Fighting the Elements: Assessing a Sino-Indian Conflict at Doklam *

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Tensions remain high between India and China over territorial control of the Doklam Plateau. What arc would a military confrontation over this territory follow? I analyze the capabilities and doctrines of the People's Liberation Army (PLA) of China and the Indian Army to establish a likely scenario for military confrontation and discuss challenges posed by the high-altitude, mountainous area of operations. I identify a plausible scenario in which China tries to create a locally-favorable balance of forces on the plateau in order to build new infrastruture without Indian interference. For this scenario, under some simplifying assumptions, I find that the PLA will be able to put multiple infantry brigades on the plateau before Indian troops can acclimatize and re-establish parity.

Introduction

In the summer of 2017, soldiers from China's Border Guard and the Indian Army stood "eyeball to eyeball" for roughly ten weeks on the Doklam plateau, a 89km slice of territory (disputed between China and Bhutan) near the so-called "tri-junction" border between India, Bhutan, and China at 4,200m above sea level. The dispute began in June when Indian soldiers operating from a border post crossed into the disputed territory to prevent a border guard-accompanied Chinese construction crew from extending and improving a roadway that would run South toward a Bhutanese army camp on the strategically crucial Jampheri ridge.[1] This initial confrontation involving infantry patrols and bulldozers quickly escalated to a standoff involving 300-400 soldiers (a little more than 2 rifle companies worth) from each side standing within meters of each others' lines on the plateau (Shukla, 2017*d*). Thousands more troops on the Indian side were moved to nearby high-altitude staging areas to acclimatize and prepare to reinforce the soldiers on the disputed plateau (Pandit, 2017).

After 73 days of a close-proximity standoff, India and China agreed to "disengage" at Doklam without either any casualties or any political resolution to the underlying territorial dispute (Shukla,

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[1] India considers the Jampheri Ridge a strategic "red line" because it is the last defensible ridge between China and the "Chicken's Neck," a 20km wide corridor that threads between Nepal and Bangladesh, connecting India's seven Northeastern states to the Deccan plain and the rest of the country.

2017*c*). Even a year after the disengagement, Indian and Chinese forces near the plateau remain on high alert: Chinese forces took the unprecedented step of remaining on the disputed territory over the winter and building military infrastructure like communication trenches, helipads, observation towers, and gun emplacements a few kilometers north of the standoff site (of India, 2018*a*; Singh, 2018; Bhat, 2018*b*). Indian soldiers, even after withdrawing to the Indian border post at Doka La pass, are well under a kilometer from the forward most Chinese positions and infrastructure.[2] Further east on the Sino-Indian Border in Arunachal Pradesh, India's III Corps and IV Corps took steps to reduce their mobilization time to the border, staging at least 2 divisions with organic artillery regiments some 70-80km forward of their normal garrison positions (Singh, 2017*a*).

Although China and India successfully de-escalated the 2017 standoff, continued preparations on both sides indicate that the Doklam issue is far from resolved. Chinese construction equipment sits ready for another attempt at extending the road toward the Jampheri ridge; a number of India's mountain infantry divisions remain on elevated alert in Sikkim and Arunachal Pradesh.

Since independence, India has fought wars over its disputed northern border on a somewhat regular basis. India and China in particular have engaged in confrontations over/incursions into disputed territory along their $>$ 3,000km shared border for decades (Fravel, 2008). Some of these confrontations and incursions have escalated into shooting wars, most notably the 1962 Sino-Indian War, which escalated over the course of two years from incursions and low casualty border skirmishes to a massive two-front Chinese offensive in October of 1962 that captured disputed territory in both the Western and Eastern sectors of the disputed border (See Figure 1) followed by a unilateral ceasefire and China's withdraw to the pre-war line of actual control (LAC) in November 1962. The war ultimately led to over 10,000 casualties, most of which were suffered by Indian soldiers (Wortzel, 2003). Subsequent smaller clashes in 1967 at Nathu La and Cho La (in Sikkim, very close to Doklam; see Figure 2) killed dozens of soldiers in only five days of fighting resulting in an Indian tactical victory (Fravel, 2008; Thapliyal, 2004). No confrontations in the last decade have produced casualties, but according to Indian accounts, the total number of cross border incursions and patrol confrontations was already rising in the years before the Doklam standoff (Topgyal, 2014; Markey, 2015).

[2] "La" means "pass" in Tibetan. As is the case with mountain warfare across the world and throughout history, many of the most strategically important locations near the Sikkim/Tibet/Bhutan confluence are passes (Walcott, 2010).

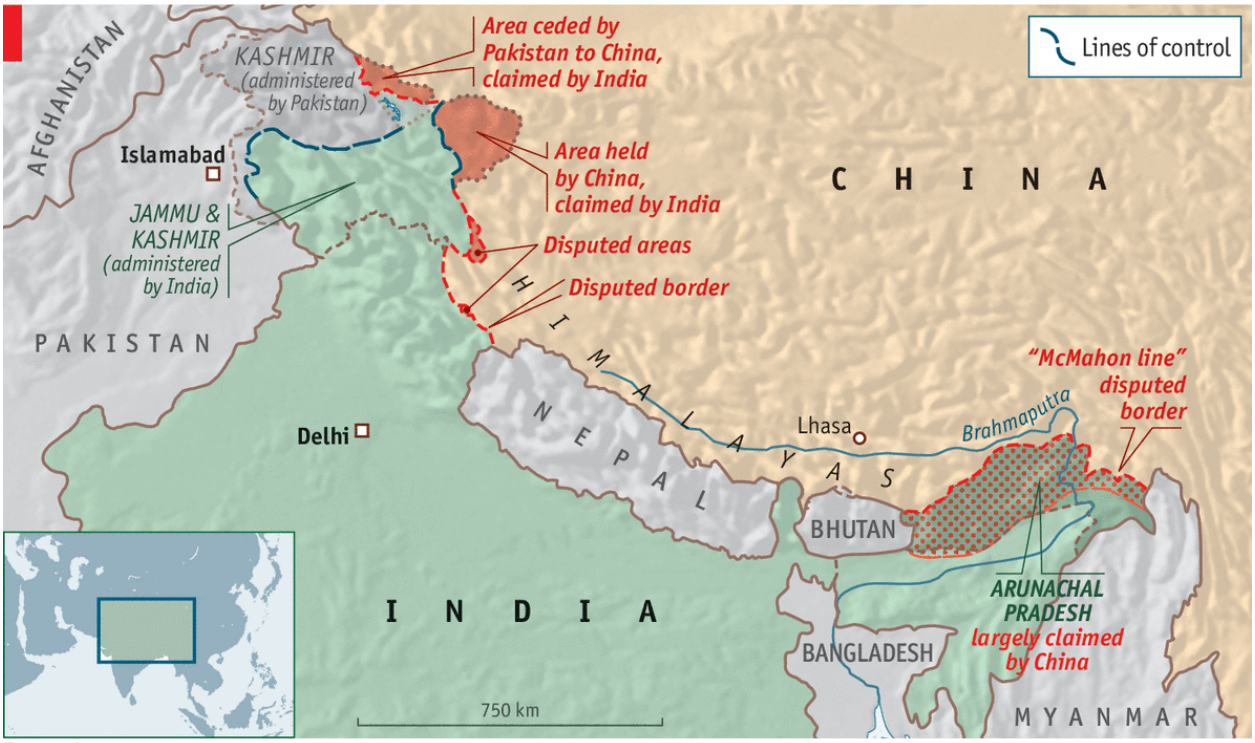

Figure 1: Map of the Sino-India Border with Disputed Areas. Doklam (not highlighted because the conflict is between China and Bhutan) sits at the confluence of India, Bhutan, and China

While the potential for another, more serious confrontation at Doklam has received substantial attention (at least in the Indian press) since 2017, little attention has been paid to what such a contingency would look like from a military perspective. I argue that China's ability to complete a road down to the Jampheri ridge hinges on whether it can either deter Indian forces from crossing the border into Doklam, or realistically expect to defeat any Indian forces that attempt to interfere. The ability to deter and defeat in turn hinges on force ratios: if China can create a favorable force ratio on the plateau, it can build its road (perhaps without any casualties). If not, China is unlikely to succeed.

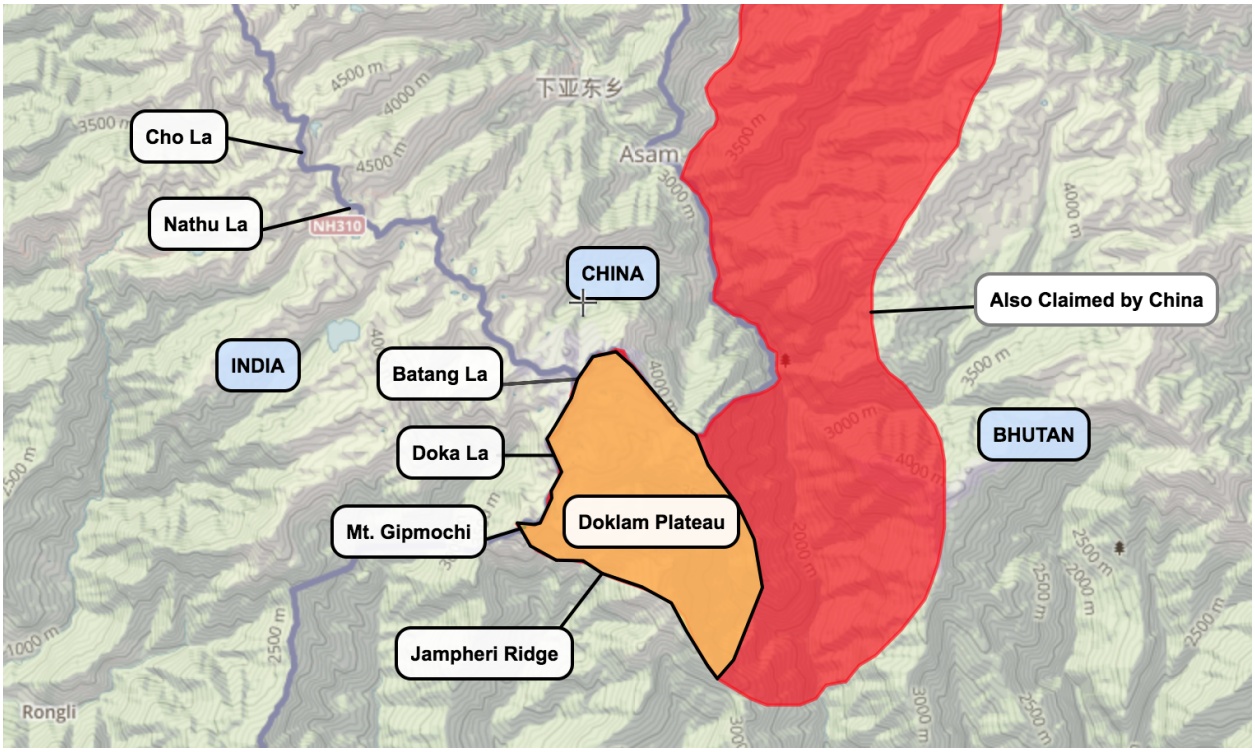

Figure 2: Doklam Area of Operations, author's map

In this paper, I assess the capability, doctrinal, and environmental factors that bear on China's ability to create and exploit a local imbalance of forces, build a road to the Jampheri Ridge, and strengthen its de facto control over the Doklam plateau. I pay special attention to the peculiarities of the high alpine environment at Doklam and the three major effects the environment has on military operations. First, fighting at 4000 to 4500m changes military operations in a number of ways: infantry takes time to adjust to the altitude and will need to carry less kit and consume more calories even after acclimatization is complete; artillery shells behave differently in thin air and firing

tables developed at sea level are absolutely useless; diesel engines become less fuel efficient and less powerful. Second, the terrain on and around the disputed territory makes maneuver challenging and changes the force ratios required to win a ground engagement. The ground on the "plateau" is far from flat (see topo map in Figure 3), making direct fire and mechanized/armored units far less potent than usual; taking territory by fighting uphill requires far more than the 3-to-1 force ratio typically desired (Army, 2000; Clausewitz, 1976). Third, both sides suffer from difficult approaches to Doklam: China's lines of communication back into Tibet run through the long and narrow Chumbi Valley, and India has overwatch into the valley for at least the last 50km of the approach; India's lines of communication rely on un-paved roads that climb steeply up to the Himalayan plateau—the last 70km of road climbs from 1200m to about 4300m before leveling off over the last 10km.

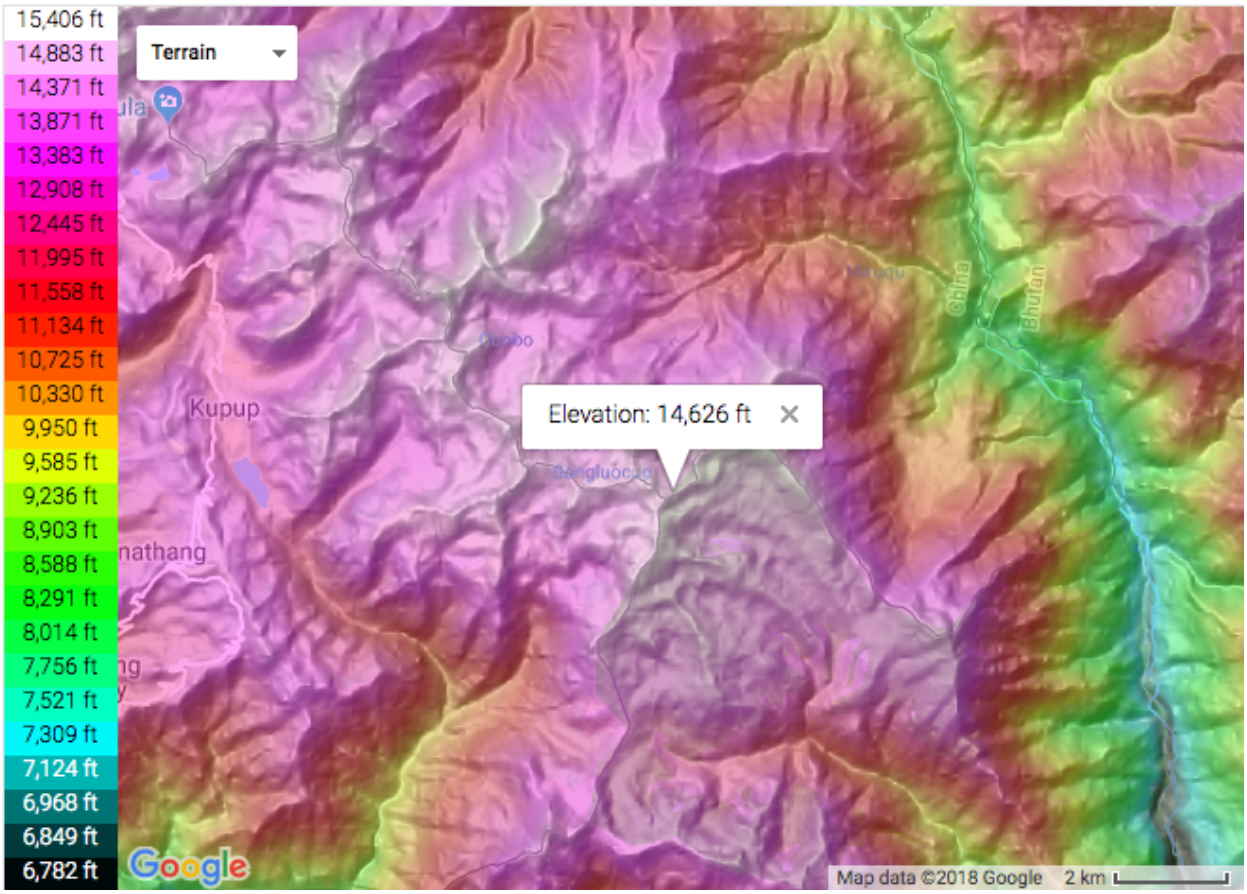

Figure 3: Topographical map of area around Doklam. The marked point is the summit of Mt. Gipmochi

The paper proceeds in six additional sections. First, I describe the military problem of Doklam

in greater detail, identify the likely campaign objectives of each side, and specify what I believe to be the most likely path that a future confrontation/escalation would follow. Second, and following from that "most likely" path, I specify and defend the parameters and assumptions that I will use to assess the campaign. Third, I assess the relevant military capabilities (mainly infantry, indirect fires, and logistics) that India and China might, based on their respective doctrines, commit to a Doklam contingency. Fourth, I construct a "doctrinal template" for Doklam and conduct a time-distance analysis to determine whether, under ideal conditions, China could create and exploit a local imbalance of forces and build its road. Fifth, I interact the doctrinal template with the actual conditions that the Indian Army and People's Liberation Army are likely to confront and re-assess whether, under realistic and decidedly non-ideal conditions, China could create an imbalance. Sixth and finally, I summarize the conclusions of the exercise and briefly detail the military planning and policy implications of my analysis.

To briefly preview these findings: China's superior transportation infrastructure and the availability of pre-acclimatized forces in the Tibet Autonomous Region (TAR) allow China to create a substantial, temporary imbalance of forces at Doklam. The PLA can buy itself a window of up to 10 days in which it has substantially more combat power in the area of operations. After that window closes, the situation returns to a stalemate: where neither the PLA nor the Indian Army can generate enough force to change the status quo substantially. As I detail in the conclusion, this forces a difficult choice on India: escalating tensions by pre-acclimatizing large formations of mountain infantry or preparing a pre-emptive strike on China's lines of communication may be the best way to prevent a PLA fait accompli but both options invite new escalation risks.

The Doklam Scenario

Since warfare is the "continuation of political intercourse," the details of the political incompatibility underlying any military contingency provide important bounds for analysis (Clausewitz, 1976).[3] This section details China and India's goals with respect to the territorial dispute between China and Bhutan (as well as their pattern of territorial disputes more broadly), and then briefly covers developments since the 2017 standoff that influence the campaign analysis in this paper.

[3]Quoting Clausewitz in a campaign analysis may be playing to type, but I plead forgiveness since this is a very practical piece of advice.

Why would India and China consider fighting over a small slice of territory with zero year-round residents and no natural resources of particular value?[4] Frankly, controlling the plateau is not the primary prize for either side. India's interest in constraining Chinese presence and infrastructure building at Doklam is really about protecting the territory downhill. If the tri-junction border were fixed at Mount Gipmochi rather than its current location at Batang La, Chinese territory would extend just past the last >4000m ridge between the Himalayan Plateau and the Siliguri Corridor or "Chicken's Neck," a 23km wide corridor of Indian territory between Nepal and Bangladesh that connects the main Indian landmass on the Deccan plain to India's seven Northeastern states. If China were to try and seize the large amount of territory that it claims in Arunachal Pradesh (one of the northeastern states, see Figure 1) it might also try to occupy the Siliguri Corridor to prevent reinforcements from surging into the Northeast (Blank, 2017).

While the vulnerability of the Siliguri Corridor certainly seems to be a reasonable and widely supported motivation for India's intervention at Doklam (Bagchil, 2017), some military commentators point out that Chinese control of the Jampheri Ridge is not quite an automatic ticket to the Siliguri Corridor. Col. (Ret.) Ajai Shukla and Lt. Gen. (Ret.) S.L. Narasimhan both point out that an invading force would still face serious difficulty (not to mention unfavorable force ratios) trying to traverse 90km of Sikkim hills that lie between Doklam and the Siliguri Corridor (Shukla, 2017*b*; Srivastava, 2017). Even if Shukla and Narasimhan are correct, though, the actions of Indian military and political leaders are consistent with significant concern about the strategic consequences of China occupying the Jampheri Ridge.

China's concrete goals in the dispute are well documented and straightforward, but their motives are less clear. Maps released by China's ministry of foreign affairs detail their goals in the dispute: exercise control over and build infrastructure in Chinese territory, which they consider to end at Mount Gipmochi. As to why this means building a road in an area that catches the attention of India—which is not even a claimant in the dispute over Doklam—there are a number of possible explanations. Jonah Blank from RAND, for instance, suggests that the road-building that sparked the standoff in 2017 may have been part a campaign of frontier infrastructure modernization, not a calibrated provocation (Blank, 2017). Other theories include that China was seeking to punish

[4]Tibetan and Bhutanese herders pasture yaks at Doklam during the summer, but do not stay through the Himalayan winters.

India for hosting the Dalai Lama in Indian-controlled but Chinese-claimed territory earlier in 2017 (Miglani and Wilkes, 2017).

Road-building in Doklam is also consistent with a pattern of Chinese action in disputed territory: building and maintaining infrastructure as a "foothold" for de facto control. China has, in the past, used roads a tool to increase control in the annexation of Tibet (Ramachandran, 2016, 2014), and in the capture of Aksai Chin (territory also claimed by India) during the prelude to war in 1962 (Das Gupta and Lüthi, 2016). In the past few years, China has used its infrastructure along the Line of Actual Control (LAC) in the Western sector as a jumping-off point for patrols and longer incursions into disputed and Indian territory. In the Dalut Beg Oldi incident in 2014, for example, a well-supplied platoon of Chinese soldiers established a small camp 18km across the border into Indian-controlled territory in Ladakh, a high alpine district of Jammu and Kashmir, and remained there for weeks (Pandit, 2013). China may see these "test incursions" and infrastructure improvement in Doklam as serving a similar purpose as in Tibet, and, more recently, dredged islands in the South China Sea: making infrastructural improvements increases the legitimacy of China's claim on the territory.

One more possible motive is worth mentioning. As Shukla and Narasimhan point out, the Sikkim sector is, of the three major border sectors, by far the least favorable to China in terms of terrain. China may see military infrastructure in Doklam and the extension of their claim south to Mount Gipmochi as an important way to counteract the effect of unfavorable territory and lessen their disadvantage vis Indian forces in the sector.

Since the end of the standoff in August 2017, Chinese infrastructure development in Doklam, though not directly next to the Indian border like the offending road construction, has proceeded apace. Developments that bear on the most likely possible contingency fall into three categories: road improvement farther from the Indian border, changes in deployment patterns, and military infrastructure building. The first development, road improvement farther from the Indian border, has two components. Existing dirt track in un-disputed China has been paved, effectively extending the blacktop road through the Chumbi Valley toward the site of the dispute, and, at the same time, the network of dirt track, pullout areas and graded parking on the disputed plateau has been expanded farther south toward the Jampheri ridge, but on the side of the ridge that sits ~5km from Indian positions. Continuing this road would give China a second approach to the ridge , and

potentially provide an opportunity to flank Indian forces (of India, 2018*b*; Bhat, 2018*a*).

The second major change is in deployment patterns. While neither side really "withdrew" troops from the Doklam plateau following the end of the standoff in 2017, China left troops on the plateau over the winter of 2017-2018 for the first time, and has increased the size of its seasonal deployment in the spring of 2018 (Times, 2017). China seems also to have bolstered its air assets in the region. Satellite images from Stratfor show increases in the number of fourth generation fighters J-10 and J-11 on the ramp at Xigaze (roughly 220km north of Doklam) and Lhasa (roughly 470km Northeast) compared to early 2017 (Marcus, 2018).

Third, and most strikingly, China has continued building military infrastructure on the plateau and farther into Tibet, effectively preparing to host much larger formations of infantry on the plateau. Satellite images from five months after the standoff show the construction of new barracks (Indian analysts suppose they are meant to house roughly 1,800 soldiers (Rikhye, 2018)) in a number of different cluster on the plateau, the appearance of an extensive network of double-layered communication trenches parallel to the Indian border, the clearing and marking of at least three helipads, multiple small depots of Heavy Equipment Transporters (vehicles that China uses to shuttle armor), a new concrete observation post near the Indian border, and multiple clusters of pre-dug—-but currently empty—-gun emplacements that are evidently designed to take advantage of a reverse slope vis existing Indian positions. Farther back in Tibet, China has built new infrastructure at the military airfields at Xigaze and Lhasa: Construction has begun on a new runway at Xigaze, and both airports increased the number of helipads/ramp space during 2017.

Taken together, these developments suggest that China is laying the groundwork necessary to support a much larger infantry and armor deployment on the Doklam plateau than the battalion-sized element that was present during the 2017 confrontation. I argue that the most likely military contingency for the Doklam plateau flows directly from these developments and the increased PLA presence they can support.

In 2017, India demonstrated its resolve to prevent China from building a road to the Jampheri Ridge and put China in an impossible situation: because there was rough parity between Indian and Chinese forces on the plateau, and because India had both the benefit of high ground defensive positions and an overwhelming numerical advantage in nearby, acclimatized reinforcements, Chinese forces got stuck in a standoff. After the standoff, new information came to light showing that China

had massed an entire division in the Chumbi valley, but was unable to use that formation in the standoff because Indian reinforcements could still beat the division to the site of the standoff (Gokhale, 2017; Singh, 2017*b*). New construction on the plateau seems like it might be an attempt to prevent such a situation (large formations of reinforcements stuck too far away to matter) from occurring again.

China's only realistic way forward with the road to the Jampheri Ridge is to create a temporary, favorable imbalance of forces on the plateau in order to either deter a numerically inferior Indian element from getting in the way, or, in a worse case, defeat that Indian element in combat before reinforcements arrive. Recent infrastructural developments, both infrastructural improvements that will support larger formations on the plateau and road improvements to improve access, are consistent with this way forward. In simple terms, the problem comes down to a sort of race between China and India: China tries to bring larger formations to the plateau in order to create a locally favorable balance of forces, and India has to keep pace, bringing its own formations near enough to the plateau that China never achieves a force ratio sufficient to deter or defeat Indian attempts to prevent road construction. China wins the race if the PLA can produce a local imbalance and sustaining it for long enough to build a segment of road. India wins if it can maintain rough parity or correct a local imbalance before China can exploit it.

In the rest of the analysis, I focus on this scenario—-an attempt to engineer a Chinese fait accompli—-as the likeliest possible military contingency given recent developments. I assess China's prospects for creating a favorable imbalance (and India's prospects for maintaining parity and the status quo) in light of both sides capabilities and doctrine, but also in light of the unforgiving environment in which China's feat has to be accomplished.

The Most Likely Scenario: Parameters and Assumptions

Whether or not China can succeed in creating a favorable local imbalance of forces at Doklam depends on a variety of factors, some of which must be held constant in order to make the campaign analysis problems tractable. In this section, I register a number of simplifying assumptions that are necessary for the analysis. Assumptions, of course, can be incorrect, but I argue that mine are realistic given political context, the doctrine of both sides, and the way that other mountain

warfare campaigns in South Asia have played out in the past.

First, I make two different assumptions about what capabilities India and China respectively will be able to commit to a fight at Doklam. Differences in these assumptions are based on differences in Indian vs. Chinese doctrinal prescriptions for fighting border wars in the Himalayas. For the Indian side of the equation, I assume that, at an absolute maximum, the four infantry corps assigned to the Eastern Command might be available for a Doklam contingency. In part, this is a matter of logistics. Moving units from outside the Eastern Command to Sikkim requires traveling extremely long distances toward the portion of India that has the lowest rail density and worst infrastructure generally speaking. Pulling a division from the Western Command, for example, is unlikely to make a difference in the scenario outlined above because the conflict is likely to be decided one way or the other before the Western division makes it to the fight.

More importantly, this assumption is a matter of Indian doctrine and expectations about the potential for a border conflict to expand geographically. India's concept of operations for the Sino-Indian border is based on large mountain infantry units garrisoned quite close to the border sectors they are responsible for defending (Rehman, 2017). All of the mountain divisions except for those in the new XVII Strike Corps are tied to a particular sector of the border. India is unlikely to un-tether any of these divisions during a crisis at Doklam. Indian military planners assume that any border conflict with China has the potential to expand to other sectors of the border: both Chinese and Indian doctrines count on political negotiations to end short border conflicts, and accordingly prioritize tit-for-tat territory grabs that can be traded in future negotiations (Scobell, 2015).

In practice, this operating concept likely means that a contingency at Doklam will actually have access to only a subset of the formations controlled by the Eastern Command, which also has responsibility for disputed territory in Arunachal Pradesh. During and after the crisis in 2017, for example, the III Corps and IV Corps in the Eastern Command were not flushed into Sikkim or West Bengal. Instead, elements of both corps were pushed forward in Arunachal Pradesh to prepare against a possible Chinese counterattack into the Eastern sector of the border (Singh, 2017*a*).

China's operating concept for border contingencies in the Himalayas is quite the opposite: ground forces assigned to the Western Theater Command (covering the entire Sino-Indian border from the Chinese side) are outnumbered by Indian forces in every sector of the border. Instead

of forward deployment of large formations, the PLA concept relies on its ability to surge large formations into the Western Theater Command from central China (Rehman, 2017; Scobell, 2015). In exercises in 2012, for example, the PLA pushed multiple brigades into Tibet in a short span of time thanks to recently built airport infrastructure and a new high-speed rail link from Beijing to Lhasa (Lhamo, 2014) . Under China's operating concept, it would not make sense to credit the PLA with only the mountain brigades already in the Western Theater Command. Of particular note are a Rapid Reaction 149th Infantry based out of Chengdu that is slated as a "first responder" to contingencies in the Tibet Autonomous Region and the PLA Airborne, based in Hubei.

For the sake of simplicity, I also assume that the air and AD assets available to India and China are those that are currently in the Eastern Command and Western Theater Command, respectively. Since crux of this campaign analysis is the balance of ground forces, this assumption serves to make the air component of the campaign more static. It is worth noting that this assumption is probably favorable to India: the balance of air assets in the region is more felicitous from an Indian perspective than the overall balance in 4th generation fighter strength between the IAF and the PLAAF (Tellis, 2016).

Another important assumption in this analysis is about the nature of tactical intelligence, both in terms of the disposition of forces at Doklam and in rear areas. China's only approach to Doklam is through the Chumbi Valley (visible in Figures 1 and 2), running North-South between Sikkim and Bhutan with an average altitude of 3,000m. India holds the entire western ridge of the Chumbi valley, and the ridge rises some 1,000m above the valley floor. This soaring advantage, combined with the narrowness of the valley (at the bottom of the valley, China's Highway S-204 is as few as 10km from the Indian-controlled ridge) give India excellent overwatch of (and, as will be discussed later, excellent artillery positions over) China's only approach to Doklam (Stratfor, 2017). China has no such vantage over India's approach to Doklam, most of which is up what amounts to a "reverse slope" vis. China's position on the plateau. Because of these geographical features, it stands to reason that India will see Chinese formations as they enter the Chumbi Valley, some 80km north of Doklam,[5] whereas China might know about Indian formations climbing toward the plateau by virtue of aerial reconnaissance or human intelligence. For the sake of this analysis, I assume that neither side has particularly useful tactical intelligence other than the mobilizations

[5]The actual driving distance is substantially longer

they can observe—during a crisis there will be a lot of activity on both sides, but it will still be hard to tell far in advance what units are bound for Doklam. This means that India has an 80km advance notice of Chinese reinforcements, and China has little if any advance notice of Indian reinforcements.

Finally, this analysis holds all other sectors of the Sino-Indian border fixed and static. I assume that both India and China (especially India, given doctrine) will pre-position forces near both the Western and Eastern sectors of the border if a crisis at Doklam emerges, and, for simplifying purposes, that they will basically stay put. Escalation of a border dispute to include sectors other than Sikkim/Doklam is certainly possible, but I do not model such escalation in this paper.

In sum, for my analysis of a contingency at Doklam, I assume that neither side is able to commit more resources than existing doctrine allocates to the Sikkim sector of the border, that neither side has particular advantages in intelligence or early warning other than those conferred by terrain features, and that the contingency is addressed on its own terms, not as part of a potential conflict involving other border sectors.

India's Capabilities

Force Levels - Ground

India's ground forces for a Doklam contingency would come from formations under the Eastern Command which is responsible for all of India's northeastern states, plus Sikkim and West Bengal. The Command comprises four Corps (III Corps, IV Corps, XVII Corps, and XXXIII Corps), all of which are made up exclusively of mountain infantry divisions (see Figure 4 for an overview of all Indian and Chinese units along the entire border). Only one of these corps (XXXIII) is assigned for deployment Sikkim (see Figure 5 for a map of XXXIII Corps formations with garrison altitudes). The III Corps, IV Corps, and the XXVI Mountain Strike Corps (one division of which is garrisoned within the Eastern Command territory) are either assigned to other sectors, or in the case of the strike corps, held back in reserve. This means the total strength assigned to Sikkim/Siliguri is three light infantry divisions, each composed of four infantry brigades and an organic artillery brigade. One additional artillery brigade is organic to the XXXIII Corps. Most Indian Corps also include organic engineer and air defense assets (Hackett, 2018). I assume this is true of the XXXIII Corps

as well, even though I cannot find unit numbers.

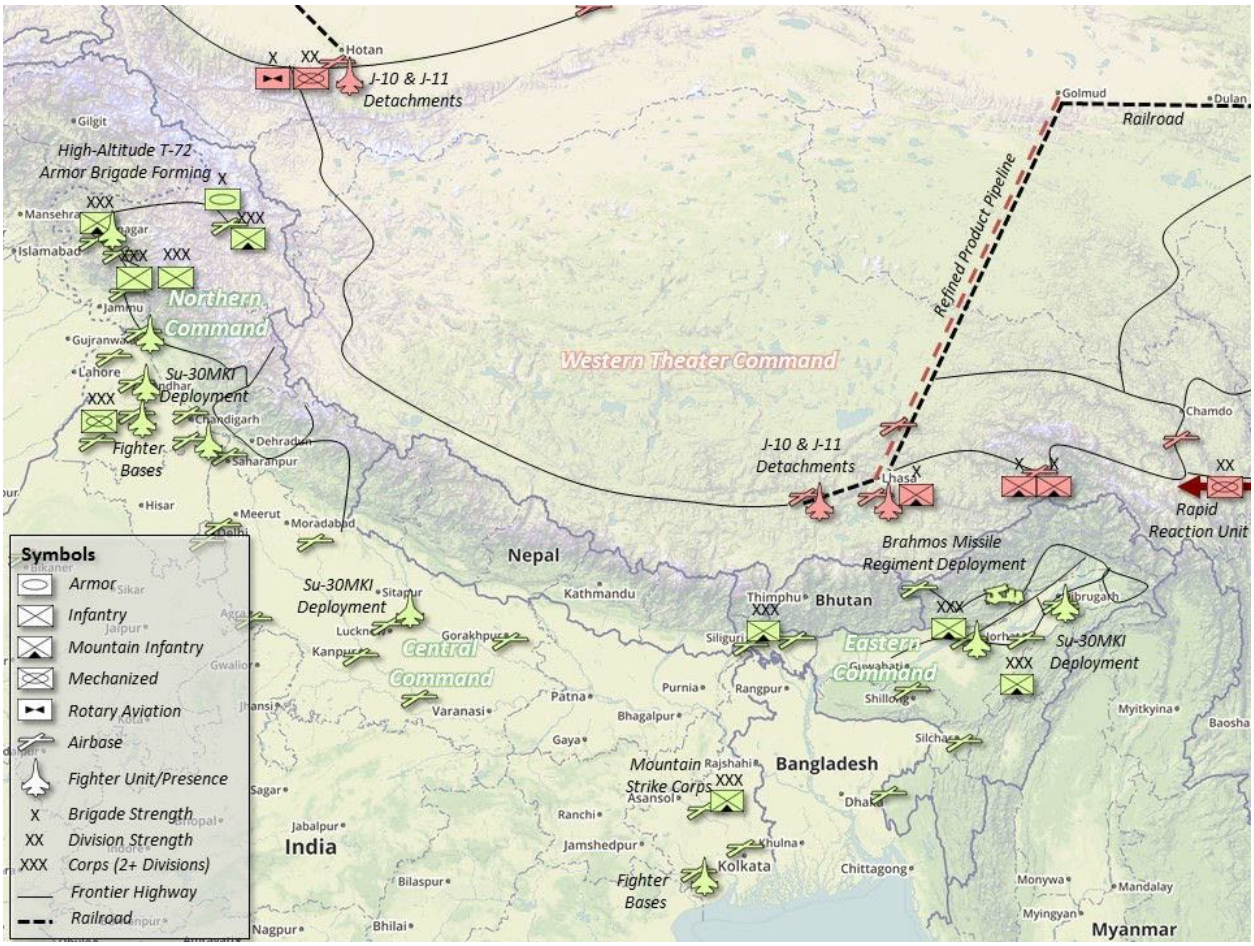

Figure 4: Chinese and Indian units stationed near the Sino-Indian border as of 2016. From Jane's Information Group.

In total, then, India should have the following ground formations available for a contingency at Doklam:

- 12 mountain infantry BDE
- 4 Artillery BDE
- 1 Engineer BDE
- 1 Air Defense BDE

Force Levels - Air

What counts as the "neighborhood" for the purpose of air assets is, of course, geographically broader. India has 10 airbases within 500km of Doklam. Each of these bases is below 1000m, and

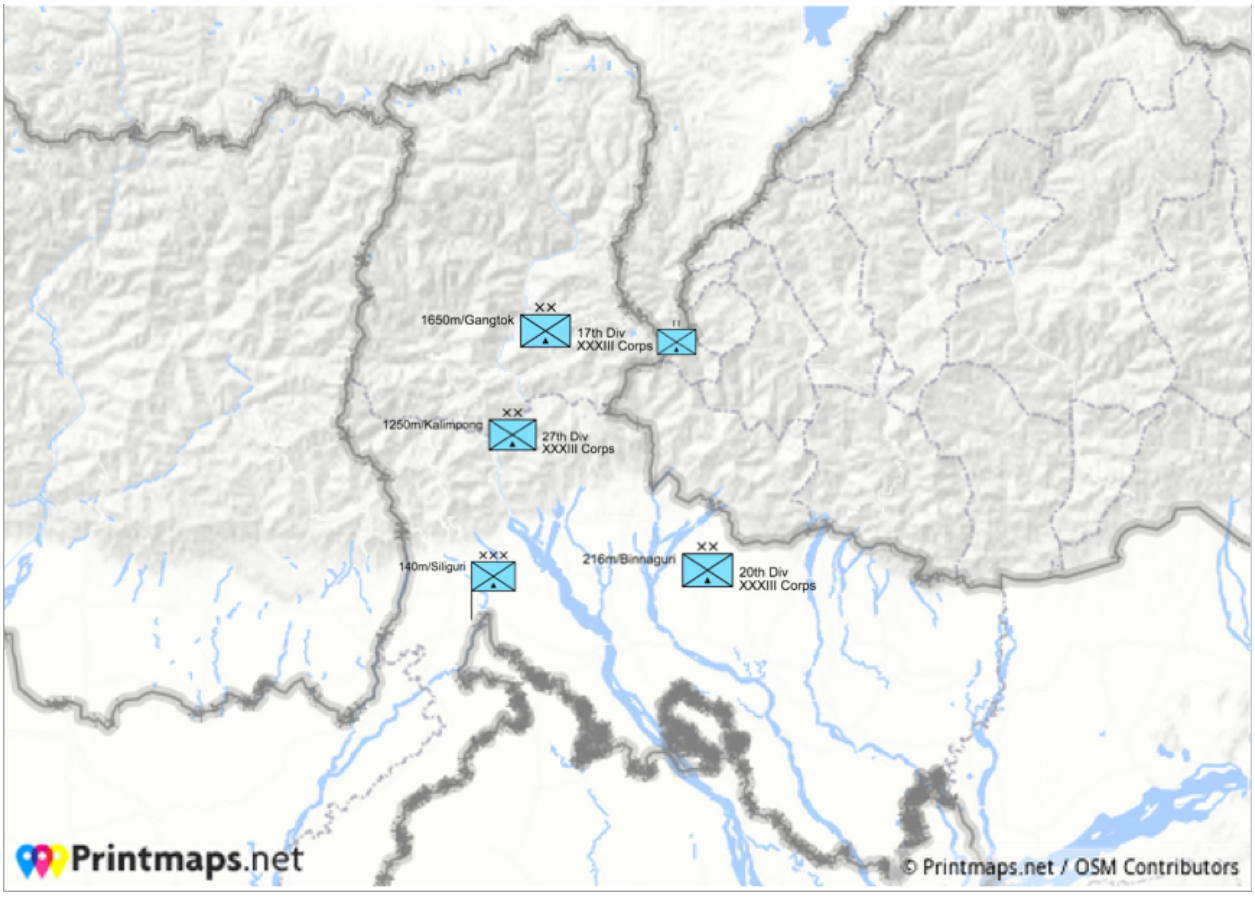

Figure 5: Major units of India's XXXIII Corps, with base altitudes. Battalion at Doklam shown. Author's Map

has a 2000-3000m runway (i.e. can support fighter/attack sorties at fully loaded weight). Squadrons available include two squadrons of Su-30MKI multirole aircraft, three squadrons of older MiG-27 ground attack aircraft, a variety of light and medium weight transportation squadrons (not highly relevant to the Doklam contingency), and nine squadrons of light and medium utility helicopters.[6] Currently, none of the helicopters squadrons in the Eastern Command have the platform best suited for mountain operations—the HAL Cheetah, a light helicopter with a 5,400m service ceiling (Hunter, 2015). The only helicopters in the neighborhood with a high enough service ceiling to be useful at Doklam are four squadrons of Mi-17 medium utility helicopters, and ten new HAL Dhruv medium utility helicopters attached to the strike corps (Gady, 2017).

In addition to fighter squadrons and helicopters, India has one Brahmos surface-to-surface supersonic cruise missile regiment deployed to Arunachal Pradesh. The Brahmos block III missiles fire from road-mobile launchers and can be positioned within range (450km) of Doklam and the Chumbi valley while still in Arunachal Pradesh (RT, 2017). I exclude other surface-launched missiles from a list of India's capabilities because other relevant platforms (like the Nirbhay cruise missile) are thought to be dual-use platforms. I assume that India should be reticent to deploy nuclear capable missiles in a limited conflict with China for fear of sending the wrong message about escalatory potential.[7]

In total, then, India should have the following air/missile assets available for a contingency at Doklam:

- 2 Sqn Su-30MKI
- 3 Sqn MiG-27
- 4 Sqn Mi-17
- 1 Sqn-equivalent HAL Dhruv
- 1 Rgt. Brahmos Missile (72 missiles)

[6] I omit some training squadrons of MiG-21M and MiG-21Bis, assuming they would not be a platform of first resort (Hackett, 2018).

[7] Only the air-launched variants of the BrahMos are thought to be dual-use (Alpha, 2017).

Quality of Forces

Of the available forces listed above, some are in areas of extreme strength for India's armed forces, and others suffer more problems. First, India's mountain divisions are extremely capable units. Perhaps no other military has as much experience fighting in high-altitude mountainous terrain as the Indian Army, and the experience shows in the capability of mountain units. India routinely deploys soldiers in Kashmir to altitudes far higher than the Doklam plateau, and thus has extensive experience with acclimatization procedures, high-alpine logistics, and combat mountaineering (Malik, 2003). The Army's High Altitude Warfare School in Kashmir is widely thought to be one of the best alpine warfare schools in the world—The U.S. Army routinely sends officers and NCOs as students in the multi-month course (Smith, 2013). Artillery regiments attached to the mountain divisions are also better-than-average performers at high altitude. All indirect fires work very differently at high altitudes due to the relatively low air pressure and reduced drag on rounds in flight. India's artillery formations, though, have substantial experience firing at high altitude, most notably during the Kargil war in 1999, where tubed artillery and mortars played an integral role in ejecting Pakistani troops from positions on ridge lines (Sengupta, 1999). One American officer, comparing India's success in Kargil to the United States' mixed results in a similar operation (Operation Anaconda) three years later points to artillery as a key difference. India fired more rounds (about a quarter million in total) and fired better in Kargil than the United States did in the Shah-i-Kot Valley (Acosta, 2003). Post-Kargil, India has continued to hone its high-altitude artillery proficiency in Kashmir; experience within the corps plus the development of altitude-specific firing tables ought to make India's indirect fires unusually potent in high altitude environments.

Against these qualitative advantages, India's forces also suffer some readiness deficits that could decrease their efficacy in conflict with China. The first, and most serious, is a fairly straightforward supply problem. According to audits released in 2017, the Indian Army faces severe ammunition shortages—half of all ammunition types are stockpiled at less than operational preparedness levels, and stockpiles of certain ammunition types like the fuses for most large-caliber artillery shells are at 10 or fewer days of war wastage reserve (Raghuvanshi, 2017). Until production increases address this problem (Grevatt, 2017), fighting for more than ten days at a stretch would likely necessitate raiding other units' supply depots for ammunition and transporting that ammunition hundreds of

kilometers to the front.

The IAF's frontline fighter and attack squadrons also suffer maintenance and spare-parts deficits that decrease the rate at which each squadron can generate sorties (Tellis, 2016). The availability rate is particularly low for the Su-30MKI, the heavy multi-role fighter that is probably India's most capable and self-sufficient platform.[8] When flying, though, the Su-30MKI ought to have a qualitative edge over Chinese platforms like the Su-27 and J-11 on account of its superior avionics and electronic attack systems (Tellis, 2016).

Quality of Border Infrastructure

Finally, it is worth mentioning the relatively poor quality of India's border infrastructure. While border roads are not a military capability, strictly speaking, they are an extremely important factor in the Doklam contingency envisioned in this paper. After decades of neglecting to improve transportation infrastructure near the border (in principle to ensure that invading Chinese forces would go without the benefit of paved roads), the Border Roads Organization has recently started major projects to improve strategic access to the Sino-Indian border. As of 2018, though, lofty plans have not translated to dramatic improvements. Only 30 percent of the planned 72 Sino-Indian border road projects are on schedule (Shukla, 2017*a*). The road up to Doklam, in particular, is less sturdy than would be ideal. Moving scores of heavy trucks up a dirt road cut into the side of a mountain would unquestionably degrade the road surface; convoys would have to travel very slowly.[9]

China's Capabilities

Force Levels - Ground

China's ground forces for a contingency at Doklam would come from two different sources. First, China would likely use formations that are already stationed in the Tibet Autonomous Region (TAR) at Lhasa and Xigaze, 440km and 350km from the road head in the Chumbi Valley, respectively. The PLA has three brigades—one mechanized infantry (54th) and two motorized mountain infantry (52nd, 53rd)—in these nearby locations. The same locations also provide an artillery

[8] Self-sufficient insofar as it can do SEAD, and a lot of its own jamming.
[9] Thank you to LTC Tim Wright for insight on this, and for checking my speed estimates.

brigade, an air defense brigade, and a special operations brigade. At first blush, this does not seem nearly sufficient to counter the entire corps that India can devote to Sikkim. China's operational concept, though, relies heavily on its superior logistics infrastructure to surge additional formations in to the TAR from other parts of the Western Theater Command (McCauley, 2016; Wortzel, 2003).

To identify which of these distant units are most likely to be used in a Doklam contingency, I use three decision rules. First, I assume that units positioned close to the Western sector of the Sino-Indian border would not be pulled east to reinforce Doklam. I assume this for the same reason that I leave Indian units outside the Eastern command off India's capability list. Second, I assume that units designated as "rapid reaction" would be units of first resort because of their ability to mobilize and move quickly. Third, except for forces designated as "rapid reaction," I assume that formations already under the Western Theater Command are, on balance, more likely to be employed. Using these three rules, I arrive at the following list of reinforcement units: The 149th Rapid Reaction motorized infantry division (Sichuan), the Airborne Corps (6 Infantry Bde, 1 Spec. Ops Bde, organic aviation),[10] the 37th Infantry Division (Chongqing).

After pulling in likely reinforcements from greater distances, China should have the following ground forces available for a contingency at Doklam (Hackett, 2018):

- 15 Infantry Bde. (Mix of motorized and light)
- 3 Artillery Bde.
- 3 Air Defense Bde.
- 2 Special Operations Bde.

Force Levels - Air

Compared to India's ten, China only has three airbases within 500km of Doklam at altitudes ranging from 2900m to 3800m, and runways between 4000 and 5000m. In addition to three regiments of transport planes based in the Western Theater Command, the PLAAF has five fighter units officially stationed in the TAR that can be used at Doklam. Three units fly the J-7, a license-built version of the MiG-21 (McCauley, 2016), and two units fly the J-11, a license built version of the Su-27 (the same airframe as the Su-30MKI). In addition, satellite imagery from early 2018 shows roughly

[10]Though not a mountain-specific unit, the Airborne Corps has taken part in high-altitude exercises in Tibet, suggesting that they might be part of a mountain contingency (Chansoria, 2012).

two squadrons of J-10Bs and J-10Cs (lightweight multi-role generation 4.5 fighters) parked on the tarmac at Lhasa and Xigaze. Also shown in the satellite images are new helipads full with Mi-17s. In addition, the PLA ground forces have organic rotary wing assets in the division-sized formations listed above.

In total, the PLAAF should be able to muster the following forces for a Doklam contingency from units already in the TAR:

- 3 Sqn. J-7
- 2 Sqn. J-10
- 2 Sqn. J-11
- Organic rotary wing assets in ground units (mostly Mi-17)

Quality of Forces

PLA Ground forces have less recent experience fighting mountain warfare than Indian forces, and far fewer of the PLA's available units for a Doklam contingency are specifically designated mountain infantry/specifically trained for high-altitude combat.[11] This suggests that there will be more variation in capability across the general-purpose PLA units (including non-mountain elite units like the Airborne Corps) than across India's units, all of which are mountain infantry. On the whole, mountain warfare proficiency and capability operating at high altitude will probably be lower for Chinese ground forces and artillery than for corresponding Indian Army forces.

In terms of air forces, the PLAAF deployment in the TAR is a slightly higher-end mix of platforms, especially with the recent deployment of J-10 variants. China's J-11s and India's Su-30s ought to be a roughly even match in the air (they are, after all, relatively similar variants of the same airframe), but the J-11s does not fulfill the SEAD/electronic attack role that the Su-30 can take on. With more advanced avionics including an AESA radar, later J-10 variants likely outmatch India's 4th generation fighters in air-to-air combat (Hunter, 2015). I assume that the 3rd generation J-7 fighters would play a limited role, and would be handily out-paced by the Su-30s.

[11] This is likely because the PLA outsources much more of the high-altitude border guard mission to the People's Armed Police than the Indian Army does to the Indo-Tibetan Border Police

Quality of Border Infrastructure

Whether coming from garrisons in the TAR or from the nearest military airfields and rail sidings, Chinese forces traveling by road to Doklam are traveling the vast majority of the distance on blacktop. China's border infrastructure is better built and ought to provide a higher through-put capacity than infrastructure on the Indian side. At the same time, the higher-quality infrastructure is equally vulnerable, if not more so, because it runs through a narrow valley for the last kilometers before approaching Doklam. China's infrastructure likely would not be degraded by the simple movement of troops, but is by no means invulnerable to Indian interdiction.

Evolution 1: Doctrinal Template

As of spring 2018, China has built infrastructure on Doklam that can theoretically support enough PLA soldiers to create a favorable (for China) balance of forces on the plateau. Whether or not they can exploit that new infrastructure to create a favorable balance of forces depends largely on logistics—how fast the PLA can move ground formations to the fight vs. How fast the Indian Army can do the same. In this section, I create what U.S. Military planners call a "doctrinal template" for the fight: a "perfect world" analysis of how Chinese and Indian capabilities would stack up against each other in a race to Doklam (Army, 2000). In the mountain warfare context, a "perfect world" means conducting the fight on a table-top instead of in the Himalayas, and at low altitude instead of high. Laying out a doctrinal template, even though it is poorly representative of the actual situation in question, provides a useful point of comparison for the final, more realistic analysis. Differences between the outcomes in the doctrinal template and the more realistic situational template can be attributed directly to the terrain and the difficulties of fighting in high mountains.

There are three important starting parameters for the doctrinal template. First, China is the "revisionist" side in the local and tactical sense: The PLA is interested in occupying new territory/building new infrastructure on the plateau, and the Indian Army is not. This means that in an interaction of forces on the plateau, India will be trying to hold a line, and China will be trying to break through. Second, as the attacker, China makes the first move. I assume that this "first move" is to push ground units up to Doklam to try and create a local imbalance of forces. Following evidence from other territorial disputes involving China, I expect that China

would conduct this "first move" mobilization gradually (Baruah, 2017; Haddick, 2014): moving ground forces up to Doklam in company-sized units such that no individual movement would raise the alarm on the Indian side of the border. Third, I assume that the force postures for India and China at t = 0 are essentially as they are now: units other than those already at the plateau are not forward deployed. This final assumption stipulates that China mobilizes slowly and as secretly as possible, and that the mobilization is likely not precipitated by a high profile event or political crisis. This is consistent with Chinese doctrine for mountain offensives, which emphasizes quick surprise movements (Wortzel, 2015; Feng and Wortzel, 2003), and is also an assumption that favors China's chances: in the 2017 standoff scenario, India moved its forces far forward of their normal positions, putting them closer to the plateau than normal.

Phase 0 - Chinese Mobilization

The basic problem for China is that force ratios on the Doklam plateau lead to a stalemate when China tries to take new territory and build new roads. I assume that China is likely to engage in a salami-slicing approach to move ground forces up to Doklam, and that India will not match these piecemeal mobilizations in real time because its infrastructure at the plateau cannot comfortably support as many soldiers. As such, phase 0 is the moment when total PLA troop deployment at Doklam reaches levels where the PLA has a large enough numerical advantage to reasonably move against Indian Army defensive positions. In this first evolution, I assume that numerical advantage should be 3-to-1, which means, given pre-existing force ratios specified in an earlier section, that phase 0 is completed when the PLA has moved an additional brigade to Doklam.

Based on patterns established during the 2017 crisis, I also assume that China's mobilization will take place alongside a larger exercise in the TAR. This would mean that some (but certainly not all) of the designated reinforcement units listed in the previous section would already be in Tibet at the start of a potential crisis. For the purpose of the Doctrinal Template, phase 0 includes moving the 149th Infantry Division (motorized, rapid reaction) to Nagqu, a city on the Qinghai-Tibet high speed railway some 300km north of Lhasa.

By the end of Phase 0, the PLA will have a) brought its rapid reaction division to a point 700km north of the Chumbi Valley, and b) will have moved the remainder of one of its mountain brigades (the 52nd) from Nyingchi to Doklam. At the completion of Phase 0, China has four

battalion-equivalents at Doklam, and India has one battalion-equivalent.[12] No PLA soldiers have moved to contact with the Indian Army, no new road construction has begun.

Phase 1A - India Counter-Mobilizes

India will begin a counter-mobilization to re-establish parity in the force levels at the plateau as soon as observers over the Chumbi Valley see movement of the marginal Chinese unit that would give the PLA a 3-to-1 ratio at the plateau. The Indian Army's easiest recourse is to regain parity by moving a brigade from the 17th Division at Gangtok. If India moves the brigade from Gangtok to Doklam, holding force levels on the Chinese side constant, it would re-establish stalemate force ratios with four battalion-equivalents on each side. This means the clock on India's counter-mobilization starts when this Chinese unit is 80km away from the plateau.

Phase 1B - Race for Balance/Imbalance: Time-Distance Analysis

Of course, China is unlikely to sit and wait for India to re-establish parity. I assume that China is likely to plan for India's counter-mobilization and be prepared to move even more reinforcements. The question for this phase, then, is whether the Indian Army can move reinforcements fast enough to close the gap as the PLA is trying to keep the gap open. In order to make this problem tractable, I simplify it to a road race and conduct a time-distance analysis for each side's ground reinforcements.

India - Distances

India's reinforcing formations (three divisions of light infantry) all travel by truck from locations in Sikkim and West Bengal. The 17th Division comes from Gangtok, 80km from the Indian border post at Doka La; the 27th Division from Kalimpong (155km); the 20th Division from Binnaguri (245km). Corps-level resources like the independent artillery, engineer, and air defense brigades come from Siliguri (200km).

India - Speeds

In this table-top doctrinal template, the major determinants of speed are a) mode of transportation and b) quality of transportation infrastructure. India's light infantry mostly relies on a 5t truck

[12] This assumes the 52nd Brigade moves 3 battalions.

(the Ashok-Leyland Stallion) for transportation. Indian exercises in the Thar Desert suggest that a strike corps brigade can complete a movement of 450km in 48 hours using the Ashok trucks.[13] This benchmark, though, is not realistic for operational planning purposes—the brigade had extensive preparation time and started the clock at the beginning of the march, not at the moment they received the order to march (Sharma, 2011). What's more, the brigade was traveling on blacktop with two or more full sized lanes for the entire distance of the march.

I take the That Desert movement as a upper limit on speed (average 9.3km/hr for the entire movement including stoppage) and assume that divisions from "holding corps" like the XXXIII corps will travel somewhat slower. Applying a 30% penalty to the upper-limit speed to account for narrower roads, the fact that a long segment of the route is dirt switchbacks, and the fact that in shorter movements the fixed time costs like stoppage remain the same, I assume that a single Indian brigade can complete the movement to Doklam at a rate of 6.5km/hr. Because the most distant brigade still travels under half of the fuel-range of the Stallion trucks, I do not factor in time for refueling stoppage. Other stoppage time is already factored into the movement rate of 6.5km/hr.

Each additional brigade puts added strain on middling-quality road infrastructure and creates more traffic. There are two road routes that meet roughly 20km from the destination. I assume that each additional brigade that travels on the same road route pays an additional 15% speed penalty to account for traffic and engineering stoppages to repair the roads. This means the second brigade to stack up on route A will complete its movement at an average rate of 5.52km/hr. I assign each Brigade to the route most convenient given its location; where both routes are equally convenient, I assign to the less crowded route. Brigades that come from more distant locations may end up lagging a day or more behind the closer brigades. Because the speed penalty is mostly to account for congestion, it will not be assessed to brigades that are 10+ hours behind the last brigade to travel the same route.

Finally, I assume that movements will start more quickly than often assumed: The Indian Army has become notorious for the glacial pace at which its formations can mobilize—after major terrorist attacks in 2001, Indian strike corps took close to a month to mobilize and travel to the

[13] Whether India has enough Stallion trucks to complete larger movements (division-sized) in one phase is another question. It is unclear from open sources what the upper-limit of this capability is.

international border with Pakistan, the alleged backer of the terrorists (Ladwig, 2008). On the contrary, I assume given the recent history of border tension between India and China in the Sikkim sector plus concerted efforts by the army to decrease mobilization times, that the brigades under the XXXIII corps would take ~24 hours to draw supplies, form convoys, and depart for Doklam. This assumption is still highly favorable to India. Large formations cannot be kept at this level of alert indefinitely during peacetime without sacrificing mid- and long-term readiness (Betts, 1995).

India - Time to Doklam

Given the distance and speed metrics laid out above, the time at which various Indian brigades would arrive at Doklam is summarized in the following table. I add a finish-lag of 48 hours to account for the time between a brigade's arrival and the earliest possible moment it can be useful:[14]

China - Distances

The first wave of Chinese reinforcements come from locations in Tibet: one brigade at Lhasa (472km), one brigade at Nyingchi (880km), and a division at Nagqu (775km). I assume further reinforcements are brought to one of two locations in Tibet by either air or rail: Lhasa has a military airport and a rail terminus; Xigaze (300km) has a military airport.

China - Speeds

The rates at which China can mobilize troops into Tibet is substantially faster than India because the PLA relies more heavily on air and rail transport, and also has superior road infrastructure leading almost all the way up to Doklam. An excellent study of the PLA's mobilization timelines in natural disaster scenarios (which require quick movement on short notice to remote areas) provides a useful guideline for how China uses inter-modal transportation to move PLA formations to remote areas of the country. Mobilization time tables for the 2010 Zhouqu Mudslides and 2010 Yushu Earthquake, both of which occurred in remote areas on the Qinghai-Tibet plateau, provide a useful starting point. In the 2010 Yushu earthquake, for example, a unit somewhat larger than a brigade (5,000 troops) in what is now the Western Theater Command completed a 1,000km movement by

[14]This lag may be an un-reasonably steep penalty for light infantry units.

Unit	Distance (km)	Route	Speed (incl. Penalties)	Arrival Time (incl. lags)
Inf. Bde. - 17th Div.	80	A	6.5	84h
Inf. Bde. - 17th Div.	80	A	5.52	87h
Inf. Bde. - 17th Div.	80	A	4.55	90h
Inf. Bde. - 17th Div.	80	A	3.57	94h
Inf. Bde. - 20th Div.	245	B	6.5	110h
Inf. Bde. - 20th Div.	245	B	5.52	117h
Inf. Bde. - 20th Div.	245	B	4.55	126h
Inf. Bde. - 20th Div.	245	B	3.57	140h
Inf. Bde. - 27th Div.	155	A	4.55	108h
Inf. Bde. - 27th Div.	155	A	3.57	116h
Inf. Bde. - 27th Div.	155	B	6.5	95h
Inf. Bde. - 27th Div.	155	B	5.52	100h
AD Bde. - XXXIII Corps	200	A	6.5	102h
Eng. Bde. - XXXIII Corps	200	B	5.52	108h
Arty. Bde. - XXXIII Corps	200	B	3.57	128h
Arty. Bde - 17th Div.	80	A	3.57	94h
Arty. Bde. - 27th Div.	155	A	3.57	115h
Arty. Bde. - 20th Div.	245	B	3.57	140h

Figure 6: Indian Unit Arrival Times

air to the disaster area in just over 24 hours, albiet without much equipment. Similarly, in the Zhouqu Mudslides, a brigade-sized element moved close to 600km in around 40 hours (Engstrom and Morris, 2015). The Zhouqu timeline is perhaps more directly comparable to the situation at Doklam. At Doklam, forces arriving at the nearest airport (Xigaze) still have to drive 300km by road to reach the plateau. In Zhouqu, the 600km movement in question was by road, not air.

Given that the most relevant benchmarks are each somewhat more accessible than Doklam (Yushu is very close to a mid-sized airport, Zhouqu has more airports at ~300km away than Doklam), I assess a quite conservative 30% time penalty for Chinese force mobilization to Doklam in comparison to these benchmarks, both to account for the difference in accessibility of destinations, and to account for heavier kit the would come with infantry units in a wartime mobilization vs. A disaster response mobilization—no one tows howitzers to a mudslide, for instance. Unlike with the Indian forces, I do not assess a 24 hour penalty on the front end for Chinese forces because Engstrom and Morris' calculations already account for time it begins to take movement: their 40-hour clock starts at the moment of the disaster. I also do not assess a 10% traffic penalty for three reasons: First, a far smaller proportion of the km traveled is by road for most PLA units, second, the quality and width of the blacktop on the Chinese side of the border is superior to the roads on the Indian side, third, the standard light infantry truck for the PLA has double the carrying capacity of India's trucks (10t versus 5t (Gander, 2015)), so a convoy of equivalent size creates half the traffic.[15] I still assess a 48 hour "readiness" penalty after arrival.

After the 30% time penalty, Chinese forces travel by road at a rate of 10.5km/hr including stoppage, refueling, and front-end lag time. All Chinese units will travel at least the last 300km (from Xigaze airport to Doklam) at this rate.

For air, I use time-distance analyses for different units that flew to the Yushu Earthquakes from various distance: on average, forces that rely on air/rail transportation can move at 1,000km per day, with a "throughput rate" of ~12,000 soldiers per day. This throughput rate and speed are calculated given only one airport in close proximity to the destination: Doklam has 3 airports (at least two of which have larger ramps/more runways than Yushu) within 500km plus a major railhead within the same radius, so the rate could in fact be even higher. I assume, though, that the

[15] Given the superior road infrastructure that China would use through most of the Chumbi Valley approach, I assume the heavier trucks do not cause serious problems.

road/rail times including time to onload/offload are not lower than those demonstrated in Yushu.[16] I assume that up to 3 brigades per day can move into each Lhasa and Xigaze at a rate of 1000km per 24hr.

China - Time to Doklam

Given the distance and speed metrics laid out above, the time at which various Chinese formations would arrive at Doklam is summarized in the following table. As above, I add a finish-lag of 48 hours to account for the time between a unit's arrival and the earliest possible moment it can be useful:[17]

Unit	Size	Distance at Road Rate	Distance at Air/Rail Rate	Arrival Time (incl. lags)
52nd Mountain Infantry	Bde	—	0	In place
53rd Mountain Infantry (Motorized)	Bde	881	0	132h
54th Mountain Infantry (Mech)	Bde	472	0	92h
TAR Arty	Bde	472	0	92h
TAR AD	Bde	472	0	92h
TAR Spec. Ops.	Bde	472	0	92h
149th Infantry (Motorized)	Div	472	300	100h
Airborne infantry	6x Bde	300	2,425	134h
Airborne Spec. Ops	Bde	300	2,425	134h
37th Infantry	Div	300	1,708	117h

Figure 7: Chinese Unit Arrival Times

Phase 1 Scorecard

Having established the approximate arrival times for major Indian and Chinese ground units, I can now evaluate the balance of forces near the Doklam plateau at intervals following the moment of mobilization. To recap, despite the presence of new Chinese helipads at Doklam, I assume that all forces on both sides travel at least the last miles via ground and that the air infrastructure at the

[16]This relies on another assumption: that China's road/rail movements would take advantage of war flats to move heavy equipment. It has demonstrated this logistical capability recently with specific reference to use on "China's Plateaus" (Lei, 2017)

[17]Again, this finish-lag is perhaps un-charitable given that the units in question are light infantry units.

plateau is intended for resupply.

Note that India's mobilization actually starts slightly before D + 0, since overwatch into the Chumbi Valley gives advanced warning of Chinese movements. I assume India can first see PLA formations at 80km away from the plateau: given PLA road transit speed, this translates to 7.6h of forewarning before the unit arrives, not including time to prepare once at Doklam. Since, in this scenario, the PLA unit that triggers Indian mobilization is company-sized, I change the "setup" lag from 48h to 12h. This means India's mobilization clock starts at approximately D-Day minus 20h. Since both sides mobilize on and through their own un-disputed territory, I assume neither side has an incentive to pre-emptively attack the other's mobilization before they make contact within the disputed territory. The table below reflects a 20h head start.

Given the force levels shown in this table below, it is likely that a mobilization of this size would either have a substantially longer frontage than the Doklam plateau itself, or would stack units deep into rear areas of Chinese-claimed territory on one side, and Indian territory on the other. The same force ratio goal, though, still ought to hold.

The following table shows the likely balance of forces at 24hr intervals from the end of Phase 0:

Phase 2 - Interaction of Forces?

Under this template, it seems unlikely that there would be any interaction of forces at all. If so, it would be brief. China manages to hold the gap open for three days before the first Indian reinforcements arrive. As soon as the first Indian brigades (from the 17th Division at Gangtok) arrive at Doklam and are ready to fight, the balance of forces shifts from favoring China's revisionist aspirations to decidedly favoring India. India maintains a numerical advantage until D + 6, at which point the vast majority of China's reinforcements arrive. Even this is likely a little generous to China: it seems unlikely that 10 infantry brigades, a special operations brigade, plus two other brigades with heavy equipment like AD and artillery could all traverse the road through the Chumbi valley in the same day. The bottom line for the doctrinal template, therefore, is that China has a fleeting window in which it could take action.

Before moving on to a situational template that accounts for the environment at Doklam, it is worth re-examining the assumptions that produced this template. First, the assumption that no Indian forces will be forward positioned is perhaps a bit strict. During the 2017 crisis, for instance,

Day	Chinese Strength	Indian Strength
D + 0	1 Bde Inf.	1 Btn Inf.
D + 1		
D + 2		
D + 3		5 Bde Inf. 1 Bde Arty.
D + 4	2 Bde Inf. 1 Bde AD 1 Bde Arty. 1 Bde SO	10 Bde Inf. 2 Bde Arty. 1 Bde Eng. 1 Bde. AD
D + 5	5 Bde Inf. 2 Bde AD 2 Bde Arty. 1 Bde SO	12 Bde Inf. 4 Bde Arty. 1 Bde Eng. 1 Bde. AD
D + 6	15 Bde Inf. 3 Bde AD 3 Bde Arty. 2 Bde SO	

Figure 8: Balance of Forces

India positioned the majority of the 17th Division closer to Doklam. Relaxing this assumption and allowing 2-3 Indian brigades to start closer to Doklam at D-Day would only strengthen the result found here. Another assumption worth examining is the built-in lag in India's deployment. Given the army's mobilization history over the past 20 years, 24 hours to move is slightly ambitious (Narang and Ladwig, 2017). Doubling or even tripling this lag estimate, though, only gives China a maximum of six days with favorable force ratios on the plateau. This is cutting it closer for India, but still likely not enough to make a difference.

Third, this template makes a fairly conservative assumption about the nature of Chinese mobilization: That reinforcement formations like the Airborne corps and 37th division remain in their home bases outside the TAR until after India counter-mobilizes. It is possible, but by no means a given, that China would push these formations forward in advance, shortening their time to Doklam.

Finally, and crucially, I assume that neither side is trying to deny the other's attempt at mobilization. This is a strong assumption—assuming otherwise would change the mobilization times dramatically and likely introduce substantial attrition—but it makes sense given the nature of the scenario. Attempts at deep interdiction before a conflict on the plateau begins would expand the scope of the problem. On both sides, pre-emptive interdiction would require bombardment with indirect fires or air delivered weapons into territory that neither side disputes.

Evolution 2: Situational Template

The doctrinal template above establishes a useful baseline for evaluating China's prospects of creating and sustaining a useful imbalance of forces at Doklam, but it leaves out a number of features of the environment that could prove consequential in a race to the plateau, and any attempts to use force while there. This second evolution, the situational template, accounts for these features in the race, and also mentions those features that are not directly relevant to race but would be consequential for any interaction of forces at Doklam.

What Stays the Same

I carry over 1) the list of available units, 2) the distances those units must travel and 3) all movements in Phase 0 for the situational template. This means that when the situational template diverges from the doctrinal template, China has a four-to-one battalion-equivalent advantage at the plateau and has moved its rapid reaction force to a point 700km north of Doklam for an exercise similar to the exercise undertaken in summer 2017. India has not mobilized beyond normal training.

What Changes - Race to Doklam

The most important effect of the environment that bears on the situational template is the effect of altitude on the rate at which both India and China can move forces to Doklam. As noted above, the Doklam plateau sits at roughly 4000m, with some critical ridge lines around the plateau topping out at close to 4500m. Soldiers take time to acclimate, and acclimatization processes cannot be shortcut or sped up without extreme deleterious effects on combat power, and increased likelihood of altitude related illnesses. Most armies follow a procedure called "graded ascent" to prepare soldiers for high-altitude combat (Grau, 2011; U.S. Department of Defense, 2010), moving soldiers to steadily higher altitudes over the course of a week to ten days to induce respiratory acclimatization (Rodway and Muza, 2011). The effects of skipping or shortcutting this step are disastrous: When India deployed soldiers to the Sino-Indian border in 1962 without time for acclimatization, up to 15% of the force developed some degree of altitude induced pulmonary edema (HAPE), which is the leading cause of death related to altitude and can kill a soldier in as few as twelve hours after the appearance of symptoms (Houston, 1998; Segal, 1990). I use a U.S. Army acclimatization and graded ascent schedule in the updated time-distance analysis in this section. It differs little from available Pakistani and Indian protocols (Pakistan and India are among the most experienced high-altitude armies, maintaining constant deployments at over 6,000m in Kashmir), except that it is calibrated for moving soldiers to Doklam-like altitudes, not the far higher altitudes necessary in Kashmir (U.S. Department of Defense, 2010).

Beyond the physiological effects of altitude, two other changes are especially relevant to the situational template in this section. First, transportation logistics become even more complicated because diesel engines (like the engines in both India and China's workhorse trucks) operating

at altitudes as high as Doklam experience up to a 35% increase in fuel consumption, as well as decreased power output (Grau, 2011, pg. 9). Decreased power will likely matter little given the already low speeds, but increased fuel consumption means more refueling stops, which add to the transit time.

Finally, the environment at Doklam has the effect of "moving the goalposts" for China. The traditional infantry force-ratio metric, which recommends attacking with a 3-to-1 advantage, is insufficient given the decreased capability of a soldier at altitude and the difficulty of the terrain. Indian soldiers in Kargil talked about needing 9-to-1 force ratios for dislodging Pakistani posts high up on ridge lines. An adjustment this dramatic is not warranted at Doklam: Indian forces at Kargil were fighting at altitudes approaching 6000m and were launching assaults that required combat mountaineering feats like climbing exposed cliffs in the dark (Acosta, 2003). Doklam is neither as high, nor as unforgiving in terms of topography. For lack of a rule of thumb specifically developed for Doklam-like terrain, I split the difference and assume that the desired force ratio increases somewhat less: a 5-to-1 advantage should be reasonable.

What Changes - Other Effects of the Environment

Some environmental effects that are not directly relevant to the race portion of the situational template are still worth mentioning because they would change a potential interaction of forces. First, operating at altitude changes the supply needs of infantry units because soldiers eat and drink more and equipment consumes more fuel and lubricants. A supply manual from the Argentine mountain infantry indicates that a company consumes 5000kg of supplies per six days (Cited in Grau, 2011). Assuming that there are four companies per battalion, and three battalions per brigade, this means that each brigade at Doklam will consume 60,000kg of supplies every six days. The Mi-17 helicopter that both India and China are likely to use at Doklam can carry 5,000kg slung under the helicopter at sea level (Network, 1999). Assuming that a 50% decrease in air-pressure induces a 50% decrease in maximum load (Acosta, 2003), supporting a brigade for a week at altitude would require 24 Mi-17 sorties. At maximum, India would have to support 18 brigade-equivalents and China would have to support 23 brigade-equivalents at altitude. Supporting these forces (not including ammunition for artillery, casualty evacuation, or other logistical needs) would require 432 sorties per six days and 552 sorties per six days, respectively.

Second, even once soldiers have acclimated to the Doklam altitude, their performance still suffers from the physiological effects of oxygen deprivation and low air pressure. Soldiers cannot carry as much kit, or march as far in a day. Their visual acuity and attention spans decrease as well at altitudes as high as Doklam (U.S. Department of Defense, 2016). Loss of appetite coupled with an increase in metabolism mean that many soldiers lose weight (up to .5kg/week for acclimated soldiers, up to 3kg/week for non-acclimated soldiers) while deployed at altitudes as high as Doklam (Frisancho, 1993). In the U.S. Operation Anaconda in Afghanistan, body-mass loss was a serious problem for some units. One soldier was evacuated from the Shah-i-Kot valley after losing close to 30kg (Acosta, 2003).

Third, fire support is both crucial for successful maneuver in the mountains and is much more difficult to execute at altitude. Rounds from tubed artillery and mortars behave differently in thin air and can be downright erratic in the high winds that are common in the mountains (Jackson, 2009). Air power (even if delivering precision munitions) is not as effective in the mountains as in normal conditions. Challenging topography, low air density, and excellent opportunities for hiding shoulder-fired anti-aircraft weapons behind terrain features all make it harder for close air support to fly low over targets and to loiter. Though some analysts credit airpower with an important role in the Kargil War in 1999 (Lambeth, 2012), most agree that artillery was more decisive than air support. When the United States launched Operation Anaconda with the latter and without the former in 2012, they suffered operational consequences (Acosta, 2003; Kugler, 2007; Kugler, Barancik and Binnendijk, 2009). If the "race" portion of the situational template results in a force-ratio conducive to combat, all three of these considerations will influence the way that fighting is conducted.

Updated Time-Distance Analysis

This section presents an updated time-distance analysis that accounts for a) necessary acclimatization b) changes in transportation logistics and c) new requirements for force ratios. The travel distances are kept the same as in Evolution 1.

India - Updated Speeds

In this template, which reflects environmental factors at Doklam, the major determinant of speed is neither mode of transportation nor quality of infrastructure, but rather the time needed for acclimatization. The rate at which a unit can arrive, ready to fight, at Doklam is a function of the difference between the altitude at Doklam and the altitude at that unit's starting location. For the formations in India's XXXIII Corps, this is only weakly correlated with distance. Figure 6 shows the graded ascent profile that the U.S. Military uses to acclimatize infantry units. Similar procedures are followed by the Indian Army.

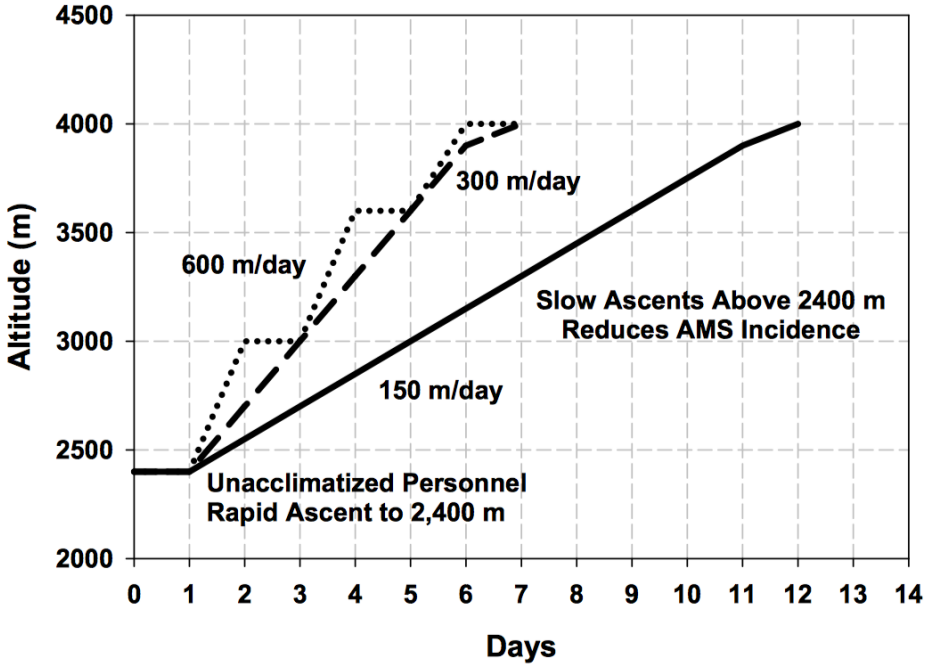

Figure 9: Graded Ascent profile from U.S. Army Technical Bulletin 505

Graded Ascents have two different components that occur at different speeds: First, units must move to an altitude of ~2400m as fast as logistically possible in order to begin acclimatizing. Second, units must ascent from 2400m to the target altitude at no more than 300m per day—physiological studies suggest there are benefits to ascending even slower, but stipulate that going faster than 300m/day carries significant risk (Norris et al., 2012). For this first component, I assume that Indian forces will move somewhat faster than Evolution 1 stipulated, because road infrastructure in the plains and foothills is substantially better than it is close to the plateau. Units can reach

2400m in the foothills above Gangtok, which is serviced by a blacktop highway. I assume that units can reach Gangtok traveling by highway at around 30km/h. Other areas at the same altitude are also accessible by highway; the congestion problem should be somewhat less in this evolution than in Evolution 1.

Once a unit reaches 2400m, the limiting factor on its speed is acclimatization rate. The foothills around Gangtok are only 80km away from the Doklam plateau, but they are 1800m below the plateau. Since infantry soldiers acclimatize at a rate of 300m/day, this means that units will cover the last 80km toward the plateau at a maximum rate of 14km/day. No Indian units in Sikkim other than those at Doklam are permanently stationed at altitudes higher than 2400m, so no unit gets a "head start" on this process.

Because the acclimatization process involves a fair amount of sitting and waiting, I assume that commanders will put this time to good use and undertake preparations for the fight while acclimatizing. Therefore, I decrease the "arrival lag" in this evolution from 48h to 12h. I maintain the same "departure lag" of 24h.

India - Time to Doklam

Times of arrival at Doklam for Indian forces, given the acclimatization rates outlined above, are shown in the following table.

Unit	Starting Altitude (m)	Time to 2400m	Time to 4200m	Arrival Time (Incl. lags)
Inf. Bde. - 17th Div. x4	1650	<24h	7d	10d
Inf. Bde. - 20th Div. x4	216	<24h	7d	10d
Inf. Bde. - 27th Div. x4	1250	<24h	7d	10d
Corps Assets (AD, Eng, Arty.)	140	<24h	7d	10d
Divisional Artillery	1650	<24h	7d	10d
	216	<24h		
	1250	<24h		

Figure 10: Indian Unit Arrival Times

In practice, not all units will be able to crowd onto the plateau on day 10, and will likely be dispersed along nearby ridges. I count this as "close enough" for the purposes of determining local force ratios.

China - Updated Speeds

Updated speeds for PLA unit movements are also mainly constrained by time needed for acclimatization. Because most PLA units are coming from somewhat farther away than Indian units, and because different transit modes are already separated in Evolution 1, I measure speed somewhat differently here. Units already stationed within the TAR are assumed to be acclimatized to the altitude of the place where they are stationed.[18] Units coming from outside the TAR get to the specified airport/railhead in the TAR at the same rate of speed as in Evolution 1, but then must begin acclimatizing. Between the time needed for acclimatization and the time spent traveling by road (calculated in evolution 1) I simply pick the larger of the two and use that as the combined acclimatization/travel time because acclimatization can be done on the move, so long as the 300m/day vertical limit is not violated.

As with India, I decrease the finish lag to 12 hours for units where movement is slowed substantially by acclimatization time. For units that can drive at essentially the same rate as in Evolution 1, I maintain the same 48 hour lag. As with Evolution 1 for China, the departure lag is already built in.

China - Time to Doklam

Phase 1 Scorecard

The tables above show more realistic arrival times for major Chinese and Indian formations racing to Doklam. This section evaluates the balance of forces, given these travel times, at intervals following the moment of mobilization.

As in Evolution 1, I assume that India's mobilization has a slight "head start" given overwatch into the Chumbi valley that provides advanced warning of Chinese movements. As above, I translate this advanced warning into a 20h head start for all Indian units. The rest of the same caveats apply

[18] Wortzel suggests that the 149th Infantry Division is also acclimatized for Tibet contingencies in its garrison and would not have to slow down more than other TAR-stationed units (Wortzel, 2015).

Unit	Starting Altitude (m)	Acclimatization Time	Drive Time	Time by Air/Rail	Arrival Time (Incl. lags)
52nd Mtn. Inf. Bde	—	—	—	0	In place
53rd Mtn. Inf. (Mot.) Bde.	3000	4d	3.5d	0	5.5d
54th Mtn. Inf. (Mech) Bde	3600	2d	2d	0	4d
TAR Arty Bde	3600	2d	2d	0	4d
TAR AD Bde	3600	2d	2d	0	4d
TAR Spec. Ops. Bde	3600	2d	2d	0	4d
149th Inf. (Mot.) Div.	4500	0d	2d	1d	5d
Airborne Inf. 6x Bde	35	7d	1.25d	2.5d	9.5d
Airborne Spec. Ops Bde	35	7d	1.25d	2.5d	9.5d
37th Inf. Div	244	7d	1.25d	2d	9d

Figure 11: Chinese Unit Arrival Times

as in Evolution 1. This table shows the likely balance of forces at 24hr intervals from the end of Phase 0:

Phase 2 - Updated Interaction of Forces?

Accounting for the effects of altitude and the time required for acclimatization changes the balance of forces dramatically: India's mobilization is slowed much more than China's, because India's bases in Sikkim are far lower than China's bases in the TAR. This suggests that China can create and sustain an extremely favorable balance of forces for quite a bit longer than the doctrinal template showed: Due to acclimatization, no Indian reinforcements arrive until D + 9, whereas the first reinforcing elements on the PLA side arrive at D + 4. Realistically, India's reinforcements might take even longer to arrive, since the prospect of pushing 18 brigade-sized elements up the final kilometers of dirt track to Doklam in a single day is frankly laughable.

From D + 4 to D + 9, infantry-only force ratios favor China by at least 4-to-1, and at most over 20-to-1. Per the objectives specified above, this is enough of an imbalance for a long enough period of time to allow China to push forward with road construction.

What would an interaction of forces look like in the week-plus before Indian reinforcements arrive at the Doklam plateau? Not good for the Indian Army, even given superior mountain infantry and higher quality indirect-fire support. By D + 4, the force ratios favor China overwhelmingly: India's

Day	Chinese Strength	Indian Strength
D + 0	1 Bde Inf.	1 Btn Inf.
D + 1		
D + 2		
D + 3		
D + 4	1 Bde Inf. 1 Bde Arty. 1 Bde AD 1 Bde SO	
D + 5	5 Bde Inf. 2 Bde AD 2 Bde Arty. 1 Bde SO	
D + 6	6 Bde Inf. 2 Bde AD 2 Bde Arty. 1 Bde SO	
D + 7		
D + 8		
D + 9	9 Bde Inf. 3 Bde AD 3 Bde Arty. 1 Bde SO	12 Bde. Inf 4 Bde. Arty 1 Bde. Eng. 1 Bde. AD
D + 10	15 Bde Inf. 3 Bde AD 3 Bde Arty. 2 Bde SO	

Figure 12: Balance of Forces

one battalion would face off against two brigades of Chinese mountain infantry and the Tibet-based special operations brigade, supported by artillery and air defense brigades also based in Tibet. It seems unlikely, given this imbalance, that India would cross the border into Doklam in order to stop Chinese construction activities.

The only forces that India could expedite to Doklam without waiting for acclimatization would be air support from the Su-30MKI and MiG-27 squadrons based in the Eastern Command. Even this support might not have a large effect. Close air support at altitude is already a challenge due to low air pressure, difficult terrain, and deleterious effects on the precision of precision guided munitions. By D + 4, moreover, the PLA will have an air defense brigade operational at Doklam. PLA Air defense brigades are currently being upgraded to include "double digit SAMs" like the Russian-designed SA-15, as well as indigenous systems like the HQ-9 and HQ-16 (Economic and Commission, 2017). Even though the Su-30MKI can fulfill a Suppression of Enemy Air Defense role, I assume that the effect of IAF airpower for battlefield interdiction in the first days of a conflict to be limited at best.

In short, the force ratios outlined above are consistent with a successful fait accompli by the PLA to construct new roadways on the Doklam plateau and push the India-China-Bhutan tri-junction border south to Mount Gipmochi. It seems unlikely, given the timetable, that there would be any interaction of forces at all on the plateau. Conflict is thought to result either from misperceptions about strength, misperceptions about resolve, or a drive to survive (Fearon, 1995; Jervis, 1968; Mearsheimer, 2001). The force ratios present on the plateau before D + 10 and the broader political conditions of the Doklam dispute are not consistent with any of these three explanations, so it seems unlikely that the mobilization would lead to an interaction of forces. Further, I assume that materiel shortages would make Indian commanders hesitant to start a conflict from a position of disadvantage and attempt to wear down the PLA. Ammunition shortages and inferior logistics infrastructure for supporting forces at altitude mean that the Indian Army's qualitative superiority might expire quite quickly.

What's more, any gains that China makes in a fait accompli before Indian reinforcements arrive are unlikely to be undone by Indian reinforcements. Roughly the same force ratios that India was trying to prevent China from achieving would, in theory, be necessary for India to achieve if the goal was to roll back China's gains. Before concluding, it is worth taking stock, once more, of the

assumptions that influence this finding which could be reasonably challenged.

The weightiest assumption in this evolution is India's lack of forward deployment. During the crisis in 2017, for example, India pre-acclimatized some units from the 17th Infantry division to reinforce the battalion at Doklam. Outside the context of an ongoing crisis, though, it is not a given that India would keep forces at altitude. Indian officials have said in the past that they fear acclimatizing large formations sends a strong and de-stabilizing signal to China; forces in the Eastern sector in particular are often kept below 3000m even when they are moved forward of their normal bases (Online, 2017; Singh, 2017*a*). Even so, it may be the case that some brigades (particularly artillery batteries) would be moved forward in advance of a conflict, and thus would arrive at Doklam earlier than this evolution suggests.

Other assumptions carry over from Evolution 1. Even if individual assumptions about basing, rate of travel, acclimatization time, or force quality are adjusted slightly, the result of this situational template seems robust. Changes would either have to be numerous or major to alter the bottom-line result: that China can maintain an overwhelming numerical advantage at the Doklam plateau for more than a week before Indian reinforcements can close the gap.

Conclusion - Implications for India

This analysis makes a number of simplifying assumptions about the nature and behavior of both PLA and Indian Army forces. Even with this caveat, however, the results should be troubling to Indian planners and commentators, many of whom see the Sikkim sector as India's area of strength on the Sino-Indian border and treat India's numerical advantage in forces in the Eastern Command vs. China's Western Theater Command as sufficient insurance against revisionist attempts in the Himalayas (Srivastava, 2017; Shukla, 2017*b*; Gurung, 2017).

What options are open to India, given that this analysis shows the PLA is able to put more soldiers at Doklam in a shorter period of time? India has two choices, both of which have potential downsides. India could either a) move the starting line by positioning large formations at altitude or b) take advantage of the vulnerability in China's main avenue of approach and try to interdict Chinese forces in the Chumbi Valley before they reach Doklam.

The first option, pre-acclimatizing infantry units from the 17th Division at Gangtok, is poten-

tially destabilizing, especially given that the Sikkim sector is thought to be the sector in which India would launch counter-attacks in response to a PLA attack in the Kashmir or Arunachal Pradesh sectors. Beyond the possibility that pre-acclimatizing large formations might send an escalatory signal to China, it is also costly. Sustaining brigades at altitude, away from base infrastructure for long periods of time is, for reasons detailed in Evolution 2, resource intensive, and taxing for the personnel involved. A half-measures version of this pre-acclimatization plan might ultimately be most feasible and prudent: forward deploying the organic artillery assets in the mountain divisions, or even moving the BrahMos missile regiment in Arunachal Pradesh could provide India with some counter-offensive capability at altitude without all of the signaling downside.

India's second option, even more escalatory than the first, is to conduct a pre-emptive strike aimed at denying China the ability to move forces up to Doklam. As noted repeatedly in this analysis, the heights in eastern Sikkim provide India with excellent vantage points to a) observe Chinese movements through the Chumbi valley and b) pre-sight the road along the valley floor for artillery fire. Up to 60km of the highway through Chumbi Valley is comfortably in range for India's standard 155mm Bofors guns. The same effect could also potentially be achieved with cruise missiles already deployed in Arunachal Pradesh, on the other side of Bhutan.

Rubbling the highway through the Chumbi Valley before any hostilities at Doklam begin, though, has severe downsides. Both sides agree that the Chumbi Valley is sovereign Chinese territory. Firing preemptively into the valley whether with tubed artillery, air strikes, or the BrahMos battery would be an unprovoked attack into another country. As the Doklam scenario stands now, no fighting is likely to take place on Indian soil and no Indian territory is at stake. Launching a strike into China, though, might invite retaliation that targets India, rather than disputed Bhutanese territory.

One of these options is clearly worse than the other, but neither ought to be particularly comforting to the Indian Army. India has to take some sort of action to lessen China's advantage in a hypothetical race to Doklam if it wants to ensure that the status quo at Doklam is maintainable. Whether taking action is worth the cost depends on political factors beyond the scope of this analysis: How highly does India value its relationship with Bhutan? Can the strategic consequences of China occupying the Jampheri ridge be mitigated? In other words, can India tolerate de facto Chinese control of the Doklam plateau?

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