 6 specific reconnaissance tasks to which NSFVs can contribute: battlefield perception, ocean surveillance, meteorological monitoring, strike effects evaluation, disaster damage monitoring, and aerial early warning.<sup>43</sup> NSFVs can almost certainly be equipped with payloads to collect IMINT, SIGINT, COMINT, and ELINT.<sup>44</sup> With the right payloads and enough resistance to enemy disruption tactics, NSFVs can almost certainly enable the PLA to collect in support of numerous strategic-, campaign-, and tactical-level intelligence goals. A list of specific intelligence goals that NSFVs can likely support with the right payload is provided in **Appendix A**.

The PLA's known and likely NSFV operations to date (see **A Balloon Over America** and **Other Balloon and Aerostat Sightings** in this report) are almost certainly in support of strategic-level goals. Although no sources seen by Insikt Group explicitly discuss long-range peacetime ISR operations of the kind the PLA currently conducts, persistent peacetime intelligence collection is essential if one has any hopes of being victorious in war, according to the 2001 Chinese military textbook *Science of Military Intelligence*.<sup>45</sup> However, Chinese combat or support units and organizations could also deploy NSFVs similar to drones during a conflict to support collection of campaign- and tactical-level intelligence.

A 2013 article by graduate students of a PLA-affiliated military academic institution offers several suggestions for strategic, campaign, and tactical uses of NSFVs. They suggest NSFVs can be used to:

- Surveil critical maritime straits and passages on a long-term basis, achieving integrated peace-war intelligence support
- Extend a naval ship's early-warning range up to 500 km after being launched from a ship's deck
- Detect, track, and monitor enemy forces and commercial ships during submarine blockade operations<sup>46</sup>

Tests conducted in 2017 by the Chinese Academy of Sciences's Academy of Opto-Electronics (中国科学院光电技术研究所) also suggest low- (10km) and high-altitude (20km) balloons could drop micro air vehicles (i.e., small drones) with sensors to map terrain, detect electromagnetic signals, and send that data to ground stations.<sup>47</sup>

The first of these suggestions — using balloons to monitor critical maritime spaces — likely echoes actual PLA operations. In 1 incident in 2021, a suspected surveillance balloon was reportedly spotted above the USS Theodore Roosevelt and its carrier group as they sailed through the South China Sea.<sup>48</sup> Aerostats have also been spotted in satellite imagery of at least 1 of China's Spratly Islands outposts.<sup>49</sup> Moreover, research by Project 2049 Institute in 2009 found that “near space airships” are “probably” 1 of 4 components of China's maritime surveillance architecture for detecting, tracking, and targeting threats at sea.<sup>50</sup>

PLA and defense industry-affiliated analysts also frequently note the potential of NSFVs in supporting the precision strike kill chain. NSFVs can provide target positioning and reconnaissance for long-range precision strikes.<sup>51</sup> They can also support the damage assessment or post-strike evaluation stage of the kill chain, as referenced in the list of potential NSFV reconnaissance tasks by a member of PLA Unit 31511 and other sources.<sup>52</sup> A 2016 study by researchers at PLA-affiliated military academic institutions highlights the role of both functions in an example that supposes an NSFV is used to target precision strikes against an enemy aircraft carrier.<sup>53</sup>

## NSFV Roles in Other Military Activities

Beyond ISR operations, many PLA and defense industry writings on NSFVs focus on another form of information support: communications. NSFVs can be used to establish communication networks and extend communications “over the horizon”.<sup>54</sup> The aforementioned member of PLA Unit 31511, for instance, has argued that NSFVs provide a rapid low-cost ability to establish communication relays that are higher capacity, higher frequency, and faster than satellites while also providing coverage of an area that is greater than ground-based wireless networks.<sup>55</sup>

Other military applications discussed by Chinese analysts include using NSFVs and other balloon technology to:

- Launch offensive strikes and position electronic warfare equipment, which sources suggest could loiter over enemy positions to continuously disrupt radar and other functions
- Facilitate control and guidance of precision strike and near-space weapons launched from other platforms (in addition to identifying targets and outcomes as noted above)
- Create feints that expose enemy anti-air defenses, waste resources, and create an opening for aerial strike
- Create aerial obstacles with pre-positioned balloons that interrupt an enemy's operations
- Support various logistics needs such as transport and resupply<sup>56</sup>

## Types of NSFVs

NSFVs are flightcraft that operate in near-space, which Chinese sources routinely define as the area between 20 km and 100,000 km — the Karman Line, an unofficial marker of where outer space “begins”.<sup>57</sup> PLA and Chinese defense industry-affiliated publications identify 2 categories of near-space platforms based on their speed of movement: low-dynamic near-space flight vehicles (LD-NSFV; 低动态临近飞行器) that operate below or near the speed of sound and high-dynamic near-space flight vehicles (HD-NSFV; 高动态临近飞行器) that operate above the speed of sound.<sup>58</sup> Depending on the characteristics of a given platform, both types could support ISR, communications, and other military activities described in the previous section, including supporting precision strike.<sup>59</sup>

Low-Dynamic NSFV		High-Dynamic NSFV	
Float-Power Type	High-altitude balloons	Unpropelled Type	Re-entry glide vehicle
	High-altitude airships		
Lift-Power Type	High/super high-altitude long-flight time drones	Air-Breathing Propulsion Type	Hypersonic cruise flight vehicle
Float-Lift Integrated Type	Float-lift-integrated near-space stations	Rocket Propelled Type	Rocket-propelled flight vehicle
		Combine Cruise Propulsion Type	No example provided

**Table 1:** Categories and types of near-space flight vehicles and platforms (Source<sup>60</sup>)

## Low-Dynamic NSFVs

The PLA possesses both LD- and HD-NSFVs. The activities of known and likely Chinese surveillance balloons demonstrate their access to low-dynamic platforms. A review of Chinese news, academic, and patent sources conducted by the New York Times further concluded that “Chinese military scientists have been studying new materials and techniques to make balloons more durable, more steerable and harder to detect and track”.<sup>61</sup> However, the PLA’s specific LD-NSFVs remain largely unidentified in public sources seen by Insikt Group. They are almost certainly developed by a mix of private companies, research organizations, and state-owned enterprises. Organizations such as Dongguan Beihang University Research Institute (东莞北京航空航天大学研究院), Eagles Men Aviation Science and Technology Group (铍格斯曼航空科技集团), and Beijing Nanjiang Aerospace Technology Co., Ltd. (北京南江空天科技股份有限公司), for example, have produced large solar-powered aerostats that achieved

near-space aviation milestones for China in 2015 and 2019, with one platform — the Cloud Chaser (追云号) — even circumnavigating the globe.<sup>62</sup> The latter 2 companies were placed on the US's Entity List in 2023 for supporting the PLA after China's surveillance balloon passed over the US, suggesting they were involved in that balloon's development.<sup>63</sup>



**Figure 2:** The Dreams Come True very-large solar-powered airship developed by Beijing Nanjiang Aerospace Technology Co., Ltd. and Beihang University (北京航空航天大学) (Source<sup>64</sup>)

Major state-owned aerospace defense contractors in China also produce LD-NSFVs with military potential. Since 2017, for example, both the Aviation Industry Corporation of China (AVIC; 中国航空工业集团公司) and the China Aerospace Science and Technology Corporation (CASC; 中国航天科技集团公司), have flown large-scale solar-powered drones — the Venus 50 (启明星50) and the Rainbow (彩虹) — capable of reaching near-space altitudes.<sup>65</sup> The Venus 50 is described as capable of executing tasks such as high-altitude reconnaissance, atmosphere environment monitoring, geographic mapping, and communication relay.<sup>66</sup>



**Figure 3:** AVIC's Venus 50 large-scale solar-powered drone (Source<sup>67</sup>)

The aforementioned research published by Project 2049 Institute assessed “the center of China’s near space vehicle design, development, and manufacturing” efforts to be China Aerospace Science and Industry Corporation’s (CASIC; 中国航天科工集团有限公司) Hunan Space Bureau (湖南航天管理局), which is also known as the 068 Base (〇六八基地).<sup>68</sup> The 068 Base almost certainly maintains a prominent position in PLA procurement of near-space and balloon- and aerostat-based surveillance capabilities. The 068 Base’s subsidiary Hunan Aerospace Yuanwang Technology Co., Ltd. (湖南航天远望科技有限公司) reportedly “provides aerial platforms for operations training, target characteristic measurement, communication command, reconnaissance and surveillance, [and] emergency communications to [military] forces [部队]”.<sup>69</sup> The company’s scope of business includes near-space aerostats, tethered balloons, unmanned equipment, and other technologies.<sup>70</sup> It has also won bids for technology procurement contracts issued by entities under the PLA Strategic Support Force as recently as 2020 and has signed, in 2017 and 2018 at least, research agreements with an unspecified military service.<sup>71</sup>



**Figure 4:** Unspecified aerostat attributed to Hunan Aerospace Yuanwang Technology (Source<sup>72</sup>)

Near-space and aerostat-based technology with non-ISR military potential, such as for communications, are also found in state-owned enterprises. CASIC's Feiyun Project (飞云工程) and Kuaiyun Project (快云工程) aim to use high-altitude, long-flight time drones and rapidly launchable aerostat platforms to establish local area and local cloud networks for emergency communication.<sup>73</sup> The company planned in 2016 to launch initial operational versions of each in 2017 and 2018, respectively.<sup>74</sup> An AVIC subsidiary, the China Special Flight Vehicle Research Institute (SVRI; 中国特种飞行器研究所) — whose staff have produced research with PLA organizations<sup>75</sup> — has developed technologies such as a “model ‘Airspace (Sea) Information Integration’ aerostat system” that incorporates “high-resolution earth observation and communication relays”.<sup>76</sup> Other entities, including the Chinese Academy of Sciences, are conducting practical experiments coordinating aerial and ground monitoring of a target area between an aerostat, drones, and land vehicles using a combination of laser-based and wireless communications.<sup>77</sup>

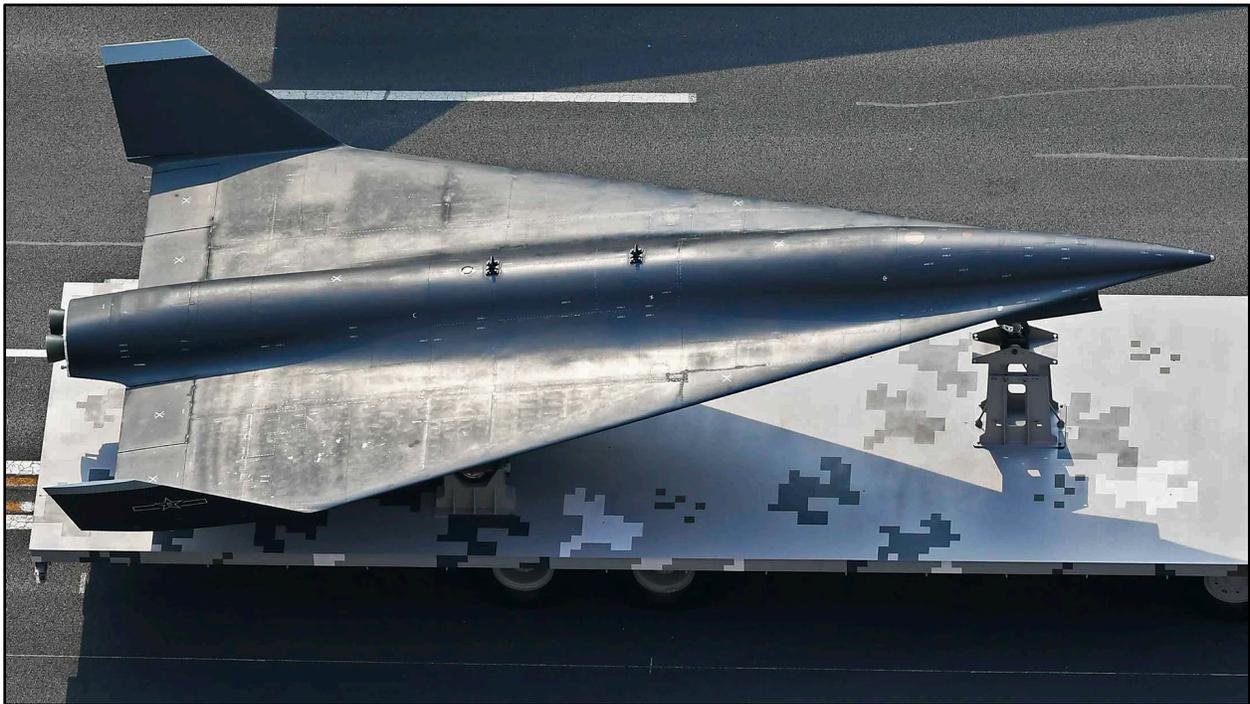
## High-Dynamic NSFVs

The PLA possesses HD-NSFVs for both precision strike and ISR operations. The former category includes the DF-ZF (东风-ZF) hypersonic boost-glide re-entry vehicle<sup>78</sup> and various other hypersonic glide vehicles under development, some of which were dropped from a high-altitude balloon during tests in 2018.<sup>79</sup> The latter category includes the Wuzhen-8 (WZ-8; 无侦-8) reconnaissance drone. Developed by AVIC subsidiaries,<sup>80</sup> the WZ-8 was first revealed in 2019 and is now described in Chinese military news media as “active duty drone equipment” (现役无人机装备).<sup>81</sup>

A press release on AVIC's website asserts the WZ-8 is an important element in the PLA Air Force's achievement of “air-space integration, with both offense and defense [capability]”.<sup>82</sup> According to a

2022 paper by engineers affiliated with CASIC's Beijing Aerospace Technology Institute (北京空天技术研究所),<sup>83</sup> the WZ-8 is a supersonic and hypersonic<sup>84</sup> unmanned reconnaissance vehicle with stealth characteristics.<sup>85</sup> It is capable of being equipped with an optical payload consisting of “many kinds of reconnaissance equipment” for obtaining high-resolution target imagery.<sup>86</sup> The paper asserts the WZ-8 can carry out “effective penetration of an enemy’s highly guarded strategic and campaign targets”.<sup>87</sup>

The WZ-8 is designed to be carried by, and launched from, the underbelly of other aircraft — reportedly a modified H-6 bomber (轰-6) — and land on a runway.<sup>88</sup> After launch, the WZ-8 would likely use its rocket engines to climb into near-space or higher.<sup>89</sup>



**Figure 5:** The WZ-8 (Source<sup>90</sup>)

## NSFV Advantages

The PLA certainly possesses more traditional strategic reconnaissance and early warning capabilities like reconnaissance planes and satellites, but NSFVs are almost certainly being pursued as a means to overcome deficiencies in those platforms and augment their capabilities. China has some 60 airborne early warning and control (AEW&C) aircraft and between 229 and 260 ISR satellites.<sup>91</sup> However, the PLA lacks the ability to deploy its reconnaissance aircraft globally due to limited access to international airfields, and PLA and Chinese defense-industry analysts assess a number of advantages that NSFVs have over both traditional aircraft and satellites.<sup>92</sup> At a minimum, NSFVs likely provide the PLA with a redundant capability in case its satellites — for ISR or communications — are destroyed or disrupted during a conflict.

Regarding specific NSFV advantages asserted by PLA and defense industry analysts, the following list is based on a 2016 study by researchers affiliated with the former National Defense Information Institute (国防信息学院; now part of the National University of Defense Technology [国防科技大学]<sup>93</sup>), a component of the former Beijing Military Region Joint Logistics Department, and PLA Unit 69221.<sup>94</sup>

- **NSFVs strike a good balance between scope of visibility and imagery resolution.** Reconnaissance satellites can achieve a wider scope but provide less-detailed images. Reconnaissance aircraft can get better images but have a more limited field of view. Operating at a height of 30 km or greater is described as an effective altitude from which a platform can see for 600 to 700 km.<sup>95</sup>
- **NSFVs can achieve persistent coverage of a reconnaissance target.** When powered by wind, solar, or other means, they can stay in the air for weeks, months, or even years, loitering over targets. By contrast, satellites are tied to orbital paths, and aircraft have limited flight times.
- **NSFVs have strong survivability.** LD-NSFVs have limited radar and infrared characteristics because of their construction materials (i.e., they have stealth characteristics). HD-NSFVs can outpace the reaction time of anti-missile systems. Both types can operate above the range of typical military aircraft and surface-to-air missiles (which are said to only reach the lower portion of near-space), though this advantage is more pronounced for highly maneuverable HD-NSFVs.
- **NSFVs are convenient and maneuverable.** They can be launched easily and rapidly deployed to operational areas. After launch, they can be quickly redeployed to new locations according to operational requirements. Additionally, at their lower altitude (compared to satellites), communication with the platform presents less lag.
- **NSFVs are cheaper, less complicated, and quicker to develop.** This is true relative to satellites and aircraft, though there are still (as of 2016) challenges to overcome with regard to structure, materials, propulsion, and detection capability.

Additional advantages asserted in sources reviewed by Insikt Group include claims that NSFVs are capable of more precise reconnaissance and detection because they:

- Operate closer to the ground than satellites
- Are capable of being rapidly launched to quickly fill reconnaissance and early warning gaps around the world (almost certainly specific to HD-NSFVs)
- Are capable of in-depth penetration of reconnaissance target areas due to their stealth characteristics
- Are capable of supporting large payloads of equipment for information collection and confrontation, electronic intelligence, and visible light, infrared, hyperspectral, synthetic aperture radar (SAR), and ultraviolet imaging
- Operate in a relatively safe and stable environment above wind, rain, and other weather conditions<sup>96</sup>

Another likely advantage of NSFVs over satellites, in particular, is their ability to cause targeted military systems to activate in response to their (the NSFV's) maneuvers. A 2022 article by researchers affiliated with the PLA's Air Force Early Warning Academy (空军预警学院), the aforementioned SVRI, and PLA Unit 93253 suggests China's military should consider using high-altitude balloons to create "abnormal aerial conditions" for the purpose of conducting electronic reconnaissance against — and evaluating the capabilities and reaction of — an enemy's activated anti-air defense systems.<sup>97</sup>

At least 2 sources reviewed by Insikt Group further stated a belief that NSFVs operate above the limits of national airspace, enabling the aforementioned in-depth penetration of sensitive locations while avoiding the political repercussions that might be caused if other platforms — such as surveillance aircraft — were to enter a country's airspace.<sup>98</sup>

### Assumptions vs. Reality

It is not clear to what extent the alleged advantages of LD-NSFVs described above reflect thinking within China's military leadership, but the navigation of a Chinese surveillance balloon across the continental US in early 2023 likely provided analysts in China an opportunity to test and evaluate some of the common assumptions. Insikt Group has not observed any examples of such an evaluation in public sources as of this writing. However, based on a review of the events, an evaluation may conclude that LD-NSFVs are:

- Not immune to political repercussions if detected
- Maneuverable, but still greatly affected by weather patterns
- Capable of operating stealthily, but that the window for exploiting the stealth characteristics against a sophisticated target like the US is closing

**Table 2** provides the basis for these potential assessments.

Assumed LD-NSFV Advantage	Evidence For or Against
LD-NSFVs operate at a politically tolerable distance or outside of territorial airspace.	<b>Disproved.</b> Although near-space is an ill-defined area of international law, <sup>99</sup> the 2023 balloon over the US ignited a media and political firestorm. This included a resolution from the US House of Representatives condemning China's "brazen violation of United States sovereignty". <sup>100</sup> Some US allies and partners reacted similarly. Japan, for example, relaxed regulations on their military's use of live ammunition to allow for the possibility of shooting down balloons and drones. <sup>101</sup> Taiwan issued a statement of condemnation, and

	the United Kingdom (UK) initiated a review to assess any activity over its country. <sup>102</sup>
LD-NSFVs are maneuverable and able to loiter over reconnaissance targets.	<b>Validated</b> , with possible limitations. The 2023 balloon that navigated over the US was equipped with propellers and capable of loitering over a fixed position and therefore almost certainly maneuverable. <sup>103</sup> However, there are limits to its controllability if the balloon’s arrival over the continental US was a mistake, as some US officials have asserted. <sup>104</sup>
LD-NSFVs are stealthy.	<b>Validated</b> , with a caveat. After the 2023 balloon traversed the US, North American Aerospace Defense Command (NORAD) Commander General Glen VanHerck confirmed that 4 previous likely Chinese surveillance balloons operating near or over the US were not detected at the time of their flights. <sup>105</sup> The 2023 balloon was tracked prior to entering US airspace, however, and the US is now working to fix its domain awareness gap in relation to balloon-like NSFVs. <sup>106</sup>
NSFVs provide collection capabilities superior to satellites.	<b>Unknown</b> . The specific capabilities of the 2023 balloon that flew over the US relative to China’s satellite capabilities are not publicly known. The US DoD assessed collection from the balloon would provide “limited additive value”, but anonymous officials later also asserted the balloon’s technology indicated China’s collection capabilities “are significant” and “better than [the US] thought they were”. <sup>107</sup>

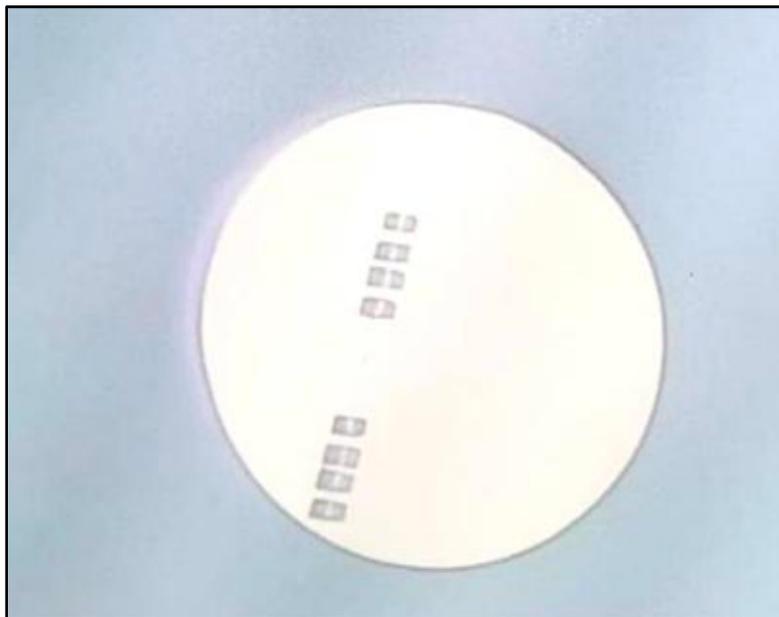
**Table 2:** Evaluation of alleged LD-NSFV advantages vs. 2023 events (Source: Recorded Future)

## Other Balloon and Aerostat Sightings

According to US DoD spokesperson remarks after the high-altitude surveillance balloon flew over the US in early 2023, China operates a “surveillance balloon program”.<sup>108</sup> The US DoD assesses that Chinese surveillance balloons of “various sizes and capabilities” have been observed over parts of Latin America, South America, South Asia, Southeast Asia, East Asia, and Europe, in addition to North America.<sup>109</sup> Chinese balloons of unknown type have also been observed in the Middle East.<sup>110</sup> In interviews with news organizations, unnamed US officials assert the PLA has carried out 2 dozen high-altitude surveillance balloon missions over more than 40 countries and 5 continents in “recent years”, with some reports indicating 2018 as the year of the earliest incidents.<sup>111</sup> A review of relevant media coverage before and after the early 2023 US-China balloon incident provides a glimpse into 14 confirmed or likely instances of Chinese high-altitude surveillance balloon or aerostat activity since 2019 in India, Japan, the Philippines, the US, Latin America, and Taiwan.

## India

In the first week of January 2022, residents of Port Blair in India's Andaman and Nicobar Islands reportedly observed a balloon with a large payload of likely solar panels flying and loitering at a high altitude.<sup>112</sup> Whether this is the incident alluded to when the US DoD asserted Chinese surveillance balloons have operated in South Asia is unknown,<sup>113</sup> but the location and timing of the balloon's appearance are suggestive. Port Blair is home to India's tri-service Army, Navy, and Air Force Andaman and Nicobar Command.<sup>114</sup> During the last week of December 2021, Andaman and Nicobar Command "concluded a multi-domain tri-service exercise".<sup>115</sup> The observed balloon was first reported on January 6, 2022,<sup>116</sup> and did not belong to the Andaman and Nicobar Command, according to a representative's statements to the press.<sup>117</sup>



**Figure 6:** Images shared by Andaman and Nicobar Islands residents in January 2022 (Source<sup>118</sup>)

## Japan

The Japanese Ministry of Defense "strongly suspects" Chinese surveillance balloons have traversed Japan on at least 3 separate occasions since 2019.<sup>119</sup> Likely surveillance balloons passed over the city of Satsumasendai in Kagoshima Prefecture in southwest Japan in November 2019; over Sendai in Miyagi Prefecture in northeast Japan in June 2020; and over Hachinohe in Aomori Prefecture in north Japan in September 2021.<sup>120</sup> Another 2 potential incidents occurred in September 2021 and January 2022, with reports suggesting some type of balloons were respectively observed above Chichijima in the Ogasawara Islands and out to sea west of Kyushu Island.<sup>121</sup>

The most detailed reports exist for the June 2020 incident. According to reporting by Nikkei Asia, the balloon shown in **Figure 7** was observed over the seat of the Miyagi prefectural government in Sendai, moving from southwest to northeast.<sup>122</sup> The payload consisted of a likely solar panel and 2 propellers,

indicating the balloon was controllable and maneuverable to some extent.<sup>123</sup> Contemporaneous comments by staff members of the Sendai Meteorological Observatory interviewed by Reuters said the balloon appeared to hang, “largely unmoving”, likely as it loitered to maximize collection time.<sup>124</sup>

While the collection targets of this likely surveillance balloon cannot be known, Nikkei Asia identified several military facilities that it may have surveyed within the vicinity of the Miyagi prefectural government building and along the balloon’s northeastern track. These include the Japanese Ground Self-Defense Force’s (JGSDF) Northeastern Army headquarters at Camp Sendai, JGSDF Camp Tagajo, and Japanese Air Self-Defense Force’s Matsushima Air Base.<sup>125</sup>



**Figure 7:** Likely surveillance balloon photographed by Sendai Astronomical Observatory over Miyagi Prefecture (Source<sup>126</sup>)

## Philippines

Citing anonymous US officials, the Washington Post reported the Philippines as being among the countries over which Chinese surveillance balloons have operated.<sup>127</sup> The only likely incident noted in public sources as of this writing relates to activity in December 2022. According to an interview with Professor Renato De Castro of the Philippines’s De La Salle University, a “flying balloon” was spotted in Pangasinan Province, including in Natividad, at that time, followed by reports of “a similar sighting” to the north in Baguio a few days later, including near Loakan Airport.<sup>128</sup> Contemporaneously, the Philippine Air Force reported an “unidentified aircraft” had entered the national airspace via Bolinao, a city in Pangasinan Province, according to De Castro.<sup>129</sup> A spokesperson for the Armed Forces of the Philippines emphasized to reporters that speculation that these events represent Chinese surveillance activities are “unconfirmed reports”.<sup>130</sup>



**Figure 8:** Unidentified aerostat observed in Pangasinan Province in December 2022 (Source<sup>131</sup>)

Interestingly, this incident is one of the only in which contemporary reports proposed the unidentified objects may be related to China’s activities.<sup>132</sup> At the time, observers and reporters in the Philippines and elsewhere noted similarities in the unidentified object’s shape and aerostat platforms being developed in China.<sup>133</sup>

## Taiwan

Anonymous officials in Taiwan assert the island “has observed dozens of Chinese military balloon flights in its airspace in recent years”, according to the Financial Times.<sup>134</sup> These balloons often reportedly operate at 20,000 feet — well below the lower boundary of near-space at 65,617 feet (20 km) — and specific identifiable instances involved balloons smaller than the balloon seen over the US, suggesting most of these instances do not reflect China’s near-space ISR activities in a strict sense.<sup>135</sup> Nevertheless, these incidents would constitute high-altitude surveillance activity. While Taiwan’s Ministry of National Defense reportedly responded to Financial Times’s reporting by saying most balloons observed over Taiwan were for collecting meteorological data,<sup>136</sup> the officials interviewed by Financial Times nevertheless reported “the balloons’ dimensions and payload put them outside the scope of ordinary weather balloons”.<sup>137</sup> In prior years, retired Taiwanese military personnel have also commented that at least some balloons that have been spotted serve military purposes.<sup>138</sup> Reviewing specific publicly reported balloon sightings in Taiwan suggests a mix of likely surveillance balloon and meteorological balloon flights over the island. Meteorological intelligence is also an important element of campaign- and tactical-level ISR (see **Appendix A**).

At least 3 incidents involving relatively large balloons occurred in 2021, though none of these have been definitively linked to China or the PLA. According to a Yonhap News Agency report citing Cheng Ming-Dean, director of Taiwan’s Central Weather Bureau, a large balloon about 15 to 20 meters (49 to 65 feet) in diameter traversed the island’s west coast in March 2021.<sup>139</sup> The path described by Cheng suggests a north-to-south trajectory, from Songshan International Airport in Taipei, through Taoyuan, Taichung, and Chiayi.<sup>140</sup> Notably, this balloon was much smaller than the 61-meter (200-foot) balloon shot down by the US,<sup>141</sup> but reportedly larger than typical weather balloons.<sup>142</sup>



**Figure 9:** Balloon and payload of unclear origin photographed above Taipei in September 2021 (Source<sup>143</sup>)

In September 2021, Taiwan’s Central Weather Bureau photographed another relatively large balloon over Taipei, coming from the direction of Songshan International Airport.<sup>144</sup> The balloon in this incident was reportedly similar to the balloon in the March 2021 incident as well as that seen in a subsequent December 2021 incident.<sup>145</sup> In the final incident of 2021, another relatively large balloon was observed over Xiaoxueshan (literally, “Little Snow Mountain”) in the Daxueshan (literally, “Big Snow Mountain”) National Forest Recreation Area.<sup>146</sup> Significantly, this very likely places the December 2021 balloon in proximity to the Xiaoxueshan Radar Station of the Republic of China (ROC) Navy’s Marine Surveillance and Reconnaissance Command (中華民國海軍海洋監偵指揮部).<sup>147</sup>

In early 2022, observers also spotted balloons over the Taiwanese cities of Keelung, Taoyuan, Hsinchu, and Taichung.<sup>148</sup> These balloons were likely smaller than those seen in the 2021 incidents and reportedly flew at an altitude of 9,000 to 10,000 feet (2.7 to 3 km).<sup>149</sup> Taiwanese media reported the balloons were released by a “PLA 72nd Group Army long-range rocket brigade” (解放军72集团军远程火箭旅) in Fujian Province, though the accuracy of this reference is unclear.<sup>150</sup> The PLA 72nd Group Army is based in Hangzhou, Zhejiang Province, while the 71st Group Army is in Fujian Province.<sup>151</sup> The 72nd does have a long-range rocket battalion as part of their artillery brigades, however.<sup>152</sup> Whether the 71st does as well is unknown as of this writing. In either case, both group armies are subordinate to the Eastern Theater Command, whose purview includes Taiwan operations.<sup>153</sup> A statement at the time by a Taiwan Ministry of National Defense spokesperson said the ROC Air Force determined the balloons were for meteorologic or scientific purposes.<sup>154</sup> These balloons ultimately flew out to sea northeast and east of Taiwan.<sup>155</sup>

A downed balloon with a payload bearing the words “Type GTS13 Digital Radiosonde” (GTS13型数字探空仪) was also discovered in Taiwan in 2022, though the details of exactly where in Taiwan and when are unclear.<sup>156</sup> The GTS13 is a product from meteorological equipment manufacturer Taiyuan Wuxiandian Yichang Co., Ltd. (太原无线电一厂有限公司) for collecting atmospheric temperature, air pressure, relative humidity, wind direction, and wind speed.<sup>157</sup>

Another 3 incidents, all involving weather balloons, occurred between February and May 2023. On February 16, Taiwan's Ministry of National Defense published information from Dongyin Area Command (東引地區指揮部) that a falling balloon was discovered and recovered near Dongyin Island (**Figure 10**).<sup>158</sup> The balloon's payload indicated it was another "Type GTS13 Digital Radiosonde" for meteorological data collection.<sup>159</sup> A Taiwanese Ministry of National Defense statement later confirmed the balloon did not carry any camera or other audio-visual recording instruments.<sup>160</sup>

Other incidents in 2023 include the inspection of a balloon over Taiwan's northern airspace by the ROC Air Force on February 24, which initial assessment determined was a meteorological balloon.<sup>161</sup> In May, the Matsu Defense Command (馬祖防衛指揮部) discovered remnants of another balloon with the markings "Type GTS12 Digital Electronic Radiosonde" (GTS12型数字式电子探空仪) and "Shanghai Changwang Meteorology Technology Co., Ltd." (上海长望气象科技股份有限公司).<sup>162</sup> As its name suggests, the GTS12 radiosonde is another meteorological data collection device.<sup>163</sup> Additionally, on February 10, 2023, Taiwan's Ministry of National Defense dismissed reports of a balloon above the Presidential Office Building in Taipei, stating a balloon was detected 40 km away over the ocean.<sup>164</sup>



**Figure 10:** Weather balloon recovered by Dongyin Area Command in February 2023 (Source<sup>165</sup>)

## United States

Of the 2 dozen surveillance balloon missions the PLA has allegedly flown in recent years, "roughly" 6 occurred within US airspace, according to an anonymous US official.<sup>166</sup> Pentagon press secretary Brigadier General Ryder has indicated there are 5 known instances of Chinese high-altitude surveillance balloons flying over US territory, including the incident from early 2023 — 3 during the administration of President Donald Trump and 2 during the administration of President Joe Biden.<sup>167</sup> However, some sources allege more incidents; Le Monde suggested in February 2023 that there were 10 such missions, "according to US authorities".<sup>168</sup> Ryder has asserted that when balloons do enter US airspace, they seek to "surveil strategic sites, to include some of our strategic bases in the continental United States".<sup>169</sup>

Including the 2023 incident discussed at the top of this report, news reporting provides limited detail on at least 5 likely incidents. In 2019, a surveillance balloon “drifted past Hawaii and across Florida” as part of a flight that circumnavigated the world.<sup>170 171</sup> The 2019 balloon was reportedly controllable and capable of operating at altitudes of 65,000 feet to 328,000 feet (20 km to 100 km).<sup>172</sup> In June 2022, another Chinese balloon reportedly “crashed into the sea” near Hawaii, and its components were “collected and analyzed”.<sup>173</sup> Other incidents prior to 2023 reportedly involved balloons navigating near or over Guam and Texas.<sup>174</sup>

Additionally, the US reportedly dispatched an F-22 fighter jet to investigate a balloon near or over Hawaii in early February 2022, though it is not clear what the results of that inspection were.<sup>175</sup> In May 2023, 3 F-22s were also reportedly deployed to inspect a separate balloon near Hawaii, but defense officials reported “no indication it is connected to China”.<sup>176</sup>

## Vietnam

Citing anonymous US officials, the Washington Post reported Vietnam as being among the countries over which Chinese surveillance balloons have operated.<sup>177</sup> However, no details of any alleged incident appear to have been made public. Vietnam’s Ministry of Foreign Affairs reportedly refuted the claim, stating that “Vietnam has not detected a strange balloon in [its] airspace”.<sup>178</sup>

## Europe

The US DoD has alluded to incidents in Europe, but no details on those instances appear to be available as of this writing.<sup>179</sup> When asked in early February 2023 about Chinese surveillance balloons over Europe, North Atlantic Treaty Organization (NATO) Secretary General Jens Stoltenberg said, “We see China over the last years has invested heavily in new military capabilities, including different types of surveillance and intelligence platforms. ... They use satellites, they use cyber, and ... also balloons”.<sup>180</sup> A British official also remarked it was “possible” Chinese surveillance balloons had flown over the UK.<sup>181</sup>

## Latin America

On February 2, 2023, media outlets in Costa Rica reported sightings of a balloon off its west coast and over the Greater Metropolitan Area, a large urban cluster surrounding the capital of San José.<sup>182</sup> The US DoD assessed it to be a Chinese surveillance balloon.<sup>183</sup> Subsequent reporting indicated that likely the same balloon was observed over Nicaragua, Colombia, and Venezuela, almost certainly traveling from north to south and east.<sup>184</sup> The Colombian Air Force issued a statement that the “National Air Defense System detected an object above 55,000 feet, which entered Colombian airspace in the northern sector of the country, moving at an average speed of 25 knots”.<sup>185</sup> A Chinese Ministry of Foreign Affairs spokesperson acknowledged the balloon originated in China.<sup>186</sup> The spokesperson asserted the “unmanned airship” was civilian and used for flight tests but had severely deviated from its planned flight path due to weather conditions and limited controllability.<sup>187</sup>

Ultimately, operators in China reportedly “terminated [this] balloon in the Atlantic Ocean off the east coast of South America”, according to testimony before the US House of Representatives Armed Services Committee by NORAD Commander General VanHerck.<sup>188</sup>

Analysts interviewed by Colombian media speculated the balloon may have targeted military facilities and assets such as Bolivar Naval Base in Cartagena, where Colombia’s surface ships and submarines are homeported, and Combat Air Command No. 3, where surveillance and reconnaissance aircraft are stationed, among others.<sup>189</sup>



**Figure 11:** Screenshot of footage of the balloon over Costa Rica (Source<sup>190</sup>)

## Middle East

Various balloons, including those identified as belonging to China, have been spotted in the Middle East, according to US Central Command commander Lieutenant General Alexis Grynkewich.<sup>191</sup> The incidents involving Chinese balloons include an event in the fall of 2022, when a balloon “primarily stayed over water”, and “one or two others” in prior years.<sup>192</sup> However, Lieutenant General Grynkewich would not characterize them as a certain kind of balloon, whether meteorological, surveillance, or otherwise.<sup>193</sup>

## Outlook

The Chinese surveillance balloon that flew over the continental US in early 2023 revealed the PLA's interest in and capabilities for exploiting near-space for long-range military ISR and early warning. Although the balloon caused a political sensation in the US and other countries, the PLA is unlikely to abandon its near-space ISR ambitions. Operations into or near the airspace of other countries with low-dynamic platforms like balloons and aerostats will likely pause, but the use of these systems over the past approximately 5 years reflects a longstanding interest among PLA and defense industry analysts in LD-NSFVs for military ISR since 2005. As a result, these peacetime high-altitude surveillance operations will likely resume. Whether the PLA will deploy the WZ-8, its only known HD-NSFV for ISR missions, above the territories of other countries during peacetime is unknown, but the PLA is likely considering the risk that doing so would be even more provocative if detected. As such, the WZ-8 may be reserved in peacetime for monitoring on-land targets from international airspace and activities in international commons, such as foreign naval operations in the Indian Ocean.

In combination with other sources of information, strategic intelligence collected during peacetime by the PLA's LD- and HD-NSFVs over strategic sites regionally and globally will very likely help the Chinese military develop national defense strategies, craft force development priorities, maintain readiness, and support contingency planning for potential conflicts. Intelligence at this level will also very likely help authorities in China monitor the capabilities and facilities the US and its allies are currently upgrading along China's periphery.<sup>194</sup>

If a war were to develop — over Taiwan, for example — the PLA's NSFVs would likely be deployed to support campaign- and tactical-level intelligence collection as well, especially if satellites were destroyed or disrupted. Intelligence collected by LD- and HD-NSFVs would almost certainly support the PLA's pursuit of a persistent, all-weather reconnaissance and battlefield perception, aiding joint operations and providing commanders with insights on the regional balance of forces, troop positions, weapons in play, strike effects, and geographical, hydrological, and meteorological conditions that shape their options.

However, the potential of LD-NSFVs such as balloons and aerostats should not be overestimated. Likely dissimilar to HD-NSFVs for both precision strike and reconnaissance, LD-NSFVs will likely be a secondary capability to more traditional platforms. This is particularly true as China's traditional capabilities, namely satellites but also drones, continue improving. China reportedly placed likely intelligence and early warning satellites in geostationary orbit in 2015, and since at least 2019 has reportedly achieved sub-meter resolution in satellite remote sensing technology.<sup>195</sup> Both of these advances encroach on the core advantages of ISR-oriented LD-NSFVs identified by Chinese analysts since 2005.

Nevertheless, the PLA is almost certainly pursuing NSFVs for ISR and direct and indirect offensive strike as capabilities that provide operational flexibility and potential asymmetric advantages to help

China to win wars. The strategic-, campaign-, and tactical-level insights that could be collected by NSFVs would support those outcomes, as would highly maneuverable hypersonic munitions. These HD-NSFVs are likely to enhance the PLA's ability to successfully strike high-priority targets over enemy defenses. Other LD- or HD-NSFVs equipped to support the precision strike kill chain with control, targeting, and strike evaluation capabilities can also likely enable more effective offensive operations and subsequent command decision-making.

Although Chinese companies and research organizations are developing some near-space communication and airship cargo-hauling capabilities,<sup>196</sup> the extent to which the PLA has acquired or trained with NSFV platforms for uses other than ISR and precision strike is unclear as of this writing. If they are pursued and deployed to the battlefield, such NSFVs would likely offer the PLA further tactical options to facilitate operational success. Electronic warfare capabilities aboard LD-NSFVs, for example, could aid the PLA in achieving information dominance, creating tactical advantages and degrading an adversary's resistance. LD-NSFVs equipped for communications and logistical functions could support PLA resilience.

Of course, any outcome that could make the PLA a more effective fighting force would be dependent on near-space technology reaching maturity and reliability suitable for the wartime roles described by Chinese analysts and on the PLA's ability to overcome enemy countermeasures. As the US's handling of the high-altitude surveillance balloon that flew over American airspace in early 2023 demonstrated, LD-NSFVs can be shot down if they drop to the lower altitudes of near-space or below. Their collection and communication payloads can also almost certainly be disrupted. The speed and maneuverability of HD-NSFVs pose a distinct challenge, but they too can be tracked and targeted with the right capabilities — a problem the US and others are focused on.<sup>197</sup>

The revelation that likely Chinese surveillance balloons have conducted dozens of operations since 2018 or 2019 marks the maturity of the PLA's LD-NSFV technology for ISR applications. The PLA's WZ-8, described as "active duty" equipment in Chinese sources, is also very likely mature and ready for deployment, as is the PLA's DF-ZF hypersonic glide vehicle. Less clear to Insikt Group is the maturity of the near-space communications and logistics platforms available to the PLA. Governments and militaries following China's military development should pursue future research into the state of these types of LD- and HD-near-space technologies in China. Excluding hypersonic munitions (the utility of which is relatively clear), research should further evaluate to what extent any NSFV military applications — ISR or otherwise — might give the PLA the advantage it almost certainly seeks in war. Ensuring that destructive or disruptive countermeasures aimed at NSFVs and their ISR and non-ISR functions are available to allies, partners, and warfighters should be a priority if significant asymmetric advantages are discovered.

## Appendix A: PLA Intelligence Goals Likely Supportable by NSFVs

The following table presents strategic-, campaign-, and tactical-level Intelligence goals identified in *Science of Military Intelligence* (2001) that NSFVs can likely support depending on an appropriate payload and the time and location of their operations.<sup>198</sup>

Level	Intelligence Goals	Possibility of NSFV Support	
		IMINT Capability	SIG/COM/ELINT Capability
Strategic	The military thought, strategic plans, and operational principles of a country, group, or area		X
Strategic	The military strength of the enemy and the hierarchical systems, organization, disposition, and equipment of the armed forces	X	X
Strategic	The enemy's battlefield preparations	X	
Strategic	The enemy's resources of national power and capacity for war	X	X
Strategic	The enemy's transport conditions and military logistics support capability	X	
Strategic	The military geography of the conflict and peripheral environment	X	
Strategic	The enemy's political and military alliances		X
Campaign	The enemy's troop strength, disposition, order of battle, formations, the quality of their training, operational characteristics, campaign intentions, weapons equipment, organization of military positions, firepower allocation, and so on	X	X
Campaign	The enemy's transport capabilities, logistics and resupply, military materiel reserves, communications, the setup of command organs, and the characteristics of commanding officers	X	X

Campaign	The distribution, types, and numbers of major enemy forces, including tank forces, rocket forces, aviation forces, airborne forces, warship forces, and nuclear, chemical, biological, and incendiary weapons, as well as their orientations and methods	X	
Campaign	The geographic, hydrological, meteorological, and social conditions of the campaign operational area	X	
Campaign	The enemy's military situation in the land, sea, and air spaces peripheral to the campaign operational area	X	
Tactical	The enemy's troops, unit numbers, combat changes, disposition, operational orientation, operational intent, the position of the command organization and communications hub, weapons equipment, firepower allocation, obstacles, transport, logistics and resupply, and so on	X	X
Tactical	The geographic, hydrological, meteorological, and social conditions of the tactical operational area	X	
Tactical	The disposition and status of the enemy's nuclear, chemical, biological, and incendiary weapons, positioning systems, helicopters, and other equipment	X	X

## About the Author

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## Endnotes

- <sup>1</sup> In Western military parlance, the levels of war are the strategic, operational, and tactical levels. In Chinese writings, the operational level is referred to as the campaign level (战役层).
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- <sup>5</sup> Pat Ryder, "Pentagon Press Secretary Air Force Brig. Gen. Pat Ryder Holds an On-Camera Press Briefing", *US Department of Defense*, February 8, 2023, <https://www.defense.gov/News/Transcripts/Transcript/Article/3293101/pentagon-press-secretary-air-force-brig-gen-pat-ryder-holds-an-on-camera-press/>.
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- <sup>7</sup> Kevin Pollpeter, "How China Might Use High-Altitude Balloons in Wartime", *Center for Naval Analyses*, February 22, 2023, <https://www.cna.org/our-media/indepth/2023/02/how-china-might-use-high-altitude-balloons-in-wartime>.
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